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Analysis of the land cover impact on boundary layer height from WRF and BLLAST data

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The effects of the land-cover (LC) type on the surface fluxes have been investigated using observational data and numerical weather prediction models in numerous studies. Most of these works stress the need for a realistic and accurate representation of the LC within the models, including appropriate soil and vegetation parameters. This is needed to obtain more realistic near-surface atmospheric processes, leading to better forecasts of atmospheric variables of common interest (2-m temperature, 10-m wind speed, relative humidity, etc.). In a previous work, we have studied these effects focusing on a fair-weather day in a heterogeneous area of southern France. To this aim, we used the Weather Research and Forecasting (WRF) model at 1 km with an improved (30-m and more realistic) representation of the LC, configured with four land surface models (LSM): Noah, Noah-MP, CLM4 and RUC.

The results showed that the influence of LC on surface fluxes were important but differed depending on the LSM, displaying some extreme flux values for specific LC categories (e.g., urban and conifer). This opened the question of how these effects impacted the development of the atmospheric boundary layer (ABL), which motivated the present work. To this aim, we analysed the ABL height (zi) simulated by WRF in each LC category using the different LSM. These values were compared to those observed with multiple instrumentation (radiosoundings, unmanned aerial vehicles, wind profilers, etc.) available during the Boundary Layer Late Afternoon and Sunset Turbulence (BLLAST) field campaign, which took place in the area of study in summer 2011.

The zi simulated values were similar in magnitude and in temporal evolution than those observed, indicating a good performance of the model for the 4 LSMs. However, some LSM displayed a higher variability in the simulated zi depending on the sensible/latent heat partitioning and on the type of LC. These results indicate that the important effects of the LC type on the surface fluxes are transferred to the top of the PBL, affecting zi even from an analysis of this variable at a model resolution of 1x1 km.

In order to disentangle whether the spatial variability of the modelled zi is close to the reality, for future works we highlight the importance of intensive and frequent zi measurements at the field over different nearby sites with contrasting LC. This will help to continue understanding how the surface forcing affects the PBL development and to what extent the processes reproduced in the model differ from those observed in the reality.