Verification of ALADIN global radiation forecasts

T. Haiden and K. von der Emde

ZAMG, Austria

1. Introduction

Global radiation is one of the ALADIN output fields that is not typically verified operationally. Global radiation forecasts, however, are becoming increasingly important, for example as input for energy consumption forecast models in the power generating industry. Here we report on a comparison of ALADIN global radiation forecasts against surface observations at 4 locations in Austria. Results show a significant negative bias at all stations and seasons.

2. Data

The 4 stations are located distributed across Austria (Figure 1). Three of them are lowland or valley stations between 200 and 500 m above msl, and one (Sonnblick) is a mountain station at an elevation at 3105 m.

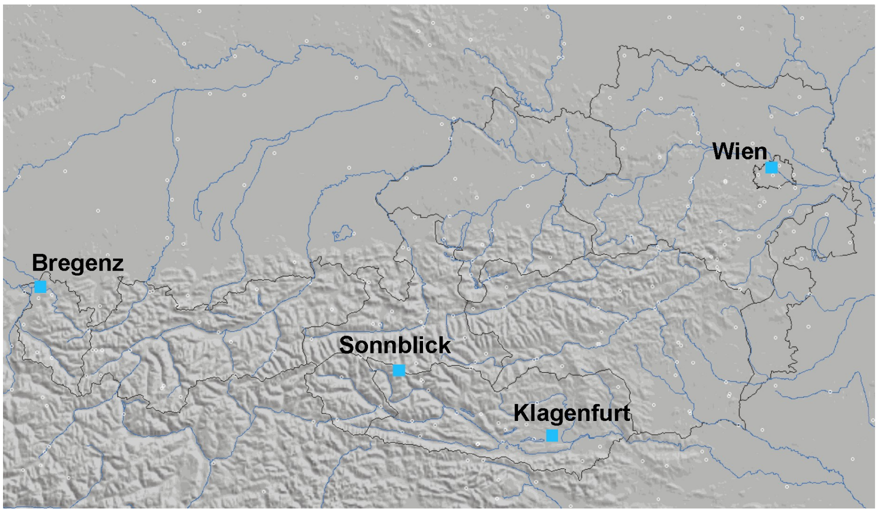

Figure 1: Location of stations used in ALADIN global radiation verification.

The stations measure global (=solar direct+diffuse) radiation in 10-min intervals. For this verification, hourly mean values are used. The verification period is Dec 2004 - Nov 2005 (1 year). The ALADIN output is interpolated bilinearly to the station locations.

3. Results

Figure 2 shows the annual evolution of observed global radiation at 12Z and of the error (forecast minus observation) of the ALADIN +12 h forecast (00Z runs) for the station Vienna. The forecast has a significant negative bias the magnitude of which mirrors the annual evolution of global radiation. Closer analysis shows that during cloud-free or almost cloud-free periods, i.e.

when the observed global radiation is close to its upper envelope, the negative bias is generally small.

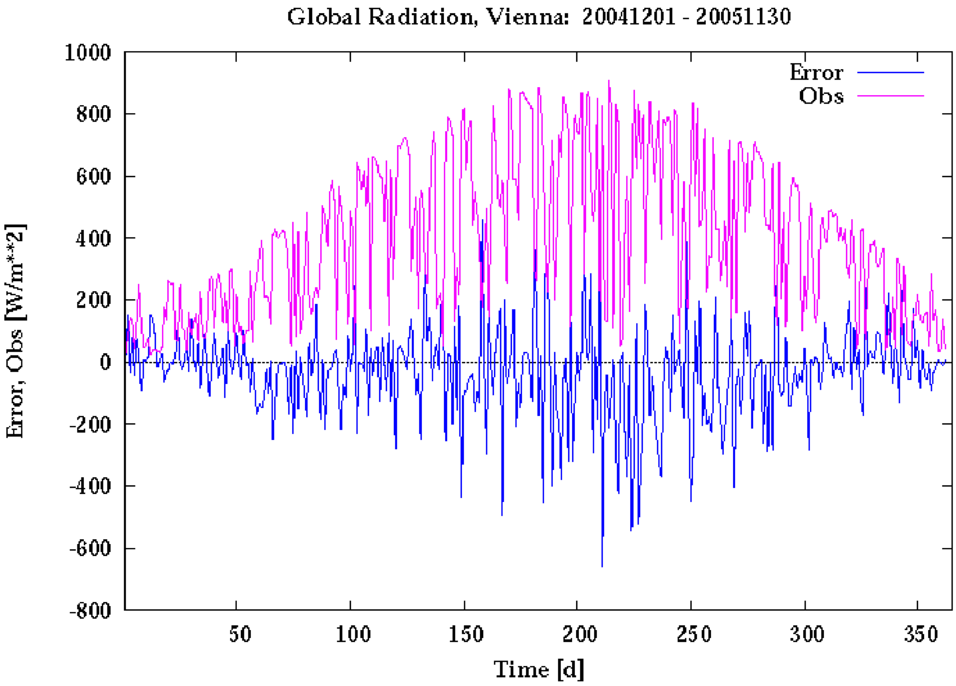

Figure 2: Observed 12Z global radiation (pink) and ALADIN forecast error (blue) within the entire verification period for the station Vienna (203 m).

