Use of Ensemble Forecast Products in the Irish Meteorological Service

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Summary: Since January 1993 a range of products from the ensemble prediction system has been routinely received by the Irish Meteorological Service. Based on feedback from operational forecasters, and some preliminary verification studies, the usefulness of the ensemble forecasts is assessed. Some suggestions for additional products from the ensemble system are discussed.

1. INTRODUCTION

For each day on which the ensemble forecasts are produced, the Irish Meteorological Service receives the cluster mean and cluster standard deviation fields of 1000hPa and 500hPa geopotential and of 850hPa and 500hPa temperature, covering the European area for timesteps 72, 84, 96, 108, 120, 132, 144, 156, and 168 hr. In addition, 'plume' diagrams depicting the evolution of 850hPa temperature, 500hPa geopotential and total precipitation for three locations are routinely received.

The 72, 96, 120, 144 and 168hr forecasts of mean sea level pressure (derived from the mean 1000hPa geopotential fields) are plotted for each cluster and passed to the operational forecaster (Fig. 1). At the moment, these are the only products from the fields dissemination which the forecaster uses.

The graphical dissemination products are used directly by the forecasters (Fig. 2).

2. USE OF THE ENSEMBLE FORECAST PRODUCTS

The main points arising from feedback from the operational forecasters regarding the use of the ensemble forecasts are summarised below.

2.1 The forecasters expect that the cluster mean fields will depict possible alternatives to the atmospheric development predicted by the operational T213 model.

The forecasts from the analysis of 12Z on 22/2/1993 provide a good example. The operational

120hr forecast (Fig. 3a) shows a strong northerly flow bringing arctic air down over Ireland, with a shallow low centre between England and Holland. The ensemble forecast system produced three clusters; the 120hr fields of mean sea level pressure for each are shown in Figs. 3b - 3d.

Cluster 1 (14 forecasts) shows a low centre in the Bay of Biscay and a north-easterly flow over Ireland. Cluster 2 (12 forecasts including the control forecast) resembles the operational forecast although the northerly flow over Ireland is less strong. Cluster 3 (7 forecasts) shows quite a different development, with a deep low forming to the west of the Iberian peninsula. In the event, the analysis of 12Z on 27/2/1993 (Fig. 3e) shows that the operational forecast, supported by cluster 2, provided the best guidance. Clusters 1 and 3 indicated possible developments which would have produced quite different weather patterns in the area of interest.

2.2 Differences between clusters are often too small to be noticeable.

In contrast to the above example, the ensemble forecast system may produce clusters showing little variation in the predicted atmospheric developments. Many operational forecasters have commented that the ensemble members do not seem to cover a sufficient range of variation to encompass all likely developments.

2.3 The consistency between the operational T213 forecast and the ensemble forecasts should indicate the reliability of the forecast.

When all the clusters support the operational forecast, the forecaster is likely to have a high degree of confidence in the model output. In many cases this may be justified, as shown by the forecasts based on the analysis of 12Z on 8/2/1993. The 144hr operational forecast (Fig 4a), and the corresponding mean fields from all 5 clusters (Figs. 4b - 4f) showed a trough crossing Ireland and the replacement of a southerly anticyclonic airflow by a cooler, Atlantic airmass. As the analysis of 12Z on 14/2/1993 shows (Fig. 4g) these forecasts captured the actual atmospheric development particularly well.

However, such consistency is no guarantee of reliability. The operational forecast (Fig. 5a) and all five cluster forecasts (Figs. 5b - 5f) based on the analysis of 12Z on 15/2/1993 showed Ireland under the influence of a northerly anticyclonic airflow at D+5. All the forecasts missed the development of a deep low to the west of Norway, which produced a north-westerly airflow over Ireland (Fig. 5g).

2.4 What relative weights should be given to the operational forecast (T213) and the ensemble output (T63)?

The lower resolution of the ensemble forecast system sometimes results in a reluctance to consider seriously any alternative atmospheric developments suggested by the cluster mean fields.

2.5 The graphical 'plume' display is considered to give a good overview of forecast development.

The 'plume' display has the great advantage of presenting the output of the ensemble forecast system in a condensed, easily-assimilated manner. Many forecasters will examine these products for an indication of how well the operational forecast is supported by the ensemble, using such consistency as a measure of the reliability of the forecast. However, as noted above, good consistency may not always indicate a good forecast.

