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Studies of Convection-Permitting Ensemble Forecasting for ICON-D2 with a 1km Nest over the Alps

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Within the context of the "Global-to-Regional ICON digital twin"(GLORI) project, a convection-permitting ensemble forecasting is established in order to study the predictability of high-impact weather events with high-resolution modeling (up to 500 m) and the influence of the land-surface—atmosphere coupling mechanisms.
At the DWD, ICON-D2-EPS is the limited-area high-resolution component of the ICON modeling system, running as an ensemble of 20 members at 2 km horizontal resolution over Germany and surrounding areas. The perturbed initial conditions are provided by the km-scale ensemble data assimilation system KENDA, run at the same resolution, assimilating a wide range of observations, including radar-derived radar volumes. Boundary conditions are provided by ICON-EPS, the global ensemble with a refinement at 13 km over Europe and is refreshed every 3 hours.
In this work, we employ a nested domain with horizontal resolution of 1-km in the southern region of the ICON-D2, encompassing the Alps mountains. We run a 24-hour forecast simulation starting at 00UTC on the 21st of June 2022, with 20 ensemble members. The choice of the date is crucial as it corresponds to a day when the DWD recorded instances of heavy rain and hail in southern Germany.
In our study, we perform all experiments using a two-moment microphysics scheme. Additionally, we incorporate the standard operational model perturbations and subsequently analyze the influence of various convection schemes on the predictability of processes that lead to convection development. Specifically, we examine the behavior of the convection scheme in two configurations: shallow convection only and deep convection parameterization in the so-called gray-zone-tuning version. By selectively enabling and disabling these schemes, our goal is to evaluate their individual contributions to predictability.
Following this, we implement a tailored variant of the stochastically perturbed parameterization scheme (SPP) in ICON in order to delve into the influence of some uncertain parameters within either microphysics or turbulent parameterization, further advancing our understanding of its effects on the model performance.

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Prediction Scales and Model Development: Hectometer scale modeling for precipitation

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