On the use of recent altimeter products in NCEP ocean forecast system for the Atlantic (RTOFS Atlantic)

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Ocean Surface Topography Science Team (OSTST) Meeting

Oct 21, 2015

Collaboration with Carlos Lozano, Avichal Mehra, Dan Iredell

Outline

- Real Time Ocean Forecast System (RTOFS-Atlantic)
- Assimilation of altimetry into RTOFS
- RTOFS results and monitoring

Real Time Ocean Forecast System (RTOFS-Atlantic)

Ocean model: Primitive equation HYCOM, 1/12 degree resolution; orthogonal curvilinear grid; 32 vertical hybrid coordinates (isopycnal, z-levels and is shallow sea terrain following).

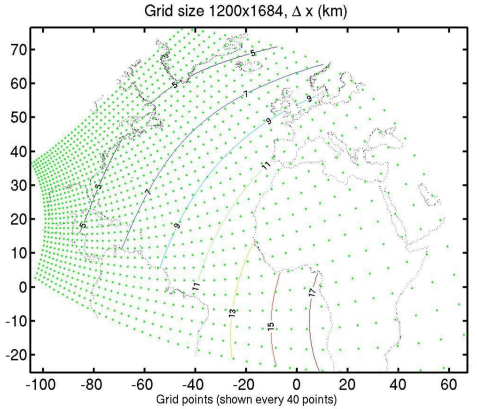
Atmospheric forcing derived from NCEP GDAS/GFS, includes short/long wave radiation fluxes, wind stress, sensible heat flux, precipitation, evaporation, atmospheric pressure.

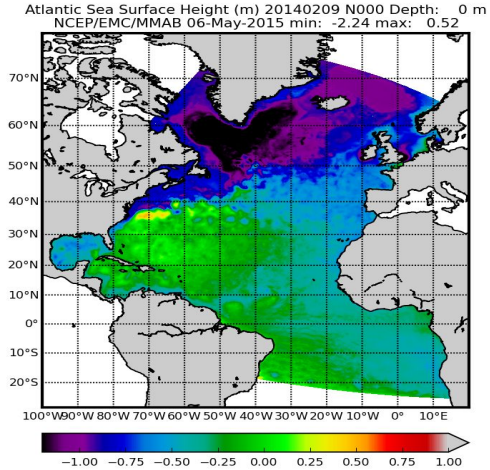
River outflow: USGS, RIVDIS climatology

Body and boundary tides (8 constituents).

Data Assimilation: SSH (Jason-2, Cryosat-2, and Altika); SST(AVHRR, GOES, and in-situ); T/S (ARGO, CTD and XBT)

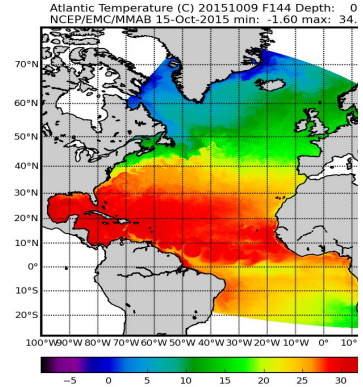
Operational Product: water temperature, salinity, currents, sea surface height, daily product with one day nowcast and up to six days forecasts

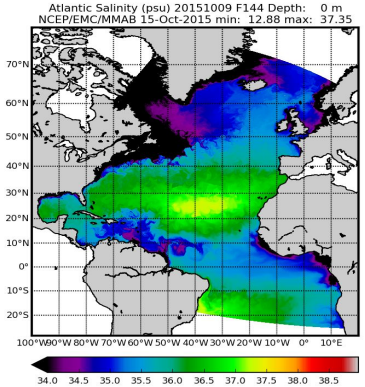


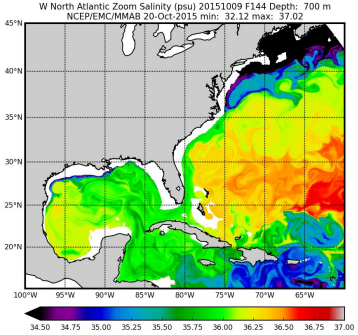


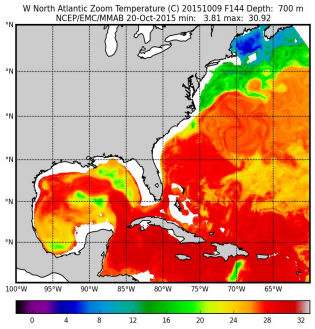
6 day forecast F144 at 20151009 (top) and 1 day nowcast N000 at 20151015 (bottom)

