Betula pendula

Description of model and ensemble projections

The current distribution of *Betula pendula* is simulated to cover primarily the low to mid altitudes of the warm and spring/summer-dry regions of Switzerland. The species occurs abundantly in the Ticino, in the Valais and scattered throughout other parts of Switzerland. The species is considered early-successional, meaning that it cannot compete against late successional, stand dominating broadleaf and needleleaf species. It grows fast, and disappears usually rapidly once stands are getting denser. Only in dry regions (Valais, Ticino) it can sustain longer in forest stands.

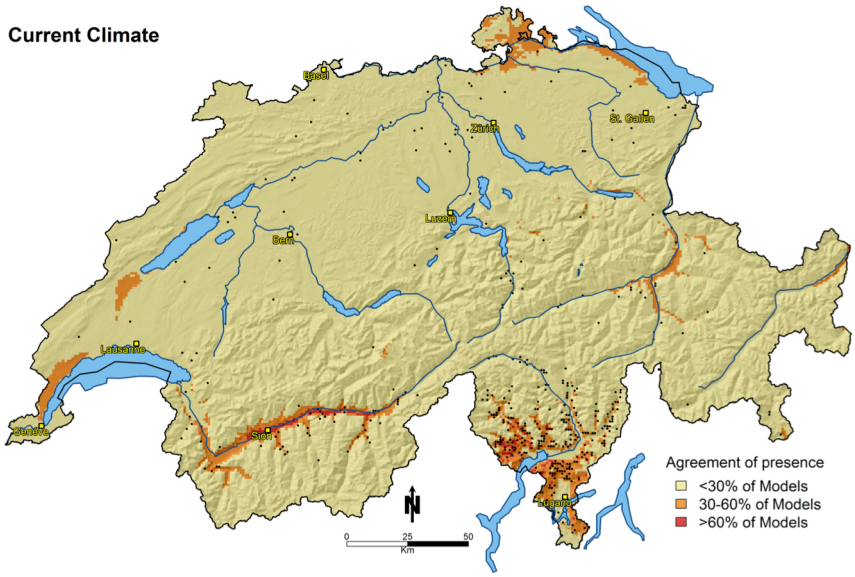

Figure 1. Current distribution (black dots) from the Swiss National Forest inventory (LFI 1) and simulated habitat suitability under current climate as calibrated from forest inventory data across the Alps (MANFRED project).

The model does not depict well the rare occurrences on the Plateau an in the Northern Pre-Alps. This is due to the fact that there is no sufficient evidence that the species consistently grows under these conditions. In fact, SDMs cannot cope well with species that are infrequently present under such conditions.

Under expected climate change using the A1B scenario, most combinations of statistical and regional climate models predict a spread of *Betula* to higher altitudes, an extension onto the Plateau and in the lower Engadin, meaning that these regions represent soon climate conditions, under which presence of *Betula* is currently being observed. The species remains strongly distributed in the Valais.

Synthesis and Conclusions

The model fits the distribution of *Betula pendula* comparably well, and can be considered a credible model to project the future habitat suitability of *Betula*. The ensemble models project a 46% overlap between the current and the future range in Switzerland and a similar overlap (44%) in Europe. In Switzerland (+163.8%) and Europe (-43.3%), considerable differences in range expansion/contraction are projected. In Switzerland, considerable uncertainties remain from the ensemble projections, since many areas of current and future range are only projected by a fraction of the climate & statistical model combinations (orange tone in maps of Figures 1 and 2). Yet, this is often the case when modelling early success species.

Range change statistics

	CH	Europe
Current range size [km²]	2'223	146'209
Future (2080) range size	5'864	82'845
Range Change 2080/2000 [%]	263.8%	56.7%
Overlap 2000/2080 [km²]	1'034	64'232
Overlap/current range [%]	46.3%	43.9%

However, the species will lose ca. 50% of its range, mostly in low altitudes. Yet, we do not consider this a real threat, since the species is very mobile, and will still find sufficient suitable habitat, both in Switzerland and in Europe. According to the modelling study by Meier *et al.* (2012), the species can almost completely track climate change due to its rapid seed dispersal, fast growth rate, and fast migration rate. According to this study, the species can even maintain its fast migration rate in the highly fragmented landscape of Central Europe.

Silver birch is strongly light demanding and does not grow well under competition. It grows best on more acidic soils that are rather dry. Due to its low shade tolerance, there is sufficient light on forest floors for a rich flora. In addition, it is a preferred food for insects. In Germany, ca. 500 species of insects have been reported on birch (*B. pendula* and *B. pendula*), mostly beetles and leptidopterans (Brändle & Brandl 2001), with 133 species of insects feeding almost exclusively on birch. The fact that it grows best on acidic soils explain the tight concentration of its preferred habitat in the interior and southern valleys.

