PERSPECTIVE ON THE OPERATIONAL USE OF TOVS AND ATOVS DATA AT THE HUNGARIAN METEOROLOGICAL SERVICE

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1. INTRODUCTION

At the Hungarian Meteorological Service (HMS) a new nowcasting system is being developed to ensure quick and better objective analysis of the weather conditions. One of the tasks of the developers is to provide the forecasters with different types of data, as detailed and faithful as possible. To handle such a dataset, a good visualization tool is required. The so-called HAWK (Hungarian Advanced Weather worKstation) package was created for this purpose (Horváth, 1998).

Data used in the nowcasting system are first tested in order to ensure reliability. The retrieved from the (A)TOVS temperature profiles are evaluated as well.

Since mid 1998, the ATOVS and AVHRR Processing Package (AAPP), the MAIA ("Masque AVHRR pour Inversion" ATOVS) software and the inversion model called ICI (Inversion Coupled with Imager) are used to process (A)TOVS data and retrieve the temperature profiles. The quality of the retrieved profiles is evaluated by the forecasters. In order to provide better comparison of the retrieved temperature profiles with the ones measured by the radiosondes and ones forecast by the ARPEGE/ALADIN model, the visualization tool was upgraded.

As reported at the ITSC-X (Randriamampianina et al, 1999), a 3-dimensionnal monitoring is required to find out, whether the ICI model has systematic errors. The output of the ICI model contains vertical statistics of the retrieved profiles.

This poster gives an overview of the current status of the (A)TOVS processing scheme and describes the results of the evaluation and the monitoring of the retrieved profiles.

2. CURRENT STATUS OF THE (A)TOVS RET RIEVAL SCHEME

One can refer to Borbás et al. (1999) to find the mechanism of the retrieval scheme at the HMS. Here we will focus on the changes done during the qualitative improvement of the retrieved temperature profiles:

- The a priori data - ECMWF (European Center for Medium range Weather Forecast) products - for the retrieval are increased qualitatively and quantitatively: The ICI model needs analyses and forecasts every 6 hours. Until May 2000, the files from ECMWF were transferred twice a day (at 00 and 12 hours), having the highest field at 100hPa height. Instead of the 06 and 18 hours analyses, therefore, we had to

use NWP forecasts. Since May 2000 the ECMWF center data files are transferred four times a day up to 1 hPa height. One can see on fig. 1 that these changes improved the quality of the retrieved profiles for heights, above 100 hPa.

- For input profiles, lower than the top of the ICI model, an automatic extrapolation procedure is used to complete them. Unfortunately, the radiosonde (TEMP) data, used operationally within the HMS networks, are cut at 100 hPa height. To avoid the use of extrapolated data above 100 hPa, the TEMP data are taken out from the input data.
- In order to provide a maximum number of profiles, the ICI package inversion is switched to all the HIRS pixels instead of the 3x3 pixels resolution, used earlier.

