Western Region Technical Attachment
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WHAT'S THE LATEST AT NMC AND TDL?

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In a rapidly advancing technological era, the National Meteorological Center (NMC) is maintaining the pace. A number of changes have occurred to the model suite in the past years and many more will follow. This Technical Attachment will summarize the recent changes as well as discuss the future plans for NMC. A figure summarizing the current NMC models has been included as well (Fig. 1).

CRAY C90-16

One of the biggest changes at NMC is the conversion from the CRAY Y-MP8 to the newer, faster CRAY C90-16 mainframe. This occurred within the last six months and the conversion of the operational model suite and jobstream to the new platform was recently completed. The Rapid Update Cycle (RUC) still runs on the Y-MP8 and, as of yet, has not been deemed "operational". With this faster computer system, both horizontal and vertical resolution can be increased within the models (Eta, Global Spectral Model, and the Meso-Eta) without compromising run-time. Therefore, the planned upgrades at the NMC discussed later in this attachment, hinge upon the full and successful transition to the C90 processor.

Early (ERL) Run

The purpose of this run is to provide a 48-hour forecast for North America as quickly as possible after 0000 and 1200 UTC. Therefore, it has the "earliest" data cut-off time of the entire model suite at NMC. On June 8, 1993, the Limited Area Fine Mesh (LFM) model was replaced by the Eta model in the ERL run. The LFM is still run at the NMC, however, it is only disseminated to the Alaska Region.

The Eta model is still considered to be in a state of change with minor improvements being tested almost weekly. Some of the more recent additions include an improvement to better handle shallow convection. The improvement doubled the amount of grid points experiencing shallow convection and slightly improved precipitation skill scores. Also, the shortwave radiation is now calculated every time step, which improved the reality of the diurnal cycle within the model as well as the surface temperature solutions, sensible and latent heat fluxes. An analysis upgrade is also planned to include more surface data will in the analysis, as well as a minor topography enhancement. These are not major changes, but do provide the "baby" steps to further fine tune the Eta model.

Overall, the Eta has much higher resolution topography and more improved physics than the Nested Grid Model (NGM). The boundary layer resolution is also better than the NGM. For example, the Eta model has 9 layers within the lowest 100 mb versus approximately 2.5 in the NGM. The shallowest of these layers is 2 mb thick in the Eta domain, compared to 35 mb in the NGM. Higher vertical resolution, centered near 250 mb, is also incorporated into the Eta model to better sample the jet-level wind field and associated jet maxima.

The first guess for the Eta model is derived from the six-hour forecast of the 0600 UTC and 1800 UTC run of the Global Data Assimilation System (GDAS). The GDAS is taken from the T-126 resolution Global Spectral Model. Due to the late data cut-off time, the GDAS run uses an extensive dataset for the initial conditions and provides a very comprehensive six-hour forecast. This will change in the near future, as a new Eta Data Assimilation System is under development. This system begins the initialization process at t-12 hours (where t=model start time) with a first guess from the GDAS. Integration through the first three hours then occurs (through t-9 hrs) and new data are assimilated. This process continues every three hours through the model start time, which slowly forces the model toward the actual 00h analysis and removes the need for model "spin up" within the first few model run hours.

Regional (RGL) Run

The purpose of this run is to compromise to a longer data cut-off time to produce the best possible 48-hour forecast for North America in an operationally significant timeframe. The hemispheric Nested Grid Model (NGM) has served as the model for this run. The NGM, and its associated analysis, are collectively referred to as the Regional Analysis and Forecast System (RAFS). The model was "frozen", meaning no more changes would occur in the code, as of December 1990.

One change which has occurred since December 1990, is in the initial snow cover fields. The modification is in the pre-processing segment of the model run and not in the actual model code. The NGM previously used a weekly update of snow cover provided through NESDIS. As of December 8, 1992, the snow cover over the Northern Hemisphere has been derived from the U.S. Air Force analysis with a horizontal resolution of 47.6 km at 60°N. The snow cover data are processed by 1700 UTC and available for the ensuing 0000 and 1200 UTC NGM runs. The alteration improved the cold season, low-level temperature fields within the NGM.

Aviation (AVN) Run

The purpose of this run is to provide model guidance and information to support of NMC's international aviation requirements. Most studies [Grumm and Siebers (1989a, 1989b, 1990), Grumm (1993), Mullen and Smith (1990), Smith and Mullen (1993)] confirm the AVN to have the best overall verification skill scores among the ERL, RAFS, and AVN, although the ERL (Eta) does not have a large sample volume. Consistently, surface anticyclone and cyclone location and intensity errors are lowest for the AVN. Since November 1986, the AVN run has been served by the Medium Range Forecast (MRF) model and is executed twice daily through 72 hours.

