

# METHODOLOGY FOR OBJECTIVE FORECASTING

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The purpose of this note is to draw attention to an objective forecasting aid methodology employing a modified 'perfect prog' strategy for use in conjunction with numerical prognosis models. This approach is considered to be better suited to prognosis and weather forecasting development arrangements in Australia than are other methods, including the standard 'perfect prog' approach and the model output statistics (MOS) method, which are in widespread use elsewhere in the world to deduce quantitative weather forecast values from broadscale numerical prognosis fields.

Price (1979) reviewed and commented on model output statistics (MOS) and so-called 'perfect prog' techniques, noting that:

- a long record and a restricted number of potential parameters is used with the 'perfect prog' approach and the method does not take into account errors of the numerical prognosis;
- a shorter record and a large number of potential parameters has been used with the MOS technique, which implicitly accounts for prognosis model errors. However, the MOS regressions may require reworking when operational changes are made to numerical prognosis models.

The status of objective forecasting in Australia was discussed at the Bureau of Meteorology Forecasters Conference in July 1978. Special reference was given to the derivation of specific weather forecasts from broadscale prognosis charts.

Current organisational arrangements in Australia for application of so-called numerical weather prediction (NWP), have developed as follows:

- Australian Numerical Meteorology Research Centre (ANMRC) in conjunction with the Bureau of Meteorology develops a new or improved numerical prognosis model that provides a broadscale prediction of typical meteorological parameters, e.g. isobaric pattern, height of a constant pressure surface, etc.;
- after extensive model operational testing and comparative evaluation in the Bureau of Meteorology over a period, using particularly the well known S1 skill score, a decision is taken on whether a new model is an improvement on the old operational one. These new broadscale prognoses may then be provided routinely to Regional Forecasting Centres where they are subjectively utilised as guidance material in preparation of local operational weather forecasts.

The character of these two distinct steps and organisational differences appears to be unique to Australia. They do not appear to be so clearly separated, for example, in the US Weather Service, where MOS has been pioneered. It is evident in Australia that the application of objective forecast techniques for use in conjunction with numerical prognosis models has evolved very slowly. It is conjectured that the origin of this problem lies basically in the distinct separation of model development from model application. Given such a separation of function and accepting current development staffing limitations, an improved strategy for development of objective forecasting in this environment is now proposed.

This strategy combines contemporaneous statistical interpretive associations with a broadscale numerical prognosis output and quality control information as indicated in Fig. 1.

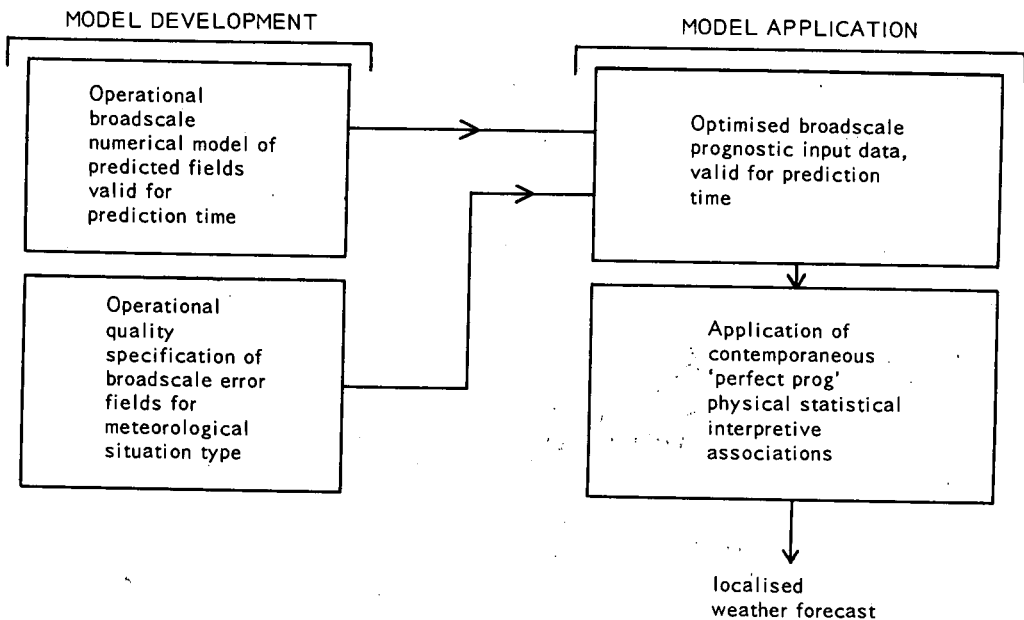


Fig. 1 Process diagram for applying the modified 'perfect prog' strategy.

Successful application of the strategy would require in the first place a more comprehensive description of the time and space error fields of numerical prognosis models than is available at present.

Each new numerical model intended for operation would need to be calibrated against a group of standard test meteorological cases representative of characteristic circulation types and intensities. The characteristic types would need to be carefully chosen for both their significance in forecasting weather and their utility in classifying the model error fields.

Thus a more adequate quality assessment would be made for each new numerical model as its development was completed. A significant advantage would be the early efficient evaluation of an improved model without incurring the expensive overhead of repeated real-time running of new models.

The second main aspect of the approach is the derivation of interpretive contemporaneous statistical regression associations 'off line' from numerical prognosis model development and operational use. Importantly, the statistical development data base would be based not only on the standard synoptic broad-scale analysis data, but also on model diagnosed initial fields at the forecast validity time. These diagnosed fields would include broadscale vertical motion, vorticity, divergence and moisture and further use of satellite imagery parameters could also be considered. The data base would then be classified into the desired characteristic circulation types referred to previously. The advantage would be that objective selection of useful forecast parameters could proceed with the guidance of physical laws besides those arising from observed statistical associations. The interpretive associations would be therefore based on observed and diagnosed atmospheric data and more likely to be soundly physically based because of much less contamination by prediction model biases etc. as in MOS.

Thus in operational practice a forecaster would recognise the prevailing circulation class, optimise the model predicted broadscale data for the forecast time, enter this into the relevant statistical associations and derive a specific weather forecast.

Briefly, the main advantages of the application of the strategy suggested here are seen to be:

- The testing and quality description of intended operational models could proceed in relative independence of forecast operations, thus allowing incorporation of improvements when they became available, without losses due to operational procedural redevelopment.
- Based on recognition of the circulation classes there would be a clearer mutual recognition of the quantitative performance standards that need to be met before justifying the change to the new operational numerical model.
- Development of meteorological broadscale to local physical/statistical interpretive associations could proceed in relative independence from model origination and developments.

Clearly there would still be scope for sound professional judgment both in the practical application of the error field specifications to prognoses and in application of the interpretive associations to weather forecasts.

Finally, this approach to numerical weather forecasting is designed to be able to improve utilisation of numerical model prognoses by explicitly incorporating model error characteristics, and promoting the practical realisation, and use, of scientifically based quantitative meteorological relationships undistorted by prognosis model bias.

## REFERENCE

Price, P.G. 1979. Objective forecasting: from prognostic charts to weather - a review. In *Proceedings of the Forecasters Conference, July 1978*. Bur. Met. Australia, 123-34.

