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Combined influence of atmospheric physics and soil hydrology on the simulated meteorology at the SIRTA atmospheric observatory

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This paper presents an approach to assess at the process level the coupled atmosphere/land continental surface system in numerical climate models. This approach is motivated by the identification of the land-atmosphere interactions as one of the key source of uncertainty in climate models and by the new developments in boundary layer/convection/clouds parametrizations as well as in the hydrological module of the Earth System Model (ESM) of Institut Pierre Simon Laplace (IPSL). Ten years of simulations of the coupled land surface/atmospheric modules are confronted with observations collected at the Site Instrumental de Recherche par Télédection Atmosphérique (SIRTA), located near Paris (France). For the sake of simplicity, the grid of the model is stretched and refined in the vicinity of the SIRTA. For the purpose of evaluation of physical parametrizations, the large scale component of the modeled circulation is adjusted toward ERA-Interim reanalysis outside of the zoomed area. The adopted methodology allows detecting situations where the parametrizations do or do not perform satisfactory well and that affect climate simulations at the regional continental scale. The performances of the packages involved in the production of climate change simulations for the Coupled Model Inter-comparison Project phase 5 (CMIP-5) exercise, are evaluated in this framework. Sensible/latent heat partition at the surface, low level cloudiness and its radiative impact at the surface, parametrization of the turbulent transport in the surface layer and complex interplay among these process are pointed out to explain biais detected in the near surface state variables simulated by the ESM. The potential of improvement of the new set of parametrizations is illustrated.