Application and verification of ECMWF products in Austria

Klaus Stadlbacher, Central Institute for Meteorology and Geodynamics (ZAMG), Vienna

1. Summary of major highlights

Medium range weather forecasts in Austria are primarily based on the ECMWF forecast. In the short range, ECMWF products are used in conjunction with those from ALADIN and COSMO_EU. The Ensemble Prediction System (EPS) forecasts are used for operational uncertainty estimates in temperature and quantitative precipitation forecasts, while the EPS-median of temperature is used for point-forecast ranges exceeding 6 days.

Seasonal forecasts are becoming more and more interesting for public as well as for special customers mainly from the energy sector.

2. Use and application of products

2.1 Post-processing of model output

2.1.1 Statistical adaptation

A model output statistics system (AUSTROMOS II) is run operationally at ZAMG, using ECMWF forecast fields as input. This MOS covers a forecast rangce up to +5 days for ~110 Austrian stations, ~60 Central European stations outside Austria, and 37 predictands (Haiden and Hermann, 2000). Three different types of predictors are used: (i) direct model output (DMO), (ii) derived quantities, such as relative vorticity or a baroclinicity index, (iii) previous observations. Additonally a PPM system based on ECMWF analyses is run on ZAMG.

A special Austrian Perfect Prog Model (APPM) based on ECMWF deterministic forecasts is used to improve point forecasts and areal quantitative forecasts of precipitation in Alpine watersheds (Seidl, 2000) for hydrological applications. For precipitation, the PPM method was found superior to the MOS method, mostly because it does not use DMO precipitation which is sensitive to NWP model resolution changes. The operational APPM system provides 6-hourly areal precipitation forecasts for 34 catchment-type areas covering Austria and parts of Bavaria up to 4 days.

An area-dependent statistical combination of ALADIN and ECMWF precipitation forecasts is made to provide high-resolution data as input for hydrological models up to 72 hours twice a day. This combination reduces the systematic errors of both models and is found superior as input for hydrological models.

2.1.2 Physical adaptation

A trajectory model (FLEXTRA) and a dispersion model (FLEXPART) are run operationally with ECMWF forecast fields as input (Pechinger et al., 2001). Forecasts are made up to +84 hrs for a domain extending from 90 deg W to 90 deg E, and 18 deg N to 90 deg N.

ECMWF precipitation forecasts are used as input for hydrological models for most of the main rivers in Austria. For the shorter forecast range ECMWF forecasts are combined (see 2.1.1) while for forecasts longer than +72 hours DMO of the deterministic as well as the ensembles are used as input.

2.1.3 Derived fields

3. Verification of products

3.1 Objective verification

3.1.1 Direct ECMWF model output

Figures 1 to 5 show a verification of ECMWF-DMO for the station Linz while figures 6 to 10 show the scores for Vienna as a function of forecast range from +18 to +234 hours. In the case of 2m temperature a height correction (0.65K/100m) has been applied. Wind direction was only verified for cases where the observation exceeded 2m/s. While most of the parameters are nearly unbiased for both stations, verification for Linz shows remarkable positive bias for relative humidity while for 2m temperature the bias is smaller than last year. Some small bias is found for relative humidity and wind speed for Vienna. Diurnal waves in forecast errors are found for most parameters with exception of mean sea level pressure and wind direction. In general, errors do not show big differences compared to last years and show the good quality of the forecasts. (ECMWF, 2007 ; ECMWF, 2006)

Monthly 'Climagramms' for temperature and precipitation anomalies are computed as mean values for the austrian domain up to 5 months and made available on intranet. An objective verification for 2007 was performed in comparing those values with mean values of representative stations. In figure 11 the result of such evaluation can be seen. The observed temperature anomaly (green line) is compared with the ensemble forecasts for January from different starting month (August to January). The forecasts vary for different runs and do hardly show the measured temperature anomaly .