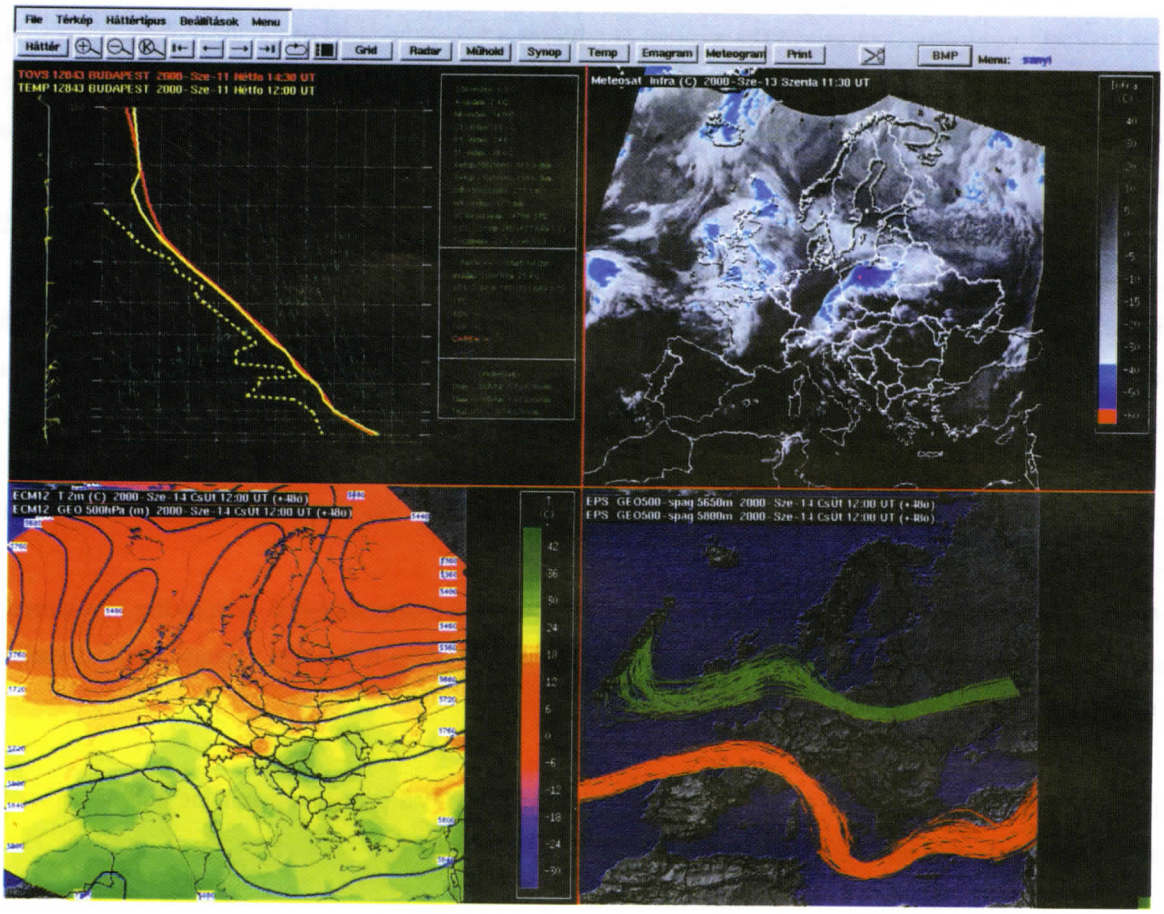

Fig. 2 An example of the HAWK display

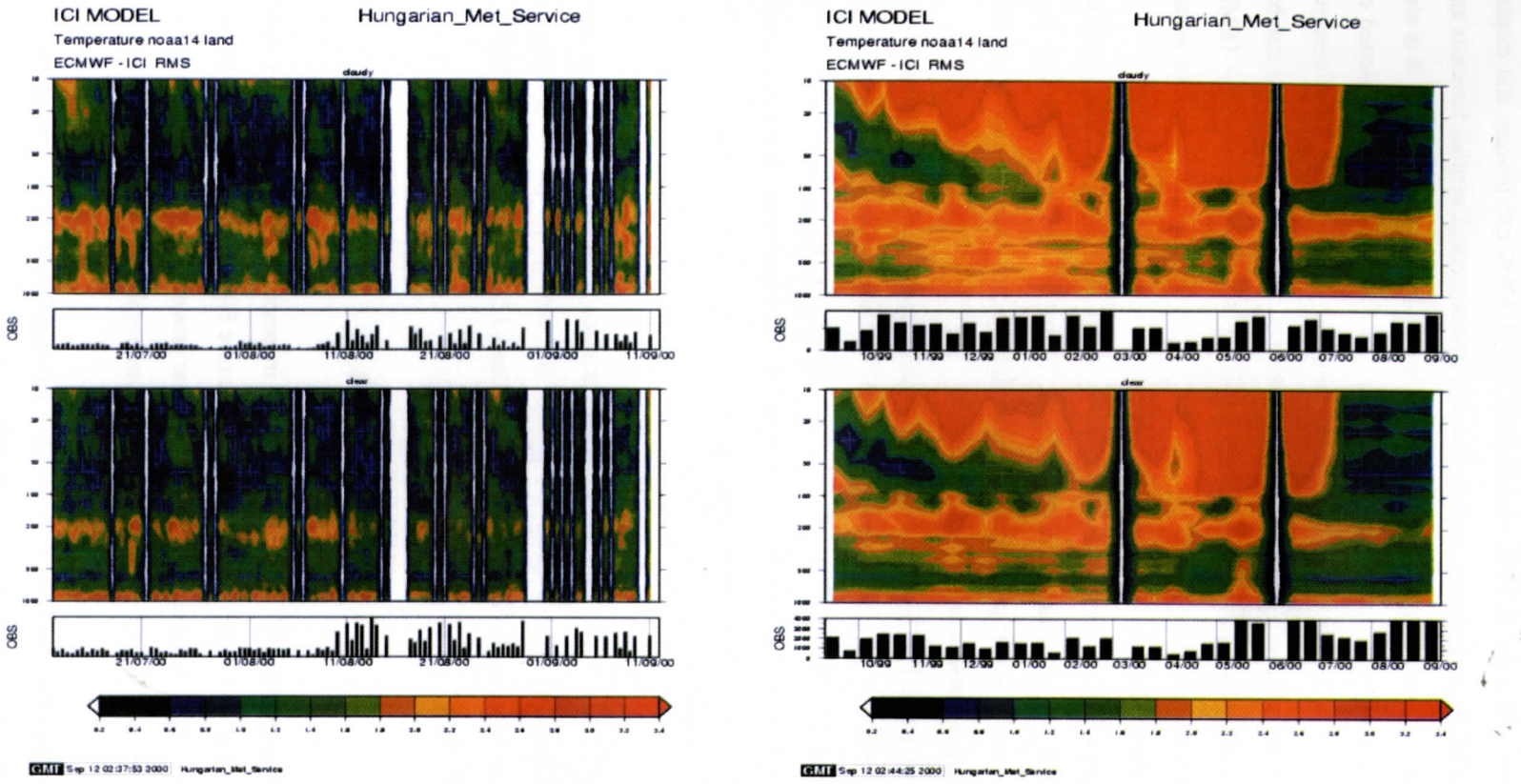

Fig. 1. Root mean square between TOVS and ECMWF analyses profiles during the last two months (left) and one year (right) for whole Europe, based on the 10 day statistics. Statistics were calculated for pixels over Land by separating the cloudy (upper graphs) and the cloudless (lower graphs) pixels. One can see the positive impact after the implementation of the ECMWF products up to 1 hPa (from 3rd July) not only for layers above 100 hPa

3. EVALUATION METHODS

The validation procedure is done within the HAWK visualization tool. HAWK can process and display irregular point data like TEMP, SYNOP and lightning, grid-format data like numerical weather forecasts and analyses and also raw images like data sensed by satellite and data measured by radar (see Fig. 2). It is also possible to display any combinations of the processed data. Single profiles like TEMP data are plotted on thermodynamic diagram (emagram). The default setting to display the profile is one dataset in one window. To provide effective evaluation of the retrieved (A)TOVS data, HAWK was developed such, that a number of profiles can be displayed on the same emagram (see fig. 3 and fig. 4). Thus, the profiles from the TEMP, the ARPEGE/ALADIN model forecasts and the (A)TOVS are plotted together. The retrieved profiles around 00 UTC and 12 UTC are used for the evaluation.

The *subjective evaluation*, performed by the forecasters for the period of February-August, 2000 consisted of the comparison of the retrieved TOVS temperature profiles with the TEMP ones for four situations: three categories of the cloud-cover conditions (clear, partly clear and cloudy) and inversion weather conditions. This evaluation concerned the Budapest meteorological station.

