8 Results and Methods of Model Verification

This section summarizes some of the operational verification results for the LM forecasts at various COSMO meteorological centres, both for near-surface and upper-air parameters. More detailed verification results are presented on a quarterly basis at the COSMO web-site. We also include research oriented contributions related to the development and test of new methods of model verification, including the use of high-resolution non-GTS data, and remote sensing data from GPS-satellites. Verification results using radar composite data have been published in COSMO Newsletter 3 (p. 123-139).

Most of the papers included in this section are write-ups from the COSMO annual meeting 2003 in Langen (D). Many thanks to all of you who provided contributions for the present issue of the Newsletter. The numbering of equations and figures in this section refers to each paper.

Before continuing with the contributions, we summarize shortly some conclusions on model deficiencies from the recent verification results as well as from diagnostic evaluations and from case studies.

Model Deficiencies

From the verification results for the last year, we can summarize some basic problems:

- During evening and nighttime, the 2m-temperature has a quite large cold bias, especially during winter. This effect is less pronounced when the new TKE turbulence and surface layer scheme is used, together with the soil moisture analysis.
- The mean diurnal cycle of 2m-temperature is represented with a too large amplitude (for both the old and new turbulence schemes). The maximum is achieved too early (at noon) and the temperature starts to decrease too early in the afternoon.
- The diurnal cycle of the 2m-dewpoint-temperature is not well captured. With the new TKE and surface layer scheme the diurnal cycle is somewhat better represented by the model.
- 10-m winds appear to be underestimated both in winter and summer, however over the Swiss Middleland (below 800 m asl) there is an overestimation, (especially during night-time) and on the mountain gridpoints there is strong underestimation.
- In summer, the mean daily cycle of both total cloudiness and precipitation is not well represented. Especially, the precipitation peaks too early (at noon) by about 4-6h.
- Low precipitation amounts appear to be overestimated by the model. This may result from convective drizzle or from a too slow evaporation of rain below stratiform clouds.
- Over regions with complex and steep topography (especially over the Alps), the simulated precipitation patterns are still not very satisfactory. However, some progress has been made by introducing the filtered topography and the new scheme for horizontal diffusion.
- A long-standing problem is the windward shift of maximum precipitation over mountain ranges and too less precipitation over the leeside. This effect is much more pronounced in winter than in summer. A test period in winter 2002/2003 showed the potential of the 2-timelevel scheme and prognostic precipitation (see COSMO Newsletter 3, 173-176).

- The cloud cover is overestimated (as compared to SYNOP observations or also to METEOSAT VIS channel): it seems to be due to an overestimation of high clouds (but these high cloud are perhaps not always well observed or not well analysed with satellite data).
- The integrated water vapor content is underestimated (as verified with GPS data) and shows a seasonal cycle with a greater negative bias in summer.
- The vertical profiles (as verified with TEMP soundings) show a cold bias from surface up to 750 hPa (mainly caused during summer season). The mean error in wind speed is small, with a positive bias in the boundary layer and a small negative bias above 800 hPa.
- When starting from interpolated GME analyses, there is a quite strong spin-down of precipitation during the first 12-24h of integration, indicating a too intense dynamical adaption of the initial fields. The nudging assimilation scheme corrects these errors.

At the recent COSMO meeting, several new work packages have been defined to investigate these problems and to find short-term remedies.