



NCEP Update (RTOFS, RTG)

*MMAB/EMC/NCEP
JPSS meeting 08/27/2015*

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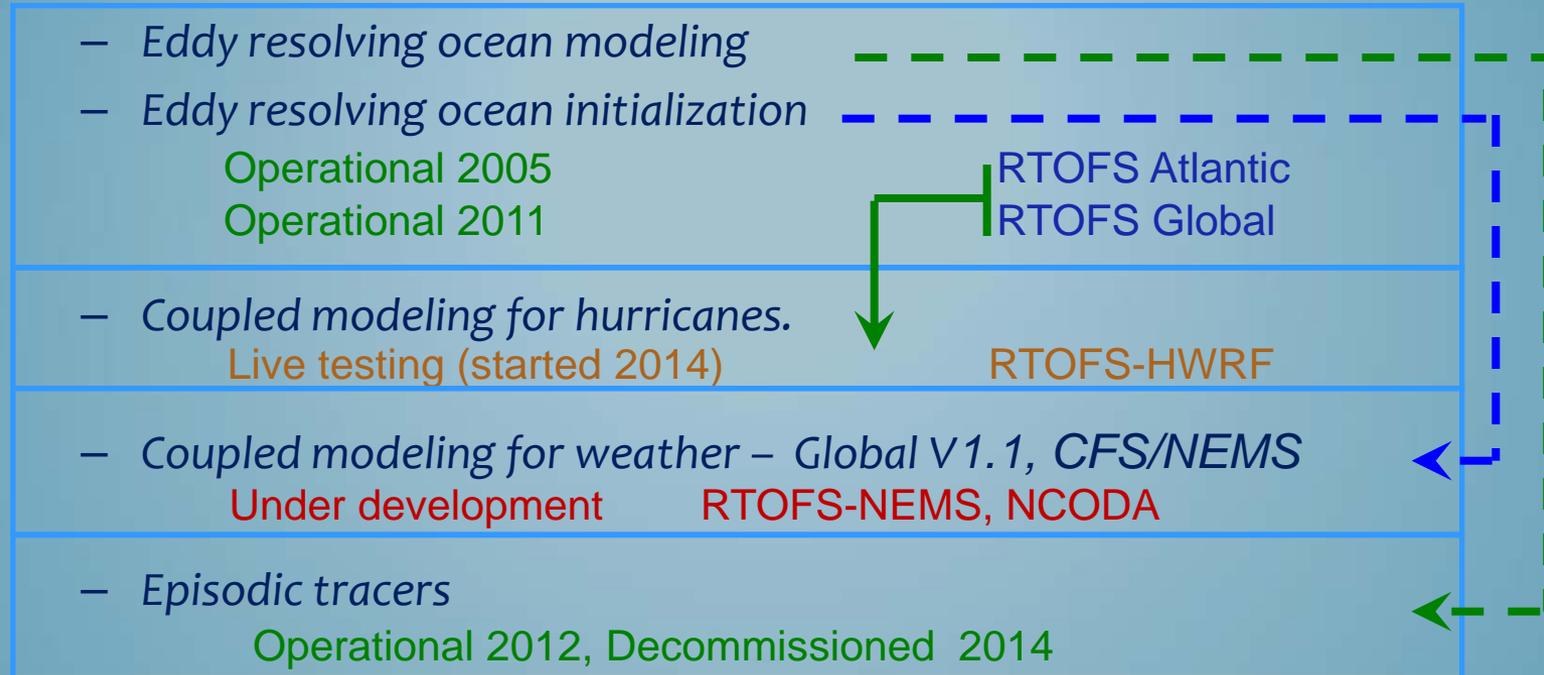


OUTLINE

- Overview ocean modelling (RTOFS)
- Global
- Regional (Atlantic, HYCOM-HWRF, ET-WPAC)
- NCODA, RTOFS-NEMS
- Analysis: SST RTG, Ice Cover
- Recent developments: NN mapping, BGC Modeling



Five major efforts:



- Real time ocean forecast system (RTOFS) represent line of products
 - HYCOM is underlying numerical ocean model

RTOFS Global Current Status

- NCEP implemented RTOFS-Global v1.0 in operations on 10/25/11 in close collaboration with Navy (GOFS 3.0)
- NAVOCEANO delivers initialization data daily (NCODA-3DVar)
- MMAB/EMC employs GFS/GDAS derived atmospheric fluxes.
- Multiple data distribution channels have been developed:
 - NOMADS (operational)
 - FTP (operational)
 - AWIPS (operational)



1/12 Degree Global Domain

Primary Users:

NWS:

EMC, OPC, NHC,
coastal WFO's,
NWPS

NOS:

CO-OPS, IOOS
RA's, WCOFS

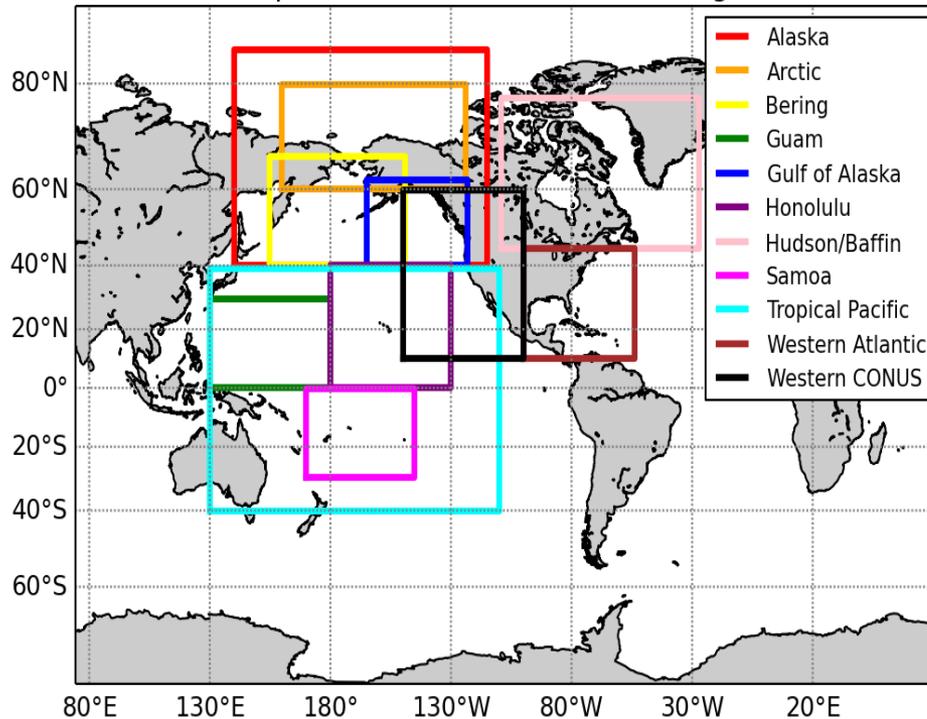
OAR:

OWAQ, AOML/HRD

DHS:

US Coast Guard

Map of Global RTOFS GRIB2 Subregions



Primary research partners: NRL, ESRL, AOML, NESDIS, JCSDA, JAEA (Japan), UMD, FSU, MSU, RSMAS, INCOIS (India)



