MEETINGS

Evapotranspiration: Challenges in Measurement and Modeling

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Evapotranspiration (ET) processes at the leaf-to-landscape scales have important controls and feedbacks for the regional and global climate systems through complex interactions among the Earth's atmospheric, hydrological, and biogeochemical cycles. Innovative methods, tools, and technologies for improved understanding and quantifying of ET are critical for adapting more effective management strategies to cope with the increasing demand for freshwater resources under global change.

A symposium focusing on challenges in measurement and modeling of ET in varying scales was convened in April 2014 in Raleigh, N.C. The meeting drew 170 participants from 16 countries and included scientists, engineers, researchers, faculty, planners, and land and water managers.

Papers presented at the symposium highlighted the greater potential of eddy covariance measurements for assessing global water and carbon dioxide (CO_2) fluxes, remote sensing–based applications from landscape to global scale, new numerical-to-artificial neural networks modeling of ET, and innovative methods of deriving crop coefficients.

Presentations also revealed new insights on ET processes under novel environmental conditions, including potential water use by short rotation woody crops, water use efficiency changes under increased CO_2 and fertilization, and the effects of ET under climate change and extreme events, with examples from recent droughts in Texas and cool spells in lake states in the United States, Inner Mongolia, and sub-Saharan African countries.

Several papers demonstrated the importance of Penman-Monteith–based reference ET estimates to better address the interactions and feedback mechanisms of climatic parameters with vegetation, particularly for sparse vegetation and croplands. For example, forest ET rate was shown to be often higher than grass reference ET. Other highlights were advances in measuring techniques from small lysimeters, sap flow to eddy covariance for high-altitude mountain environments, the effects of land use change on ET, and increased sublimation from the ground and stream flows due to diseases and infestations such as pine beetle outbreaks.

Participants recognized a large knowledge gap among plot, watershed, regional, and global scales, including the need for conducting long-term ET and related process measurements for sustainable and adaptive management of limited water resources. Presentations on modeling focused on the need for extending Budyko's framework to multiple scales, coupling ecohydrologic models with biophysical processes, and enhancing their predictive capability for extreme climates (droughts), including an artificial neural network approach in modeling complex nonlinear ecosystem ET relationships.

Scintillometry, another alternative to measure or estimate ET accurately for agricultural applications, was also a topic of discussion. Thermal remote sensing applications were shown to be an innovative way for irrigation water management and crop water use including regional- and global-scale ET modeling. High resolution images from unmanned aerial vehicles were also demonstrated as the solution for precision agriculture and irrigation scheduling, as they have the potential to provide surface temperature and ET maps on demand in the near future. However, establishing the validity of all of these new methods and tools will require a significant amount of research.

The American Society of Agricultural and Biological Engineers was the main sponsor of the symposium, with additional support from the U.S. Department of Agriculture Forest Service and Weyerhaeuser Company. The 3-day event concluded with field tours of two forest hydrological study sites on the North Carolina coastal plain. Special issues of the journals *Transactions of the ASABE* and *Agricultural and Forest Meteorology* will publish selected papers. A detailed summary is available at http://elibrary.asabe.org/conference.asp?confid=cmmllsb2014, and the symposium abstracts are available at http://www.srs.fs.usda.gov/charleston/santee/.

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