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Service Change Notice 22-91
NOAA's National Ocean Service Headquarters Silver Spring MD
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From: Patrick Burke
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 and Services

Subject: NOS OFS Version Updates and Implementation of Upgraded
Oceanographic Forecast Modeling Systems for Lakes Superior and Ontario:
Effective October 25, 2022

Effective on or about October 25, 2022 beginning at 1800 Coordinated Universal Time (UTC), NOAA/National Ocean Service's (NOS') framework of Operational Forecast Systems (NOS OFS) will be updated to version 3.5. With this update, the upgraded Lake Superior Operational Forecast System (LSOFS) and Lake Ontario Operational Forecast System (LOOFS) will be implemented by the National Centers for Environmental Prediction (NCEP) Central Operations (NCO). The development and implementation of LSOFS and LOOFS is a joint project of the NOS/Center for Operational Oceanographic Products and Services (CO-OPS), the NOS/Office of Coast Survey (OCS), the OAR/Great Lake Environmental Research Laboratory (GLERL), the FVCOM development group at the University of Massachusetts, Dartmouth and NCO. This NOS OFS version update will change the directory structure on the NOAA Operational Model Archive and Distribution System (NOMADS)/ftpprd to com/nosofs from com/nos. The upgraded LOOFS and LSOFS will replace the existing Princeton Ocean Model (POMGL) based LOOFS and LSOFS. The existing LOOFS and LSOFS will be retired and their outputs will no longer be available after the upgraded LOOFS and LSOFS are implemented into operations.

NOS OFS NOMADS/FTPPRD directory structure changes:
The code package of the NOS model will be updated to v3.5 from v3.4, and the name of the overall directory structure will change. This update will change NOS directory structures on NOMADS/FTPPRD under the top-level com/ directory:

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

The following changes will be observed:

```
nos/{ENV}/cbofs.YYYYYMMDD -> nosofs/{ENV}/cbofs.YYYYYMMDD
nos/{ENV}/ciofs.YYYYYMMDD -> nosofs/{ENV}/ciofs.YYYYYMMDD
nos/{ENV}/creofs.YYYYYMMDD -> nosofs/{ENV}/creofs.YYYYYMMDD
nos/{ENV}/dbofs.YYYYYMMDD -> nosofs/{ENV}/dbofs.YYYYYMMDD
nos/{ENV}/gomofs.YYYYYMMDD -> nosofs/{ENV}/gomofs.YYYYYMMDD
nos/{ENV}/leofs.YYYYYMMDD -> nosofs/{ENV}/leofs.YYYYYMMDD
nos/{ENV}/lmhofs.YYYYYMMDD -> nosofs/{ENV}/lmhofs.YYYYYMMDD
nos/{ENV}/ngofs2.YYYYYMMDD -> nosofs/{ENV}/ngofs2.YYYYYMMDD
nos/{ENV}/sfbofs.YYYYYMMDD -> nosofs/{ENV}/sfbofs.YYYYYMMDD
nos/{ENV}/tbofs.YYYYYMMDD -> nosofs/{ENV}/tbofs.YYYYYMMDD
nos/{ENV}/wcofs.YYYYYMMDD -> nosofs/{ENV}/wcofs.YYYYYMMDD
```

where ENV is "prod" and "v3.4" for nos/ and "prod" and "v3.5" for nosofs/
and YYYYYMMDD is the forecast day.

Parallel data is available in the following locations:

<https://nomads.ncep.noaa.gov/pub/data/nccf/com/nosofs/v3.5>
<https://nomads.ncep.noaa.gov/pub/data/nccf/com/nosofs/para>
<https://ftpprd.ncep.noaa.gov/data/nccf/com/nosofs/v3.5>
<https://ftpprd.ncep.noaa.gov/data/nccf/com/nosofs/para>
<ftp://ftpprd.ncep.noaa.gov/pub/data/nccf/com/nosofs/v3.5>
<ftp://ftpprd.ncep.noaa.gov/pub/data/nccf/com/nosofs/para>

NOTE: The ftpprd link only works for FTP-enabled web browsers.

