Product Description Document:
NCEP Model Analyses & Forecasts
09/11/2007

Part I - Mission Connection

A. Product Description – Provides meteorological forecast model output graphics on a website maintained by the National Centers for Environmental Prediction (NCEP). This document is http://www.weather.gov/infoservicechanges/NCEPMAF.pdf and is described in the http://www.weather.gov/infoservicechanges/database.pdf product description database document. The link to the production model graphics web site is:

http://www.nco.ncep.noaa.gov/pmb/nwprod/analysis

There are twelve models covering six regions described in this document. A description of the details of each model is included in Part II. These models are:

1. North American Mesoscale (NAM);
2. Global Forecast System (GFS);
3. Wave Watch III (WW3);
4. Nested Grid Model (NGM);
5. Short Range Ensemble Forecast (SREF);
6. Rapid Update Cycle (RUC);
7. High Resolution Window (HRW) Weather Research and Forecast (WRF);
8. Polar Ice Drift (POLAR);
9. Geophysical Fluid Dynamics Laboratory (GFDL) hurricane model (GHM);
10. Global Ensemble Forecast System (GEFS);
11. Real Time Mesoscale Analysis (RTMA); and
12. Hurricane Weather Research and Forecasting (HWRF).

The GEFS, RTMA and HWRF models were added to the Model Analyses and Forecasts web site in the June 2007 update.

Graphics are made for the African, Eastern Pacific, North American, South American, Western North Atlantic, and Polar regions. African graphics for the GFS and GEFS were added in the September 2007 update. South American GFS and GEFS graphics were added in the June 2007 update.

The GEFS is a GFS-based model run with twenty ensemble members. The GEFS decameter height line "spaghetti" charts show each ensemble member for a given parameter. They are available at 6 hourly increments out to 384 hours. The parameters plotted on these GEFS graphics include:

1. 200 mb decameter height lines;
2. 500 mb decameter height lines, mean, spread, absolute vorticity;
3. mean sea-level pressure, mean and spread; and
4. probability plots for 10m winds and 2m temperature.

Each of the above parameters is available in a 1024x768-resolution GIF image as a single image or as 4-panel images. Looping is available for most of the above graphics.

RTMA graphics provide 5 KM mesoscale analyses of select parameters for sixteen different regions in North America. These regions are California, the Carolinas, Colorado, the Dakotas, Florida, the Gulf Coast, Michigan, the Mid-Atlantic, the Midwest, Montana, New England, Ohio, the Pacific Northwest, Southwest, Texas, and Wisconsin. The RTMA is produced hourly. The parameters plotted on these graphics include:

1. Two meter temperature;
2. Two meter dew point; and
3. Ten meter wind speed.

These charts are available at three resolutions. These resolutions are:

1. Coarse 640x480 image size, approx. 37 Kb per image;
2. Medium 1024x768 image size, approx. 50 Kb per image; and
3. Fine 1280x1024 image size, approx. 100 Kb per image.

The HWRF hurricane model graphics were added to the North America Models Analyses & Forecasts web page as two links to the Full Domain (Atlantic/Pacific) storms and Nested Domain (5x5 degrees). From those pages, two web pages will display up to four hurricanes.

The HWRF graphics include seven different types for the Atlantic/Pacific view and seven for the nested "close-up" view for a combined total of 14 graphics. Graphics are available at six hour increments out to 126 hours. These include:

1. 200mb heights, vorticity and winds;
2. 500mb streams, relative humidity, and omega;
3. 500mb heights, vorticity and winds;
4. 700mb heights, vorticity and winds;
5. 850mb heights, vorticity and winds;
6. Ten-meter ground winds, mean sea level pressure, and surface temperature; and
7. Six-hour precipitation and mean sea level pressure.

The graphics are depicted in different resolutions to accommodate various display and download capabilities. These resolutions are:

1. Coarse 640x480 image size, approximately 37 kilobytes per image;
2. Medium 1024x768 image size, approximately 70 kilobytes per image; and
3. Fine 1280x1024 image size, approximately 100 kilobytes per image.

In addition, two series of panel charts are available. The first of these is a two panel display of the full and nested domains. The second series contains two sets of four panel displays at the same forecast hour: 1st) 200mb vorticity, 500mb relative humidity, 500mb vorticity, and 850 mb temperature and six hour precipitation; and 2nd) 700 mb vorticity, 850 mb vorticity, 10m winds, and 850mb temperature and six hour precipitation. The charts are created at consecutive forecast time steps up to 126 hours every six hours.