Monthly forecasts for temperature, wind speed, precipitation and cloud cover are visualized for 6 different locations on the intranet. An objective verification is performed regularly. One example is shown in Figure 12. Generally the ensemble covers the observations, though the variations are not predicted in detail. This statement is true for any

3.1.2 ECMWF model output compared to other NWP models

Comparisons between models (including MOS) show that ECMWF forecast quality is less good for wind speed and direction if compared with high-resolution model ALADIN. The statistical model (ECMWF-MOS) gives the most significant improvement for temperature and short range cloudiness DMO forecasts.

3.1.3 Post-processed products

MOS forecasts are verified together with ECMWF-DMO, ALADIN and human forecasts. Weekly graphs are available for forecasters via intranet.

3.1.4 End products delivered to users

3.2 Subjective verification

3.2.1 Subjective scores

3.2.2 Synoptic studies

4. References to relevant publications

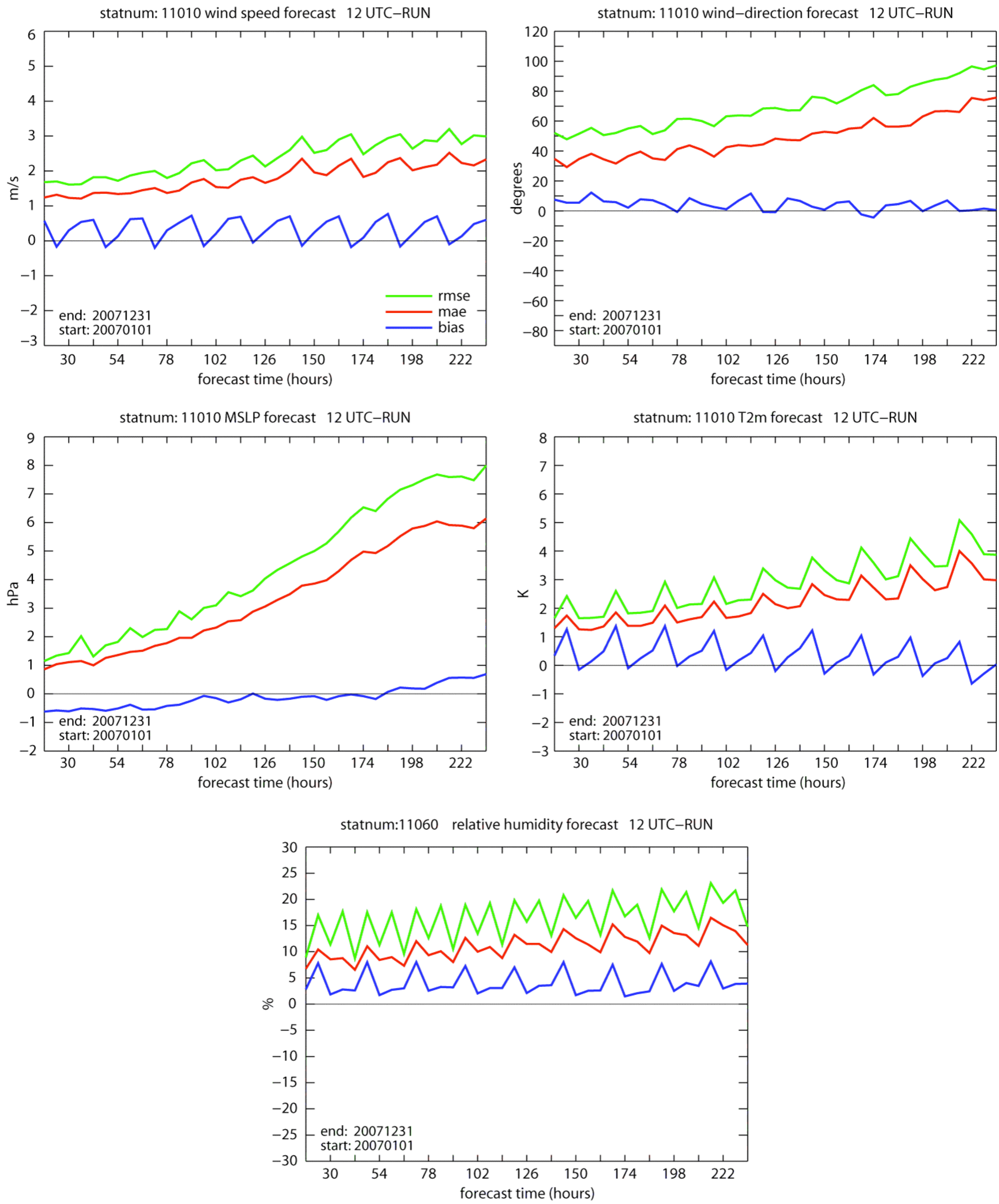
ECMWF, 2006: Verification of ECMWF products in member states and co-operating states,141 p .

