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Fine resolution mapping of wetlands at the regional scale

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The prediction of wetlands is a major challenge to design and implement a coherent national policy to preserve these fragile but vital ecosystems, involved in the production of many ecosystem services. Strongly related to the topography, the occurrence of wetlands is mainly conditioned by the geomorphology, precipitation and elevation from the natural drainage network. However fine scale data related to geomorphology and precipitation is often scarce and new methodology enabling to combine available data with additional covariates are needed for fine resolution mapping of wetlands, over large areas compatible with policy making. Wetland maps might also in turn be useful for assessing other soil properties such as soil organic carbon stocks.
This study tests, at the scale of the French Indre department, predictive statistical models based on boosted regression trees (BRT). These models offered several advantages such as the handling of missing data, correlated predictors and the robustness to the presence of outliers within the dataset. Moreover, it enables the modeling of interactions between predictors with a varying degree of complexity. The department of Indre covers an area of 6791 km^2 and is located between Paris Basin and northern fringe of the Massif Central. Soils are particularly diverse, illustrating a wide range of pedological processes (brunification, leaching, podzolisation), both on calcareous materials, aeolian deposits, detrital, plutonic and metamorphic basement. Wetlands distribution in Indre is as much characterized by parent material by topography, and the diversity of specific configurations makes it interesting from a modeling point of view. Several datasets were available for fitting and validating the models, i.e. 1361 soil profile observations and a previous map of wetlands distribution based on a 1:50.000 soil map. Punctual observations where classified into two classes: occurrence or absence of wetland, as defined by the French regulation on wetlands. The BRT model was fitted on these point observations to predict the wetland occurrence and validated through cross-validation and against the existing former map. Covariates used to fit the BRT model included variables related to topography, hydrology, climate, parent material, gamma radiometry data, land use data and Landsat data.
The model yielded, as assessed by cross-validation, kappa coefficient of 0.3, errors of omission of 0.65 and error of commission of 0.35, that is reasonable in performance compared to previous studies, but still leaving room for improvement. Fitted models were used to produce a 50m resolution map of the department with associated uncertainty.