STAiR

International Research Education Programme for Soil Technology And inter-disciplinary Research in Soil and Environmental Sciences

International PhD Course in
MERGING MEASUREMENTS AND MODELING IN SOIL PHYSICS
March 28 – April 3, 2011
at Aarhus University, Faculty of Agricultural Sciences
Guest lecturers
Professor Ty Ferre, University of Arizona
Professor Markus Tuller, University of Arizona

Course content

This course will present accepted and emerging concepts of key processes of water flow in unsaturated porous media. These concepts will be presented together with standard and novel methods to make the measurements necessary to describe these processes. The focus of the course is the need for a unified treatment of measurement and modeling in quantitative soil physics. Specifically, we will discuss how advancements in our understanding of soil physics should guide the design of measurement and monitoring efforts. Similarly, we will discuss how the interpretation of measurements made with emerging indirect methods should be made in the context of the soil physical model of interest.

Tentative course schedule

Monday March 28, 2011
a.m. - Soil Physics Basics
p.m. – Traditional Soil Physics Modeling
Tuesday March 29, 2011
a.m. – Traditional Soil Physics Measurement Methods - Theory
p.m. – Traditional Soil Physics Measurement Methods – Practice
Ksat, K(h), SWC, Air Permeability – Laboratory Demonstrations
Wednesday March 30, 2011
a.m. – New Concepts in Soil Physics - Theory
p.m. – New Concepts in Soil Physics Modeling – Practice
Computer Laboratory
Thursday March 31, 2011
a.m. – New Approaches to Soil Physics Measurement - Theory
p.m. – New Approaches to Soil Physics Measurement – Practice
TDR, EM38, Air Permeability – Field Demonstrations
Friday April 1, 2011
a.m. – New Approaches to Soil Physics Measurement - Theory
p.m. – New Approaches to Soil Physics Measurement - Excursion to instrumented field site
Georadar and ERT – Field Demonstrations

Saturday April 2, 2011
a.m./p.m. – Merging Measurement and Modeling – Case studies

Sunday April 3, 2011
Young Scientist forum

Material to be covered in the sessions includes:

Soil Physics Basics

- Energy distributions during hydrostatic, steady state, and transient flow through
- Homogeneous and heterogeneous media;
- Relationships between soil physical and soil hydraulic properties;
- Macroscopic soil hydraulic property models.

Traditional Soil Physics Modeling

- Simplified representations of infiltration and drainage;
- A spreadsheet-based analysis of steady-state unsaturated flow;
- Numerical solutions of Richards' equation.

Traditional Soil Physics Measurement Methods

- Laboratory and field methods to measure water pressure;
- Laboratory and field methods to measure water content;
- Laboratory and field methods to measure hydraulic conductivity;
- Laboratory and field methods to measure and infer soil hydraulic model parameters.

New Concepts in Soil Physics

New Approaches to Soil Physics Measurement (I)

- Time domain reflectometry and related water content measurement methods;
- Passive and active heat transport monitoring to infer water flux.

New Approaches to Soil Physics Measurement (II)

- Gravity for storage change;
- Electrical resistance tomography for water content and solute concentration change;
- Electromagnetic induction for water content change and solute concentration change;
- Ground penetrating radar for water content change.

Merging Measurement and Modeling

- Time domain reflectometry as a case study for correcting local effects of instrument sensitivity for inferring soil hydraulic model parameters;
- Gravity as a case study for the direct integration of geophysical measurements in hydrologic investigations.

Course outline

The course will last six days. Each day will begin with a lecture session. The second half of the day will involve hands-on modeling and measurement activities. On the 7^{th} day we encourage the participants to take part in a young scientist forum, where the aim is exchange of knowledge, experience, and ideas.

Background of participants

The Ph.D. students should have a background in

- agronomy, environmental engineering, hydrology, or hydrogeology
- numerical modeling

Time and place
March 28 – April 3, 2011
Aarhus University, Faculty of Agricultural Sciences, Research Center Foulum, Denmark

Organizers
Lis Wollesen de Jonge, Aarhus University Lis.w.de.jonge@agrsci.dk
Per Møldrup, Aalborg University pm@bio.aau.dk
Bo Vangsø Iversen, Aarhus University Bo.V.Iversen@agrsci.dk

Work load and credit points
Approximately 125 hours in total including the lectures and exercises during the course and preparatory reading before and during the course. The workload corresponds to 5 ECTS.

Study material
Notes and copies of references papers will be provided during the course. Software and key papers will be made available ahead of time.

Admission
Applicants are requested to submit the registration form no later than March 1, 2011. Information on admission to the course will be forwarded shortly after. The total number of participants is limited to 25. PhD students are given first priority, but depending on the number of registrants we also welcome post-graduate participants and MSc students. The course is fee is 400 Euro for students enrolled in STAiR and 500 Euro for others. This covers course materials, housing, transportation during the course, and two course dinners.

Accomodation and travel
The STAiR programmes will arrange for accommodation in residence facilities near the Faculty of Agricultural Sciences.

Further information
Please contact the course organizers or STAiR.