Quercus ilex

Description of model and ensemble projections

The current distribution of *Quercus ilex* is projected to be largely absent in Switzerland. Only in the Valais, there are some regions (mostly Central Valais) suitable, yet with high uncertainty as simulated by the ensemble projections of the different statistical models. In the Ticino, no suitable habitat is simulated from the National Forest Inventory points of the countries around the European Alps.

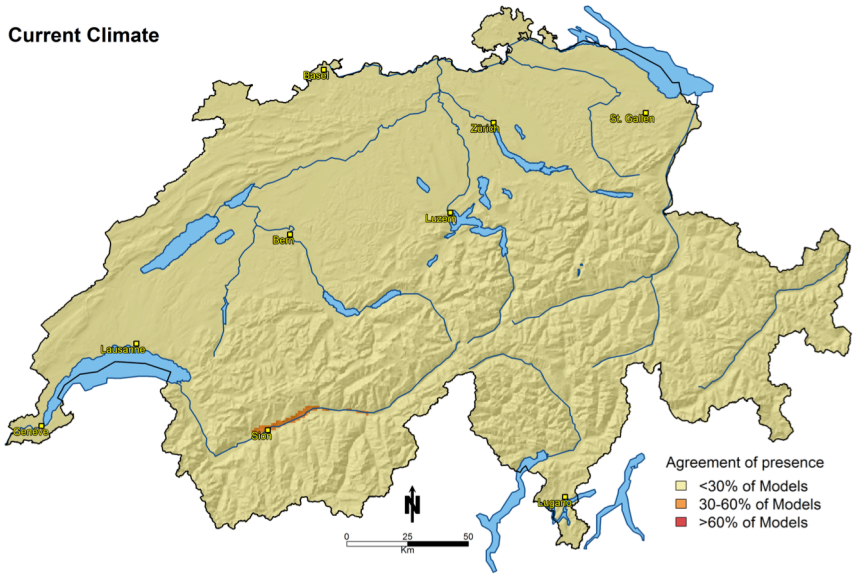

Figure 1. Current distribution (black dots) from the Swiss National Forest inventory (LFI 1) and simulated habitat suitability under current climate as calibrated from forest inventory data across the Alps (MANFRED project).

Under expected climate change using the A1B scenario, most combinations of statistical and regional climate models predict a slight increase of the simulated range – again with high uncertainty, meaning that these regions represent soon climate conditions, under which *Q. ilex* is currently not being observed. These regions are mostly in the Valais and in the Geneva region. In these two regions, very few pixels are simulated to be certainly suitable in be the end of the Century.

Synthesis and Conclusions

The model fits the distribution of *Quercus ilex* well across the Alps (MOTIVE study, not shown here), and can be considered a credible model to project the future habitat suitability of *Q. ilex*. The ensemble models project a 60% overlap between the current and the future range in in Europe. In Switzerland, the overlap is 100% for areas where at least 30% of the models project presence. Also, the species will likely conserve +/- its range (-19%), and will spread northwards, notably onto the Atlantic coast in France, North of the Pyrenees. In Switzerland, a minority of models (30-60%) projects a considerable increase of suitable habitat area. However, since this is not projected by >60% if the models, these projections remain vary uncertain.

Range change statistics

	CH	Europe
Current range size [km²]	87	93'827
Future (2080) range size	590	75'705
Range Change 2080/2000 [%]	678%	80.7%
Overlap 2000/2080 [km²]	87	57'019
Overlap/current range [%]	100.0%	60.8%

The species is currently very dominant in the Mediterranean region, and can be considered an iconic species of Mediterranean forests. It is evergreen, and as such is sensitive to long lasting soil frosts and to air temperatures below ca. -15° to -17°C. If temperatures drop below this threshold, then the leaves are damaged.

The species is long-lived, slow growing and rather a late successional species. It has been demonstrated to spread very slowly (ca. 30m/yr) from plantations at the Atlantic coast in Southwestern France over the last 130 years (Delzon *et al.* 2013). These plantations represent locations north of its native range. Such slow migration rates are typical for late successional, stand dominating trees that grow to old ages with a slow growth rate (Meier *et al.* 2012). Such migration rates are far below the rates of lateral climate change velocity of >1000m/yr, and will not be sufficient to track climate change. On the other hand, the species is migrating, and is very dominant in its current range. Unless very severe drought events are occurring over the next decades in the current range of the species, it will likely be able to slowly adapt its range Northwards, although with a severe time lag. It is not one of the threatened species, but rather represents a winner of climate change.

