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PNSWSH

Service Change Notice 20-119 Updated  
National Weather Service Headquarters Silver Spring, MD  
230 PM EDT Fri Mar 19 2021

To:           Subscribers:  
              -NOAA Weather Wire Service  
              -Emergency Managers Weather Information Network  
              -NOAAPort  
              Other NWS Partners, Users and Employees

From:         Mike Farrar, Director  
              National Centers for Environmental Prediction

Subject: Upgrade of National Water Model on NCEP's WCOSS System,  
and its Post-Processing Application on the Integrated  
Dissemination Platform (IDP): Effective April 20, 2021

Updated to reflect the new implementation date of April 20,  
2021.

Effective on or about April 20, 2021, beginning with the 1200  
Coordinated Universal Time (UTC) run, the National Centers for  
Environmental Prediction (NCEP) will begin operationally running  
Version 2.1 of the National Water Model (NWM) on the Weather and  
Climate Operational Supercomputing System (WCOSS), and its  
related output post-processing application will begin running on  
the Integrated Dissemination Platform (IDP).

The NWM is an hourly cycling uncoupled analysis and forecast  
system that provides streamflow for over 2.7 million river  
reaches and other hydrologic information on grids ranging in  
resolution from 100m to 1km. It provides complementary  
hydrologic guidance at current NWS River Forecast Center (RFC)  
river forecast locations and significantly expanded guidance  
coverage and type in underserved locations. Further information  
on the observation- and model-based forcing sources used by the  
NWM, along with details on the NWM domain and modeling  
components, can be found at:

<https://water.noaa.gov/about/nwm>

The NWM post-processing application ingests NWM raw channel,  
land forecast and forcing files and then creates subset data  
files and derived variables for the NWS River Forecast Centers

(RFCs). The subsetting of data is intended to reduce system and network resource usage in obtaining critical NWM data of interest. The Post-Processing also supports the Office of Water Prediction (OWP) web services with NWM image products and map service data for select NWM variables.

(A) Enhancements in the Model Version 2.1

- First-time NWM coverage for Puerto Rico and United States Virgin Islands (USVI), complementing RFC-sourced streamflow forecasts with island-wide hydrologic guidance.
- Expansion of streamflow modeling and data assimilation coverage to the Great Lakes and Lake Champlain Basins, allowing for a full accounting of inflow into the Great Lakes.
- An enhanced treatment of reservoirs, with use of U.S. Geological Survey (USGS) and U.S. Army Corps of Engineers (USACE) data via a persistence methodology, and ingest of RFC-supplied reservoir outflow forecast data.
- New open-loop no-DA (non-data assimilation) model configurations to support interpretation and use of model forecasts.
- Forcing improvements including use of Multi-Radar Multi-Sensor version 12 (MRMS) Quantitative Precipitation Estimate (QPE) data over Hawaii, and improved bias correction and downscaling of meteorological forcing over the Continental United States (CONUS).
  - Improved snow melt physics
  - Improved and expanded calibration of hydrologic parameters
  - Corrections to stream connectivity
  - Improved code modularity
  - Refined land surface and hydrologic parameters by expanding calibration from ~1,100 to ~1,400 calibration basins and improving parameter regionalization process.
- Various hydrofabric improvements for all domains, detailed in Appendix 1 at the end of this notice.
- Expanded coverage within existing NWM streamflow and reservoir output files, to now include hydrologic guidance for the Great Lakes and Lake Champlain Drainage Basins.

- Increase in the output frequency of Medium-Range (ensemble members 1 through 7) forecast streamflow from 3-hourly to hourly.
- Elimination of the 06Z and 18Z Hawaii Short-Range forecast cycles and reduction of forecast length from 60 to 48 hours (due to alterations in forcing data).
- Increase of output frequency of Hawaii hydrologic output files from once per hour to every 15 minutes at 00, 15, 30 and 45 past the hour.

