Argynnis paphia (Linnaeus, 1758) – Silver-washed Fritillary

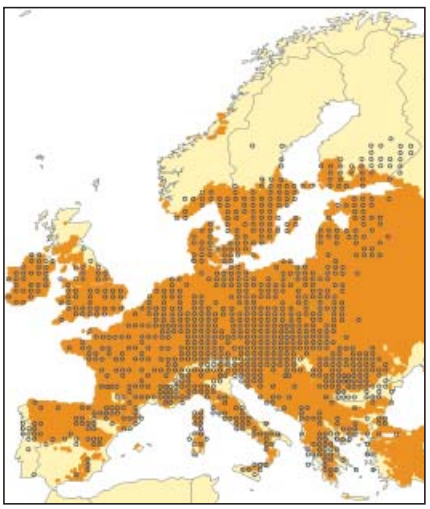
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-1366 (-7.47%)	-3351 (-18.34%)
	BAMBU	-2110 (-11.55%)	-3766 (-20.61%)
	GRAS	-2577 (-14.1%)	-4369 (-23.91%)
2080	SEDG	-2912 (-15.93%)	-5757 (-31.5%)
	BAMBU	-4872 (-26.66%)	-8253 (-45.16%)
	GRAS	-6457 (-35.33%)	-11083 (-60.64%)

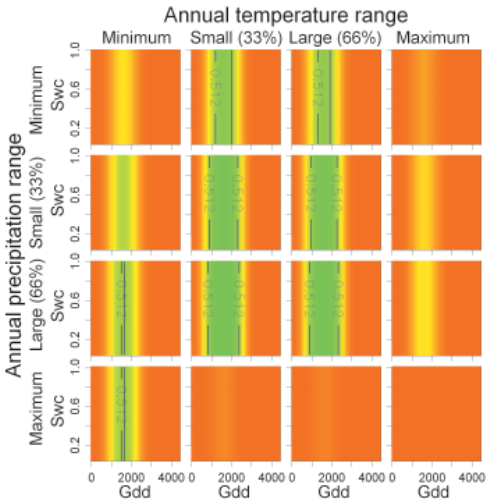
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 18276)

The Silver-washed Fritillary is a large, conspicuous butterfly that is often present in large numbers. Needing a lot of nectar, they are often found on thistles at the edge of woodland. They also occur on rough vegetation in woodland clearings. Unlike other butterflies, the eggs are not laid on the foodplant. Instead, the female deposits them singly on the branches and trunks of trees growing at woodland edges. As soon as they emerge from the egg in the late summer, the tiny caterpillar looks for somewhere to hibernate. In the spring it starts looking for violets (*Viola* spp.), on which it feeds at night, hiding under the leaves of the foodplant during the day. It pupates on a stalk of a violet plant, or in a crevice in the bark of a tree. The Silver-washed Fritillary has one generation a year.

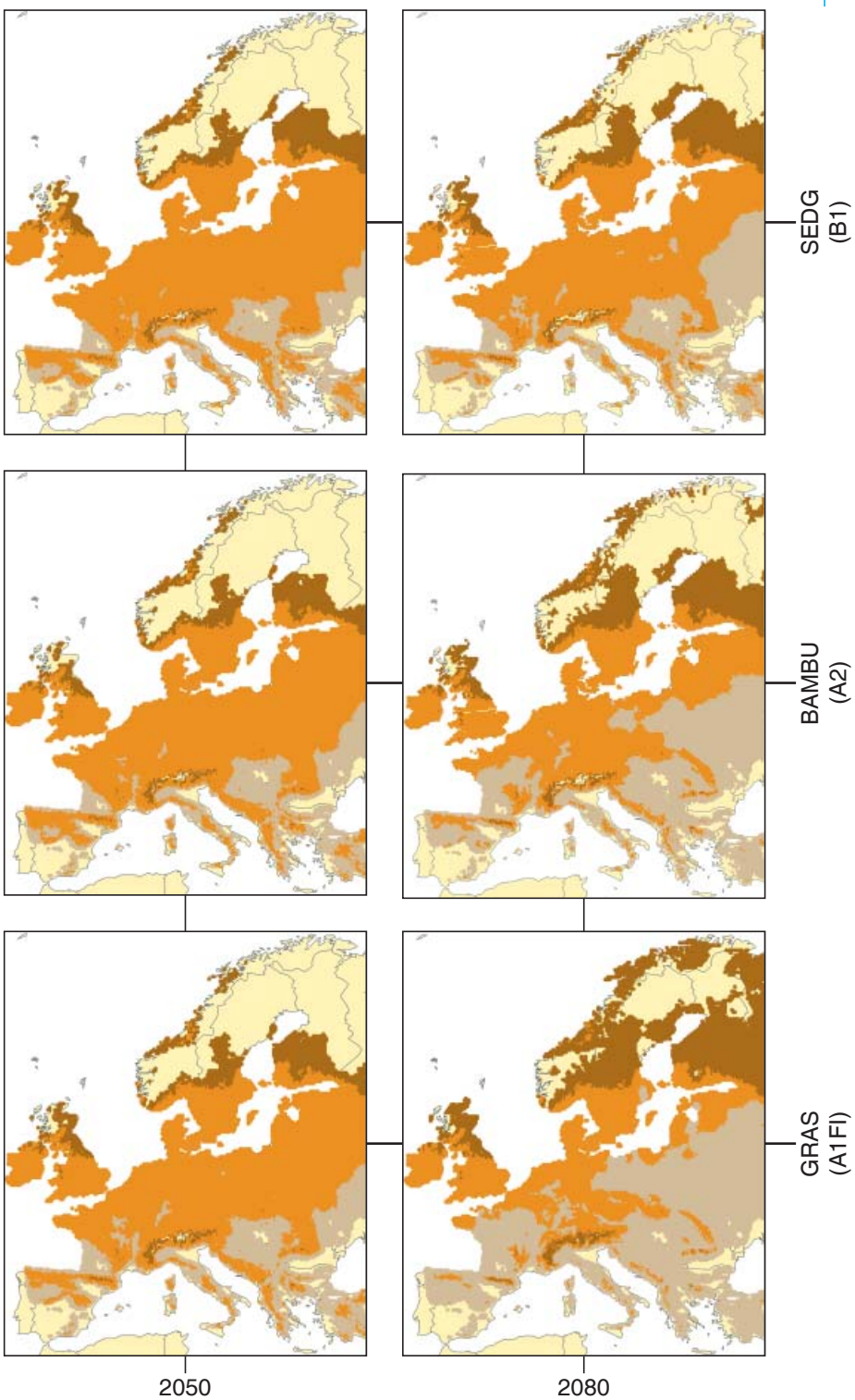
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.78).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Argynnis pandora ([SCHIFFERMÜLLER], 1775) – Cardinal

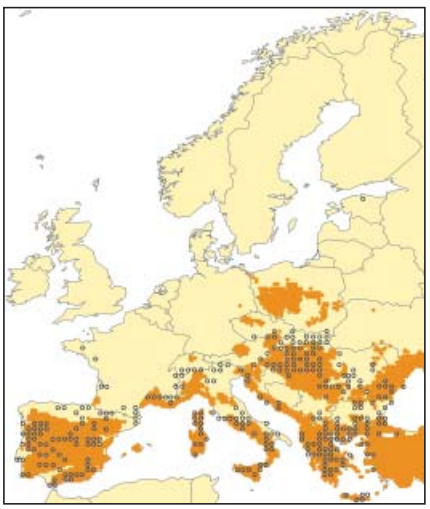
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	1193 (21.96%)	-1626 (-29.93%)
	BAMBU	-1933 (-35.58%)	-2556 (-47.05%)
	GRAS	-587 (-10.8%)	-2566 (-47.23%)
2080	SEDG	-1599 (-29.43%)	-3246 (-59.75%)
	BAMBU	-3121 (-57.45%)	-4172 (-76.79%)
	GRAS	-2148 (-39.54%)	-4744 (-87.32%)

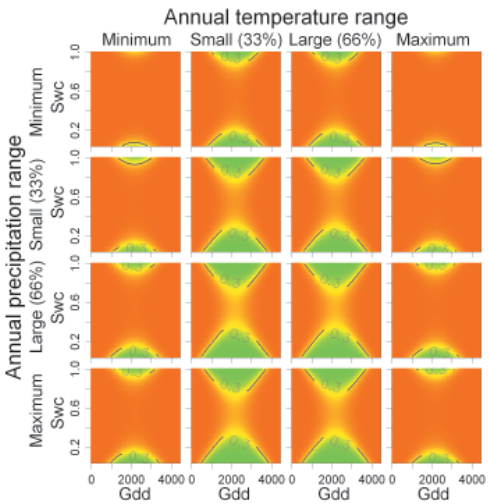
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 5433)

The Cardinal is a woodland butterfly occurring at woodland edges and in glades with bushes and grassy, flower-rich vegetations. Like the Silver-washed Fritillary (*A. paphia*), these butterflies are often seen in places where plants rich in nectar, such as thistles, are plentiful. The Cardinal is a fast and powerful flyer, vagrants being sometimes observed outside the distribution range. The eggs are laid singly on the leaves of violets (*Viola* spp.). It hibernates as a small caterpillar and pupates in the spring, suspended low down on the foodplant or on the nearby vegetation. It is single-brooded.

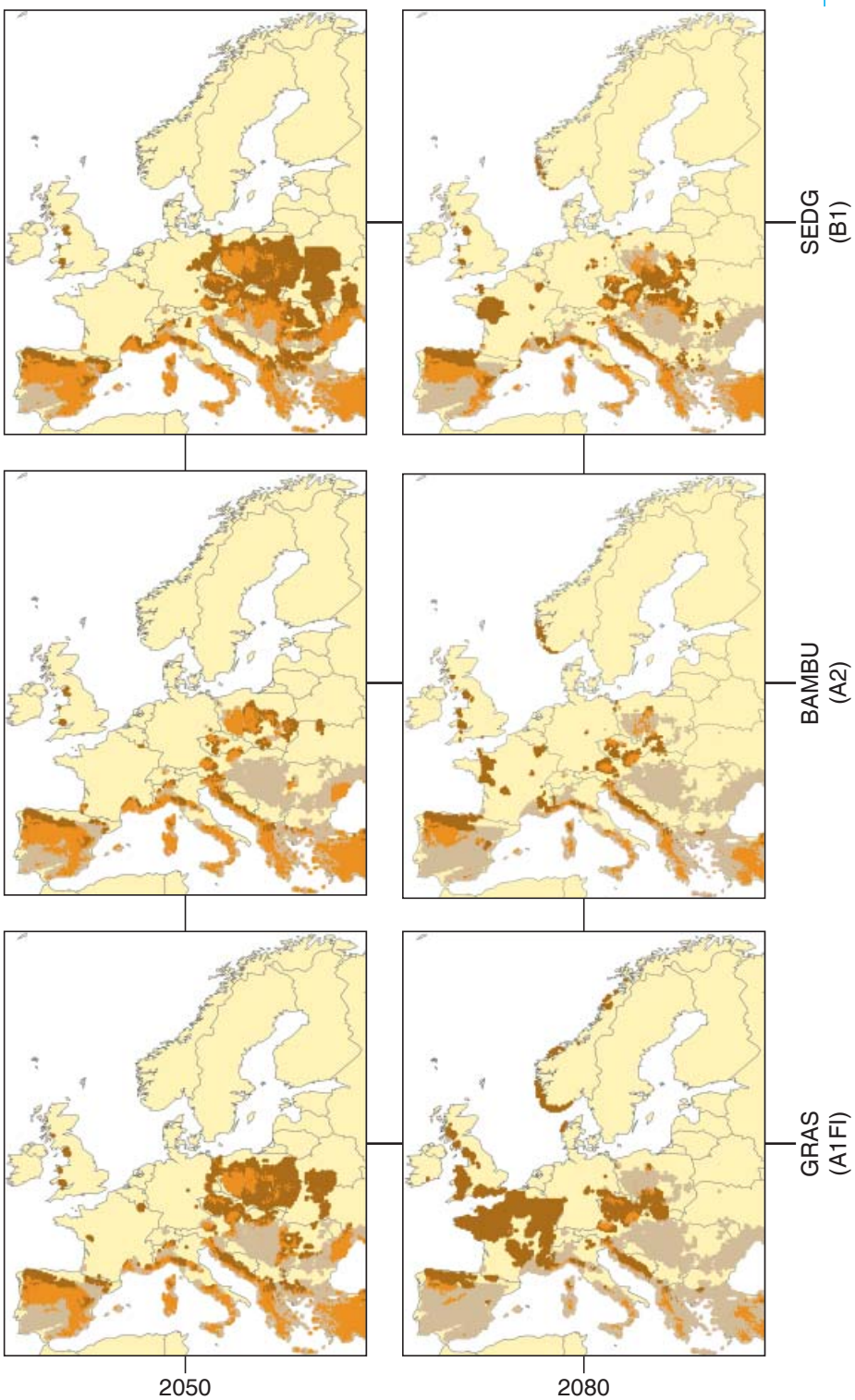
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.83).
Climate risk category: HHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Argynnis aglaja (Linnaeus, 1758) – Dark Green Fritillary

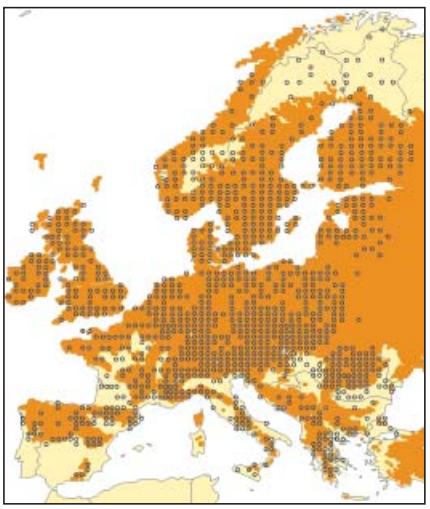
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-1213 (-5.9%)	-3328 (-16.19%)
	BAMBU	-2865 (-13.94%)	-4599 (-22.38%)
	GRAS	-2885 (-14.04%)	-4947 (-24.07%)
2080	SEDG	-4162 (-20.25%)	-7016 (-34.14%)
	BAMBU	-7493 (-36.46%)	-10512 (-51.15%)
	GRAS	-9906 (-48.2%)	-13024 (-63.37%)

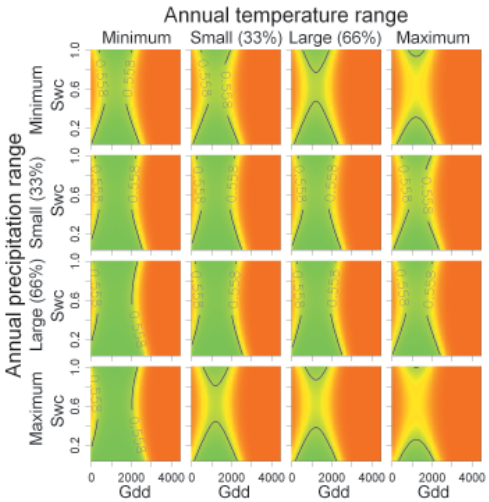
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 20551)

The Dark Green Fritillary can be found on many different types of flower-rich grasslands. The grassland is often situated in or at the edge of woodland, and may be dry, calcareous or dune grassland, or damp grasslands along the edges of bogs. The eggs are laid on the often already withered leaf-stems of violets (*Viola* spp.). Directly after hatching, the small caterpillar prepares for hibernation, hiding itself in the litter layer until the spring. It then begins to feed on the fresh, new growth of the violet plants, continuing into the summer, when it pupates either in the moss layer, or under a tussock of grass. The caterpillars are quite mobile and visit several plants when feeding. The Dark Green Fritillary is single-brooded.

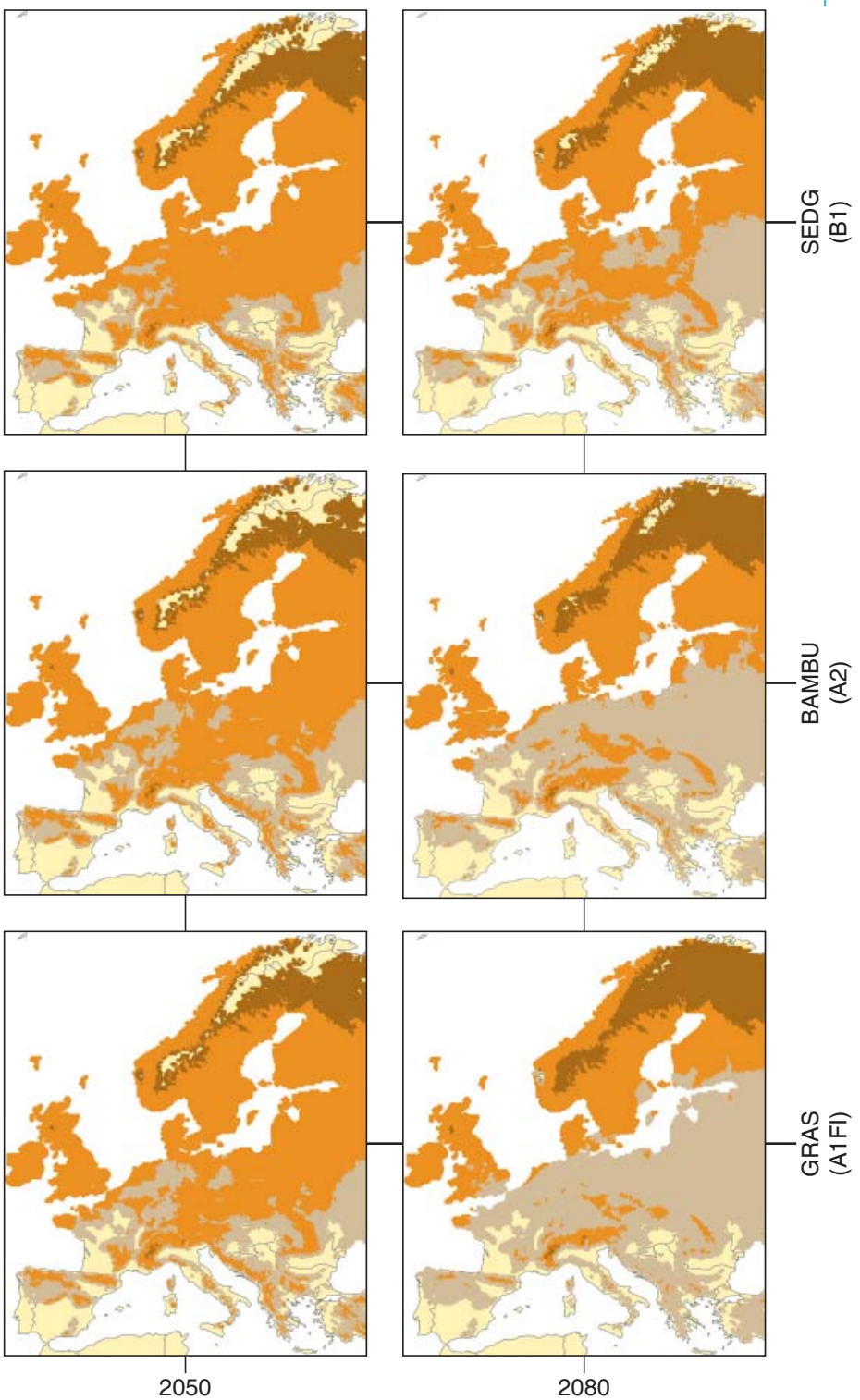
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.78). Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Argynnis adippe ([SCHIFFERMÜLLER], 1775) – High Brown Fritillary

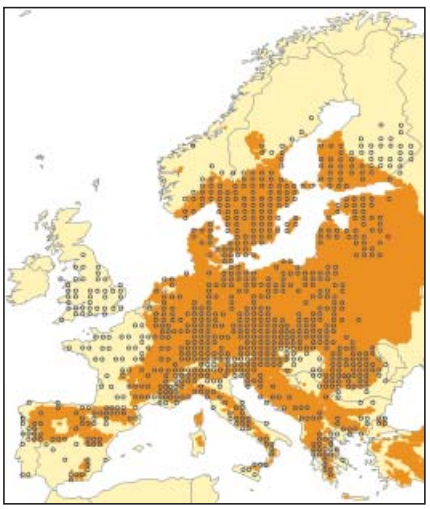
© Peter Ginzinger

		Full dispersal	No dispersal
2050	SEDG	-1589 (-11.19%)	-2919 (-20.56%)
	BAMBU	-2493 (-17.56%)	-3556 (-25.04%)
	GRAS	-3720 (-26.2%)	-4865 (-34.26%)
2080	SEDG	-3763 (-26.5%)	-5920 (-41.69%)
	BAMBU	-5935 (-41.8%)	-8143 (-57.35%)
	GRAS	-8102 (-57.06%)	-10604 (-74.68%)

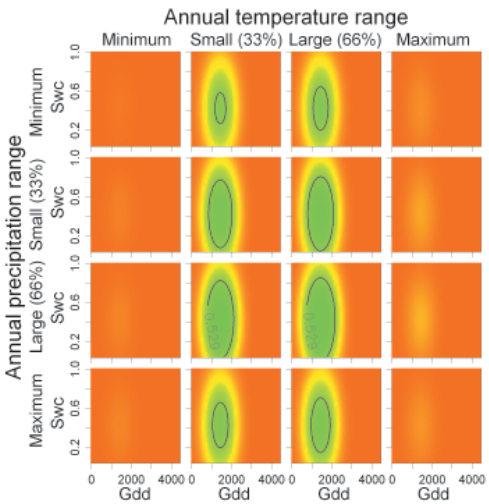
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 14199)

The High Brown Fritillary occurs on woodland edges and in woodland clearings, where there is lush, rough vegetation with plenty of nectar plants. The eggs are laid on the leaves of violets (*Viola* spp.) and also on the bark of trees with violets growing near them. The tiny caterpillar remains within the egg during the winter, and from about the beginning of March, leaves the egg and starts feeding on violet leaves. It pupates on a twig or on a leaf close to the ground. The High Brown Fritillary has one generation a year.

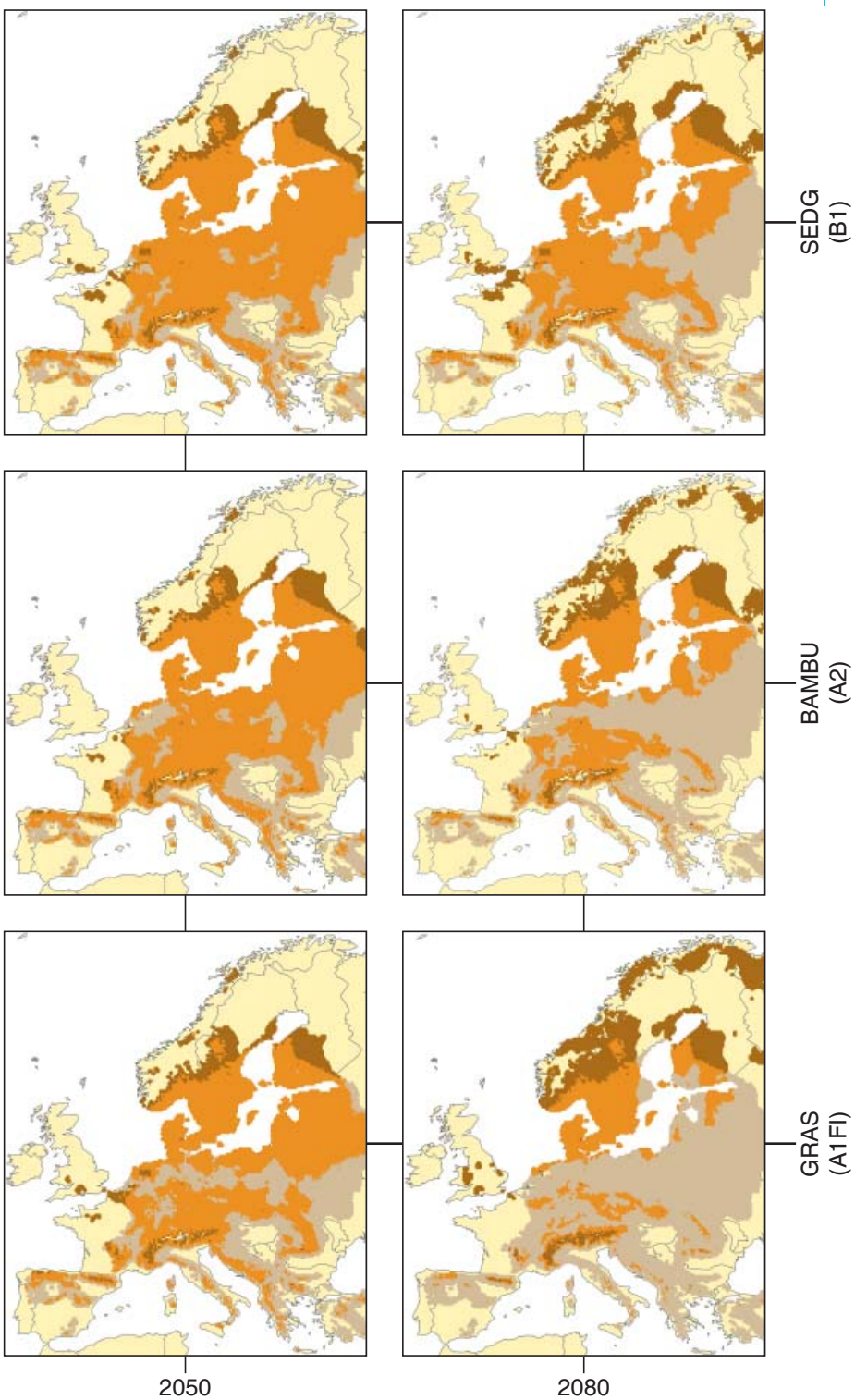
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.78). Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Argynnis niobe (Linnaeus, 1758) – Niobe Fritillary

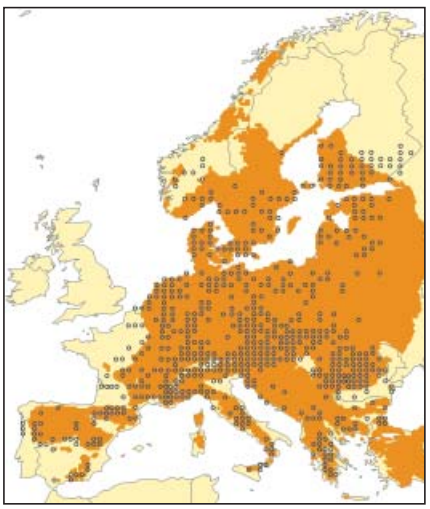
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-1295 (-7.83%)	-2967 (-17.94%)
	BAMBU	-2109 (-12.75%)	-3441 (-20.81%)
	GRAS	-2562 (-15.49%)	-3948 (-23.87%)
2080	SEDG	-3322 (-20.09%)	-6045 (-36.55%)
	BAMBU	-5110 (-30.9%)	-7946 (-48.04%)
	GRAS	-7117 (-43.03%)	-10289 (-62.21%)

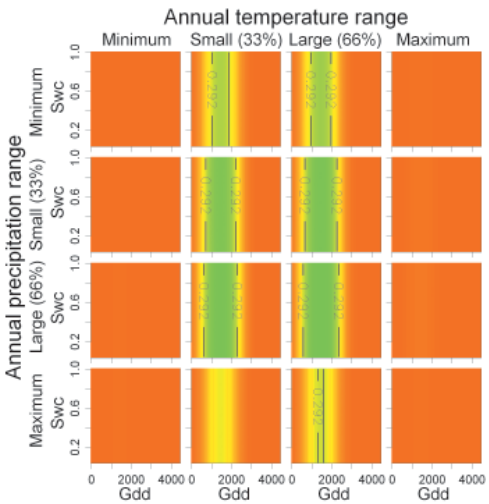
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 16539)

The Niobe Fritillary occurs on poor, dry grassland, often with woodland or scrub nearby. The eggs are laid on the woody stock of violets (*Viola* spp.). The caterpillar develops quickly within the egg, but does not hatch until after hibernation. Staying hidden during the day, it feeds on the violet plants at night. It pupates low down in the vegetation. The Niobe Fritillary has one generation a year.

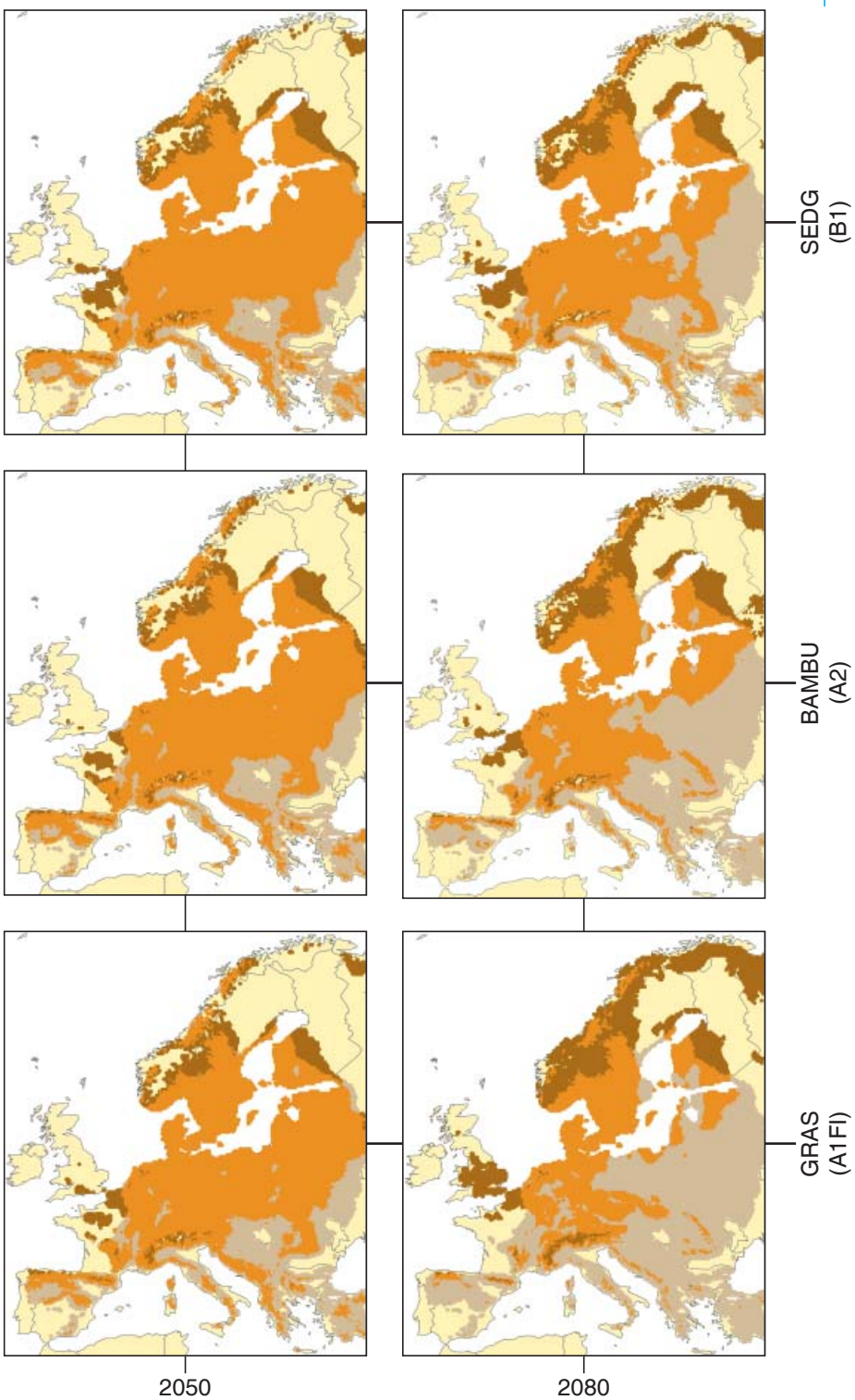
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.74). Climate risk category: PR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Argynnis laodice (Pallas, 1771) – Pallas' Fritillary

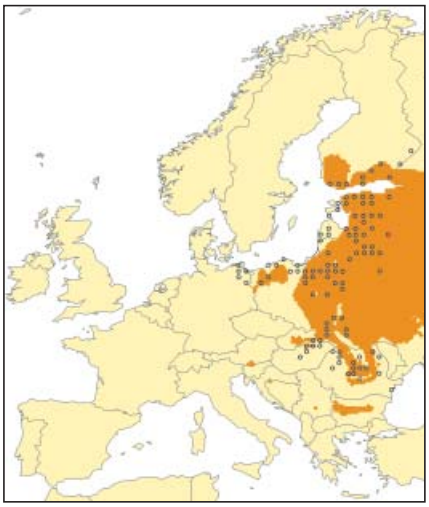
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	-679 (-13.69%)	-2209 (-44.53%)
	BAMBU	201 (4.05%)	-1794 (-36.16%)
	GRAS	-443 (-8.93%)	-2242 (-45.19%)
2080	SEDG	-358 (-7.22%)	-2923 (-58.92%)
	BAMBU	960 (19.35%)	-3083 (-62.14%)
	GRAS	167 (3.37%)	-3849 (-77.59%)

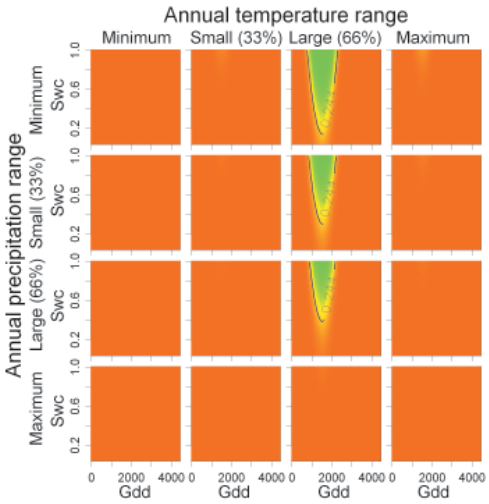
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 4961)

The Pallas's Fritillary can be easily recognized by the noticeable jagged, white line, running across the underside of the hindwing. It can be found on damp, flower-rich grassland in open or deciduous forests or mixed woods. Both males and females are fond of sucking nectar from bramble blossom. The caterpillars live on Marsh Violet (*Viola palustris*) and Heath Dog Violet (*V. canina*). It has one generation a year and passes the winter in the egg stage.

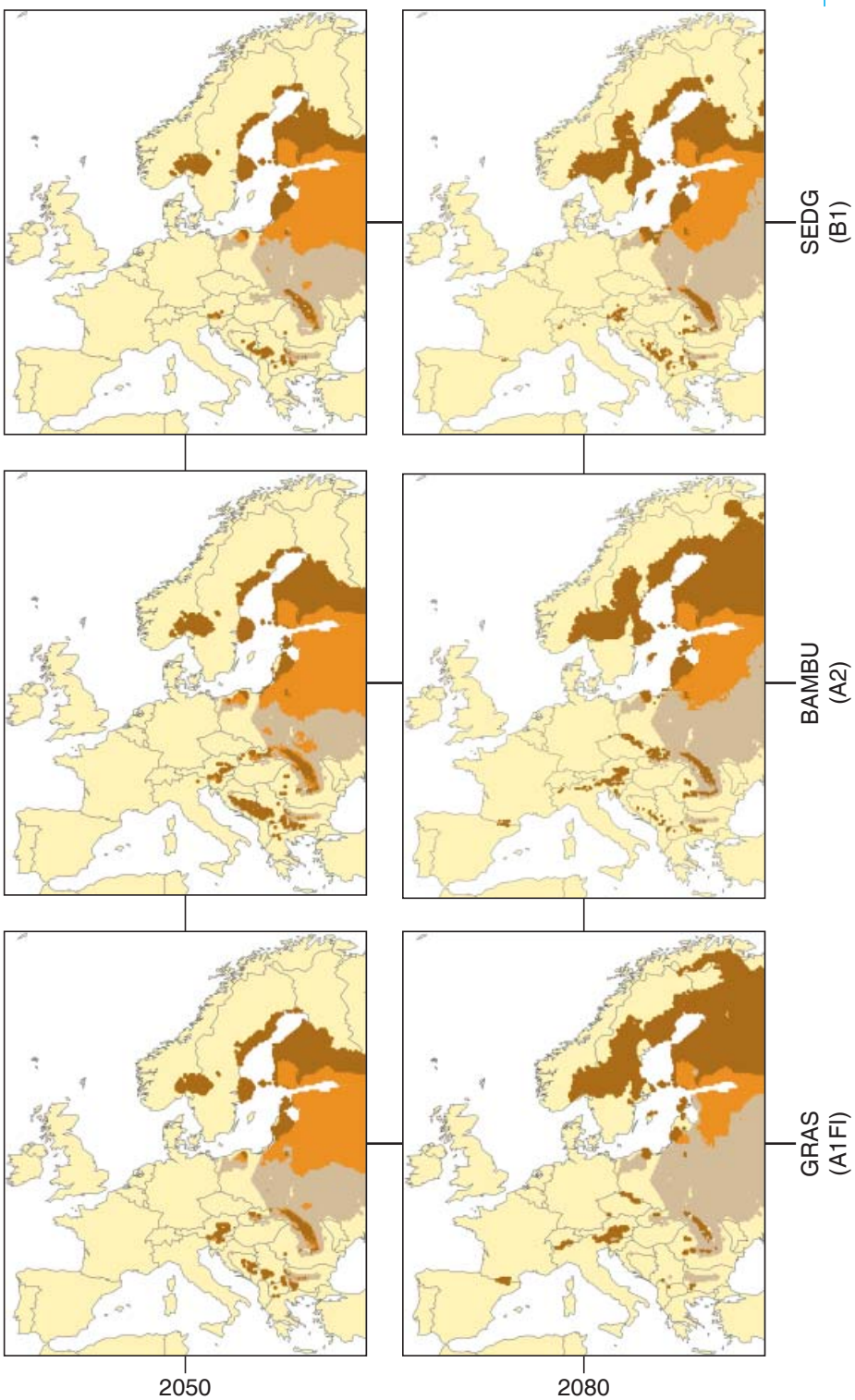
Present distribution can be well explained by climatic variables (AUC = 0.89).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Issoria lathonia (Linnaeus, 1758) – Queen of Spain Fritillary

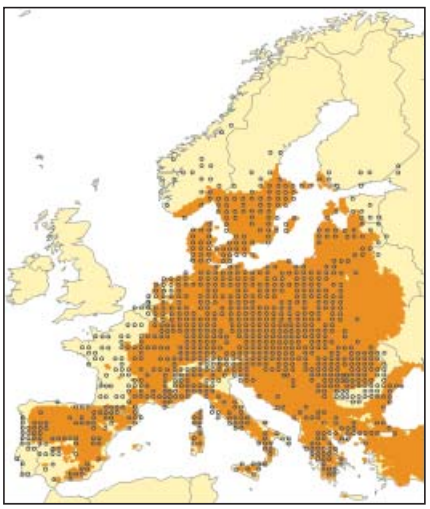
© Martin Wiemers

		Full dispersal	No dispersal
2050	SEDG	-770 (-5.48%)	2836 (-20.17%)
	BAMBU	-2545 (-18.1%)	-4088 (-29.08%)
	GRAS	-2031 (-14.45%)	-3944 (-28.05%)
2080	SEDG	-4326 (-30.77%)	-6463 (-45.97%)
	BAMBU	-6471 (-46.02%)	-8591 (-61.1%)
	GRAS	-7632 (-54.28%)	-10003 (-71.15%)

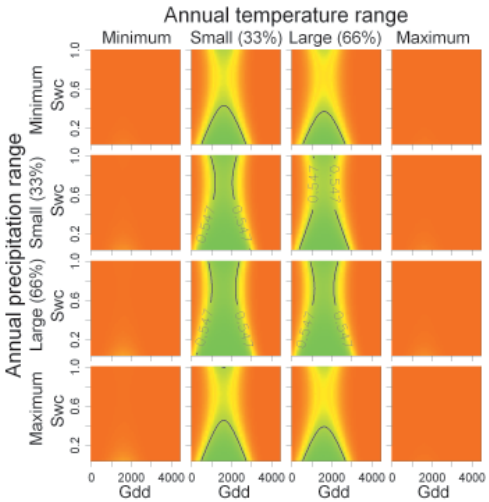
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 14060)

The large, silver-white mirrors on the underside of the hindwings, distinguish the Queen of Spain Fritillary from other fritillaries. The butterflies of the first brood that emerge at the end of the spring are quite small, but those of summer broods are often bigger. They can be found on a wide range of dry, flower-rich grasslands, wasteland and fields. The female deposits her eggs singly on the underside of the leaves of violets (*Viola* spp.) on which the caterpillars later feed. On this nutritious diet the caterpillars grow very quickly, pupating low down in the vegetation. The Queen of Spain Fritillary has two to four generations a year, depending on the altitude and geographical position of the habitat. Hibernation takes place in the larval stage in temperate areas, but probably it can overwinter in other stages as well.

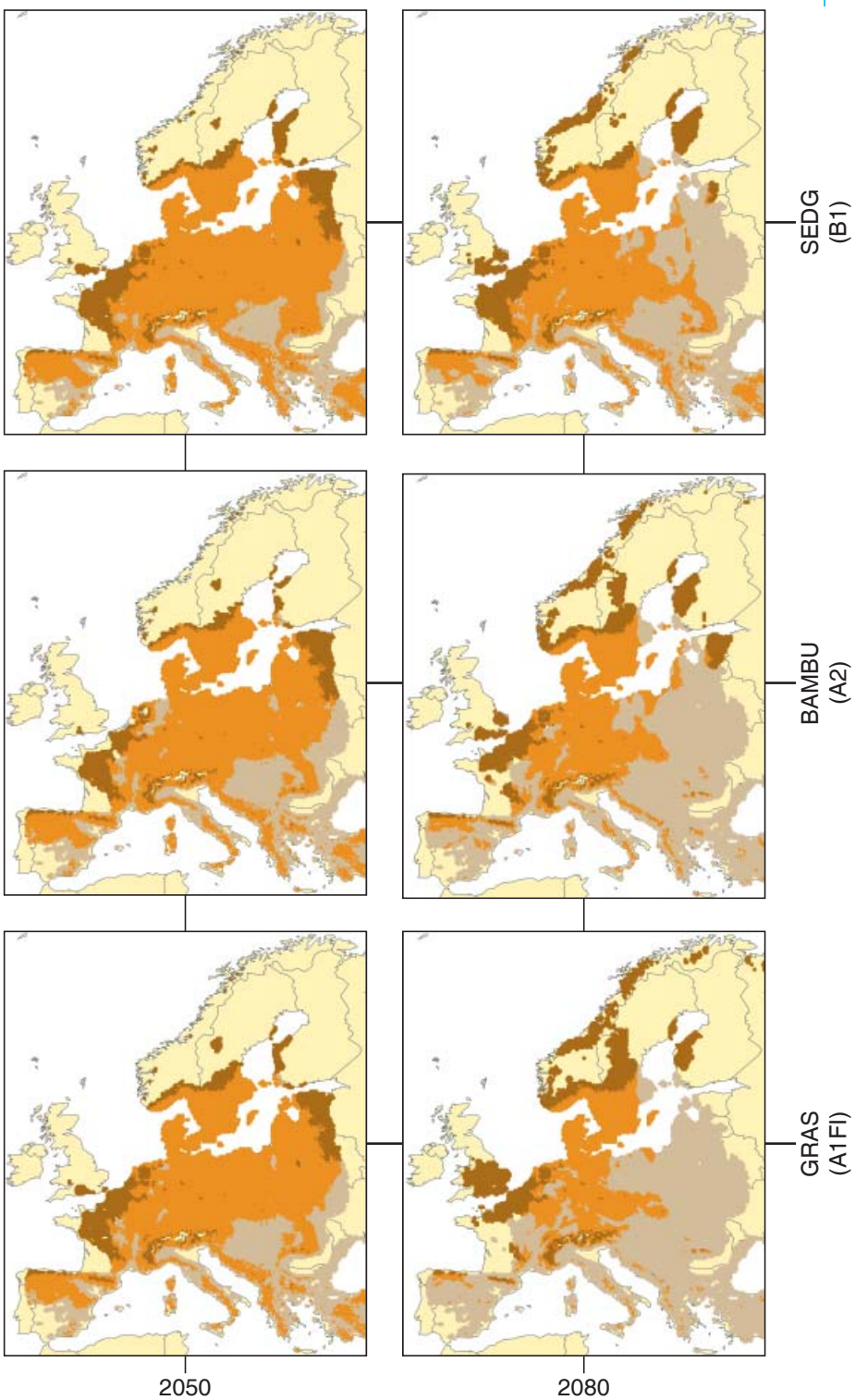
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.78). Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Brenthis ino (Rottemburg, 1775) – Lesser Marbled Fritillary

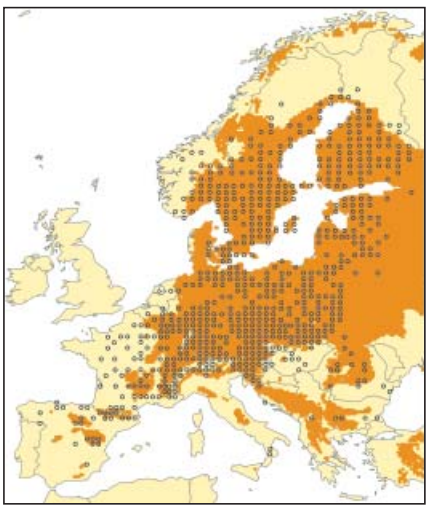
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	-2157 (-15.64%)	-4631 (-33.59%)
	BAMBU	-2329 (-16.89%)	-4748 (-34.44%)
	GRAS	-2704 (-19.61%)	-5157 (-37.4%)
2080	SEDG	-4126 (-29.92%)	-7216 (-52.34%)
	BAMBU	-4906 (-35.58%)	-8460 (-61.36%)
	GRAS	-6908 (-50.1%)	-10472 (-75.95%)

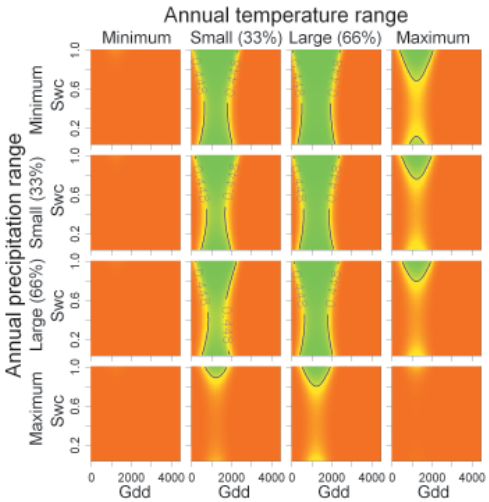
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 13788)

The Lesser Marbled Fritillary occurs on damp to wet, flower-rich, rough vegetation, growing in the shelter of woodland. This can be situated in a valley, or on the banks of a stream, in abandoned meadows and swampy habitats. Because of changes in agricultural practices, this butterfly has been able to expand into some abandoned wet meadows. After continuing succession, these meadows will get overgrown by scrub and become unsuitable for the Lesser Marbled Fritillary. Eggs are laid singly or in pairs on the leaves and flowerheads of Meadowsweet (*Filipendula ulmaria*), Goat's-beard (*Aruncus dioicus*), Great Burnet (*Sanguisorba officinalis*) and brambles (*Rubus* spp.). It hibernates either as an egg or a caterpillar. The caterpillars feed at night, and in bad weather, also during the day. They pupate on the foodplant. The Lesser Marbled Fritillary is single-brooded.

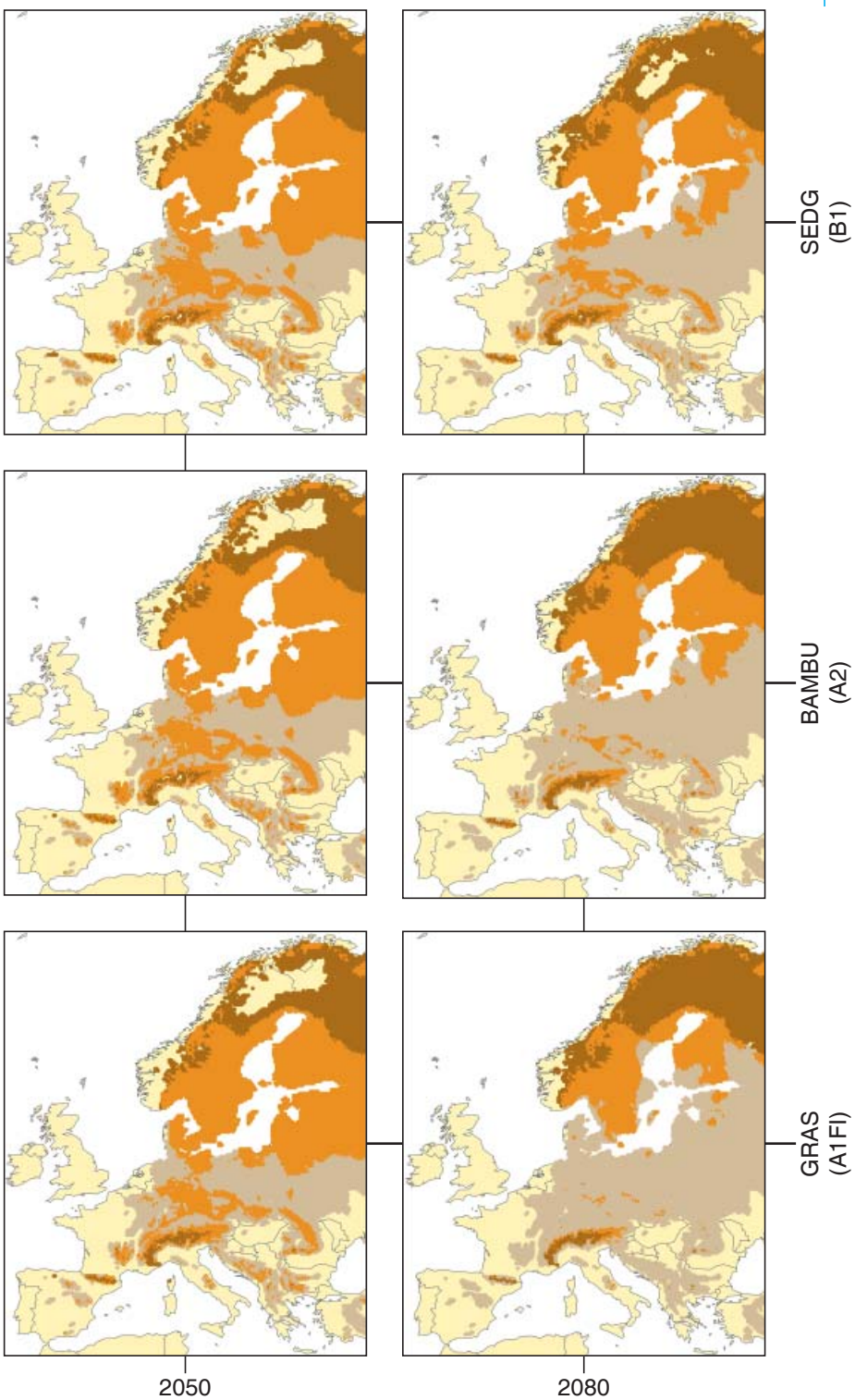
Present distribution can be well explained by climatic variables (AUC = 0.87).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Brenthis daphne (Bergsträsser, 1780) – Marbled Fritillary

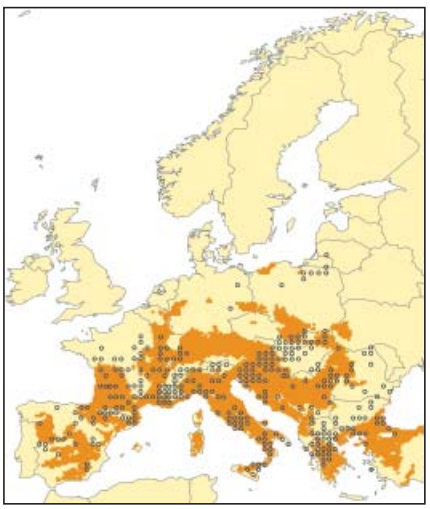
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	1518 (27.55%)	-1190 (-21.6%)
	BAMBU	1916 (34.78%)	-1365 (-24.78%)
	GRAS	763 (13.85%)	-1779 (-32.29%)
2080	SEDG	2653 (48.16%)	-1927 (-34.98%)
	BAMBU	2007 (36.43%)	-2868 (-52.06%)
	GRAS	1929 (35.02%)	-3676 (-66.73%)

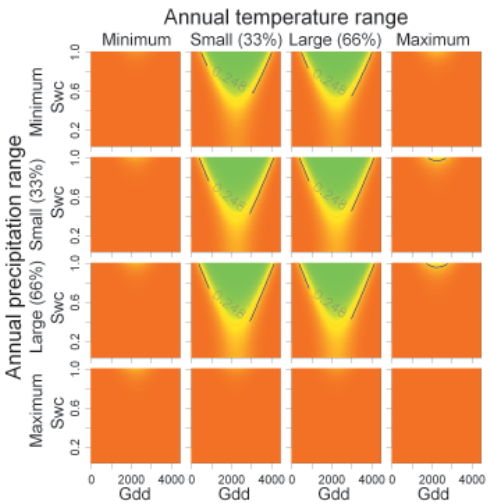
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 5509)

The Marbled Fritillary occurs at the edges of woods or in scrub where brambles are growing. It takes nectar from thistles growing in rough vegetation. Eggs are deposited singly on the leaves and sepals of brambles (*Rubus* spp.), where they pass the winter, protected by withered leaves. In the spring, the small caterpillar feeds on the new, young leaves in the leaf buds, the later larval stages eating older leaves. The pupa is suspended from a leaf or branch of the foodplant. The Marbled Fritillary is single-brooded.

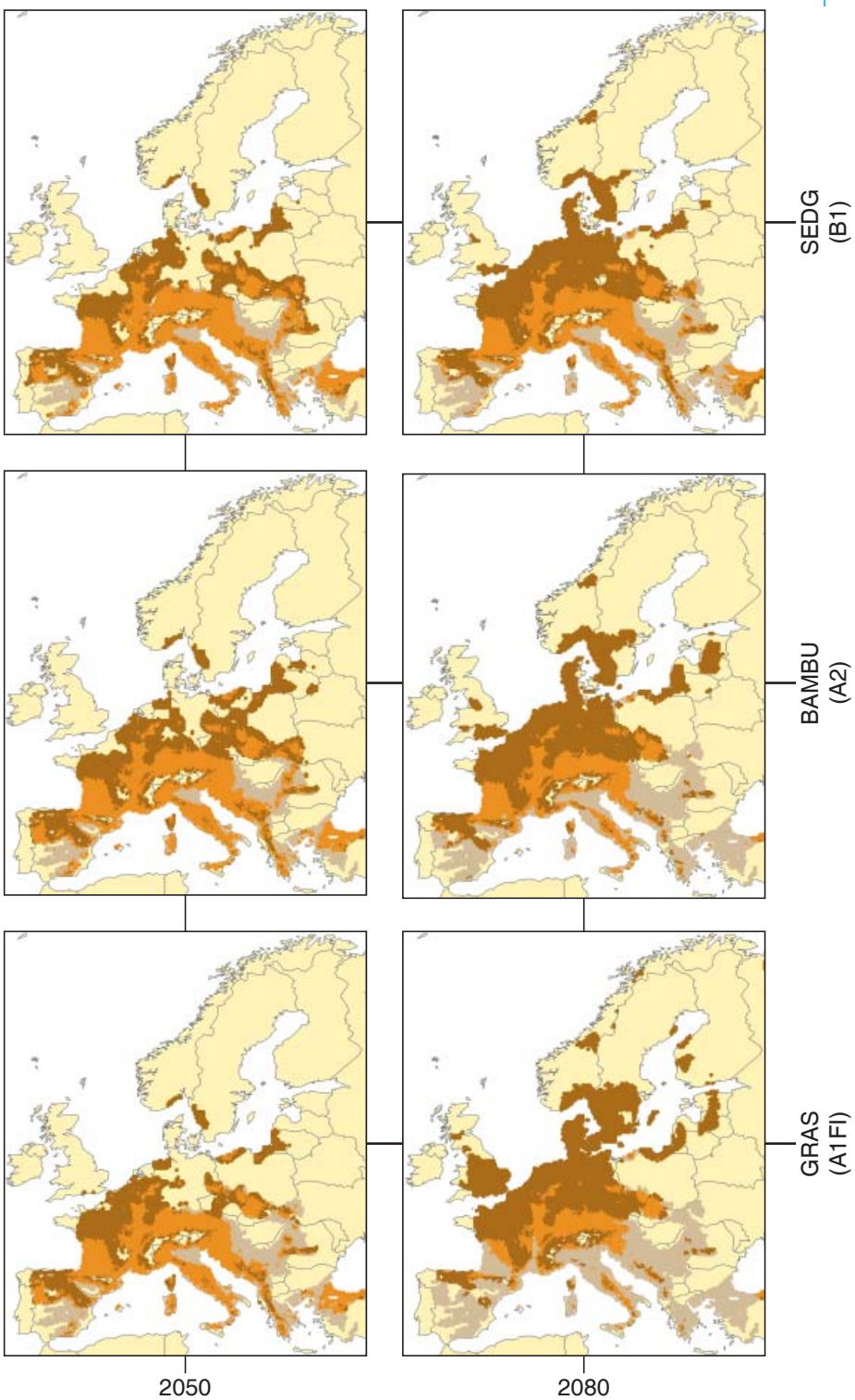
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.77). Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Brenthis hecate ([Schiffermüller], 1775) – Twin-spot Fritillary

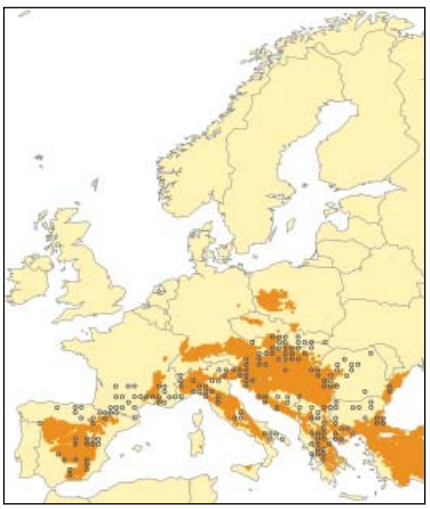
© Rudi Verovnik

		Full dispersal	No dispersal
2050	SEDG	554 (14.53%)	-1741 (-45.65%)
	BAMBU	-589 (-15.44%)	-2135 (-55.98%)
	GRAS	-270 (-7.08%)	-2292 (-60.09%)
2080	SEDG	-217 (-5.69%)	-2542 (-66.65%)
	BAMBU	-554 (-14.53%)	-3243 (-85.03%)
	GRAS	-508 (-13.32%)	-3442 (-90.25%)

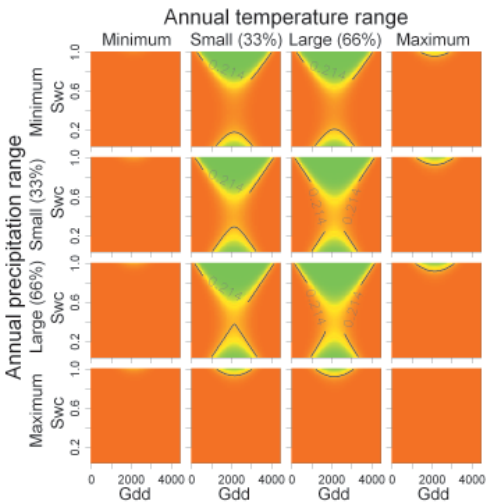
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 3814)

The Twin-spot Fritillary can be found in flower-rich grassland, situated in the shelter of a woodland edge, or in scattered bushes. The most important foodplant is Meadowsweet (*Filipendula ulmaria*), although different species of *Dorycnium*, a leguminous plant, are named as a foodplant in Spain. It is single-brooded, and passes the winter in the egg or caterpillar stage.

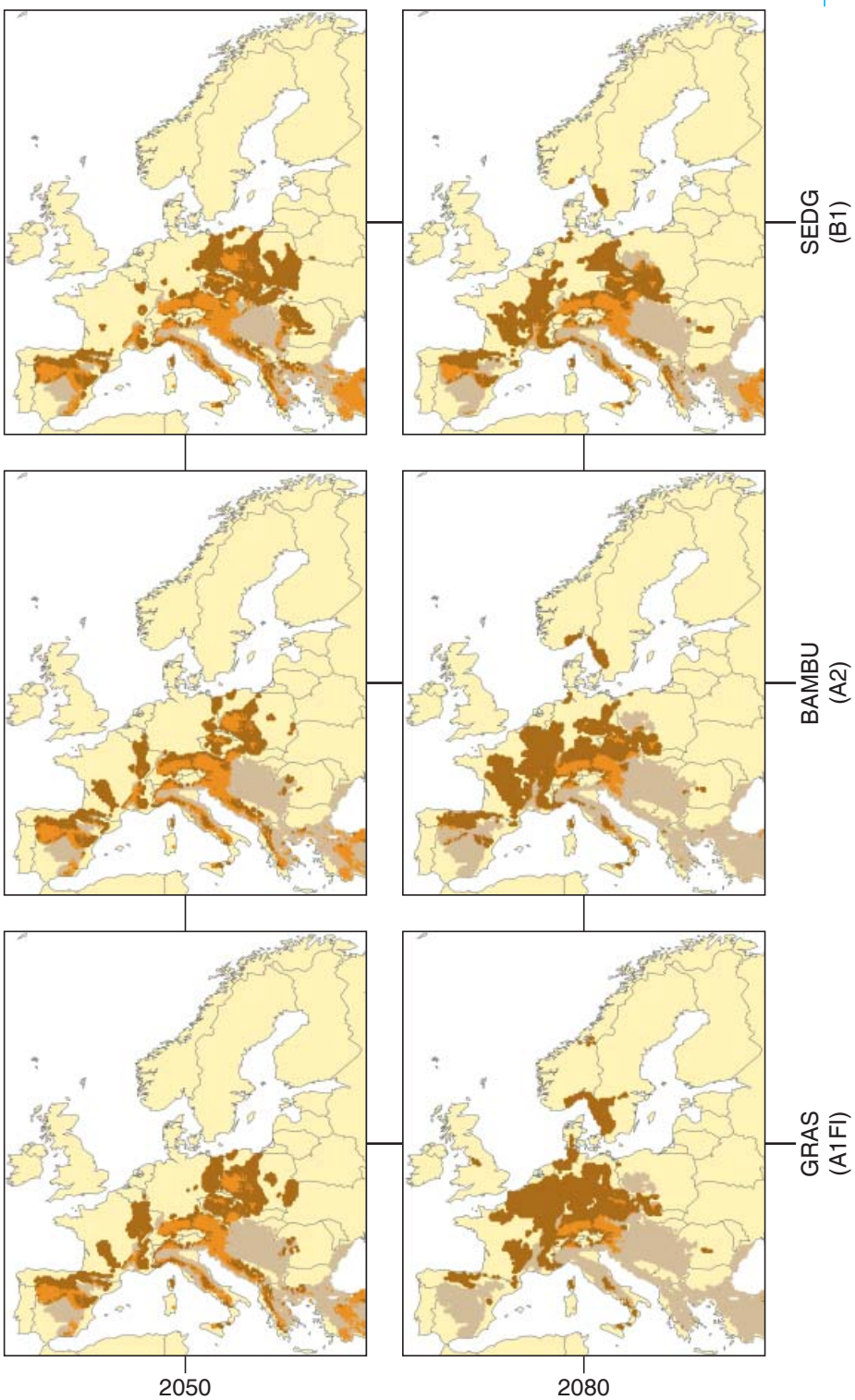
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.79). Climate risk category: HHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Boloria eunomia (Esper, 1799) – Bog Fritillary

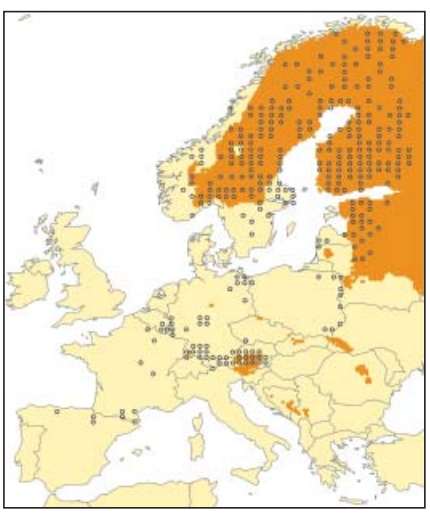
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	-1589 (-19.98%)	-1783 (-22.42%)
	BAMBU	-1220 (-15.34%)	-1399 (-17.59%)
	GRAS	-1564 (-19.66%)	-1760 (-22.13%)
2080	SEDG	-1843 (-23.17%)	-2291 (-28.8%)
	BAMBU	-2410 (-30.3%)	-2747 (-34.54%)
	GRAS	-3171 (-39.87%)	-3443 (-43.29%)

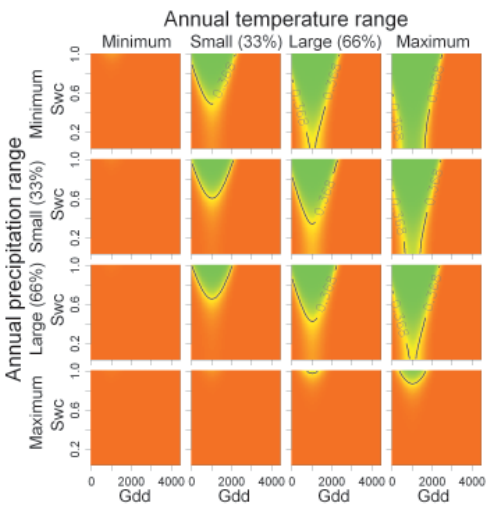
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 7954)

The Bog Fritillary occurs on wet grasslands and marshy ground by streams, rivers, or lakes, and at the edges of raised bogs. Sometimes, the area they occupy is very small. They can be seen beside streams, flying slowly back and forth between small patches where its foodplant Common Bistort (*Polygonum bistorta*) is growing. The small caterpillars live together in a loosely spun nest, and hibernate when half-grown. However, the larger, later caterpillars are solitary and considerably more mobile, frequently leaving their foodplants in order to bask in the sun on another plant. The Bog Fritillary has one generation a year. There are two subspecies in Europe. The species' range in central Europe is highly fragmented.

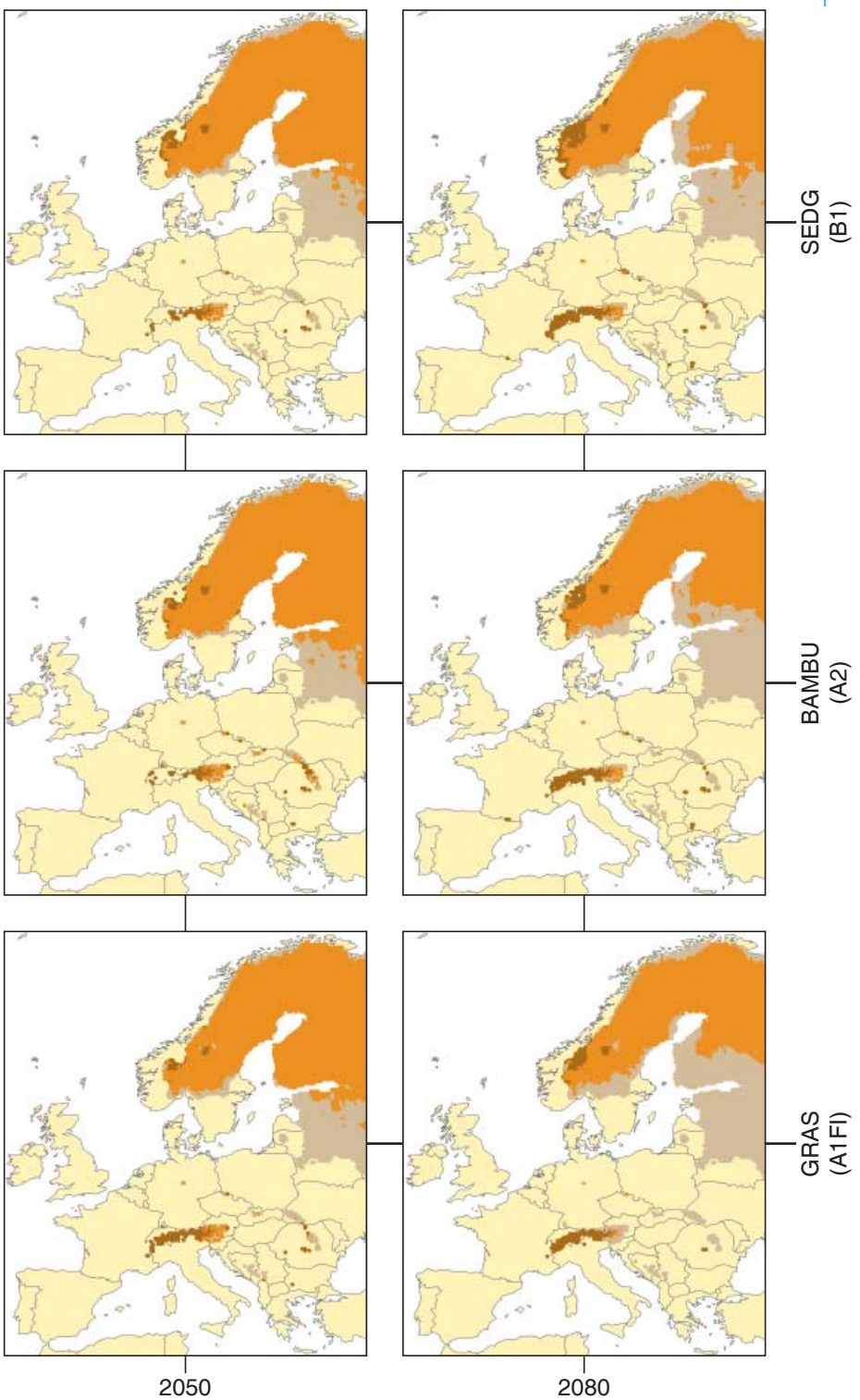
Present distribution can be well explained by climatic variables (AUC = 0.89).
Climate risk category: LR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Boloria euphrosyne (Linnaeus, 1758) – Pearl-bordered Fritillary

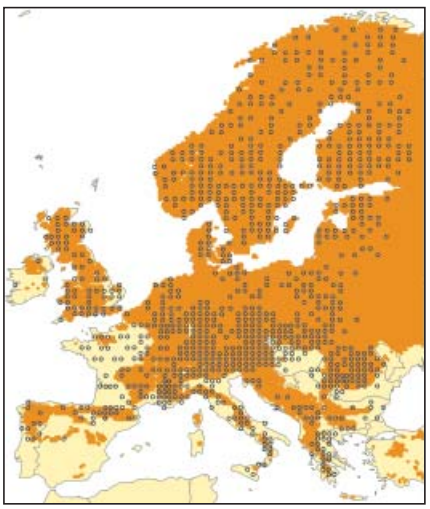
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-4042 (-18.77%)	-4132 (-19.19%)
	BAMBU	-3553 (-16.5%)	-3587 (-16.66%)
	GRAS	-5707 (-26.51%)	-5782 (-26.86%)
2080	SEDG	-4372 (-20.31%)	-4649 (-21.59%)
	BAMBU	-7044 (-32.72%)	-7118 (-33.06%)
	GRAS	-8912 (-41.4%)	-9059 (-42.08%)

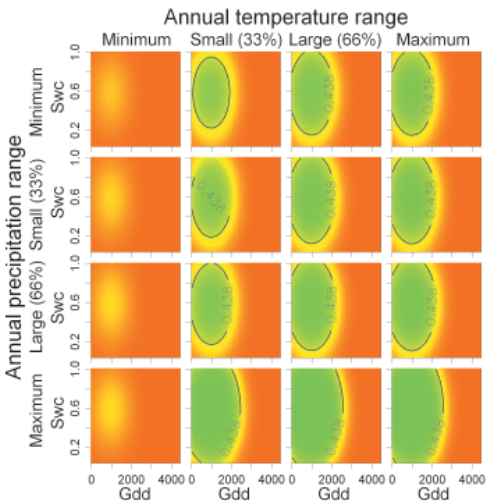
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 21529)

The Pearl-bordered Fritillary occurs at the edges of woods and in clearings, in meadows and on pastures near scrub. Its habitats are usually dry and moderately rich in nutrients. The butterflies are quite mobile, leaving the habitat in search of nectar, visiting vegetation that ranges from very dry to wet. Most species of violet (*Viola* spp.) can be used as a foodplant. The female lays her eggs singly, either on a foodplant or on a neighbouring plant. The caterpillars feed on the violet leaves, hibernating in a rolled-up, withered leaf, when half-grown. The species pupates on the foodplant, close to the ground. It has one to two broods per year.

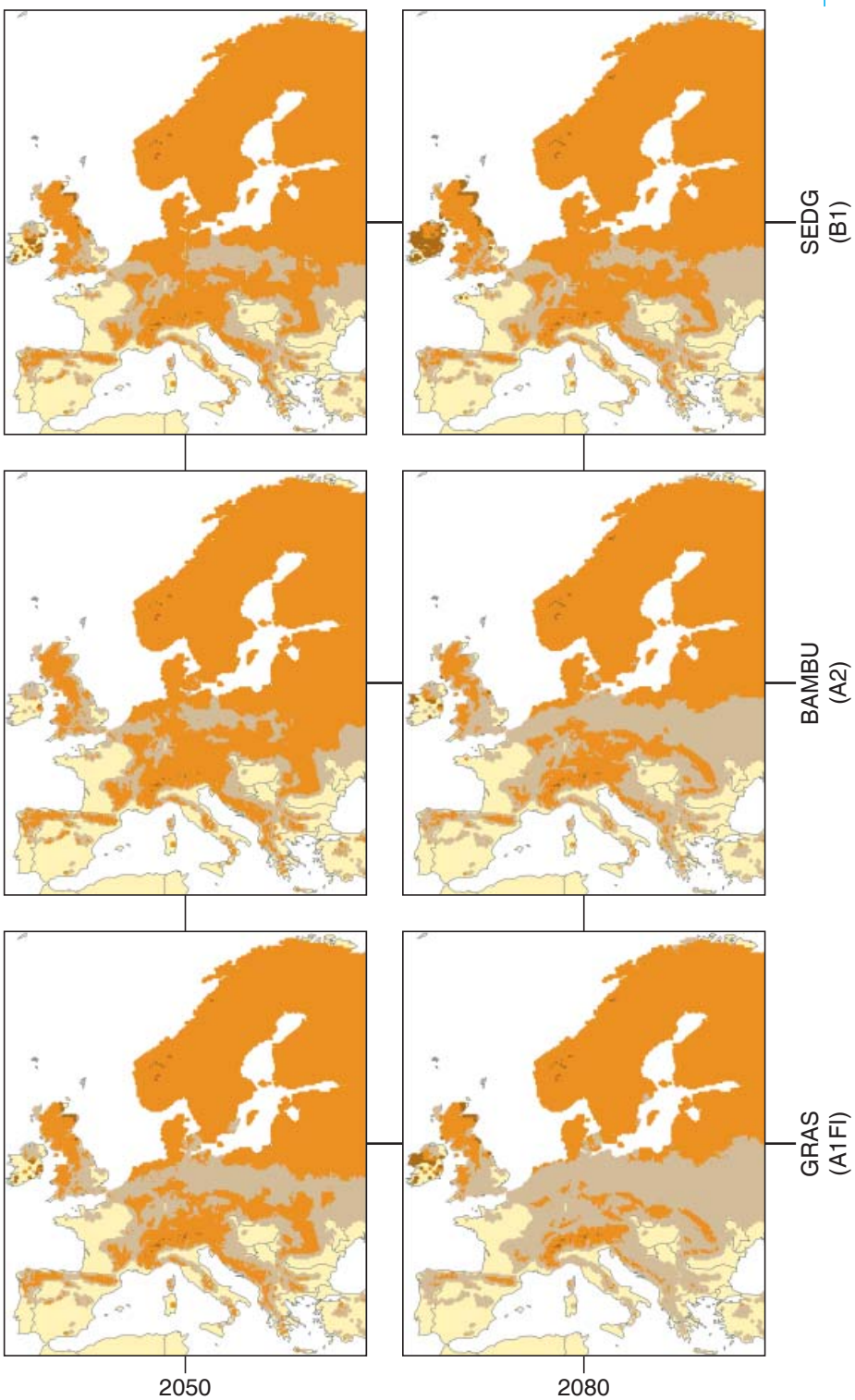
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.73). Climate risk category: PR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Boloria titania (Esper, 1793) – Titania's Fritillary

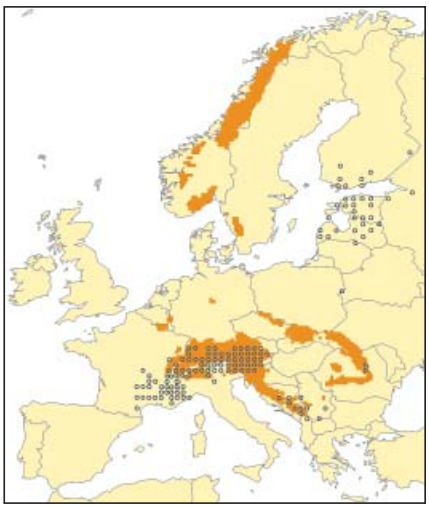
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-377 (-19.74%)	-766 (-40.1%)
	BAMBU	-151 (-7.91%)	-525 (-27.49%)
	GRAS	-580 (-30.37%)	-874 (-45.76%)
2080	SEDG	116 (6.07%)	-863 (-45.18%)
	BAMBU	570 (29.84%)	-926 (-48.48%)
	GRAS	492 (25.76%)	-1181 (-61.83%)

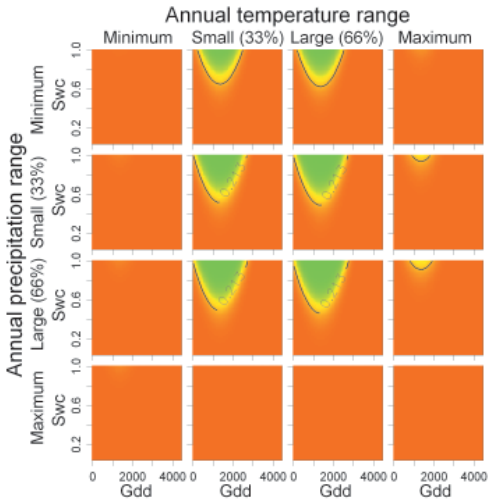
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1910)

Titania's Fritillary occurs in grassy, open places at the edges of woodland, or in woodland clearings, or on grassland with scattered trees, mostly on damp to swampy ground, where its foodplant Snake-root or Common Bistort (*Polygonum bistorta*) is growing among tall flower-rich vegetation. Various violets (*Viola* spp.) are also used as a foodplant. The female deposits her rather large eggs singly on either the foodplant, or on a plant nearby. The caterpillars go into hibernation in an early stage, and pupate at the end of the spring on a stalk, near to the ground. The species is single-brooded.

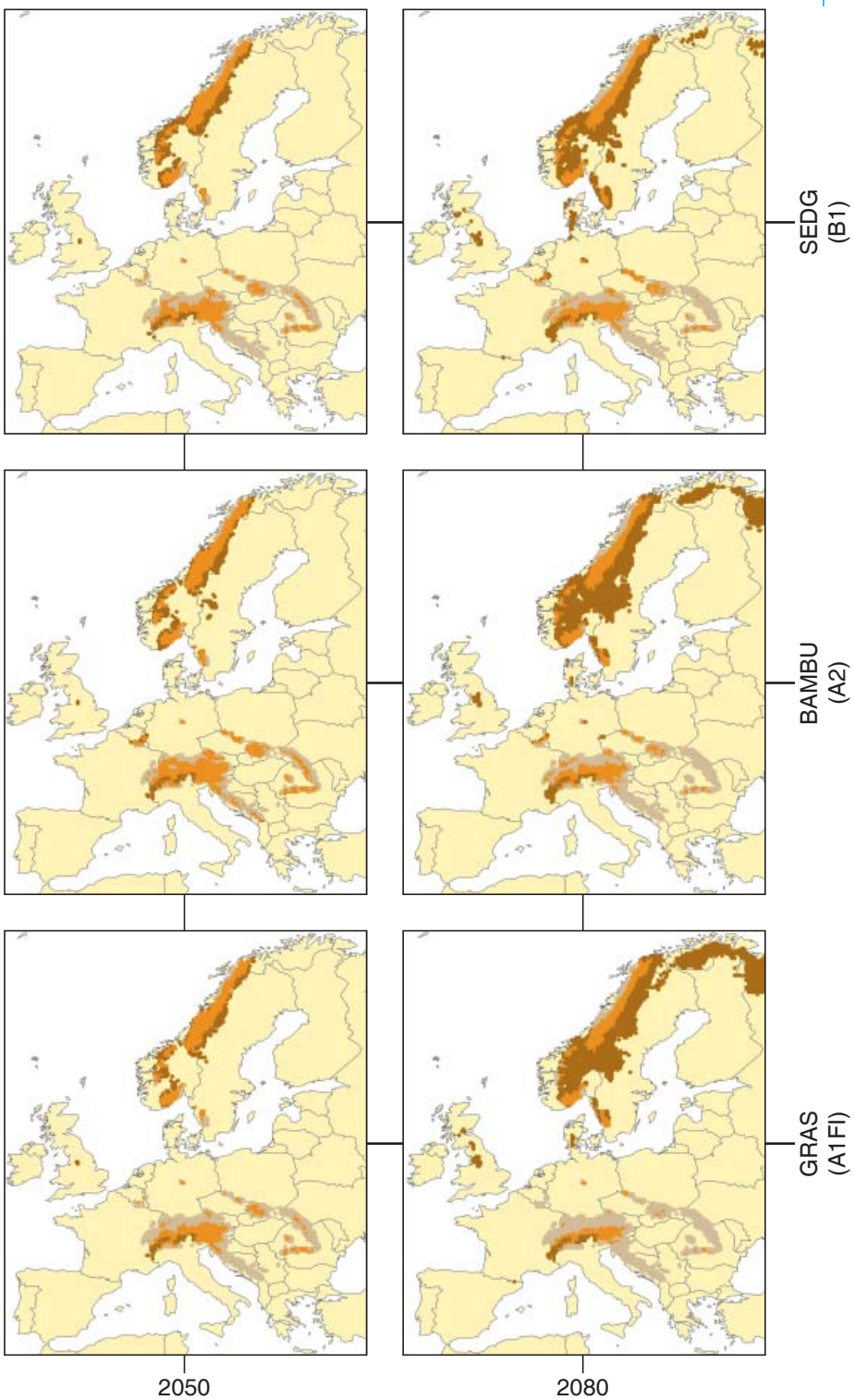
Present distribution can be well explained by climatic variables (AUC = 0.9).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Boloria selene ([SCHIFFERMÜLLER], 1775) – Small Pearl-bordered Fritillary

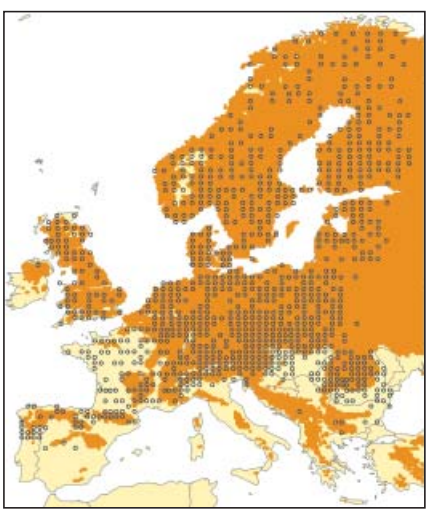
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	-4708 (-23%)	-5037 (-24.61%)
	BAMBU	-5114 (-24.99%)	-5424 (-26.5%)
	GRAS	-6093 (-29.77%)	-6442 (-31.47%)
2080	SEDG	-6291 (-30.74%)	-6771 (-33.08%)
	BAMBU	-8549 (-41.77%)	-8996 (-43.95%)
	GRAS	-10443 (-51.02%)	-10927 (-53.39%)

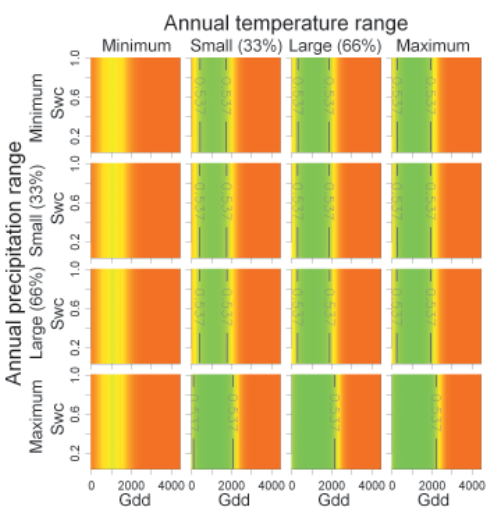
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 20468)

The Small Pearl-bordered Fritillary, is found in damp to wet meadows or on lightly-grazed pastures. It is also found on raised bogs and in swampy habitats. Populations may occur in small, sheltered locations, but also in an open landscape. The butterflies can often be seen taking nectar, seeming to prefer thistles of various kinds. The eggs are laid on violets (*Viola* spp.). When half-grown, the caterpillars hibernate in a rolled-up leaf of the foodplant. They pupate low down on a stalk in the litter layer. At high altitudes and in the north, the Small Pearl-bordered Fritillary is single-brooded, but has two generations a year elsewhere.

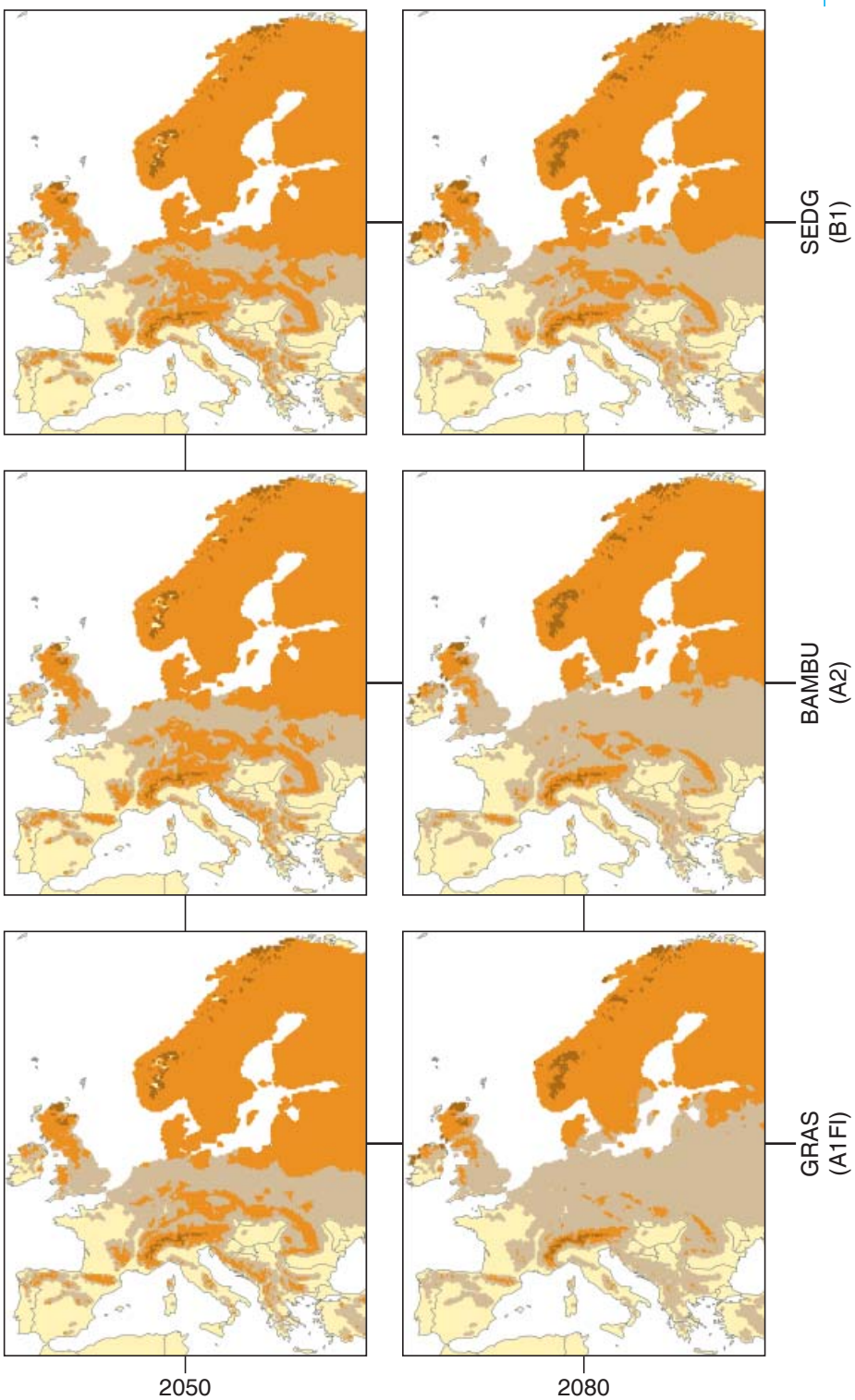
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.73). Climate risk category: PR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Boloria chariclea (Schneider, 1794) – Arctic Fritillary

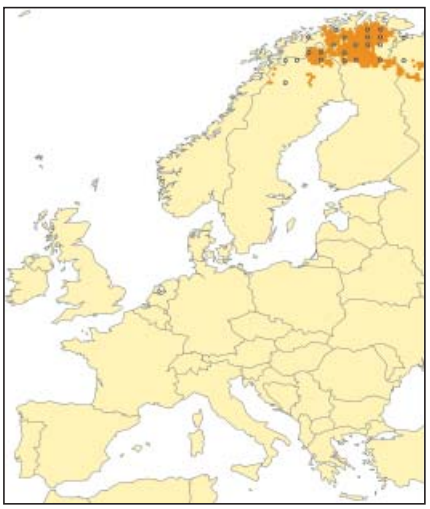
© Jostein Engdal

		Full dispersal	No dispersal
2050	SEDG	-519 (-98.3%)	-523 (-99.05%)
	BAMBU	-518 (-98.11%)	-521 (-98.67%)
	GRAS	-518 (-98.11%)	-524 (-99.24%)
2080	SEDG	-512 (-96.97%)	-528 (-100%)
	BAMBU	-526 (-99.62%)	-528 (-100%)
	GRAS	-528 (-100%)	-528 (-100%)

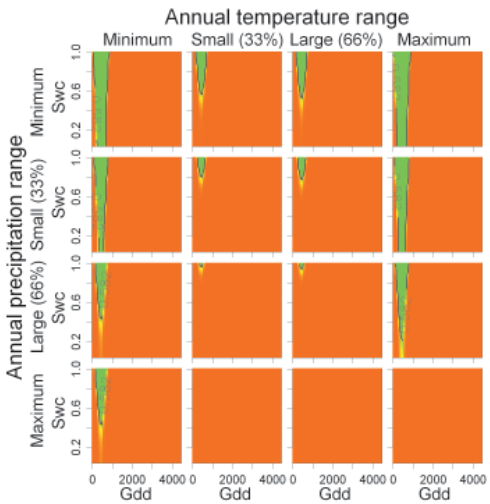
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 528)

The Arctic Fritillary occurs in a harsh environment, the windy, dry, rocky tundra in the far north of Europe, with a vegetation of grass and dwarf shrubs. The foodplant is not certain, but *Cassiope tetragon* (Ericaceae) and violets (*Viola* spp.) may be used. The butterflies, which only appear for about two weeks a year, fly close to the ground, seeking the shelter of rocks or hollows.

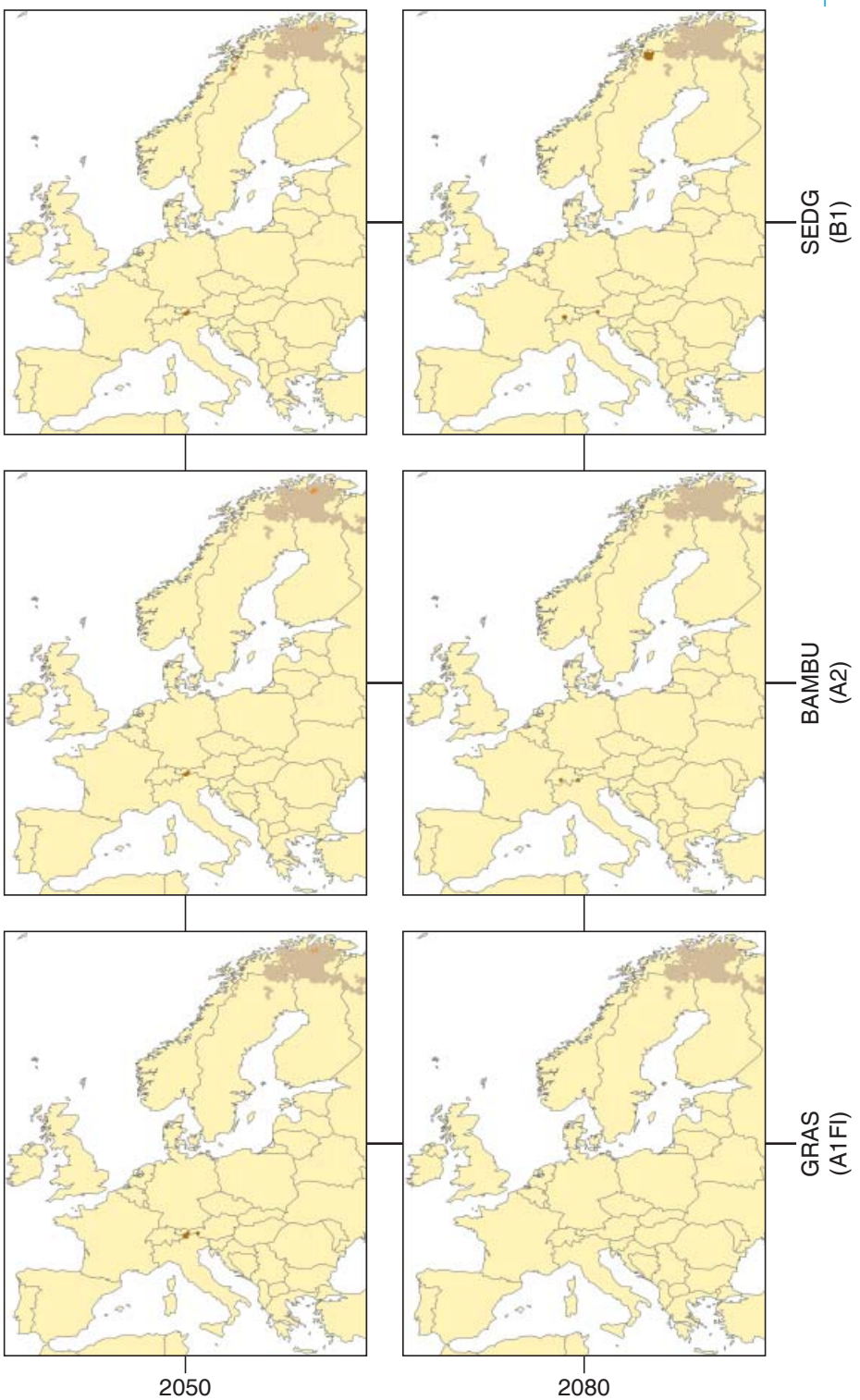
Present distribution can be very well explained by climatic variables (AUC = 1).
Climate risk category: HHHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Boloria freija (Becklin, 1791) – Frejya's Fritillary

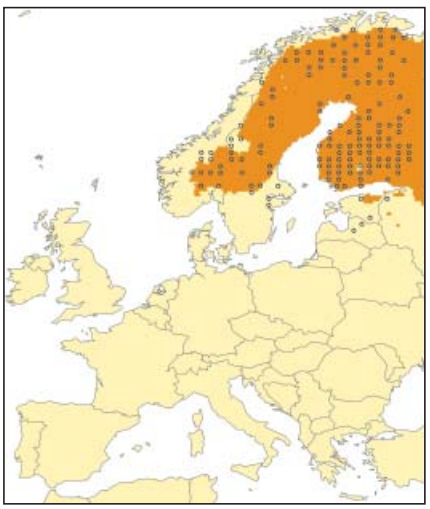
© Jostein Engdal

		Full dispersal	No dispersal
2050	SEDG	-1904 (-34.57%)	-1930 (-35.05%)
	BAMBU	-1434 (-26.04%)	-1446 (-26.26%)
	GRAS	-1581 (-28.71%)	-1593 (-28.93%)
2080	SEDG	-3654 (-66.35%)	-3670 (-66.64%)
	BAMBU	-3324 (-60.36%)	-3340 (-60.65%)
	GRAS	-4189 (-76.07%)	-4197 (-76.21%)

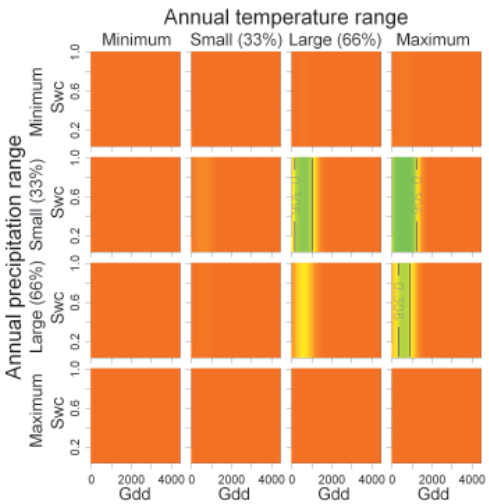
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 5507)

Frejya's Fritillary occurs in damp, peatland habitats. The female lays her eggs singly on Bog Whortleberry (*Vaccinium uliginosum*), and possibly also on Cloudberry (*Rubus chamaemorus*), Bearberry (*Arctostaphylos uva-ursi*), Alpine Bearberry (*A. alpinus*), and Crowberry (*Empetrum nigrum*). The butterflies can also be seen on drier, grassy vegetation, searching for nectar, visiting Moss Campion (*Silene acaulis*) frequently. Frejya's Fritillary is single-brooded.

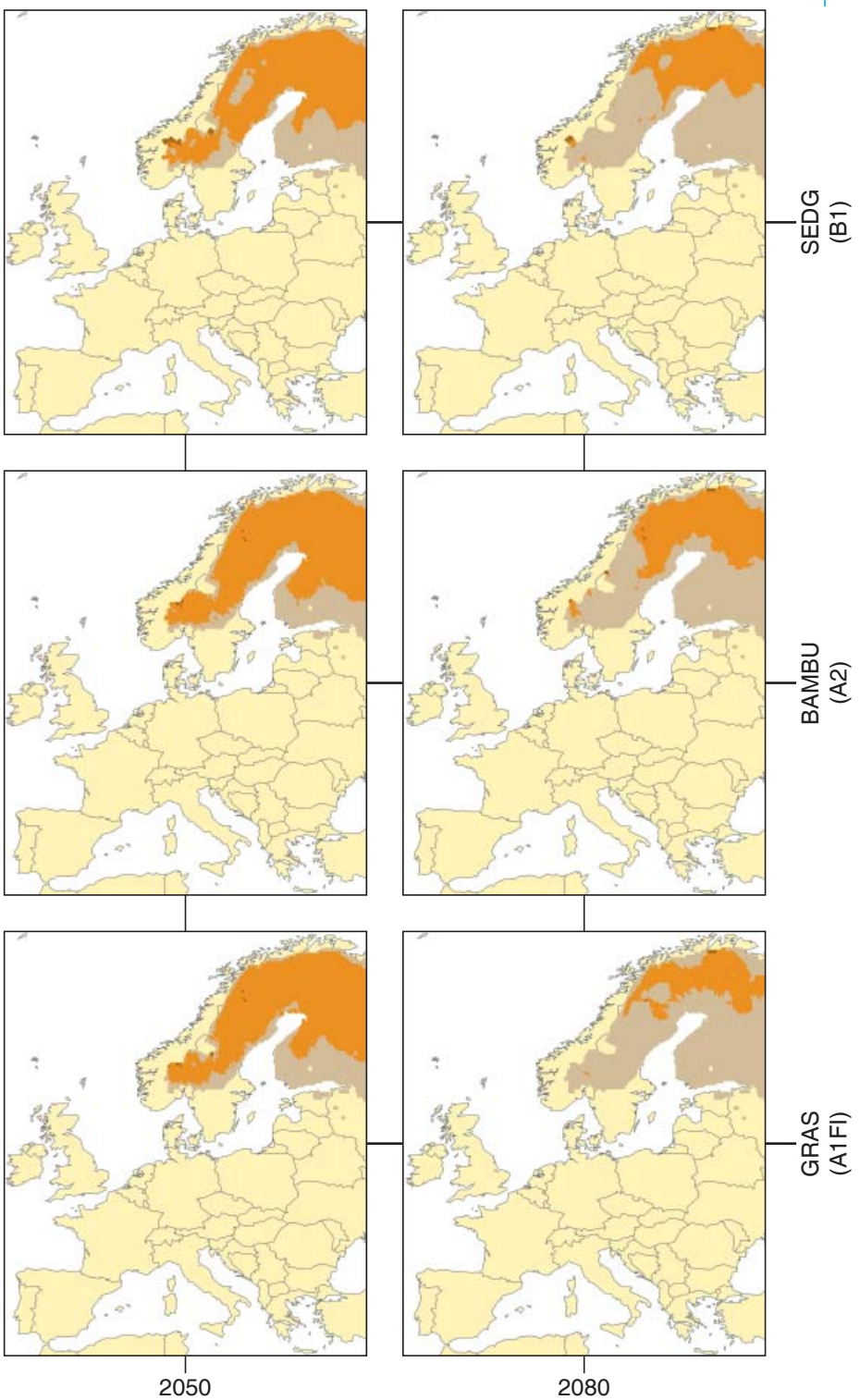
Present distribution can be well explained by climatic variables (AUC = 0.95).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Boloria dia (Linnaeus, 1767) – Weaver's Fritillary

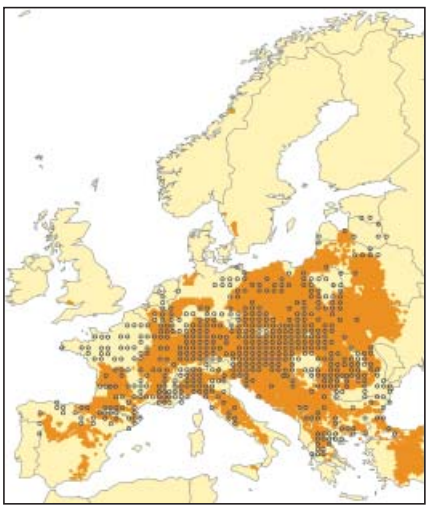
© Karl Heyde

		Full dispersal	No dispersal
2050	SEDG	1212 (14.54%)	-2342 (-28.09%)
	BAMBU	1436 (17.22%)	-2450 (-29.38%)
	GRAS	-2 (-0.02%)	-3190 (-38.26%)
2080	SEDG	1325 (15.89%)	-4030 (-48.33%)
	BAMBU	892 (10.7%)	-5229 (-62.71%)
	GRAS	605 (7.26%)	-6394 (-76.69%)

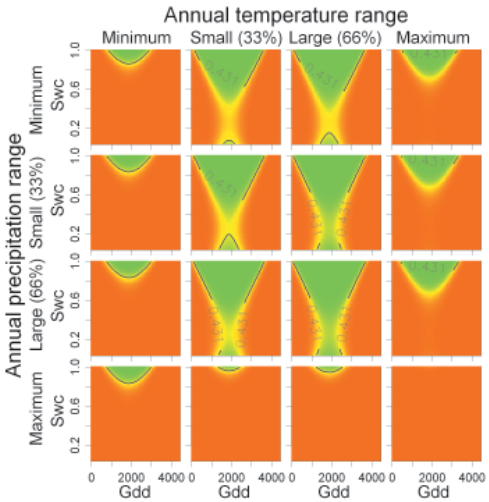
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 8338)

In the northern part of its range, the Weaver's Fritillary can be found on warm slopes with open woodland, scrub, and flower-rich grassland. More to the south, it is also found in damp, shady places. It can be very common in a traditional South-European agricultural landscape. The eggs are laid singly on various violets (*Viola* spp.). The caterpillars hibernate when half-grown in the litter layer. They pupate deep down in the vegetation. Weaver's Fritillary has two to three broods a year.

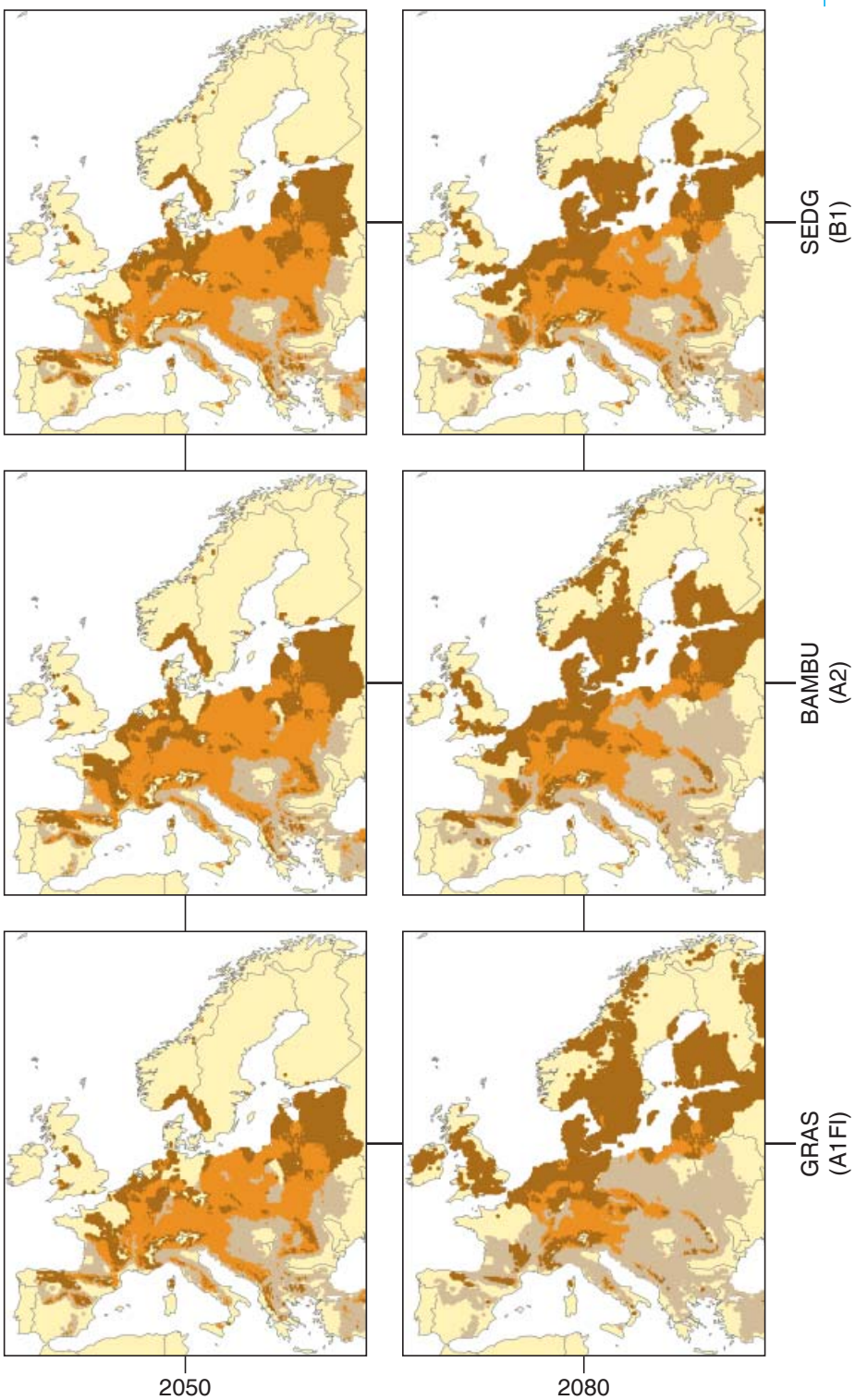
Present distribution can be well explained by climatic variables (AUC = 0.86).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Boloria thore (Hübner, 1806) – Thor's Fritillary

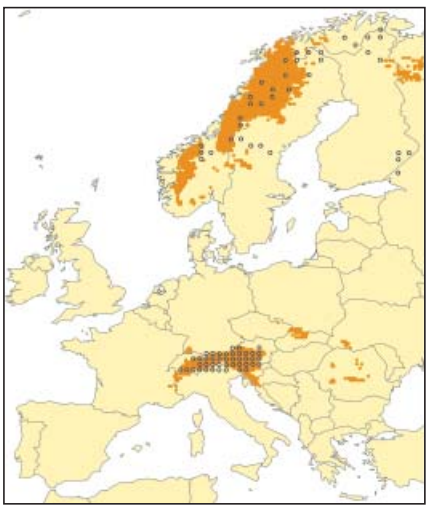
© Rudi Verovnik

		Full dispersal	No dispersal
2050	SEDG	-200 (-12.32%)	-396 (-24.38%)
	BAMBU	-237 (-14.59%)	-370 (-22.78%)
	GRAS	-365 (-22.48%)	-471 (-29%)
2080	SEDG	579 (35.65%)	-405 (-24.94%)
	BAMBU	229 (14.1%)	-437 (-26.91%)
	GRAS	388 (23.89%)	-549 (-33.81%)

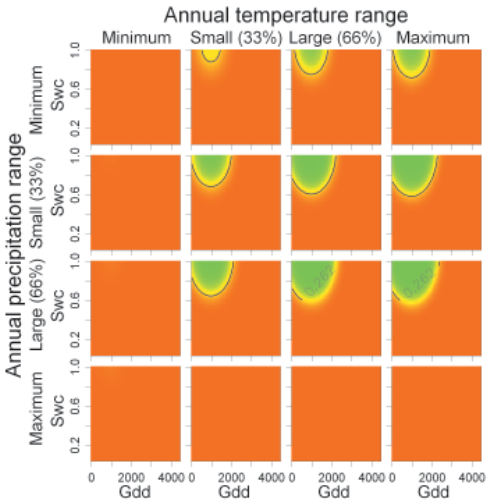
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1624)

In the Alps, Thor's Fritillary can be found in flower-rich places, in clearings, or in sheltered "alcoves" at the edges of woods. It prefers damp, north-facing slopes, and is often found beside streams or in ravines. In the Scandinavian part of its range, the butterflies can be seen in clearings in birch woods and coniferous forests, and near mountain lakes, swampy places, in gullies, and river beds. The Yellow Wood Violet (*Viola biflora*) is its major foodplant, but other violets are used as well. The female lays her eggs either on the foodplant, or on a neighbouring plant, and the caterpillars take nearly two years to develop.