The *objective evaluation* of the retrieved TOVS temperature profiles consists of the vertical statistics of the ICI model and horizontal bias. The ICI model calculates the daily and last 10-day bias, standard deviation and root mean square between the TOVS and ECMWF analysis profiles for whole Europe. A 10-day calculation consists of nearly 4000 cases. Four different situations are distinguished, depending on the location (over sea or surface) and cloud-cover (clear or cloudy sky). The results of the ICI vertical statistics are available on the WEB.

The horizontal objective evaluation of the TOVS profiles is carried out since 11 August, 2000 for 6 isobar levels (1000, 850, 700, 500, 300 and 100 hPa). Neither the type of the surface nor the cloud cover are distinguished. We calculate the bias between the TOVS (orbits at 00±3 and 12±3 UTC) and the ECMWF 12 hours forecast profiles for whole Europe.

4. RESULTS

According to the *subjective evaluation*, the TOVS profiles were good in general, having a deviation of 2 °C as maximum. Completely good, "ideal" fits were observed time to time (see Fig. 3). Some common frequent problems, however, were reported by the forecasters. The inversion (near ground and in the free atmosphere) is not detected by the ICI (see Fig. 4). The temperature of the low troposphere is often underestimated, especially for cases of cloudy sky.

Smaller differences, depending on the cloud amount, were found in the middle and upper troposphere. The best fit of the TOVS retrieved profiles to the TEMP ones, with differences less then 1 °C were found for the 300-700 hPa layer.