(B) Model Output Changes

Model output is available via NCEP web services here:

<https://nomads.ncep.noaa.gov/pub/data/nccf/com/nwm>  
<ftp://ftpprd.ncep.noaa.gov/pub/data/nccf/com/nwm>

B1. Additions to existing files

- \* New fields were added to reservoir files.
  - Reservoir\_type: attributes flag\_values 1, 2, and flag\_meanings Level\_pool, USGS-persistence
  - Reservoir\_assimilated\_value: for USGS-sourced locations, [m<sup>3</sup>/s]
- \* New fields were added to the existing CONUS Analysis and Assimilation, Extended Analysis and Assimilation, and Long-Range Analysis and Assimilation, as well as the Hawaii Analysis and Assimilation land files:
  - ACSNOM: accumulated melting water out of snow bottom, [mm]
  - QSNOW: snowfall rate on the ground, [mm/s]
  - QRAIN: rainfall rate on the ground, [mm/s]
  - EDIR: direct from soil evaporation rate, [kg/m<sup>2</sup>s]
- \* New fields were added to the existing CONUS Long-Range Analysis and Assimilation and Medium-Range channel files:
  - qSfcLatRunoff: runoff from terrain routing, [m<sup>3</sup>/s]
  - qBucket: flux from gw bucket, [m<sup>3</sup>/s]
  - qBtmVertRunoff: runoff from bottom of soil to bucket, [m<sup>3</sup>]

B2. Renamed Hawaii Output

- \* Analysis and Assimilation in analysis\_assim\_hawaii/
  - Old filenames:
    - nwm.tCCz.analysis\_assim.channel\_rt.tm##.hawaii.nc
    - nwm.tCCz.analysis\_assim.reservoir.tm##.hawaii.nc
    - nwm.tCCz.analysis\_assim.land.tm##.hawaii.nc
    - nwm.tCCz.analysis\_assim.terrain\_rt.tm##.hawaii.nc

Where CC is cycle (00-23), ## is 00-02.

- New filenames:

nwm.tCCz.analysis\_assim.channel\_rt.tm##?.hawaii.nc  
nwm.tCCz.analysis\_assim.reservoir.tm##?.hawaii.nc  
nwm.tCCz.analysis\_assim.land.tm##?.hawaii.nc  
nwm.tCCz.analysis\_assim.terrain\_rt.tm##?.hawaii.nc

Where CC is cycle (00-23), ## is 00-02, and ?? is  
45, 30, 15 or 00.

\* Short Range in short\_range\_hawaii/

- Old filenames:

nwm.tCCz.short\_range.channel\_rt.f###.hawaii.nc  
nwm.tCCz.short\_range.reservoir.f###.hawaii.nc  
nwm.tCCz.short\_range.land.f###.hawaii.nc  
nwm.tCCz.short\_range.terrain\_rt.f###.hawaii.nc

Where CC is cycle (00, 12), ### is 001-060

- New filenames:

nwm.tCCz.short\_range.channel\_rt.f###?.hawaii.nc  
nwm.tCCz.short\_range.reservoir.f###?.hawaii.nc  
nwm.tCCz.short\_range.land.f###?.hawaii.nc  
nwm.tCCz.short\_range.terrain\_rt.f###?.hawaii.nc

Where CC is cycle (00, 12), ### is 001-048, and ??  
is 45, 30, 15 or 00.

### B3. New Puerto Rico/ US Virgin Islands Output

New elements in the new files are detailed in Appendix 2 at the  
end of this notice.

\* Analysis and Assimilation in analysis\_assim\_puertorico/

nwm.tCCz.analysis\_assim.channel\_rt.tm##.puertorico.nc  
nwm.tCCz.analysis\_assim.reservoir.tm##.puertorico.nc  
nwm.tCCz.analysis\_assim.land.tm##.puertorico.nc  
nwm.tCCz.analysis\_assim.terrain\_rt.tm##.puertorico.nc

Where CC is cycle (00-23) and ## is 00-02.

\* Analysis and Assimilation Forcing in  
forcing\_analysis\_assim\_puertorico/

nwm.tCCz.analysis\_assim.forcing.tm##.puertorico.nc

Where CC is cycle (00-23) and ## is 00-02.

\* Short Range in short\_range\_puertorico/

nwm.tCCz.short\_range.channel\_rt.f###.puertorico.nc  
nwm.tCCz.short\_range.reservoir.f###.puertorico.nc  
nwm.tCCz.short\_range.land.f###.puertorico.nc  
nwm.tCCz.short\_range.terrain\_rt.f###.puertorico.nc

Where CC is cycle (06, 18) and ### is 001-048.

\* Short Range Forcing files in forcing\_short\_range\_puertorico/

nwm.tCCz.short\_range.forcing.f###.puertorico.nc

Where CC is cycle (06, 18) and HHH is 001-048.

