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THE RAPID UPDATE CYCLE (RUC) AT NMC

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Editors Note: This Technical Attachment summarizes presentations made by Stan Benjamin (Forecast Systems Laboratory, Boulder, Colorado) at the September 24, 1993 Committee on Analysis and Forecast Techniques Implementation (CAFTI) meeting and during the recent Cooperative Program for Operational Meteorology, Education, and Training (COMET) Mesoscale Course held in Boulder, Colorado. The figures used have been taken from the presentations mentioned above.

The Rapid Update Cycle (RUC) is the name given by the National Meteorological Center for the Mesoscale Analysis and Prediction System (MAPS) developed at the Forecast Systems Laboratory (FSL). The RUC is composed of four components (Fig. 1): 1) observation ingest; 2) quality control; 3) objective analysis; and 4) the actual model run out to six hours. Observation ingest and quality control each require about 30 seconds of run time, while objective analysis requires about 7 minutes and the six-hour model run requires 5 minutes. Currently, the RUC is being evaluated at NMC through November and December, with implementation planned for February 1994.

The RUC is designed to produce frequent mesoscale analyses and short-range forecasts by utilizing hourly profiler data, hourly surface observations, aircraft wind and temperature observations reported by the Automated Commercial Aircraft Reporting System (ACARS), and rawinsonde data. From the ACARS, approximately 1500-2000 aircraft observations are available during each three-hour period centered on 1500, 1800, 2100, 0000, and 0300 UTC (Fig. 2). At night, the number of aircraft observations decreases to 500-600 observations for the three-hour time periods centered on 0600, 0900, and 1200 UTC (Fig. 2). Approximately 600-900 surface observations are also available each hour with data from 26 profilers. Data cut-off for each run of the RUC is 1 hour and 25 minutes from the analysis time.

The RUC will produce three- and six-hour forecasts, in addition to an analysis, every three hours (Fig. 3) using 60 km horizontal resolution with 25 vertical levels (Fig. 4). Future plans include decreasing the interval between runs to one hour. The RUC uses a hybrid isentropic-sigma vertical coordinate (Fig. 5). Isentropic vertical coordinates are used away from the terrain to capture upper-level jets and fronts more accurately. At the same time, sigma surfaces are used within the lowest levels of the RUC to resolve the terrain without the problems of vertical coordinate surfaces intersecting the surface.

MAPS has been running at FSL since 1988, while the current version has been used there in 1991. During this time, FSL has noted improved model forecasts due to the frequent updates of the model's initial conditions. That is, the three- or six-hour forecast from the MAPS (or RUC) tends to produce a more accurate forecast than the 12-hour forecast from the NGM, verifying at the same time. A Technical Procedures Bulletin (TPB) is being drafted and will be sent out near the time of the RUC implementation.

Observation Ingest

- **Gross Quality Control**
- **Check against platform reject lists**
- **Interpolation to analysis levels**

Observation Quality Control

- **Buddy check with surrounding observations**
- **Performed on isentropic/sigma surfaces**

Objective Analysis

- **Multivariate wind/mass analysis**
- **Univariate analysis of moisture and follow-up analysis of temperature**
- **Performed on isentropic/sigma surfaces**

Forecast Model

- **Isentropic/sigma (vertical coordinate) model**
- **Hydrostatic**
- **Stable and convective precipitation**
- **Surface fluxes and planetary boundary layer physics**
- **Forward/backward initialization**
- **NGM used for lateral boundary conditions**

Pre- and Post-processing

- **NGM data interpolated to RUC/MAPS grid points for lateral boundary conditions and cold starts**