Existing output changes:

One station is added to both the Lake Michigan and Huron Operational Forecast System (LMHOFS) and the Northern Gulf of Mexico Operational Forecast System (NGOFS2) station output files. Therefore, there are now 48 stations/locations for LMHOFS and 293 stations/locations for NGOFS2.

The following ice related float variables are added to the Lake Erie Operational Forecast System (LEOFS) and LMHOFS hourly fields files: aice, latent_heat_flux, long_wave, sensible_heat_flux, tsfc, uice, vice and vvice.

The following float variables are added to the LEOFS forecast met and hflux forcing files: long_wave, short_wave, net_heat_flux and air_pressure.

The Tair (surface air temperature) variable is added to surface field output files for the Gulf of Maine Operational Forecast System (GOMOFS) and the West Coast Operational Forecast System (WCOFS).

Changes to the existing LOOFS and LSOFS:

The existing LOOFS and LSOFS will be retired after the upgraded LOOFS and LSOFS are implemented in operations. Accordingly, the following output files will no longer be available on the CO-OPS THREDDS server, <https://opendap.co-ops.nos.noaa.gov/thredds/catalog.html> and on NCEP NOMADS and FTPPRD Web services:

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

Under directory structure:

```
glofs/prod/glofs.YYYYMMDD
glofs.loofs.fields.nowcast.YYYYMMDD.tCCz.nc
glofs.loofs.fields.forecast.YYYYMMDD.tCCz.nc
glofs.lsofs.fields.nowcast.YYYYMMDD.tCCz.nc
glofs.lsofs.fields.forecast.YYYYMMDD.tCCz.nc

glofs.loofs.stations.nowcast.YYYYMMDD.tCCz.nc
glofs.loofs.stations.forecast.YYYYMMDD.tCCz.nc
glofs.lsofs.stations.nowcast.YYYYMMDD.tCCz.nc
glofs.lsofs.stations.forecast.YYYYMMDD.tCCz.nc
glofs.loofs.corms.YYYYMMDD.tCCz.log
glofs.lsofs.corms.YYYYMMDD.tCCz.log
```

Where YYYY, MM, DD is year, month, day, CC is cycle (00, 06, 12, 18).

Information on the new LOOFS and LSOFS output is provided further below.

Meteorological forcing condition changes of forecast cycles for LEOFS and LMHOFS:

LEOFS and LMHOFS meteorological forcing conditions for forecast cycles will switch to the hybrid HRRR and NDFD from NDFD for LEOFS and GFS for LMHOFS. As a result, the meteorological forcing condition file for LMHOFS is smaller because NDFD provides 6-hourly products after forecast hour 66. Note that the size of the meteorological forcing condition file for LEOFS is still increased because of additional fields added, as discussed earlier. HRRR forecasts from 00, 06, 12, 18 cycles are used for forecast hours 00-48, and a hybrid of HRRR+NDFD products are used for forecast hours 48-120. As a result, the job start/launch time of the Great Lake models must be after HRRR completion which is roughly 1:50, 7:50, 13:50, 19:50 UTC.

Delivery time changes for LEOFS, LMHOFS, LOOFS, and LSOFS:

The Great Lake OFS product delivery times will be delayed by approximately 65 minutes for LEOFS and LMHOFS, approximately 100 minutes for LOOFS, and approximately 120 minutes for LSOFS due to the dependence on HRRR completion and LOOFS and LSOFS upgrades to FVCOM-based high-resolution models. The new delivery completion times in UTC are: 2:20, 8:20, 14:20, and 20:20 for LEOFS; 2:45, 8:45, 14:45, and 20:45 for LMHOFS; 2:35, 8:35, 14:35, and 20:35 for LOOFS; and 2:55, 8:55, 14:55, and 20:55 for LSOFS. The four delivery completion times correspond to 00Z, 06Z, 12Z and 18Z model forecast cycles.