\* No-DA Analysis and Assimilation in  
analysis\_assim\_puertorico\_no\_da/  
- Open Loop channel files

nwm.tCCz.analysis\_assim\_no\_da.channel\_rt.tm##.puertorico.nc

\* No-DA Short Range in short\_range\_puertorico\_no\_da/  
- Open Loop channel files  
nwm.tCCz.short\_range\_no\_da.channel\_rt.f###.puertorico.nc

#### B4. New CONUS No-DA Output

New elements in the new files are detailed in Appendix 3 at the end of this notice.

\* Analysis and Assimilation in analysis\_assim\_no\_da/  
- Open Loop channel files  
nwm.tCCz.analysis\_assim\_no\_da.channel\_rt.tm##.conus.nc

\* Extended Analysis and Assimilation in  
analysis\_assim\_extend\_no\_da/  
- Open Loop channel files

nwm.tCCz.analysis\_assim\_extend\_no\_da.channel\_rt.tm##.conus.nc  
Where CC is cycle (16) and ## is 00-27

\* Long-Range Analysis and Assimilation in  
analysis\_assim\_long\_no\_da/  
- Open Loop channel files

nwm.tCCz.analysis\_assim\_long\_no\_da.channel\_rt.tm##.conus.nc  
Where CC is cycle (00, 06, 12, 18) and ## is 00-27

\* Medium Range in medium\_range\_no\_da/  
- Open Loop channel files  
nwm.tCCz.medium\_range\_no\_da.channel\_rt.f###.conus.nc  
Where CC is cycle (00, 06, 12, 18) and ### is 003,  
006,... 240.

#### B5. New Hawaii No-DA Output

New elements in the new files are detailed in Appendix 4 at the end of this notice.

\* Analysis and Assimilation in analysis\_assim\_hawaii\_no\_da/  
- Open Loop channel files  
nwm.tCCz.analysis\_assim\_no\_da.channel\_rt.tm##??.hawaii.nc  
Where CC is cycle (00-23), ## is 00-02, and ?? is

45,30,15 or 00.

\* Short Range in short\_range\_hawaii\_no\_da/  
- Open Loop channel files  
nwm.tCCz.short\_range\_no\_da.channel\_rt.f###??.hawaii.nc

Where CC is cycle (00, 12), ### is 001-048, and ?? is 45, 30, 15 or 00.

#### (C) Post-Processing Application Output Changes

C1. New RFC output created for the Puerto Rico and Virgin Islands (Southeast River Forecast Center) on the NCEP Web Services here:

<https://nomads.ncep.noaa.gov/pub/data/nccf/com/nwm/post-processed/RFC/SE/>

File names contain puertorico.serfc

C2. New Puerto Rico/Virgin Islands domain Web Map Service data and image file products are on the NCEP Web Services here:

<https://nomads.ncep.noaa.gov/pub/data/nccf/com/nwm/post-processed/WMS>

<https://nomads.ncep.noaa.gov/pub/data/nccf/com/nwm/post-processed/IMAGES>

File names for Puerto Rico and Virgin Islands contains puertorico in the file name.

C3. New RFC No Data Assimilation (No-DA) model run products are created for the following range type and region:

- Short Range (Hawaii and Puertorico/Virgin Islands region)
- Medium Range (CONUS region)
- Analysis Assimilation (CONUS, Hawaii and Puerto Rico region)
- Long Range Analysis Assimilation (CONUS region)
- Extended Range Analysis Assimilation (CONUS region)

File names have the descriptor no\_da in the filename.

C4. Web Map Service data products are created for all channel\_rt ensemble members of the medium and long ranges.

#### (D) Timing Changes

With the implementation of NWM V2.1, the timing of NWM output dissemination will change as follows:

Later Timing:

- \* CONUS Medium-Range forcing - up to 18 minutes longer
- \* CONUS Medium Range model - 28 minutes longer (17 minutes inherited from forcing + 11 minutes from model)
- \* CONUS Long-Range model - 06/12/18Z members 2, 3, 4 - up to 35 minutes longer
- \* Hawaii Short-Range forcing - 18 minutes longer

\* Hawaii Analysis forcing - up to four hours longer as now driven with MRMS precipitation observations instead of NWP forecast data

Earlier Timing:

\* CONUS Long-Range model - 00/06/12/18Z member 1 - 3 to 9 hours early

\* CONUS Long-Range model - 00Z members 2, 3, 4 - 23 minutes early

(E) OWP Water Website visualization services

End users are able to visualize several NWM outputs via the interactive map and image viewer on the Office of Water Prediction (OWP) website:

<https://water.noaa.gov/about/nwm>

Please refer to the OWP Water Website v1.5.2 Service Change Notice (SCN) for further information on visualization product changes related to NWM v2.1.

