Contribution ID: **230** Type: **Oral Presentation**

Development and experimental validation of lattice Boltzmann method-based simulator for vapor transport in air over a moist soil layer

Tuesday, 31 May 2022 11:30 (15 minutes)

We present an efficient computational approach for simulating component transport within single-phase free flow over a soil. A numerical model based on this approach is validated using controlled experiments in a climate-controlled low-speed wind tunnel. The wind tunnel is interfaced with a soil tank to study problems of heat and mass flux across the land-atmospheric interface. The developed modeling approach is based on a combination of the lattice Boltzmann method (LBM) formulated for a weakly compressible fluid flow and the mixed-hybrid finite element method (MHFEM) for solving constituent transport. Both those methods individually, as well as when coupled, are implemented entirely on a GPU accelerator in order to utilize its computational power and avoid the hardware limitations caused by slow communication between the GPU and CPU over the PCI-E bus. We describe the mathematical details behind the computational method, focusing primarily on the coupling mechanisms. The performance of the solver is demonstrated using modern high-performance supercomputers. Flow and transport simulation results are validated and compared herein with experimentally obtained velocity and relative humidity data based on measurements made above the soil surface over which water evaporates under steady air flow conditions. Model robustness and flexibility is demonstrated by introducing rectangular bluff-bodies to the flow in several different experimental scenarios.

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Time Block Preference

Time Block B (14:00-17:00 CET)

Participation

In person

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