Improving The Geophysical Prediction of Soil Texture by Calibrating an Electromagnetic Induction Survey with Collocated Direct Current Electrical Resistivity Measurements

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Ground-based electromagnetic induction (EMI) surveys can infer soil properties essential for judging the risk of nutrient loss from agricultural fields. In low-relief settings, the transport of nutrients from agricultural fields to nearby surface waters depends on subsurface hydrologic connectivity, which is largely controlled by soil texture. While data on soil texture and associated soil drainage classifications are often obtained from published soil surveys, the resolution of these soil survey data are often too coarse to inform nutrient risk assessments at the scale of individual fields. In this study, we tested EMI as a tool for producing high-resolution maps of soil texture in flat agricultural fields with elevated risks of subsurface nutrient transport. Specifically, we sought to ascertain whether the relationship between EMI data and soil texture was improved by calibrating the apparent electrical conductivity measured by an EMI sensor with a 2D electrical resistivity imaging (ERI) survey. The joint geophysical survey was performed across a ~1-ha field in Princess Anne, Maryland, United States. Relative to the uncalibrated EMI data, calibrated EMI conductivity values showed a higher Spearman’s correlation coefficient with a new ERI survey performed roughly 80 m from the first ERI survey. The calibrated EMI data significantly improved Spearman’scorrelation coefficient between representative soil properties (d10, d50, d90) measured from grain size analysis and electrical conductivity. This study shows that the calibration of EMI data with an ERI profile is required to obtain a significant predictive relationship between EMI-derived electrical conductivity and representative soil properties. Such relationships will ensure a finer-resolution proxy soil map for evaluating the risk of subsurface nutrient transport from agricultural fields.