(F) Other information and contacts

Users should refer to the V2.0, V1.2, V1.1 and V1.0 SCNs/Technical Implementation Notices (TINs) for information on the other unchanged filename and directory structures:

[https://www.weather.gov/media/notification/pdf2/scn19-42natl\\_water\\_model.pdf](https://www.weather.gov/media/notification/pdf2/scn19-42natl_water_model.pdf)

[https://www.weather.gov/media/notification/tins/tin16-30natl\\_water\\_model.pdf](https://www.weather.gov/media/notification/tins/tin16-30natl_water_model.pdf)

[https://www.weather.gov/media/notification/pdfs/scn17-41natl\\_water\\_modelaaa.pdf](https://www.weather.gov/media/notification/pdfs/scn17-41natl_water_modelaaa.pdf)

[https://www.weather.gov/media/notification/pdfs/scn18-16national\\_water\\_model.pdf](https://www.weather.gov/media/notification/pdfs/scn18-16national_water_model.pdf)

As in V2.0, 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.

Most NWM NetCDF output files are directly viewable using standard NetCDF visualization utilities. The exception 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:

[https://www.nohrsc.noaa.gov/pub/staff/keicher/NWM\\_live/web/data\\_tools/NWM\\_channel\\_hydrofabric.tar.gz](https://www.nohrsc.noaa.gov/pub/staff/keicher/NWM_live/web/data_tools/NWM_channel_hydrofabric.tar.gz)

This archive contains an ESRI file geodatabase (gdb), which provides full geospatial information for all NWM stream reaches. The gdb file can easily be used with ESRI ArcGIS software, and other GIS software, to associate the correct geospatial data with NWM channel\_rt data by feature\_id. A full text description of the gdb contents and basic use instructions are available as a separate file in the archive.

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

<https://para.nomads.ncep.noaa.gov/pub/data/nccf/com/nwm/para>

And here for the parallel post-processed data:\

<https://nomads.ncep.noaa.gov/pub/data/nccf/com/nwm/para/post-processed/>

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.

## APPENDICES

Appendix 1, hydrofabric improvements by domain.

A1.1) CONUS DOMAIN

- \* Channel Segments
  - Addition of 48,186 stream segments (Great Lakes region)
  - Geometry changes to 1,636 existing stream segments
  - 18 Stream segment topology and attribute fixes
- \* Streamflow Gauges
  - Addition of 455 stream gauges into the assimilation routine (347 Canadian stream gages)
  - Adjusted location of 14 gauges
  - Replaced IDs of 2 existing gauges
- \* Miscellaneous



- Addition of 342 reservoirs (Great Lakes region)
- NLCD 2016 land cover update over CONUS
- Ontario provincial land cover update

#### A1.2) HAWAII DOMAIN

- Use of CONUS contributing-area based regression parameters for channel bottom width (BtmWdth) and channel side slope (ChSlp) variables

#### A1.3) NEW PUERTO RICO / US VIRGIN ISLANDS DOMAIN

- 13,692 channel drainage catchments (8,427 km<sup>2</sup>)
- 14,017 channel segments (11,838 km)
- 15 reservoirs
- 83 USGS stream gages used for assimilation routine (all on the island of Puerto Rico)
  - 10-meter horizontal resolution elevation base from USGS 3DEP
  - NHDPlus v2 hydrography
  - Land cover from 30m regionalized CCAP land cover (2010 for Puerto Rico and 2012 for U.S. Virgin Islands)
  - Soil types from Gridded Soil Survey Geographic (gSSURGO) data set

#### Appendix 2, New Puerto Rico/ US Virgin Islands Output

\* Analysis and Assimilation in analysis\_assim\_puertorico/

- Channel files

nwm.tCCz.analysis\_assim.channel\_rt.tm##.puertorico.nc

Where CC is cycle (00-23) and ## is 00-02.

