Editorial: Digital soil mapping - advancing the knowledge frontiers

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Editorial: Digital soil mapping - advancing the knowledge frontiers

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Editorial on the Research Topic
Digital soil mapping - advancing the knowledge frontiers

This Research Topic focuses on "*Digital Soil Mapping - Advancing the Knowledge Frontiers*". Digital Soil Mapping (1) (DSM) is now routinely used by soil scientists and soil institutions for creating Digital Soil Maps and populate Soil Information Systems (2). Despite the global, widespread adoption of these techniques, several challenges remain to improve the quality and usability of the products (3, 4), including:

-1) Developing DSM models capable to support a better fundamental understanding of soil systems,

-2) Increasing the value of DSM products using Digital Soil Assessments (DSA), and generating information grids that can directly improve sustainable land management,

-3) Engaging with stakeholders and end-users in DSM and DSA exercises,

-4) Developing quality assessments of DSM and DSA products through novel or improved quality assessment metrics,

-5) Improving the communication of associated uncertainties and their consequences to all end-users,

-6) Sustaining and fostering the rescue of large amounts of legacy data into consistent, spatially explicit and continuous global soil information.

This Research Topic gathers five articles related to these various issues of DSM and DSA

In the first article, Fuentes et al. clearly address the 2nd and 3rd challenge described above. They developed DSM and DSA sustainable soil management tools for enhanced food security on US Tribal Lands. Overall, the approach developed high-resolution maps aiming at improving soil, crop, and land-use decisions at the farm and Tribal-level, for increased agricultural productivity and economic development. This is a very nice example of a DSA approach driven by end-users' needs, i.e. the Tribal lands producers and inhabitants who are faced with greater food insecurity, as well as the desire to cultivate culturally important crops.

The second article features the work of Minai et al.. Here they address the renewal of archival legacy soil data in a region of Kenya. This article describes in detail the different steps of bringing legacy soils data "back to life", using historical "Reconnaissance Soil Survey" in western Kenya, as an example. Its first step involves meeting and deliberating with key institutions and stakeholders (challenge 3). Nearly all the following steps illustrate in detail how to address challenge 6. The last step allowed authors to produce maps showing the ability of the land to perform specific agronomic functions and to derive many different crop suitability maps, which is a clear move from DSM to DSA (challenge 2).

The third article is from Gebauer et al. focuses on producing 100-m grid DMS predictions of the topsoil texture of agricultural soils of Germany. The method developed for validation is fully detailed and relevant, and clearly addresses challenge 4. The iterative approach the authors used, along with the maps and interpretations they derived from them, provide very interesting insights into the understanding and the controlling factors of the distribution of the topsoil texture of agricultural German soils. They clearly show the main drivers of soil texture at regional and local scales. They even suggest that their model could not capture some local soil systems processes such as local redistribution. In this sense, they bring a useful illustration on how to address challenge 1.

The fourth article features the work of Xia et al.. They present a thorough review based on 79 regional and national studies quantifying soil organic carbon within lands dominated by agriculture using SCORPAN approaches (1) that rely on soil (*S*), climate (*C*), organisms (*O*), relief (*R*), parent material (*P*), age (*A*), and space (*N*) covariates representing soil forming factors. This review provides interesting statistics on model validation and uncertainty analysis for soil organic carbon prediction and shows that challenge 4 was still an issue in many studies. It also shows that some sources of uncertainty, including data interpolation or rescaling, and spatial and temporal mismatches were largely unaddressed. The conclusions about the relative use of soil forming factors are consistent with other recent reviews (5, 6).

The fifth article features the work of Su and Adamchuck deals with local scales and proximal sensing techniques often used for site-specific soil and crop management. It analyses the temporal and operation-induced instability of apparent soil electrical conductivity measurements. This study is specific as it provides practical conclusions and useful directions about the sensitivity and the use of different proximal sensors, i.e., galvanic contact resistivity (GCR) and electromagnetic induction (EMI), frequently used to produce maps of apparent soil electrical conductivity, at the field scale. Interestingly, it is the only article focusing on uncertainties linked to the measurement of co-variates in DSM. This methodological study addresses some issues of challenge 4.

The five articles in this Research Topic cover a wide range of topics and scales. Interestingly, they cover almost all the challenges cited above, except challenge 5. Even if many of them provided uncertainties, the studies do not state if nor how these uncertainties were communicated to the end-users of the DSM and DSA products. It also remain unclear if the consequences of these uncertainties for modelers, or for decision makers at all scales (from field to globe) were appropriately communicated. The uncertainty propagation, coming from measurements or from covariates, is nearly absent from these articles except partly for the fifth one. The diversity of the articles shows, however, that some challenges previously highlighted are already and progressively addressed, which is encouraging for the future of DSM and DSA.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work, contributed equally to writing, and approved it for publication.

Conflict of interest

The authors DA and VM declared that they were editorial board members of Frontiers, at the time of submission. This had no impact on the peer review process and the final decision.

The remaining author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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