3. FUTURE USE OF ENSEMBLE FORECAST PRODUCTS

3.1 There is considerable interest in the proposal to present charts of the probability of certain weather events over Europe. Reliable probabilities of temperature anomaly and precipitation would be especially useful.

3.2 Some form of clustering would appear essential if the operational forecasters are to utilise the large volumes of output generated by the ensemble prediction system. However the present clustering arrangement, based on a large area (all of Europe) and time interval 120hr - 168hr, may not adequately meet the requirements of forecasters in the different member states.

3.3 Instead of the Centre distributing cluster products, it may be desirable to disseminate a selection of ensemble fields, allowing clustering or other post-processing to be done in the individual member states. The Centre might supply the member states with software to generate clusters for user-selected areas and time-steps.

4. ACKNOWLEDGMENTS

I wish to thank Tom Sheridan and Jim Logue, both of the Irish Meteorological Service, for their help in the preparation of this paper.

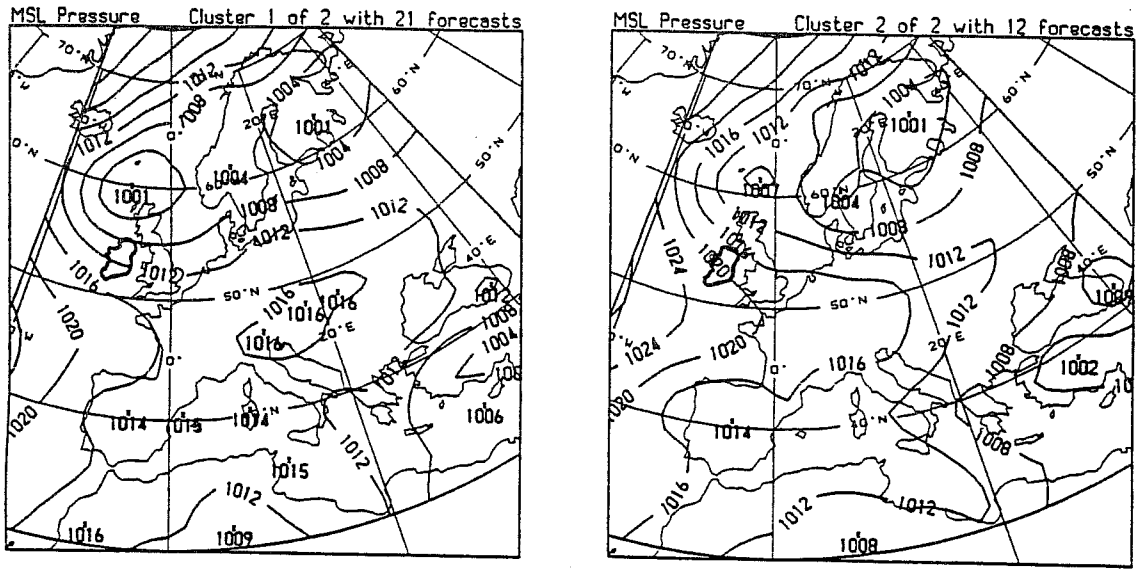


Fig. 1 Cluster mean fields of MSL Pressure
144hr forecasts from analysis on 3 July 1993

