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PNSWSH

Technical Implementation Notice 14-46 Amended
National Weather Service Headquarters Washington DC
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 -NOAA Weather Wire Service
 -Emergency Managers Weather Information Network
 -NOAAPORT
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From: Timothy McClung
 Chief, Science Plans Branch
 Office of Science and Technology

Subject: Amended: Global Forecast Systems (GFS) Update:
 Effective January 7, 2015

Amended to change effective date to January 7, 2015

Effective on or about January 7, 2015, beginning with the
1200 Coordinated Universal Time (UTC) run, the National
Centers for Environmental Prediction (NCEP) will upgrade the
GFS Analysis and Forecast System which includes:

- Changes to the model components
- Increases in horizontal resolution
- Addition of 0.25 degree gridded output
- New product fields
- Change of product naming convention
- Changes in product timeliness
- Downstream model impacts

1) Model changes to the GFS Global Spectral Model:

- Increase horizontal resolution of the first segment of the forecast from Eulerian T574 (~27 km) to Semi-Lagrangian T1534 (~13 km), and extend the length of forecast from 192 hours to 240 hours
- Increase horizontal resolution of the second segment of the forecast from Eulerian T192 (~84 km) to semi-Lagrangian T574 (~35 km), and set forecast time from 240 hours to 384 hours
- Change from Eulerian dynamics to Semi-Lagrangian dynamics, which uses Hermite interpolation in both vertical and horizontal directions.
- Use 5 minute daily Real-Time Global (RTG) Sea Surface Temperature (SST) to replace 1.0 degree Reynolds 7 day SST analysis
- Initialize ice at small inland lakes in the northern

hemisphere with 4 km Interactive Multi-sensor Snow and Ice Mapping System (IMS) ice analysis data from the National Ice Center. For large water bodies, use 5 minute NCEP/MMAB ice analysis data to replace 30 minute ice data

- Use 1982-2012 5 minute SST climatology (replacing 1982-2001 1 degree SST climatology).
- Use 1982-2012 30 minute sea ice concentration climatology (replacing 1982-2001 1 degree climatology).
- Replace update of model snow depth by direct insertion of AFWA depth data with a blend of the model first guess depth and the AFWA depth.
- Use X-number to prepare spectral transform base functions. X-number is a numerical technique. It uses paired numbers to represent real number to avoid computational underflow or overflow that can occur in spectral truncation for wave number larger than T1000.
- Use divergence damping in the stratosphere to reduce noise
- Add a tracer fixer for maintaining global column ozone mass
- Use the Monte-Carlo Independent Column Approximation (McICA) for Rapid Radiative Transfer Model (RRTM) Radiation
- Reduce drag coefficient at high wind speeds
- Use Hybrid Eddy-Diffusivity Mass-Flux Planetary Boundary Layer (EDMF PBL) scheme and Turbulent Kinetic Energy (TKE) dissipative heating
- Re-tune ice and water cloud conversion rates, orographic gravity-wave forcing and mountain block; and reduce background diffusion of momentum
- Add stationary convective gravity wave drag
- Modify initialization of forecast state variables to reduce a sharp decrease in cloud water in the first model time step
- Correct a bug in the condensation calculation after the digital filter is applied
- Replace 1.0 degree bucket soil moisture climatology with CFS/Global Land Data Assimilation System (GLDAS) climatology at T574 (~27 km)
- Replace 1.0 degree momentum roughness length climatology by using a look-up table based on vegetation type
- Add a dependence of the ratio of the thermal and momentum roughness on vegetation type

2) Model changes to the GDAS/GFS Hybrid 3D-VAR Ensemble Kalman Filter (EnKF) Data Assimilation:

- Increase EnKF resolution from T254L64 to T574L64
- Assimilate hourly GOES and EUMETSAT atmospheric motion vectors
- Update radiance assimilation:
 - Assimilate SSM/IS UPP LAS and Metop-B IASI radiances
 - Use enhanced radiance bias correction scheme
- Update to version 2.1.3 of the Community Radiative Transfer Model (CRTM). CRTM v2.1.3 improves specification of microwave sea surface emissivities. This, in turn, improves the analysis of near surface

temperature over water, especially in the southern oceans.

- Use stochastic physics in EnKF ensemble forecasts
- The dump window for GOES Satellite Wind (satwnd) data will change from 1 hour to 6 hours. Subtypes will be added for (NOAA/METOP AVHRR SATWIND) infrared cloud motion vector and (NESDIS/GOES 3.9 micron channel) derived cloud motion vector

3) Output product changes

All filenames given below can be located on the NCEP ftp server, the NCEP http server, NOMADS or the NWS ftp server respectively via the following URLs (YYYYMMDD is the year, month, and day; CC is the cycle):