Upgraded LSOFS and LOOFS:

LSOFS/LOOFS will provide users with nowcasts (analyses of near present) and forecast guidance of the three-dimensional (3-D) physical conditions of Lake Superior and Lake Ontario including surface water levels and 3-D water currents and water temperature, as well as ice concentration, thickness and velocity out to 120 hours.

As its core ocean prediction model, LSOFS and LOOFS use the Finite Volume Community Ocean Model (FVCOM) developed jointly by the University of Massachusetts, Dartmouth and the Woods Hole Oceanographic Institution. FVCOM is a prognostic, unstructured-grid, finite-volume, free-surface, 3-D primitive equation coastal ocean model with a horizontal grid comprised of unstructured triangular cells. The irregular bottom is presented using generalized terrain-following coordinates. FVCOM ice sub-model is adapted from an unstructured grid variant of Los Alamos Sea Ice Model (UG-CICE), version 3.4. Some updates have been made to reflect changes in the subsequent versions of CICE. Ice dynamics include ice motion and deformation, and ice thermodynamics describe new ice formation, growth and melting.

FVCOM and CICE are community models for NOS hydrodynamic and ice forecast systems. LSOFS and LOOFS operate within the NOS Coastal Ocean Modeling Framework (COMF) and have four daily nowcast and forecast cycles at 00, 06, 12, and 18 UTC.

The unstructured model grid for LSOFS has 90,964 nodes and 174,015 elements, and for LOOFS has 34,395 nodes and 64,453 elements. The cell size ranges from approximately 200 m to 2.5 km, with higher resolution along the shoreline and coarser resolution in the open waters of both lakes. The model has 21 vertical sigma levels.

The surface meteorological forcing for the nowcast cycles is provided by short-term forecast guidance from NOAA's hourly updated High-Resolution Rapid Refresh (HRRR) atmospheric forecast modeling system using the Coupled Ocean-Atmosphere Response Experiment (COARE2.6) flux algorithm. Surface forcing for the forecast cycles is obtained from a combination of HRRR forecast guidance for the first 48 hours and then from the NWS National Digital Forecast Database (NDFD) forecasts from 49 to 120 hours.

The specification of water levels due to inflow from tributaries, outflow from connecting channels, and over-lake precipitation and evaporation is prescribed to track low-frequency seasonal changes in the lake water levels. NWS National Water Model (NWM) analysis and predictions are used for LOOFS and LSOFS river forcing conditions for eight rivers for both the nowcast and forecast cycles. Real-time river discharge observations at U.S. Geological Survey river gauges are used as a backup in both cycles when NWM predictions are not available. Unaccounted inflow/outflow due to inflow from additional tributaries, runoff, and over-lake precipitation and evaporation is determined via FVCOM's precipitation and evaporation parameters. Artificial "precipitation" or "evaporation" is calculated from the difference between the modeled spatially-averaged water level and the average of measured water level over the previous five days at six stations for LSOFS and four stations for LOOFS from CO-OPS' National Water Level Observation Network (NWLON) and Canadian water level observation system.

The temperature of waters flowing into Lakes Superior and Ontario were specified at U.S. Geological Survey (USGS) station 04024000 (St. Louis River) in LSOFS and USGS station 0421964005 YNTN6 (Niagara River) in LOOFS.

New LSOFS/LOOFS Product Outputs:

Gridded fields and station/point forecast guidance from LSOFS and LOOFS will be available in NetCDF format on the CO-OPS THREDDS server.

<http://opendap.co-ops.nos.noaa.gov/thredds/catalog.html>

and on NCEP Web services under lsofs.YYYYMMDD and loofs.YYYYMMDD:

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

Where YYYYMMDD is year, month, and day.

