

Assimilation of OC-CCI data into the coupled ocean-biogeochemical model MITgcm-REcoM

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The coupled model: MITgcm - REcoM

MITgcm

notes:

- Massachusetts Institute of Technology General Circulation Model (MITgcm).
(Marshall et al., 1997). <http://mitgcm.org>
- designed to study ocean, atmosphere and climate.

Global configuration

80°N - 80°S

30 layers

Resolution:

lon : 2 deg

lat : 2 deg in North.

up to 0.38 deg in South

depth : 10 m – 500 m.

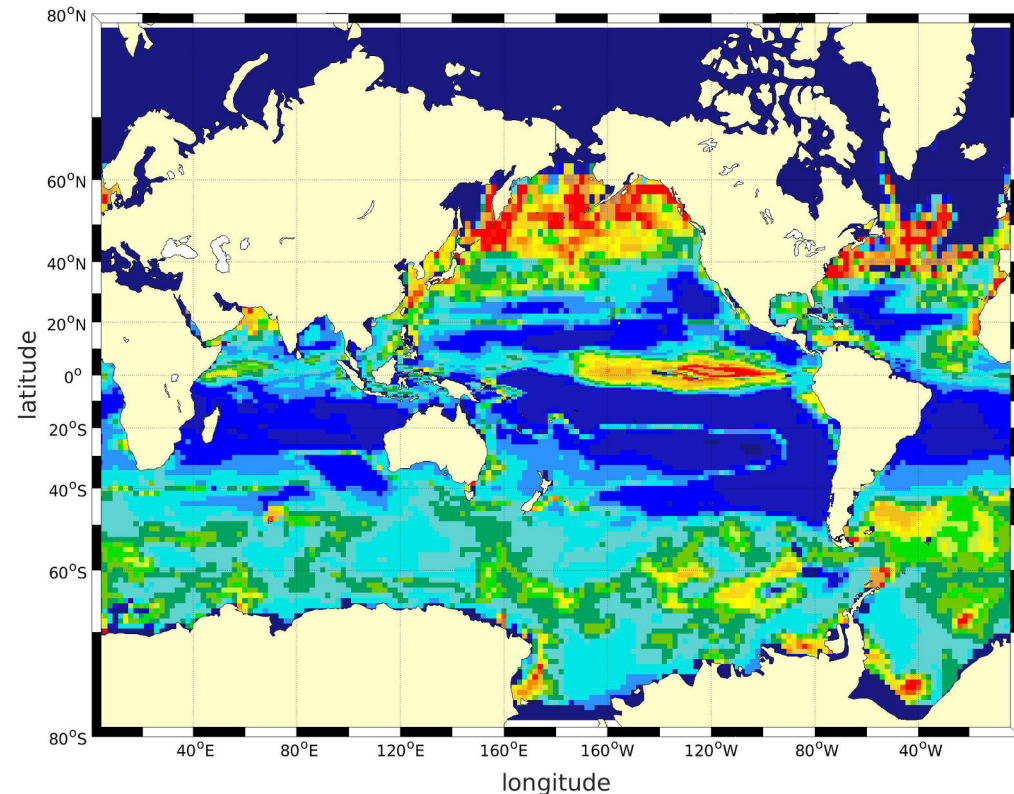


Figure: Model domain

Ecosystem part: REcoM2

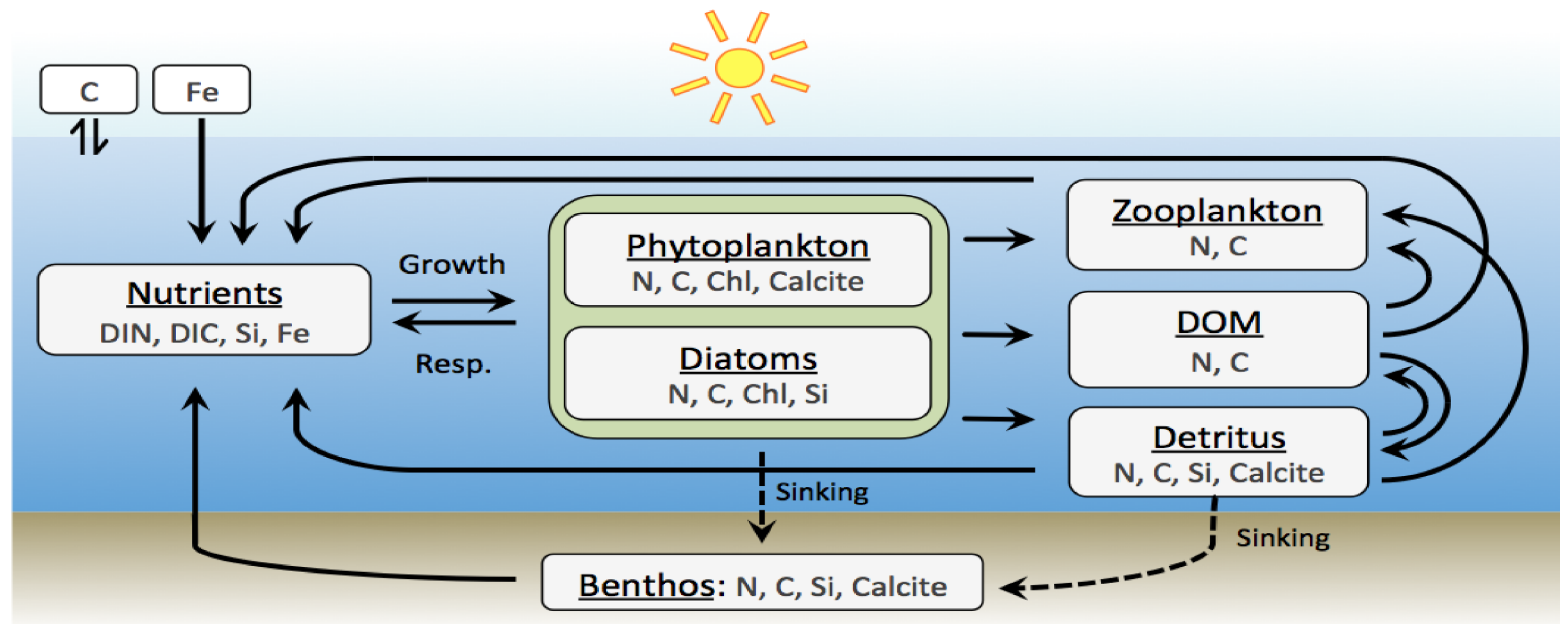
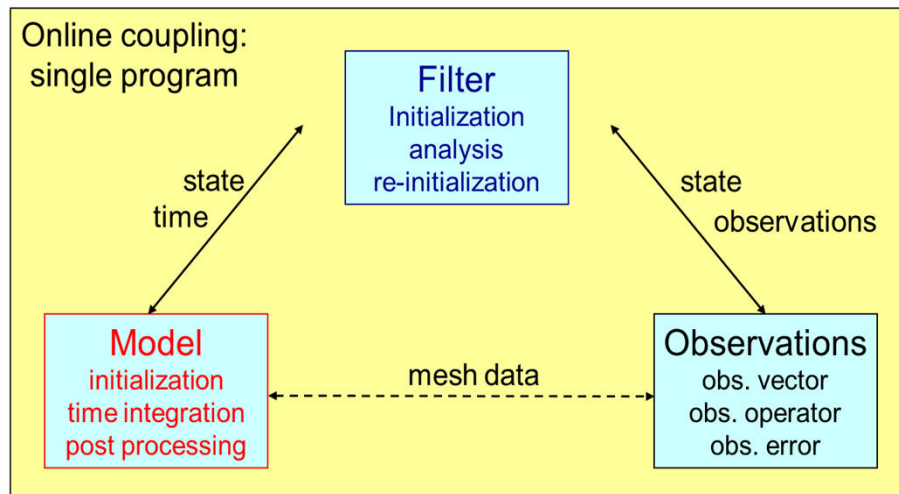


Figure: **Regulated Ecosystem Model - 2** (Hauck et al., 2013) and its pathways

Features:

