Product Description Document:
NCEP Model Analyses & Guidance
October 2010

Part I - Mission Connection

Product Description – The Model Analyses and Guidance (MAG) website showcases the National Weather Service's observational database and graphical suite of numerical model analysis and guidance. The site is maintained by National Centers for Environmental Prediction Central Operations (NCEP/NCO) and NOAA's Web Operations Center (WOC). During the past fifteen months, the current NWS/NCEP Model Analysis and Forecast website was redesigned to create a more professional and interactive interface. In an effort to respond to user needs to protect life and property and support the nation's growing need for environmental information, a streamlined graphical approach in displaying products used by forecasters in making forecasts will serve not only NWS Offices but also the Private and Public Sectors.

The link to the new production model graphics web site is:

http://mag.ncep.noaa.gov/

The data sources covering various regions are described in this document. Links to descriptions of each data source are included in Part II. The data sources are grouped by the following three categories:

- **Model Guidance**
  1. North American Mesoscale (NAM);
  2. Global Forecast System (GFS);
  3. Wave Watch III (WW3);
  4. Short Range Ensemble Forecast (SREF);
  5. Rapid Update Cycle (RUC);
  6. High Resolution Window/Non-Hydrostatic, hybrid, vertical coordinate Mesoscale Model
  7. Polar Ice Drift (POLAR);
  8. Global Ensemble Forecast System (GEFS)
  9. North American Ensemble Forecast System(NAEFS)

- **Observations and Analyses**
  10. Real Time Mesoscale Analysis (RTMA)
  11. Observed Upper Air Data
  12. Skew-T Plots

- **Tropical Guidance**
  13. Geophysical Fluid Dynamics Laboratory (GFDL) Hurricane Model (GHM);
  14. Hurricane Weather Research and Forecasting (HWRF).

Two tables at the end of this document list all of the graphics created for each of the forecast models. The Observed Upper Air data is presented as station values on a map and as Skew-T graphs for individual reports.

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.

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

Presentation Format - The data is presented in standard Graphics Interchange Format (GIF) including static images and looping images. The processing, located at the WOC, which creates these forecast graphics uses the General Meteorology PAcKage (GEMPAK) software to convert forecast model output into images to be transferred to the MAG website. The forecast graphics are available on the MAG website at the same time products from the models are available to National Weather Service and private users. The graphical model guidance is updated as each model forecast hour becomes available. The graphics are available as GIF images.

Feedback Method - Comments regarding the products may be emailed to:

Mag.helpdesk@noaa.gov

Part II Technical Section

A. Format & Science Basis

Graphics from twelve Numerical Weather Prediction models are available. The models described in this document are: NAM, GFS, WW3, SREF, RUC, HRW, POLAR, GEFS, NAEFS, RTMA, GHM 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.

Graphical model guidance for the NAM is available for the following regions:

1) North America
2) Western North Atlantic
3) North Pacific

4) Eastern North Pacific

Information on the model 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/mmb/mmbpll/etapll/

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 27 km (T574) forecast out to 192 hours but these are not converted to graphic images. NCEP implemented major changes to GFS on July 28, 2010. The horizontal resolution increased from approximately 35 km (T382) to approximately 27km (T574) in both the analysis and forecast model. The vertical resolution is 64 layers, with a model top at 0.2 hPa. Additionally, a number of improvements have been made to the model's ability to represent physical atmospheric processes. These improvements include an upgraded radiation and cloud package, upgraded specification of gravity wave drag, a higher resolution grid for hurricane relocation, an upgraded boundary layer scheme, the use of a higher resolution snow analysis, a new mass flux shallow convection scheme and an updated deep convection scheme.
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/.

Graphical model guidance for the GFS is available for the following regions:

1) North America
2) North Atlantic Ocean Basin
3) Western North Atlantic
4) South America
5) North Pacific
6) Eastern North Pacific
7) Africa

The link to the latest information about the GFS is:
http://wwwt.emc.ncep.noaa.gov/?branch=GFS&tab=doc

3. WAVEWATCH III (WW3)

The MAG website presents the WW3 model as three separate model names:

- WAVEWATCH III (WW3) for the regions Atlantic, North Pacific, East Pacific, entire North Atlantic and North Pacific ocean and Western North Atlantic (Southeast US, Central America and Caribbean).
- WAVEWATCH III Eastern North Pacific (WW3-ENP) for the region of the Eastern North Pacific Ocean and Pacific Ocean
- WAVEWATCH III Western North Atlantic (WW3-WNA) for the region of Western North Atlantic Ocean.

