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Service Change Notice 18-16
National Weather Service Headquarters Silver Spring, MD
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From: Dave Myrick
           NWS Office of Science and Technology Integration

Subject: Upgrade of National Water Model
           Effective March 6, 2018

Effective on or about March 6, 2018, beginning with the 1200
Coordinated Universal Time (UTC) run, the National Centers for
Environmental Prediction (NCEP) will begin operationally running
Version 1.2 of the National Water Model (NWM).

The NWM is an hourly cycling uncoupled analysis and forecast
system that provides streamflow for 2.7 million river reaches
and other hydrologic information on 1km and 250m grids. The
model provides complementary hydrologic guidance at current NWS
River Forecast Center river forecast locations and significantly
expanded guidance coverage and type in underserved locations.

The NWM ingests forcing from a variety of sources including
Multi-Radar Multi-Sensor (MRMS) radar-gauge observed
precipitation data and High-Resolution Rapid Refresh (HRRR),
Rapid Refresh (RAP), Global Forecast System (GFS) and Climate
Forecast System (CFS) Numerical Weather Prediction (NWP)
forecast data. USGS real-time streamflow observations are
assimilated and all NWM configurations benefit from the
inclusion of ~1,500 reservoirs. The core of the NWM system is
the National Center for Atmospheric Research (NCAR)-supported
community Weather Research and Forecasting (WRF)-Hydro
hydrologic model. WRF-Hydro is configured to use the Noah Multi-
Parameterization (Noah-MP) Land Surface Model (LSM) to simulate
land surface processes. Separate water routing modules perform
diffusive wave surface routing and saturated subsurface flow
routing on a 250m grid, and Muskingum-Cunge channel routing down
NHDPlusV2 stream reaches. River analyses and forecasts are
provided across a domain encompassing the continental U.S. and
hydrologically-contributing areas, while land surface output is
available on a larger domain that extends beyond the continental
U.S. into Canada and Mexico (roughly from latitude 19N to 58N).
In addition, NWM forcing datasets are provided on this domain at
a resolution of 1km.

List of Enhancements in Version 1.2:

- Refined land surface and hydrologic parameters by expanding
calibration from ~40 to ~1000+ calibration basins and improving
parameter regionalization process

- Improved streamflow data assimilation in Analysis cycle

- Introduced the ability to make on-demand updates of
hydrological parameters within the modeling system. Users can
find notifications for when an update was introduced here:
  http://water.noaa.gov

- Made various hydrofabric improvements including
    -Fixing 500 stream breaks
    -Adding 12,468 OCONUS basins (94,824 km^2)
    -Adding 680 USGS stream gauges into assimilation routine
    -Adding 328 reservoirs (now totaling ~1,500)
    -Including a new elevation base harmonized with the NHDPlus
channel network

- Changes to the fields and metadata contained within NWM output
files including:
    -Compressing the reservoir output files from the Analysis,
Short-, Medium- and Long-Range configurations to match
compression applied to other model output file types. This
compression greatly reduces reservoir-type output file sizes.
Files affected include:
  nwm.tCCz.analysis_assim.reservoir.tm##.conus.nc
Where CC is cycle (00-23) and ## is 00-02.
  nwm.tCCz.short_range.reservoir.f###.conus.nc
Where CC is cycle (00-23) and ### is 001-018
  nwm.tCCz.medium_range.reservoir.f###.conus.nc
Where CC is cycle (00,06,12,18) and ### is 003-240
  nwm.tCCz.long_range.reservoir_M.f###.conus.nc
Where CC is cycle (00,06,12,18), M is member (1-4) and ### is
006-720
    -Changed the data type of the output variable "inflow" from
"float" to "integer" in the reservoir model output files from
the Analysis, Short-, Medium- and Long-Range configurations as
part of compression. Files affected include:
  nwm.tCCz.analysis_assim.reservoir.tm##.conus.nc
Where CC is cycle (00-23) and ## is 00-02.
  nwm.tCCz.short_range.reservoir.f###.conus.nc
Where CC is cycle (00-23) and ### is 001-018
  nwm.tCCz.medium_range.reservoir.f###.conus.nc
Where CC is cycle (00,06,12,18) and ### is 003-240
  nwm.tCCz.long_range.reservoir_M.f###.conus.nc
Where CC is cycle (00,06,12,18), M is member (1-4) and ### is
006-720
    -Changed the data type of the metadata variable "time" from
"double" to "integer" in the forcing output files to match the
convention used in the non-forcing (i.e., model) output files.
Files affected include:

```
   nwm.tCCz.analysis_assim.forcing.tm##.conus.nc
Where CC is cycle and ## is 00-02
   nwm.tCCz.short_range.forcing.f###.conus.nc
Where CC is cycle and ### is 001-018
   nwm.t${cyc}z.medium_range.forcing.f###.conus.nc
Where CC is cycle and ### is 001-240
```

   -Addition of output variable (velocity) to the Long-Range channel output files. Files affected include:

```
   nwm.tCCz.long_range.channel_rt_M.f###.conus.nc
Where CC is cycle (00,06,12,18), M is member (1-4) and ### is
006-720
```

