

**Minutes of the 2013 Annual Meeting of the W-2188 Multi-State Research Project  
“Characterizing Mass and Energy Transport at Different Vadose Zone Scales”**

**January 2-4, 2013 – Las Vega, NV**

The annual meeting of W-2188 was called to order by Tyson Oschner (Chair) at 1:00 p.m. on Wednesday, Jan. 2, 2013. The project members and visitors in attendance were:

Members:

- |                               |                                    |
|-------------------------------|------------------------------------|
| 1. Heinse, Robert             | University of Idaho                |
| 2. Jacobsen, Jeff (W-2188 AA) | Montana State University           |
| 3. Kluidtenberg, Gerard       | Kansas State University            |
| 4. Jones, Scott               | Utah State University              |
| 5. Casey, Frank               | North Dakota State University      |
| 6. Kelleners, Thijs           | University of Wyoming              |
| 7. Maziar, Kandelous          | University of California-Davis     |
| 8. Nieber, John (Secretary)   | University of Minnesota            |
| 9. Ochsner, Tyson (Chair)     | Oklahoma State University          |
| 10. Yang, Yang                | University of Kentucky             |
| 11. Flury, Markus             | Washington State University        |
| 12. Young, Michael            | University of Texas-Austin         |
| 13. Moradi, Ahmad             | University of California-Davis     |
| 14. Ghezzehei, Teamrat        | University of California-Merced    |
| 15. Dragila, Maria            | Oregon State University            |
| 16. Simunek, Jirka            | University of California-Riverside |
| 17. Caldwell, Todd            | University of Texas-Austin         |
| 18. Ewing, Toby               | Iowa State University              |
| 19. Shukla, Manoj             | New Mexico State University        |
| 20. Harter, Thomas            | University of California-Davis     |
| 21. Wang, Zhi                 | Fresno State University            |
| 22. Hopmans, Jan              | University of California-Davis     |
| 23. Berli, Markus             | DRI-Las Vegas                      |

Guests:

- |                      |                                |
|----------------------|--------------------------------|
| 24. Scanlon, Bridget | University of Texas-Austin     |
| 25. John Stande      | University of Nevada-Las Vegas |

Order of Business:

***Wednesday, 1:00 pm.***

1. Oshner called the meeting to order.

2. Ray Knighton called in by video meeting and reported on the opportunities for USDA research funding in NIFA and AFRI.
  - a. Has avoided 8-9% cut to NIFA and AFRI so far, but because of lack of budget agreements and possible sequester it is not known yet what the funding levels will be. Also, Congress needs to act on the new Farm Bill. Previous Farm Bill has been extended for now.
  - b. Possible cuts of 25-30 million for AFRI.
  - c. RFA out in January for water and bioenergy nexus.
  - d. RFA for fellowships for pre-doc (\$80,000/2 years) and post-doc (\$150,000/2 years). Dr. Ramaswamy would like to double or triple the funding for this program.
  - e. In the long term there will be more of an emphasis put on water and nutrients (especially nitrogen) and less on soil itself. Programs will not be to soils itself, but more to general natural resources terms.
3. Jeff Jacobsen – Gave overview of the W2188 project.
  - a. Commented that the group report put together by Tyson Oschner was excellent.
  - b. The current W2188 project ends in October 2014. Need a new write-up for the project, and this needs to be in by January 2014 to be reviewed in time.
  - c. Refer to the Science Roadmap prepared by the Experiment Station Directors – this should be a good guide for what should be the focus for the project for the next five years. Jeff will send out the information on this.
  - d. At this meeting we should have a discussion of ideas for the new project. This was tabled until Friday morning. The request for volunteers to work on the write-up of the new project will also wait until then.

### ***Break***

4. Maria Dragila – Oregon State University. Presented research about water repellency on production soils. Discussed the mechanisms for the water repellency, and also showed that the water repellency could be affected by the size of individual particles.
5. Navin Twarakavi – DRI-Las Vegas. Presented results of a study examining wildfire hydrophobicity. Discussed the mechanism of the phenomenon. Used by WDPT and MED tests. Conducted tests on artificial media of different texture. Tests in the field found a dependence of water repellency on the distance of the location from a combusted tree.
6. Maziar Kandelous – University of California-Davis. Presented results of research on the irrigation of an almond orchard with drip and fanjet irrigation systems. Applied the HYDRUS model to simulate measured soil water content distributions.
7. Ahmad Moradi – University of California-Davis. Discussed studies of detailed measurements of root water uptake in thin chambers using neutron radiography methods. Found that the soil near the root is somewhat water repellent. Did not find water moving from the root to the soil.
8. Markus Flury – Washington State University. Presented research about the fate and transport of colloids in unsaturated porous media. Studies were conducted at various scales, microscale, lab scale, and field scale. Also presented results of studies on water repellency and the mechanism for such effect on water adsorption into porous media. Discussed the characteristics of the water repellency in terms of the Gibbs free energy

and the Bond number. Show water repellency effect manifested by the 'liquid marble' and explained what conditions are needed in terms of Bond number.

