Editorial for pedometrics 2017 special issue

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In 1992 pedometrics as a concept became Pedometrics in the formal sense, with the establishment of a Working Group of the International Union of Soil Sciences (IUSS) and a first conference in Wageningen, the Netherlands (de Grujter et al., 1994). To celebrate its 25th anniversary, the pedometrics community therefore convened again in Wageningen in 2017. This special issue is one of two that contains selected papers presented at the 2017 Pedometrics conference. The two special issues show how pedometrics has matured over the past 25 years.

Pedometrics is the branch of soil science that applies mathematical and statistical methods to the study of the distribution and genesis of soils. In the early years it was mainly dedicated to geostatistical modelling of soil spatial variation. Kriging proved to be a very powerful technique for mapping quantitative soil properties and has since been applied to soil mapping on countless occasions. We only need mention that this year’s landmark paper by Burgess & Webster (1980), which, together with its companion papers, has had an immense impact on soil surveying (Lark et al., 2019, this issue). In fact, it marked the start of what we now call ‘digital soil mapping’ (McBratney et al., 2003), which has rapidly become a mainstream approach to soil mapping that is practised by all major soil institutions in the world. This is one of the major achievements of pedometrics.

But pedometrics is much more than digital soil mapping. Currently, the Pedometrics Commission of the IUSS has six Working Groups under its umbrella:

- Digital Soil Mapping
- Modelling of Soil and Landscape Evolution
- Digital Soil Morphometrics
- Soil Monitoring
- Proximal Soil Sensing
- Global Soil Map

Thus, other main subjects of pedometrics are the development, calibration, application and statistical validation of soil–landscape evolution models, the application of uncertainty propagation and sensitivity analyses to soil models, the development of techniques for mapping and modelling the soil profile, the use of big data, machine learning and citizen-science for soil science, the development and application of soil sampling and monitoring schemes, and proximal soil sensing.

This special issue is dedicated mainly to pedometric studies on the fine spatial scale. Thus, it begins with several articles on mapping and modelling the soil profile. Zhang & Hartemink mapped the profile wall of an Alfisol using digital morphometry techniques and compared results with those obtained from field-delineated soil horizons. Chen et al. used vis–NIR spectroscopy to determine soil classes for 130 soil profiles in Zhejiang province, China. The results of their numerical approach correspond well with expert-derived soil classification, particularly at the soil order level. The compatibility of numerical soil classification with the Chinese Soil Taxonomy was also researched by Zeng R. et al., using the concept of taxonomic distances between whole-profile spectra. In their study the agreement between the numerical soil classification and expert-driven hierarchical soil classification was poor. The authors explain why this occurred and suggest how numerical taxonomy might be used to rethink some of the concepts behind hierarchical soil classification systems. Ojeda-Magaña et al. zoom in to even finer spatial resolution and use X-ray tomography to derive the three-dimensional pore distribution of a $<1\text{cm}^3$ cube from an arable sandy loam soil in Scotland.

Proximal soil sensing is another thriving pedometric subject and more than half of the articles in this special issue address its advancement. Hobley & Pareter use visible near-infrared spectroscopy to estimate soil texture and then apply error propagation rules to identify poorly predicted samples, in support of the optimization of decisions from laboratory analysis. A comparison of three different techniques to derive soil properties from soil spectra is found in Ma et al. This study showed that soil pH was estimated best using attenuated total reflectance spectroscopy, and soil organic matter and total nitrogen were estimated best using diffuse reflectance spectroscopy, whereas none of the three methods could predict available phosphorus well. Clingensmith et al. address the problem of optimizing the splitting of a given soil spectroscopy dataset into a calibration and validation set. They show that random subsetting is not always optimal. They also successfully explored the use of methods from genomics for modelling the relation between spectra and soil properties. Jacobi et al. show that estimation of soil organic carbon fractions with near-infrared spectroscopy benefits from log-ratio transformation because by design this approach satisfies the constraint that the fractions must...
The added value of visible near-infrared spectroscopy for inference in oil-contaminated soils is demonstrated in Douglas et al. Both polycyclic aromatic hydrocarbons and alkanelnes measured in oil-contaminated soils in the Niger delta, Nigeria, could be predicted fairly accurately by random forest models. Soltani et al. show that reflectance spectroscopy is not only useful for the estimation of soil water content, but can also aid assessment of the effect of soil texture and soil organic carbon on soil water content. Whether fusion of information derived from multiple sensors can lead to improved estimation of soil properties was investigated by Xu et al. Results for a dataset from the Yangtze River delta indicate that this is possible when integration is based on a Bayesian model averaging approach. Fusion was also tested in Zeng C-Y. et al., but using remote sensing data instead of proximal soil sensing data. Fusion of high temporal resolution MODIS data with high spatial resolution Landsat data allowed the construction of a land surface dynamic feedback layer that in turn was successfully used to map soil texture in a case study in Anhui province, China.

The special issue closes with two methodological articles. Libohova et al. unravel the various error sources for soil pH prediction. For a case study using data from the SSURGO database (USA) they found that laboratory measurement error had the smallest contribution, that harmonization error and positional uncertainty had intermediate contributions, and that spatial interpolation was the main source of error. Brus et al. extend the spatial optimization of sampling design by including accessibility costs in the optimization criterion. They show that the cost-efficiency of estimation of the mean soil organic matter content for a study area in Anhui province, China, can be increased substantially by accounting for differences in accessibility.

We hope that you will enjoy this special issue and that it will give you some idea of the diversity of pedometrics. Although pedometrics is a discipline of soil science in its own right, it should never become isolated from other soil science disciplines. It is crucially important that it has strong links with other branches of soil science, such as pedology, soil physics, soil chemistry and soil biology. We hope that this special issue will inspire and enthuse both pedometric and non-pedometric soil scientists to identify research topics of common interest and incite new research collaborations.

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