



Surface heterogeneity effects on regional-scale fluxes in stable boundary layers: a tuning-free dynamic LES approach

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Parameterization of regional-scale turbulent fluxes over heterogeneous terrain is hindered by our limited understanding of the complex, non-linear interaction between land-surface heterogeneity and atmospheric boundary layer dynamics. Under stable conditions, the effect of stratification on local turbulence length scales further complicates this interaction. In this research, large-eddy simulation (LES), with recently developed tuning-free dynamic subgrid-scale models (Stoll and Porté-Agel, 2006), is used to study the effect of heterogeneous surface temperature distributions on regional-scale turbulent fluxes. The simulation setup is based on the GABLS LES intercomparison case (Beare et al., 2006) with an expanded domain. The surface heterogeneity consists of simple one-dimensional patches with different surface temperatures. Simulations are performed with several patch sizes and temperature differences between patches. Results indicate that existing surface flux aggregation schemes fail to fully represent the average turbulent fluxes of heat and momentum. The error increases with increasing patch size and also with increasing temperature difference between patches. Motivated by these results, a new parameterization based on local similarity theory is proposed.