8 Results and Methods of Model Verification

The operational verification results for the LM forecasts at various COSMO meteorological centres, both for near-surface and upper-air parameters, are summarized in this section. More detailed verification results are presented on a quarterly basis at the COSMO web-site. In this section are also included research oriented contributions related to the development and test of new methods of model verification, including the use of high-resolution non-GTS data, remote sensing data from GPS-satellites and radar composite data.
Most of the papers included in this section are write-ups from the COSMO annual meeting 2004 in Milano (I).
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, 2004, we can summarize some basic problems:

- The mean diurnal cycle of 2m-temperature still shows too rapid increase during early morning and too rapid decrease in the afternoon (for both the old and new turbulence schemes) During evening and night-time, the 2m-temperature has a quite large cold bias, especially during winter; this effect is less pronounced with the new model version (using the TKE turbulence scheme, surface layer scheme and the soil moisture analysis), but is still a problem.

- The diurnal cycle phase of the 2m-dewpoint-temperature is relatively well by the model even if the diurnal wave amplitude is not so good. The improvement in the diurnal cycle is due to the new TKE and surface layer scheme.

- 10-m winds generally appear to be underestimated on mountain stations and especially during the night, for low altitude stations as well as there is a constant overestimation of wind gusts.

- Cloud cover cycle is not well reproduced, generally overestimated (comparison SYNOP and METEOSAT VIS Channel), particularly there is an overestimation of high cloud cover. In the diurnal cycle of total cloudiness (especially in Spring and Summer) there is a mostly negative bias independent on the season.

- The mean daily cycle of both total cloudiness and precipitation is not well represented. Especially, during the summer the model shows too early onset of convective precipitation and too rapid increase of convective precipitation during afternoon. In Summer there is a too strong diurnal cycle on the mountain gridpoints (due to a too pronounced convection at daytime) and the daily maxima are forecasted too early.

- Low precipitation amounts appear to be overestimated by the model. Over regions with complex and steep topography (especially over the Alps and Appenini), the simulated precipitation patterns are still not very satisfactory and still show great precipitation amount upwind and an underestimation of rainfall downwind mountain chains.

- The integrated water vapor content is underestimated (as verified with GPS data) and shows a seasonal cycle with a greater negative bias in summer and in complex terrain (probably due to height differences).
- The temperature vertical profiles (as verified with TEMP soundings) show a cold bias from the surface up to 750 hPa (mainly during summer season) and a small positive one above 500 hPa. The mean error in wind speed is small, with a generally positive bias in the boundary layer and negative bias above 800 hPa. The relative humidity profiles give generally a positive error up to 700 hPa, above this level they seem to systematically be biased towards positive values. The two model set-ups, LM and LAMI (driven by the same boundary conditions), show a similar drop-off of the near-surface geopotential at the 48 h forecast range.
- Statistical verification results have shown that the enlargement of the domain have a measurable negative impact on LM forecast skill. In particular the wind vector and the MSLP have the worst scores after T+24h. It seems that LM dynamics does not give a good representation of the meteorological evolution in the larger domain.

At the recent COSMO meeting, new work packages have been defined to investigate these problems and to find short-term solutions as well as to improve effectively the model (medium and long term solutions) with the verification of new LM versions, originating from latest development within WGs 1-3, made on predefined set of test cases collected for this purpose.