- time: valid output time, [minutes since 1970-01-01 00:00:00 UTC]
  - reference\_time with long\_name model initialization time and units minutes since 1970-01-01 00:00:00 UTC
  - crs with long\_name CRS definition
  - feature\_id with long\_name Reach ID
  - streamflow with long\_name River Flow and units m<sup>3</sup>/s
  - nudge with long\_name Amount of stream flow alteration and units m<sup>3</sup>/s
    - velocity with long\_name River Velocity and units m/s
    - qSfcLatRunoff with long\_name Runoff from terrain routing and units m<sup>3</sup>/s
      - qBucket with long\_name Flux from gw bucket and units m<sup>3</sup>/s
        - qBtmVertRunoff with long\_name Runoff from bottom of soil to bucket and units m<sup>3</sup>
- Reservoir files
  - nwm.tCCz.analysis\_assim.reservoir.tm##.puertorico.nc
    - Where CC is cycle (00-23) and ## is 00-02.
    - time with long\_name valid output time and units minutes since 1970-01-01 00:00:00 UTC

- reference\_time with long\_name model initialization time and units minutes since 1970-01-01 00:00:00 UTC
- crs with long\_name CRS definition
- feature\_id with long\_name Reach ID
- latitude with long\_name Lake latitude and units degrees\_north
- longitude with long\_name Lake longitude and units degrees\_east
- reservoir\_type with long\_name reservoir\_type and attributes flag\_values 1, 2, 3, 4, and flag\_meanings Level\_pool USGS-persistence USACE-persistence RFC-forecasts
- reservoir\_assimilated\_value with long\_name reservoir\_assimilated\_value and units m<sup>3</sup>/s
- inflow with long\_name Lake Inflow and units m<sup>3</sup>/s
- outflow with long\_name Lake Outflow and units m<sup>3</sup>/s
- water\_sfc\_elev with long\_name Water Surface Elevation and units m
- Land files
  - nwm.tCCz.analysis\_assim.land.tm##.puertorico.nc
    - Where CC is cycle (00-23) and ## is 00-02.
- time with long\_name valid output time and units minutes since 1970-01-01 00:00:00 UTC
- reference\_time with long\_name model initialization time and units minutes since 1970-01-01 00:00:00 UTC
- crs with long\_name CRS definition
- x with long\_name projection\_x\_coordinate and units m
- y with long\_name projection\_y\_coordinate and units m
- EDIR with long\_name Direct from soil evaporation rate and units kg m<sup>-2</sup> s<sup>-1</sup>
- SNLIQ with long\_name Snow layer liquid water and units mm
- SOIL\_T with long\_name soil temperature and units K
- SOIL\_M with long\_name volumetric soil moisture, the dimensionless ratio of water volume (m<sup>3</sup>) to soil volume (m<sup>3</sup>) and units m<sup>3</sup>/m<sup>3</sup>
- SNOWH with long\_name Snow depth and units m
- SNEQV with long\_name Snow water equivalent and units kg/m<sup>2</sup>
- QSNOW with long\_name Snowfall rate on the ground and units mm/s
- ISNOW with long\_name Number of snow layers and units count
- FSNO with long\_name Snow-cover fraction on the ground and units 1
- ACSNOM with long\_name accumulated melting water out of snow bottom and units mm

