Probabilistic Forecasting at KNMI

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1. INTRODUCTION

In the winter of 1992/1993 ECMWF made its ensemble products quasi-operationally available to the member states. This coincided with developments at KNMI, where experiments with a probabilistic forecast scheme for the short range had reached a stage where results needed to be tested in an operational environment. It gave us the stimulus to integrate both schemes, and try the integrated system out on a selected group of operational forecasters, and, above all, evaluate their comments and response.

2. THE PROBABILISTIC SCHEMES

2.1 EPS

The ECMWF ensemble prediction system (EPS) aims at the medium range. The EPS ensemble provides the user with possible alternative forecasts to the single deterministic forecast (Buizza, 1992; Palmer et al., 1992).

From the large range of possible parameters (circulation as well as weather parameters) a small subset was used.

the operational Fax products:

1) plume diagram T850 , Z500 and precipitaion

products at KNMI:

2) daily clusters (Z500, maps at day 5,6,7,8,9,10);
3) stamp plots (Z500, maps at day 5,6,7);

An example of the clusters at day 7 is shown in Fig.1 . The clusters differ from the ECMWF clusters! The early response of forecasters was that the ECMWF clusters showed too little spread, and it was therefore decided to perform the clustering for each separate forecast day . In this way the day-to-day consistency was deliberately sacrificed. Such clusters are to be interpreted as a summary of the ensemble of each day, and the forecaster is expected to look for more detail in the stamp plots (if necessary).

The operational fax products were available to the operational weather service at KNMI; all other products in the above list were made available to the weather forecasting branch of the Royal Air Force, where they were used (as much as possible real time).

