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PLANNED UPGRADE OF THE MEDIUM RANGE FORECAST MODEL

Since its inception in 1985, the Medium Range Forecast (MRF) model has undergone changes to improve its performance. The most important update was the inclusion of a physics package in late 1985. In the next few months, some dramatic changes are planned for the MRF. These changes have been made possible largely because of NMC's acquisition of the second Cyber 205 Computer in December 1986. This has enabled NMC to incorporate revisions in an experimental MRF, run it in parallel with the operational MRF and make direct comparisons of the output.

During the past few months, several other updates have been successfully run in parallel with the operational MRF and are planned for implementation later this summer. A few of the more important changes are detailed below:

1. Increased Horizontal Resolution - The current MRF is a 40-wave spectral model. NMC will increase the resolution to 80 spectral waves. This represents a giant step forward. Recent parallel runs employing the 80-wave MRF have demonstrated a marked improvement in performance. The physical processes calculated at each time step of the 80-wave model will be computed on a horizontal grid with 150 km spacing.

   It should be noted that the highly successful European Center's Medium Range Forecast model currently has a horizontal spectral resolution of 106 waves.

2. Gravity Wave Parameterization - It has been observed that as all spectral models extend to 4-5 days, the mid latitude westerlies become too strong and increase in strength with increasing projections. Increasing the surface friction had little effect in solving this problem. A planned solution is to parameterize gravity wave propagation.

   These gravity waves are the result of air flow over mountainous terrain and are not to be confused with gravity waves that are filtered during model initialization. These latter gravity waves are the result of data inconsistency (interpolation and extrapolation) and instrument errors. The gravity waves generated by higher terrain propagate vertically as well as horizontally, carrying momentum. As these waves in the real atmosphere reach higher altitudes, they tend to "break" (as ocean waves break on shore), resulting in a frictional drag on the westerlies. It is hoped that the parameterization of gravity waves in the MRF will lead to more realistic mid latitude westerlies in the extended range.

3. Diurnal Cycle - The operational MRF does not have a diurnal cycle. At each grid point, the mean solar angle is computed for each 12-hour portion of the forecast (00-12Z, 12-00Z). This mean value is then used to determine the solar input. The resulting value is used at each time step during the 12-hour cycle.

A "poor man's" diurnal cycle is planned. The mean solar input for each grid point will be calculated as given above. However, at each time step, this mean value will be multiplied by the ratio of the actual sun angle at that time to the computed mean sun angle. This simple scheme approximates the solar cycle very closely.

The above and other changes require more computational resources as given below.

MODEL	WAVES	COMPUTER TIME REQUIRED FOR EACH 24-HR FCST	COMPUTER TIME FOR 10-DAY FCST
PRESENT MRF	40	16 MIN	2 HRS 40 MIN
NEW MRF	80	24 MIN	4 HRS
EUROPEAN CENTER MODEL	106	24 MIN	4 HRS

The 80-wave MRF, therefore, takes 1 hour and 20 minutes longer to run to 10 days. This may mean that the data cut-off will have to be moved up in time. If the new MRF is run earlier, this could impact the NGM. These details have not been worked out yet.

The full impact of planned changes to the MRF, of course, will not be evident until we gain operational field experience with the revised model. However, it is safe to assume that somewhat more accurate guidance for 3-5 and 6-10 day forecasts will be likely.