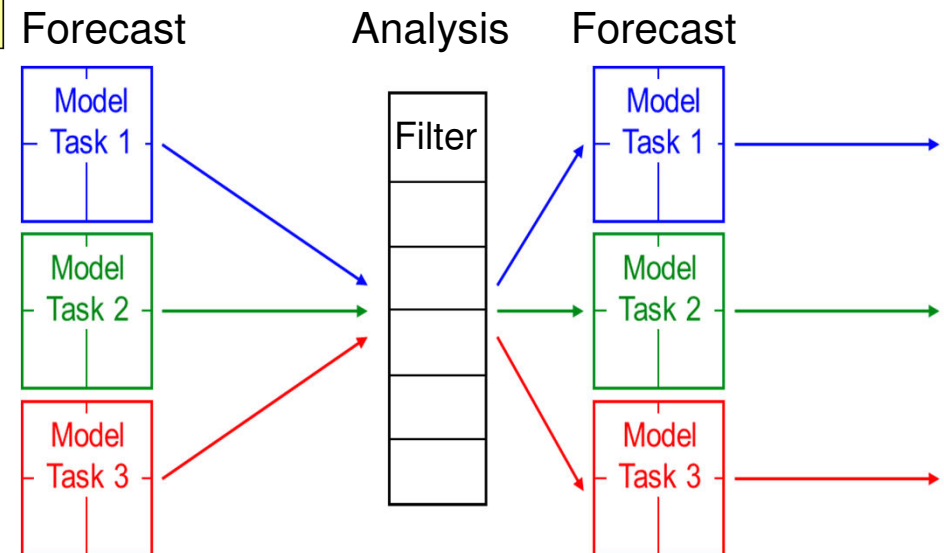
- Internal stoichiometry of cells depends on light, temperature, nutrients (Geider et al., 1998)
- Uptake of nutrients based in internal concentrations
- Two phytoplankton groups: Small phytoplankton and Diatoms

Logical separation of the assimilation system

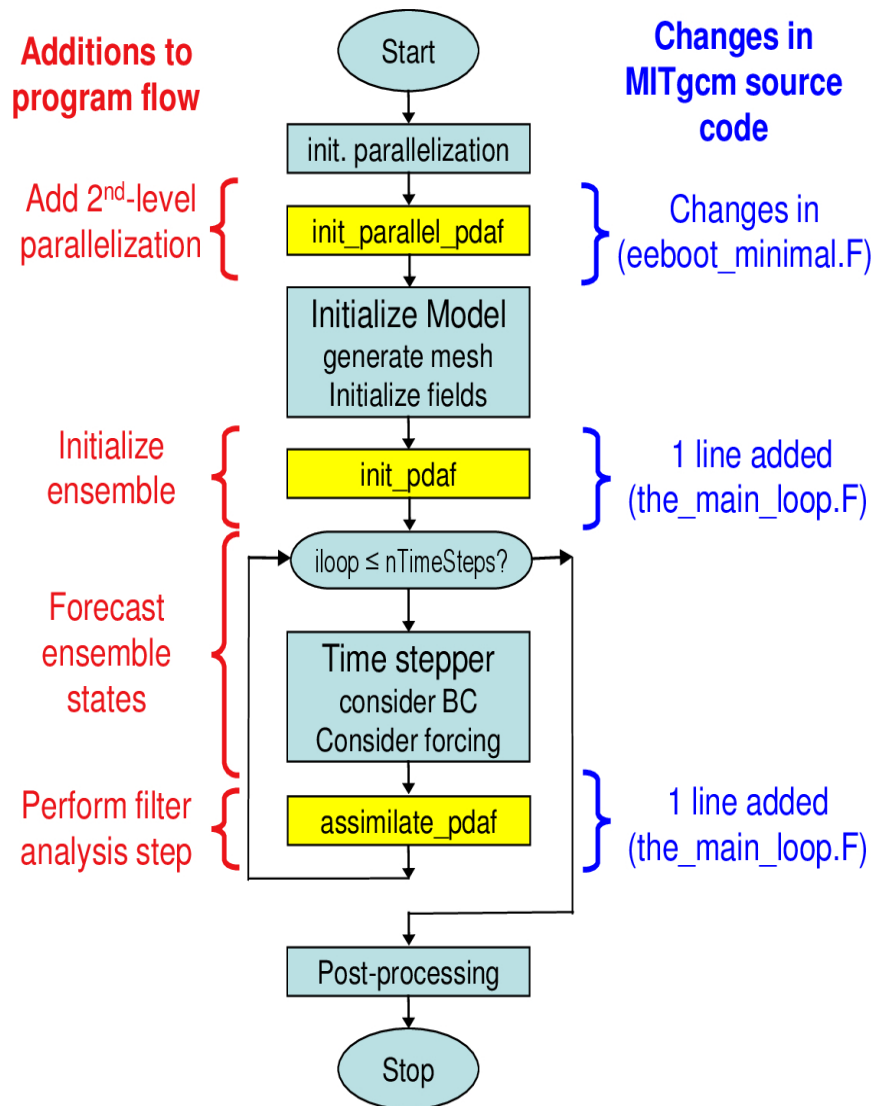


- Each model integration can be parallelized.
- All model tasks are executed concurrently.