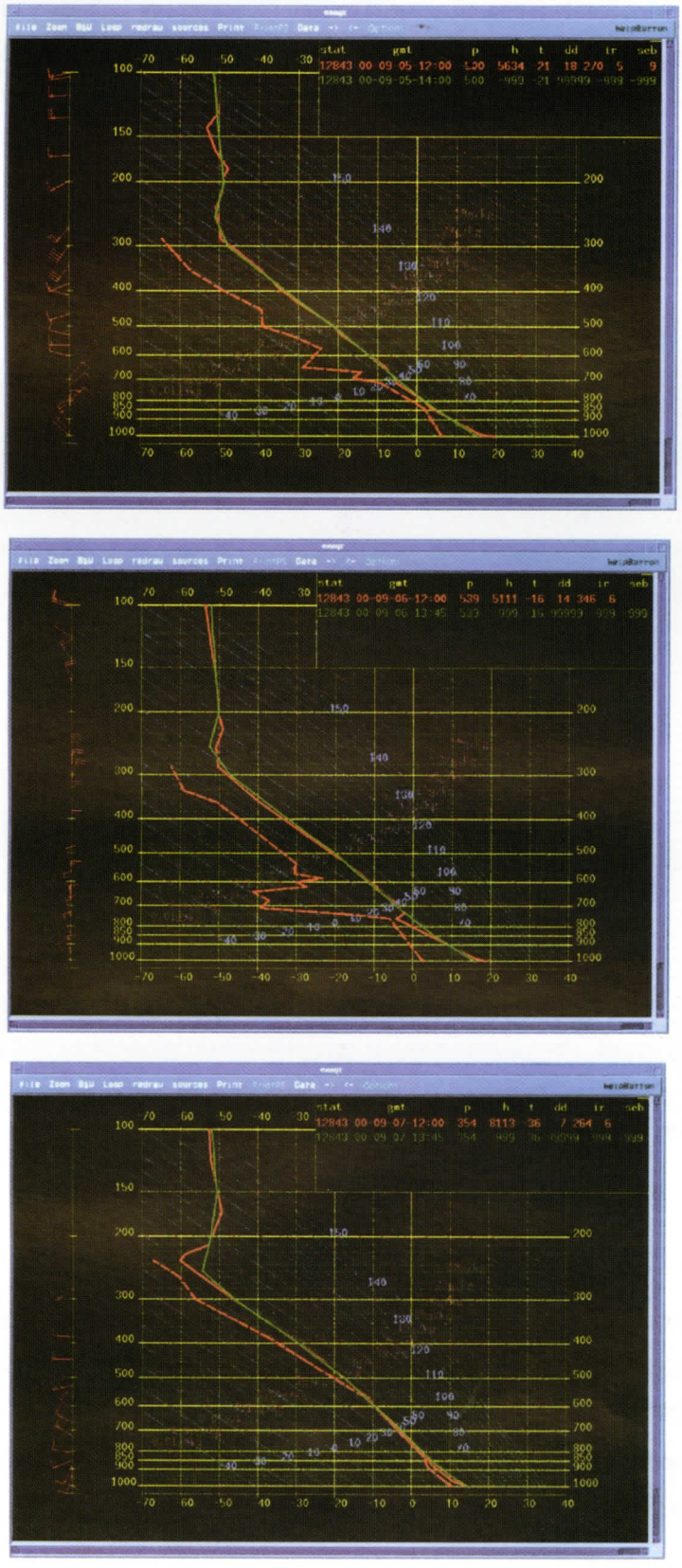

Fig.3 Emagrams of 3 consecutive days (red-dashed: radiosonde humidity; red-line: radiosonde temperature; green line: TOVS temperature)

Based on the results of the first month of the *objective evaluation* (fig.5/a-e) we concluded, that the ICI model does not have a horizontal systematic error. The relief has a strong influence on the temperature of the 1000 hPa layer, causing big differences up to 5 °C. For Southern Europe the ICI model overestimates (for 3 °C as a maximum) the 100 hPa layer temperature. The bias, calculated from the 2x10 orbits statistics is between -2 °C and 2 °C for all the layers in most of the cases. All the bigger deviations were caused by the processing of one or at maximum two erroneous orbits. We mark, that one could find some calculation uncertainty over the sea, but this is not important for the Hungarian forecasters.

