The grid editor and verification results

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Introduction

The grid editor has been used at FMI since spring 1999 (Kilpinen 1999; Pietarinen and Kilpinen, 2000). The editor software is still under development and some major changes will be implemented within the next 12 months.

One of the problems with the editor is that the present version is too complicated for forecasters. In the next version the user interface will be made less complicated. This means in practice that some kind of scripts or macros will be used and the complicity will be hidden behind the buttons.

Maybe the most difficult thing to forecasters is to learn to think in a different way. The way synoptic meteorologists are used to think (conceptual models) is not anymore as relevant as it used to be when one handles gridded fields of meteorological parameters. However, the editor is approved as an elementary part of the production system at FMI. The editor is used in central forecasting office (Helsinki) and in three local offices (Tampere, Kuopio and Rovaniemi). The central forecasting office is in responsible of forecast length between 1 to 7 days. The local offices take care of shorter nowcasting forecasts lengths with higher editing frequency.

The edited data is used to produce thousands of different commercial and non-commercial products per day and so the edited data is a fundamental part of the production system at FMI. The exact number of updated products is impossible to estimate precisely because most products are generated on demand. The system architecture is shown in Fig. 1.

The edited data is also used as input to other models. The surface model uses the edited data to estimate road surface temperature and road conditions. The plan is also to use the edited data as a first guess input for aviation production.

The recent verification results indicate that editing of gridded data by the forecaster is able to add value to model data at shorter lead times. The quality of grid editing is comparable to traditional point editing. This means that now the same quality can be assured for much more locations than earlier. This is important from economical point of view.

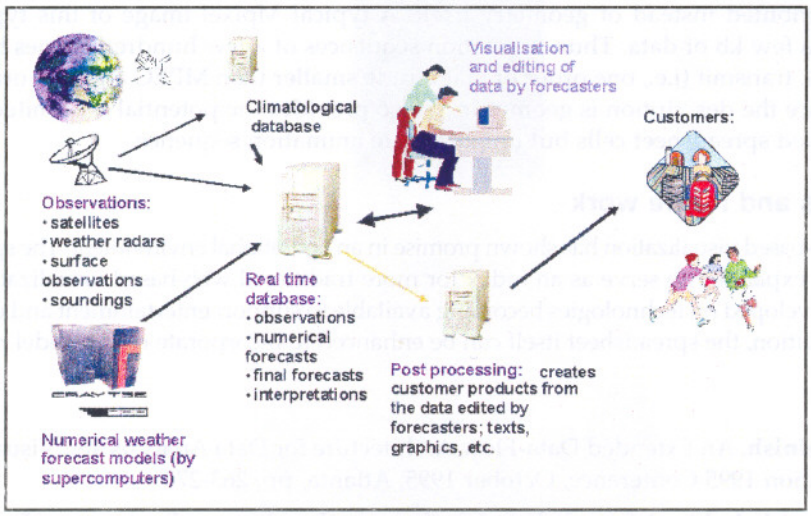

Fig. 1: Flow diagram of the automated production system at FMI.

Grid editor

The idea of the editor is to edit or check time series of different variables using masks or combination of masks. Time-series editing tool (Fig. 2.upper middle panel) can handle all grid points or one can limit the number of point by using a mask. The mask can be any other variable available in the system, topography, land-sea mask, any forecasted variable, any error estimate etc. So the editor tries to handle both spatial and time editing at the same time. A mask is a kind of dynamical filter, which allows conditional changes in time and space.

The editor has a main window with a map display and a toolbar. The main window can display one area at a time but the system can overlay several variables. This window is shown in Fig.2 (left panel). Today the data consists of hourly model data from Finland. We have also radar data for nowcasting work.

The editor has many (maybe too many) editing tools (Fig. 2). At the moment the data is edited using both **time-series editing** tool and the two different **paint brush** (spatial editing) tools. Also **time and spatial shifting and smoothing** tools are available. The mask can be combined to some of these tools.