Graphics for South America include the entire suite of graphics produced for the North American background. They are created only at a medium 1024x768 resolution.

Other additional graphics have been added to the product suite. They include six hour total precipitation for the NAM (out to 84 hrs), NGM (out to 48 hrs), and GFS (every 6 hrs out to 180 hrs, then every 12 hrs from 192 to 384 hrs). Several total precipitation charts for the GFS beyond forecast hour 180 have been added for the 12, 24, 36, 48, and 60 hr forecasts. In June 2007, 1000 – 850 mb thicknesses and 850 – 700 mb thicknesses were added to the GFS, NAM, and NGM for coarse, medium, and fine resolutions.

B. Purpose - The forecast graphics are available on the NCEP website at the same time products from these models are available to National Weather Service and private users. The website is updated as each model forecast hour is completed.

C. Audience - The major users of the website are the general public as well as governmental organizations, universities, and businesses.

D. Presentation Format - The data is presented in several standard formats including static images and looping images. The processing that creates these forecast graphics uses the NAWIPS software to convert forecast model output into images to be transferred to the NCEP website. The forecast graphics are available on the NCEP website at the same time products from the models are available to National Weather Service and private users. The NCEP website is updated as each model forecast is completed. The graphics are available as GIF images.

Feedback Method - We are always seeking to improve our products. A comment period for the updated model graphics is September 11, 2007 through October 9, 2007. The http://www.nco.ncep.noaa.gov/pmb/nwpara/analysis web site contains a form http://www.weather.gov/survey/nws-survey.php?code=ncep001 for user feedback. Comments regarding the products can also be sent to:

National Centers for Environmental Prediction
ATTN: Lauren Morone, Rm. 101
5200 Auth Road
Camp Springs, MD 20746
Email: Lauren.Morone@noaa.gov

Part II Technical Section

A. Format & Science Basis

Graphics from twelve forecast models are available. The forecast models described in this document are: NAM, GFS, WW3, NGM, SREF, RUC, HRW, POLAR, GFDL, GEFS, RTMA and HWRF.

1. North American Mesoscale (NAM)

The NAM model is a regional mesoscale data assimilation and forecast model system based on the WRF common modeling infrastructure, currently running at 12 km resolution and 60 layers. NAM forecasts are produced every six hours at 00, 06, 12 and 18 UTC. The NAM graphics are available at six hour increments out to 84 hours. The NAM has non-hydrostatic dynamics and a full suite of physical parameterizations and a land surface model. Information on the model products is found at http://www.nco.ncep.noaa.gov/pmb/products/nam/ page.

The link to the latest information about the NAM model is:
http://www.emc.ncep.noaa.gov/modelinfo

2. Global Forecast System (GFS)

The GFS is a global spectral data assimilation and forecast model system. GFS forecasts are produced every six hours at 00, 06, 12 and 18 UTC. The GFS graphics are based on 70 km grid (T190) and are available at six hour increments out to 384 hours. The GFS also produces 35 km (T382) forecast out to 180 hours but these are not converted to graphic images. NCEP implemented major changes to GFS on May 31, 2005. The horizontal resolution increased from approximately 50 km (T254) to approximately 35km (T382) in both the analysis and forecast model. The vertical resolution is now 64 layers, with a model top at 0.2 hPa. The GFS contains a full suite of parameterized physics as well as accompanying sea-ice and land-surface models. The model structure is computationally efficient and ready for ESMF (Earth System Modeling Framework) and a hybrid (sigma, p) vertical coordinate. Information on the model products can be found at the production model web page http://www.nco.ncep.noaa.gov/pmb/products/gfs/.

The link to the latest information about the GFS is:
http://www.emc.ncep.noaa.gov/modelinfo

3. WAVEWATCH III (WW3)

WW3 is a third generation wave model developed at NCEP. WW3 forecasts are produced every six hours at 00, 06, 12 and 18 UTC. The WW3 graphics are based model fields of 1.0^0 x 1.25^0 to 5^0 x 5^0 and are available at six hour increments out to 126 hours. WW3 solves the spectral action density balance equation for wave number-direction spectra. Assumptions for the model equations imply that the model can generally be applied on spatial scales (grid increments) larger than 1 to 10 km, and outside the surf zone. Information on the model products can be found at the production model web page http://www.nco.ncep.noaa.gov/pmb/products/wave/.