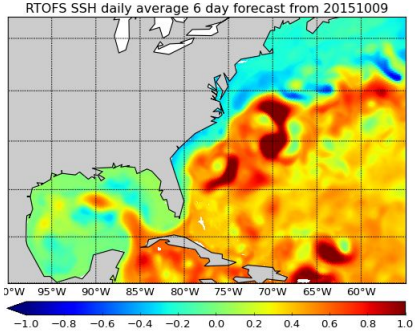
Daily metrics made available at: http://polar.ncep.noaa.gov/

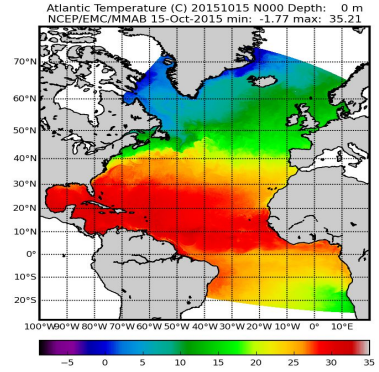


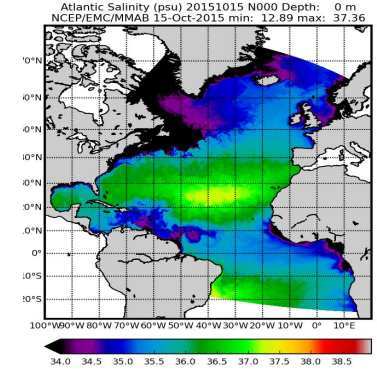


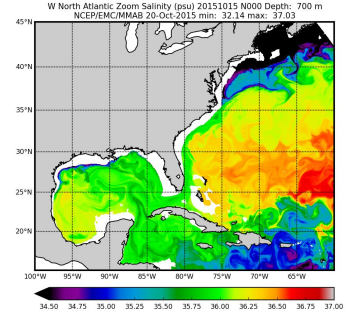


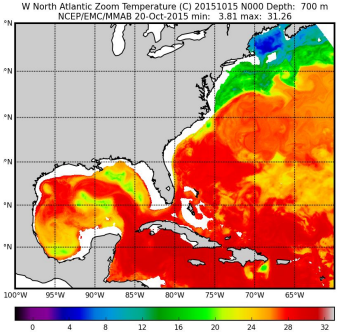


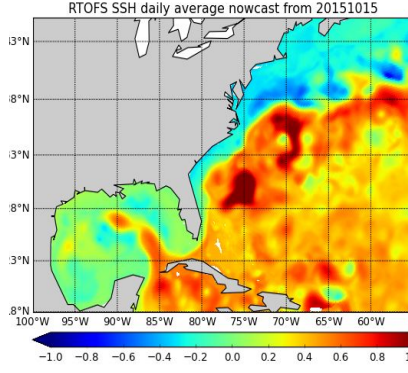






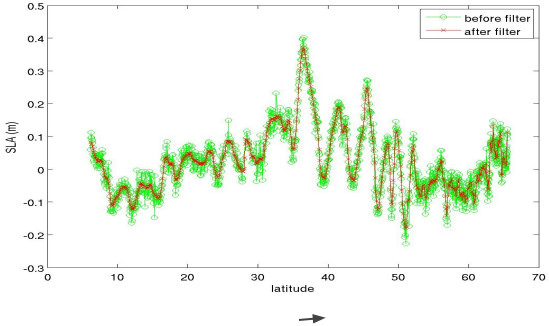






Assimilation of altimeter data into RTOFS: data treatment

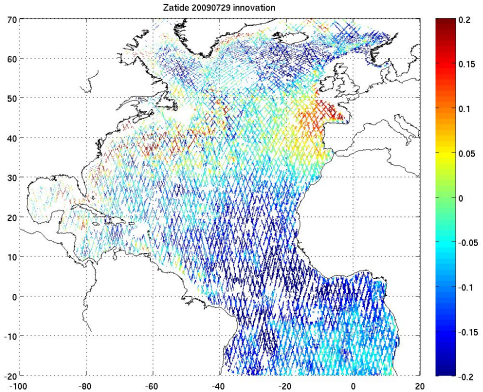
Altimeter data: Delay mode IGDR Jason-2, Cryosat-2 and Altika from NAVOCEANO (long wavelength error removed; two days delay)



Filtering/correction along tracks:
remove length scales less than 60 km [high wavenumber signal]
Tide [de-tide model with model tide estimates]
Atmospheric pressure [remove inverse barometer estimation]

