Testing the implementation of sampling designs for soil carbon monitoring

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Soil resources are at risk from a variety of threats operating over a broad range of scales. Therefore, monitoring soil quality is essential in order to detect adverse changes in their status at an early stage. There are many generic issues that must be addressed by scientists when establishing and operating soil monitoring networks (SMNs), including the requirement for these to be effective for different soil-systems. Of particular importance is the requirement for SMNs to detect change in soil over relevant spatial and temporal scales with adequate precision and statistical power.

In France, a national SMN has been established during the 2000-2010 period. However, as it has only one campaign of measurements, it is still an inventory. The implementation of this SMN has been realized progressively, region after region, depending on financial and logistic considerations. As a result, the national maps and statistics might be biased by this regional drift in the sampling, as the spatial and temporal distributions of the samples are correlated. In this paper, we test several ways of implementing a new national soil sampling strategy, taking into account limited yearly costs. For doing this we test various ways to resample progressively the initial 16-to-16-km grid. Other sampling strategies were of course possible. However, resampling the same grid as that of the first campaign has several advantages: first, it allows a homotopic comparison with the first campaign, and therefore leads to a more accurate estimation of the temporal trend, if there is any; second, new soil properties, measured during the second campaign, will be better correlated with previously analyzed ones. We assess the representativeness of these samplings, and their ability to detect simulated changes in soil carbon at an early stage. Our results show that subsampling yearly from the 2,200 sites of the whole grid can be efficient if these sites are chosen correctly. Additionally, the time needed for detection is strongly dependent on the number of samples that we will be able to collect each year, that number depending on financial constraints.

We present another example obtained in the framework of the Integrated Carbon Operation System (ICOS) project focused on the minimal detectable changes at the site level.