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Technical Implementation Notice 11-16, Amended
National Weather Service Headquarters Washington DC
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Subject: Implementation Date Delayed: Changes to the North American Mesoscale (NAM) Analysis and Forecast System

Amended to postpone the implementation of changes to the NAM Analysis and Forecast System previously scheduled for Tuesday, September 20, 2011, at the National Centers for Environmental Prediction (NCEP). The delay in implementation is needed to fix a failure of the fire weather nest run and a model output problem causing too weak vertical velocity to be displayed. An amendment to this notice will be sent when the implementation date has been determined.

Effective in the next several weeks, the National Centers for Environmental Prediction (NCEP) will modify the NAM Analysis and Forecast System.

These changes include:

-Introducing a new modeling framework
-Installing a major upgrade to the prediction model
-Modifying the data analysis and assimilation system
-Adding to existing NAM products
-Adding new higher-resolution nests within the NAM including a very high-resolution but small domain to support fire weather and Incident Meteorologist (IMET) interests

Details on the various changes are provided below, along with a notice about possible changes to product generation time.

Model Upgrades

NCEP will introduce the use of the new NOAA Environmental Modeling System (NEMS), which is based on the tenets put forth by the Earth System Modeling Framework to which NOAA has subscribed. Eventually all of NCEP's major modeling will be

performed within NEMS. This NAM upgrade represents the first implementation of NEMS and a major step in the evolution of NCEP's modeling suite.

The prediction model used in the NAM run will go from being the strictly regional Nonhydrostatic Mesoscale Model (NMM) to a new extended capability version now known as Nonhydrostatic Multiscale Model on B-grid (NMMB), which can be run either regionally or globally with or without embedded nests. This NEMS-NMMB also will serve as the prediction model running in the NAM Data Assimilation System (NDAS). Model changes/enhancements in the NEMS-NMMB will include the following:

a) Native horizontal grid is an Arakawa staggered B-grid (rotated 45 deg. from the Arakawa E-grid in the WRF-NMM NAM)
b) New more conservative Eulerian advection scheme for passive tracers like water vapor condensate fields
c) Generalized vertical coordinate
d) Modified vertical level distribution with more layers in the stratosphere (14 layers above 200 mb instead of 7 in the current operational NAM)
e) Boundary condition treatment changed to specify 5 boundary rows instead of 1
f) Microphysics changes to produce higher peak reflectivities above 45 dBZ, with higher peak surface rainfall rates in the high-resolution nests and more realistic grid-scale cloud fractions from cold, high cirru
g) Change from USGS to MODIS_IGBP land-use definitions
h) Enhanced diffusion for specific humidity and cloud water
i) Run 5 high-resolution nested domains inside the 12km NAM every cycle. These nests will run with greatly reduced convective triggering, which improved quantitative precipitation forecast (QPF) bias compared to using explicit convection

All model changes will also be applied to the Downscaled GFS by NAM Extension (DGEX) forecast system.

NDAS Changes:

a) Initial first guess at T-12hr will reflect relocation of tropical cyclones
b) Will use 1/12 degree high resolution real-time sea surface temperature (RTG_SST_HR) analysis instead of the 1/2 degree real-time SST analysis.
c) Will update 2 m temperature and moisture and 10 m wind with portion of first layer correction

Changes to the Gridscale Statistical Interpolation (GSI) analysis:

a) New faster version of the GSI code with new observation error estimates, retuned background error covariances for NMMB and upgraded radiative transfer (CRTM v2.0.2)

b) Assimilation of new observations: ACARS humidity, Windsat and ASCAT (superob'ed Scatterometer winds over oceans), HIRS radiances from NOAA-19, AMSU-A radiances from NOAA-19 and AQUA, IASI radiances from METOP, GPS radio occultation refractivity (COSMIC), RASS virtual temperatures, MAP (boundary layer profiler) winds and MESONET surface pressure/temperature/ humidity (winds already included)
c) Use dynamic reject list for surface mesonet data from the NCEP Real-time Mesoscale Analysis (RTMA)

