“Comparing the atmospheric boundary layer in a high-resolution model with ground-based observations: a detailed look at boundary layer clouds. "

Predicting the response of boundary layer clouds to climate change is associated to large uncertainties, mainly due to the due to their parameterization in climate models. Climate models parameterize turbulent motions in the planetary boundary layer (PBL) by applying so-called PBL-schemes, which can be situation dependent.
In order to better understand how low-level clouds are affected by the PBL scheme at a given time, a classification of different boundary layer types is used, associated with specific parametrizations of entrainment, mixing and shallow cumulus or non-local schemes. Since the choice of one PBL scheme can dramatically affect the model output, it is essential to evaluate the parametrized PBL schemes with observations.
We exploit a new PBL classification based on wind lidar, ceilometer and tower measurements applied to observations of the JOYCE supersite in Germany in order to evaluate the PBL representation in the high-resolution (150 - 300 m) Icosahedral non-hydrostatic general circulation model (ICON).
ICON is developed by the Max Planck Institute for Meteorology (MPI-M) and the German Weather Service (DWD). A PBL classification analogous to the one used for the observations has been developed for the large eddy model output (ICON-LEM) to properly compare the different PBL regimes identified with the observations, aiming at the improvement of the PBL schemes adopted in the global circulation model.
Different cloud regimes described on the basis of the PBL classification are compared to observations with respect to different parameters, like liquid water path, mean lifting condensation level, mean vertical velocity at cloud base, cloud thickness, cloud base and cloud top heights and Rayleigh radar reflectivity. The goal is to understand if the mechanisms for cloud formation are properly described in the model and in which conditions differences and biases are observed.
Moreover, various methodologies in literature are currently used to establish the degree of coupling of marine stratoculumus clouds. Some of them are based on synergies of model and satellite data, while others rely on ground based measurements. Here, we apply such methodologies to ICON-LEM model data as well as to ground-based observations for the PBL clouds at the JOYCE supersite. The goal is to compare and evaluate the current methods on a common dataset of continental boundary layer clouds. The results will be beneficial for improving model parametrizations of boundary layer clouds and PBL schemes in global circulation models.