<ftp://ftp.ncep.noaa.gov/pub/data/nccf/com/gfs/prod/gfs.YYYYMMDDCC/>

<ftp://ftp.ncep.noaa.gov/pub/data/nccf/com/gfs/prod/gdas.YYYYMMDD>

<http://www.ftp.ncep.noaa.gov/data/nccf/com/gfs/prod/gfs.YYYYMMDDCC/>

<http://www.ftp.ncep.noaa.gov/data/nccf/com/gfs/prod/gdas.YYYYMMDD/>

<http://nomads.ncep.noaa.gov>

ftp://tgftp.nws.noaa.gov/nfs/nwstg/ftp/SL.us008001/ST.opnl/MT.gfs_CY.CC/RD.YYYYMMDD/

Product Removals:

With this upgrade NCEP is removing output files that are obsolete and not widely used. Please reference this html for explanations and possible replacement products:

http://www.nco.ncep.noaa.gov/pmb/changes/gfs_upgrade.shtml

- The following files will be removed

- gfs.YYYYMMDDCC/gfs.tCCz.sstgrb
- gfs.YYYYMMDDCC/gfs.tCCz.engicegrb
- gfs.YYYYMMDDCC/gfs.tCCz.snogrb
- gdas.YYYYMMDD/gdas1.tCCz.engicegrb.grib2
- gdas.YYYYMMDD/gdas1.tCCz.sstgrb.grib2
- PT.grid_DF.gr2/fh.00xx_tl.press_gr.sstgrb
- gdas.YYYYMMDD/gdas1.tCCz.snogrb.grib2
- gfs.YYYYMMDDCC/gfs_grb211.tCCz.pgrbFH.grib2
- gfs.YYYYMMDDCC/gfs.tCCz.master.grbFF.10m.uv.grib2
- PT.grid_DF.gr2/fh.xxxx_pa.sw10m_tl.press_gr.0p5deg
- gdas.YYYYMMDD/gdas1.tCCz.satang
- gfs.YYYYMMDDCC/gfs.tCCz.trmm.tm00.bufr_d
- gfs.YYYYMMDDCC/gfs.tCCz.sptrmm.tm00.bufr_d
- gdas.YYYYMMDD/gdas1.tCCz.sptrmm.tm00.bufr_d
- gdas.YYYYMMDD/gdas1.forecmwf.YYYYMMDDCC.grib2

- Remove variables from GFS and GDAS pressure GRIB files (*pgrb*)
 - Geopotential Height Anomaly (GPA)
 - 5-Wave Geopotential Height Anomaly (5WAVA)

Current Product Changes:

- The naming convention will change to include the grid and 3 digit forecast hours:

On the NCEP server -

GFS FH = "anl" or "f000-f384"

GDAS FH = "anl" or "f000-f009"

gfs.tCCz.pgrb2.fFFF -[greater than] gfs.tCCz.pgrb2.0p50.FH
 gfs.tCCz.pgrb2b.fFFF -[greater than] gfs.tCCz.pgrb2b.0p50.FH
 gfs.tCCz.pgrb.fFFF.grib2 -[greater than] gfs.tCCz.pgrb2.1p00.FH
 gfs.tCCz.pgrb2b.fFFF -[greater than] gfs.tCCz.pgrb2b.1p00.FH
 gfs.tCCz.pgrb.2p5deg.fFFF.grib2 -[greater than]
 gfs.tCCz.pgrb2.2p50.FH
 gfs.tCCz.pgrb.fFFF.grib2 -[greater than] gfs.tCCz.pgrb2.2p50.FH
 gfs.tCCz.goessimpgrb2fFFF.1p0deg -[greater than]
 gfs.tCCz.goessimpgrb2FH.1p0deg
 gfs.tCCz.goessimpgrb2fFFF.grd221 -[greater than]
 gfs.tCCz.goessimpgrb2FH.grd221
 master/gfs.tCCz.mastergrb2fFFF -[greater than]
 gfs.tCCz.pgrb2full.0p50.FH
 gdas1.tCCz.pgrbFFF.grib2 -[greater than] gdas1.tCCz.pgrb2.1p00.FH

On the NWS server:

GFS FH = 000-384

fh.0FH_tl.press_gr.0p5deg -[greater than]
 fh.0FH_tl.press_gr.0p50deg
 fh.0FH_tl.press_gr.1p0deg -[greater than]
 fh.0FH_tl.press_gr.1p00deg
 fh.0FH_tl.press_gr.2p5deg -[greater than]
 fh.0FH_tl.press_gr.2p50deg

- The following files will have decreased forecast hour availability to now only:
 - gfs.YYYYMMDDCC/gfs.tCCz.bFFF hourly output from 00-12
 - gfs.YYYYMMDDCC/gfs.tCCz.sFFF hourly output from 00-12

- There are numerous changes to the operational NOMADS files. For all of the details please reference this page:

http://www.nco.ncep.noaa.gov/pmb/changes/gfs_upgrade.shtml

- The packing for GRIB2 will be switched to secondorder complex packing. The benefits for users will be much faster IO time compared with the existing JPEG packing. The second order packing provides good accuracy, although files will be slightly larger than JPEG packing.