2-level Parallelism



Extending the coupled model for data assimilation

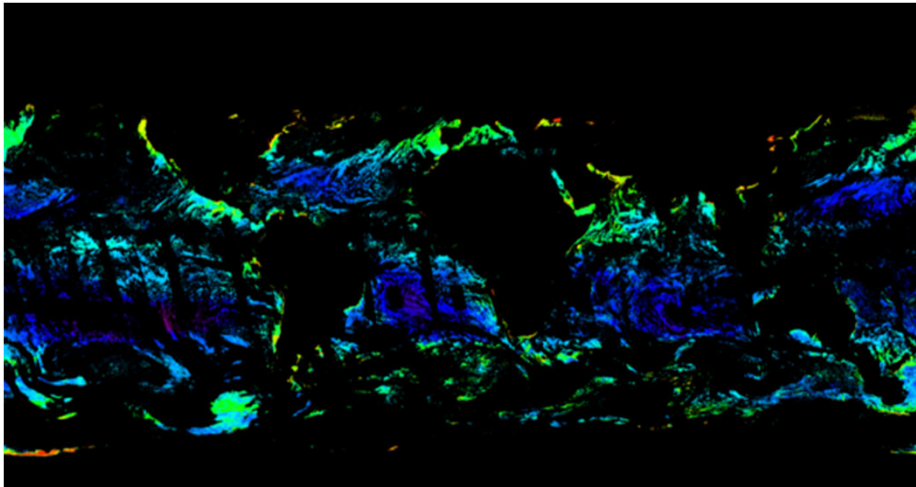


- Add three subroutines to coupled model
- Modify parallelization for ensemble
- Compute assimilation step in model

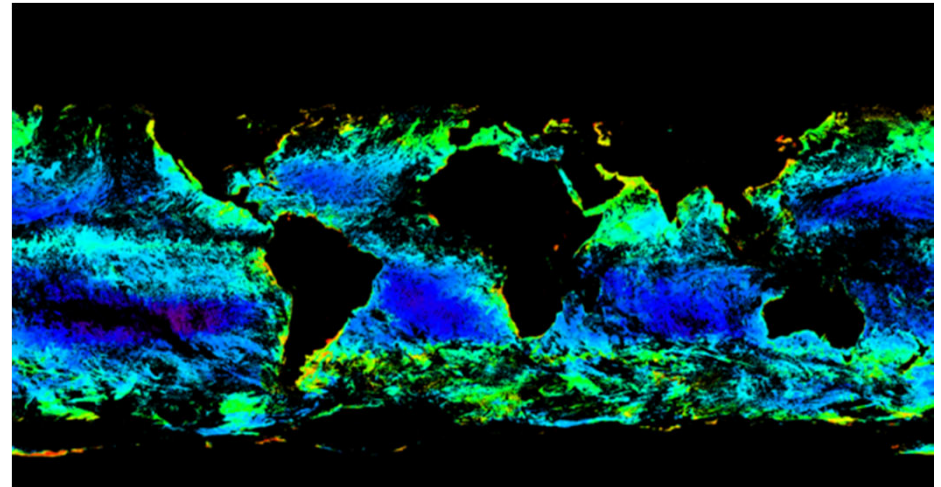
Chlorophyll-a data

Chlorophyll-a data is taken from European Space Agency- Ocean Color Climate Change Initiative (OC-CCI).

