An Attempt to Suppress Spurious Convective Rain ('Convective Drizzle')

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1 Description

There is evidence from objective verification (Damrath, 2002) that LM tends to overpredict the number of events with small precipitation rates both in summer and in winter. Although the effect seems to be larger in winter, this investigation deals with convective precipitation only. (In fact, also for winter situations there might be a considerable effect of convection on this model problem, as rather shallow convection often occurs in winter.) On checking the code of the convection subroutines two details appeared to be conspicuous for producing low convective precipitation rates:

1) The minimum value prescribed for the cloud base massflux $cmfcmin = 10^{-10} kg/(m^2s)$ is only a parameter for numerical security of the code. There is no physical reasoning behind this value.

2) A minimum cloud depth of 100 hPa is prescribed for the onset of precipitation generation. If this value is exceeded, precipitation generation starts at a height of 100 hPa above cloud base.

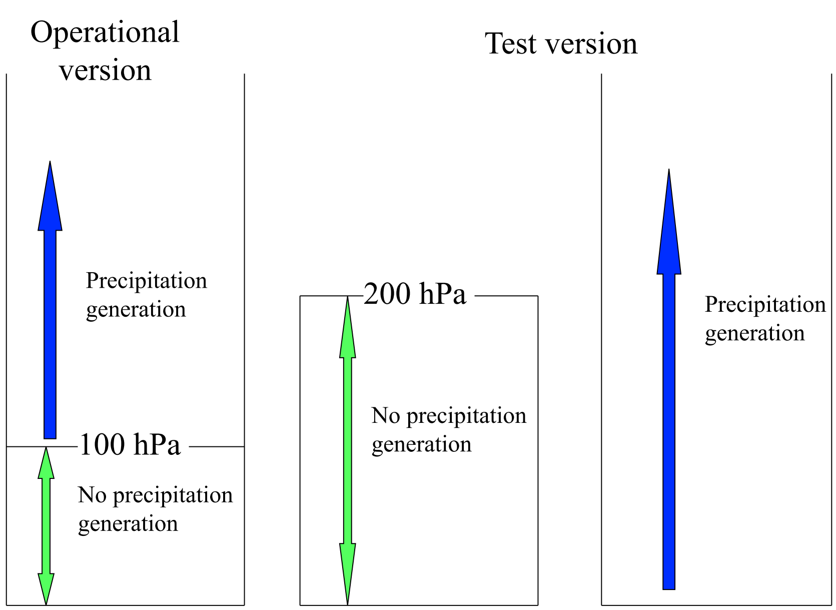

Figure 1: Sketch of the precipitation generation in convective clouds. See text for details.

These two assumptions are changed in the following manner:

1) For the cloud base massflux a minimum value $cmfcmin = 10^{-3} kg/(m^2 s)$ is prescribed. If this value is not met by the closure condition, convection is suppressed.

2) Precipitation is only produced by clouds with a depth of more than 200 hPa. If the cloud depth exceeds 200 hPa, precipitation is produced over the total depth of the cloud (see Figure 1).

The general impact of these changes was first investigated in some test cases. A rather drastic example of the impact of the modifications is shown in Figures 2 and 3. They provide results from the parallel experiment in comparison to the operational version. In the operational version small amounts of convective precipitation are found in large areas especially in the western part of Figure 2. In the test version, most of the small amounts are suppressed. In this case even some areas with more than 1 mm convective precipitation in 12 hours do not show up in the modified experiment. As Figure 3 reveals, there seems to be no significant shift from convective to stratiform precipitation. The areas free of convective precipitation in the experiment are mostly also free of total precipitation.

Additionally, a parallel experiment has been startet with these modifications. It will cover the two months July and August 2002. Objective verification will be used in addition to the inspection of single cases to ensure the positive impact of the modifications.