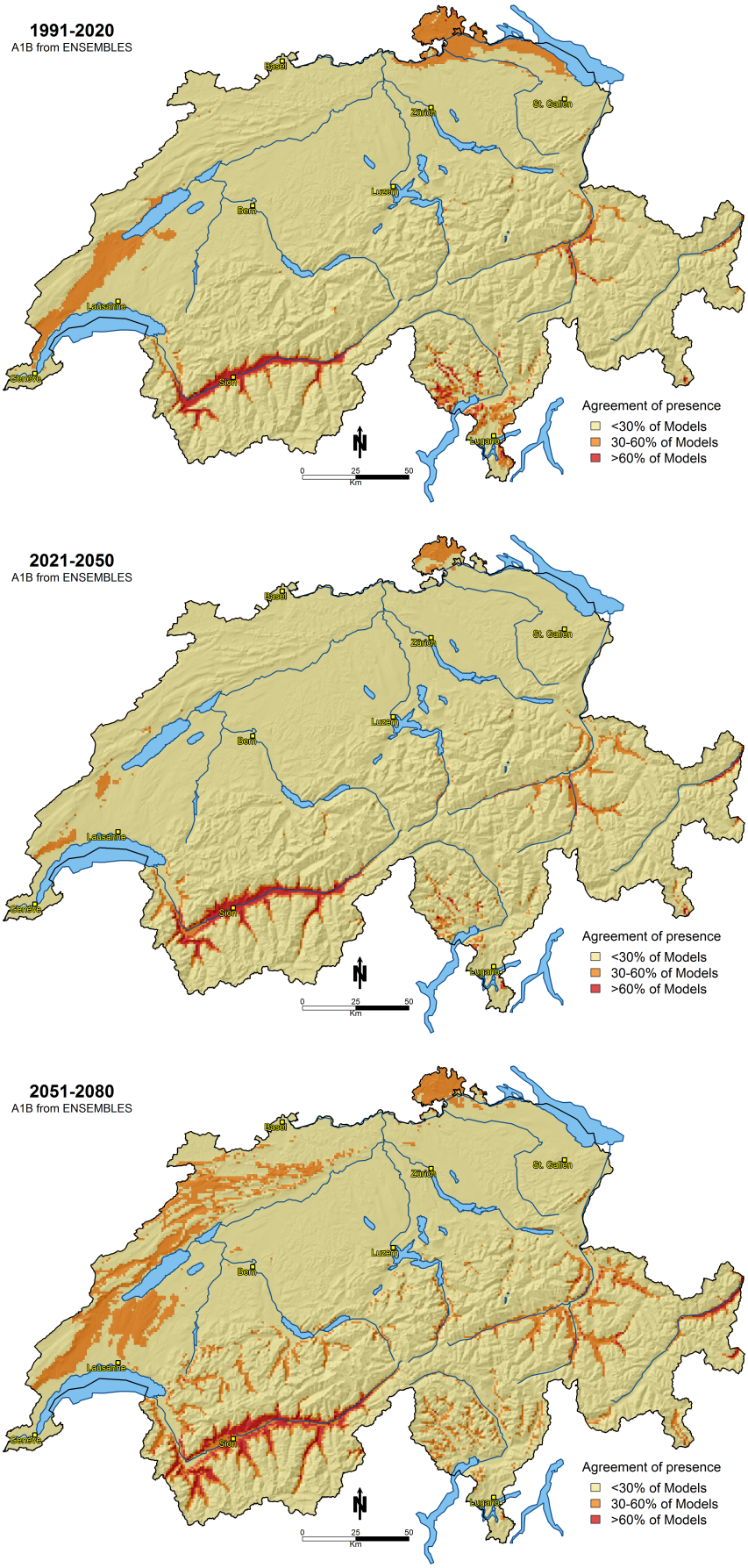

Figure 2: Ensemble of projected future ranges of suitable habitat as modeled from six RCMs and six statistical models. Light yellow colors indicate that all climate & statistical model combinations project absence of the species, while dark red colors indicate presence. Orange colors indicate uncertainty regarding habitat suitability.

References

Brändle M, Brandl R (2001) Species richness of insects and mites on trees: expanding Southwood. *Journal of Animal Ecology* **70**, 491–504.

Meier ES, Lischke H, Schmatz DR, Zimmermann NE (2012) Climate, competition and connectivity affect future migration and ranges of European trees. *Global Ecology and Biogeography* **21**, 164-178.