

40 km/40 Layer Version of the Global Model GME of DWD

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On 27 September 2004 DWD put a new version of its global model GME (Majewski et al., 2002) in operation. The new version has higher horizontal and vertical resolution. The width of the hexagonal grid cells was reduced from 60 km to 40 km. This corresponds to a reduction of mean grid cell area from 3100 km² to 1384 km². The number of main levels of the model was increased from 31 to 40. As in the previous version the top level is at 10 hPa, however the lowest level is at a height of approximately 10 m above the surface.

In addition a multi-layer soil model (Schrodin and Heise, 2001) which solves the temperature and humidity equations for the soil is employed. It replaces the old 2-layer force-restore soil model of Jacobsen and Heise (1982). The layer boundaries are listed in Table 1. The temperature at the lowest depth of 21.87 m is constant in time and set to the climatological mean 2 m temperature. The new soil model allows for more realistic freezing and thawing of the soil.

The changes lead to an overall improvement of GME. The temperature and spread at 2 m predicted by the old and new GME are compared with observations in Figure 1. The root mean square error at 1281 stations in Europe from 1 September to 30 October 2004 is shown for the old GME (red) and the new GME (blue). The new GME has much smaller errors with a reduction of variance (SK) of 28 % for the spread, and 11 % for temperature.

For the old model the subgrid scale orographic drag was too strong. With higher horizontal resolution this drag is reduced, which diminishes the wind speed bias of the model. This is demonstrated in Figure 2 where model forecasts are compared with TEMP winds in the northern hemisphere. In the old version the bias increased with forecast time, whereas it is constant, and much smaller with the new version. Further tuning of the SSO scheme at the new model resolution will be performed in the near future.

The forecast range is extended mainly after 3 days. Figure 3 shows the anomaly correlation of the 500 hPa height, mean sea level pressure, and temperature at 850 hPa over the northern hemisphere for 31 forecasts at 12 UTC from 26 September to 26 October 2004. There is marked improvement for the sea level pressure and the temperature at 850 hPa.

The new model requires approximately 5 times as much computing power as the old model. A 178 hour forecast takes approximately 120 minutes on 450 Power III processors of an IBM RS/6000. It produces approximately 45 GB of data.

References

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Table 1: Depth of lower boundaries and thicknesses of the layers of the new soil model.

| | | | | | | | | | |
|-----------|------|---|---|---|----|----|-----|-----|------|
| Top | [cm] | 0 | 1 | 3 | 9 | 27 | 81 | 243 | 729 |
| Bottom | [cm] | 1 | 3 | 9 | 27 | 81 | 243 | 729 | 2187 |
| Thickness | [cm] | 1 | 2 | 6 | 18 | 54 | 162 | 486 | 1458 |

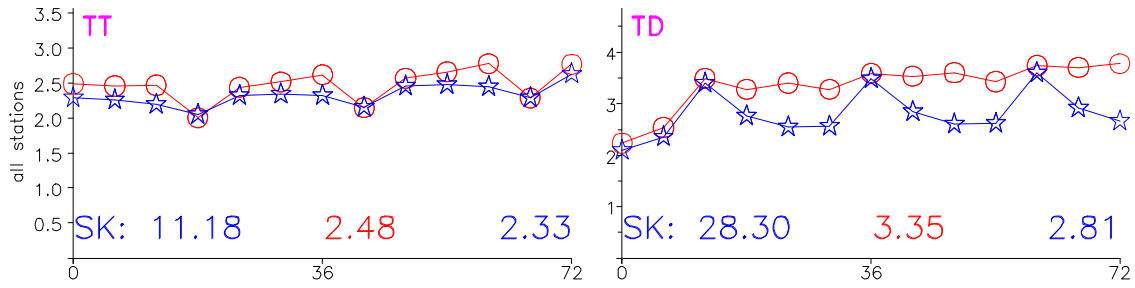


Figure 1: Root mean square error of temperature (TT) and spread (TD) at 2 m as a function of forecast time; old (red) and new (blue) GME. The mean value over 72 hours is written above the abscissa. To the left the skill (reduction of variance, SK) is written.

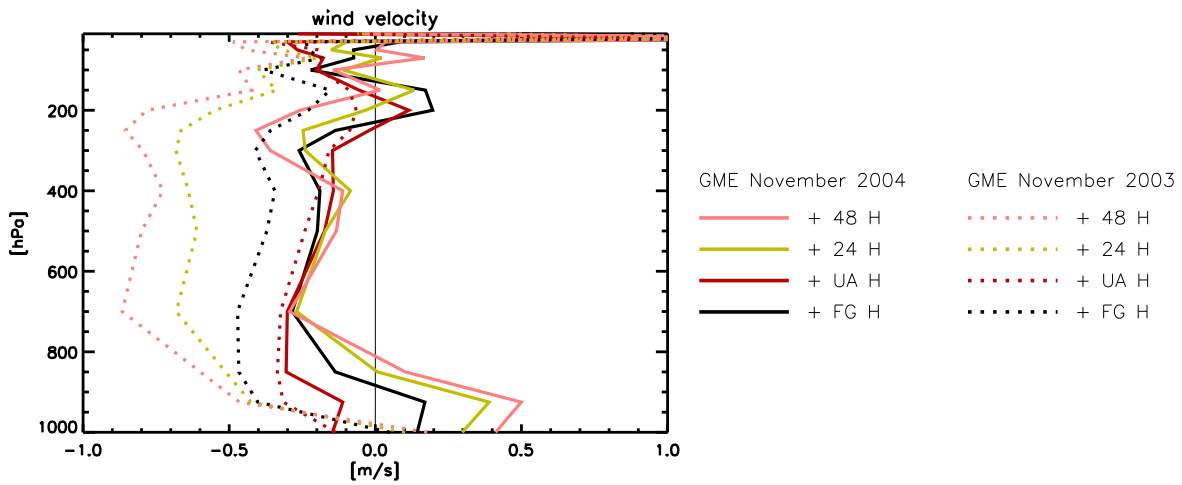


Figure 2: Wind bias of 00 UTC runs in November 2004 (solid, new GME) and November 2003 (dotted, old GME): uninitialized analysis (UA), first guess (FG), 24 h and 48 h forecasts. Comparison of forecasts and TEMP observations in the northern hemisphere.

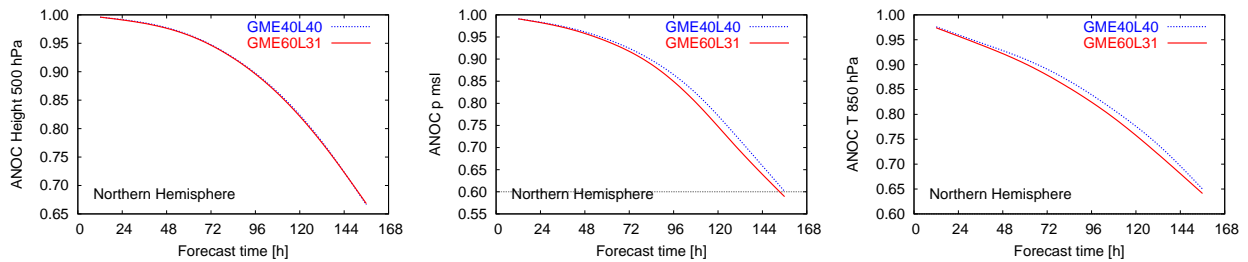


Figure 3: Anomaly correlation of 500 hPa height, mean sea level pressure, and temperature at 850 hPa in the northern hemisphere for 31 forecasts at 12 UTC in September and October 2004; old (red) and new (blue) GME (red).