# Estimation of unsaturated hydraulic properties of peat soils from evaporation method and multi-step outflow method

# Kei Asada[1]; Serika Matsushima[2]; Hirotaka Saito[3]; Taku Nishimura[4]; Ken Kawamoto[5]; Toshiko Komatsu[5]

[1] United Graduate School of Agricultural Science, TUAT; [2] Rn,TUAT; [3] Ecoregion Sci., TUAT; [4] Agricultural and Life Sciences, Univ. of Tokyo; [5] Science and Engineering, Saitama Univ.

Knowledge of water flow and solute transport in unsaturated peat soils are needed for effective management of wetlands and surrounding arable lands. Inverse modeling has increasingly been used for estimating unsaturated soil hydraulic functions, such as soil water retention and unsaturated hydraulic conductivity functions. However, reports dealing with parameter estimation of peat soils using inverse methods are scarce. The objective of this study was to determine inversely unsaturated hydraulic properties of peat soils from data collected using evaporation and multistep outflow methods.

The Bibai bog is located in the northeast of the central Hokkaido, Japan. Soils at the site are categorized high moor peat soils, called histosols by FAO‘s classification. 100 $cm^3$ soil core samples (5.0 cm in i.d. and 5.1 cm in height) were taken at 10, 30, and 50 cm depths in June 2008. Groundwater level was about 40-50 cm below the surface. After the multistep outflow method, the same soil core samples were saturated again with 0.005 $molL^{-1}$ $CaSO_4$ solution for the evaporation method. The measured soil water retention curve was determined by the volumetric water content of soil cores and their respective tensiometer readings inserted into soil cores during both experiments. HYDRUS-1D was then used to analyze data to estimate soil unsaturated hydraulic parameters. Several scenarios were considered for both methods to improve parameter estimation.

In the multistep outflow method, there was substantially large amount of outflow volumes with a rise in air pressure from 0 cm to -10 cm pressure head without a clear air entry value. Therefore, at the high pressure head, the measured water retention curve from multistep outflow method would be in poor agreement with the estimated water retention curve from evaporation method and multistep outflow method. On the other hand, at the low pressure head, the measured water retention curves from both methods were in good agreement with the estimated water retention curves.

Relatively high residual moisture content (theta-r) values estimated from the evaporation and multistep outflow methods were found for soils collected from 10 and 30 cm depths, which were also reported for peat layers in previous study (Gnatowski et al. 2005). Values of saturated water content (theta-s) were fixed at the measured value for each sample. When theta-s was optimized in the multistep outflow procedure, the estimated water retention curve was much lower than the measured water retention curve. In the evaporation method, however, the estimated water retention curve was slightly higher than the measured water retention curve. Theta-s needs to be a fitting parameter for peat soils when the multistep outflow method is used.