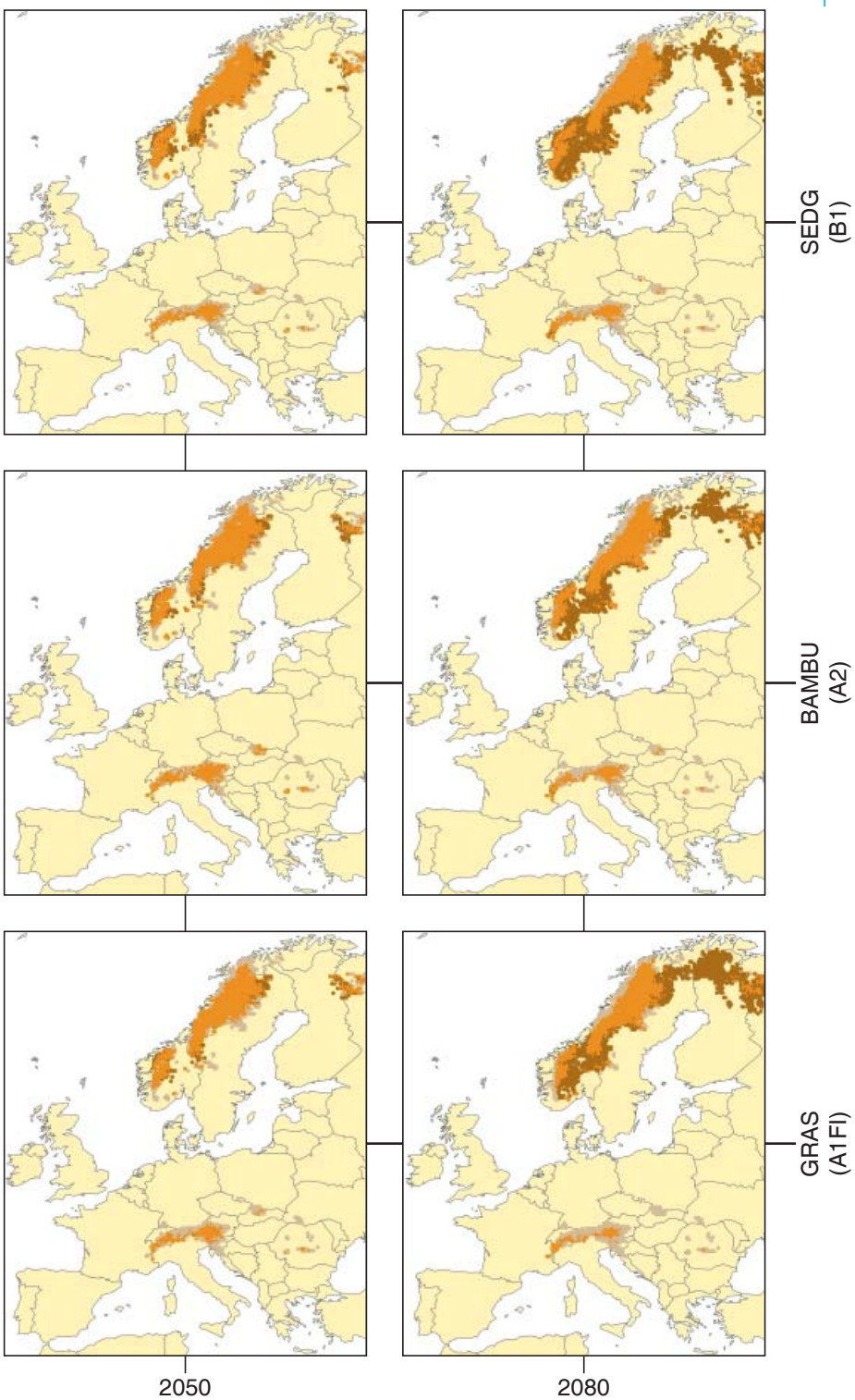
Present distribution can be well explained by climatic variables (AUC = 0.95).
Climate risk category: LR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Boloria frigga (Becklin, 1791) – Frigga's Fritillary

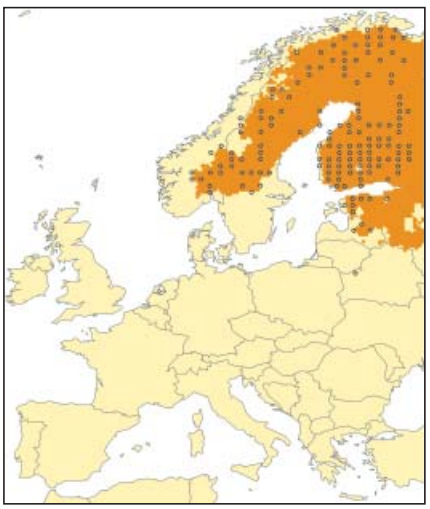
© Jostein Engdal

		Full dispersal	No dispersal
2050	SEDG	-1825 (-30.7%)	-1919 (-32.28%)
	BAMBU	-1331 (-22.39%)	-1457 (-24.51%)
	GRAS	-1842 (-30.98%)	-1949 (-32.78%)
2080	SEDG	-3317 (-55.79%)	-3406 (-57.29%)
	BAMBU	-2550 (-42.89%)	-2690 (-45.25%)
	GRAS	-3189 (-53.64%)	-3323 (-55.9%)

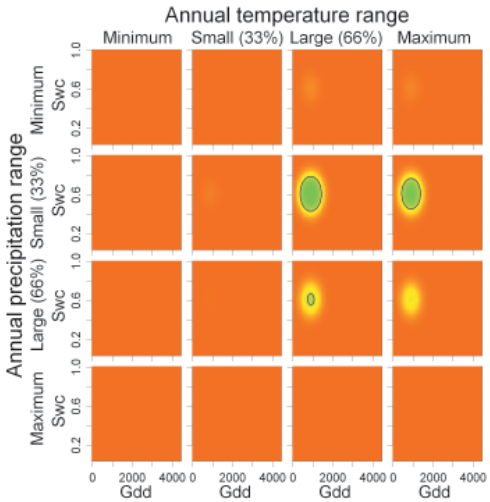
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 5945)

Frigga's Fritillary is mostly found on open bogs and in swampy areas with shrubs of Birches (*Betula* spp.) and willows (*Salix* spp.) scrub, in swampy areas in birch woods, and on bogs in coniferous forests. It is a rare fritillary that occurs locally and always in low to very low numbers. Despite its size, it is inconspicuous and can suddenly seem to vanish. The eggs are laid singly on Cloudberry (*Rubus chamaemorus*).

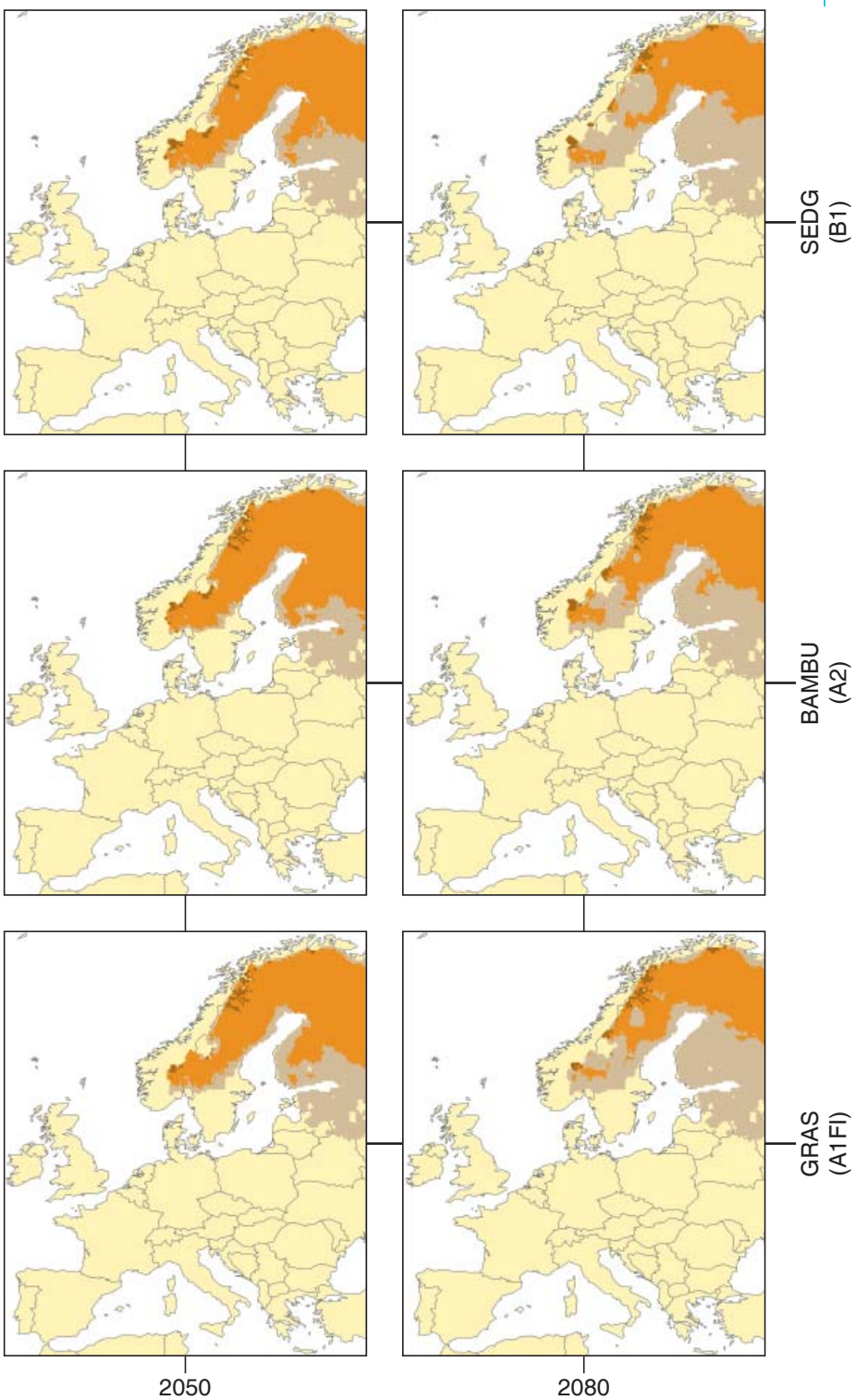
Present distribution can be well explained by climatic variables (AUC = 0.96).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Boloria pales ([Schiffermüller], 1775) – Shepherd's Fritillary

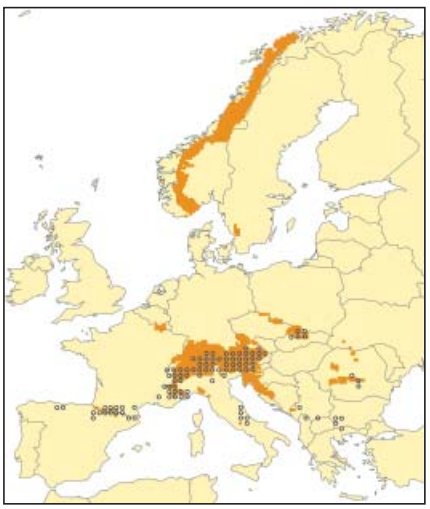
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-359 (-23.68%)	-493 (-32.52%)
	BAMBU	-286 (-18.87%)	-463 (-30.54%)
	GRAS	-520 (-34.3%)	-631 (-41.62%)
2080	SEDG	-533 (-35.16%)	-808 (-53.3%)
	BAMBU	-417 (-27.51%)	-782 (-51.58%)
	GRAS	-631 (-41.62%)	-1002 (-66.09%)

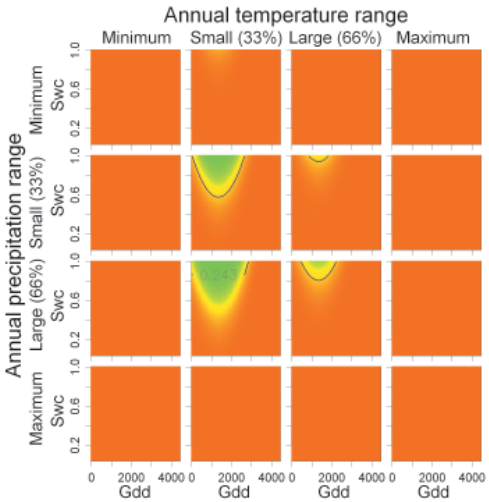
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1516)

The Shepherd's Fritillary is a characteristic species of flower-rich sub-alpine and alpine grasslands and can even be found on quite heavily grazed pastures. They can occur in high numbers. At the end of the day, they often roost communally in damp vegetation with tall plants. Long-spurred Pansy (*Viola calcarata*) is the major foodplant, but Alpine Plantain (*Plantago alpina*) and valerians (*Valeriana*) are probably also used. Caterpillars are mostly found on plants growing in dry, rocky places. The Shepherd's Fritillary has one generation a year and passes the winter in the larval stage.

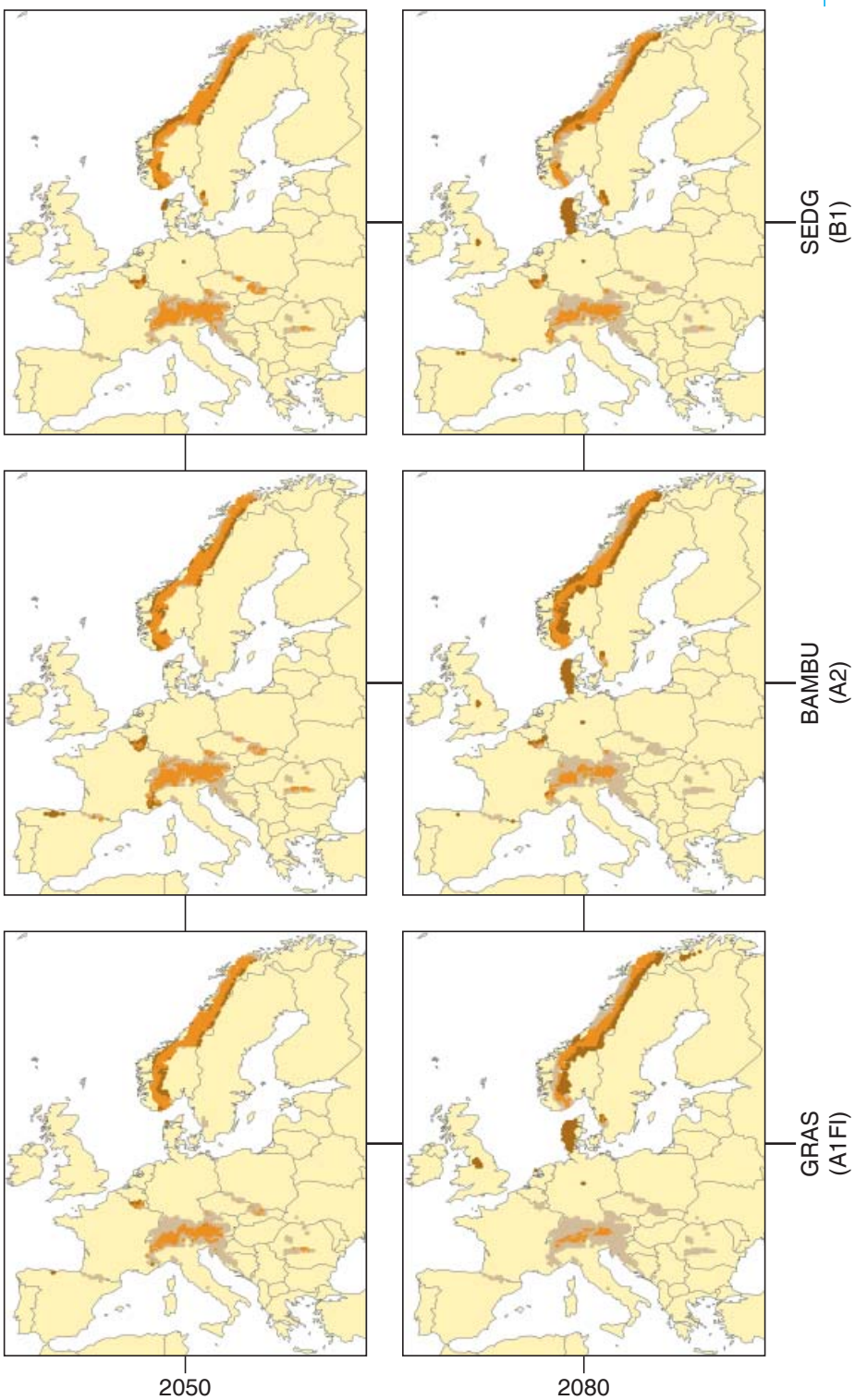
Present distribution can be well explained by climatic variables (AUC = 0.89).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Boloria aquilonaris (Stichel, 1908) – Cranberry Fritillary

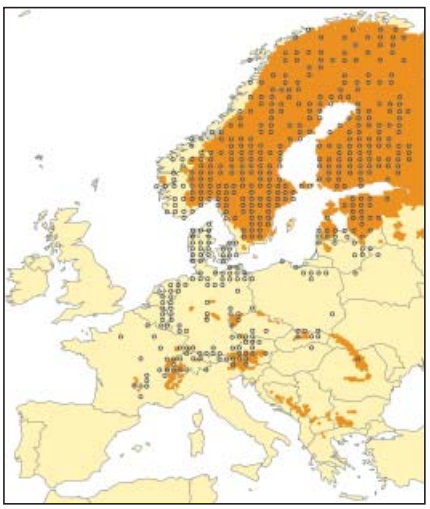
© Peter Ginzinger

		Full dispersal	No dispersal
2050	SEDG	-2371 (-29%)	-2668 (-32.63%)
	BAMBU	-1964 (-24.02%)	-2230 (-27.27%)
	GRAS	-2362 (-28.89%)	-2625 (-32.1%)
2080	SEDG	-3359 (-41.08%)	-3768 (-46.08%)
	BAMBU	-3717 (-45.46%)	-4025 (-49.22%)
	GRAS	-4789 (-58.57%)	-5019 (-61.38%)

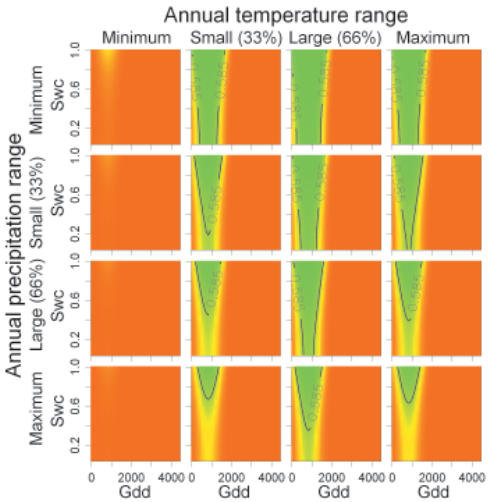
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 8177)

The Cranberry Fritillary inhabits raised bogs and wet heaths, mostly in sheltered places at the edges of woods, or in clearings. The female lays her eggs singly on the leaves of Cranberry (*Vaccinium oxycoccos*) and Marsh Andromeda (*Andromeda polifolia*). The caterpillar goes into hibernation in the moss layer just after hatching, only beginning to feed and grow the following year. However, in adverse conditions, the caterpillar may hibernate a second time. It pupates low down in the vegetation. It is usually single-brooded.

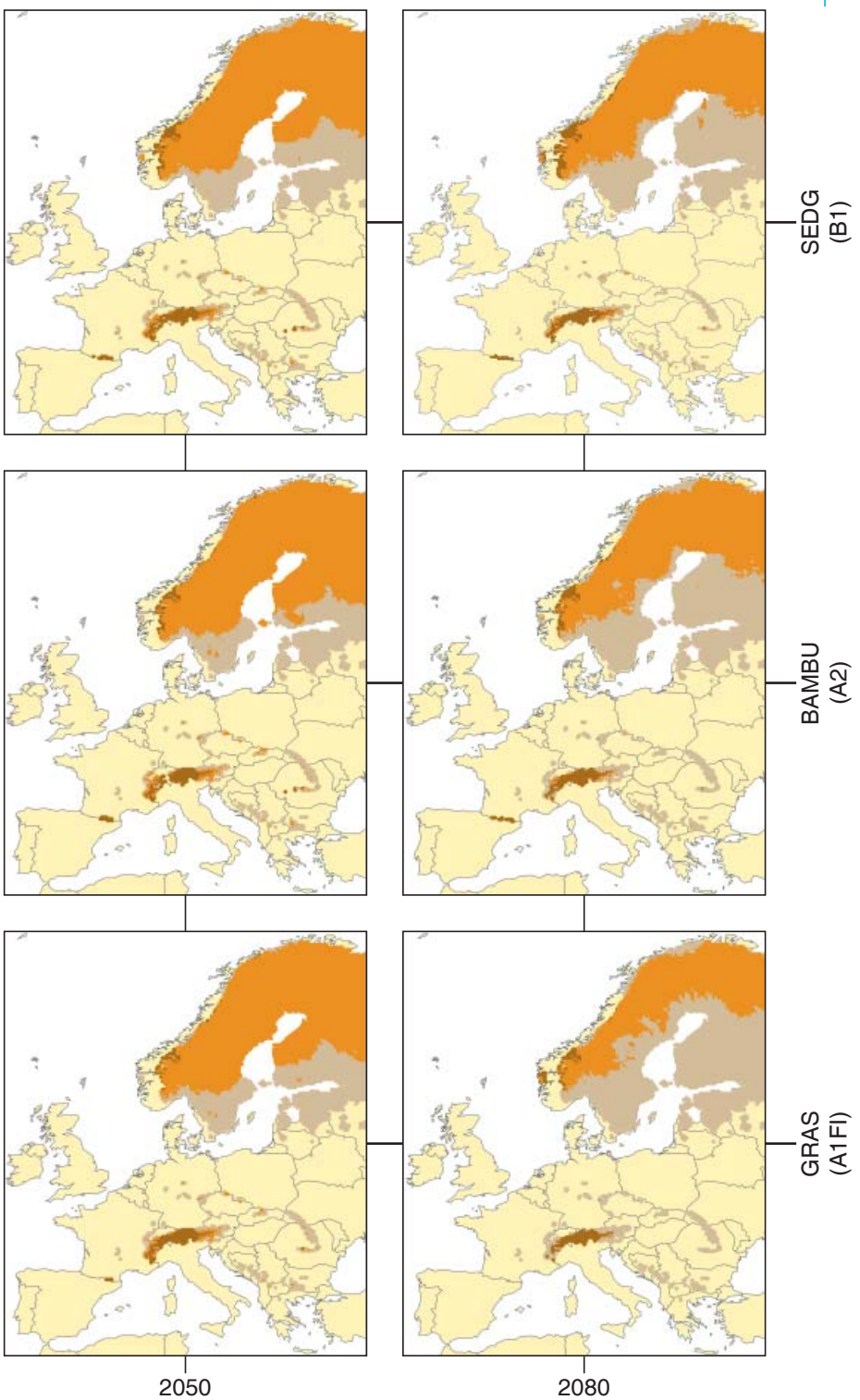
Present distribution can be well explained by climatic variables (AUC = 0.89).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Boloria graeca (Staudinger, 1870) – Balkan Fritillary

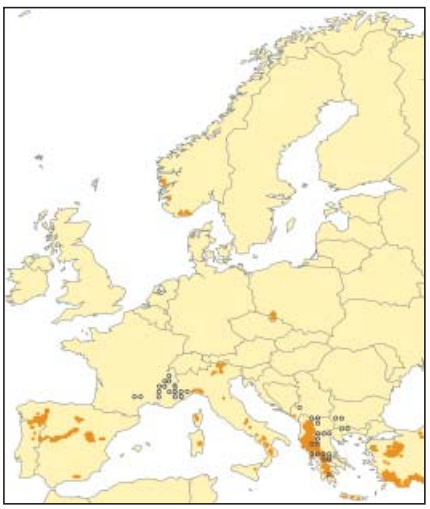
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-239 (-49.69%)	-353 (-73.39%)
	BAMBU	-281 (-58.42%)	-370 (-76.92%)
	GRAS	-271 (-56.34%)	-378 (-78.59%)
2080	SEDG	-197 (-40.96%)	-370 (-76.92%)
	BAMBU	-330 (-68.61%)	-418 (-86.9%)
	GRAS	-259 (-53.85%)	-433 (-90.02%)

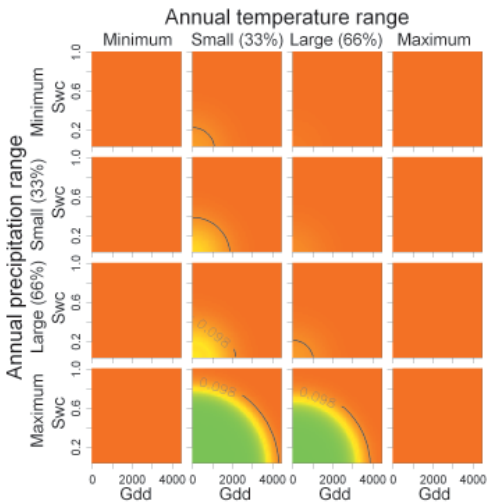
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 481)

The Balkan Fritillary can be found in the mountains on flower-rich grasslands, or on grassland with scattered bushes, and in clearings in woods. These butterflies usually fly close to the ground. Various violets (*Viola* spp.) are used as foodplant. The female lays her eggs either on the foodplant, or on a plant nearby. The Balkan Fritillary has one generation a year and hibernates as a small caterpillar.

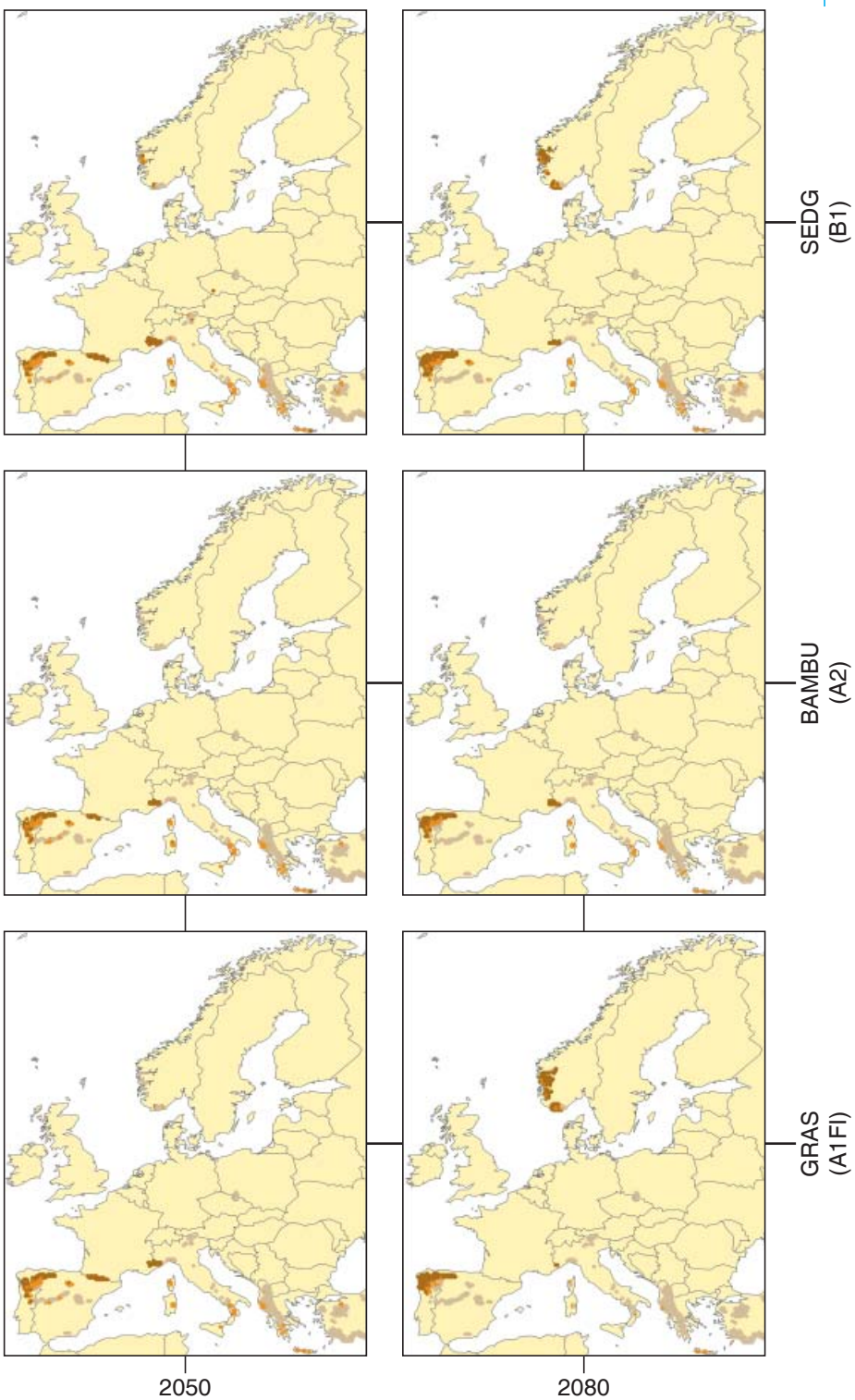
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.75). Climate risk category: PR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Vanessa atalanta (Linnaeus, 1758) – Red Admiral

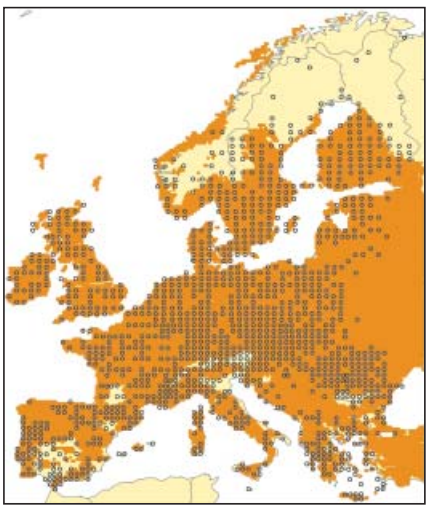
© Peter Ginzinger

		Full dispersal	No dispersal
2050	SEDG	-2683 (-11.89%)	-3874 (-17.16%)
	BAMBU	-4288 (-19%)	-4857 (-21.52%)
	GRAS	-4073 (-18.04%)	-5063 (-22.43%)
2080	SEDG	-5008 (-22.18%)	-6755 (-29.92%)
	BAMBU	-8963 (-39.7%)	-10381 (-45.99%)
	GRAS	-11874 (-52.6%)	-13684 (-60.62%)

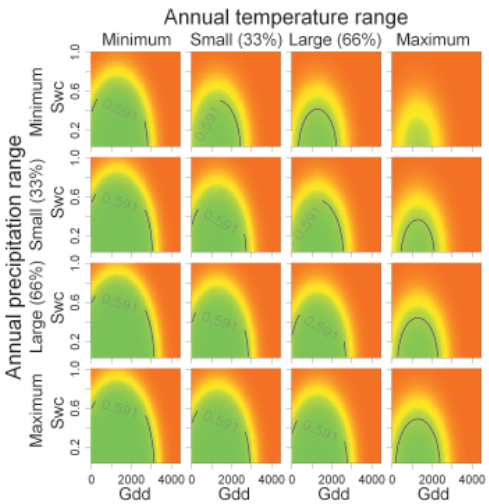
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 22574)

The Red Admiral is a wide-ranging, migratory butterfly that in temperate areas can only survive mild winters. Each year, butterflies from southern Europe fly northwards, and in good years Red Admirals can be seen practically everywhere. The butterflies need a lot of nectar, which they get from flowers. They also feed on rotting fruit and at harvest time are often seen in orchards. They are also attracted to the resin oozing from trees. The Red Admiral lays its eggs on Stinging Nettle (*Urtica dioica*) and Pellitory (*Parietaria* spp.) in sunny, but not all too dry places. The caterpillars live alone or in small groups in small tent-like shelters made by spinning leaves together. The caterpillars pupate in a little tent of spun leaves.

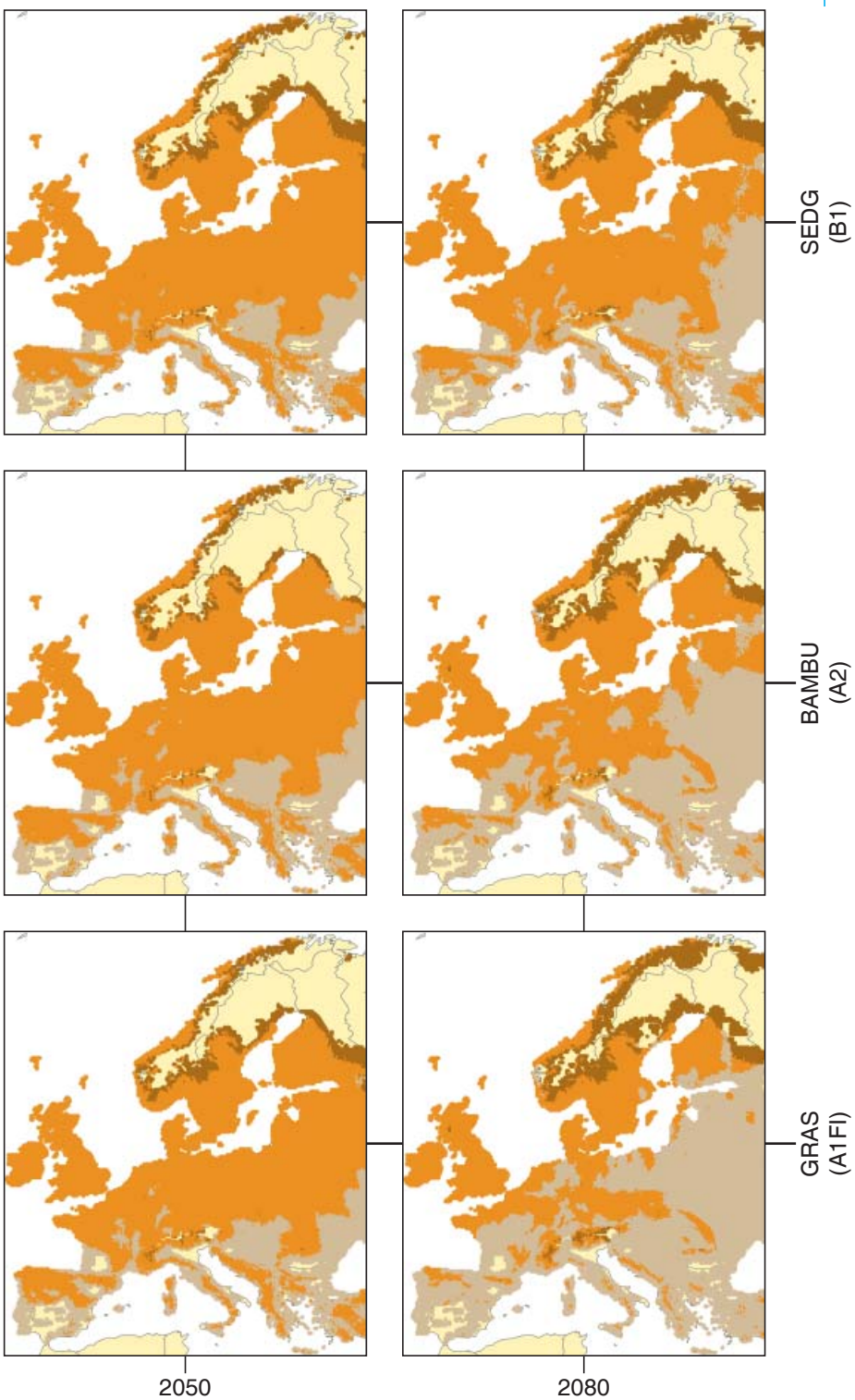
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.65). Climate risk category: PR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Vanessa cardui (Linnaeus, 1758) – Painted Lady

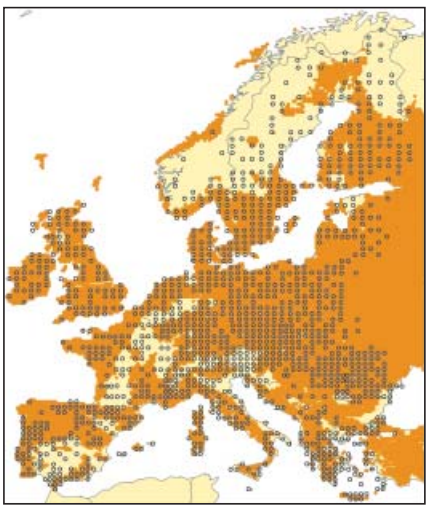
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-1792 (-8.9%)	-3883 (-19.28%)
	BAMBU	-4224 (-20.98%)	-5073 (-25.19%)
	GRAS	-3350 (-16.64%)	-5180 (-25.73%)
2080	SEDG	-2799 (-13.9%)	-5567 (-27.65%)
	BAMBU	-7054 (-35.03%)	-9170 (-45.54%)
	GRAS	-9272 (-46.05%)	-11805 (-58.63%)

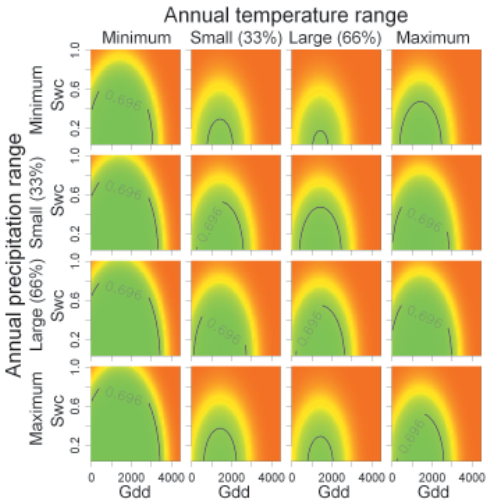
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 20136)

The Painted Lady is a visitor from the south, which is difficult to confuse with other butterflies. The black triangle on the tip of the forewing distinguishes it from the proper fritillaries. It is a migrant and cannot survive the winter in temperate climates. Each year, Western Europe is recolonized by butterflies from the south of Spain and Africa. In good years, the Painted Lady can be seen nearly everywhere, but otherwise seems to be absent. It visits a variety of flowers for nectar. The Painted Lady lays its eggs on very different foodplants. It prefers various thistles (*Cirsium* spp., *Carduus* spp., and *Onopordum* spp.), but also uses mallows (*Malva* spp.) especially in the south, Viper's Bugloss (*Echium vulgare*), and Stinging Nettle (*Urtica dioica*). The eggs are laid singly on the upperside of the leaves. The caterpillars feed in a shelter of loosely spun leaves. They pupate on the foodplant.

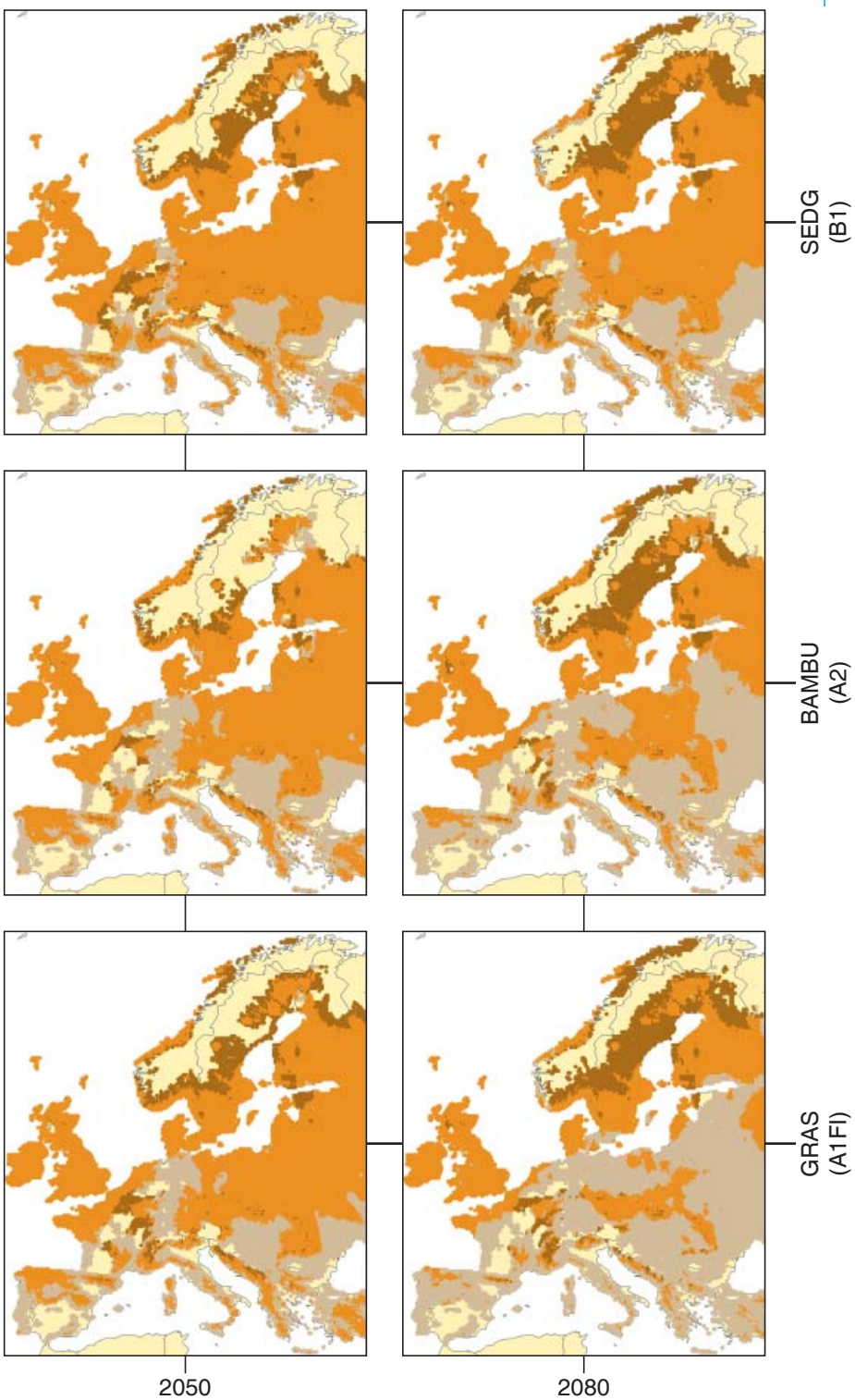
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.63). Climate risk category: PR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Aglais io (Linnaeus, 1758) – Peacock

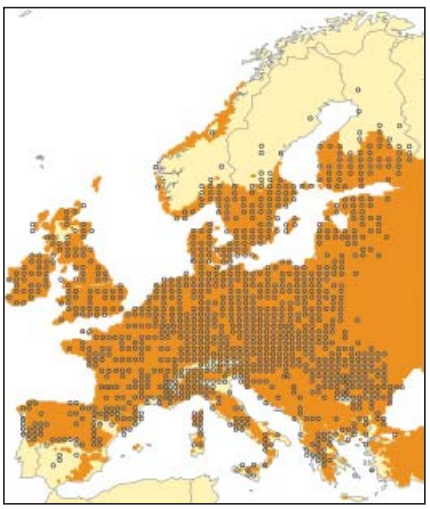
© Peter Ginzinger

		Full dispersal	No dispersal
2050	SEDG	-1220 (-5.96%)	-3269 (-15.96%)
	BAMBU	-1744 (-8.51%)	-3602 (-17.59%)
	GRAS	-2035 (-9.94%)	-4094 (-19.99%)
2080	SEDG	-1718 (-8.39%)	-5136 (-25.07%)
	BAMBU	-3006 (-14.68%)	-7383 (-36.04%)
	GRAS	-5130 (-25.05%)	-10412 (-50.83%)

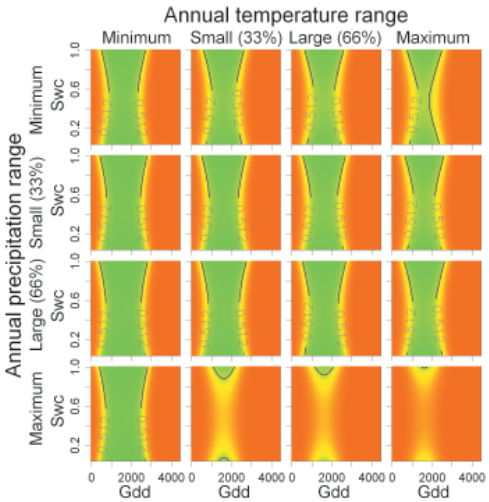
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 20483)

In temperate Europe, the Peacock is one of the best-known butterflies, because of its striking appearance and common occurrence. There is no other diurnal butterfly with such noticeable eye-spots on the upperside of its wings. It is often seen in gardens and parks on herbaceous borders and flowering shrubs, looking for nectar. Eggs are laid on Stinging Nettle (*Urtica dioica*) in damp, shady places, sometimes at edges of woodland. Occasionally, Hop (*Humulus lupulus*) is also used. The caterpillars live gregariously in flimsy webs. Sometimes, plants are completely covered with spun silk, which serves as a home for tens of caterpillars. They leave the web to pupate on the foodplant. The adult butterfly goes into hibernation, hiding itself away in cold lofts and sheds. The species usually has one and sometimes a partial second generation per year.

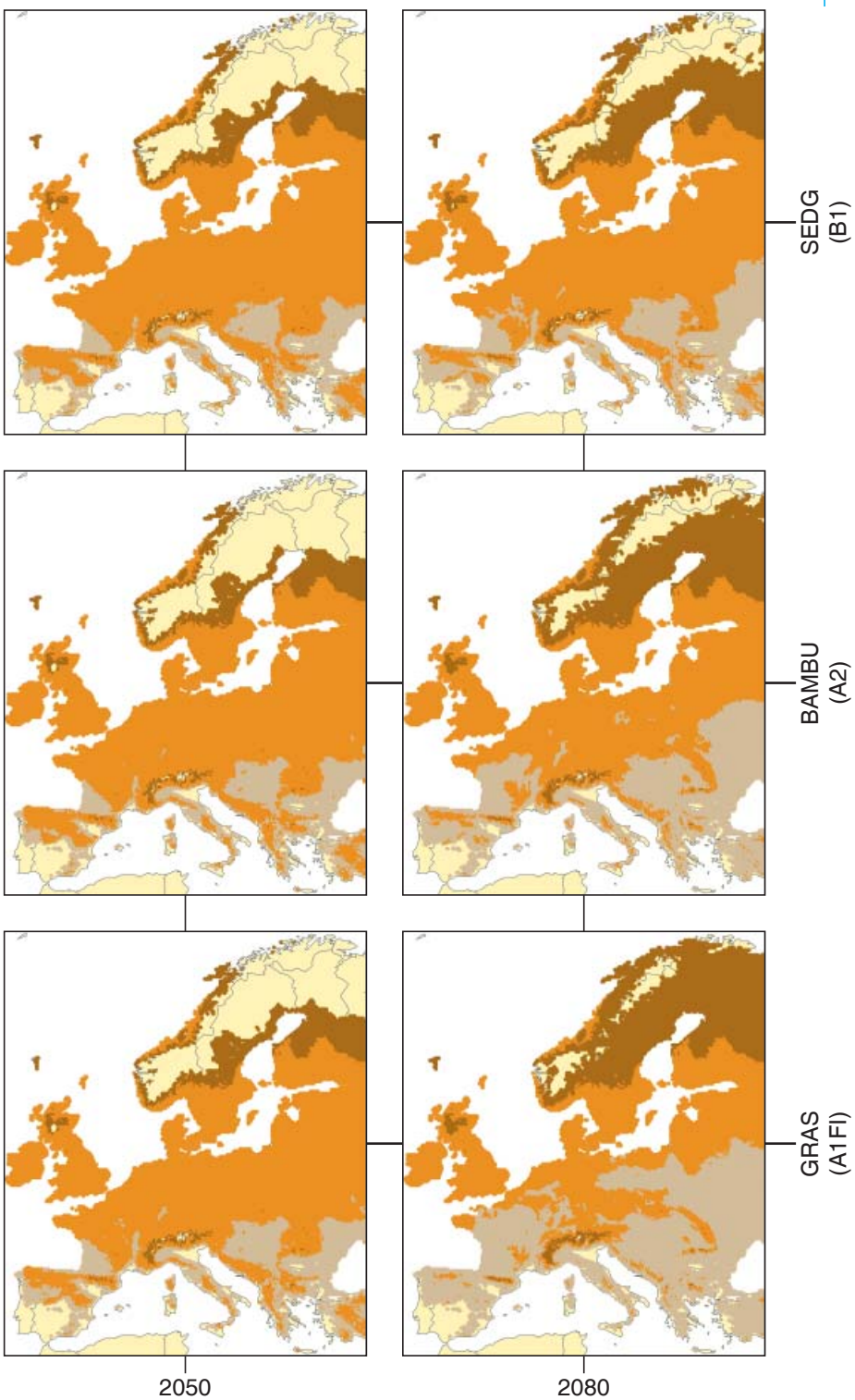
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.8).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Aglais urticae (Linnaeus, 1758) – Small Tortoiseshell

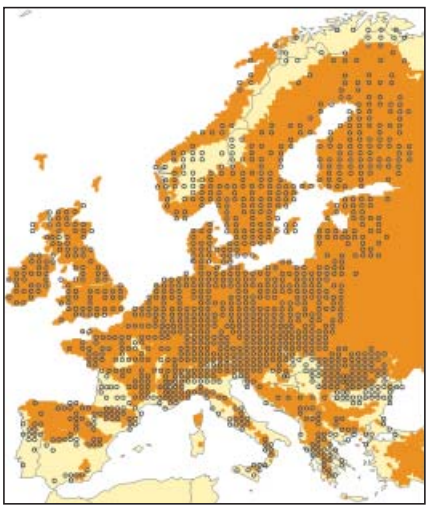
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-2522 (-11.56%)	-3317 (-15.2%)
	BAMBU	-3394 (-15.56%)	-4153 (-19.03%)
	GRAS	-3835 (-17.58%)	-4718 (-21.62%)
2080	SEDG	-4391 (-20.13%)	-5898 (-27.03%)
	BAMBU	-7863 (-36.04%)	-9692 (-44.42%)
	GRAS	-10097 (-46.28%)	-12111 (-55.51%)

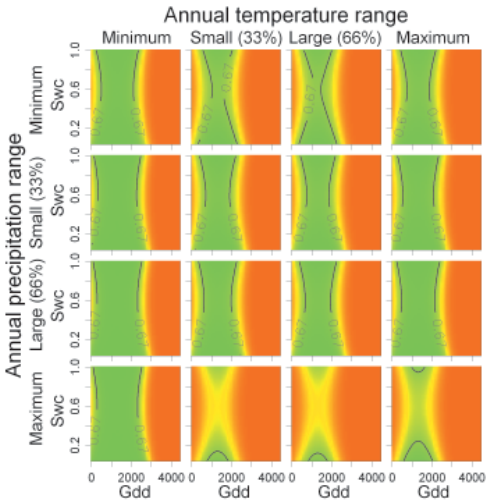
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 21818)

The Small Tortoiseshell is a common and welcome guest in parks and gardens, and is sometimes very abundant. It occurs in low numbers in nearly all habitats. Its only foodplant is Stinging Nettle (*Urtica dioica*). The foodplants are often growing on nutrient-rich, disturbed ground in the sun, such as in rough vegetation at the edges of meadows treated with manure or fertilizer. The eggs are laid in large batches on the underside of the nettle leaves. The caterpillars are gregarious, living in flimsy webs until they go their separate ways in the last larval instar. The species forms its pupa on the foodplants. The Small Tortoiseshell hibernates as a butterfly, and can often be found in the cold months hiding in houses or sheds. It is one of the first butterflies to be seen in the spring.

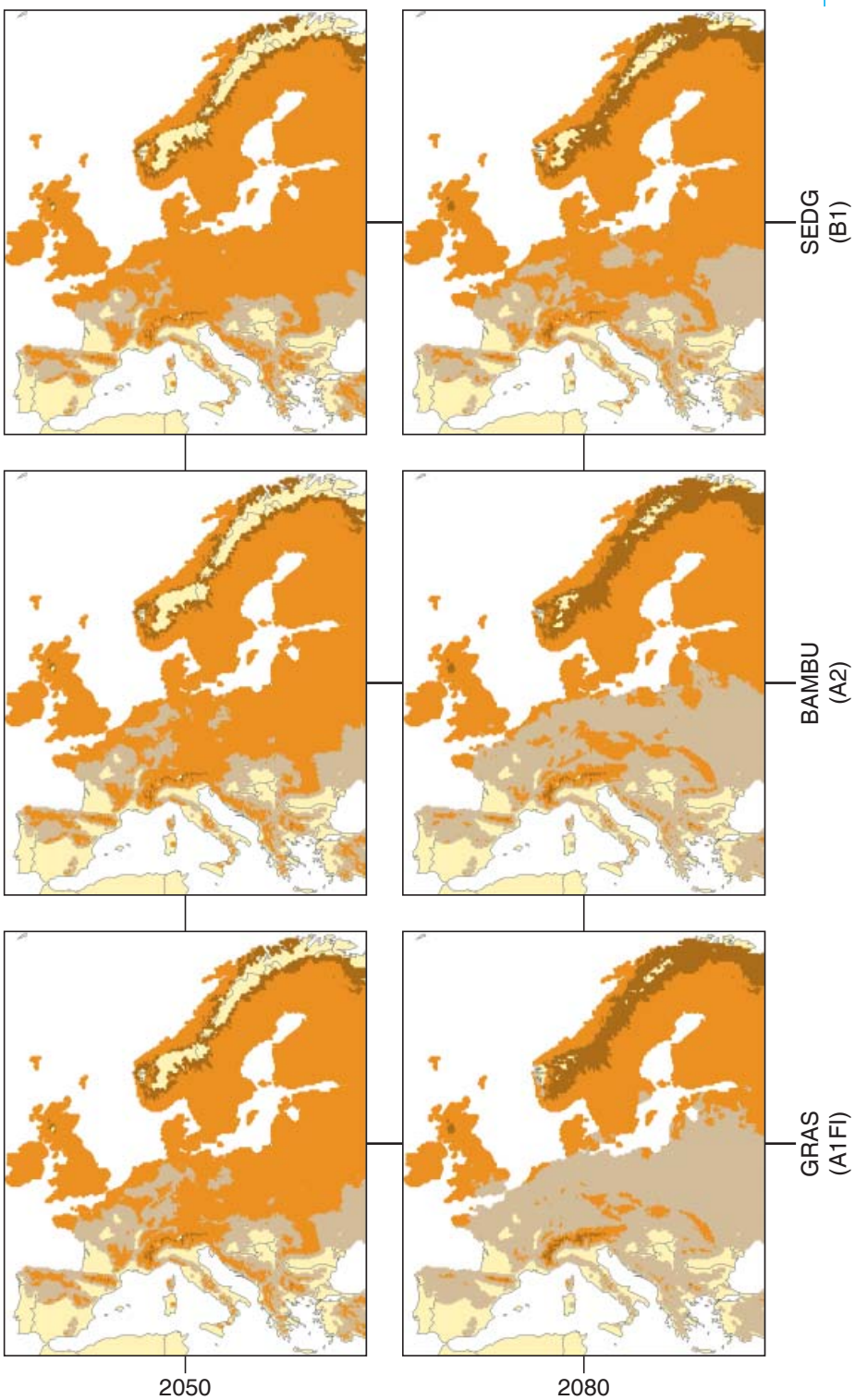
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.8).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Nymphalis c-album (Linnaeus, 1758) – Comma

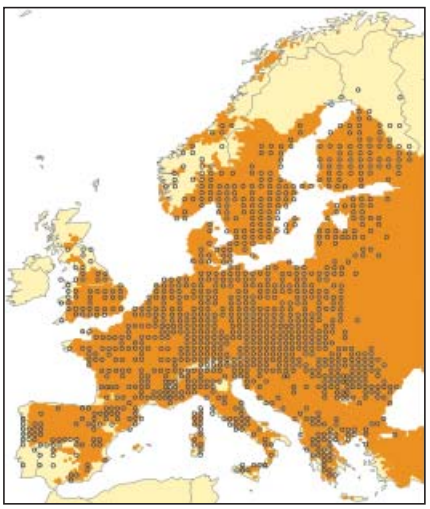
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	-811 (-3.79%)	-2936 (-13.72%)
	BAMBU	-1830 (-8.55%)	-3404 (-15.91%)
	GRAS	-1943 (-9.08%)	-3916 (-18.3%)
2080	SEDG	-1279 (-5.98%)	-5032 (-23.52%)
	BAMBU	-3567 (-16.67%)	-7489 (-35%)
	GRAS	-5154 (-24.09%)	-9934 (-46.42%)

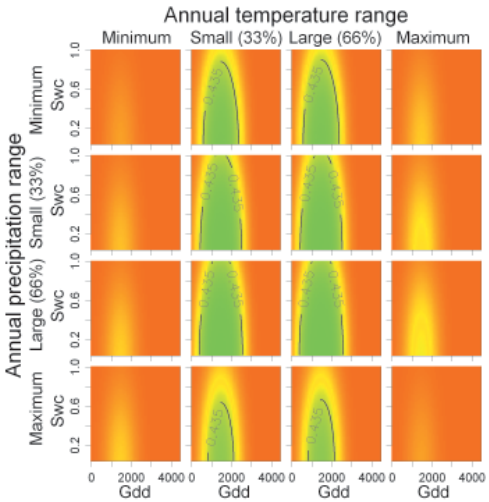
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 21399)

The Comma is a butterfly of wood edges and clearings in wood, except in very dry places. It is easily recognized by the deep indentations in the margins of its wings, and the small white comma on the otherwise dusky underside of the hindwing. Eggs are laid on many different plant species, like Stinging Nettle (*Urtica dioica*), bramble (*Rubus* spp.), elm (*Ulmus* spp.), willow (*Salix* spp.), Hazel (*Corylus avellana*), and Hop (*Humulus lupulus*). The caterpillar is solitary, brownish-black with long spines and a broad white stripe on his back towards the rear, making it look like a bird dropping. The pupa hangs from the foodplant on a small stalk. The butterflies hibernate in hollow trees, hedgerows, and shrubs. In large parts of Europe it is double-brooded. However, in Scandinavia it only has one generation, and in warm locations in Spain and Greece, it can have three.

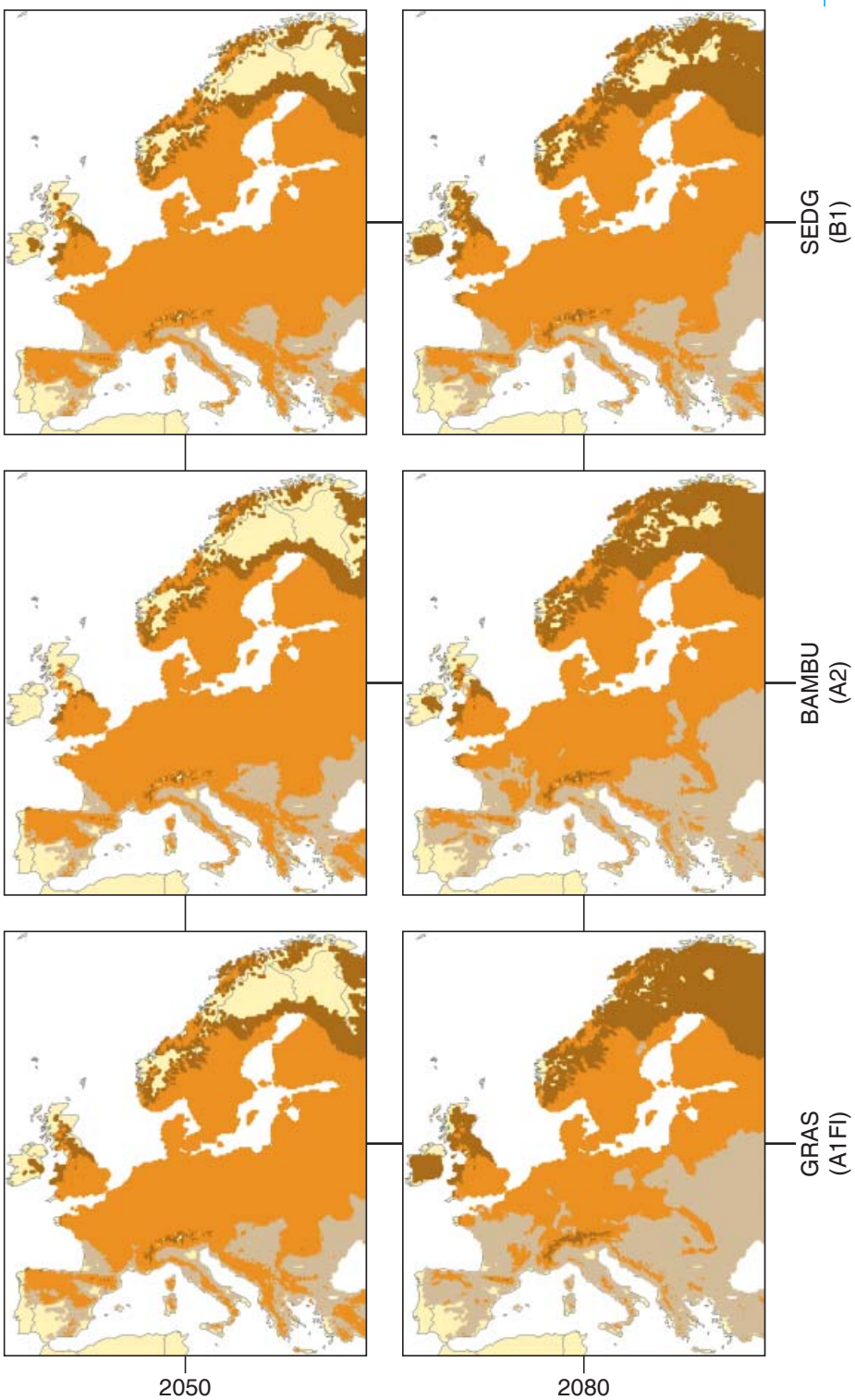
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.77). Climate risk category: LR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Nymphalis egea (Cramer, 1775) – Southern Comma

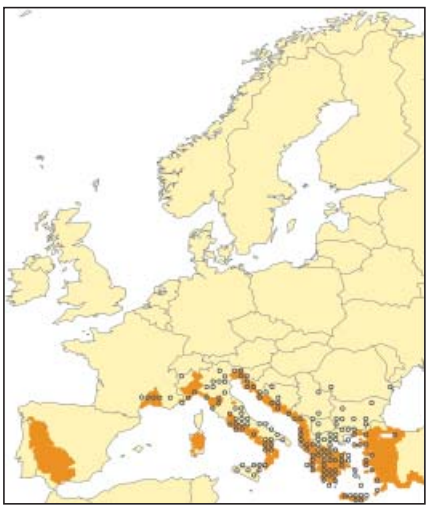
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	283 (15.9%)	-368 (-20.67%)
	BAMBU	309 (17.36%)	-330 (-18.54%)
	GRAS	348 (19.55%)	-414 (-23.26%)
2080	SEDG	937 (52.64%)	-471 (-26.46%)
	BAMBU	709 (39.83%)	-784 (-44.04%)
	GRAS	1380 (77.53%)	-1161 (-65.22%)

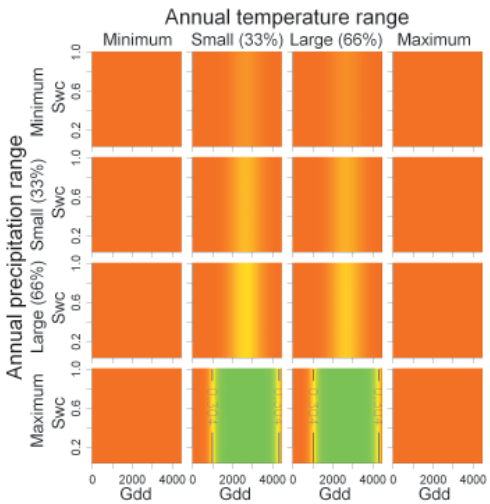
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1780)

The Southern Comma is a species of dry grasslands and dry scrub. The major foodplant is Common Pellitory (*Parietaria officinalis*), a plant that often grows on old walls, so that these butterflies are often found near buildings. They can often be seen, wings widespread, basking in the sun on walls and rocks, or on the ground. The caterpillars probably also feed on Stinging Nettle (*Urtica dioica*), willows (*Salix* spp.), and elms (*Ulmus* spp.). The Southern Comma has two to three generations a year, and just as the ordinary Comma (*P. c-album*), hibernates as an adult butterfly. It can therefore be seen early in the spring.

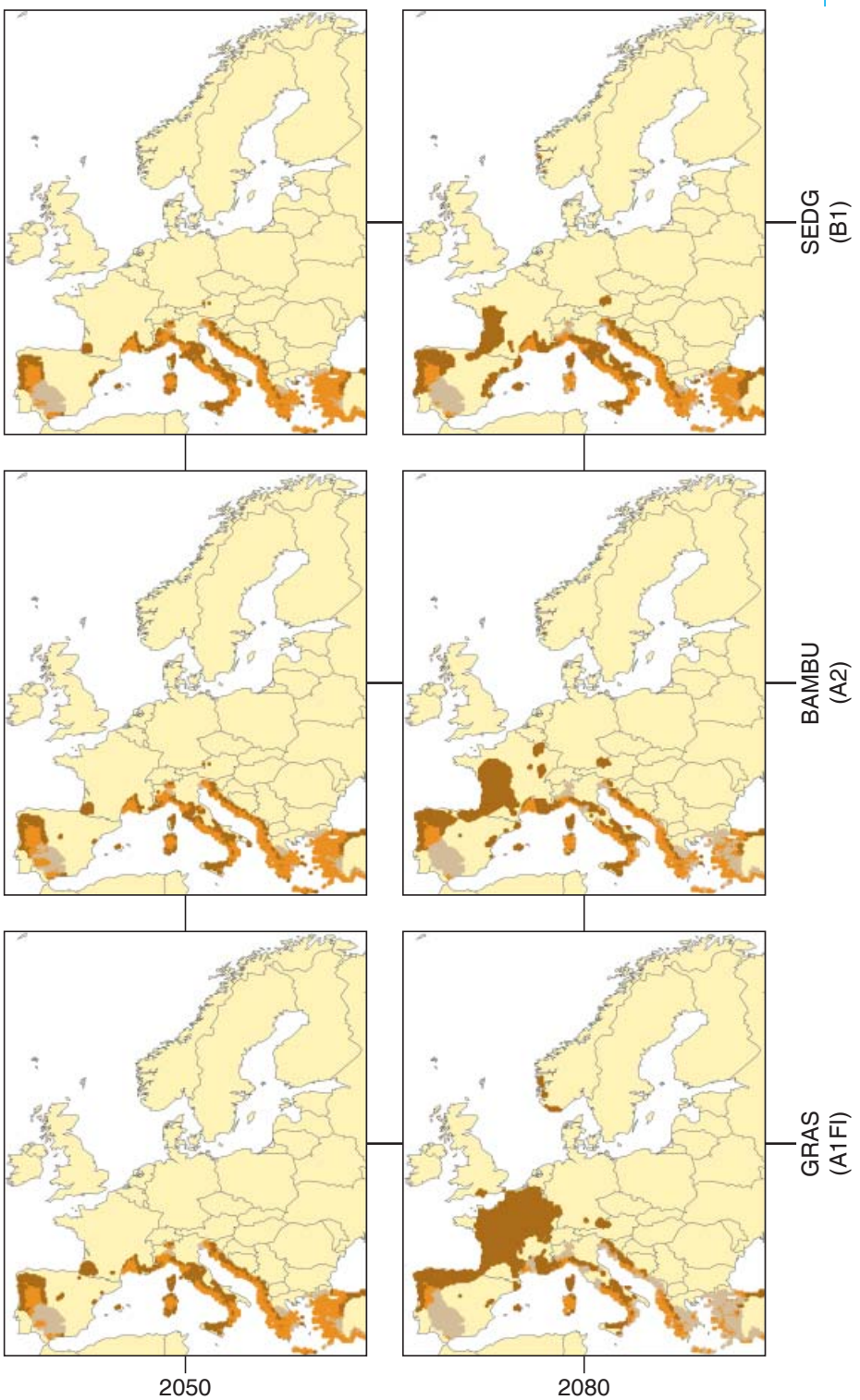
Present distribution can be well explained by climatic variables (AUC = 0.94).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Nymphalis antiopa (Linnaeus, 1758) – Camberwell Beauty

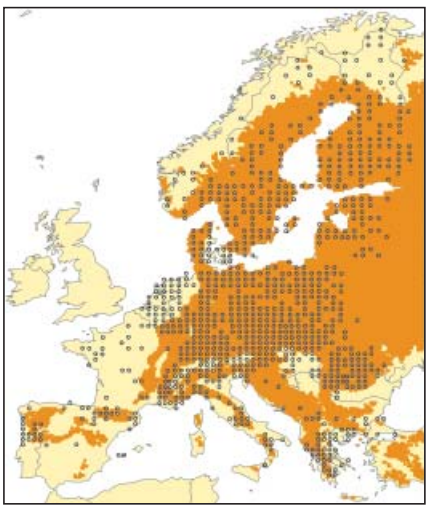
© Peter Ginzinger

		Full dispersal	No dispersal
2050	SEDG	-886 (-5.5%)	-2806 (-17.43%)
	BAMBU	-1047 (-6.5%)	-2840 (-17.64%)
	GRAS	-2083 (-12.94%)	-3979 (-24.71%)
2080	SEDG	-805 (-5%)	-3615 (-22.45%)
	BAMBU	-3635 (-22.57%)	-6079 (-37.75%)
	GRAS	-5251 (-32.61%)	-8017 (-49.79%)

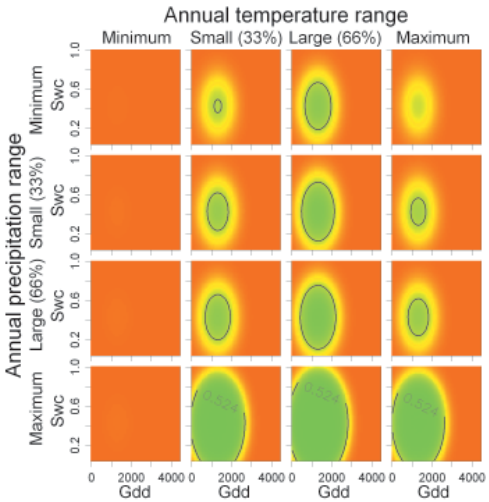
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 16102)

The Camberwell Beauty is an imposing butterfly, which can fly large distances, although this only happens in some years. It occurs near patches of woodland in stream valleys, gullies, along woodland edges and on scrub. Because they are fairly mobile, they can be seen in open countryside far away from their foodplants. The female lays her eggs in large clusters around the twigs of birches (*Betula* spp.), willows (*Salix* spp.), and poplars (*Populus* spp.). At first, the caterpillars live together in a communal web, becoming solitary when nearly fully-grown. The caterpillar is easily recognized, black and spiny with a double row of red spots on its back. They pupate on the bark of the foodplants. The adult butterflies hibernate in a hollow tree, wood pile or just hidden in the vegetation, and wait for spring before mating. The Camberwell Beauty has one generation a year.

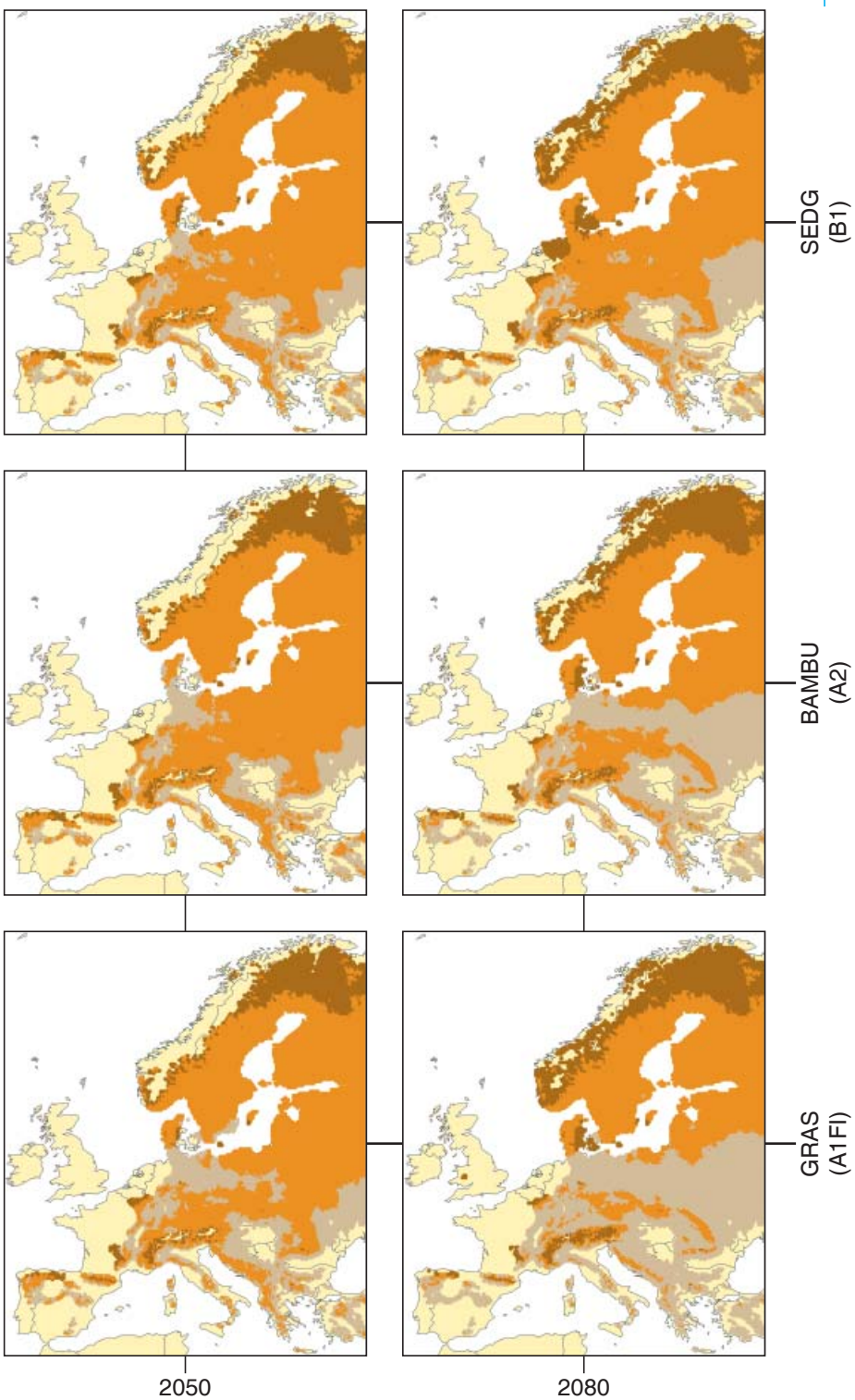
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.76). Climate risk category: LR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Nymphalis polychloros (Linnaeus, 1758) – Large Tortoiseshell

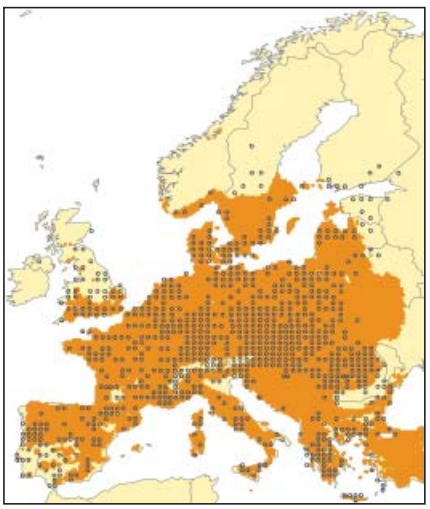
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-1494 (-9.42%)	-3210 (-20.24%)
	BAMBU	-2991 (-18.86%)	-4236 (-26.71%)
	GRAS	-2864 (-18.06%)	-4403 (-27.76%)
2080	SEDG	-4926 (-31.06%)	-6669 (-42.05%)
	BAMBU	-6995 (-44.1%)	-8952 (-56.44%)
	GRAS	-8220 (-51.83%)	-10595 (-66.8%)

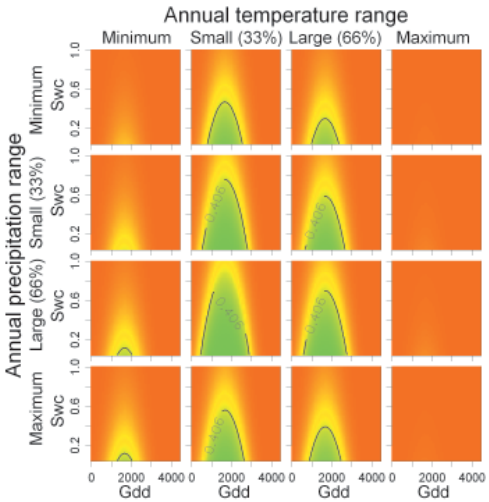
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 15861)

The Large Tortoiseshell is found in warm, sunny places in deciduous woods and near groups of trees. Elms (*Ulmus* spp.), willows (*Salix* spp.) and sometimes fruit trees or Hawthorn (*Crataegus monogyna*) are used as foodplants. The female, usually choosing a twig from the previous year, deposits a large group of eggs in a band around it. The caterpillars live together in silken tents until the last larval instar when they become solitary. They are fond of sitting on the sunny side of the foodplant or on branches in the sun. The caterpillar is dull, dark-grey with rust-coloured stripes along its back and sides, and long rust-brown spines. The pupa hangs from a twig in the foodplant, looking very like a withered leaf. The newly-emerged butterflies often roam. The Large Tortoiseshell hibernates as a butterfly in cool, dark places such as in a hollow tree. It has one generation a year.

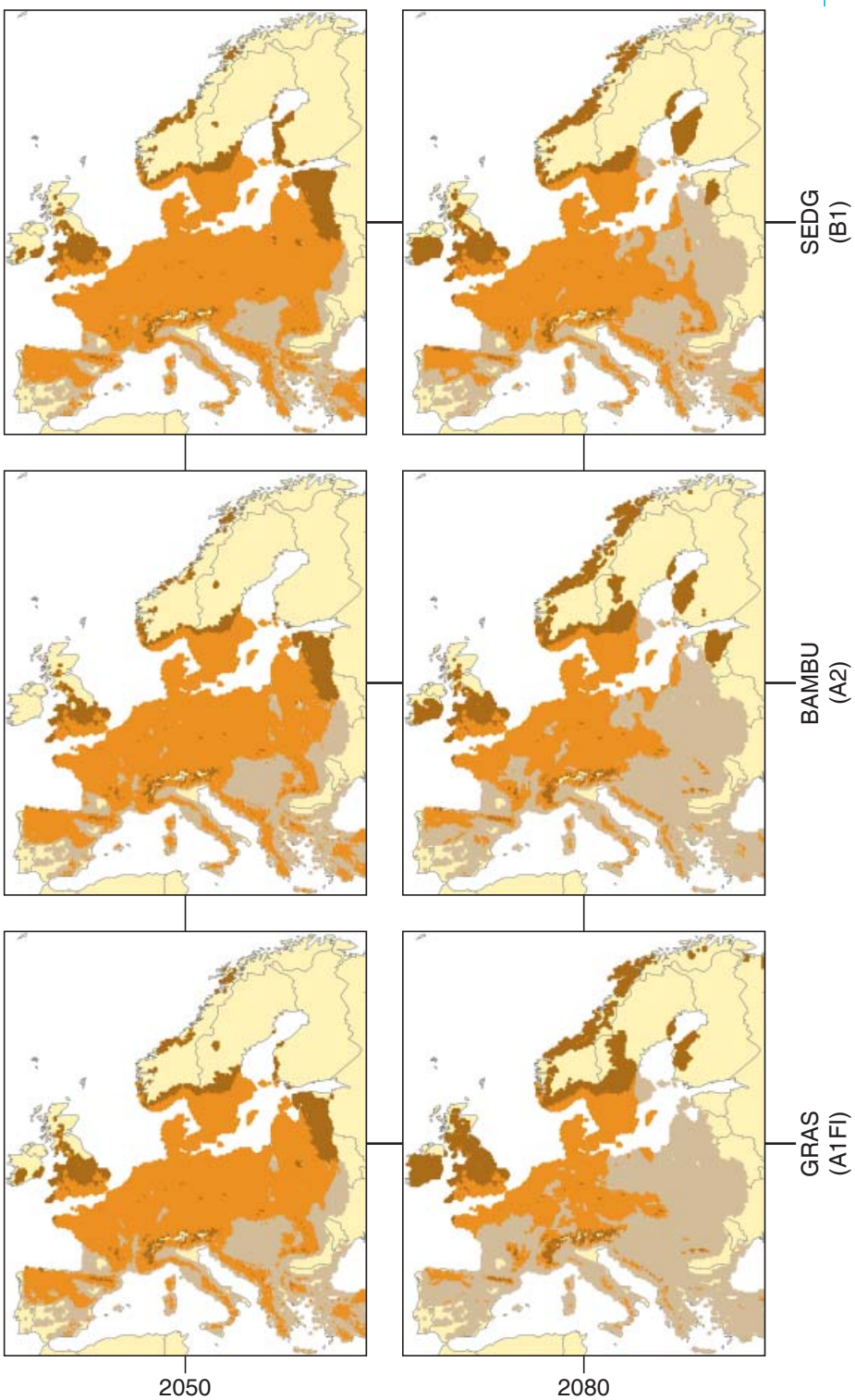
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.7). Climate risk category: PR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Nymphalis xanthomelas (Esper, 1781) – Yellow-legged Tortoiseshell

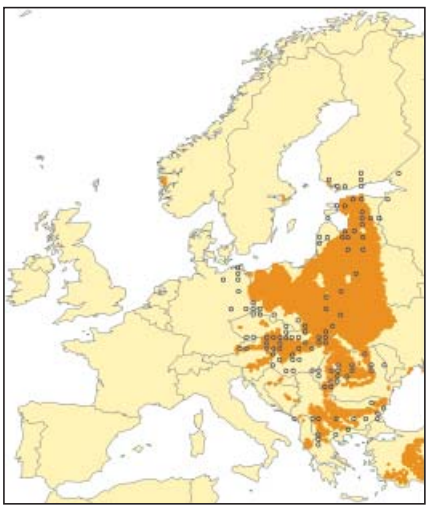
© Heiner Ziegler

		Full dispersal	No dispersal
2050	SEDG	-292 (-7.1%)	-1789 (-43.52%)
	BAMBU	-155 (-3.77%)	-1981 (-48.19%)
	GRAS	-272 (-6.62%)	-2183 (-53.1%)
2080	SEDG	-2210 (-53.76%)	-3846 (-93.55%)
	BAMBU	-1738 (-42.28%)	-3683 (-89.59%)
	GRAS	-2297 (-55.87%)	-4031 (-98.05%)

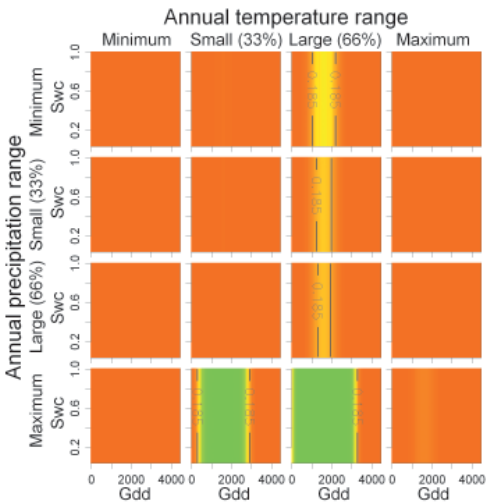
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 4111)

The Yellow-legged Tortoiseshell occurs in lowland woodland in Eastern Europe, in damp, deciduous woods growing on flood plains, or on the wooded banks of streams and rivers. Different trees are used as foodplants, including willows (*Salix* spp.), poplars (*Populus* spp.), elms (*Ulmus* spp.), and Nettle Tree (*Celtis australis*). Until nearly fully-grown, the caterpillars inhabit large communal nests, which they spin in branches that hang over the water. The Yellow-legged Tortoiseshell hibernates as a butterfly hidden away in such places as hollow trees or wood piles. It is single-brooded.

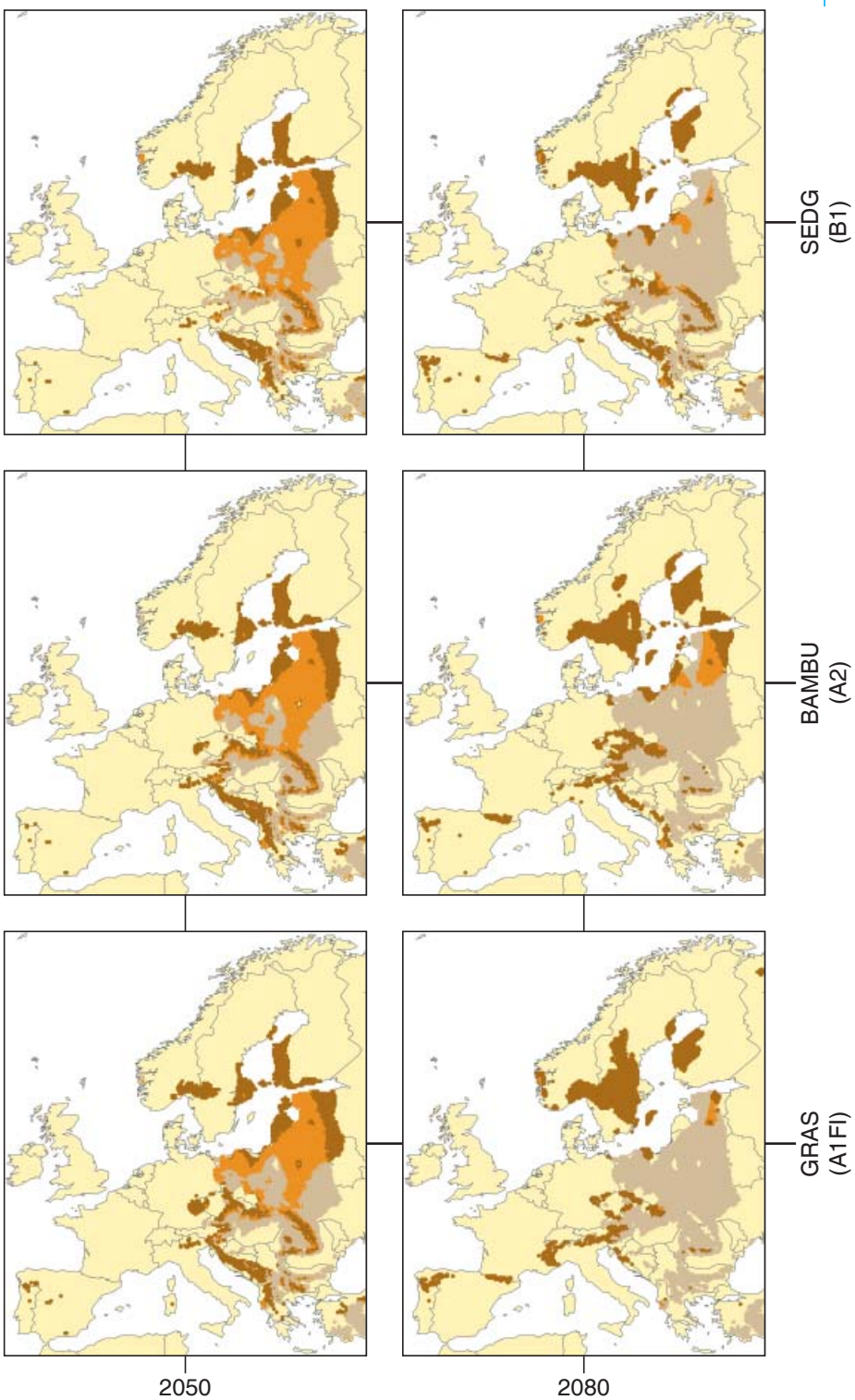
Present distribution can be well explained by climatic variables (AUC = 0.87).
Climate risk category: HHHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Nymphalis l-album (Esper, 1780) – False Comma

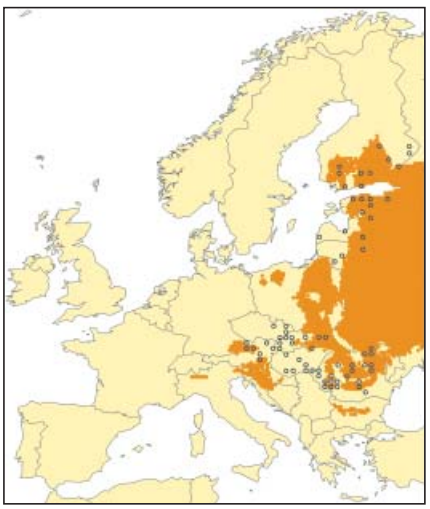
© Zdravko Kolev

		Full dispersal	No dispersal
2050	**SEDG**	101 (1.93%)	-1761 (-33.63%)
	BAMBU	1514 (28.91%)	-850 (-16.23%)
	GRAS	90 (1.72%)	-1836 (-35.06%)
2080	**SEDG**	3311 (63.22%)	-1611 (-30.76%)
	BAMBU	3350 (63.97%)	-2324 (-44.38%)
	GRAS	3035 (57.95%)	-2884 (-55.07%)

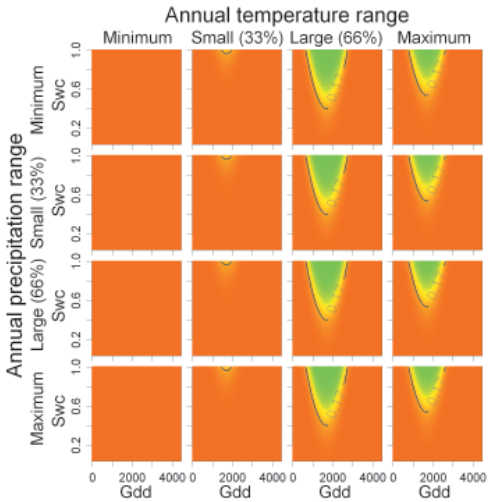
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 5237)

The False Comma occurs in the lowlands of Eastern Europe, in deciduous or mixed woods. It prefers damp woods, and is found in clearings or at the wood edge. It is a mobile butterfly and a strong migrant. The female lays her eggs in the spring, clustered around the twigs of the foodplants which may be birches (*Betula* spp.), willows (*Salix* spp.), poplars (*Populus* spp.), or elms (*Ulmus* spp.). The False Comma has one generation a year, and because it hibernates as a butterfly, can be seen for much of the year.
This species is listed in Annexes II and IV of the Habitats' Directive, where it erroneously is named *N. vaualbum*.

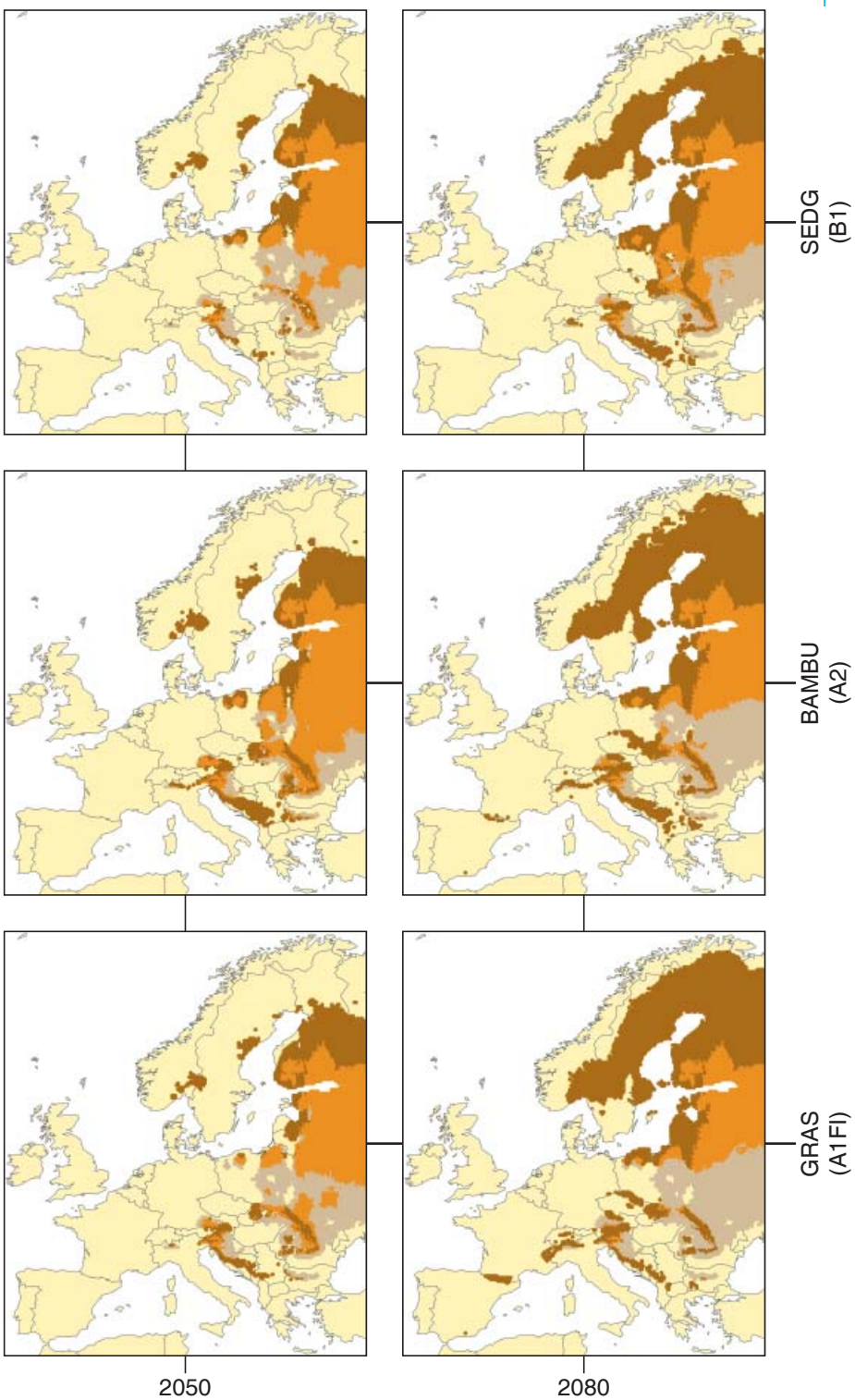
Present distribution can be well explained by climatic variables (AUC = 0.89).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Araschnia levana (Linnaeus, 1758) – Map

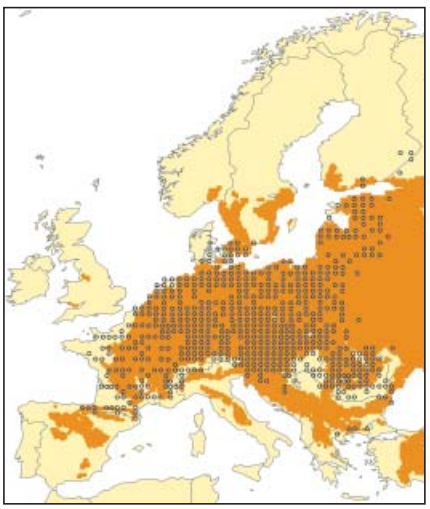
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	-750 (-5.89%)	-3045 (-23.93%)
	BAMBU	-231 (-1.82%)	-2980 (-23.42%)
	GRAS	-1214 (-9.54%)	-3737 (-29.37%)
2080	SEDG	-2108 (-16.57%)	-5787 (-45.48%)
	BAMBU	-1661 (-13.05%)	-7261 (-57.06%)
	GRAS	-2943 (-23.13%)	-9390 (-73.79%)

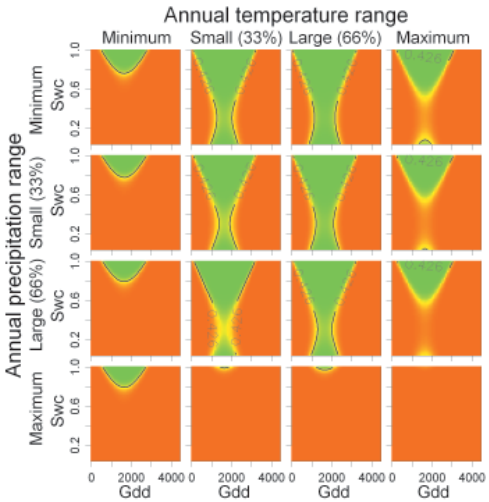
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 12725)

The Map is a common butterfly of woodland edges, coppices, hedgerows and wood banks. It normally has two generations a year, and the butterflies of the spring brood are predominantly orange, and those of the summer brood predominantly black on the upperside of the wings. The Map gets its name from the intricate pattern on the underside of its wings. These butterflies enjoy basking in the sun with their wings wide open, often on the ground. The Map has a dainty floating flight, but it settles again quite quickly. The foodplants are Stinging Nettle (*Urtica dioica*) and Small Nettle (*U. urens*). The eggs are deposited in short chains on the underside of the nettle leaves and look very much like threaded pearls. The caterpillars are gregarious, but do not spin a nest. They pupate on the foodplants, and pass the winter as a pupa.

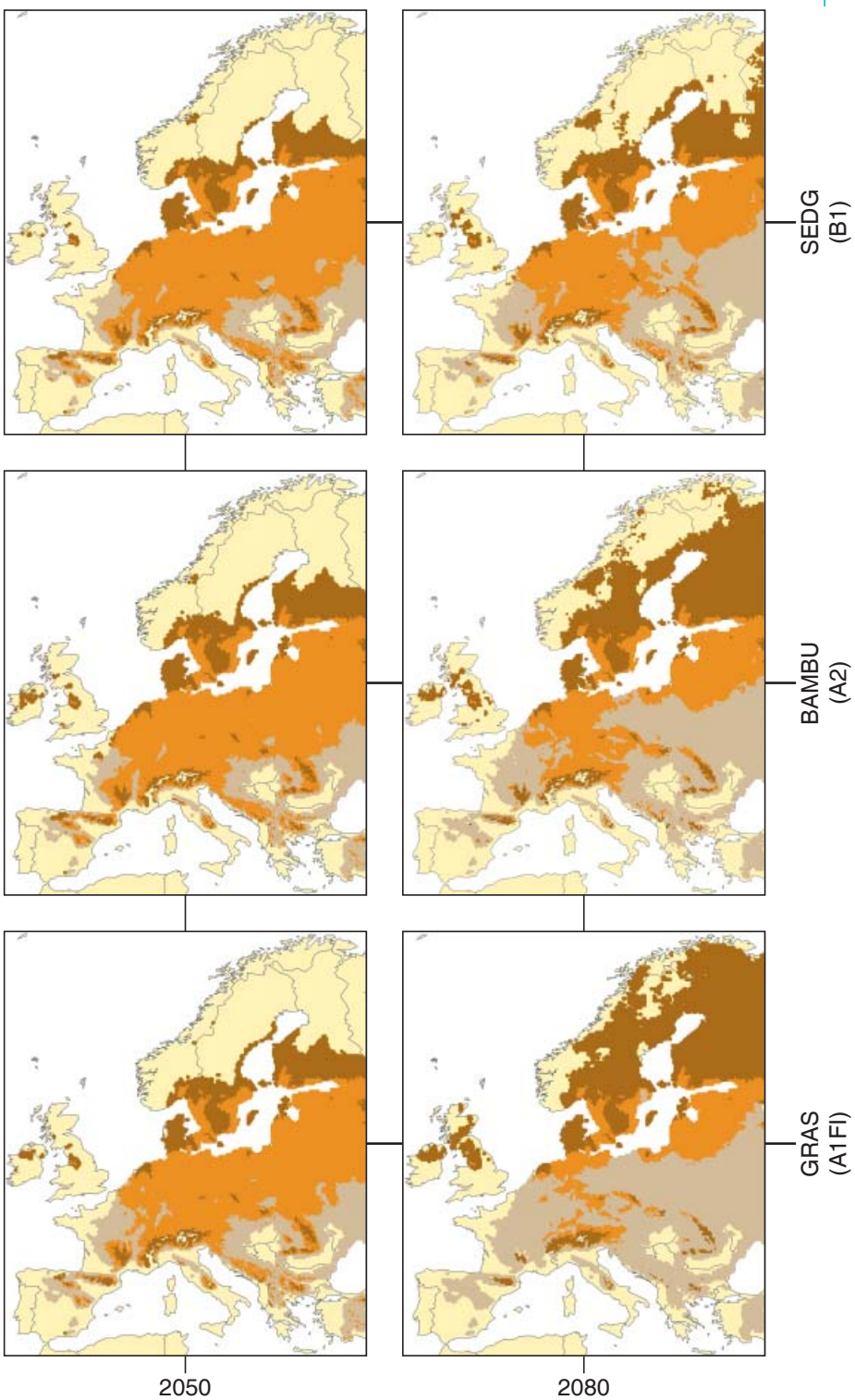
Present distribution can be well explained by climatic variables (AUC = 0.87).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Euphydryas iduna (Dalman, 1816) – Lapland Fritillary

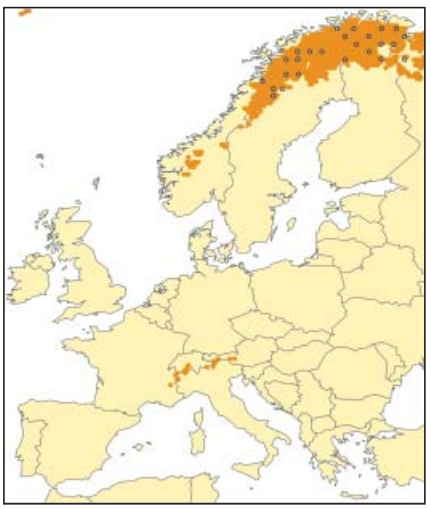
© Otakar Kudrna

		Full dispersal	No dispersal
2050	SEDG	-1047 (-79.32%)	-1062 (-80.45%)
	BAMBU	-1047 (-79.32%)	-1057 (-80.08%)
	GRAS	-1086 (-82.27%)	-1095 (-82.95%)
2080	SEDG	-1211 (-91.74%)	-1223 (-92.65%)
	BAMBU	-1276 (-96.67%)	-1280 (-96.97%)
	GRAS	-1315 (-99.62%)	-1315 (-99.62%)

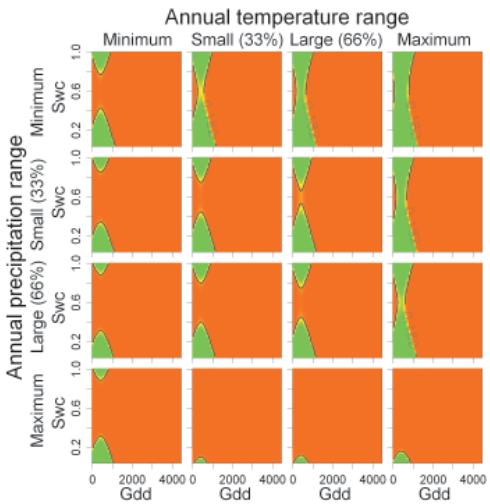
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1320)

At lower altitudes in Lapland, this lovely fritillary occurs on flower-rich swampy areas and wet slopes with scattered birches. Above 500 m, it is found in drier rocky places. Compared to the other fritillaries that occur in Lapland, the Lapland Fritillary is remarkably colourful. It is one of the first arctic species to be seen, appearing practically as soon as the snow has melted. It flies quickly, zigzagging low over the vegetation. The female lays her eggs in small groups on plantains (*Plantago* spp.), Alpine Speedwell (*Veronica alpina*), Rock Speedwell (*V. fruticans*), and species of *Vaccinium*. The caterpillars live communally in small silken webs and hibernate there. They pupate in the spring. It has one brood a year.

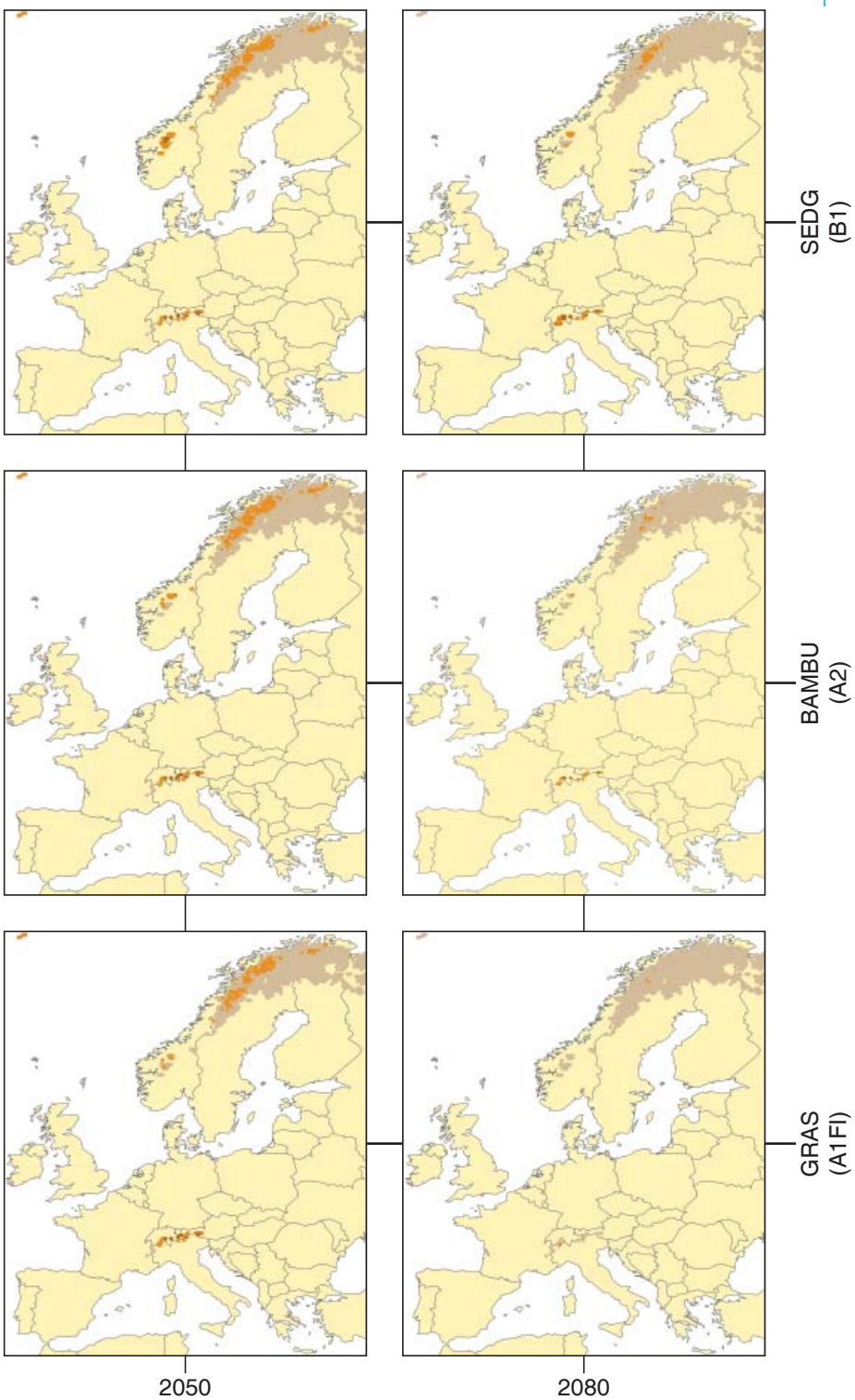
Present distribution can be very well explained by climatic variables (AUC = 1).
Climate risk category: HHHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Euphydryas cynthia ([Schiffermüller], 1775) – Cynthia's Fritillary

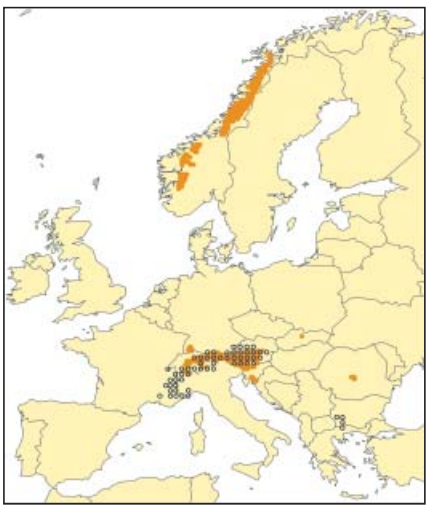
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-77 (-19.49%)	-147 (-37.22%)
	BAMBU	-80 (-20.25%)	-149 (-37.72%)
	GRAS	-132 (-33.42%)	-180 (-45.57%)
2080	SEDG	-233 (-58.99%)	-285 (-72.15%)
	BAMBU	-165 (-41.77%)	-249 (-63.04%)
	GRAS	-210 (-53.16%)	-327 (-82.78%)

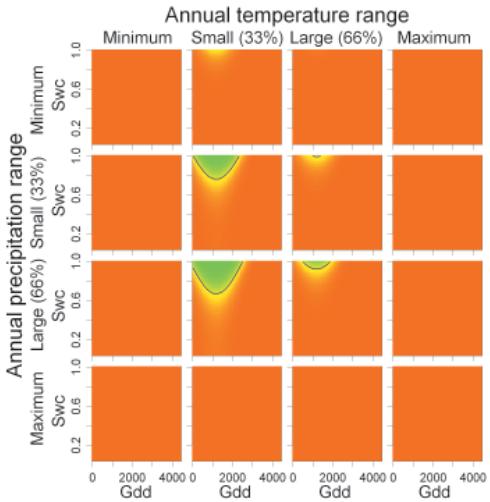
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 395)

Cynthia's Fritillary distinguishes itself from other fritillaries by the large amount of white on the basal parts of the upperside of the wings of the male. The butterflies occur on sub-alpine and alpine grassland with short, grassy vegetation and low-growing shrubs and in rocky areas. They fly quickly, close to the ground, and are fond of basking in the sun on rocks or bare patches of ground. The female lays her eggs in clusters under leaves of Alpine Plantain (*Plantago alpina*) and Long-spurred Pansy (*Viola calcarata*). The caterpillars are black and bristly with yellow bands between each segment. They can be very numerous and take two years to develop. The first hibernation takes place communally in a silken web. In the fourth larval instar, they hibernate a second time, solitarily under stones, where they later pupate.

