



# NEMO-HadOCC

Initial coupling and biological data assimilation

Karen Edwards, NEMO Users Meeting, Paris, 2-3 July 2009

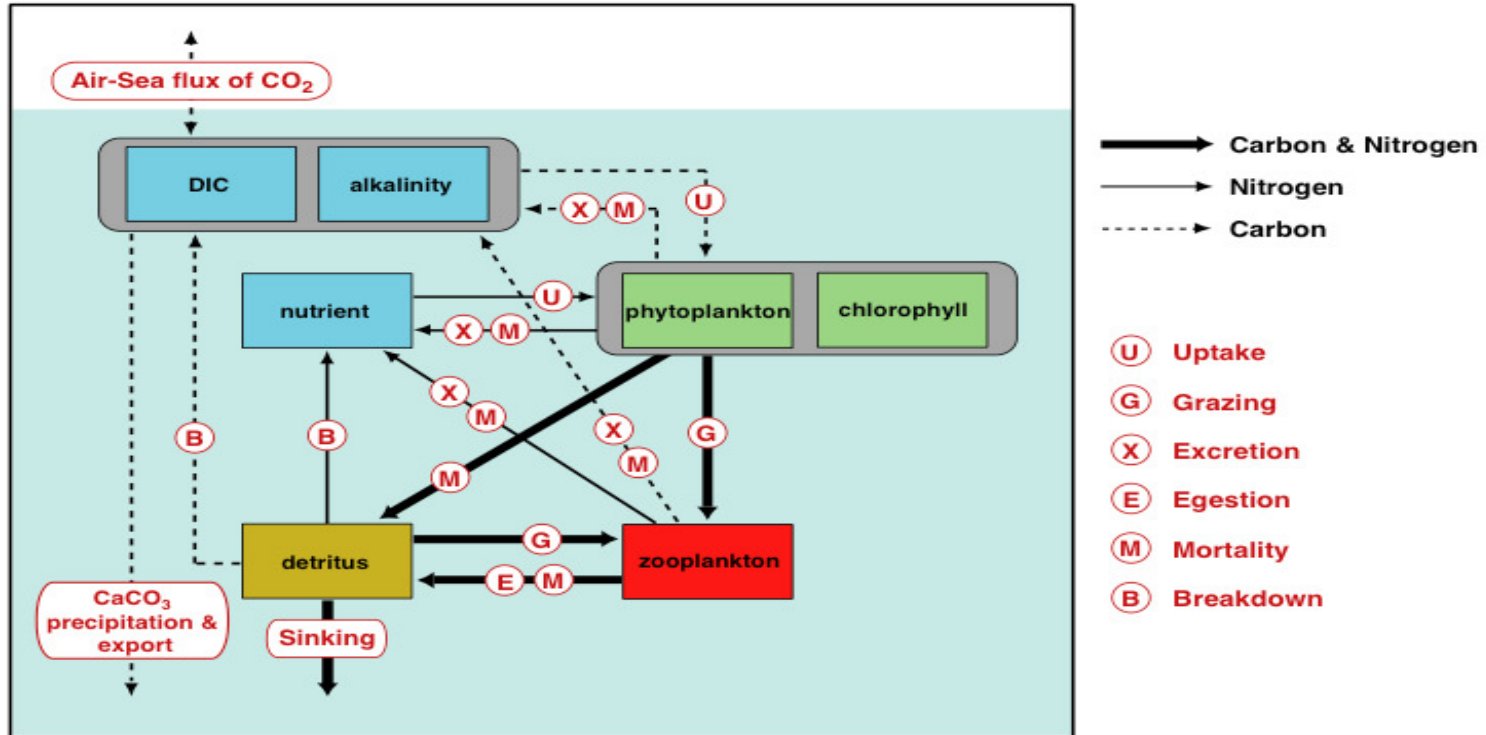
Thanks to Rosa Barciela and David Ford



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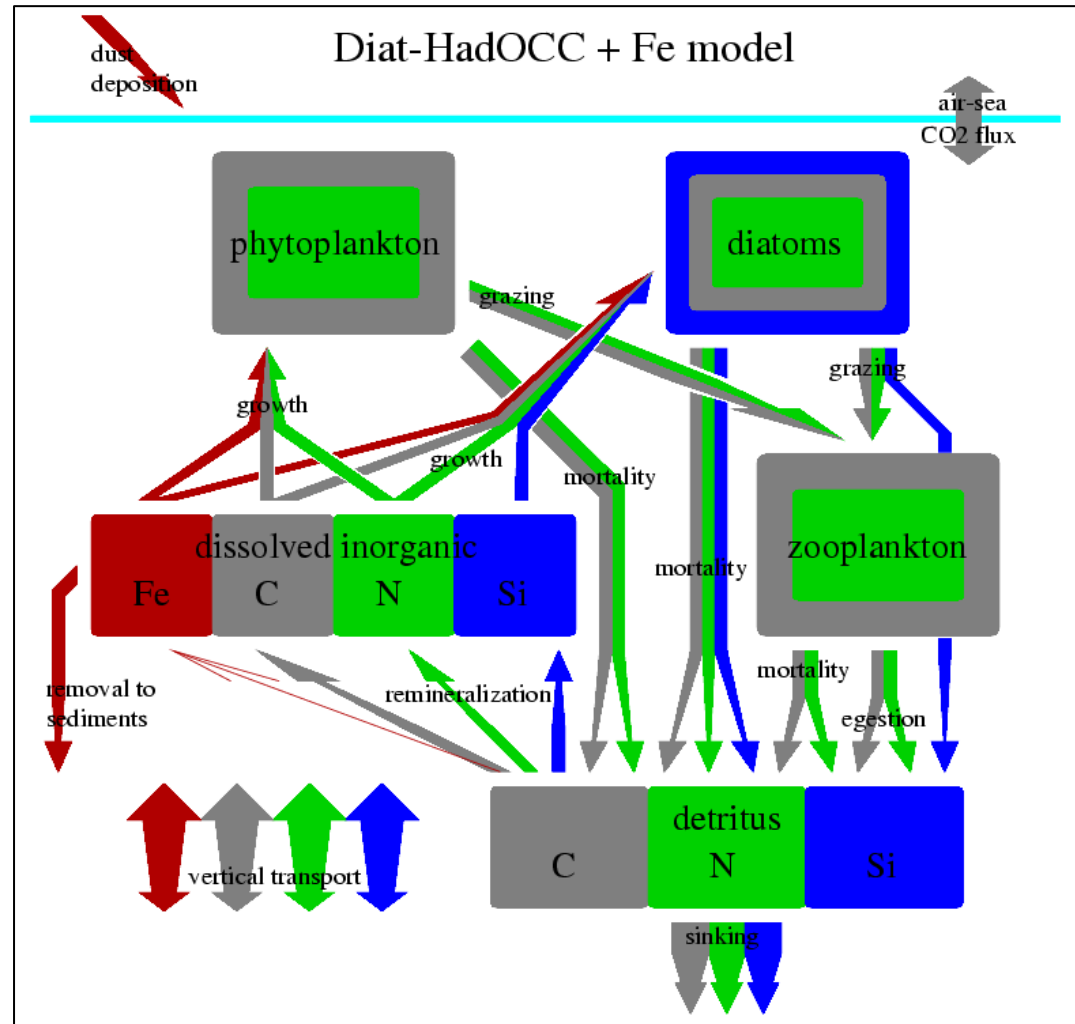
# The Hadley Centre Ocean Carbon Cycle model (HadOCC)



- HadOCC is a NPZD (plus DIC and alkalinity) biogeochemical model used at the Hadley Centre for climate studies.

# The HadOCC model: Diat-Hadoccc

- The Diat-HadOCC model additionally includes **diatoms**, **diatom silicate**, **detrital carbon**, **detrital silicate**, **dissolved silicate** and **dissolved iron**.
- A parameterisation for DMS (dimethyl sulphide) production is also available.



