CNRM, UMR 3589

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THE COUPLING OF LAND AND ATMOSPHERIC SUB-GRID PARAMETERIZATIONS (CLASP) PROJECT

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Abstract :

The role of surface heterogeneity in the sub-grid coupling of the land and atmosphere remains vastly oversimplified in Earth System Models (ESMs). While the past few decades have seen the development of increasingly sophisticated sub-grid parameterizations for both the land surface (e.g., tiling schemes) and the atmosphere (e.g., turbulence closure schemes), these approaches generally only interact via sub-grid spatial means of surface states and fluxes (e.g., evaporation). The ongoing Coupling of Land and Atmosphere Sub-grid Parameterizations (CLASP) project is addressing this persistent challenge. The primary objective of CLASP is to parameterize sub-grid heterogeneous exchanges between the land and atmosphere and to characterize its implications for surface climate, variability, and extremes. This presentation will provide an overview of the results that have emerged from the CLASP project over the past four years, ongoing efforts, as well as future directions that CLASP aims to tackle.

Parameterization development efforts within CLASP have focused on three distinct approaches: 1) more fully leveraging the simulated tile-level surface heterogeneity of states and fluxes to define the time-varying surface boundary conditions of turbulence closure schemes, 2) using the modeled sub-grid surface heterogeneity to inform the size, velocity, and intensity of sub-grid buoyant plumes, and 3) developing a two-column (over warm and cold patch) approach to parameterize sub-grid mesoscale circulations and inform cloud development. As will be discussed, the third approach has shown the most promise to reproduce Large Eddy Simulations experiments that were conducted during the CLASP project. It will also be discussed how CLASP has also brought to light the inadequacy of existing land-atmosphere metrics to quantify the representation of heterogeneity in land surface models as well to quantify the corresponding atmospheric response. Finally, a set of mesoscale Weather Research and Forecasting (WRF) experiments will be presented to illustrate the strong atmospheric response that emerges from the explicit representation of sub-100 km surface heterogeneity; thus providing further evidence for the need for CLASP-type parameterizations within Earth system models.

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