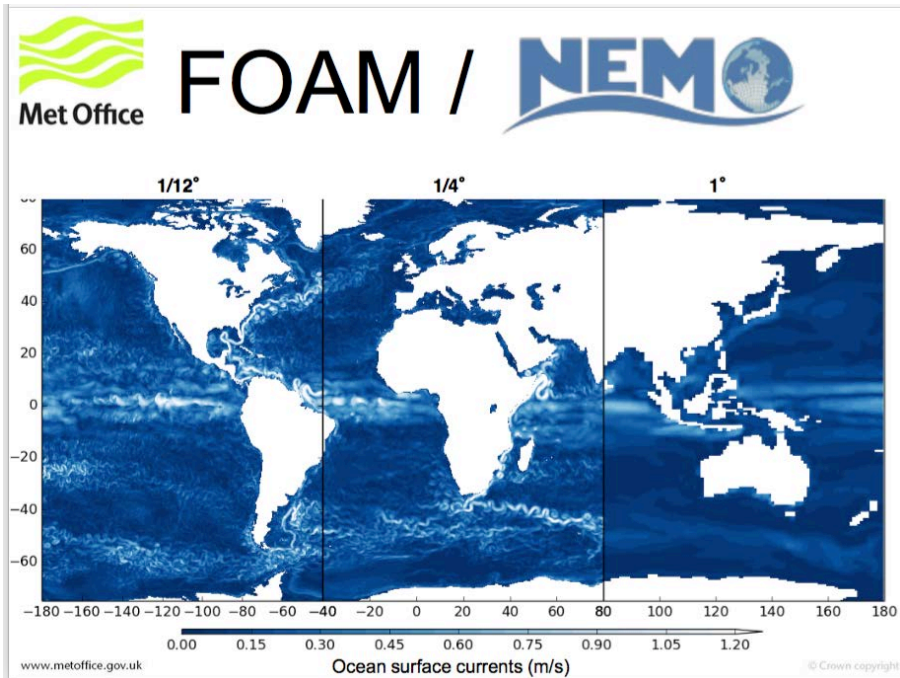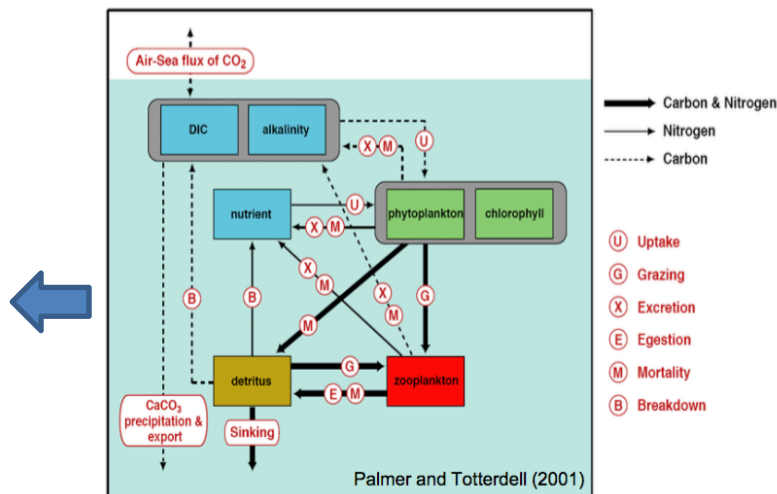# Ecological Forecasting

Ecological Forecasting
## (Efforts in Europe: e.g., U.K. Met Office)

Forecasting Ocean Assimilation Model recently transitioned to Nucleus for European Modeling of the Ocean as a core ocean modeling component

HadOCC
Hadley Centre Ocean Carbon Cycle Model

Palmer and Totterdell (2001)