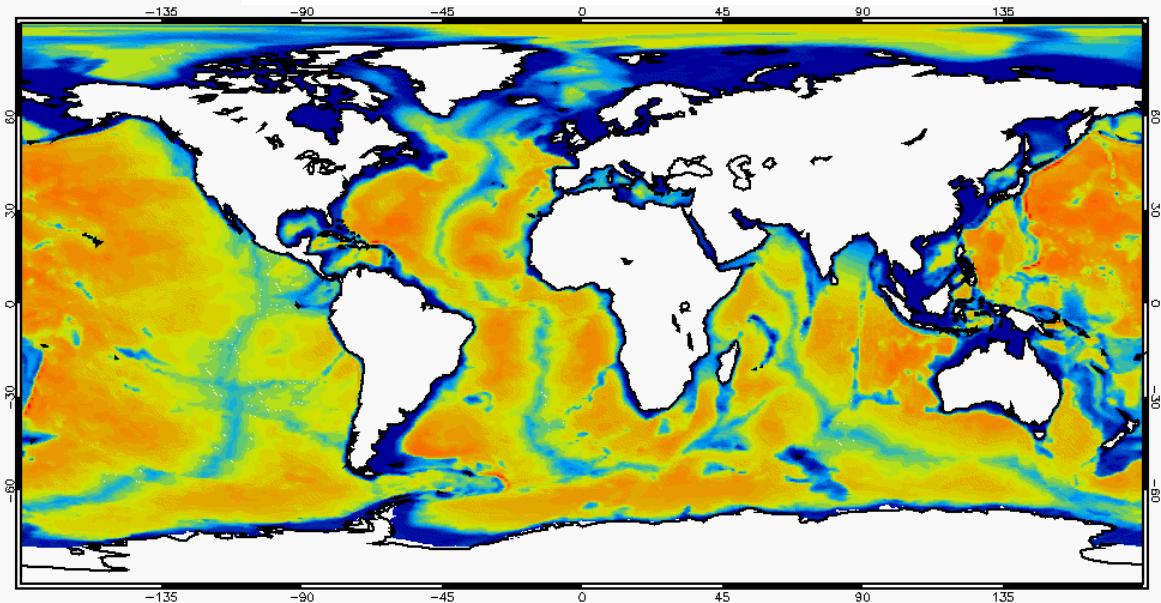


# Online Coupling: NEMO-HadOCC

## FOAM-NEMO:

- ORCA1 grid vs ORCA025 and others.
- Physical assimilation
  - Includes: T and S profiles, and SST
  - Not including: SSH or sea-ice concentration
- Run with operational NWP 6 hourly fluxes
- Using some NEMO-TOP routines but not in TOP directory

