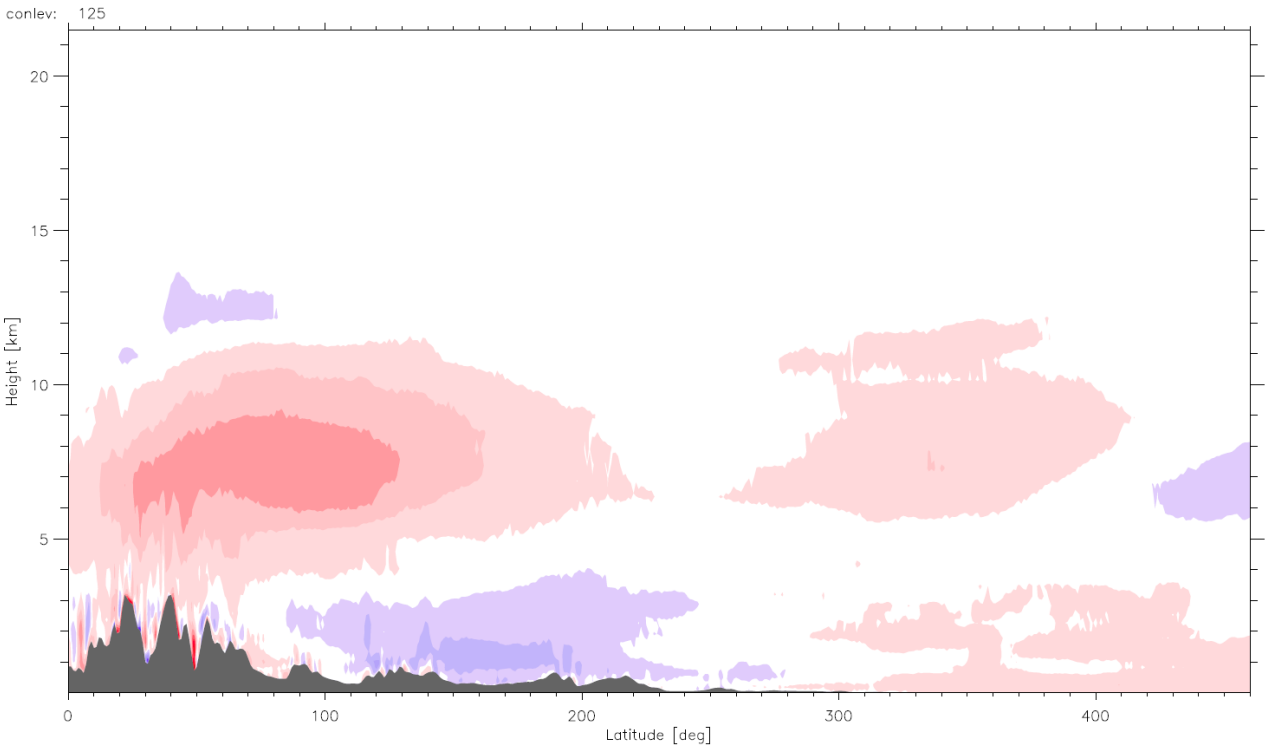
Project: **722**
Project title: **High Order Schemes for the COSMO model**
Project leader: **Andreas Will**
Report period: **01.01.2018 - 31.12.2018**

In 2018 the non-dissipative higher order schemes (S4p4) were implemented in COSMO model version, 'cosmo_5.5'. The series of 15 year long simulations comparing the reference scheme (C3p2d0.25) and S4p4 over Europe at horizontal resolutions 0.44, 0.165, 0.11 and 0.0625 degrees and over Germany at 0.045 and 0.025 resolution have been analysed for all 3D fields and a series of 2D fields. The results consistently show a strong enhancement of vertical circulation if the deep convection parameterization is switched off.