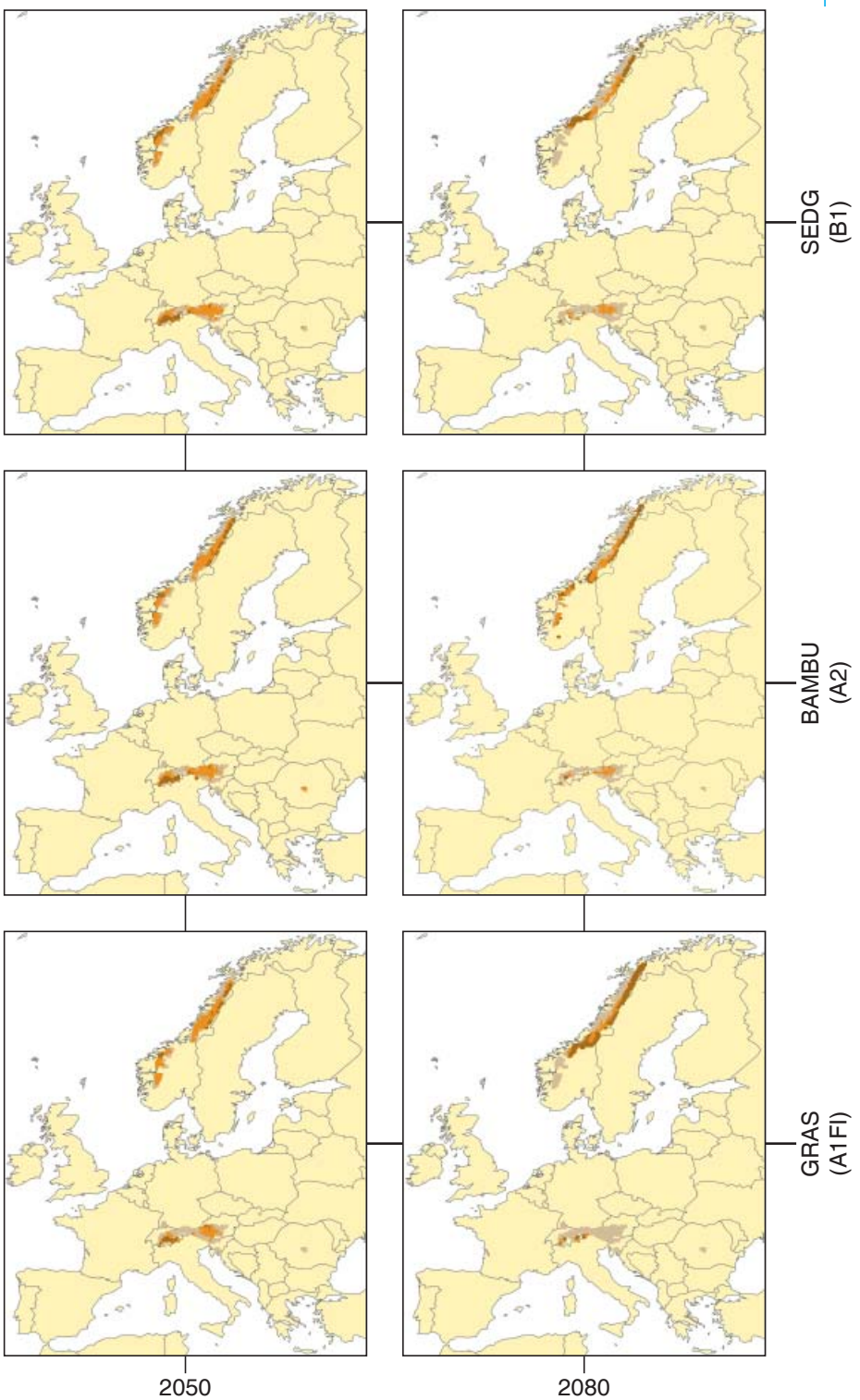
Present distribution can be very well explained by climatic variables (AUC = 0.98).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Euphydryas intermedia (Menetries, 1859) – Asian Fritillary

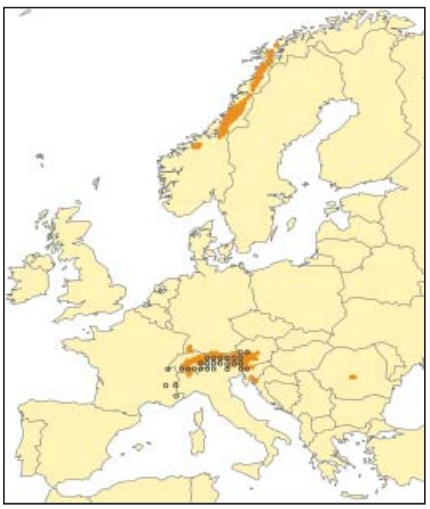
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-24 (-8.92%)	-127 (-47.21%)
	BAMBU	-11 (-4.09%)	-123 (-45.72%)
	GRAS	-69 (-25.65%)	-155 (-57.62%)
2080	SEDG	-157 (-58.36%)	-231 (-85.87%)
	BAMBU	-45 (-16.73%)	-193 (-71.75%)
	GRAS	-105 (-39.03%)	-233 (-86.62%)

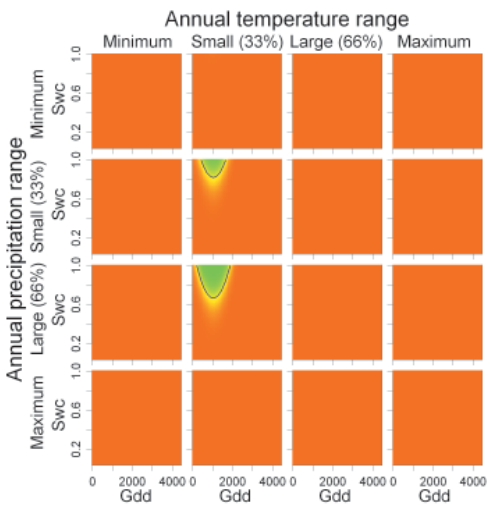
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 269)

The Asian Fritillary can be seen searching for nectar or foodplants on open scrub, rich in herbaceous plants, or in clearings in open woodland, in flower-rich grassland, and on vegetation of dwarf shrubs above the tree-line. These butterflies only occur locally, although at times in large numbers. The female lays all her eggs at once, on the underside of a leaf of its foodplant, Blue Honeysuckle (*Lonicera caerulea*). The caterpillars live in communal webs, and in the autumn make a more substantial shelter of leaves, spun together with silk, in which to hibernate. They take two years to develop and have to hibernate twice. The fully-grown caterpillar leaves the nest after the second hibernation, and pupates on the foodplant or adjacent rocks.

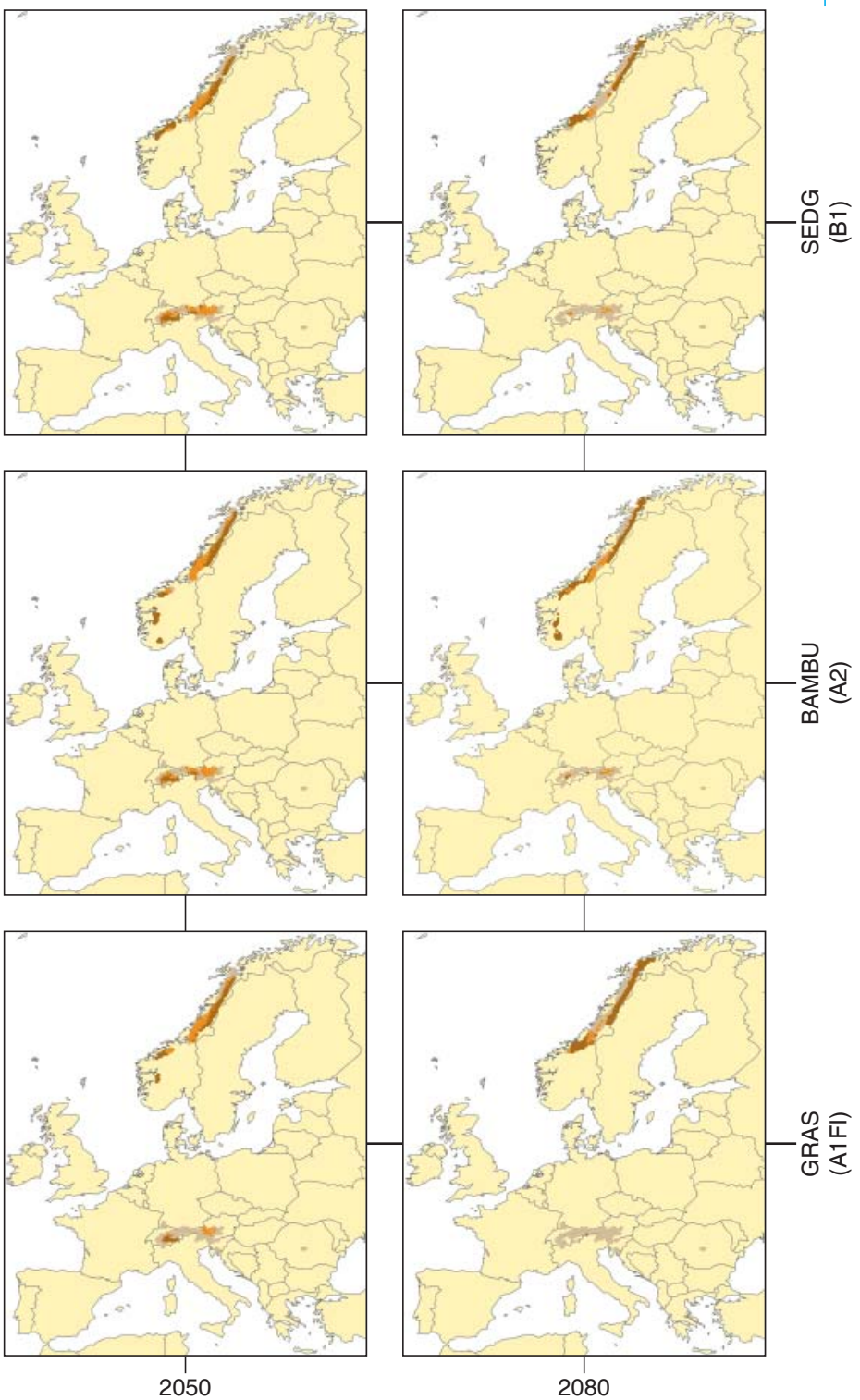
Present distribution can be very well explained by climatic variables (AUC = 0.98).
Climate risk category: HHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Euphydryas maturna (Linnaeus, 1758) – Scarce Fritillary

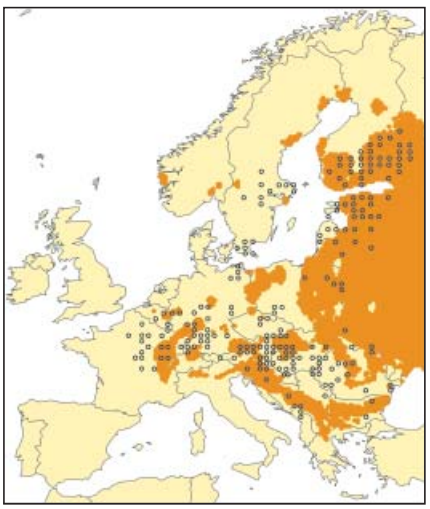
© Rudi Verovnik

		Full dispersal	No dispersal
2050	SEDG	296 (4.13%)	-2439 (-34.05%)
	BAMBU	3998 (55.81%)	-981 (-13.69%)
	GRAS	2526 (35.26%)	-1754 (-24.48%)
2080	SEDG	3354 (46.82%)	-1971 (-27.51%)
	BAMBU	3987 (55.65%)	-2446 (-34.14%)
	GRAS	2476 (34.56%)	-3429 (-47.86%)

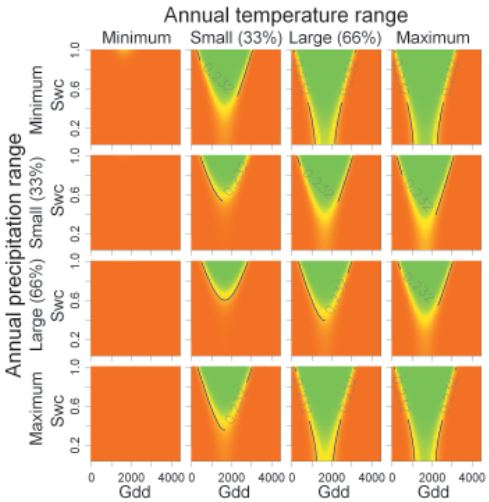
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 7164)

The Scarce Fritillary occurs in clearings, where young ash trees are growing in open, mixed woodland. The eggs are laid in one batch on a leaf of Ash (*Fraxinus excelsior*) or Aspen (*Populus tremula*), preferably at a height of around 4 m. The caterpillars build a nest of silk and leaves, and feed together at first, while still quite small. They go into hibernation, remaining in the nest, which usually falls onto the woodland floor. In spring, they leave the nest and separate, spreading out in search of food. They use a variety of larval foodplants at this stage, including honeysuckle (*Lonicera* spp.), plantains (*Plantago* spp.), or privets (*Ligustrum* spp.). They pupate in the litter layer. The species has one generation a year although some of the caterpillars hibernate a second time before pupating. This species is listed in Annexes II and IV of the Habitats' Directive.

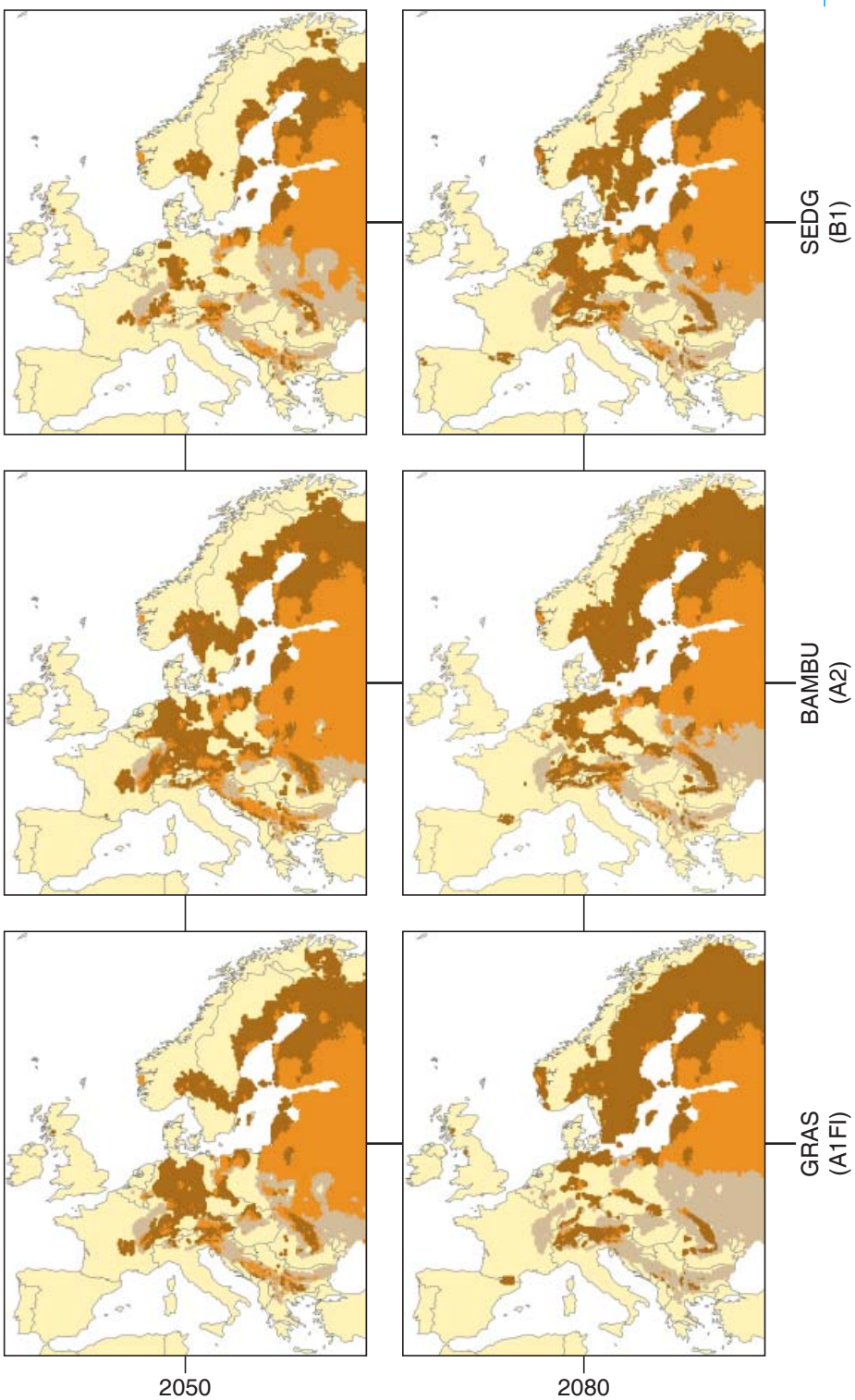
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.79). Climate risk category: LR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Euphydryas desfontainii (Godart, 1819) – Spanish Fritillary

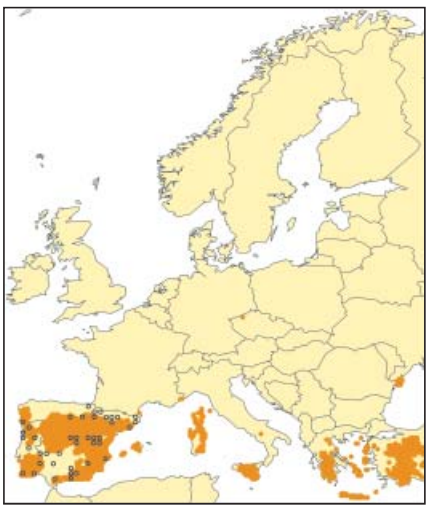
© Bernard Fransen

		Full dispersal	No dispersal
2050	SEDG	-1003 (-61.12%)	-1132 (-68.98%)
	BAMBU	-1226 (-74.71%)	-1256 (-76.54%)
	GRAS	-1202 (-73.25%)	-1314 (-80.07%)
2080	SEDG	-1406 (-85.68%)	-1481 (-90.25%)
	BAMBU	-1593 (-97.07%)	-1622 (-98.84%)
	GRAS	-1624 (-98.96%)	-1640 (-99.94%)

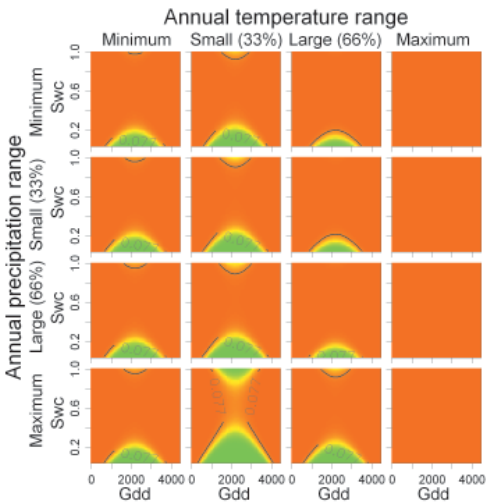
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1641)

The Spanish Fritillary occurs on open, grassy places with stony soil and lots of shrubs. It uses various foodplants, such as *Cephalaria leucantha* and *C. syriaca*, the teasels *Dipsacus fullonum* and *D. comasus*, scabious (*Scabiosa* and *Knautia* spp.) and possibly knapweeds (*Centaurea* spp.). The female lays her eggs in small batches on the underside of leaves. The caterpillars live in a communal spun nest, also hibernating there. There is one brood a year.

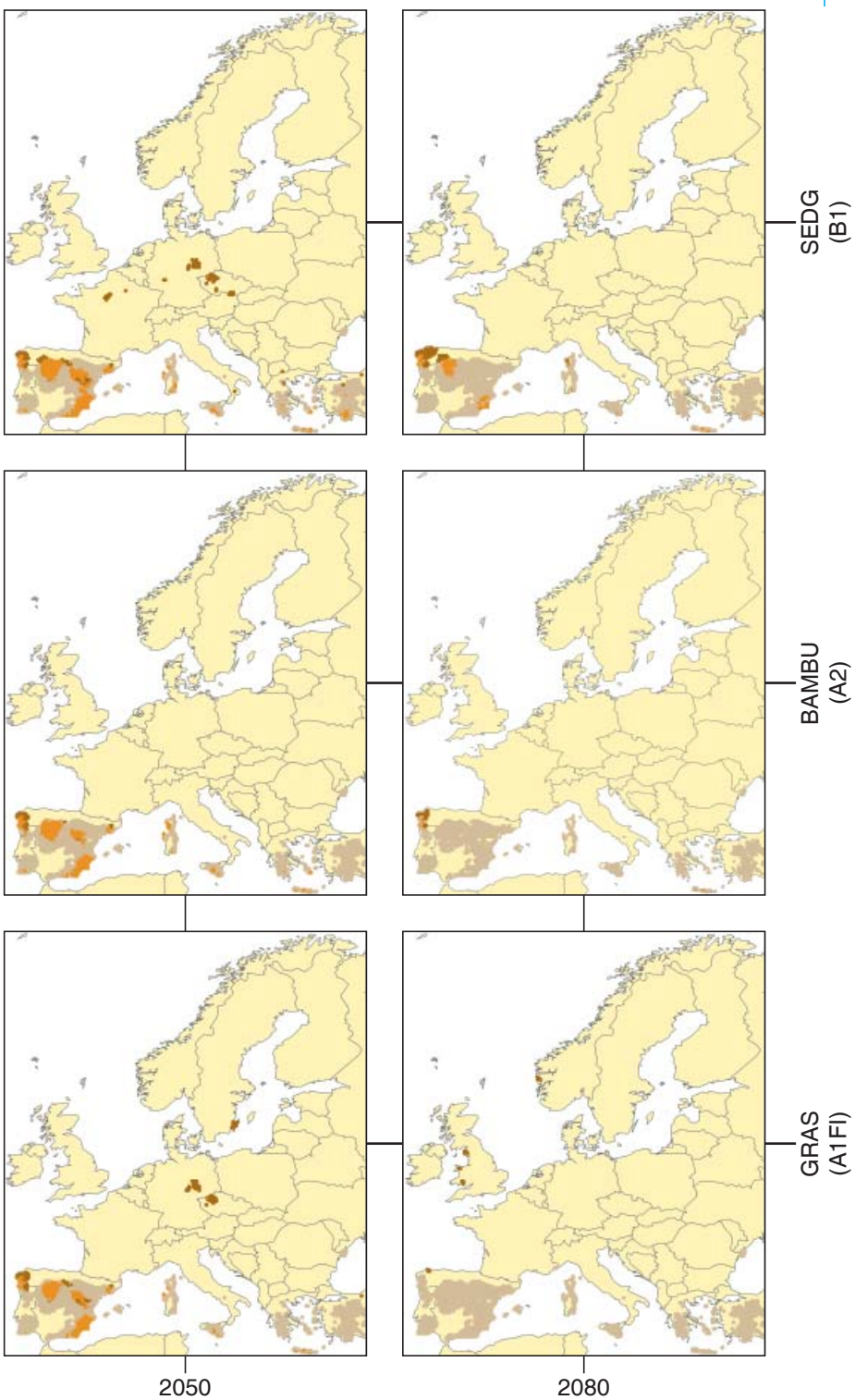
Present distribution can be well explained by climatic variables (AUC = 0.88).
Climate risk category: HHHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Euphydryas aurinia (Rottemburg, 1775) – Marsh Fritillary

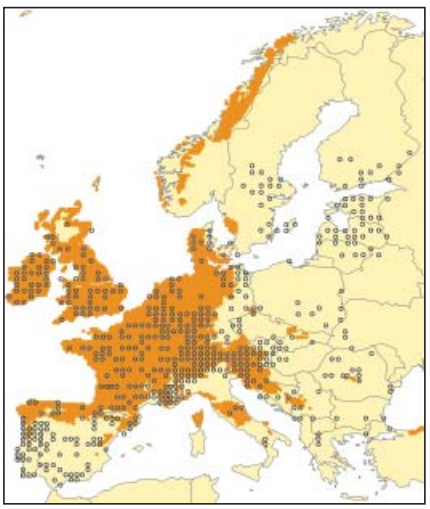
© Peter Ginzinger

		Full dispersal	No dispersal
2050	SEDG	-276 (-4.24%)	-976 (-14.99%)
	BAMBU	335 (5.14%)	-786 (-12.07%)
	GRAS	-543 (-8.34%)	-1292 (-19.84%)
2080	SEDG	-1055 (-16.2%)	-1908 (-29.3%)
	BAMBU	-1115 (-17.12%)	-2365 (-36.31%)
	GRAS	-2488 (-38.2%)	-3659 (-56.18%)

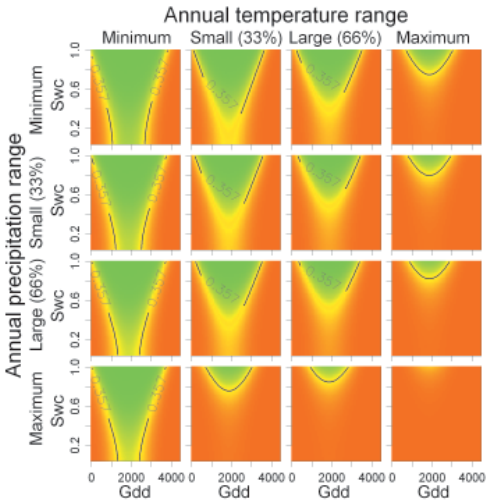
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 6513)

The Marsh Fritillary occurs in very different types of habitat, like moist, sheltered grasslands, along the edges of raised bogs and on dry, calcareous grasslands. The foodplants are Devil's-bit Scabious (*Succisa pratense*), Small Scabious (*Scabiosa columbaria*), Field Scabious (*Knautia arvensis*), and teasels (*Dipsacus* spp.). The eggs are laid in large clumps under the leaves. The caterpillars spin a substantial nest between the leaves of the foodplants, feeding in it, and also hibernating communally there. However, later they are solitary, and look for places deep in the vegetation in which to pupate. The Marsh Fritillary has one brood a year.
This species is listed in Annex II of the Habitats' Directive.

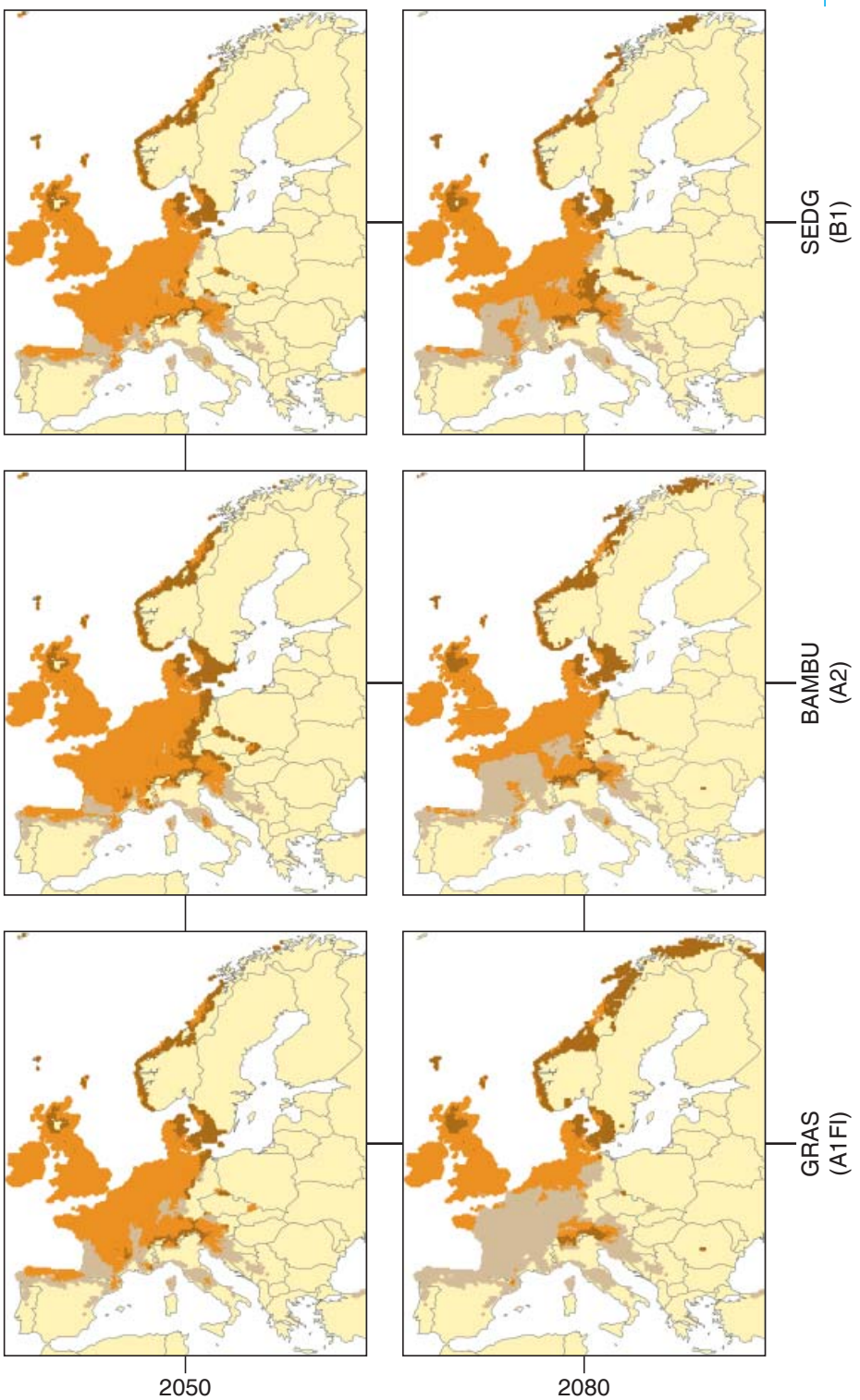
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.72).
Climate risk category: PR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Melitaea cinxia (Linnaeus, 1758) – Glanville Fritillary

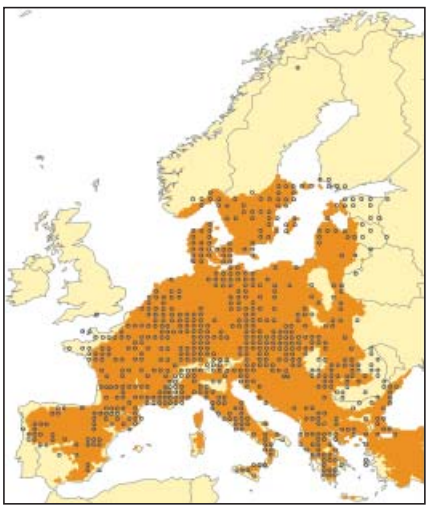
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	-1505 (-11.41%)	-2787 (-21.12%)
	BAMBU	-2602 (-19.72%)	-3692 (-27.98%)
	GRAS	-2647 (-20.06%)	-3961 (-30.02%)
2080	SEDG	-4653 (-35.26%)	-5935 (-44.98%)
	BAMBU	-5706 (-43.24%)	-7293 (-55.27%)
	GRAS	-6896 (-52.26%)	-8941 (-67.76%)

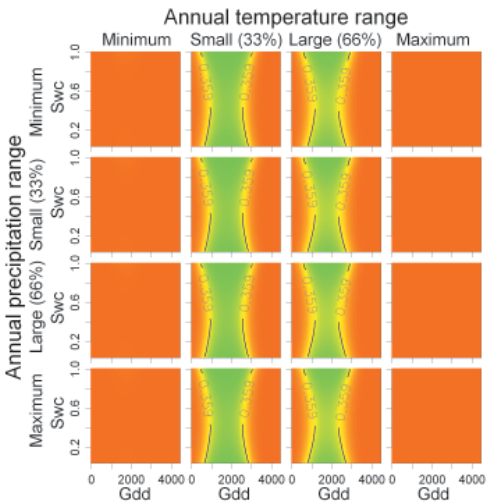
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 13195)

The Glanville Fritillary is found on many different types of flower-rich grasslands, both on calcareous and acid soils. This butterfly can survive on meadows and pastures, as well as on road verges and forgotten patches of vegetation, sometimes small habitats supporting large populations. Various plantains (*Plantago* spp.), speedwells (*Veronica* spp,), and knapweeds (*Centaurea* spp.) are used as foodplants. The eggs are laid in large batches on the underside of the leaves. The caterpillars live gregariously in a spun nest, also hibernating in a thicker one when half-grown. The Glanville Fritillary, usually has one generation a year, partially a second one under favourable conditions.

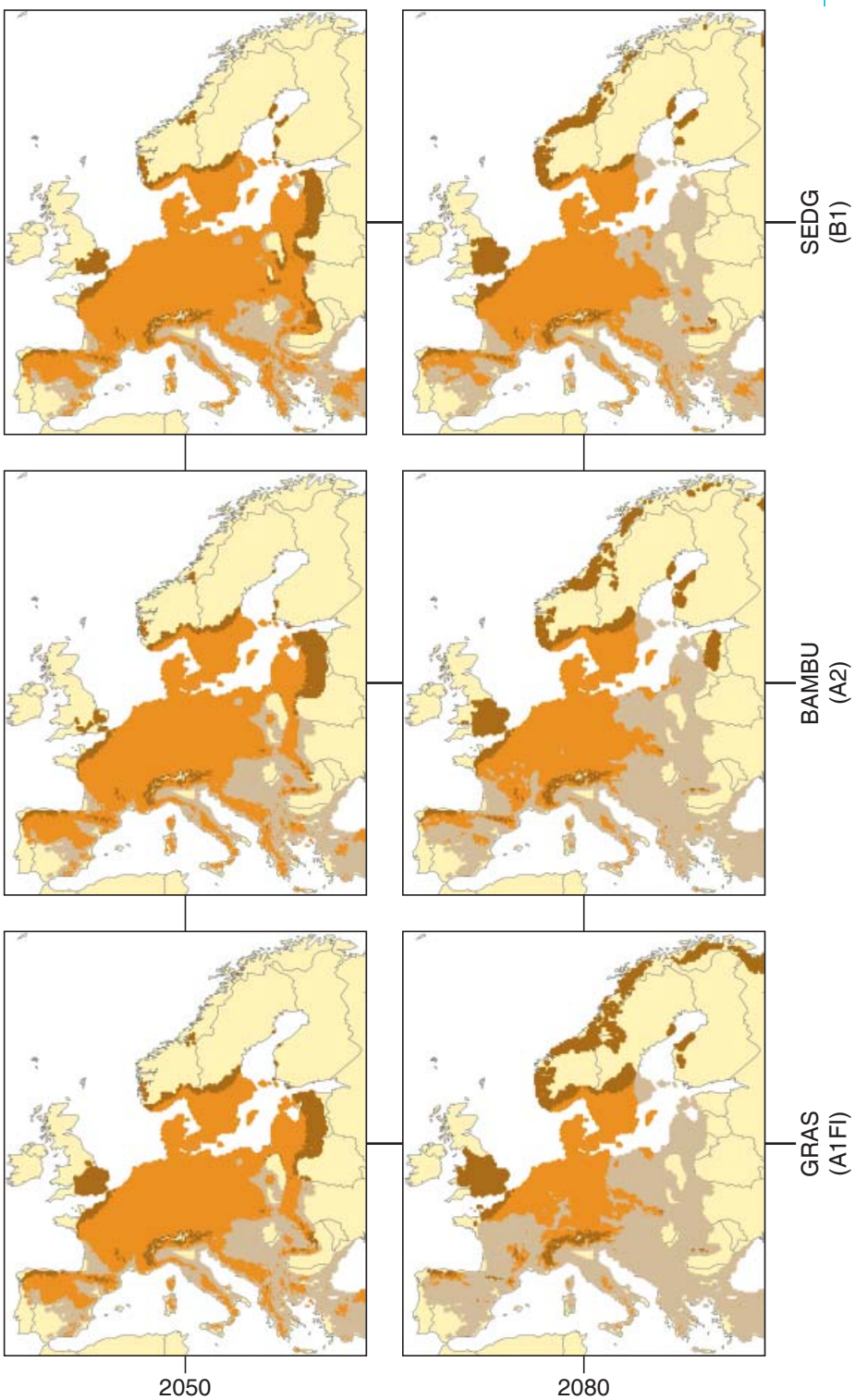
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.75). Climate risk category: PR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Melitaea phoebe (Goeze, 1779) – Knapweed Fritillary

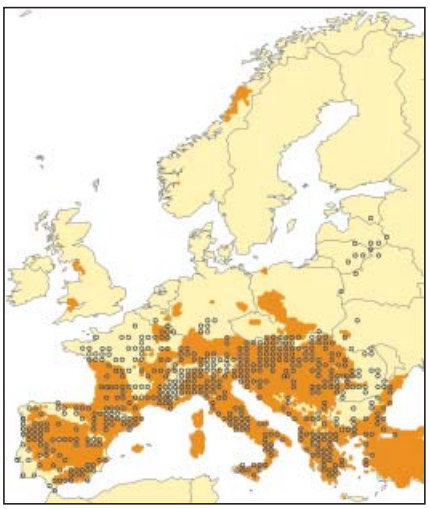
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	2383 (30.98%)	-1579 (-20.53%)
	BAMBU	1413 (18.37%)	-2181 (-28.35%)
	GRAS	1267 (16.47%)	-2473 (-32.15%)
2080	SEDG	2605 (33.86%)	-2630 (-34.19%)
	BAMBU	1417 (18.42%)	-4209 (-54.71%)
	GRAS	1843 (23.96%)	-5324 (-69.21%)

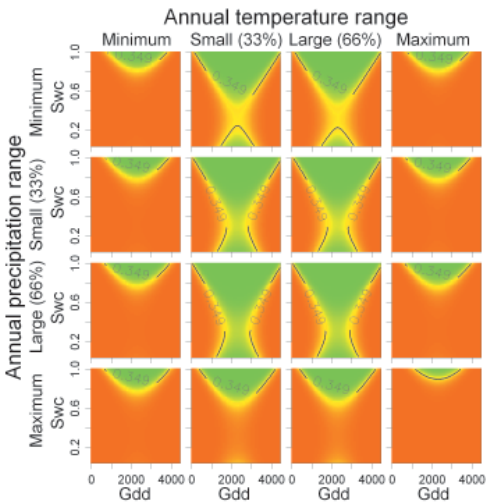
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 7693)

The Knapweed Fritillary occurs in dry, open places with flower-rich vegetation. These grasslands are often in a sheltered situation at the edge of woodland, or of groups of shrubs. In the north of its range, the grasslands are mostly calcareous. The larval foodplants are knapweeds (*Centaurea* spp.). The female lays her eggs in large batches on the undersides of the leaves. The small caterpillars live gregariously in a silken nest, also hibernating together. Later, they become solitary, and when ready to pupate, choose somewhere close to the ground. The Knapweed Fritillary usually has two broods, but at higher altitudes and in the north of its range only one.

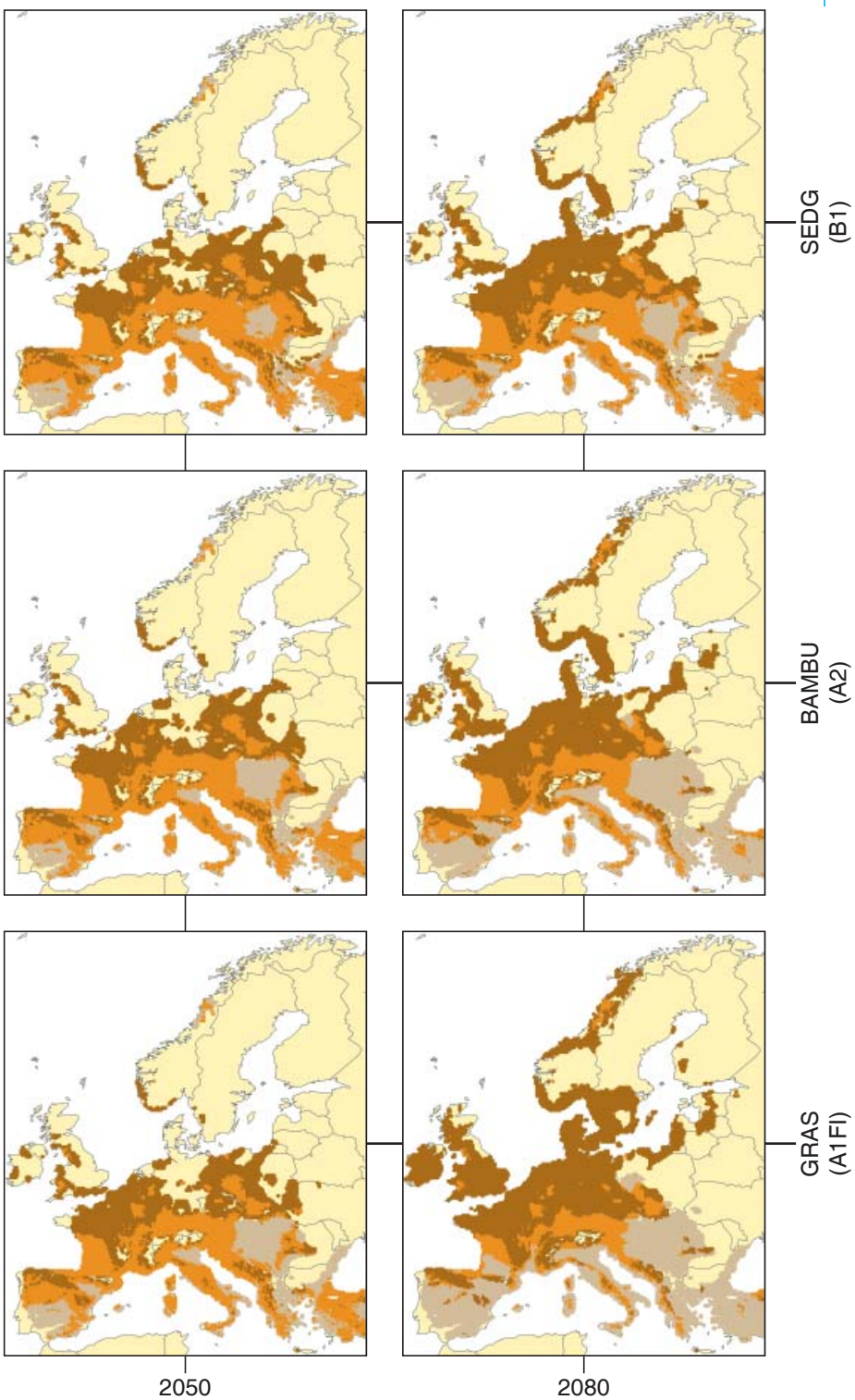
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.77). Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Melitaea aetherie (Hübner, 1826) – Aetherie Fritillary

© Albert Vliegenthart

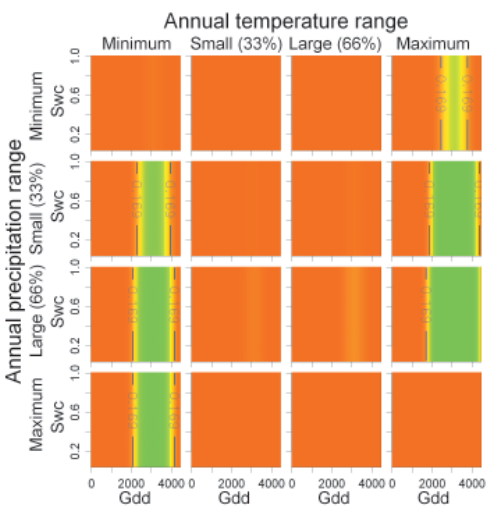
		Full dispersal	No dispersal
2050	SEDG	51 (13.01%)	-215 (-54.85%)
	BAMBU	261 (66.58%)	-184 (-46.94%)
	GRAS	214 (54.59%)	-248 (-63.27%)
2080	SEDG	642 (163.78%)	-318 (-81.12%)
	BAMBU	2480 (632.65%)	-351 (-89.54%)
	GRAS	4348 (1109.18%)	-386 (-98.47%)

Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 392)

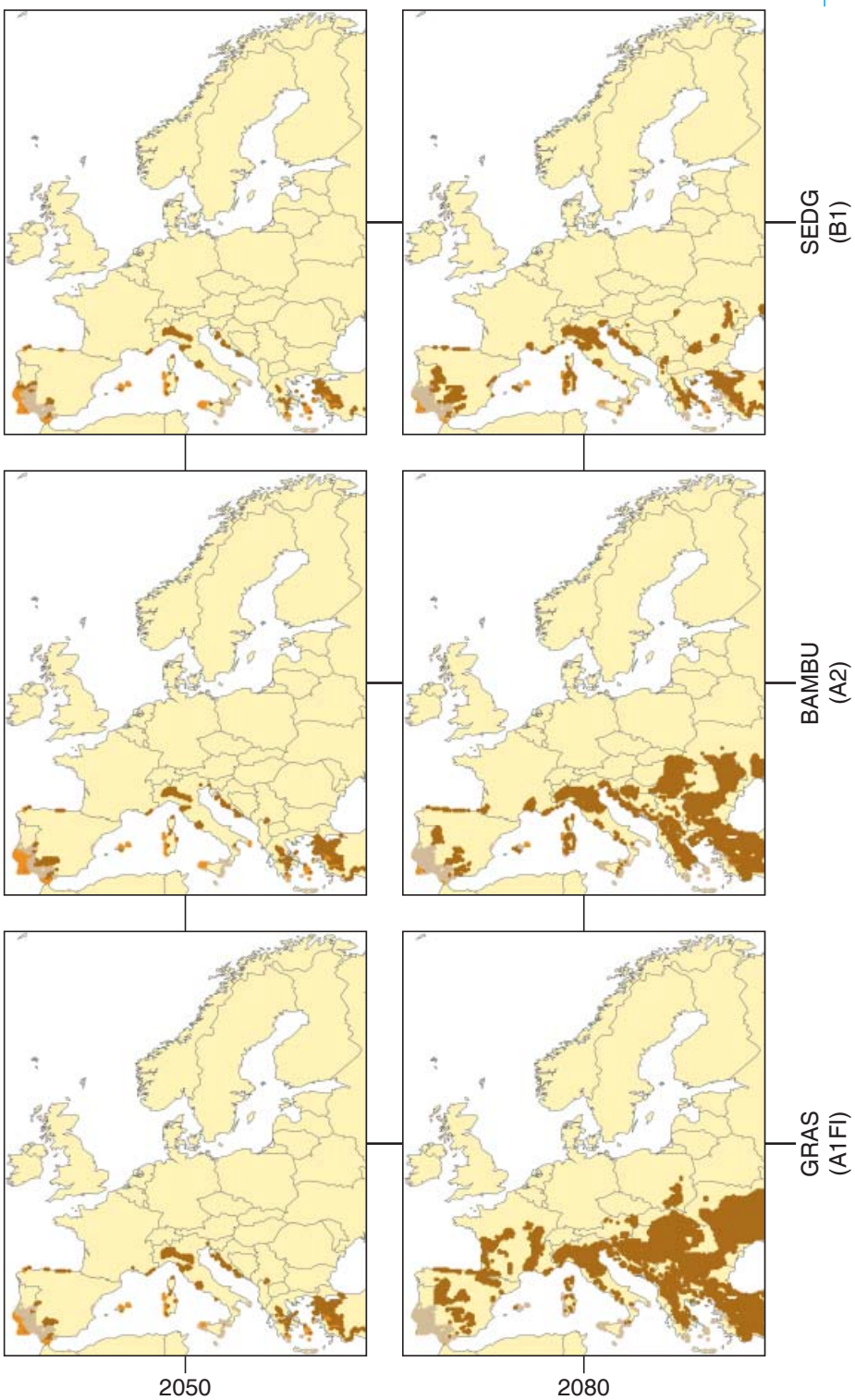
In Spain, the Aetherie Fritillary is found in clearings in disturbed Holm Oak (*Quercus ilex*) woodlands, where its foodplants, thistles (*Cirsium* spp.) and knapweeds (*Centaurea* spp.), such as Star Thistle (*Centaurea calcitrapa*), Brown Knapweed (*C. jacea*), and *C. carratracensis* grow. The female lays her eggs in batches on the foodplants. The Aetherie Fritillary normally has one brood a year, and hibernates as a caterpillar.

Present distribution can be well explained by climatic variables (AUC = 0.95).
Climate risk category: HHHR.

Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Melitaea trivia ([Schiffermüller], 1775) – Lesser Spotted Fritillary

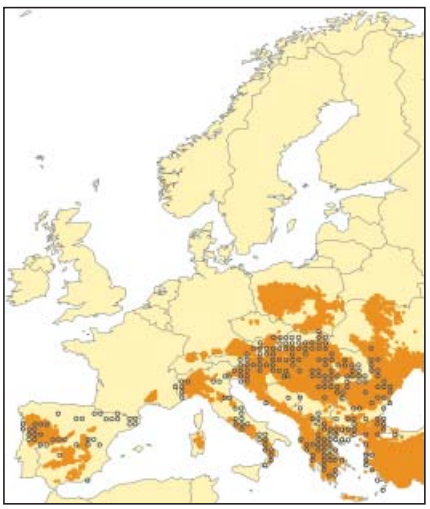
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	1635 (31.47%)	-1421 (-27.35%)
	BAMBU	-715 (-13.76%)	-2237 (-43.06%)
	GRAS	299 (5.76%)	-2154 (-41.46%)
2080	SEDG	-75 (-1.44%)	-2656 (-51.13%)
	BAMBU	-1820 (-35.03%)	-3718 (-71.57%)
	GRAS	-1070 (-20.6%)	-4285 (-82.48%)

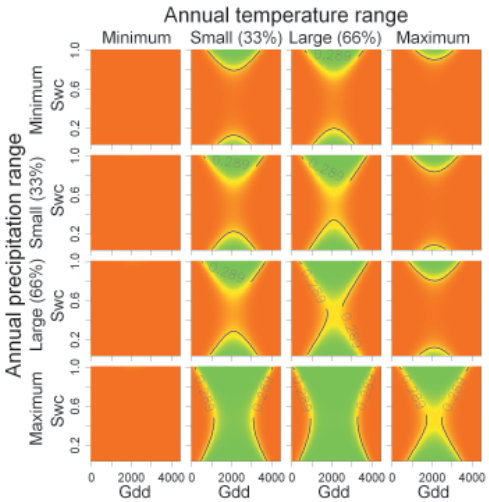
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 5195)

The Lesser Spotted Fritillary occurs on flower-rich, grassy vegetation, in both dry and damp places, and on waste ground. Various mulleins (*Verbascum* spp.) are used as foodplants, including Aaron's Rod (*Verbascum thapsus*), *V. densiflorum* and *V. longifolium*. The eggs are laid in batches on the underside of the leaves. The young caterpillars feed, gregariously in a communal web, where they also hibernate. After hibernation, they form smaller groups, and are often seen on the upper surface of the leaves. This species has one or two broods a year, depending on the climatic zone of its flight area.

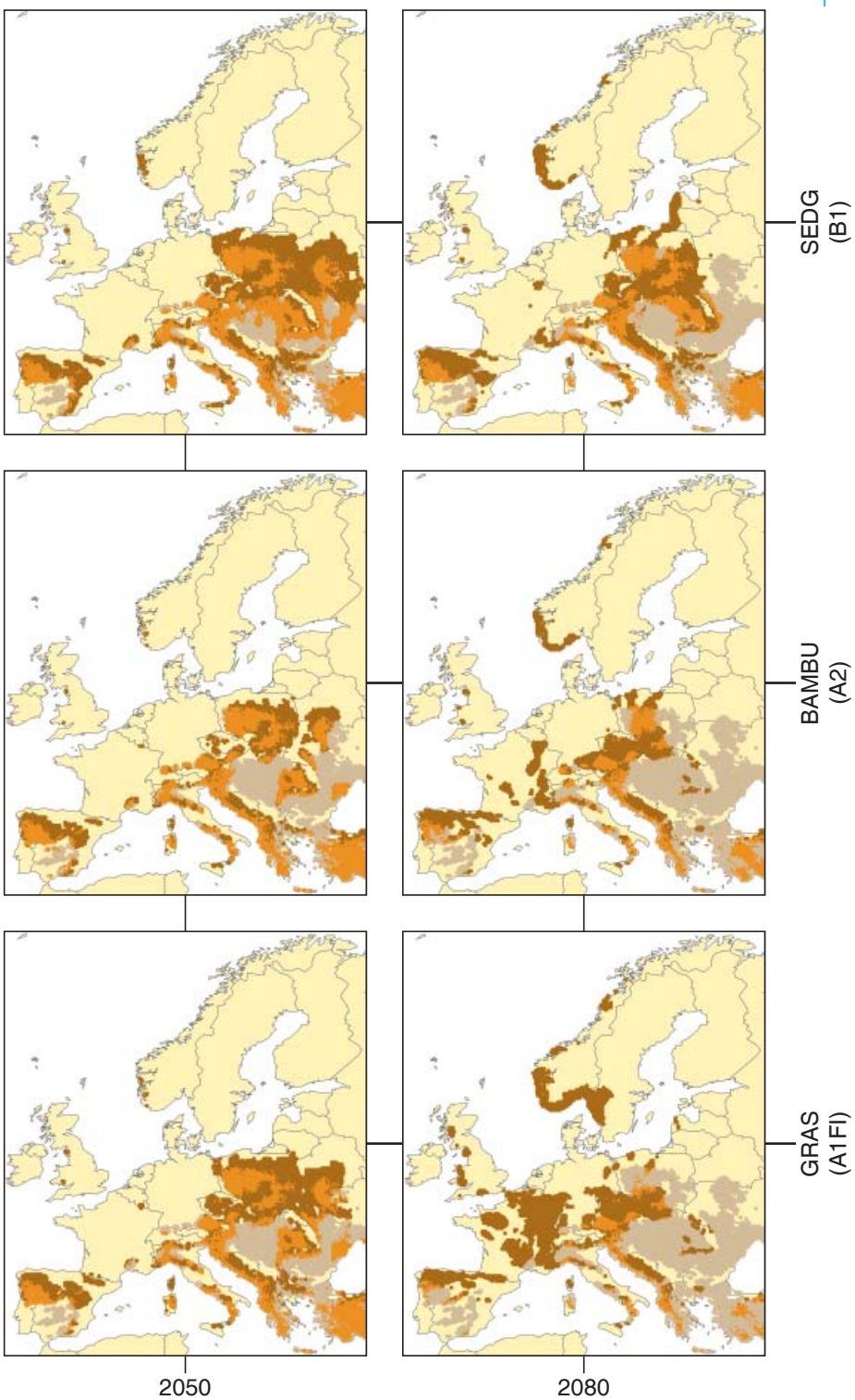
Present distribution can be well explained by climatic variables (AUC = 0.86).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Melitaea didyma (Esper, 1779) – Spotted Fritillary

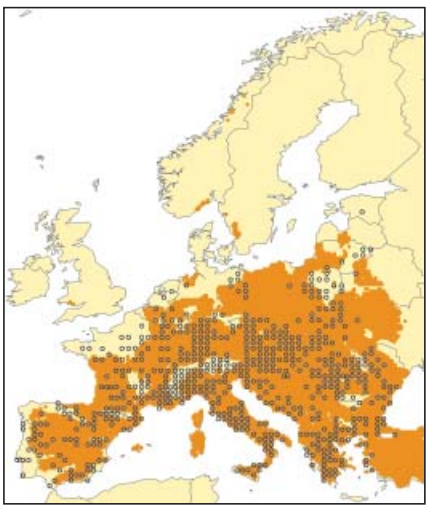
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	2540 (20.48%)	-1554 (-12.53%)
	BAMBU	1759 (14.19%)	-2270 (-18.31%)
	GRAS	1374 (11.08%)	-2686 (-21.66%)
2080	SEDG	1522 (12.27%)	-3397 (-27.4%)
	BAMBU	-73 (-0.59%)	-5816 (-46.9%)
	GRAS	-347 (-2.8%)	-7258 (-58.53%)

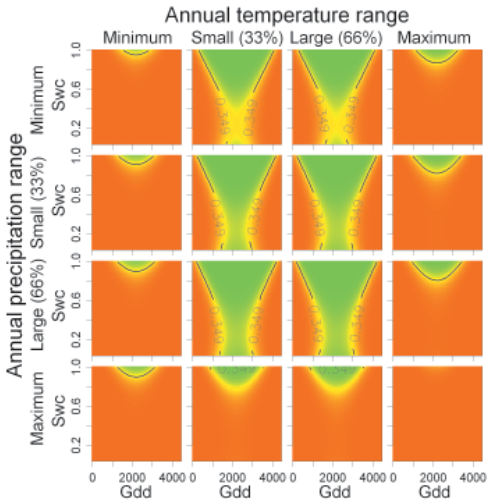
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 12400)

The Spotted Fritillary can be found on poor grasslands, steppe-like vegetation, and dry, rough vegetation near rocks and on slopes. Further, it is also seen on fallow agricultural land, or at the edges of fields. It uses a wide variety of plants as foodplant, plantains (*Plantago* spp.), toadflaxes (*Linara* spp.), speedwells (*Veronica* spp.), foxgloves (*Digitalis* spp.), woundworts (*Stachys* spp.), valerians (*Valeriana* spp.), and mulleins (*Verbascum* spp.). The female lays her eggs in clumps on the underside of the leaves, near to the ground. At first, the caterpillars feed communally in a loosely spun shelter, but they separate quite soon, either into smaller groups, or become solitary. The caterpillars hibernate alone, or in small groups, in a spun web. They pupate low down on the foodplant or in the vegetation. The Spotted Fritillary has one to three broods a year, depending on the geographical location and altitude of its breeding ground.

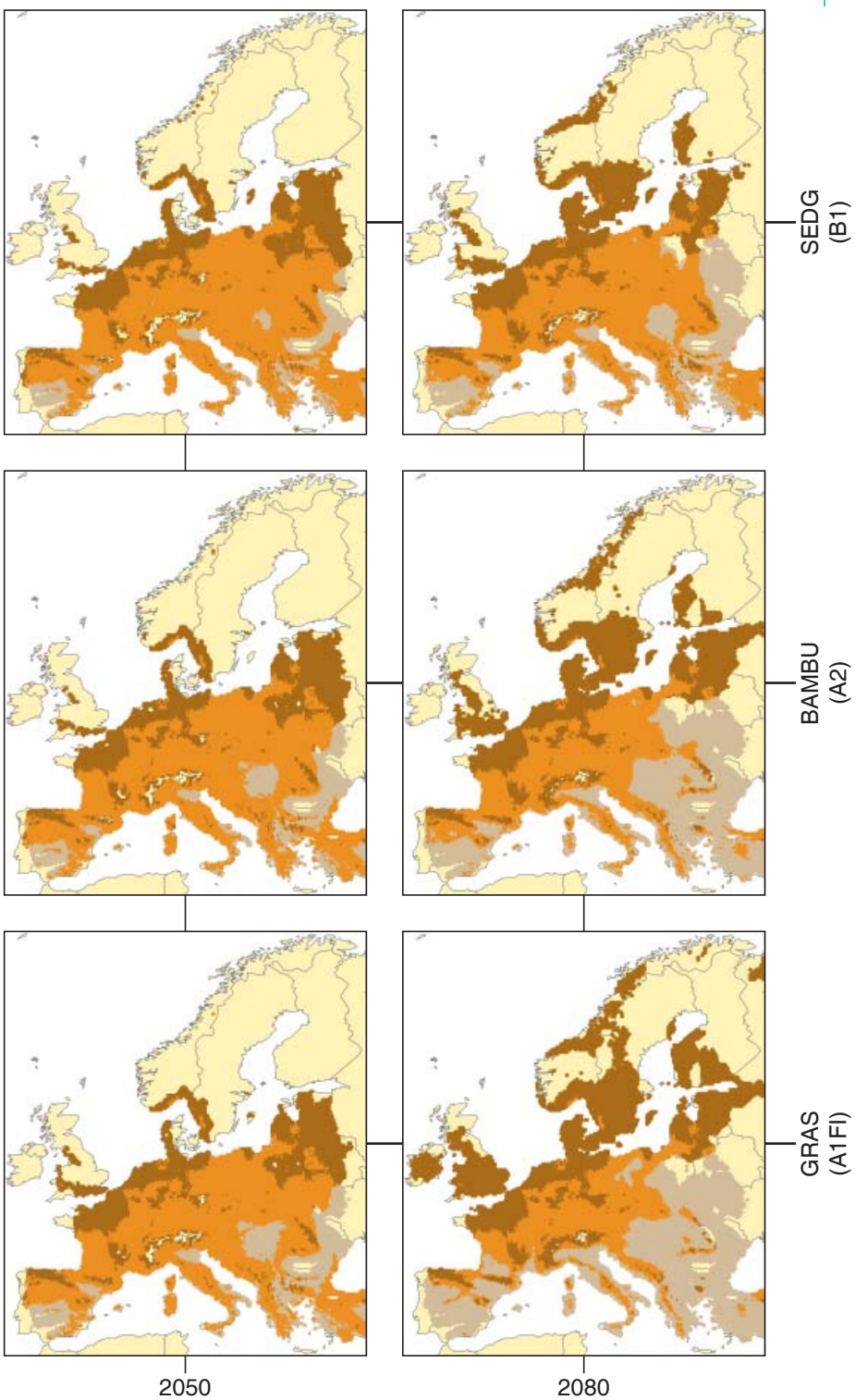
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.77). Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Melitaea diamina (Lang, 1789) – False Heath Fritillary

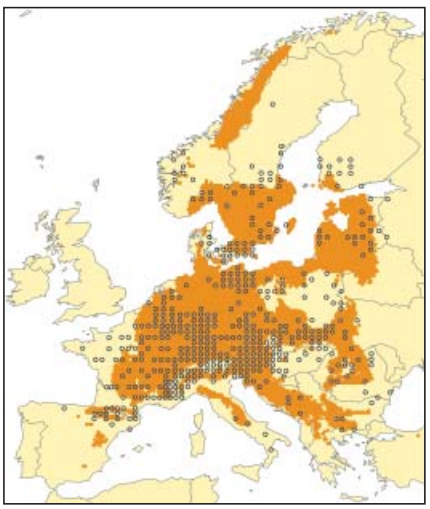
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-1169 (-13.54%)	-2382 (-27.59%)
	BAMBU	171 (1.98%)	-1648 (-19.09%)
	GRAS	-1511 (-17.5%)	-2780 (-32.2%)
2080	SEDG	-2257 (-26.14%)	-4026 (-46.64%)
	BAMBU	-1780 (-20.62%)	-4472 (-51.8%)
	GRAS	-3377 (-39.12%)	-6073 (-70.35%)

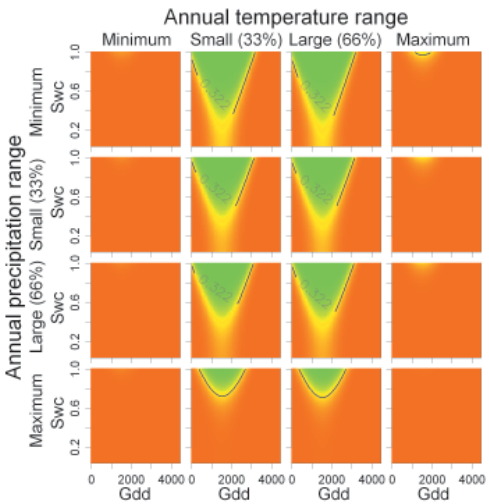
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 8633)

The False Heath Fritillary is found in sheltered, marshy habitats and damp woodland clearings. At higher altitudes, it is also found on rough, calcareous grasslands. Different sorts of valerian (*Valeriana* spp.) are used as foodplants, the female depositing her eggs in large clusters on the underside of the leaves. The small caterpillars only feed for a short time before hibernating communally in a silken shelter. After hibernation, they separate, later pupating low down on the foodplant. The False Heath Fritillary usually has one brood a year, but at low altitudes it sometimes has two.

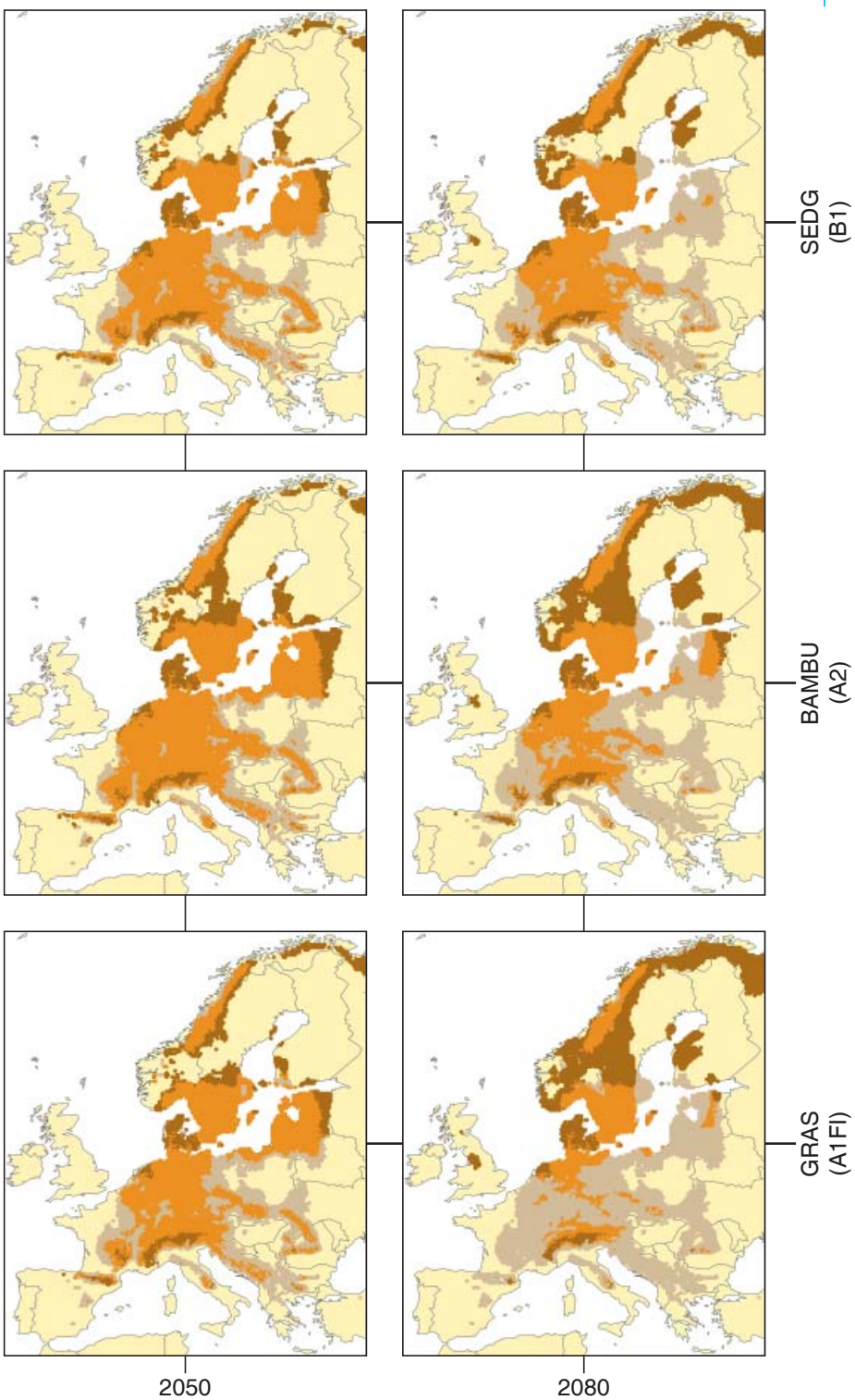
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.84). Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Melitaea deione (Geyer, 1832) – Provençal Fritillary

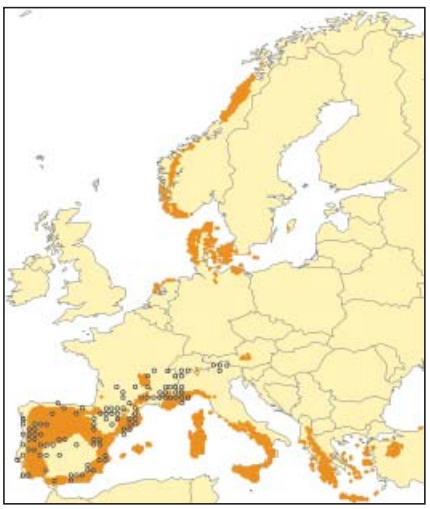
© Martin Wiemers

		Full dispersal	No dispersal
2050	SEDG	-832 (-34.3%)	-1587 (-65.42%)
	BAMBU	-1517 (-62.53%)	-1792 (-73.87%)
	GRAS	-1220 (-50.29%)	-1824 (-75.19%)
2080	SEDG	-1099 (-45.3%)	-2005 (-82.65%)
	BAMBU	-1236 (-50.95%)	-2071 (-85.37%)
	GRAS	-1062 (-43.78%)	-2213 (-91.22%)

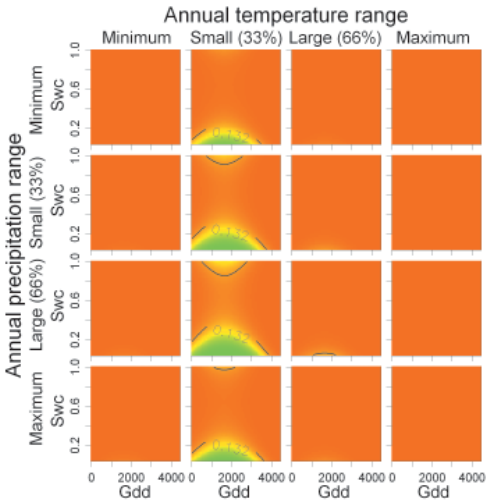
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 2426)

The Provençal Fritillary occurs in all sorts of flower-rich, grassy places; on flower-rich grasslands, both in damp and dry places, and on calcareous as well as acid soil, on flower-rich, grassy vegetation on the banks of rivers and streams, in scrub and at woodland edges. In Switzerland, at the extreme north of its distribution range, it is only found in dry, warm, bushy places. Its foodplants are toadflax (*Linaria* spp.), snapdragons (*Antirrhinum* spp.), and sometimes also foxgloves (*Digitalis* spp.). The female lays her eggs in small batches on the underside of the leaves. The caterpillars hibernate in a spun shelter. In most locations, this species has two broods a year, however in cooler places only one.

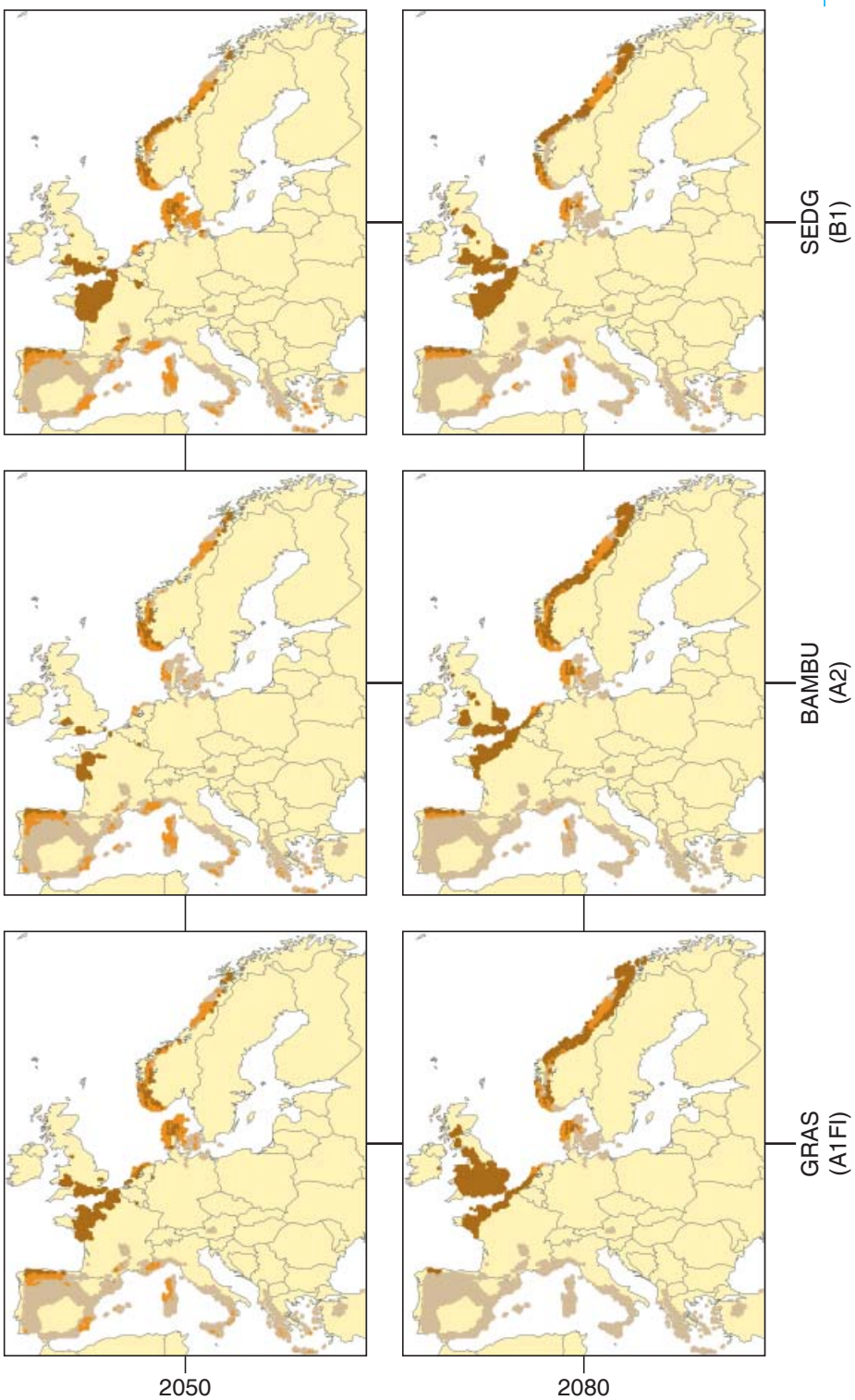
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.76). Climate risk category: HHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Melitaea varia (Meyer-Dür, 1851) – Grisons Fritillary

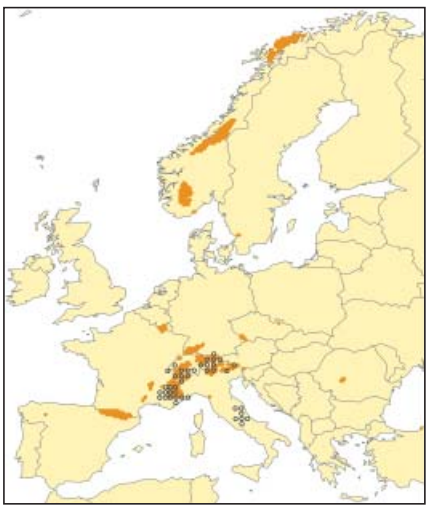
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-19 (-3.75%)	-281 (-55.53%)
	BAMBU	85 (16.8%)	-232 (-45.85%)
	GRAS	-66 (-13.04%)	-298 (-58.89%)
2080	SEDG	-232 (-45.85%)	-438 (-86.56%)
	BAMBU	-123 (-24.31%)	-355 (-70.16%)
	GRAS	-249 (-49.21%)	-434 (-85.77%)

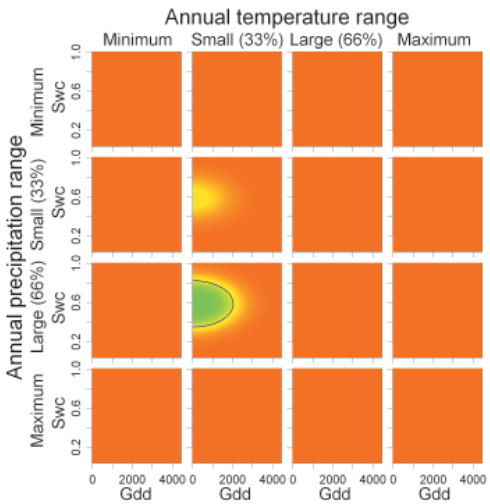
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 506)

The Grisons Fritillary is a small fritillary that breeds on flower-rich sub-alpine and alpine grasslands and on sunny, grassy slopes. The adult butterflies visit mostly low plants for nectar, and the males are also seen on damp patches, excrement, and dead animals. The female lays her eggs in clusters on the foodplant. The caterpillars have been found on Alpine Plantain (*Plantago alpina*) and *Achillea* species, but Spring Gentian (*Gentiana verna*) and Stemless Trumpet Gentian (*G. acaulis*) are also named as foodplants. The caterpillars hibernate, pupating in June or July of the following year, the pupa usually hanging from a stone. However, at higher altitudes, development is slower, taking nearly two years, and they hibernate twice.

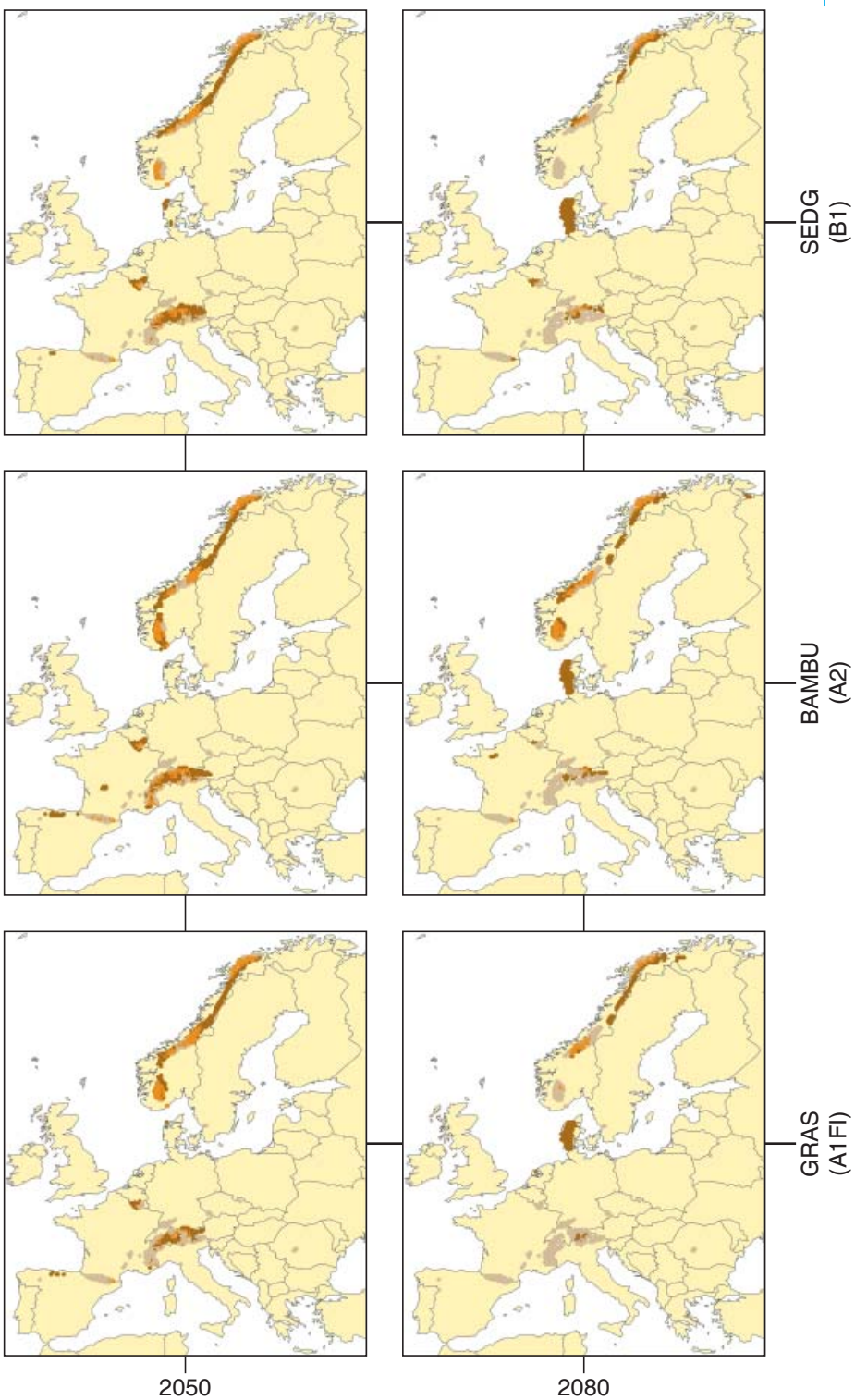
Present distribution can be very well explained by climatic variables (AUC = 0.96).
Climate risk category: HHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Melitaea parthenoides (Keferstein, 1851) – Meadow Fritillary

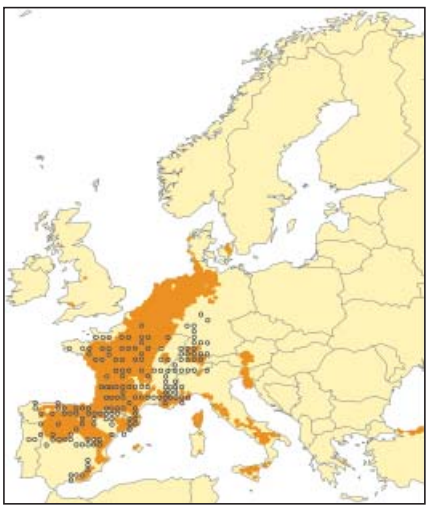
© Henk Bosma

		Full dispersal	No dispersal
2050	SEDG	-263 (-8.26%)	-1251 (-39.3%)
	BAMBU	-467 (-14.67%)	-1326 (-41.66%)
	GRAS	-805 (-25.29%)	-1756 (-55.17%)
2080	SEDG	-1137 (-35.72%)	-2098 (-65.91%)
	BAMBU	-1391 (-43.7%)	-2457 (-77.19%)
	GRAS	-1842 (-57.87%)	-2969 (-93.28%)

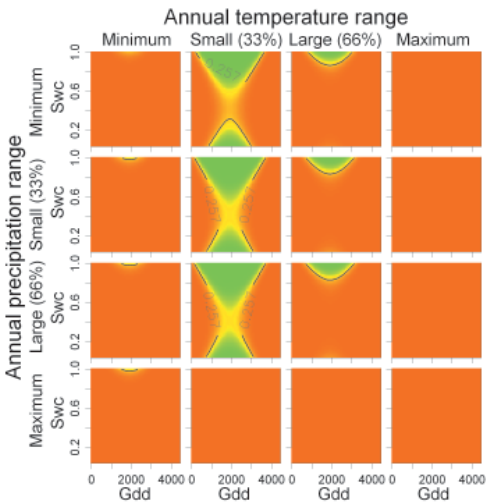
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 3183)

The Meadow Fritillary occurs in both dry and moderately damp habitats in many sorts of open, grassy, flower-rich places near woodland. Plantains (*Plantago* spp.) are the main foodplants, especially Ribwort Plantain (*P. lanceolata*). The eggs are laid in clusters on the underside of the leaves. The caterpillars feed and hibernate communally in a silken shelter, only separating in the last larval instar. They then look for a safe place to pupate, low down on the foodplant. The Meadow Fritillary usually has two generations a year, but only one in cool breeding grounds.

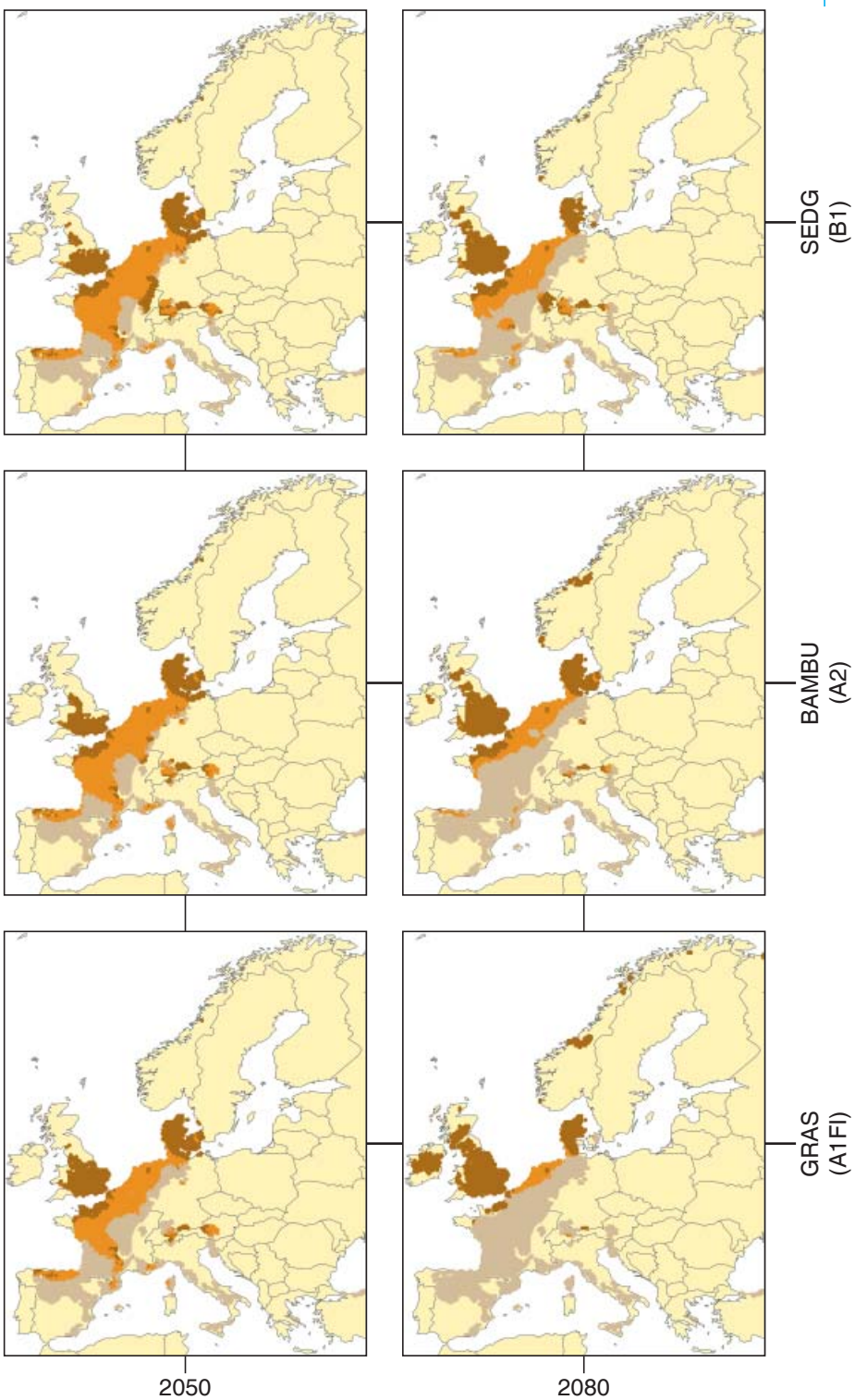
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.84). Climate risk category: HHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Melitaea aurelia (Nickerl, 1850) – Nickerl's Fritillary

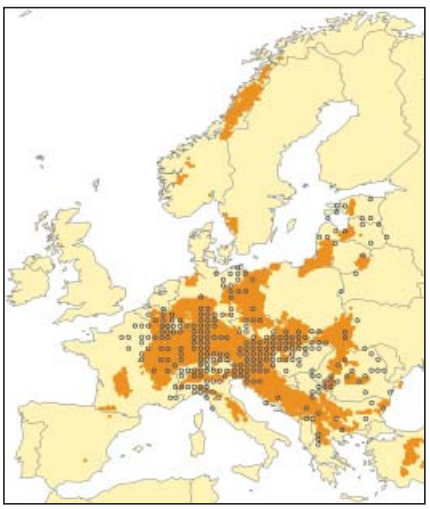
© Martin Wiemers

		Full dispersal	No dispersal
2050	SEDG	335 (7.57%)	-1527 (-34.52%)
	BAMBU	2241 (50.67%)	-1117 (-25.25%)
	GRAS	801 (18.11%)	-1641 (-37.1%)
2080	SEDG	625 (14.13%)	-2076 (-46.94%)
	BAMBU	1372 (31.02%)	-2361 (-53.38%)
	GRAS	490 (11.08%)	-3288 (-74.34%)

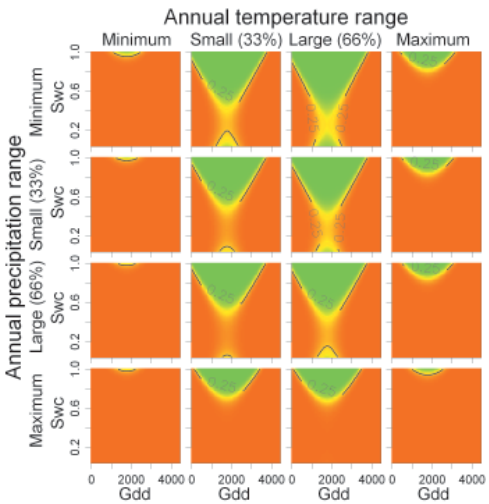
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 4423)

Nickerl's Fritillary occurs on open, dry grasslands and heaths on calcareous slopes and is very heat-tolerant. The female deposits her eggs in clusters on the underside of the leaves of its foodplant Ribwort Plantain (*Plantago lanceolata*). The caterpillars feed and also hibernate in communal silken nests. They pupate low down in the vegetation. Nickerl's Fritillary has one generation a year.

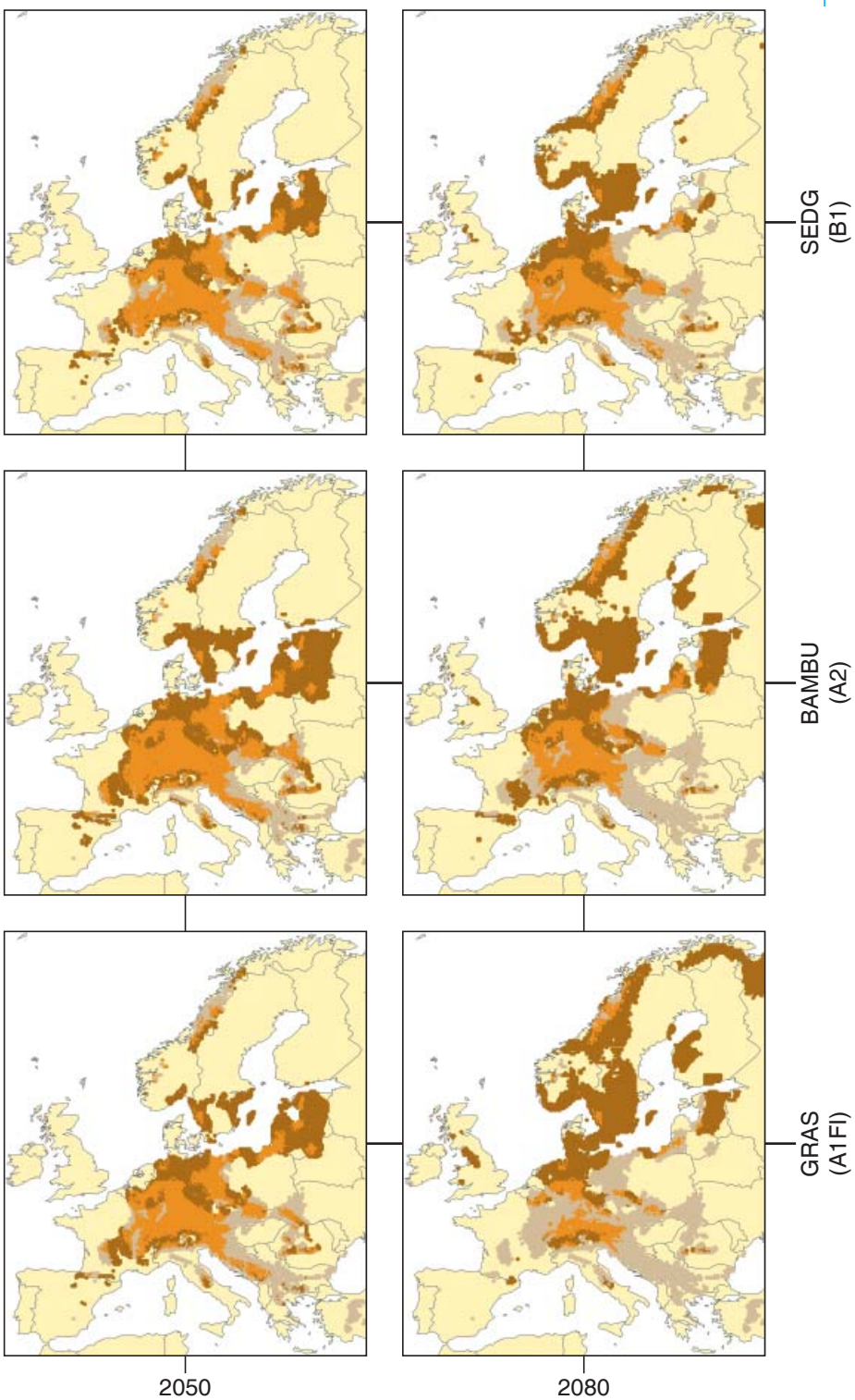
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.82). Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Melitaea britomartis (Assmann, 1847) – Assmann's Fritillary

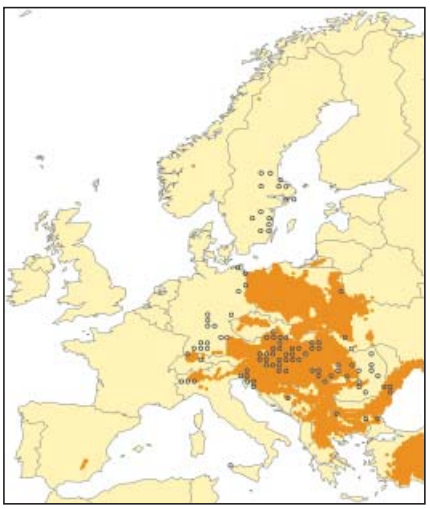
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	1268 (29.63%)	-1324 (-30.93%)
	BAMBU	31 (0.72%)	-2095 (-48.95%)
	GRAS	793 (18.53%)	-1987 (-46.43%)
2080	SEDG	-1646 (-38.46%)	-3144 (-73.46%)
	BAMBU	-1961 (-45.82%)	-3747 (-87.55%)
	GRAS	-2251 (-52.59%)	-4035 (-94.28%)

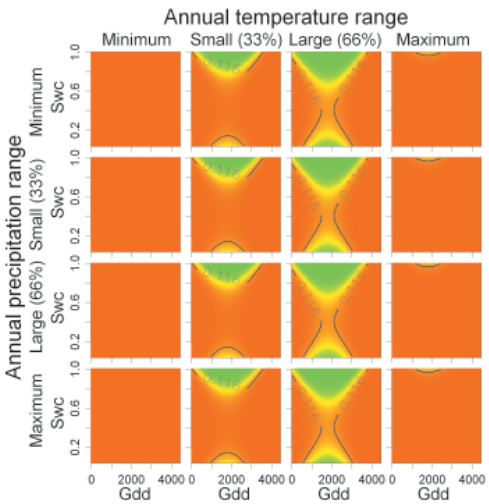
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 4280)

Assmann's Fritillary occurs on warm grasslands and heath that are often situated at the edges of woodland, or near groups of shrubs. Its foodplants are Ribwort Plantain (*Plantago lanceolata*), Yellow Rattle (*Rhinanthus minor*), and the Speedwell (*Veronica austriaca*). The female lays her eggs in batches on the underside of the leaves. The caterpillars feed communally in a silken nest, where they also hibernate. They then separate, later pupating low-down in the vegetation. This fritillary is single-brooded.

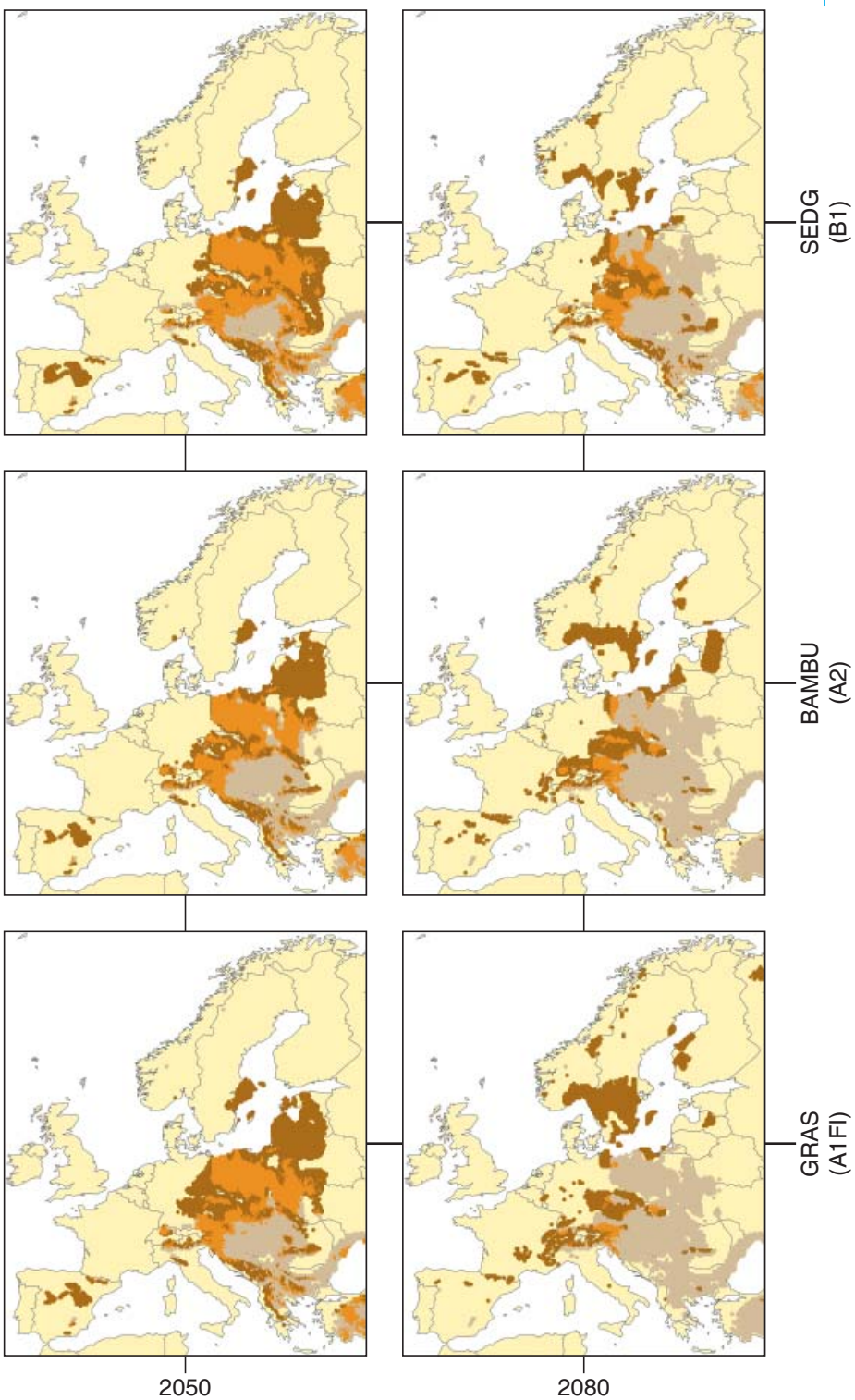
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.83). Climate risk category: HHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Melitaea athalia (Rottemburg, 1775) – Heath Fritillary

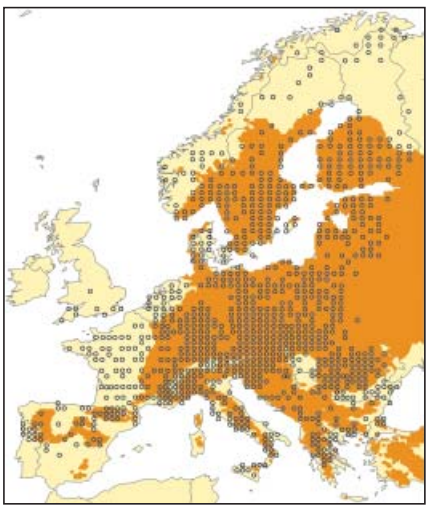
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	109 (0.7%)	-2510 (-16.21%)
	BAMBU	-610 (-3.94%)	-2730 (-17.63%)
	GRAS	-1391 (-8.98%)	-3658 (-23.63%)
2080	SEDG	560 (3.62%)	-3902 (-25.2%)
	BAMBU	-1542 (-9.96%)	-5975 (-38.59%)
	GRAS	-2980 (-19.25%)	-7785 (-50.28%)

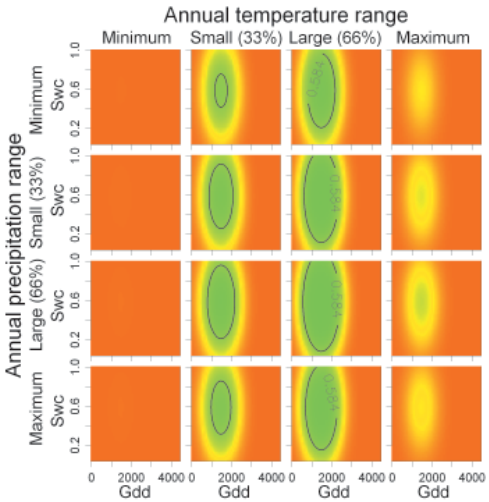
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 15482)

The Heath Fritillary is found in many different sorts of biotope, ranging from dry to damp, grassy, flower-rich places, often situated near bushes or in woodland, or in clearings and along the edges of paths in woods. Its foodplants are plantains (*Plantago* spp.), cow-wheats (*Melampyrum* spp.), speedwells (*Veronica* spp.), foxgloves (*Digitalis* spp.), and toadflaxes (*Linara* spp.). The female lays her eggs in clusters on the underside of the leaves. The caterpillars feed communally in silken nests, also hibernating together when half-grown. They then disperse over the plant, either into small groups, or, mostly, become solitary. They pupate on the foodplant, and usually have one brood a year, except in the south, where they have two.

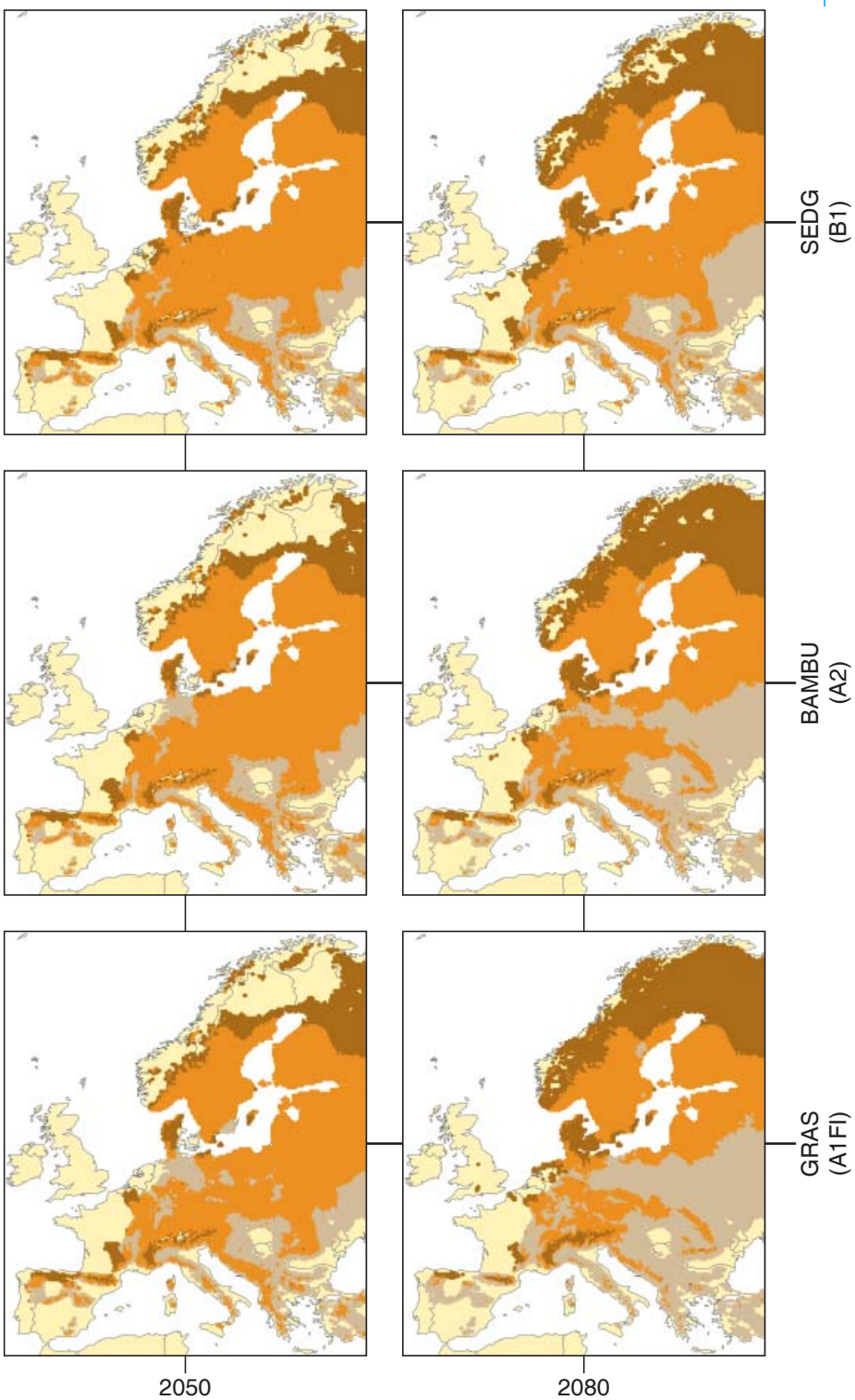
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.79). Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Limenitis populi (Linnaeus, 1758) – Poplar Admiral

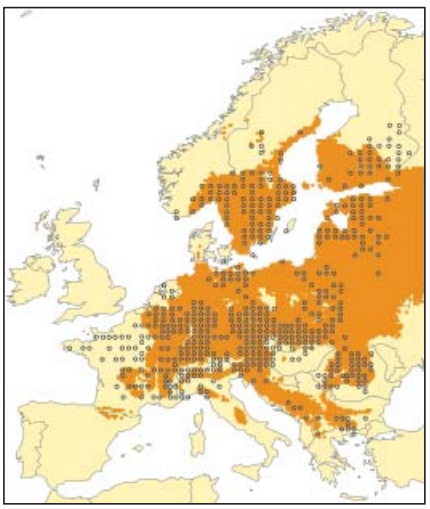
© Rudi Verovnik

		Full dispersal	No dispersal
2050	SEDG	-2247 (-19.83%)	-4349 (-38.38%)
	BAMBU	-937 (-8.27%)	-3448 (-30.43%)
	GRAS	-2695 (-23.78%)	-4819 (-42.53%)
2080	SEDG	-1234 (-10.89%)	-5291 (-46.69%)
	BAMBU	-1580 (-13.94%)	-6352 (-56.05%)
	GRAS	-3162 (-27.9%)	-8315 (-73.38%)

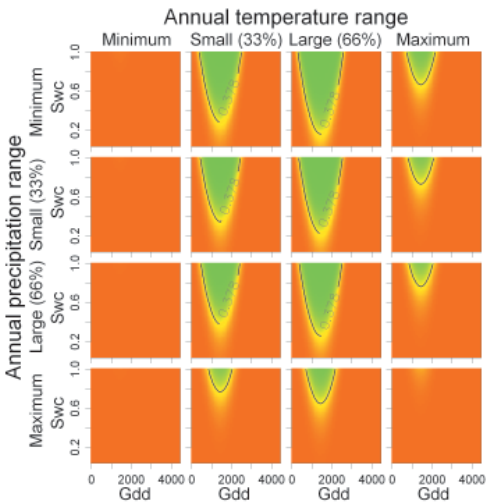
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 11332)

An encounter with the Poplar Admiral is one of those things that one never forgets. It is an impressive butterfly, and the woods it inhabits are areas of natural beauty. They are found in mixed woodlands with damp clearings, where its foodplants Aspen (*Populus tremula*) and Black Poplar (*Populus nigra*) grow. The female deposits her eggs one by one on leaves that are preferably situated in the sun, with more branches above them. The caterpillar feeds on the leaves and usually builds a hibernaculum, which is fastened tightly onto a twig with spun thread. It hibernates in the second larval instar, and in the spring eats large numbers of leaves before finally pupating, suspended from a leaf. The Poplar Admiral has one generation a year.