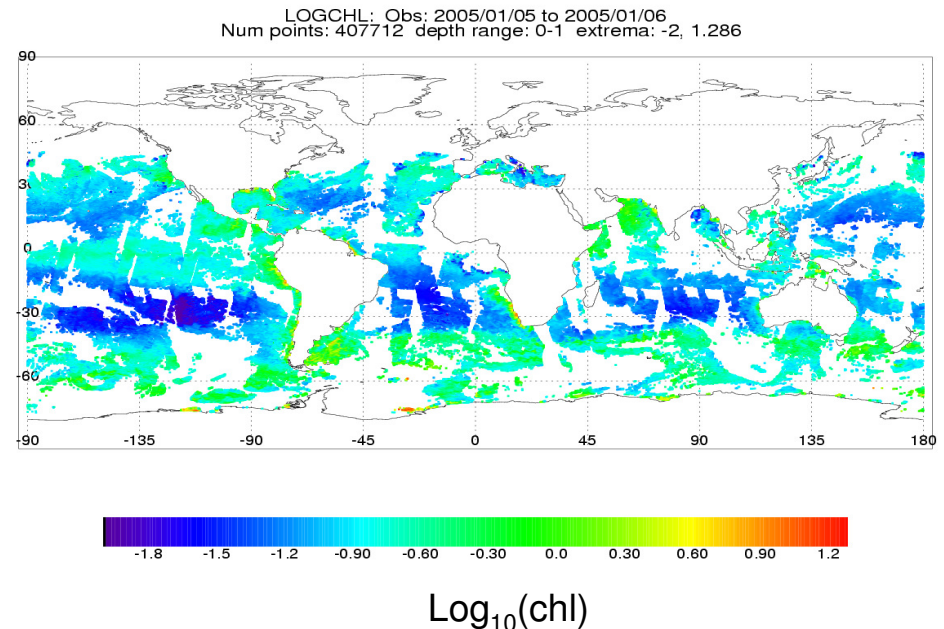
## ORCA1 Bathymetry



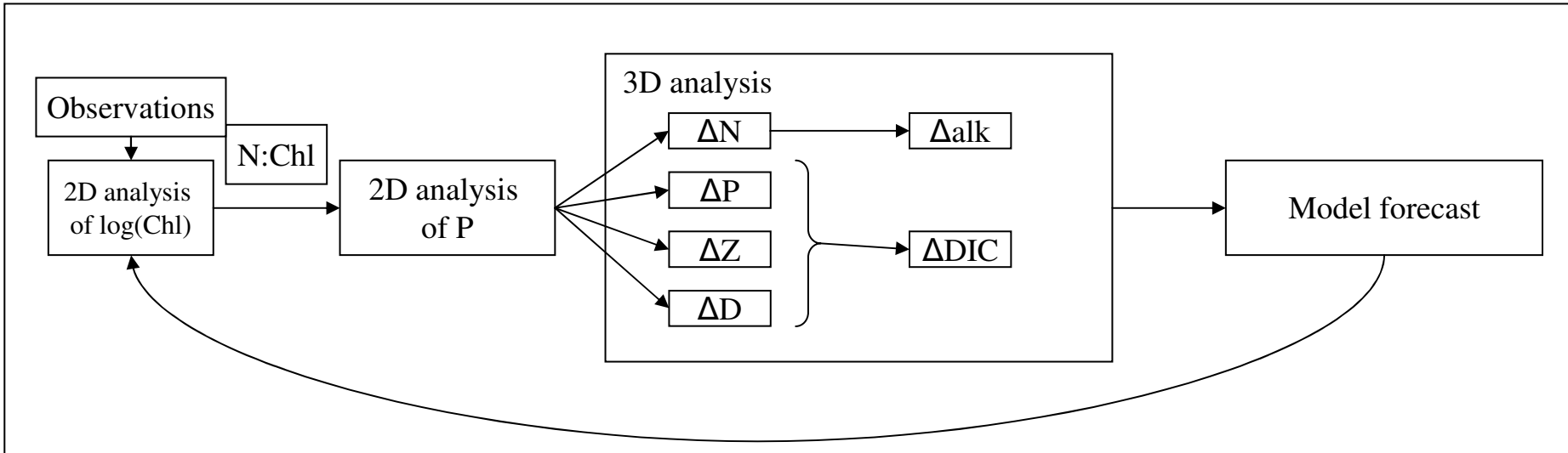


# GlobColour Project

- Goals:
  - test operational capability of NRT GlobColour service.
  - test impact of assimilation of GlobColour products on carbon cycle diagnostics: surface and profile chl, PP & air-sea fluxes of CO<sub>2</sub>, pH.
- Data assimilation scheme implemented & tested with SeaWiFS data in FOAM-UM-HadOCC system in 2007.
- Now implemented in FOAM-NEMO-HadOCC with MODIS and MERIS data from GlobColour.
- Hindcast has been transitioned to daily near-real-time run at the end of June09.
- ESA funding through ARGANS.



# GlobColour Project: Chlorophyll Data Assimilation Scheme

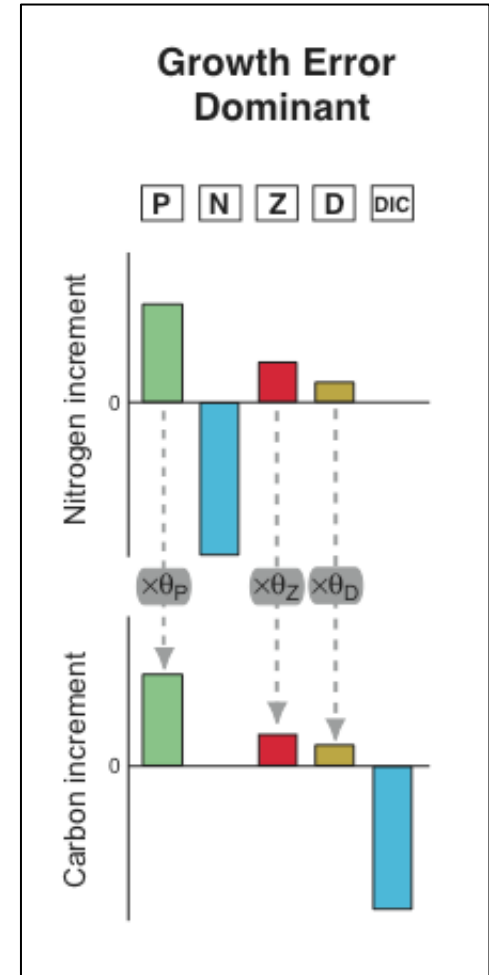


- Aim: improve air-sea CO<sub>2</sub> flux by improving surface DIC and alkalinity, hence pCO<sub>2</sub>
- A 2D analysis of log<sub>10</sub>(Chl) is performed using the same method as for SST (OI-type scheme). The output from this is a field of surface log<sub>10</sub>(Chl) increments.
- These can then be converted into surface phytoplankton increments using the model's N:Chl ratio.
- Increments to the other ecosystem model variables are calculated using a scheme jointly developed by NOCS and Met Office (Hemmings, Barciela & Bell, 2008).



