

# Interaction between ocean colour and biogeochemical modelling communities: What can we learn from each other?



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(with input from John Dunne, Watson Gregg and Stephanie Henson)

Essential Climate Variables (ECV's):  
to support work of the UNFCCC and IPCC,  
including “inter-comparison of model output  
with data”

Acronym Cheat Sheet:

UNFCCC- united nations framework  
convention on climate change

IPCC – intergovernmental panel on  
climate change

**Essential Climate Variables (ECV's):**  
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**How does the numerical  
modelling community use  
ocean colour?**

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How does the numerical modelling community use ocean colour?

- 1) What products are used?
- 2) How are these products used?

How does the numerical modelling community use ocean colour?

### 1) What products are used?

- almost exclusively gridded (Level 3) data
- mostly Chlorophyll
- some primary production
- (uncertainty estimates needed)

What about other products?

- less know (need better evaluation/documentation)
- models do not resolve some products  
(e.g. reflectance)

How does the numerical modelling community use ocean colour?

**2) How are ocean colour products used?**

A) end users:

“one way street”

B) synthesis:

combining models/ocean colour

C) feedback:

“two way street”

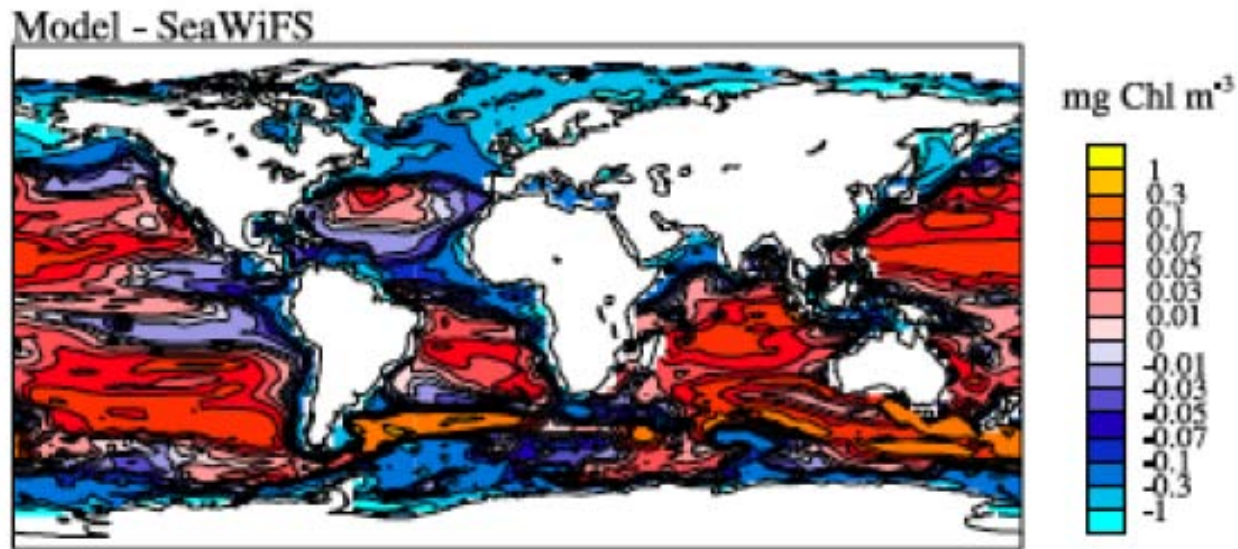
### A) Modellers as end users of Ocean Colour:

- context/motivation
- initial conditions
- boundary forcing
- model validation

## Interaction between ocean colour and biogeochemical modelling

### A) Modellers as end users of Ocean Colour:

- model validation:



Doney et al, JMS, 2008



## Interaction between ocean colour and biogeochemical modelling

Essential Climate Variables (ECV's):  
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So how are IPCC models using ocean colour data?

