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Estimating Soil Organic Carbon stocks and uncertainties for the National inventory Report - a study case in Southern Belgium

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As many other countries, Belgium complies with Annex I of the United Nations Framework Convention on Climate Change (UNFCCC). Belgium thus reports its annual greenhouse gas emissions in its national inventory report (NIR), with a distinction between emissions/sequestration in cropland and grassland (EU decision 529/2013). The CO_2 fluxes are then based on changes in SOC stocks computed for each of these two types of landuse. These stocks are specified for each of the agricultural regions which correspond to areas with similar agricultural practices (rotations and/or livestock) and yield potentials. For Southern Belgium (Wallonia) consisting of ten agricultural regions, the Soil Monitoring Network (SMN) 'CARBOSOL' has been developed this last decade to survey the state of agricultural soils by quantifying SOC stocks and their evolution in a reasonable number of locations complying with the time and funds allocated. Unfortunately, the 592 points of the CARBOSOL network do not allow a representative and a sound estimation of SOC stocks and its uncertainties for the 20 possible combinations of land use/agricultural regions. Moreover, the SMN CARBIOSOL is based on a legacy database following a convenience scheme sampling strategy rather than a statistical scheme defined by design-based or model-based strategies.
Here, we aim to both quantify SOC budgets (i.e. How much?) and spatialize SOC stocks (i.e. Where?) at regional scale (Southern Belgium) based on data from the SMN described above. To this end, we developed a computation procedure based on Digital Soil Mapping techniques and stochastic simulations (Monte-Carlo) allowing the estimation of multiple (10,000) independent spatialized datasets. This procedure accounts for the uncertainties associated to estimations of both i) SOC stock at the pixelscale and ii) parameters of the models. Based on these 10,000 individual realizations of the spatial model, mean SOC stocks and confidence intervals can be then computed at the pixel scale, for selected sub-areas (i.e. the 20 landuse/agricultural region combinations) and for the entire study area.