COMMENTS ON THE SECOND REVISION OF THE EUROPEAN COMMISSION´S PROPOSAL FOR A

"DIRECTIVE ON SOIL MONITORING AND RESILIENCE"

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General comments

The second revision of the SML proposal has been improved in various aspects which is much appreciated.

However, one of the most critical points has not been addressed. The 2nd revision of the SML still requires member states to conduct soil monitoring according to methodologies that are partly incompatible with existing monitoring systems. Given limited resources, member states with well-established soil monitoring methodologies will be urged to switch to the SML approach, resulting in disconnection of future samplings from legacy data and sample archives, without gaining a better data base for supporting soil health management. This is unproportionate, ineffective and in some cases likely less accurate. Details are commented below. Priority should be given to the continuation of well-established monitoring systems at national level, with the possibility to adopt the SML approach if no established system is in place or if it cannot serve the purpose.

Article 1

o.k.

Article 2

o.k.

Article 3

Item 9a: "soil unit" definition? (monitoring design, reporting unit, uncertainty level)

Item 11: better "aspect" than "characteristic" of soil health

Item 17c: better use "restoration" or "regeneration" instead of "renaturation" as soils will not be put back to their (full) natural conditions, and may then be used for crop production and other types of human land use.

Article 4

Paragraph 1: o.k.

Paragraph 2: Soil regions are required to be defined using the map of 'Soil Regions of the European Union and Adjacent Countries 1:5,000,000', 2005, accessed 2024-03-07, http://data.europa.eu/88u/dataset/ae71ffee-1ae9-4624-ae3f-f49513fe9dcb.

This map is outdated as it uses soil group definitions of an early version of the World Reference Base for Soil Resources (WRB) which substantially deviates from later ones, including the current version (WRB, 2022). Moreover, the predominant soil groups shown in this map are partly not in line with the information available at member state level, and the spatial delineation of soil units is prone to substantial inaccuracy. For Lower Austria, the resulting seven soil zones are compiled in the Table below. For soil zone 150, our data show that beneath cropland and cultivated land, which together make up the majority of land use in the Lower Austrian part of this zone, the dominant soil groups are Eutric Cambisols and Phaeozems whereas Umbrisols and Dystric Cambisols as indicated by the soil zone map are virtually not occurring. Similarly, we find Eutric Cambisols and Phaeozems in soil zone 202, but virtually no Dystric Cambisols. In zone 208, Leptosols occur to some extent beneath forests but rarely in cultivated and grassland soils where we find Cambisols and Regosols to be among the dominant soil groups. The delineation of soil zone 153 (Chernozems) is clearly wrong regarding the northwestern part, and does not reflect the soil cover there (mainly Cambisols). As a result, I am questioning the accuracy and suitability of the soil zone map for delineating soil units and selecting sampling points.

