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Service Change Notice 23-124 Updated
National Weather Service Headquarters Silver Spring MD
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From: Ben Kyger, Director
           NCEP Central Operations

Subject: Updated: Upgrade of the Surge and Tide Operational Forecast
System (STOFS): Effective May 14, 2024

Updated to reflect the new implementation date of May 14, 2024 and to
update version number to v2.1.7.

On or about Tuesday, May 14, 2024 beginning with the 1200 Coordinated
Universal Time (UTC) cycle, the National Centers for Environmental
Prediction (NCEP) will be upgrading the Surge and Tide Operational
Forecast System (STOFS) to v2.1.7.

STOFS v2.1.7 represents a major upgrade of the STOFS modeling system. It
was last upgraded in January 2023. STOFS v2.1.7 contains several
enhancements improving model performance, resolution, and coverage. It
includes upgrades to the global modeling system (STOFS-2D-Global) and to
the three-dimensional (3D) component for the Atlantic basin (STOFS-3D-
Atlantic).

Model upgrades for STOFS-2D-Global (ADCIRC-based) include:

- Inclusion of bias correction at station locations where National Ocean
Service (NOS)/CO-OPS observations are available. This bias correction a)
computes the bias at these stations by subtracting the combined (storm
surge + tide) water level forecast guidance from the observed water level;
b) removes this hourly bias from the current cycle's 6-hour nowcast; c)
averages the bias over 5 days using the most recent five (5) days of
nowcasts and observations; and d) removes this average bias from the
future forecast guidance (with a 12-hour linear interpolation from current
bias to average bias). This post-processing bias correction is
implemented in STOFS-2D-Global in the same way that Extra-Tropical Storm
Surge (ETSS) implements it (also called "anomaly", which is the same as
the negative bias). Note that no gridded bias correction is implemented
in this version of STOFS-2D-Global.

- Improved temporal resolution for GFS forcing, by including hourly Global
Forecast System (GFS) forcing out to 5 days in the forecast, then 3-hourly
from five (5) days to 7.5 days in the forecast. Previously, 3-hourly GFS
forcing was used for the entire forecast period.

- Improvements to coastal topography, bathymetry, friction values, and the mesh, for improved accuracy of water level forecast guidance. Specifically, there are improvements to the bottom boundary conditions (friction, topography, and bathymetry), and a few mesh nodes were adjusted for improvement in performance. Also, a model output station was added at a relatively new tide gauge at NOS/CO-OPS Bremerton, WA (9445958).

Model upgrades for STOFS-3D-Atlantic (SCHISM-based) include:

- Major improvements to the mesh in the watersheds, including better resolving of river channels to enhance watershed flow and connectivity and to minimize ponding. The mesh in coastal areas such as the Great South Bay and Shinnecock Bay is also improved for enhanced accuracy of water level forecast guidance.

- Incorporation of satellite altimetry observations, specifically absolute dynamic topography (ADT), to improve open ocean boundary conditions and overall accuracy. Also, xGEOID20b is used instead of North American Vertical Datum 1988 (NAVD88) to improve model initialization and vertical datum referencing. Station output will remain in NAVD88, while gridded output (e.g., *field*.nc and *.grib2) will be referenced to xGEOID20b.

- Extending the forecast horizon from 48 to 96 hours into the future.

- Expanding the model coverage east and north to include the St. Lawrence River and improve boundary conditions and overall accuracy, especially in the Gulf of Maine.

New and existing data files for STOFS-2D-Global and STOFS-3D-Atlantic will remain at their current location on the NOAA Operational Model Archive and Distribution Service (NOMADS)/FTPPRD web services at:

ftp://ftp.ncep.noaa.gov/pub/data/nccf/com/stofs/prod/
https://www.ftp.ncep.noaa.gov/data/nccf/com/stofs/prod
https://nomads.ncep.noaa.gov/pub/data/nccf/com/stofs/prod/

Below are the changes to the files on NOMADS and FTPPRD web services:

A. File additions and file name changes:

- Additional forecast hours for STOFS-3D-Atlantic CONUS East and Puerto Rico (this data will also be made available via the existing NOMADS Grib Filter and OPeNDAP applications):

stofs_3d_atl.tCCz.conus.east.f{hour}.grib2
stofs_3d_atl.tCCz.puertori.f{hour}.grib2

Where {hour} = {49, 50, 51, ...,96}, and tCCz is forecast cycle: CC = 12.

