Testing COMAD correction of interpolation weights used in SL advection scheme with ALARO physics in high resolution experiments.

Petra Smolíková
March 6, 2017
file : comad.tex

The COMAD (COntinuous MApping about Departure points) correction is a modification of the interpolation weights in the SL advection scheme which introduces the concept of cell-averaging into the traditional pointwise SL scheme. This idea has been developped and implemented in the ALADIN/IFS model code by Sylvie Malardel from ECMWF. When COMAD modification is applied on the standard interpolation weights the deformation of the air parcels along each direction of interpolation is taken into account in order to improve the continuity and conservativity of the re-mapping between the model grid points and the origin points of the SL trajectory.

The method has been validated in [1] with the small planet configuration of IFS at ECMWF and with the limited area version using AROME physics. The aim of this note is to validate the same method with the limited area model using ALARO physics in high resolution experiments. The COMAD correction only concerns interpolation weights used in the SL advection scheme and as such it is purely dynamic concept, but the interactions with other model parts as physics and horizontal diffusion are extremely significant for its performance and hence we expect that the behaviour with ALARO physics may considerably differ from the one obtained with IFS in global version or with AROME physics for LAM. Moreover, the biggest benefit of the COMAD correction has been observed in the reduction of the overestimated precipitation and better representation of the wind field at the edges of the cold outflows generated by the precipitation evaporation in the vicinity of convective clouds which indicates the importance of the used representation of convective processes and of its interactions with dynamics for the evaluation of the COMAD method.

Validation with a real case was performed with 1.25km horizontal resolution and 87 vertical levels of the Czech operational configuration (2016), for a domain covering Alps and small surrounding. The integration with $\Delta t = 30s$ from 30 June 2012 00UTC for 24 hours has been performed. The COMAD correction was used for all horizontal interpolations (i.e. model variables as temperature, horizontal wind components, surface pressure and both non-hydrostatic variables, pressure departure and vertical velocity based variable; then prognostic water species as relative humidity, ice, liquid water, snow and rain fractions and total kinetic energy and total turbulent energy).

Since SLHD (semi-Lagrangian horizontal diffusion) is a different concept realized through a similar approach via corrections of the interpolation weights in the SL advection scheme, it was decided that the combination of these two methods whould be too combersome to be understood and hence it was avoided. It follows that SLHD may not be used when testing COMAD correction. Thus our horizontal diffusion setting is purely spectral and follows the Mětěo France operational one (since March 2015) with damping coefficients equal to 20. for all spectral prognostic variables (vorticity, divergence, temperature, relative humidity, plus the non-hydrostatic pressure departure and vertical divergence).

The representation of convection is in the centre of our interest and it is as well one of the big gaps between the AROME physics and the ALARO one. Unlike the AROME physics which does not have any explicit parametrization of the deep convection, the ALARO physics is based on the concept of 3MT (Modular Multi-scale Microphysics and Transport scheme) including a multiscale parametrizaion of deep convection aiming on the grey zone horizontal resolutions (1-7km). Hence the first question was, whether in the current experiment with high horizontal resolution, the convection is already fully resolved, or it is still partially parametrized. Since ALARO reflects a self-adaptive approach, we do not control the intensity of convection parametrization applied, but we may diagnose it. Hence, two initial experiments were prepared with the same namelists reflecting the ALARO-1 parameters as they are used in the Czech operational run, one with 3MT applied and one with the so called STRAPRO parametrization restricted to stratiform precipitation avoiding any deep convection parametrization. See Fig. 1 and 2.