A new tool is so called **control point editing** (Fig 3.). You choose as many point as you wish and then you can make a detailed description of weather time-series. Once the editing has been made for several points the interpolation to all grid points is made using increments (delta functions), not directly from grid point values.

With the present version of editor new probability tools are available. The uncertainties are estimated to a grid point using values from a grid square around the point. The developers are able to apply all possible uncertainties in final products. An example of this is presented in Fig. 4.

To help the forecasters the text generator has been implemented to the system. The text generator is normally used to generate mobile weather (WAP/SMS) forecasts. Once the text generator is activated a new window appears and one day as well as three days forecasts are generated on line from that point where the cursor is pointing.

The generation of graphical products for visualisation purposes is also connected to grid data. A set of newspaper products are generated on line to help the forecasters to see how their grid data looks like on a possible newspaper page. The system generates the products on Postscript and jpeg form (Fig. 5).

The software is written in C++ and it is running on Windows-platform (NT and 2000).

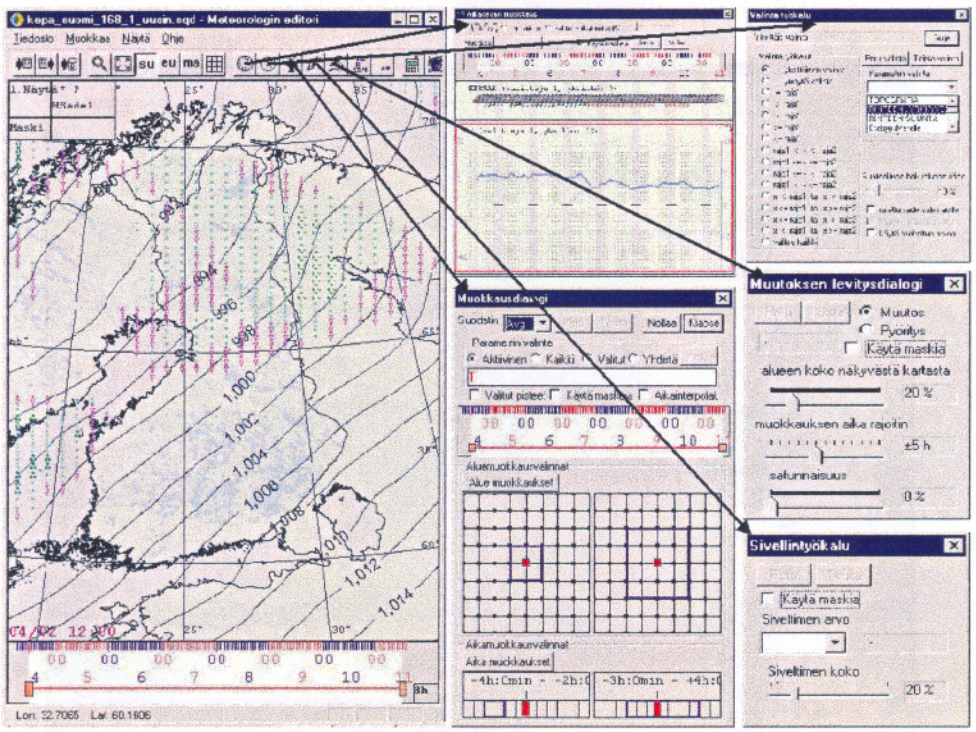

Fig. 2: The main display window of the grid editor software (left panel). The toolbar is at the top of the window and the time ruler is at bottom of the window. The other tools (time-series editor (upper middle), smoothing/time shifting tool (lower middle), mask control (upper right) and two paintbrush tools (lower right).

