



Scuola di Ingegneria, via S. Marta 3, Firenze – aula 177
Seminario – 8 ottobre 2024, ore 11:30



Non-isothermal diffusion of water vapor: Conditions where it may matter, and a surprising connection to ETRHEQ (Evaporation from Relative Humidity at Equilibrium).

Hydrologic models of evaporation are based on molecular diffusion and turbulent mixing. Diffusion occurs in the so-called laminar sublayers, which occupy approximately the first millimeter of air in contact with leaf, soil, and water surfaces. Molecular diffusion is also responsible for dissipation of humidity variability caused by turbulent mixing. These models, however, are based on isothermal (Fickian) diffusion. But by definition, when evaporation is occurring, temperature gradients are also present. In the laminar sublayer, these gradients can be on the order of a few degrees per millimeter. With such large gradients, additional terms appear in the full, non-isothermal diffusion equation. These terms (sometimes referred to as Soret effects) cause diffusion of vapor due to gradients of temperature. In fact, in a steady state condition of zero humidity flux but constant heat flux, the specific humidity is not spatially constant (as predicted by Ficks law): the humidity is higher where the temperature is higher. Ultimately, it is the relative humidity that is constant, as the relative humidity determines the thermodynamic chemical potential that drives diffusion. For isothermal conditions, the system collapses back to Ficks law. In this seminar I will show examples of the magnitude and nature of error caused by ignoring non-isothermal processes, and also show how this process might explain the predictive performance of the ETRHEQ method.

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