Changes to the NAM post-processing code:

a) The height and wind speed at the maximum wind level will be computed by assuming the wind speed varies quadratically in height in the neighborhood of the maximum wind level with the search being capped at 100mb. The previous algorithm defines maximum wind level as the level with the maximum wind speed among all the model levels.
b) The static Tropopause level will be obtained by finding the lowest level that has a temperature lapse rate of less than 2K/km over a 2km depth above it. If no such level is found below 50 mb, the Tropopause is set to 50 mb. The previous algorithm defines the Tropopause by finding the lowest level with a mean temperature lapse rate of 2K/Km over three model layers.
c) All Convective Available Potential Energy (CAPE), Convective Inhibition (CIN), and Lifted Index (LI) variables in the NAM output will be computed using virtual temperature instead of sensible temperature. See the NWS Public Information Statement issued January 12, 2011, for more details on this change.

Users should be aware that this NAM upgrade will impact all downstream models and systems using the NAM or NDAS as input.

Output Product Changes:

New NAM Nest runs, including placeable Fire Weather Nest. Five new high-resolution nested domains will run inside the 12 km NAM every cycle:

a) CONUS (4 km resolution, 0-60 h)
b) Alaska (6 km resolution, 0-60 h)
c) Hawaii and Puerto Rico (both 3 km resolution, 0-60 h)
d) Placeable nest will run to 36-h inside either the CONUS nest (at 1.33 km resolution) or Alaska nest (at 1.5 km resolution). This nest is primarily for Fire Weather/IMET-DHS Support (FWIS). The locations of this domain for each of the 4 NAM cycles will be determined via a daily coordination call conducted by the NCEP Senior Duty Meteorologist.

A sample display of the domain coverage of these new nests is available at:

www.emc.ncep.noaa.gov/mmb/mmbpll/misc/nmmb_domains.png

Output grids from the NAM nest runs will be available on the NCEP ftp server immediately and on the NCEP NOMADS server in the future. The fields contained in the NAM nest output grids are listed at:

www.emc.ncep.noaa.gov/mmb/mmbpll/misc/sampleinv_namnests.html

Changes to parent NAM gridded output on the NCEP ftp server and the NWS ftp server:

a) In all NAM grids that contain roughness length, the precision was changed to provide better decimal scaling because many land-use types have roughness length much less than 1.
b) Surface slope type was dropped from all NAM output grids as it is no longer used in the model land-surface physics
c) Time-averaged surface momentum flux record is being removed from all NAM GRIB files as it is not defined and thus had been set to zero in the current operational NAM
d) New output fields:
- Clear Air Turbulence (Ellrod Index), every 25 mb from 150-525 mb, and Inflight Icing every 25 mb from 300-600 mb, every 50 mb from 650-950 mb, and 725 mb; added to grid #221 (32 km grid over North America)
- 80 km above ground level pressure, temperature, wind, and specific humidity; added to grid #221 (32 km grid over North America), grid #218 (12 km grid over CONUS, pressure file only) and grid #242 (11.25 km grid over Alaska, pressure file only).
- Hourly max and min surface fields (10-meter wind, 2-meter temperature, 2-meter relative humidity); added to grid #221 (32 km grid over North America), grid #218 (12 km grid over CONUS, both versions) and grid #242 (11.25 km grid over Alaska).
- Haines Index: Added to grid #218 (12 km grid over CONUS, both versions) and grid #242 (11.25 km grid over Alaska, both versions)
- Ventilation Rate: Added to grid #218 (12 km grid over CONUS) and grid #242 (11.25 km grid over Alaska).
- Rain and snow on lowest model level: added to grid #218 surface file "awip12"
- Thunder parameter (called lightning in GRIB): added to both grid #218 files

e) All NAM output files on the native horizontal staggered E-grid of the current operational WRF-NMM will be on the staggered B-grid of the NEMS-NMMB. The current native grid files with names "egrd3d," "edgawp," and "egrdsf" will be removed from the NCEP FTP server and replaced with files with names "bgrd3d", "bgdawp," and "bgrdsf," respectively. Users who process current NAM native GRIB files with e-grid staggering will need to modify their software to process b-grid staggering.