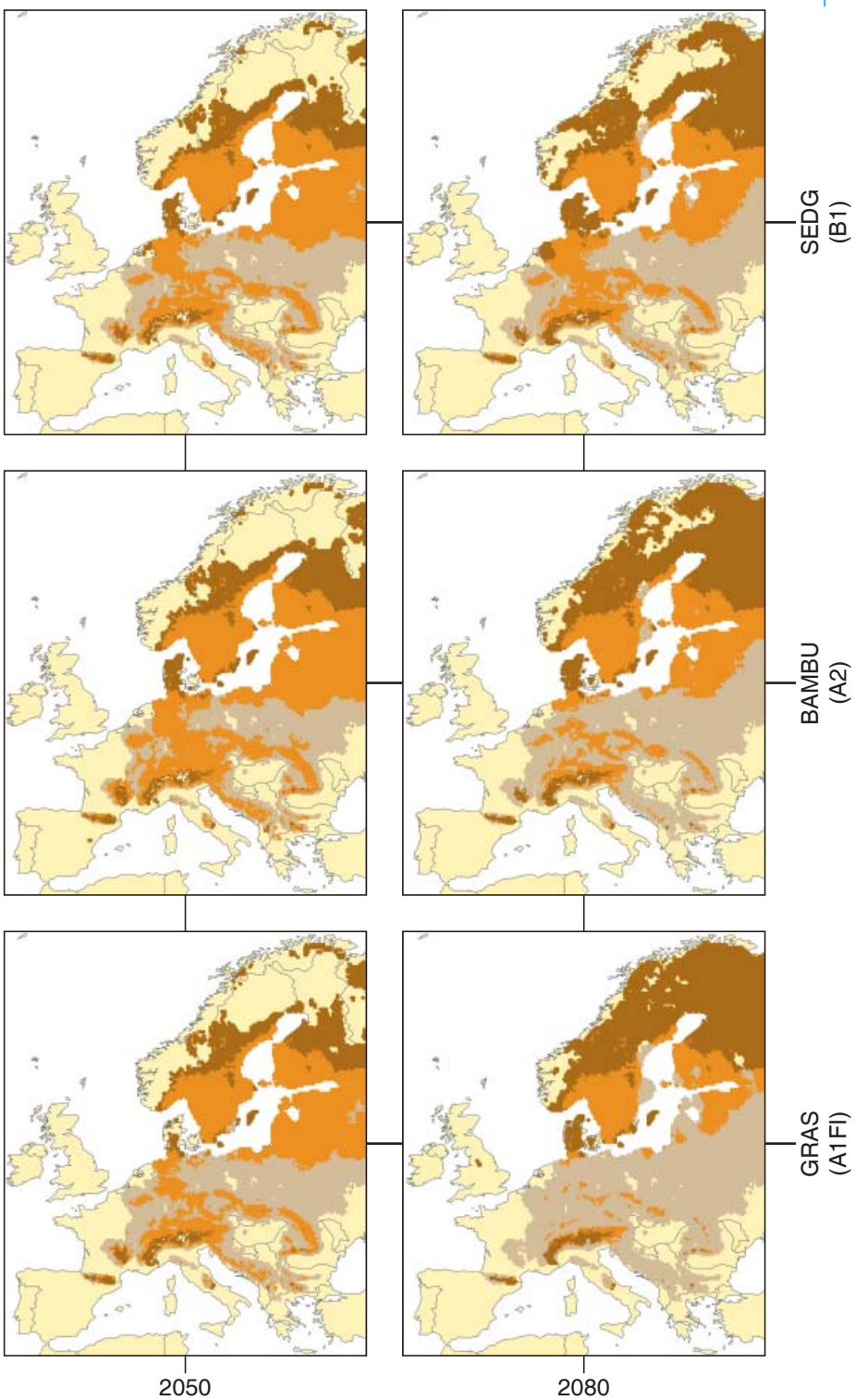
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.84). Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Limenitis camilla (Linnaeus, 1764) – White Admiral

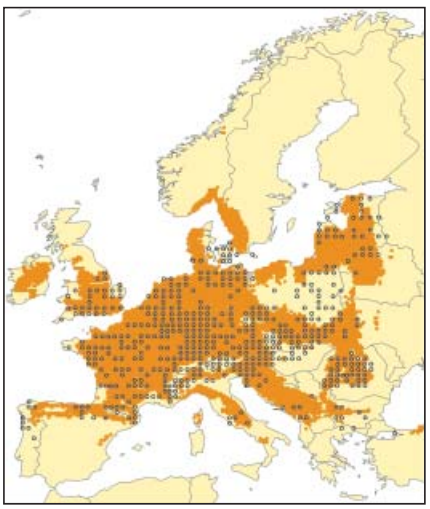
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	-1009 (-11.42%)	-2600 (-29.44%)
	BAMBU	890 (10.08%)	-1716 (-19.43%)
	GRAS	-1369 (-15.5%)	-3179 (-35.99%)
2080	SEDG	-979 (-11.08%)	-3580 (-40.53%)
	BAMBU	-161 (-1.82%)	-4232 (-47.91%)
	GRAS	-1447 (-16.38%)	-6253 (-70.79%)

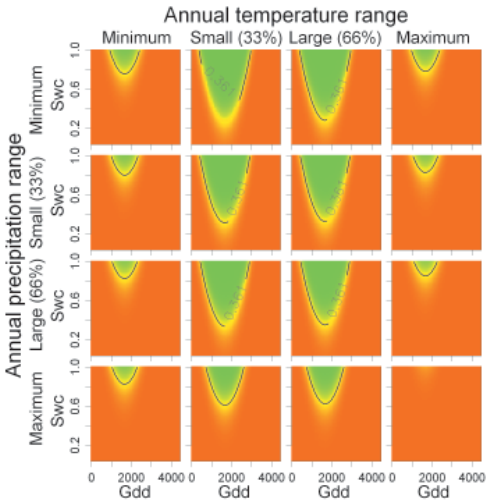
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 8833)

The White Admiral is a true woodland butterfly and is found in clearings and woodland rides. The female lays her eggs on young honeysuckle (*Lonicera* spp.) leaves, preferring those which are half in the shade. The caterpillars feed on the leaves in a characteristic way. Starting at the tip and working towards the stalk, they leave the main nerve intact, and use it to rest upon. The hibernation is in the second larval instar. To make the hibernaculum the remaining part of the leaf is spun into a little tube, and the leaf stalk is spun tightly onto a twig. After hibernating, the caterpillar feeds on the newly-emerged leaves. It pupates upside down on a twig, and has one brood a year.

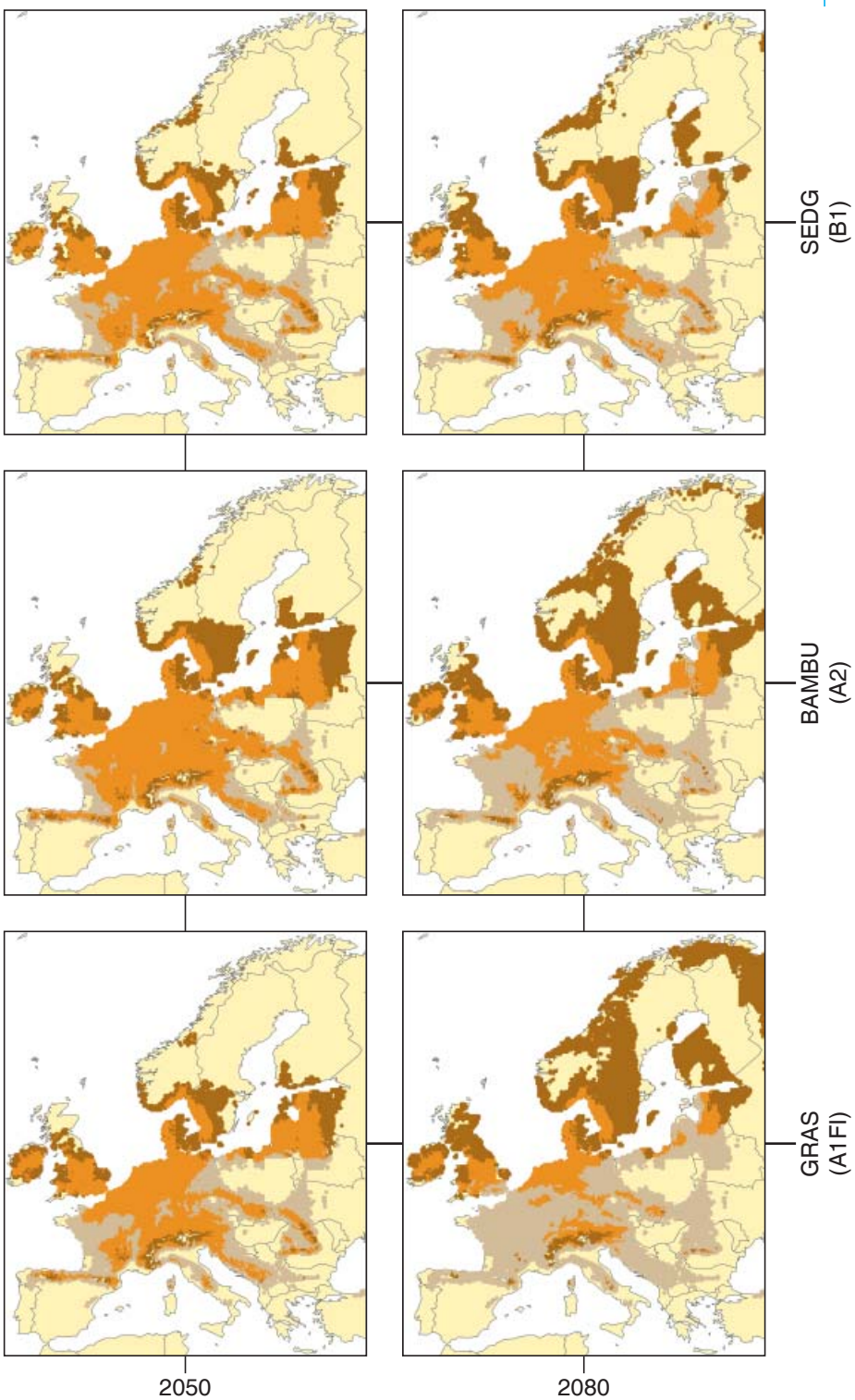
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.81). Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Limenitis reducta (Staudinger, 1901) – Southern White Admiral

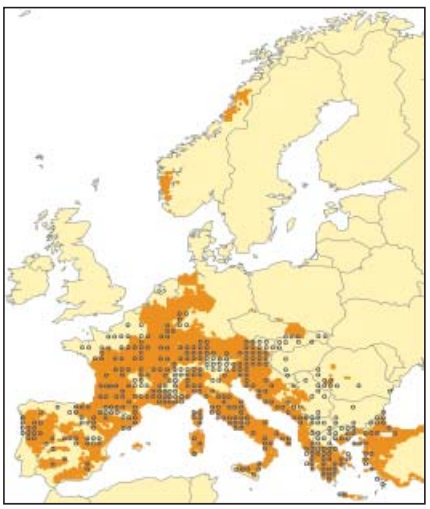
© Peter Ginzinger

		Full dispersal	No dispersal
2050	SEDG	347 (6.07%)	-1259 (-22.03%)
	BAMBU	735 (12.86%)	-1332 (-23.3%)
	GRAS	161 (2.82%)	-1546 (-27.05%)
2080	SEDG	1180 (20.64%)	-1764 (-30.86%)
	BAMBU	897 (15.69%)	-2390 (-41.81%)
	GRAS	254 (4.44%)	-3262 (-57.07%)

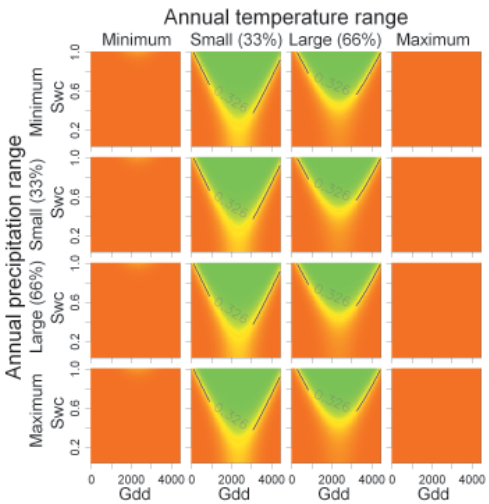
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 5716)

The Southern White Admiral occurs in warm to very warm places in woodland and scrub, often situated near streams, springs or other damp places. The eggs are laid on nearly all species of honeysuckle (*Lonicera* spp.). The caterpillars feed on the leaves in the manner characteristic of this genus, nibbling at the soft tissues while leaving the main nerve free. For hibernation, a small cradle is made from the remains of the leaf, which is secured to a twig with silk. When they come out of hibernation, they begin feeding on the young honeysuckle leaves. The caterpillar pupates suspended from a twig of the foodplant. This species has one brood a year North of the Alps but two in the Mediterranean region.

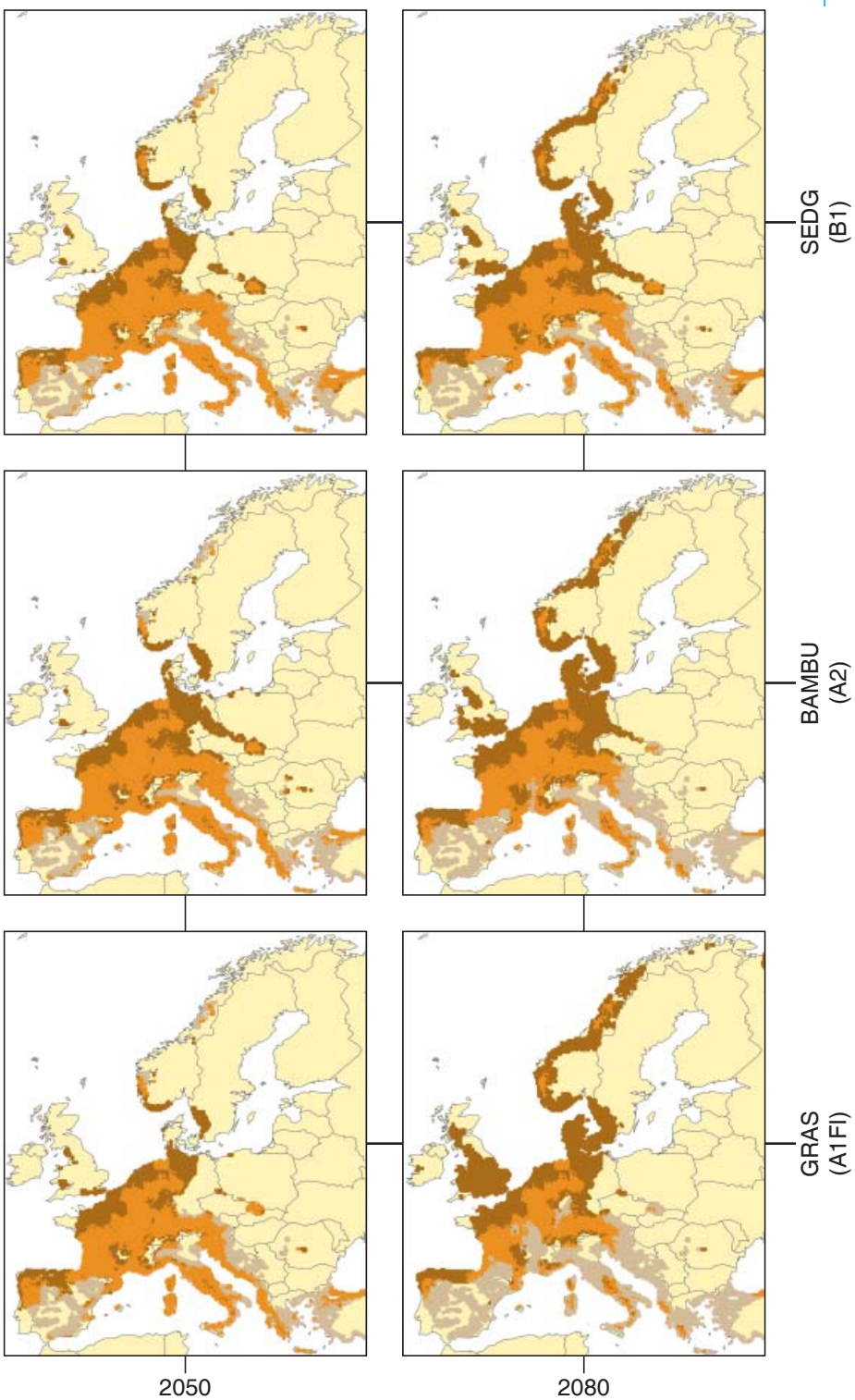
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.82). Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Neptis sappho (Pallas, 1771) – Common Glider

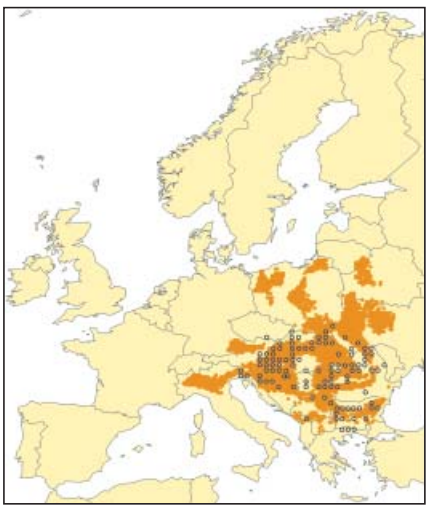
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	1384 (53.09%)	-1028 (-39.43%)
	BAMBU	2187 (83.89%)	-1038 (-39.82%)
	GRAS	1157 (44.38%)	-1389 (-53.28%)
2080	SEDG	876 (33.6%)	-1769 (-67.86%)
	BAMBU	1506 (57.77%)	-2254 (-86.46%)
	GRAS	1649 (63.25%)	-2435 (-93.4%)

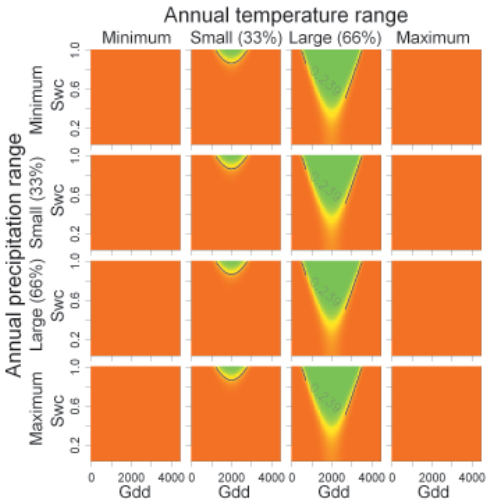
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 2607)

The Common Glider inhabits damp, deciduous woodland, especially in river valleys. The butterflies often settle in the top of the trees to rest or bask in the sun, with their wings wide open, just like the Hungarian Glider (*N. rivularis*). This butterfly has a characteristic flight, elegantly gliding from perch to perch. The caterpillars feed on Spring Pea (*Lathyrus vernus*) and Black Pea (*L. niger*). The Common Glider has two broods a year and hibernates as a small caterpillar.

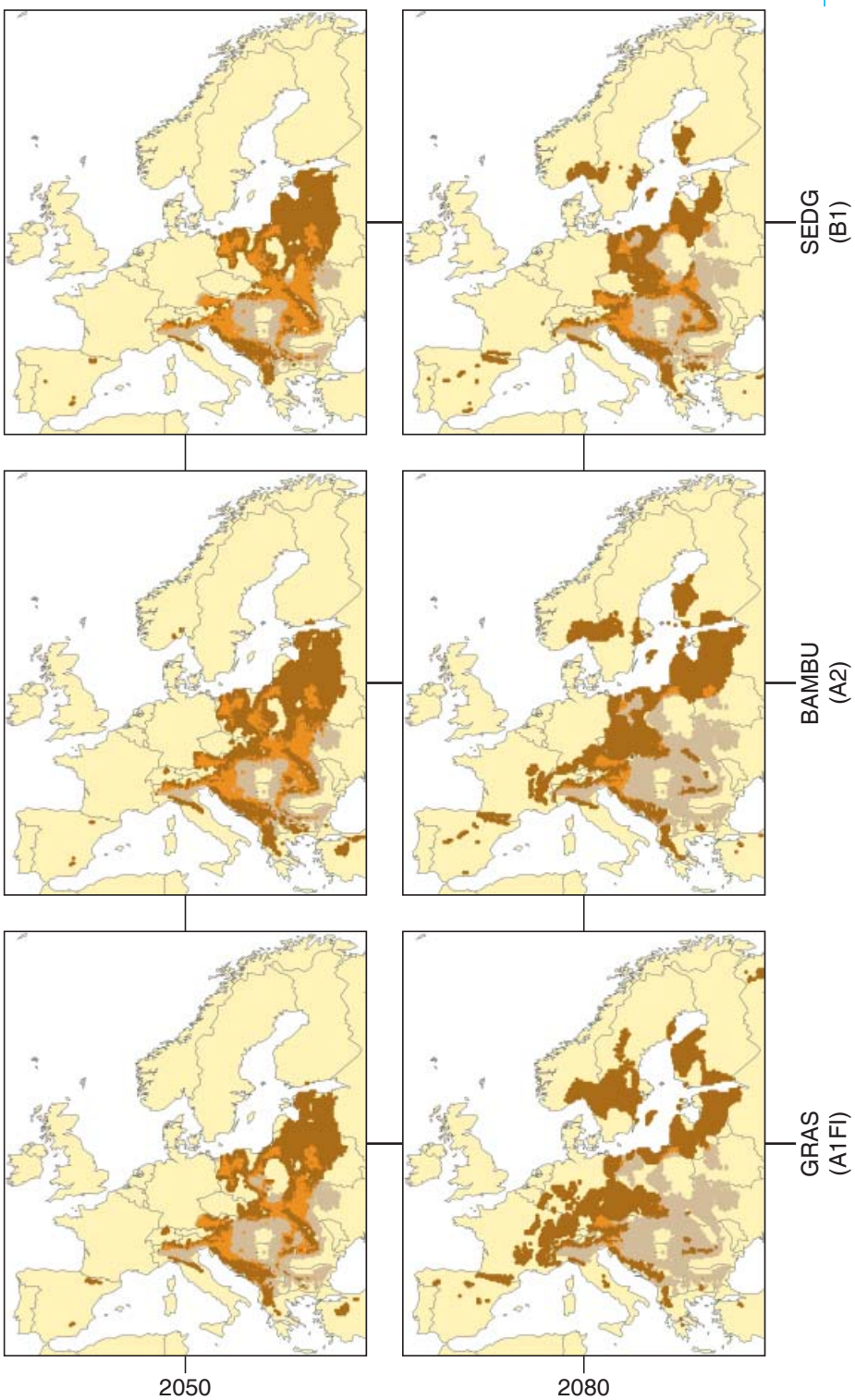
Present distribution can be well explained by climatic variables (AUC = 0.92).
Climate risk category: HHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Neptis rivularis (Scopoli, 1763) – Hungarian Glider

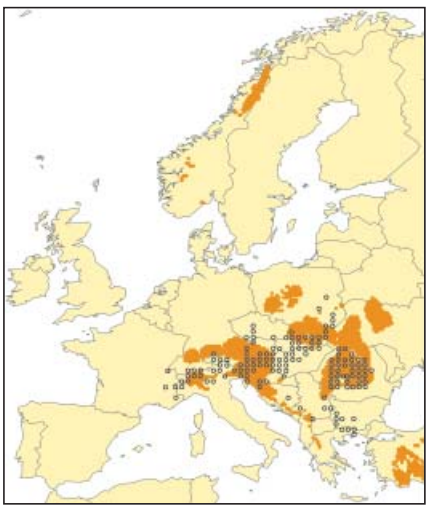
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	-655 (-30.68%)	-1086 (-50.87%)
	BAMBU	-739 (-34.61%)	-1113 (-52.13%)
	GRAS	-1082 (-50.68%)	-1391 (-65.15%)
2080	SEDG	74 (3.47%)	-1285 (-60.19%)
	BAMBU	-458 (-21.45%)	-1520 (-71.19%)
	GRAS	-121 (-5.67%)	-1763 (-82.58%)

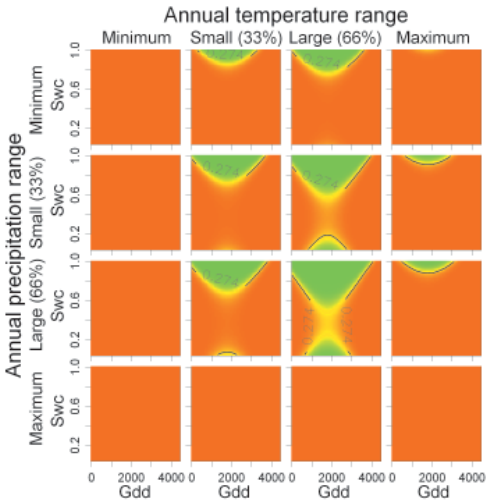
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 2135)

The Hungarian Glider is a butterfly of light, damp woodland, occurring in deciduous, as well as in mixed woods. It is similar to the White Admiral (*Limenitis camilla*), which is also a woodland butterfly. The butterflies are rarely seen drinking nectar from flowers. It glides from perch to perch with only an occasional flap of the wings. Goat's-beard (*Aruncus dioicus*), Meadowsweet (*Filipendula ulmaria*), Bridewort (*Spiraea salicifolia*), and *S. chamaedryfolia* are used as foodplants. The female deposits the eggs singly on the upperside of the leaves. After hatching, the tiny caterpillar first eats up the eggshell and then makes itself a shelter in the tip of the leaf. It only leaves the shelter to feed. In the autumn, it makes another shelter in which to hibernate. It has one brood a year.

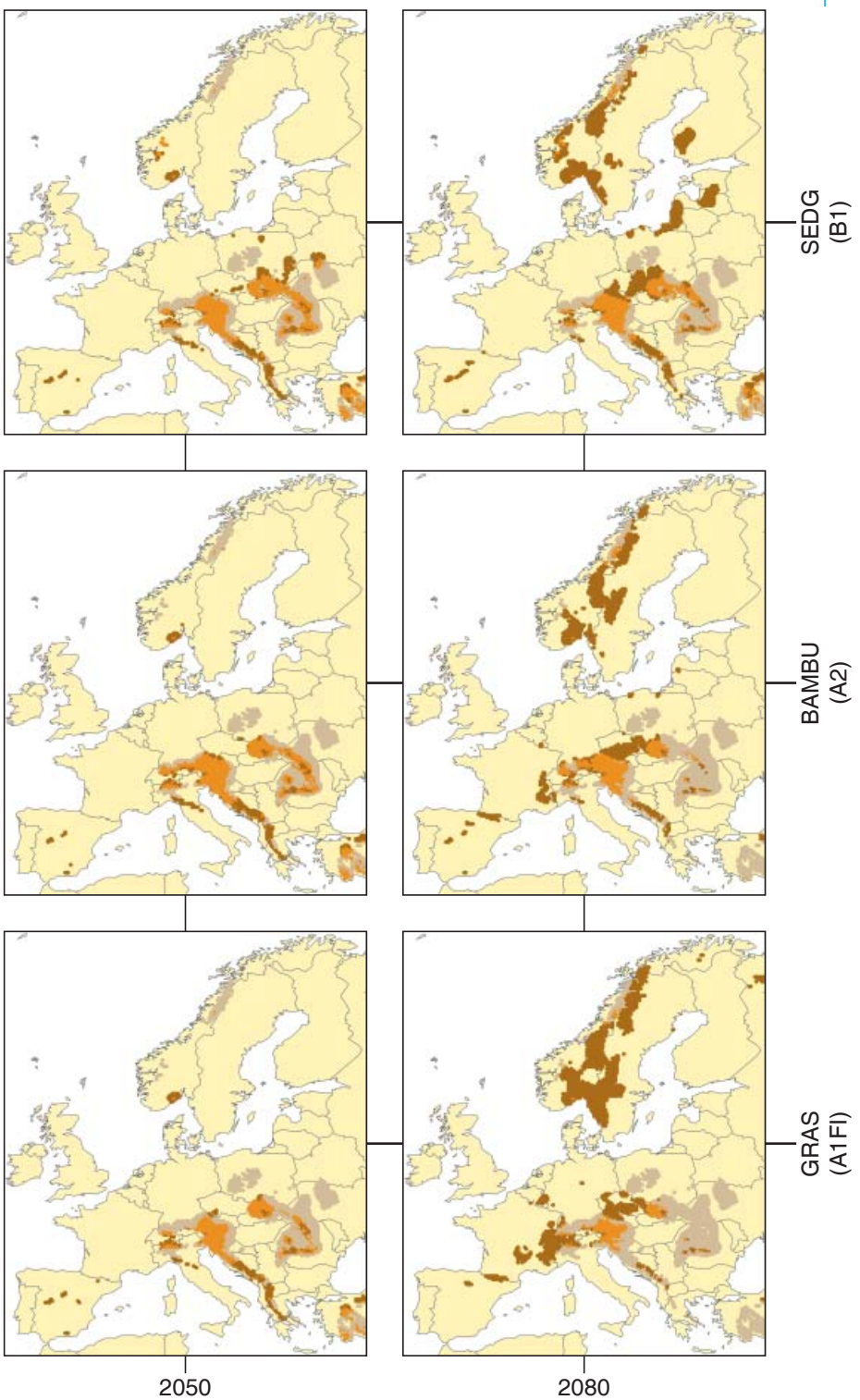
Present distribution can be well explained by climatic variables (AUC = 0.87).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Charaxes jasius (Linnaeus, 1767) – Two-tailed Pasha

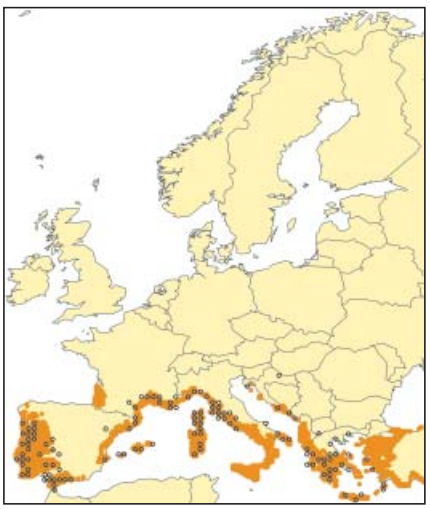
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	-760 (-38.4%)	-1174 (-59.32%)
	BAMBU	-879 (-44.42%)	-1198 (-60.54%)
	GRAS	-840 (-42.45%)	-1367 (-69.08%)
2080	SEDG	-795 (-40.17%)	-1504 (-76%)
	BAMBU	-1121 (-56.64%)	-1737 (-87.77%)
	GRAS	-1012 (-51.14%)	-1918 (-96.92%)

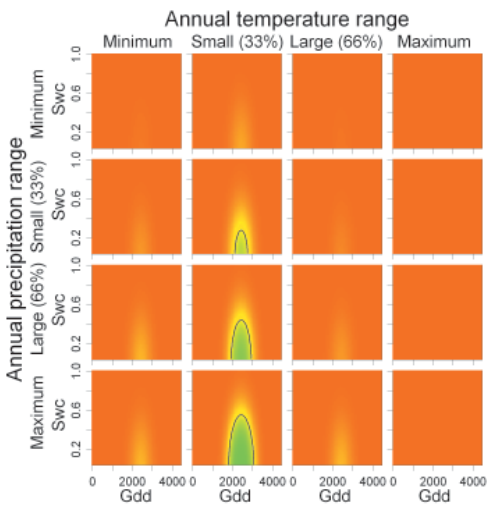
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1979)

With the whimsical patterning on the undersides of its wings and elegant little tails, the Two-tailed Pasha is one of the most beautiful European butterflies. It breeds in warm, dry places with many shrubs and trees where its foodplant, the Strawberry Tree (*Arbutus unedo*), is mostly abundant. The males defend their territory, attacking other insects. The butterflies can often be seen feeding on the juices of rotting fruit, such as figs, and are also attracted to alcoholic drinks. They are strong flyers, often roaming into areas where their foodplant is absent. The Two-tailed Pasha has mostly two broods a year. It hibernates as a caterpillar and pupates suspended from the foodplants. On Gibraltar, Samos and Cyprus, it also uses other foodplants.

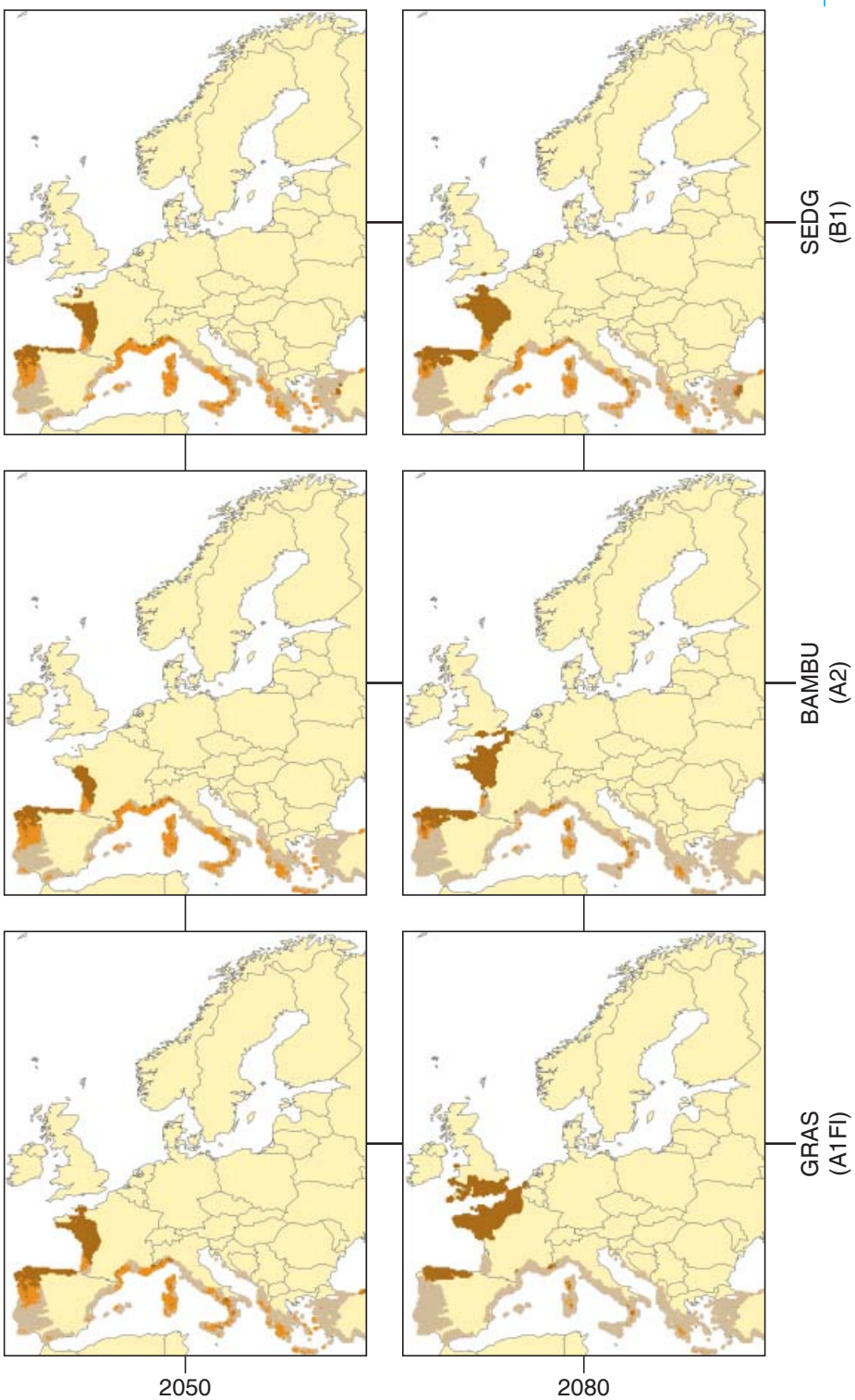
Present distribution can be well explained by climatic variables (AUC = 0.94).
Climate risk category: HHHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Apatura metis (Freyer, 1829) – Freyer's Purple Emperor

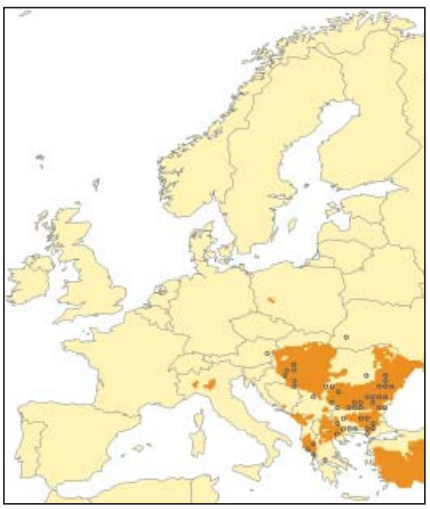
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	3014 (144.14%)	-141 (-6.74%)
	BAMBU	1346 (64.37%)	-589 (-28.17%)
	GRAS	2759 (131.95%)	-488 (-23.34%)
2080	SEDG	1951 (93.3%)	-880 (-42.09%)
	BAMBU	212 (10.14%)	-1703 (-81.44%)
	GRAS	787 (37.64%)	-1885 (-90.15%)

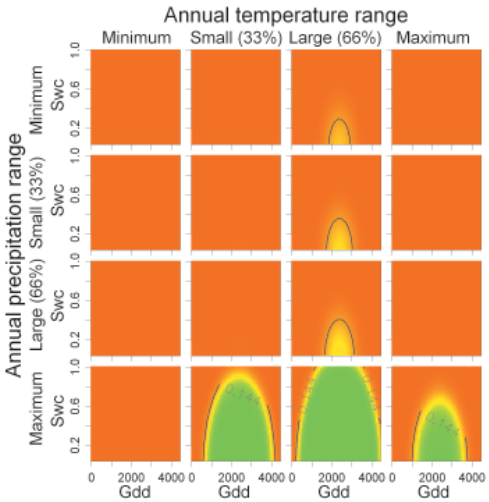
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 2091)

Freyer's Purple Emperor is a butterfly of very warm, damp places. The butterflies can be found along wooded riverbanks, where its foodplant, White Willow (*Salix alba*) grows. The males and females meet each other at the tops of tall trees, and the females lay their eggs in small batches at the top of the tree, on leaves in the crown. The caterpillars grow quickly, and pupate suspended under a leaf or on a twig. The caterpillars from the brood that follows, hibernate. The butterflies have a varied diet. The females visit flowers for nectar, aphids for honeydew, and ripe fruit for the sugars. The males are often found on damp ground, on dung and on carrion. The butterflies are also attracted to sap oozing from wounded trees. This species has two generations a year.
This species is listed in Annex IV of the Habitats' Directive.

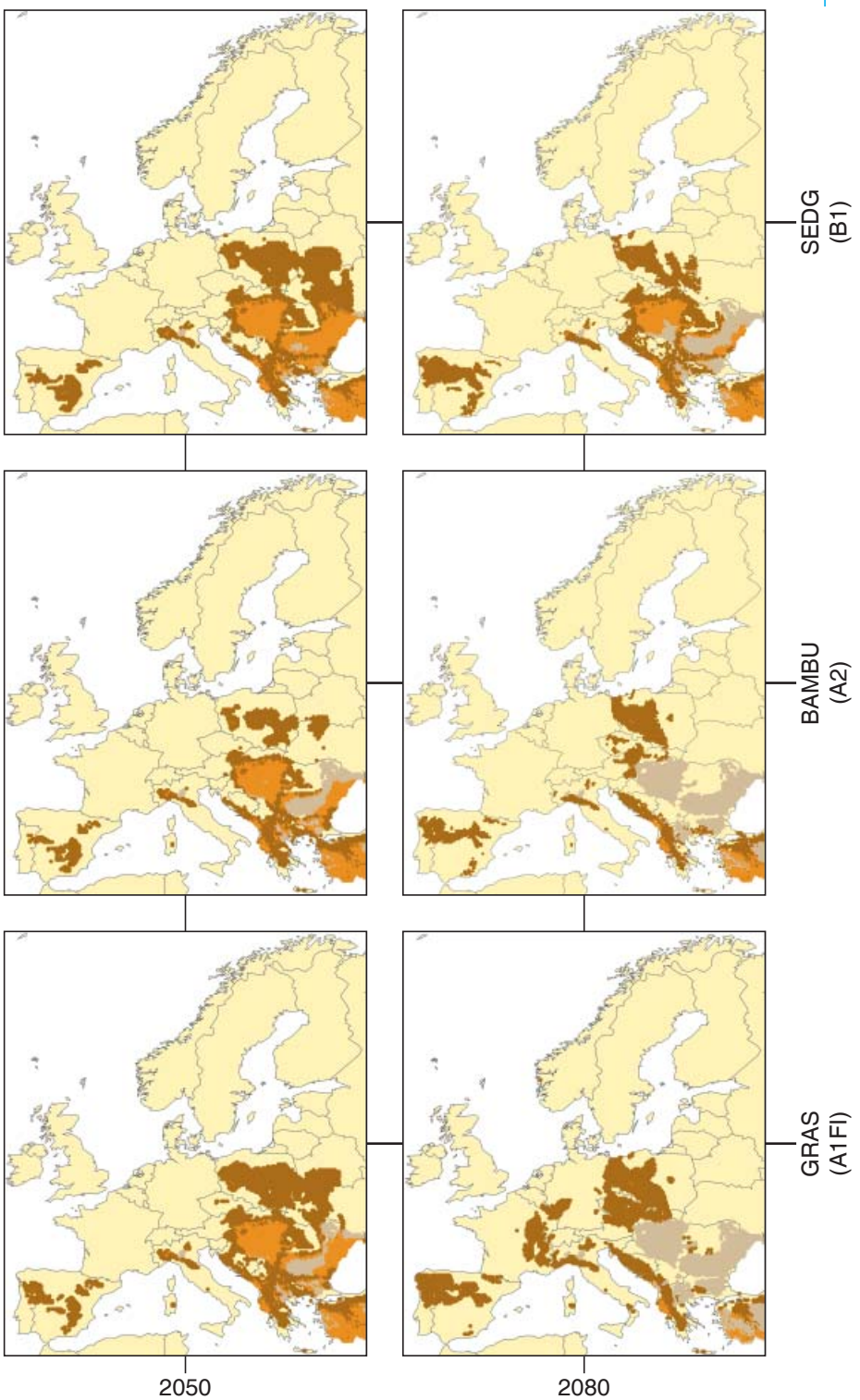
Present distribution can be very well explained by climatic variables (AUC = 0.98).
Climate risk category: HHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Apatura ilia ([SCHIFFERMÜLLER], 1775) – Lesser Purple Emperor

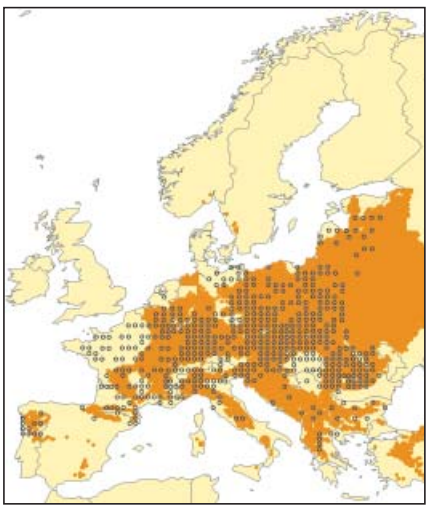
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	322 (3.23%)	-2420 (-24.3%)
	BAMBU	1144 (11.49%)	-2085 (-20.94%)
	GRAS	-633 (-6.36%)	-3412 (-34.26%)
2080	SEDG	1042 (10.46%)	-4137 (-41.54%)
	BAMBU	526 (5.28%)	-5548 (-55.71%)
	GRAS	-37 (-0.37%)	-7270 (-73.01%)

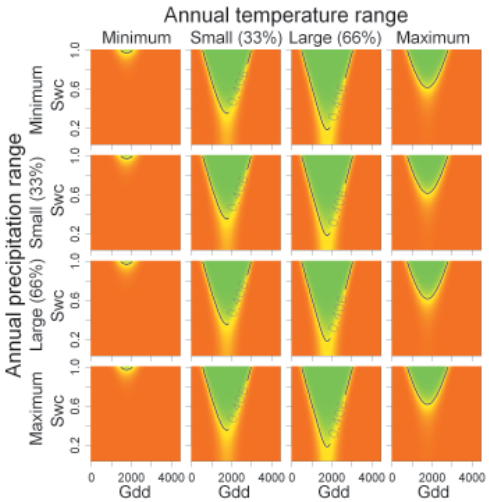
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 9958)

The Lesser Purple Emperor is found in clearings and along paths in damp, deciduous woodland that is often situated in river valleys or on the banks of rivers. The butterflies are often seen near puddles on the road, and on dung from other animals. Especially the males are attracted to strongly smelling cheese. Its foodplants are poplars (*Populus* spp.), and willows (*Salix* spp.). The female, choosing rather small, not so robust trees, deposits her eggs on the upperside of leaves that are half in the shade, or in the sun. The half-grown caterpillar spins itself a little pad in the fork of a twig on which it hibernates. In the spring, it returns to the fresh buds and leaves to feed. It pupates suspended from the underside of a leaf or branch. The Lesser Purple Emperor has one to two broods a year.

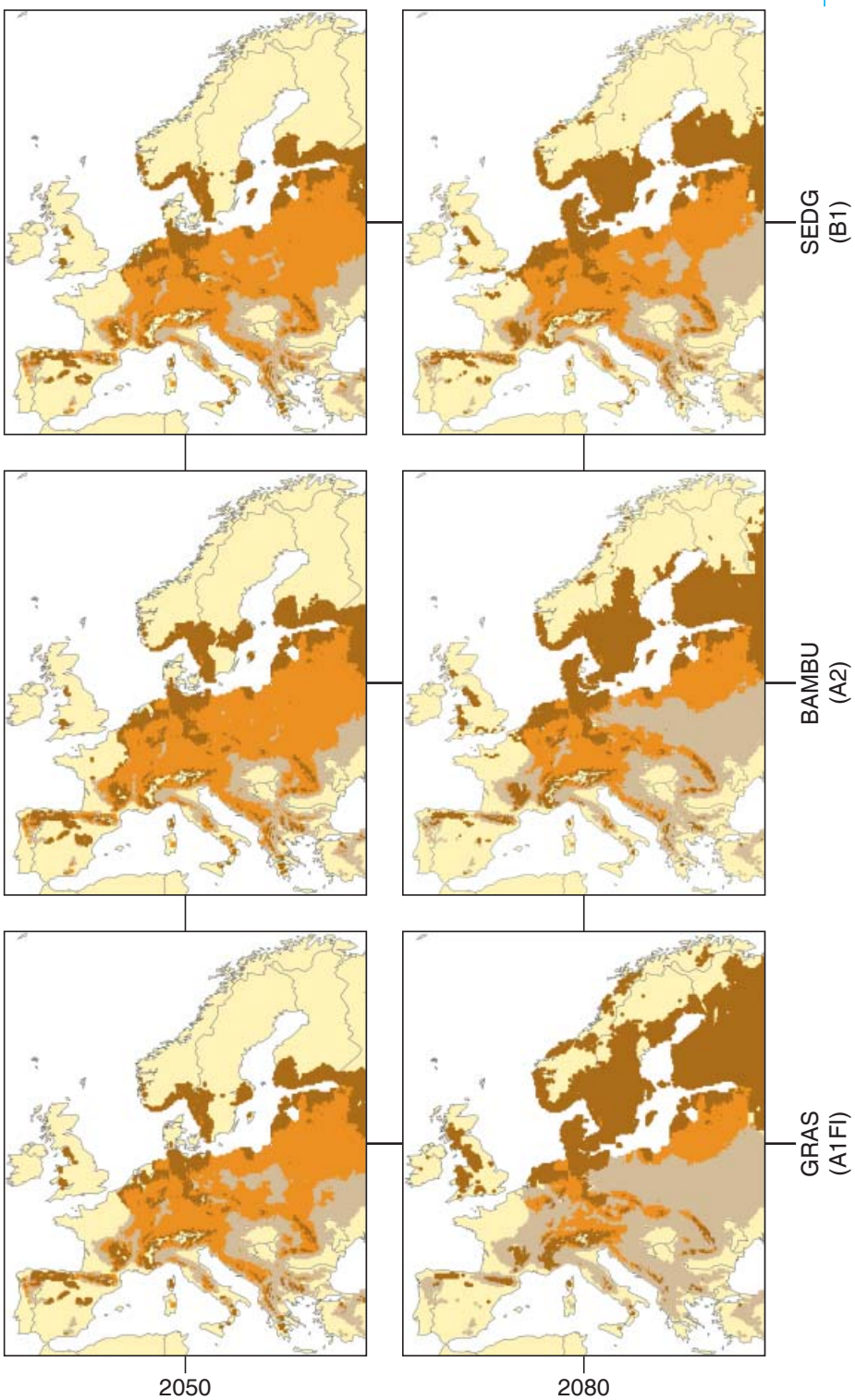
Present distribution can be well explained by climatic variables (AUC = 0.86).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Apatura iris (Linnaeus, 1758) – Purple Emperor

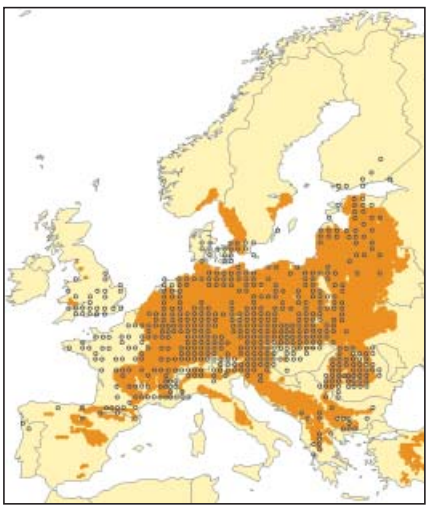
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-1777 (-20.23%)	-3899 (-44.39%)
	BAMBU	-1063 (-12.1%)	-3547 (-40.38%)
	GRAS	-2504 (-28.51%)	-4708 (-53.6%)
2080	SEDG	-2825 (-32.16%)	-5511 (-62.74%)
	BAMBU	-2969 (-33.8%)	-6641 (-75.6%)
	GRAS	-3732 (-42.49%)	-8007 (-91.15%)

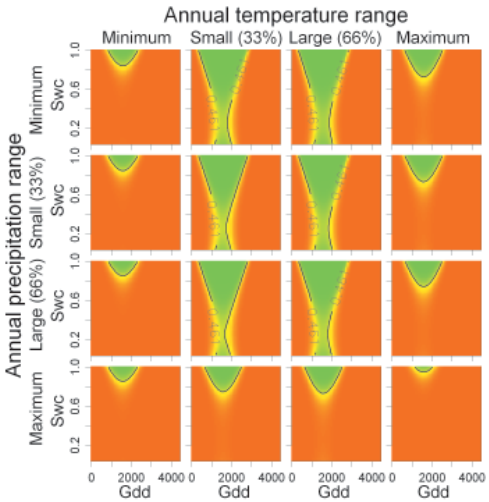
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 8784)

The Purple Emperor inhabits damp, mature, deciduous woods with clearings in them. These woods often have different sorts of trees, stream valleys, and woodland rides. Male butterflies are often seen near puddles on the road and on the dung of other animals. They are also attracted to strongly smelling cheese. Various willows (*Salix* spp.) are used as foodplants, the female depositing her eggs preferably at the top of the tree, on the upperside of leaves that do not get the sun. The half-grown caterpillar spins itself a small cushion in the fork of a twig on which it hibernates. In the spring, it resumes feeding on the buds and fresh young leaves. It pupates, suspended from the underside of a leaf, and has one generation a year.

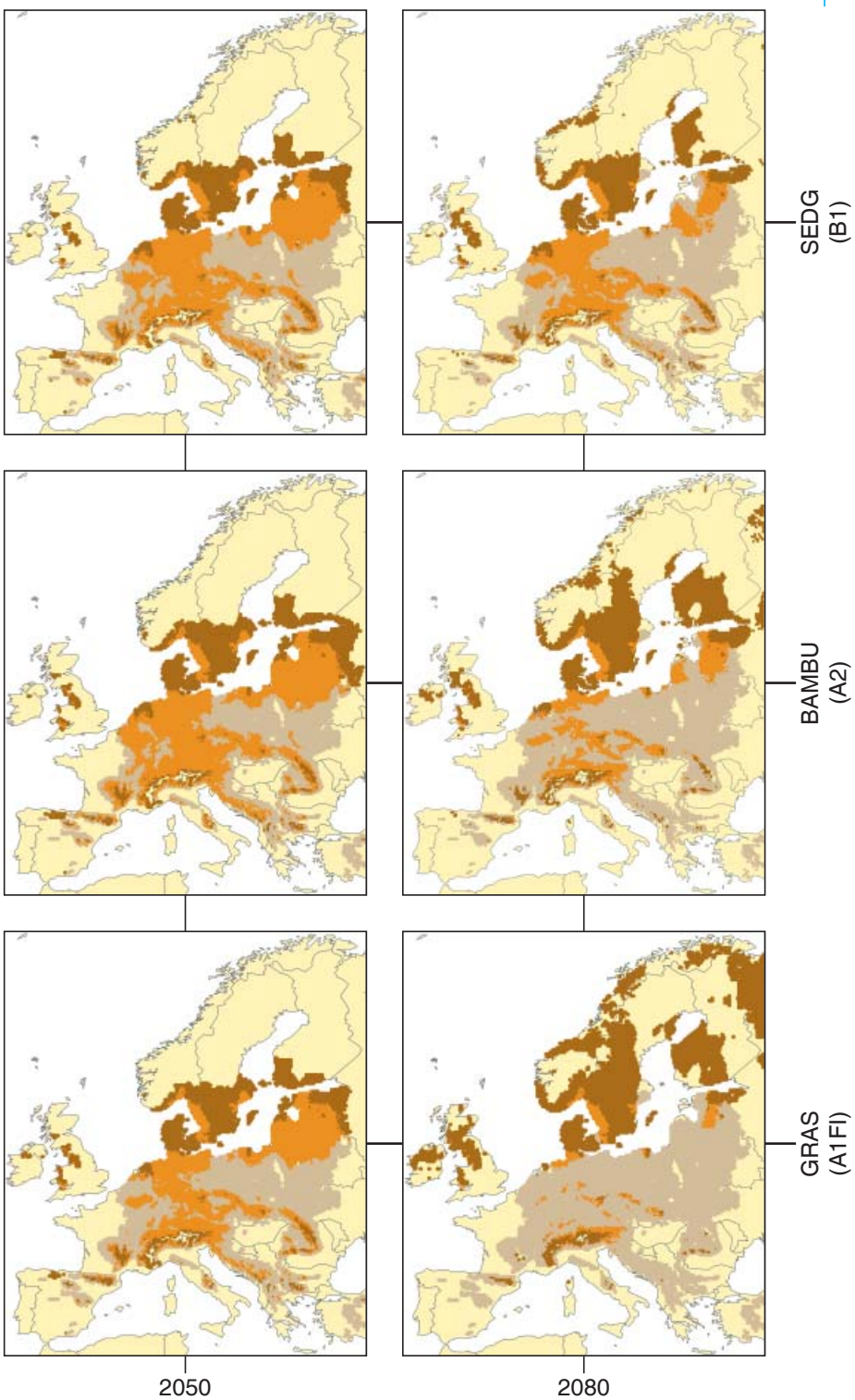
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.85). Climate risk category: HHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Kirinia roxelana (Cramer, 1777) – Lattice Brown

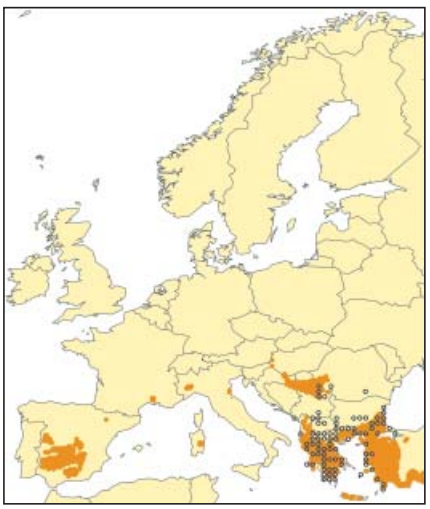
© Peter Ginzinger

		Full dispersal	No dispersal
2050	SEDG	257 (21.45%)	-459 (-38.31%)
	BAMBU	177 (14.77%)	-438 (-36.56%)
	GRAS	207 (17.28%)	-523 (-43.66%)
2080	SEDG	644 (53.76%)	-587 (-49%)
	BAMBU	62 (5.18%)	-726 (-60.6%)
	GRAS	491 (40.98%)	-882 (-73.62%)

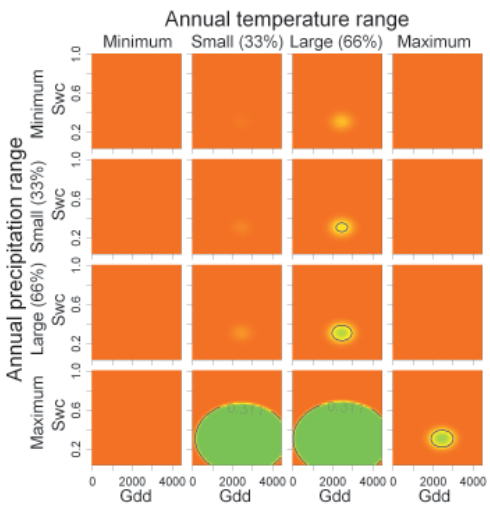
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1198)

The Lattice Brown inhabits open, dry woodland and dry scrub. In the hottest part of the day, the butterflies settle on tree trunks, hiding themselves away in the deep shade of bushes and thickets. They are also sometimes seen on dry riverbeds. The female deposits her eggs in crevices in the bark of trees and bushes. The caterpillars feed on grasses, such as meadow-grass (*Poa* spp.), quaking grass (*Briza* spp.), brome (*Bromus* spp.), and foxtail (*Alopecurus* spp.). The Lattice Brown has one brood a year. It hibernates as a caterpillar.

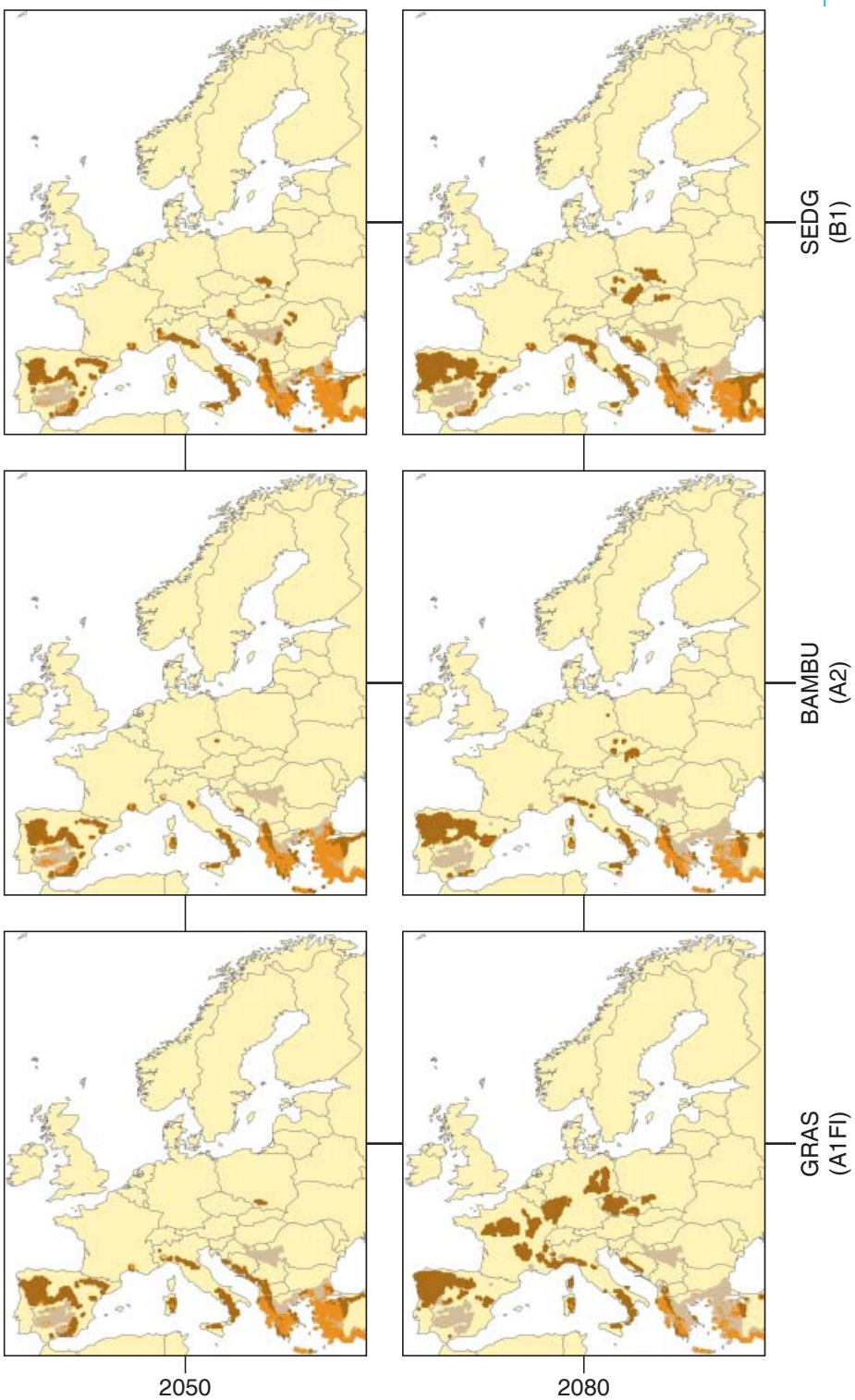
Present distribution can be explained by climatic variables to quite some extent (AUC = 0.91). Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Pararge aegeria (Linnaeus, 1758) – Speckled Wood

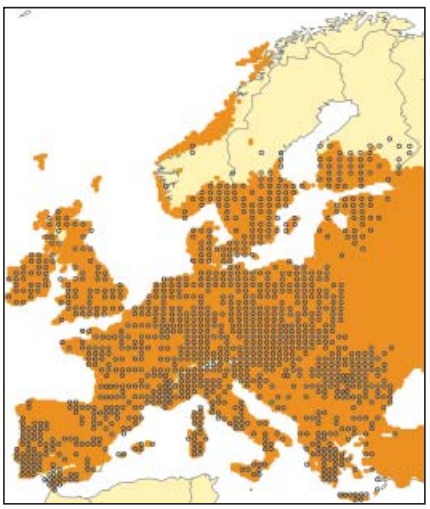
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	111 (0.49%)	-1693 (-7.4%)
	BAMBU	-359 (-1.57%)	-2025 (-8.85%)
	GRAS	-845 (-3.69%)	-2662 (-11.63%)
2080	SEDG	-686 (-3%)	-3718 (-16.25%)
	BAMBU	-2115 (-9.24%)	-5993 (-26.19%)
	GRAS	-3117 (-13.62%)	-8080 (-35.31%)

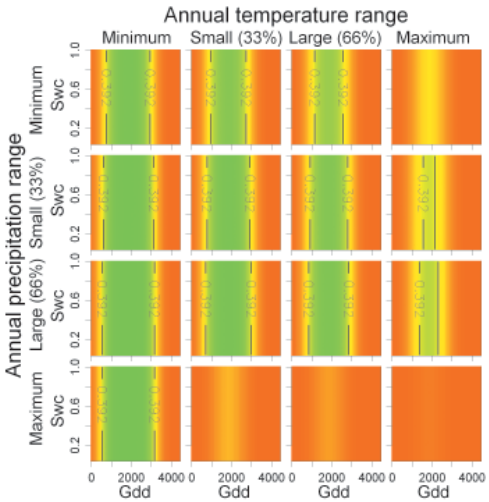
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 22882)

The Speckled Wood is a typical woodland butterfly. The woods may be deciduous, coniferous or mixed, and the butterfly occurs along woodland rides, in clearings and at wood edges. In the north, it occurs mostly in quite extensive areas of woodland, but in the south a line of trees can be sufficient to support a population. Each male claims his territory on a branch that gets the sun, projecting out of the crown of the tree, and waits there for a female to fly along. The foodplants are grasses that grow in woodland and damp grassland, such as fescues (*Festuca* spp.), false-bromes (*Brachypodium* spp.), meadow-grasses (*Poa* spp.), cock's-foot (*Dactylus* spp.), Purple Moor-grass (*Molinea caerulea*) and *Holcus* spp. The female deposits her eggs singly on the blades of grass. Hibernation takes place as a caterpillar or pupa, deep down in a tussock of grass. The Speckled Wood has two to three generations a year.

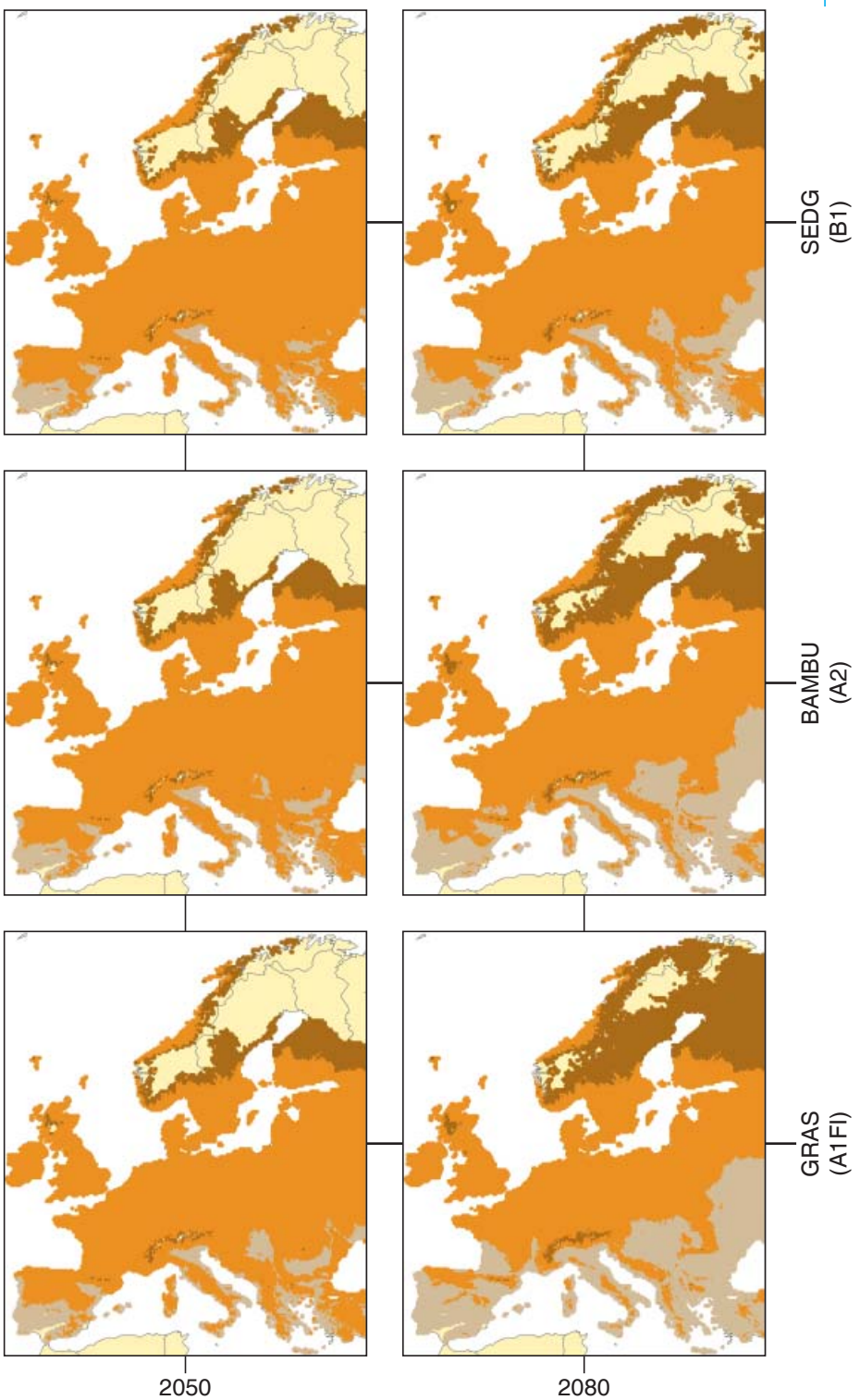
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.65). Climate risk category: PR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Lasiommata megera (Linnaeus, 1767) – Wall Brown

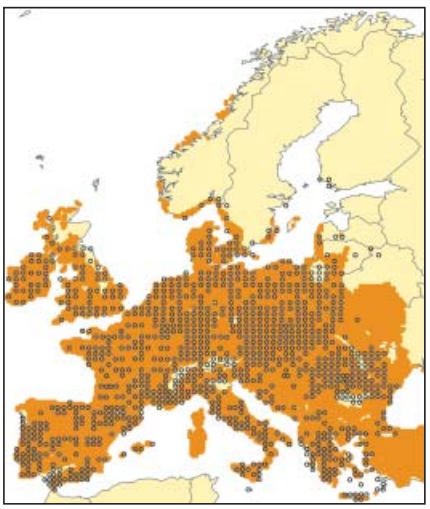
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	-590 (-3.57%)	-3165 (-19.15%)
	BAMBU	-2401 (-14.53%)	-4201 (-25.42%)
	GRAS	-2133 (-12.9%)	-4415 (-26.71%)
2080	SEDG	-3806 (-23.03%)	-5677 (-34.35%)
	BAMBU	-6087 (-36.83%)	-8167 (-49.41%)
	GRAS	-7558 (-45.73%)	-9777 (-59.15%)

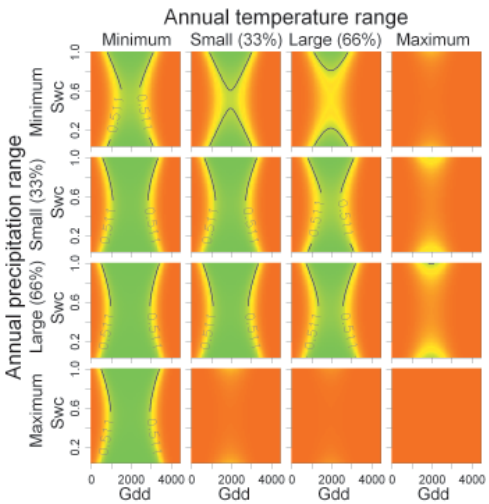
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 16529)

The Wall Brown inhabits many different sorts of grassland, natural grasslands, as well as not all too intensively farmed land. The butterflies are mostly very active, the males very alert. They fly up when disturbed from rocks or walls on which they often bask in the sun, and are therefore conspicuous. The males have a broad scent-brand on their forewings. The female deposits her eggs on the blades of many different grasses, including fescues (*Festuca* spp.), false-bromes (*Brachypodium* spp.), cock's-foot (*Dactylus* spp.), bromes (*Bromus* spp.), and Crested Dog's-tail (*Cynosurus aristatus*). When half-grown, the caterpillar hibernates in the litter layer, where it later, deep down, pupates. The Wall Brown has two to three broods a year.

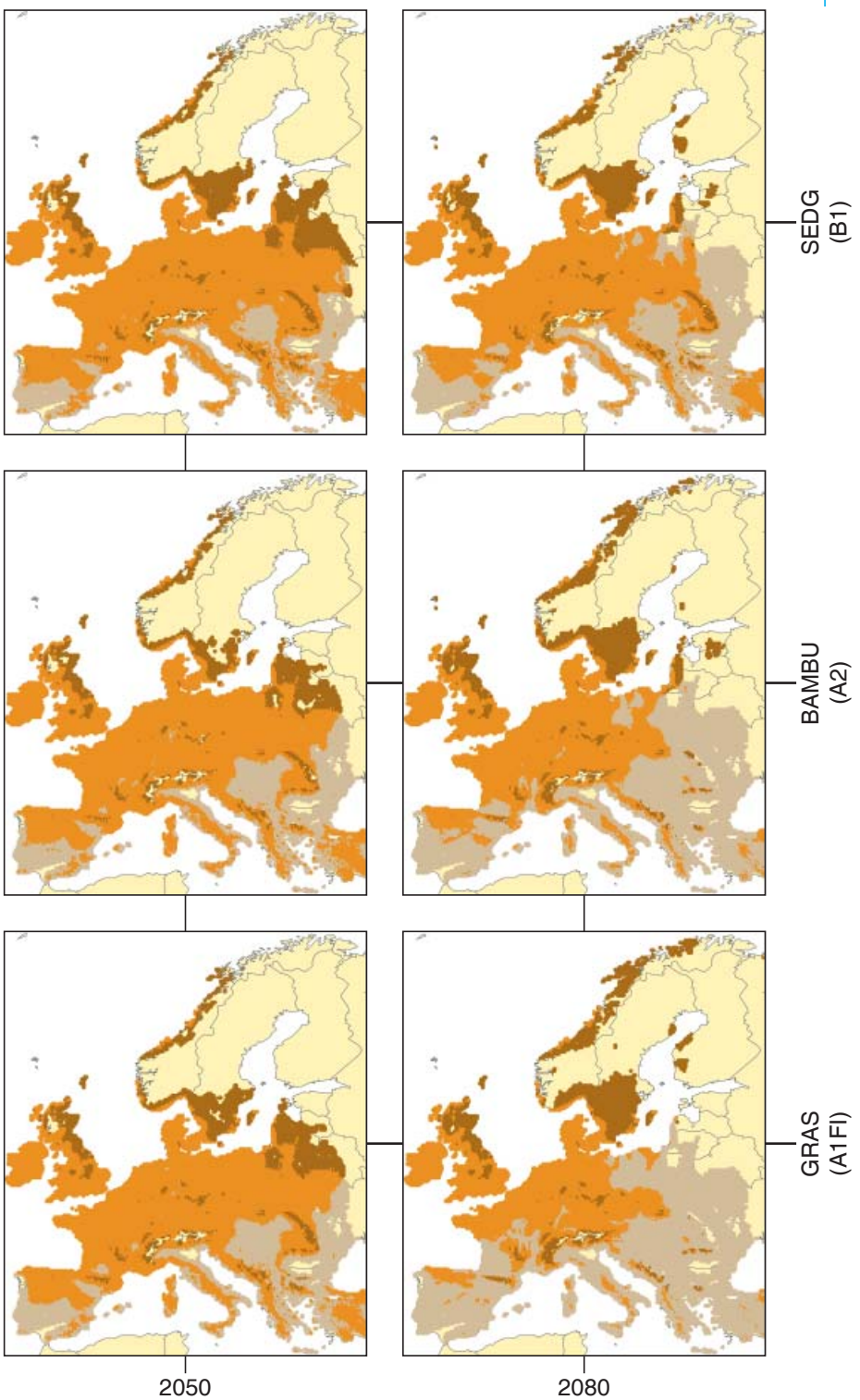
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.75). Climate risk category: PR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Lasiommata petropolitana (Fabricius, 1787) – Northern Wall Brown

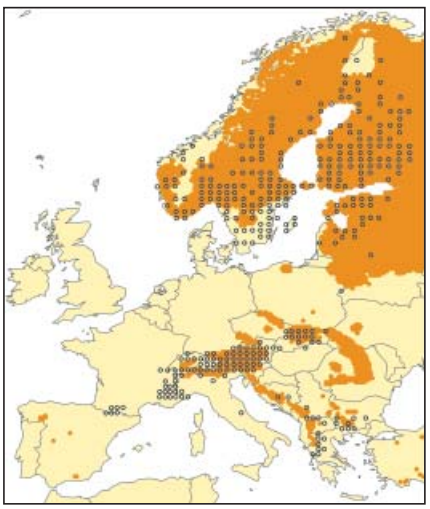
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-2647 (-28.91%)	-3215 (-35.11%)
	BAMBU	-3026 (-33.05%)	-3477 (-37.98%)
	GRAS	-3135 (-34.24%)	-3656 (-39.93%)
2080	SEDG	-2440 (-26.65%)	-3621 (-39.55%)
	BAMBU	-3879 (-42.37%)	-4711 (-51.45%)
	GRAS	-4594 (-50.17%)	-5721 (-62.48%)

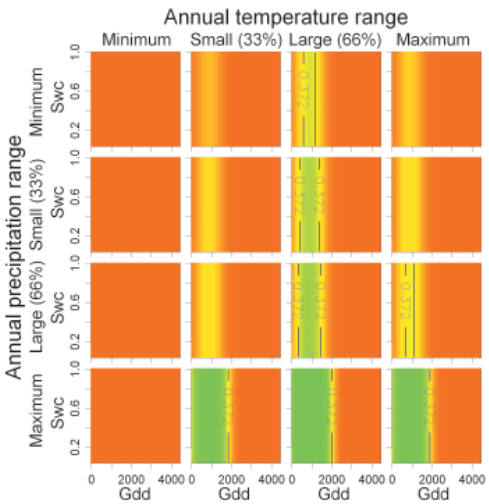
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 9156)

The Northern Wall Brown is found in woodland clearings and meadows in woodland, usually in relatively warm places with large rockmasses. The butterflies are fond of basking in the sun on warm rocks or on the ground. The eggs are laid on a number of grasses, including fescues (*Festuca* spp.), small-reeds (*Calamagrostis* spp.), and cock's-foot (*Dactylus* spp.). The Northern Wall Brown hibernates either in the last larval instar, or as a pupa, and has one brood a year.

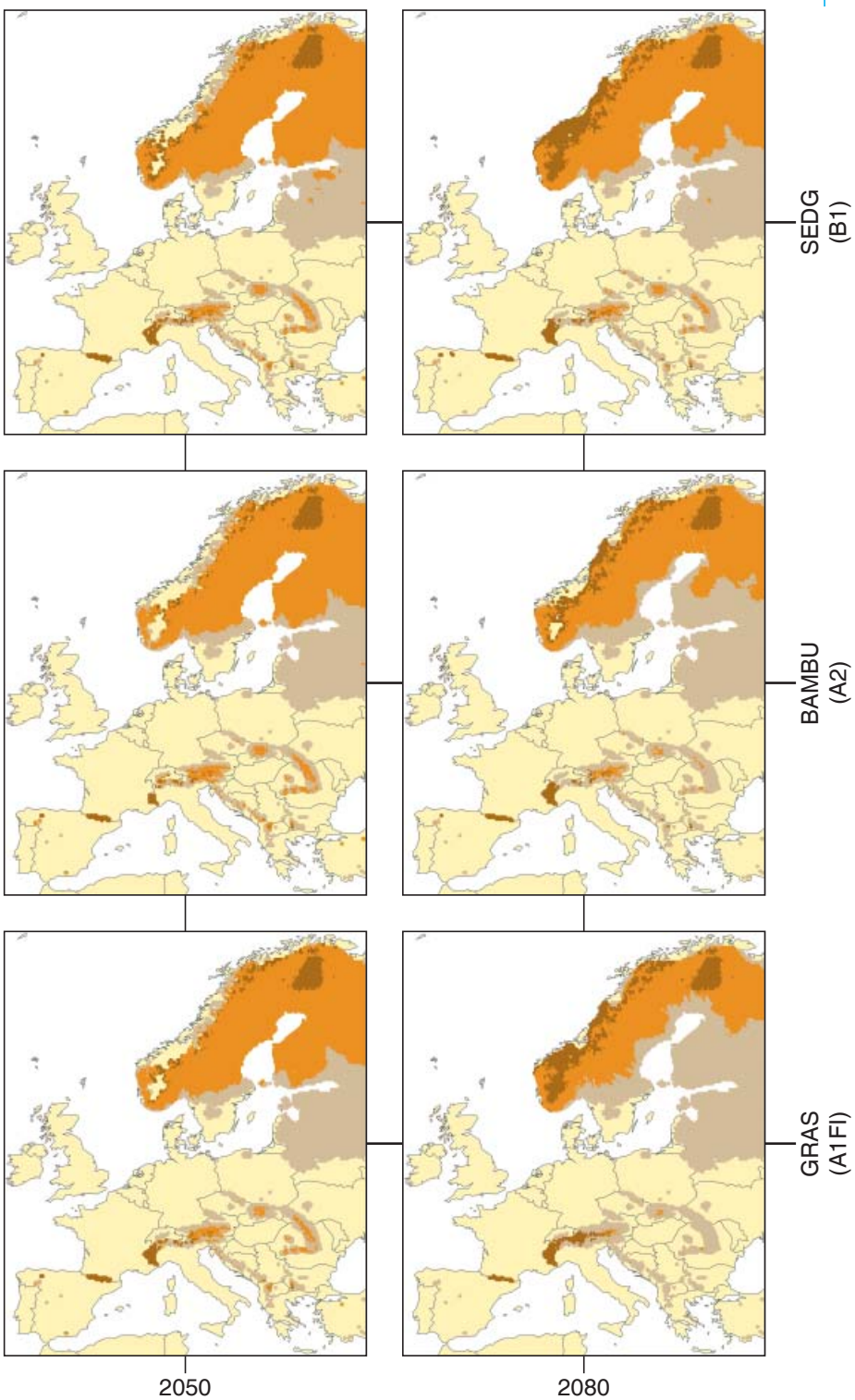
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.84). Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Lasiommata maera (Linnaeus, 1758) – Large Wall Brown

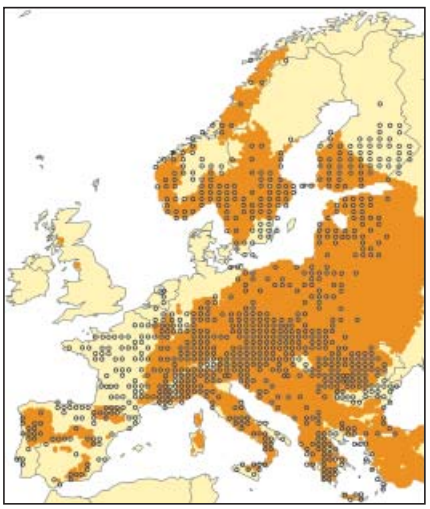
© Rudi Verovnik

		Full dispersal	No dispersal
2050	SEDG	-126 (-0.86%)	-2562 (-17.45%)
	BAMBU	-485 (-3.3%)	-2663 (-18.14%)
	GRAS	-1564 (-10.65%)	-3521 (-23.98%)
2080	SEDG	780 (5.31%)	-4420 (-30.1%)
	BAMBU	-1019 (-6.94%)	-6194 (-42.18%)
	GRAS	-1106 (-7.53%)	-7698 (-52.42%)

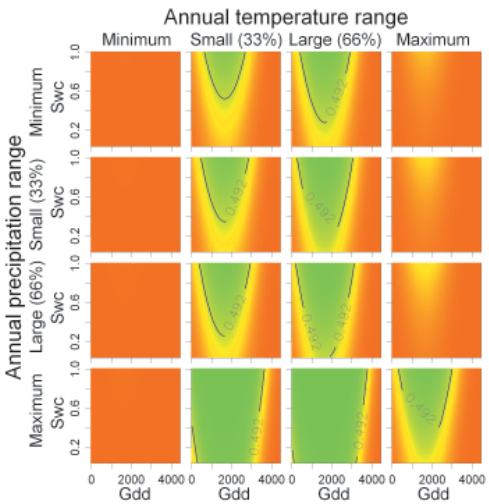
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 14684)

The Large Wall Brown occurs in quite different habitats. It is mainly found in warm, dry places near rocks, and poor grassland, or on rough vegetation near woodland edges. However, it can also occur on damp grassland and rough vegetation near wood margins. The butterflies need a lot of nectar, often visiting purple or pink flowers of thistles and other nectar-rich plants. The female lays her eggs on the blades of grasses that include *Holcus* spp., bents (*Agrostis* spp.), and small-reeds (*Calamagrostis* spp.). The caterpillars hibernate when half-grown in a grass tussock, and pupate later deep down in the vegetation. The Large Wall Brown has one brood a year in the north of its distribution range, and two a year in the south.

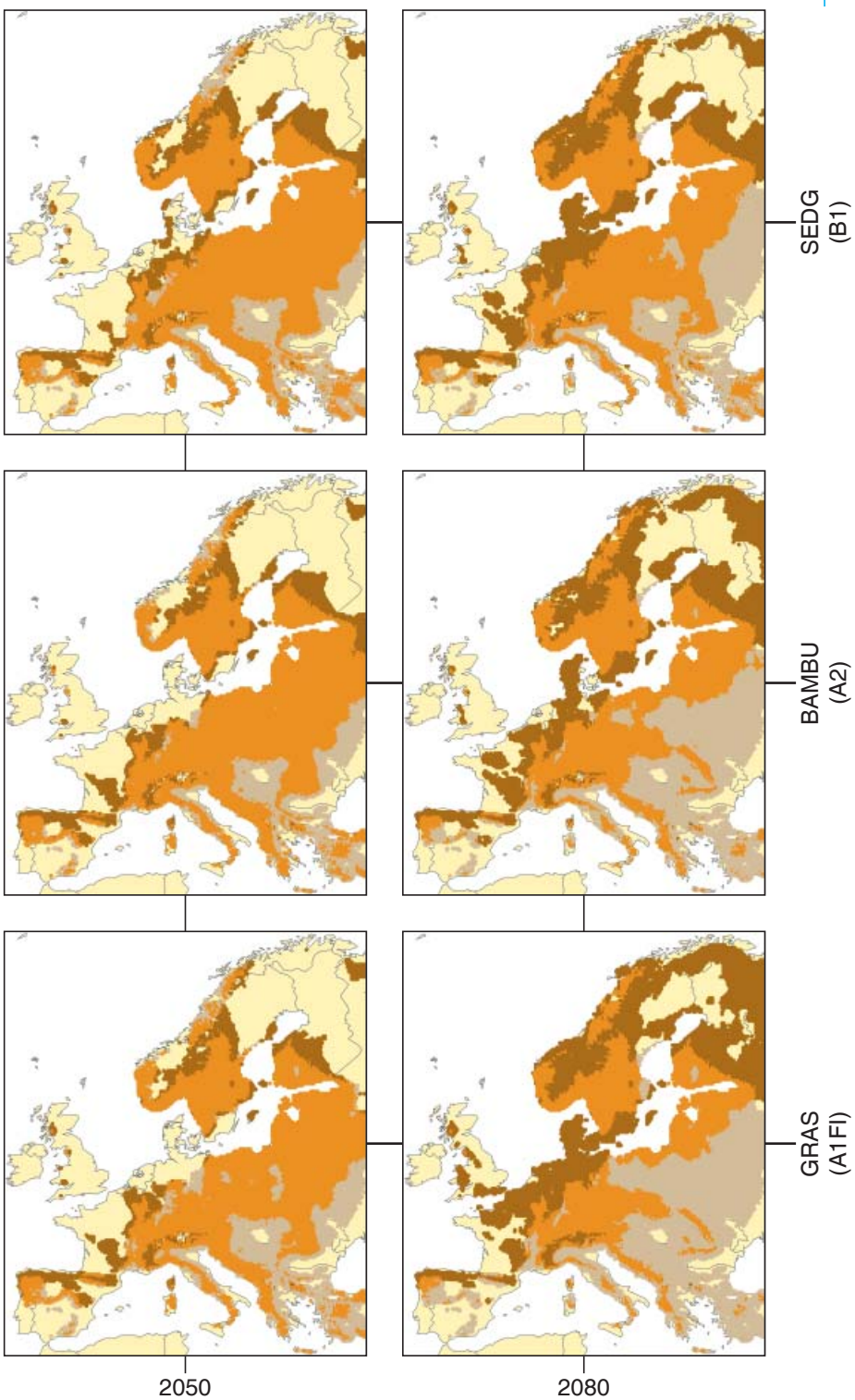
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.75). Climate risk category: PR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Lopinga achine (Linnaeus, 1763) – Woodland Brown

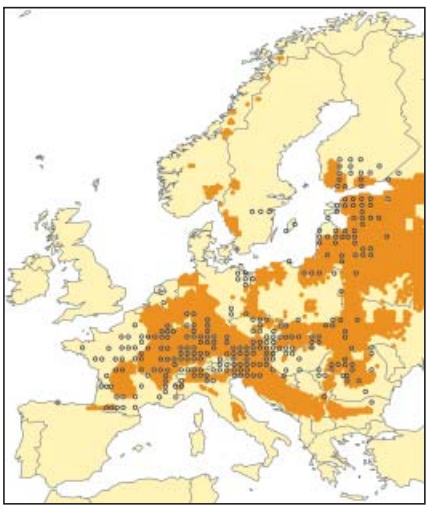
© Rudi Verovnik

		Full dispersal	No dispersal
2050	SEDG	-645 (-9.66%)	-2182 (-32.66%)
	BAMBU	2968 (44.43%)	-893 (-13.37%)
	GRAS	-282 (-4.22%)	-2207 (-33.04%)
2080	SEDG	3110 (46.56%)	-2392 (-35.81%)
	BAMBU	4790 (71.71%)	-2501 (-37.44%)
	GRAS	3726 (55.78%)	-3777 (-56.54%)

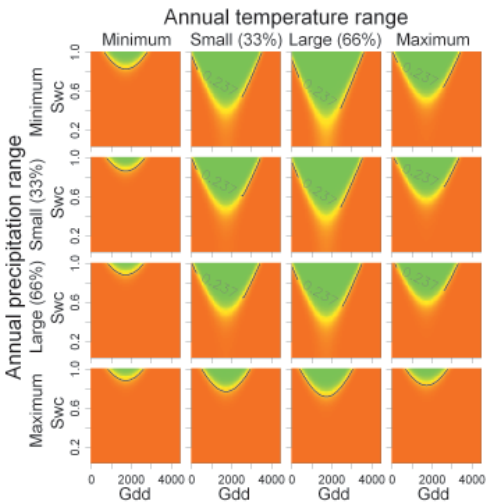
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 6680)

The Woodland Brown is fond of warm, open places in damp, deciduous or mixed woods with well-developed shrub and herbaceous layers. The butterflies rarely visit flowers, preferring to feed on honeydew, moisture on buds, and sap oozing from wounded trees. The males often settle on puddles on the ground, while the females tend to stay in the very top of the trees. Eggs are laid on all sorts of grasses, including fescues (*Festuca* spp.), meadow-grasses (*Poa* spp.), small-reeds (*Calamagrostis* spp.), and false-bromes (*Brachypodium* spp.), and also on sedges (*Carex* spp.). The half-grown caterpillar hibernates in a grass tussock, where later in the year it also pupates. The Woodland Brown has one brood a year.
This species is listed in Annex IV of the Habitats' Directive.

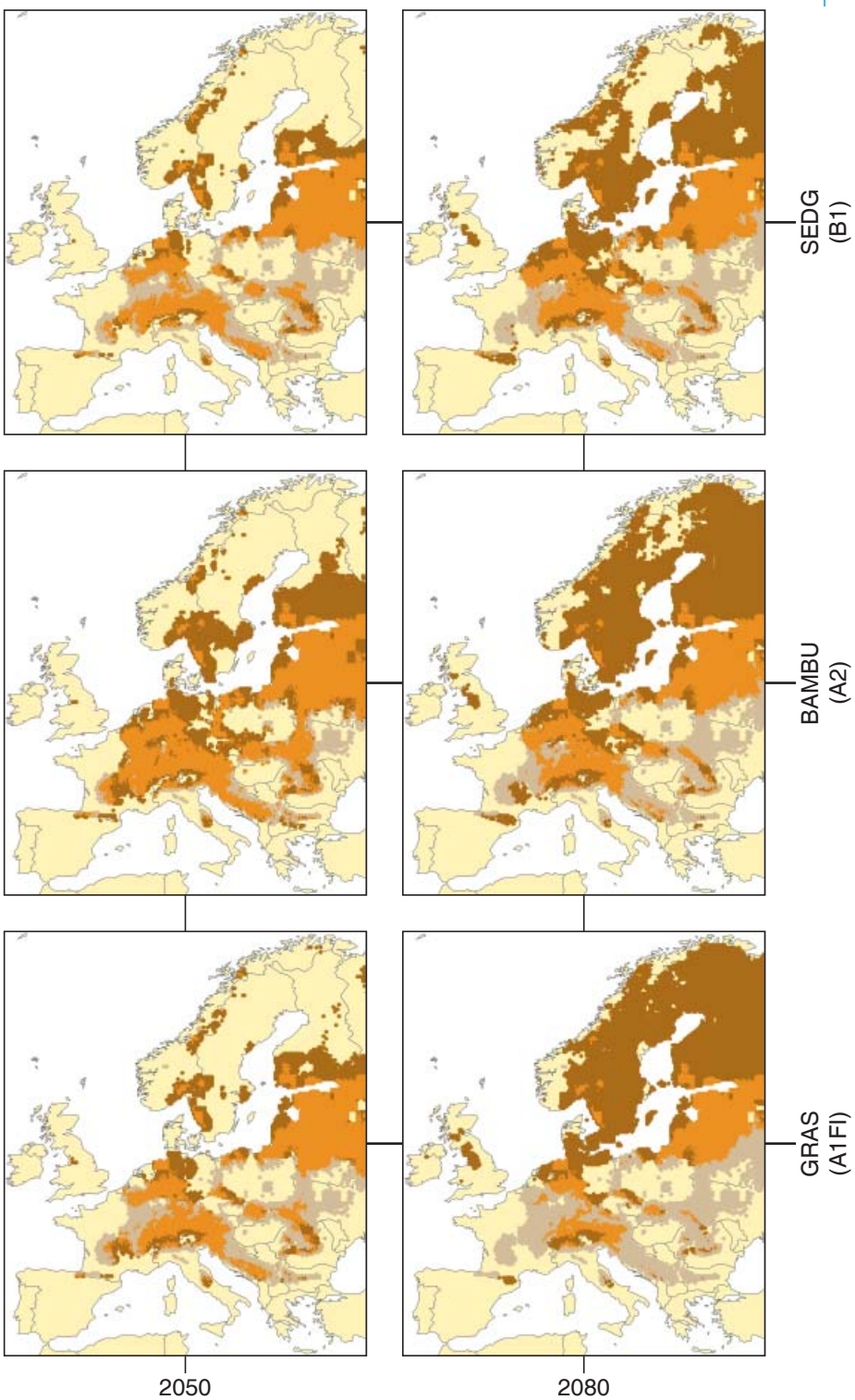
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.81).
Climate risk category: R



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Coenonympha tullia (Müller, 1764) – Large Heath

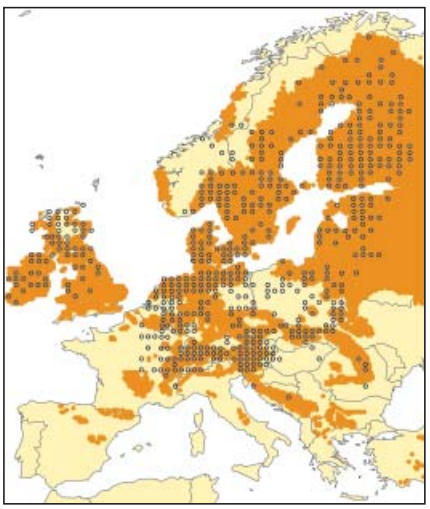
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	-3534 (-27.06%)	-4743 (-36.31%)
	BAMBU	-3047 (-23.33%)	-4287 (-32.82%)
	GRAS	-3802 (-29.11%)	-5109 (-39.11%)
2080	SEDG	-4213 (-32.25%)	-6226 (-47.66%)
	BAMBU	-4915 (-37.63%)	-7441 (-56.97%)
	GRAS	-6014 (-46.04%)	-8747 (-66.97%)

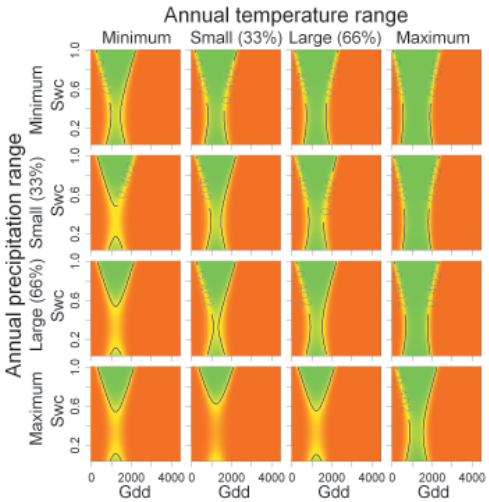
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 13062)

The Large Heath inhabits raised bogs, wet heaths, swampy habitat and wet grasslands, often occurring on quite rough vegetation. As a consequence of land drainage remaining habitat patches are often small, and populations they contain very small indeed, making them difficult to detect. Main foodplants are Cotton-grass (*Eriophorum vaginatum*), as well as other *Eriophorum* species. The female deposits her eggs singly on, or in the neighbourhood of, the foodplant. The caterpillars hibernate in the third or fourth larval instar, hidden in tussocks of grass. They also pupate in the tussocks of the foodplant. The Large Heath has one generation a year. The species already seems to have been affected by climate change and has declined severely at the southern edge of its range.

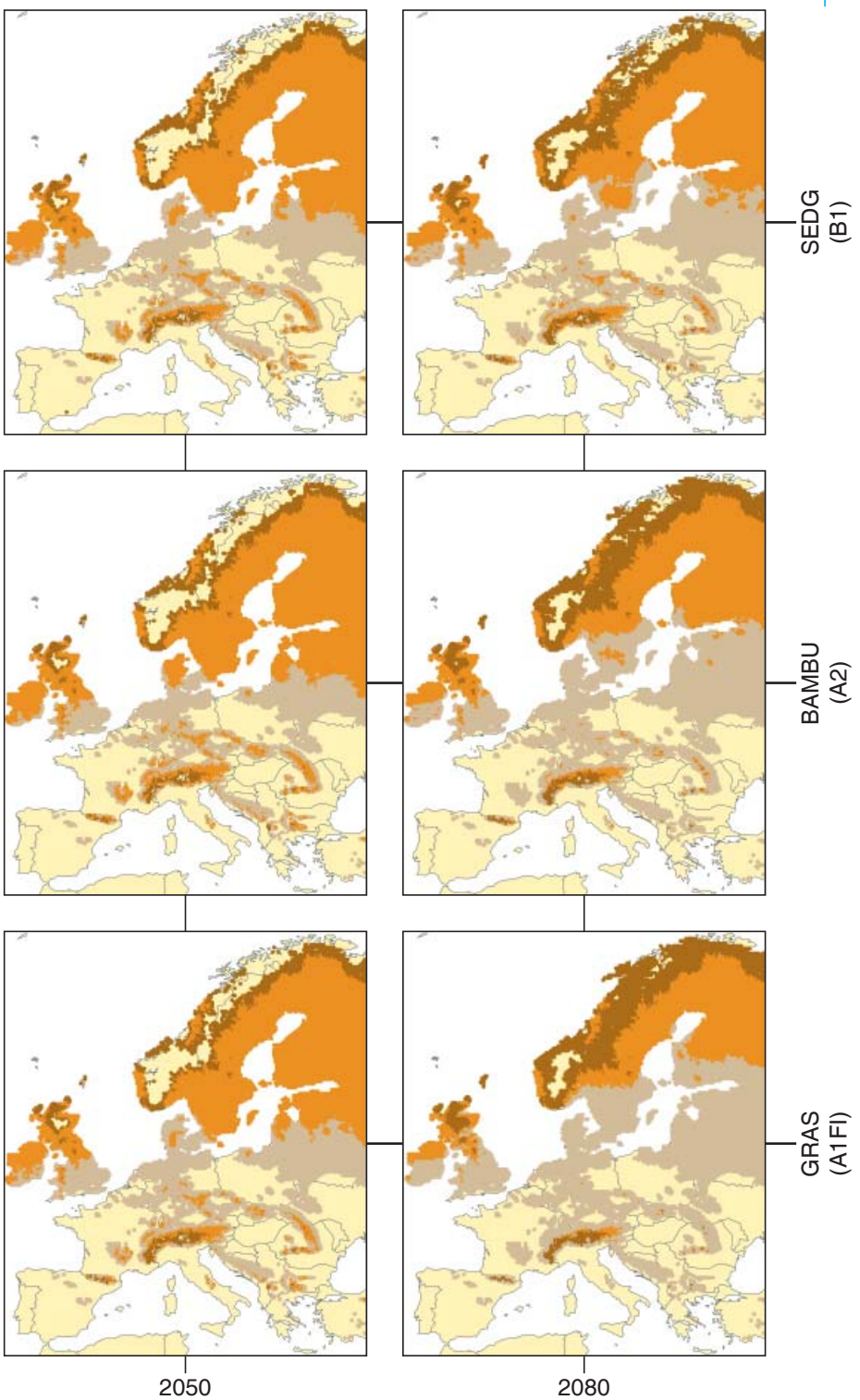
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.83).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Coenonympha oedippus (Fabricius, 1787) – False Ringlet

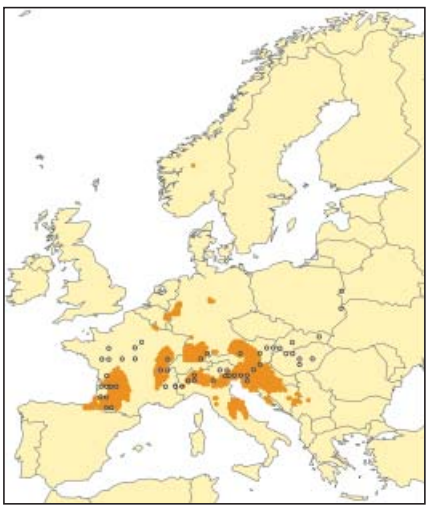
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-5 (-0.47%)	-269 (-25.5%)
	BAMBU	1170 (110.9%)	-109 (-10.33%)
	GRAS	168 (15.92%)	-331 (-31.37%)
2080	SEDG	732 (69.38%)	-387 (-36.68%)
	BAMBU	2128 (201.71%)	-481 (-45.59%)
	GRAS	2236 (211.94%)	-713 (-67.58%)

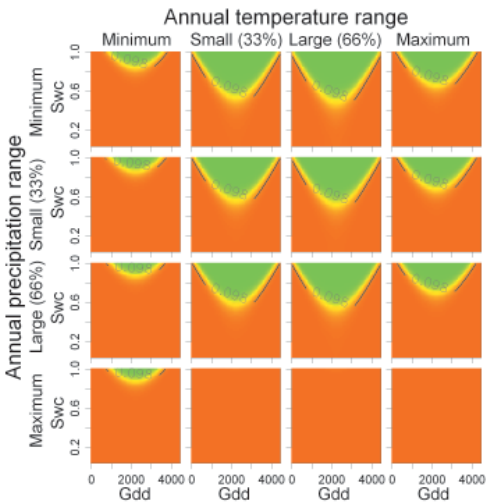
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1055)

The False Ringlet is one of the rarest butterflies of Europe and is declining at an alarming rate. Seeing one is therefore a very special event. The False Ringlet inhabits low-lying, grassy marshes and reed-beds that are usually situated in the shelter of woodland, creating a warm and humid environment. The butterflies fly very slowly and hardly ever migrate to nearby habitats. The eggs are deposited one by one on the blades of grasses, like meadow-grasses (*Poa* spp.), rye-grasses (*Lolium* spp.), hair-grasses (*Deschampsia* spp.) and Purple Moor-grass (*Molinea caerulea*). The caterpillars hibernate half-grown in the tussock, where they pupate as well. The False Ringlet has one generation a year.
This species is listed in Annexes II and IV of the Habitats' Directive.

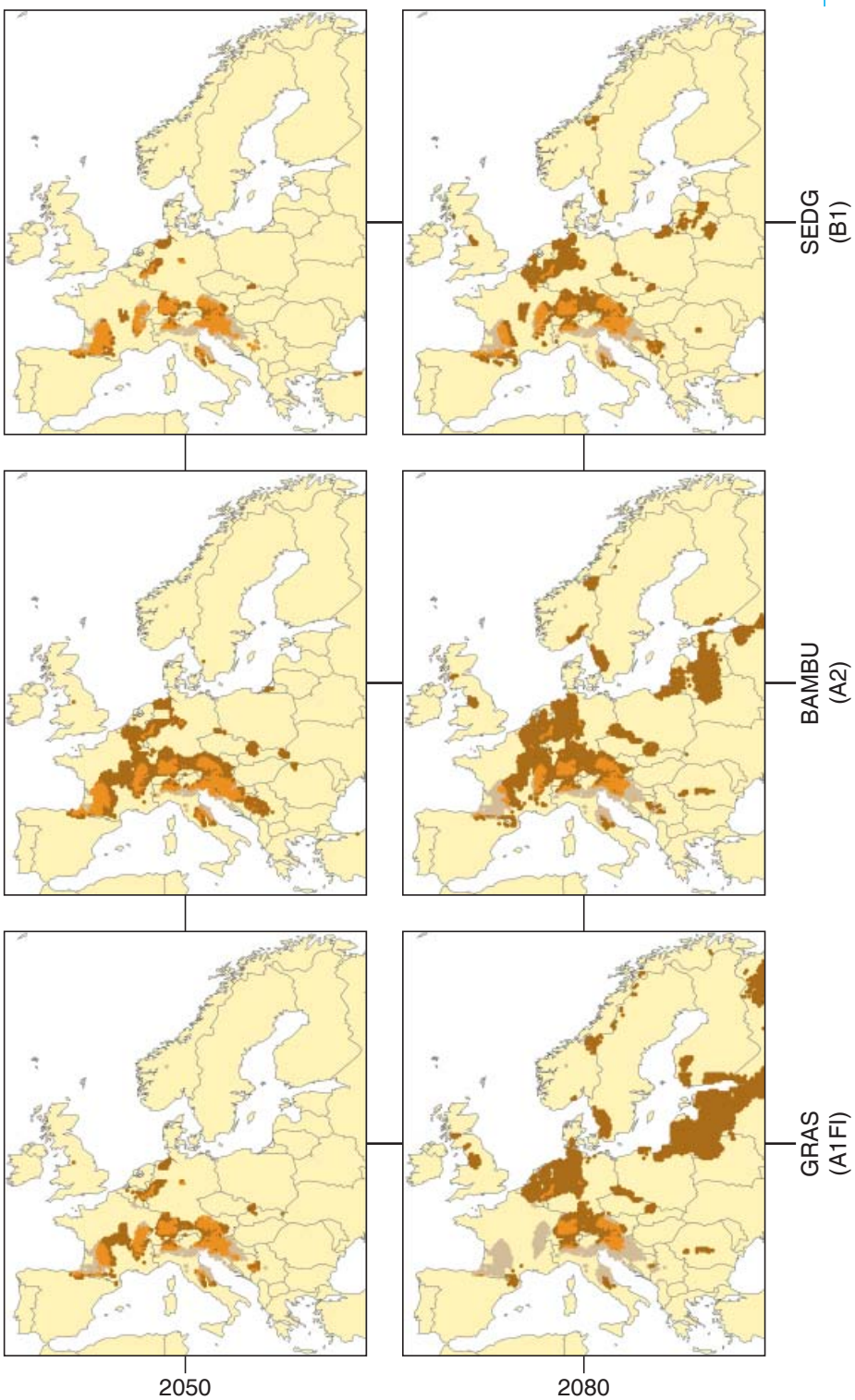
Present distribution can be well explained by climatic variables (AUC = 0.95).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Coenonympha rhodopensis Elwes, 1900 – Eastern Large Heath

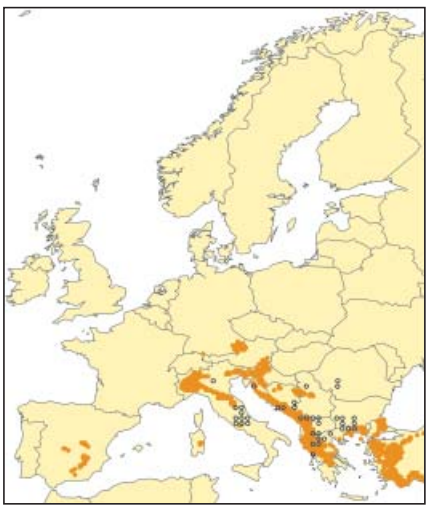
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	332 (43.74%)	-514 (-67.72%)
	BAMBU	125 (16.47%)	-592 (-78%)
	GRAS	197 (25.96%)	-603 (-79.45%)
2080	SEDG	351 (46.25%)	-606 (-79.84%)
	BAMBU	432 (56.92%)	-705 (-92.89%)
	GRAS	322 (42.42%)	-737 (-97.1%)

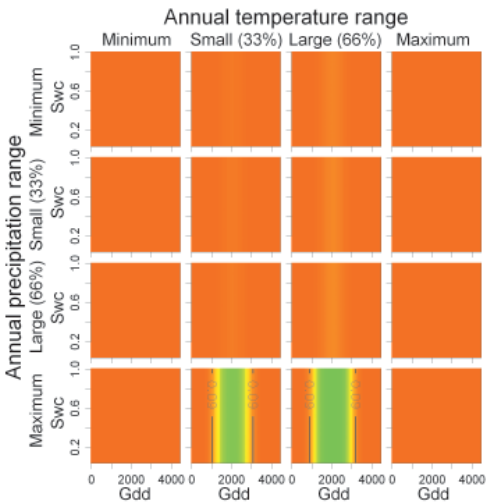
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 759)

The Eastern Large Heath occurs mainly on grasslands above the tree-line. It is also sometimes found in clearings in damp woodland. The caterpillars feed on fescues (*Festuca* spp.), Blue Moor-grass (*Sesleria albicans*), cotton-grasses (*Eriophorum* spp.), White Beak-sedge (*Rhynchospora alba*), and Beaked Sedge (*Carex rostrata*). This species has one generation a year and passes the winter as a caterpillar.