OC-CCI daily data



OC-CCI 5-day composite



Data features:

- Available are Daily, 5-day, 8-day & monthly data.
- Chlorophyll, remote sensing reflectance and inherent optical properties.
- Lot of missing data, due to cloud cover.



source: (<https://www.oceancolour.org/>)



Data Assimilation Experiments

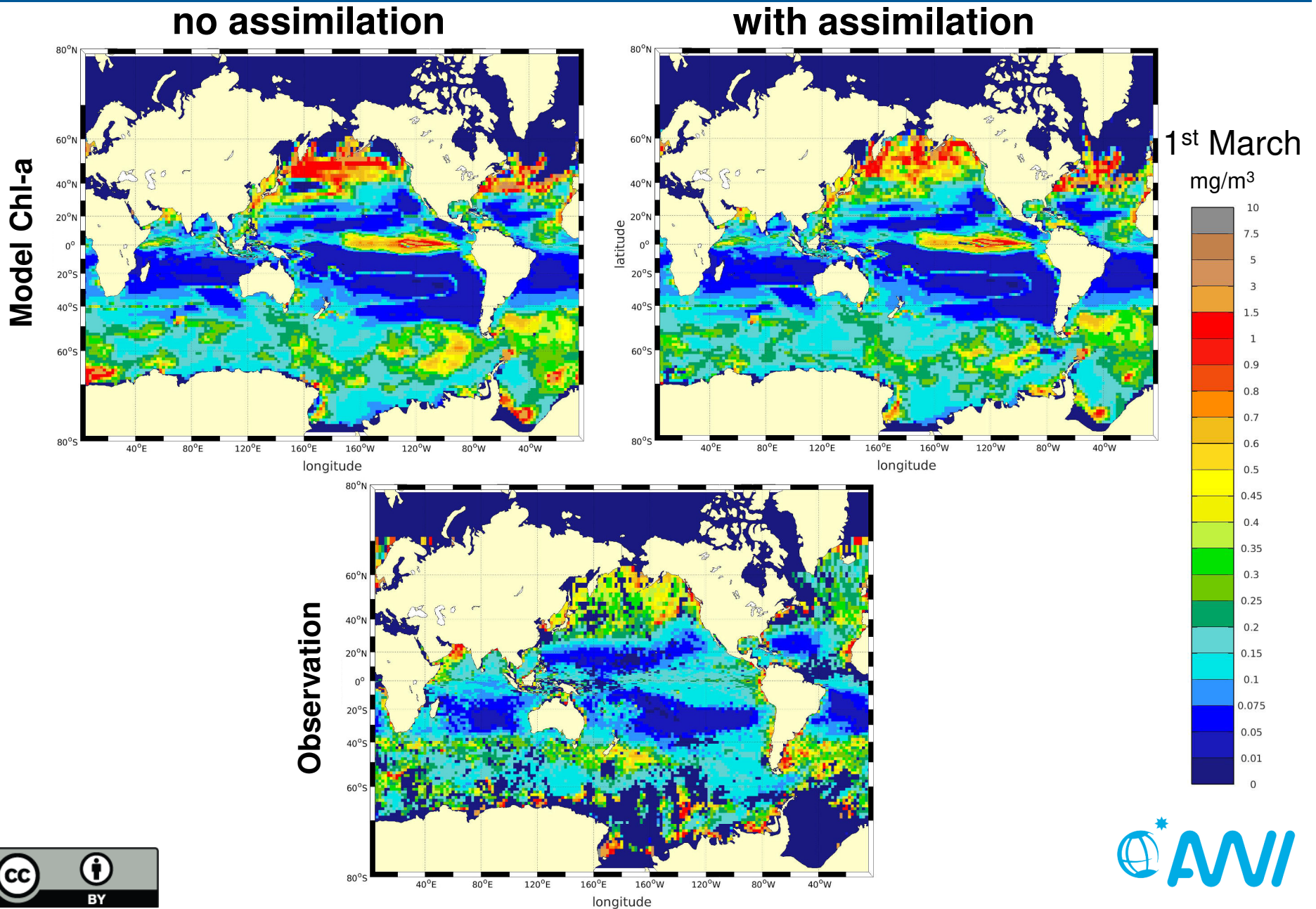
Simulation strategy:

The coupled model simulation is continued for a year after a four year spin-up.