f) To provide the critical variables used at Weather Forecast

Offices to generate their National Digital Forecast Database (NDFD) forecast grids, NCEP will begin to populate the current NAM Downscaled Numerical Guidance (DNG - a small set of 2-dimensional fields) in the 0-60 hr range from the new high-resolution NAM nested fields instead of the parent NAM 12 km fields. The NAM DNG grids are currently distributed to CONUS, Alaska, Hawaii and Puerto Rico over the AWIPS SBN/NOAAPORT. In response to requests from the NWS Regions, NCEP also plans on producing a CONUS 2.5km NAM-DNG for the 0-60 hr in addition to the current CONUS 5 km version. A separate TIN will announce the addition of those 2.5 km grids to NOAAPORT.

g) Several users have noted differences in the precision of the accumulated precipitation at different forecast projections. With this upgrade, the precision for all forecast hours will be standardized.

Product Delivery Time Change:

NCEP anticipates that output delivery times after the NAM upgrade will differ slightly throughout the run compared to the current operational NAM products. The precise amounts still need to come out of the final pre-implementation testing by NCEP Central Operations, but the following is the worst case scenario. When the CONUS Fire Weather nest is run during the first 36 hours of the forecast, product delivery will lag the current delivery by ~13 seconds each forecast hour such that 36 hour guidance will be 468 seconds or 7.8 minutes later than at present. Following the 36 hour point of the forecast, NWS will recover delivery time at roughly 10 seconds each forecast hour such that delivery of the 84 hr guidance will be at the same time as it is delivered today, which is 10 minutes earlier than its target. As an example, for 0000UTC run, the following delivery time differences would be expected, with current time in parentheses:

12hr PRODUCTS at 01:52:52 (01:50:16)
24hr PRODUCTS at 02:05:26 (02:00:14)
36hr PRODUCTS at 02:17:49 (02:10:01)
48hr PRODUCTS at 02:25:47 (02:19:59)
60hr PRODUCTS at 02:34:04 (02:30:16)
72hr PRODUCTS at 02:40:23 (02:38:35)
84hr PRODUCTS at 02:50:23 (02:50:35)

The target delivery for 84 hr guidance is 3:00:00.

When the fire weather nest is over Alaska, product delivery will lag the current delivery by ~5 seconds each forecast hour such that 36 hour guidance will be 180 seconds or 3 minutes later than at present.

For a detailed description of this NAM and NDAS upgrade, including verification statistics, please see:

www.emc.ncep.noaa.gov/mmb/mmbpll/misc/NAM_Q32011_Upgrade.pdf

For more general information about the NAM and NDAS, please see:

http://www.emc.ncep.noaa.gov/NAM/

A consistent parallel feed of data will become available on the NCEP server once the model is running in parallel on the NCEP Central Computing System by late May. The parallel data will be available via the following URLs:

http://www.ftp.ncep.noaa.gov/data/nccf/com/nam/para

ftp://ftp.ncep.noaa.gov/pub/data/nccf/com/nam/para

NCEP has tried to anticipate all filename and product content changes associated with this implementation, but if we discover additional changes during the course of the testing, we will send an amended version of this TIN with that information as soon as possible.

NCEP urges all users to ensure their decoders can handle changes in content order, changes in the scaling factor component within the product definition section (PDS) of the GRIB files, changes to the GRIB Bit Map Section (BMS), and volume changes. These elements may change with future NCEP model implementations. NCEP will make every attempt to alert users to these changes before implementation.

For questions regarding these changes, please contact:

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NWS National Technical Implementation Notices are online at:

http://www.nws.noaa.gov/os/notif.htm

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