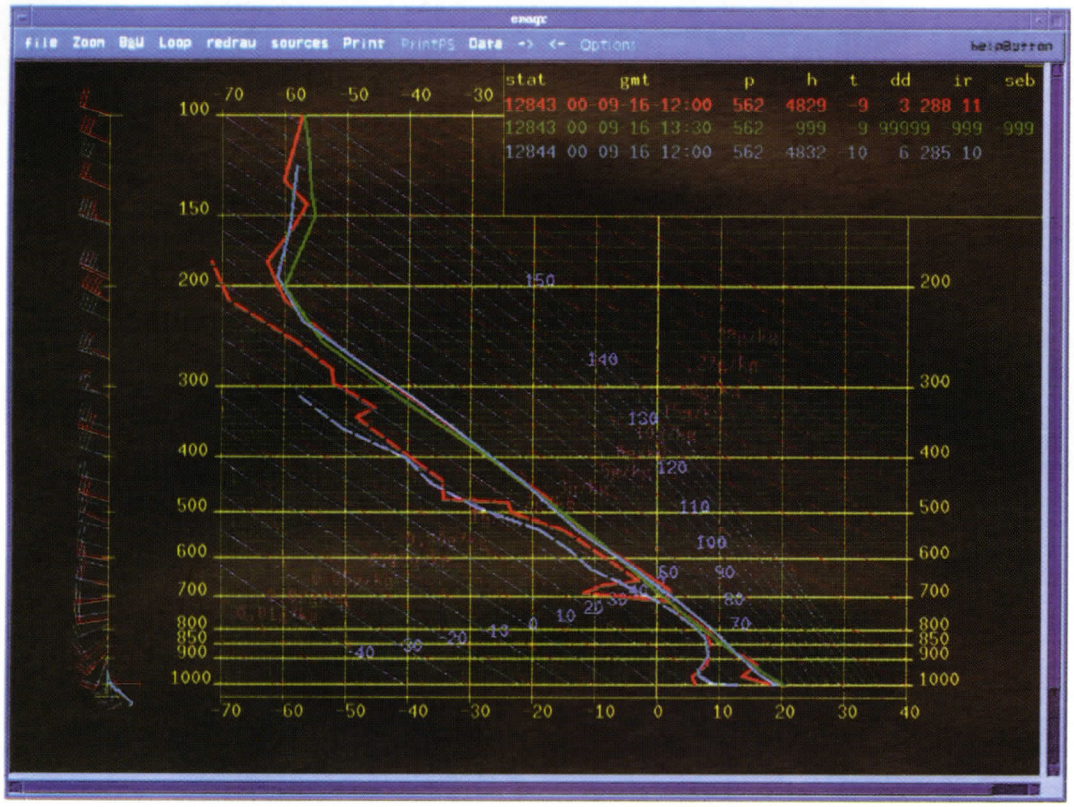

Fig. 4 Comparison of the TOVS profile (green line) with radiosonde (red) and ALADIN "pseudo-TEMP" (blue) (line- temperature, dashed- humidity)

5. FUTURE PLANS

- The current version of the ICI does not use any observed profiles (TEMP is switched off). It would be desirable to involve the upper part (layers higher than 100 hPa) of the radiosonde profiles as a first guess into the TOVS retrieval scheme.
- Until now we concentrated our attention on the evaluation of the *temperature* profiles, because the humidity profiles still need to be corrected using AMSU-B channels.