ECMWF, 2007: **http://www.ecmwf.int/products/greenbook/2007/GB_2007_Austria.pdf**

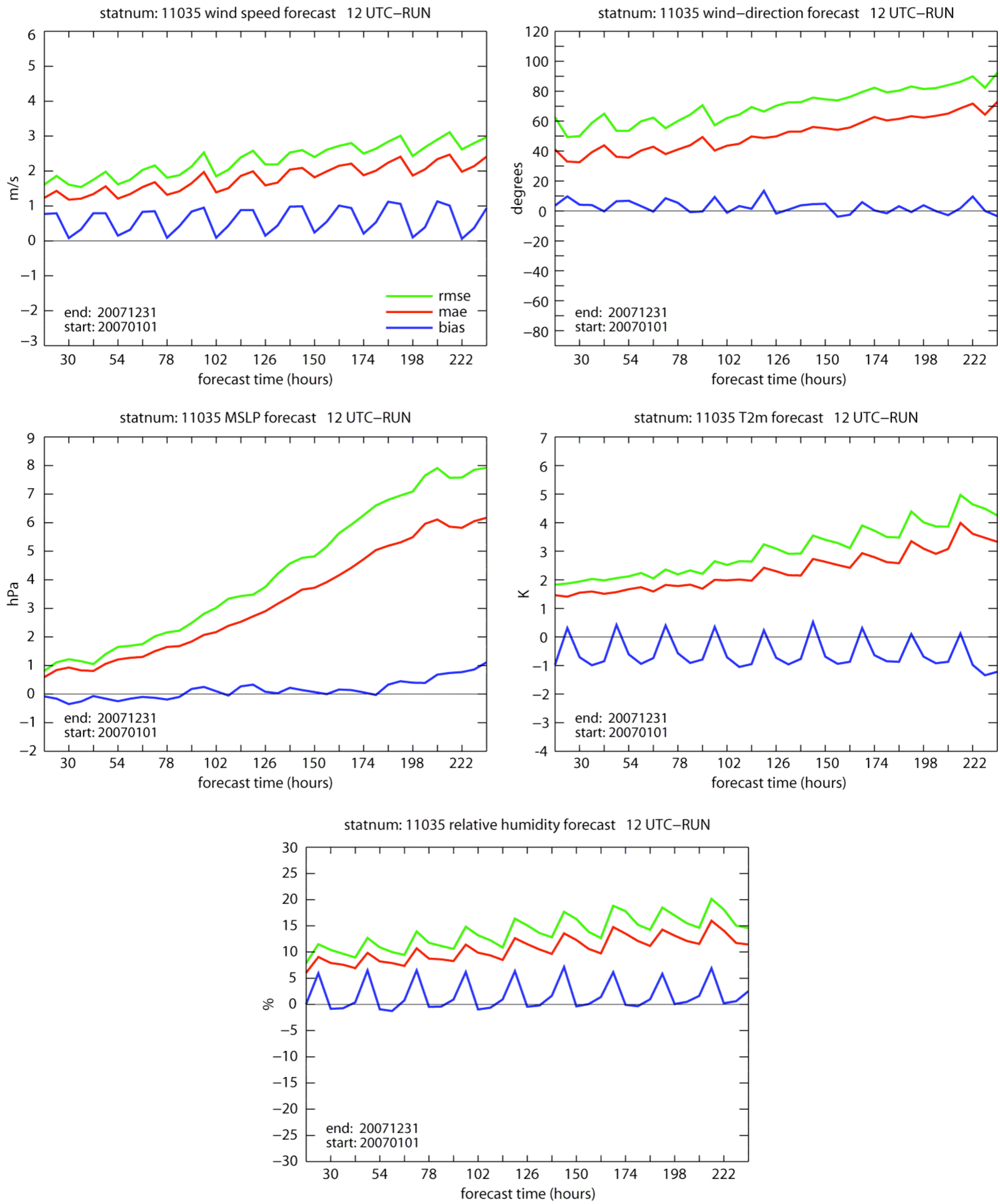
Haiden, T., and **G. Hermann**, 2000: Experiences with the Austrian MOS system. Preprints, 1st SRNWP Workshop on Statistical Adaptation, Vienna, 10-11.

