Fraxinus excelsior

Description of model and ensemble projections

The current distribution of *Fraxinus excelsior* is modelled to cover most of the Swiss Plateau, the lower Jura Mountains, the Northern Pre-Alps, lower altitudes in dry Interior valleys, as well as the Ticino. Few of the highest altitude distribution points in the Jura are not well modelled, and the model ensemble is uncertain regarding the quite abundant observations in the Valais, where *F. excelsior* grows under quite different conditions, namely on dry and sunny slopes with shallow soils.

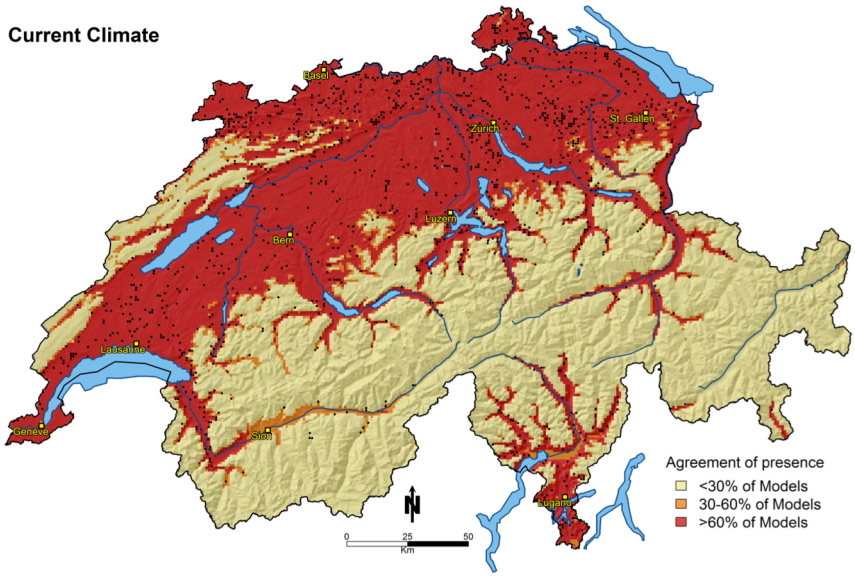

Figure 1. Current distribution (black dots) from the Swiss National Forest inventory (LFI 1) and simulated habitat suitability under current climate as calibrated from LFI forest inventory data of Switzerland.

Under projected climate change using the A1B scenario from ENSEMBLES, most combinations of statistical and regional climate models predict a clear spread of *F. excelsior* to higher altitudes almost everywhere in Switzerland, and the lowest altitudes are almost entirely kept suitable. Only in the lowest and warmest regions of the Swiss Plateau, the Valais and the Ticino, the model ensemble predicts a considerable uncertainty as to whether *F. excelsior* will still find suitable habitats. All other regions will soon harbor climate conditions, under which *F. excelsior* finds suitable habitats comparable to its currently observed distribution. Simply, the species "escapes" to higher altitudes.

Synthesis and Conclusions

The model fits the distribution of *Fraxinus excelsior* very well, and can be considered a credible model to project the future habitat suitability of *F. excelsior*. The ensemble models project a 58% overlap between the current and the future range in Switzerland and somewhat lower overlaps (35%) across Europe.

Range change statistics

	CH	Europe
Current range size [km²]	18'197	–
Future (2080) range size	17'849	–
Range Change 2080/2000 [%]	98.0%	–
Overlap 2000/2080 [km²]	10'603	–
Overlap/current range [%]	58.2%	–

With regards to range change, the species will only shrink its range size by 2% in Switzerland. This means that the species is not particularly threatened, and will still find sufficient suitable habitat in Switzerland. As one of the preferred timbers, it might profit from assisted migration to higher altitudes. In addition, the species has fast migration rates mostly due to its life history characteristics as an early successional, fast growing species. These have been reported to have fast migration rates that allow a species to almost track climate change (Meier *et al.* 2012). The species naturally inhabits primarily moist, mineral-rich and deep soils, requires a rather moist climate and enough light due to its low shade tolerance. It does not grow well under late spring frost climates. However, in some regions it also grows on very sunny and dry sites on shallow soils, representing completely different site conditions. Therefore, the species seems to encompass a very broad environmental niche spanning from very wet, waterlogged soils to very dry and shallow soils. Only on mesic and nutrient rich to moderately dry soils the species is outcompeted by late successional, seral species. Yet, the species can still be found in early successional stages, and therefore is modelled to occur almost everywhere below critical frost temperatures.