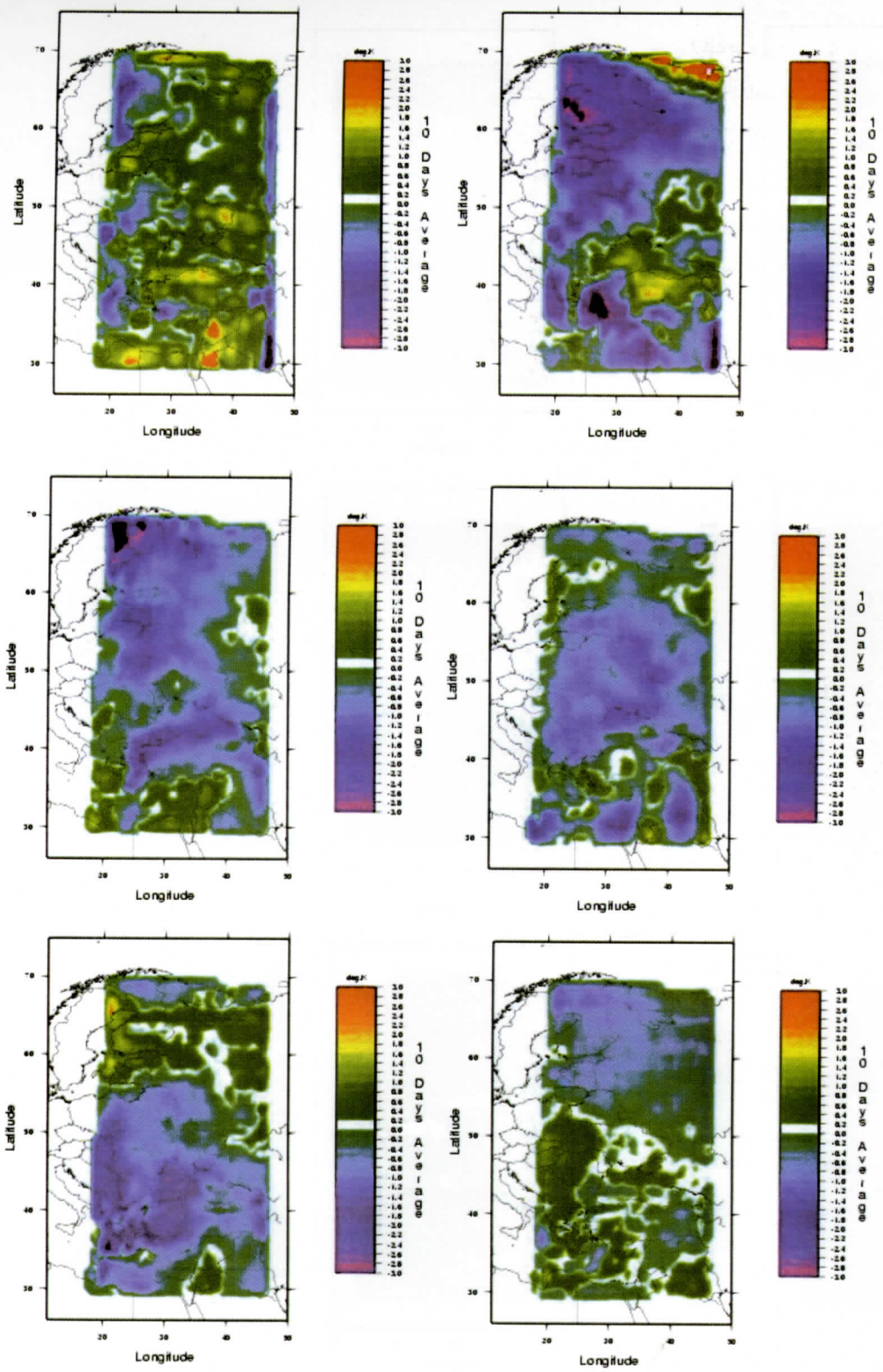

Fig. 5/b Temperature bias for the first 10 orbits at 00 UTC: 100 (left, top), 850, 700, 500, 300 and 100 hPa (right, bottom)

