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Present Trends in Long-Range Forecasting at the U. S. Weather Bureau

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Dr. Berson of the Division of Meteorological Physics, C. S. I. R. O., Aspendale, discussed some of the developments in long-range forecasting methods he had seen during a ten months stay at the Extended Forecast Branch, U. S. Weather Bureau.

Essentially three main methods are combined in arriving at the so-called 30-day outlook; extrapolation of monthly mean upper air circulation patterns, their dynamical-empirical projection in time, and statistical specification of temperature and precipitation in terms of chosen circulation parameters (predictors).

In regard to methodology, if not to its bearing on the underlying processes, this combination appears to be broadly patterned on that used in extended (5-day) forecasting. However, there are important differences, too. For instance, in the latter case the application of the principle of absolute vorticity conservation (barotropic forecast) is inherent in two successive steps required to arrive at a 5-day mean map centred on the fourth day after forecast day. Together with an objective method of specification of the predictand, this has boosted extended forecast skill significantly.

In the longer range case, however, the emphasis is necessarily still on subjective extrapolation of dominant waves and judicious shifting of anomalies (deviations from the long-term average) on the monthly mean hemispheric maps. Significantly positive skill scores for forecasts of temperature and to a lesser extent, precipitation, must be ascribed at present to very long experience and sound judgment of the physical processes associated with the anomalies, such as blocking, surface influences, heating in the atmosphere, etc. However, the problem of introducing objective methods for both monthly circulation forecasts and specification of parameters is being vigorously pursued.

Parallel with these efforts go attempts to apply probability methods based on multiple regression equations derived by the so-called screening method and using electronic computers. As with the rather similar problem of specification, the aim is to minimise the number of predictors required (e. g. 700 mb contour height and temperature at remote points) and at the same time to maximise the multiple correlation coefficient.

While this method seems to be of considerable value to extended forecasting, in the longer range work considerations of scale require the use of mathematical functions for the pressure and temperature field and their time changes. Thus one part of the current operational research programme is concerned with the application of empirical orthogonal functions (of pressure and temperature) with time as well as space coefficients, which were developed at M. I. T. Meteorologically these have an important advantage over previously used theoretical functions of this kind, in that separate and independent contributions are made to the total variance accounted for by each of the individual functions, which, depending on their order, describe the large scale zonal or the smaller cellular features of the general circulation.

Simultaneously a search is going on for predictors suitable for long range forecast models of the future. As examples of this, two recent investigations in the Branch were briefly discussed. One dealt with the synoptic-scale approximation of the vertical distribution of heating in the atmosphere; the other, with the role of ocean-atmospheric interactions in the maintenance of sea surface temperature anomalies. This latter is part of the general problem of surface influences which are being studied synoptically on a hemispheric scale.