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Evaluation of the AROME model for forecasting convective events: impact of high resolution and modified semi-Lagrangian scheme

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AROME-France is the limited-area operational forecast model of Météo-France with a 2.5-km horizontal resolution and 60 vertical levels dedicated for short-range weather forecasting (Seity et al. 2010). 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.

First, we have tested a modified SL scheme taking into account the variation in volume associated to each gridpoint due to wind field by modifying the interpolation weights of the SL scheme. This consists to weight the values of prognostic variables in function of expansion/contraction of atmosphere parcels associated to each gridpoint. Indeed, the lack of conservation in the SL scheme is suspected to generate too intense outflows under convective cells with unrealistic structures when using a strong diffusion. This modified scheme is tested for cases of deep convection for which convergence and divergence effects are important with a strong interaction between the dynamical core and the physical parameterizations. Preliminary tests show a decrease of precipitation amount and intensity of the outflows.

In the near future, the resolution of AROME-France will be increased to 1.3-km horizontal grid spacing and 90 vertical levels. Tests are currently carried out to assess the benefit of this finer resolution for forecasting thunderstorms in comparison with the current operational version. We have selected 48 days with moderate or strong convective activity over France. The comparison is based on subjective analysis but also on objective diagnostics (classic and fuzzy scores, cells statistics, spectra . . .) that show improvement in precipitation forecasts with smaller convective cells and reduced precipitation amounts more consistent with radar data.

Besides, sensitivity to diffusive processes (implicit diffusion from SISL scheme, explicit diffusion, physical mixing) and time step duration are also examined for convective events.