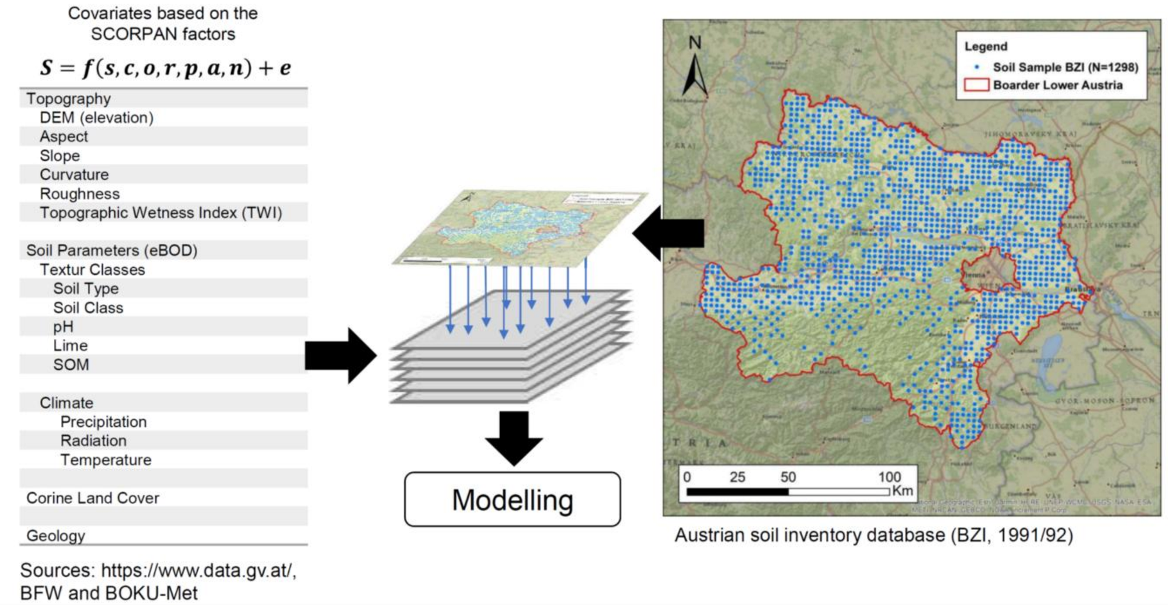
Soil Unit	Dominant soils	Dominant parent materials	Predominant climate
121	Haplic Luvisols Eutric Cambisols Eutric Gleysols	Loamy to sandy morainic deposits Sandy to gravely glaciofluvial sediments Loess	Temperate sub-oceanic
150	Dystric Cambisols Endoskeletic Umbrisols	Igneous rocks Metamorphic rocks Palaeozoic sedimentary rocks	Temperate sub-oceanic to temperate sub-continental incluenced by mountains
153	Chernic Chernozems Calcic Chernozems	Sandy and loamy loess Tertiary sediments Fluvial deposits	Temperate to warm temperate sub-continental, partly arid
200	Eutric Cambisols Dystric Cambisols Eutric Planosols	Cretaceous to tertiary flysch Cretaceous to tertiary marlstone	
202	Dystric Cambisols	Igneous rocks Metamorphic rocks	Temperate mountainous
208	Rendzic Leptosols Lithic Leptosols	Mesozoic limestone Mesozoic dolomite	
	Fluvisols, undifferentiated	Sandy to loamy fluviatile deposits	Without classification

