Examining feedback effects on remote sensing-based turbulent flux estimates

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Abstract.

Generally, remote sensing-based Land Surface Models (LSM) are driven by spatially heterogeneous surface inputs and spatially uniform inputs from the lower Atmospheric Boundary Layer (ABL). Since near-surface ABL properties are far from uniform the inclusion of their spatial variability in remote sensing-based LSMs might be expected to improve the resulting turbulent flux estimates. Therefore, for a little more than a decade now, research has been carried out to investigate whether and how incorporation of lower ABL variability in remote sensing data driven flux schemes could improve turbulent flux estimates.

In this contribution we examine the magnitude of these atmospheric property variations and their corresponding feedback effects on turbulent flux estimates. This has been done by coupling a boundary layer simulator, by means of a Large-Eddy Simulation (LES) model, to a remote sensing-based Land Surface Model (LSM), where the coupling takes place in the lowest nodes of the LES model.

We first illustrate the near-surface performance of recent discretization and sub-grid-scale parameterizations in the coupled LES-LSM framework by implementations over synthetic surfaces. We then quantify the consequences of the relevant feedback effects on the land surface flux estimates through numeric simulations. The effect of step-changes in heterogeneous surface states and conditions, that are typical for remote sensing-based turbulent flux models, on the atmospheric states and their potential feedback is shown. Analysis of these individual coupling factors revealed that the dominant feedback effect is the horizontal wind speed. Concluded is with an analysis of the combined feedback effects over natural surfaces using data from several large-scale field campaigns.

Keywords: Feedback effects, Land-atmosphere interaction, Large-eddy simulation, Sub-grid-scale model

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