- **Interpolation of RUC grids to isobaric and isentropic coordinates**

Fig. 1 Components of the Rapid Update Cycle

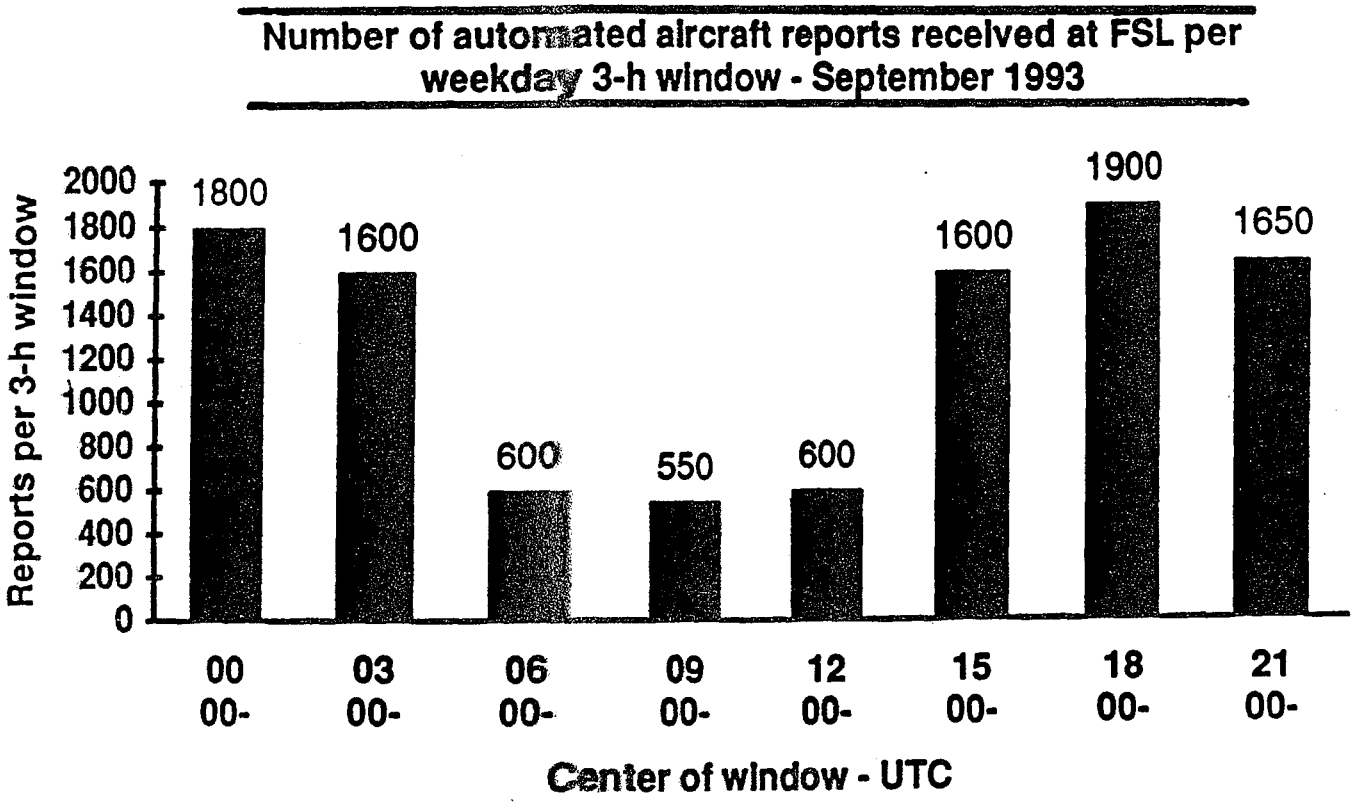

Fig. 2

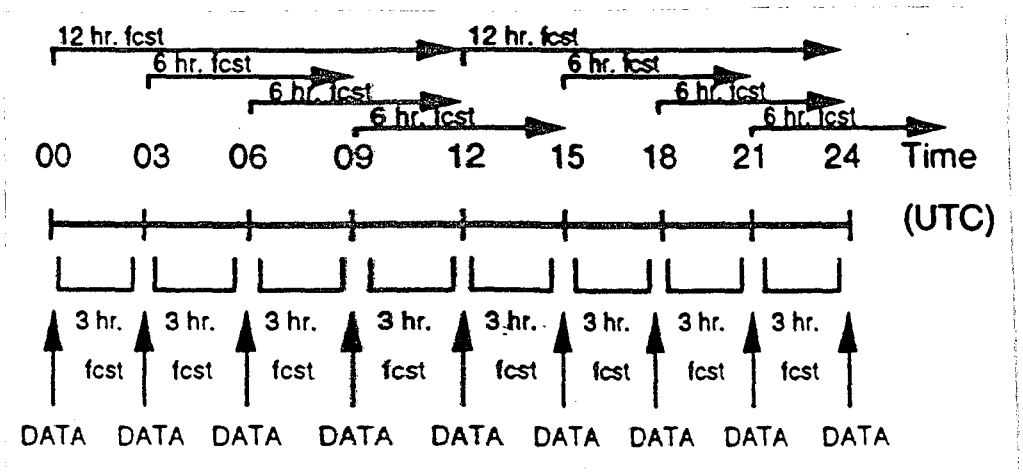