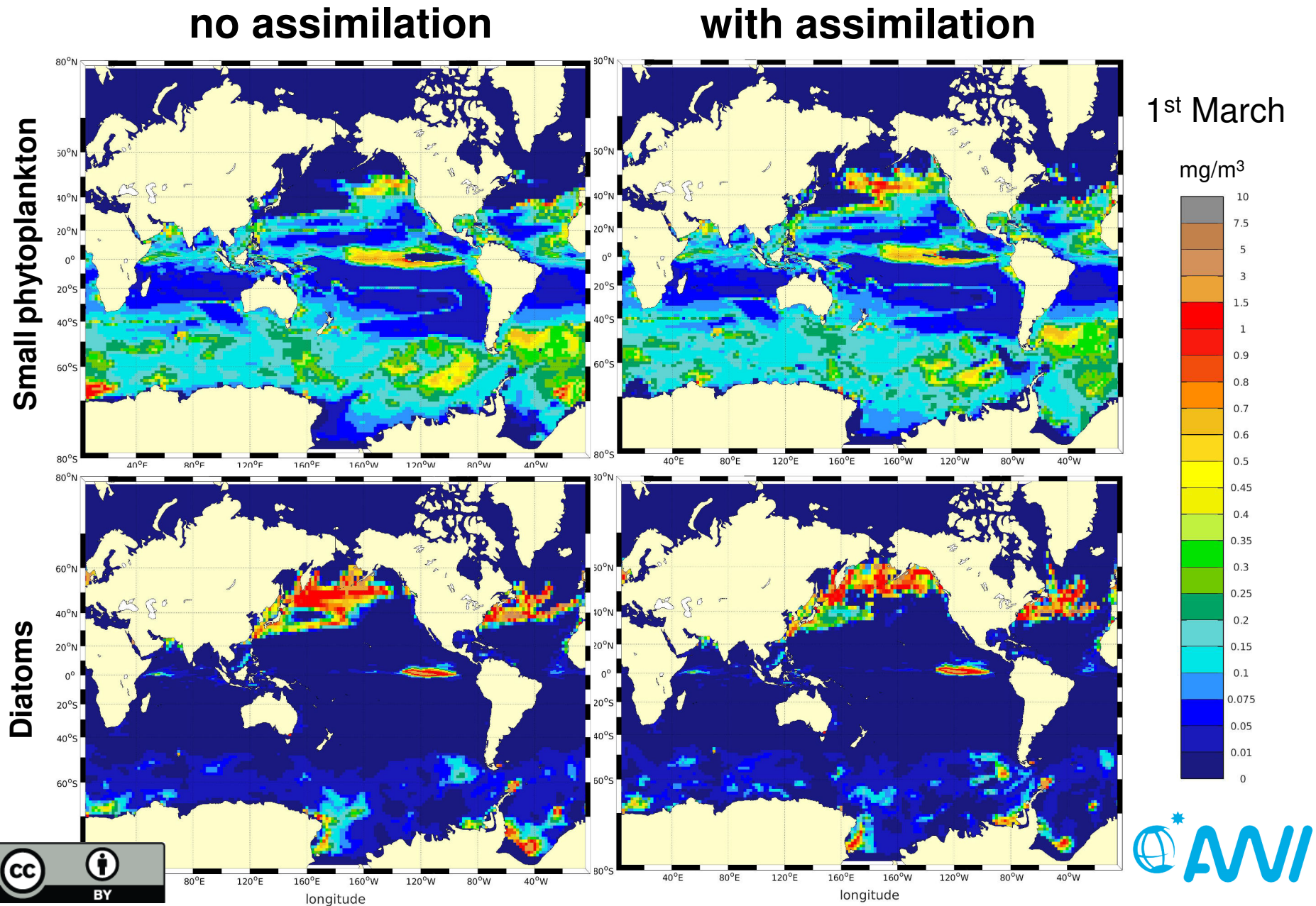
Assimilation methodology:

- 5 days forecast/analysis cycles.
- Ensemble size = 24
- Assumed observation error
relative error of 30%
- Ensemble Kalman filter (LESTKF, *Nerger et al. 2012*)
- Localization radius = 10 degrees.

Assimilation influence on total chlorophyll



Influence of assimilation on phytoplankton groups



Conclusion

Initial data assimilation experiments

- Successful assimilation of Chl-a data with ensemble filter
- Improvement of total chlorophyll
- Both phytoplankton groups modified differently

Plans

- improve model by
 - estimate spatially varying parameters (e.g. chlorophyll degradation rate)



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