Quercus robur

Description of model and ensemble projections

The current distribution of *Quercus robur* is modelled to cover most of the Swiss Plateau the low altitude regions of the interior Alps and of the Ticino and Misox. The species is not projected to climb very high in altitude along Jura and Alps. The species is predicted to occur throughout all of Switzerland's low altitudes, but doesn't seem to climb very high into Jura and Alps.

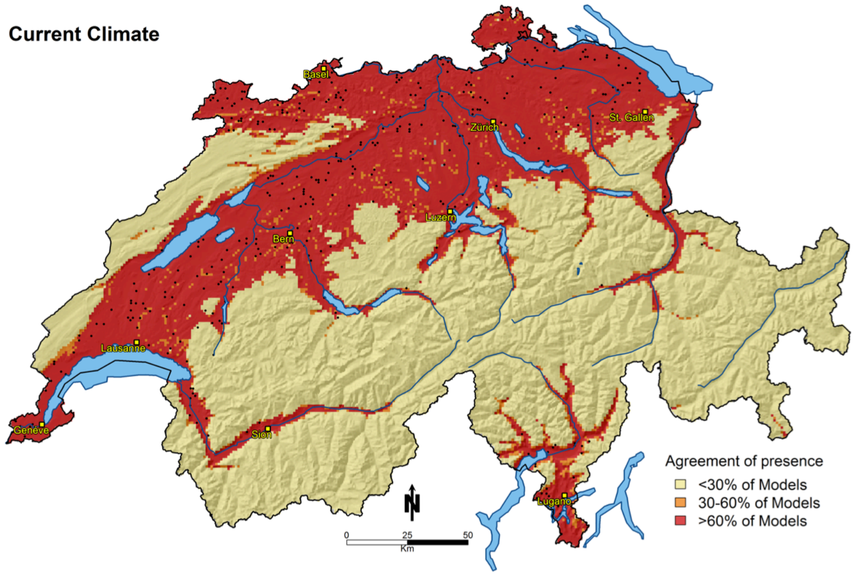


Figure 1. Current distribution (black dots) from the Swiss National Forest inventory (LFI 1) and simulated habitat suitability under current climate as calibrated from LFI forest inventory data of Switzerland.

Under expected climate change using the A1B scenario, most combinations of statistical and regional climate models predict a rapid spread of *Q. robur* on the Plateau, in the Ticino and in the interior Valleys, meaning that these regions will soon represent climate conditions, under which *Q. robur* can be expected to grow well. In all regions the species is projected to expand to higher altitudes, e.g. reaching almost the highest peaks in the Jura and in the southern Ticino. The most massive spread is projected to occur after 2050, meaning that until then no strong expansion is modelled. This is especially visible for the Jura Region.

Synthesis and Conclusions

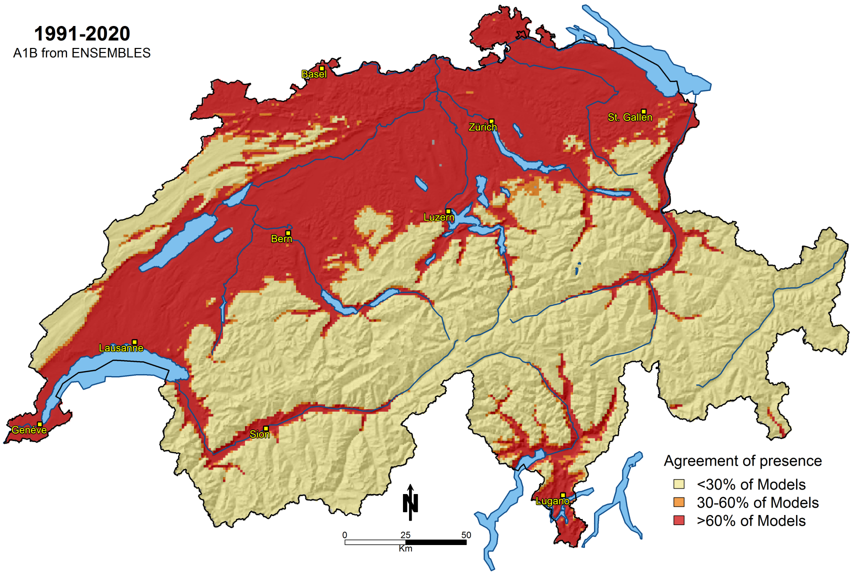
The model fits the distribution of *Q. robur* well, and can be considered a credible model to project the future habitat suitability of *Q. robur*. The ensemble models project a 99%% overlap between the current and the future range in Switzerland and still considerably high overlap (60%) in Europe. This 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 moderately high 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.

