Project: **1178**

Project title: **Analysis of representation of wind fields in the models participating in DYAMOND summer, DYAMOND winter and nextGEMS**

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Report period: **2023-05-01 to 2024-04-30**

The project was outlined for two main tasks: i) statistical analysis of the wind fields simulated by the models participating in DYAMOND summer, DYAMOND winter as well as nextGEMS (https://easy.gems.dkrz.de) and ii) investigating the effects on modelled global mineral dust and sea spray emissions. In the reporting period, in particular analysis for task i) was conducted for, however due to lack of personnel (mainly student helpers) not in the envisioned amount. After analysis of the first application of horizontal wind fields to the dust emission model, the previously reported simulations had to be rejected. Due to lack of personnel, no new simulations were conducted. Simulations with the global atmospheric model ECHAM (done under resources of a different project) were further post-processed and these data saved for use in this project. During the project duration, most of the planned storage resources were used temporarily. Computational resources were not used and less will be applied for in the upcoming allocation period. For the upcoming period, this project will given higher priority in finding student helpers. The already analyzed data that is saved under the projects resources is still of use and it is aimed to further analyze it. Therefore, similar storage resources will be applied for. The content of the request for the upcoming period will be largely unchanged.

Results of statistical analysis of DYAMOND model's wind fields (covering the whole project period beyond the last year)

For the analysis, the vertical wind fields were translated into histograms showing frequencies of occurrence with 0.1 m s-1 resolution for all models and available horizontal resolutions. Apart from the global field (3D + time), also subdomains (lowest 500 m vs full troposphere, Central Europe) were analyzed similarly. In addition, such histograms were created for the high-resolution regional simulations performed with the ICON-LEM model over Germany during the HD(CP)2 project, which are also hosted at DKRZ. The different model data were compared to observations of vertical velocity derived from doppler lidars and windprofilers. The observational datasets comprise several years and is representative for Central German Lowlands (observations situated at Leipzig and Lindenberg, Germany). From the observational datasets comparable histograms were created.

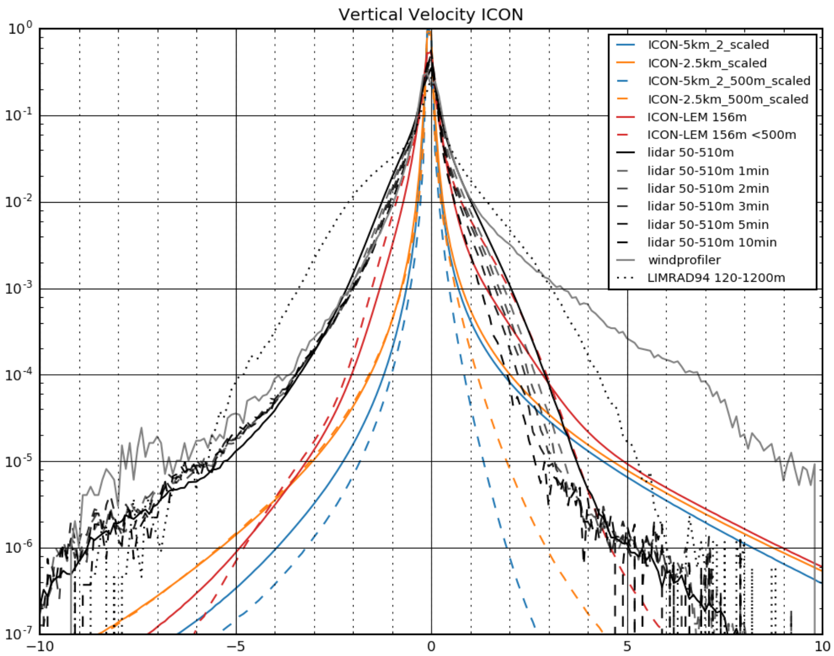

Figure: PDF of vertical velocity (x-axis in m s-1) of different resolutions of the global ICON runs from DYAMOND and regional ICON LEM runs from HD(CP)2, and comparison against lidar and windprofiler observations in Leipzig.

The comparison revealed a large spread between the different high-resolution models in terms of the frequency of occurrence of strong vertical wind speeds (+/- 5 m s-1, factor of 2-3 for updrafts and factor 10-100 for downdrafts). As expected also the model resolution has a large impact on the occurrence rate of vertical velocities due to the more smoothed wind fields. In comparison to the observed vertical velocity frequencies at the two locations in Germany, it could be seen that none of the global high resolution models reaches similar high frequencies in the observable range with sufficient statistics between +/- 0.5 - 7 m s-1 (and opposite overestimating low vertical velocity frequencies). Naturally, the available horizontal resolutions of 2.5 km and more miss the observed small scale structures. Observation and model can be brought closer together, if the observations are averaged to time intervals of a few minutes. Furthermore, the vertical velocities frequencies derived from the 156 m ICON-LEM simulations show a good agreement with the observed frequencies. However, the interpretation needs some caution since the selection of simulated cases with ICON-LEM during HD(CP)2 is not necessarily representative to the observation period of several years. However, the occurrence of high vertical velocities is mostly driven by convective situations, which was a key target for the HD(CP)2 project.

A publication on this analysis is still in preparation, but on hold until nextGEMS and DYAMOND winter simulations have been analyzed accordingly. The analysis was refined in terms of vertical extent of the conducted histograms in order to match observed and modeled vertical velocities better.

In addition to vertical velocities, horizontal wind fields of some of the DYAMOND summer simulations were extracted and histograms were produced. The extracted fields were applied to a desert dust emission algorithm typically used in atmospheric chemistry transport models. The results were not further analyzed, yet.

Further analysis in the next allocation period aims at taking into account as well the DYAMOND winter and nextGEMS runs.