   -Additing three output variables (QSfcLatRunoff, QBucket, QBtmVertRunoff) to the Short-Range and Analysis channel output files to support channel-only configuration of NWM used in research and development activities. Files affected include:

```
   nwm.tCCz.analysis_assim.channel_rt.tm##.conus.nc
Where CC is cycle (00-23) and ## is 00-02.
   nwm.tCCz.short_range.channel_rt.f###.conus.nc
Where CC is cycle (00-23) and ### is 001-018
```

   -Removal of variable (qlat) from the Analysis, Short-, Medium- and Long-Range channel output files. Files affected include:

```
   nwm.tCCz.analysis_assim.channel_rt.tm##.conus.nc
Where CC is cycle (00-23) and ## is 00-02.
   nwm.tCCz.short_range.channel_rt.f###.conus.nc
Where CC is cycle (00-23) and ### is 001-018
   nwm.tCCz.medium_range.channel_rt.f###.conus.nc
Where CC is cycle (00,06,12,18) and ### is 003-240
   nwm.tCCz.long_range.channel_rt_M.f###.conus.nc
Where CC is cycle (00,06,12,18), M is member (1-4) and ### is
006-720
```

   - Network Common Data Form (NetCDF) metadata and data structure updates to improve compatibility with NetCDF file readers--as above, decoders may need to be adjusted to adapt to these changes.

General Framework:

Version 1.2 of the NWM will be run in the same four configurations as Version 1.1--Analysis and Assimilation, Short-Range, Medium-Range and Long-Range.

End users are able to view the output via the interactive map and image viewer on the Office of Water Prediction (OWP) website, http://water.noaa.gov/about/nwm

Additionally, the full set of NWM output and a subset of forcing files are available on NCEP web services at:
   http://nomads.ncep.noaa.gov/pub/data/nccf/com/nwm
   ftp://ftpprd.ncep.noaa.gov/pub/data/nccf/com/nwm
   http://ftp.ncep.noaa.gov/data/nccf/com/nwm

Output Changes on the NCEP web services:
No directory structures or file name conventions will change

with this upgrade. Users should refer to the V1.1 and V1.0 TINs
for information on filename and directory structures.

http://www.nws.noaa.gov/os/notification/tin16-30natl_water_model.htm
http://www.nws.noaa.gov/os/notification/scn17-41natl_water_modelaaa.htm

Changes were made to the internal contents of the output files.

These include
-Adding three new variables (QSfcLatRunoff, QBucket,
QBtmVertRunoff) to the Short-Range and Analysis channel output
files
-Removing one variable (qlat) from the Analysis, Short-, Medium-
and Long-Range channel output files
-Changing the metadata variable "time" data type from "double"
to "integer"
-Changing the output variable "inflow" from "float" to "integer"
in the reservoir model output files from the Analysis, Short-,
Medium- and Long-Range configurations.

As in V1.1, users will find that long range products have enough
of a lag time in creation that they may appear in the previous
day's output directory. For example, long range mem 1 products
for the 18z cycle will not show up until the day after their
initialization time. For this reason, users are encouraged to
look back in the previous dated directory for long range product
availability.

File availability time changes:

Due to the variability of the timing of observation input data
from the U.S. Geological Survey (USGS), an increased frequency
of running the observation aggregation process, and enhanced
parsing of quality control flags, the USGS timeslice files will
continue to vary in timing and updates throughout the day.
Output files from the NWM medium range forecast will now be
available up to 25 minutes earlier due to changes in the file
contents mentioned above.

Most NWM NetCDF output files are directly viewable using
standard NetCDF visualization utilities. The exceptions are the
point-type NWM channel output files containing streamflow and
other variables. In particular, due to storage space
limitations, the latitude and longitude of each point are stored
outside of the file, but are available at:

ftp://ftp.nohrsc.noaa.gov/pub/staff/keicher/NWM_live/web/data_tools/NWM_v
1.2_nc_tools_v1.tar.gz

Scripts are also available at this location which will append
this geospatial data to a user selected output file, enabling
viewing of channel output files within NetCDF visualization
utilities.

A consistent parallel feed of NWM data is available on the NCEP
server via the following URLs:

http://para.nomads.ncep.noaa.gov/pub/data/nccf/com/nwm/para

NCEP encourages all users to ensure their decoders are flexible
and are able to adequately handle changes in content order and
also any volume changes which may be forthcoming. These elements
may change with future NCEP model implementations. NCEP will
make every attempt to alert users to these changes prior to any
implementations.

For more general information about the NWM, please see:
   http://water.noaa.gov/about/nwm

Direct questions regarding this implementation to the contacts
below. NCEP will evaluate feedback and decide whether to proceed.

For questions on the science aspects, please contact:
    Brian Cosgrove
    OWP/Analysis and Prediction Division
    Silver Spring, MD
    301-427-9513
    brian.cosgrove@noaa.gov

For questions regarding the data flow aspects of these datasets,
please contact:
    Carissa Klemmer
    NCEP/NCO Dataflow Team
    College Park, Maryland
    301-683-0567
    ncep.list.pmb-dataflow@noaa.gov

NWS National Service Change Notices are online at:

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

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