- Modify the list of stations for which BUFR data is generated for the GFS. The changes will also modify the lists of stations in the GFS BUFR sounding collectives disseminated on NOAAPORT. For the full list please reference this page:

http://www.nco.ncep.noaa.gov/pmb/changes/gfs_upgrade.shtml

- Use of the enhanced radiance bias correction scheme will be changing the abias file. The format of the file is being changed to incorporate information from the satang file.
gdas.YYYYMMDD/gdas1.tCCz.abias

- The GFS cyclone tracker file code has changed from "NA" to "AA" for storms in the Arabian Sea.
PT.text_GP.tratcf/cyclone.trackatcf

- Change variables averaged or accumulated over time, such as precipitation accumulation, to 6 hourly up to forecast hour 240 for all products (some had been 12 hourly after forecast hour 180 and some had been 12 hourly after forecast hour 192).

- Modify fields to both GFS and GDAS:
- Add Frozen Precipitation Fraction (CPOFP)
- Add Ozone (O3MR) at 150, 200, 250, 300, 350, and 400 mb
- Add Dew Point (DPT) at 2 meters
- Add Apparent Temperature (APTMP)
- Add instantaneous precipitation type (CICEP, CFRZR, CRAIN, CSNOW)
- Add Membrane SLP in GDAS pressure grib files
- Rename TMP at 0-0.1 m, 0.1-0.4 m, 0.4-1.0 m, and 1-2 m to the more accurate name of Soil Temperature (TSOIL)
- Modify the precision of Relative Humidity (RH) grids
- Modify GRIB encoding level of Total Cloud Cover (TCDC), removing "considered as a single layer"
- Move Snow Depth (SNOD) from the *pgrb2b* files into the *pgrb2* files

New Products:

- Produce GRIB2 output at the highest resolution on 0.25 degree latitude-longitude grid 193 (1440x721)
gfs.YYYYMMDDCC/gfs.tCCz.pgrb2.0p25.FH
gfs.YYYYMMDDCC/gfs.tCCz.pgrb2b.0p25.FH

Product Timeliness:

GFS product delivery timing on NOMADS, the ftp server and NOAAPORT will be delayed for numerous products. Pressure GRIB (*pgrb*) files will be as much as 20 minutes delayed. Please reference this page for a full list of delays:

http://www.nco.ncep.noaa.gov/pmb/changes/gfs_upgrade.shtml

NOAAPORT/SBN product changes:

- Additional forecast hours 186, 198, 210, 222, and 234 will be added for the following GRIB2 grids only. There are no new headers to add as these grids use existing headers:

- 201 - 381km Northern Hemisphere
- 212 - 40km CONUS
- 213 - 95km CONUS
- 160 - 47.5km Alaska
- 161 - 0.5 degree lat/lon for Puerto Rico
- 254 - 40km Pacific Region

- Variables averaged or accumulated over time, such as precipitation, will now be valid over a 6 hour period for forecast hours 180 through 240, rather than a 12 hour period. There are no new headers to add as these new grids use existing headers.

4) Downstream model impacts

There are impacts to downstream GFS models and their product output. Please reference this page for more information on the following:

http://www.nco.ncep.noaa.gov/pmb/changes/gfs_upgrade.shtml

- GFS-based Model Output Statistics (MOS) products
- Global Ensemble Forecast System variable change
- Numerous downstream model output timeliness changes. These changes impact both NOAAPORT/SBN and the NCEP/NWS servers.

5) Parallel data available

Due to system constraints the parallel GFS will run on the backup supercomputer. This will cause impact to output availability on at least 3 days due to mandatory maintenance. We will notify users when a cycle will not be available through this user list:

<https://lstsrv.ncep.noaa.gov/mailman/listinfo/ncep.list.nomads-ftpprd>

Starting in late October all parallel data sets will be available on the following servers:

<ftp://ftp.ncep.noaa.gov/pub/data/nccf/com/gfs/para/gfs.YYYYMMDDCC/>
<ftp://ftp.ncep.noaa.gov/pub/data/nccf/com/gfs/para/gdas.YYYYMMDD>

<http://www.ftp.ncep.noaa.gov/data/nccf/com/gfs/para/gfs.YYYYMMDDCC/>

<http://www.ftp.ncep.noaa.gov/data/nccf/com/gfs/para/gdas.YYY YMMDD/>

<http://nomads.ncep.noaa.gov>

NCEP has a full list of products that will be available for download from both the NCEP and NWS servers as well as NOMADS. You can find the file names and their inventory through the following http page:

<http://www.nco.ncep.noaa.gov/pmb/products/gfs/index.shtml.upgrade>

For more information on this GFS upgrade, please see EMC real-time and retrospective parallels and verification pages:

<http://www.emc.ncep.noaa.gov/gmb/wx24fy/vsdb/gfs2015/>

<http://www.emc.ncep.noaa.gov/gmb/wd20rt/>

http://www.emc.ncep.noaa.gov/gmb/STATS_vsdb/

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, 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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For questions regarding the data flow aspects of these data sets, 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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