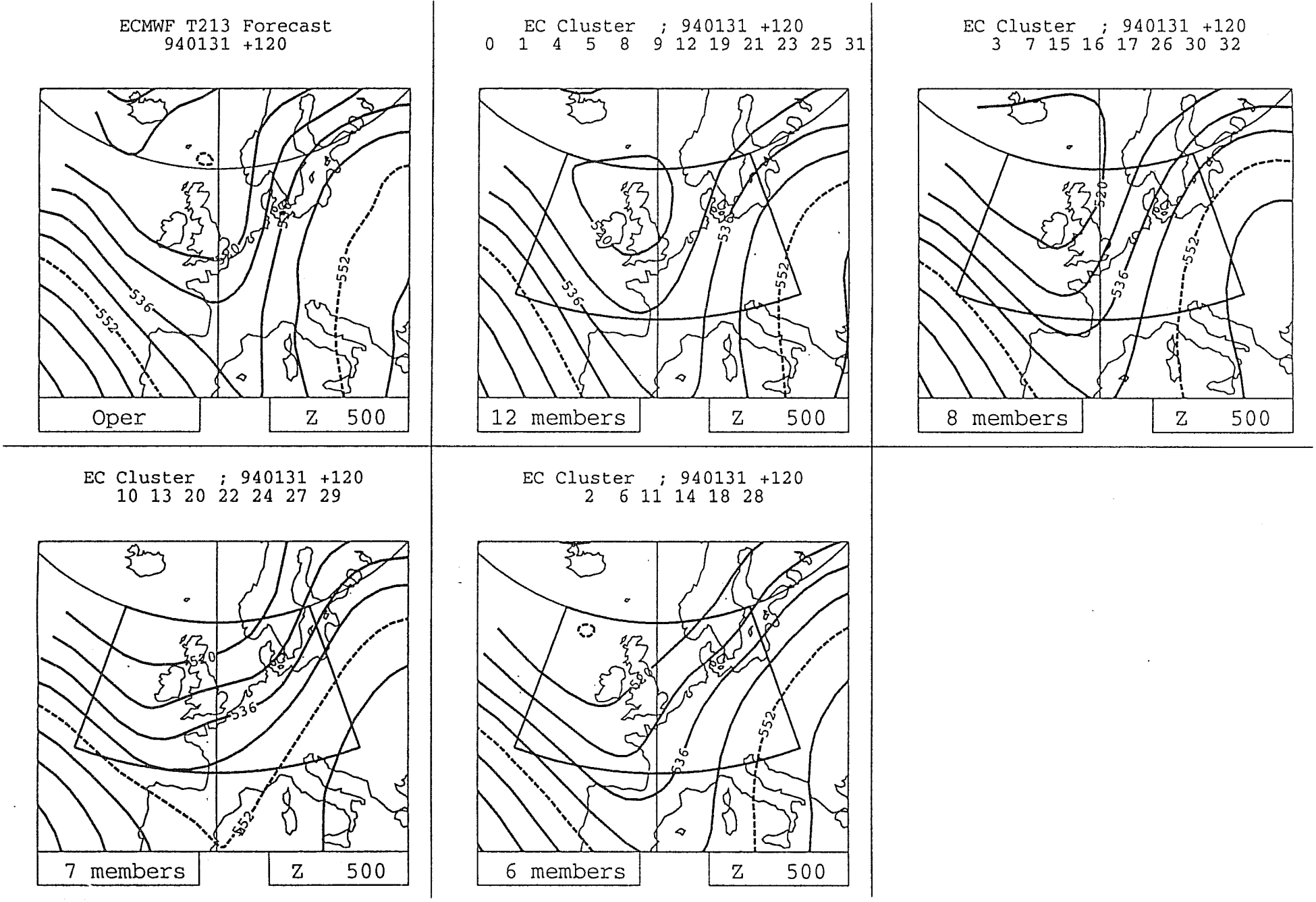

Fig.1 EPS ensemble. Clusters at 500hPa for the day 5 forecast from 31 January 1994. The top left hand panel gives the operational forecast, the remaining panels the clusters. Over the panels a list of the various members in each cluster is given. The clustering is carried out over the indicated area.

2.2 KNMI SCHEME

The KNMI error pattern estimate method uses a linear technique and is therefore restricted to the short range, where error growth is linear (Houtekamer 1993; Barkmeijer, 1993). A set of optimally growing circulation patterns and their probability of occurrence is calculated as eigenvectors and eigenvalues of the error covariance matrix, for forecast days 2, 3 and 4 and for a preselected area (Europe). All calculations are carried out with a 3 layer quasi-geostrophic model, linearized with respect to the operational ECMWF forecast. From the patterns a large set of alternative forecasts (2000) is constructed with a statistical technique assuming that the projections of the initial error on the optimally growing patterns are Gaussian distributed. Currently, this full set is clustered similar to the ECMWF system, whereas the population of the clusters represent probabilities. (See Fig.2, for a set of 500hPa clusters at day 2). Note that this ensemble is, by definition, centered around the ECMWF trajectory.

3. DISCUSSION

3.1 GENERAL FINDINGS

There was a great deal of interest in the probabilistic forecasts. However, there were several major restrictions in the subjective verification:

(1) Written Forecasts are issued in a deterministic way.

All forecasters realize the potential of probabilistic forecasts. However, probabilistic forecasts are difficult to handle in the current operational environment, where often a deterministic choice is required (in particular about the surface weather parameters). Alhough forecasters are very much aware of the uncertainty of a forecast (by comparing two models or by comparing an entire ensemble), this uncertainty has usually disappeared when the forecast is presented in a written form to the outside world. The Met Service and the users, however, require a presentation in a deterministic format, even in the situation when models contradict each other (in the latter case one model solution is chosen). The result for the probabilistic forecast is that the most probable cluster is chosen, which is usually the cluster with the operational forecast. However, in our Air Force test group, clusters representing significantly different solutions were incorporated in the daily weather discussions and oral briefings.