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 87 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. 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 across the North American region. 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

5. 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 for the North American region. The RUC graphics are available for the most recent 4 hours at hourly increments out to 18 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/

6. High Resolution Window (HRW-NMM)

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). 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

The MAG website presents the HRW-NMM model broken down by the regions

- HRW-NMM-EUS for the region of Eastern US available at 00 and 12 UTC
- NRW-NMM-WUS for the region of Western US available at 06 UTC
- HRW-NMM-AK for the region of Alaska available at 18 UTC

HRW-ARW

The HRW (also known as Nested Window Run or NWR) contains images from the Weather Research and Forecasting (WRF) model 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

The MAG website presents the HRW-NMM model broken down by the regions

- HRW-ARW-EUS for the region of Eastern US available at 00 and 12 UTC
- NRW-ARW-WUS for the region of Western US available at 06 UTC
- HRW-ARW-AK for the region of Alaska available at 18 UTC

7. 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

8. 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.

Graphical model guidance for the GFS is available for the following regions:

1) North America
2) North Atlantic Ocean Basin
3) Western North Atlantic
4) South America
5) Africa

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

The MAG website presents the GEFS model as

- GEFS-SPAG: GEFS individual members that run every 6 hrs that creates spaghetti charts.
- GEFS-MNSPRD: GEFS mean and spread that runs every 6 hrs.

9. North American Ensemble Forecast System (NAEFS):

The North American Ensemble Forecast System is a global weather modeling system run jointly by the Meteorological Service of Canada (MSC) and the U.S. National Weather Service (NWS) to provide numerical weather prediction (NWP) probabilistic products to weather forecasters in both countries for a forecast period that runs out 16 days. The NAEFS combines the Canadian global forecast model ensemble and the NWS Global Ensemble Forecast System model (GEFS) into a joint ensemble that will create global weather forecasts which include all of North America. At present, all the national weather agencies in North America are participating in NAEFS - the Meteorological Service of Canada, the National Meteorological Service of Mexico, and the U.S. National Oceanic and Atmospheric Administration NWS.

NAEFS forecasts are produced every six hours at 00, 06, 12 and 18 UTC.
(Note: For 06 and 18 UTC graphical products are produced by NWS GEFS input only).
The NAEFS graphics are based on 70 km grid (T190) bias-corrected and are available at six hour increments out to 384 hours. The latest NAEFS and NWS GEFS major implementation was on Feb. 23rd 2010
(see: http://wwwt.emc.ncep.noaa.gov/gmb/ens/ens_imp_news.html for more information).

Graphical model guidance for the NAEFS is available for the following regions:

1) North America
2) North Atlantic Ocean Basin
3) Western North Atlantic
4) South America
5) North Pacific
6) Eastern North Pacific
7) Africa.

10. Real Time Mesoscale Analysis (RTMA)

The MAG website presents the RTMA model by two separate regions:

- RTMA : Offers products available for the Continental United States
- RTMA-GUAM : Offers products available for Guam

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 down-scaling 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.

Graphical model output for the RTMA is available for the following regions:

1) Southwest U.S.
2) California
3) North Carolina/South Carolina
4) Colorado
5) North Dakota/South Dakota
6) Midwest region of U.S.
7) Gulf Coast region of U.S.
8) Mid-Atlantic region of U.S.
9) Michigan
10) Montana
11) New England
12) Ohio Valley
13) Texas
14) Pacific Northwest region of U.S.
15) Wisconsin

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/.

11. Observed Upper Air Data

Provides a selection of levels (1000 to 100 mb) and observations of station data within North America, South America, Africa, Canada, Alaska, and the Western North Atlantic.

12. Skew-T Plots

Provides Graphical Skew-T plots for stations in North America, South America, Africa, and the Northern Pacific.

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

The GFDL Hurricane Model (GHM) 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 five tropical cyclones at a time. The GHM 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 GHM 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

14. 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 five tropical cyclones 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://mag.ncep.noaa.gov/. 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

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

b) For more information about Models products please contact:

Michelle Mainelli (Branch Chief)
Systems Integration Branch
NCEP Central Operations
5200 Auth Road, Room 302
Camp Springs, MD 20746-4325

Email: mag.helpdesk@noaa.gov

c) Specific parameter graphics available for NAM, GFS, SREF, NAEFS, POLAR, RTMA and RTMA-GUAM are:

NAM	GFS	SREF	NAEFS	POLAR
3-hour precipitation	3-hour precipitation	Mean 6-hour precipitation	10m Wind	Ice drift
6-hour precipitation	6-hour precipitation	Mean12-hour precipitation	2m Temperature	
12-hour precipitation	12-hour precipitation	Mean 24-hour precipitation	Mean Sea Level Pressure	
24-hour precipitation	24-hour precipitation	Probability of 6-hour precipitation > 0.25(in)	250mb Temperature	