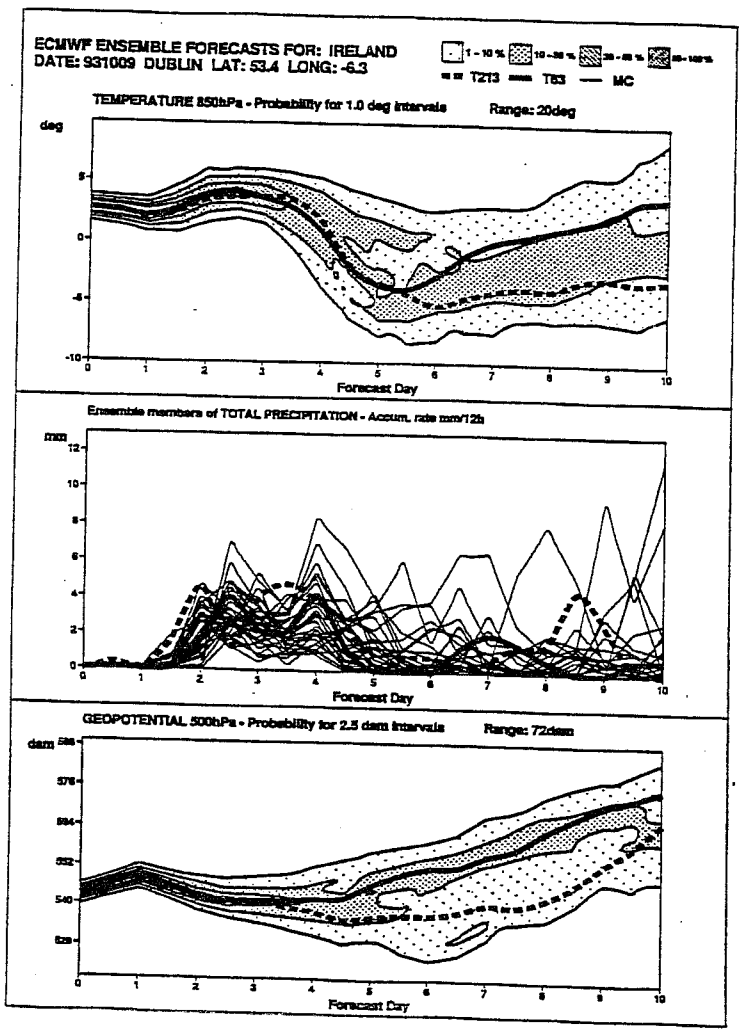


Fig. 2 'Plume' forecast for Dublin from analysis on 9 October 1993

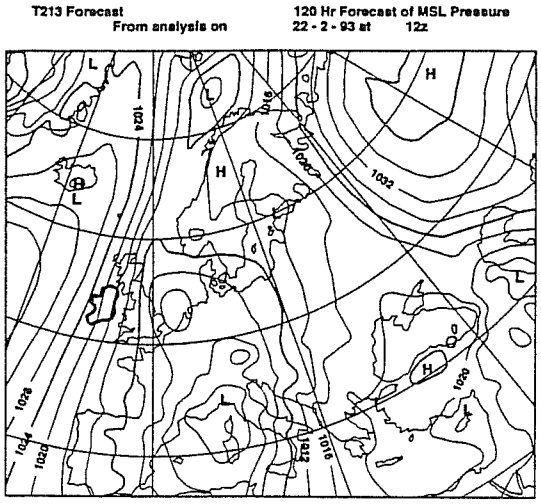


Fig 3a T213 Forecast

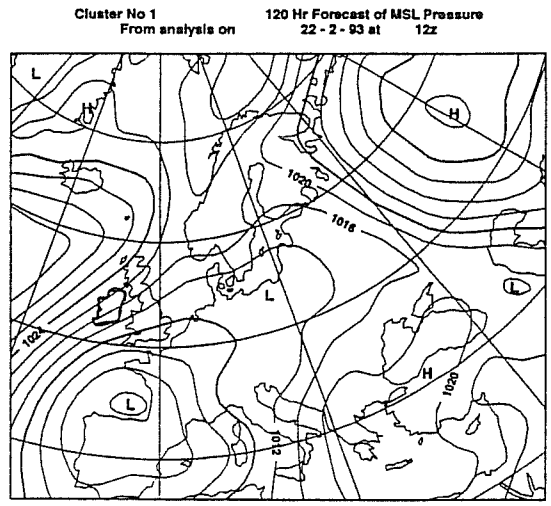


Fig 3b Cluster 1

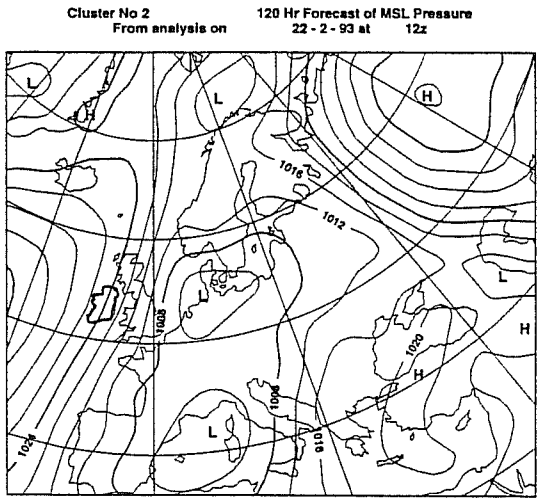


Fig 3c Cluster 2

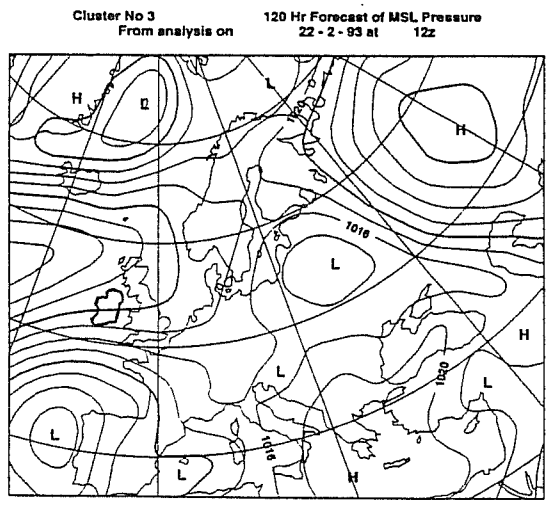