# GlobColour Project: Chlorophyll Data Assimilation Scheme

- Two stage analysis scheme:
  - Model chl vs. satellite obs: increments
  - Balancing increments to biogeochemical variables
- Increments to other pools (N, Z, D, DIC, Alk) depend on the likely contributions to phytoplankton error from errors in growth and loss
- Increments constrained to conserve total nitrogen & carbon at each grid point (if sufficient nitrogen is available)
- Surface increments applied to mixed layer. Nutrient-profile correction increments below mixed layer.
- Hemmings, Barciela and Bell (2008).

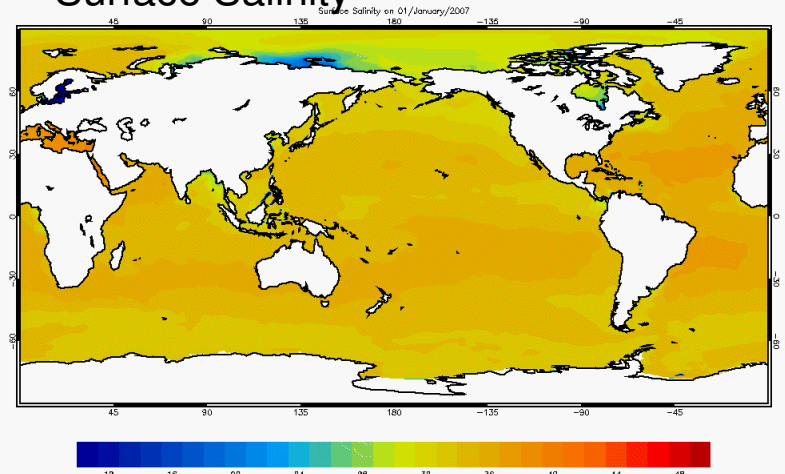




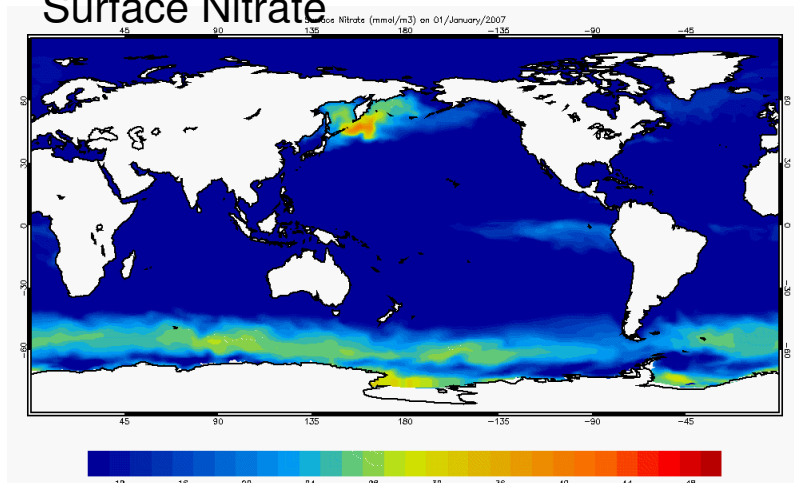
# Initial Runs & Model Results: Model Setup

- Model spin-up in 2007
  - Initial T, S and biological fields.
  - Includes physical DA from April 2007.
- 2008 hindcast to compare results with and without biological data assimilation.