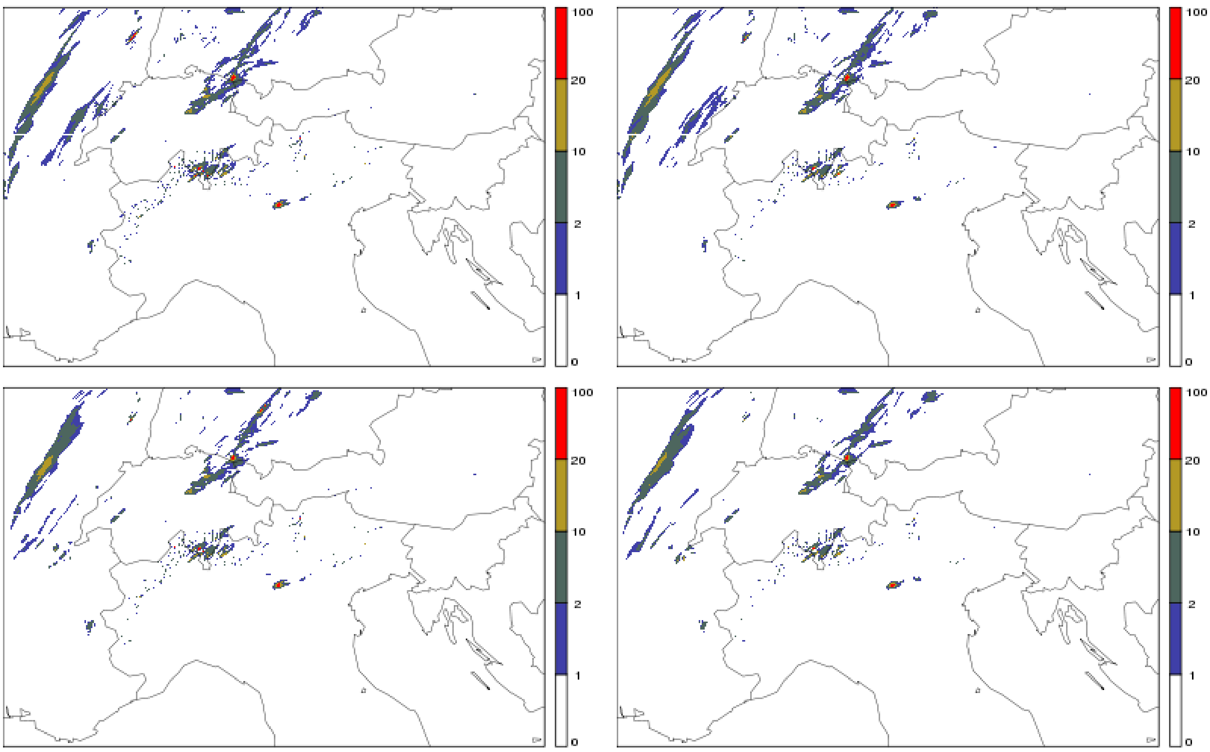

Figure 1: *Accumulated precipitation between 00UTC and 18UTC from a forecast starting from 30 June 2012 00UTC. Top: 3MT, bottom: STRAPRO. Left: without COMAD, right: with COMAD.*

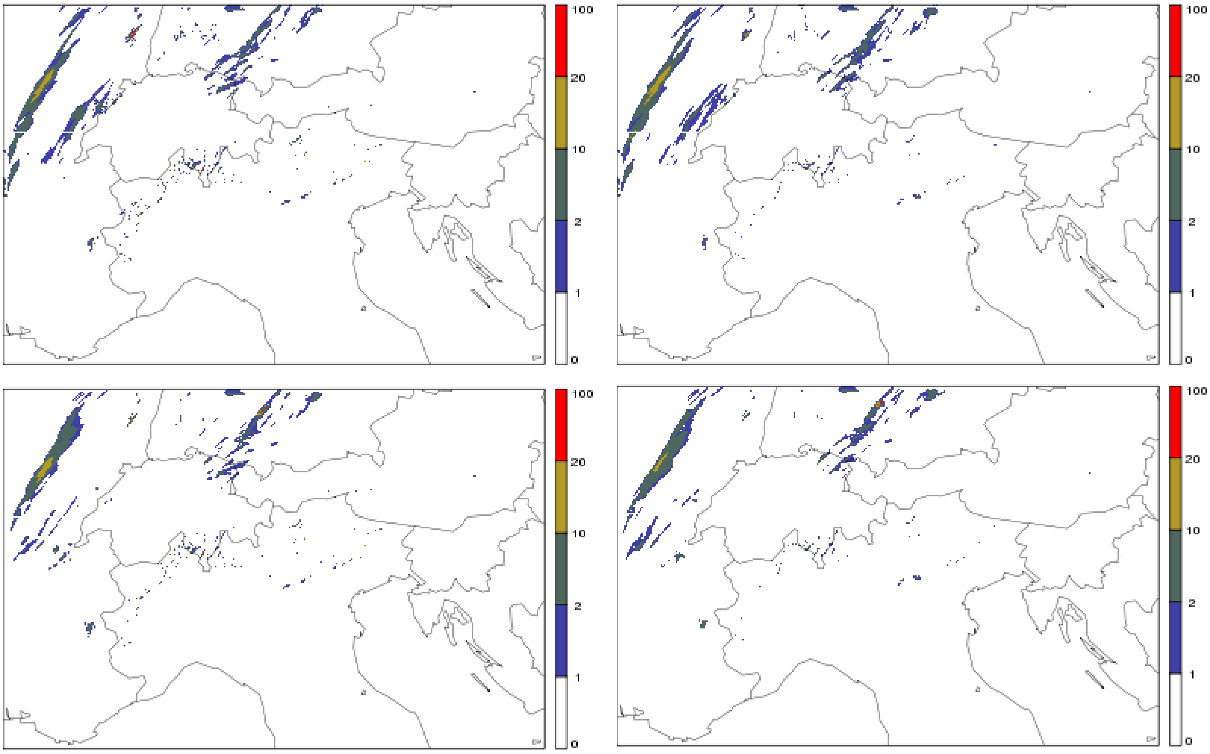

Figure 2: *Same as previous picture, but without first two hours, i.e. accumulated precipitation between 02UTC and 18UTC. Top: 3MT, bottom: STRAPRO. Left: without COMAD, right: with COMAD.*

References

[1] Malardel S., Ricard D. 2015: An alternative cell-averaged departure point reconstruction for pointwise semi-Lagrangian transport schemes, Q. J. R. Meteorol. Soc. 141, 2114-2126.