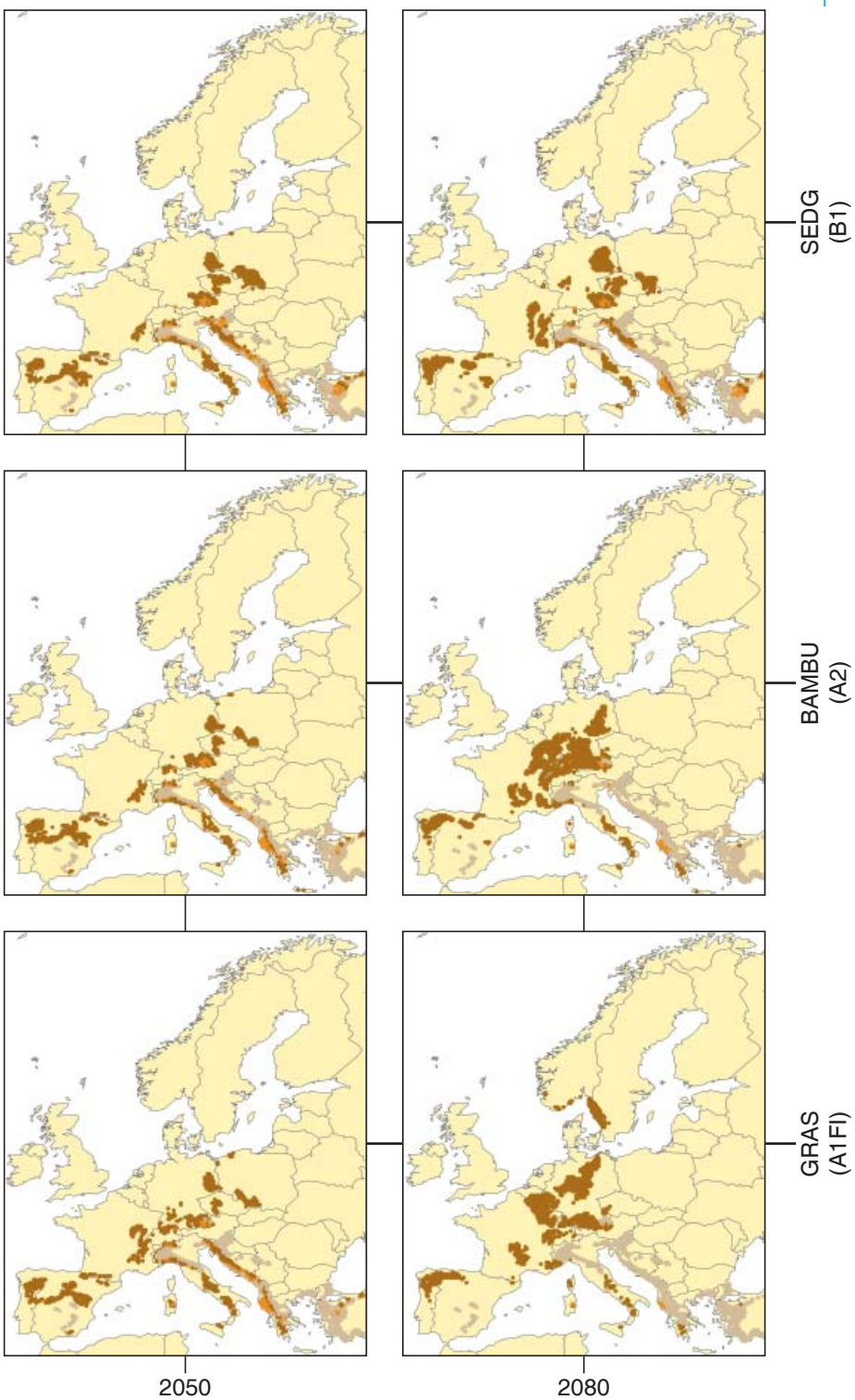
Present distribution can be well explained by climatic variables (AUC = 0.95).
Climate risk category: HHHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Coenonympha arcania (Linnaeus, 1761) – Pearly Heath

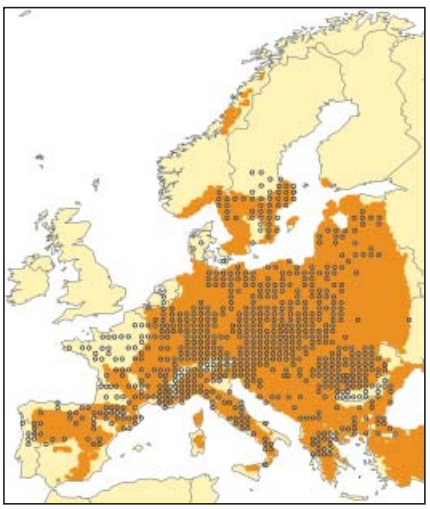
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-389 (-2.87%)	-2771 (-20.46%)
	BAMBU	-1104 (-8.15%)	-3319 (-24.51%)
	GRAS	-1501 (-11.08%)	-3774 (-27.86%)
2080	SEDG	-2377 (-17.55%)	-5692 (-42.03%)
	BAMBU	-3556 (-26.26%)	-7474 (-55.18%)
	GRAS	-4819 (-35.58%)	-9350 (-69.03%)

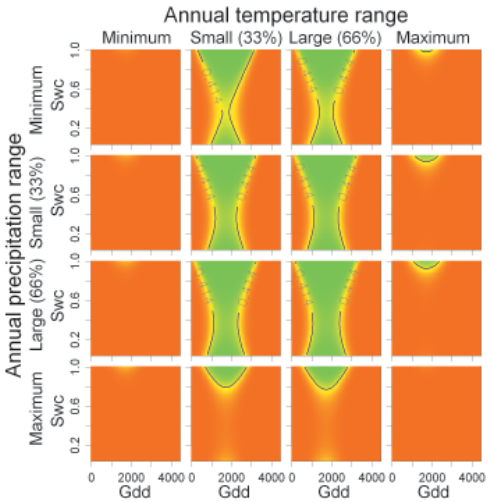
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 13544)

The Pearly Heath is found on dry, to moderately damp, grasslands and grassy places at the edges of woodland or scrub. The Pearly Heath is common in some areas. The males can often be found, perched in scrub, basking in the sun, from where they chase females that pass by. In the evening, the butterflies gather together to roost communally in scrub or at wood margins. Meadow-grasses (*Poa* spp.), bents (*Agrostis* spp.), melicks (*Melica* spp.), fescues (*Festuca* spp.), and many other grasses are used as foodplants, the preferred species differing between regions. The female lays her eggs one by one or in short rows, on blades of grass. When half-grown, the caterpillar hibernates in a tussock of grass, also pupating there later, deep down in the tussock. This species has one brood a year.

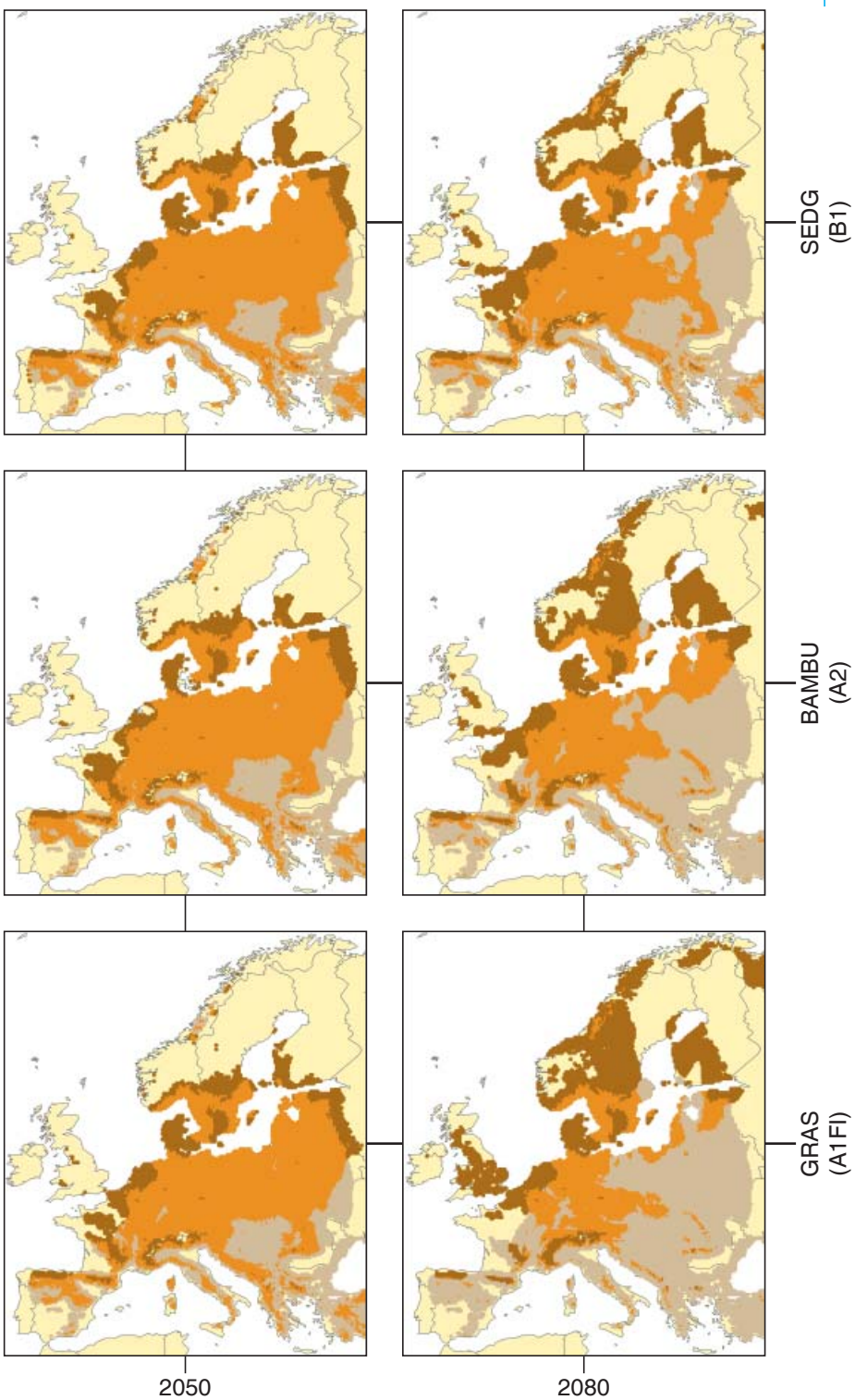
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.83). Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Coenonympha glycerion (Borkhausen, 1788) – Chestnut Heath

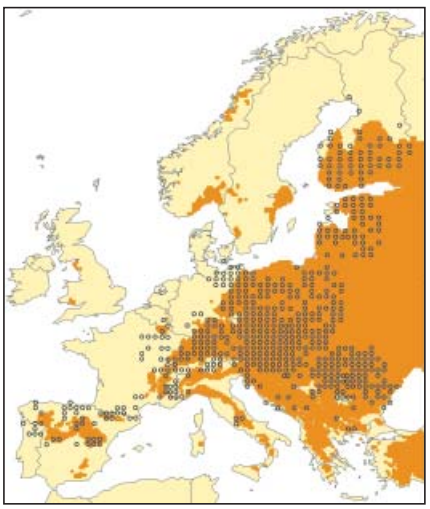
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	735 (5.73%)	-2415 (-18.82%)
	BAMBU	-174 (-1.36%)	-2688 (-20.94%)
	GRAS	90 (0.7%)	-2849 (-22.2%)
2080	SEDG	2334 (18.18%)	-3666 (-28.56%)
	BAMBU	609 (4.74%)	-5395 (-42.03%)
	GRAS	-1143 (-8.91%)	-7723 (-60.17%)

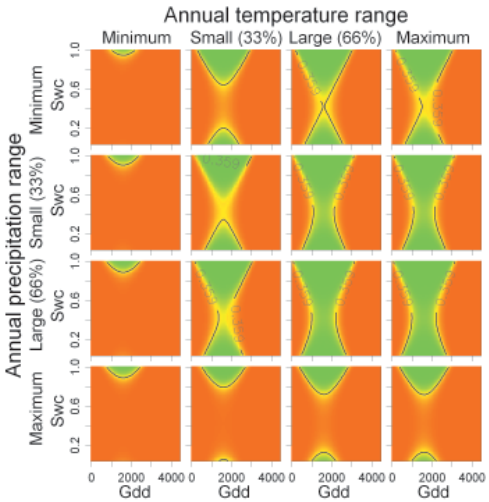
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 12835)

The Chestnut Heath inhabits dry to damp grasslands in woods, meadows, poor grassland, calcareous grasslands, and open marshy habitats. These grasslands are sometimes quite intensively grazed, as can happen on calcareous grassland. However, if grazing is absent, for a few years, change in the grassland does not seem to affect the butterflies. The butterflies do not fly very much, and only cover limited distances. The eggs are laid one by one in short rows on the blades of grasses, such as fescues (*Festuca* spp.), Tor-grass (*Brachypodium pinnatum*), Purple Moor-grass (*Molinea caerulea*), Upright Brome (*Bromus erectus*), and Crested Dog's-tail (*Cynosurus cristatus*). Pupation takes place deep down in the vegetation. The Chestnut Heath mostly has one or two generations a year, depending on altitude and latitude.

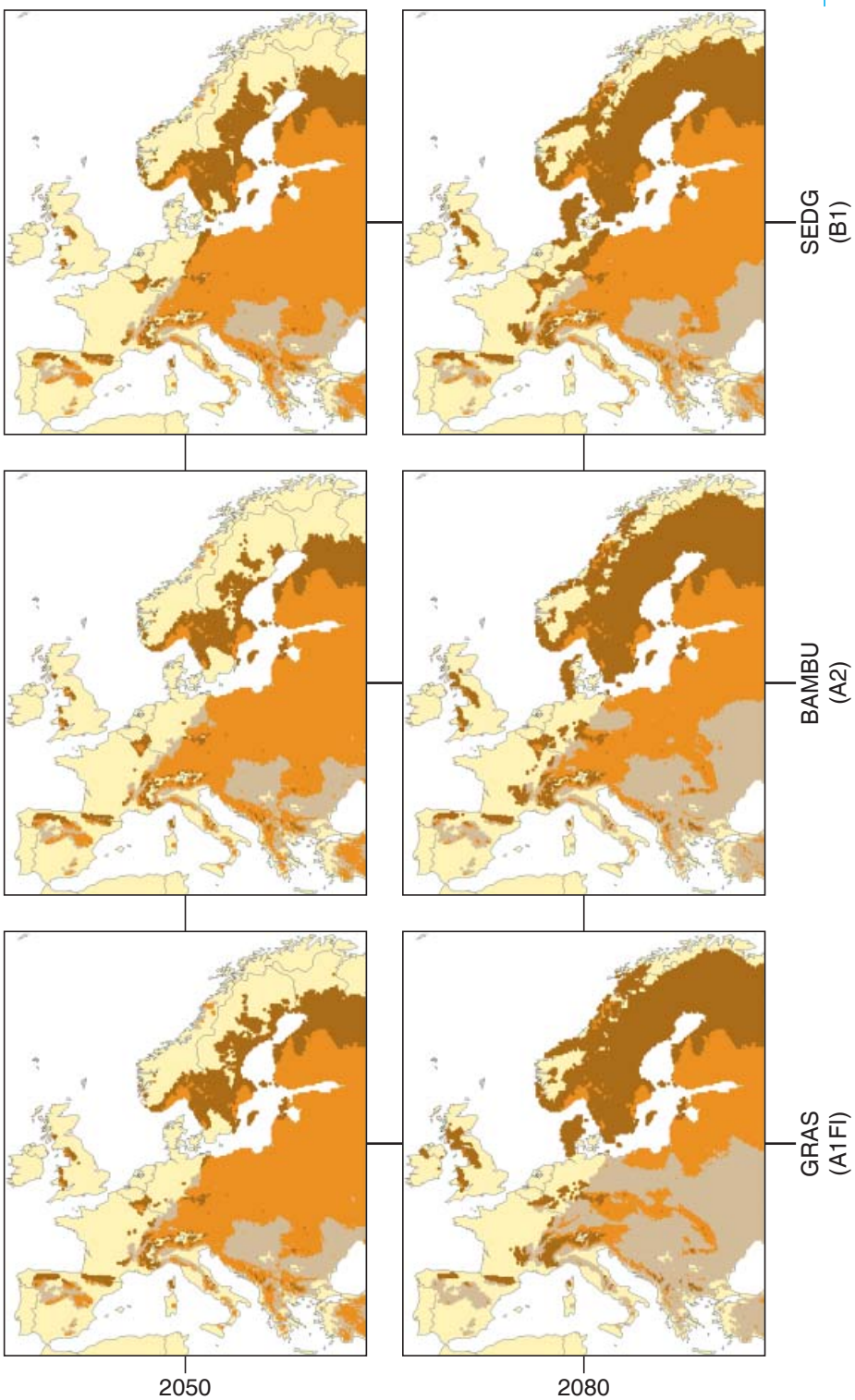
Present distribution can be well explained by climatic variables (AUC = 0.86).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Coenonympha gardetta (Prunner, 1798) – Alpine Heath

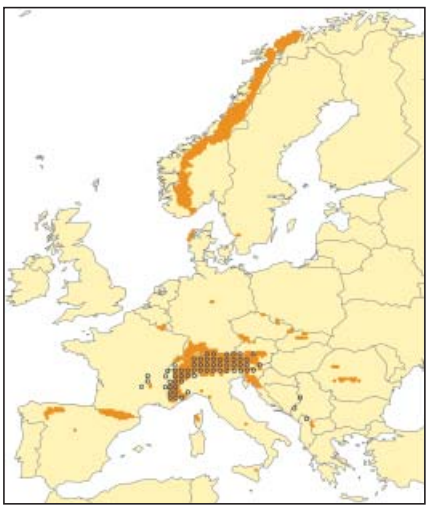
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-167 (-17.75%)	-312 (-33.16%)
	BAMBU	-97 (-10.31%)	-279 (-29.65%)
	GRAS	-207 (-22%)	-354 (-37.62%)
2080	SEDG	-405 (-43.04%)	-570 (-60.57%)
	BAMBU	-213 (-22.64%)	-475 (-50.48%)
	GRAS	-466 (-49.52%)	-662 (-70.35%)

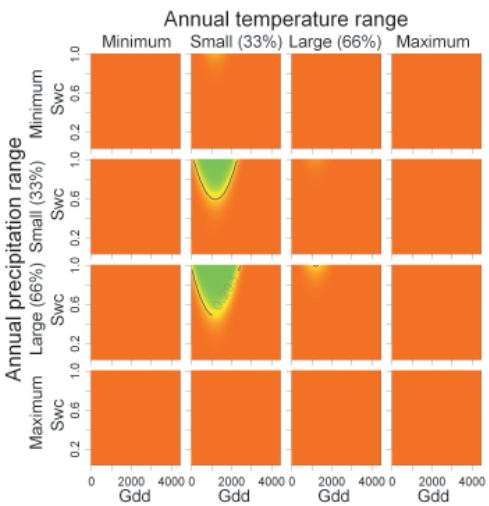
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 941)

The Alpine Heath is mostly found on open, sub-alpine and alpine grasslands, and on grasslands with scattered bushes and trees. It can occur in high numbers in some places. The female lays her eggs, mostly one by one, on grass stalks. The caterpillars hibernate, and pupate at the beginning of the summer, the pupa hanging from a plant, usually close to the ground. It is single-brooded.

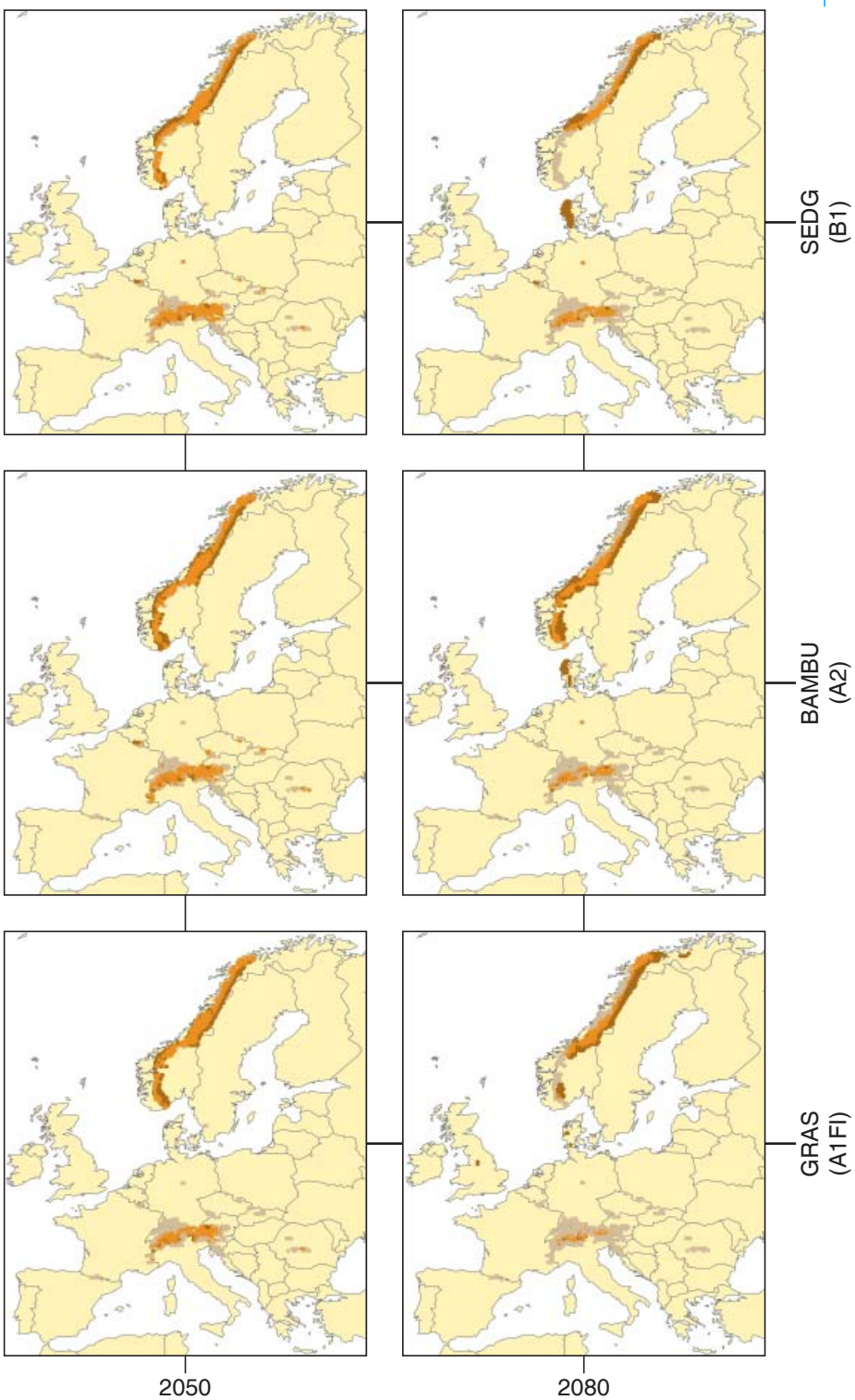
Present distribution can be very well explained by climatic variables (AUC = 0.97).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Coenonympha dorus (Esper, 1782) – Dusky Heath

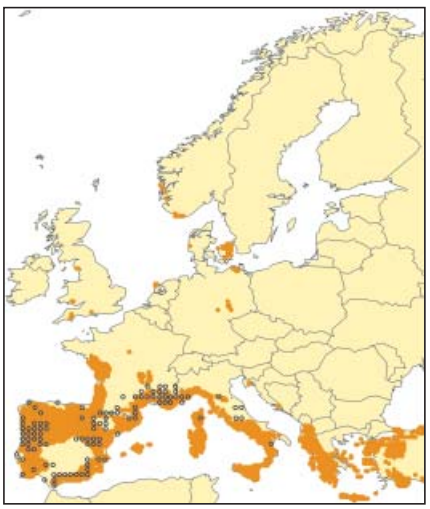
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-508 (-18.27%)	-1864 (-67.03%)
	BAMBU	-1152 (-41.42%)	-1907 (-68.57%)
	GRAS	-856 (-30.78%)	-2128 (-76.52%)
2080	SEDG	-927 (-33.33%)	-2297 (-82.6%)
	BAMBU	-1232 (-44.3%)	-2501 (-89.93%)
	GRAS	-877 (-31.54%)	-2689 (-96.69%)

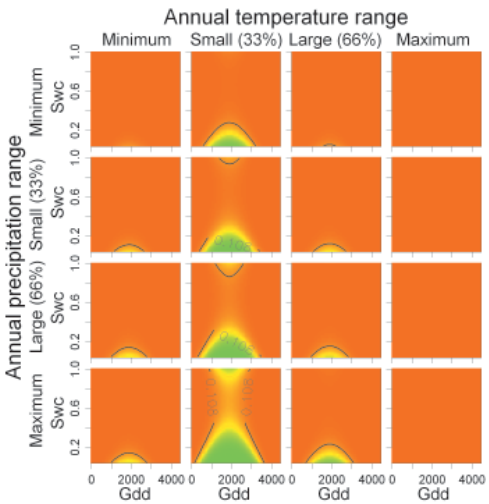
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 2781)

The Dusky Heath is a butterfly of dry, grassy vegetation, such as found on rocky slopes in low scrub, thickets and in woodland clearings. Different grasses are used as foodplant, including bent (*Agrostis* spp.), and Sheep's-fescue (*Festuca ovina*). It has one generation a year and hibernates as a caterpillar.

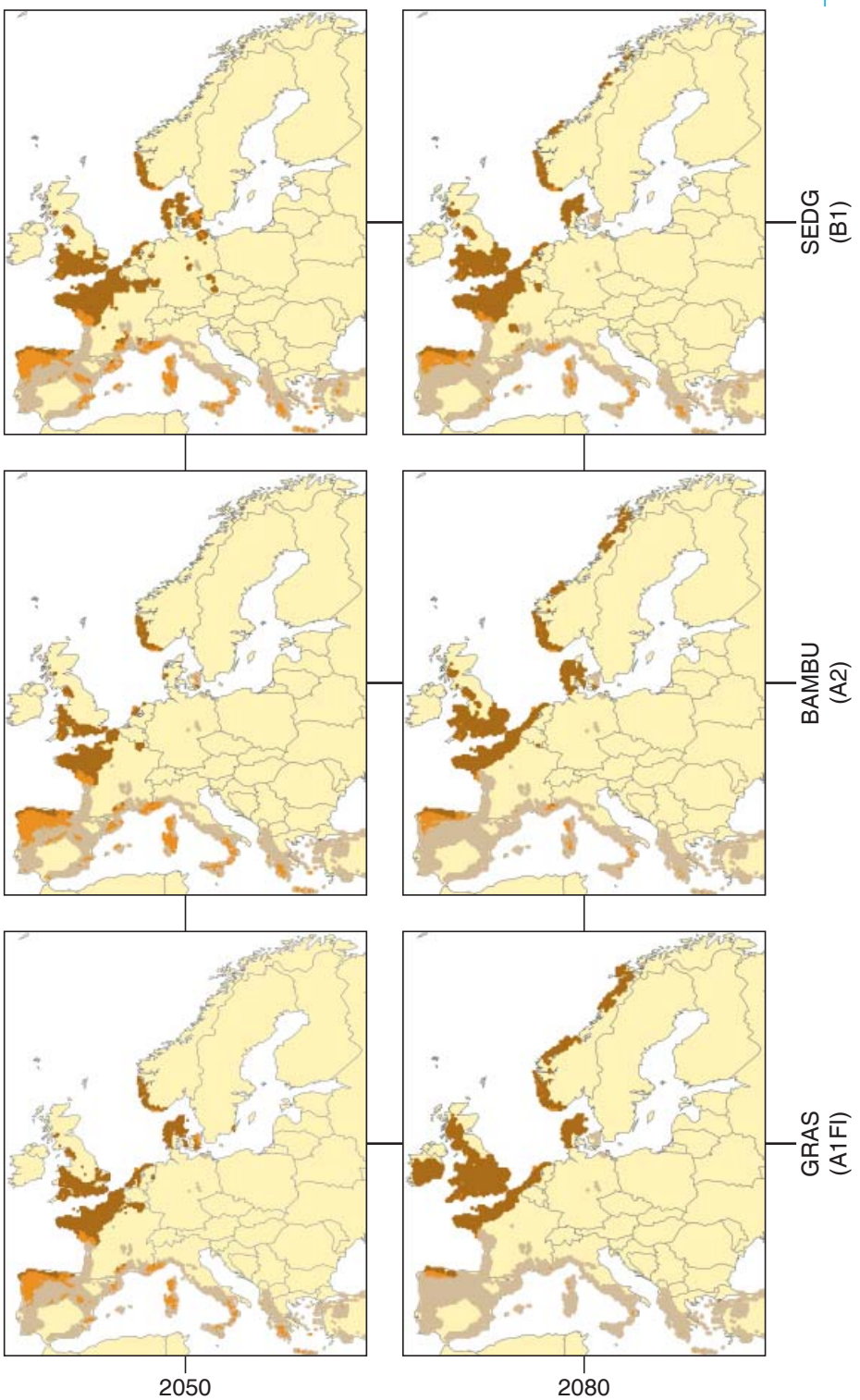
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.83). Climate risk category: HHHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Coenonympha hero (Linnaeus, 1761) – Scarce Heath

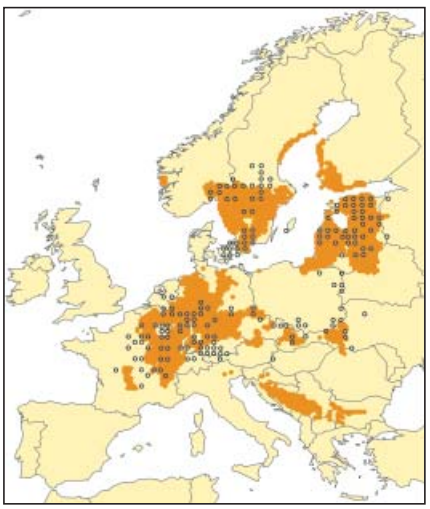
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-1416 (-39.97%)	-1929 (-54.45%)
	BAMBU	941 (26.56%)	-845 (-23.85%)
	GRAS	-517 (-14.59%)	-1545 (-43.61%)
2080	SEDG	-1761 (-49.7%)	-2493 (-70.36%)
	BAMBU	-882 (-24.89%)	-2331 (-65.79%)
	GRAS	-2024 (-57.13%)	-3301 (-93.17%)

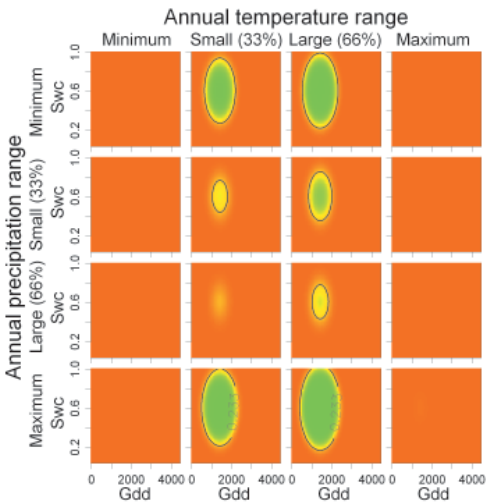
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 3543)

The Scarce Heath occurs in damp to wet grassy meadows in or at the edges of woods. Sometimes, they occur away from woods in drier places or in flower-rich grassland. The butterflies are fond of settling in grass, and do not fly far, nor very often. Among the grasses they use as food are Tufted Hair-grass (*Deschampsia cespitosa*), and Bearded Couch (*Elymus caninus*). When half-grown, the caterpillar hibernates in a grass tussock, where it later also pupates. This species has one generation a year. It should be noted that this species is severely declining. (Many dots on the map actually represent already extinct populations.)
This species is listed in Annex IV of the Habitats' Directive.

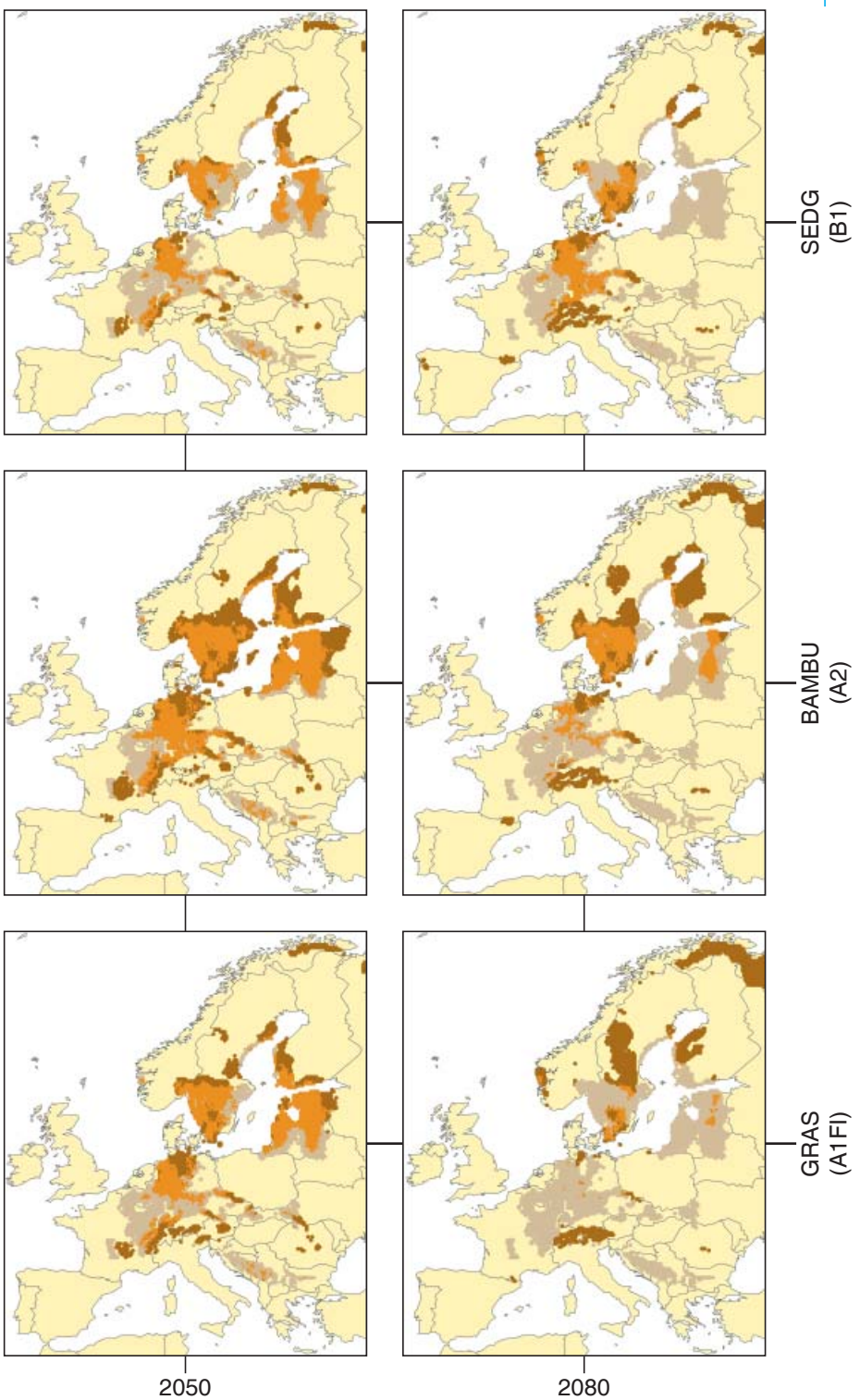
Present distribution can be well explained by climatic variables (AUC = 0.88).
Climate risk category: HHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Coenonympha leander (Esper, 1784) – Russian Heath

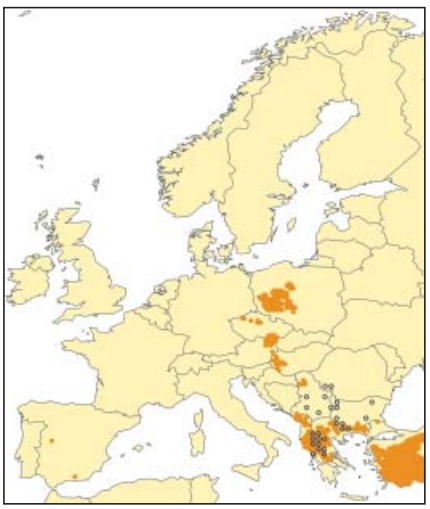
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	225 (27.21%)	-425 (-51.39%)
	BAMBU	-399 (-48.25%)	-597 (-72.19%)
	GRAS	-46 (-5.56%)	-571 (-69.04%)
2080	SEDG	-168 (-20.31%)	-546 (-66.02%)
	BAMBU	-574 (-69.41%)	-746 (-90.21%)
	GRAS	-571 (-69.04%)	-798 (-96.49%)

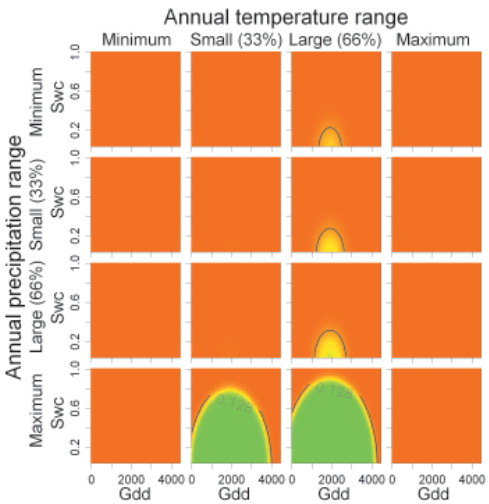
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 827)

The Russian Heath is found both on dry, as well as somewhat damp, grassy vegetation, at wood margins and in woodland clearings and on grasslands. The butterflies have a rather low flight. At rest, just like other heaths, the Russian Heath keeps its wings closed. Sheep's-fescue (*Festuca ovina*) and Slender False-brome (*Brachypodium sylvaticum*) are among the grasses used as foodplants. This species has one brood a year and hibernates as a caterpillar.

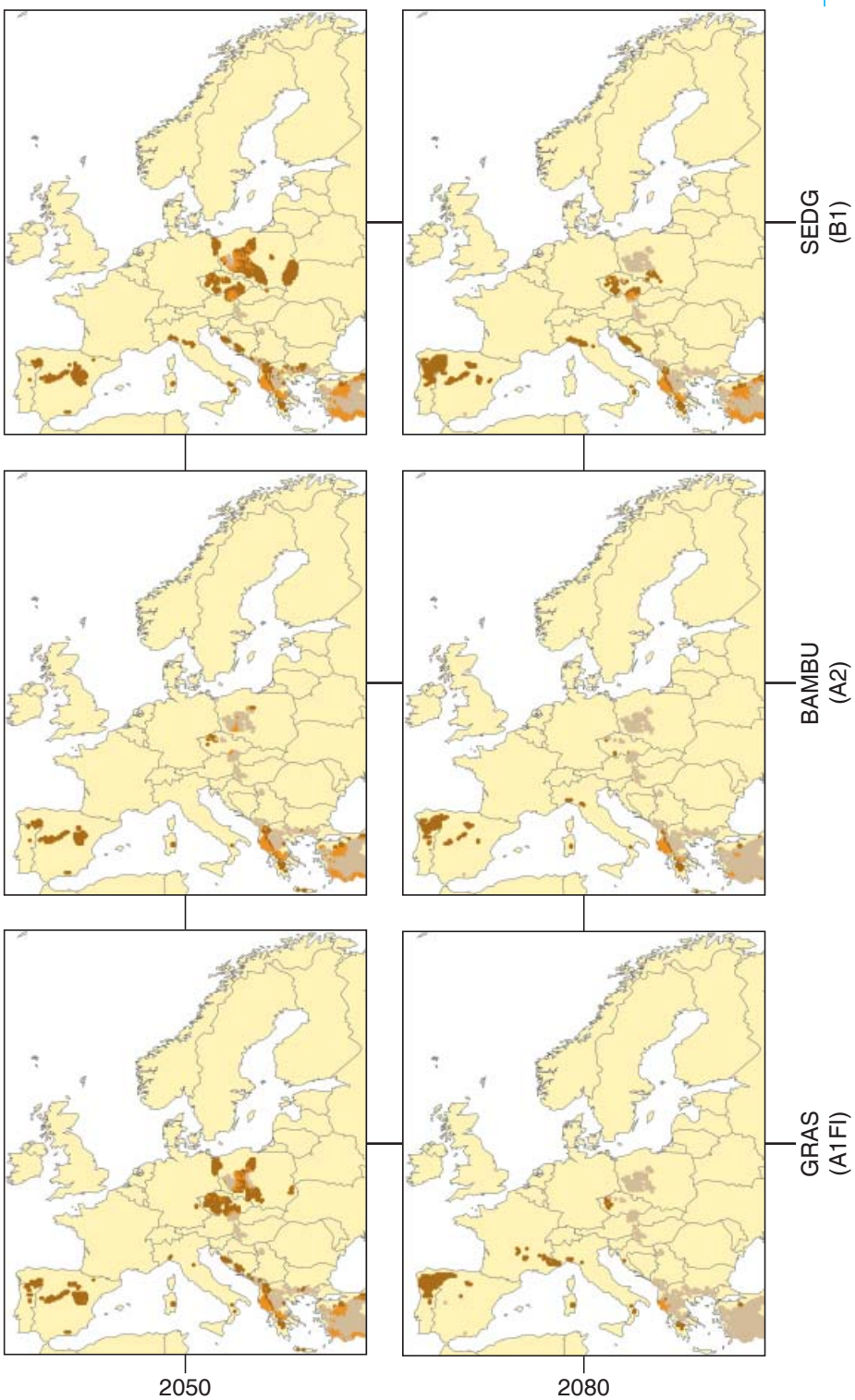
Present distribution can be well explained by climatic variables (AUC = 0.89).
Climate risk category: HHHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Coenonympha pamphilus (Linnaeus, 1758) – Small Heath

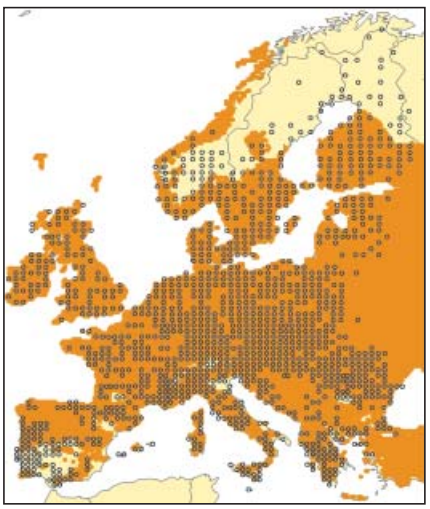
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-1709 (-7.66%)	-3476 (-15.58%)
	BAMBU	-2727 (-12.22%)	-3878 (-17.38%)
	GRAS	-2920 (-13.09%)	-4439 (-19.9%)
2080	SEDG	-1994 (-8.94%)	-5095 (-22.84%)
	BAMBU	-4197 (-18.81%)	-7614 (-34.13%)
	GRAS	-6105 (-27.36%)	-10438 (-46.79%)

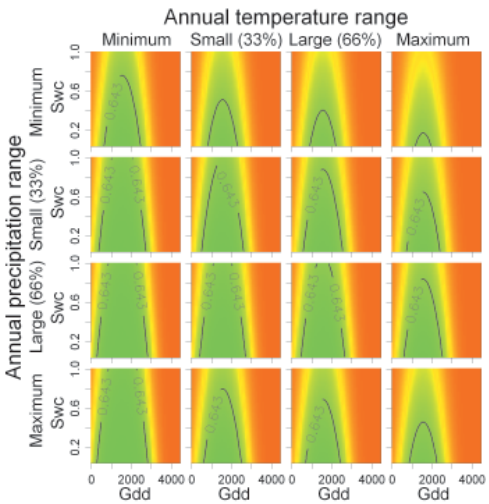
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 22310)

The Small Heath is a common species of nearly all types of grassland. It is mostly found on fairly open, poor meadows and pastures. The female deposits her eggs one by one, or in rows, on the blades of most grasses, including meadow-grasses (*Poa* spp.), Sweet Vernal-grass (*Anthoxanthum odoratum*), fescues (*Festuca* spp.), and bents (*Agrostis* spp.). The caterpillar grows very quickly on nutritious grasses, but can also use poor grasses, growing then more slowly. In the third or fourth larval instar, the caterpillar hibernates deep down in a tussock of grass, where it also later pupates. The number of broods a year is between one and three and depends on the geographical position of the habitat.

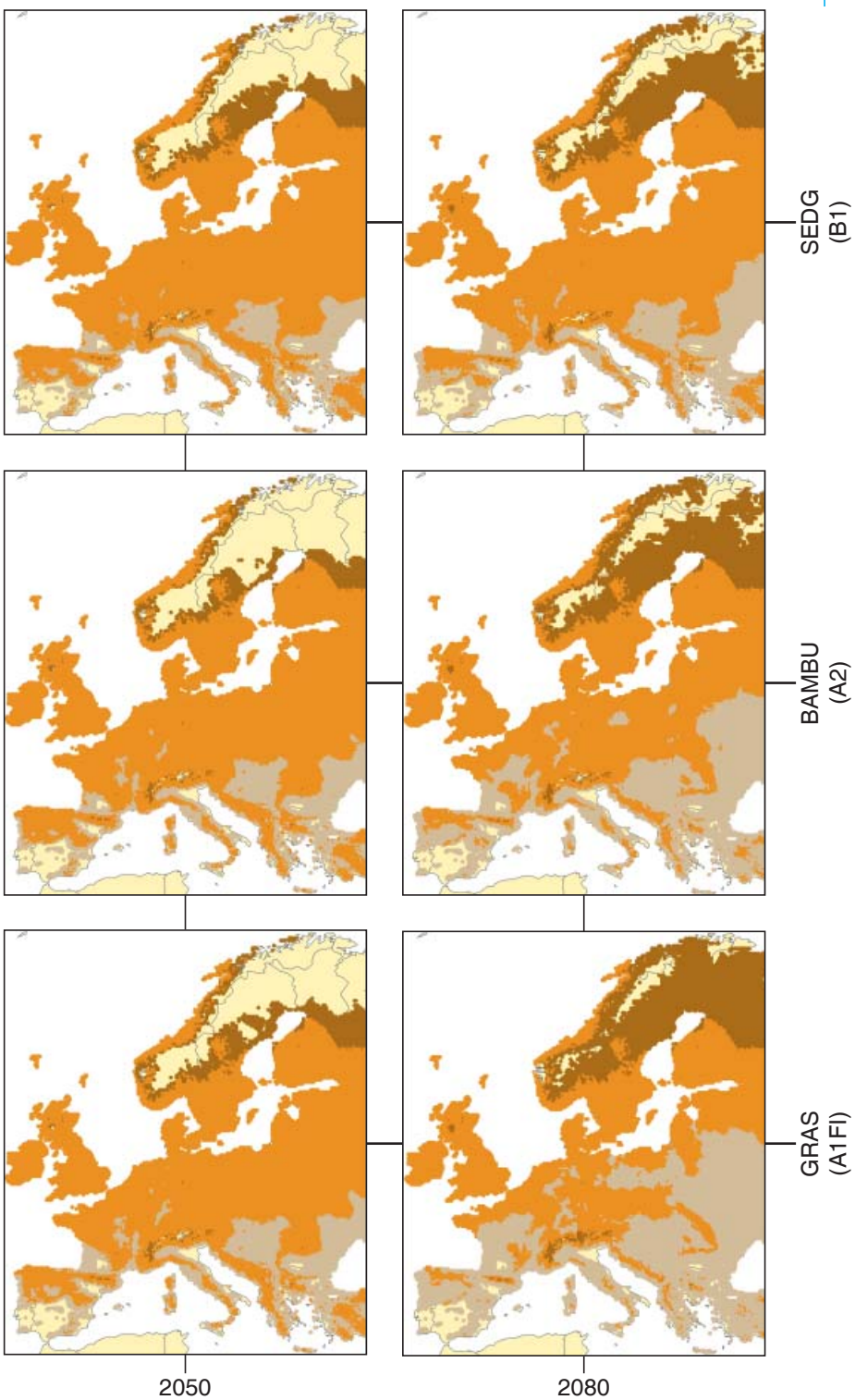
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.66). Climate risk category: PR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Pyronia tithonus (Linnaeus, 1771) – Gatekeeper

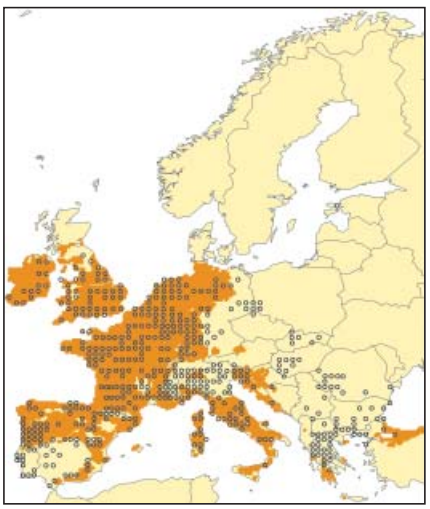
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-385 (-6.01%)	-1451 (-22.63%)
	BAMBU	-48 (-0.75%)	-1437 (-22.41%)
	GRAS	-511 (-7.97%)	-1691 (-26.38%)
2080	SEDG	-898 (-14.01%)	-2029 (-31.65%)
	BAMBU	-1165 (-18.17%)	-2649 (-41.32%)
	GRAS	-2622 (-40.9%)	-3899 (-60.82%)

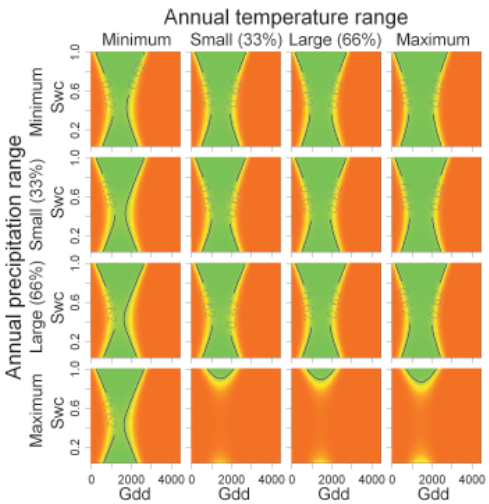
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 6411)

The Gatekeeper occurs on many different types of grassland. Mostly, it chooses rather rough, dry to damp vegetation, situated beside woodland or scrub, or not far from them. The butterflies are fond of basking in the sun on scrub, and are often seen visiting flowers. The female lays her eggs singly on the leaf-blades of nearly all soft grasses, such as Cock's-foot (*Dactylus* spp.), fescues (*Festuca* spp.), bents (*Agrostis* spp.), and Rye-Grass (*Lolium* spp.). The caterpillar avoids bright sunlight, and feeds mostly on grasses growing in the shade. When half-grown, it hibernates in a tussock of grass. It completes its growth the following year, and pupates low down in the vegetation. The Gatekeeper is single-brooded.

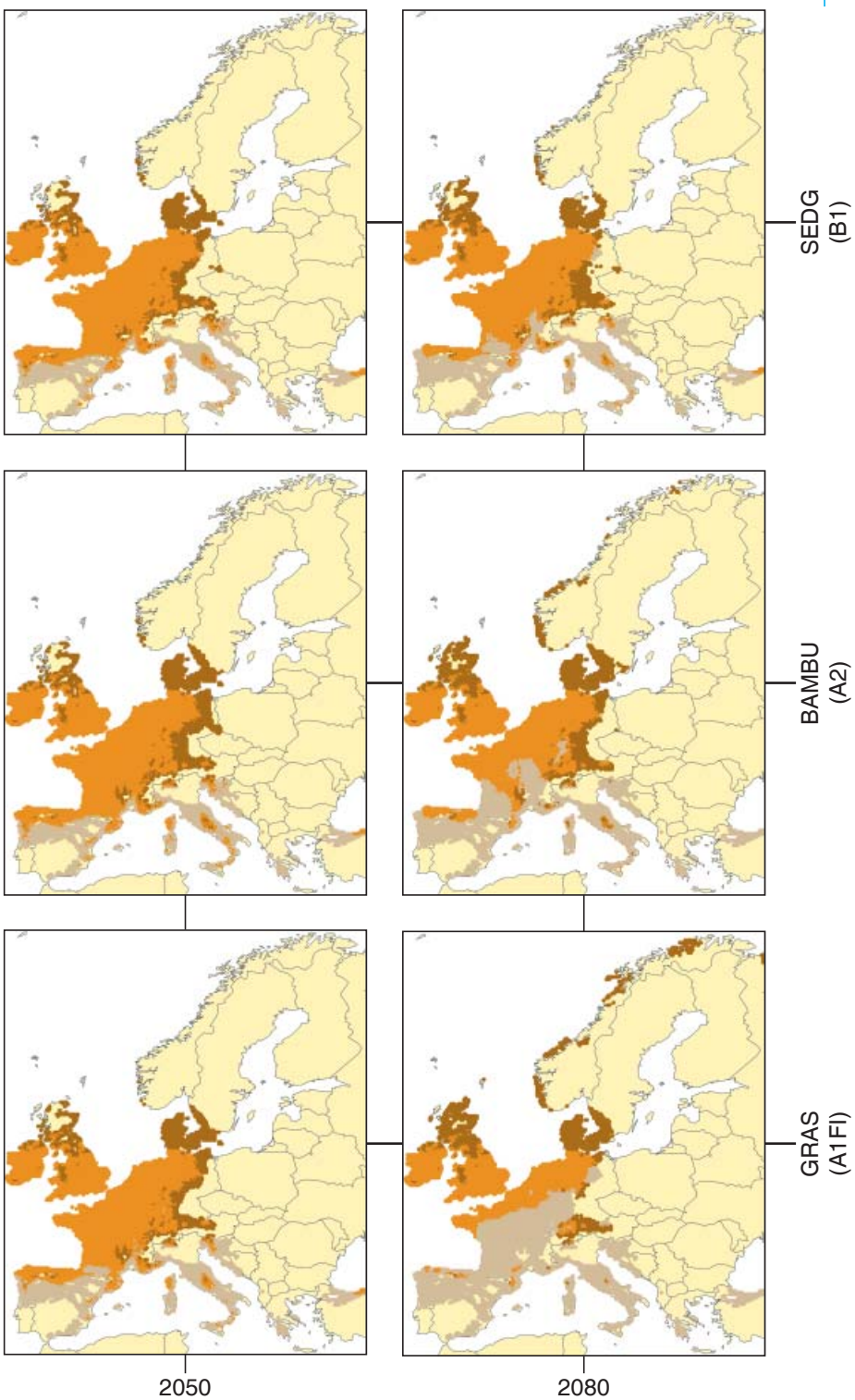
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.82). Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Pyronia cecilia (Vallantin, 1894) – Southern Gatekeeper

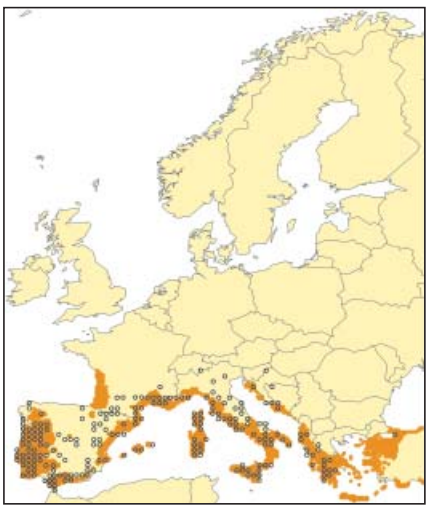
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-794 (-33.79%)	-1382 (-58.81%)
	BAMBU	-925 (-39.36%)	-1406 (-59.83%)
	GRAS	-939 (-39.96%)	-1613 (-68.64%)
2080	SEDG	-891 (-37.91%)	-1781 (-75.79%)
	BAMBU	-1206 (-51.32%)	-2042 (-86.89%)
	GRAS	-1037 (-44.13%)	-2280 (-97.02%)

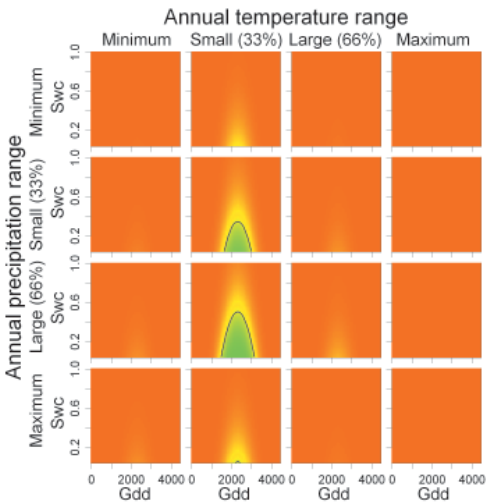
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 2350)

The Southern Gatekeeper can be found on dry grasslands, rocky slopes with grassy vegetation, in open scrub, and now and then in woodland clearings. The foodplants are grasses, probably Tufted Hair-grass (*Deschampsia cespitosa*), although this is still uncertain. This butterfly species has one or two broods a year, and passes the winter as a caterpillar.

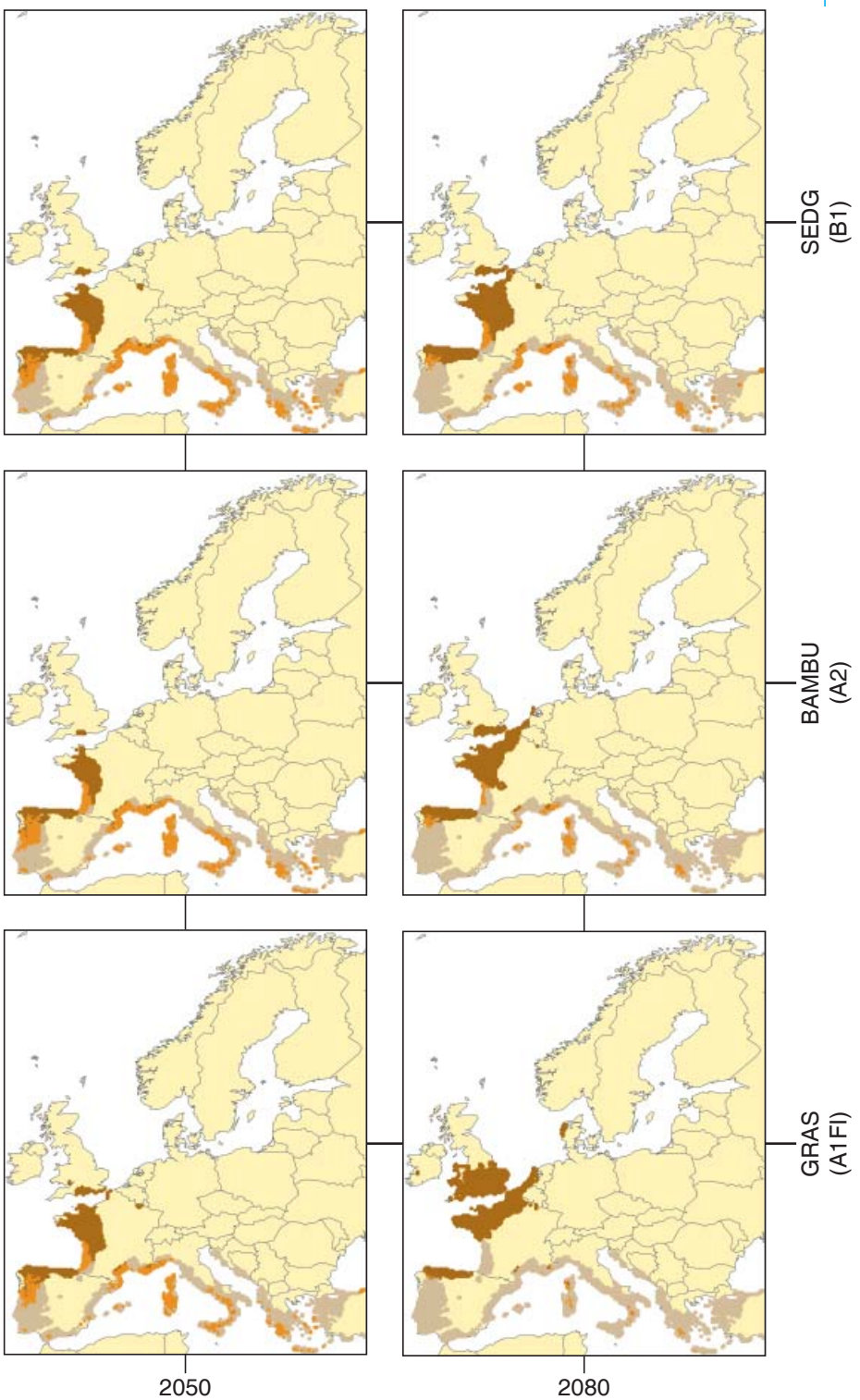
Present distribution can be well explained by climatic variables (AUC = 0.91).
Climate risk category: HHHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Pyronia bathseba (Fabricius, 1793) – Spanish Gatekeeper

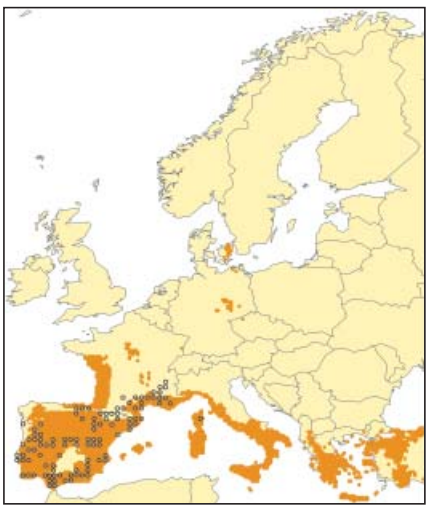
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-696 (-20.11%)	-1954 (-56.46%)
	BAMBU	-1440 (-41.61%)	-2070 (-59.81%)
	GRAS	-1151 (-33.26%)	-2282 (-65.93%)
2080	SEDG	-1610 (-46.52%)	-2673 (-77.23%)
	BAMBU	-2178 (-62.93%)	-3150 (-91.01%)
	GRAS	-2079 (-60.07%)	-3404 (-98.35%)

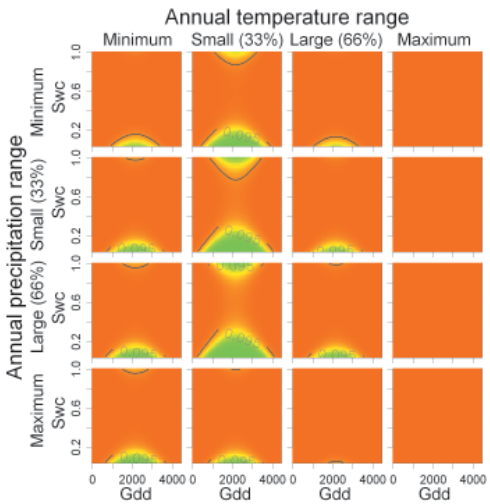
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 3461)

The markings on the Spanish Gatekeeper are brighter than those of the other gatekeepers. The butterflies are mostly found on dry, rather rough, grassy vegetation with trees or bushes in the neighbourhood. The caterpillars feed on grasses, especially false-bromes (*Brachypodium* spp.), but also probably bromes (*Bromus* spp), and meadow-grasses (*Poa* spp.). The Spanish Gatekeeper is single-brooded, and passes the winter in the caterpillar stage.

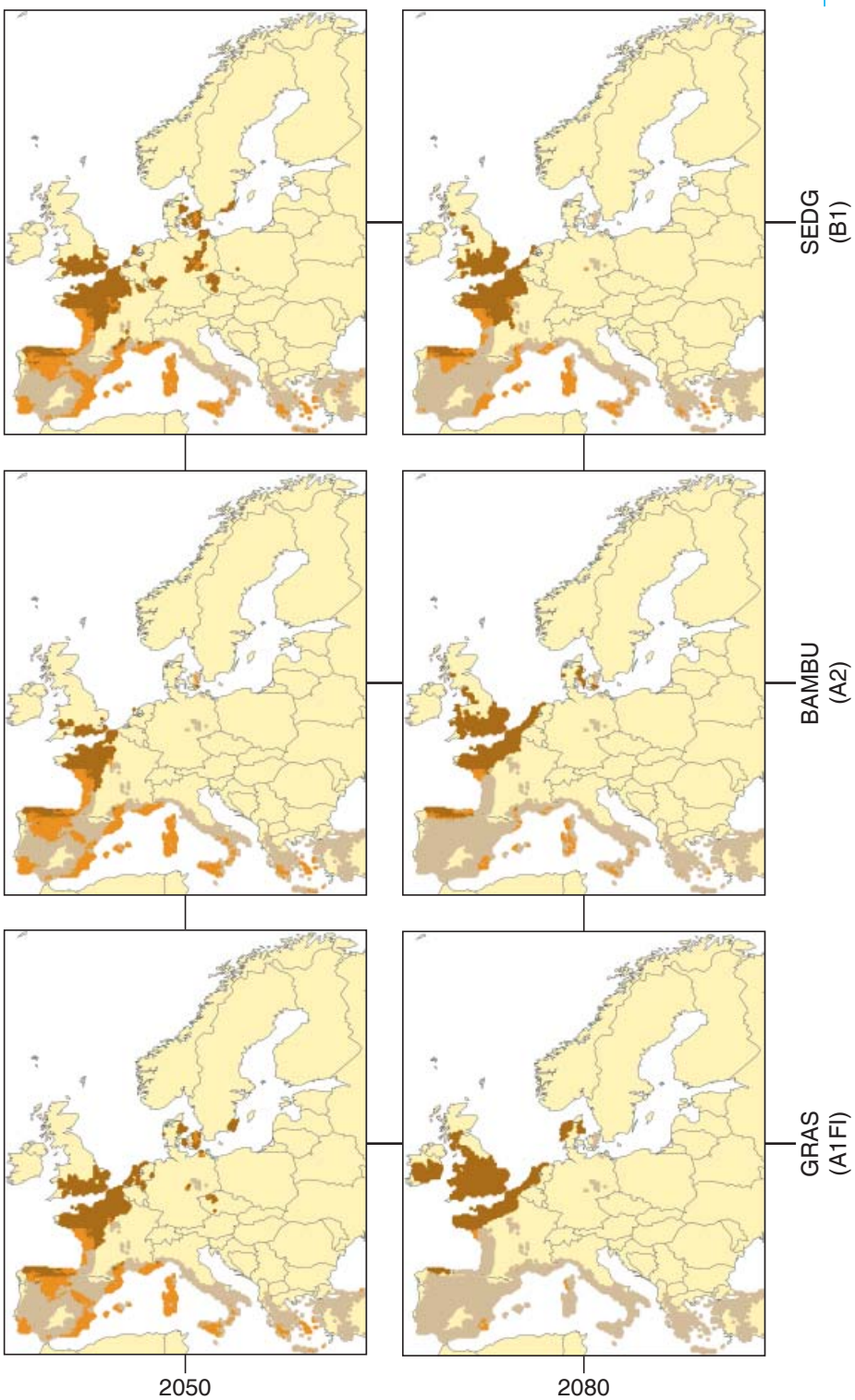
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.83). Climate risk category: HHHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Aphantopus hyperantus (Linnaeus, 1758) – Ringlet

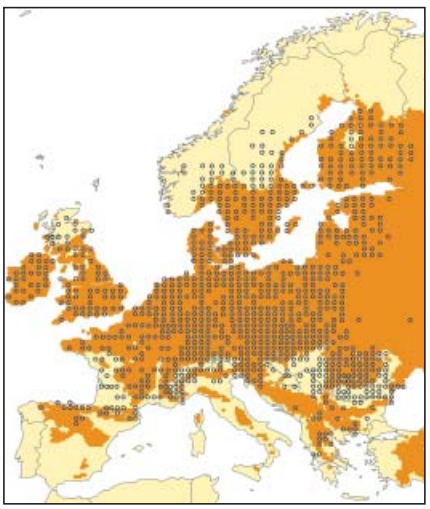
© Peter Ginzinger

		Full dispersal	No dispersal
2050	SEDG	-1583 (-9.49%)	-3790 (-22.73%)
	BAMBU	-1875 (-11.25%)	-4274 (-25.64%)
	GRAS	-2340 (-14.04%)	-4840 (-29.03%)
2080	SEDG	-3828 (-22.96%)	-7230 (-43.37%)
	BAMBU	-5021 (-30.12%)	-9337 (-56%)
	GRAS	-7118 (-42.69%)	-12005 (-72.01%)

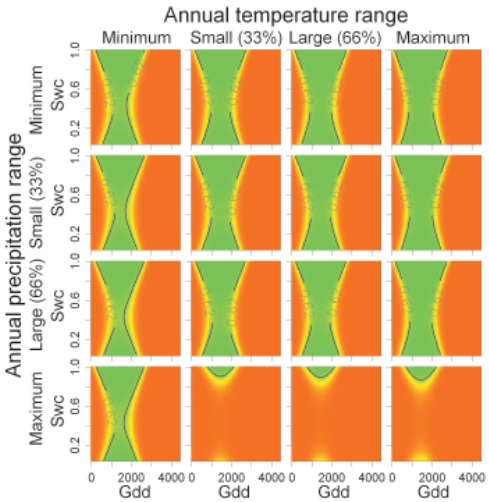
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 17662)

The Ringlet can be found in grassy places with bushes, woodland clearings, and on grasslands bordering woods. The habitats vary from dry to rather wet, such as at the edge of a raised bog. The butterflies are avid visitors of such flowers as thistles, knapweed, and other plants rich in nectar. The caterpillars feed on nutrient-rich grasses, such as cock's-foot (*Dactylus* spp.), false-bromes (*Brachypodium* spp.), fescues (*Festuca* spp.), and cat's-tails (*Phleum* spp.). The female usually just releases her eggs, letting them fall into the vegetation, either while perched or in flight. The caterpillars hibernate, hidden in a grass tussock, and when they resume feeding, only do so at night. They also pupate deep down in the vegetation. The Ringlet has one brood a year.

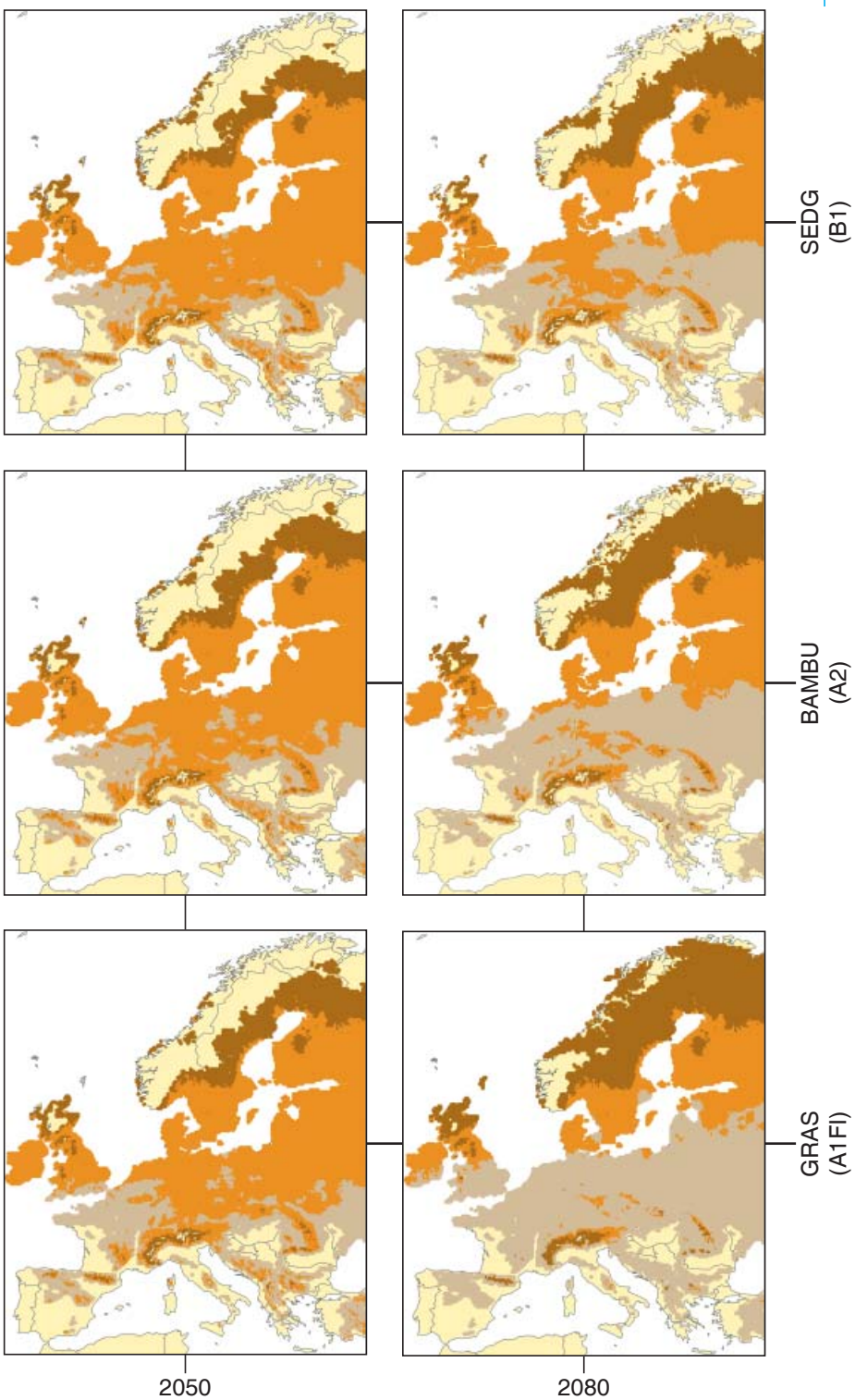
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.84).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Maniola jurtina (Linnaeus, 1758) – Meadow Brown

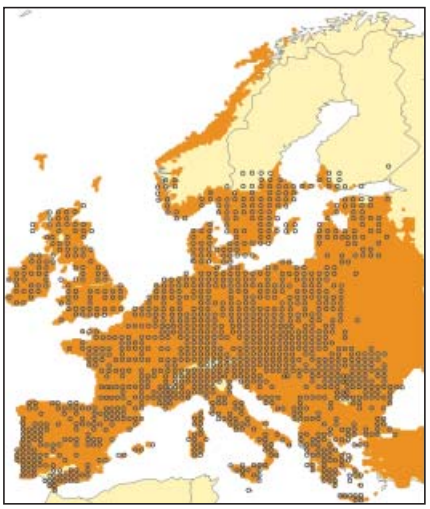
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-1330 (-6.1%)	-3022 (-13.85%)
	BAMBU	-2884 (-13.22%)	-4188 (-19.19%)
	GRAS	-2986 (-13.68%)	-4489 (-20.57%)
2080	SEDG	-4349 (-19.93%)	-6262 (-28.7%)
	BAMBU	-6627 (-30.37%)	-9090 (-41.66%)
	GRAS	-9317 (-42.7%)	-11852 (-54.32%)

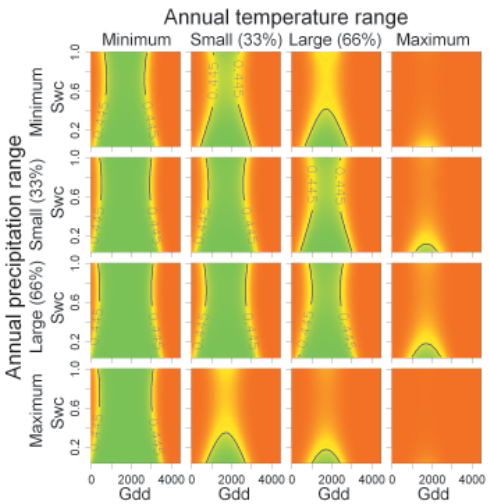
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 21820)

The Meadow Brown is a common butterfly of many different sorts of grassland, both natural grasslands and not too intensively used farmland, and semi-natural grassland. The butterflies are noticeable by their lively behaviour. The female deposits her eggs on a large number of grasses, including species of fescue (*Festuca* spp.), false-brome (*Brachypodium* spp.), cock's-foot (*Dactylus* spp.), dog's-tail (*Cynosurus* spp.), and brome (*Bromus* spp.). Sometimes, she also just drops the eggs in flight. The caterpillar goes into hibernation in the litter layer when half-grown. It also pupates deep in the litter layer. The Meadow Brown has one generation a year.

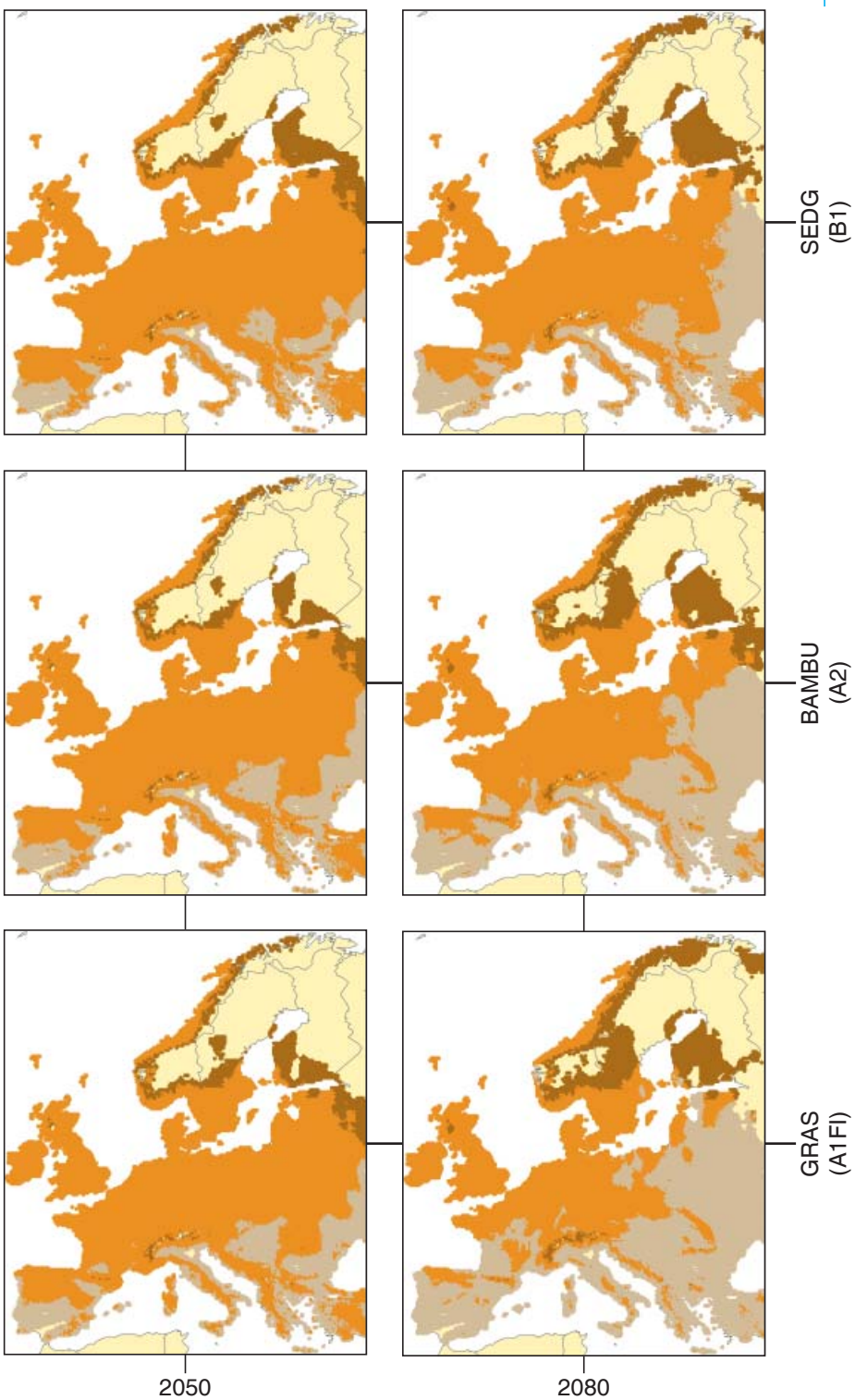
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.7). Climate risk category: PR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Hyponephele lycaon (Kühn, 1774) – Dusky Meadow Brown

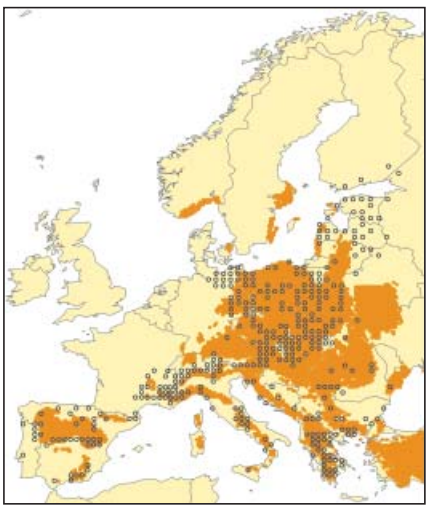
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-805 (-11.69%)	-2069 (-30.06%)
	BAMBU	-3974 (-57.73%)	-4245 (-61.66%)
	GRAS	-2698 (-39.19%)	-3454 (-50.17%)
2080	SEDG	-3582 (-52.03%)	-4792 (-69.61%)
	BAMBU	-5739 (-83.37%)	-6138 (-89.16%)
	GRAS	-5461 (-79.33%)	-6406 (-93.06%)

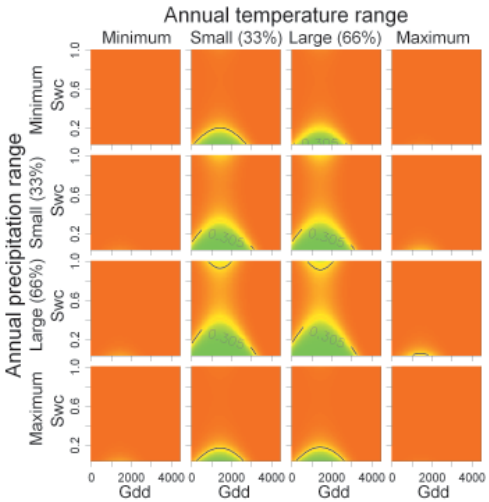
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 6884)

The Dusky Meadow Brown occurs in many different sorts of grassland. It is important that its habitat is dry and warm. In the north of its range, the grassland is steppe-like, and more to the south the butterfly is found on closer vegetation. It uses various grasses as foodplant, including fescues (*Festuca* spp.), false-bromes (*Brachypodium* spp.), and *Stipa* species. When the female is about to lay an egg, she first alights on the ground and walks to a foodplant, then she chooses a low-hanging grass blade on which to deposit an egg. The caterpillar hibernates in the first larval instar and only starts feeding in the spring. At first, it feeds mainly during day, but when the weather gets too warm, it only feeds at night. Pupation takes place deep in the vegetation or litter layer. The Dusky Meadow Brown is single-brooded.

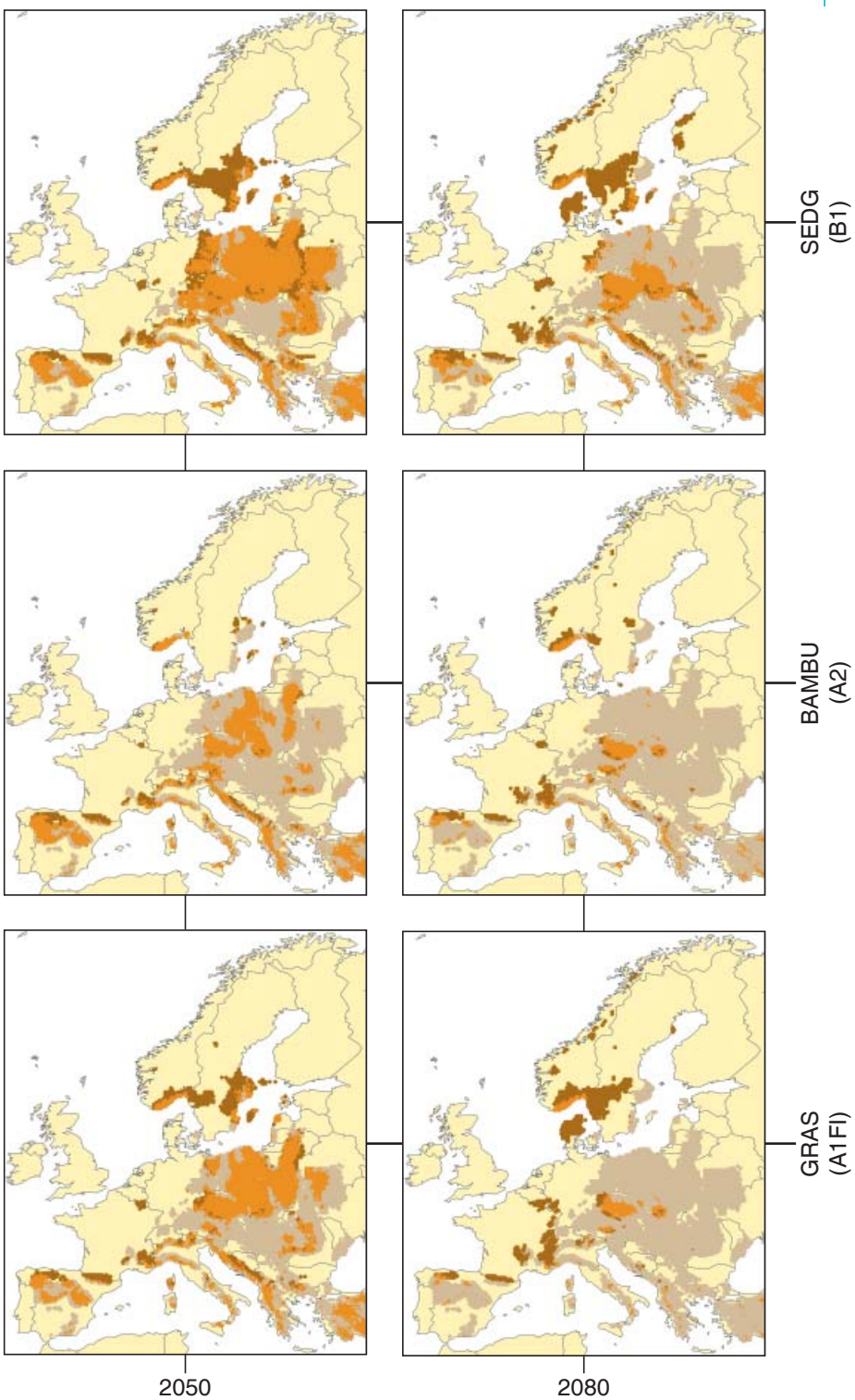
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.78). Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Hyponephele lupina (Costa, 1836) – Oriental Meadow Brown

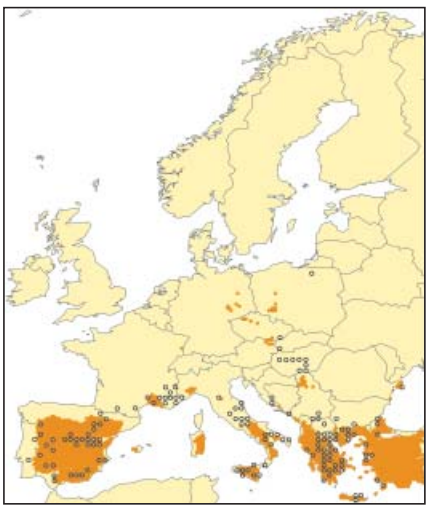
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-389 (-13.75%)	-1308 (-46.24%)
	BAMBU	-1228 (-43.41%)	-1547 (-54.68%)
	GRAS	-981 (-34.68%)	-1690 (-59.74%)
2080	SEDG	-1383 (-48.89%)	-1845 (-65.22%)
	BAMBU	-2198 (-77.7%)	-2482 (-87.73%)
	GRAS	-2354 (-83.21%)	-2720 (-96.15%)

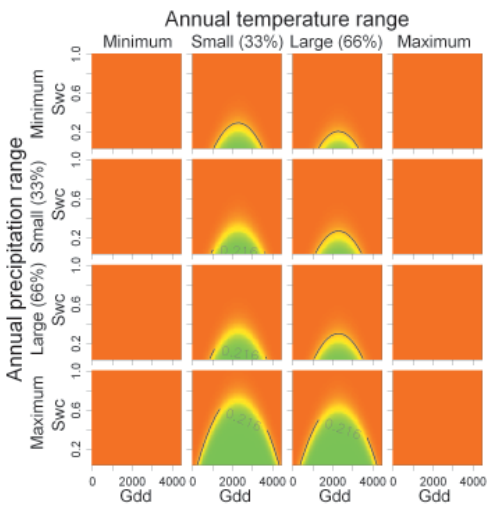
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 2829)

The Oriental Meadow Brown is a butterfly of warm, dry places. The butterflies can be found on dry grasslands with scattered bushes, or dry scrub vegetation, and in light woodland. At rest, their wings are almost always closed. They have a rapid flight, often keeping to the shadow cast by trees or bushes. Grasses, such as meadow-grasses (*Poa* spp.) and fescues (*Festuca* spp.) are used as foodplants. The species has one generation a year and hibernates in the larval stage.

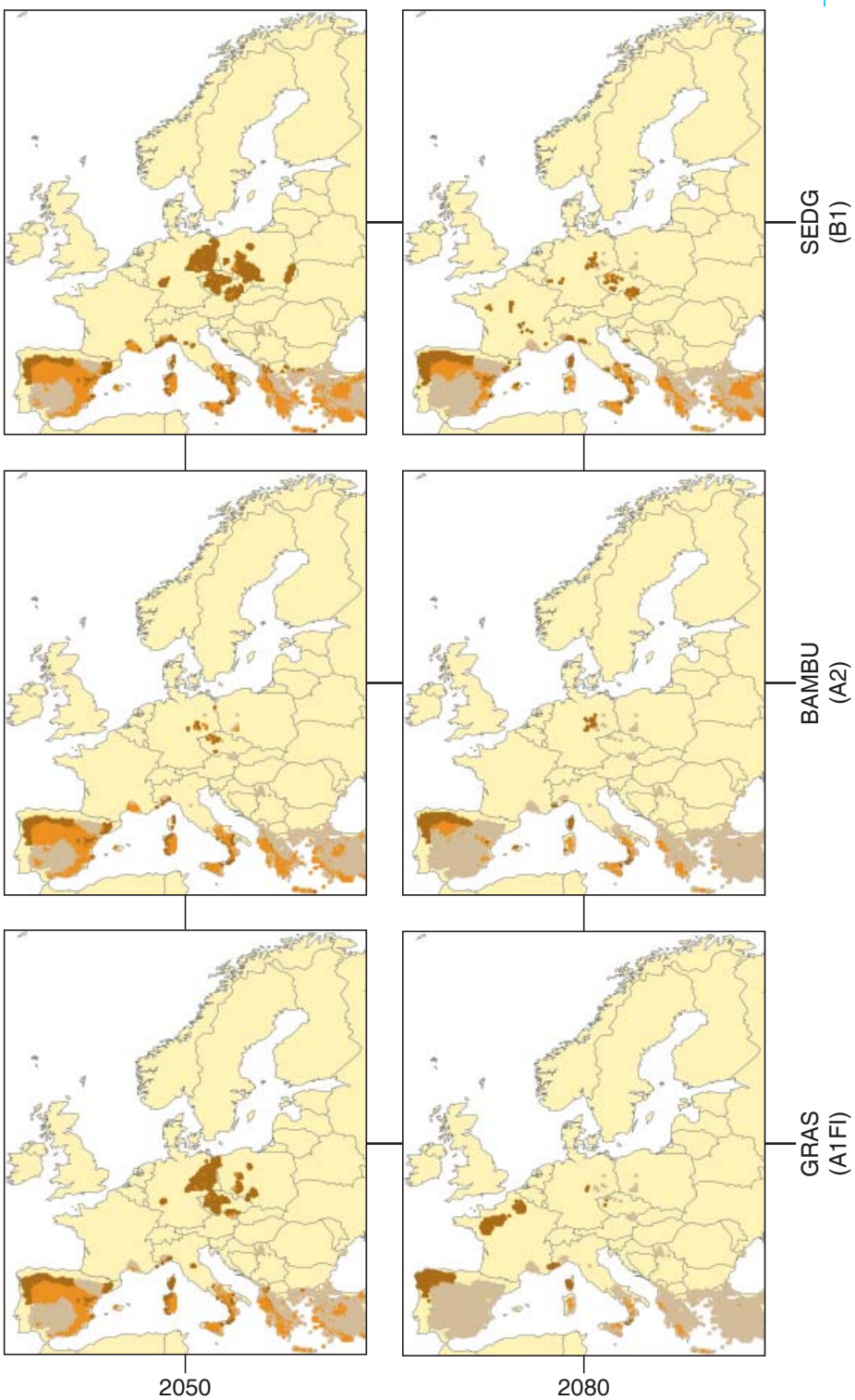
Present distribution can be well explained by climatic variables (AUC = 0.88).
Climate risk category: HHHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia ligea (Linnaeus, 1758) – Arran Brown

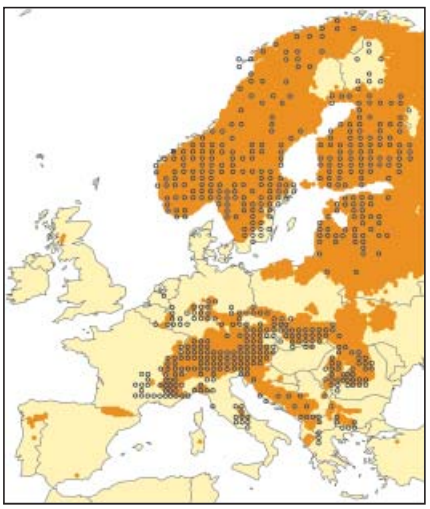
© Martin Wiemers

		Full dispersal	No dispersal
2050	SEDG	-2958 (-23.74%)	-3875 (-31.09%)
	BAMBU	-2415 (-19.38%)	-3187 (-25.57%)
	GRAS	-4075 (-32.7%)	-4737 (-38.01%)
2080	SEDG	-2798 (-22.45%)	-3895 (-31.26%)
	BAMBU	-4435 (-35.59%)	-5388 (-43.24%)
	GRAS	-5485 (-44.01%)	-6418 (-51.5%)

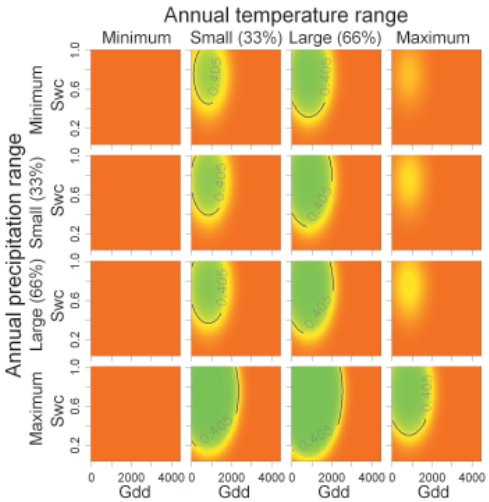
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 12462)

The Arran Brown occurs in sheltered, grassy, flower-rich places in woodland. These places are usually rather damp and in deep shade. The female deposits her eggs on the withered blades of various grasses, including cock's-foots (*Dactylus* spp.), hair-grasses (*Deschampsia* spp.), fescues (*Festuca* spp.), and Heath-grass (*Danthonia decumbens*). Sedges (*Carex* spp.) are also used. The egg hibernates, and the following year, the caterpillar feeds and grows, and in the last larval instar hibernates again. In the summer, the caterpillar pupates. The Arran Brown is single-brooded, but the life cycle takes two years to complete.

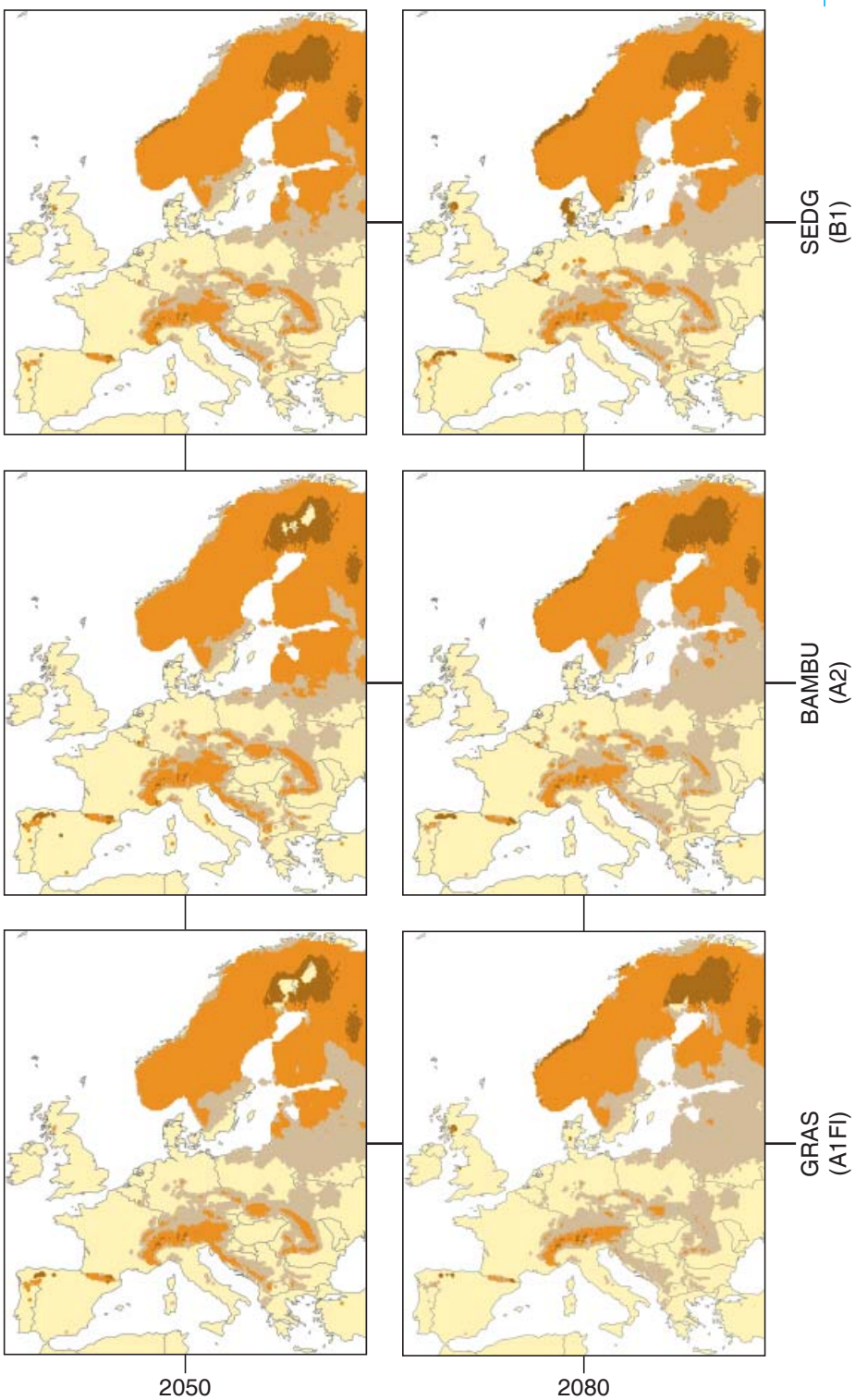
Present distribution can be well explained by climatic variables (AUC = 0.86).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia euryale (Esper, 1805) – Large Ringlet

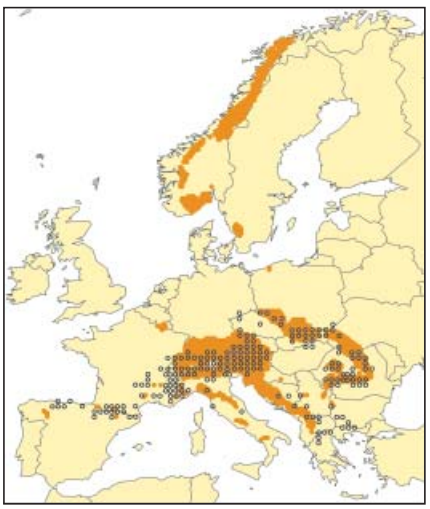
© Rudi Verovnik

		Full dispersal	No dispersal
2050	SEDG	-524 (-25.05%)	-825 (-39.44%)
	BAMBU	-435 (-20.79%)	-769 (-36.76%)
	GRAS	-791 (-37.81%)	-1100 (-52.58%)
2080	SEDG	-326 (-15.58%)	-1147 (-54.83%)
	BAMBU	-275 (-13.15%)	-1218 (-58.22%)
	GRAS	-500 (-23.9%)	-1541 (-73.66%)

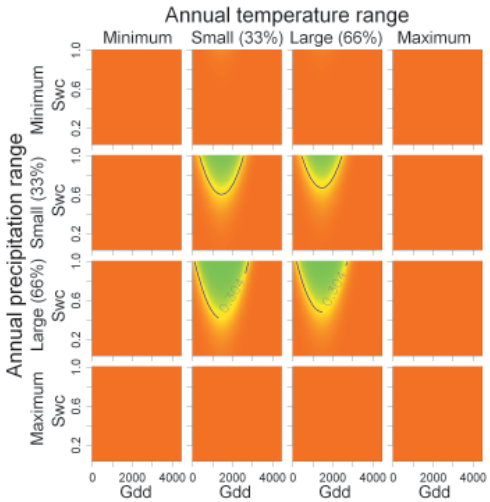
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 2092)

The Large Ringlet occurs in light woodland, in grassy clearings in woods, and above the tree-line on grassland with rather tall vegetation. In the Jura Mountains, these butterflies can be found at the edge of raised bogs, and at an altitude of 1000 m, also in light, damp woods. The Greek populations also seem to prefer damp places. Both the males and females visit flowers for their nectar and the males can often be seen drinking on damp ground or on dung. Various grasses are used as foodplant, including Blue Moor-grass (*Sesleria albicans*), Wood Meadow-grass (*Poa nemoralis*), Red Fescue (*Festuca rubra*), Sheep's-fescue (*F. ovina*), *Calamagrostis varia*, and also sedges (*Carex* spp.). It takes two years for the development from egg to butterfly.

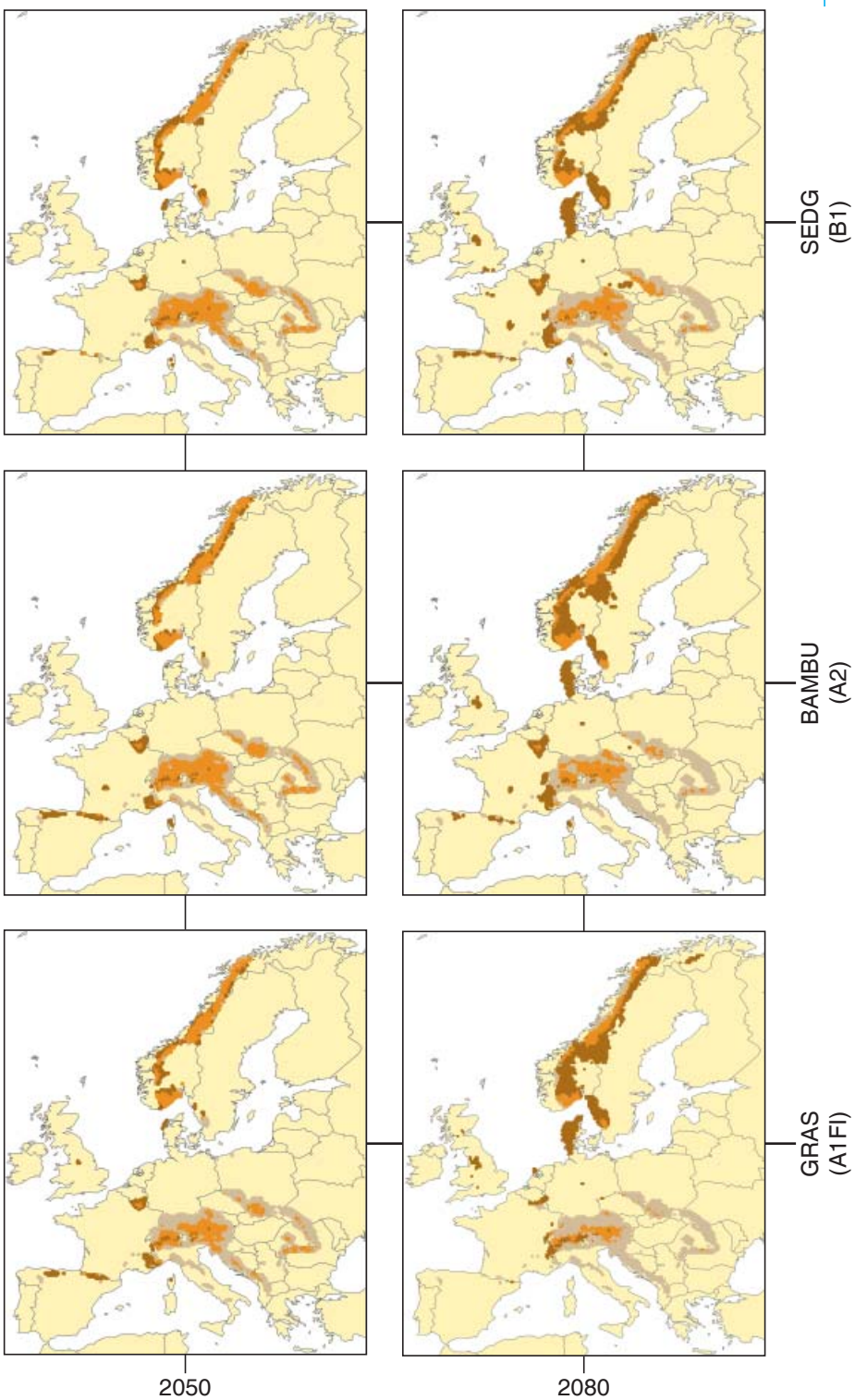
Present distribution can be well explained by climatic variables (AUC = 0.89).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia eriphyle (Freyer, 1836) – Eriphyle Ringlet

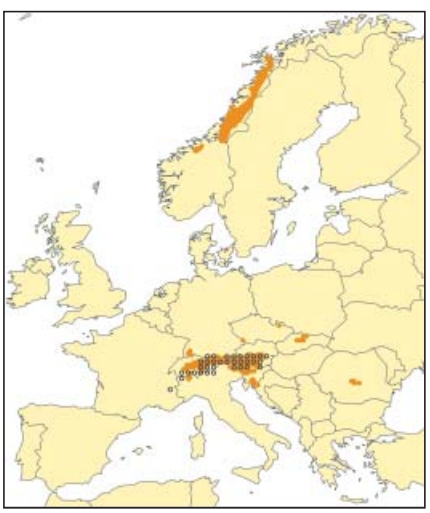
© Josef Pennerstorfer

		Full dispersal	No dispersal
2050	SEDG	-57 (-14.81%)	-144 (-37.4%)
	BAMBU	-33 (-8.57%)	-141 (-36.62%)
	GRAS	-99 (-25.71%)	-172 (-44.68%)
2080	SEDG	-168 (-43.64%)	-250 (-64.94%)
	BAMBU	-76 (-19.74%)	-251 (-65.19%)
	GRAS	-121 (-31.43%)	-304 (-78.96%)

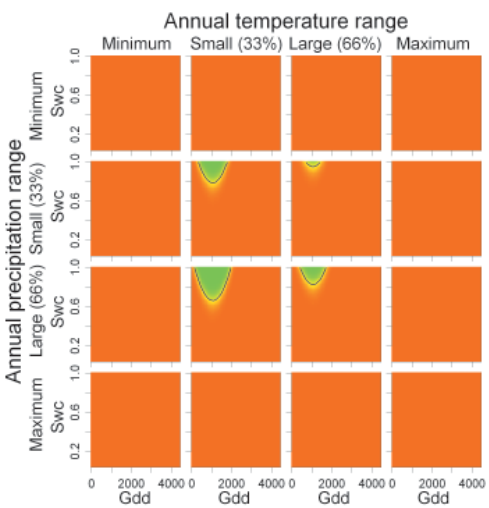
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 385)

The Eriphyle Ringlet occurs locally in the Alps and is one of the smaller ringlets. It is a characteristic species of the north-facing slopes, occurring on rough, herbaceous vegetation in the alpine and subalpine zones, where there are plenty of alder (*Alnus* spp.) saplings. They are often found in places where the conspicuous plants *Adenostyles alliariae* and Masterwort (*Peucedanum ostruthium*) are growing. It uses Sweet-Vernal-grass (*Anthoxanthum odoratum*) and Tufted Hair-grass (*Deschampsia cespitosa*) as foodplants. Some of the caterpillars leave the egg before the winter, but the rest hibernate in the egg and emerge in the spring, when they all start feeding on grasses. In the autumn, they hibernate again and moult twice before pupating at the end of May.

