Cyberinfrastructure Tools for Precision Agriculture in the 21st Century

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This interdisciplinary project applies computer science approaches and computational resources to large multidimensional environmental datasets, and synthesizes this information into finer resolution, spatially explicit products that can be systematically analyzed with other variables. The main emphasis is ecoinformatics, a branch of informatics that analyzes ecological and environmental science variables such as information on landscapes, soils, climate, organisms, and ecosystems. The project focuses on synthesis/computational approaches for producing high-resolution soil moisture datasets, and the pilot application is precision agriculture. The effort combines analytical geospatial approaches, machine learning methods, and high performance computing (HPC) techniques to build cyberinfrastructure tools that can transform how ecoinformatics data is analyzed.

The investigators build upon publicly available data collections (soil moisture datasets, soil properties datasets, and topography datasets) to develop: (1) tools based on machine-learning techniques to downscale coarse-grained data to fine-grained datasets of soil moisture information; (2) tools based on HPC techniques to estimate the degree of confidence and the probabilities associated with the temporal intervals within which soil-moisture-base changes, trends, and patterns occur; and (3) data- and user- interfaces integrating data preprocessing to deal with data heterogeneity and inaccuracy, containerized environments to assure portability, and modeling techniques to represent temporal and spatial patterns of soil moisture dynamics. The tools will inform precision agriculture through the generation and use of unique information on soil moisture for the coterminous United States. Accessibility for field practitioners (e.g., local soil moisture information) is made possible through lightweight virtualization, mobile devices, and web applications.

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