LSOFS and LOOFS graphics output is displayed on the CO-OPS web page at:

<https://tidesandcurrents.noaa.gov/ofs/lsofs/lsofs.html> and
<https://tidesandcurrents.noaa.gov/ofs/loofs/loofs.html>.

LSOFS and LOOFS have two types of model output data where YYYYMMDD is year, month, day; CC is forecast cycle (00, 06, 12, 18).

One is field/gridded data which include two- and three-dimensional gridded data with hourly intervals:

nos.l[s|o]ofs.fields.nHHH.YYYYMMDD.tCCz.nc
where HHH is 000, 001, 002, ..., 006

nos.l[s|o]ofs.fields.fHHH.YYYYMMDD.tCCz.nc
where 'n' and 'f' are used in front of nowcast and forecast hours respectively, HHH is 000, 001, 002, ..., 120.

The other is station/point output data with a 6-minute interval. Water level, surface wind, water temperature, and water currents are the preliminary output variables:

nos.l[s|o]ofs.stations.nowcast.YYYYMMDD.tCCz.nc
nos.l[s|o]ofs.stations.forecast.YYYYMMDD.tCCz.nc

Model Input Files:

Initial files for nowcast:

nos.l[s|o]ofs.init.nowcast.YYYYMMDD.tCCz.nc

Surface meteorological forcing NetCDF files:

nos.l[s|o]ofs.met.nowcast.YYYYMMDD.tCCz.nc
nos.l[s|o]ofs.met.forecast.YYYYMMDD.tCCz.nc
nos.l[s|o]ofs.hflux.nowcast.YYYYMMDD.tCCz.nc
nos.l[s|o]ofs.hflux.forecast.YYYYMMDD.tCCz.nc

River forcing files:

nos.l[s|o]ofs.river.YYYYMMDD.tCCz.nc.tar

LSOFS/LOOFS runtime input files:

nos.l[s|o]ofs.nowcast.YYYYMMDD.tCCz.in

nos.l[s|o]ofs.forecast.YYYYMMDD.tCCz.in

LSOFS/LOOFS also include the following log files:

The corms log file is used for generating OFS status flags for NOS/CO-OPS Continuous Operational Real-Time Monitoring System (CORMS)

nos.l[s|o]ofs.corms.YYYYMMDD.tCCz.log.

ROMS runtime log file:

nos.l[s|o]ofs.jlogfile.YYYYMMDD.tCCz.log

nos.l[s|o]ofs.nowcast.YYYYMMDD.tCCz.log

nos.l[s|o]ofs.forecast.YYYYMMDD.tCCz.log

Additional information about LSOFS and LOOFS will be available after implementation into production at:

<https://tidesandcurrents.noaa.gov/ofslsofs/lsofsinfo.html>

<https://tidesandcurrents.noaa.gov/ofslsofs/loofsinfo.html>

LSOFS and LOOFS predictions are used by commercial, recreational mariners, fishermen, emergency managers, search and rescue responders, and NWS marine weather forecasters. The development and implementation of LSOFS and LOOFS is a joint project of the CO-OPS, OCS, GLERL, NCO, and the FVCOM development group at the University of Massachusetts, Dartmouth. LSOFS and LOOFS are monitored 24 x 7 by both NCO/NCEP and CO-OPS Continuous Operating Real-time Management System (CORMS) personnel.

NCEP urges all users to ensure their decoders can handle changes in content order 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.

As part of NCEP's standard 30-day parallel testing, the new output products will be available here:

<https://nomads.ncep.noaa.gov/pub/data/nccf/com/nosofs/v3.5>

Any questions, comments or requests regarding this implementation should be directed to the contacts below. We will review any feedback and decide whether to proceed.

If you have any questions concerning these changes, please contact:

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For questions regarding the dataflow aspects, please contact:

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National Service Change Notices are online at:

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

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