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Effective roughness in meso-scale modeling.

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Accurate estimation of effective roughness lengths for use in meso-scale models in heterogeneous terrain requires assessment of highly non-linear processes. These non-linear effects are often neglected in meso-scale modeling where, typically, a simple logarithmic average or a dominant vegetation type provide crude estimates of the aggregated aerodynamical roughness length in each grid cell. Although the parameterizations are computationally efficient, improvements are needed since some regional-scale sensitivity studies indicate that grid cell roughnesses strongly influence model predictions (i.e. Hasager and Jensen, 1999).

Effective roughness parameterizations can be provided through the use of microscale flow models, which simulate the he local scale effect of orography and roughness changes. Results from two linearized micro-scale models and a k- model (Sogachev and Panferov, 2006) are presented for an idealized terrain with roughness changes. Furthermore, sensitivity experiments are performed within the meso-scale model WRF (Weather Research and Forecasting) using the standard Community Noah Land Surface model. The same experiment will be performed with a new modified version with multi-physics options (Niu et al.,submitted 2009). The analysis is carried out using different roughness aggregation techniques in WRF and the influence on scalar fluxes such as temperature, humidity and CO2 is investigated. Based on the WRF sensitivity analysis and the results of micro-scale modeling, the potential improvement of using micro-scale models for parameterization of sub-grid scale variability is evaluated.