The fact that *F. excelsior* seems to have two poles along a moisture gradient had lead some ecologists to propose that these might represent two clades of the same broader species, a "water ash" and a "calcareous ash", where the latter represents those populations on well-drained, shallow and dry soils. Yet, genetic analyses have not been able to confirm any sub-specific typification. Therefore, it likely just represents a manifestation of a very broad environmental range. The species can still "survive" well in beech dominated forest landscapes because it tolerates quite high shade levels as juvenile. Only in the adult stage it is very shade intolerant.

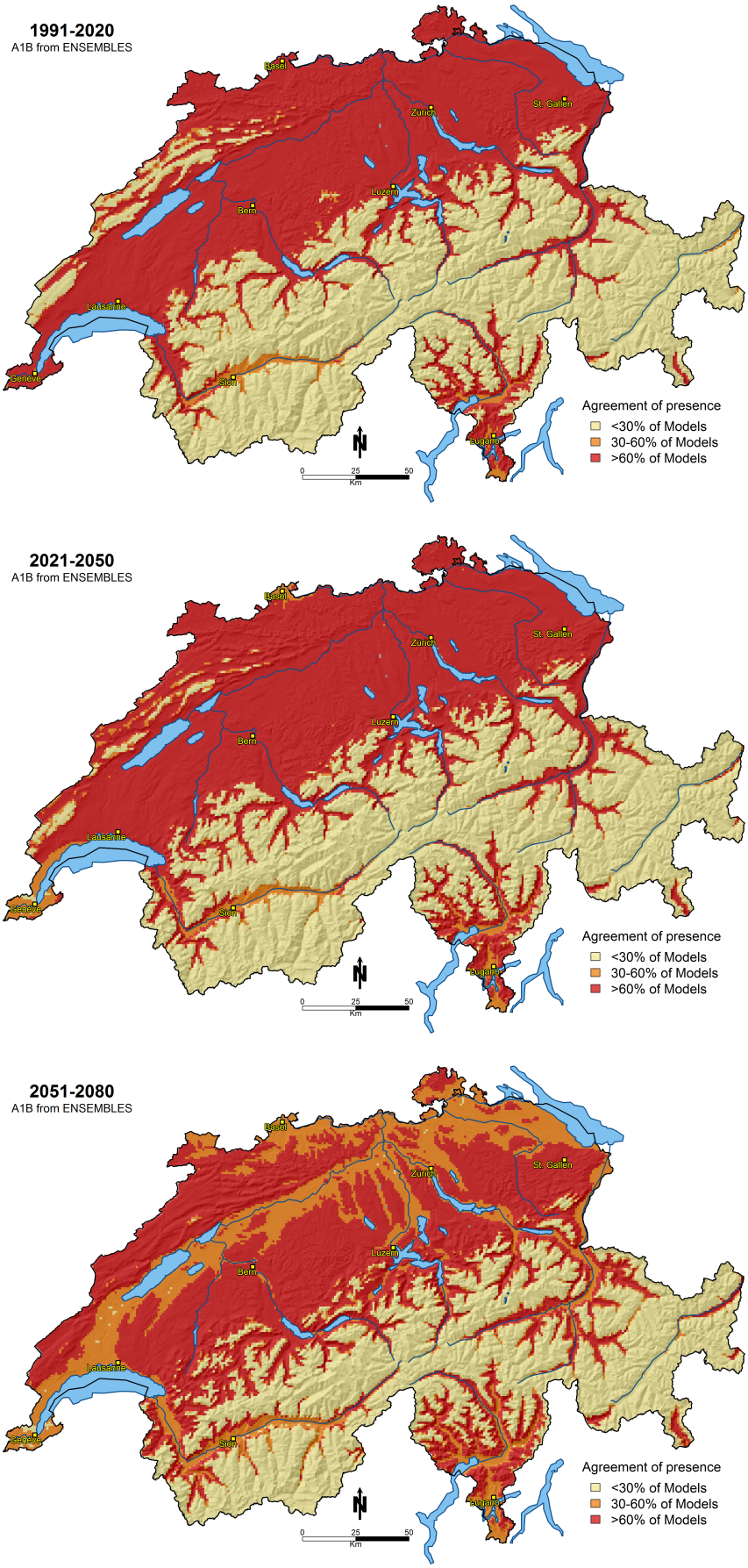

Figure 2: Ensemble of projected future ranges of suitable habitat as modeled from six RCMs and six statistical models. Light yellow colors indicate that all climate & statistical model combinations project absence of the species, while dark red colors indicate presence. Orange colors indicate uncertainty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

References

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.