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# Predicting plant distribution in an heterogeneous Alpine landscape: does soil matter?

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Topographic and climatic factors are usually used to predict plant distribution because they are known to explain their presence or absence. Soil properties have been widely shown to influence plant growth and distributions. However, they are rarely taken into account as predictors of plant species distribution models (SDM) in an edaphically heterogeneous landscape. Or, when it happens, interpolation techniques are used to project soil factors in space. In heterogeneous landscape, such as in the Alps region, where soil properties change abruptly as a function of environmental conditions over short distances, interpolation techniques require a huge quantities of samples to be efficient. This is costly and time consuming, and bring more errors than predictive approach for an equivalent number of samples.

In this study we aimed to assess whether soil proprieties may be generalized over entire mountainous geographic extents and can improve predictions of plant distributions over traditional topo-climatic predictors.

First, we used a predictive approach to map two soil proprieties based on field measurements in the western Swiss Alps region; the soil pH and the ratio of stable isotopes $^{13}C/^{12}C$ (called $\delta^{13}C_{SOM}$). We used ensemble forecasting techniques combining together several predictive algorithms to build models of the geographic variation in the values of both soil proprieties and projected them in the entire study area. As predictive factors, we employed very high resolution topo-climatic data. In a second step, output maps from the previous task were used as an input for vegetation regional models. We integrated the predicted soil proprieties to a set of basic topo-climatic predictors known to be important to model plants species. Then we modelled the distribution of 156 plant species inhabiting the study area. Finally, we compared the quality of the models having or not soil proprieties as predictors to evaluate their effect on the predictive power of our models.

In this study, we first showed that variation of soil proprieties can be modelled over large and complex areas at high resolution using predictive modelling techniques. Moreover, we also assessed that addition of predicted soil factors improved the predictive power of the 156 plant SDMs. The inclusion of soil factors improved the average area under the ROC curve (AUC) of the models by 2.5% and the average True Skill Statistic (TSS) by 2.7%. The poorest models experienced an AUC increase of 12% and a TSS increase of 13%. The soil pH became the second most important variable after air temperature in explaining the plant spatial distribution.