Medium Range Forecast (MRF) Run

This Global Spectral Model (GSM) is run at 1200 UTC through 72 hours (the AVN run), and at 0000 UTC out to 384 hours (16 days). NWS forecasters have access to the MRF data through 10 days. The remaining hours of the run (days 10-16) are used in the ensemble package. The GSM is also run through at least 6 hours as the Final (FNL), at 1800 and 0600 UTC, to produce the first guess fields for the Eta model runs through the Global Data Assimilation System (GDAS). Thus, the Eta model initialization stems from the GSM.

The horizontal resolution of the MRF was increased from Triangular Truncation-80 modes (T80, 160 km) to T126 (105 km) in March 1991. The number of vertical levels was increased from 18 to 28 in 1993. A number of other changes have been incorporated in the last year including the use of interactive satellite sounding retrievals. This has improved the GSM 250 mb wind forecasts over the tropics and oceans. It slightly enhanced the Northern Hemisphere jet-level forecasts, as well as tropical cyclone precipitation forecasts. The GSM also began using a new cumulus parameterization scheme. NMC plans to upgrade the GSM model to a T170, 42-level version later this year.

Rapid Update Cycle (RUC)

A new model run has been adapted (from the Forecast Systems Lab (FSL)) at NMC designed to "update" the forecaster with model guidance in the short term (00-12 hours). The RUC cycle runs the Mesoscale Analysis and Prediction System (MAPS) designed by FSL in Boulder through 12 hours, 8 times per day. Designed to enhance the short term forecast, the MAPS has a horizontal resolution of 60 km and 25 layers in the vertical. Running every three hours, it uses auxiliary data input from wind profilers and airline reports (ACARS). The RUC takes approximately 20 minutes to run on the Y-MP8 with a data cutoff time near t+1:20 hrs, which may be shortened to near one hour in the future.

It is currently disseminated only in gridded form and is still considered "non-operational". The data are currently available in three hour blocks, however, a change to hourly availability (in-house at NMC) will occur later this year. A decision on the means by which the hourly data distribution will occur, and its availability to the field, has not yet been made.

The Meso-Eta

A mesoscale, regional domain version of the Eta model is currently being run at NMC. The model has a horizontal resolution of 29 km and 50 vertical layers. The Meso-Eta, as it is called, will **not** replace the lower resolution Eta model in the ERL, but rather complement it. It is run after the AVN run, from which it obtains its boundary conditions, and is initiated at 0300 and 1500 UTC. The forecast projection is through 33 hours from 0300 or 1500 UTC. Look for more information later this summer on the availability of the now experimental Meso-Eta or refer to Black (1994).

Model Output Statistical (MOS) Guidance

- ♦ LFM - The LFM MOS is still being distributed and was abbreviated in 1993 to include only precipitation and temperature guidance. It is scheduled for termination on August 31, 1994.

- ♦ NGM - The NGM provides the model data used for the NGM MOS guidance product which became "complete" in the fall of 1993. On May 11, 1994, the NMC began production and distribution for an additional 200+ stations nationwide. The NGM MOS (FWC) now provides an extensive, 48 hour prognostic summary of various parameters for over 600 sites within the United States.

To improve temperature guidance, four season NGM MOS equations have been developed in lieu of the current two season format. The improved NGM MOS temperature equations will be implemented later this summer. Revised POP equations for the western United States should be available by October 1, 1994. By adding two "wetter" seasons and decreasing the regional grouping of sites, the POPs were improved. The NGM MOS replaced the LFM MOS as the official guidance used by NWS forecasters in verification scores beginning last year.

♦ AVN - Work continues on the new AVN MOS 00-72 hour guidance and the product should begin distribution over AFOS on or about August 31, 1994.

♦ MRF - To improve temperature guidance, the perfect-prog approach to the MRF guidance product was switched to a MOS technique. The min/max temperatures are based on 3-month seasons. The precipitation equations still use a calibrated perfect-prog technique and will be changed later this year.

♦ Eta - No official plans have been instituted to develop MOS guidance for the Eta. However, it is believed that once the Eta model development has stabilized, a MOS-type guidance will be considered. Changes to the base code within the Eta model are still too frequent to generate a consistent statistical guidance product.

Future Plans

This is an exciting time for operational forecasters. A number of model improvements and developments are underway. All of the items discussed below are projected for January 1997 in NMC (Fig. 2):

▸ The Meso-Eta will increase to 15 km horizontal resolution and increase the number of vertical layers to 70. It will complement the AVN and run four times per day, starting at 0300, 0900, 1500, and 2100 UTC.

▸ The NGM will be phased out. The early Eta model will be replaced by a four run per day AVN model (see below).

▸ The AVN will run at T200 resolution (64 km) with 50 levels. It will be run to 72 hours twice daily (0000/1200 UTC) and to 36 hours twice daily (0600/1800 UTC).

