Upgrade of the Operational Global Real Time Ocean Forecast System

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1. Introduction

RTOFS (**R**eal **T**ime **O**cean **F**orecast **S**ystem)-Global is the first global eddy resolving ocean forecast system implemented operationally at NOAA/NWS/NCEP. This system is based on the 1/12 degree global HYCOM (**HY**brid **C**oordinates **O**cean **M**odel) (Bleck, 2002) and is part of a larger national backbone capability of ocean modeling at NOAA in a strong partnership with US Navy.

2. Current Status

The forecast system runs once a day and completes an eight day long forecast using the daily initialization fields produced at NAVOCEANO (**NAV**al **OCEAN**ographic **O**ffice) using NCODA (**N**avy **C**oupled **O**cean **D**ata **A**ssimilation), a 3DVAR data assimilation methodology (Cummings and Smedstad, 2013). As configured within RTOFS, HYCOM has a horizontal equatorial resolution of 0.08º or ~9 km. The HYCOM grid is on a Mercator projection from 78.64ºS to 47ºN and north of this it employs an Arctic dipole patch where the poles are shifted over land to avoid a singularity at the North Pole. This gives a mid-latitude (polar) horizontal resolution of approximately 7 km (3.5 km). After a two-day spin up with hourly NCEP's Global Data Assimilation System atmospheric fluxes, the daily forecast cycle is forced with 3-hourly momentum, radiation and precipitation fluxes from NCEP's Global Forecast System fields. Running operationally since October 2011, this global system provides boundary conditions and initializations for other operational, regional (North–West Pacific for dispersion of Fukushima radionuclides, HYCOM-HWRF hurricane coupled model) and coastal ocean forecast systems at NOS (**N**ational **O**cean **S**ervice).

3. Upgrade details and impacts

This fiscal year, the existing RTOFS-Global v1.0 will be upgraded to v1.1 in close collaboration with US Navy (Metzger et al. 2014). This upgrade developed by the Naval Research Laboratory includes the following significant modifications:

a) Number of vertical layers has been increased to 41 from 32 hybrid layers, with extra iso-level coordinate layers in the upper ~200m.
b) Ocean component HYCOM is coupled to Los Alomos National Lab's CICE (**C**ommunity **I**ce **C**od**E**) model using ESMF (**E**arth **S**ystem **M**odeling **F**ramework).
c) The bathymetry has been updated which allows grid points in shallow regions, where minimum depth is set to 5m.
d) The climatology has been updated to U.S. Navy's GDEM (**G**eneralized **D**igital **E**nvironmental **M**odel) v4.2 from v3.0.
e) An updated equation of state, 17-term sigma2 instead of a 9-term definition.

The new simulation resolves previously masked very shallow ocean regions, as an example near Bahamas (see Fig. 1). Mesoscale features in coastal regions in the Gulf of Mexico and west of the Florida Current are also better defined. The upper ocean and coastal regions are resolved with higher vertical resolution,

20 layers in the upper 150m in version 1.1 vs 11 layers in version 1.0 (Fig. 2). The Florida Current (Fig. 2, 80°W) shows a better defined baroclinicity in the new system.

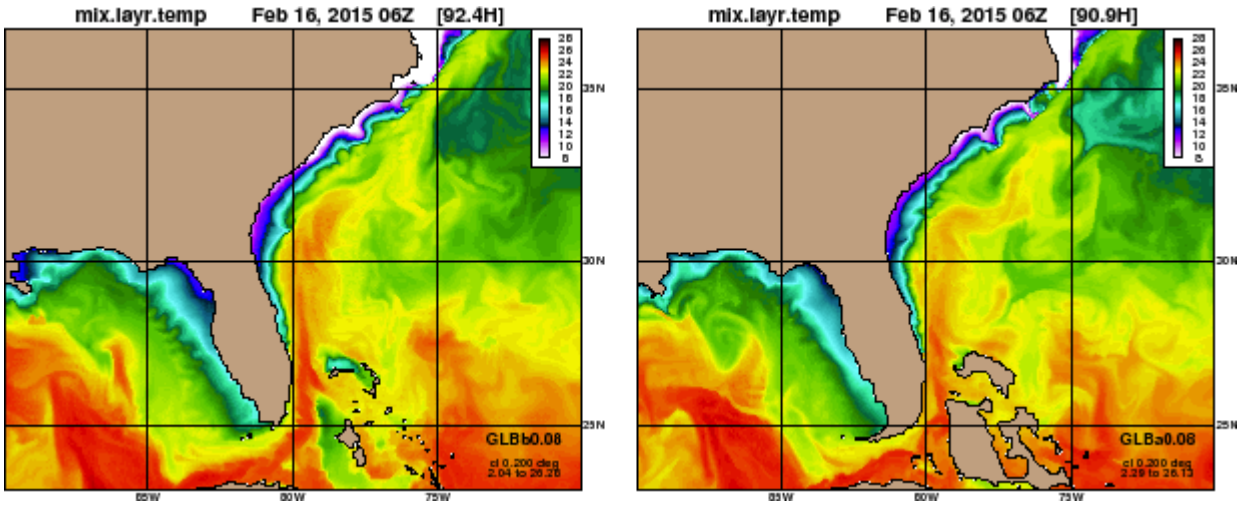

Figure 1. Sea Surface Temperature in a region covering part of the Gulf of Mexico, the Florida Current and Gulf Stream separation, for 16 February 2015 00Z, obtained by RTOFS-Global versions 1.1 (left) and version 1.0 (right). The shallow region north of Grand Bahamas is present in version 1.1 while it was masked as land in version 1.0.

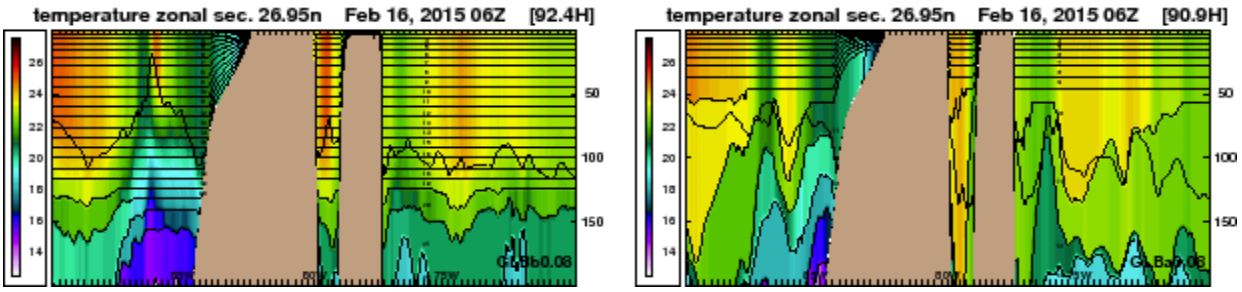

Figure 2. Section at 27N, passing just north of Grand Bahamas, from RTOFS-Global versions 1.1 (left) and version 1.0 (right). The section covers the Eastern Gulf of Mexico, Florida Current and the adjacent Atlantic Ocean, with higher vertical resolution in version 1.1.

References:

Bleck, R., 2002: An oceanic general circulation model framed in hybrid isopycnic-cartesian coordinates. *Ocean Modeling*, 4, 55-88.

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