T2m Nowcasting

S. Greilberger and T. Haiden
Central Institute for Meteorology and Geodynamics

Problem

There is a growing demand for very accurate forecasts of 2m temperature for the next couple of hours, in particular during the winter season. Nowadays, a typical value of mean absolute error for height-corrected point forecasts of T2m in the short range is about 1.5 K. Classical MOS techniques allow to reduce this error by a few tenths of a degree. Since T2m is not assimilated, the nowcasting range (say, up to +03 hours) is usually not significantly better predicted than the whole first 12 hours of a forecast. Thus, any method which takes into account the current observed value can greatly improve the skill of the point forecast in the first few hours. Kalman filtering has often been used in this context (e.g. Izsak, 2002).

A problem with Kalman filtering methods is that changes in the type (and reason) of model errors caused by changes in the weather situation are not handled well. By design the system needs some time to adapt to a new error structure. At ZAMG a project has been started, to develop a combined physical/statistical correction system that produces short-term T2m forecasts for the station Vienna Hohe Warte with highest possible accuracy.

As part of this project, the mean absolute error (MAE) of ALADIN forecasts (corrected for true station height) was compared with persistence and adapted climatology forecasts. "Adapted" means that the forecast is shifted to match the observed temperature at the current hour. Thus an adapted climatology forecast simply puts the mean diurnal cycle during that time of the year on top of the observed current temperature. Interestingly, this method which does not involve any NWP gives rather good results in terms of MAE (Figure 1) and is therefore a good benchmark for measuring the skill of NWP forecasts.

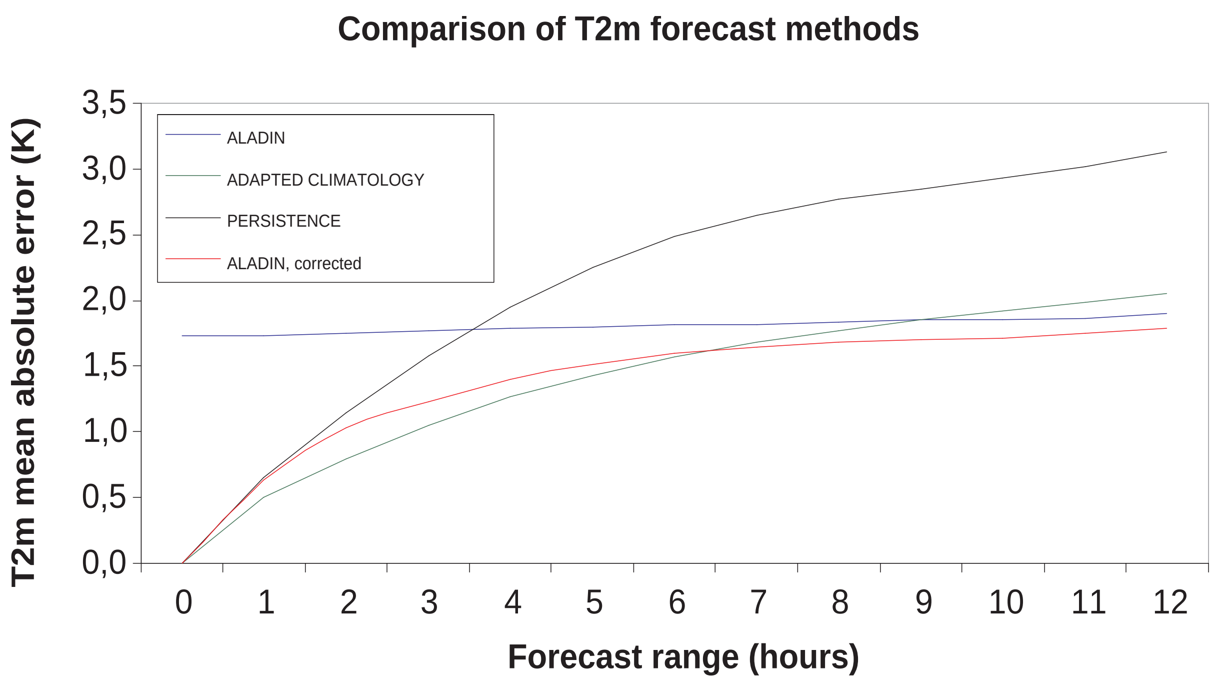

Figure 1: Mean absolute error (K) of different T2m forecast methods as a function of forecast range. The verification period is 1 Nov. 2000 - 30 Nov. 2002 (without summer months June-Sept.).