Fig 3d Cluster 3

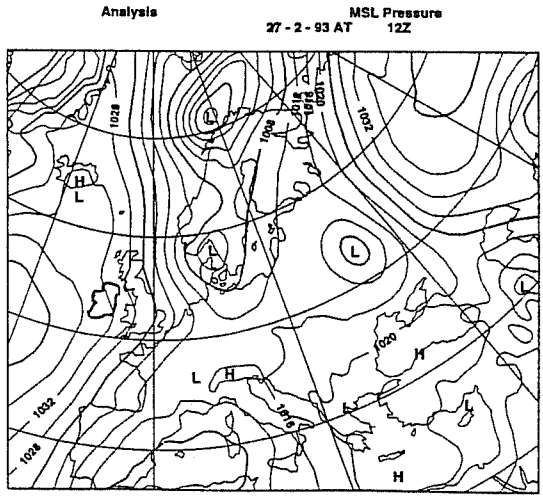


Fig 3e Verifying Analysis

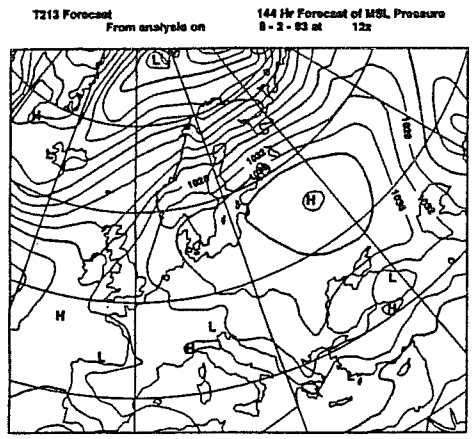


Fig 4a T213 Forecast

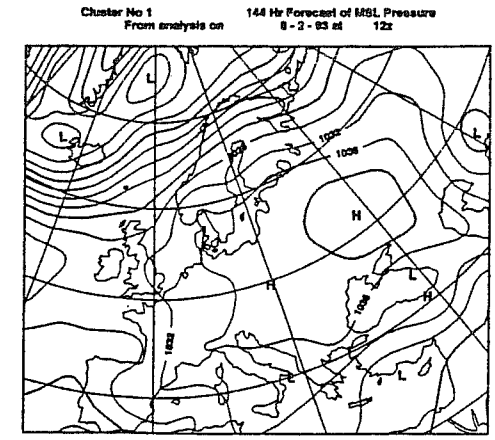


Fig 4b Cluster 1

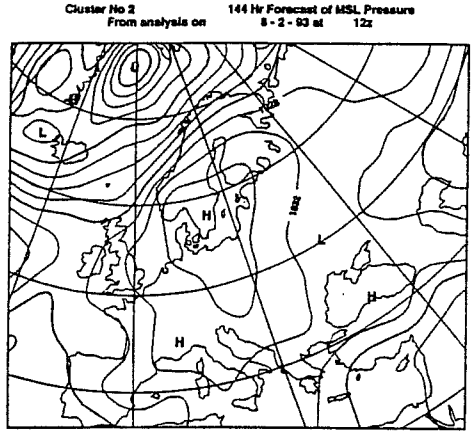


Fig 4c Cluster 2

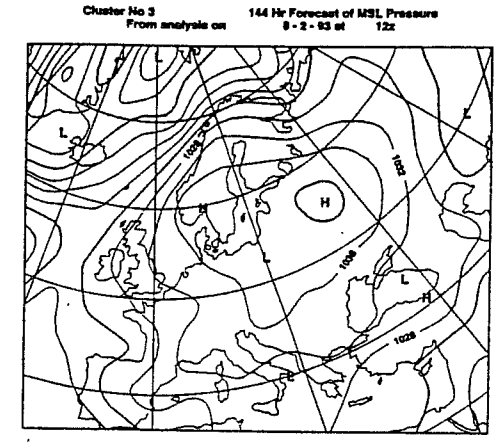


Fig 4d Cluster 3

