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Large eddy simulation of radiation fog: impact of microphysics on the fog life cycle

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Large eddy simulations (LESs) of a radiation fog event occurring during the ParisFog experiment at the SIRTA (Site Instrumental de Recherche par Télédétection Atmosphérique) observatory are studied with a view to analyse the impact of the microphysics on the fog life cycle.
A first LES of this case, presented in Mazoyer et al. (2017), performed with the Meso-NH model (Lac et al., 2018) at a resolution of 5 m horizontally and 1 m vertically with a 2-moment microphysical scheme, includes the drag effect of a tree barrier and the deposition of droplets on vegetation. The model showed good agreement with measurements of near-surface dynamic and thermodynamic parameters and liquid water path. The blocking effect of the trees induced elevated fog formation, as actually observed, and horizontal heterogeneities during the formation. Deposition was found to exert the most significant impact on fog prediction as it not only erodes the fog near the surface but also modifies the fog life cycle and induces vertical heterogeneities. A comparison with the 2m horizontal resolution simulation reveals small differences, meaning that grid convergence is achieved. But the simulation overestimated significantly cloud droplet concentration and mixing ratio near the ground compared to the observation as is often the case in the models.
Therefore new tests have been conducted with the updated LIMA (Liquid Ice Multiple Aerosols) 2-moment microphysical scheme (Vié et al., 2016). Additionally, considering that the diagnostic maximum supersaturation may be partly responsible for the overestimation of droplet concentration, the pseudo-prognostic supersaturation scheme proposed by Thouron et al. (2012) is tested in order to mitigate cloud condensation nuclei activation. An aerosol sensitivity study on the fog life cycle is finally conducted.