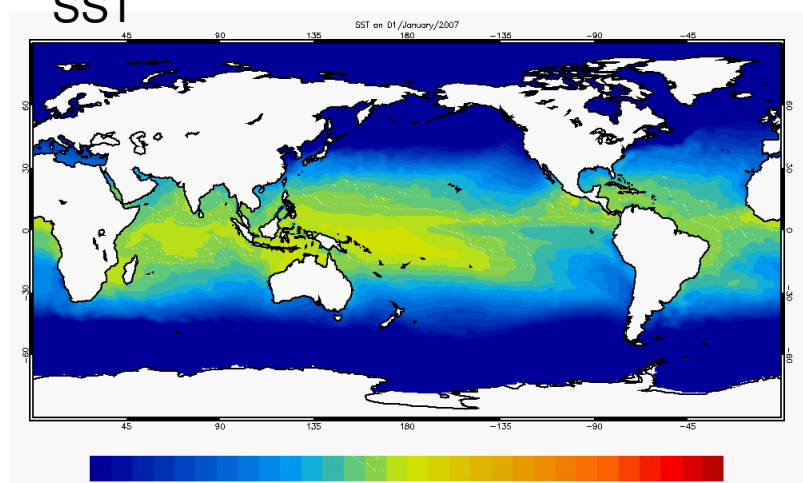
Surface Salinity



Surface Nitrate

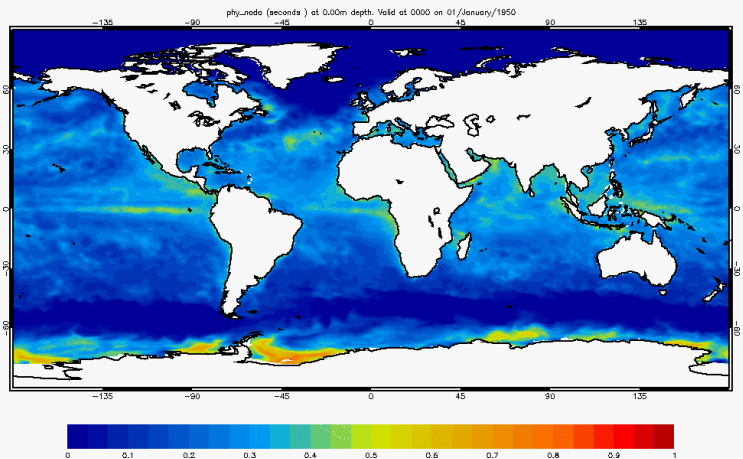


SST



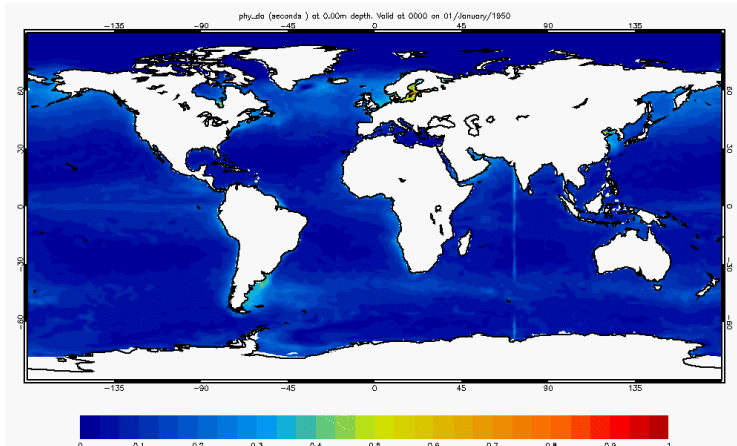
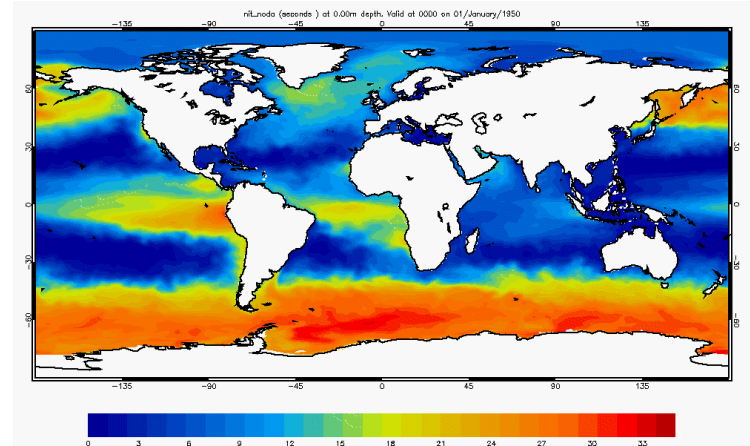
# Initial Results: Annual Mean