- ACCET with long\_name Accumulated total ET and units  
mm
- SOILICE with long\_name fraction of soil moisture that  
is ice and units 1
- SOILSAT\_TOP with long\_name fraction of soil  
saturation, top 2 layers and units 1
- SNOWT\_AVG with long\_name average snow temperature (by  
layer mass) and units K
- QRAIN with long\_name Rainfall rate on the ground and  
units mm/s
- Terrain files  
nwm.tCCz.analysis\_assim.terrain\_rt.tm##.puertorico.nc  
Where CC is cycle (00-23) and ## is 00-02.
- time with long\_name valid output time and units  
minutes since 1970-01-01 00:00:00 UTC
- reference\_time with long\_name model initialization  
time and units minutes since 1970-01-01 00:00:00 UTC
- crs with long\_name CRS definition
- x with long\_name projection\_x\_coordinate and units m
- y with long\_name projection\_y\_coordinate and units m
- zwattablrt with long\_name water table depth and units  
m
- sfcheadsubrt with long\_name surface head and units mm
- \* Analysis and Assimilation Forcing in  
forcing\_analysis\_assim\_puertorico/  
nwm.tCCz.analysis\_assim.forcing.tm##.puertorico.nc  
Where CC is cycle (00-23) and ## is 00-02.
- time with long\_name valid output time and units  
minutes since 1970-01-01 00:00:00 UTC
- reference\_time with long\_name model initialization  
time and units minutes since 1970-01-01 00:00:00 UTC
- crs with long\_name CRS definition
- x with long\_name projection\_x\_coordinate and units m
- y with long\_name projection\_y\_coordinate and units m
- U2D with long\_name 10-m U-component of wind and units  
m/s
- V2D with long\_name 10-m V-component of wind and units  
m/s
- LWDOWN with long\_name Surface downward long-wave  
radiation flux and units W/m<sup>2</sup>
- SWDOWN with long\_name Surface downward short-wave  
radiation flux and units W/m<sup>2</sup>
- RAINRATE with long\_name Surface Precipitation Rate  
and units mm/s
- T2D with long\_name 2-m Air Temperature and units K
- Q2D with long\_name 2-m Specific Humidity and units  
kg/kg

- PSFC with long\_name Surface Pressure and units Pa
- \* Short Range in short\_range\_puertorico/
  - Channel files
    - nwm.tCCz.short\_range.channel\_rt.f###.puertorico.nc
      - Where CC is cycle (06, 18) and ### is 001-048.
    - time with long\_name valid output time and units minutes since 1970-01-01 00:00:00 UTC
    - reference\_time with long\_name model initialization time and units minutes since 1970-01-01 00:00:00 UTC
    - crs with long\_name CRS definition
    - feature\_id with long\_name Reach ID
    - streamflow with long\_name River Flow and units m<sup>3</sup>/s
    - nudge with long\_name Amount of stream flow alteration and units m<sup>3</sup>/s
    - velocity with long\_name River Velocity and units m/s
    - qSfcLatRunoff with long\_name Runoff from terrain routing and units m<sup>3</sup>/s
    - qBucket with long\_name Flux from gw bucket and units m<sup>3</sup>/s
    - qBtmVertRunoff with long\_name Runoff from bottom of soil to bucket and units m<sup>3</sup>
  - Reservoir files
    - nwm.tCCz.short\_range.reservoir.f###.puertorico.nc
      - Where CC is cycle (06, 18) and ### is 001-048.
    - time with long\_name valid output time and units minutes since 1970-01-01 00:00:00 UTC
    - reference\_time with long\_name model initialization time and units minutes since 1970-01-01 00:00:00 UTC
    - crs with long\_name CRS definition
    - feature\_id with long\_name Reach ID
    - latitude with long\_name Lake latitude and units degrees\_north
    - longitude with long\_name Lake longitude and units degrees\_east
    - reservoir\_type with long\_name reservoir\_type and attributes flag\_values 1, 2, and flag\_meanings Level\_pool, USGS-persistence
    - reservoir\_assimilated\_value for USGS sourced locations with long\_name reservoir\_assimilated\_value and units m<sup>3</sup>/s
    - inflow with long\_name Lake Inflow and units m<sup>3</sup>/s
    - outflow with long\_name Lake Outflow and units m<sup>3</sup>/s
    - Water\_sfc\_elev with long\_name Water Surface Elevation and units m
  - Land files
    - nwm.tCCz.short\_range.land.f###.puertorico.nc
      - Where CC is cycle (06, 18) and ### is 001-048.