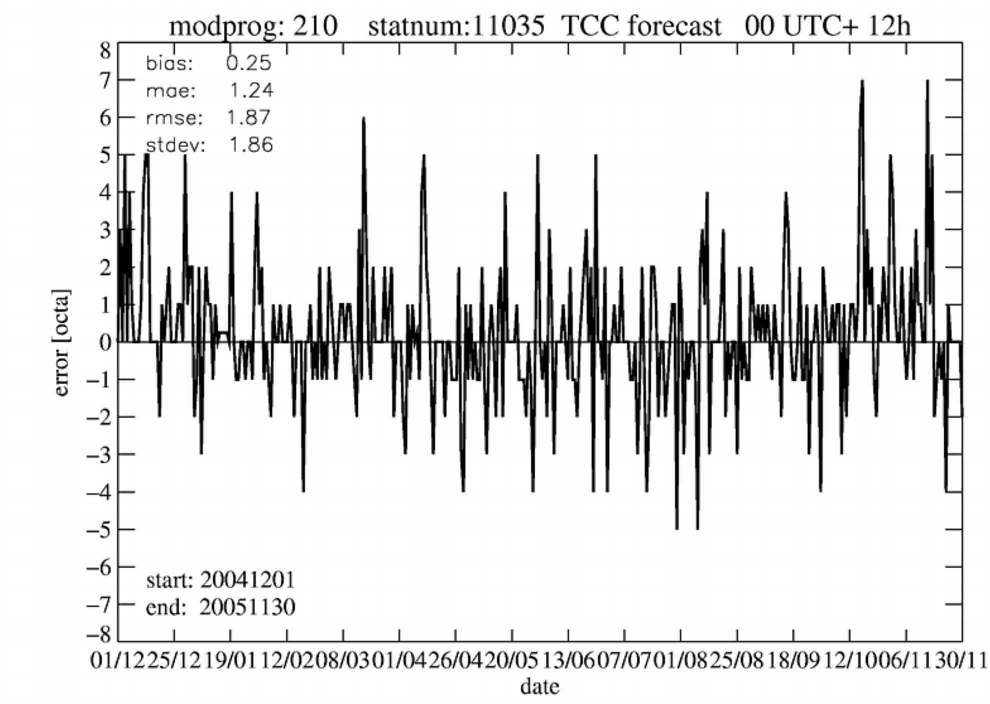

Figure 3: ALADIN 00Z run +12 h total cloudiness forecast error (octa) for Vienna within the 1-year verification period Dec 2004 – Nov 2005. Only a small part of the error is due to a systematic bias.

Examples can be found near days 70, 125, 175, 315. Thus ALADIN predicts surface global radiation satisfactorily under conditions where cloudiness does not play a significant role, but on average underestimates it otherwise. This can be due to (a) an overestimation of cloudiness, or (b) an underestimation of shortwave transmission in clouds, or (c) both. Figure 3 shows that there is indeed an overestimation of total cloudiness in the forecast but it is too small (0.25 octa) to explain the negative global radiation bias. This suggests that the shortwave transmissivity of clouds is too small in ALADIN. The possibility remains, however, that the partition of total cloudiness into low, medium, high, differs between model and observations, even though the bias of total cloudiness is small. This could also lead to a bias in global radiation.

Hourly forecast output of ALADIN during the entire daytime period was used to determine bias and mean absolute error (MAE). In relative terms, the negative bias at the three lowland stations amounts to between 10-20% of the observed global radiation, with highest values occurring during the summer season. The relative MAE is on average twice as large (20-40%) as the bias.

At the mountain station Sonnblick there is an even more pronounced negative bias, on the order of 50%, which may be due to an underestimation in ALADIN of multiple diffuse reflection between the atmosphere and the surface in the presence of snow cover. At this station, snow covers the ground during most of the year. A small contribution to the bias may also come from the fact that the model surface at this location is located at a height of ~2500 m, which is 600 m below the true station height.

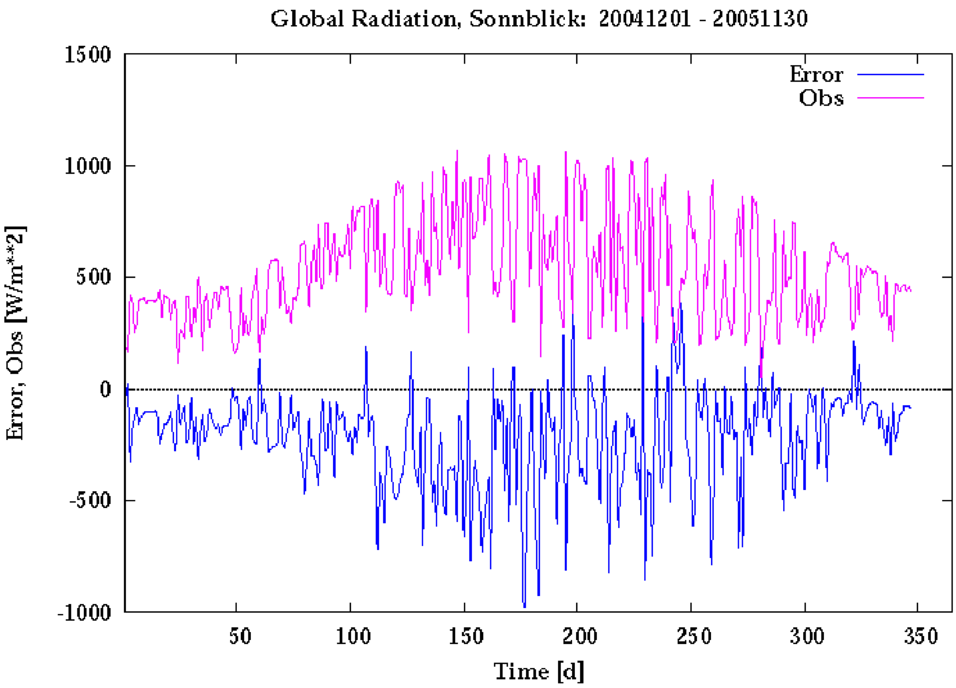

Figure 4: Observed 12Z global radiation (pink) and ALADIN forecast error (blue) within the entire verification period for the mountain station Sonnblick (3105 m).