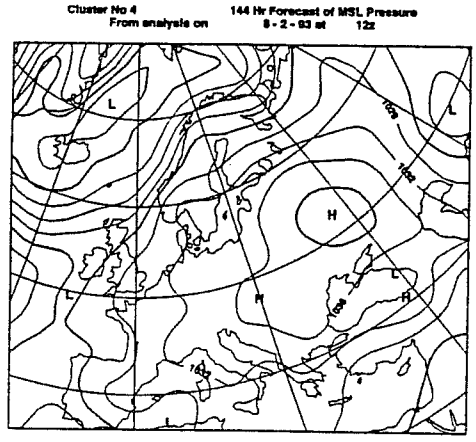


Fig 4e Cluster 4

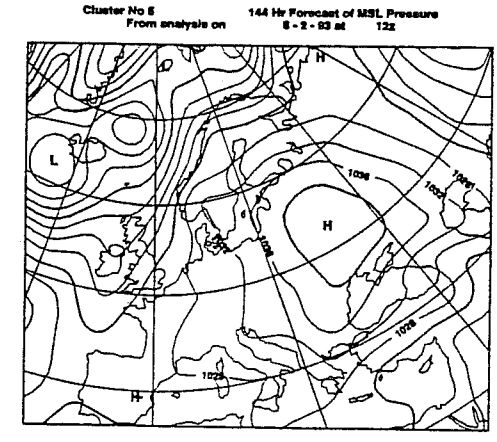


Fig 4f Cluster 5

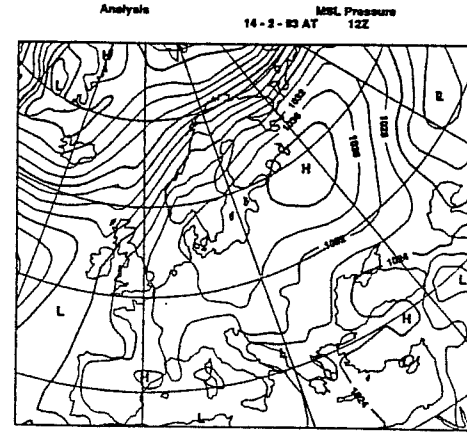


Fig 4g

Verifying Analysis

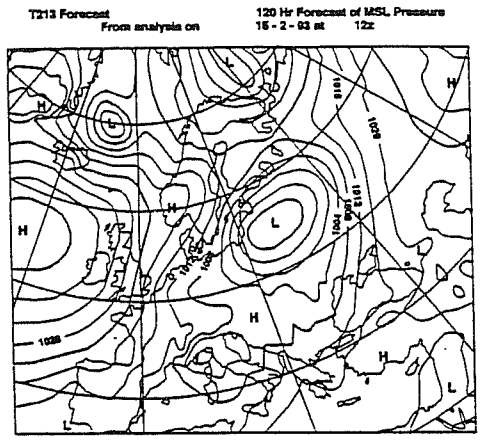


Fig 5a T213 Forecast

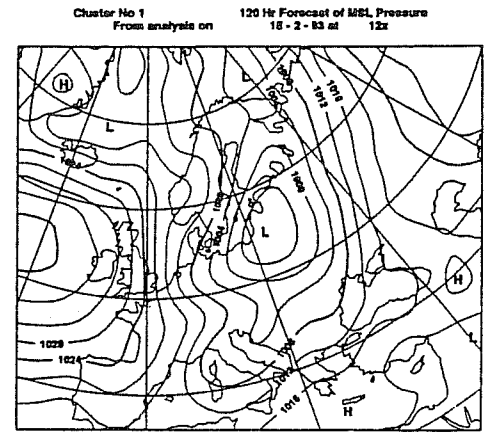


Fig 5b Cluster 1