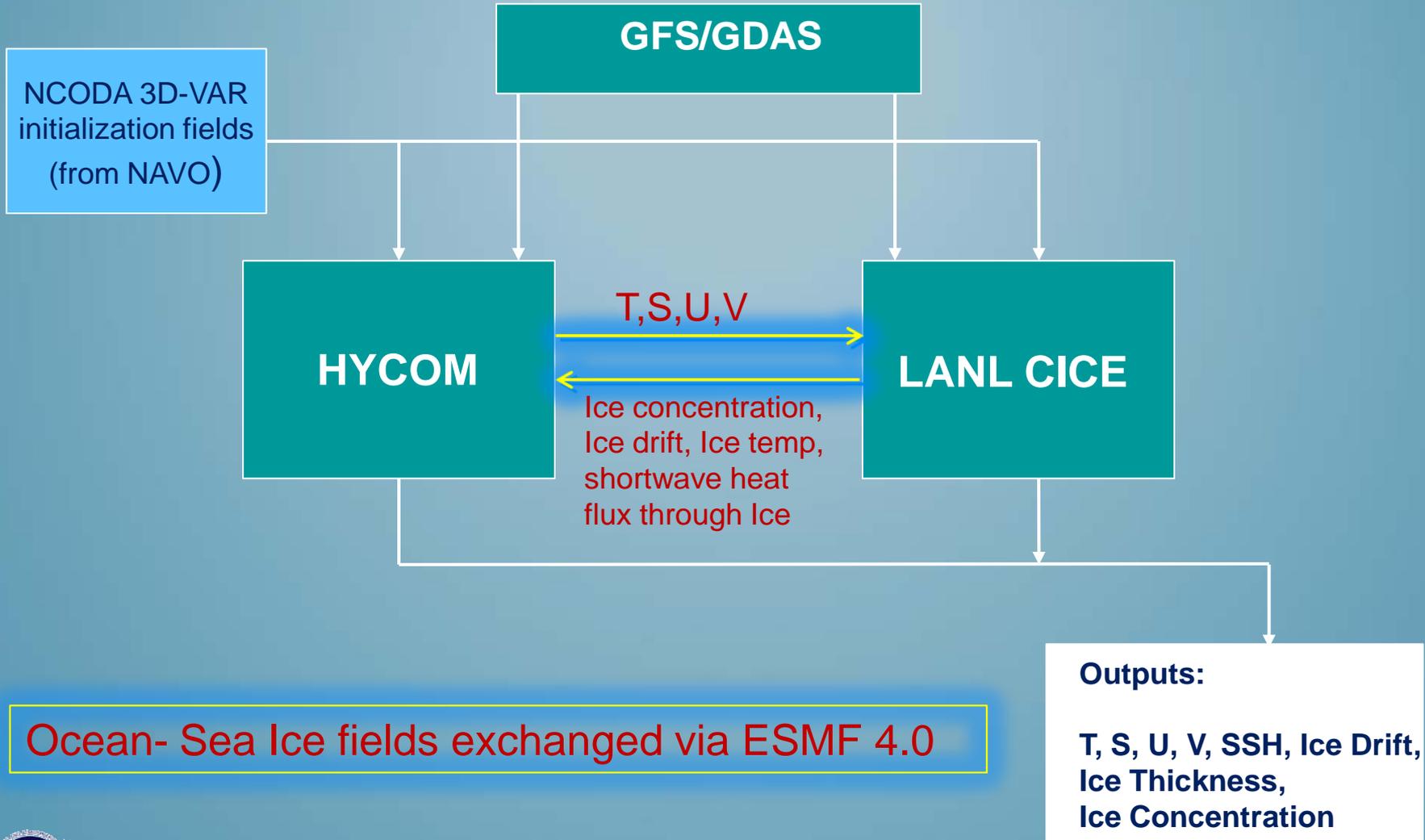
RTOFS Global v1.1.0/GOFS 3.1

Primary upgrades:

- 41 hybrid layers (increased from 32 layers)
 - Air-Sea boundary flux improvements for coupled applications (including Hurricanes)
 - Finer resolution for mixed layer (9 additional near surface layers)
 - Improved vertical coastal resolution for downstream applications
- Two-way coupled HYCOM with Los Alamos CICE (Community ICE code) (which replaces Energy-Loan Sea-Ice model)
 - 1 hour coupling frequency
 - Using ESMF v4.0 (non-NUOPC)
 - Additional forecasts (ice thickness, ice concentration, ice drift and speed)
- Improved climatology/bathymetry