- The following STOFS-3D-Atlantic files experience file name changes, increased temporal resolution, and/or an extended forecast horizon that results in additional files:

stofs_3d_atl.tCCz.f001_024.field2d.nc and
stofs_3d_atl.tCCz.f025_048.field2d.nc become:
stofs_3d_atl.tCCz.field2d_fhhh1_hhh2.nc

Where {fhhh1_hhh2} = {f001_012, f013_024, f025_036, f037_048, f049_060,
f061_072, f073_084, f085_096}, and tCCz is forecast cycle: CC = 12.

stofs_3d_atl.tCCz.n001_024.field2d.nc becomes:
stofs_3d_atl.tCCz.field2d_nhhh1_hhh2.nc

Where {nhhh1_hhh2} = {n001_012, n013_024}, and tCCz is forecast cycle: CC
= 12.

stofs_3d_atl.tCCz.fields.out2d_forecast_day1.nc and
stofs_3d_atl.tCCz.fields.out2d_forecast_day2.nc become:
stofs_3d_atl.tCCz.fields.out2d_fhhh1_hhh2.nc

Where {fhhh1_hhh2} = {f001_012, f013_024, f025_036, f037_048, f049_060,
f061_072, f073_084, f085_096}, and tCCz is forecast cycle: CC = 12.

stofs_3d_atl.tCCz.fields.out2d_nowcast.nc becomes:
stofs_3d_atl.tCCz.fields.out2d_nhhh1_hhh2.nc

Where {nhhh1_hhh2} = {n001_012, n013_024}, and tCCz is forecast cycle: CC
= 12.

B. Timeliness changes:

- For the STOFS-2D-Global model, the Gridded Binary version two (GRIB2)
and Standard Hydrometeorological Exchange Format (SHEF) products will be
delivered up to 20 minutes later. The NetCDF products will be delivered
up to 30 minutes later, while the htp NetCDF files will be delivered up to
15 minutes earlier.

- For the STOFS-3D-Atlantic model, the SHEF and NetCDF products will be
delivered up to 45 minutes later, and the GRIB2 products will be delivered
up to 70 minutes later.

C. File size changes:

- The expanded domain east and north and some SCHISM code input/output
(I/O) changes increase the following STOFS-3D-Atlantic file sizes:

stofs_3d_atl.tCCz.fields.cwl.maxele.nc
stofs_3d_atl.tCCz.conus.east.cwl.grib2
stofs_3d_atl.tCCz.puertori.cwl.grib2

Where tCCz is forecast cycle: CC = 12.

- The reduction in the station number from 342 to 108 or 107 decreases the
following file sizes:

stofs_3d_atl.tCCz.fcast.station.profile.nc
stofs_3d_atl.tCCz.ncast.station.profile.nc

```
stofs_3d_atl.tCCz.points.cwl.temp.salt.vel.nc
stofs_3d_atl.tCCz.points.cwl.nc
stofs_3d_atl.tCCz.points.cwl.shef
```

Where tCCz is forecast cycle: CC = 12.

- The addition of stations increases the following file sizes:

```
stofs_2d_glo.tCCz.points.cwl.shef
stofs_2d_glo.tCCz.points.htp.shef
stofs_2d_glo.tCCz.points.swl.shef
```

Where tCCz is forecast cycle: CC = 00, 06, 12, and 18.

- The increase in coverage to north of the Aleutian Islands increases the following file sizes:

```
stofs_2d_glo.tCCz.alaska.cwl.grib2
stofs_2d_glo.tCCz.alaska.htp.grib2
stofs_2d_glo.tCCz.alaska.swl.grib2
stofs_2d_glo.tCCz.alaska.f{hour}.grib2
```

Where {hour} = {0, 1, 2, 3, ...,180}, and tCCz is forecast cycle: CC = 00, 06, 12, and 18.

- The removal of coverage in the Gulf of California decreases the following file sizes:

```
stofs_2d_glo.tCCz.conus.west.cwl.grib2
stofs_2d_glo.tCCz.conus.west.htp.grib2
stofs_2d_glo.tCCz.conus.west.swl.grib2
stofs_2d_glo.tCCz.conus.west.f{hour}.grib2
```

Where {hour} = {0, 1, 2, 3, ...,180}, and tCCz is forecast cycle: CC = 00, 06, 12, and 18.

D. File content changes:

- The Bremerton, WA and many other stations are added to the following STOFS-2D-Global files:

```
stofs_2d_glo.tCCz.points.cwl.nc
stofs_2d_glo.tCCz.points.htp.nc
stofs_2d_glo.tCCz.points.swl.nc
stofs_2d_glo.tCCz.points.cwl.shef
stofs_2d_glo.tCCz.points.htp.shef
stofs_2d_glo.tCCz.points.swl.shef
```

Where tCCz is forecast cycle: CC = 00, 06, 12, and 18.