Pechinger, U., **M. Langer**, **K. Baumann**, and **E. Petz**, 2001: The Austrian Emergency Response Modelling System TAMOS. Phys. Chem. Earth, B26, 99-103.

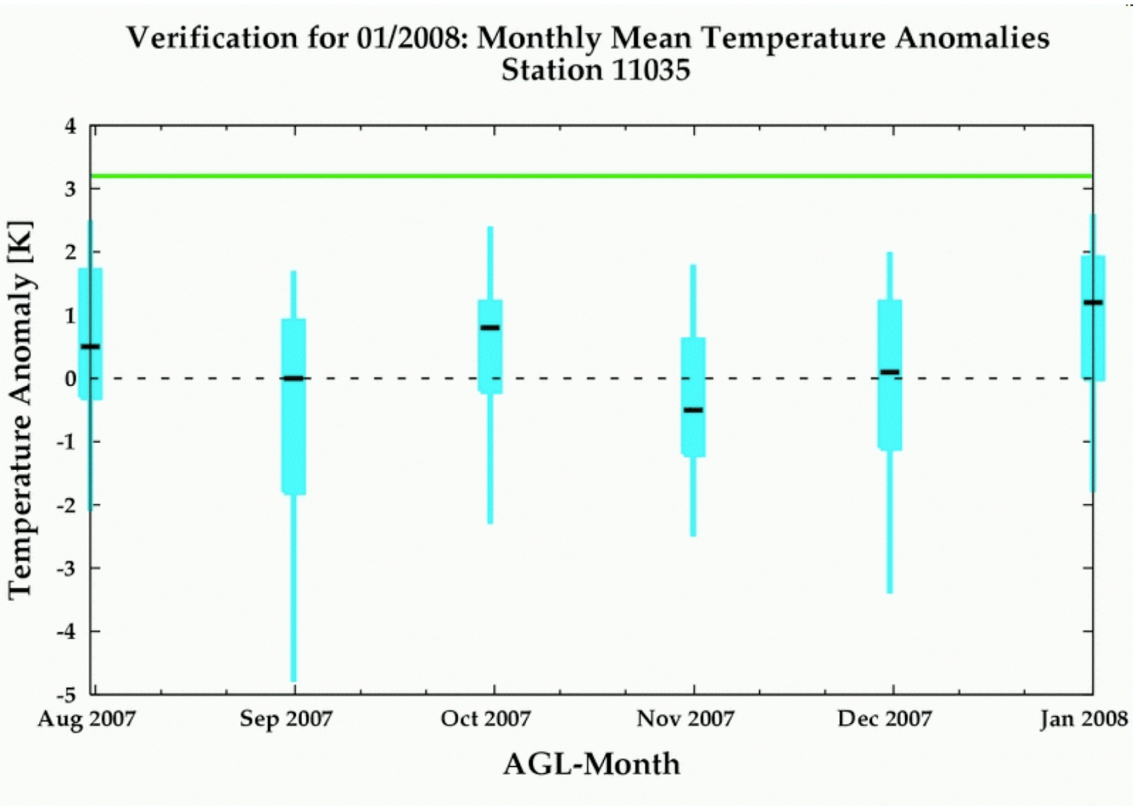
Seidl, H., 2000: An operational PPM for areal precipitation predictands transformed into Gaussian variables. Preprints, 1st SRNWP Workshop on Statistical Adaptation, Vienna, 2-5.