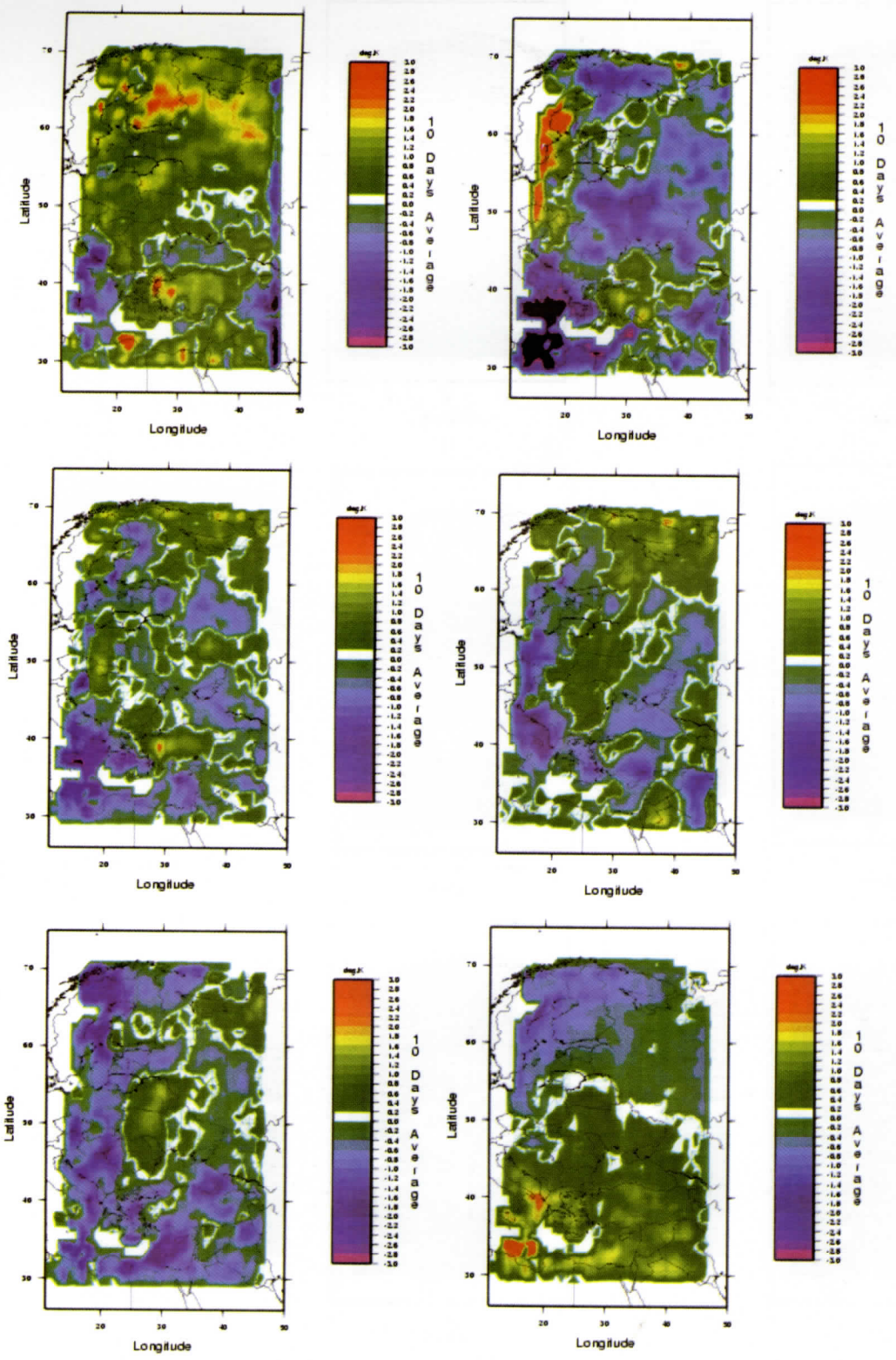

Fig. 5/c Temperature bias for the second 10 orbits at 00 UTC: 100 (left, top), 850, 700, 500, 300 and 100 hPa (right, bottom)

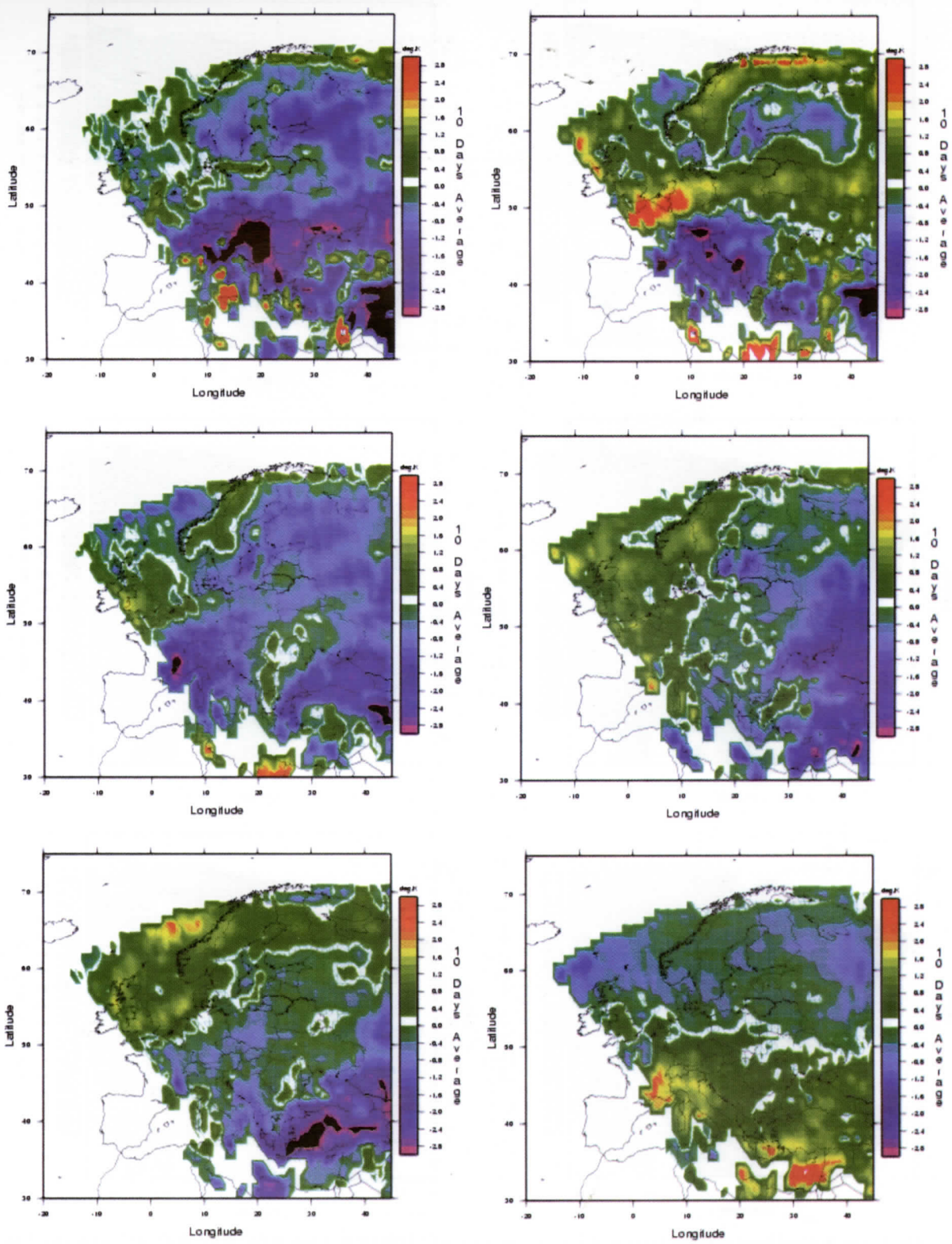

Fig. 5/d Temperature bias for the first 10 orbits at 12 UTC: 100 (left, top), 850, 700, 500, 300 and 100 hPa (right, bottom)