An interesting result is found in the Rhone valley. At 2.8km resolution an increase of winter zonal velocity in the troposphere is found of up to 1m/s over the Alpine region. An increase of mean winter velocity of up to 2 m/s is found in Sitten in Rhone valley (grid points (nx=125, ny=50). This valley wind is known to be significantly underestimated by COSMO, even at 1km resolution (see Figure 1). This result showed the high potential of higher order non-dissipative scheme for operational numerical weather prediction. The HOS dynamics in cosmo_5.0_clm9 was found to improve significantly the regional climate at convection permitting scales in terms of 2m temperature and precipitation. It will be used in the convection permitting pilot studies for the next IPCC report in the CLM-Community.
The cosmo_5.5 model version will be used for pre-operational weather forecast at DWD. Furthermore, it is participating in the optimum calibration project in COSMO in order to find optimum tuning parameters for turbulence and shallow convection parameterization. Hereto first simulations at 1km resolution are ongoing in order to explore the need of shallow convection parameterization and/or 1D TKE parameterization if the Smagorinsky 3D turbulence parameterization is used.



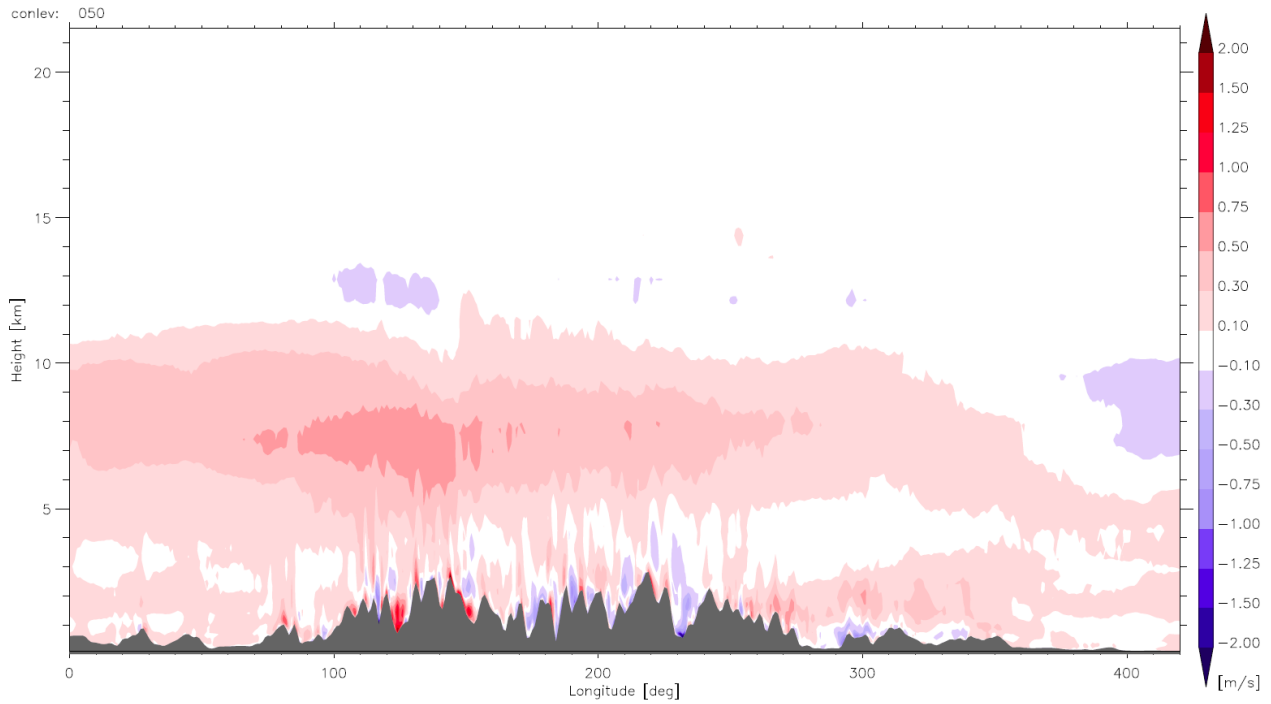


Figure 1: Mean December zonal wind 2000-2014 difference S4p4d0.00-C3p2d0.00 in convection permitting simulation at dlam=0.25°: Vertical-latitudinal at ny=50 (top) and Vertical-longitudinal at nx=125 (bottom) cross sections. The common intersection point is close to Sitten in the Rhone valley.

Unfortunately, the series of simulation planned of 2018 could not be conducted for the following reasons:

1. The cosmo_5.5 model version was released in autumn 2018
2. Threre have been technical problems with the compiled model version at DKRZ originating in several updates and intel compiler problems if using a high number of horizontal gridpoints.
3. The time for postprocessing of model results was underestimated. This lead to longer times for result analysis

Thus, the simulation planned for 2018 are now planned for 2019.