NAM	GFS	SREF	NAEFS	POLAR
36-hour precipitation	36-hour precipitation	Mean 1000-500mb thickness (m)	250mb Wind	
48-hour precipitation	48-hour precipitation	Mean 1000-850mb thickness (m)	500mb Temperature	
60-hour precipitation	60-hour precipitation	10m Winds	500mb Vorticity and Height	
Total Precipitation	Total Precipitation	2m Temperature	500mb Wind	
1000-500mb thickness 6-hr precipitation, mslp	1000-500mb thickness 6-hr precipitation, mslp	Mean 850-700 thickness(m)	700mb Temperature	
1000-850 mb thickness 6-hr precipitation, mslp	1000-850 mb thickness 6-hr precipitation, mslp	Mean Convective Available Potential Energy(CAPE)	700mb Vorticity and Height	
10m wind/ precipitation	10m wind/ precipitation	Mean Convective Inhibition(CIN)	700mb Wind	
850-700 thickness 6-hr precipitation, mslp	850-700 thickness 6-hr precipitation, mslp	Mean Lifted Index	850mb Temperature	
850mb temperature/ mean sea level/ precipitation	850mb temperature/ mean sea level/ precipitation	Mean sea level pressure	850mb Vorticity and Height	
Simulated radar reflectivity				
200mb wind/height	200mb wind/height	Probability of 10m wind speeds > 25 knots	850mb Wind	
250mb wind/height	250mb wind/height	Probability of 2m temperature < 0	925mb Wind	

NAM	GFS	SREF	NAEFS	POLAR
250mb Streamlines	250mb Streamlines			
300mb wind/height	300mb wind/height	Probability of CAPE > 2000		
500mb relative humidity/ height	500mb relative humidity/ height	250mb vorticity and height		
500mb vorticity/ height	500mb vorticity/ height	250mb wind		
700mb relative humidity/ height	700mb relative humidity/ height	500mb vorticity and height		
850mb perceptible water/height	850mb perceptible water/height	700mb relative humidity		
850mb relative humidity/ height	850mb relative humidity/ height	700mb temperature		
850 temperature/ height	850 temperature/ height	850mb relative humidity		
850mb vorticity/height	850mb vorticity/height	850mb temperature		
850mb streamlines	850mb streamlines	850mb wind		
850mb vorticity / 500mb height / 200mb wind	850mb vorticity / 500mb height / 200mb wind			

RTMA	RTMA-GUAM
10m Wind direction and speed	10m Wind direction and speed
2m dew point	2m dew point
2m temperature	2m temperature

d) Specific graphics available for RUC, GEFS-SPAG, GEFS-MNSPRD, WW3, WW3-ENP and WW3-WNA

RUC	GEFS-SPAG	GEFS-MNSPRD	WW3	WW3-ENP	WW3-WNA
1-hour total precipitation	200mb 1176 height contours	Dominant precipitation type	Peak wave direction and period(sec)	Regional WW3 model peak wave direction and period	Regional WW3 model peak wave direction and period
1000-500mb thickness	200mb 1118 height contours	Mean 6-hour precipitation	Significant wave height and wind	Regional WW3 model wind wave direction and period	Regional WW3 model wind wave direction and period
1000-850mb thickness	200mb 1200 height contours	Mean 24-hour precipitation	Wind wave direction and period(sec)	Regional WW3 model sig wave height and wind	Regional WW3 model sig wave height and wind
850-700mb thickness	200mb 1212 height contours	Probability of ice > 0.25(in)			
Convective inhibition (CAPE/CIN)	200mb 1224 height contours	Probability of 6-hrly precipitation > 1.00(in)			
Helicity 10m wind	200mb 1230 height contours	Probability of 6-hrly precipitation > 0.25(in)			
250mb wind/height	500mb 510/552 height contours	Probability of 6-hrly precipitation > 0.50(in)			
300mb wind/height	500mb 516/558 height contours	10m winds			

RUC	GEFS-SPAG	GEFS-MNSPRD	WW3	WW3-ENP	WW3-WNA
500mb vorticity/ height	500mb 522/564 height contours	2m temperature			
700mb relative humidity/ height	500mb 528/570 height contours	Mean Convective Available Potential Energy (CAPE)			
850mb temperature/ height	500mb 534/576 height contours	Mean Seal Level Pressure (MSLP)			
	500mb 540/582 height contours	Probability of CAPE > 2000			
	MSLP 1000/1040 isobar contours	Probability of CAPE > 250			
	MSLP 1004/1044 isobar contours	Probability of CAPE > 2000			
	MSLP 1008/1048 isobar contours	Probability of CAPE > 500			
	MSLP 1012/1052 isobar contours	250mb temperature			
	MSLP 984/1024 isobar contours	250mb winds			
	MSLP 996/1036 isobar contours	500mb temperature			