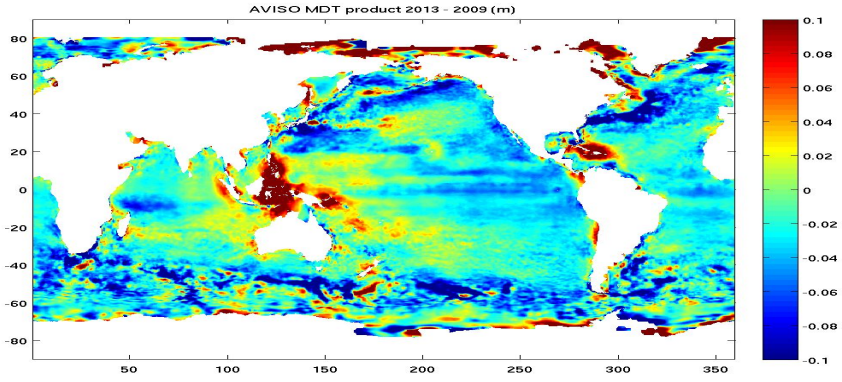
Quality control: Observation SSHA, is accepted if deviation from climatological mean (Ssalto/Duacs Climatological monthly MSLA product) is within 2.1STD; and deviation from model estimate of SSHA (=model SSH - MDT), is within 2.1STD.

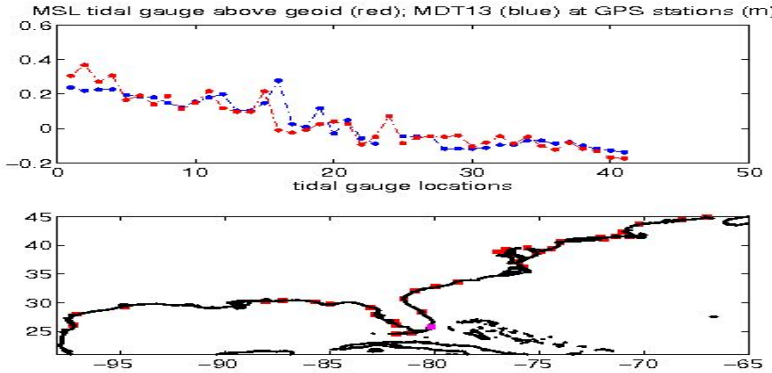
Innovation=SSHA-SSHA from model

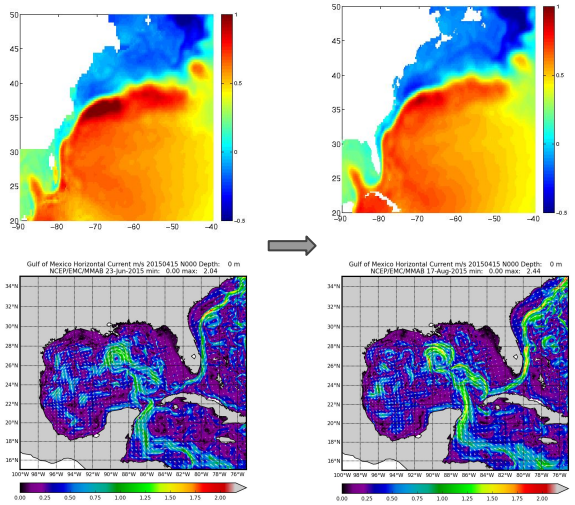


Assimilation of altimetry into RTOFS: MDT update

- Obtained from Ssalto/Duacs MDT_CNES-CLS13: 20 years Mean Sea Surface (MSS) altimetry and insitu data, and EGM (Earth Gravitational Model) geoid (2 years GOCE and 7 years GRACE)
- MDT = MSS - Geoid
- MDT in Ocean Data Assimilation: SSH=SSHA+MDT







The tidal gauge station information were kindly provided by P.L. Woodworth and C.W. Hughes.

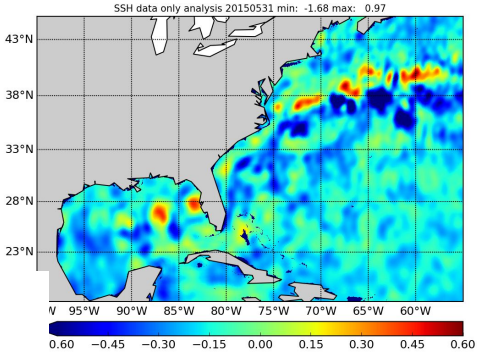
Assimilation of altimetry into RTOFS: data gridding