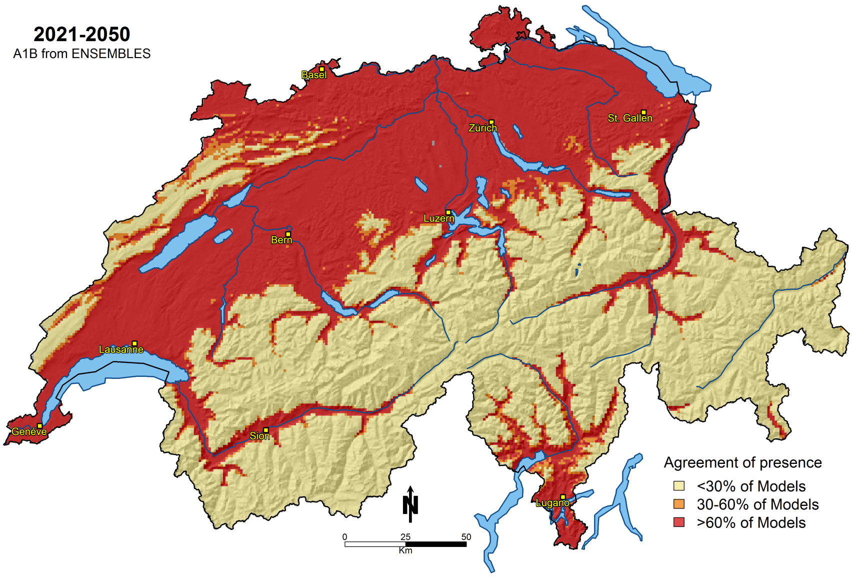
Range change statistics

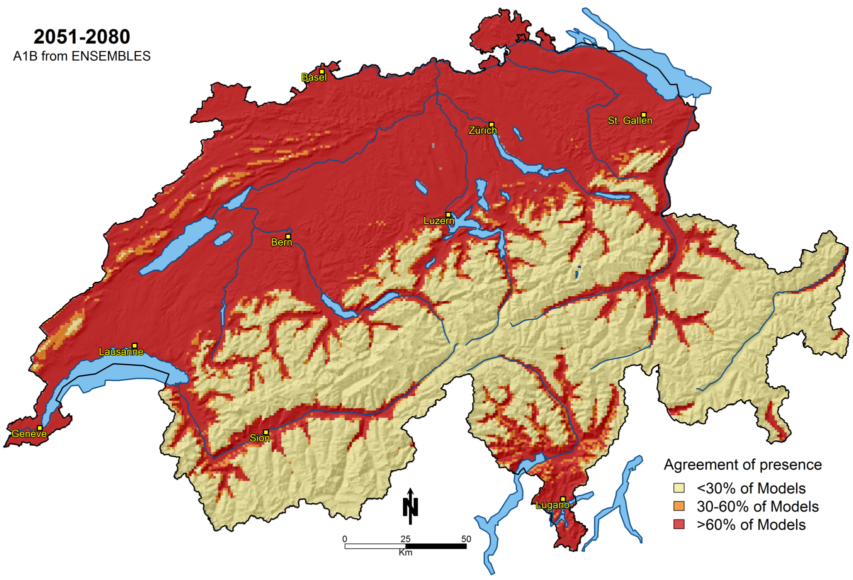
	CH	Europe
Current range size [km²]	15'146	177'871
Future (2080) range size	22'225	186'918
Range Change 2080/2000 [%]	146.7%	105.1%
Overlap 2000/2080 [km²]	15'036	106'206
Overlap/current range [%]	99.3%	59.7%

The species is expected to lose +/- no habitat in Switzerland that is currently suitable, and also in Europe it loses only 40% of the currently suitable habitat. On the other hand, the gain in suitable habitat is considerable (+47%), while in Europe the overall range is more or less maintained (+5%). The species colonizes dry and warm habitats, but occasionally also dominates on more mesic conditions (given it is warm). It can grow on very wet soils and especially on soils that are partly inundated and partly dried out during a growing season. Many oak forests are of human origin. Oaks in general tolerate disturbance by (frequent) cutting (coppicing), which favors oaks over other, less tolerant species such as beech or maple. Yet, on drier and variably dry sites, the species can dominate due to its tolerance to variable drought levels. *Q. robur* is the least cold-sensitive among the three most abundant Oak species (*Q. robur*, *Q. petraea* and *Q. pubescens*). *Q. robur* inbreeds often with *Q. petraea* and also (less frequently) with *Q. pubescens*.

Oaks are very well adapted to the expected climate change and the associated abiotic and partly also biotic effects. The species is quite drought tolerant, can grow on acidic and alkaline (though a bit less well) soils, and it is very tolerant to disturbance. This is partly due to its high genetic variability and partly due to its high capacity to re-sprout after being browsed, coppiced or damaged (Bonfils *et al.* 2015). The species can be considered a winner of climate change, and will likely spread strongly on the Swiss Plateau, which it has done already earlier during warm phases of the Holocene (Lang 1994).







References

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