Phytoplankton

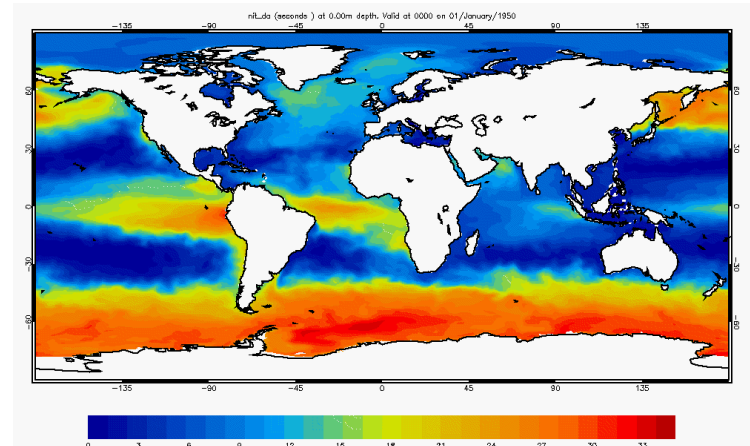


No biological assimilation

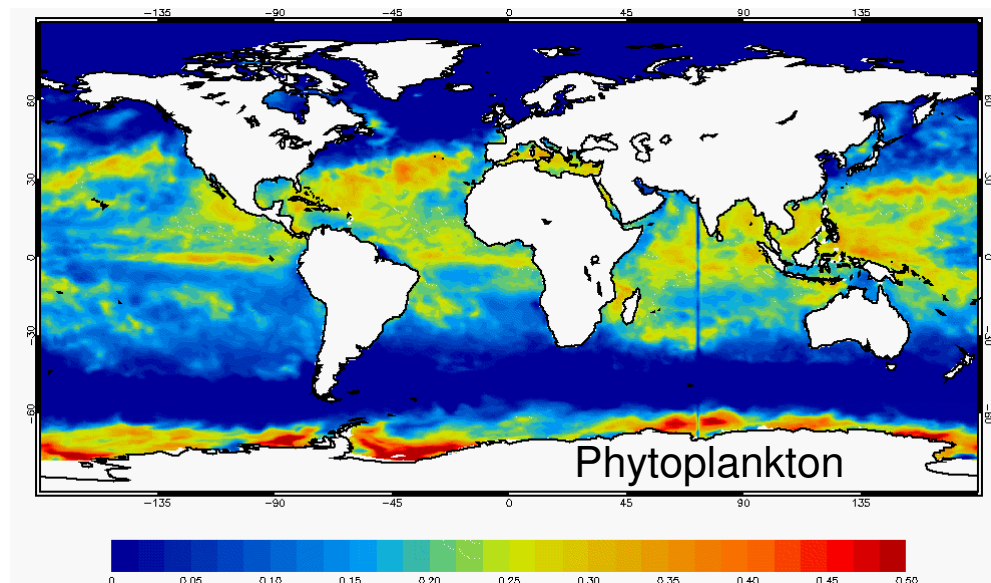
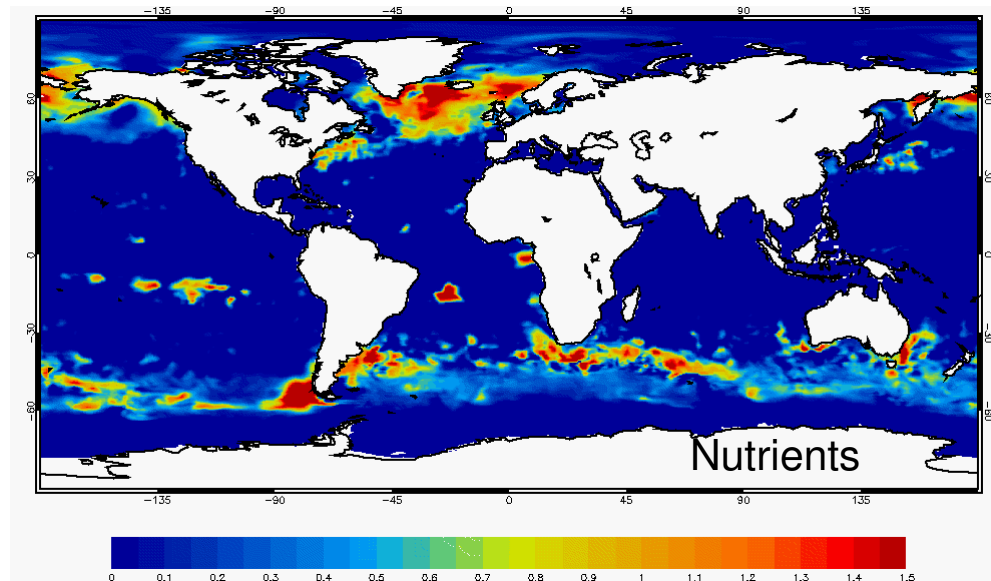
Nutrients