Other interesting details are that ALADIN becomes better than persistence at about +3.5 h, and better than adapted climatology around +9 h. Also shown is a linear combination of persistence and ALADIN, with statistically determined optimal weights for each forecast range. It can be seen that this method beats the adapted climatology in the +7 to +12 h range, but not in the first 6 h.

Process-specific approach

In order to obtain forecast improvements beyond those provided by purely statistical methods, one needs to identify the primary processes causing errors. A large part of wintertime T2m errors in ALADIN is caused by underestimations of low cloudiness. Frequently, the modelled diurnal amplitude of T2m is significantly larger than observed. To account for this specific source of error, a simple correction based on the ratio between predicted and observed low cloudiness has been developed and is being tested. Results will be published in the next Newsletter.

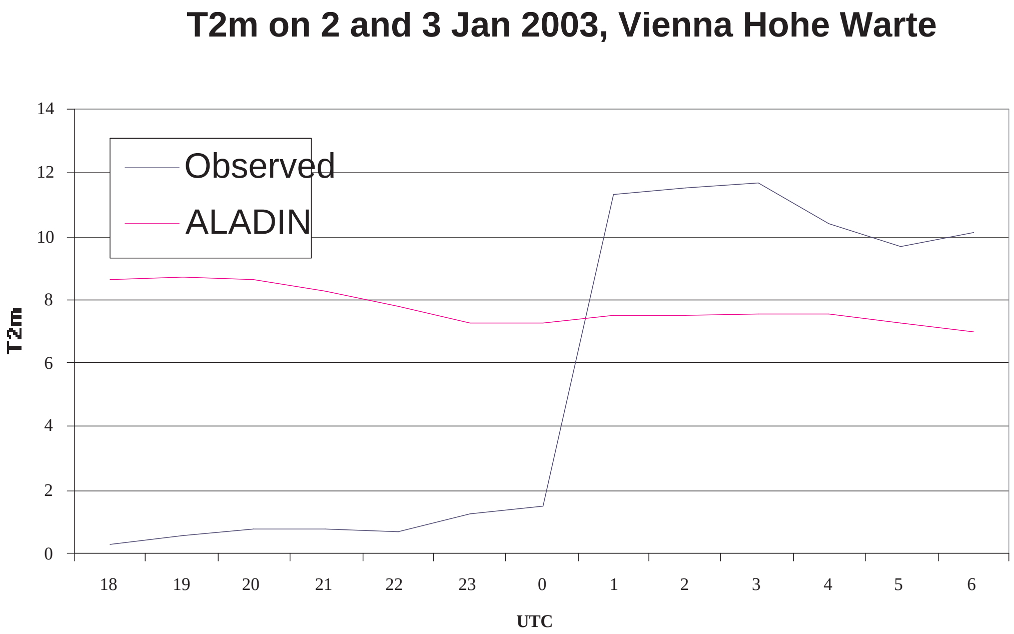

Figure 2: A shallow (100-200 m) cold PBL in the Vienna area is replaced by a well-mixed one. T2m rises by 10 K within 1 hour. The largest T2m forecast errors occur during shallow cold air episodes.

Another problematic situation arises when cold air pools are eroded or advectively removed. In such cases the temperature error can become very large, due to difficulties in modelling shallow (100-200 m deep) cold air pools and their removal. A recent, quite extreme case is shown in Figure 2. For this type of process we plan to use ALADIN model trajectories to advect a corrected temperature field based on the ALADIN forecast and the most recent observations. In order to handle the process of warming by vertical mixing, a high-resolution 1d model with prognostic TKE will be used. Our goal is to push the error of the forecast significantly below the adapted climatology values shown in Figure 1.

References

Izsak, B., 2002: The use of Kalman filter for improving the short range forecast of 2m temperature. ALADIN Newsletter 21, 76-79.