HYCOM CICE coupling

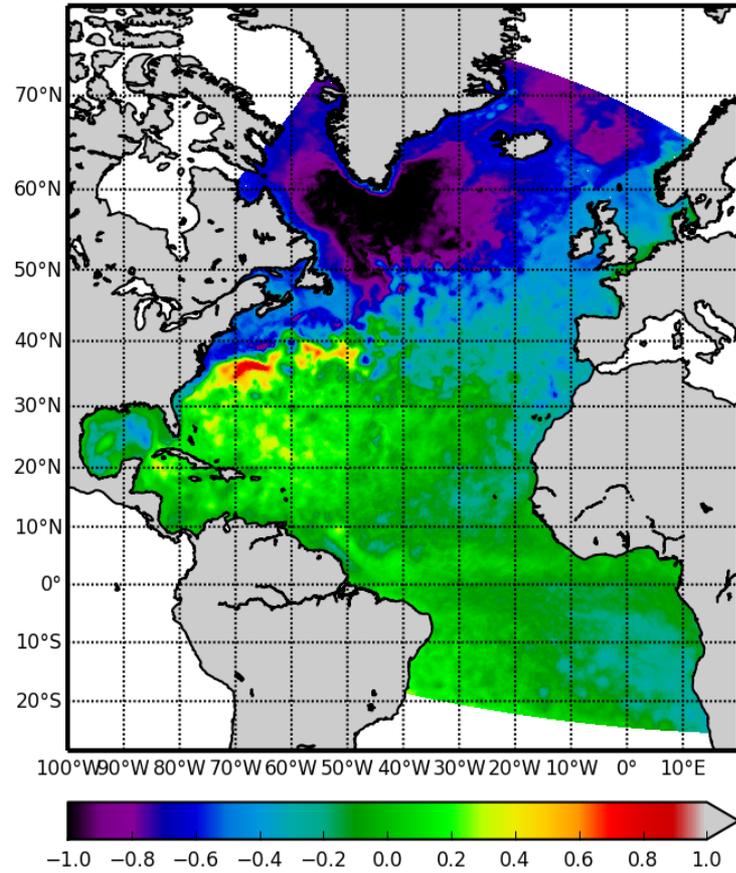


Ocean- Sea Ice fields exchanged via ESMF 4.0

RTOFS ATLANTIC V3.0.0

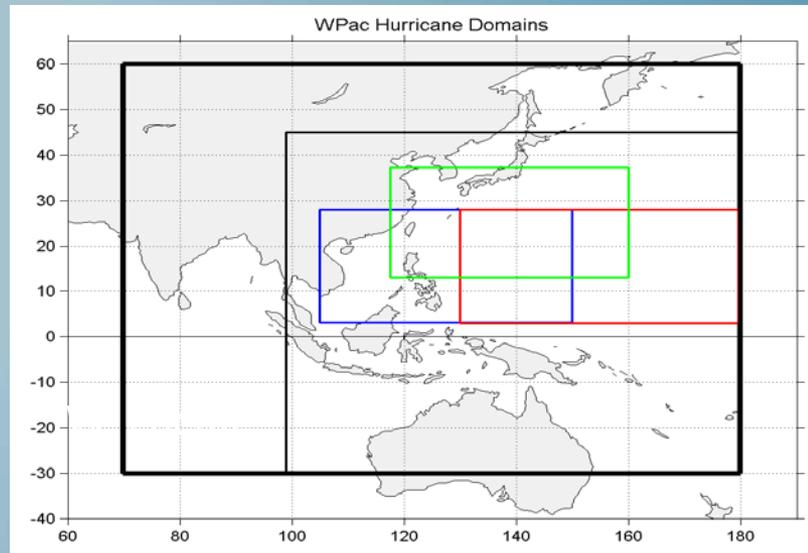
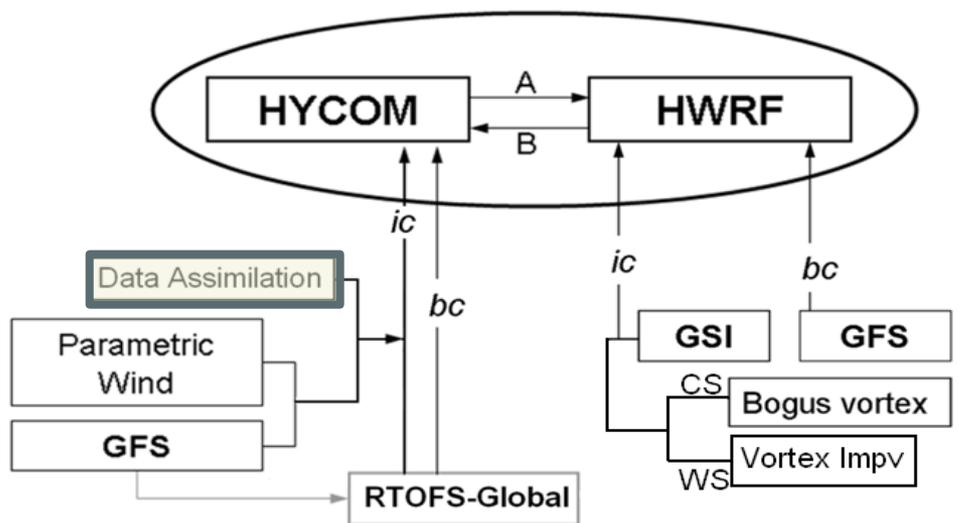
- Update codes to unify with RTOFS Global.
- Improve representation of basin geometry.
- Updates to data assimilation algorithm with new data sets for surface (SST, SSH, SSS).
- Updates to open boundary conditions to prevent drift.
- Ready to receive boundary data from RTOFS-Global.

Atlantic Sea Surface Height (m) 20131110 N000 Depth: 0 m
NCEP/EMC/MMAB 27-Jun-2014 min: -1.35 max: 0.85

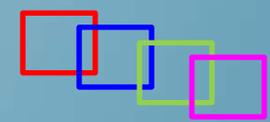


Coupled HWRF-HYCOM System

Coupled hurricane modeling with regional ocean components



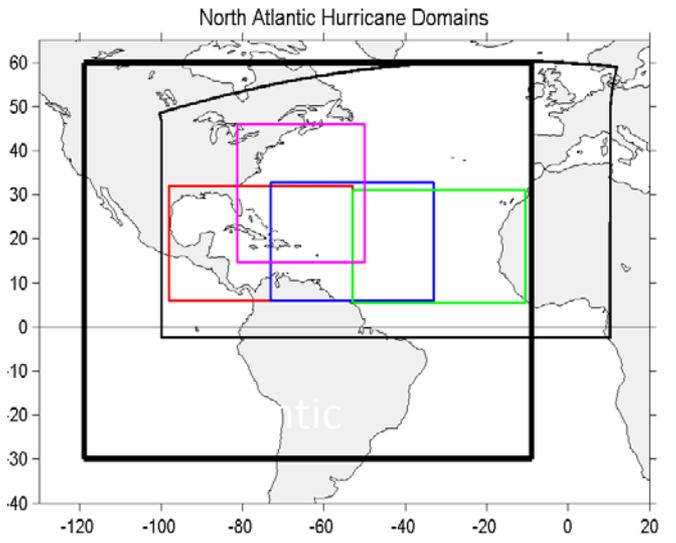
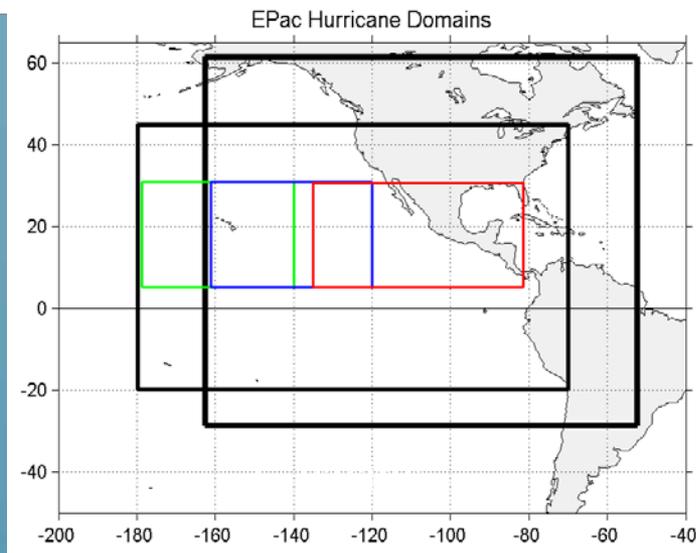
Current:



Future - basin



HWRF parent

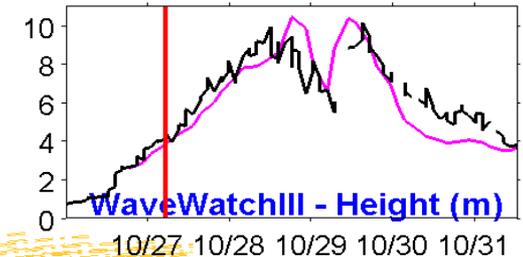
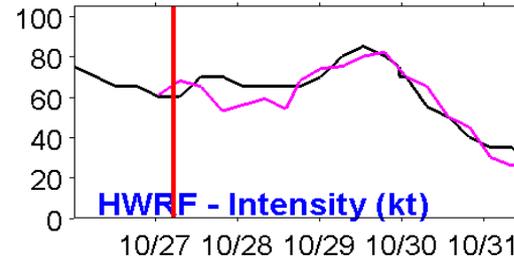