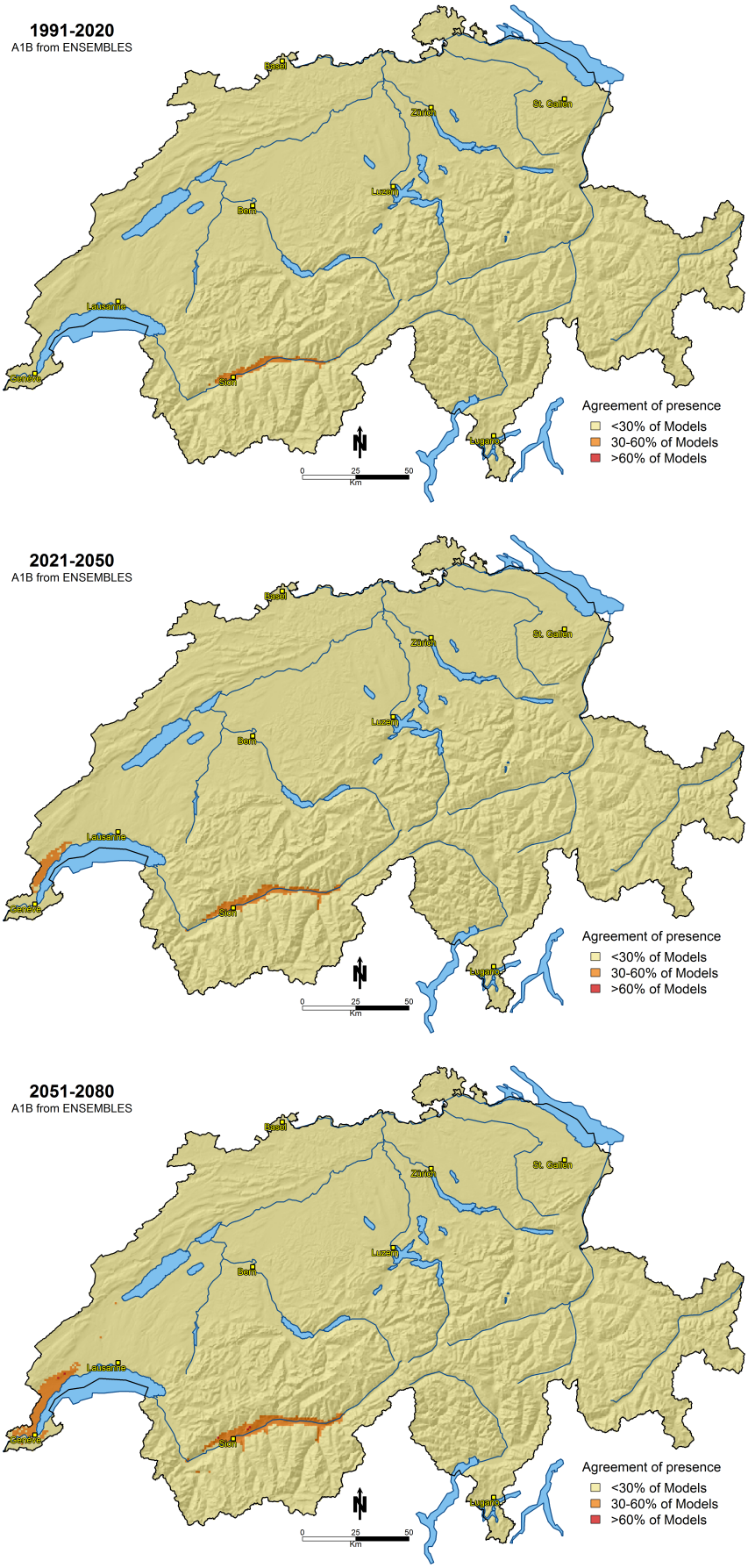

Figure 2: Ensemble of projected future ranges of suitable habitat as modeled from six RCMs and six statistical models. Light yellow colors indicate that all climate & statistical model combinations project absence of the species, while dark red colors indicate presence. Orange colors indicate uncertainty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

References

Delzon S, Urli M, Samalens J-C, *et al.* (2013) Field evidence of colonisation by Holm oak, at the northern margin of its distribution range, during the Anthropocene period. *Plos One* **8** e80443.

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.