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Effects of Land Surface Heterogeneity on Simulated Boundary Layer Structure

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Land heterogeneity is expected to influence boundary layer structure including secondary circulations and related exchange fluxes, its effects cannot be incorporated explicitly in regional and climate models, due to their large spatial grid scales. While tile or mosaic approach capture the aggregation effects related to surface heterogeneity, they neglects any dynamical effects. Thus, parameterizations lead to high inherent uncertainties in modeled surface fluxes, boundary layer evolution, cloud initiation and precipitation.

This study analyzes the impact of different horizontal grid resolutions on the simulated boundary layer structure in terms of stability, height and induced secondary circulations and relate them to land surface heterogeneity. A LES-model, ICON-LES conducted within the framework of HD(CP)^2, at 156 m resolution is used. The ICON-LES is dynamically downscaled through multiple scales and grid resolutions of 20 km, 7 km, 2.8 km, 625 m and 312 m for several days over Germany for different synoptic conditions. We examined the entropy spectrum and patchiness of the land surface heterogeneity at these grid resolutions for several locations close to measurement sites and studied its influence on the surface fluxes and the evolution of the boundary layer profile. The goal is a development of an empirical relationship between the land-surface heterogeneity and the dynamics of the boundary layer.