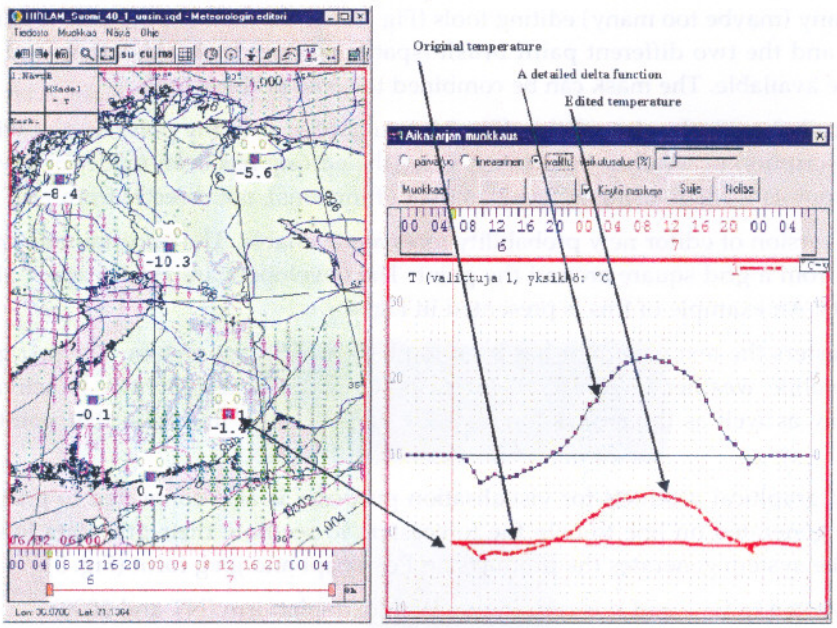

Fig. 3: Control point editing tool combined with time-series editing window.

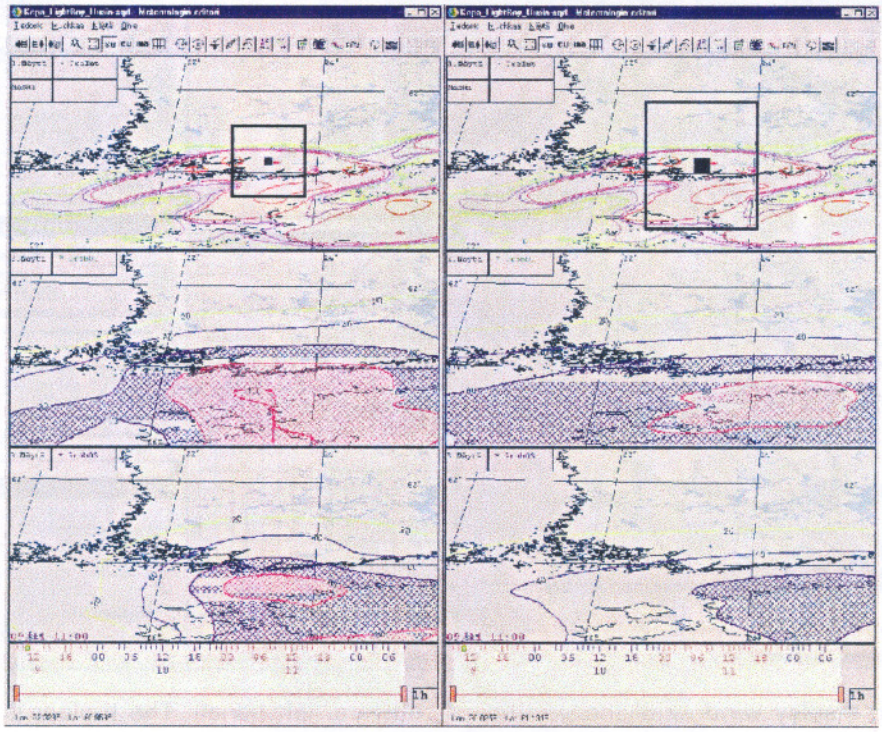

Fig. 4: Visualisation of probability fields of shorter forecast length with smaller grid square (left) and longer forecast length with larger grid square (right). The rain intensity (upper), Pop (r>0.1 mm/h) (middle) and Pop (r>0.3 mm/h) (lower).

