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Analysis and evaluation of ice clouds in high-resolution simulations (Karol Ćorko b309188, Ulrike Burkhardt b309022)

Within the BMBF Monsoon project we have investigated inter-model variability in the tropical ice water path simulated by the high-resolution global simulations performed in the DYAMOND and MONSOON project and compared them with observations, ERA5 reanalysis data as well as two versions of the NWP ICON model. In order to evaluate the high-resolution simulations with observational data and ERA5 we analyzed the data on lower resolution. Analyzing the data on high spatial resolution enables analysis on the storm scale, where we can distinguish convective updrafts and downdrafts, both connected to large TIWP (Figure 1). Just like in our earlier analysis at lower resolution, we found significant inter-model variability in simulated TIWP. Those differences are not simply caused by differences in the detrainment levels, the total water path (liquid + ice) also varies a lot.

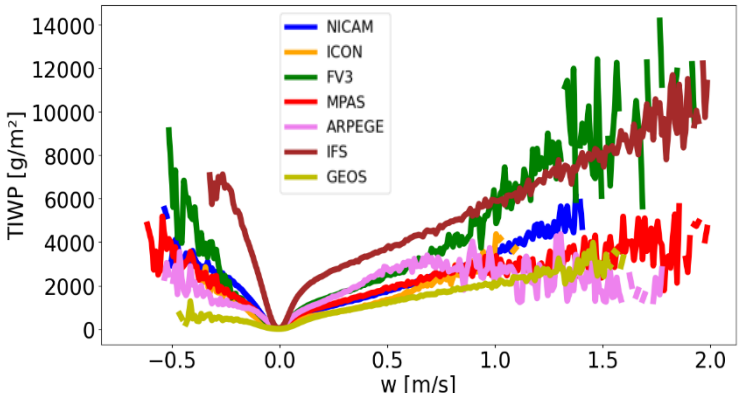

Figure 1: TIWP for different daily mean vertical velocity bins in high-resolution DYAMOND models on daily time-scale and 0.1° grid (cca 10 km)

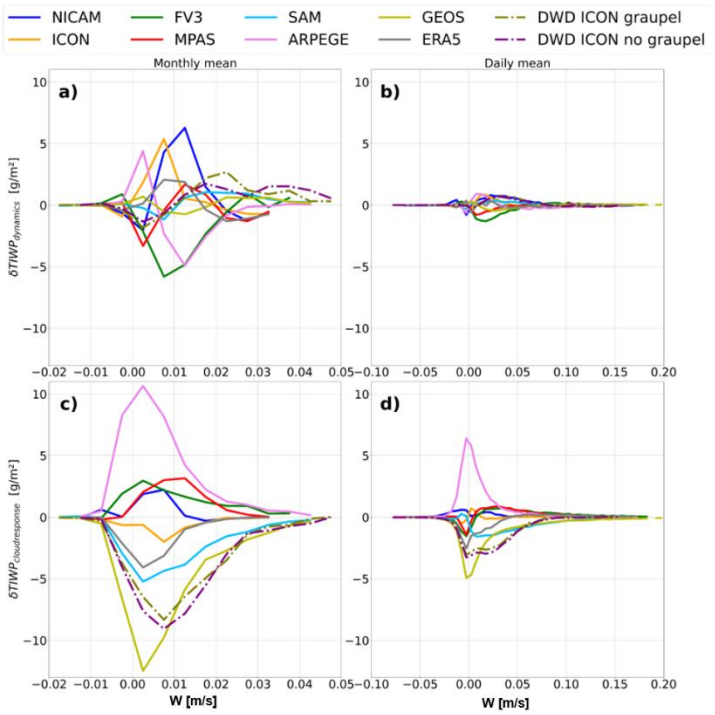

Figure 1: Reasons for differences of TIWP simulated by the DYAMOND models and (NWP) DWD ICON and in ERA5 caused by differences in a,b) the dynamics, delta $TIWP_{dynamics}$, c,d) cloud response, delta $TIWP_{cloud response}$ and e,f) covariation of the differences in vertical velocity and the associated TIWP response $TIWP_{w,covar}$ on monthly (left) and daily (right) time-scale

We disentangled dynamical reasons for the above inter-model variability from reasons connected with the cloud response to convective forcing in monthly and daily mean data. As expected, we find that differences in the models' cloud response are mainly responsible for the inter-model variability (Figure 2, Ćorko et al.).

References

Ćorko et al.: Inter-model variability in the tropical total ice water path simulated by the convection permitting DYAMOND models, JGR-Atmospheres, under the review