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PNSWSH

Service Change Notice 20-119
National Weather Service Headquarters Silver Spring, MD
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To: Subscribers:
           -NOAA Weather Wire Service
           -Emergency Managers Weather Information Network
           -NOAAPort
           -Other NWS Partners, Users and Employees

From: Brian Gross
            Acting Director
            National Centers for Environmental Prediction

Subject: Upgrade of National Water Model on WCOSS system, and
           its post-processing application on the Integrated
           Dissemination Platform Effective January 26, 2021

Effective on or about January 26, 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. 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 USGS and USACE data via a persistence methodology, and ingest of River Forecast Center (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.
  - 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 ~1100 to ~1400 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:

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^3/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^2s]
  * New fields were added to the existing CONUS Long-Range Analysis
and Assimilation and Medium-Range channel files
    - qSfcLatRunoff: runoff from terrain routing, [m^3/s]
    - qBucket: flux from gw bucket, [m^3/s]
    - qBtmVertRunoff: runoff from bottom of soil to bucket, [m^3]

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 Puertorico 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 Puertorico 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 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/TINs for information on the other unchanged filename and directory structures.

https://www.weather.gov/media/notification/scn19-42natl_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/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

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.

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

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

For questions on post-processing derived variables and general product format and processing, please contact:
    Trey Flowers
    OWP/Analysis and Prediction Division
    Tuscaloosa, AL 205-347-1450
    trey.flowers@noaa.gov

For questions regarding the data flow aspects of the post-processing application, please contact:
    Joshua Huber
    NCEP/NCO OnBoarding Team Lead
    College Park, Maryland
    idp-feedback@noaa.gov

For questions regarding the data flow aspects of the model data, please contact:
    Anne Myckow
    NCEP/NCO Dataflow Team Lead
    ncep.pmb.dataflow@noaa.gov

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 (8427 km^2)
   - 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^3/s
         - nudge with long_name Amount of stream flow alteration and
units m3/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
         - qBtmVertRunoff with long_name Runoff from bottom of soil to
bucket and units m^3
      - 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_time 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^3/s
- inflow with long_name Lake Inflow and units m^3/s
- outflow with long_name Lake Outflow and units m^3/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^{-2} s^{-1}
- 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 (m3) to soil volume (m3) and units m^3/m^3
- SNOWH with long_name Snow depth and units m
- SNEQV with long_name Snow water equivalent and units kg/m^2
- 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^2
          - SWDOWN with long_name Surface downward short-wave radiation
flux and units W/m^2
          - 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^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
          - qBtmVertRunoff with long_name Runoff from bottom of soil to
bucket and units m^3
      - 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_time 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^3/s
            - inflow with long_name Lake Inflow and units m^3/s
            - outflow with long_name Lake Outflow and units m^3/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^2
            - 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
            - sfcheadsubrt 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^2
        - SWDOWN with long_name Surface downward short-wave radiation
flux and units W/m^2
        - 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^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
  * 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^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


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^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

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^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
   * 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^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

NWS National Service Change Notices are online at:

https://www.weather.gov/notification/

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