- time with long\_name valid output time and units  
minutes since 1970-01-01 00:00:00 UTC
- reference\_time with long\_name model initialization  
time and units minutes since 1970-01-01 00:00:00 UTC
- crs with long\_name CRS definition
- x with long\_name projection\_x\_coordinate and units m
- y with long\_name projection\_y\_coordinate and units m
- SNOWH with long\_name Snow depth and units m
- SNEQV with long\_name Snow water equivalent and units  
kg/m<sup>2</sup>
- FSNO with long\_name Snow-cover fraction on the ground  
and units 1
- ACCET with long\_name Accumulated total ET and units  
mm
- SOILSAT\_TOP with long\_name fraction of soil  
saturation, top 2 layers and units 1
- SNOWT\_AVG with long\_name average snow temperature (by  
layer mass) and units K
- Terrain files  
nwm.tCCz.short\_range.terrain\_rt.f###.puertorico.nc  
Where CC is cycle (06, 18) and ### is 001-048.
- time with long\_name valid output time and units  
minutes since 1970-01-01 00:00:00 UTC
- reference\_time with long\_name model initialization  
time and units minutes since 1970-01-01 00:00:00 UTC
- crs with long\_name CRS definition
- x with long\_name projection\_x\_coordinate and units m
- y with long\_name projection\_y\_coordinate and units m
- zwattablrt with long\_name depth to saturation rounde  
to highest saturated layer and units m
- sfheadsubrt with long\_name surface head and units mm
- \* Short Range Forcing files in forcing\_short\_range\_puertorico/  
nwm.tCCz.short\_range.forcing.f###.puertorico.nc  
Where CC is cycle (06, 18) and HHH is 001-048.
- time with long\_name valid output time and units  
minutes since 1970-01-01 00:00:00 UTC
- reference\_time with long\_name model initialization  
time and units minutes since 1970-01-01 00:00:00 UTC
- crs with long\_name CRS definition
- x with long\_name projection\_x\_coordinate and units m
- y with long\_name projection\_y\_coordinate and units m
- U2D with long\_name 10-m U-component of wind and units  
m/s
- V2D with long\_name 10-m V-component of wind and units  
m/s
- LWDOWN with long\_name Surface downward long-wave  
radiation flux and units W/m<sup>2</sup>

- SWDOWN with long\_name Surface downward short-wave radiation flux and units W/m<sup>2</sup>
- RAINRATE with long\_name Surface Precipitation Rate and units mm/s
- T2D with long\_name 2-m Air Temperature and units K
- Q2D with long\_name 2-m Specific Humidity and units kg/kg
- PSFC with long\_name Surface Pressure and units Pa

\* No-DA Analysis and Assimilation in analysis\_assim\_puertorico\_no\_da/

- Open Loop channel files

nwm.tCCz.analysis\_assim\_no\_da.channel\_rt.tm##.puertorico.nc

Where CC is cycle (00-23) and ## is 00-02.

- time with long\_name valid output time and units minutes since 1970-01-01 00:00:00 UTC
- reference\_time with long\_name model initialization time and units minutes since 1970-01-01 00:00:00 UTC
- crs with long\_name CRS definition
- feature\_id with long\_name Reach ID
- streamflow with long\_name River Flow and units m<sup>3</sup>/s
- nudge with long\_name Amount of stream flow alteration and units m<sup>3</sup>/s
- velocity with long\_name River Velocity and units m/s
- qSfcLatRunoff with long\_name Runoff from terrain routing and units m<sup>3</sup>/s
- qBucket with long\_name Flux from gw bucket and units m<sup>3</sup>/s

\* No-DA Short Range in short\_range\_puertorico\_no\_da/

- Open Loop channel files

nwm.tCCz.short\_range\_no\_da.channel\_rt.f###.puertorico.nc

Where CC is cycle (06, 18) and ### is 001-048.

- time with long\_name valid output time and units minutes since 1970-01-01 00:00:00 UTC
- reference\_time with long\_name model initialization time and units minutes since 1970-01-01 00:00:00 UTC
- crs with long\_name CRS definition
- feature\_id with long\_name Reach ID
- streamflow with long\_name River Flow and units m<sup>3</sup>/s
- nudge with long\_name Amount of stream flow alteration and units m<sup>3</sup>/s
- velocity with long\_name River Velocity and units m/s
- qSfcLatRunoff with long\_name Runoff from terrain routing and units m<sup>3</sup>/s
- qBucket with long\_name Flux from gw bucket and units m<sup>3</sup>/s