Ocean colour data assimilation
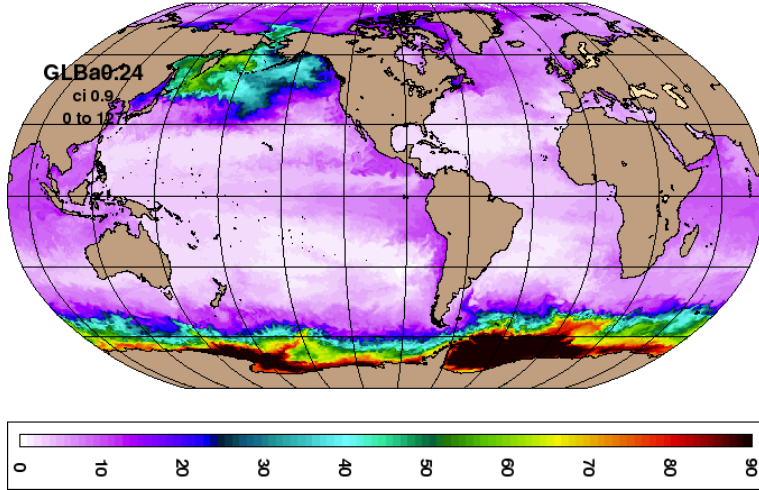
- Surface $\log_{10}$(chlorophyll) increments produced by 3D-Var (NEMOVAR)

- All 3D biogeochemical state variables updated by nitrogen balancing (Hemmings et al., 2008)
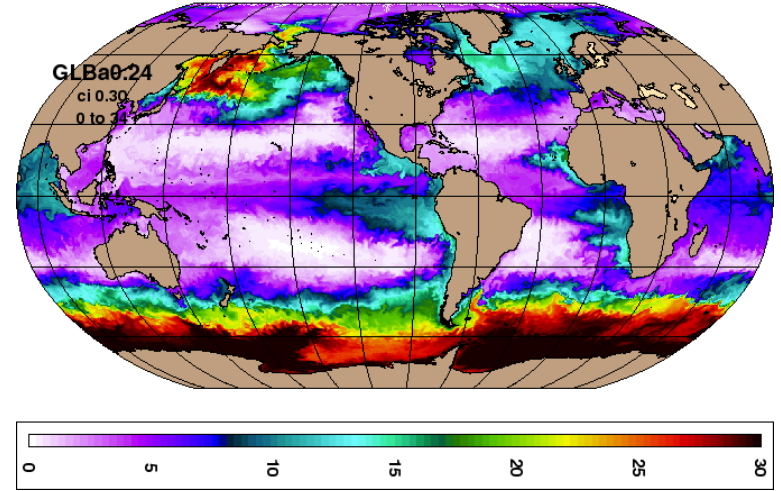
Ford et al. (2012, Ocean Science)
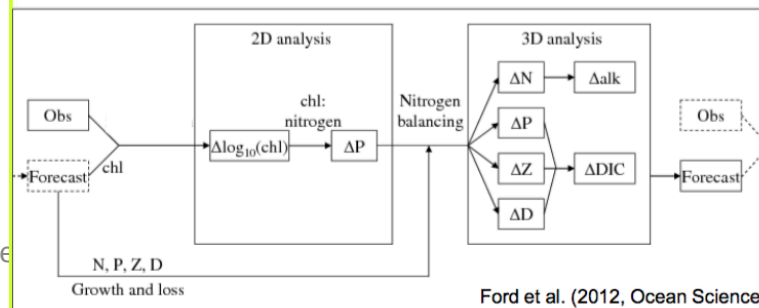
Ecosystem Model

