Geophysical Research Abstracts
Vol. 19, EGU2017-11694, 2017
EGU General Assembly 2017

A Brief History of the use of Electromagnetic Induction Techniques in Soil Survey

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Electromagnetic induction (EMI) has been used to characterize the spatial variability of soil properties since the late 1970s. Initially used to assess soil salinity, the use of EMI in soil studies has expanded to include: mapping soil types; characterizing soil water content and flow patterns; assessing variations in soil texture, compaction, organic matter content, and pH; and determining the depth to subsurface horizons, stratigraphic layers or bedrock, among other uses. In all cases the soil property being investigated must influence soil apparent electrical conductivity (ECa) either directly or indirectly for EMI techniques to be effective. An increasing number and diversity of EMI sensors have been developed in response to users' needs and the availability of allied technologies, which have greatly improved the functionality of these tools and increased the amount and types of data that can be gathered with a single pass. EMI investigations provide several benefits for soil studies. The large amount of georeferenced data that can be rapidly and inexpensively collected with EMI provides more complete characterization of the spatial variations in soil properties than traditional sampling techniques. In addition, compared to traditional soil survey methods, EMI can more effectively characterize diffuse soil boundaries and identify included areas of dissimilar soils within mapped soil units, giving soil scientists greater confidence when collecting spatial soil information. EMI techniques do have limitations; results are site-specific and can vary depending on the complex interactions among multiple and variable soil properties. Despite this, EMI techniques are increasingly being used to investigate the spatial variability of soil properties at field and landscape scales. The future should witness a greater use of multiple-frequency and multiple-coil EMI sensors and integration with other sensors to assess the spatial variability of soil properties. Data analysis will be improved with advanced processing and presentation systems and more sophisticated geostatistical modeling algorithms will be developed and used to interpolate EMI data, improve the resolution of subsurface features, and assess soil properties.