### ***Thursday***

***Keynote address:*** Bridget Scanlon – University of Texas-Austin. Bridget was the invited guest speaker for the 2013 W2188 meeting. She spoke philosophically about the hydrology, water balances, groundwater recharge, and freshwater sustainability. Also emphasized the importance of giving significant time to think about things instead of always being busy.

9. Teamrat Ghezzehei – University of California-Merced. Presented research on rhizosphere hydrology. Conducted detailed observations to measure the exudation of organics out of roots into the surrounding soils. Mentions that about 40% of C in photosynthesis is put into the plant rhizosphere. The presence of the organics in the surrounding soils affects the matric potential and the osmotic potential of the root environment.

### ***Break***

10. Gerard Kluitenberg – Kansas State University. Presented a mathematical formulation for the diffusion of solute to a porous cup. The application is to be able to characterize a passive porous cup to be used in collecting water samples and then quantify concentrations of solute in-situ inside of the cup. This relates to the sampler developed by the Hopmans group. Also discussed the analysis of heat pulse sensors composed of large probes.
11. Zhi Wang – Fresno State University. Discussed studies on the salinity of shallow groundwater. Presented ideas about how water vapor capture occurs in natural vegetation. Presented the idea of 'straw grids' that have been used in China to restore areas that have been damage. Also discussed the measurement of the plant water retention curve.
12. Toby Ewing – Iowa State University. Presented ideas about the connectivity of intra-granular pores. From studies that have been conducted it is concluded that pore connectivity is critical to imbibition of water into the soil matrix.

### ***Lunch***

13. Thomas Harter – University of California-Davis. Presented results of studies of nitrates in groundwater. Surveys of nitrate in groundwater in the Central Valley have been conducted back to the 1950's until the present time. The data shows that the nitrate levels have worsened. It is estimate it would take \$20-\$36 million to remove the nitrate from the groundwater. Has developed a 3-D model of flow in the groundwater along with the nitrate transport.
14. Yang Yang – University of Kentucky. Presented results of tracer studies intended to quantify the transport of solutes in agricultural soils. Bromide was used as the tracer, and sampling was conducted on a high density network of samplers. Two different crops were represented along the transect of the applied tracer and samplers.

15. Frank Casey – North Dakota State University. A new initiative related to saline and sodic soils in North Dakota was undertaken recently. Four new professional positions are related to this. Also discussed studies on the fate and transport of estrogenic compounds that are derived from animal manure.

### ***Break***

16. Thijs Kelleners – University of Wyoming. Presented results of studies on field monitoring of water flow in snow and in the underlying frozen soil. Applied a model he developed to simulate the coupled water flow and heat transport processes and compared them to the measured data.
17. Todd Caldwell – University of Texas-Austin. Discussed research on the biotic and abiotic processes impacting the hydraulic properties of soils. Also discussed the analysis current being conducted to examine the spatial variability of soil moisture. Using the large soil moisture data bases that are now available – NLDAS, SCAN, USCRN, COSMOS, Ameriflux, NEON.
18. Manoj Shukla – New Mexico State University. Presented results of a course that involved the teaching of the skills for doing research and teaching in soils physics. Discussed freshwater conservation, and studies on the application of treated wastewater to fields. Examine the effect of sodium on the reduction of hydraulic conductivity of soils as a result of application of wastewater. Also examined the compensated root uptake that occurs in some plant species. In this case the experiments were conducted with Chili plant.
19. Jan Hopmans – University of California-Davis. Presented work that is being conducted related to the critical zone experiment. Monitoring the soil profile for soil moisture and matrix potential. From detailed monitoring data found that 1/3 of transpired water comes from deep in the soil profile. A single tree and the soil with its roots were modeled with the HYDRUS model. For the model the tree water discretized as well as the soil. The MCMC (DREAM) scheme was optimized for system parameters.

### ***Friday***

#### ***2014 Planning***

- We should try to get more students to the meetings. How to do this is an issue because of the cost of travel as well as the registration fee for the meeting. PI's will balk at paying much for student participation. But it should be tried if the finances can be managed. Should up to the individual PI as to what to do.
- Question came up about how to make the meetings more open but not to allow it to get carried away since the presentation need to be short and the members can stay only two or three days.
- Need to prepare a new project writeup. Volunteers were requested and the following persons volunteered; John Nieber (University of Minnesota), Navin Twarakavi (DRI), Markus Berli (DRI), and Teamrat Ghezzehei (UC-Merced)
- Ideas for topics were jotted down by everyone and the sheets were put on a table. People voted by placing plastic straws in a cup set next to an idea. The tally of the votes is in the attached table. The topic with the most votes was “soil-plant-atmosphere interactions” suggested by Thijs Kellener.