- A testbed region (GLBa0.24) was made and set up for implementation of on-line coupling of NPZD-type ecosystem models
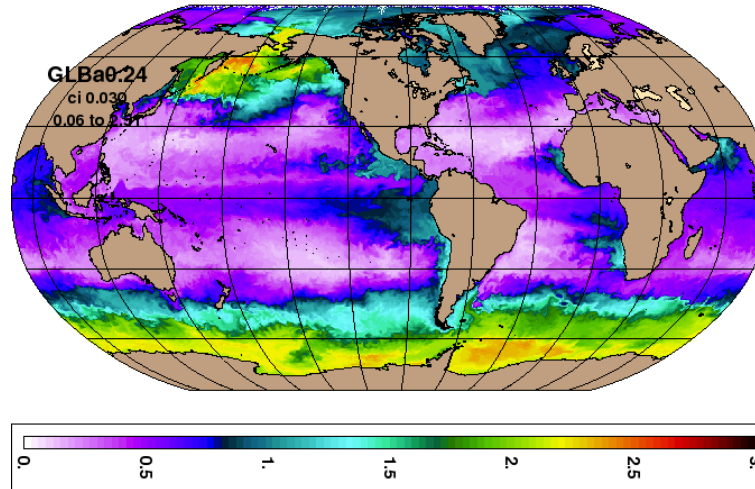

