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SUBJECT: MGT – Executive Summary – July 22, 2010
International Workshop on Frontiers of Hydropedology and Earth's Critical Zone: Research and Applications, Beijing, China, July 11-13, 2010

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Brief Narrative:

The purpose of the *International Workshop on Hydropedology and Earth's Critical Zone* was to bring researchers together to discuss the role of hydropedology in the *Earth's Critical Zone*. Emerging interests in the *Earth's Critical Zone* (spans zone from the top of vegetation to the bottom of aquifers) has increased our awareness to the complexity of environmental systems and the need to merge the disciplines of hydrology, pedology and geomorphology to better understand ongoing processes and structures. At the Workshop, I presented two papers (one a 60 minute keynote presentation) and also moderated a session.

Purpose: Why did you go? Where did you go? When did you go? What did you do?

I was contacted by the organizing committee and invited to give a keynote presentation at the *International Workshop on Hydropedology and Earth's Critical Zone: Research and Applications*. The workshop was held at the Ying Dong Conference Hall at Beijing Normal University in Beijing, China, on July 11 to 13, 2010. I provided two talks: a one hour **Keynote** presentation entitled "Defining Hydropedologic Functional Units (HFUs) with Electromagnetic Induction (EMI)"; and a second 40 minute presentation entitled "Use of Ground-Penetrating Radar (GPR) in Hydropedologic Investigations". I also moderated a session on *Measuring Soil-Water-Plant Relationships* at the workshop. The workshop was sponsored by Beijing Normal University, China Agricultural University, and the Committee of Sustainable Resources Utilization and Disaster Reduction, CSNR. My entire trip lasted from 8 to 14 July 2010.

Participants:

The conference was attended by about 100 participants who were mostly professors and doctorate students from China. Participants from North America were from Pennsylvania State University, Iowa State University, and Decagon Devices (Pullman, Washington). I was the sole representative of the USDA. There was one representative from Mongolia (Institute of Geography, Mongolian Academy of Science) and Germany (Agropshere Institute, Forshungszentrum Jülich). Though largely soil physicists, the backgrounds of the participants included agronomists, ecologists, geologists, geophysicists, modelers, remote-sensing specialists, and soil scientists.

International Workshop on Hydropedology and Earth's Critical Zone: Research and Applications

Discussion:

The themes of my two presentations were "*connecting the dots*". This theme immediately connected with the experiences of the participants. Quantifying soil properties and hydrologic processes at different spatio-temporal scales is recognized as a major challenge in hydropedology and soil science. Even in highly instrumented sites, physiochemical soil properties must be inferred among widely-spaced measurement and sampling points. Soil-water interactions and landscape-soil-hydrology relationships at different spatial scales (e.g., pedon, watershed, and regional) are exceedingly complex and variable. Soil properties and hydrologic processes have been frequently monitored, characterized, and modeled at regional scales using remote-sensing techniques as well as at point or pedon scales using *in situ* instrumentation. At intermediate scales (e.g., catena, field, and catchment), however, data gaps exist that need to be bridged. Characterizing the spatial and temporal heterogeneities of the subsurface at intermediate scales remains a daunting challenge. The resolution of most remote-sensing techniques is too coarse for site-specific use and these methods generally cannot penetrate deep into the subsurface (generally limited to top 5-6 cm of soil surface). Point-sampling methods attain various depths in the subsurface and provide high resolution data; however, such data collections are time-consuming, costly, generally destructive, and frequently confined to a limited number of sampling points. Because of these limitations, hydropedologic properties and processes for the more extensive areas among sampling points must be inferred. Such inferences are often based on deductions and simplified assumptions drawn from the parameters measured at the individual sampling points. The inability of point sampling methods to adequately characterize the subsurface across various landscapes foster significant ambiguity in data interpolations and model predictions.

My presentations stressed the use of two noninvasive geophysical methods: ground-penetrating radar (GPR) and electromagnetic induction (EMI). These continuous recording and noninvasive geophysical tools offer significant potentials to hydropedologic investigations at intermediate scales because of their speed, economy, ease of use, reasonable resolution, and comprehensive coverage of the subsurface. Examples and discussions of the uses of these two geophysical tools in hydropedological investigations were provided in my talks.

Within the soil and agricultural communities of China, USDA-NRCS is recognized as a leader in the use of GPR and EMI in soils. The participants are very interested in the methodology and interpretations

used by USDA-NRCS to investigate soils. After my presentations, during breaks and at dinners, I was questioned repeatedly on the instruments, methods and interpretation that we use to study soils and soil properties. In recent years, the Chinese have significantly expanded their use of geophysical tools in soil explorations.

During the workshop, I was approached by a post-doctorate student interested in preparing a GPR soil suitability map of China similar to the "*GPR Soil Suitability Map of the Conterminous United States*" that was developed by the Soil Survey Division. He noted the importance of understanding the spatial variability of soils and soil properties that affected the performance of GPR. China has not been an active participant in international GPR conferences in the past and I was pleasantly surprised to find that the Chinese are knowledgeable of our maps and interested in replicating our procedures to produce similar maps for China.

Benefits to U.S. agriculture, NRCS, cooperating country, and Personal:
This workshop afforded me the opportunity to evaluate the state-of-the-art for rapidly advancing GPR and EMI technologies in China. I had been aware of their use of GPR in permafrost and engineering applications; and EMI in soil salinity assessments. I learned that the uses of these two geophysical tools are widespread and diversified in China. This workshop enabled me to emphasize the role played by USDA-NRCS in developing the effective use of these noninvasive geophysical tools in soil exploration.

Follow-up Plans:
This workshop provided an opportunity for me to make contact with interested users of ground-penetrating radar and electromagnetic induction in China. Several Chinese researchers expressed interest in my returning to China to provide instructions on the use of these tools and the interpretations of collected data. I have already forwarded a list of references to two researchers interested in using GPR for soil moisture determinations, and have provided recommendations on the most suitable EMI meters for soil investigations to another.

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