The link to the latest information about the WW3 is:
http://www.emc.ncep.noaa.gov/modelinfo

4. Nested Grid Model (NGM)

The NGM is a 16-layer primitive equation model with an outer nest covering the Northern Hemisphere at 160 km grid-spacing and an inner nest covering all of North America and offshore waters at 80 km resolution. NGM forecasts are produced every 12 hours at 00 and 12 UTC. The NGM graphics are available at six hour increments out to 48 hours. Its name comes from the technique of using a finer grid over North America and coarser grid over the oceans. It is initialized over North America from the NAM analysis and from a 6 hour GFS forecast for the back half of the hemisphere. While a few gridded products are generated, its output is used primarily to drive a suite of Model Output Statistics (MOS) guidance. Development has been frozen on the NGM since 1990. At the moment, there is no termination date set for this system.

The link to the latest information about the NGM is
http://www.emc.ncep.noaa.gov/modelinfo

5. Short Range Ensemble Forecast (SREF)

The SREF system is a set of model runs called ensemble members using either a single model with different initial conditions or different models with the same initial conditions. SREF forecasts are produced every six hours at 03, 09, 15 and 21 UTC. The SREF graphics are available at three hour increments out to 87 hours. The evaluation of SREF has shown improvements in providing CONUS forecasts during the one to three day time range. The SREF runs operationally four times daily. SREF produces ensemble forecasts from 21 members: five ETA members, five ETA Kain-Fristch members, five Regional Spectral Model (RSM) members, and three members each with the WRF-NMM and WRF-ARW. The current SREF aviation ensemble forecast has 11 primary ensemble products, including the probability, mean and spread of: icing, turbulence, cloud, ceiling, visibility, jet stream, lower level wind shear, and tropopause height. Information on the model products can be found at http://www.nco.ncep.noaa.gov/pmb/products/sref.

The link to the latest information about the SREF model is
http://www.emc.ncep.noaa.gov/modelinfo

6. Rapid Update Cycle (RUC)

The RUC is a hybrid sigma-isentropic analysis and forecast system. It has a horizontal resolution of 13 km and 50 vertical layers. RUC utilizes an hourly data assimilation system. The RUC forecasts are produced every hour. The RUC graphics are available for the most recent 4 hours for forecasts up to 12 hours. Information on the model products can be found at the production model web page
http://www.nco.ncep.noaa.gov/pmb/products/ruc2/.

The link to the latest information about the RUC model is http://maps.fsl.noaa.gov/

7. High Resolution Window (HRW)

The HRW (also known as Nested Window Run or NWR) contains images from the Weather Research and Forecasting (WRF) model versions of the non-hydrostatic, hybrid vertical coordinate mesoscale model (NMM) and Advanced Research WRF (ARW). WRF forecasts are produced every six hours at 00, 06, 12 and 18 UTC. The WRF graphics are available at three hour increments out to 48 hours. The WRF-NMM replaced Early ETA Forecast Model (ETA) on June 20, 2006. WRF is a next-generation mesoscale numerical weather prediction system designed to serve both operational forecasting and atmospheric research needs. WRF is a multi-agency effort providing the infrastructure that accommodates multiple dynamic solvers, physics packages that plug into the solvers, programs for initialization, multiple dynamical cores, a 3-dimensional variational data assimilation system, and a software architecture allowing for computational parallelism and system extensibility. WRF is suitable for a broad spectrum of applications across scales ranging from meters to thousands of kilometers.

The link to the latest information about the WRF modeling system is:
http://wrf-model.org/index.php

8. Polar Ice Drift (POLAR)

The Polar and Great Lakes Ice group works on sea ice analysis from satellite, sea ice modeling, and ice-atmosphere-ocean coupling. Automated analyses have been used by the NWS global atmospheric models for their sea ice conditions since February 1998. POLAR forecasts are produced once daily at 00 UTC. The POLAR graphics are available at 24 hour increments out to 384 hours. The analysis provides a daily, 0.5 degree resolution in latitude and longitude, condition for the models. During spring and fall, the sea ice edge can move by 200 km (2 degrees) in a week. Discussion of the use and representation of sea ice in the global weather models is available at http://polar.ncep.noaa.gov/seaice/Models.html.

