Geophysical Research Abstracts
Vol. 14, EGU2012-9946, 2012
EGU General Assembly 2012

Heat Fluxes and Evaporation Measurements by Multi-Function Heat Pulse Probe: a Laboratory Experiment

V. Sharma (1), F. Ciocca (1), J.W. Hopmans (2), T. Kamai (2), I. Lunati (3), and M.B. Parlange (1)

(1) EPF Lausanne (CH): School of Architecture, Civil and Environmental Engineering , (2) UC Davis (USA): Departement of Land,Air and Water Resources, (3) UNI Lausanne (CH): Geophysics Departement

Multi Functional Heat Pulse Probes (MFHPP) are multi-needles probes developed in the last years able to measure temperature, thermal properties such as thermal diffusivity and volumetric heat capacity, from which soil moisture is directly retrieved, and electric conductivity (through a Wenner array). They allow the simultaneous measurement of coupled heat, water and solute transport in porous media, then. The use of only one instrument to estimate different quantities in the same volume and almost at the same time significantly reduces the need to interpolate different measurement types in space and time, increasing the ability to study the interdependencies characterizing the coupled transports, especially of water and heat, and water and solute. A three steps laboratory experiment is realized at EPFL to investigate the effectiveness and reliability of the MFHPP responses in a loamy soil from Conthey, Switzerland. In the first step specific calibration curves of volumetric heat capacity and thermal conductivity as function of known volumetric water content are obtained placing the MFHPP in small samplers filled with the soil homogeneously packed at different saturation degrees. The results are compared with literature values. In the second stage the ability of the MFHPP to measure heat fluxes is tested within a homemade thermally insulated calibration box and results are matched with those by two self-calibrating Heatflux plates (from Huxseflux), placed in the same box. In the last step the MFHPP are used to estimate the cumulative subsurface evaporation inside a small column (30 centimeters height per 8 centimeters inner diameter), placed on a scale, filled with the same loamy soil (homogeneously packed and then saturated) and equipped with a vertical array of four MFHPP inserted close to the surface. The subsurface evaporation is calculated from the difference between the net sensible heat and the net heat storage in the volume scanned by the probes, and the values obtained are matched with the overall evaporation, estimated through the scale in terms of weight loss.

A numerical model able to solve the coupled heat-moisture diffusive equations is used to interpolate the obtained measures in the second and third step.