North Atlantic Hurricane Forecasts

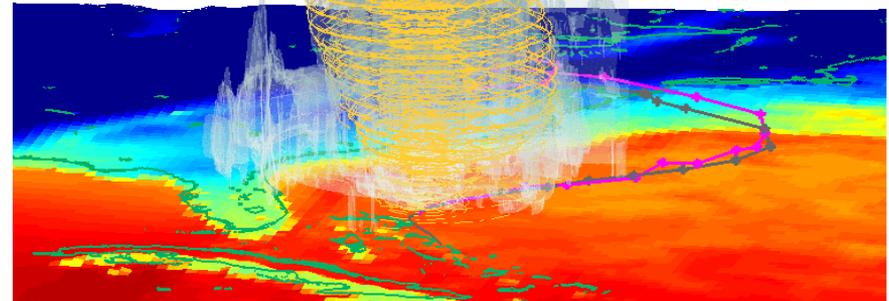
RTOFS-HWRF

Example of coupled simulation for Sandy 2012

- Top left – Intensity (kt) comparison between coupled HWRF-HYCOM simulation (pink) with best track (black)
- Top right – H_s (m) comparison between WWIII (pink) and NDBC buoy observations (black).
- Bottom - HWRF-HYCOM simulation (IC=2012/10/27 00Z) , T. of the ocean and land (color); water content (black-gray shade); vertical velocity (yellow lines); forecast tracks (pink) and best track (dark gray).

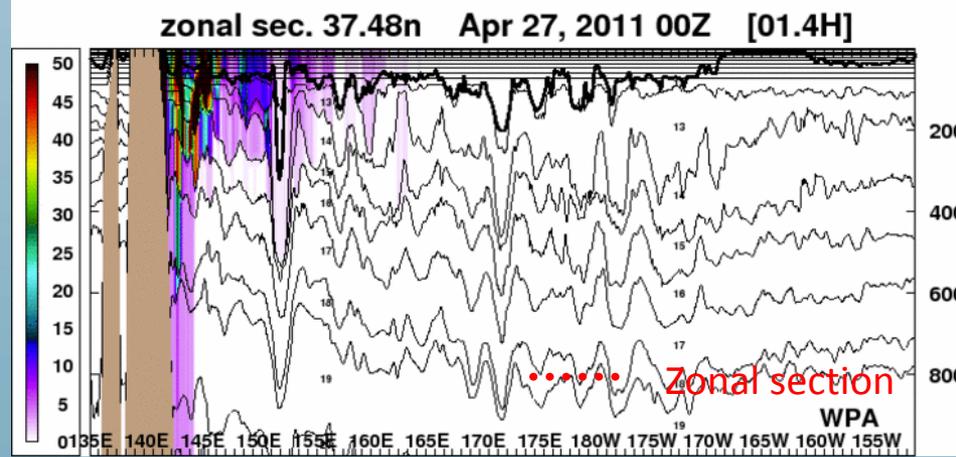
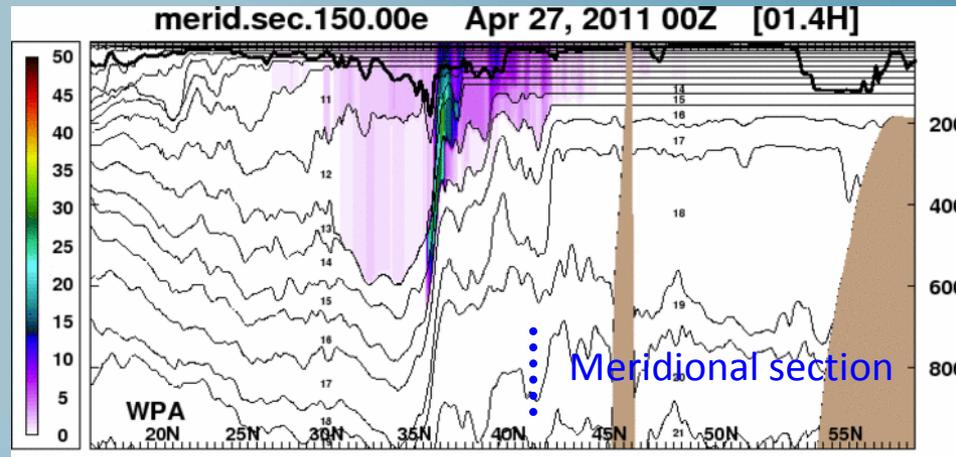
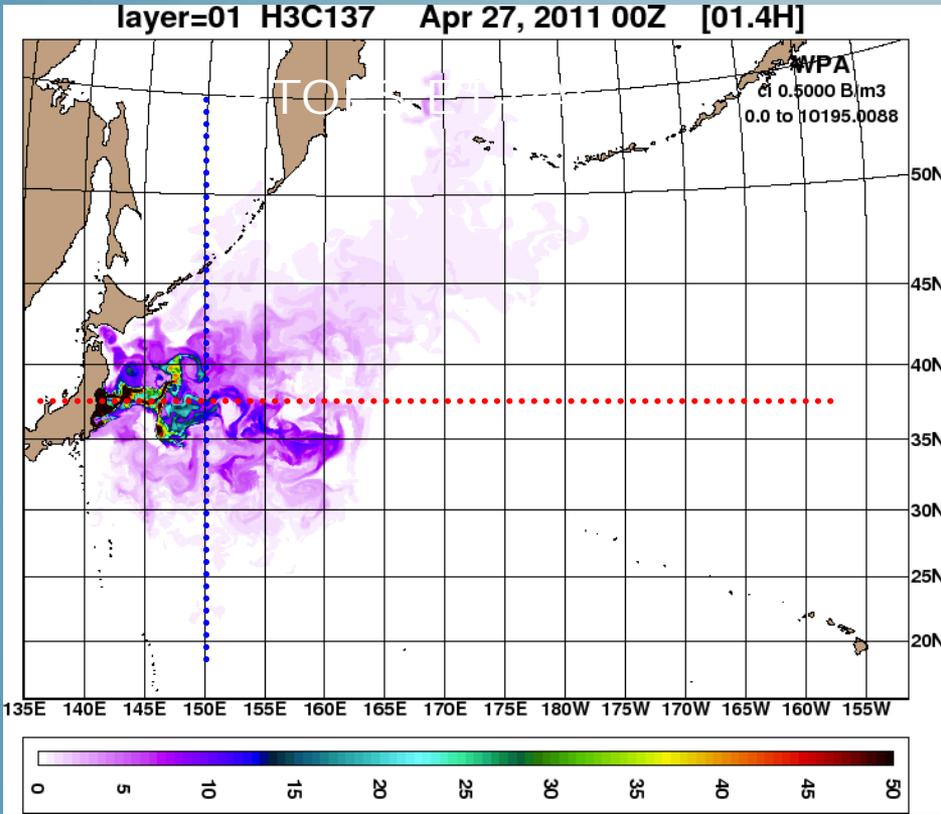


03:00Z 10/27



<http://polar.ncep.noaa.gov/global/tracers>

	MCL (Bq/l)	1 mrem dose (Bq/l)
^{137}Cs	7.4	33



^{137}Cs surface concentration
(scale max: 0.05 Bq/m³ or 50 Bq/m³)

Simulated results after atmospheric (HYSPLIT) and coastal (ROMS) sources were combined (April 27, 2011 ~ December 31, 2011) (Garraffo et al. WAF 2014)

Decommissioned on 1st April, 2014



- EMC became US government lead on ocean plume modeling for Fukushima Dai'ichi ocean issues.
 - CONOPS to rapidly generate actionable information for decision makers.
 - Prototype for emergency response and ecosystems modeling
 - Active ongoing research collaboration with JAEA
 - Repeat experiments with improved sources of radiation

- As part of the Navy-NCEP collaboration Navy's NCODA (3Dvar) will be used for NCEP ocean forecast systems
 - Initially for RTOFS Global
 - 3DVAR, seven overlapping regions
 - Configure to use NCEP data tanks and data streams.
 - Tentative implementation FY 2016.
 - Add new observations in the future (e.g. SSS, HF Radar)
 - Next step: NAVY-NCEP joint DA development work.

