

Real-Time Extension of NOAA-NCEP Next Generation Global Ocean Data Assimilation System (NG-GODAS)

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As part of the collaborative development effort for the Unified Forecast System (UFS) Research-to-Operations (R2O) Project, a 40-year reanalysis was completed for the period of January 1979 – August 2019. This reanalysis was based on the NG-GODAS system, where the ocean model has a 1-deg horizontal resolution and 75 layers in the vertical. The model set-up, resolution, forcing, data assimilation scheme and ingested observations are described in [1]. To better serve the ocean monitoring task at the National Oceanic and Atmospheric Administration (NOAA), the National Centers for Environmental Prediction/Environmental Modeling Center (NCEP/EMC) and NCEP/CPC (Climate Prediction Center) are working together to set up the NG-GODAS in a real-time configuration to replace a 20-year old operational ocean data assimilation system (GODAS). As a first step of this joint effort, the NG-GODAS run is being extended from September 2019 up to real-time, and is initialized from the ocean and sea-ice state from the 40-year reanalysis.

For the real-time extension of the NG-GODAS, changes had to be made to the atmospheric forcing and some ingested observations because of their unavailability in real time.

Atmospheric forcing: the Global Ensemble Forecast System (GEFS) forcing, obtained from NOAA/PSL (Physical Sciences Laboratory) used in the later period of the 40-year reanalysis is not available after 2019. For the real-time extension run, the CFSR forcing with a bias correction [2] is applied for the period of January 2020 - March 2021 and the Global Data Assimilation System (GDAS) forcing is used after that.

In-situ observations: Temperature and salinity profiles from the US Navy's Fleet Numerical Meteorology and Oceanography Center (FNMOC) are assimilated. These data are passed through the Navy Coupled Ocean Data Assimilation's (NCODA) Quality Control System (QC) [3].

SST: Level 4 SSTs from the Operational Sea Surface Temperature and Sea Ice Analysis (OSTIA) analysis are assimilated, which are produced daily on an operational basis at the UK Met Office using optimal interpolation (OI) on a global 0.054° x 0.054° degree horizontal resolution (https://resources.marine.copernicus.eu/product-detail/SST_GLO_SST_L4_NRT_OBSERVATIONS_010_001/). The data are superobbed onto the 1° model grid with the number of observations being assimilated reduced from 17 million to 80000. The superobbing process increases the error estimates based on the variance of the original data within each bins (Figure 1).

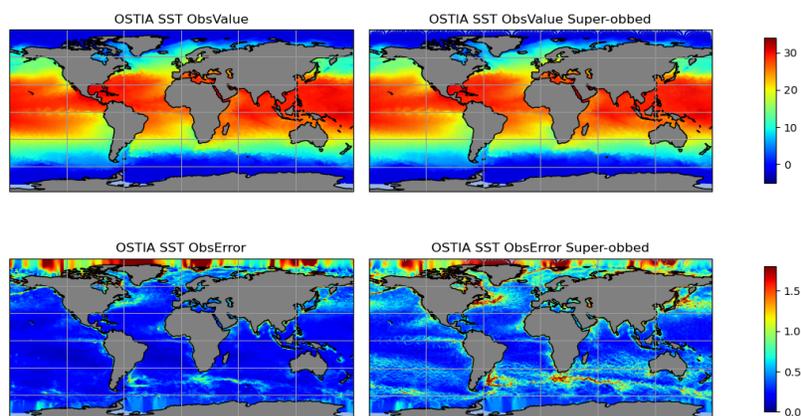


Figure 1. Superobbed OSTIA L4 SST data for August 31, 2019.

Sea-ice concentration: Level 4 sea ice fractions of the Climate Data Record (CDR) are assimilated, which are produced by the National Snow & Ice Data Center (NSIDC) from passive microwave on a 25km x 25km grid for the Northern and Southern Hemispheres (ftp://sidads.colorado.edu/pub/DATASETS/NOAA/G02202_V4).

The current version of the data atmosphere option of the UFS coupled global atmosphere sea ice (DATM-MOM6-CICE6; [1]) model being cycled with JEDI-SOCA [1] data assimilation is based on the prototype P7c. The model

has been integrated from 2019-08-31 to 2019-12-31 with GEFS forcing, and with CFSR forcing for the period 2020-01-01 to 2021-03-31. The model temperature and salinity are compared with two current operational ocean data assimilation systems at NOAA (CFSR and GODAS) by validating against the UK Met Office Hadley Center EN4.2 objective analysis [4]. Figure 2 shows the mean difference of GODAS, CFSR and NG-GODAS compared against EN4 for the period of simulation in the top 300m. The results show that there is significant improvement over both GODAS and CFSR in the salinity field with the NG-GODAS system, whereas the temperature field is comparable with both GODAS and CFSR. The current configuration will be run in real-time mode as an operational system by NCEP/CPC.

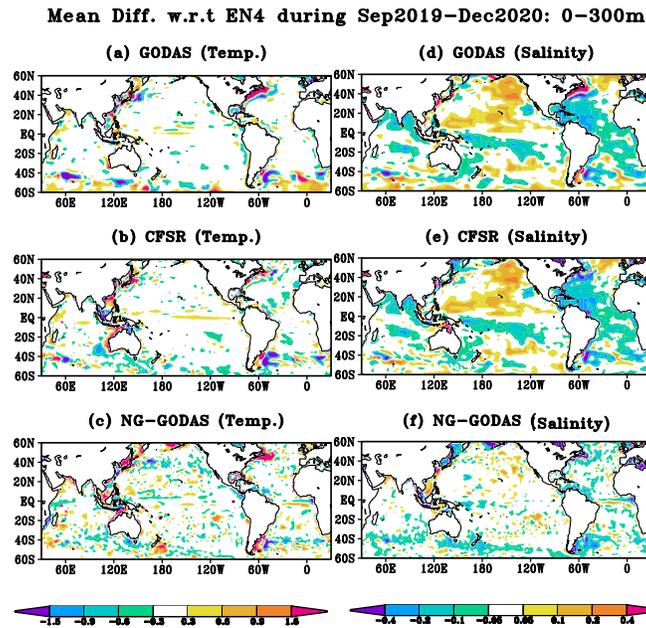


Figure 2. Mean difference of upper 300m averaged (left) temperature and (right) salinity in GODAS, CFSR and NG-GODAS relative to EN4 for the period 2019-09 till 2020-12.

[1] The NOAA-NCEP 40 year reanalysis with the Next Generation global Ocean Data Assimilation System (NG-GODAS): 1979-2019, U.S. D.O.C, NOAA, NWS, NCEP Tech Note not yet published)

[2] J.Kim, Y.C.Teng, G.Vernieres, T.Sluka, S.Paturi, Y.Hao, D.Worthen, B.Li, J.Wang, J.S.Zhu, H.C.Kim, D.Kleist. “NOAA-NCEP Next Generation Global Ocean Data Assimilation System (NG-GODAS).” Research activities in Earth system modelling. Working Group on Numerical Experimentation. Report No. 51. WCRP Report No.4/2021. WMO, Geneva (http://bluebook.meteoinfo.ru/index.php?year=2021&ch_=2), pp. 8-05—8-06.

[3] www.usgodae.org/pub/outgoing/fnmoc/data/ocn/.

[4] S.A. Good, M.J. Martin and N.A.Rayner, 2013: EN4: Quality Controlled ocean temperature and salinity profiles and monthly objective analyses with uncertainty estimates. Journal of Geophysical Research, 118.6704-6716.