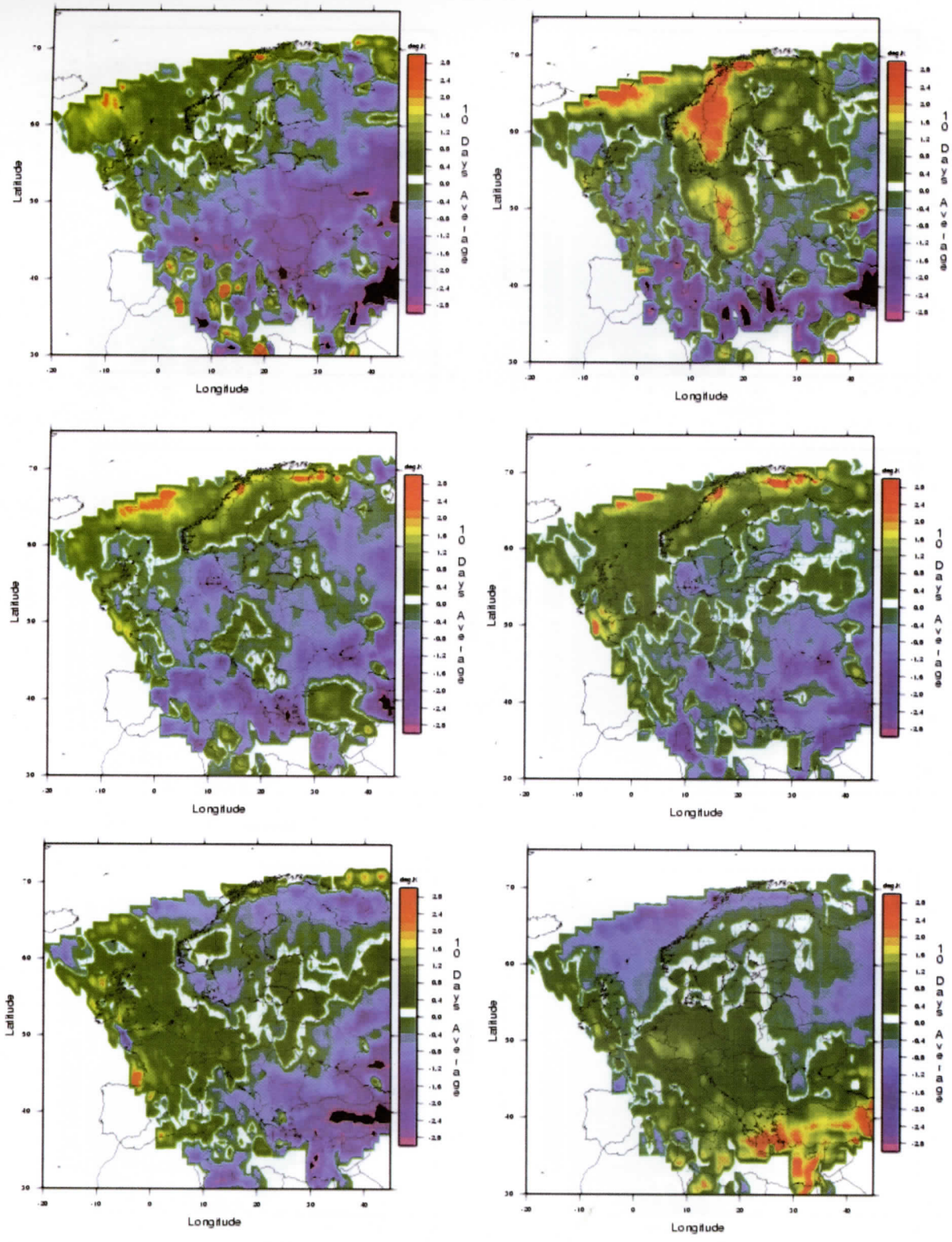

Fig. 5/e Temperature bias for the second 10 orbits at 12 UTC:100 (left, top), 850, 700, 500, 300 and 100 hPa (right, bottom)

ACKNOWLEDGMENT

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