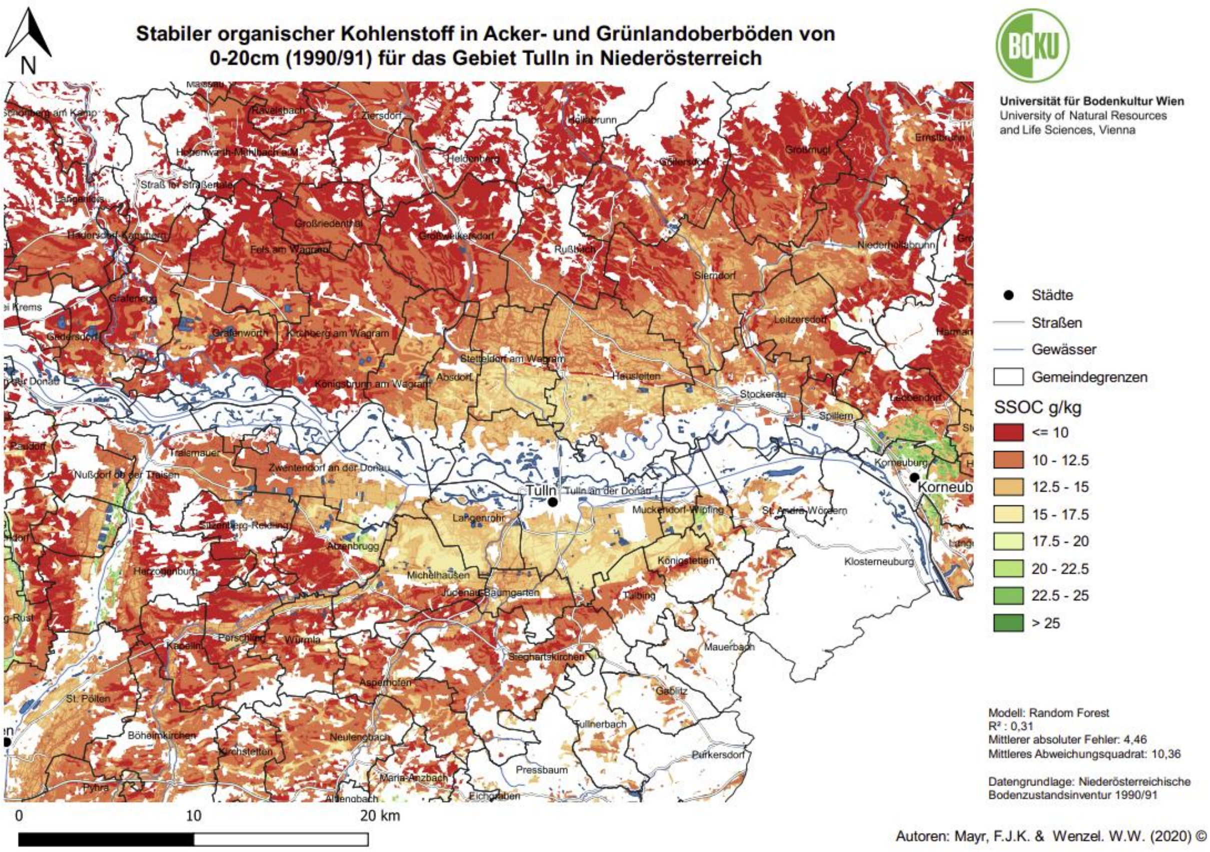
Article 5

o.k.

Article 6, Article 8

In combination with Article 8, Article 6 in the second revision of the SML still requires the member states to adopt the LUCAS-derived stratified sampling approach to select the sampling sites for the implementation of the soil health monitoring. This may be helpful if a member state has no suitable soil monitoring system in place but creates additional work load and costs otherwise. Moreover, changing monitoring sites results in the disconnection of future data from the legacy of data and archived samples of previous sampling campaigns by the member states. This is neither efficient nor proportionate. I therefore reinforce my demand for giving priority to the continuation of existing national and international (e.g., in the case of forest soils) soil monitoring programmes, if member states wish to keep them. In the case of Lower Austria, the regular sampling grid, established back in 1991/1992, allows for a dense coverage with a distance between sampling points of only 2.75 km. The average distance between sampling sites according to the procedure required by the SML is not known but, according to preliminary calculations likely to be considerably larger. Therefore, given the high density of sampling points in Lower Austria and other Austrian provinces I am advocating to allow for continuation of the existing sampling schemes of member states without forcing additional sampling according to the SML methodology. Using soil data from existing monitoring systems along with detailed available information on covariable layers, maps of soil health status can be produced by machine learning (e.g., Random Forest) or other adequate approaches. An example for stable SOC (SSOC) maps for Lower Austria is provided in the figures below. The results allow for detailed delineation of areas with differential SOC status at province level (= soil district) and for even smaller regions (e.g., area around the city of Tulln, see figure below), and can be directly used for deriving management options/plans for the soil districts (here: Lower Austria), and relevant subunits (e.g., soil units).





Using the approach required by the SML proposal (Article 4), soil monitoring sites in the province of Lower Austria (= soil district) would have to be selected based on 7 soil regions, and 3 major landuse categories (managed forest land, managed grassland, managed cropland) plus wetlands, resulting in 21 or, including wetlands which have very limited spatial extension, 22 soil units. As to now, I have no evidence that the SML approach would allow for more accurate spatial information on the soil health status as compared to the already implemented national monitoring system in Lower Austria.

The content of the envisaged guidelines for in-situ sampling should be available in advance. Moreover, they should not be binding to allow member states to continue their own monitoring systems without duplication. It is expected that the guidelines will determine topsoil sampling at a depth of 0-30 cm (LUCAS approach; see also SML Annex II, Part A.2) whereas national monitoring programmes have been using, for good reasons, other depth increments. Requiring member states to follow procedures deviating from their system will result in disconnection of future data from the legacy data and archived samples. Similarly, this applies to the spatial sampling design and other aspects.

<u>Article 7</u>

Generally, o.k., but without knowing the objectives and cornerstones of the intended guidelines, the impact of this article cannot be evaluated.

<u>Annex I, Part A</u>

The 2^{nd} revision of the SML is still using the SOC: clay ratio and a uniform threshold of 1:13 to separate healthy and unhealthy soils in terms of their SOC status. Even though corrective factors for soil types and climate conditions are possible, this approach lacks scientific foundation and is inappropriate. SOC: clay ratios are strongly biased by clay content, which in turn are typically related to parent material, often not related to structure quality, and would rate many soils as unhealthy that can provide ecosystem services at a high level. For details look up the following references:

Poelplau, C. and Don, A. 2023. A simple soil organic carbon level metric beyond the organic carbon-to-clay ratio. Soil Use Manage. 2023;39:1057–1067.

Rabot et al. 2024. Relevance of the organic carbon to clay ratio as a national soil health indicator. Geoderma 443 (2024) 116829.

Wenzel, W.W., Golestanifard, A., Duboc, O. SOC: Clay Ratio: A Mechanistically-Sound, Universal Soil Health Indicator Across Ecological Zones and Land Use Categories? https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4725180