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An improved adaptive radiative transfer scheme

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Since the computational burden of radiative transfer parameterisations is considerable, operational atmospheric models use various sampling, coarsening and interpolation techniques to reduce this load, which, however, introduce errors.

The general idea behind an adaptive transfer scheme is to combine an accurate with a fast parameterisation. The accurate parameterisation used in this study is the standard delta-two-stream radiative transfer scheme of the numerical weather prediction model COSMO. The fast parameterisations are basically linear models. A fast, simple parameterisation may be biased compared to an accurate one. This difference can be determined by an occasional computation with the accurate scheme. Due to the spatial and temporal correlations in the optical characteristics of the atmosphere, especially correlations in the cloud fields, these differences are also spatially and temporally correlated and can thus be corrected well.

In previous studies a simple spatial adaptive scheme was implemented in the numerical weather prediction model COSMO and compared to the operational configuration for Germany, COSMO-DE, where the radiation computations are performed quarter-hourly on 2x2 averaged atmospheric columns. The results showed that the radiation fields are modelled more accurately and that physical relationships are reproduced more closely. It was also shown that these improvements lead to improvements with respect to the dynamical development of the model simulation, which has a smaller divergence from the reference model run. In all cases frequent radiation computations for the full grid are used as reference.

Currently we are working on an improved adaptive scheme, which is based on the original spatial adaptive scheme, taking both the surface heat fluxes as well as the atmospheric heating rates into account. The main improvement is that the new scheme additionally uses a simple parameterisation scheme to correct the end results for remaining differences in the radiative properties of the atmosphere and surface. With this step, the new adaptive scheme is able to make another clear accuracy gain over the operational scheme.

For more information please go to:
http://www2.meteo.uni-bonn.de/venema/themes/adaptive_parameterisations/