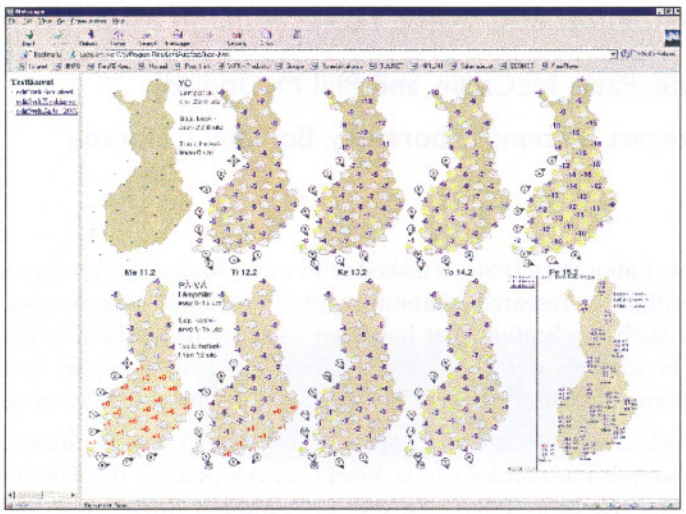

Fig. 5: An example of the products (newspaper page) generated online from grid data.

Verification results

A comparison has been made between the traditional point data and grid data edited by forecasters and the model data. The grid data has been interpolated to same stations. The period covers one year from December 2000 to November 2001. The minimum and maximum temperature forecasts from 3 stations were only considered. The stations are Helsinki-Vantaa Airport (02974), Tampere-Pirkkala Airport (02945) and Sodankylä (02863). The number of cases is not exactly the same and it has to be kept in mind when evaluating the results.

The forecasts lengths were from +12h - +5 days corresponding to a bit longer lead times in model data. Both ECMWF and HIRLAM models were considered without any statistical post-processing.

The verification results in Fig. 6. indicate that on average a forecaster is able add value for temperature forecasts and the quality of grid editing is about the same as the quality of point editing. The most of this added value comes from shorter time scales and cold season when temperature inversions occur more frequently.

In precipitation forecasts the same kind of increase in quality can not be seen (not shown). This is partly caused by the fact the operational verification compares model output from an area of the order of 1000 square kilometres while an observation corresponds to an area of 1000 square centimetres.

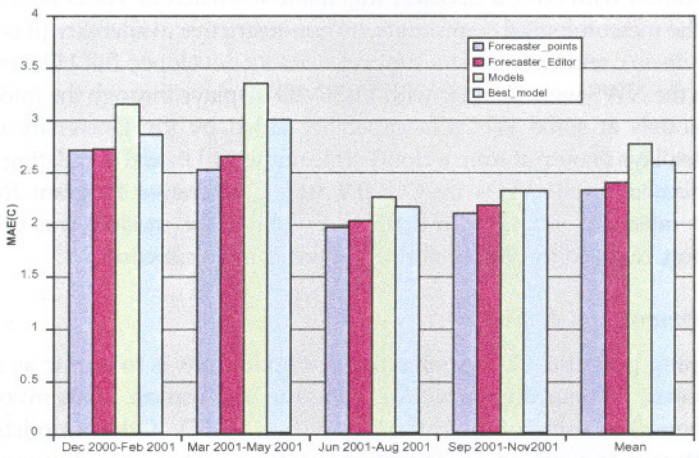

Fig. 6: Mean absolute error (MAE) of temperature forecasts made by duty forecasters (traditional point editing and grid editing) and models (ECMWF/HIRLAM) for 3 stations.

References

Kilpinen Juha, 1999: The grid editor and other new developments at the FMI, Proceedings of Seventh Workshop On Meteorological Operational Systems, ECMWF, 15-19 November 1999, 217-222.

Pietarinen Marko and Kilpinen Juha, 2000: The grid editor, Proceedings of the 11th EGOWS Meeting held at FMI, Helsinki, Finland, 5-8 June 2000, 117-120.