Ground Network Design and Dynamic Operation for Near Real-Time Validation of Space-Borne Soil Moisture Measurements

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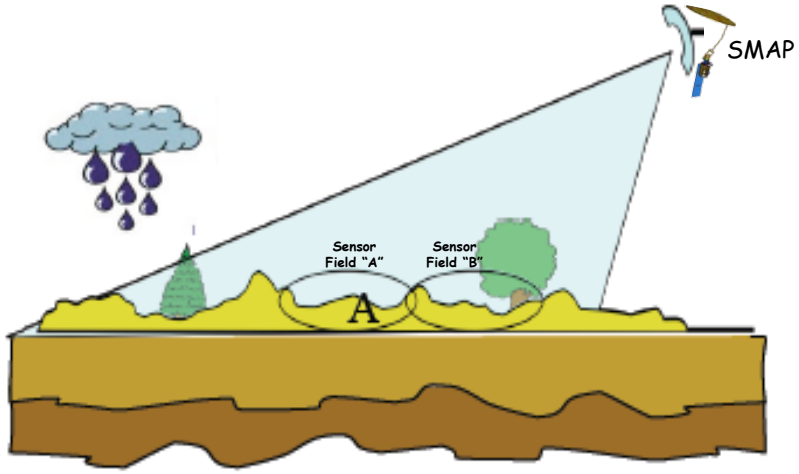
Objective

Develop technologies for dynamic and near-real-time validation of space-borne soil moisture measurements, particularly for the Soil Moisture Active – Passive (SMAP) mission; solve the joint problem of sensor placement and scheduling.

- Develop optimal sensor node placement policies based on non-stationary spatial statistics of soil moisture. For each node, build dynamic scheduling policies
- Develop physics-based spatial aggregation strategy to correlate in-situ and space-based estimates of soil moisture
- Develop actuation and telecommunication protocols and hardware for controlling the optimally architectured ground sensors



Dynamic, real time, in-situ measurements allow validation of satellite generated estimates of average soil moisture

Accomplishments

- Derived placement/scheduling policies to maximize the quality of ground estimates while minimizing resource usage; these policies were mathematically obtained by solving a joint optimization problem
- Developed a statistical aggregation method to relate estimates of soil moisture from the fine-scale wireless sensor network to the coarse-scale aircraft and space-based retrievals of soil moisture
- Developed an energy-efficient platform to command sensors and transmit measured data to base station in real time
- Procured equipment and parts for full scale sensor networks in multiple locations
- Installed large scale sensor field networks on rancher's fields of varied topology and soil type in Oklahoma and California
- Performed full-scale field experiments in coordination with SMAP cal/val team to prototype the validation system

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$TRL_{in} = 2$ $TRL_{out} = 6$