- Progress on RTOFS-NEMS
 - HYCOM coupled to GSM/GFS using ESMF NUOPC layer (with ESRL, GFDL and Navy)
 - Initial testing of the coupler ongoing for $\frac{1}{4}^{\circ}$ global model
 - Mediators/connectors also being built for Sea Ice, Waves and Land
 - Feasibility of RTOFS-NEMS in GFS or CFS context for future operational applications.
 - Working with global branch.
 - Weather time scales will benefit from proper seasonal characteristics too.
 - Control model drift in coupled model.
 - Coupling with WW III® , CICE, KISS
 - Explore medium-term events (MJO)
 - Proposal pending for India's Monsoon project

Assimilation of Near Real Time Satellite Sea-surface Salinity Fields: upper ocean impact

Temperature:

Employing satellite SSS tends to create general heating throughout

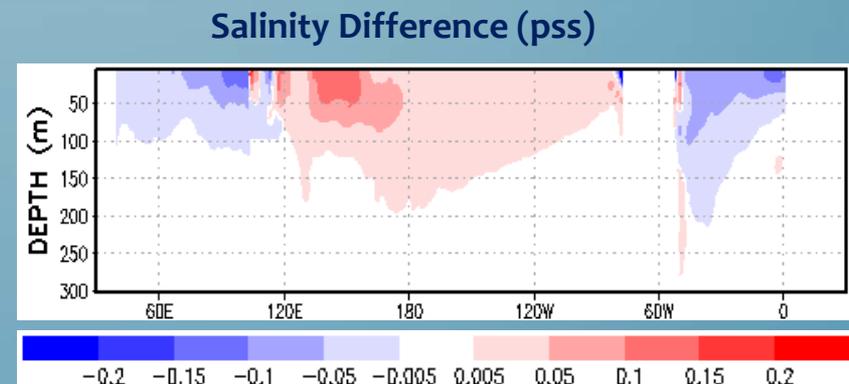
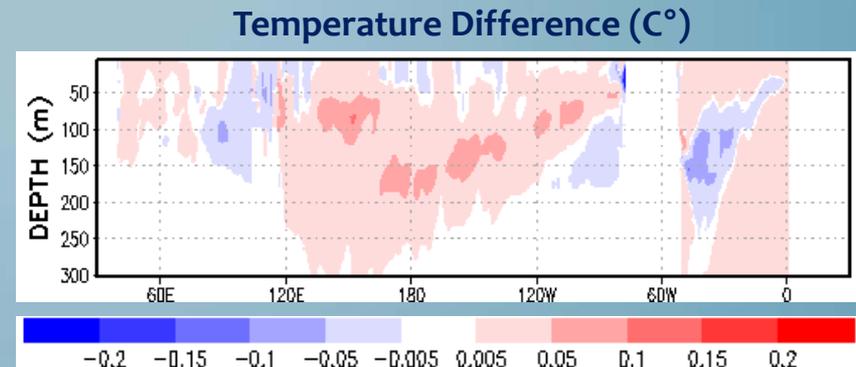
Salinity:

Employing satellite SSS generally freshens the Atlantic and Indian Oceans while increasing the salinity in the Pacific

Collaborators:

STAR-NESDIS, JCSDA, NASA

Impacts of using Aquarius V3.0 data on upper ocean (0-300m) equatorial region (5°S – 5°N)

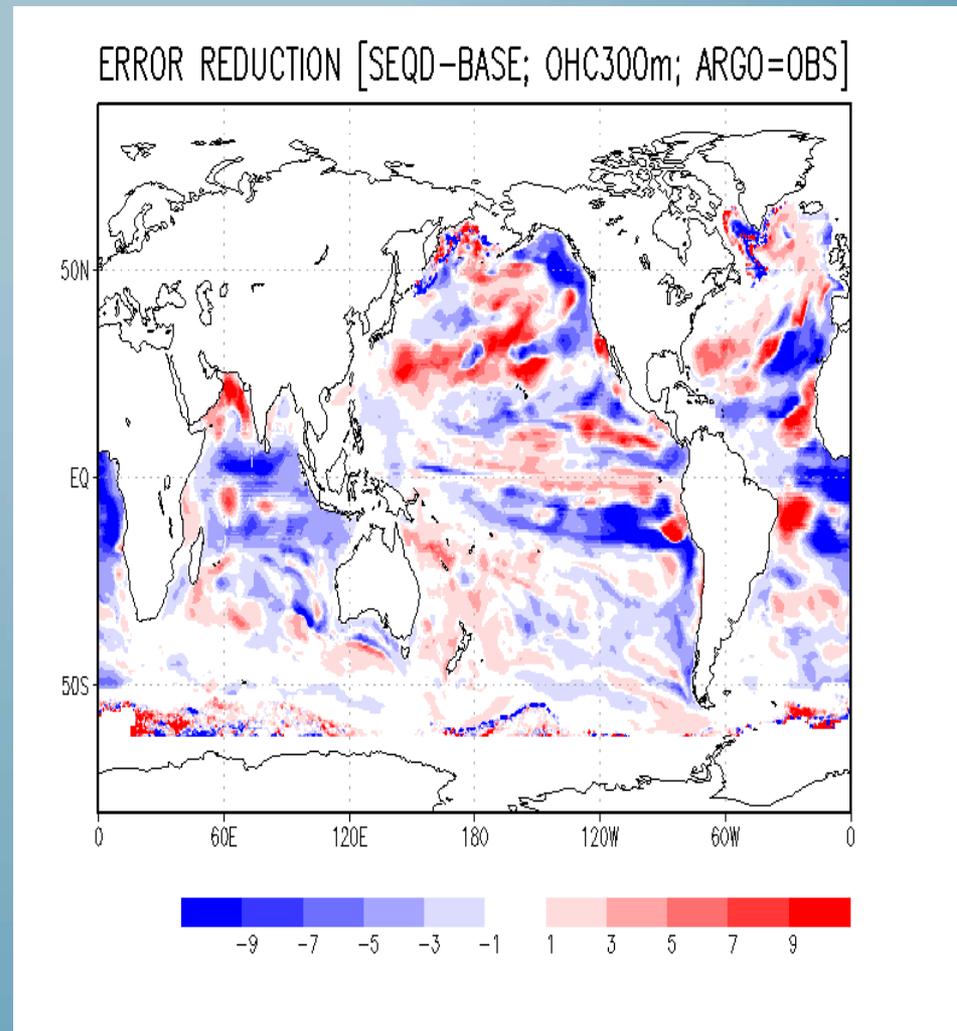


Use of near real time Ocean Color data for improved air-sea fluxes

Using composited daily SeaWiFS/VIIRS ocean color fields instead of the existing operational framework (monthly climatology from 1997-2001) reduces ocean heat content (0-300m) errors.