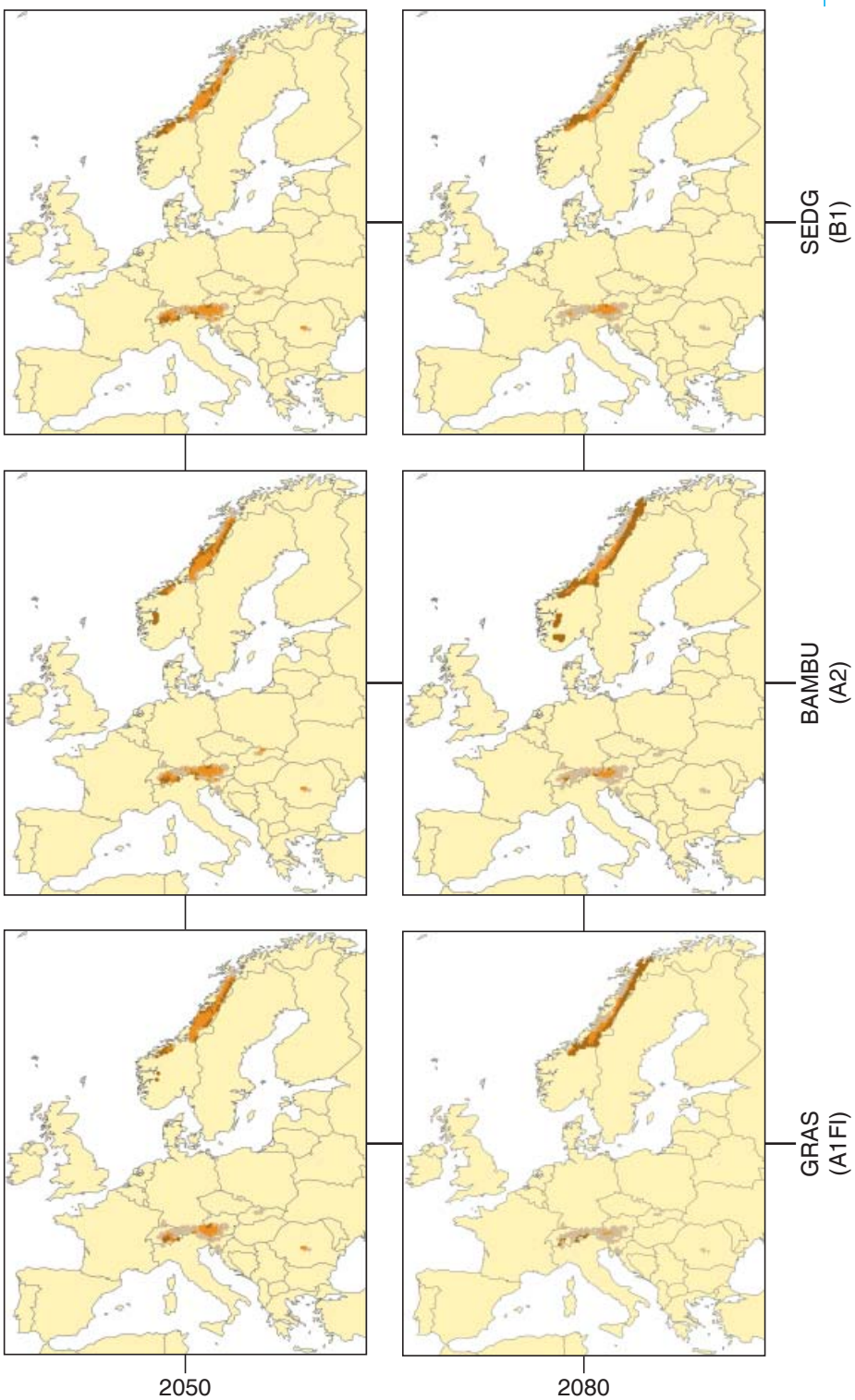
Present distribution can be very well explained by climatic variables (AUC = 0.99).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia manto ([Schiffermüller], 1775) – Yellow-spotted Ringlet

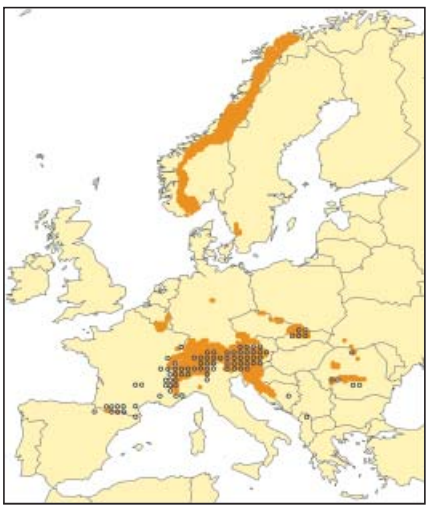
© Josef Pennerstorfer

		Full dispersal	No dispersal
2050	SEDG	-258 (-19.07%)	-466 (-34.44%)
	BAMBU	-165 (-12.2%)	-394 (-29.12%)
	GRAS	-357 (-26.39%)	-548 (-40.5%)
2080	SEDG	-368 (-27.2%)	-668 (-49.37%)
	BAMBU	-228 (-16.85%)	-661 (-48.85%)
	GRAS	-402 (-29.71%)	-850 (-62.82%)

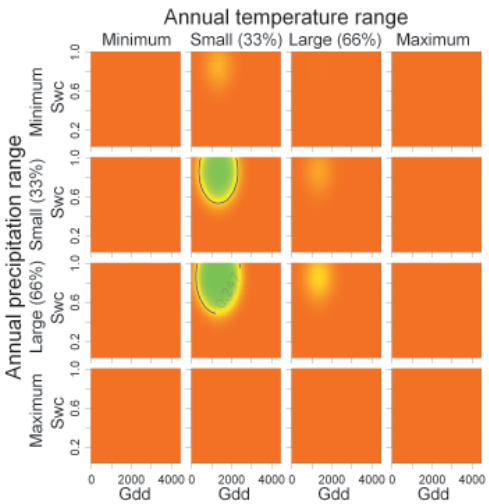
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1353)

The Yellow-spotted Ringlet is a species of cool and cold conditions. Above the tree-line it occurs on open mountain meadows, and below it inhabits damp, flower-rich grasslands and woodland glades. The female deposits her eggs one at a time on the blades of various grasses, such as fescues (*Festuca* spp.) and cat's-tails (*Phleum* spp.). It hibernates twice, the first time as an egg or a tiny caterpillar, without having fed at all. During the next summer, the caterpillar develops as far as the penultimate stage and then hibernates again. It pupates in the following summer.

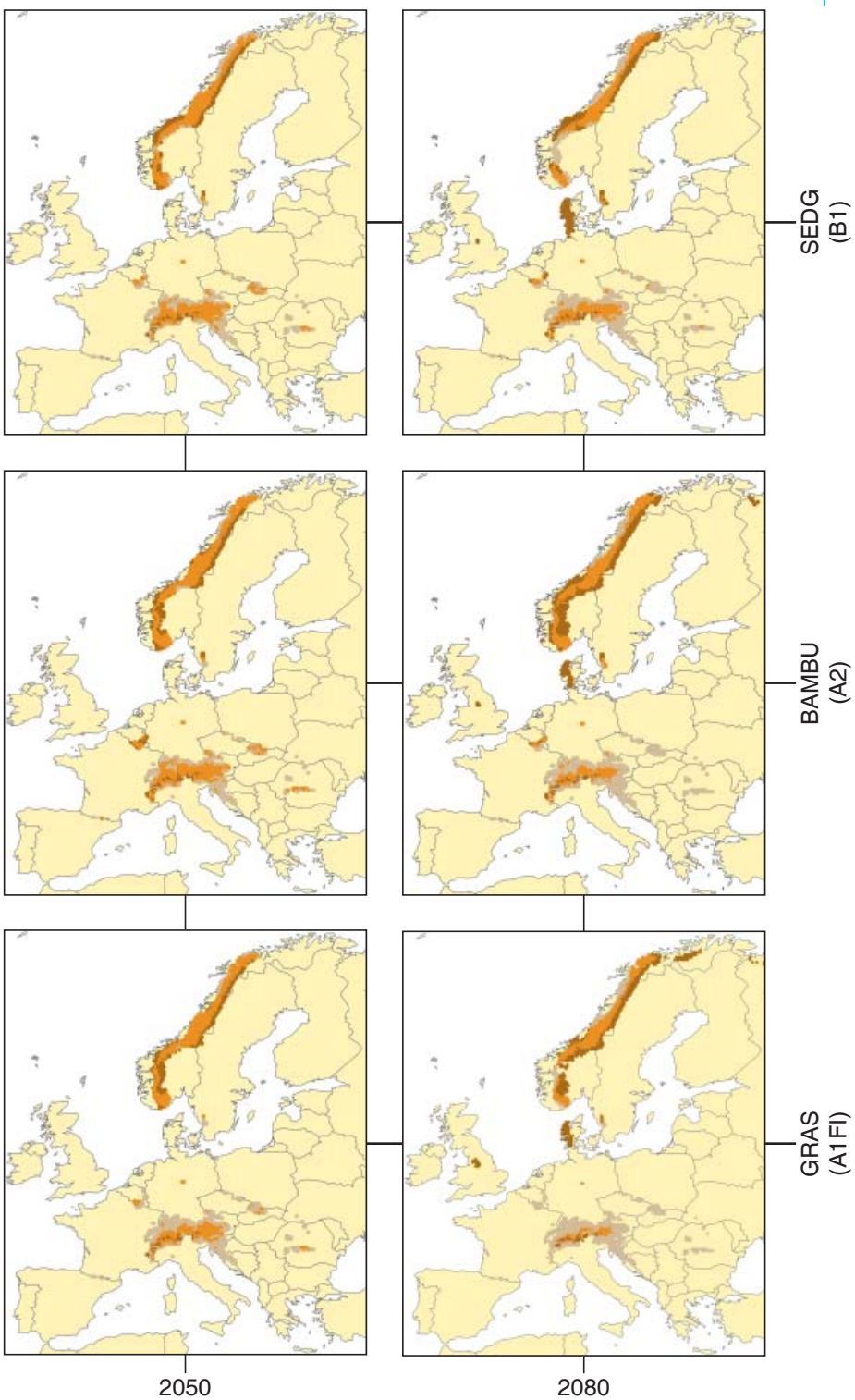
Present distribution can be well explained by climatic variables (AUC = 0.9).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia epiphron (Knoch, 1783) – Mountain Ringlet

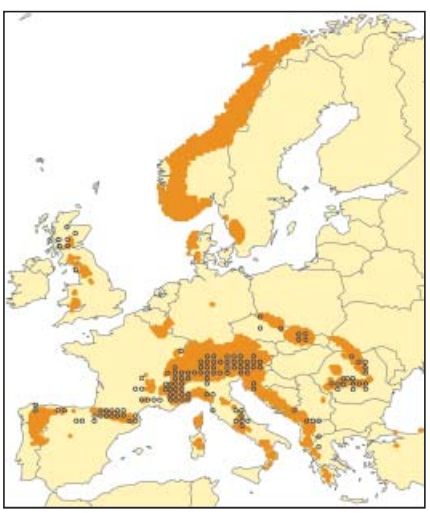
© Rudi Verovnik

		Full dispersal	No dispersal
2050	SEDG	-747 (-23.03%)	-1068 (-32.93%)
	BAMBU	-761 (-23.47%)	-1057 (-32.59%)
	GRAS	-980 (-30.22%)	-1321 (-40.73%)
2080	SEDG	-524 (-16.16%)	-1317 (-40.61%)
	BAMBU	-717 (-22.11%)	-1526 (-47.06%)
	GRAS	-679 (-20.94%)	-1837 (-56.65%)

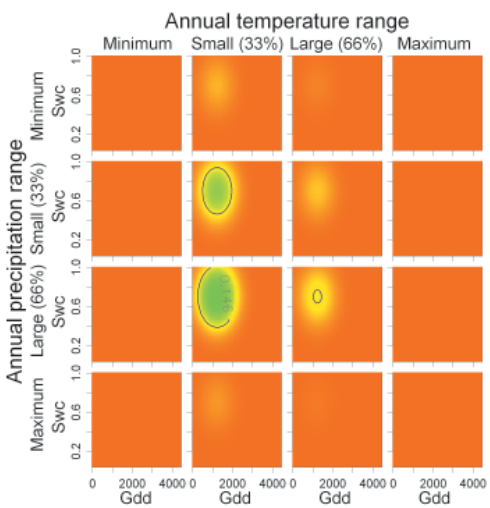
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 3243)

The Mountain Ringlet inhabits mountainous areas that are snow-covered in winter. It is found on damp grasslands and rough vegetation, often in the shelter of a slope or woodland edge. The female lays her eggs on various grasses and sedges, including fescues (*Festuca* spp.), Mat-grass (*Nardus stricta*), and Heath-grass (*Danthonia decumbens*). The caterpillar hibernates twice. It completes the first larval instar before hibernating the first time. By the end of the summer it reaches the last but one stage before hibernating again. The following year, it pupates in the summer, and the butterfly emerges. The Mountain Ringlet is a very variable butterfly with many local and regional subspecies and forms.

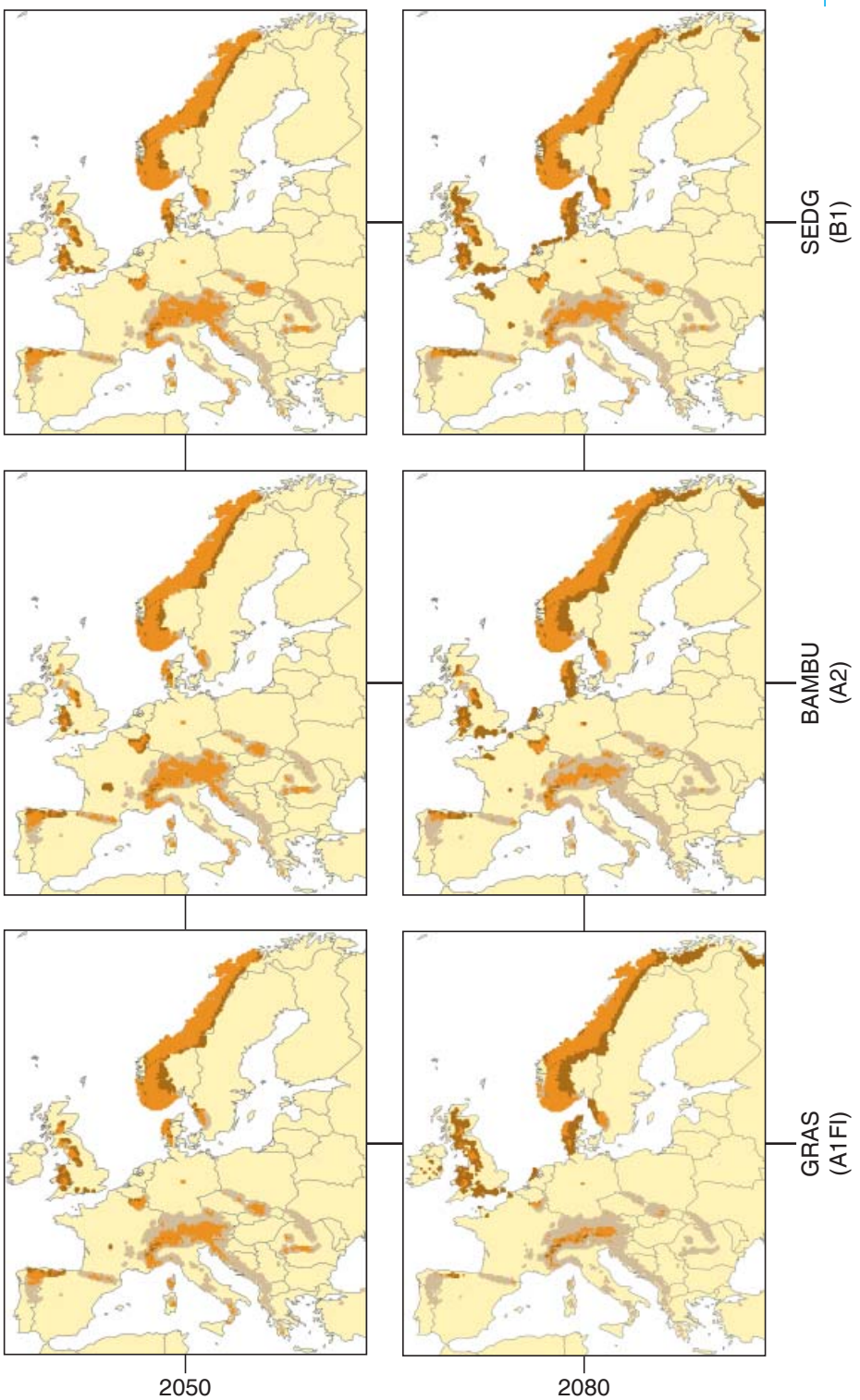
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.84). Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia pharte (Hübner, 1804) – Blind Ringlet

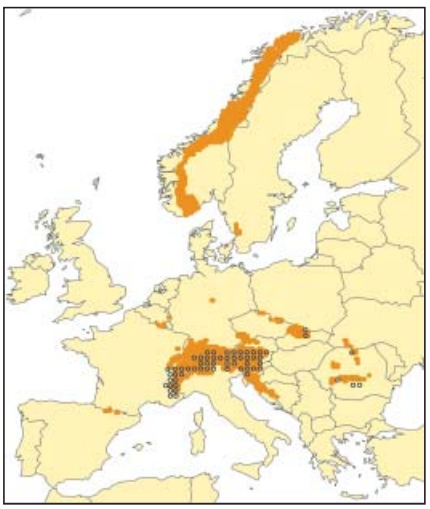
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-284 (-20.94%)	-487 (-35.91%)
	BAMBU	-212 (-15.63%)	-429 (-31.64%)
	GRAS	-337 (-24.85%)	-542 (-39.97%)
2080	SEDG	-428 (-31.56%)	-679 (-50.07%)
	BAMBU	-269 (-19.84%)	-666 (-49.12%)
	GRAS	-426 (-31.42%)	-832 (-61.36%)

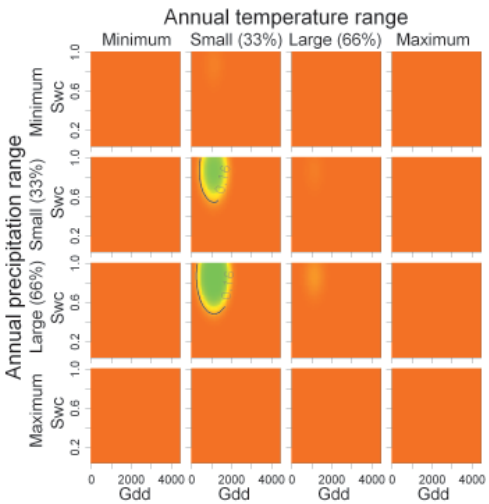
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1356)

This Ringlet owes its rather odd name to the absence of eye-spots on both surfaces of the wings. The Blind Ringlet occurs both on dry and damp grasslands, especially where the vegetation is tall, and in grassy places at the edge of woodland. Above the tree-line, they occur mainly on dry vegetation. They have various foodplants, depending on the habitat. In dry places, the caterpillars can be found on Mat-grass (*Nardus stricta*), *Festuca quadriflora*, and Sheep's Fescue (*F. ovina*), and in damper places in the shade on Red Fescue (*F. rubra*), Glaucous Sedge (*Carex flacca*), and *C. ferruginea*. The caterpillar hibernates twice, pupating at the end of May between spun grass stalks.

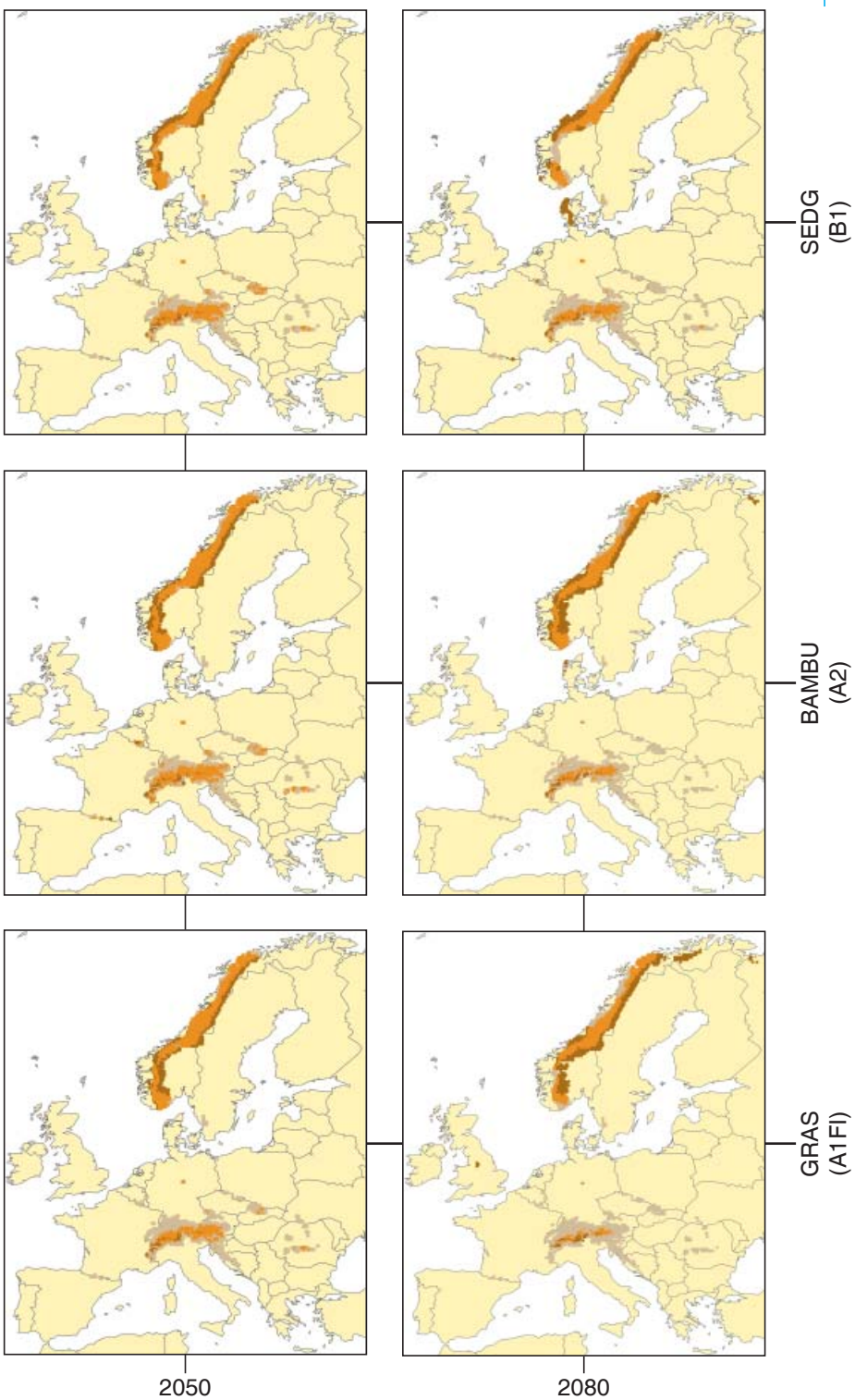
Present distribution can be well explained by climatic variables (AUC = 0.89).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia melampus (Fuessli, 1775) – Lesser Mountain Ringlet

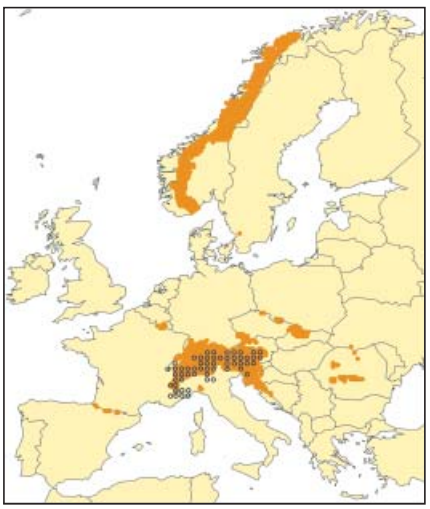
© Martin Wiemers

		Full dispersal	No dispersal
2050	SEDG	-333 (-23.43%)	-444 (-31.25%)
	BAMBU	-244 (-17.17%)	-389 (-27.38%)
	GRAS	-413 (-29.06%)	-520 (-36.59%)
2080	SEDG	-499 (-35.12%)	-740 (-52.08%)
	BAMBU	-379 (-26.67%)	-686 (-48.28%)
	GRAS	-588 (-41.38%)	-917 (-64.53%)

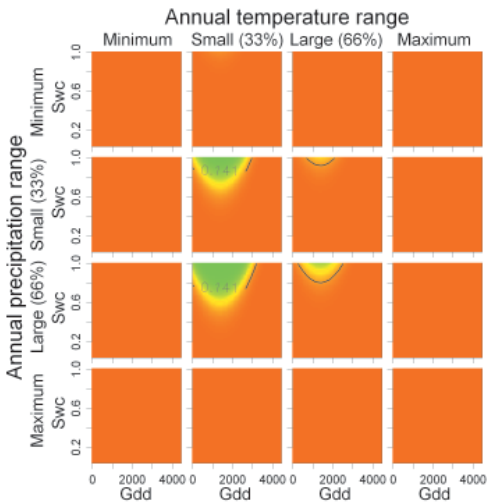
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1421)

The Lesser Mountain Ringlet occurs in many different biotopes. It can be found on wet grasslands, pastures and meadows, on dry, nutrient-poor grasslands in light woodland, on dry grasslands with bracken, and above the tree-line on alpine grasslands. Because of the wide choice in biotope, this butterfly is common throughout the Alps. In the time up to hibernation, the caterpillars feed during the day. After hibernating, they are only active at night. They can be found on Wood Meadow-grass (*Poa nemoralis*), Sweet Vernal-grass (*Anthoxanthum odoratum*), and Sheep's Fescue (*Festuca ovina*). The development from egg to butterfly takes one year.

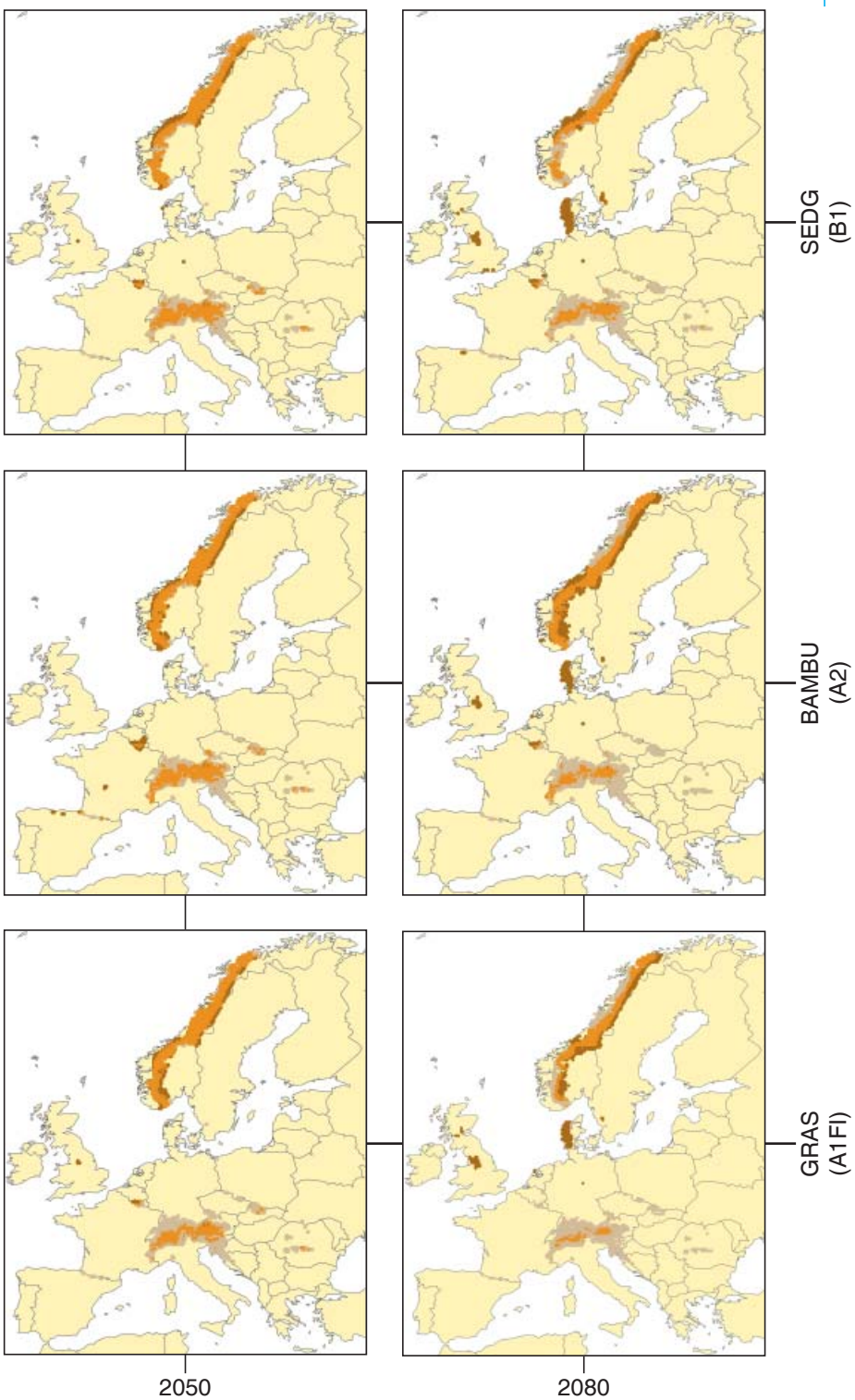
Present distribution can be very well explained by climatic variables (AUC = 0.98).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia aethiops (Esper, 1777) – Scotch Argus

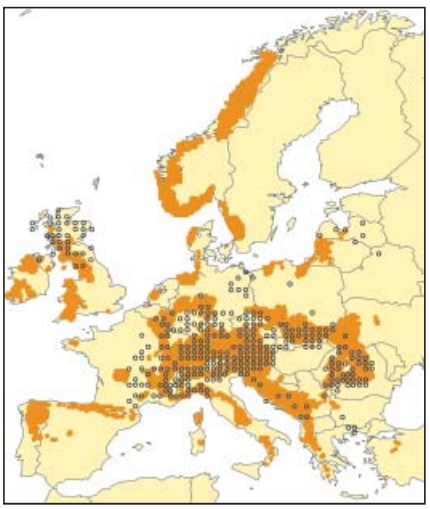
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-968 (-21.4%)	-1883 (-41.63%)
	BAMBU	-519 (-11.47%)	-1542 (-34.09%)
	GRAS	-1395 (-30.84%)	-2226 (-49.22%)
2080	SEDG	491 (10.86%)	-1899 (-41.99%)
	BAMBU	316 (6.99%)	-2318 (-51.25%)
	GRAS	548 (12.12%)	-2876 (-63.59%)

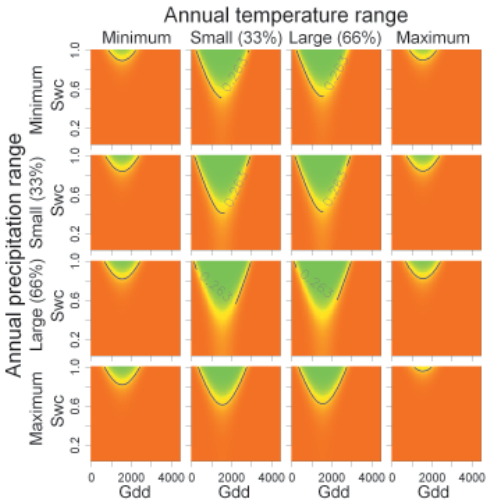
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 4523)

The Scotch Argus can be found in a wide variety of habitats. It inhabits flower-rich grasslands and grassy woodland clearings, and can also be found on heathland, bogs and marshy areas with very open woodland. Many different grasses can be used as a foodplant, such as Purple Moor-grass (*Molinea caerulea*), Blue Moor-grass (*Sesleria albicans*), Tor-grass (*Brachypodium pinnatum*), Cock's-foot (*Dactylus glomerata*), fescues (*Festuca* spp.), cat's-tails (*Phleum* spp.), Sweet Vernal-grass (*Anthoxanthum odoratum*), and Quaking Grass (*Briza media*), and also sedges (*Carex* spp.). The caterpillar hibernates in the second or third larval instar. It pupates in the litter layer, and is single-brooded.

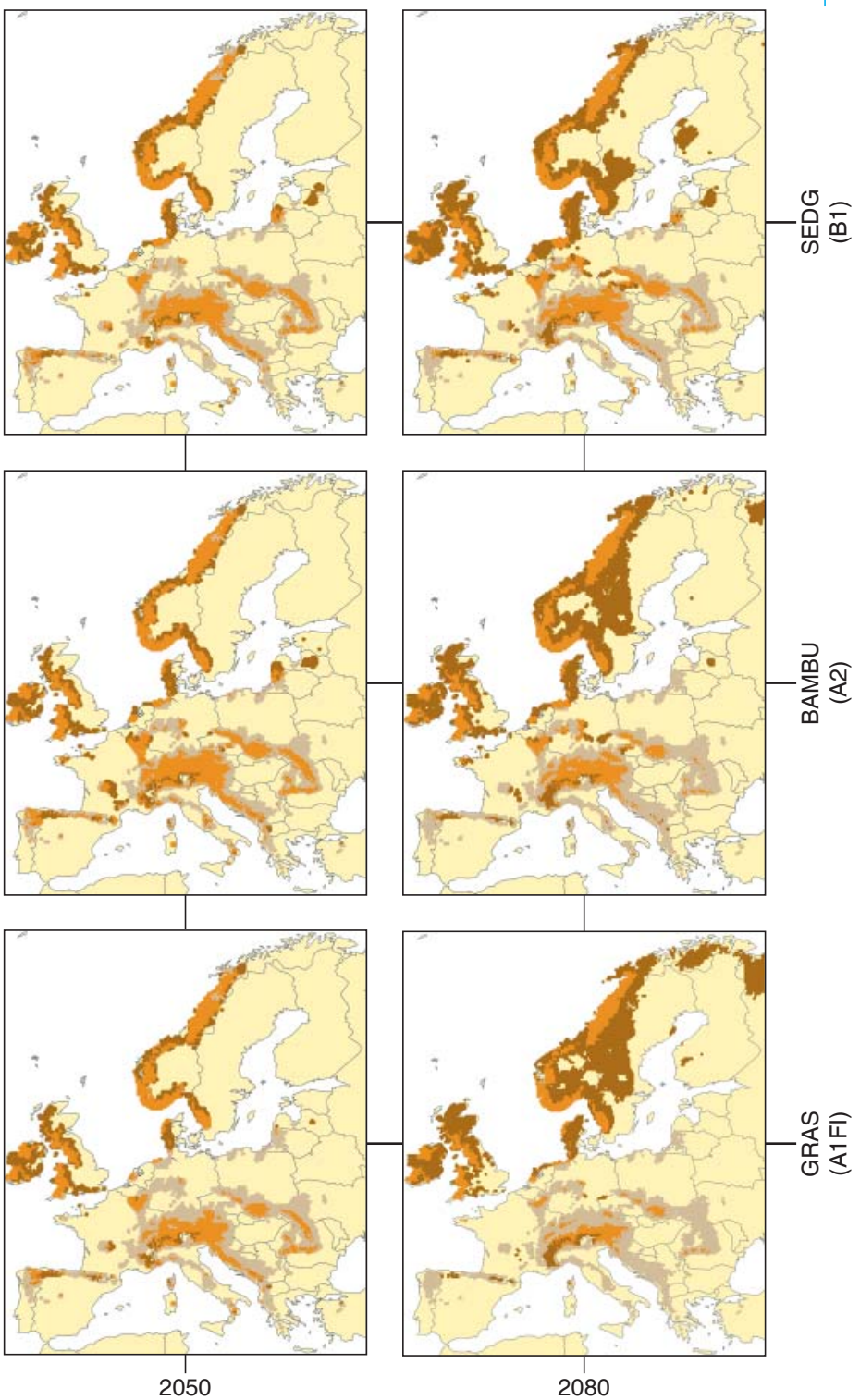
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.82). Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia triaria (Prunner, 1798) – de Prunner's Ringlet

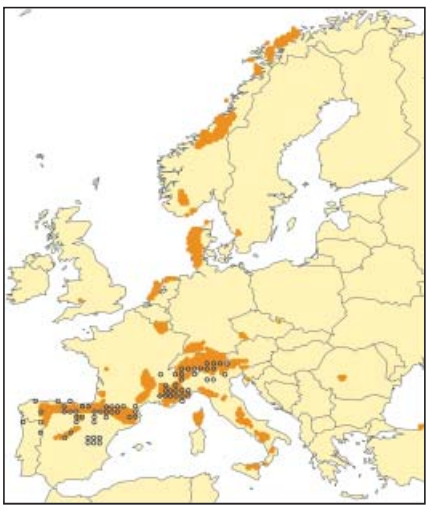
© Bernard Fransen

		Full dispersal	No dispersal
2050	SEDG	70 (5.99%)	-590 (-50.47%)
	BAMBU	7 (0.6%)	-608 (-52.01%)
	GRAS	-66 (-5.65%)	-690 (-59.02%)
2080	SEDG	-255 (-21.81%)	-877 (-75.02%)
	BAMBU	-236 (-20.19%)	-847 (-72.46%)
	GRAS	-285 (-24.38%)	-943 (-80.67%)

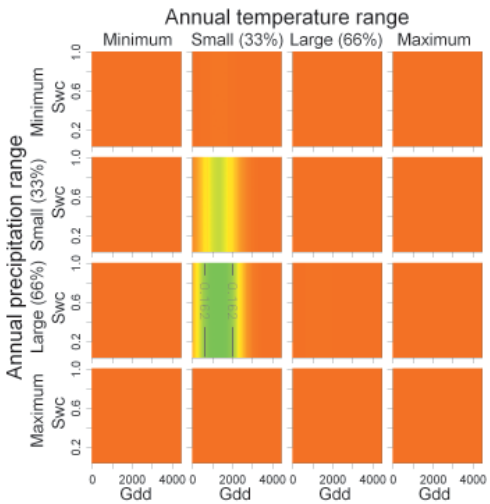
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1169)

In the Alps, de Prunner's Ringlet is found on very dry grasslands with scattered rocks, whereas more to the south it occurs in clearings in woods growing on rocky ground, in Spain in clearings in pine forests on limestone. Its foodplants are Sheep's-fescue (*Festuca ovina*), Smooth Meadow-grass (*Poa pratensis*), Alpine Meadow-grass (*P. alpina*), and Feather-grass (*Stipa pinnata*). It hibernates as a caterpillar and has one brood a year.

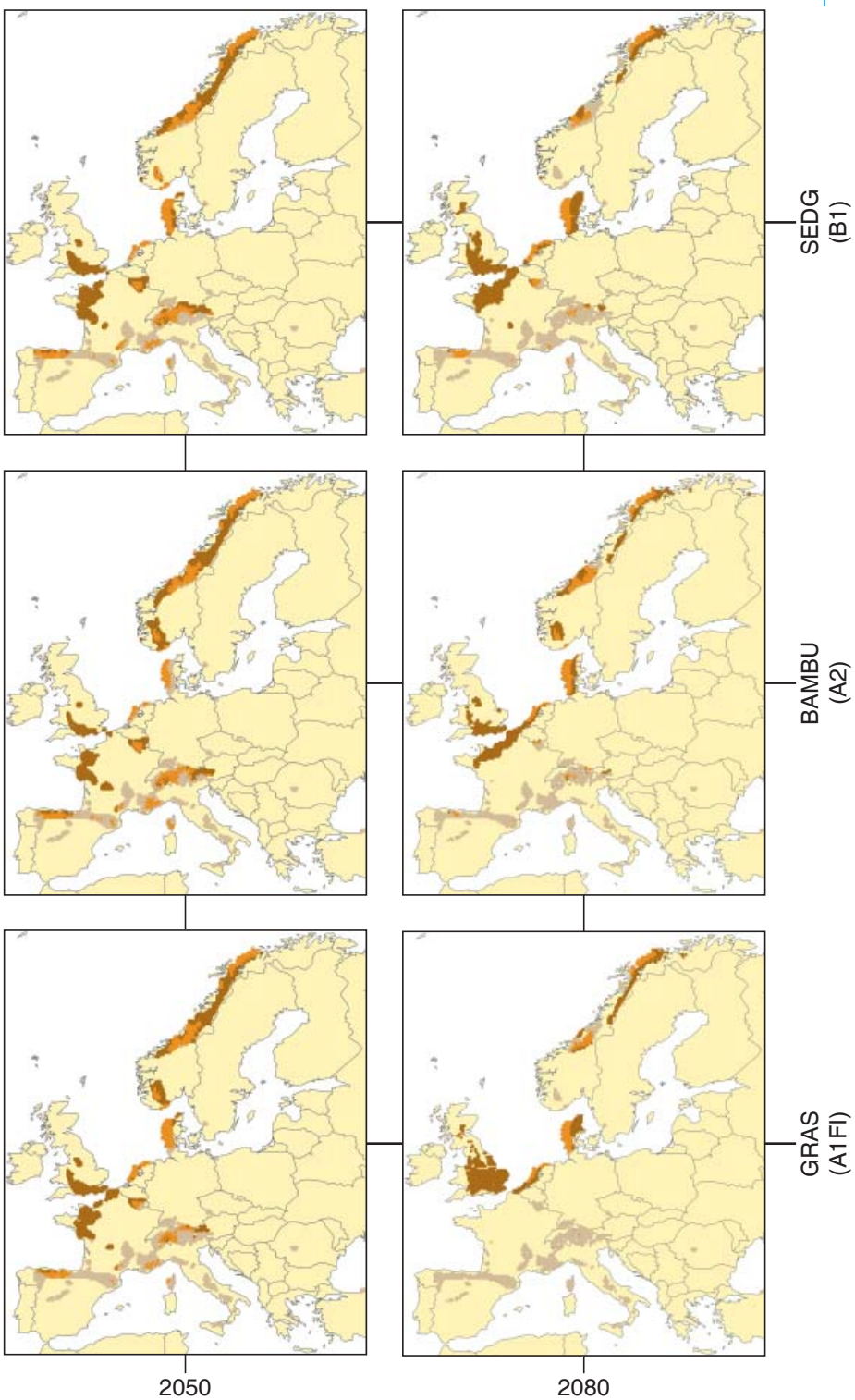
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.81). Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia embla (Becklin, 1791) – Lapland Ringlet

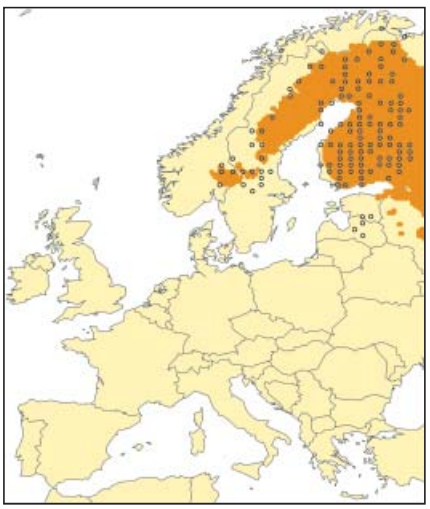
© Jostein Engdal

		Full dispersal	No dispersal
2050	SEDG	-835 (-21.95%)	-1141 (-29.99%)
	BAMBU	-782 (-20.56%)	-1145 (-30.1%)
	GRAS	-806 (-21.19%)	-1207 (-31.73%)
2080	SEDG	-1583 (-41.61%)	-1864 (-49%)
	BAMBU	-1605 (-42.19%)	-2010 (-52.84%)
	GRAS	-2238 (-58.83%)	-2592 (-68.14%)

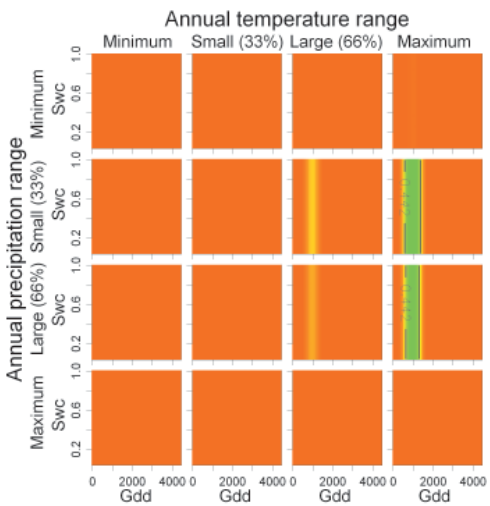
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 3804)

The Lapland Ringlet inhabits bogs and marshes with sedges and grasses, and scattered groups of willows and myrtle. The marshes are often situated in coniferous or birch woods. Its foodplants are probably sedges (*Carex* spp.), Tufted Hair-grass (*Deschampsia cespitosa*), and Bog Hair-grass (*D. setacea*). These butterflies are difficult to find because they are shy and always occur in low numbers. Also, their habitat is very inaccessible. The development of the Lapland Ringlet takes two years.

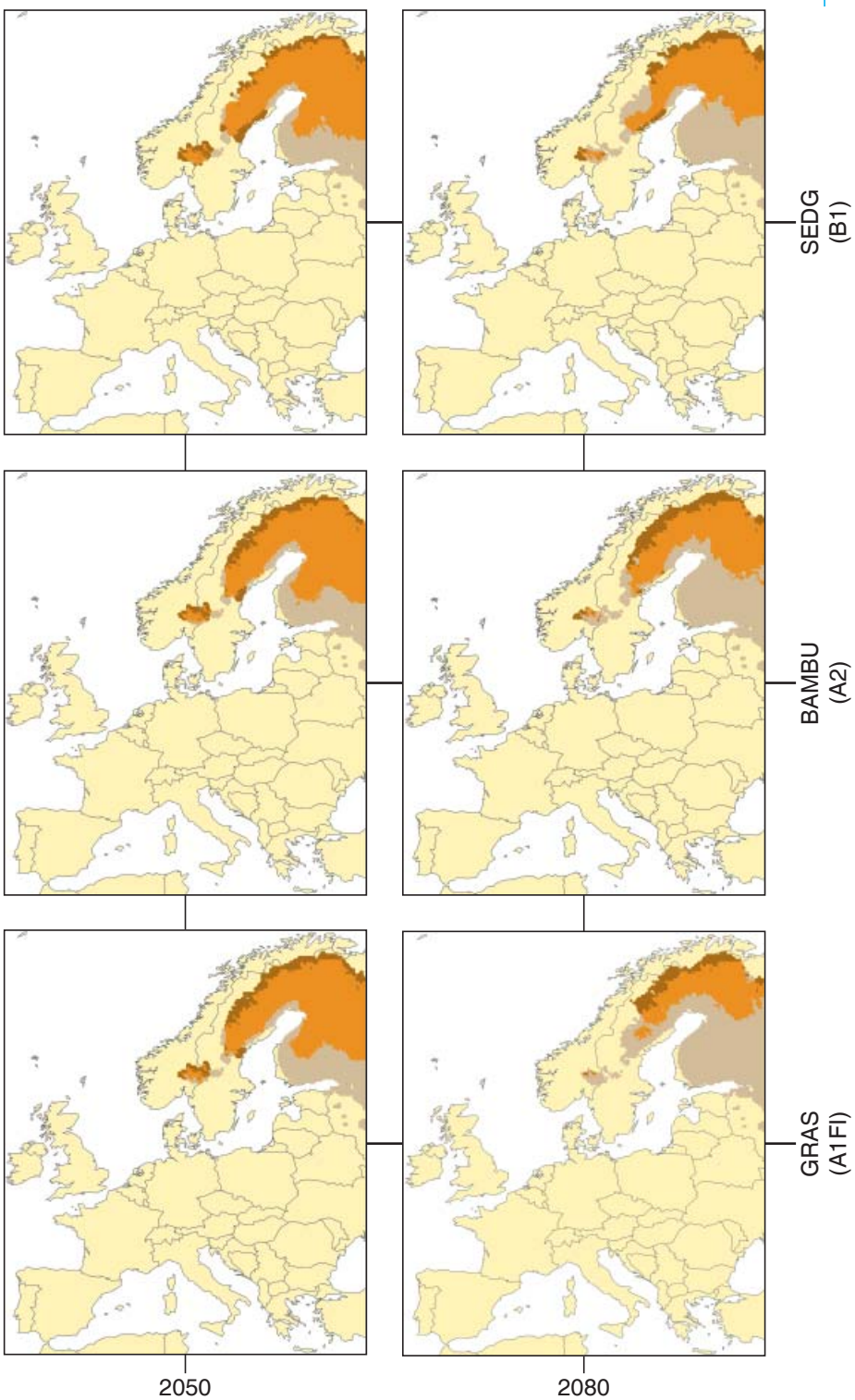
Present distribution can be very well explained by climatic variables (AUC = 0.97).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia disa (Becklin, 1791) – Arctic Ringlet

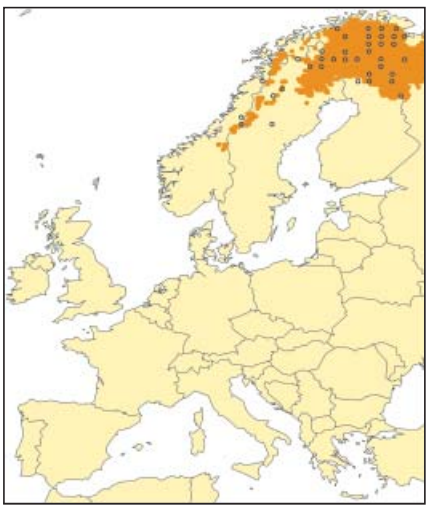
© Jostein Engdal

		Full dispersal	No dispersal
2050	SEDG	-1068 (-72.41%)	-1242 (-84.2%)
	BAMBU	-956 (-64.81%)	-1166 (-79.05%)
	GRAS	-1025 (-69.49%)	-1249 (-84.68%)
2080	SEDG	-1285 (-87.12%)	-1446 (-98.03%)
	BAMBU	-1347 (-91.32%)	-1470 (-99.66%)
	GRAS	-1405 (-95.25%)	-1472 (-99.8%)

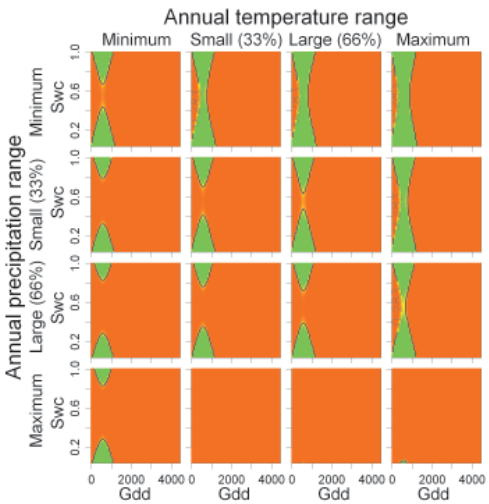
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1475)

Just like the Lapland Ringlet (*E. embla*), the Arctic Ringlet is a marsh butterfly, but the two species do not overlap, the Arctic Ringlet avoiding lowland marshes. It occurs above 350 m altitude, on open marshes in woods, namely marshes with a low cover of grasses and sedges without trees or bushes, although surrounded by birch trees. It also occurs at lakesides and near small streams and is also seen in woodland clearings in its search for nectar. Its foodplants are grasses. It takes two years for the egg to develop into a butterfly.

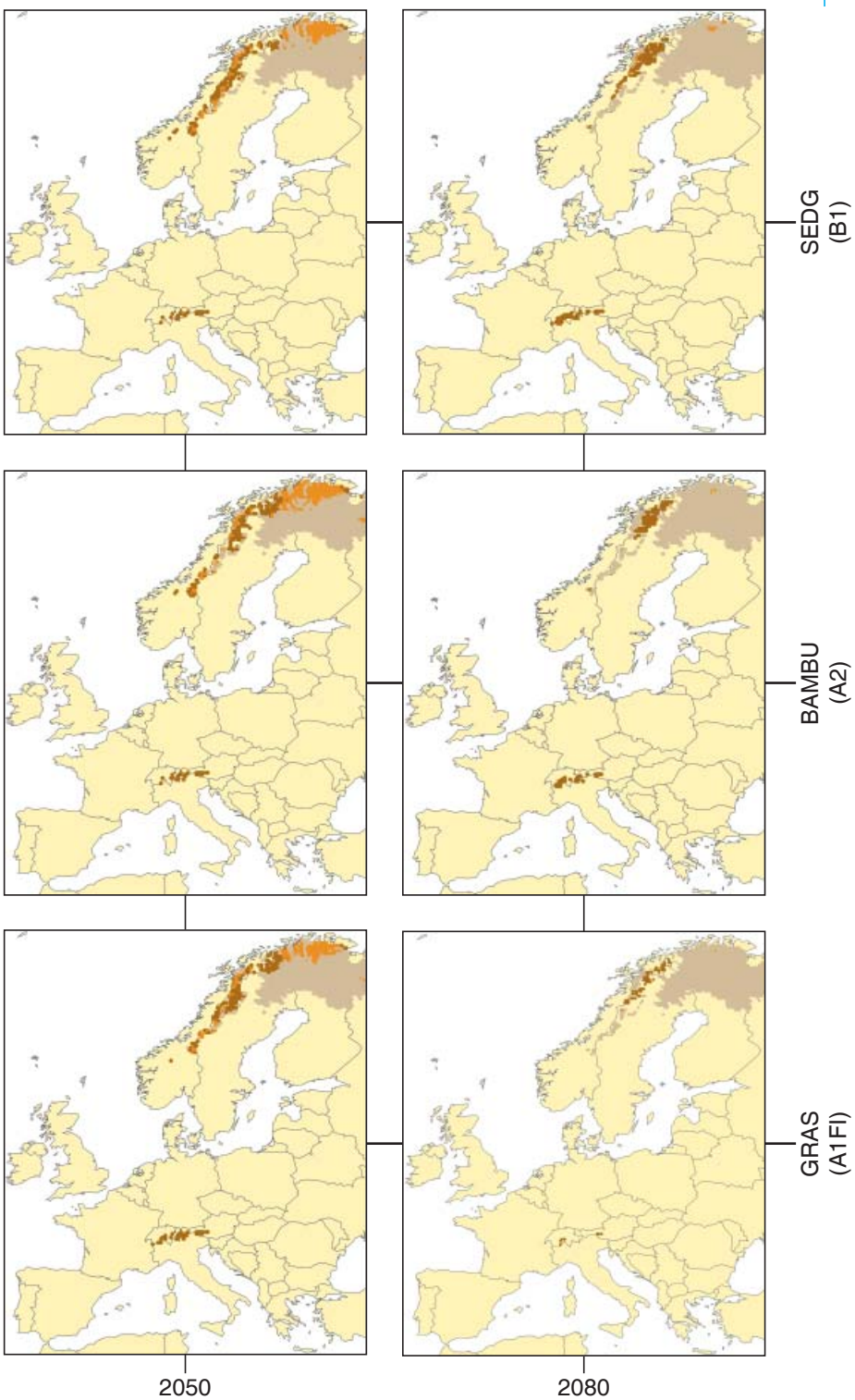
Present distribution can be very well explained by climatic variables (AUC = 0.99).
Climate risk category: HHHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia medusa (Fabricius, 1787) – Woodland Ringlet

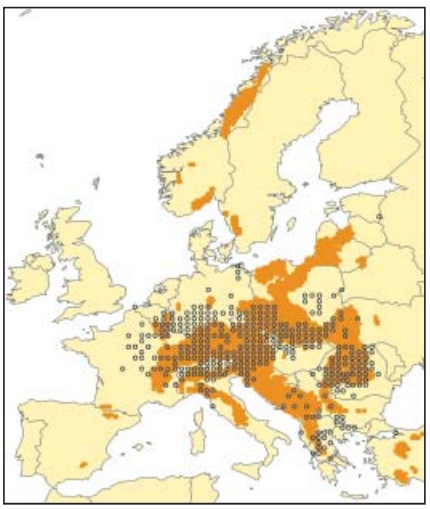
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	-943 (-22.87%)	-1907 (-46.24%)
	BAMBU	-151 (-3.66%)	-1635 (-39.65%)
	GRAS	-1416 (-34.34%)	-2279 (-55.26%)
2080	SEDG	304 (7.37%)	-2199 (-53.32%)
	BAMBU	106 (2.57%)	-2660 (-64.5%)
	GRAS	-111 (-2.69%)	-3288 (-79.73%)

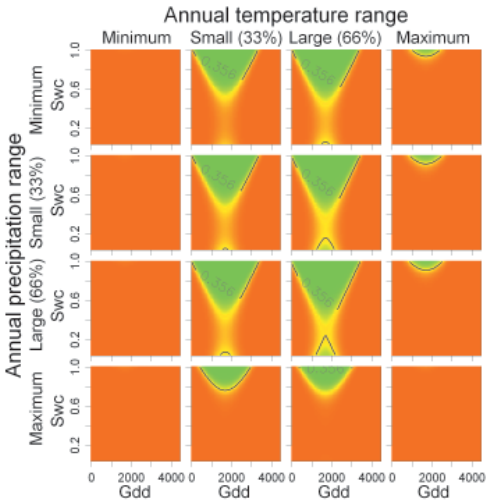
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 4124)

The Woodland Ringlet occurs in many different biotopes. It can be found on damp, flower-rich grasslands and rough vegetation near or in woodland, in marshes, but also on calcareous grasslands. Its foodplants are various grasses, such as Purple Moor-grass (*Molinea caerulea*), fescues (*Festuca* spp.), Tor-grass (*Brachypodium pinnatum*), Upright Brome (*Bromus erectus*), and Wood Millet (*Milium effusum*), and also sedges (*Carex* spp.). The caterpillar is active at night and mostly hibernates when half-grown, but at very high altitudes it may hibernate twice. It pupates in the litter layer. The development takes between one and two years.

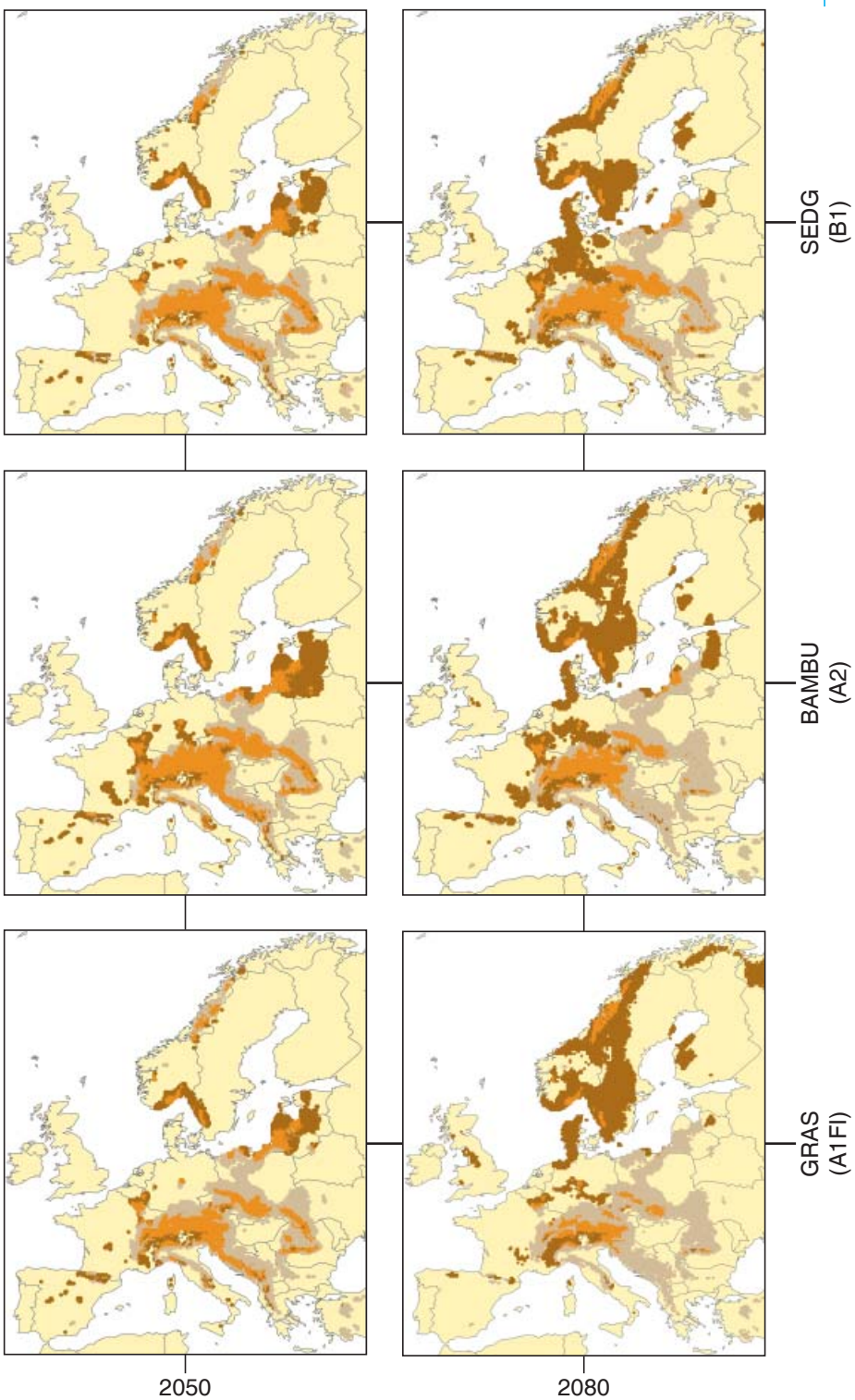
Present distribution can be well explained by climatic variables (AUC = 0.9).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia alberganus (Prunner, 1798) – Almond-eyed Ringlet

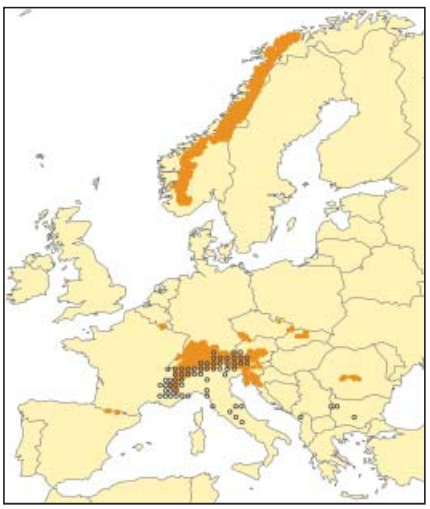
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-208 (-20.29%)	-328 (-32%)
	BAMBU	-95 (-9.27%)	-258 (-25.17%)
	GRAS	-244 (-23.8%)	-352 (-34.34%)
2080	SEDG	-427 (-41.66%)	-585 (-57.07%)
	BAMBU	-276 (-26.93%)	-483 (-47.12%)
	GRAS	-513 (-50.05%)	-685 (-66.83%)

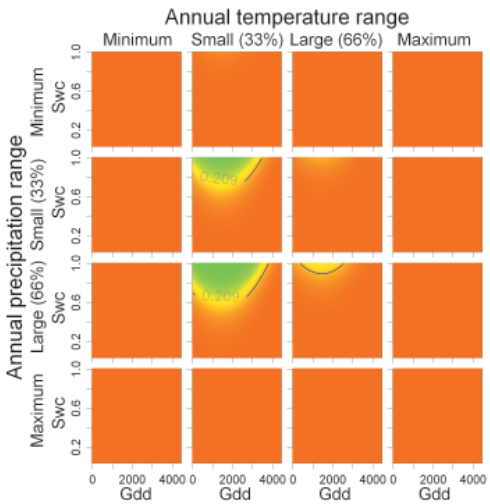
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1025)

The Almond-eyed Ringlet is found on sub-alpine grasslands, and on, sometimes damp, grasslands, in woodland clearings or in the shelter of woods. The butterflies can often be seen on flowers, drinking nectar. On warm days, the males congregate to drink on damp patches. In the Alps, the caterpillars feed on Sheep's Fescue (*Festuca ovina*) and Sweet Vernal-grass (*Anthoxanthum odoratum*). They hibernate when half-grown, and pupate at the end of the following spring.

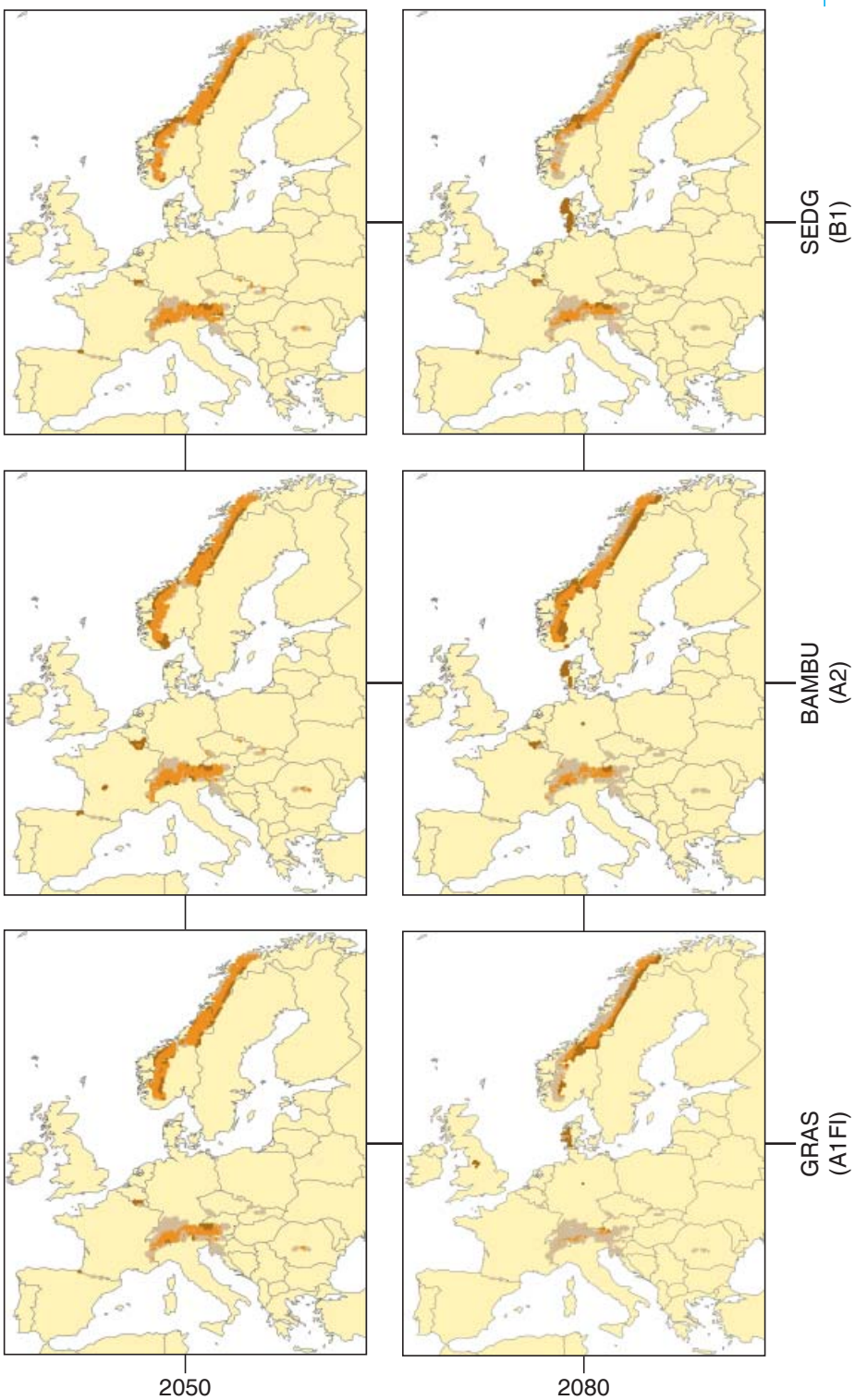
Present distribution can be well explained by climatic variables (AUC = 0.87).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia pluto (Prunner, 1798) – Sooty Ringlet

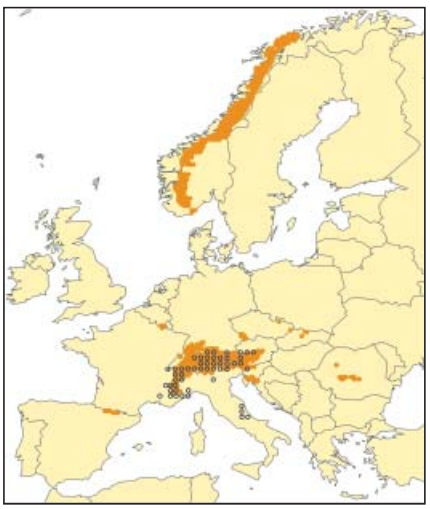
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-189 (-21.4%)	-306 (-34.65%)
	BAMBU	-145 (-16.42%)	-274 (-31.03%)
	GRAS	-239 (-27.07%)	-353 (-39.98%)
2080	SEDG	-437 (-49.49%)	-597 (-67.61%)
	BAMBU	-285 (-32.28%)	-467 (-52.89%)
	GRAS	-468 (-53%)	-648 (-73.39%)

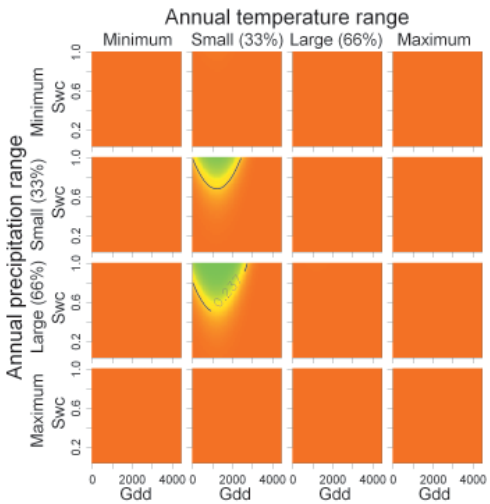
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 883)

The Sooty Ringlet is a butterfly of mountainous areas with everlasting snows and glaciers. It occurs high up, on steep screes and moraines, breeding on patches with a mosaic of sparse vegetation and small stones. The female deposits the pale-coloured eggs on mostly light-coloured stones. Once the caterpillar has emerged from the egg, it sometimes has to travel some distance before finding one of the grasses it uses as a foodplant. Caterpillars have been found on the fescues *Festuca halleri* and *F. quadriflora*, as well as on Annual Meadow-grass (*Poa annua*). The caterpillars take two or possibly three years to develop.

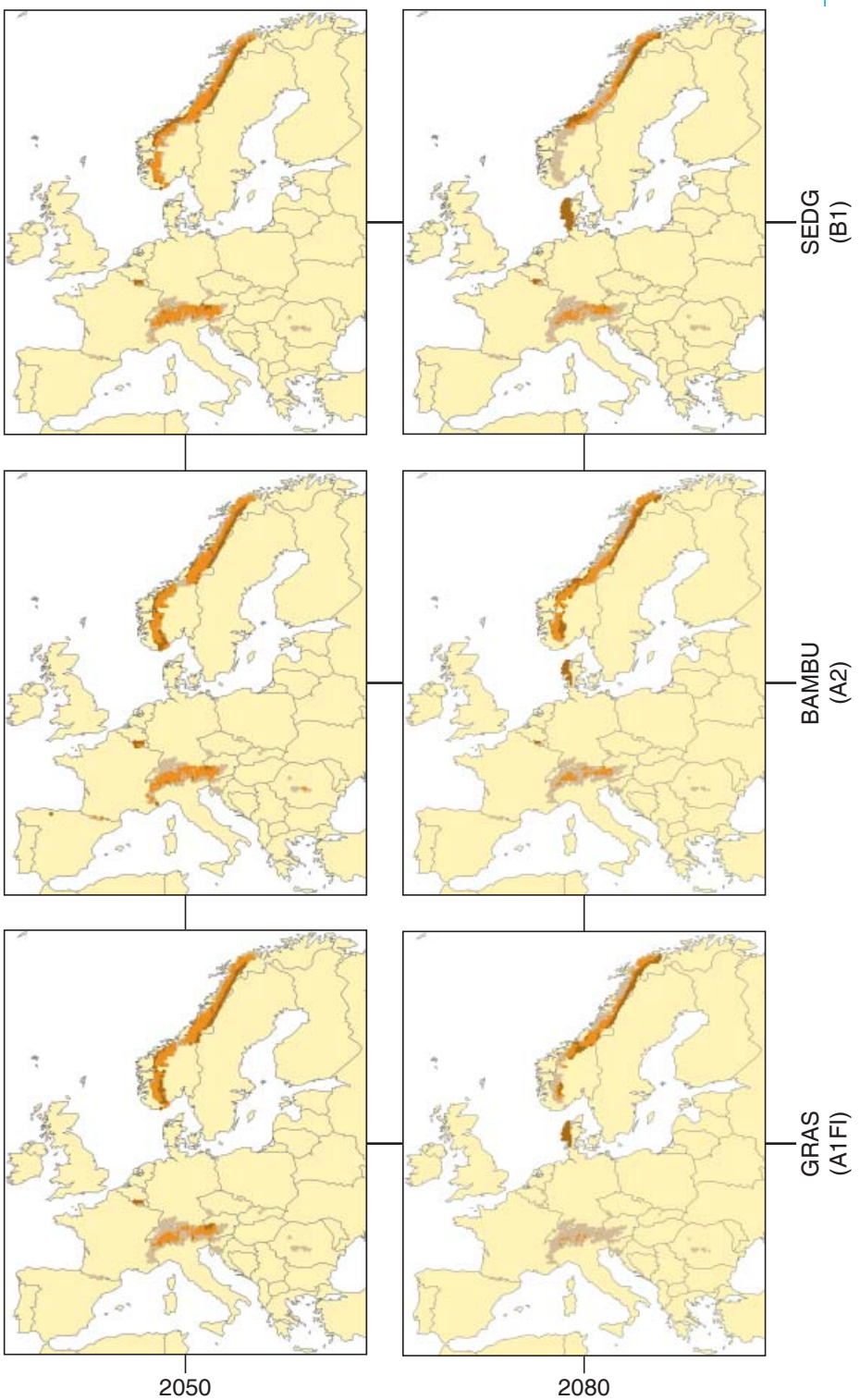
Present distribution can be very well explained by climatic variables (AUC = 0.98).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia gorge (Esper, 1805) – Silky Ringlet

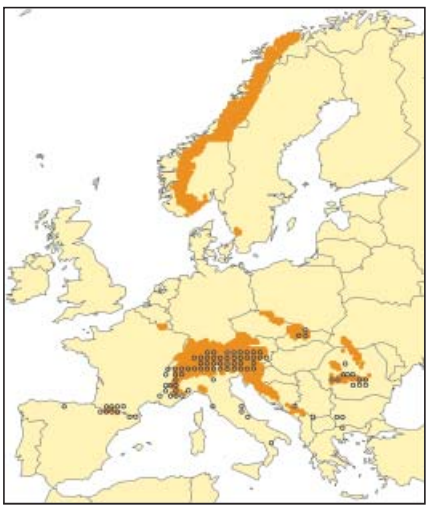
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-452 (-26.49%)	-578 (-33.88%)
	BAMBU	-375 (-21.98%)	-538 (-31.54%)
	GRAS	-602 (-35.29%)	-717 (-42.03%)
2080	SEDG	-587 (-34.41%)	-884 (-51.82%)
	BAMBU	-534 (-31.3%)	-900 (-52.75%)
	GRAS	-721 (-42.26%)	-1128 (-66.12%)

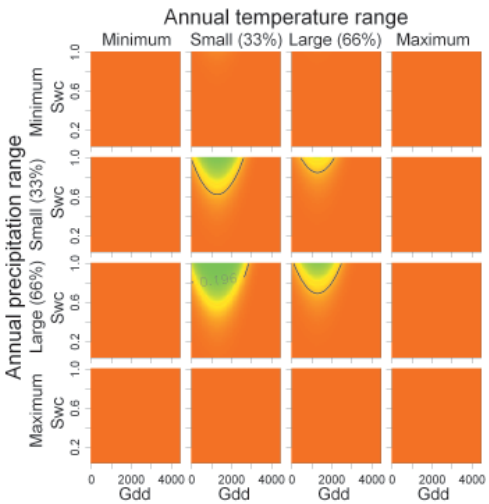
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1706)

The Silky Ringlet can be found on screes, sunny, rocky slopes, and dry grasslands with scattered rocks. The butterflies often bask in the sun on stones, but, their wings closed, they are hardly noticeable. They are rarely seen visiting flowers. The caterpillars are found on fescues (*Festuca* spp.), Alpine Meadow-grass (*Poa alpina*), *P. minor,* and Blue Moor-grass (*Sesleria albicans*). The caterpillars take two years to develop.

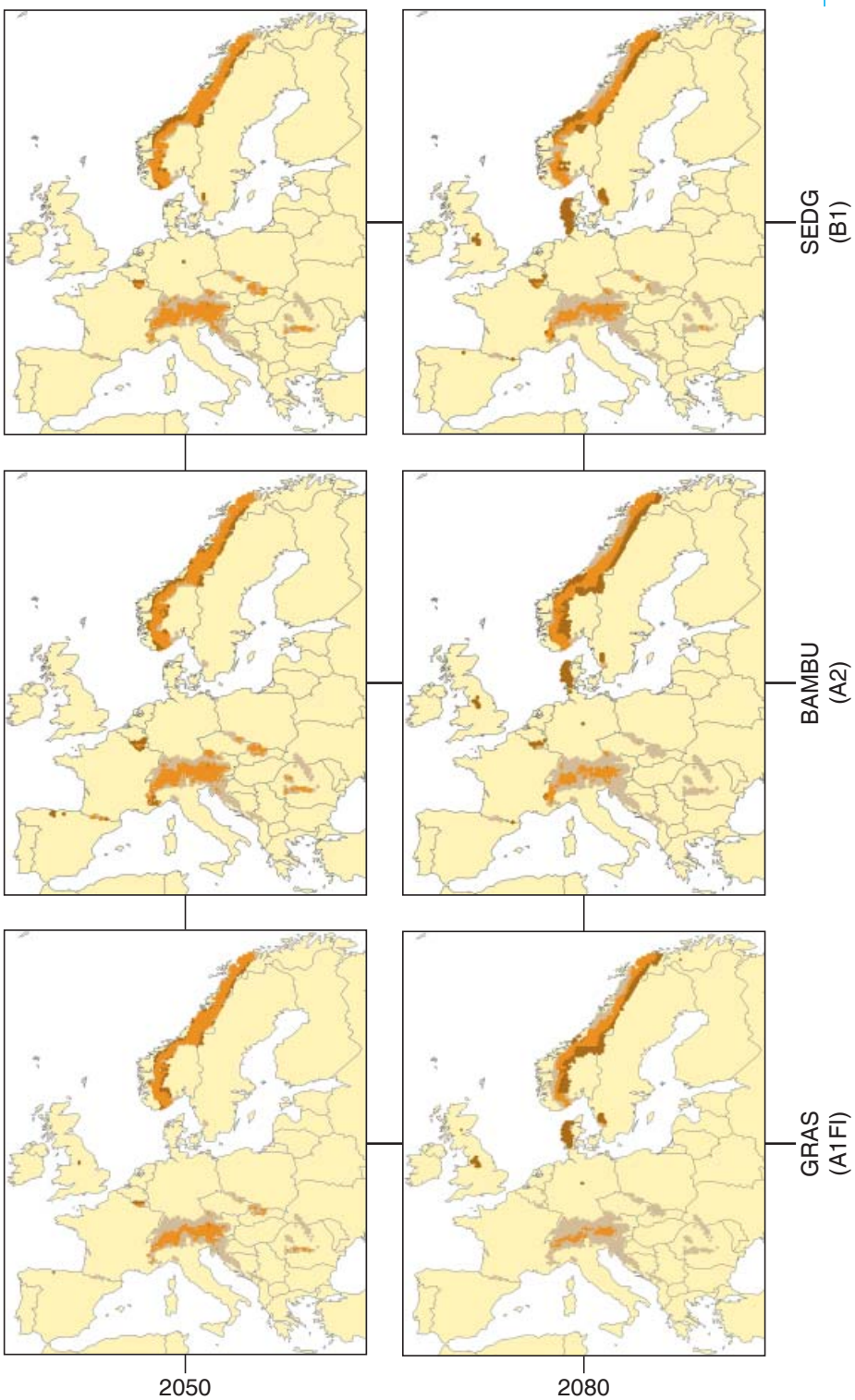
Present distribution can be well explained by climatic variables (AUC = 0.88).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia mnestra (Esper, 1805) – Mnestra's Ringlet

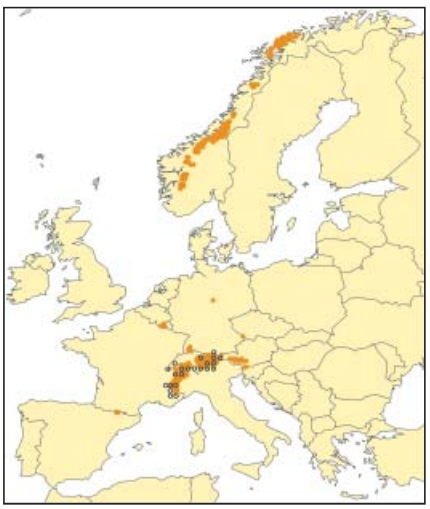
© Martin Wiemers

		Full dispersal	No dispersal
2050	SEDG	72 (25.71%)	-119 (-42.5%)
	BAMBU	160 (57.14%)	-68 (-24.29%)
	GRAS	75 (26.79%)	-108 (-38.57%)
2080	SEDG	-169 (-60.36%)	-216 (-77.14%)
	BAMBU	-69 (-24.64%)	-173 (-61.79%)
	GRAS	-185 (-66.07%)	-241 (-86.07%)

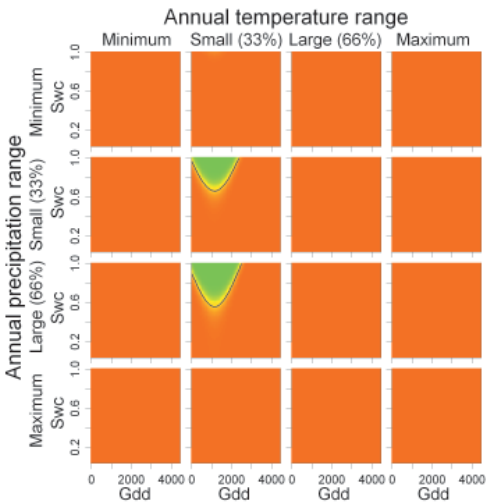
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 280)

Mnestra's Ringlet occurs on sub-alpine and alpine grasslands, especially dry grasslands on steep, sunny slopes. The butterflies are seldom seen on flowers, drinking nectar. The female lays her eggs close to the ground on dry stalks of grass. The plain green caterpillars have been found on fescues (*Festuca* spp.) and also on Blue Moor-grass (*Sesleria albicans*). They hibernate twice.

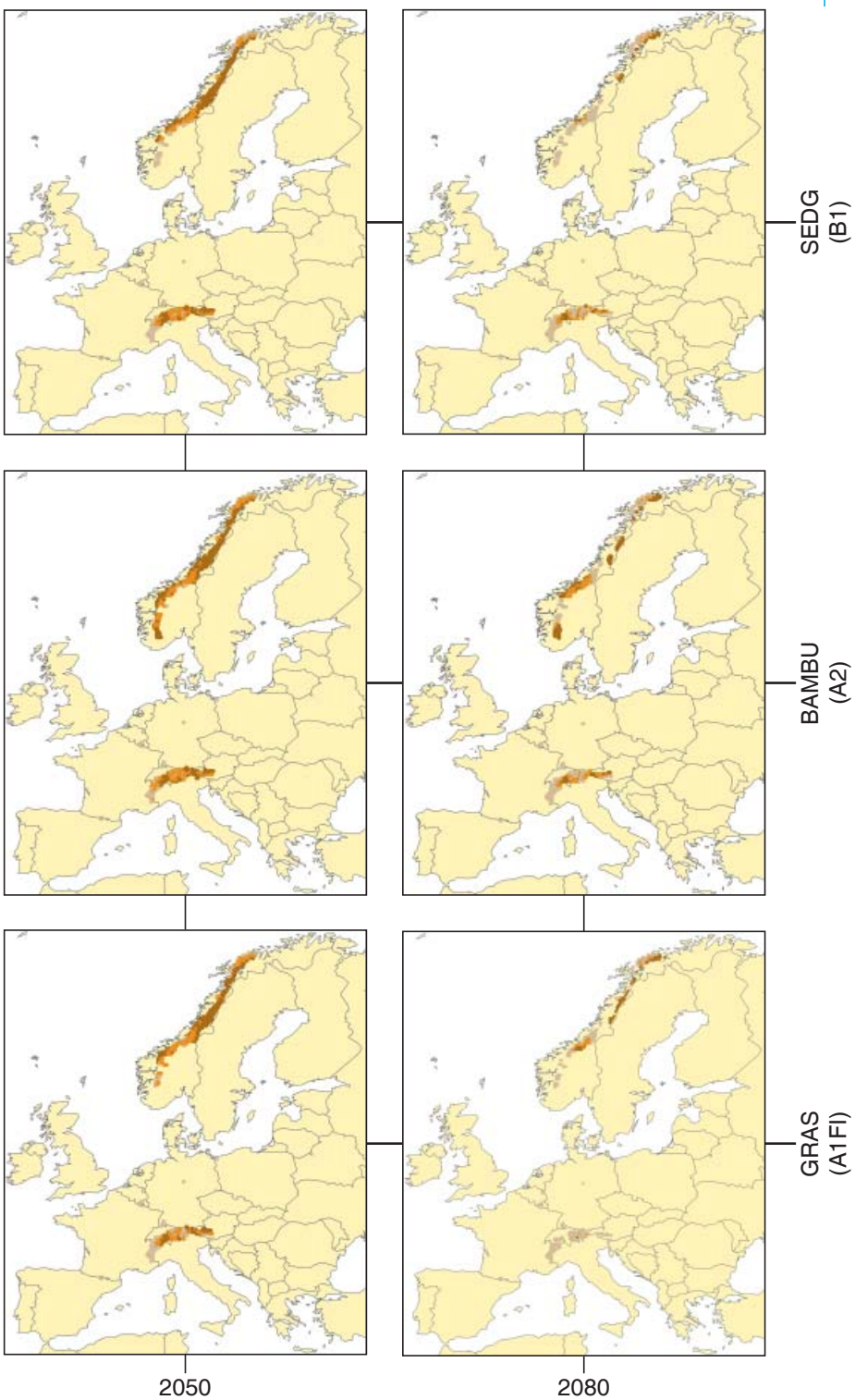
Present distribution can be very well explained by climatic variables (AUC = 0.96).
Climate risk category: HHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia epistygne (Hübner, 1819) – Spring Ringlet

© Bernard Fransen

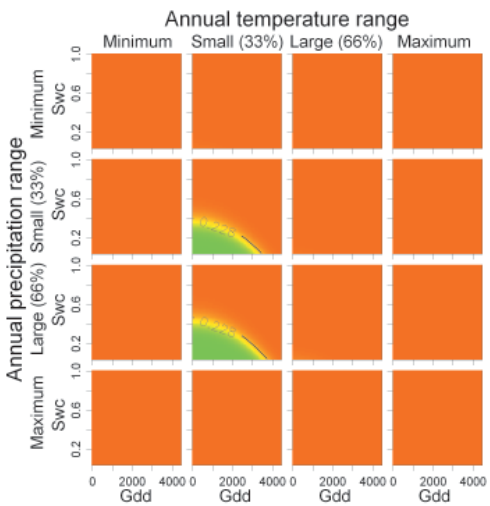
		Full dispersal	No dispersal
2050	SEDG	-137 (-79.65%)	-162 (-94.19%)
	BAMBU	-165 (-95.93%)	-167 (-97.09%)
	GRAS	-165 (-95.93%)	-170 (-98.84%)
2080	SEDG	-166 (-96.51%)	-172 (-100%)
	BAMBU	-172 (-100%)	-172 (-100%)
	GRAS	-172 (-100%)	-172 (-100%)

Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 172)

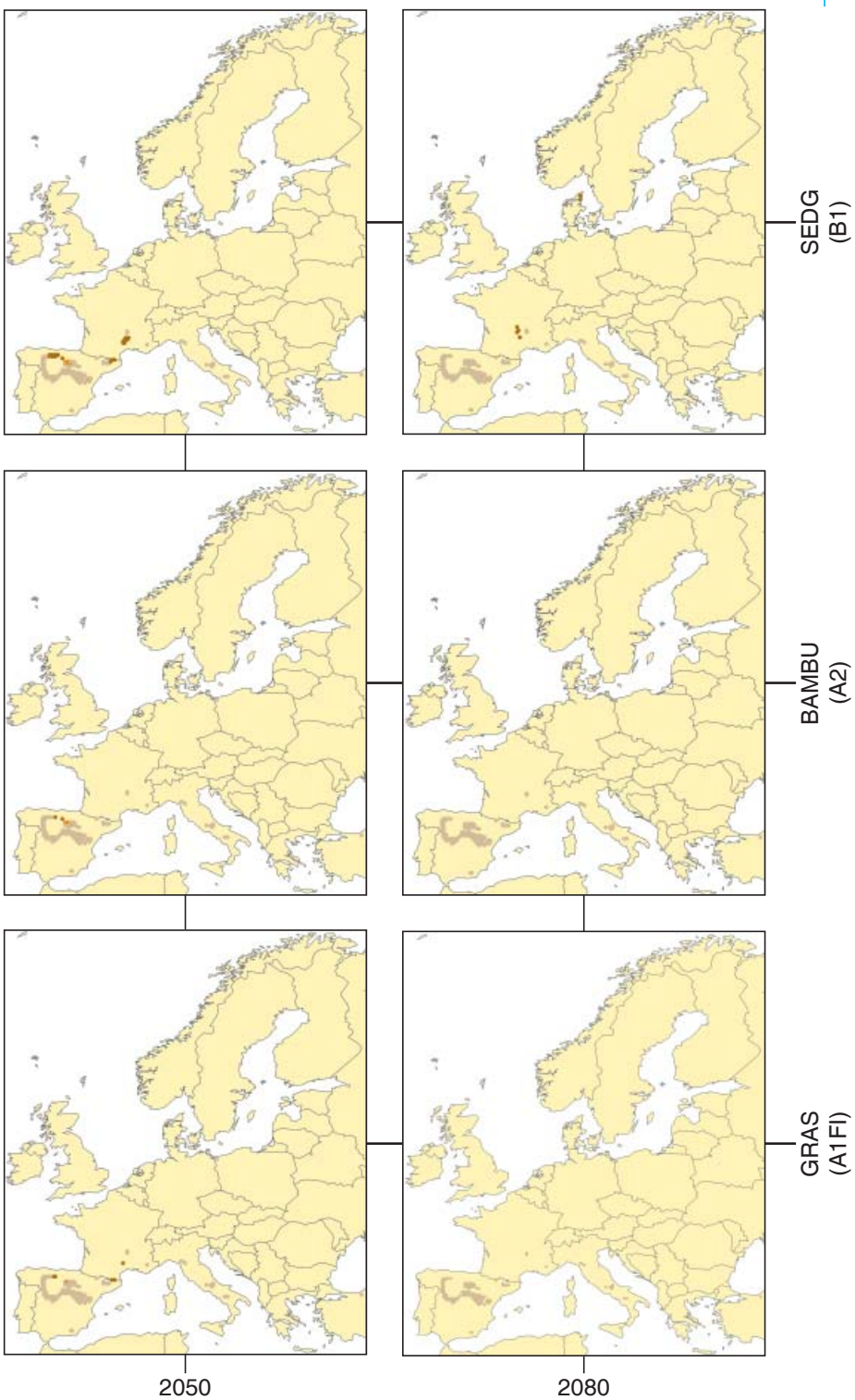
The Spring Ringlet appears in the early spring in grassy, rocky clearings in light woodland. The Spanish populations in the Montes Universales occur in clearings or on level ground in light pinewoods on calcareous soil, on short, grassy vegetation with low shrubs and scattered rocks. The main foodplant is Sheep's-fescue (*Festuca ovina*), but other fescues and meadow-grasses (*Poa* spp.) have also been named as foodplants. *E. epistygne* has one generation per year.

Present distribution can be well explained by climatic variables (AUC = 0.91).
Climate risk category: HHHR.

Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia ottomana (Herrich-Schäffer, 1847) – Ottoman Brassy Ringlet

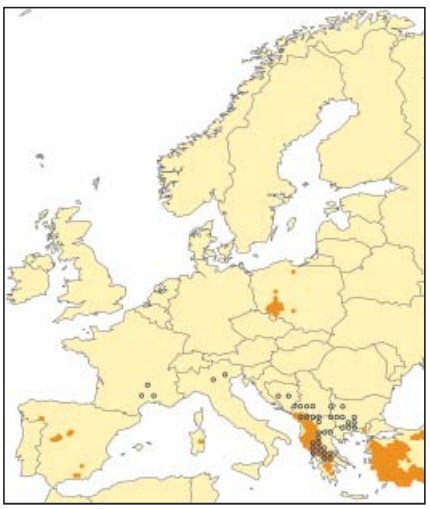
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-69 (-10.94%)	-240 (-38.03%)
	BAMBU	-144 (-22.82%)	-297 (-47.07%)
	GRAS	-95 (-15.06%)	-304 (-48.18%)
2080	SEDG	193 (30.59%)	-212 (-33.6%)
	BAMBU	-158 (-25.04%)	-431 (-68.3%)
	GRAS	-118 (-18.7%)	-476 (-75.44%)

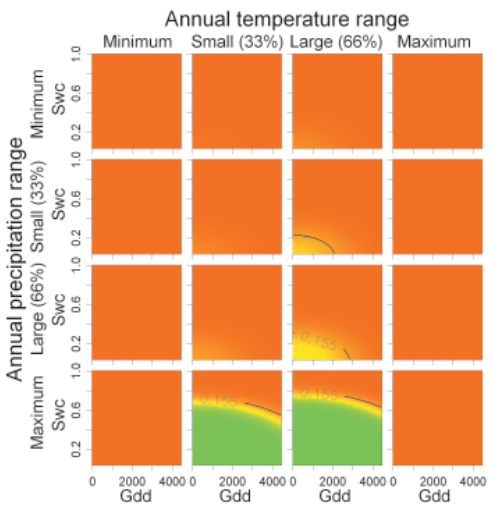
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 631)

In the mountains, the Ottoman Brassy Ringlet occurs on slopes and level ground with grassy vegetation. At lower altitudes, it is found in woodland clearings. The caterpillars feed on Sheep's-fescue (*Festuca ovina*) and other fine-leaved grasses. It is single-brooded.

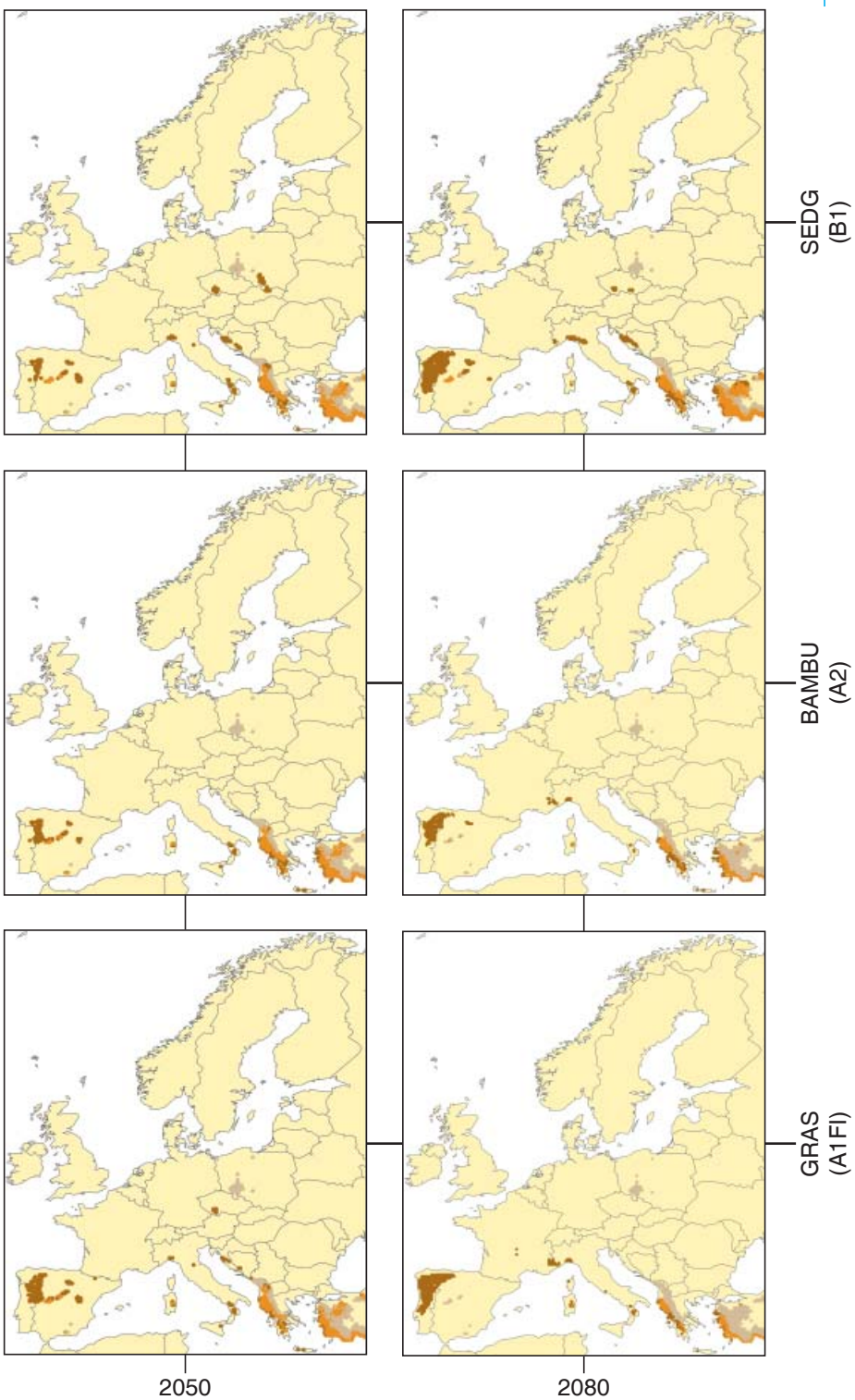
Present distribution can be explained by climatic variables to quite some extent (AUC = 0.81). Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia tyndarus (Esper, 1781) – Swiss Brassy Ringlet

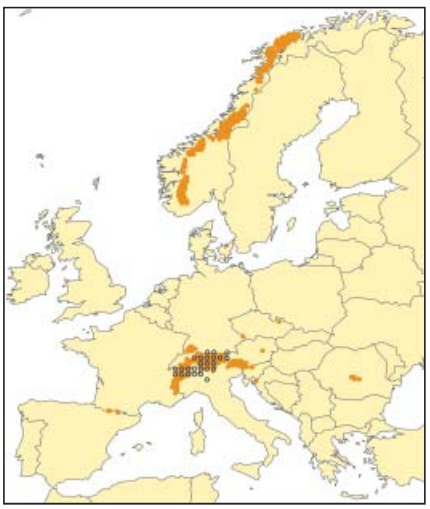
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-24 (-5.52%)	-205 (-47.13%)
	BAMBU	51 (11.72%)	-160 (-36.78%)
	GRAS	-11 (-2.53%)	-204 (-46.9%)
2080	SEDG	-251 (-57.7%)	-357 (-82.07%)
	BAMBU	-80 (-18.39%)	-272 (-62.53%)
	GRAS	-200 (-45.98%)	-339 (-77.93%)

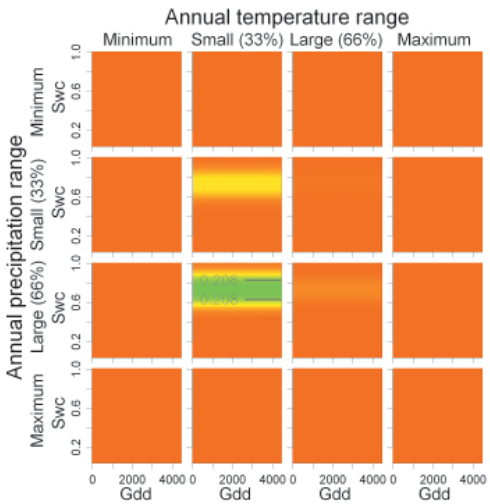
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 435)

The Swiss Brassy Ringlet occurs in woodland clearings on grassy, rocky slopes, and on screes. The caterpillars feed on different fescues (*Festuca* spp.) and on Mat-grass (*Nardus stricta*). The caterpillars hibernate when they are still small. They develop further the following spring, pupating sometime between June and August.

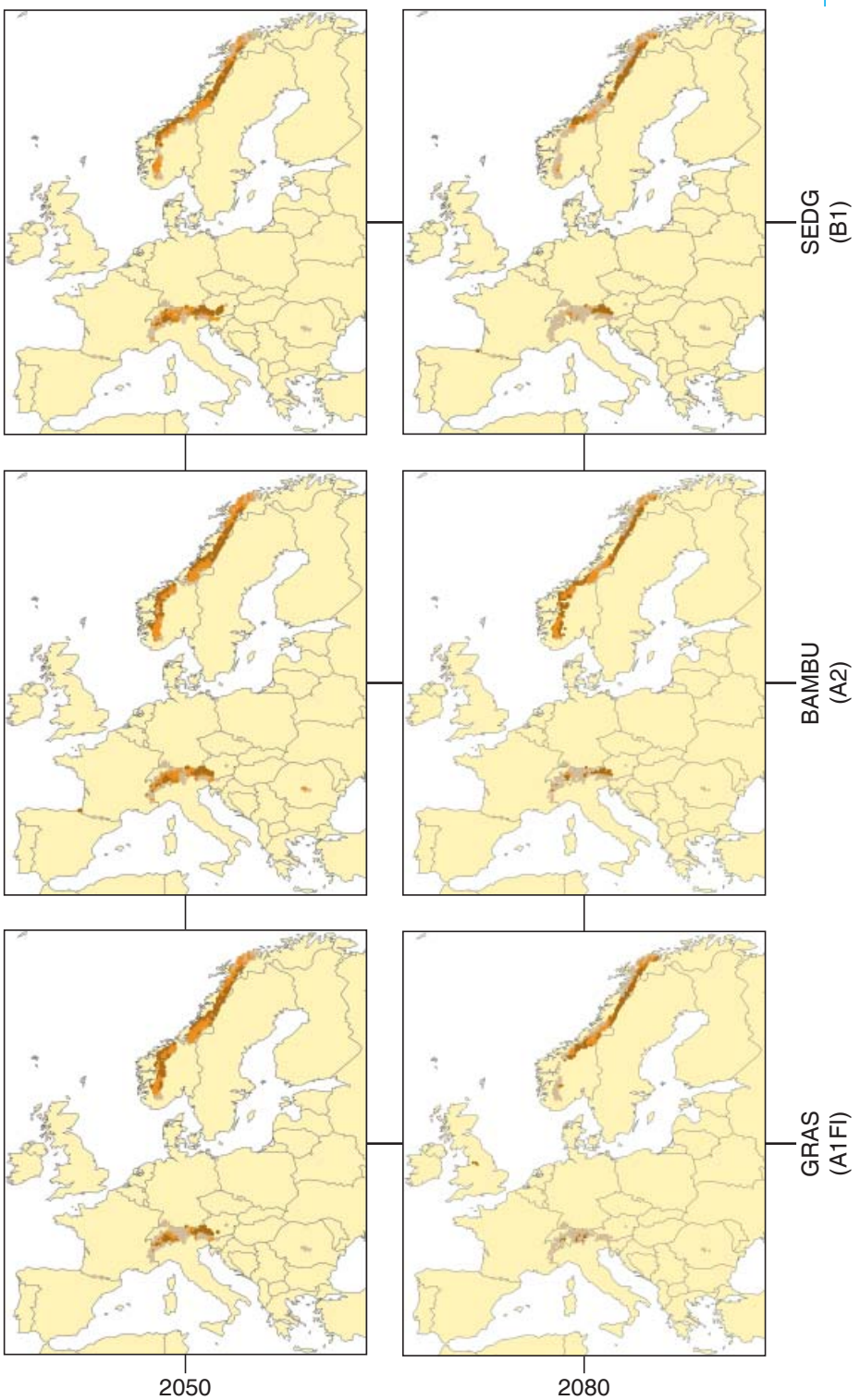
Present distribution can be very well explained by climatic variables (AUC = 0.99).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia cassioides (Reiner & Hohenwarth, 1792) (complex) – Common Brassy Ringlet

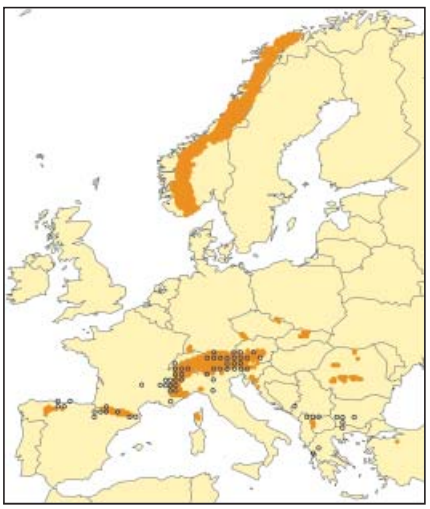
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-337 (-28.66%)	-404 (-34.35%)
	BAMBU	-320 (-27.21%)	-378 (-32.14%)
	GRAS	-398 (-33.84%)	-457 (-38.86%)
2080	SEDG	-656 (-55.78%)	-746 (-63.44%)
	BAMBU	-525 (-44.64%)	-630 (-53.57%)
	GRAS	-647 (-55.02%)	-747 (-63.52%)

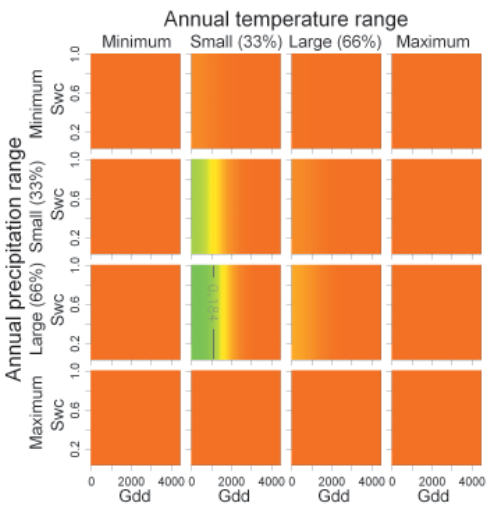
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1176)

The Common Brassy Ringlet encompasses 4 taxa which are included in this species complex: *arvernensis*, *cassioides*, *macedonica*, *carmenta*. They represent isolates in different glacial refugia. Their separate species status however is still uncertain and requires verification. The butterflies live on dry, grassy slopes, rocky slopes with patches of grassy vegetation, and scree. The females lay their eggs on dry stalks of grass, close to the ground. The species' foodplants are various fescues (*Festuca* spp.). The caterpillars hibernate in the first or second larval instar and pupate the following year between June and August.

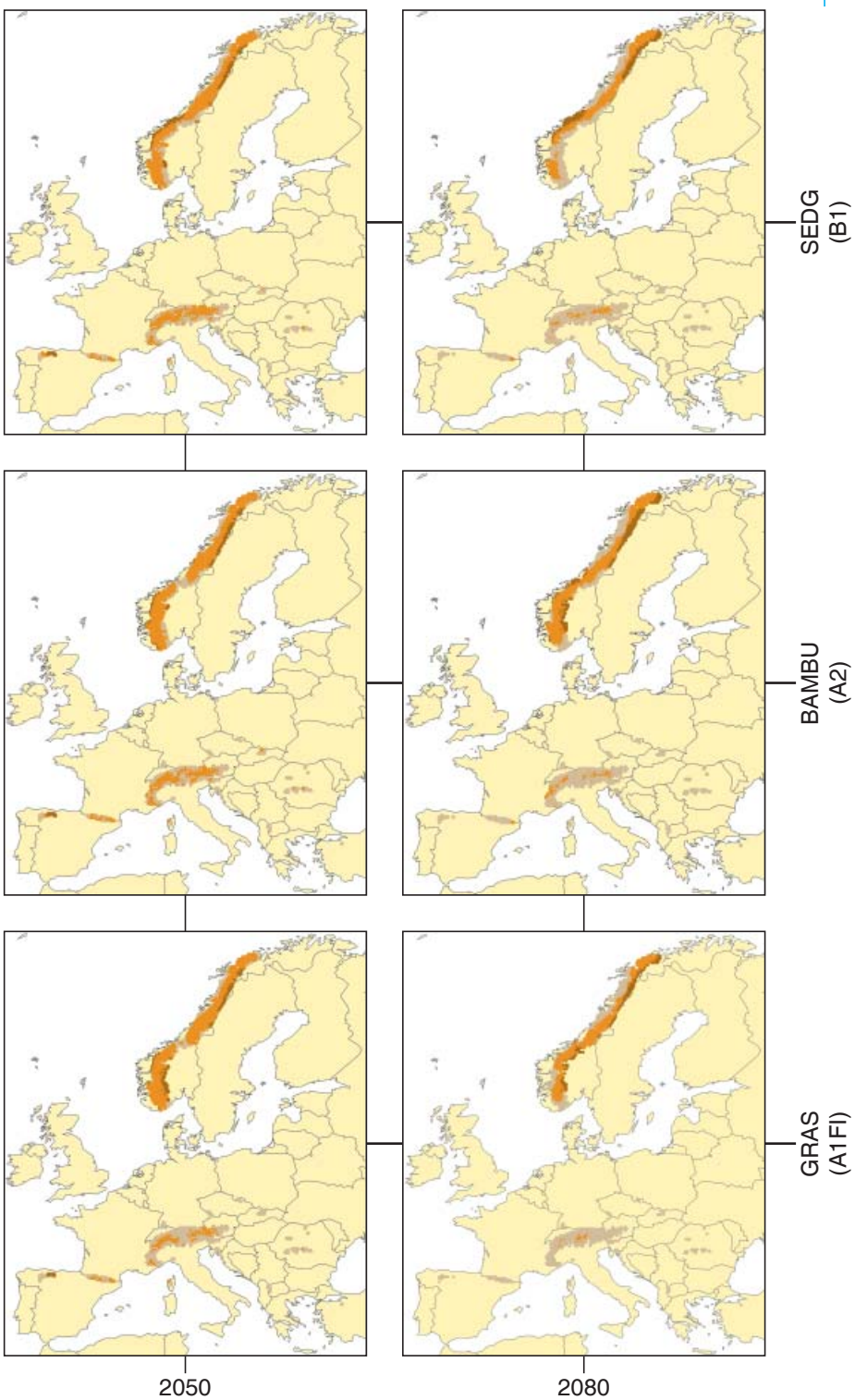
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.8).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia pronoe (Esper, 1780) – Water Ringlet

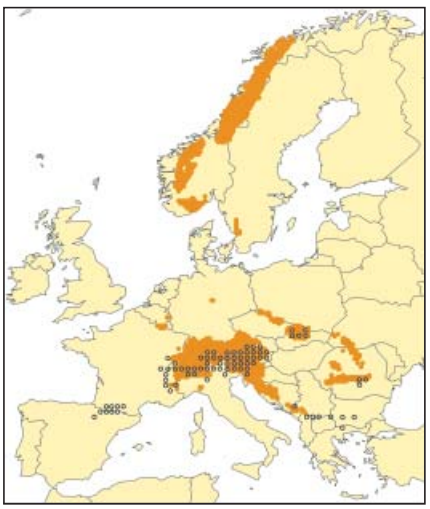
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-407 (-24.23%)	-570 (-33.93%)
	BAMBU	-326 (-19.4%)	-472 (-28.1%)
	GRAS	-586 (-34.88%)	-692 (-41.19%)
2080	SEDG	-315 (-18.75%)	-721 (-42.92%)
	BAMBU	-319 (-18.99%)	-774 (-46.07%)
	GRAS	-466 (-27.74%)	-1011 (-60.18%)

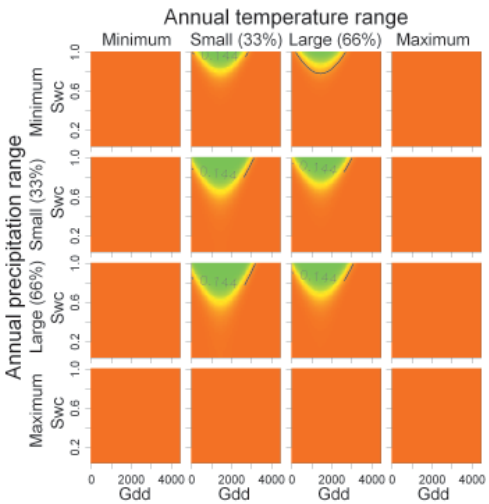
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1680)

The Water Ringlet is found especially on flower-rich grasslands, rocky, grassy slopes, and near woodland. The female usually deposits her eggs close to the ground, on dry stalks of grass. The caterpillars feed on Sheep's Fescue (*Festuca ovina*), *F. quadriflora* and various meadow-grasses (*Poa* spp.). The caterpillars hibernate in the first larval instar and pupate in June or July of the following year.

