Analysis of representation of vertical velocities in the models participating in DYAMOND I and II

Within ESIWACE (Excellence in Simulation of Weather and Climate in Europe) project DYAMOND (DYnamics of the Atmospheric general circulation On Non-hydrostatic Domains, https://www.esiwace.eu/services/dyamond, Stevens et al., 2019[1]) a total of 11 global atmospheric models were applied in extremely high horizontal grid resolution of up to 2.5 km for a period of 40 days. On operational weather forecast grid resolutions in global weather forecast applications, important weather elements such as convection of thunderstorms on scales in the order of a few kilometers cannot be resolved and therefore need to parameterized. Due to the high resolution applied in the DYAMOND project, there is no need for such parameterizations anymore and such weather elements can be explicitly and likely more realistically represented. These model applications therefore show the potential of future operational weather forecast. However, key features of the resulting, less parameterized modelled atmosphere need to be analysed and evaluated. The DYAMOND project therefore aims at the analysis of the model exercises from many different viewpoints. To investigate the effect of grid resolution and whether or not convection parameterizations are considered, for many models simulations on different horizontal resolutions and with and without convection parameterization were conducted.

The goal of the proposed project is to analyse the horizontal and vertical wind fields of these many different model realizations of the Earth's atmosphere and compare the results to available observations. As the models were not restricted, a comparison to observed time series of physical quantities cannot be conducted. Therefore, the analysis focuses on statistical quantities such as probability density functions and frequencies of occurrence. Due to well worldwide distributed observations from meteorological operational networks, doppler lidars, and wind profilers, similar statistics based on observations are generally available. For this purpose, the 3D time varying fields of the two horizontal wind components and the vertical wind component from all models need to be extracted and further processed.

Furthermore, the implications of the high resolved models on the global emission of mineral dust shall be investigated using the emission model of the chemistry transport model COSMO-MUSCAT. The emission of dust in this framework depends on the horizontal wind speed close to the ground as well as the soil humidity. The latter can be approximated utilizing the precipitation intensity. For this investigation, in addition to the fields mentioned above the 2D precipitation fields need to be extracted and converted into regular latitude-longitude grid.

Overall, the planed investigations will lead to a better understanding of the capabilities of new generation global weather models to better represent real atmospheric air flow and hence important small-scale features such as thunderstorms and hurricanes.

[1] Stevens, B., Satoh, M., Auger, L. *et al.* DYAMOND: the DYnamics of the Atmospheric general circulation Modeled On Non-hydrostatic Domains. *Prog Earth Planet Sci* **6,** 61 (2019). https://doi.org/10.1186/s40645-019-0304-z