- Dimension parameters (such as node, nele, nbou, nvel, and max_nvell) are changing in the following STOFS-2D-Global files due to the ADCIRC model grid change and the adjustment of a few mesh nodes:

```
stofs_2d_glo.tCCz.fields.cwl.nc
stofs_2d_glo.tCCz.fields.htp.nc
stofs_2d_glo.tCCz.fields.swl.nc
```

Where tCCz is forecast cycle: CC = 00, 06, 12, and 18.

- A new processID "21", which is Extra-tropical Storm Surge Atlantic
Domain (3D), is used for the following STOFS-3D-Atlantic GRIB2 files:

```
stofs_3d_atl.tCCz.conus.east.f{hour}.grib2
stofs_3d_atl.tCCz.puertori.f{hour}.grib2
stofs_3d_atl.tCCz.conus.east.cwl.grib2
stofs_3d_atl.tCCz.puertori.cwl.grib2
```

Where {hour} = {1, 2, 3, ...,96}, and tCCz is forecast cycle: CC = 12.

- Due to the change of the vertical datum referencing to xGEOID20b for the
STOFS-3D-Atlantic model, the number of stations is reduced from 342 to 108
or 107 (i.e., xGEOID20b to NAVD88 or MLLW conversion is not available for
some stations). The affected files are:

```
stofs_3d_atl.tCCz.fcast.station.profile.nc
stofs_3d_atl.tCCz.ncast.station.profile.nc
stofs_3d_atl.tCCz.points.cwl.temp.salt.vel.nc
stofs_3d_atl.tCCz.points.cwl.nc
stofs_3d_atl.tCCz.points.cwl.shef
```

Where tCCz is forecast cycle: CC = 12.

- The following files have new variables:

Variable crs is added to provide the Coordinate Reference System (CRS)
definition in the following file:

```
stofs_3d_atl.tCCz.fields.cwl.maxele.nc
```

Where tCCz is forecast cycle: CC = 12.

Variables crs, SCHISM_hgrid_face_x, SCHISM_hgrid_face_y,
SCHISM_hgrid_edge_x, SCHISM_hgrid_edge_y, evaporationRate,
precipitationRate, windStressX, and windStressY are added in the following
files:

```
stofs_3d_atl.tCCz.fields.out2d_nhhh1_hhh2.nc
stofs_3d_atl.tCCz.fields.out2d_fhhh1_hhh2.nc
```

Where {nhhh1_hhh2} = {n001_012, n013_024}, {fhhh1_hhh2} = {f001_012,
f013_024, f025_036, f037_048, f049_060, f061_072, f073_084, f085_096}, and
tCCz is forecast cycle: CC = 12.

- A new type source "HMIFR" is used for these STOFS-3D-Atlantic SHEF
files:

```
stofs_3d_atl.tCCz.points.cwl.shef
```

Where tCCz is forecast cycle: CC = 12.

- The Advanced Weather Interactive Processing System (AWIPS) header is changing from "TIBEP" to "TIBEA" in these STOFS-3D-Atlantic SHEF files:

stofs_3d_atl.tCCz.points.cwl.shef

Where tCCz is forecast cycle: CC = 12.

- The coverage increases to north of the Aleutian Islands in the following files:

stofs_2d_glo.tCCz.alaska.cwl.grib2
stofs_2d_glo.tCCz.alaska.htp.grib2
stofs_2d_glo.tCCz.alaska.swl.grib2
stofs_2d_glo.tCCz.alaska.f{hour}.grib2

Where {hour} = {0, 1, 2, 3, ...,180}, and tCCz is forecast cycle: CC = 00, 06, 12, and 18.

- The coverage for Gulf of California is removed in the following files:

stofs_2d_glo.tCCz.conus.west.cwl.grib2
stofs_2d_glo.tCCz.conus.west.htp.grib2
stofs_2d_glo.tCCz.conus.west.swl.grib2
stofs_2d_glo.tCCz.conus.west.f{hour}.grib2

Where {hour} = {0, 1, 2, 3, ...,180}, and tCCz is forecast cycle: CC = 00, 06, 12, and 18.

A consistent parallel feed of STOFS v2.1.7 data is available on the NCEP sites at the following URLs:

https://nomads.ncep.noaa.gov/pub/data/nccf/com/stofs/para/
https://www.ftp.ncep.noaa.gov/data/nccf/com/stofs/para/
ftp://ftp.ncep.noaa.gov/pub/data/nccf/com/stofs/para/
https://para.nomads.ncep.noaa.gov/pub/data/nccf/noaaport/stofs_2d_glo/

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.

Any questions, comments or requests regarding this implementation should be directed to the contacts below.

For questions concerning science changes, please contact:

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For questions regarding the data flow aspects of these datasets, contact:

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National Service Change Notices are online at:

https://www.weather.gov/notification

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