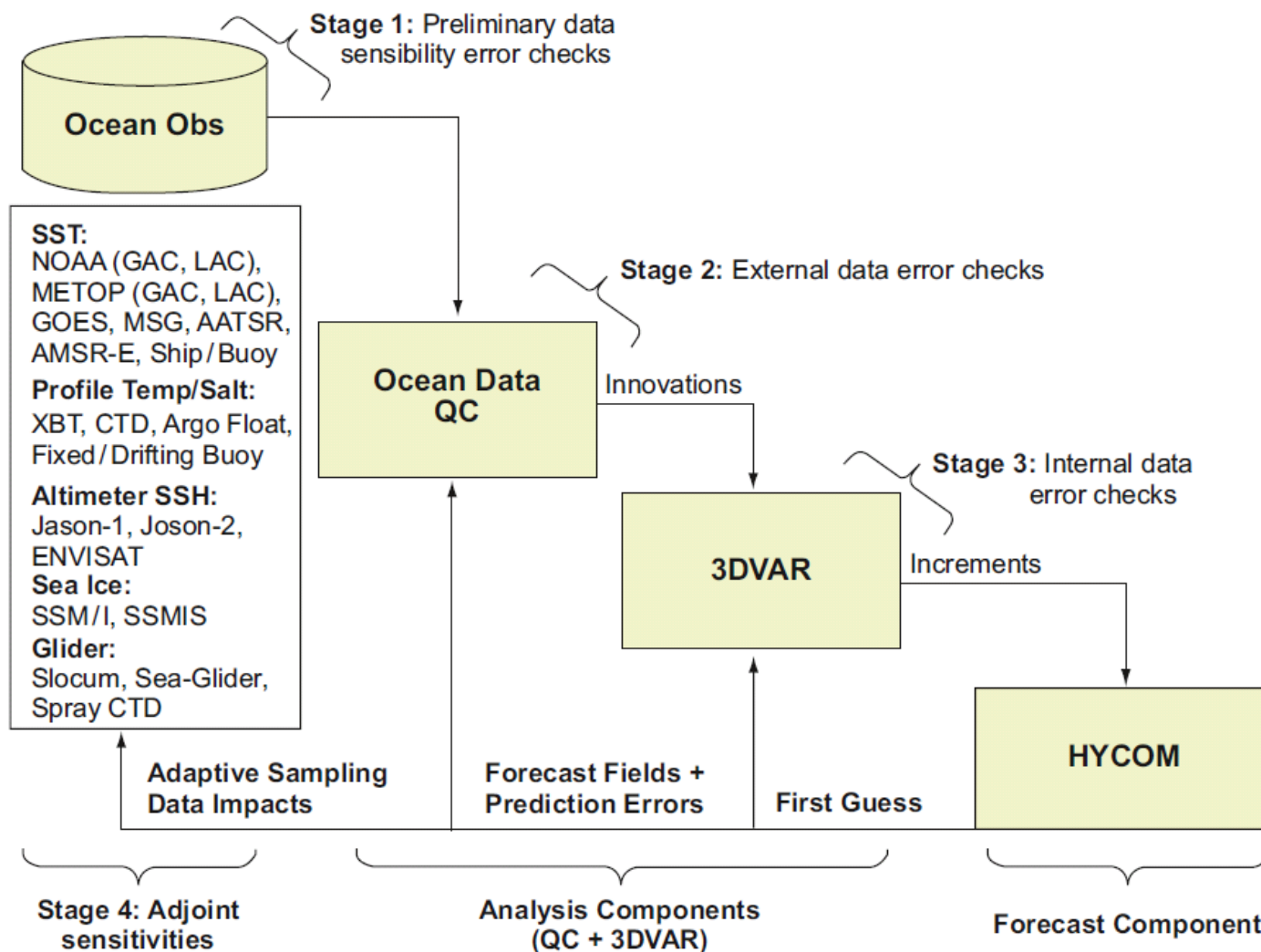Silicate D010 1998

Nitrate D010 1998
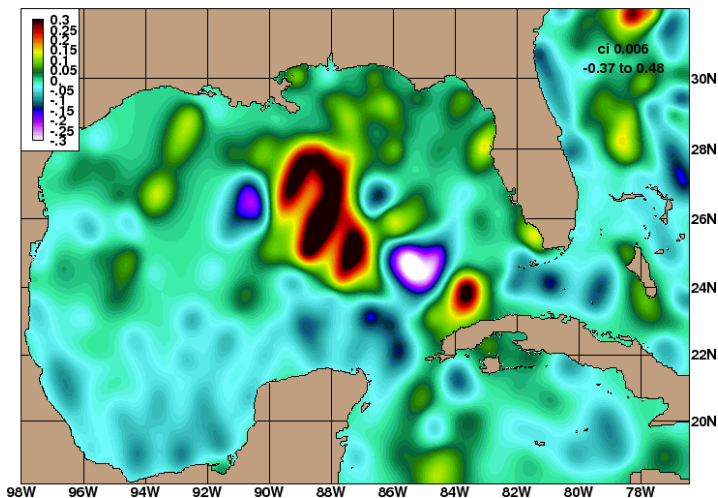

Phosphate D010 1998

Ocean Data Assimilation
(Navy Coupled Ocean Data Assimilation: NCODA)

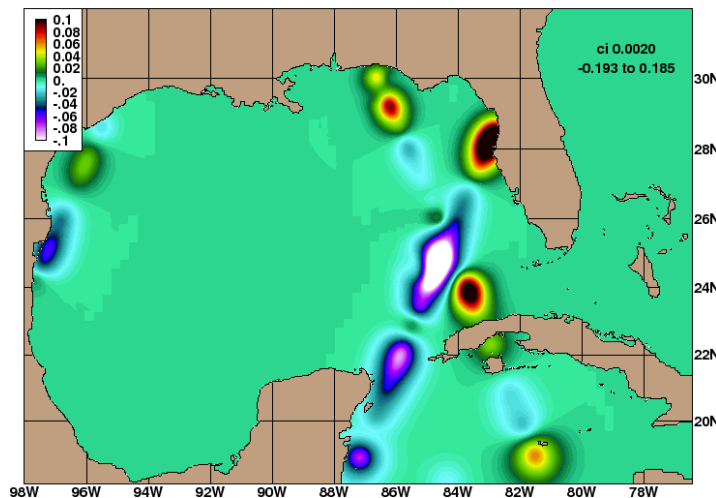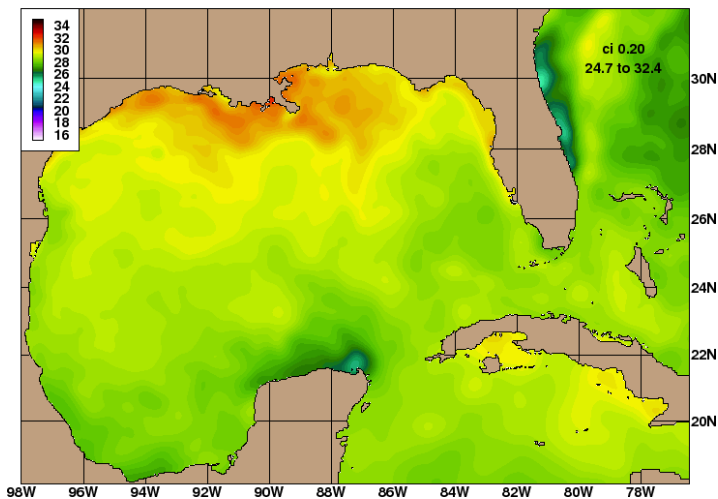# NCODA Exercises