20. Markus Berli – DRI-Las Vegas. Presented results about the changes in the rhizosphere that can occur due to root expansion. Studies an individual root with synchrotron micro-tomography and used COMSOL-MP software to model water flow and solid mechanics stress modeling. Results showed the root growing in cross-section and the mechanical deformation of the soil surrounding the root as a result of the root expansion. Also studied the effect of this expansion on the water flow in the root.
21. John Stande – University of Nevada-Las Vegas. Is studying the electrokinetic transport of permanganate to produce the in-situ oxidation of TCE in the vadose zone and saturated zone.
22. John Nieber – University of Minnesota. Briefly discussed the study on water repellency of an area near Bemidji where an oil spill occurred in 1979. Also presented results of a study to quantify the proportions of streamflow in Minnehaha Creek (Twin Cities Metro Area watershed) originating from groundwater and surface water. The objective of the project is to examine the possibility of augmenting baseflow in the creek to provide a more sustainable flow.
23. Jirka Simunek – University of California-Riverside. Discussed the multitude of new developments of the HYDRUS model suite, and also the many applications of the models for water flow and solute transport.

### ***Break***

24. Michael Young – University of Texas-Austin. Presented a study on the fate of pharmaceutical compounds applied to an active golf course. Showed a nice way to build the Gee type of flux meter by using a stove pipe over a PVC pipe. Also discussed the topic of hydraulic fracturing. Stated that there is funding available to study the long-term effects of hydraulic fracturing. His center has purchased a high resolution LIDAR system that produces 40 points per square meter.
25. Scott Jones – Utah State University. Discussed research to quantify CO<sub>2</sub> emissions from manure. Discussed methods that are being developed to measure soil evaporation remotely and insitu. Also discussed the development of a flux meter that he hopes can get resolution down to 1 mm/day. One approach is to measure the streaming potential. But heat pulse is an alternative.
26. Robert Heisne – University of Idaho. Studied the variability of soil moisture at the field scale, and examined the effect of soil terracing in complex terrain. Also studied the effect of crop type on the stored water in the soil profile remaining for the next growing season.
27. Tyson Oschner – Oklahoma State University. Discussed his work with the sensor network he is managing. Discussed the development of a drought monitoring system based on the soil moisture measurements. Also, discussed briefly the used of Bayesian Maximum Entropy principle used to map soil moisture over large areas.

Meeting adjourned at 12:15 p.m, January 4.

Minutes recorded by:  
John L. Nieber  
2012 W-2188 Secretary

Topic	Proposer	Votes
Gas transport and fate from porous media. This could include greenhouse gasses but should not be restricted to only these; radon, regulated gasses and others may also be of interest.	Scott Jones	5
Fate and transport of bioactive compounds, nitrogen, colloids, etc. at field and lab scales and the multiple coupled processes involved	Frank Casey	1
Emission of trace gasses from the soil	Gerard Kluitenberg	2
Soil-plant-atmosphere interactions	Thijs Kelleners	14
Mathematical modeling of water-soil-plant-atmosphere processes	Jirka Simunek	4
Nitrate management in irrigated agricultural systems	Jan Hopmans	2
Root-soil-interactions	Ahmad Moradi	2
Linkages between biological processes (microbial, root...) and soil physical and mechanical properties and processes	Teamrat Ghezzehei	8
Effect of heterogeneity on salinity	Anon	0
Address the important role of soil physics in water and nitrate movement (which seems to be forgotten)	Maziar Kandelous	4
Plant storage of water and plant water movement to soil	Zhi (Luke) Wang	0
Blue water footprint and crop production	Bridget Scanlon	3
Efficient irrigation management using nonpotable water	Manoj Shukla	2
Research to support agriculture to understand its impact to groundwater quality <ul style="list-style-type: none"> <li>• GW emissions of specific practices,</li> </ul>	Anon	2

<p>especially nitrate</p> <ul style="list-style-type: none"> <li>Monitoring GW emissions</li> </ul>		
<p>Stronger connection to water availability and the interaction between society, energy and natural resources (including soils)</p>	Michael Young	7
<p>How to connected the physical processes in vadose zone at different scales? i.e., How to downscale or upscale?</p>	Yang Yang	2
<p>Coupled processes</p>	Toby Ewing	1
<p>Linking soil physics and modeling to larger scale climate-land-atmosphere models</p> <ul style="list-style-type: none"> <li>i.e., participating in soil moisture @ continental/watershed scale</li> <li>we're missing the boat</li> </ul>	Todd Caldwell	3