Collaborators:

STAR-NESDIS, JCSDA, NASA



- Global: stays at $1/12^\circ$, coupled via ESMF in NEMS
 - Resources for resolution versus resources for ensemble.
 - High-resolution for NCEP justifiable on US coasts only.
 - New data types for NCODA.
 - Better MLD, OHC, coupling with WW III® for Langmuir and Stokes mixing in ocean.
- HYCOM-HWRF
 - Continue real-time testing in 2015 season for all basins.
 - Upgrade HYCOM source code, vertical levels, expanded domains.
 - Development of data assimilation algorithms.
 - Explore coupling with WW III®.

- Basin scale models:
 - RTOFS-Arctic: New model, coupled to NMMB, Sea Ice, Waves.
 - RTOFS-Atlantic: New finer grid.
 - RTOFS-Pacific: New model for East Pacific.
- Future of basin scale models:
 - $1/24^\circ$ or $1/36^\circ$ resolution.
 - Nested in Global.
 - Coupled:
 - Waves for upper ocean mixing (and surface fluxes if coupled to atmosphere)
 - Ice and atmosphere for Arctic.
 - Ensemble, particular for Arctic.

SEA-ICE

- Ice Concentration
- Ice Drift
- Ice Modeling



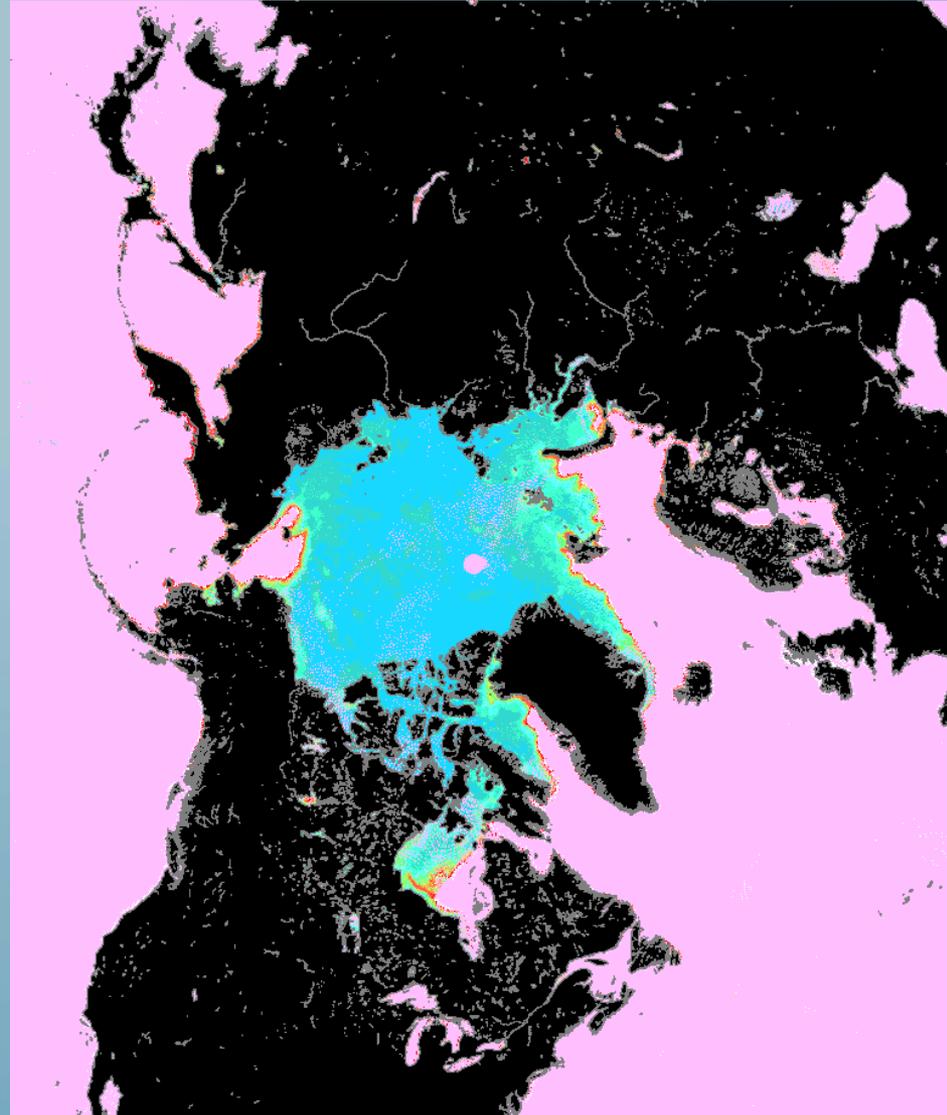
ICE CONCENTRATION ANALYSIS

Added in FY 14:

- Climatology Reference
- Use NIC IMS if overage data

Coming in FY 15:

- Adding Instruments:
AMSR2
SSM/I/S from F-16, F-18
- Updated weather filter



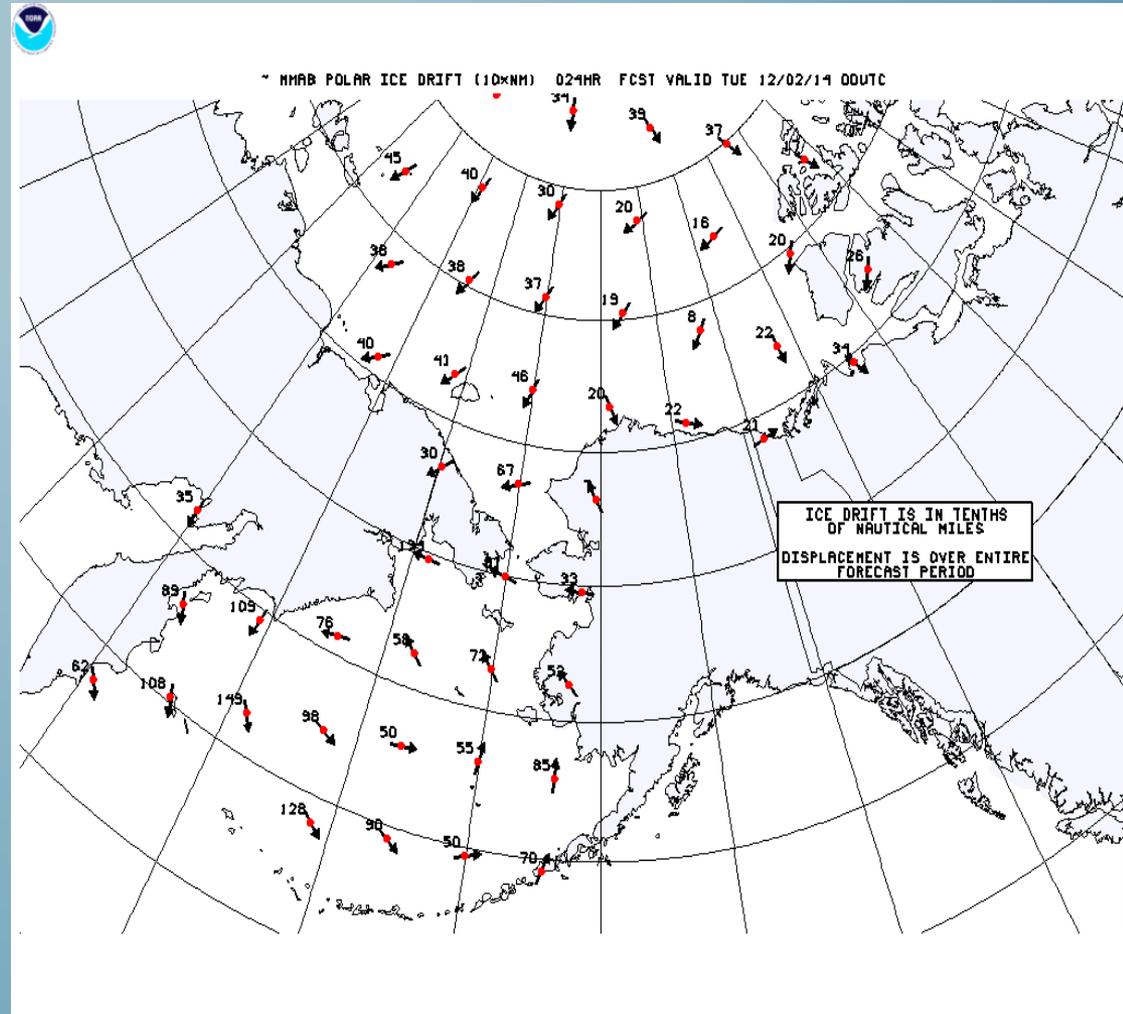
ICE DRIFT MODEL

Change in 2014:

- Now runs on GEFS
- Operational .kml output
- AR favorable evaluation

Changes for FY 15:

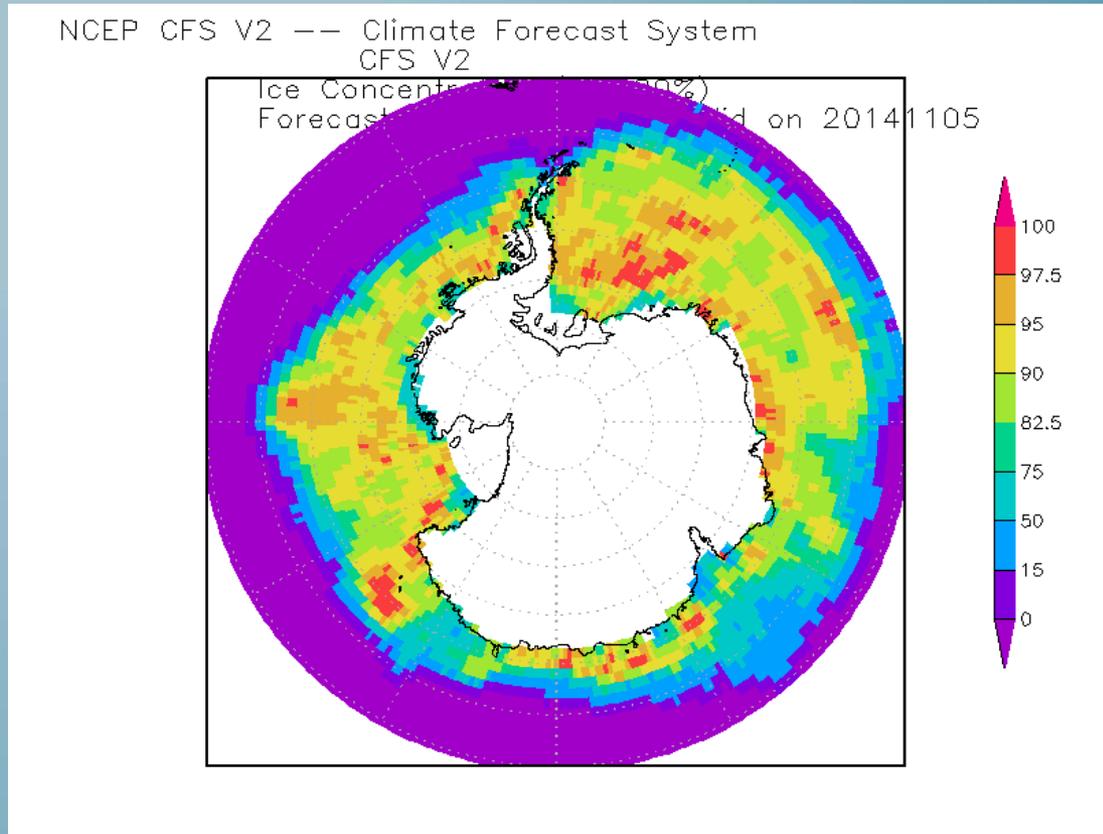
Update for new GEFS



KISS ICE MODEL

Coming for FY15:

- Thermodynamics
- Velocity plots
- NUOPC framing
- Coupled modeling tests
- Additional skill measures



<http://polar.ncep.noaa.gov/develop/icemodel>

User: icemodel

Password: nansen



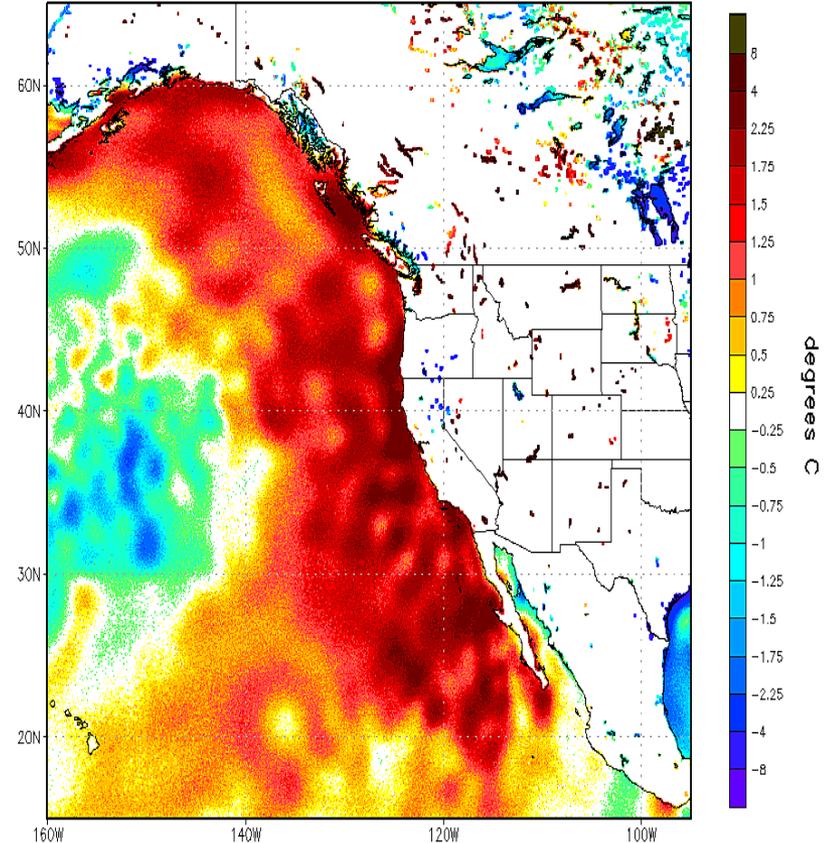
REAL TIME GLOBAL (RTG) SST

Additions for FY15:

- Updated Climatology Reference
- New Instruments:
 - GOES (hourly scans)
 - VIIRS (high res)
 - METOP-B
 - AMSR2 (Microwave)
- Updated land treatment (update from Weaver)

NOAA/NWS/NCEP/EMC Marine Modeling and Analysis Branch Oper H.R.

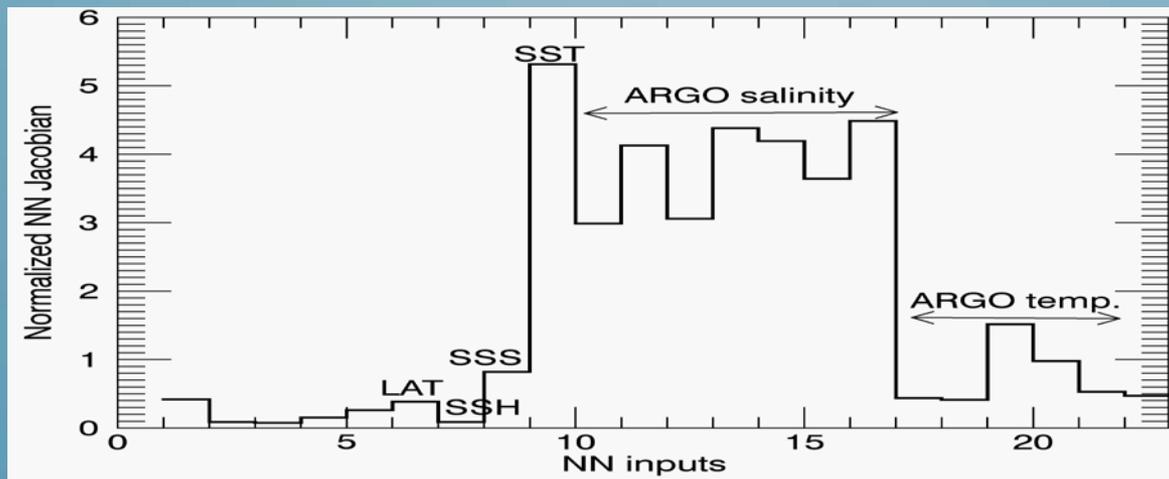
RTG_SST_HR Anomaly (0.083 deg X 0.083 deg) for 30 Nov 2014



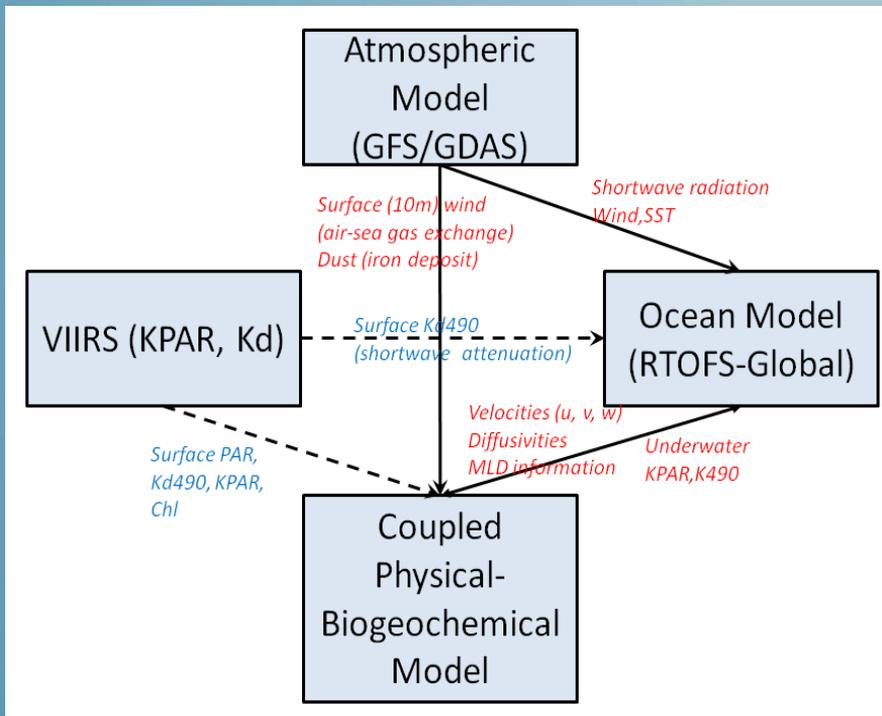
22:52:16 SUN NOV 30 2014

NEURAL NETWORK MAPPING OCEAN PHYSICAL FIELDS TO CHLA

- $Chla = Nnmap(SST, SSS, T\&S \text{ profiles}, SSH, \text{Location}, \text{Time})$
- Provides an accurate, computationally cheap method for filling gaps in satellite ocean color fields.
- Accurately estimates the seasonal cycle and large-scale spatial patterns in the VIIRS chl-a fields.
- Best reproduces VIIRS chl-a variability in the major ocean gyres at mid-latitudes.
- The largest errors are found where the spatial scales of variability are small and the variability is large, e.g., continental shelves, coastal regions, marginal seas, etc.



BIOGEOCHEMISTRY COUPLED TO PHYSICS (RTOFS-PHYSICS-BGC-GLOBAL)



- A modified NASA Ocean Biogeochemical Model (NOBM) will be embedded into RTOFS-Global;
- NOBM has 12 ecosystem components (nutrients, phytoplankton, detritus) with 2 carbon components (DOC, DIC) for air-sea CO₂ dynamics;
- Dissolved oxygen submodule will support Ecological Forecasting Roadmap strategy
- VIIRS products will be assimilated.

See Hae-Cheol Kim Session 5 JPSS 2015
(August 25)

RTOFS-RTG

USER NEEDS & WISH LIST

- *SST high space-time coverage is needed to support data assimilation, verification, monitoring and process studies to improve operational products derived from all ocean models and analyses .*
- *Resolve coastal and inland water bodies. To support high resolution weather prediction.*
- *Physical based retrievals*
- *After a major data processing update, a revised edition of previously released data is provided.*
- *Timeliness for products supporting real time forecasting.*
- *Operational grain distribution*