(GOMl0.04; 3DVAR w/ SSH, SST)
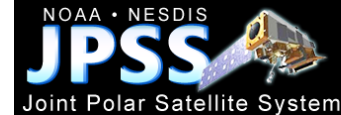
Neural Network Application
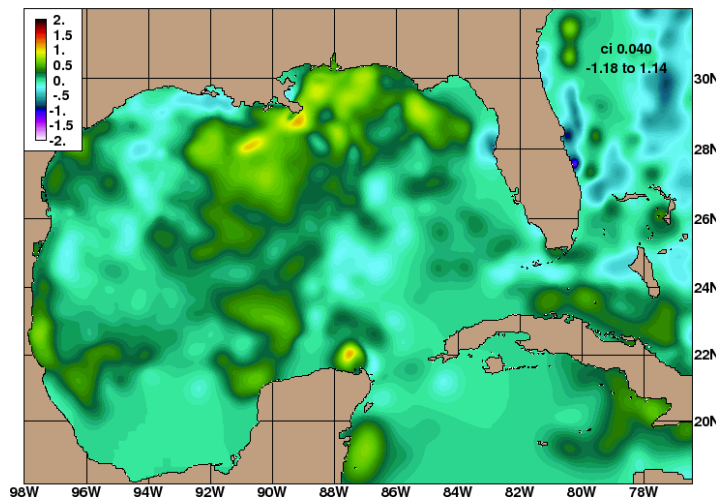
Neural Network Applications

(status)

- Neural Network (NN) technique applied to ocean color applications — gap-filling, consistent ocean color, etc.

- NN: robust, flexible, accurate, and computationally cheap

- In-house expertise from Dr. Vladimir Krasnopolsky

- Exploits statistical linkages between ocean biological parameter (e.g., chlorophyll-a) and upper ocean variables (e.g., SST, SSH, Argo Temperature & Salinity profiles, etc)

(status continued)

- Basic premise: **(a)** inputs — SST, SSH, etc., — are stable, and **(b)** relationship between chlorophyll-*a* and inputs holds over time

- NN trained on NASA/VIIRS (2012-2014), applied to 2005-2014 to reconstruct chlorophyll-*a*

- Results: stable over time, accurate (Krasnopolsky, et al., *Computational Intelligence and NeuroScience.,* 2015)

Neural Network Applications

(results)

- NN trained on daily VIIRS yields promising results

- Good fidelity in western equatorial Pacific

- Significant errors in eastern equatorial Pacific, possibly due to upwelling

- May need more input diagnostic variables from ocean models (upwelling velocities, horizontal advection, etc.)

- NN trained on monthly SeaWiFS, expected (Spring 2017)

- NN trained on SeaWiFS will produce consistent chlorophyll-*a*

On-going or ToDo List

- Science quality VIIRS products and thermal structure effects

- On-line coupling of NPZD-type ecosystem model

- Added complexities (e.g., 9-component including carbon and dissolved oxygen sub-modules)

- Ocean color (SeaWiFS/VIIRS) data assimilation (2DVAR) into BGC-coupled RTOFS-Global

- NCODA implementation for physical/biogeochemical variables (3DVAR)