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Simulations of deep convection as a testbed for two fine-scale models

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Three-dimensional numerical simulations of deep moist convection are used to evaluate the ability of two mesoscale models, AROME and Meso-NH, at kilometric and hectometric scales.

AROME-France (Seity et al. 2011) is the limited-area nonhydrostatic model at Meteo-France dedicated for short-range and fine-scale numerical weather prediction. It is a spectral model using a semi-implicit (SI) temporal scheme and a semi-Lagrangian (SL) advection scheme with a physical package including microphysical, shallow convection, surface and 1D turbulence schemes. The current operational version has a 1.3-km horizontal resolution and 90 vertical levels. Meso-NH (Lafore et al. 1998) is a grid-point Eulerian model based on anelastic equations. This research model can simulate atmospheric motions ranging from the synoptic scale down to LES. At kilometric resolution, the physics package is the same for both models. At higher resolution, Meso-NH can use a 3D turbulence.

Real and idealized cases of deep convection are used to compare these two models based on different dynamical cores. Indeed, the divergence modes are important in deep convective systems with a strong interaction between the dynamical core and the physical parameterizations.

Sensitivity tests to the explicit diffusion and physical dissipation (shallow convection scheme, 1D or 3D turbulence scheme), as well as to time step and horizontal resolution are conducted to illustrate some damping mechanisms. The characteristics of convective systems are analyzed and the experiments are assessed using different diagnostics (kinetic energy spectra, precipitation patterns, cell size . . .)