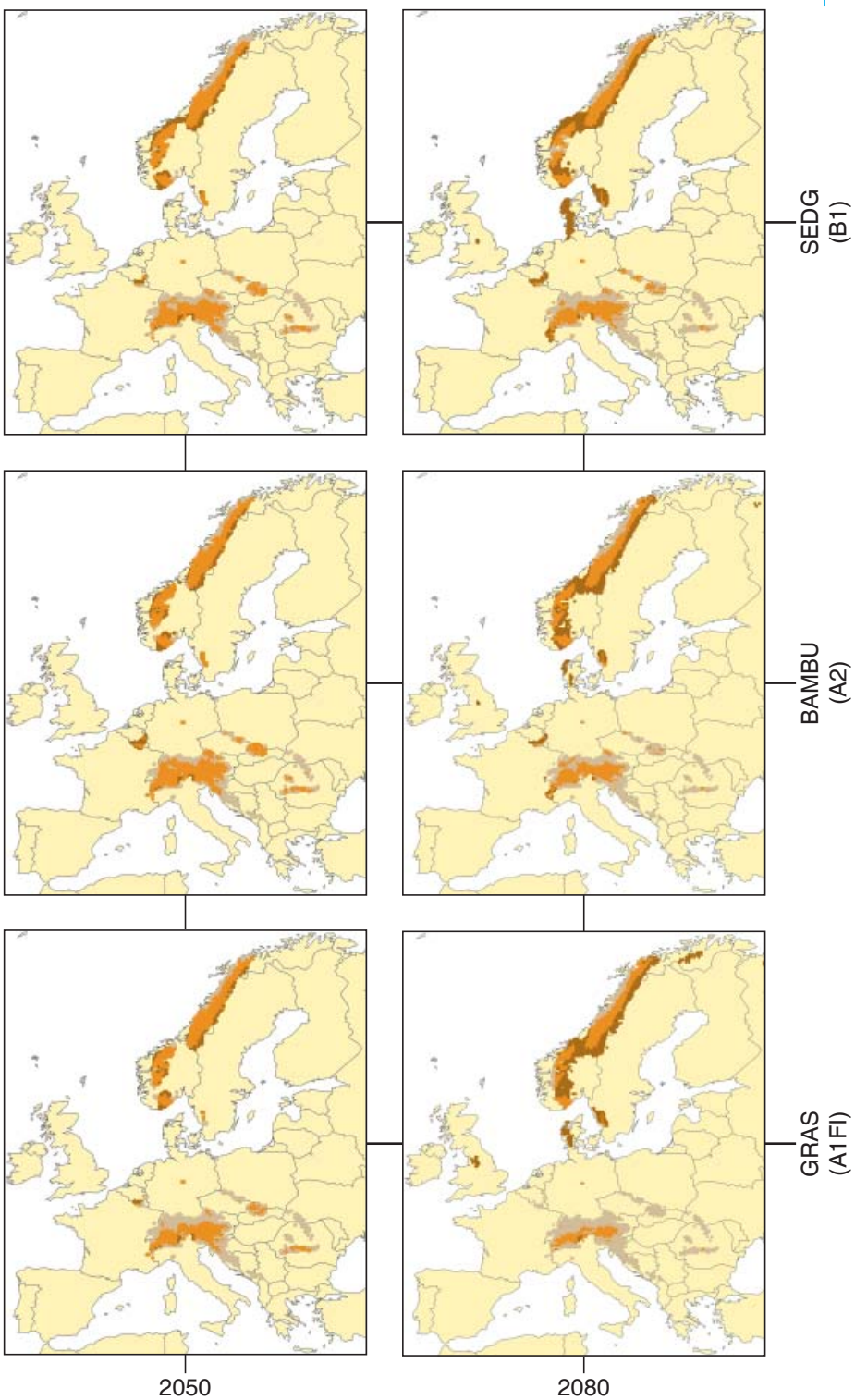
Present distribution can be well explained by climatic variables (AUC = 0.89).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia styx (Freyer, 1834) – Stygian Ringlet

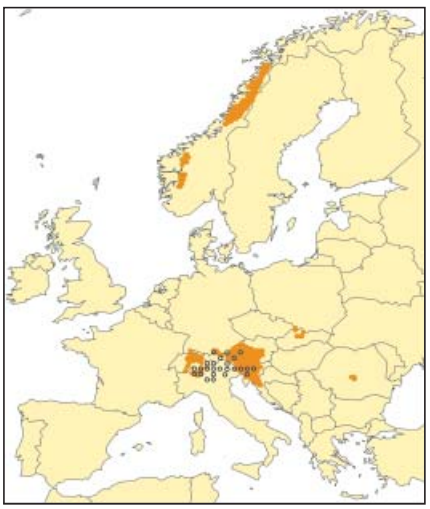
© Martin Wiemers

		Full dispersal	No dispersal
2050	SEDG	-200 (-46.62%)	-227 (-52.91%)
	BAMBU	-186 (-43.36%)	-206 (-48.02%)
	GRAS	-255 (-59.44%)	-264 (-61.54%)
2080	SEDG	-247 (-57.58%)	-282 (-65.73%)
	BAMBU	-242 (-56.41%)	-280 (-65.27%)
	GRAS	-287 (-66.9%)	-361 (-84.15%)

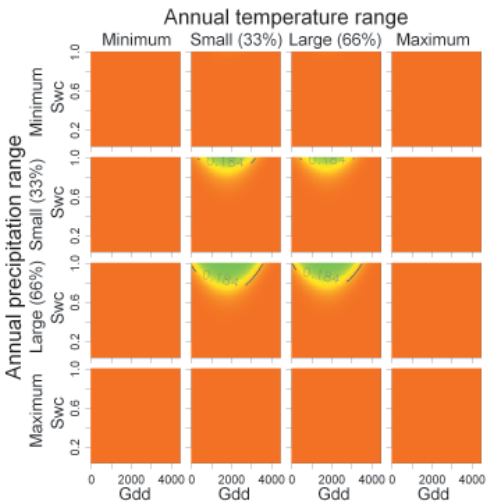
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 429)

The Stygian Ringlet occurs on warm, steep, rocky slopes with grassy vegetation and sometimes scattered bushes, often on limestone. Its foodplant is Blue Moor-grass (*Sesleria albicans*). In Switzerland, it takes two years for the egg to develop into a butterfly. The tiny caterpillar goes into hibernation immediately after leaving the egg, only starting to feed the next spring. In the autumn, they again hibernate, pupating in June or July of the following year. In other areas at lower altitudes, they can complete their life cycle in one year.

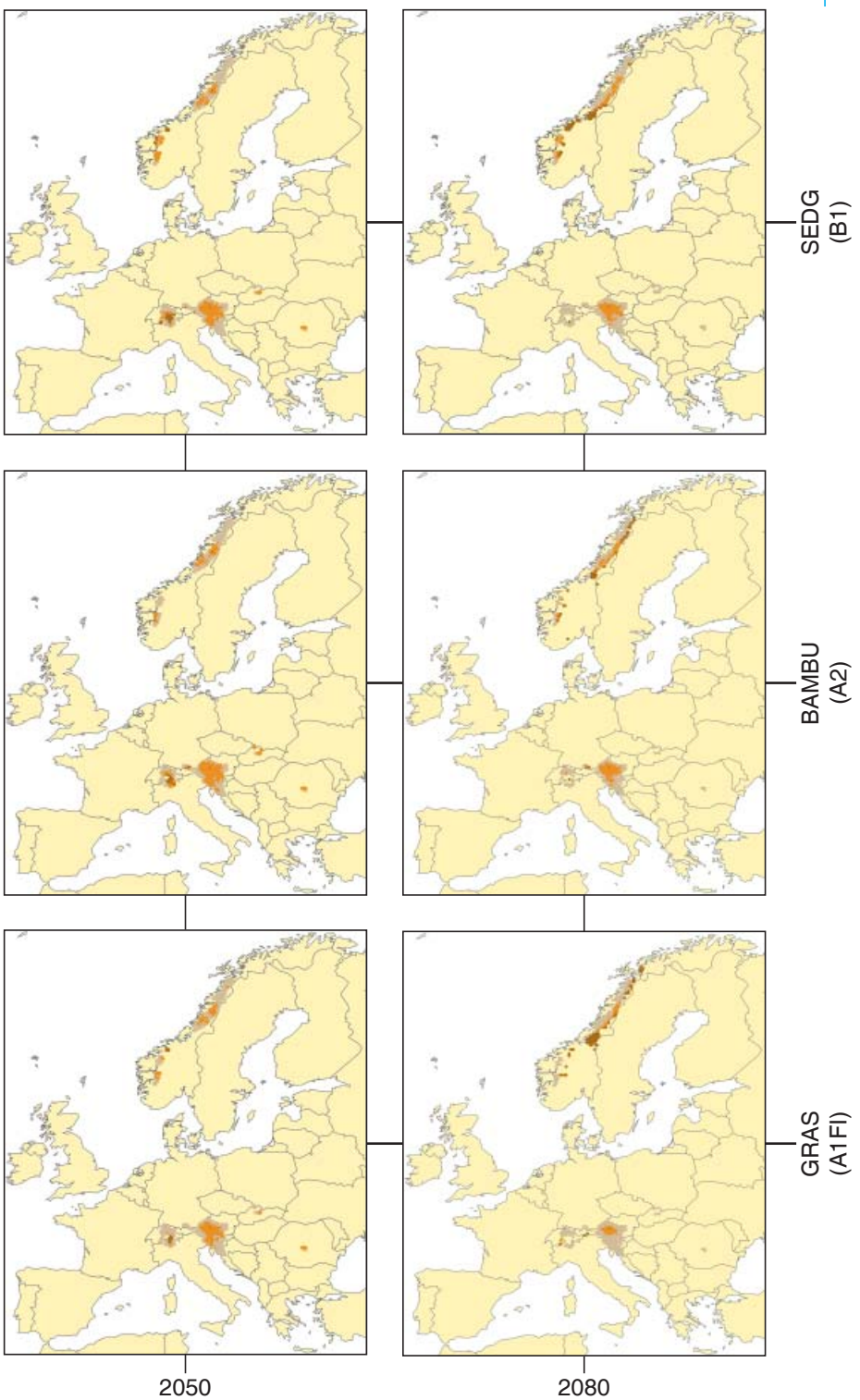
Present distribution can be well explained by climatic variables (AUC = 0.95).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia montana (Prunner, 1798) – Marbled Ringlet

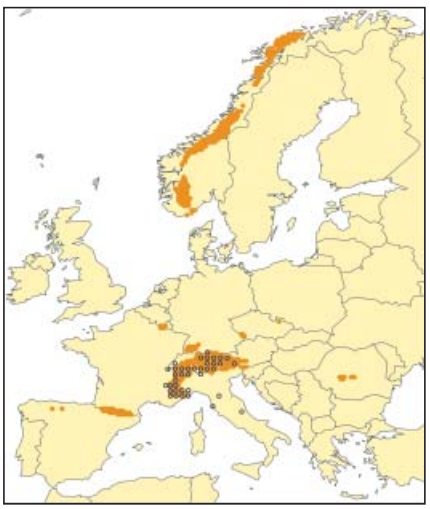
© Neil Thompson

		Full dispersal	No dispersal
2050	SEDG	-77 (-12.13%)	-282 (-44.41%)
	BAMBU	25 (3.94%)	-224 (-35.28%)
	GRAS	-112 (-17.64%)	-303 (-47.72%)
2080	SEDG	-349 (-54.96%)	-530 (-83.46%)
	BAMBU	-186 (-29.29%)	-409 (-64.41%)
	GRAS	-332 (-52.28%)	-512 (-80.63%)

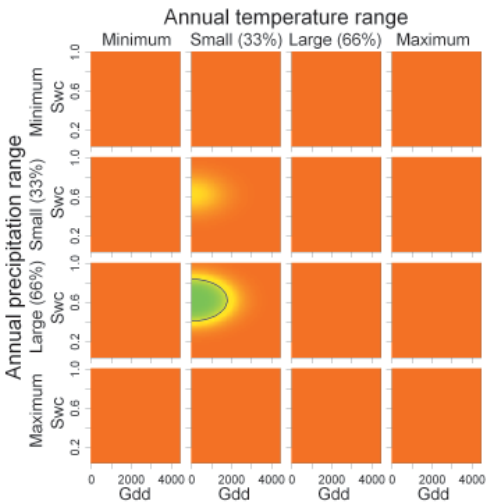
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 635)

The Marbled Ringlet is mainly found on warm, rocky slopes with patches of grassy vegetation in flower-rich grasslands, and occasionally in woods, for the most part on limestone. When the butterflies settle on stones or on the ground with their wings closed, they are hardly noticeable. However, they can be seen visiting flowers, which they do regularly. The caterpillars hibernate in the first larval instar and in the spring begin feeding on fescues (*Festuca* spp.), or on Mat-grass (*Nardus stricta*). The caterpillars have been found on the larger tussocks growing in the shelter of rocks. They pupate in June or July.

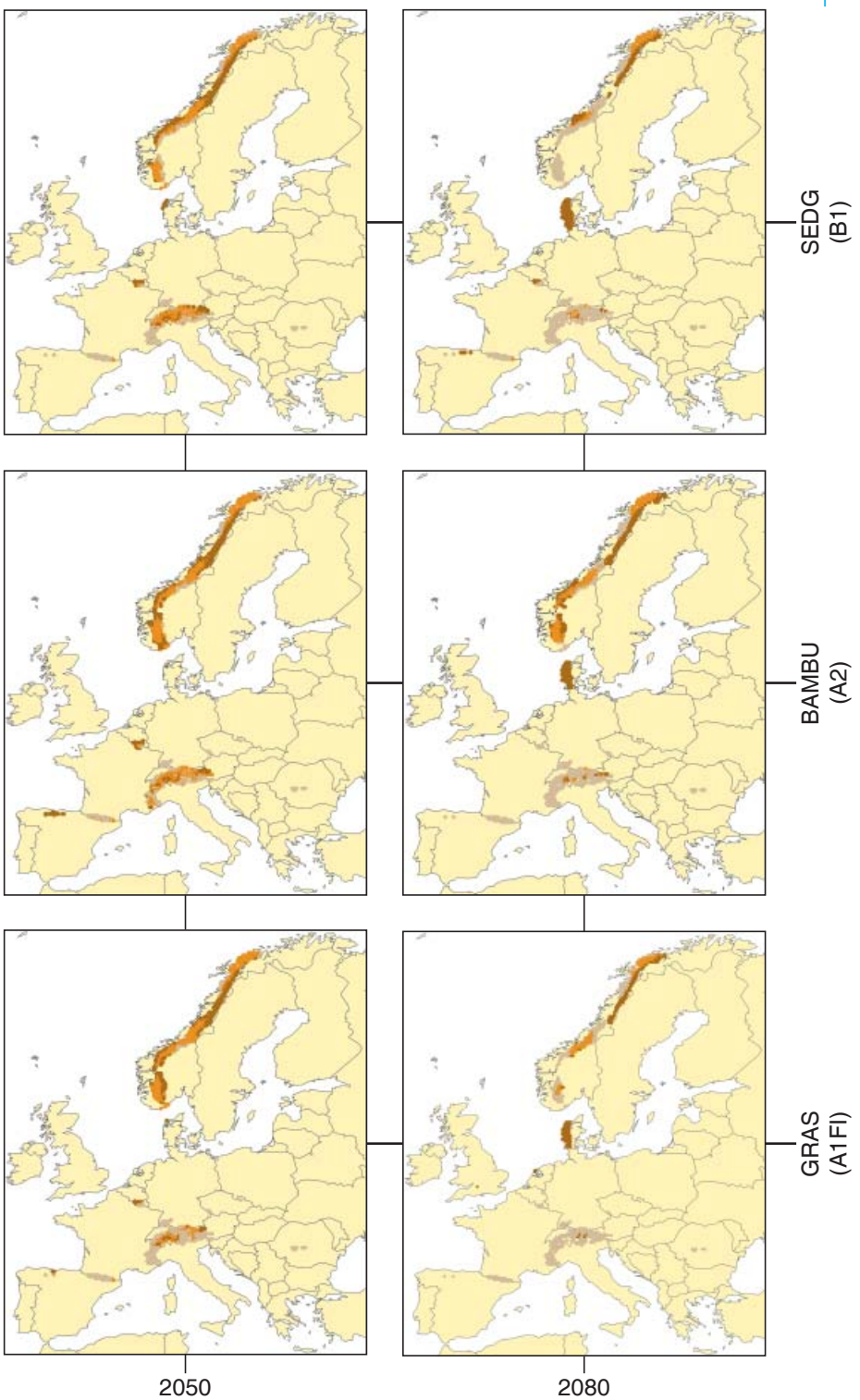
Present distribution can be very well explained by climatic variables (AUC = 0.98).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia neoridas (Boisduval, 1828) – Autumn Ringlet

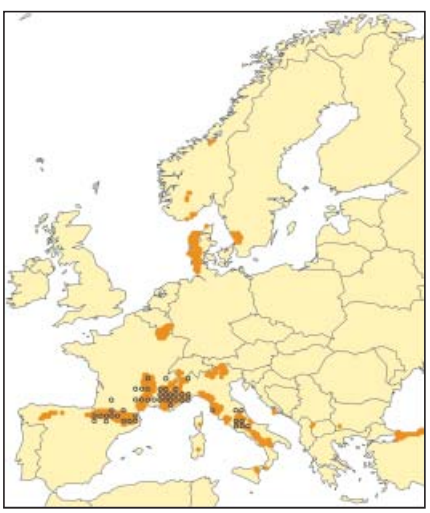
© Matt Rowlings

		Full dispersal	No dispersal
2050	SEDG	-10 (-1.48%)	-473 (-69.87%)
	BAMBU	-1 (-0.15%)	-488 (-72.08%)
	GRAS	18 (2.66%)	-521 (-76.96%)
2080	SEDG	219 (32.35%)	-560 (-82.72%)
	BAMBU	-162 (-23.93%)	-591 (-87.3%)
	GRAS	-265 (-39.14%)	-605 (-89.36%)

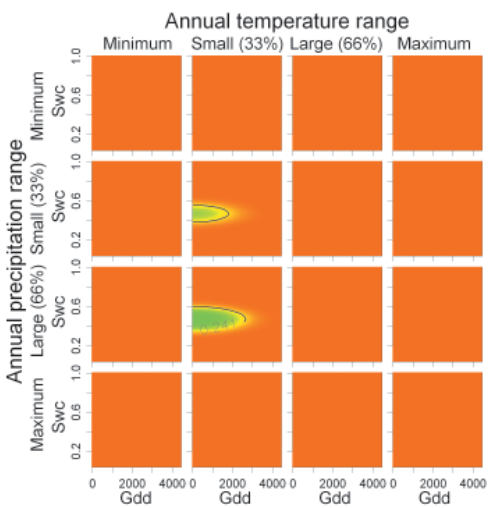
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 677)

The Autumn Ringlet occurs in woodland clearings and on grassy vegetation with scattered bushes. The caterpillars feed on different grasses, such as Crab-grass (*Digitaria sanguinalis*), Alpine Meadow-Grass (*Poa alpina)*, Smooth Meadow-grass (*Poa pratensis*), Annual Meadow-grass (*P. annua*), Sheep's-fescue (*Festuca ovina*), and Meadow Fescue (*F. pratensis*). This species is single-brooded and hibernates as a caterpillar.

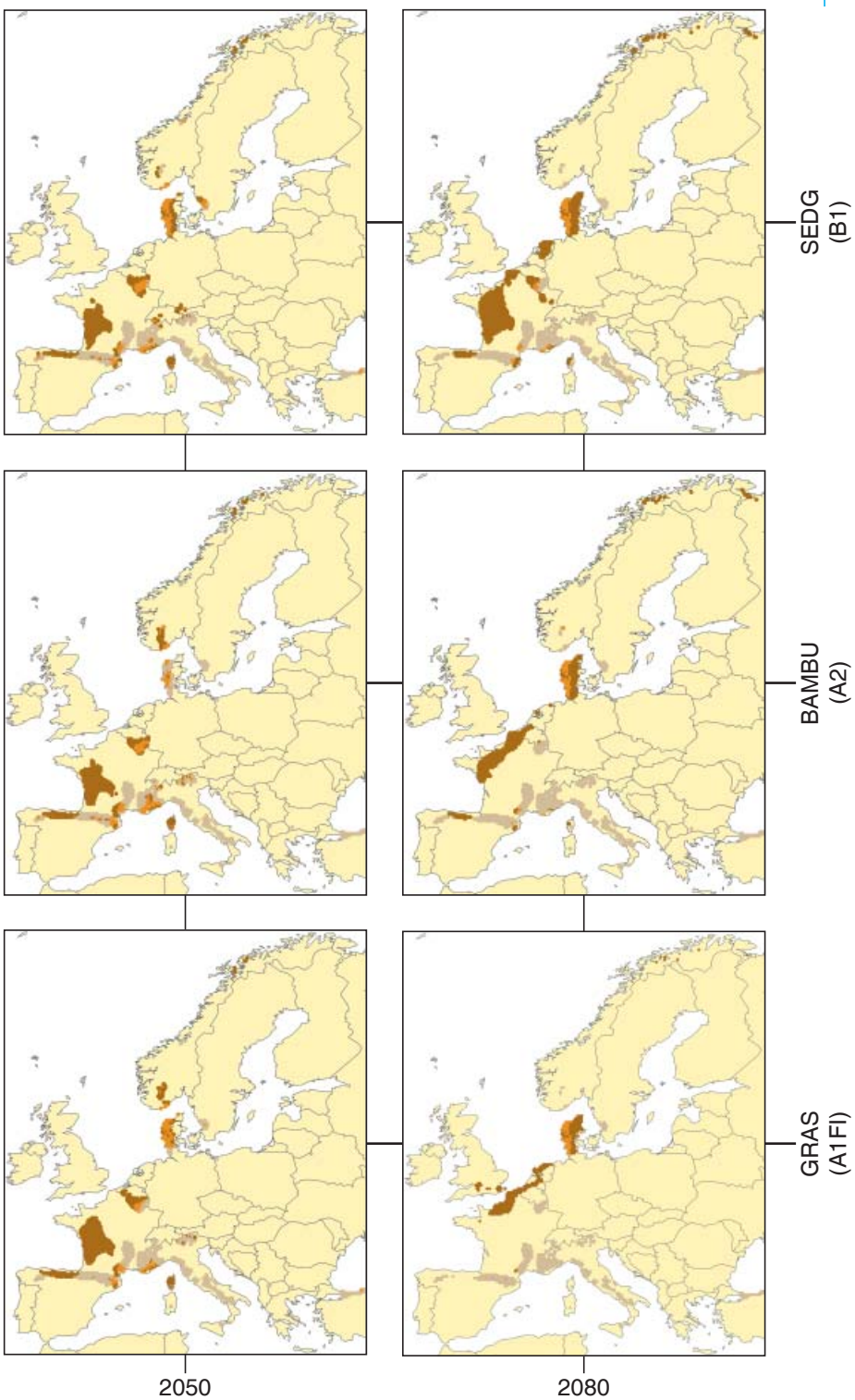
Present distribution can be well explained by climatic variables (AUC = 0.93).
Climate risk category: HHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia melas (Herbst, 1796) – Black Ringlet

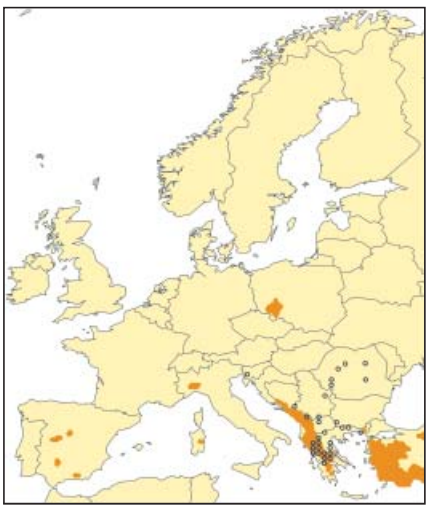
© Rudi Verovnik

		Full dispersal	No dispersal
2050	SEDG	179 (27.54%)	-158 (-24.31%)
	BAMBU	40 (6.15%)	-239 (-36.77%)
	GRAS	121 (18.62%)	-231 (-35.54%)
2080	SEDG	416 (64%)	-167 (-25.69%)
	BAMBU	-35 (-5.38%)	-434 (-66.77%)
	GRAS	40 (6.15%)	-496 (-76.31%)

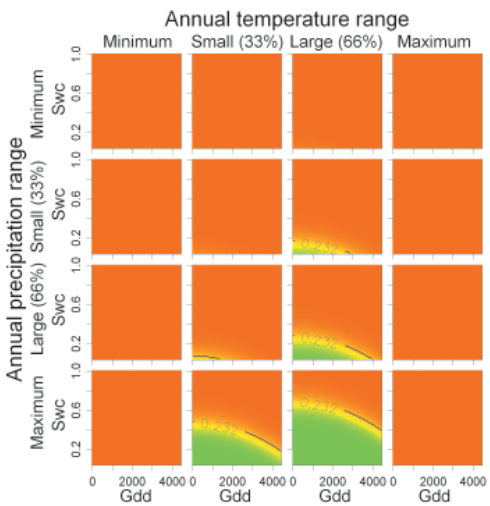
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 650)

The Black Ringlet can be found on rocky slopes with patches of grassy vegetation, in dry and subalpine and alpine grasslands, and sometimes in clearings in coniferous woods. The butterflies fly close to the ground, often resting with wings widespread. The caterpillars feed on Sheeps'-fescue (*Festuca ovina*), and possibly other grasses. The Black Ringlet has one generation a year and hibernates in the larval stage.

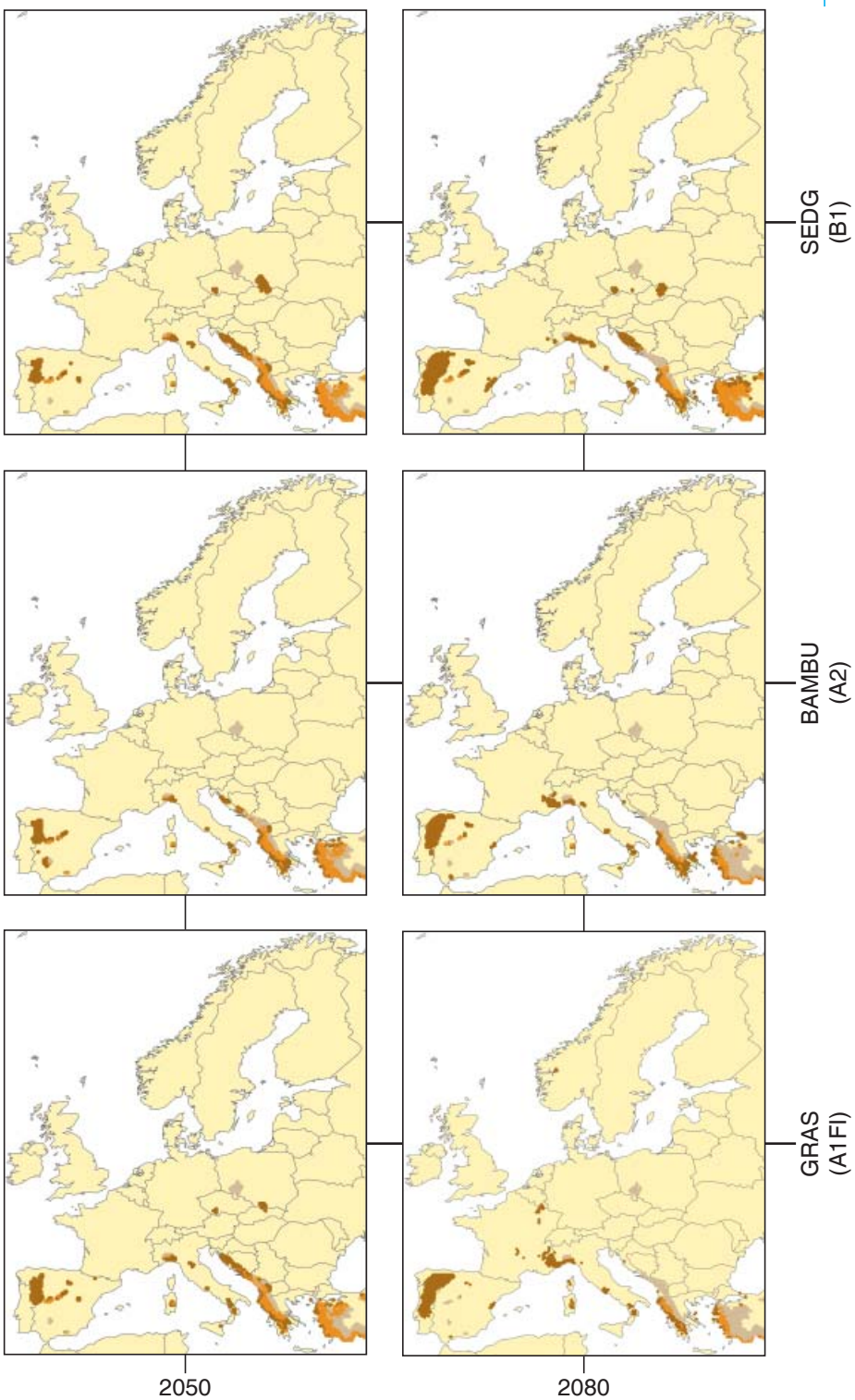
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.84). Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia oeme (Esper, 1805) – Bright-eyed Ringlet

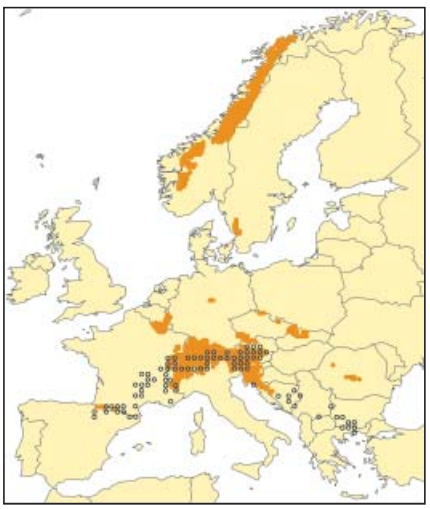
© Rudi Verovnik

		Full dispersal	No dispersal
2050	SEDG	-195 (-17.81%)	-357 (-32.6%)
	BAMBU	-32 (-2.92%)	-276 (-25.21%)
	GRAS	-298 (-27.21%)	-427 (-39%)
2080	SEDG	-260 (-23.74%)	-538 (-49.13%)
	BAMBU	-155 (-14.16%)	-523 (-47.76%)
	GRAS	-413 (-37.72%)	-732 (-66.85%)

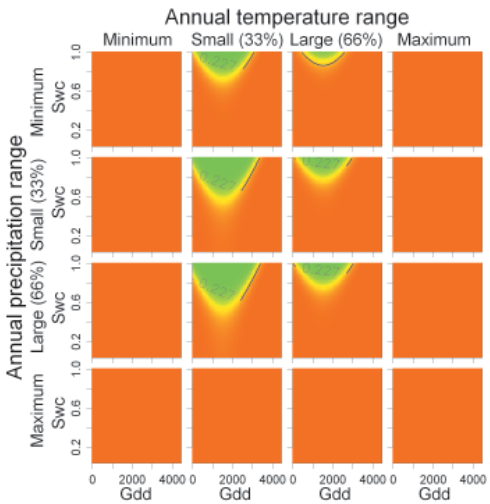
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1095)

The Bright-eyed Ringlet is often found on damp to wet grasslands, sometimes with lots of sedges in the vegetation. However, it also occurs on dry grasslands, rocky slopes and in woodland clearings. The grass in some of these habitats may be quite tall. Several different foodplants are known, including sedges (*Carex* spp.), rushes (*Juncus* spp.), Purple Moor-grass (*Molinea caerulea*), Quaking Grass (*Briza media*), Red Fescue (*Festuca rubra*), and meadow-grasses (*Poa* spp.). The caterpillars take one or two years to develop, depending on the altitude of the breeding ground.

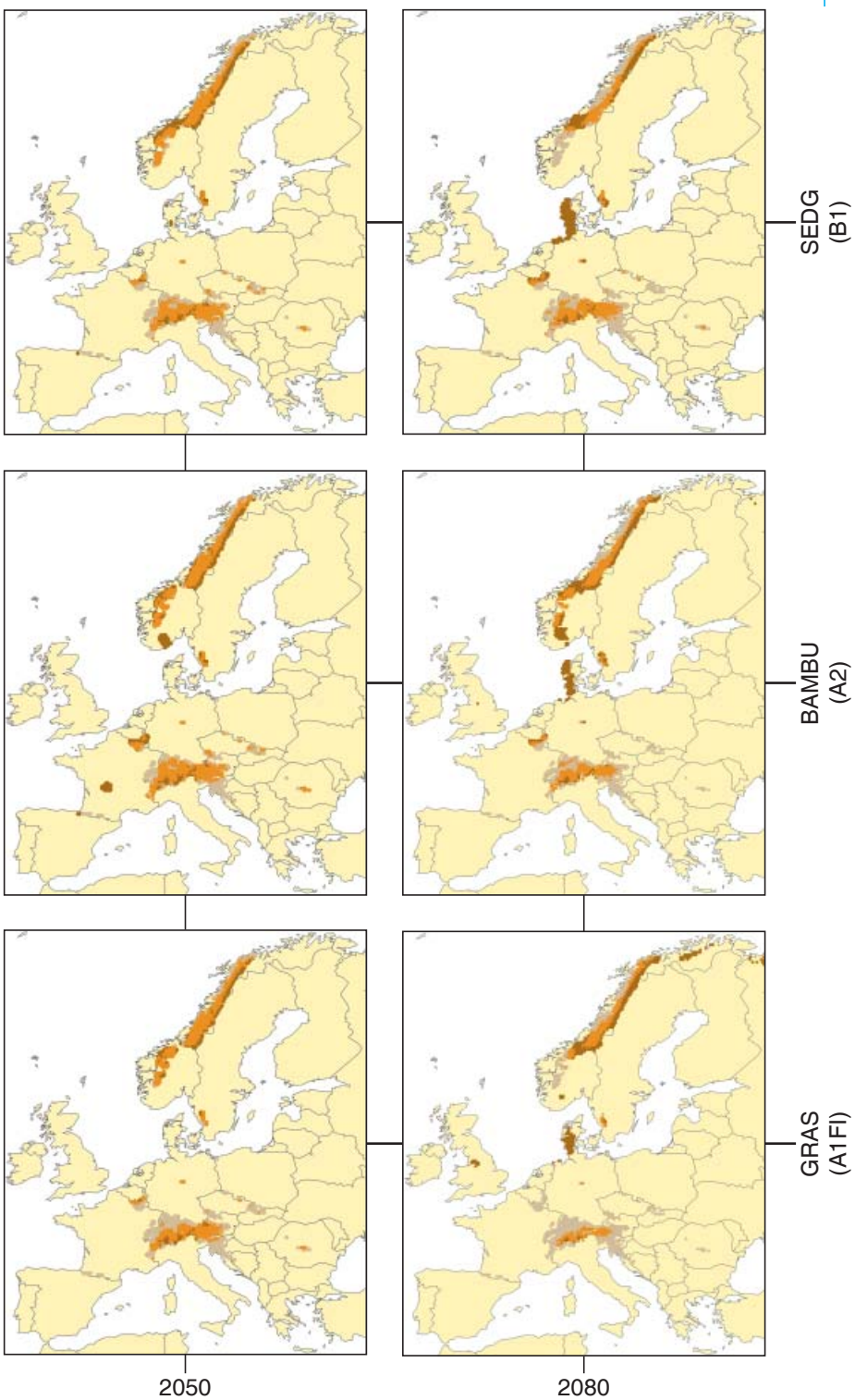
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.89). Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia meolans (Prunner, 1798) – Piedmont Ringlet

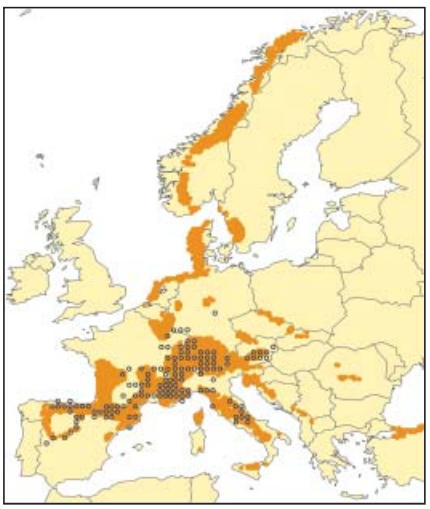
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-89 (-3.23%)	-1130 (-40.97%)
	BAMBU	-153 (-5.55%)	-1103 (-39.99%)
	GRAS	-342 (-12.4%)	-1389 (-50.36%)
2080	SEDG	-360 (-13.05%)	-1687 (-61.17%)
	BAMBU	-644 (-23.35%)	-1813 (-65.74%)
	GRAS	-1145 (-41.52%)	-2198 (-79.7%)

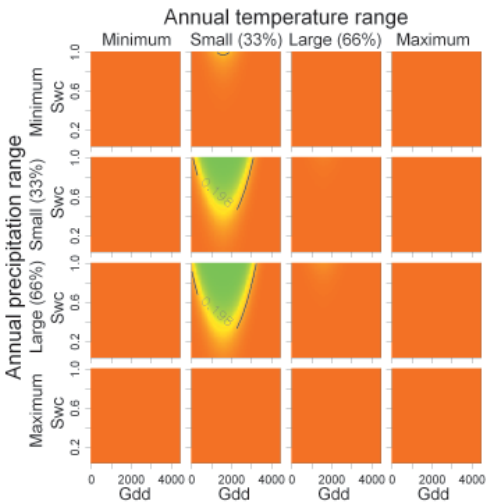
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 2758)

The Piedmont Ringlet occurs on a variety of grassy places in and near woods. The female lays her eggs on many different grasses, including fescues (*Festuca* spp.), Wavy Hair-grass (*Deschampsia flexuosa*), Mat-grass (*Nardus stricta*), and several sorts of bent (*Agrostis* spp.). At very high altitudes, when the caterpillars are half-grown, they hibernate in the litter layer. They may hibernate twice before pupating deep down in the vegetation.

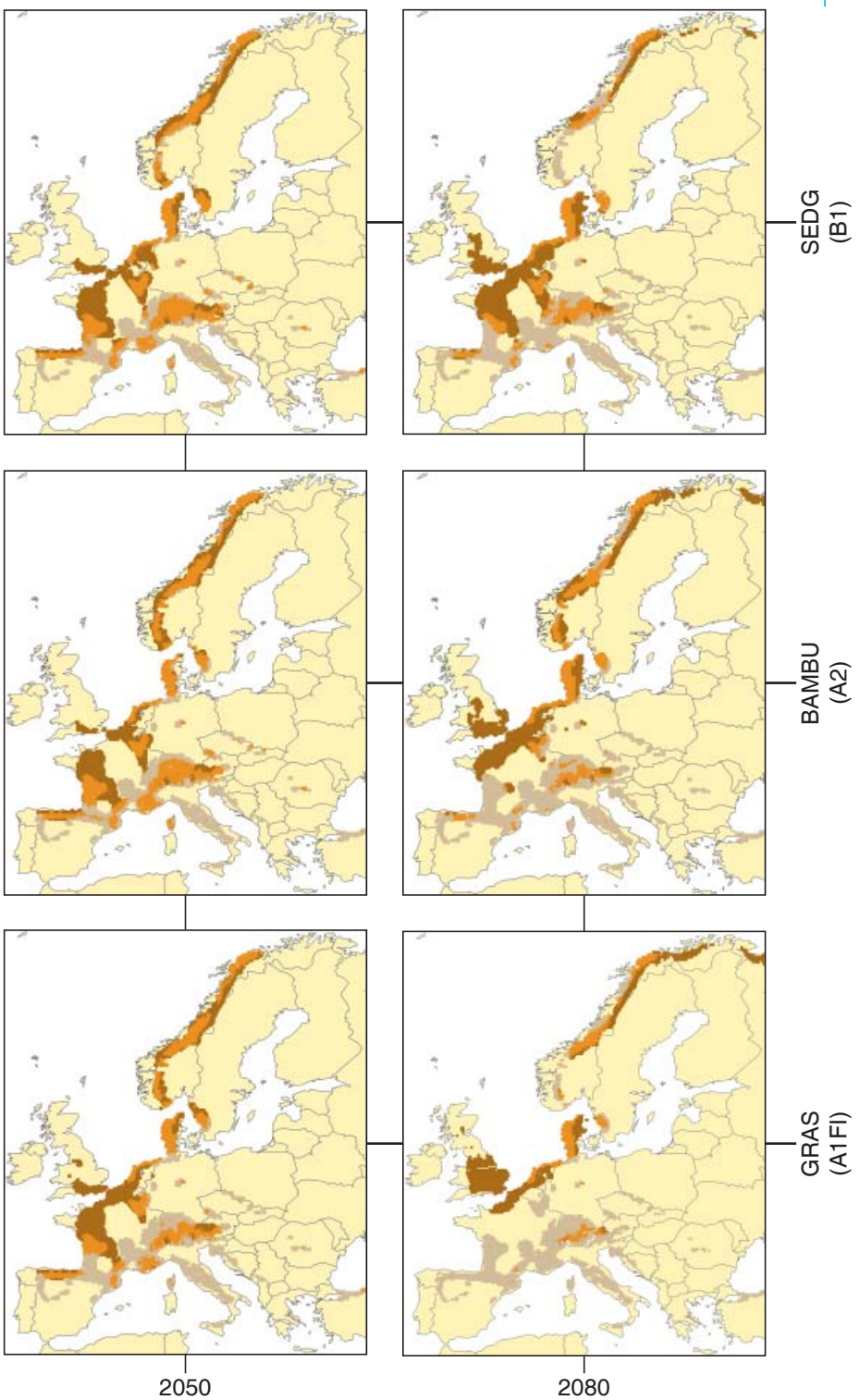
Present distribution can be well explained by climatic variables (AUC = 0.92).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Erebia pandrose (Borkhausen, 1788) – Dewy Ringlet

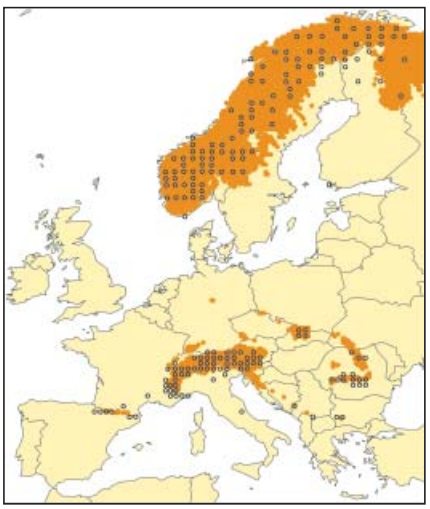
© Rudi Verovnik

		Full dispersal	No dispersal
2050	SEDG	-950 (-21.14%)	-1006 (-22.39%)
	BAMBU	-779 (-17.34%)	-830 (-18.47%)
	GRAS	-1212 (-26.98%)	-1215 (-27.04%)
2080	SEDG	-883 (-19.65%)	-1106 (-24.62%)
	BAMBU	-1128 (-25.11%)	-1265 (-28.15%)
	GRAS	-1444 (-32.14%)	-1546 (-34.41%)

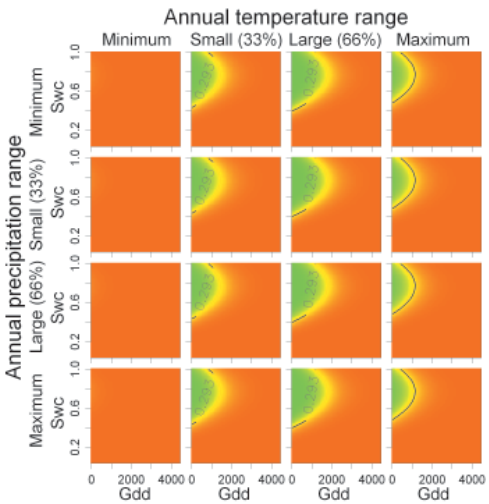
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 4493)

The Dewy Ringlet is a common species. In Scandinavia, it is mostly found in damp places where grass and bushes are growing, often near small streams, and in more mountainous areas on grassy slopes. In Central Europe, the butterflies occur on stony, alpine meadows with a vegetation of short grasses and dwarf shrubs. These butterflies have a characteristic, undulating flight. This gives the impression that they are not using their hindwings, and are just about to fall to the ground. The female lays her eggs on different grasses, such as fescues (*Festuca* spp.), meadow-grasses (*Poa* spp.), Blue Moor-grass (*Sesleria albicans*), or Mat-grass (*Nardus stricta*). In most parts of its range, the caterpillars hibernate twice.

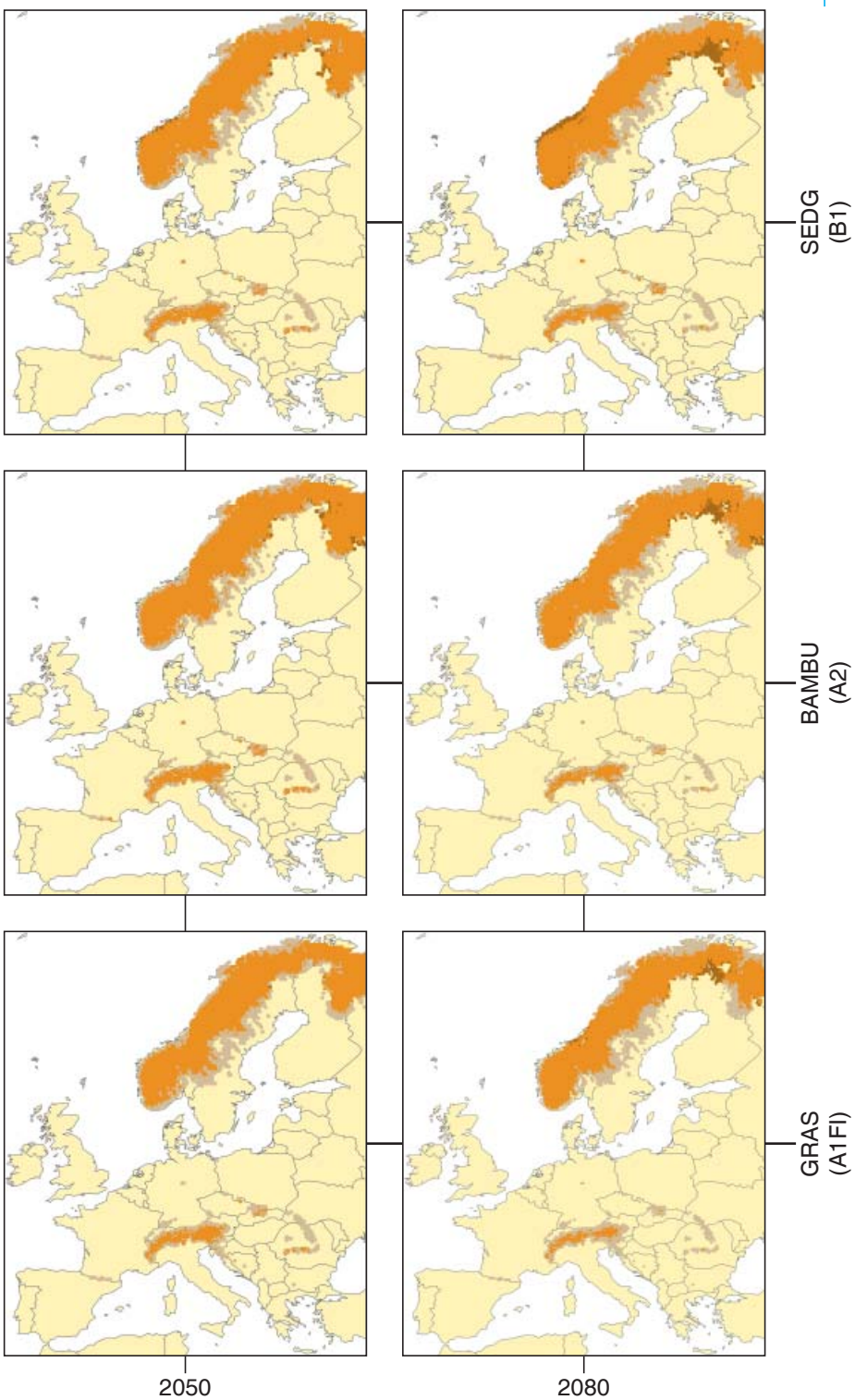
Present distribution can be well explained by climatic variables (AUC = 0.86).
Climate risk category: LR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Melanargia russiae (Esper, 1784) – Esper's Marbled White

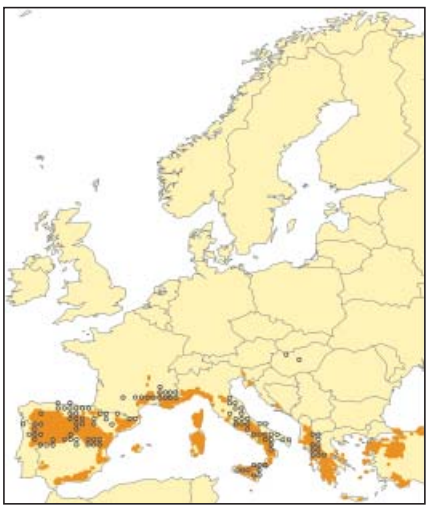
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-781 (-51.55%)	-1158 (-76.44%)
	BAMBU	-988 (-65.21%)	-1169 (-77.16%)
	GRAS	-982 (-64.82%)	-1275 (-84.16%)
2080	SEDG	-752 (-49.64%)	-1352 (-89.24%)
	BAMBU	-1026 (-67.72%)	-1441 (-95.12%)
	GRAS	-752 (-49.64%)	-1504 (-99.27%)

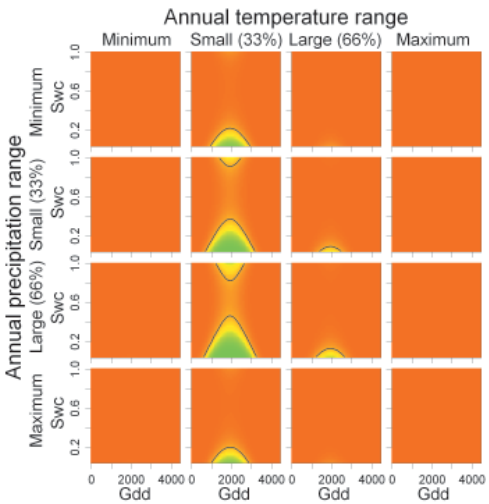
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1515)

Esper's Marbled White is a butterfly of grassy vegetation, occurring both on acid and calcareous soils. The butterflies are often found on dry, rocky slopes but also in grassy glades in woods. They are fond of visiting thistles and like plants for their nectar. Various meadow grasses (*Poa* spp.) and false bromes (*Brachypodium* spp.), Feather Grass (*Stipa pinnata*), and *Aegilops geniculata* are used as foodplants. The caterpillars hibernate and pupate on the ground in the spring. This species is single-brooded.

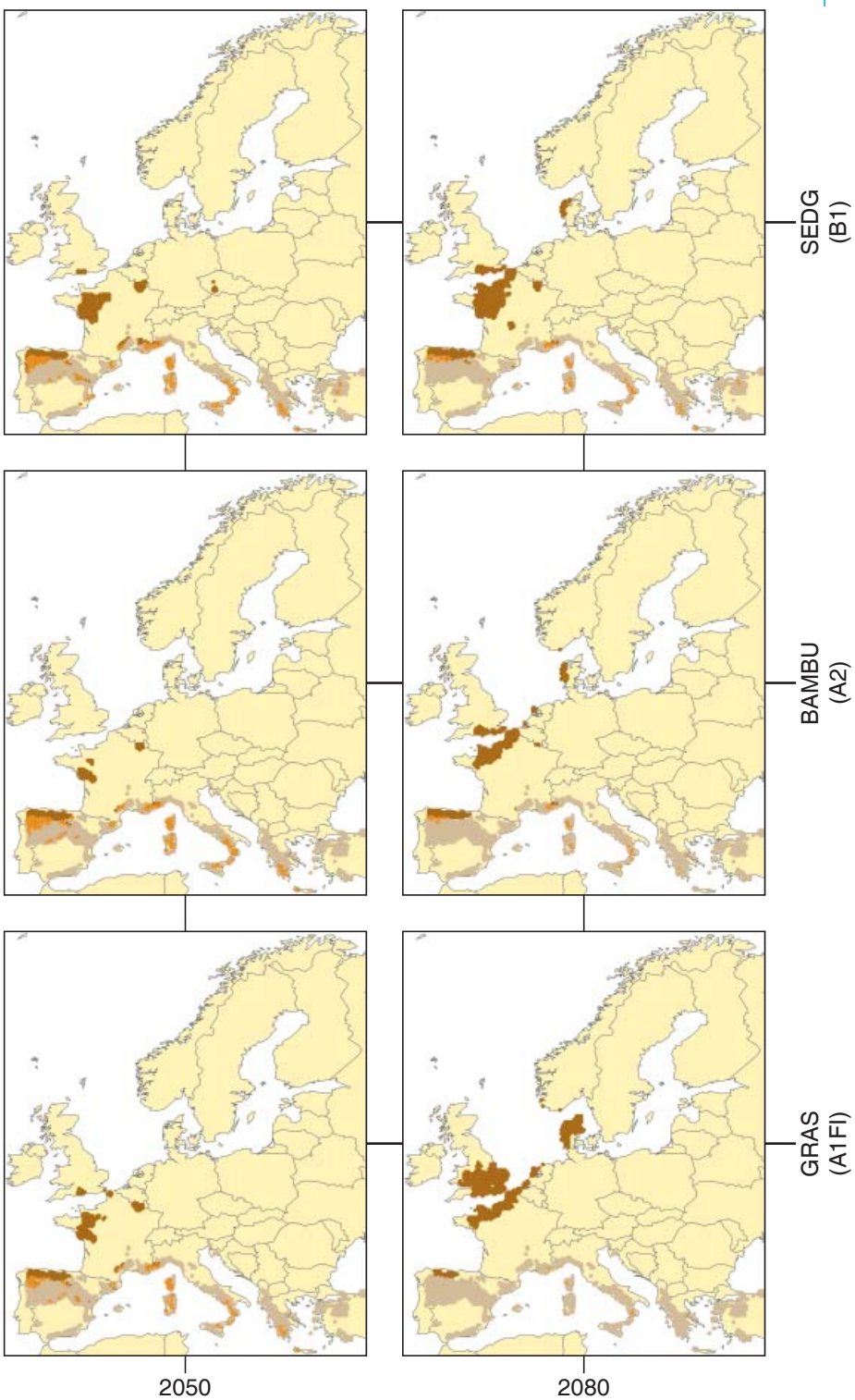
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.85). Climate risk category: HHHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Melanargia galathea (Linnaeus, 1758) – Marbled White

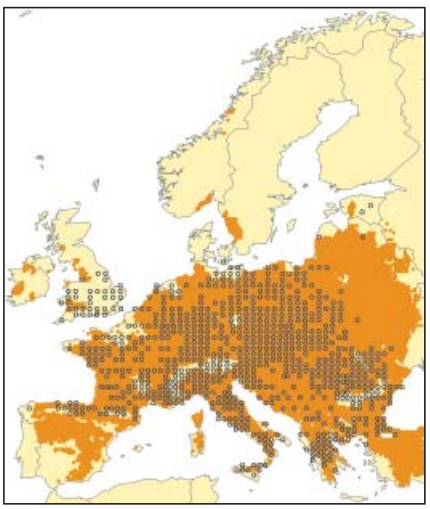
© Peter Ginzinger

		Full dispersal	No dispersal
2050	SEDG	884 (6.33%)	-2681 (-19.21%)
	BAMBU	912 (6.53%)	-3015 (-21.6%)
	GRAS	-12 (-0.09%)	-3686 (-26.41%)
2080	SEDG	483 (3.46%)	-4811 (-34.47%)
	BAMBU	-22 (-0.16%)	-6633 (-47.52%)
	GRAS	-609 (-4.36%)	-8654 (-62%)

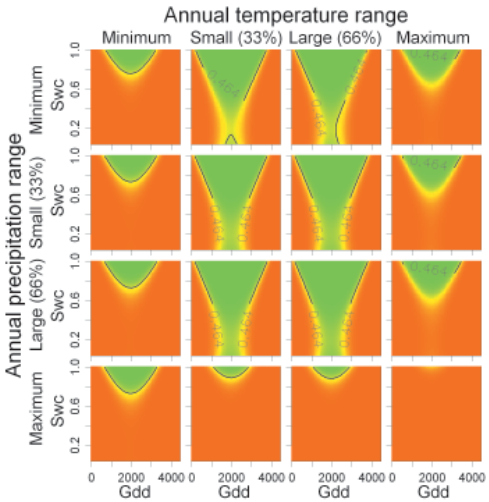
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 13958)

The Marbled White inhabits many different types of poor grassland that has not been fertilized. It is common in the southern part of its range, also on road verges and in agricultural areas. The butterflies need a lot of nectar, and are often seen on plants in bloom. Various grass species, mostly fine-leaved, are used as foodplants. The female usually just drops her eggs into the grass, sometimes while flying. The first instar caterpillar hibernates without eating first. In periods of hot weather, the other instars can also go without food. They pupate deep in the vegetation. The Marbled White has one generation a year.

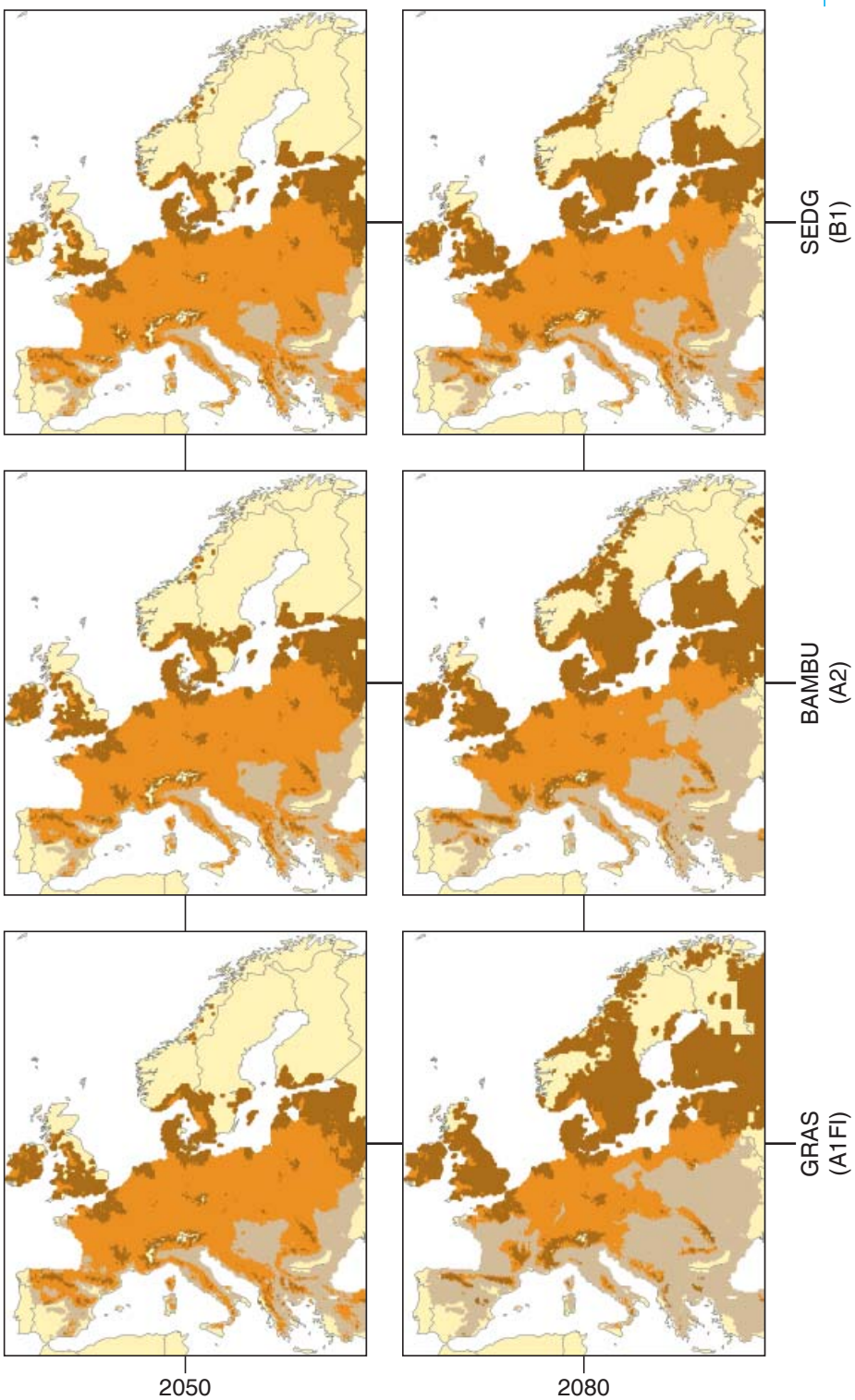
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.81). Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Melanargia lachesis (Hübner 1790) – Iberian Marbled White

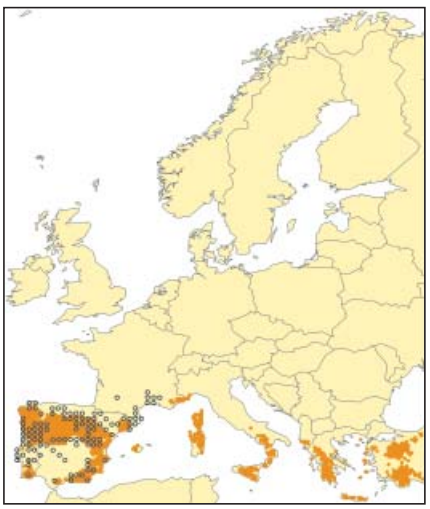
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-863 (-61.91%)	-1047 (-75.11%)
	BAMBU	-1054 (-75.61%)	-1131 (-81.13%)
	GRAS	-1045 (-74.96%)	-1232 (-88.38%)
2080	SEDG	-1055 (-75.68%)	-1324 (-94.98%)
	BAMBU	-1129 (-80.99%)	-1374 (-98.57%)
	GRAS	-910 (-65.28%)	-1394 (-100%)

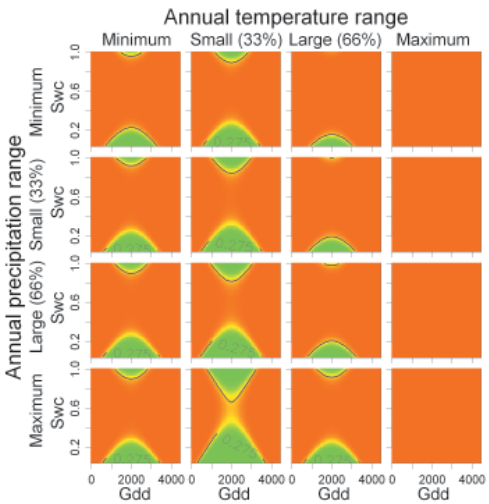
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1394)

The Iberian Marbled White occurs in flower-rich, dry to damp grasslands, near dry scrub, and along woodland edges and hedgerows. Grasses such as Annual Meadow-grass (*Poa annua*), Meadow Fescue (*Festuca pratensis*), Compact Brome (*Bromus madritensis*), and *Brachypodium retusum* are used as foodplants. This species is single-brooded and hibernates as a caterpillar.

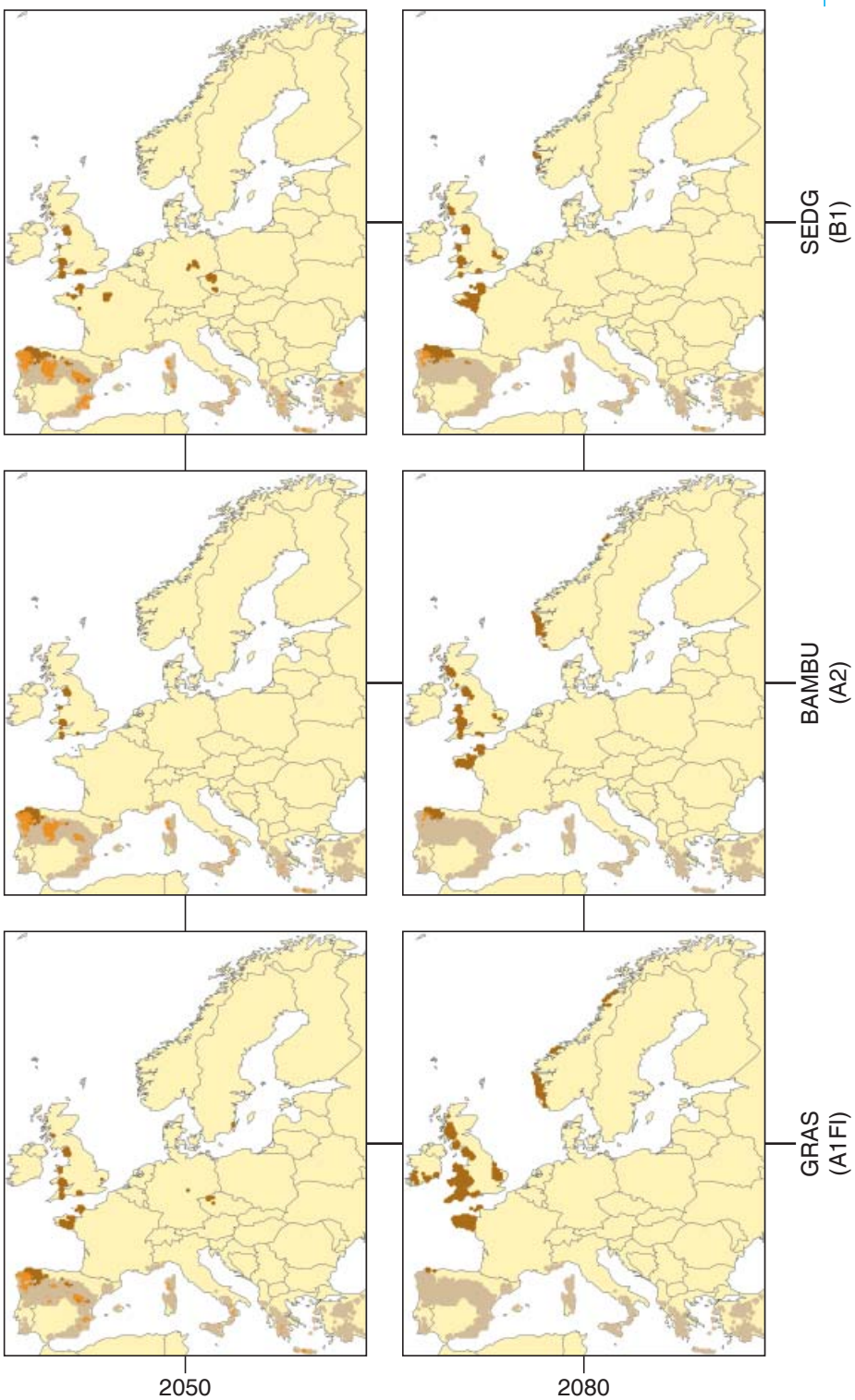
Present distribution can be well explained by climatic variables (AUC = 0.89).
Climate risk category: HHHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Melanargia larissa (Esper, 1784) – Balkan Marbled White

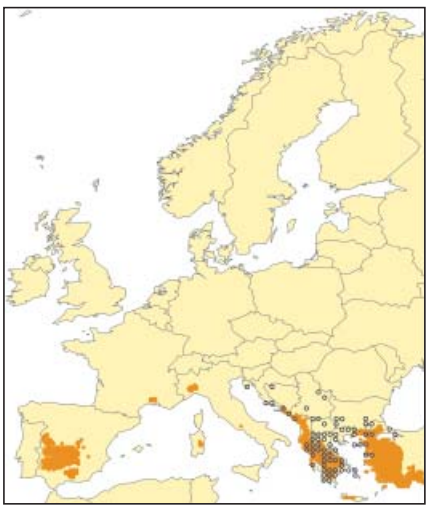
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	127 (11.33%)	-497 (-44.34%)
	BAMBU	-25 (-2.23%)	-534 (-47.64%)
	GRAS	24 (2.14%)	-598 (-53.35%)
2080	SEDG	246 (21.94%)	-586 (-52.27%)
	BAMBU	-410 (-36.57%)	-873 (-77.88%)
	GRAS	-249 (-22.21%)	-1008 (-89.92%)

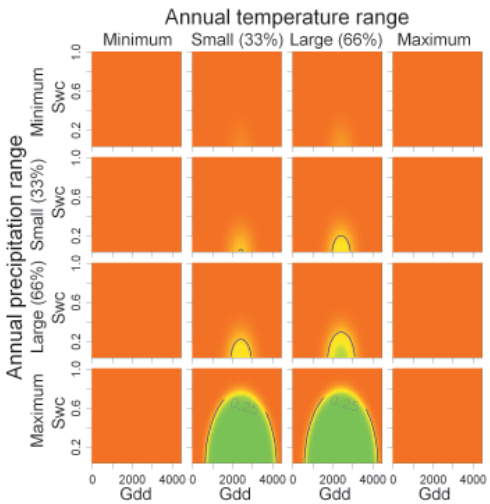
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1121)

The Balkan Marbled White occurs on dry grasslands, rocky slopes, in open scrub, and in grassy clearings in woods. Sometimes, these butterflies are even seen in villages. The caterpillars feed on different grasses. This butterfly is single-brooded and hibernates as a caterpillar.

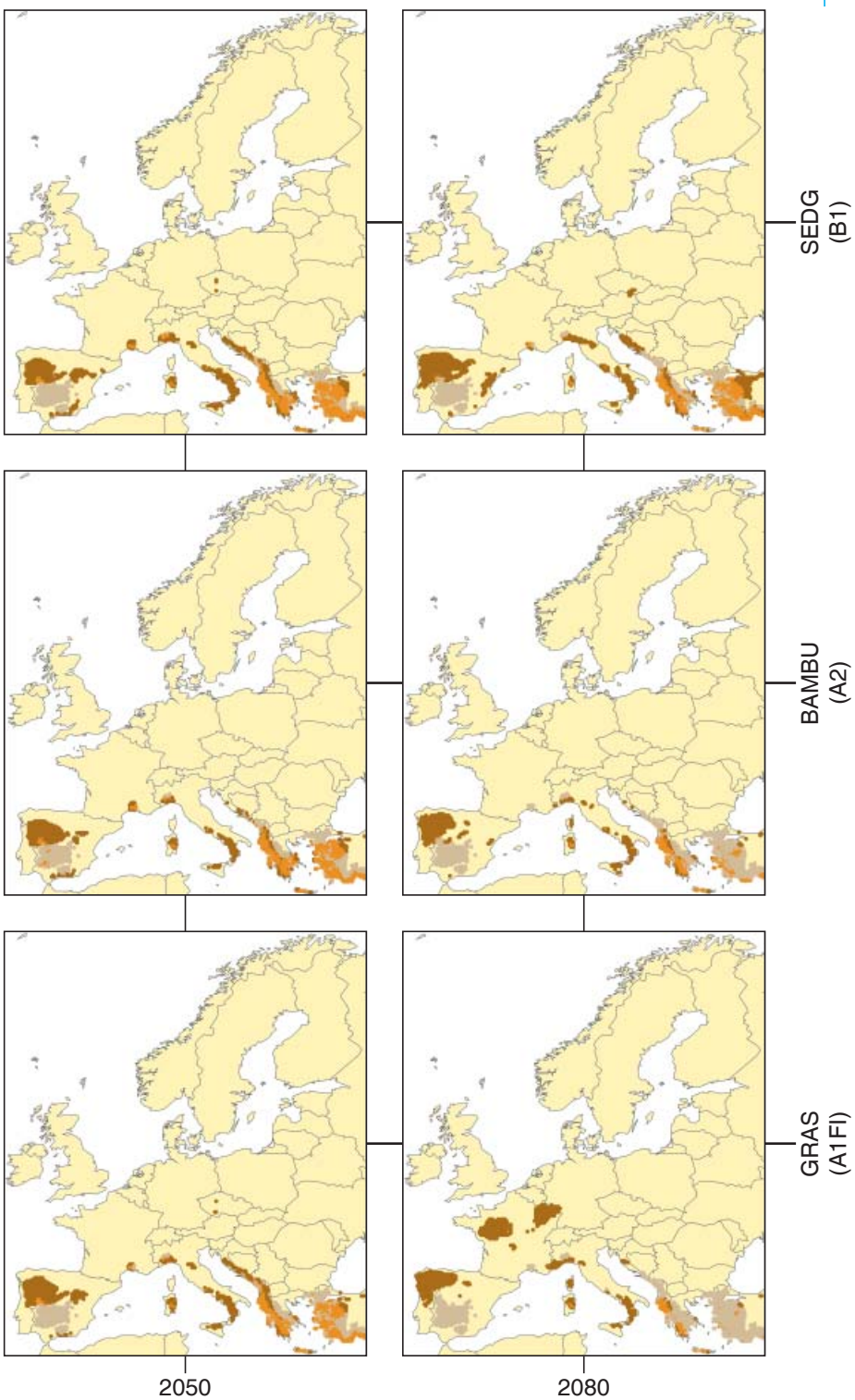
Present distribution can be well explained by climatic variables (AUC = 0.89).
Climate risk category: HHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Melanargia arge (Sulzer, 1776) – Italian Marbled White

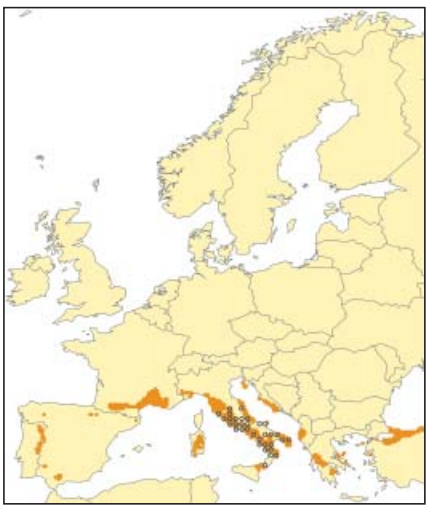
© Otakar Kudrna

		Full dispersal	No dispersal
2050	SEDG	488 (79.09%)	-281 (-45.54%)
	BAMBU	497 (80.55%)	-291 (-47.16%)
	GRAS	719 (116.53%)	-305 (-49.43%)
2080	SEDG	776 (125.77%)	-331 (-53.65%)
	BAMBU	767 (124.31%)	-409 (-66.29%)
	GRAS	655 (106.16%)	-447 (-72.45%)

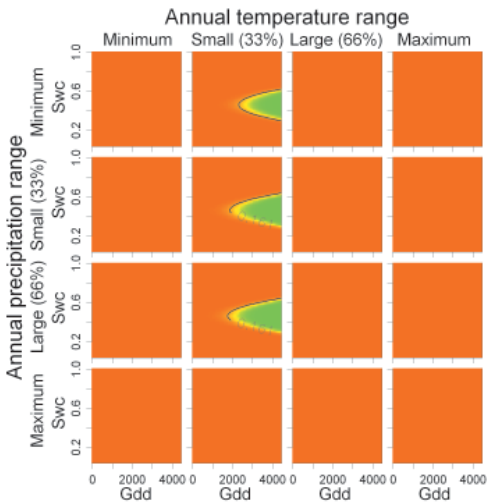
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 617)

The Italian Marbled White occurs locally in small populations. It occurs in rocky, calcareous places on patches of dry, grassy vegetation among loose thickets of Prickly Juniper (*Juniperus oxycedrus*), *Rosa sempervirens*, the bramble *Rubus ulmifolius*, and *Thymus capitatus,* with a few scattered trees. The caterpillars feed on grasses such as Feather Grass (*Stipa pinnata*), and the false-brome *Brachypodium retusum*. The Italian Marbled White has one generation a year, and only flies for three weeks per year in any one location.
This species is listed in Annexes II and IV of the Habitats' Directive.

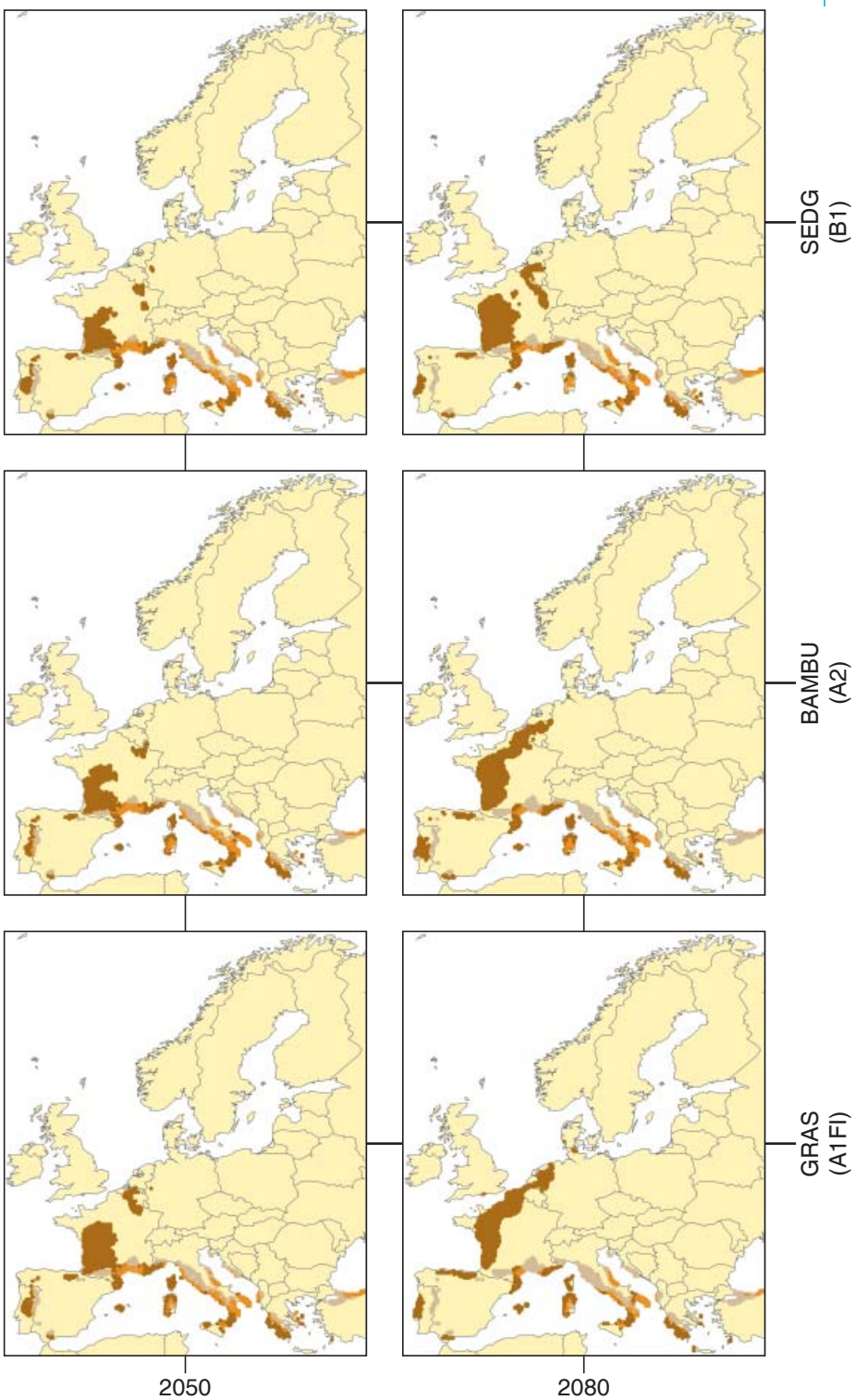
Present distribution can be very well explained by climatic variables (AUC = 0.98).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Melanargia occitanica (Esper, 1793) – Western Marbled White

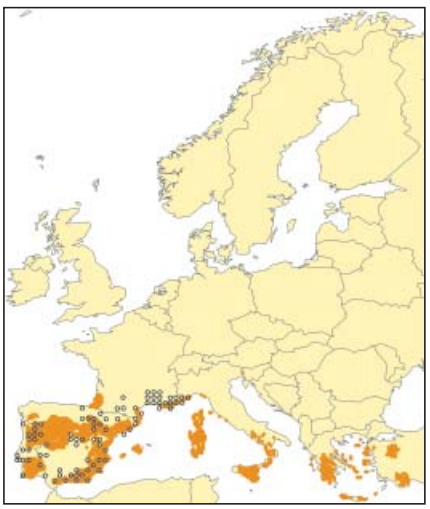
© Martin Wiemers

		Full dispersal	No dispersal
2050	SEDG	-958 (-68.19%)	-1076 (-76.58%)
	BAMBU	-1081 (-76.94%)	-1137 (-80.93%)
	GRAS	-1141 (-81.21%)	-1246 (-88.68%)
2080	SEDG	-1081 (-76.94%)	-1345 (-95.73%)
	BAMBU	-1196 (-85.12%)	-1402 (-99.79%)
	GRAS	-1014 (-72.17%)	-1405 (-100%)

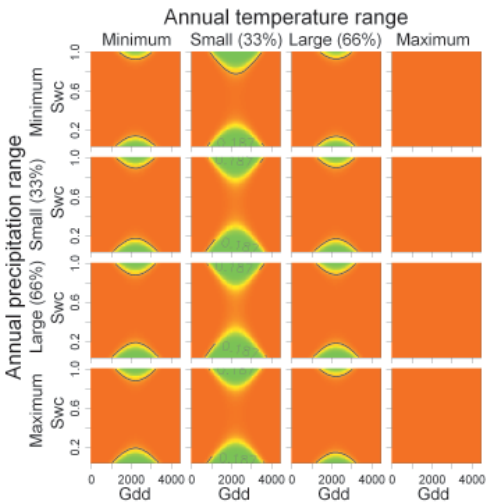
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1405)

The Western Marbled White is mostly found in dry, rocky places with grassy vegetation and scattered rocks, although it is also seen in damper locations. Its foodplants are various grasses, such as Tor-grass (*Brachypodium pinnatum*), Bermuda-grass (*Cynodon dactylon*), and Cock's-foot (*Dactylus glomerata*). This species is single-brooded and hibernates as a caterpillar.

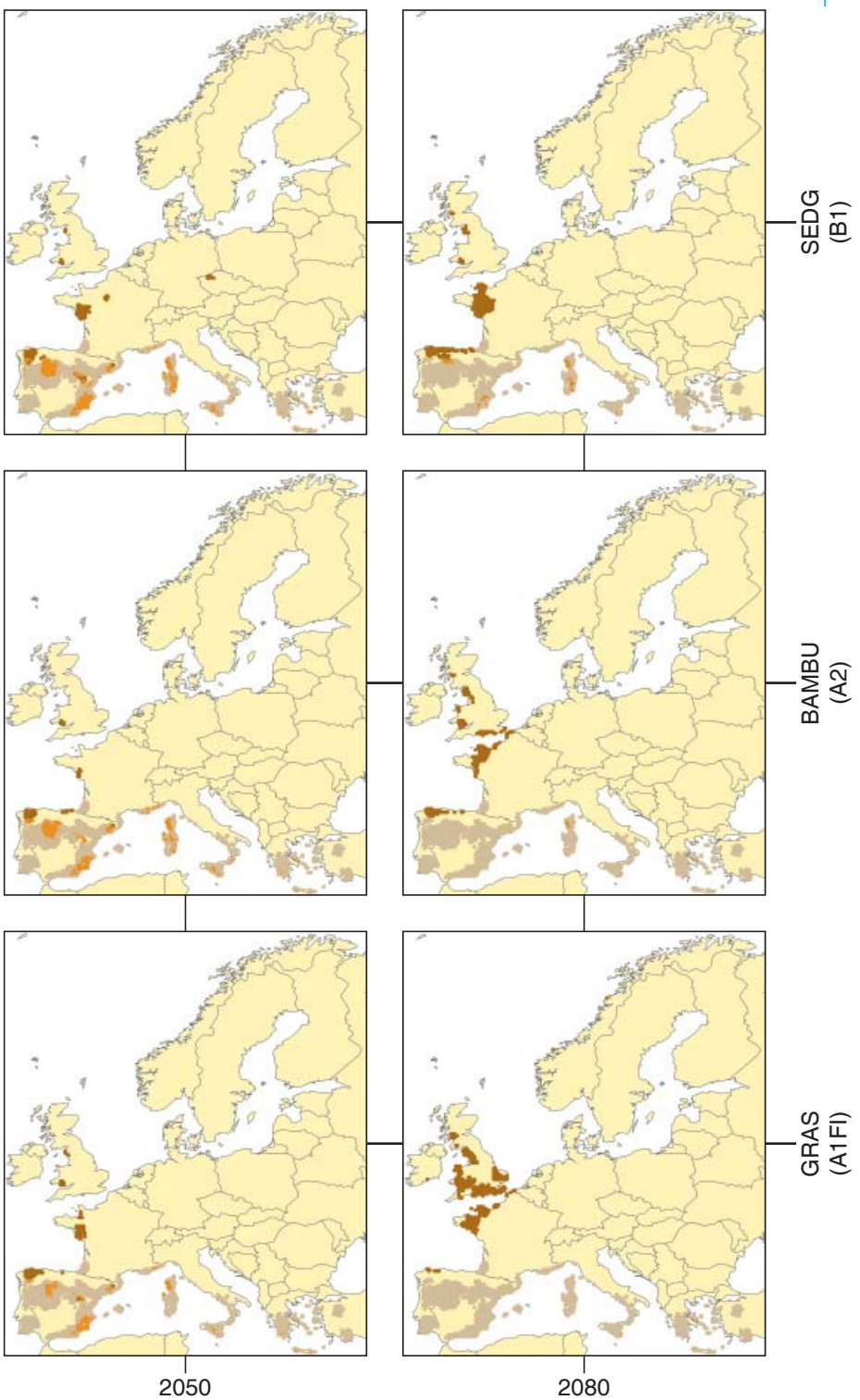
Present distribution can be well explained by climatic variables (AUC = 0.86).
Climate risk category: HHHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Melanargia ines (Hoffmansegg, 1804) – Spanish Marbled White

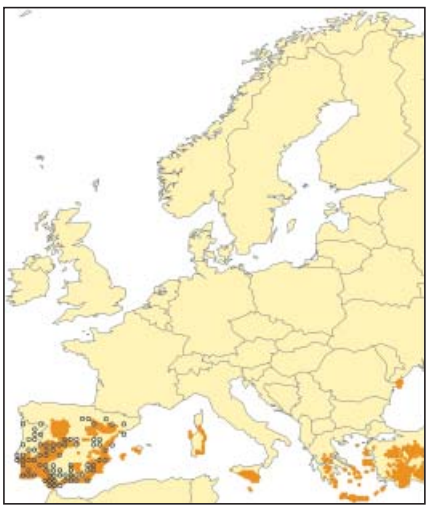
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-460 (-41.52%)	-547 (-49.37%)
	BAMBU	-648 (-58.48%)	-659 (-59.48%)
	GRAS	-657 (-59.3%)	-690 (-62.27%)
2080	SEDG	-794 (-71.66%)	-833 (-75.18%)
	BAMBU	-1019 (-91.97%)	-1019 (-91.97%)
	GRAS	-1073 (-96.84%)	-1073 (-96.84%)

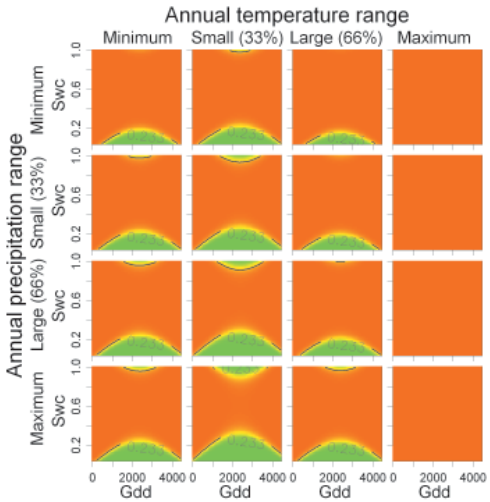
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1108)

The Spanish Marbled White is found in warm, dry places with low vegetation on rocky slopes, on flower-rich grassy vegetation, and in scrub. Its foodplants are grasses, such as Tor-grass (*Brachypodium pinnatum*) and Compact Brome (*Bromus madritensis*). The caterpillars hibernate, pupating on the ground in the early spring.

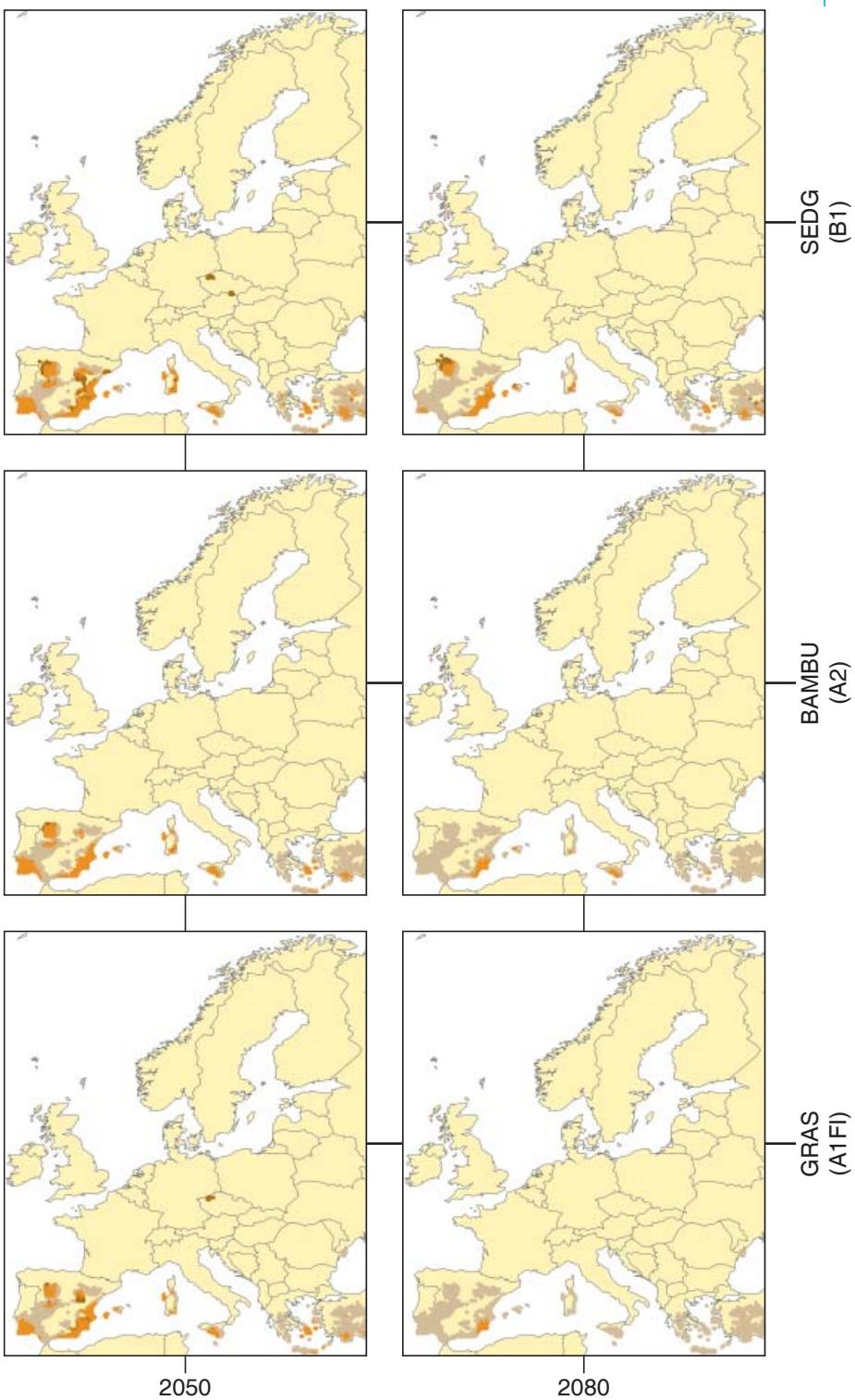
Present distribution can be well explained by climatic variables (AUC = 0.95).
Climate risk category: HHHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Satyrus ferula (Fabricius, 1793) – Great Sooty Satyr

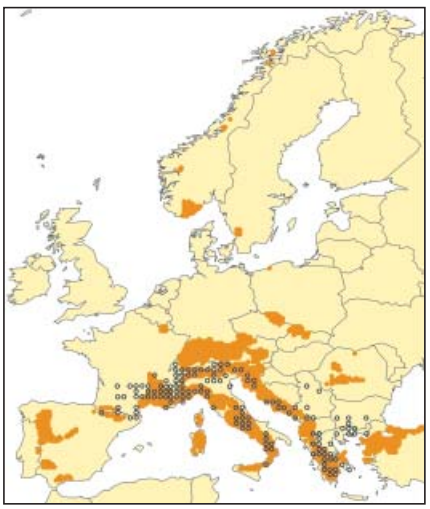
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	-703 (-31.91%)	-1206 (-54.74%)
	BAMBU	-741 (-33.64%)	-1333 (-60.51%)
	GRAS	-941 (-42.71%)	-1572 (-71.36%)
2080	SEDG	-378 (-17.16%)	-1706 (-77.44%)
	BAMBU	-601 (-27.28%)	-1846 (-83.79%)
	GRAS	-631 (-28.64%)	-2036 (-92.42%)

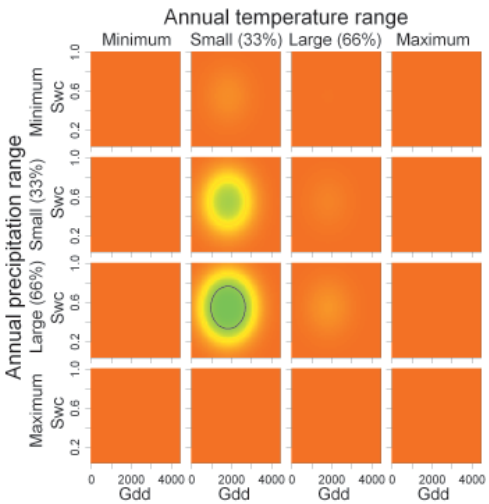
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 2203)

In the mountains, the Great Sooty Satyr is mostly found in open, dry, rocky places with grassy vegetation. At lower altitudes, the butterflies occur in open clearings in woods, or at wood edges. They can often be seen drinking nectar on such flowers as thistles and scabious (*Knautia* spp.). The female lays her eggs low down on dry grass stems. The caterpillars hibernate when still quite small, and pupate in May or June. Sheep's-fescue (*Festuca ovina*) is the most important foodplant, but other fescues (*Festuca* spp.), false-bromes (*Brachypodium* spp.), and bromes (*Bromus* spp.) are probably also used.

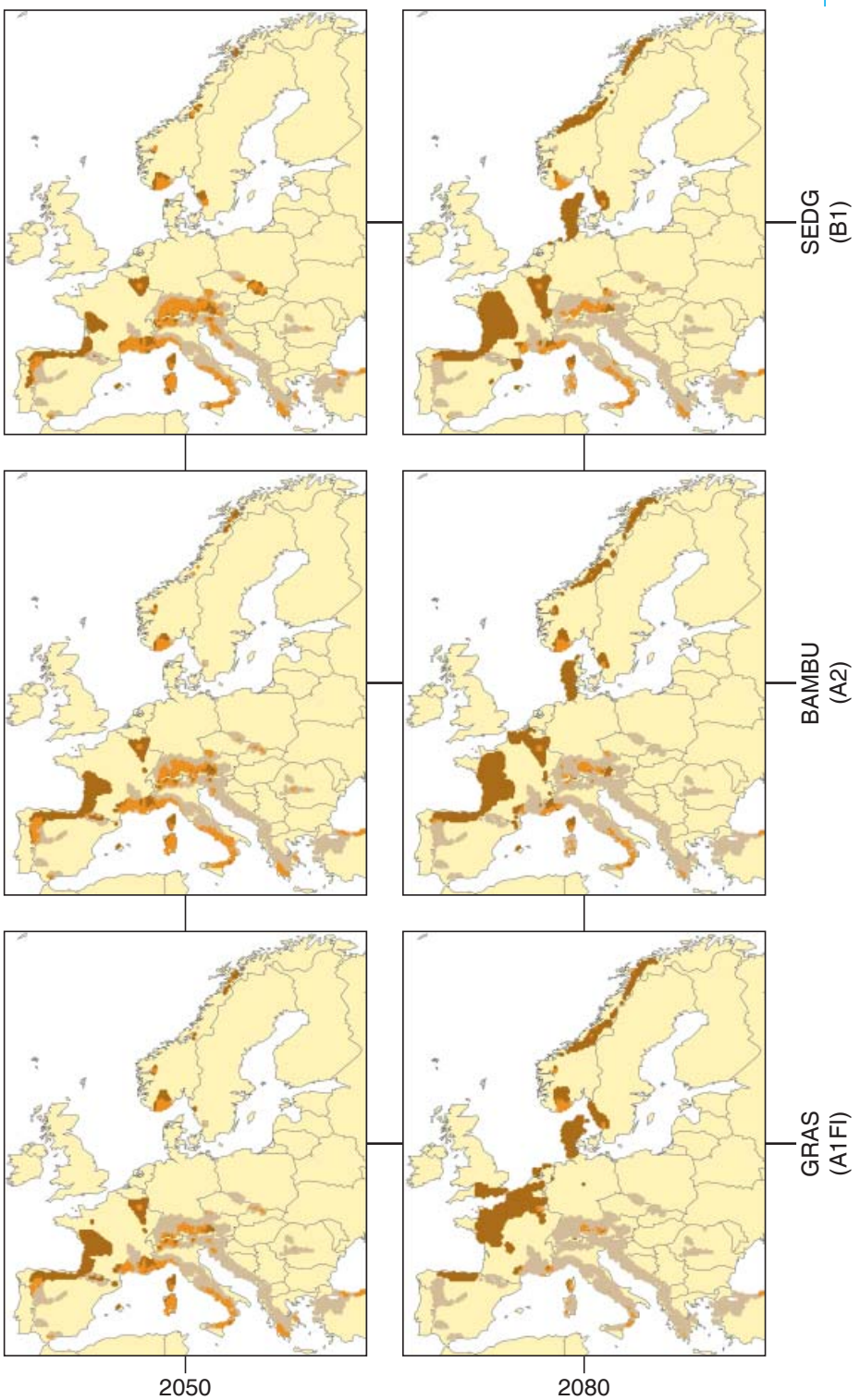
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.76). Climate risk category: HHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Satyrus actaea (Esper, 1780) – Black Satyr

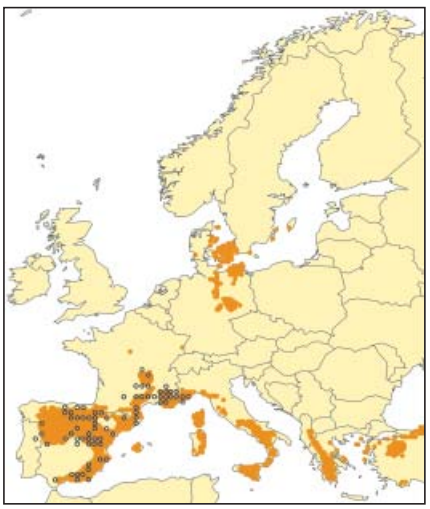
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	-200 (-12.36%)	-1171 (-72.37%)
	BAMBU	-1060 (-65.51%)	-1317 (-81.4%)
	GRAS	-669 (-41.35%)	-1373 (-84.86%)
2080	SEDG	-749 (-46.29%)	-1522 (-94.07%)
	BAMBU	-1016 (-62.79%)	-1579 (-97.59%)
	GRAS	-1015 (-62.73%)	-1611 (-99.57%)

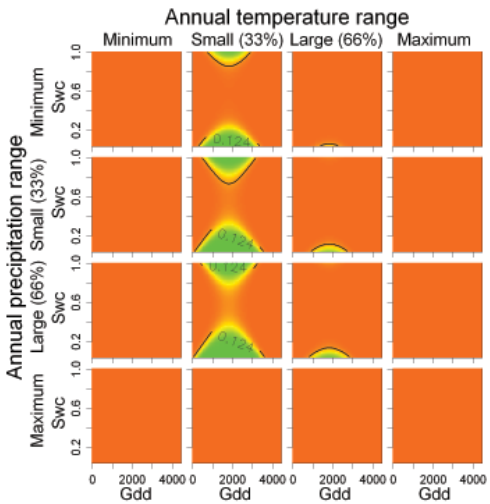
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1618)

The Black Satyr can be found on grassy vegetation, rocky slopes, and in scrub. The caterpillars feed on various grasses, such as fescues (*Festuca* spp.), meadow-grasses (*Poa* spp.), false-bromes (*Brachypodium* spp.), and bromes (*Bromus* spp.). They hibernate and then pupate on the ground at the end of the spring in May to June. The Black Satyr is single-brooded.

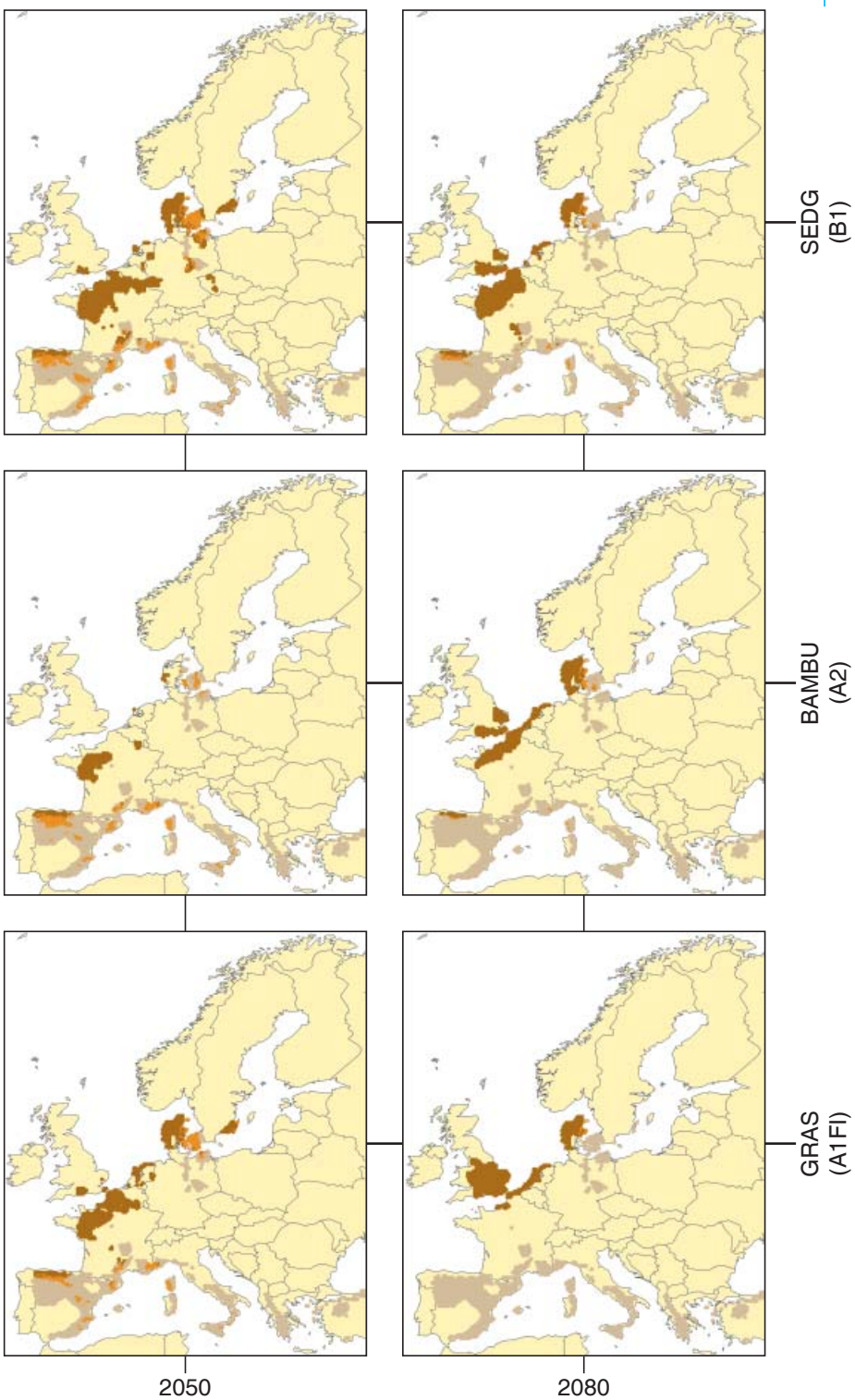
Present distribution can be well explained by climatic variables (AUC = 0.92).
Climate risk category: HHHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Minois dryas (Scopoli, 1763) – Dryad

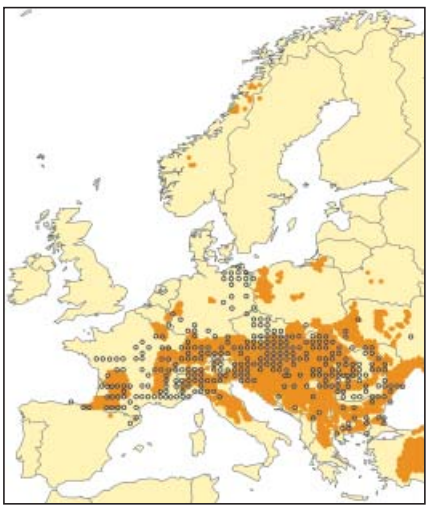
© Martin Wiemers

		Full dispersal	No dispersal
2050	**SEDG**	2262 (53.35%)	-1957 (-46.16%)
	BAMBU	3822 (90.14%)	-1934 (-45.61%)
	GRAS	2375 (56.01%)	-2311 (-54.5%)
2080	**SEDG**	3230 (76.18%)	-2611 (-61.58%)
	BAMBU	3810 (89.86%)	-3066 (-72.31%)
	GRAS	4305 (101.53%)	-3463 (-81.67%)

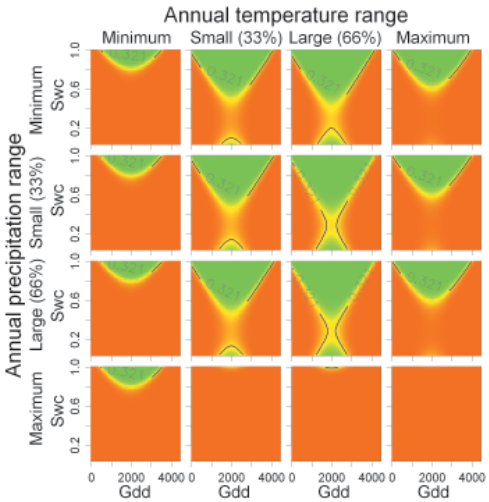
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 4240)

The Dryad inhabits grassy, rather rough vegetation, often located at the edge of woodland or scrub, and mostly quite damp. The foodplants are relatively broad-leaved, nutritious grasses, such as Purple Moor-grass (*Molinea caerulea*), small-reeds (*Calamagrostis* spp.), and bromes (*Bromus* spp.). The female drops her eggs in flight into the grass. The tiny caterpillars emerge and, without feeding, enter a period of inactivity during the summer months. In the autumn, they begin to feed, hibernating in the first or second larval instar. The caterpillars make a little hollow in the ground in which to pupate, but do not spin a cocoon. The Dryad is single-brooded.