With biological assimilation

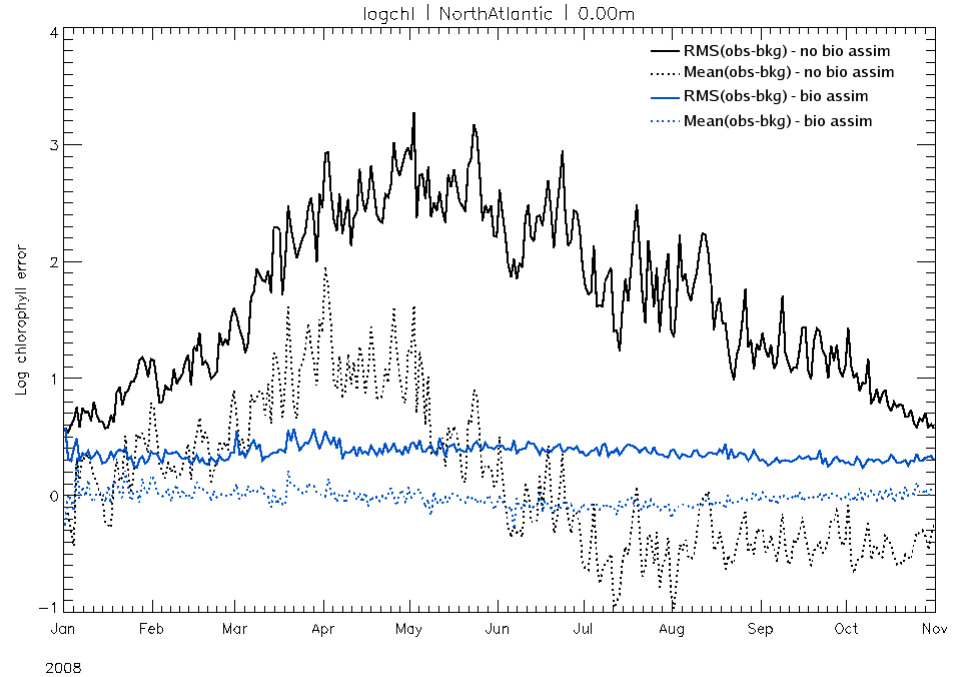
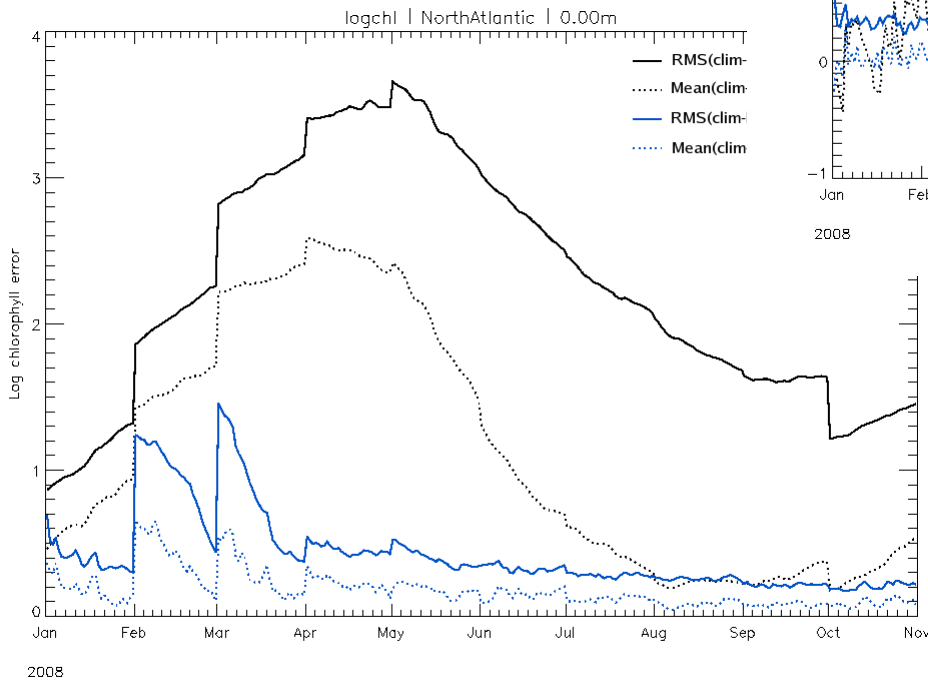


# Initial Results: Difference



# Initial Results:

## Model – Climatology



## Model – Observations



# Questions & answers