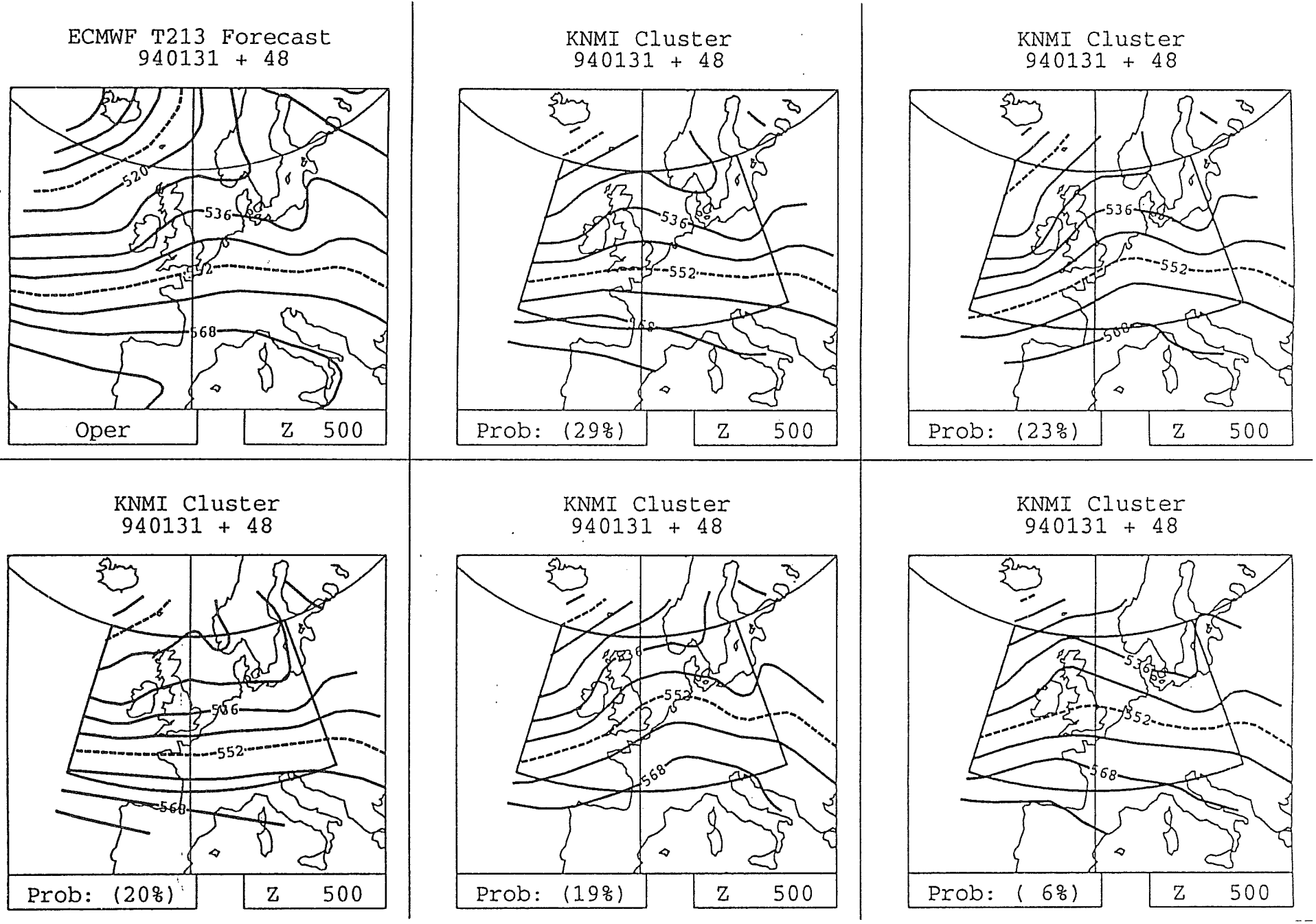

Fig.2 KNMI enemble. Clusters at 500hPa for the day 2 forecast from 31 January 1994. The poulation of each cluster is given in percentage. The ensemble consists of 2000 members (=100%). The top left hand panel is the operational forecast.

(2) No forecasts are issued for the range beyond T+144 (day 6).

There is a fairly common policy, both at KNMI as well as at the Air Force, not to go beyond this range. This did limit the verification of the EPS to the early medium range.

We have to bear these specific operational requirements and restrictions in mind when evaluating the new EPS products. An operational forecaster cannot easily adapt to the new situation and incorporate the EPS products in his schedule. A thorough verification and demonstration of skill of probabilistic forecasts (in the short and medium range) over deterministic forecasts will help the introduction of a new system.

3.2 RECOMMENDATIONS

There appeared to be a clear need for a presentation of the surface weather parameters and frontal positions. Probability maps are preferred over the plume diagrams. Work is underway at KNMI to derive guidance forecasts from the EPS and the KNMI scheme. A simple analog scheme, linking Tmin and Tmax to analog situations in the past, showed promising results (Kok and Lammers, 1993). This has to be followed up by a MOS or Perfect Prog statistical system.

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