Fig. 3 Progression of the Rapid Update Cycle

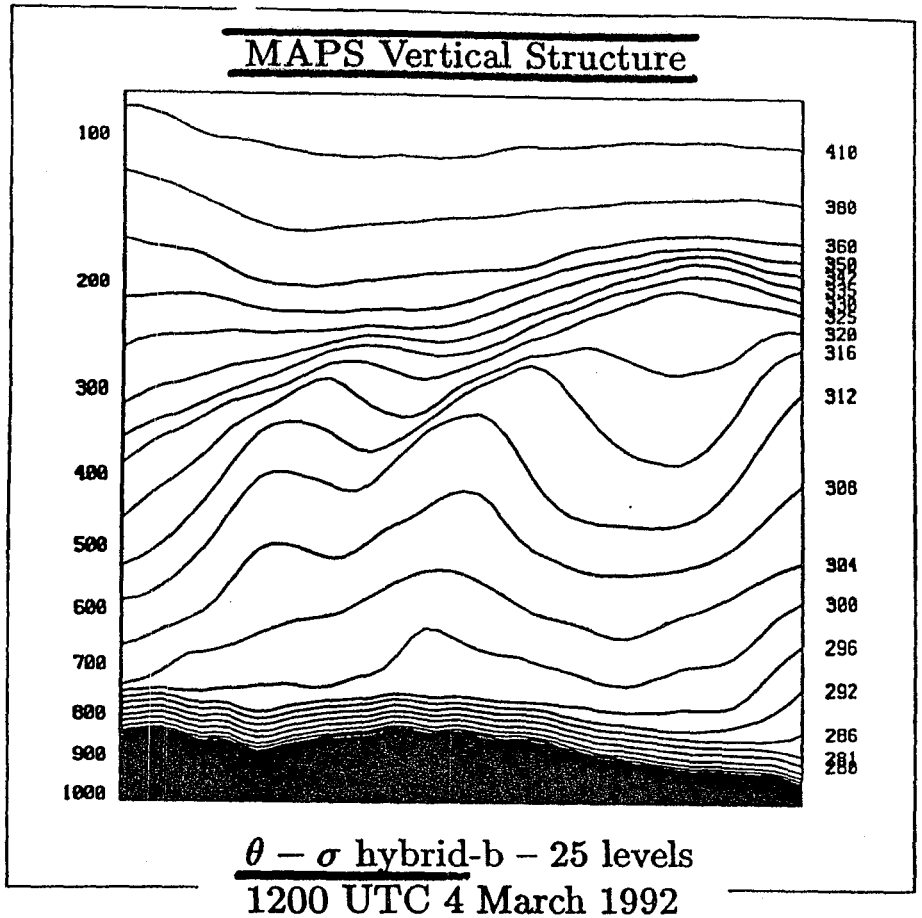

Fig. 5 An example of structure of vertical levels

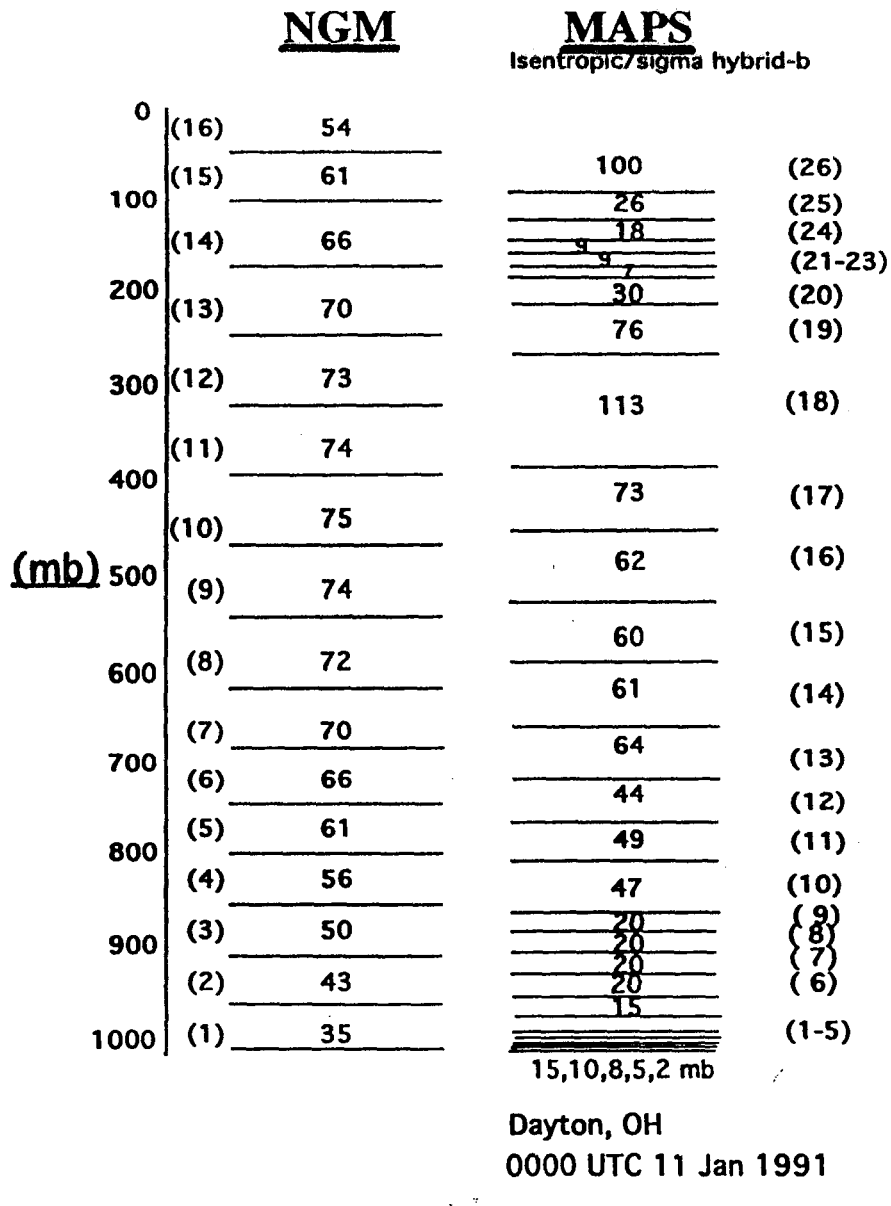

Fig. 4 Comparison of NGM and RUC vertical level distribution