### Appendix 3. New CONUS No-DA Output

```
* Analysis and Assimilation in analysis_assim_no_da/
- Open Loop channel files
  nwm.tCCz.analysis_assim_no_da.channel_rt.tm##.conus.nc
    Where CC is cycle (00-23) and ## is 00-02
    - time with long_name valid output time and units
minutes since 1970-01-01 00:00:00 UTC
    - reference_time with long_name model initialization
time and units minutes since 1970-01-01 00:00:00 UTC
    - crs with long_name CRS definition
    - feature_id with long_name Reach ID
    - streamflow with long_name River Flow and units m^3/s
    - nudge with long_name Amount of stream flow alteration
and units m^3/s
    - velocity with long_name River Velocity and units m/s
    - qSfcLatRunoff with long_name Runoff from terrain
routing and units m^3/s
    - qBucket with long_name Flux from gw bucket and units
m^3/s
* Extended Analysis and Assimilation in
analysis_assim_extend_no_da/
- Open Loop channel files

nwm.tCCz.analysis_assim_extend_no_da.channel_rt.tm##.conus.nc
  Where CC is cycle (16) and ## is 00-27
  - time with long_name valid output time and units
minutes since 1970-01-01 00:00:00 UTC
  - reference_time with long_name model initialization
time and units minutes since 1970-01-01 00:00:00 UTC
  - crs with long_name CRS definition
  - feature_id with long_name Reach ID
  - streamflow with long_name River Flow and units m^3/s
  - nudge with long_name Amount of stream flow alteration
and units m^3/s
  - velocity with long_name River Velocity and units m/s
  - qSfcLatRunoff with long_name Runoff from terrain
routing and units m^3/s
  - qBucket with long_name Flux from gw bucket and units
m^3/s
* Long-Range Analysis and Assimilation in
analysis_assim_long_no_da/
- Open Loop channel files

nwm.tCCz.analysis_assim_long_no_da.channel_rt.tm##.conus.nc
  Where CC is cycle (00, 06, 12, 18) and ## is 00-27
* Medium Range in medium_range_no_da/
- Open Loop channel files
```

nwm.tCCz.medium\_range\_no\_da.channel\_rt.f###.conus.nc  
Where CC is cycle (00, 06, 12, 18) and ### is 003,  
006,... 240.

- time with long\_name valid output time and units  
minutes since 1970-01-01 00:00:00 UTC
- reference\_time with long\_name model initialization  
time and units minutes since 1970-01-01 00:00:00 UTC
- crs with long\_name CRS definition
- feature\_id with long\_name Reach ID
- streamflow with long\_name River Flow and units m<sup>3</sup>/s
- nudge with long\_name Amount of stream flow alteration  
and units m<sup>3</sup>/s
- velocity with long\_name River Velocity and units m/s

#### Appendix 4. New Hawaii No-DA Output

\* Analysis and Assimilation in analysis\_assim\_hawaii\_no\_da/  
- Open Loop channel files  
nwm.tCCz.analysis\_assim\_no\_da.channel\_rt.tm##?.hawaii.nc  
Where CC is cycle (00-23), ## is 00-02, and ?? is  
45,30,15 or 00.

- time with long\_name valid output time and units  
minutes since 1970-01-01 00:00:00 UTC
- reference\_time with long\_name model initialization  
time and units minutes since 1970-01-01 00:00:00 UTC
- crs with long\_name CRS definition
- feature\_id with long\_name Reach ID
- streamflow with long\_name River Flow and units m<sup>3</sup>/s
- nudge with long\_name Amount of stream flow alteration  
and units m<sup>3</sup>/s
- velocity with long\_name River Velocity and units m/s
- qSfcLatRunoff with long\_name Runoff from terrain  
routing and units m<sup>3</sup>/s
- qBucket with long\_name Flux from gw bucket and units  
m<sup>3</sup>/s

\* Short Range in short\_range\_hawaii\_no\_da/  
- Open Loop channel files  
nwm.tCCz.short\_range\_no\_da.channel\_rt.f###?.hawaii.nc  
Where CC is cycle (00,12), ### is 001-048, and ?? is  
45,30,15 or 00.

- time with long\_name valid output time and units  
minutes since 1970-01-01 00:00:00 UTC
- reference\_time with long\_name model initialization  
time and units minutes since 1970-01-01 00:00:00 UTC
- crs with long\_name CRS definition
- feature\_id with long\_name Reach ID
- streamflow with long\_name River Flow and units m<sup>3</sup>/s



- nudge with long\_name Amount of stream flow alteration and units m<sup>3</sup>/s
- velocity with long\_name River Velocity and units m/s
- qSfcLatRunoff with long\_name Runoff from terrain routing and units m<sup>3</sup>/s
- qBucket with long\_name Flux from gw bucket and units m<sup>3</sup>/s

Any questions regarding this implementation should be directed below. We will evaluate any feedback and decide whether to proceed.

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National Service Change Notices are online at:  
<https://www.weather.gov/notification/>

NNNN