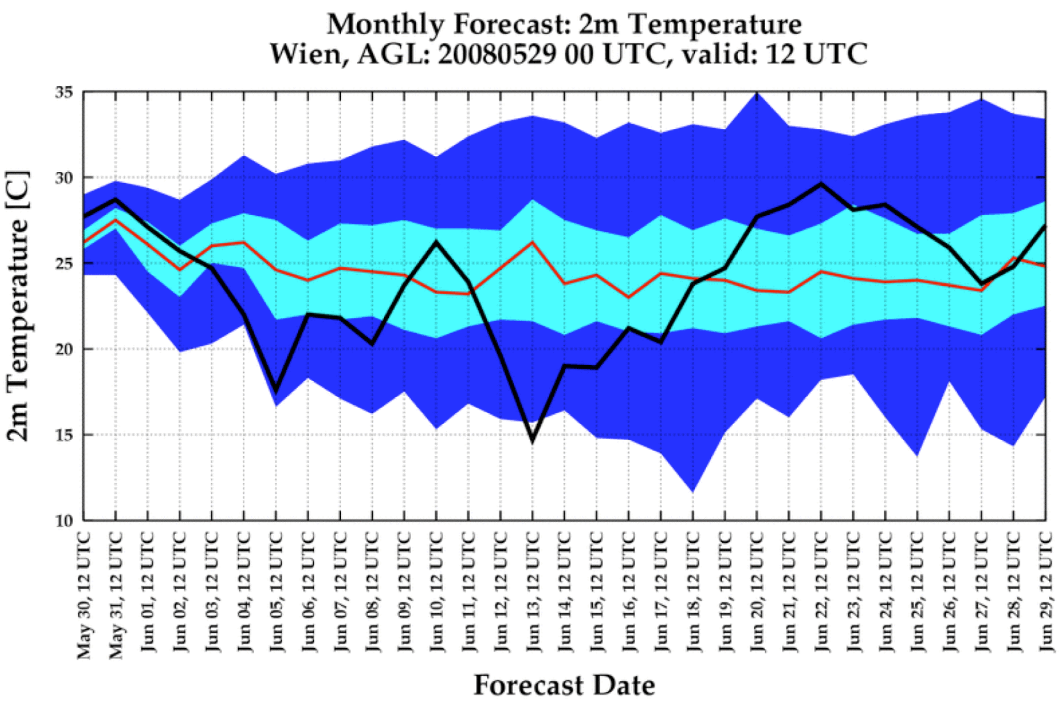
Figs. 1-5 Mean error (bias), mean absolute error (MAE) and RMSE of ECMWF point forecasts of 10m wind speed and direction, MSL pressure, 2m temperature and 2m relative humidity as a function of forecast range for station LINZ in the period Jan-Dec 2007.



Figs. 6-10 Mean error (bias), mean absolute error (MAE) and RMSE of ECMWF point forecasts of 10m wind speed and direction, msl pressure, 2m temperature and 2m relative humidity as a function of forecast range for station WIEN in the period Jan-Dec 2007.



Figs. 11 Comparison of forecasted (bars) and measured (green line) temperature anomalies for the station Vienna. All forecasts valid for January 2008. Abscissa shows the month of the forecast issue.



Figs 12 Ensemble-forecast (blue area+red line) and measured (black line) 2m-temperature for the station Vienna for 12 UTC of ECMWF monthly forecast issued on 30th of May.