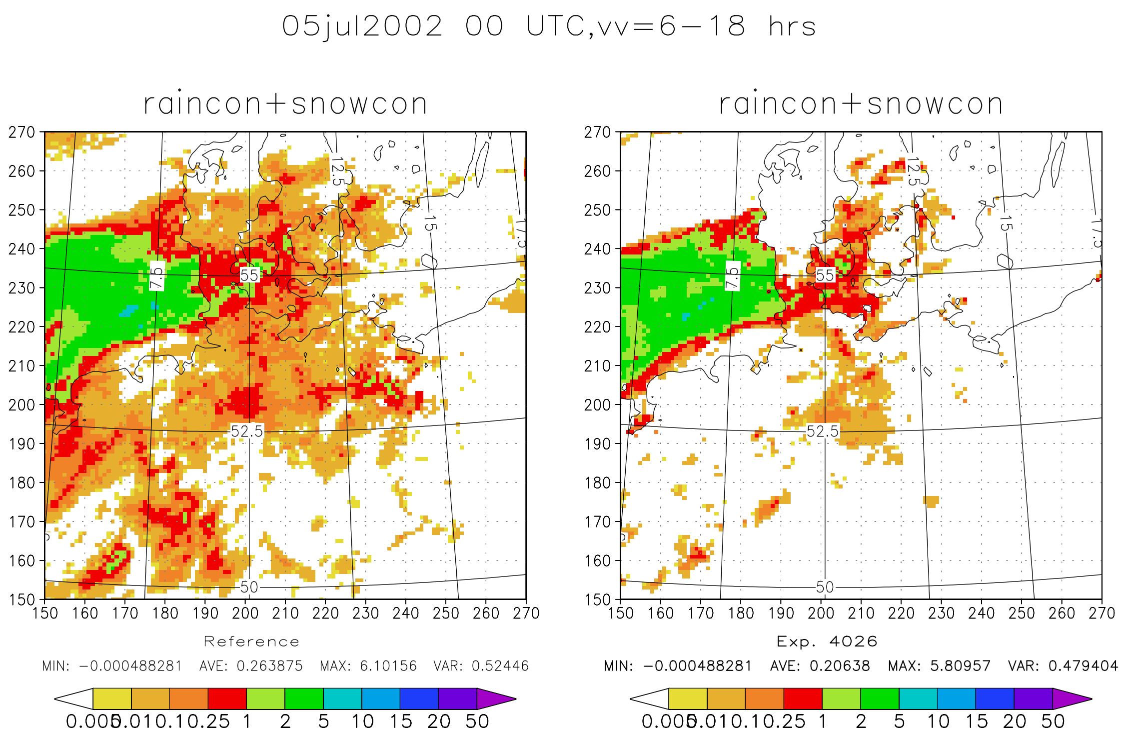

Figure 2: Convective precipitation predicted with the operational version of the convection parameterization (left) and with the modified version (right).

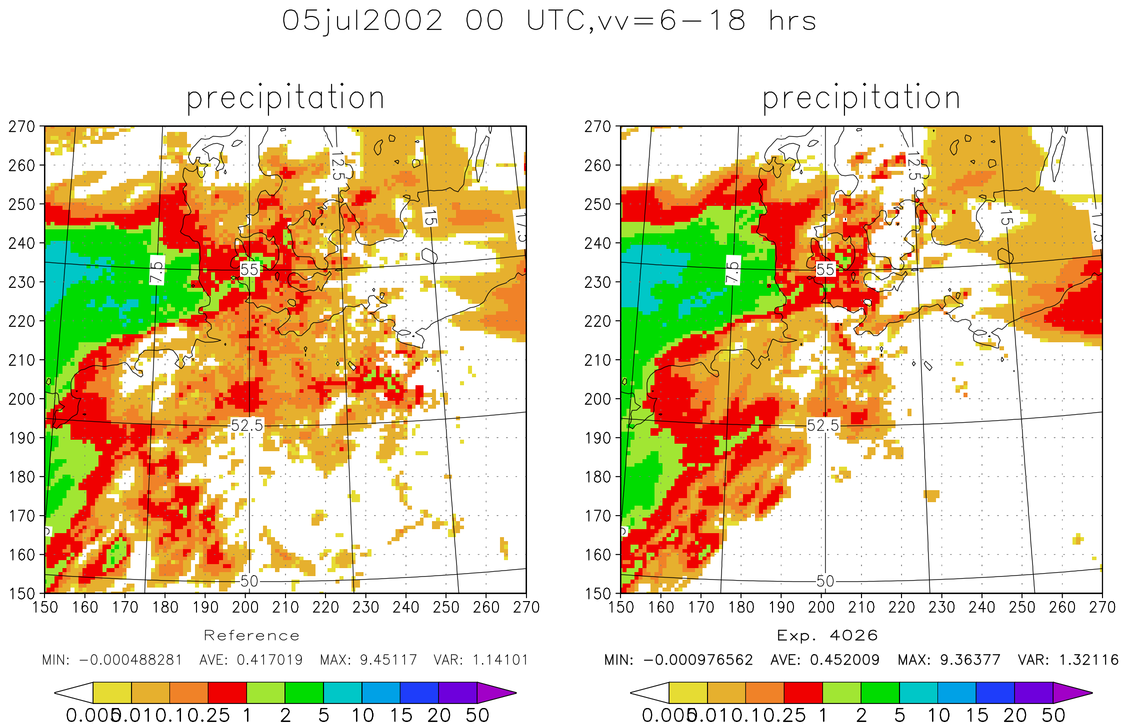

Figure 3: Total precipitation predicted with the operational version of the convection parameterization (left) and with the modified version (right).

2 References

Damrath, U., 2002: Operational verification at DWD. COSMO Newsletter No. 2, February 2002, 56-58.