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Significance of subgrid-scale parametrizations for cloud resolving modelling

F. Guichard (1), F. Couvreux (1), J.-P. Lafore (1), J.-L. Redelsperger (1) and M. Tomasini

(1) CNRM-GAME (CNRS and Météo-France) (francoise.guichard@meteo.fr)

Previous studies have demonstrated the ability of cloud resolving modelling (CRM) to realistically simulate many fundamental features of observed deep precipitating convective phenomena with a horizontal grid-scale on the order of one to a few kilometres.

The representation of processes occurring on smaller-than-resolved scale such as part of boundary layer circulations or shallow cumulus convection nevertheless relies on subgrid-scale parametrizations in CRMs. Therefore, it is useful to assess to what extend the results obtained with CRMs may be affected by these parametrizations, i.e. assessing CRM robustness.

In this talk, we will focus on the sensitivity of CRM simulations to subgrid-scale parametrizations, in particular to the turbulence scheme (notably its mixing length-scale formulation), and subgrid microphysics. For this purpose, we will rely mostly on simulations of moist precipitating convection developing over land during daytime.

We will show how these parametrizations may affect the timing of convective initiation as well as some aspects of the mature phase of moist convection.

Then, we will relate these sensitivities to specific features of the simulated atmosphere, for instance to the convective characteristic of the lower atmospheric layer for turbulence sensitivities, and to the formulation of the parametrization itself.

Finally, we will (1) summarize the improvements resulting from some specific and motivated choices in the parametrizations, and (2) discuss more generally what is expected from future parametrization developments.