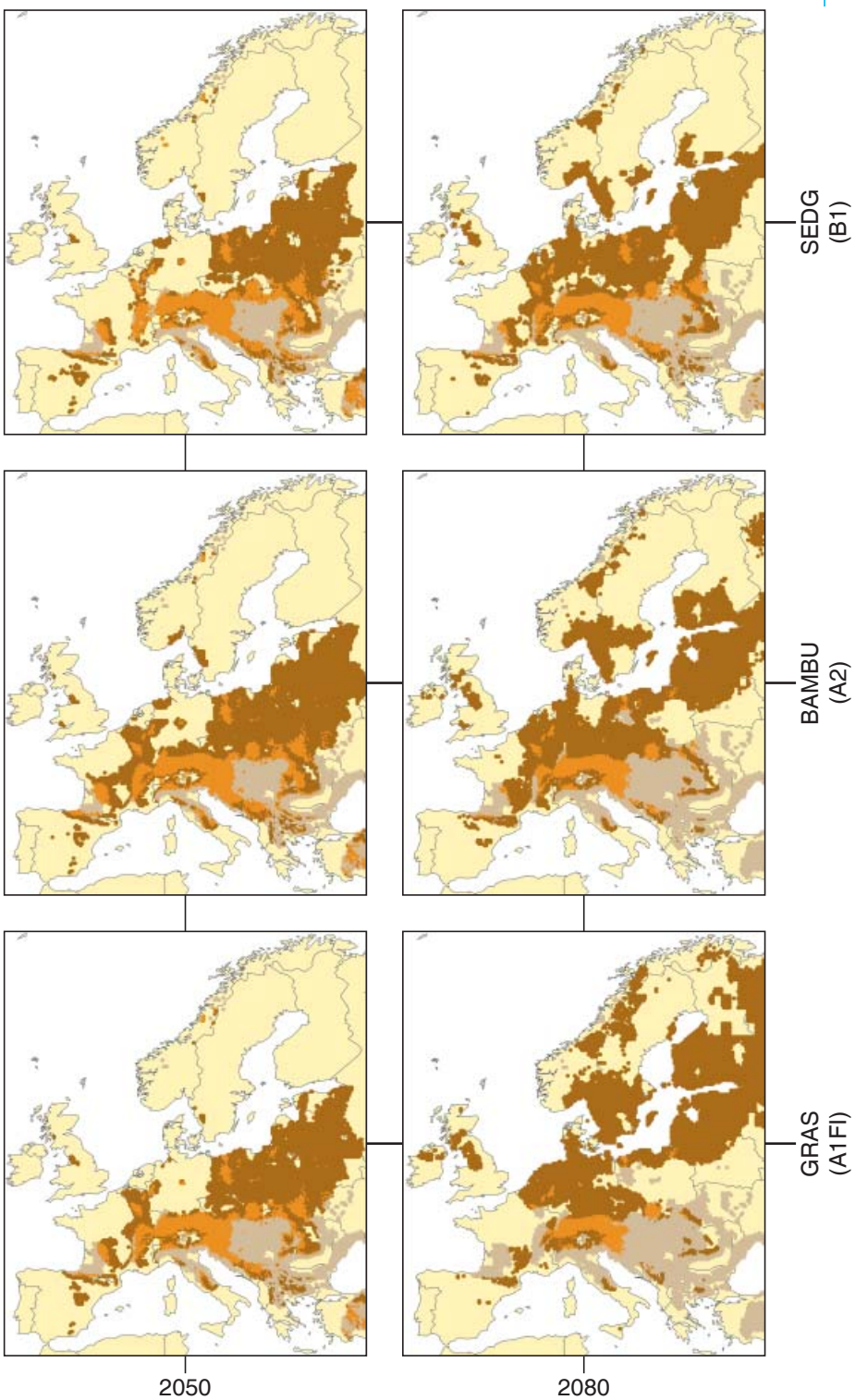
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.83).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Hipparchia fagi (Scopoli, 1763) – Woodland Grayling

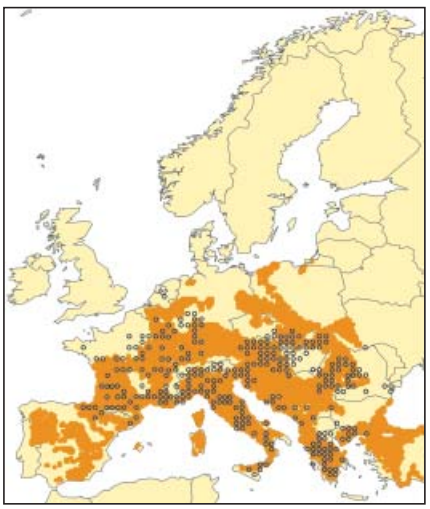
© Rudi Verovnik

		Full dispersal	No dispersal
2050	SEDG	1516 (23.19%)	-1565 (-23.94%)
	BAMBU	2258 (34.54%)	-1710 (-26.16%)
	GRAS	830 (12.7%)	-2226 (-34.05%)
2080	SEDG	2059 (31.5%)	-2487 (-38.04%)
	BAMBU	1747 (26.72%)	-3478 (-53.2%)
	GRAS	1334 (20.41%)	-4425 (-67.69%)

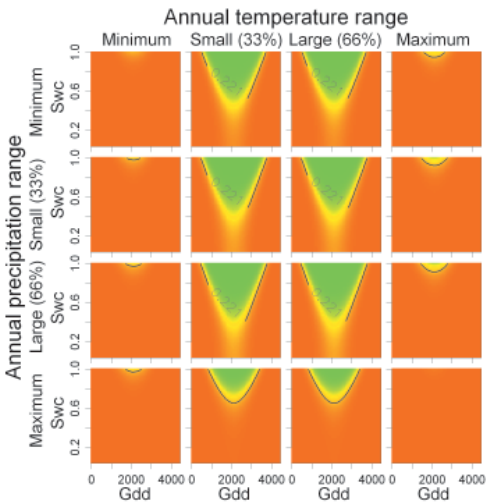
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 6537)

The Woodland Grayling is a butterfly of open woods that occurs on grassy vegetation, along woodland rides, and in woodland glades. The butterflies are fond of settling on tree trunks, head end up, where, with their wings tightly closed and the eye-spots hidden, they are very well camouflaged. The eggs are laid on the blades of such grasses as fescues (*Festuca* spp.), false-bromes (*Brachypodium* spp.), and bromes (*Bromus* spp.). The caterpillars grow very slowly and, when they are half-grown, they hibernate in the litter layer. The caterpillar pupates in a little hollow in the ground, spinning itself a sort of cocoon. The Woodland Grayling has one generation a year.

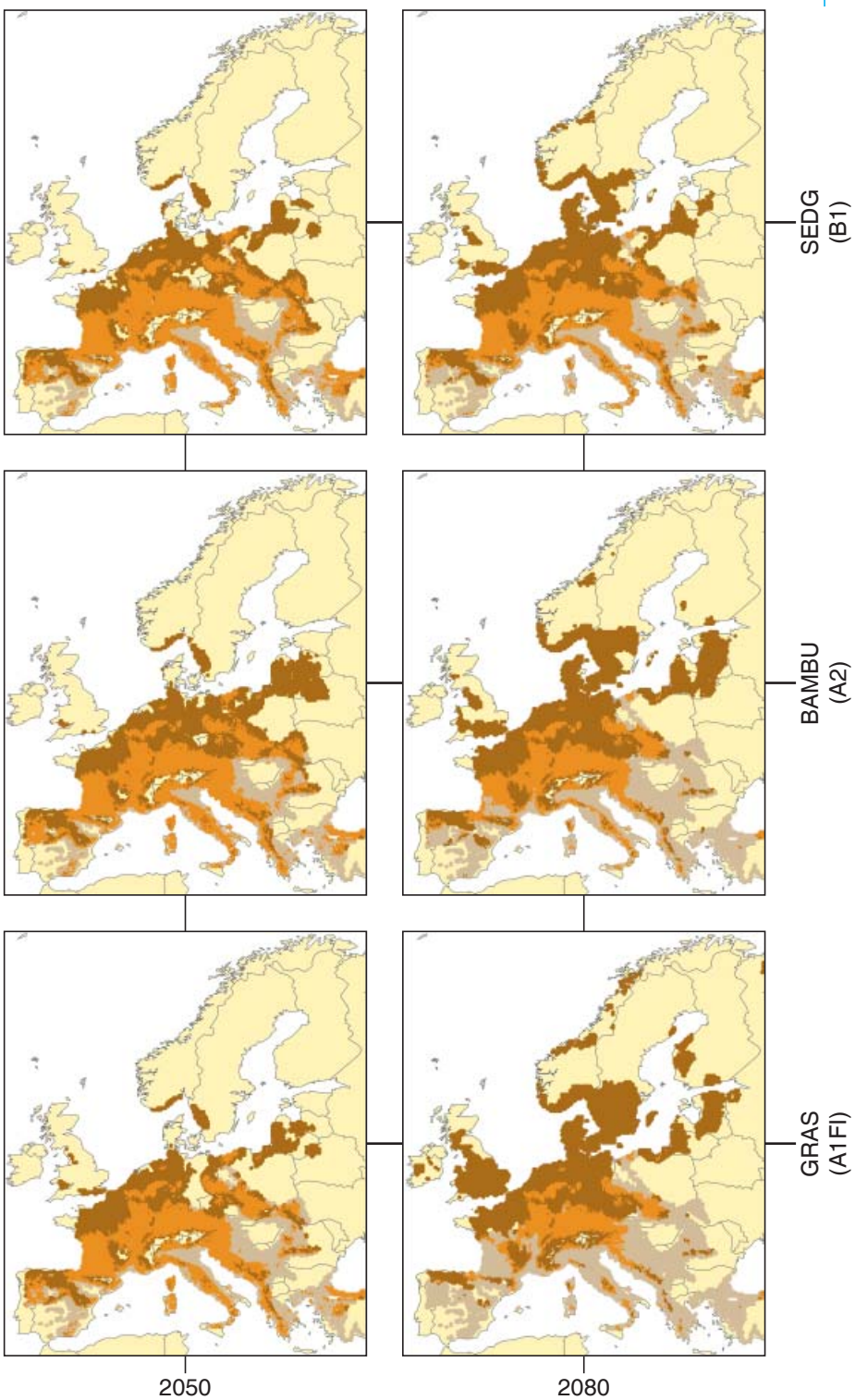
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.83). Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Hipparchia hermione (Linnaeus, 1764) – Rock Grayling

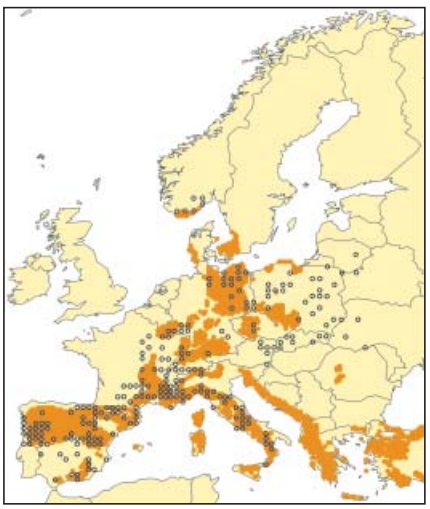
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	14 (0.42%)	-1651 (-49.89%)
	BAMBU	-1810 (-54.7%)	-2266 (-68.48%)
	GRAS	-1329 (-40.16%)	-2414 (-72.95%)
2080	SEDG	-906 (-27.38%)	-2535 (-76.61%)
	BAMBU	-2091 (-63.19%)	-2968 (-89.69%)
	GRAS	-2086 (-63.04%)	-3191 (-96.43%)

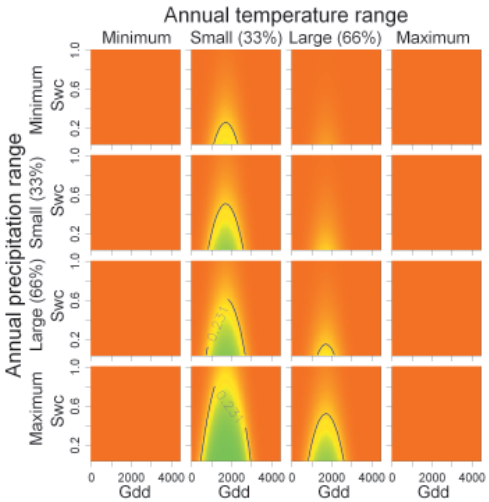
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 3309)

The Rock Grayling can be found at the edge of very open woodland on poor steppe-like grasslands, as found, for example, near open coniferous woods growing on sandy ground. In these habitats, there are usually rock masses or other sorts of open ground. The butterfly often rests on the ground or against tree trunks, where the colours and pattern of the underside of its wings provide excellent camouflage. The eggs are laid on different grasses, including fescues (*Festuca* spp.) and false-bromes (*Brachypodium* spp.). The caterpillars grow very slowly and hibernate when half-grown in the litter layer. They pupate in a little hollow in the ground, after spinning a sort of cocoon. The Rock Grayling has one brood a year.

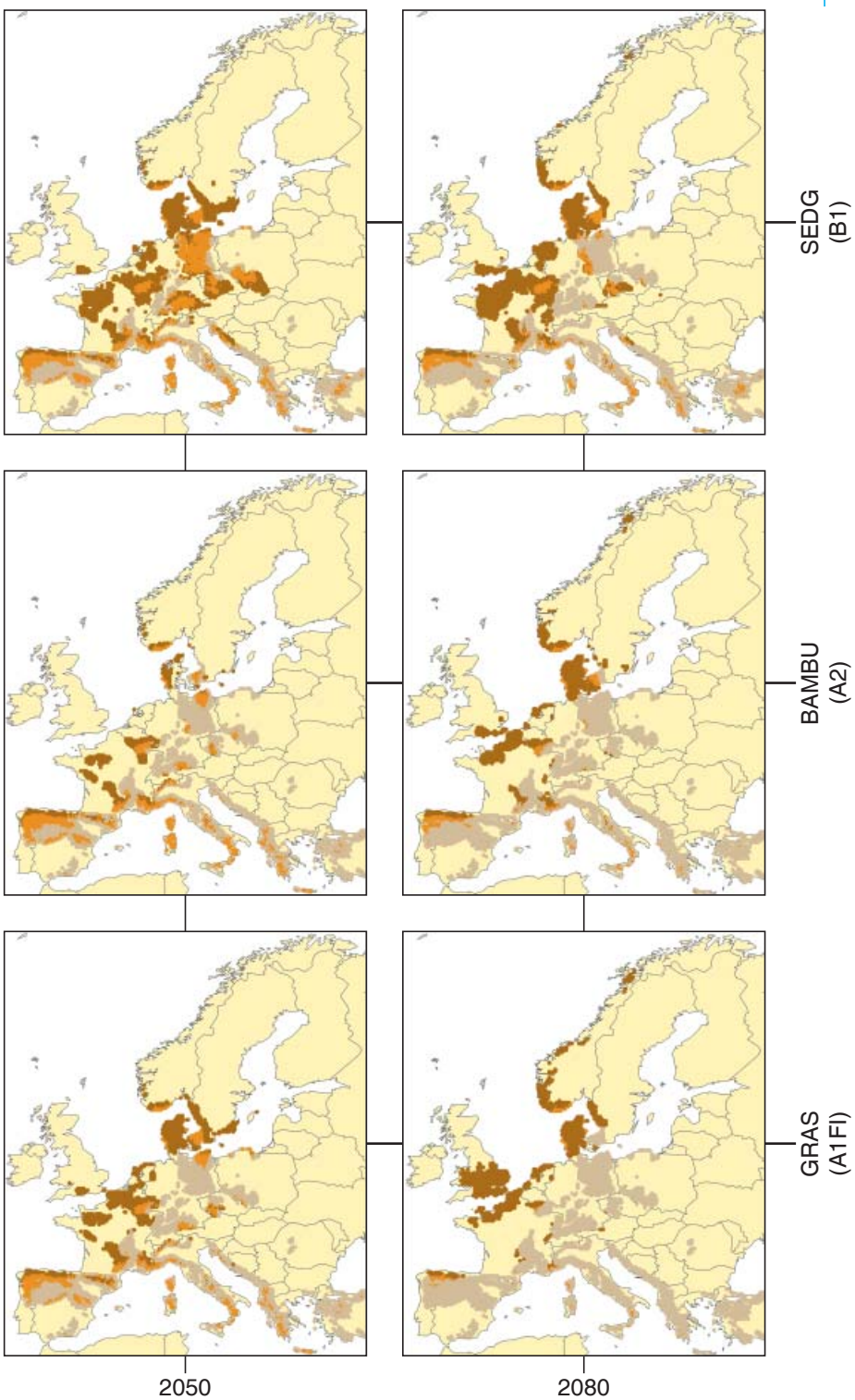
Present distribution can be explained by climatic variables to only a limited extent (AUC = 0.72). Climate risk category: PR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Hipparchia syriaca (Staudinger, 1871) – Eastern Rock Grayling

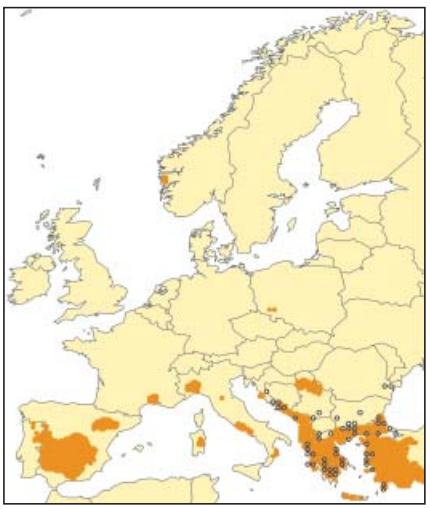
© Josef Pennerstorfer

		Full dispersal	No dispersal
2050	SEDG	774 (40.33%)	-595 (-31.01%)
	BAMBU	481 (25.07%)	-646 (-33.66%)
	GRAS	534 (27.83%)	-773 (-40.28%)
2080	SEDG	652 (33.98%)	-893 (-46.53%)
	BAMBU	-201 (-10.47%)	-1231 (-64.15%)
	GRAS	445 (23.19%)	-1432 (-74.62%)

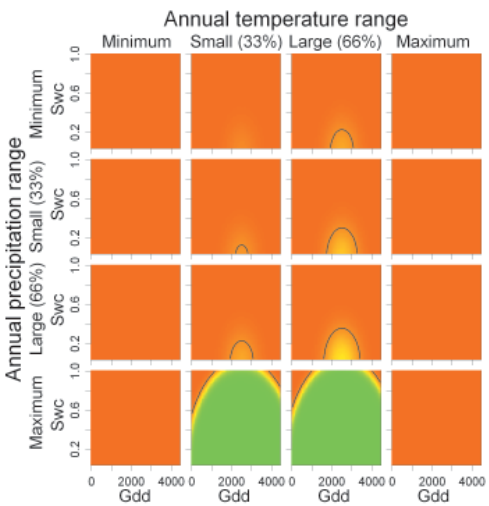
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1919)

The Eastern Rock Grayling looks very much like the Woodland Grayling (*H. fagi*), and they occur together in some places.. This butterfly is a species of scrub and light woodland of all sorts, deciduous, coniferous and mixed. At the hottest part of the day, the butterflies hardly fly at all, resting with closed wings on the shadow side of the tree trunk, or on the ground where they blend into their surroundings. They hardly ever visit flowers. Their flight is quick and powerful. The caterpillars feed on grasses. Although single-brooded, they can be seen from May until September. The butterflies may be inactive during the hot, dry summer.

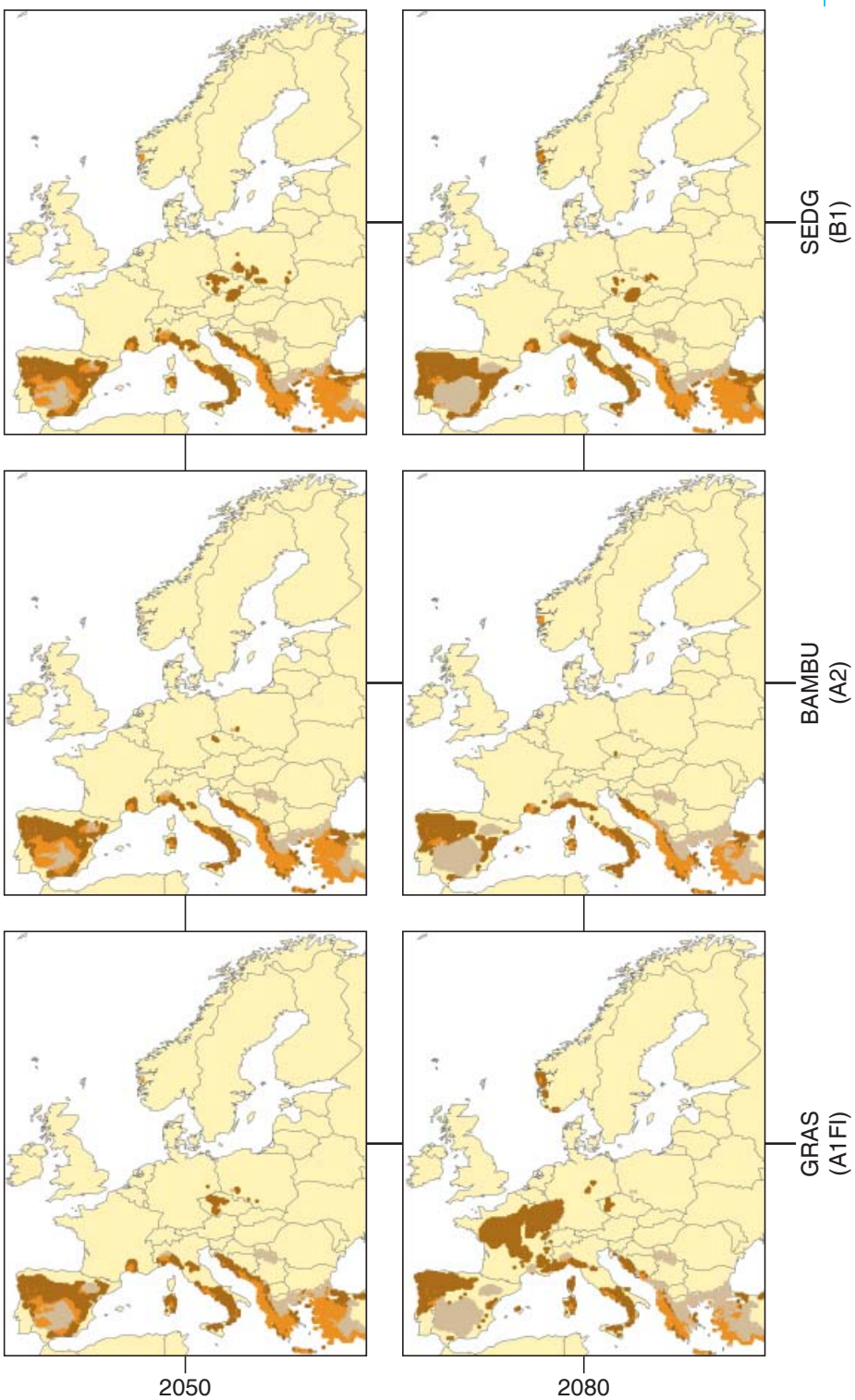
Present distribution can be well explained by climatic variables (AUC = 0.95).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Hipparchia semele (Linnaeus, 1758) – Grayling

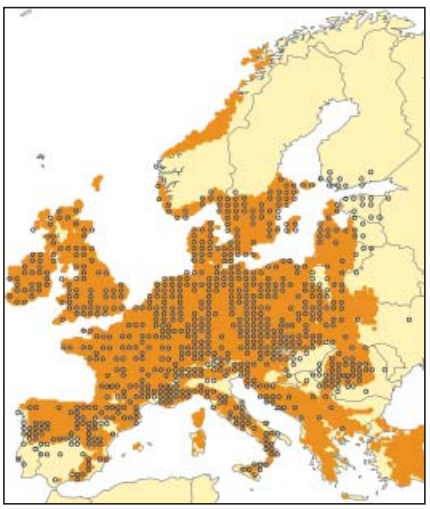
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	-2284 (-16.51%)	-3095 (-22.37%)
	BAMBU	-3269 (-23.63%)	-4031 (-29.14%)
	GRAS	-3564 (-25.76%)	-4405 (-31.84%)
2080	SEDG	-5233 (-37.83%)	-6024 (-43.55%)
	BAMBU	-6634 (-47.96%)	-7748 (-56.01%)
	GRAS	-8424 (-60.9%)	-9748 (-70.47%)

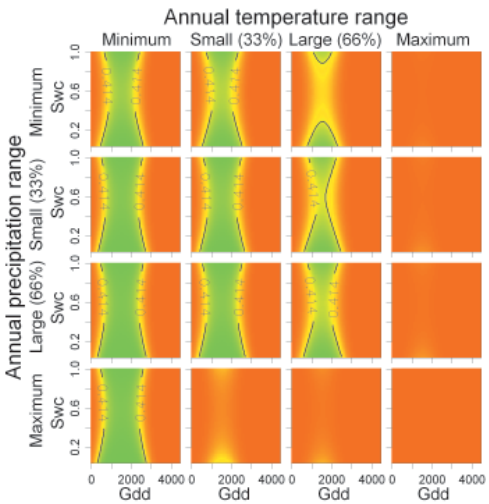
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 13833)

The Grayling is found in dry, infertile surroundings, occurring on poor, dry grasslands, dry heaths, and also often at the coast. The males and females meet each other above a solitary tree in a wide open landscape, such as a pine on heathland. The female lays her eggs on various fine-leaved grasses, including fescues (*Festuca* spp.), bents (*Agrostis* spp.), and bromes (*Bromus* spp.). Walking over the bare ground, she approaches a grass tussock, and deposits an egg on a withered grass blade a few centimetres above the ground. The caterpillar grows very slowly, feeding mostly at night. It hibernates deep down in a grass tussock. When it is ready to pupate, it spins itself a sort of cocoon in a little hollow in the ground. The Grayling has one brood a year.

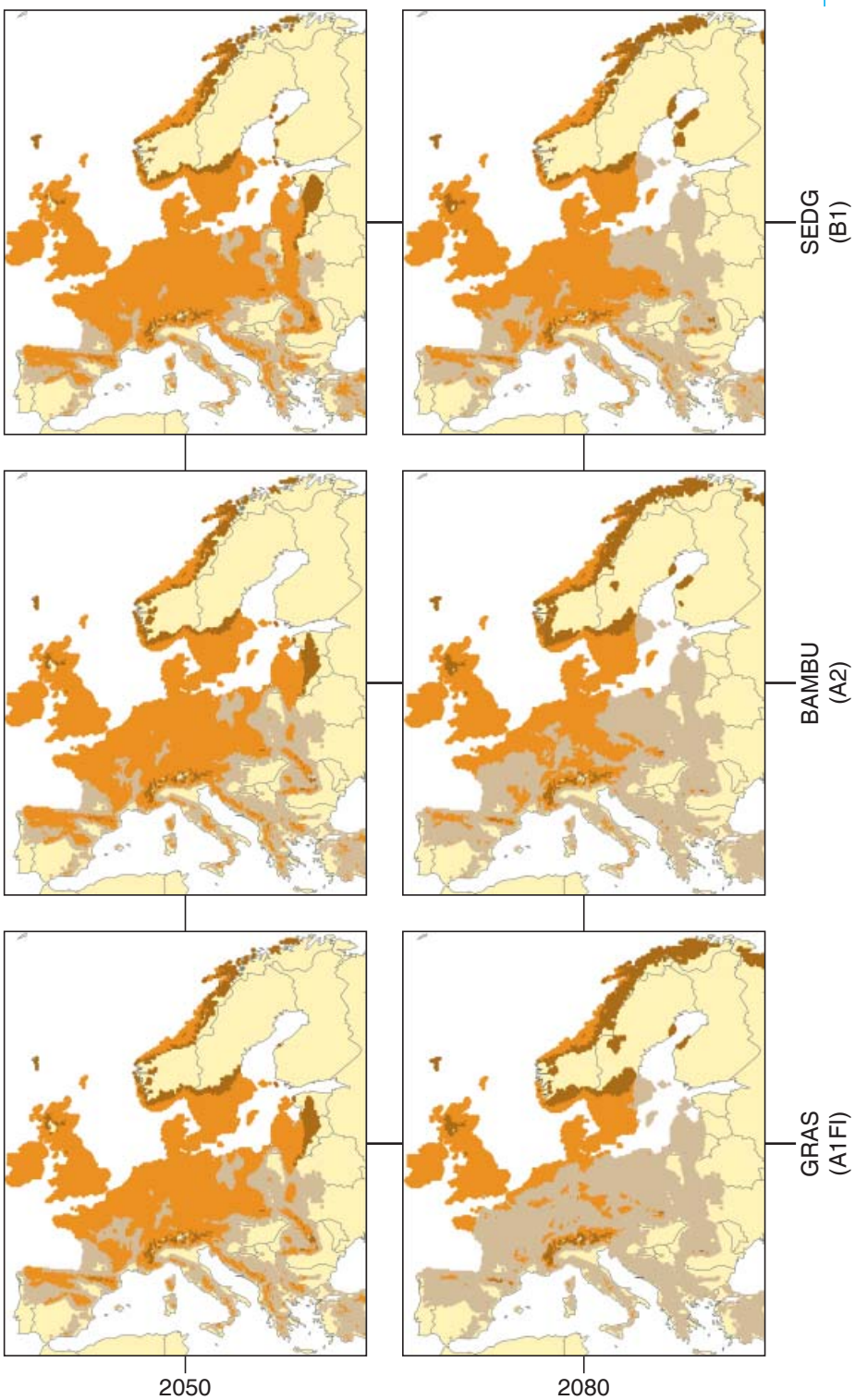
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.79). Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Hipparchia volgensis (Mazochin-Porshnyakov, 1952) – Delattin's Grayling

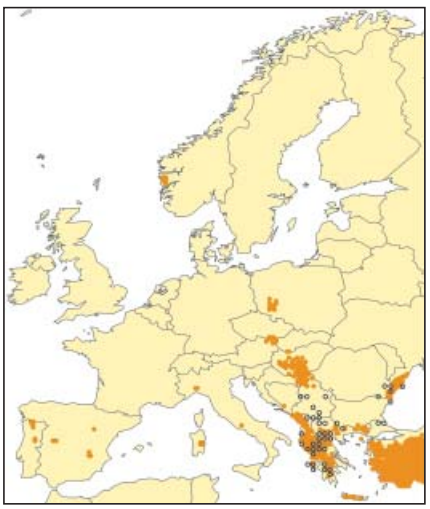
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	426 (43.43%)	-382 (-38.94%)
	BAMBU	-96 (-9.79%)	-549 (-55.96%)
	GRAS	155 (15.8%)	-575 (-58.61%)
2080	SEDG	152 (15.49%)	-465 (-47.4%)
	BAMBU	-432 (-44.04%)	-735 (-74.92%)
	GRAS	-467 (-47.6%)	-856 (-87.26%)

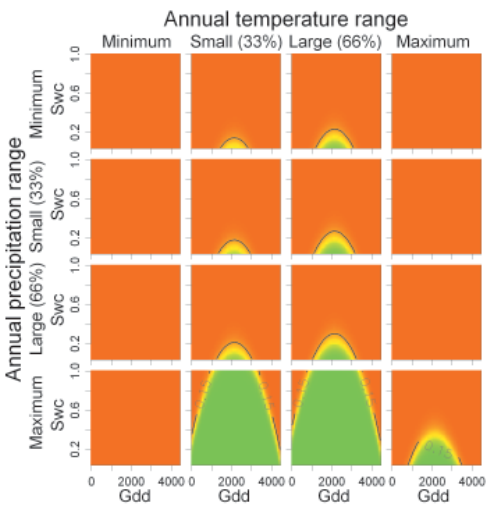
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 981)

Delattin's Grayling is a butterfly of warm and dry places. It is found on rocky slopes, on dry grasslands, and in light woodland. It is single-brooded. Adults fly from June to July. Details of the ecology of the species are unknown.

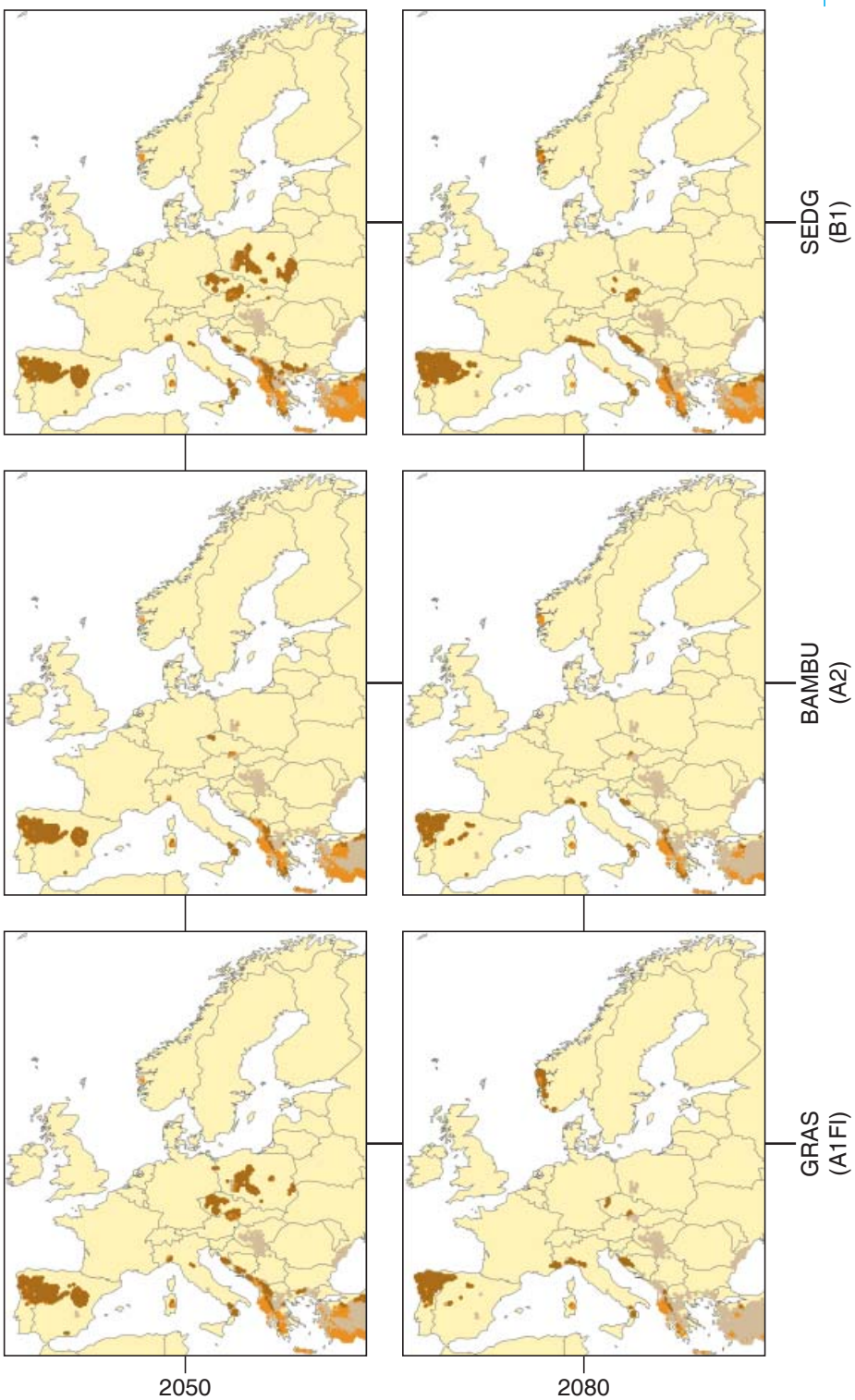
Present distribution can be well explained by climatic variables (AUC = 0.94).
Climate risk category: HHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Hipparchia statilinus (Hufnagel, 1766) – Tree Grayling

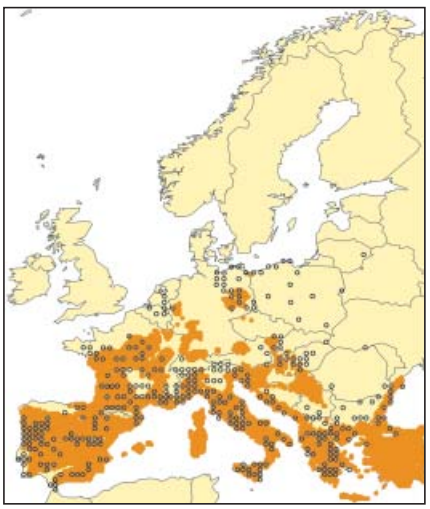
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	1004 (16.41%)	-1947 (-31.83%)
	BAMBU	-56 (-0.92%)	-2416 (-39.5%)
	GRAS	506 (8.27%)	-2640 (-43.16%)
2080	SEDG	-99 (-1.62%)	-3063 (-50.07%)
	BAMBU	-506 (-8.27%)	-4017 (-65.67%)
	GRAS	-1068 (-17.46%)	-5188 (-84.81%)

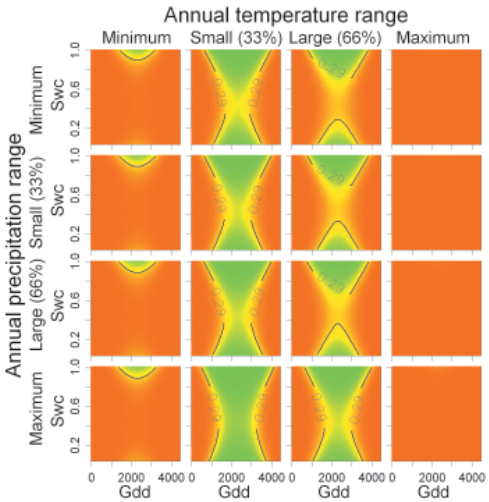
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 6117)

The Tree Grayling occurs in very warm, dry and nutrient-poor areas with much open ground and sparse vegetation. The size and markings of this butterfly are very variable. While remaining on the ground, the female deposits her eggs one by one on withered blades of grass. Grey Hair-grass (*Corynephorus canescens*), Sheep's-fescue (*Festuca ovina*), Brown Bent-grass (*Agrostis vinealis*), bromes (*Bromus* spp.), Feather grass (*Stipa pinnata*), and other grasses are used as foodplants. The small caterpillar passes the winter in a grass tussock and, if it does not freeze, remains active during the winter. However, growth only begins after hibernation. As development is very slow, the caterpillar only pupates in the summer. The flight period of the Tree Grayling, that only has one brood a year, is therefore very late.

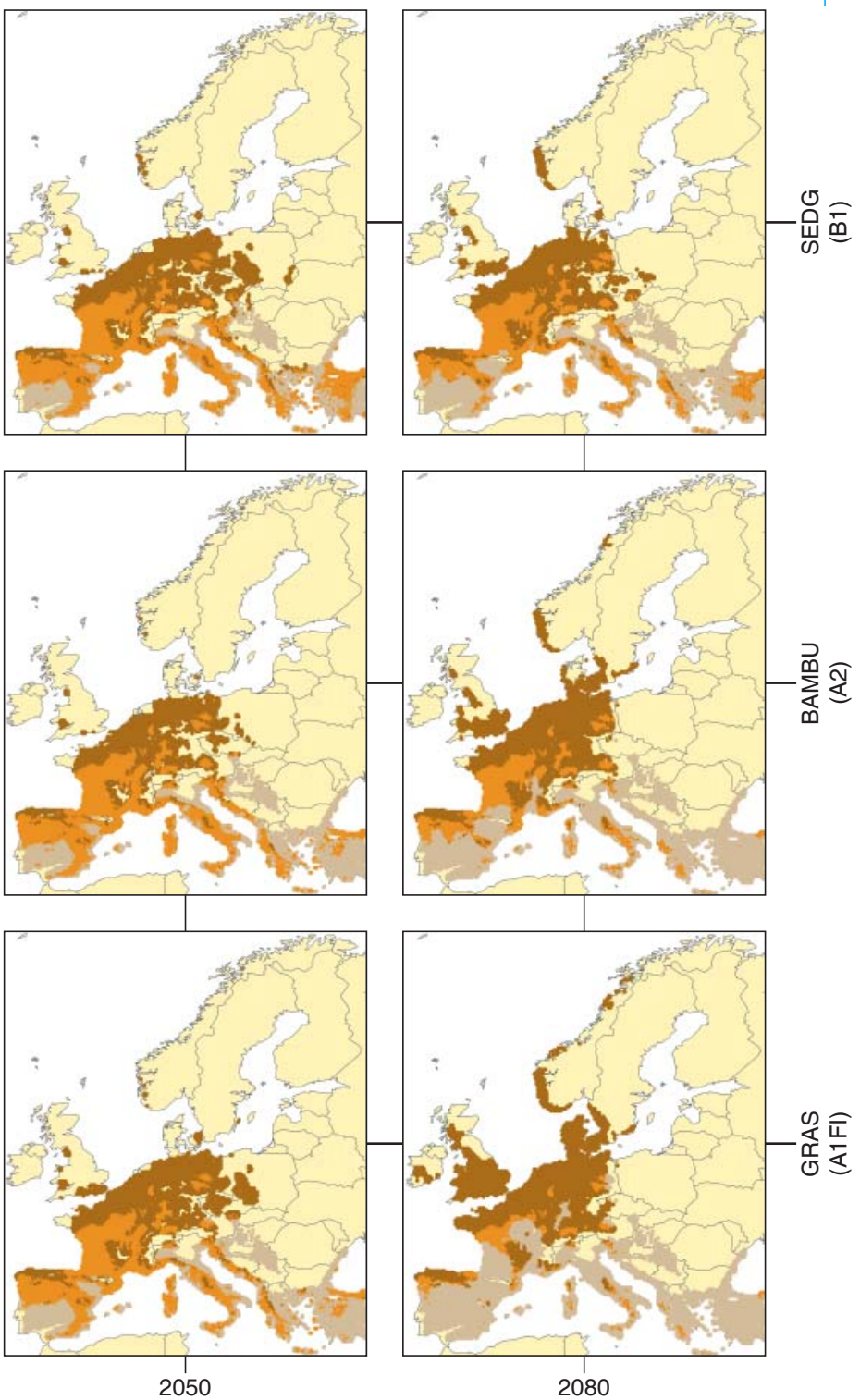
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.76). Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Hipparchia fatua (Freyer, 1845) – Freyer's Grayling

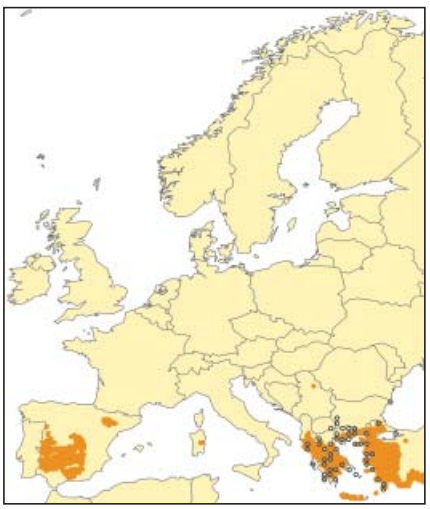
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-89 (-8.69%)	-482 (-47.07%)
	BAMBU	-46 (-4.49%)	-439 (-42.87%)
	GRAS	-92 (-8.98%)	-513 (-50.1%)
2080	SEDG	235 (22.95%)	-527 (-51.46%)
	BAMBU	-245 (-23.93%)	-693 (-67.68%)
	GRAS	-426 (-41.6%)	-827 (-80.76%)

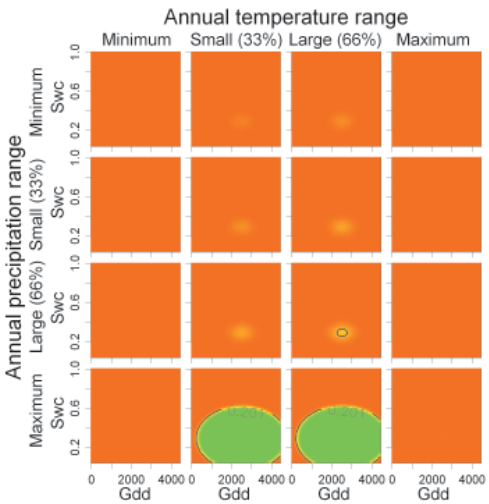
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 1024)

Freyer's Grayling can be found in dense thickets, on rocky slopes, on dry, grassy vegetation, in light woodland and in olive groves and orchards. There are trees in most habitats. In appearance and choice of biotope, Freyer's Grayling is very similar to the Tree Grayling (*H. statilinus*). The butterflies are fond of resting on the ground or on tree trunks, and hardly ever visit flowers. It uses different grasses as foodplants, and has one generation a year.

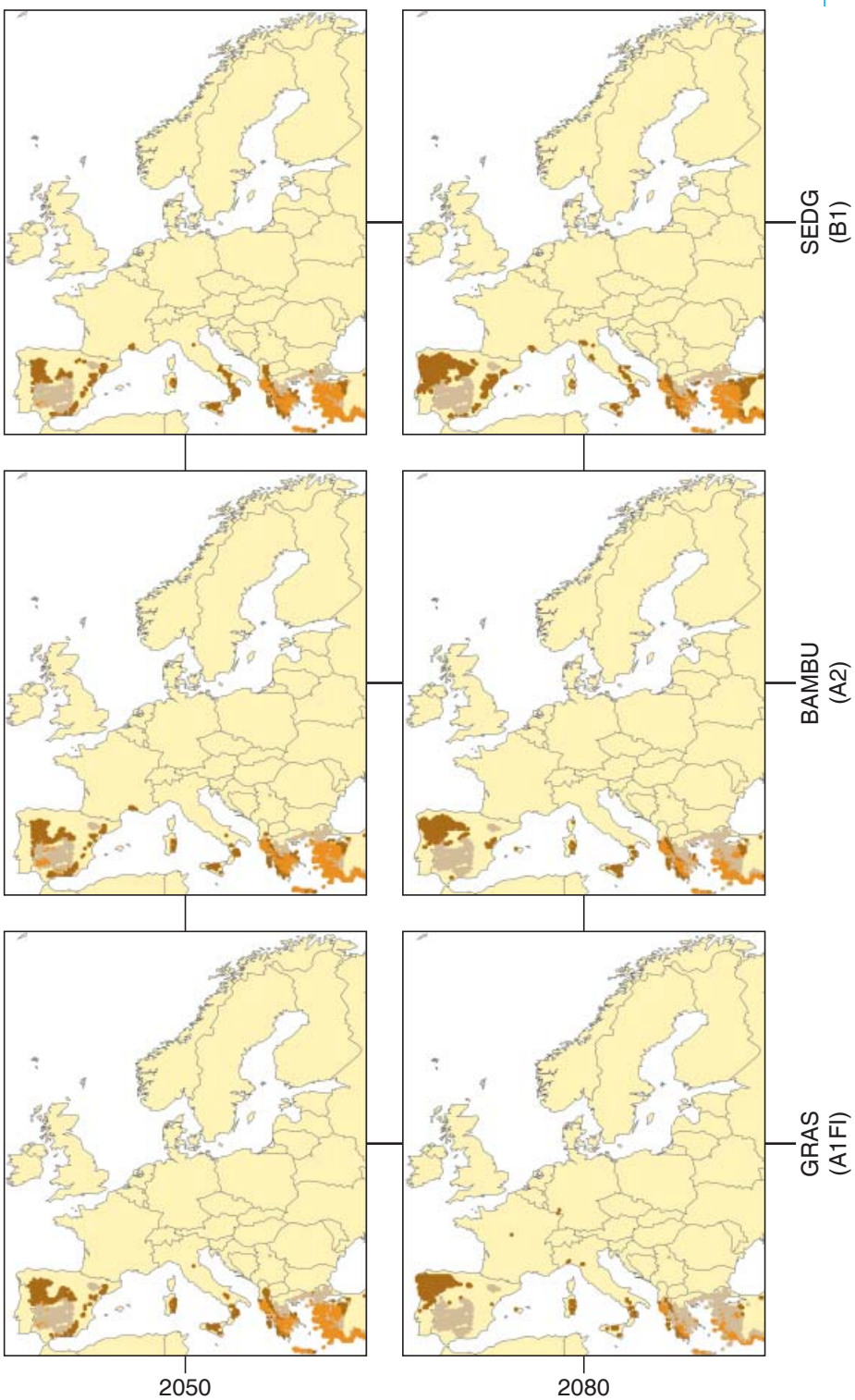
Present distribution can be very well explained by climatic variables (AUC = 0.98).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Hipparchia fidia (Linnaeus, 1767) – Striped Grayling

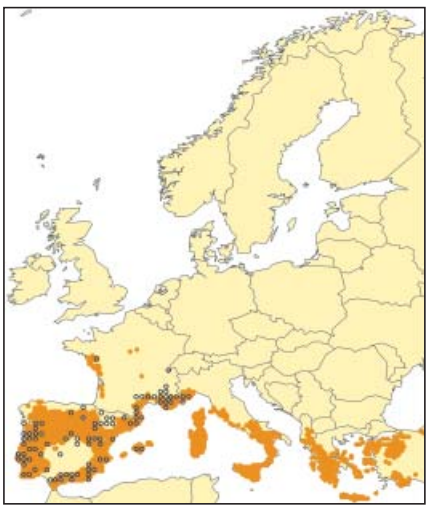
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	-731 (-33.35%)	-1623 (-74.04%)
	BAMBU	-1294 (-59.03%)	-1644 (-75%)
	GRAS	-1040 (-47.45%)	-1875 (-85.54%)
2080	SEDG	-1112 (-50.73%)	-1959 (-89.37%)
	BAMBU	-1518 (-69.25%)	-2110 (-96.26%)
	GRAS	-1463 (-66.74%)	-2180 (-99.45%)

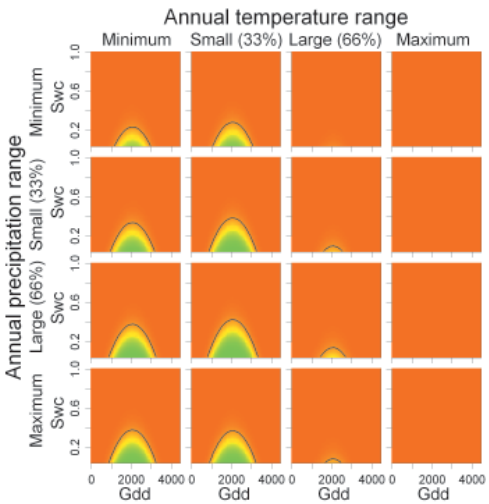
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 2192)

The Striped Grayling occurs mostly on dry, rocky slopes with bushes and grassy vegetation, and in light woodland. The butterflies often rest on the ground or on tree trunks. Foodplants are various grasses, such as Bermuda-grass (*Cynodon dactylon*), Cock's-foot (*Dactylus glomerata*), meadow-grasses (*Poa* spp.), and false-bromes (*Brachypodium* spp.). This butterfly is single-brooded and hibernates as a caterpillar, on or just in the ground.

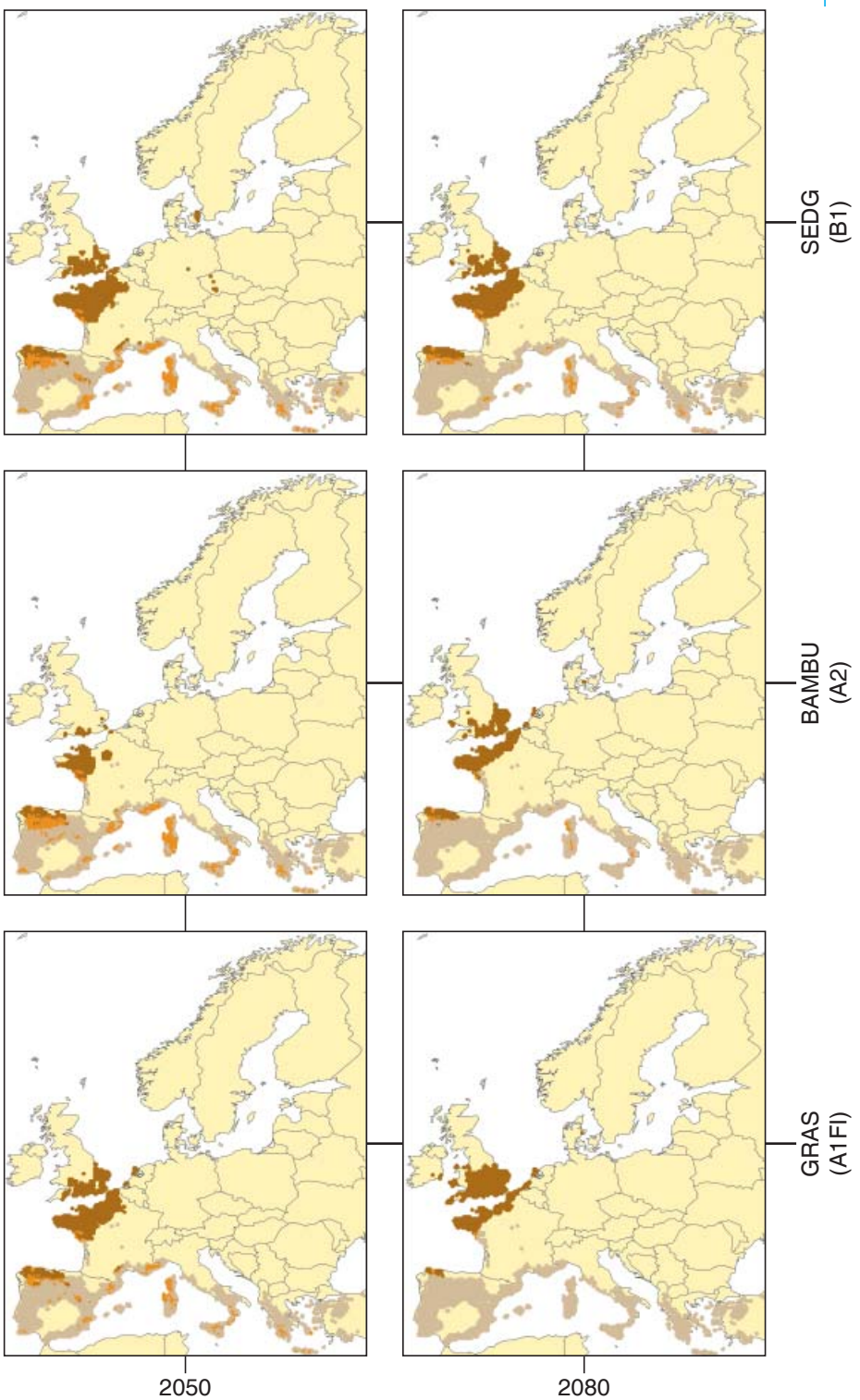
Present distribution can be well explained by climatic variables (AUC = 0.88).
Climate risk category: HHHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Hipparchia senthes (Fruhstorfer, 1908) – Balkan Grayling

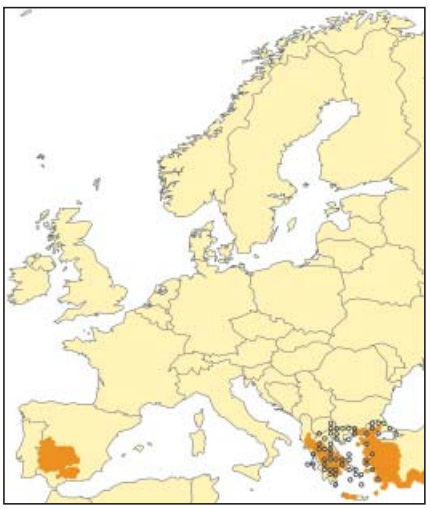
© Neil Thompson

		Full dispersal	No dispersal
2050	SEDG	-62 (-7.38%)	-350 (-41.67%)
	BAMBU	-2 (-0.24%)	-293 (-34.88%)
	GRAS	-85 (-10.12%)	-386 (-45.95%)
2080	SEDG	207 (24.64%)	-421 (-50.12%)
	BAMBU	-280 (-33.33%)	-631 (-75.12%)
	GRAS	-444 (-52.86%)	-767 (-91.31%)

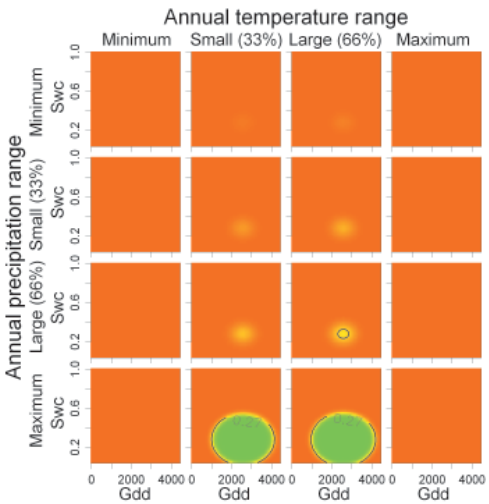
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 840)

The Balkan Grayling replaces the Grayling (*H. semele*) in the Southern Balkan Peninsula, the Greek island of Levkas and the Aegean islands. It lives in dry grasslands, scrubland, and open woodlands and occurs from 0-1600m elevation. The species has one generation per year with adults on the wing from May until October.

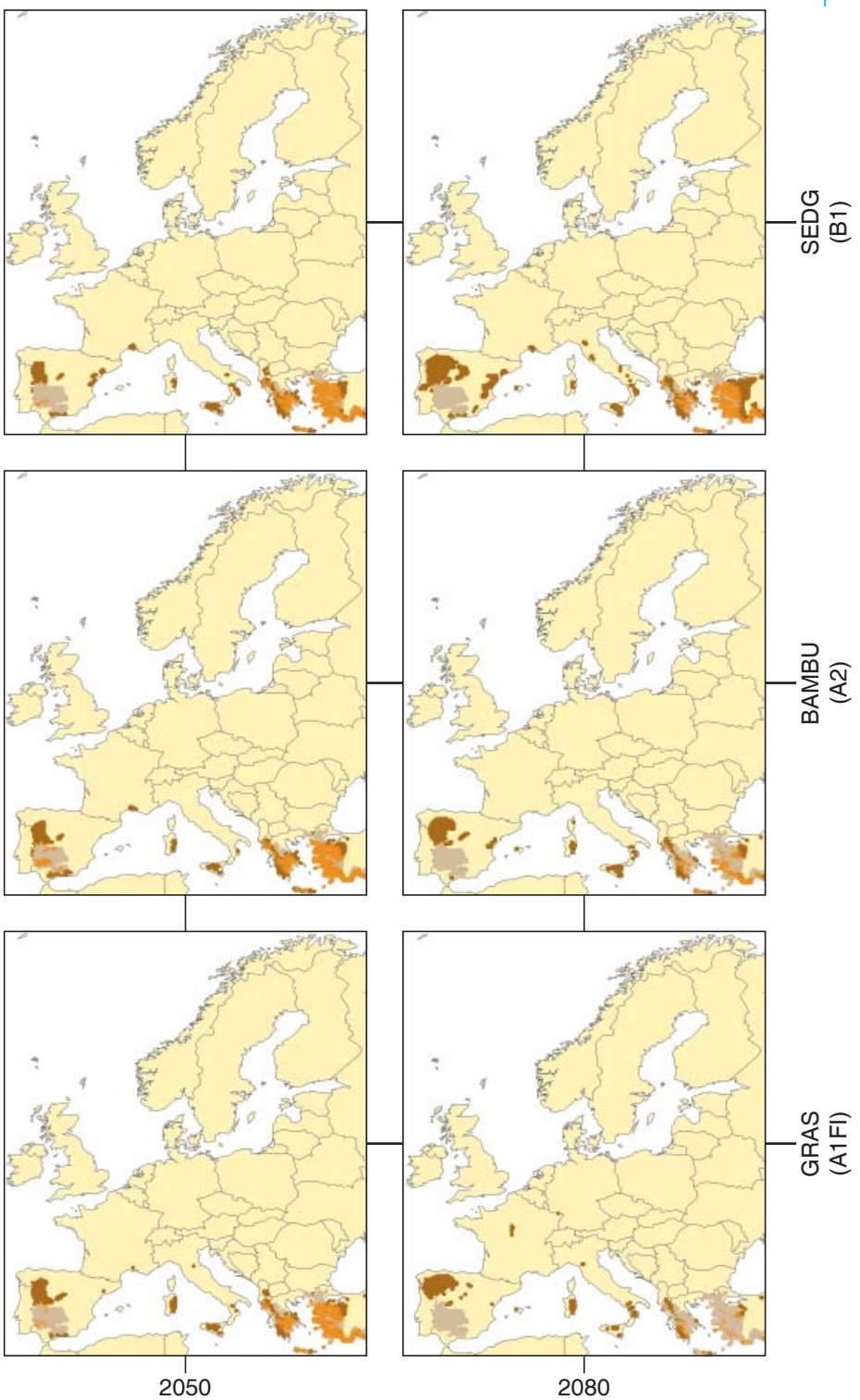
Present distribution can be well explained by climatic variables (AUC = 0.94).
Climate risk category: HHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Arethusana arethusa ([Schiffermüller], 1775) – False Grayling

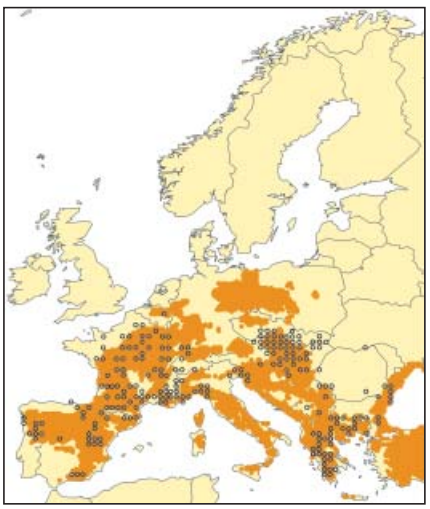
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	1068 (19%)	-2313 (-41.15%)
	BAMBU	-64 (-1.14%)	-2666 (-47.43%)
	GRAS	487 (8.66%)	-2938 (-52.27%)
2080	SEDG	-616 (-10.96%)	-3665 (-65.2%)
	BAMBU	-1332 (-23.7%)	-4595 (-81.75%)
	GRAS	-2335 (-41.54%)	-5381 (-95.73%)

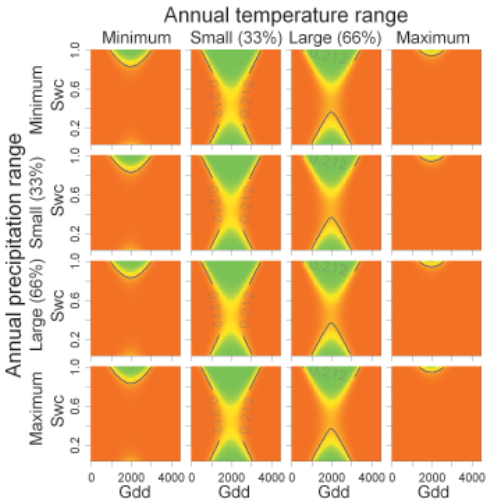
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 5621)

The False Grayling is an inconspicuous butterfly. It occurs on warm, poor grasslands, often situated near the edges of woodland or scrub, on both calcareous and acid soils. The female drops her eggs at random into the vegetation, leaving the young caterpillars to choose what to eat. They feed on different grasses, including Upright Brome (*Bromus erectus*), Gray Hair-grass (*Corynephorus canescens*), Tor-grass (*Brachypodium pinnatum*), Crested Dog's-tail (*Cynosurus cristatus*), and fescues (*Festuca* spp.). The caterpillars hibernate in the first larval instar. They pupate in a grass tussock and have one brood a year.

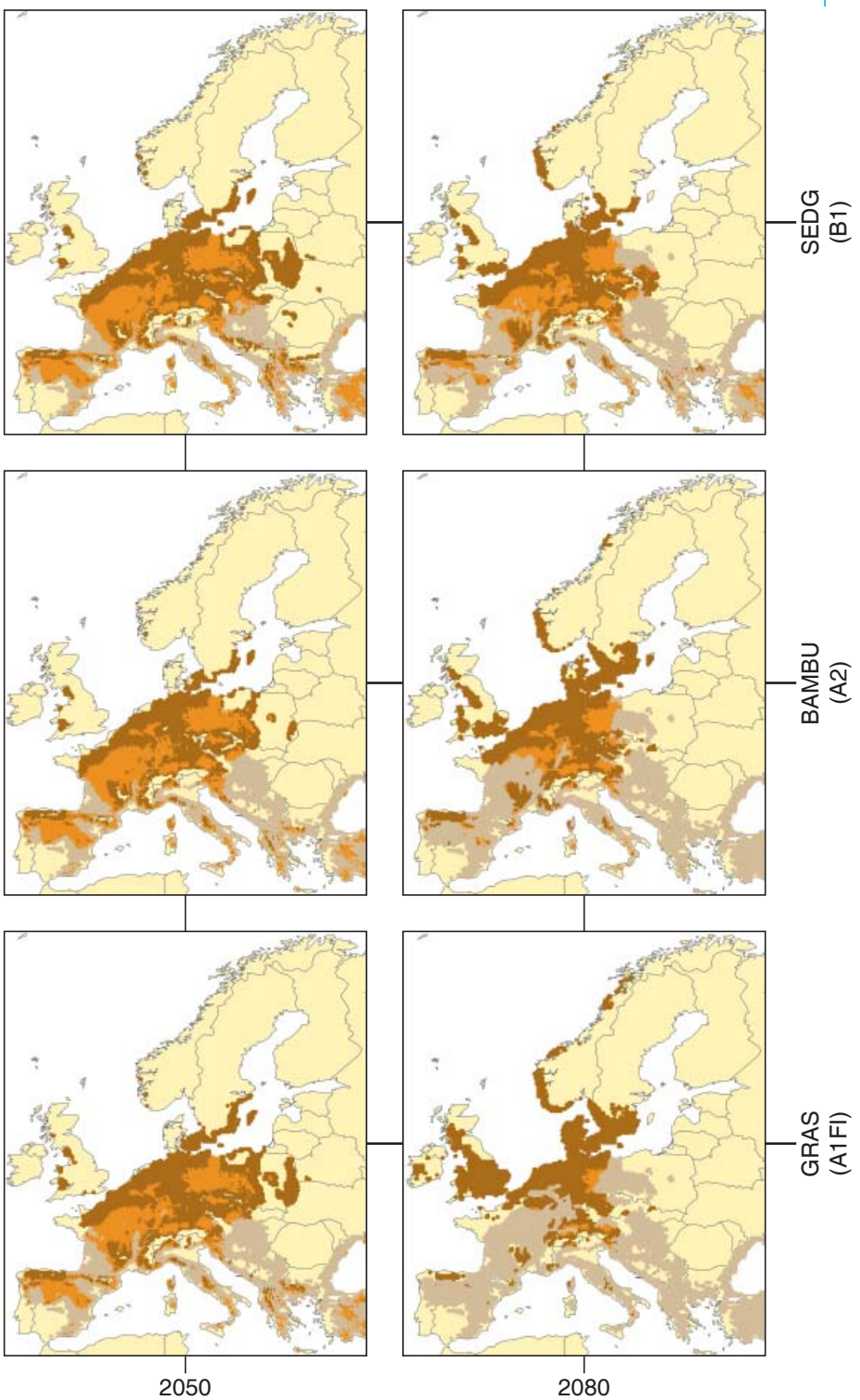
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.77). Climate risk category: HHHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Brintesia circe (Fabricius, 1775) – Great Banded Grayling

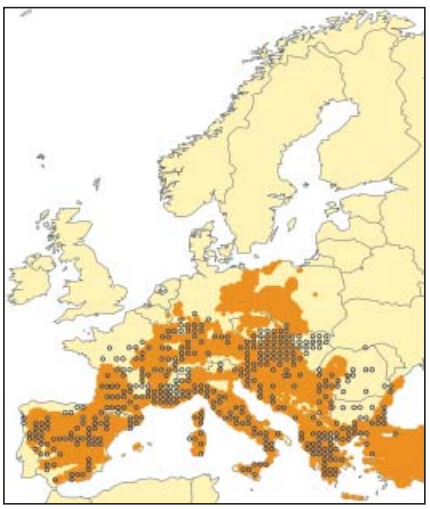
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	1057 (14.02%)	-2308 (-30.61%)
	BAMBU	-443 (-5.88%)	-2864 (-37.99%)
	GRAS	-42 (-0.56%)	-3143 (-41.69%)
2080	SEDG	185 (2.45%)	-3680 (-48.81%)
	BAMBU	-961 (-12.75%)	-5018 (-66.56%)
	GRAS	-1518 (-20.14%)	-6183 (-82.01%)

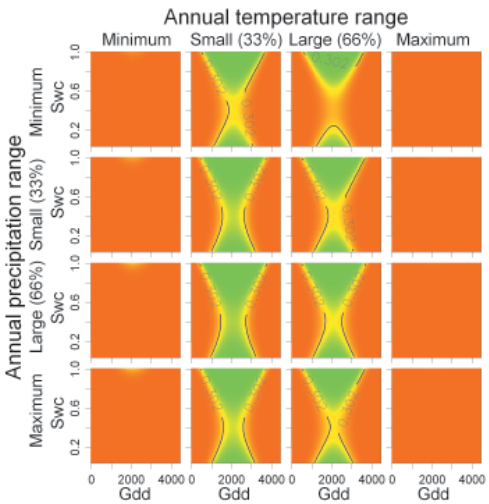
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 7539)

The Great Banded Grayling is immediately noticeable by its size, and is one of the largest butterflies of Europe. It glides more than it flies, and can be seen on dry grasslands at the edges of woodland, and on poor and moderately nutrient-rich agricultural land. The butterflies need quite a lot of nectar, and are easily observed on the purple flowers of thistles and other plants. The females release their eggs into the vegetation, sometimes while perched, often while in flight. The caterpillars can use most grasses as a foodplant. The tiny caterpillar first hibernates in a grass tussock, only in the spring beginning to feed and grow. The caterpillars pupates in a sort of cocoon in a little hollow in the ground. This butterfly species is single-brooded.

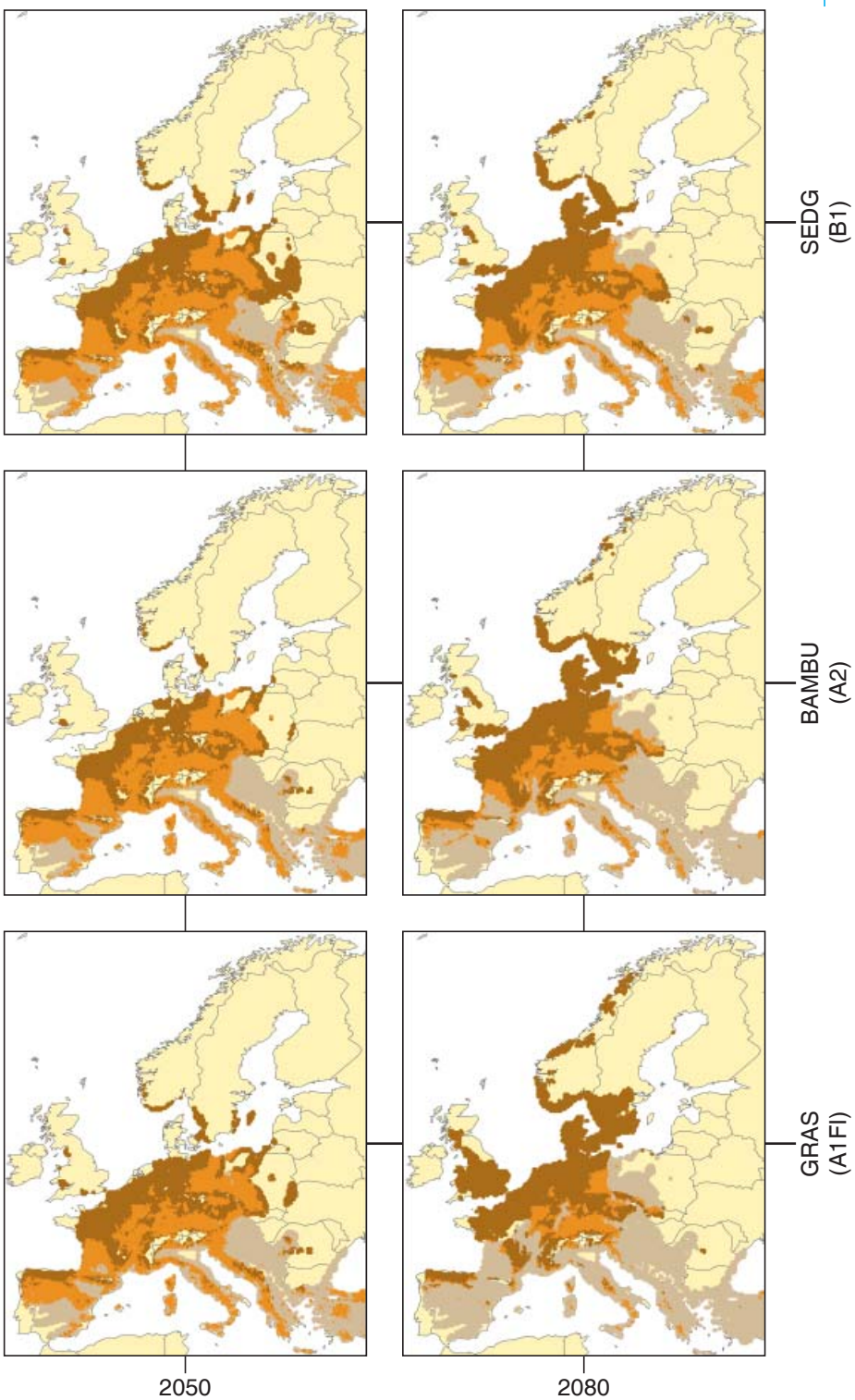
Present distribution can be explained by climatic variables to a moderate extent (AUC = 0.81).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Chazara briseis (Linnaeus, 1764) – The Hermit

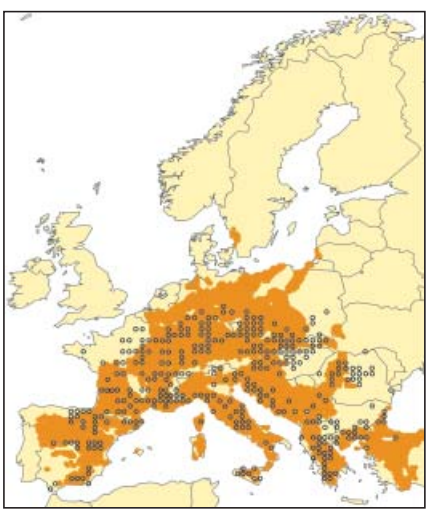
© Albert Vliegenthart

		Full dispersal	No dispersal
2050	SEDG	645 (8.85%)	-1902 (-26.08%)
	BAMBU	-27 (-0.37%)	-2256 (-30.94%)
	GRAS	-349 (-4.79%)	-2727 (-37.4%)
2080	SEDG	-402 (-5.51%)	-3226 (-44.24%)
	BAMBU	-1170 (-16.04%)	-4231 (-58.02%)
	GRAS	-2263 (-31.03%)	-5429 (-74.45%)

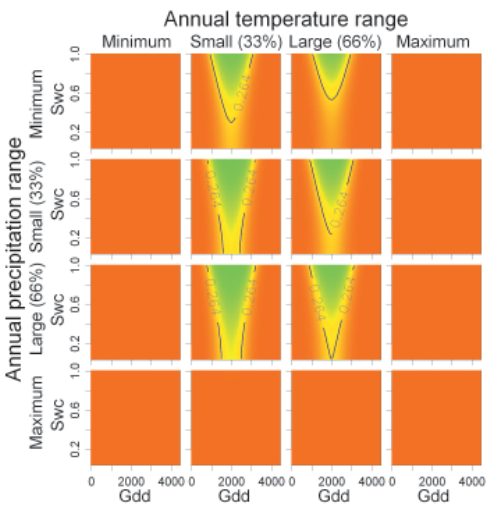
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 7292)

The Hermit inhabits steppe-like grasslands in dry, warm places. In the northern part of its distribution range, it is restricted to dry chalk hills. Although it is a very large butterfly, when its wings are closed, it blends perfectly into its surroundings. Especially when resting so on a rock, they are almost invisible. The female deposits her eggs one at a time on the withered blades of many different grasses, including false-bromes (*Brachypodium* spp.), bromes (*Bromus* spp.), and fescues (*Festuca* spp.). The caterpillars hibernate in the first larval instar. They pupate in a sort of cocoon, in a little hollow in the ground, or sometimes low down on the foodplant. The Hermit has one brood a year and is one of the most seriously threatened species in central Europe.

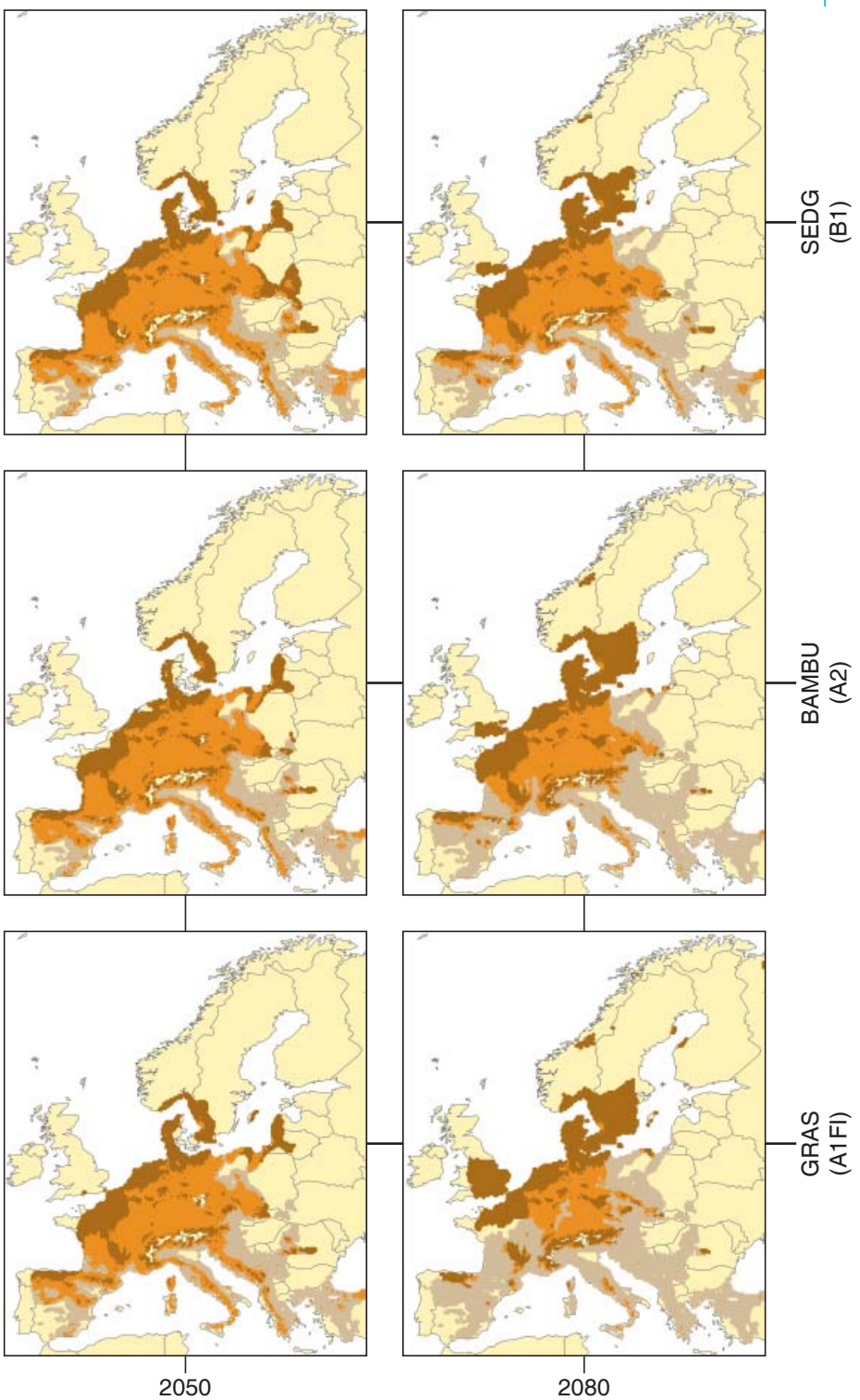
Present distribution can be explained by climatic variables to quite some extent (AUC = 0.8).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Pseudochazara anthelea (Lefebvre, 1831) – White-banded Grayling

© Albert Vliegenthart

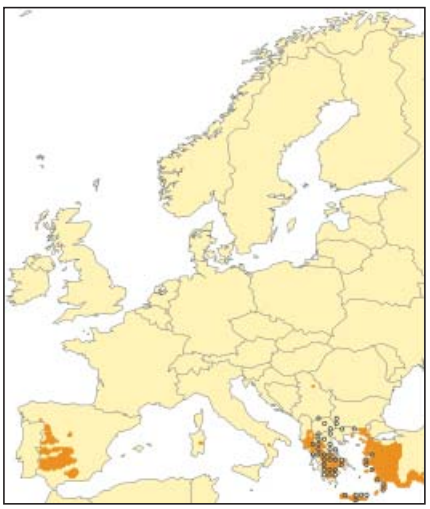
		Full dispersal	No dispersal
2050	SEDG	-175 (-21.39%)	-360 (-44.01%)
	BAMBU	-134 (-16.38%)	-332 (-40.59%)
	GRAS	-181 (-22.13%)	-385 (-47.07%)
2080	SEDG	193 (23.59%)	-379 (-46.33%)
	BAMBU	-231 (-28.24%)	-481 (-58.8%)
	GRAS	-322 (-39.36%)	-623 (-76.16%)

Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 818)

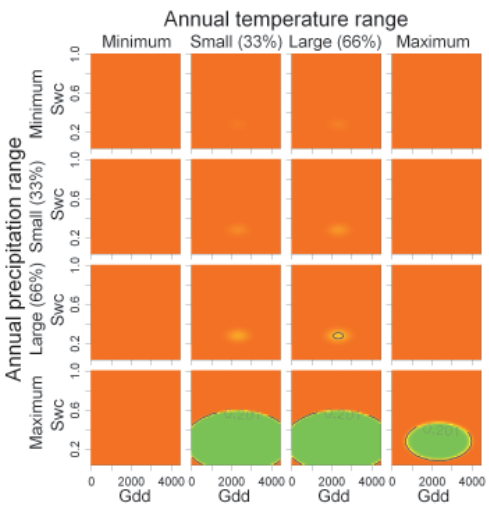
With the white bands on each wing and the dark narrow scent-brand, the males of the White-banded Grayling are unmistakable. The butterflies occur on dry, grassy vegetation in open scrub, and on rocky slopes. Sometimes, they are seen in open woods. They often drink nectar from thistle-like plants. The males defend their territory, perching on a rock or other prominent features in the surroundings. This butterfly is single-brooded.

Pseudochazara amalthea (Friwaldszky, 1845), placed by Kudrna (2002) provisionally in the genus *Hipparchia*, is a subspecies of *Pseudochazara anthelea* (Lefebvre, 1831), as it is already treated by many authors.

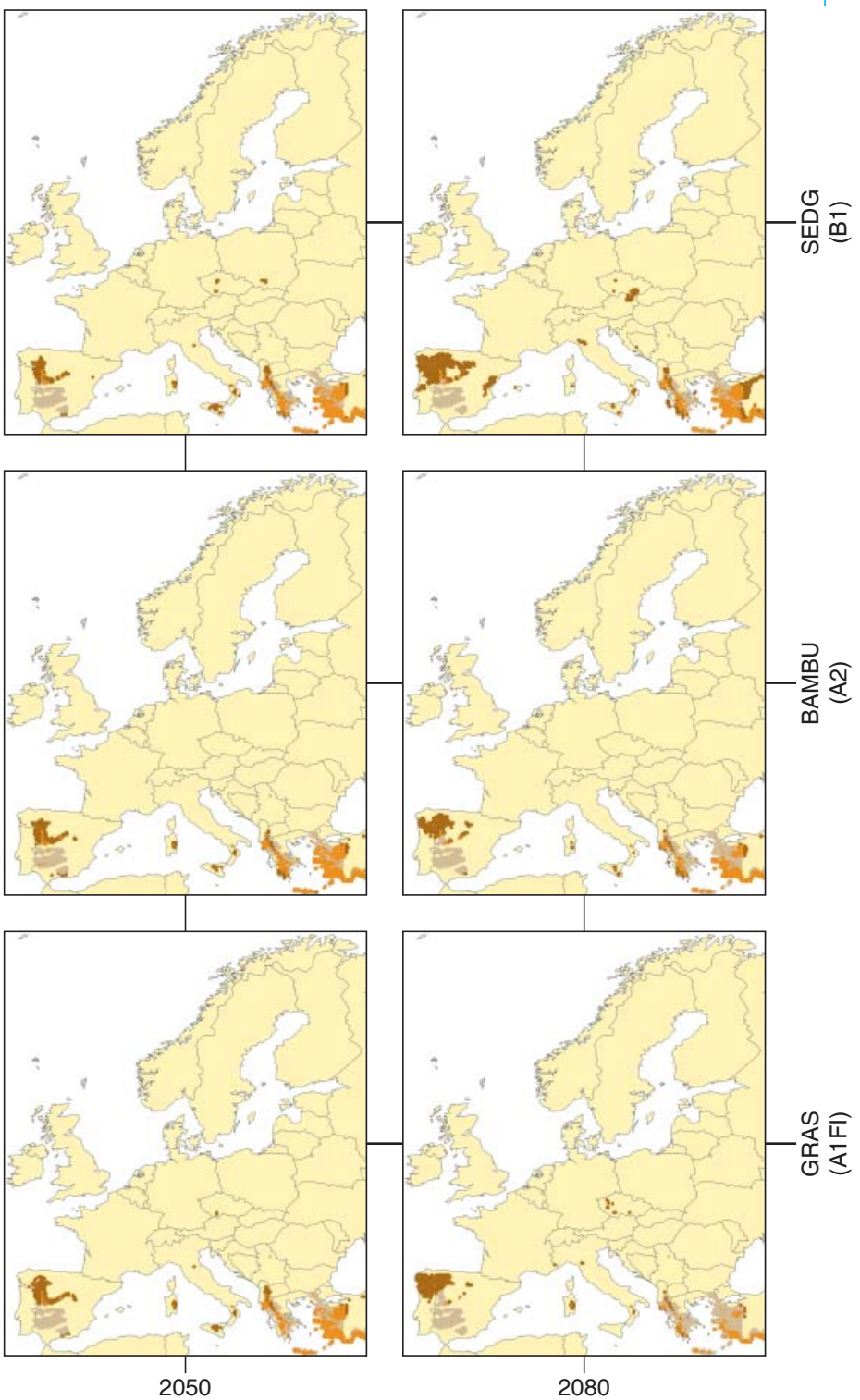
Present distribution can be well explained by climatic variables (AUC = 0.9).
Climate risk category: HR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Oeneis norna (Becklin, 1791) – Norse Grayling

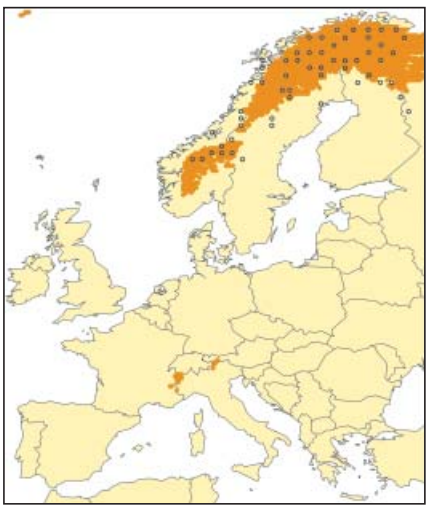
© Bernard Fransen

		Full dispersal	No dispersal
2050	SEDG	-1683 (-81.03%)	-1691 (-81.42%)
	BAMBU	-1680 (-80.89%)	-1687 (-81.22%)
	GRAS	-1729 (-83.25%)	-1737 (-83.63%)
2080	SEDG	-1899 (-91.43%)	-1909 (-91.91%)
	BAMBU	-2026 (-97.54%)	-2030 (-97.74%)
	GRAS	-2065 (-99.42%)	-2065 (-99.42%)

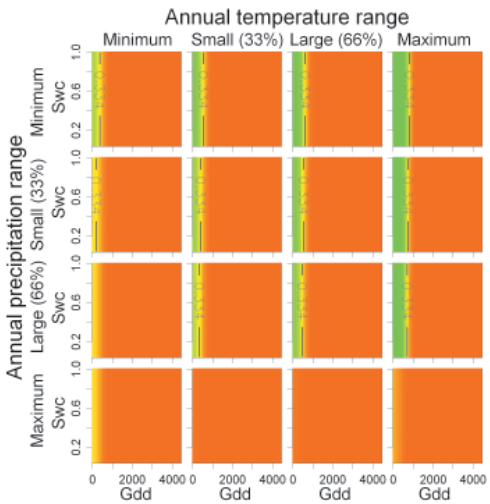
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 2077)

The Norse Grayling occurs in both dry and wet biotopes, on marshes with a vegetation of mosses and grasses, at the edges of swampy habitats and streams, in low birch scrub, on sparse vegetation in clearings in birch woods, and on sunny, rocky slopes with low shrubs. The butterflies spend much of the day resting on tree trunks or on the ground with their wings closed and are so hardly noticeable. They are quick flyers and difficult to approach. The female lays her eggs on various sedges and grasses. The egg takes two years to develop into a butterfly, and the caterpillars hibernate twice.

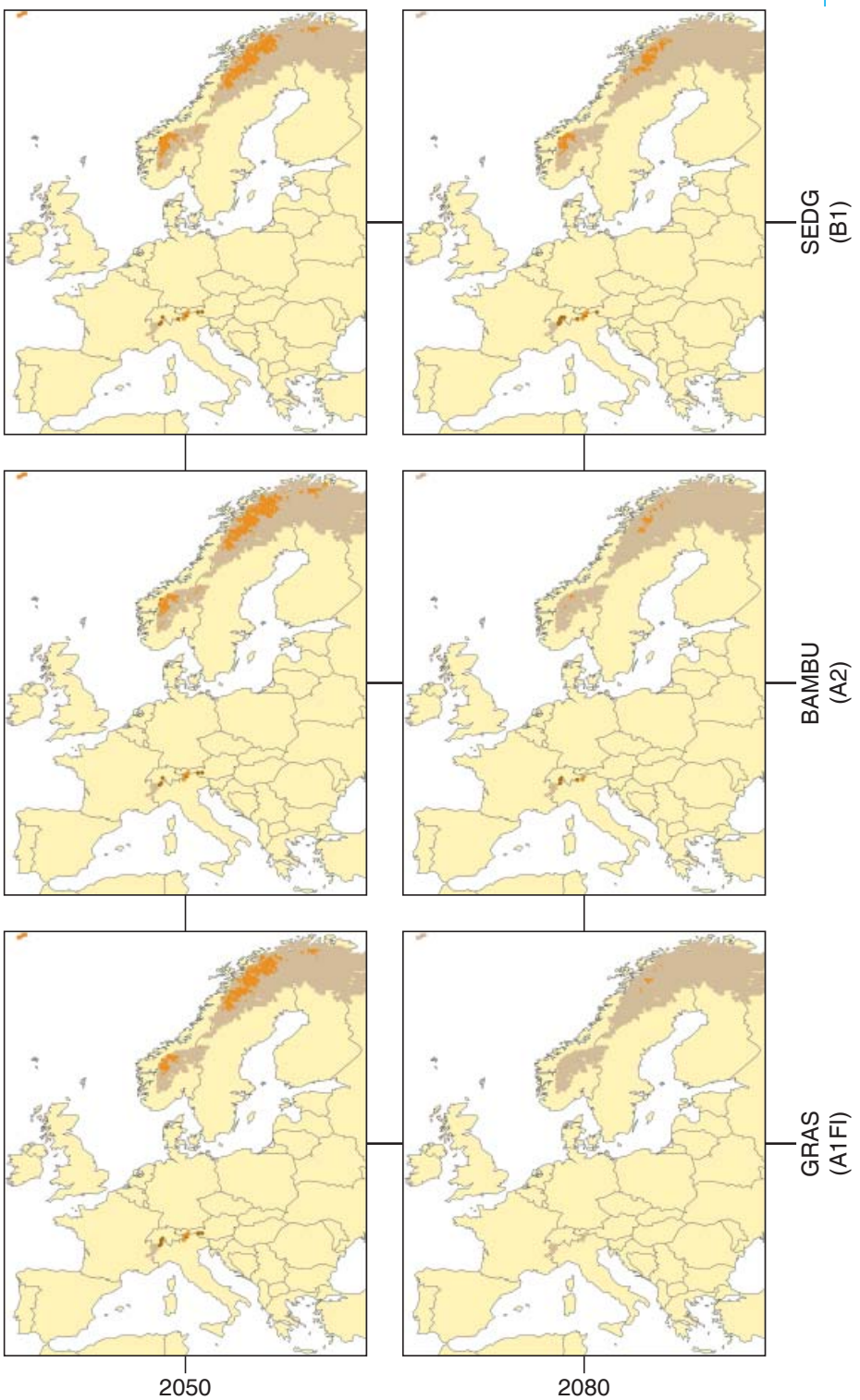
Present distribution can be very well explained by climatic variables (AUC = 0.98).
Climate risk category: HHHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Oeneis glacialis (Moll, 1785) – Alpine Grayling

© Kars Veling

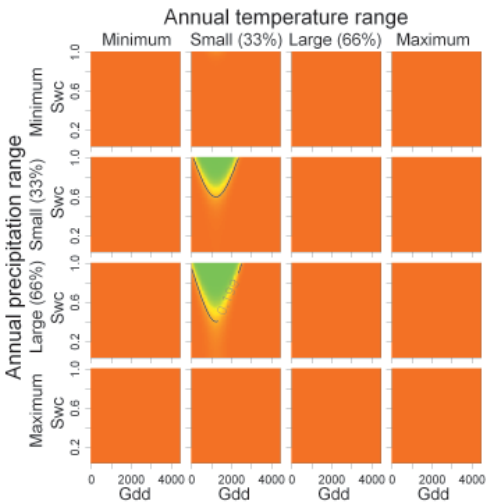
		Full dispersal	No dispersal
2050	SEDG	-192 (-20.65%)	-368 (-39.57%)
	BAMBU	-114 (-12.26%)	-323 (-34.73%)
	GRAS	-247 (-26.56%)	-400 (-43.01%)
2080	SEDG	-430 (-46.24%)	-637 (-68.49%)
	BAMBU	-272 (-29.25%)	-529 (-56.88%)
	GRAS	-480 (-51.61%)	-710 (-76.34%)

Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 930)

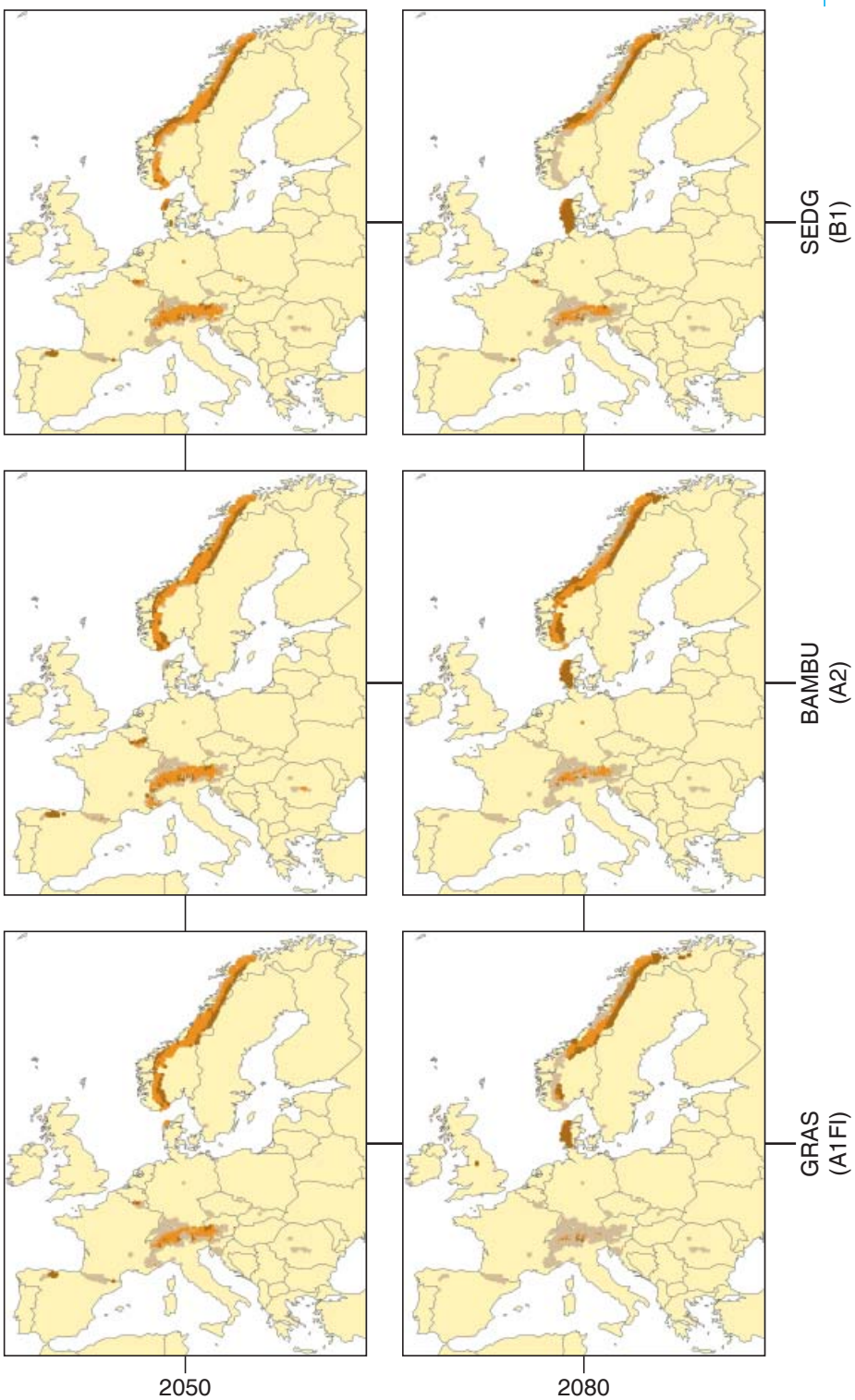
At altitudes of about 1500 m, the Alpine Grayling occurs on dry, scrubby vegetation. Above the tree-line, they can be seen in dry, stony alpine grasslands, and on dry, open sunny slopes. Most habitats have a stream in the vicinity. Perched on a stone, the males defend their territory, chasing away other butterflies, as well as other insects. The female lays her eggs one at a time on dry grass stalks close to the ground. The caterpillar hibernates in the first larval instar, and having fed during the growing season, hibernates again in the last instar. Eventually, some time between April and June, it pupates. Its main foodplant is Sheep's-fescue (*Festuca ovina*) but other fescues are also used. This butterfly is single-brooded.

Present distribution can be very well explained by climatic variables (AUC = 0.99).
Climate risk category: HR.

Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Oeneis jutta (Hübner, 1806) – Baltic Grayling

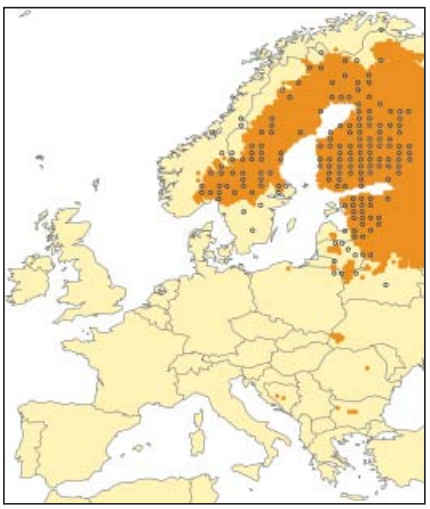
© Chris van Swaay

		Full dispersal	No dispersal
2050	SEDG	-1165 (-19.45%)	-1791 (-29.89%)
	BAMBU	-1434 (-23.94%)	-2057 (-34.33%)
	GRAS	-1446 (-24.14%)	-2091 (-34.9%)
2080	SEDG	-1820 (-30.38%)	-2670 (-44.57%)
	BAMBU	-2096 (-34.99%)	-3090 (-51.58%)
	GRAS	-2839 (-47.39%)	-3887 (-64.88%)

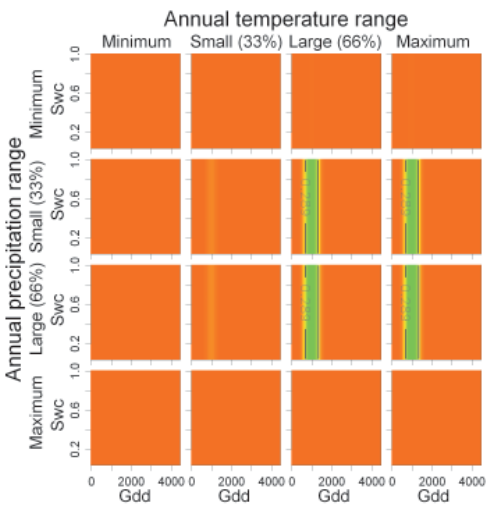
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 5991)

Both in lowland and mountains, the Baltic Grayling occurs in peaty and swampy habitats. Most butterflies are found in damp habitats with a vegetation of grasses and sedges, often with open water in the middle and surrounded by coniferous woodland. The butterflies frequently visit the wood edge looking for flowers, because the peat vegetation is poor in nectar plants. They also rest on the branches or trunks of trees, or on dead wood. The Baltic Grayling shares its habitat with hardly any other butterfly. The female lays her eggs on various grasses, but which ones the caterpillars feed on is not known. The caterpillar's development takes nearly two years.

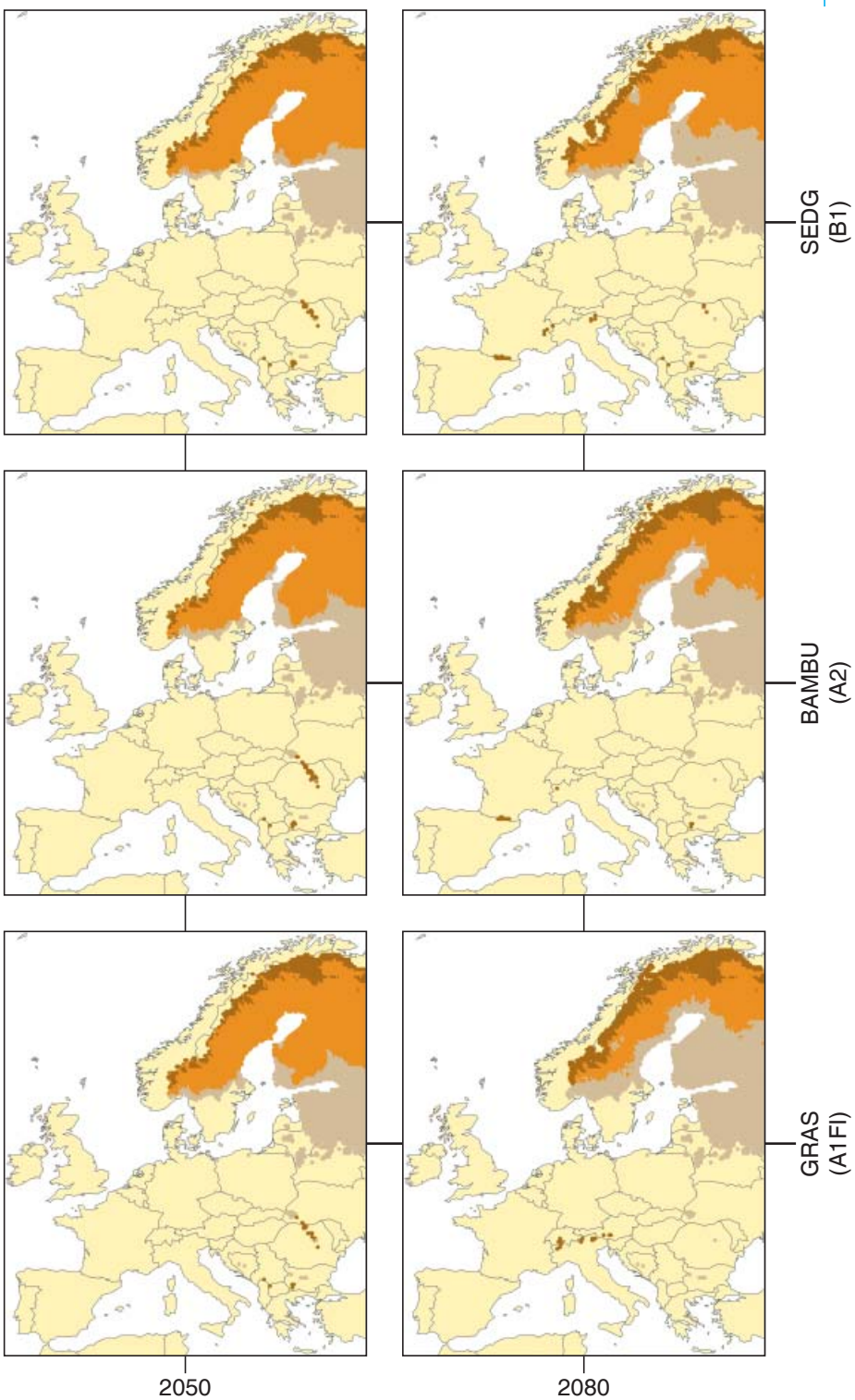
Present distribution can be very well explained by climatic variables (AUC = 0.96).
Climate risk category: R.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080

Danaus chrysippus (Linnaeus, 1758) – Plain Tiger

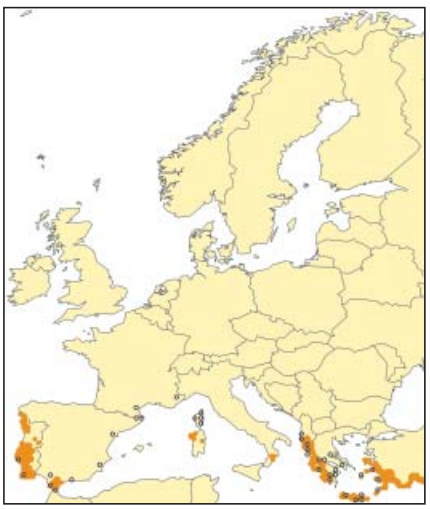
© Kars Veling

		Full dispersal	No dispersal
2050	SEDG	-204 (-49.51%)	-270 (-65.53%)
	BAMBU	-171 (-41.5%)	-262 (-63.59%)
	GRAS	-209 (-50.73%)	-304 (-73.79%)
2080	SEDG	-74 (-17.96%)	-273 (-66.26%)
	BAMBU	-195 (-47.33%)	-334 (-81.07%)
	GRAS	-203 (-49.27%)	-369 (-89.56%)

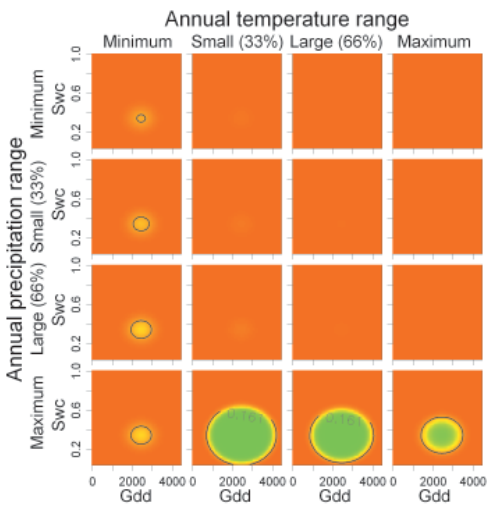
Changes in climatic niche distribution
(in 10'×10' grid cells; present niche space: 412)

The Plain Tiger occurs in coastal areas on warm, rocky places with scrub, on agricultural land and in gardens. The Plain Tiger can fly great distances, and in this way can found new populations. The caterpillars feed on the milkweeds *Asclepias curassavica* and *Cynachum procera*. It has several broods a year and does not hibernate. In areas with cold winters, populations can therefore only be temporary. It is difficult to establish whether the species is present as a resident the whole year, or as a migrant, only breeding in the summer.

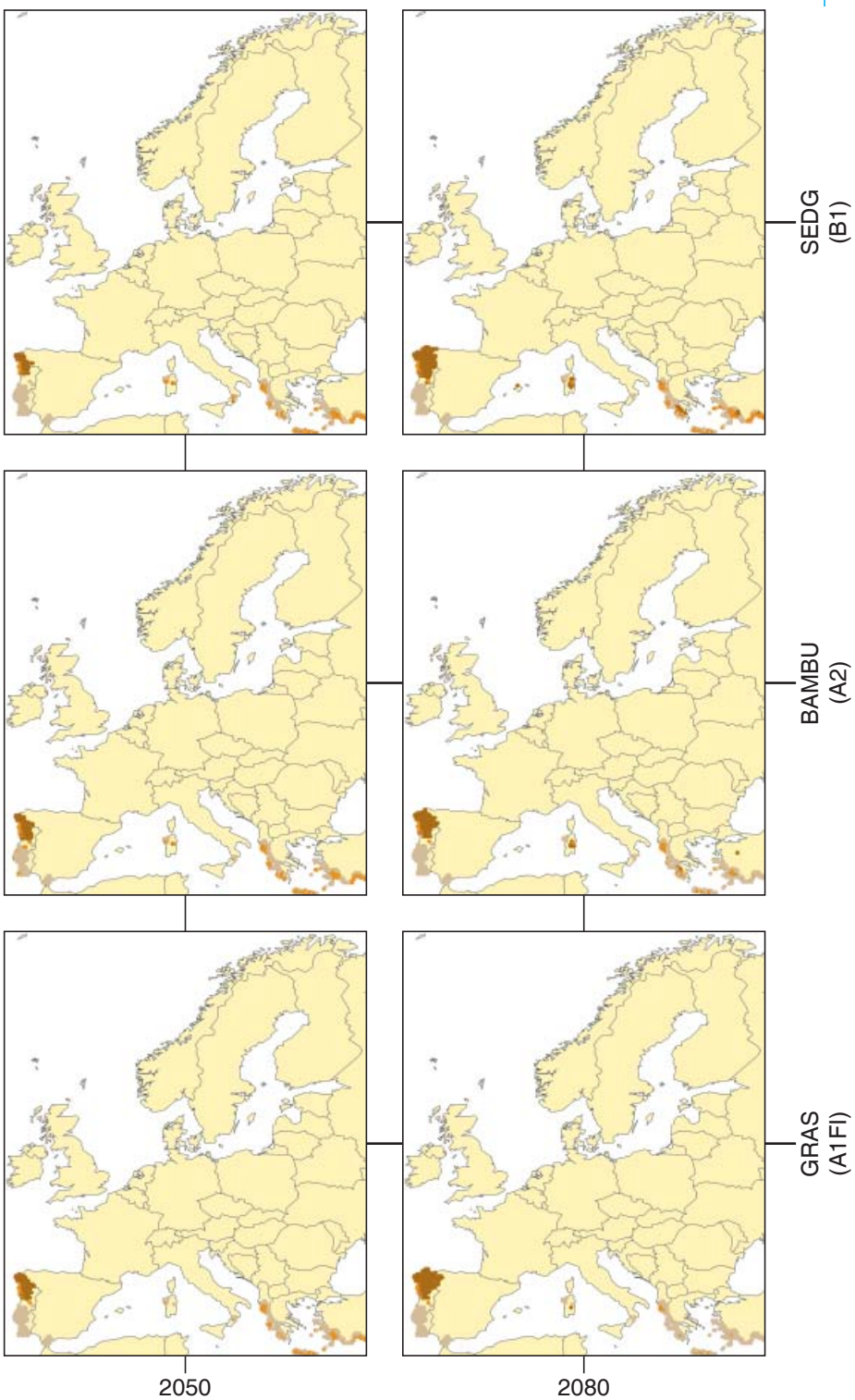
Present distribution can be well explained by climatic variables (AUC = 0.89).
Climate risk category: HHR.



Observed species distribution (50 × 50 km² UTM grid; black circles) and modelled actual distribution of climatic niche (orange areas)



Multidimensional climatic niche. Occurrence probability defined by accumulated growing degree days until August (Gdd) and soil water content (Swc) for combinations of minimum, lower tercile, upper tercile and maximum values of annual temperature range and annual precipitation range. Climatic conditions: orange – unsuitable; green – hostile; black line – modelled threshold


SEDG (B1)
BAMBU (A2)
GRAS (A1FI)
2050
2080