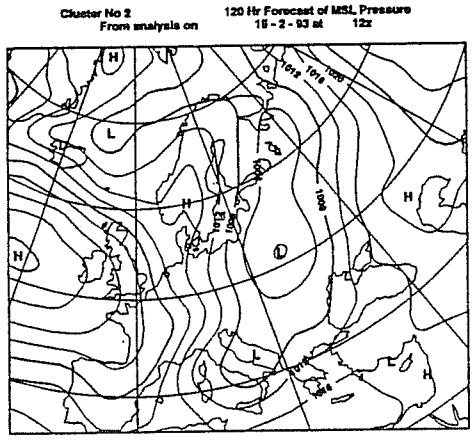


Fig 5c Cluster 2

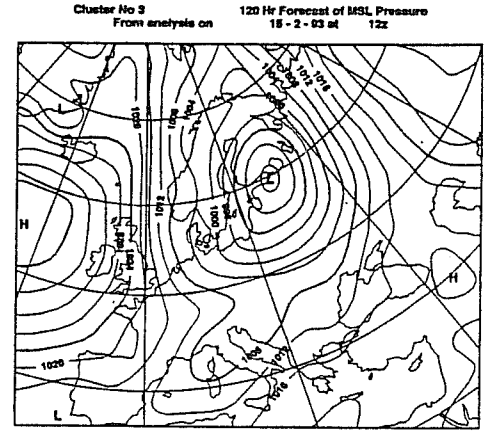
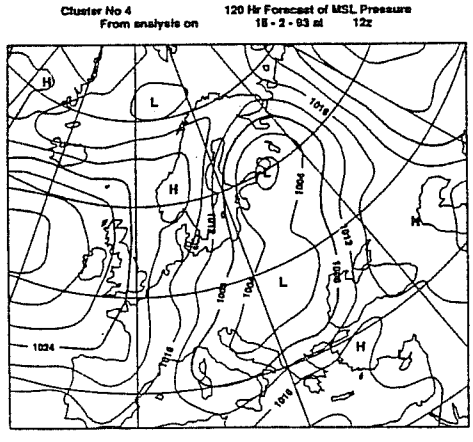


Fig 5d Cluster 3



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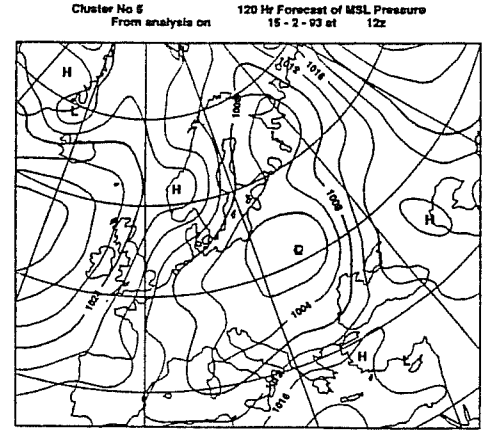

Fig 5f Cluster 5

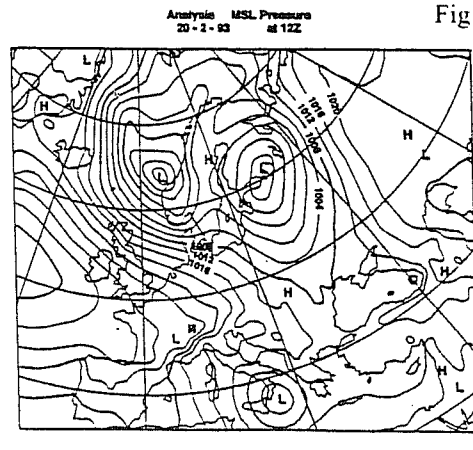

Fig 5g

Verifying Analysis