RUC	GEFS-SPAG	GEFS-MNSPRD	WW3	WW3-ENP	WW3-WNA
		500mb Vorticity and Height			
		500mb winds			
		700mb Temperature			
		700mb Vorticity and Height			
		700mb Winds			
		850mb Temperature			
		850mb Vorticity and Height			
		850mb Winds			
		925mb Winds			

e) Specific graphics available for HRW-NMM-EUS, HRW-NMM-WUS, HRW-NMM-AK, HRW-ARW-EUS, HRW-ARW-WUS and HRW-ARW-AK

HRW-NMM-EUS	HRW-NMM-WUS	HRW-NMM-AK	HRW-ARW-EUS	HRW-ARW-WUS	HRW-ARW-AK
Total precipitation every 3 hours	Total precipitation every 3 hours	Total precipitation every 3 hours			
Total precipitation every 12 hours	Total precipitation every 12 hours	Total precipitation every 12 hours			
Total precipitation every 24 hours	Total precipitation every 24 hours	Total precipitation every 24 hours			
Total	Total	Total			

HRW-NMM-EUS	HRW-NMM-WUS	HRW-NMM-AK	HRW-ARW-EUS	HRW-ARW-WUS	HRW-ARW-AK
precipitation every 36 hours	precipitation every 36 hours	precipitation every 36 hours			
Total precipitation every 48 hours	Total precipitation every 48 hours	Total precipitation every 48 hours			
MSLP, 1000-500mb thickness, 3-hourly total precipitation	MSLP, 1000-500mb thickness, 3-hourly total precipitation	MSLP, 1000-500mb thickness, 3-hourly total precipitation	MSLP, 1000-500mb thickness, 3-hourly total precipitation	MSLP, 1000-500mb thickness, 3-hourly total precipitation	MSLP, 1000-500mb thickness, 3-hourly total precipitation
Simulated radar reflectivity	Simulated radar reflectivity	Simulated radar reflectivity	Simulated radar reflectivity	Simulated radar reflectivity	Simulated radar reflectivity
250mb wind and height	250mb wind and height	250mb wind and height	250mb wind and height	250mb wind and height	250mb wind and height
300mb wind and height	300mb wind and height	300mb wind and height	300mb wind and height	300mb wind and height	300mb wind and height
500mb vorticity, wind and height	500mb vorticity, wind and height	500mb vorticity, wind and height	500mb vorticity, wind and height	500mb vorticity, wind and height	500mb vorticity, wind and height
700mb relative humidity, wind and height	700mb relative humidity, wind and height	700mb relative humidity, wind and height	700mb relative humidity, wind and height	700mb relative humidity, wind and height	700mb relative humidity, wind and height
850mb temperature, wind and height	850mb temperature, wind and height	850mb temperature, wind and height	850mb temperature, wind and height	850mb temperature, wind and height	850mb temperature, wind and height

f) Specific graphics available for GHM, GHM-Nested, HWRF, HWRF-Nested

GHM	GHM- NESTED	HWRF	HWRF- NESTED
Mean Sea Level Pressure and 35 Meter Wind	Mean Sea Level Pressure and 35 Meter Wind	Mean Sea Level Pressure and 35 Meter Wind	Mean Sea Level Pressure and 35 Meter Wind

GHM	GHM- NESTED	HWRF	HWRF- NESTED
850 MB Temperature, MSLP, and 6-Hourly Total Precipitation	850 MB Temperature, MSLP, and 6-Hourly Total Precipitation	850 MB Temperature, MSLP, and 6-Hourly Total Precipitation	850 MB Temperature, MSLP, and 6-Hourly Total Precipitation
850 MB Vorticity, Wind, and Height	850 MB Vorticity, Wind, and Height	850 MB Vorticity, Wind, and Height	850 MB Vorticity, Wind, and Height
700 MB Vorticity, Wind, and Height	700 MB Vorticity, Wind, and Height	700 MB Vorticity, Wind, and Height	700 MB Vorticity, Wind, and Height
500 MB Vorticity, Wind, and Height	500 MB Vorticity, Wind, and Height	5000 MB Vorticity, Wind, and Height	500 MB Vorticity, Wind, and Height
500 MB Relative Humidity, Wind, and Omega	500 MB Relative Humidity, Wind, and Omega	500 MB Relative Humidity, Wind, and Omega	500 MB Relative Humidity, Wind, and Omega
200 MB Vorticity, Wind, and Height	200 MB Vorticity, Wind, and Height	200 MB Vorticity, Wind, and Height	200 MB Vorticity, Wind, and Height
850mb vorticity / 500mb height / 200mb wind	850mb vorticity / 500mb height / 200mb wind	850mb vorticity / 500mb height / 200mb wind	850mb vorticity / 500mb height / 200mb wind