The link to the latest information about the ice drift system is:
http://polar.ncep.noaa.gov/seaice

9. Geophysical Fluid Dynamics Laboratory (GFDL) hurricane model (GHM)

The GFDL provides operational guidance for forecasters at the National Hurricane Center in both the Atlantic and East Pacific basins. Hurricane forecasts are produced on demand every six hours at 00, 06, 12, and 18 UTC for up to four tropical storms at a time. The GFDL hurricane model graphics are available at six hour increments up to 126 hours. Often, there are less than 126 hours.

The model is a nested grid system with an outermost domain and 2 nested grids with resolutions of 55, 27 and 9 km respectively and 42 vertical levels. A spin-up vortex initialization is used with an axisymmetric version of the forecast model forced by intensity and structure parameters provided operationally by NHC. The GFDL hurricane

model is coupled to a high-resolution version of the Princeton Ocean Model for the Atlantic Basin and a one dimensional mixed layer model for the East Pacific. The ocean initialization system uses observed altimeter observations to provide a more realistic Loop Current and Gulf Stream conditions. Information on the model products can be found at the products model web page http://www.nco.ncep.noaa.gov/pmb/products/hur/.

The link to the latest information about the GFDL hurricane model is http://www.gfdl.noaa.gov/research/weather/tpb_gfdl.html

10. Global Ensemble Forecast System (GEFS)

The GEFS is a GFS-based modeling system run with 20 ensemble members per cycle plus one control at T126. GEFS forecasts are produced up to 28 levels every six hours at 00Z, 06Z, 12Z, and 18Z. All runs are shown out to 384 hrs at 6-hour intervals. Data is interpolated to 1°x1° resolution from 0 to 384 forecast hours. Information on the model products can be found at the production model web page http://www.nco.ncep.noaa.gov/pmb/products/gens/.

The link to the latest information about the GEFS model is http://www.emc.ncep.noaa.gov/modelinfo

11. Real Time Mesoscale Analysis (RTMA)

The RTMA is a "quick look" analysis designed to meet the immediate need of those requiring a real time gridded analysis. This is the first phase of the "Analysis of Record" (AOR) underway at NWS. The RTMA is produced by downscaling the RUC forecast/analysis from its horizontal resolution of 13 km to a 5 km NDFD grid. This is then used as a first guess for a 2D-Variational analysis which a) uses a full complement of surface observations, b) uses anisotropic background error covariance mapped to local terrain, c) produces analyses of 2 m temperature, 2m dew-point and 10 m wind and d) produces estimates of analysis uncertainty as well. The RTMA provides hourly, near real time, mesoscale analyses of surface hydrometeorological variables in a grid format. These grid hydrometeorological products are used by field forecasters for various operational applications. RTMA product destinations include all CONUS and OCONUS sites, NWS special centers, and external partners and customers. The RTMA products can be found at the following web page: http://weather.noaa.gov/pub/SL.us008001/ST.expr/DF.gr2/DC.ndgd/GT.rtma/.

12. Hurricane Weather Research Forecast (HWRF) model

The HWRF provides operational guidance for forecasters at the National Hurricane Center in both the Atlantic and East Pacific basins. Hurricane forecasts are produced on demand every six hours at 00, 06, 12, and 18 UTC for up to four tropical storms at a time. The HWRF hurricane model graphics are available at six hour increments up to 126 hours. Often, there are less than 126 hours.

The model is a nested grid system with an outermost domain and a nested grid with resolutions of 27 and 9 km respectively and 42 vertical levels. The HWRF vortex initialization uses the 6 hour forecast as the first guess, then uses regional GSI 3DAR data assimilation to produce the initial hurricane vortex that matches the intensity and structure parameters provided operationally by NHC. The HWRF is coupled to a high-resolution version of the Princeton Ocean Model for the Atlantic Basin. The ocean initialization system uses observed altimeter observations to provide a more realistic Loop Current and Gulf Stream conditions.

Information on the model products can be found at the production model web page http://www.nco.ncep.noaa.gov/pmb/products/hur/

B. Product Availability

This service is provided at the web site http://www.nco.ncep.noaa.gov/pmb/nwprod/analysis/ . The NCEP has no control over the reliability of the Internet. Users need to factor this uncertainty into their decision to use this service.

NCEP does not guarantee the service will be continuously available. However, every effort will be made to assure reliable provision of this service.

