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Using Electromagnetic Induction Technique to Detect Hydropedological Dynamics: Principles and Applications

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Hydropedological dynamics including soil moisture variation, subsurface flow, and spatial distributions of different soil properties are important parameters in ecological, environmental, hydrological, and agricultural modeling and applications. However, technical gap exists in mapping these dynamics at intermediate spatial scale (e.g., farm and catchment scales). At intermediate scales, in-situ monitoring provides detailed data, but is restricted in number and spatial coverage; while remote sensing provides more acceptable spatial coverage, but has comparatively low spatial resolution, limited observation depths, and is greatly influenced by the surface condition and climate. As a non-invasive, fast, and convenient geophysical tool, electromagnetic induction (EMI) measures soil apparent electrical conductivity (ECa) and has great potential to bridge this technical gap. In this presentation, principles of different EMI meters are briefly introduced. Then, case studies of using repeated EMI to detect spatial distributions of subsurface convergent flow, soil moisture dynamics, soil types and their transition zones, and different soil properties are presented. The suitability, effectiveness, and accuracy of EMI are evaluated for mapping different hydropedological dynamics. Lastly, contributions of different hydropedological and terrain properties on soil ECa are quantified under different wetness conditions, seasons, and land use types using Classification and Regression Tree model. Trend removal and residual analysis are then used for further mining of EMI survey data. Based on these analyses, proper EMI survey designs and data processing are proposed.