

Picea abies

Description of model and ensemble projections

The current distribution of *Picea abies* is modelled to cover most of the Swiss Plateau and the Northern Pre-Alps. In addition, the species also grows at higher altitudes in the inner Alpine valleys and in the Northern part of the Ticino. The species naturally inhabits primarily the subalpine region, and is planted widely on the Plateau. The fact that some (the warmest) parts of the Plateau region are not modeled to be suitable reflects the fact that the model does not find sufficient evidence for *Picea* being present in these situations consistently.

Under expected climate change using the A1B scenario, most combinations of statistical and regional climate models predict a rapid disappearance of *Picea* on the Plateau, meaning that these regions represent soon climate conditions, under which no presence of *Picea* is currently being observed. The species “escapes” to higher altitudes.

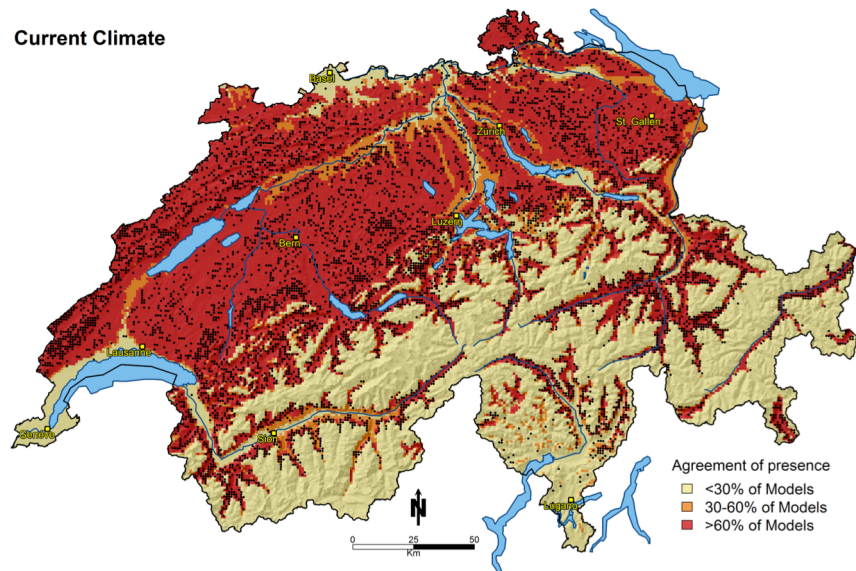


Figure 1. Current distribution (black dots) from the Swiss National Forest inventory (LFI 1) and simulated habitat suitability under current climate as calibrated from forest inventory data across the Alps (MANFRED project).

Synthesis and Conclusions

The model fits the distribution of *Picea abies* well, and can be considered a credible model to project the future habitat suitability of *Picea*. The ensemble models project a 31% overlap between the current and the future range in Switzerland and a similarly high overlap (41%) in Europe. This is a much higher overlap than previously modeled (Zimmermann *et al.* 2006). The difference mostly originates from using less extreme climate scenarios in this report. Here we used the A1B scenario, which is a moderate warming scenario from the fourth IPCC assessment report (IPCC 2007). The previous simulations were based on the 3rd assessment report (IPCC 2001), where the A1FI scenario was much more extreme compared to the current A1B.

However, the species will lose ca. 50% of its range and the future range is much smaller than the current one (64% and 47% for Switzerland and Europe, respectively). Overall, the species is not particularly threatened, and will still find sufficient suitable habitat, both in Switzerland and in Europe. As a preferred timber, it will get assisted migration to higher altitudes, where necessary. There may be provenances (originating from the South of the Alps) that might be characterized by higher drought tolerance than the northern Alpine provenances, and these might be suitable alternatives to improve the drought adaptation of the species north of the Alps.

The disappearance on the Swiss Plateau means, that the future climate is warmer (and partly also drier) than any observed current distribution of *Picea*. On the other hand it might take 100s if not 1000s of years, until the species is outcompeted by immigrating competitor species, such as oaks or beech. Until 2050, and despite projections of habitat loss on the Plateau, the climate will probably not be extreme enough to drive *Picea* to extinction. The growth analyses (S2) indicate that under a warming climate, *Picea* might thrive well, as long as summer precipitation is not declining.

Range change statistics		
	CH	Europe
Current range size [km ²]	21'072	159'325
Future (2080) range size	13'636	74'752
Range Change 2080/2000 [%]	64.7%	46.9%
Overlap 2000/2080 [km ²]	6'533	65'444
Overlap/current range [%]	31.0%	41.0%

References

IPCC (2001) *Climate Change 2001: The Physical Science Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change* Cambridge University Press, Cambridge, UK and New York, NY, USA.