C. Additional Information

(1) The Model Analyses & Forecasts web pages are maintained by the NCEP Central Operations Systems Integration Branch. See the link http://www.nco.ncep.noaa.gov/sib/

(2) For more information about Models products please contact:

Steve Schotz (acting branch chief)
Systems Integration Branch
NCEP Central Operations
5200 Auth Road, Rm. 302
Camp Springs, MD 20746-4325
email: NCEP.NCO.Graphics@noaa.gov
phone: 301-763-8000 x7186

Please see the following two pages for tabular list of the parameters by model.

(3) Specific graphics available for NAM, NGM, GFS, SREF, and HUR

NAM 84 fcst hrs	NGM 48 fcst hrs	GFS 384 fcst hrs	SREF 87 fcst hrs	GFDL/HWRF 126 fcst hrs
simulated reflectivity			mslp % spread, mean CAPE spread, mean CIN spread, prob of CAPE > 3000	
		10 m wind, 6-hr pcp, 2 m temp	10 m winds spread, 2 m temps %spread, prob of 2m temp and 10m winds	35m mslp, winds ground, temps/sea
200 mb wind, Ht, Isotachs	250 mb wind, Ht, Isotachs	200 and 250 mb wind, Ht, Isotachs	250 mb mean Hts, vort, Ht, winds spread	200mb heights, vorticity and winds
300 mb wind, Ht, Isotachs	300 mb wind, Ht, Isotachs	300 mb wind, Ht, Isotachs	---	
500 mb vort, Ht	500 mb vort, Ht	500 mb vort, Ht	500 mb mean Hts, vort, Ht spread	500mb streams, RH; mega; Ht, vort, and winds
700 mb RH, Ht, Omega	700 mb RH, Ht, Omega	700 mb RH, Ht, Omega	700 mb RH, %spread, temp	700 mb Ht, vort, winds
850 mb temp, Ht, wind	850 mb temp, Ht, winds	850 mb temp, Ht, wind	850 mb mean temp and winds	850 mb Ht, vort, winds
850 mb temp, mslp	---	850 mb vort, Ht, wind	850 mb mean RH, %spread	
850-700 mb 6-hr pcp, mslp	850-700 mb 6-hr pcp, mslp	850-700 mb 6-hr pcp, mslp	850-700 thickness	
1000-500 mb 6-hr pcp, mslp	1000-500 mb 6-hr pcp, mslp	1000-500 mb 6-hr pcp, mslp	1000-500 mb thickness	
1000-850 mb 6-hr pcp, mslp	1000-850 mb 6-hr pcp, mslp	1000-850 mb 6-hr pcp, mslp	1000-850 mb thickness	
6 hour pcp	6 hour pcp	6 hour pcp	mean and prob. of 6 hr pcp	6 hour pcp and mslp
12 hour pcp	12 hour pcp	12 hour pcp	mean 12hr pcp	
24 hour pcp	24 hour pcp	24 hour pcp	mean 24hr pcp	
36 hour pcp	36 hour pcp	36 hour pcp		
48 hour pcp	48 hour pcp	48 hour pcp		
60 hour pcp	---	60 hour pcp		
total pcp	total pcp	total pcp		

(4) Specific graphics available for RUC, RTMA, HIRESW, GEFS, POLAR, and WW3

RUC 12 fcst hrs	RTMA Analysis	HIRESW 48 fcst hrs	GEFS 384 fcst hrs	POLAR 384 fcst hrs	WW3 126 fcst hrs
	surface level pressure		surface level pressure, mean,spread	ice drift	wave Hts winds
	2 m dew point, temp and 10 m winds		prob 2m temp and 10m wind		peak wave direction period
250 mb wind, Ht, Isotachs		250 mb wind, Ht, Isotachs	200 mb decameter height lines		wind wave direction period
300 mb wind, Ht, Isotachs		300 mb wind, Ht, Isotachs			
500 mb vort, Ht		500 mb vort, Ht	500 mb decameter height lines, mean,spread abs vorticity		
700 mb RH, Ht, Omega		700 mb RH, Ht, Omega			
CAPE/CIN		850 mb temp, Ht, winds			
Helicity					
1000-500 mb thick 1-hr pcp, mslp		1000-500 mb 6-hr pcp, mslp			
1 hour pcp, mslp, 850 mb temps		3 hour pcp, mslp, temp			
		12 hour pcp			
		24 hour pcp			
		36 hour pcp			
		48 hour pcp			