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- ensemble techniques
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Application of an adaptive radiative transfer scheme in a mesoscale numerical weather prediction model

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Since the computational burden of radiative transfer parameterization is considerable, operational atmospheric models use various sampling, coarsening and interpolation techniques to reduce this load, which, however, introduce new errors. An adaptive radiative transfer scheme takes advantage of the spatial and temporal correlations in the optical characteristics of the atmosphere to make the parameterization computationally more efficient. The adaptive scheme employed in this study generalises the accurate radiation computations made in a fraction of the spatial and temporal space to the rest of the field.

In this study a previously developed scheme was extended to atmospheric heating rates and implemented in the numerical weather prediction model COSMO. Case studies with different synoptic conditions were carried out with the operational COSMO-DE setup for Germany on a 2.8 km horizontal grid size and COSMO-EU setup for Europe on a 7 km grid. The performance of the adaptive scheme is compared with the performance of the currently operational COSMO-DE radiation configuration, where the radiation computations are performed quarter-hourly on 2x2 averaged atmospheric columns and the COSMO-EU configuration, which computes radiation ones every hour for all columns. The reference for both schemes is frequent radiation computations for the full grid.

We show that the adaptive scheme is able to reduce the sampling errors in the radiation surface fluxes considerably and to conserve the spatial variability in contrast to the operational schemes. Deviations in the three-dimensional heating rates are reduced for larger averaging scales. Physical relationships, such as those between the radiative quantities and cloud water or rain rates, are better captured. The improvements are especially visible during the afternoon on convective days with much small scale variability. It is shown that these improvements also lead to improvements with respect to the dynamical development of the model simulation, which has a smaller divergence from the reference model run.

The manuscript on which this abstract is based can be found on:
http://www2.meteo.uni-bonn.de/mitarbeiter/venema/articles/