Geophysical Research Abstracts,
Vol. 10, EGU2008-A-10233, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-10233
EGU General Assembly 2008

Coupled energy and mass fluxes in field soils

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Understanding the coupled transport of energy and mass in unsaturated soils is important for many hydrological applications. In particular, water content and temperature of upper soil play an important role on the water cycle by affecting runoff and water recharge, and more generally the interaction between land surface and atmosphere. The coupling between energy and moisture fluxes can be seen as a consequence of water phase transition: the mass transport is affected by vaporization and condensation as they influence the unsaturated flow parameters; on the other hand, the vapor flux affects the energy balance by transporting latent heat. A correct model has to be based on a thermodynamically complete description. In this framework, different models are reviewed and compared in order to point the implications of the underlying assumptions. Also, data obtained from a lysimeter experiment are discussed. The lysimeter experiments allow monitoring temperature, water-content, and water-retention profiles under daily heat forcing. The analysis of these data allows determining the impact of phase change on moisture and heat transport, hence the degree of coupling between the two.