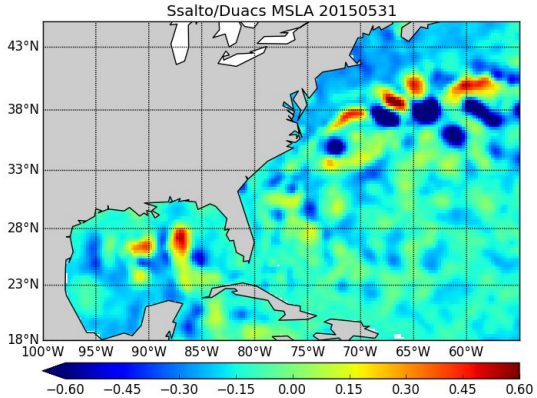
2DVAR: assumes Gaussian isotropic, inhomogeneous covariance matrix (Jim Purser's recursive filtering)

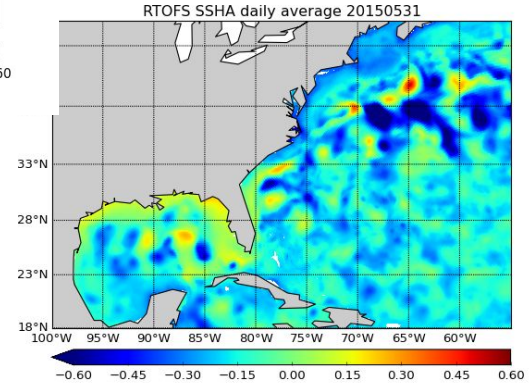
Spatial correlation scale: latitudinal dependent, with a certain zonal to meridional length scale ratio at different latitudes.

Temporal correlation scale:10 days before and 10 days after the centered day, for DT mode, 21 day time window with exponential decay; no future data for RT mode;

2DVAR SSHA monitor





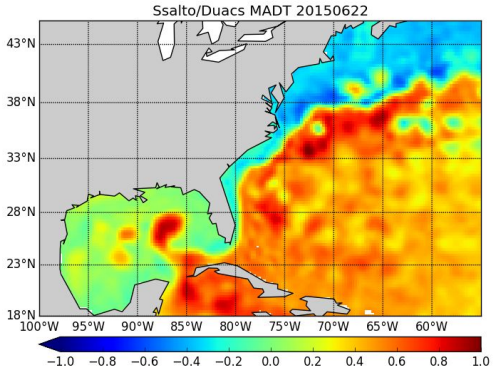


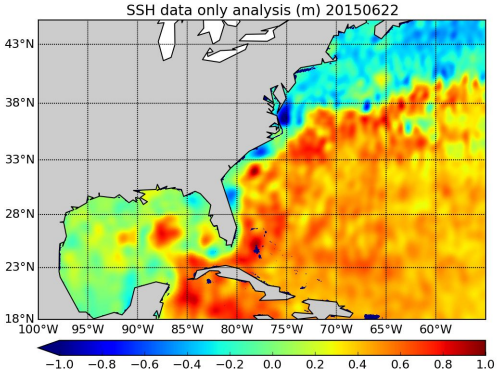
2DVAR SSH altimeter data only analysis: no ocean model dynamics evolved; background field is yesterday analysis; DT: [D-10days, D+10days];

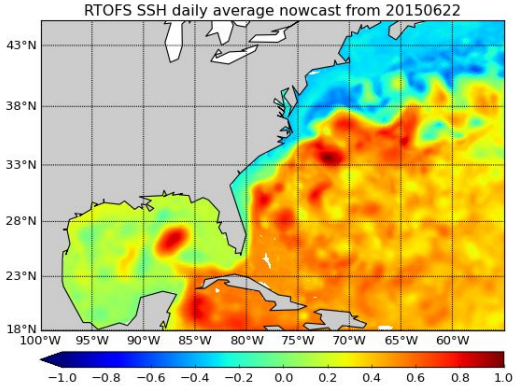
Ssalto/Duacs MSLA DT altimeter product using four altimeters: [D-6weeks, D+6weeks]

RTOFS SSHA=SSH-MDT, with model evolution: Background field is taken to be the model forecast from yesterday analysis field; RT: [D-10days, D]

RTOFS Daily average SSH product







2DVAR SSH data only analysis: SSH=SSHA+MDT; no ocean model dynamics evolved; background field is yesterday; DT: [D-10days, D+10days];

Ssalto/Duacs MADT NRT product using fou altimeters: [D-6weeks, D]
SSH=SSHA+MDT

RTOFS:
25 hourly average to remove tides with model evolution
Background field is taken to be the model forecast from yesterday analysis field forcing fields NCEP (GDAS/GFS) model