Title
CON0: CENS Contaminant Transport Observation and Management Research: Overview

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CENS Contaminant Transport Observation and Management Research: Overview

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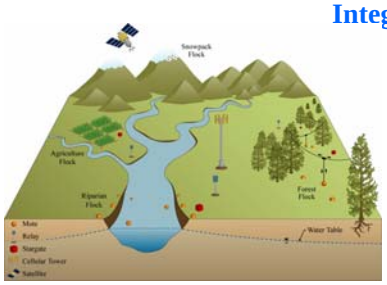
Introduction: Multiscale observation of distributed contaminants in environmental systems

Integrating multiscale observations using remote and embedded networked sensing



The embedded networked sensing (ENS) problem being addressed by the contaminant transport application domain projects is the design of sensor networks supporting physical and chemical observations within and between environmental media, including land, air and water. An interdisciplinary approach is needed because it is difficult to conceive of an effective spatiotemporal sampling plan without domain-specific knowledge and network programming tools are not yet user-friendly enough to see widespread use amongst application domain experts. The contaminant transport observation projects are evolving from controlled test beds to specific real-world deployments to a proposed large, multiscale water quality observation and management network. The current emphasis is on the soil domain which is by nature a rich context for ENS development because of the natural heterogeneity of such media and the inherent cost and technical challenges of deploying sensor networks in these environmental media.

Problem Description: Finding optimal network configurations to safely manage contaminants

1. Contaminant Source Assessment

Use laboratory test beds with simplistic sensing demands (temperature) in order to develop spatiotemporal design strategies

2. Soil Pylon Sensor Array Design and Validation

Create a robust, modular soil sensor array design; use sensing to automatically hone simulators; then us feedback-control to balance irrigation and fertilization with groundwater protection

3. Multiscale Soil Sensor Network Deployment

Attack test cases at multiple scales to challenge the hardware-software designs: field scale agricultural and single plant rhizosphere test beds

4. Future Directions

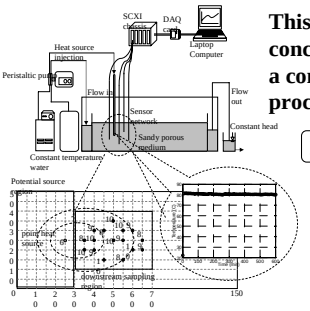
To maximize the impact of the contaminant observation systems being developed here, we will expand our approach to:

(1) *New modality* in soil, aquatic sediment, riparian and forest modular ENS systems

(2) *Multiscale environmental observatory designs* fusing of ENS-level data streams with larger scale embedded and remote (aerial/satellite) sensing

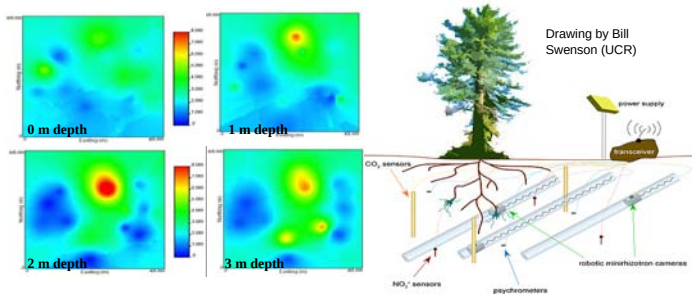
Proposed Solution: Integrating network design with process simulation and management

Contaminant Source Assessment in a laboratory test bed



This completed project proved the concept of real-time ENS design using a combined genetic algorithm-inverse process modeling strategy

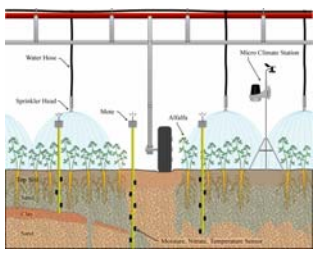
Tailoring the ENS design to multiple scales



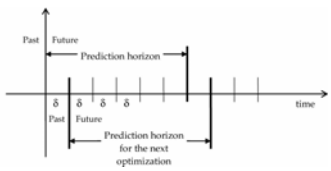
Geopatial statistically based deployment of soil pylon-based observation networks at an agricultural scale (30 acres) and at the single plant scale.

Soil Pylon Design and Validation

- Local rain gauge sensors monitor spatially distributed irrigation rate
- Soil moisture sensors monitor local water content to support the observations of water infiltration and redistribution
- Thermistors monitorlocal a ir temperature and below-ground gradient to support energy balance in evapotranspiration calculations
- Off-the-shelf vs. CENS-fabricated nitrate sensors (in situ test bed system for CENS Sensor Group)



Feedback Control for Optimal Irrigation



Long term vision: multiscale observatories

CLEANER
Collaborative Large-scale Engineering Analysis Network for Environmental Research