IPCC (2007) *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* Cambridge University Press, Cambridge, UK and New York, NY, USA.

Zimmermann NE, Bolliger J, Gehrig-Fasel J, et al. (2006) Wo wachsen die Bäume in 100 Jahren? In: *Wald und Klimawandel* (ed. Wohlgemuth T), pp. 63-71. WSL, Birmensdorf, Schweiz.

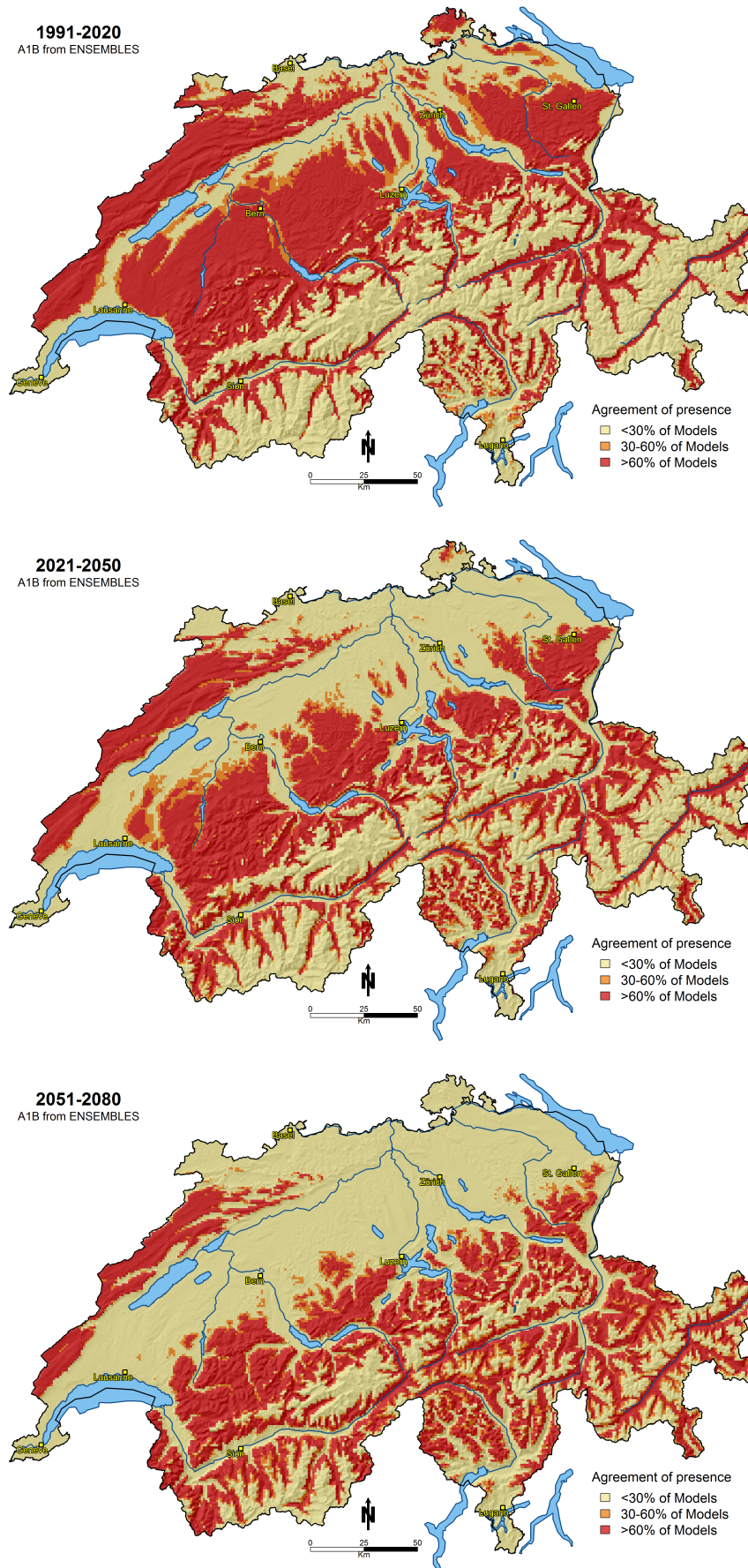


Figure 2: Ensemble of projected future ranges of suitable habitat as modeled from six RCMs and six statistical models. Light yellow colors indicate that all climate & statistical model combinations project absence of the species, while dark red colors indicate presence. Orange colors indicate uncertainty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