EGU21-11431
https://doi.org/10.5194/egusphere-egu21-11431
EGU General Assembly 2021
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Options and extensions for the stochastic shallow convection scheme in ICON

Maike Ahlgrimm, Daniel Klocke, Alberto de Lozar, Ekaterina Machulskaya, Mirjana Sakradzija, and Axel Seifert
Deutscher Wetterdienst, Offenbach, Germany

The Icosahedral Model (ICON) of the German Weather Service (Deutscher Wetterdienst, DWD) is used for numerical weather prediction at global and regional scales. In the limited area mode, resolution is typically on the order of a few kilometers horizontal grid spacing. Deep convective transport is partially resolved at these scales, but shallow convection remains poorly represented without a parameterization.

A stochastic shallow convection scheme was developed in collaboration with the Max Planck Institute for Meteorology, and is now being implemented in ICON with a view towards operational use. The scheme is scale-adaptive and renders resolution-dependent tuning of the convection parameterization unnecessary. Mass flux limiters essential for the stable operation of the unaltered convection scheme can be removed when the stochastic perturbations are introduced.

Alongside the original, explicit stochastic scheme an approximation using stochastic differential equations (SDE) has been developed. The advantage of the SDE version is a lower computational and memory cost, and the ability to save and restart the model's stochastic cloud state easily.

Equivalence of the two versions can be demonstrated by running one version interactively, the other passively ("piggy-backing"). While the SDE approximation is computationally more efficient, the explicit version of the scheme can be easily extended to keep track of additional properties of the shallow cloud ensemble. For example, the convective updraft core fraction can be calculated for use in the diagnostic subgrid cloud scheme. Or knowledge of individual clouds' depth can be used to derive a more realistic lateral detrainment profile than is currently in use.

We demonstrate the performance of the scheme and illustrate options and applications in single column mode, case studies and month-long hindcasts.