▸ The MRF (T200/50 levels) will run to 168 hours (7 days) and at a reduced resolution from 7-30 days.

▸ A "regional" Global Spectral Model will be developed and run.

Most advances in operational modeling are rooted in technology and faster processing. As the processing speeds increase, resolution can be increased while precious processing time is not forfeited. The future is trended toward the mesoscale, with the birth and maturation of regional domain models and highly specialized weather forecasting.

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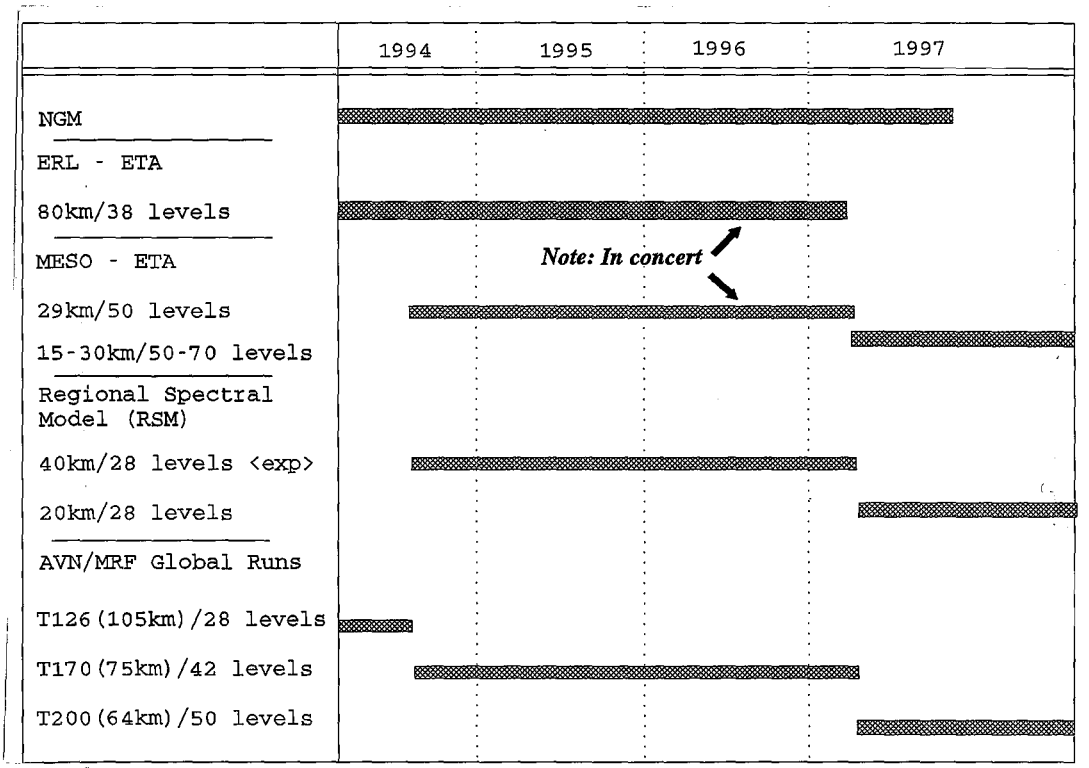

Figure 2. Future model timeline for the NMC.

Figure 1

Run	Model	Domain / Runs per 24hrs	Analysis	Data Cut-off (t+__)	Resolution: Horizontal 60N	Resolution: Vertical	Forecast Projection	MOS ?
Early (ERL)	Eta	Regional (N.A.) 2	Gridpoint Semi-Staggered OI	1:30	GRIDPOINT: ≈80 km (@52N) Semi-staggered	38 layers	48 hours	No
Regional (RGL)	Nested Grid Model (NGM)	Hemispheric 2	Gridpoint 3-dimensional Optimum Interpolation (OI)	2:00	GRIDPOINT: Grid B 180km Grid C ≈90km, (≈87.5km@52N)	16 layers	48 hours	Yes
Aviation (AVN)	Medium Range Forecast Model (MRF)	Global 2	3-dimensional Spectral Optimum Interpolation (OI)	2:45	Spectral Wave T-126 (105km)	28 layers	72 hours	In Dvlpt
Medium Range (MRF)	Medium Range Forecast Model (MRF)	Global 1	3-dimensional Spectral OI	6:00	Spectral Wave 00-132 hr: T-126 (105km) 132-384 hr: T-62 (206km)	28 layers 18 layers	384 hours	Yes
Final (FNL)	Medium Range Forecast Model (MRF)	Global 4	3-dimensional Spectral OI	6-9 hours	Spectral Wave T-126 (105km)	28 layers	Four 6-hour segments	No
Rapid Update Cycle (RUC)	Mesoscale Analysis & Prediction System (MAPS)	Regional (U.S.) 8	OI on isentropic surfaces	1:20	GRIDPOINT: 60 km	25 layers	12 hours	No