CMIP5 earth system  
models include carbon  
cycling in air/land/ocean

### Acronym Cheat Sheet:

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AR5 – fifth assessment report

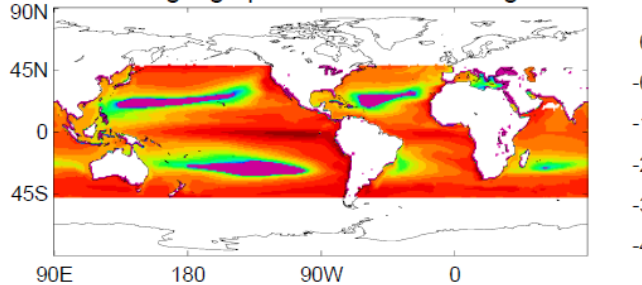
CMIP5 – coupled model intercomparison  
project phase 5

# Interaction between ocean colour and biogeochemical modelling

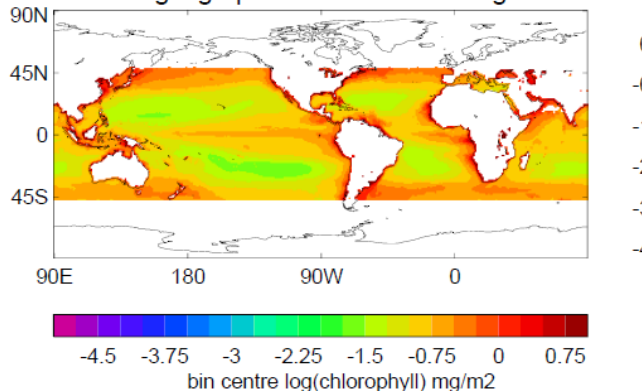
## A) Modellers as end users of Ocean Colour:

- model validation: IPCC AR5

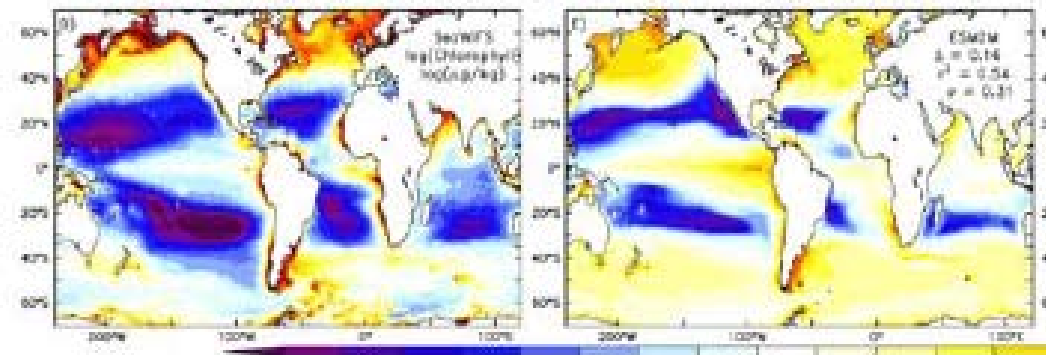
Control run: geographical location of histogram bins



SeaWiFs: geographical location of histogram bins

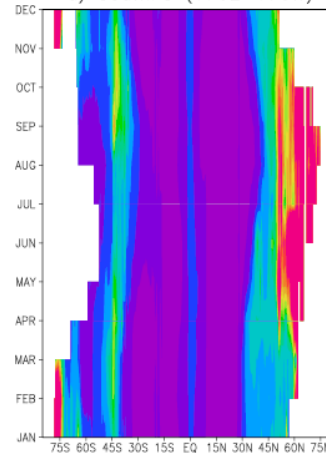


HadGEM2: Collins et al, GMD, 2011

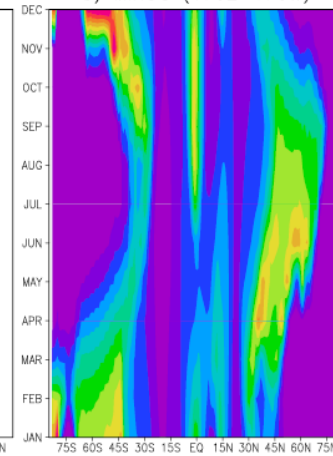


GFDL's ESM2: Dunne et al, JCLim, 2011

a) SeaWiFS (170E~170W)



b) MIROC (170E~170W)



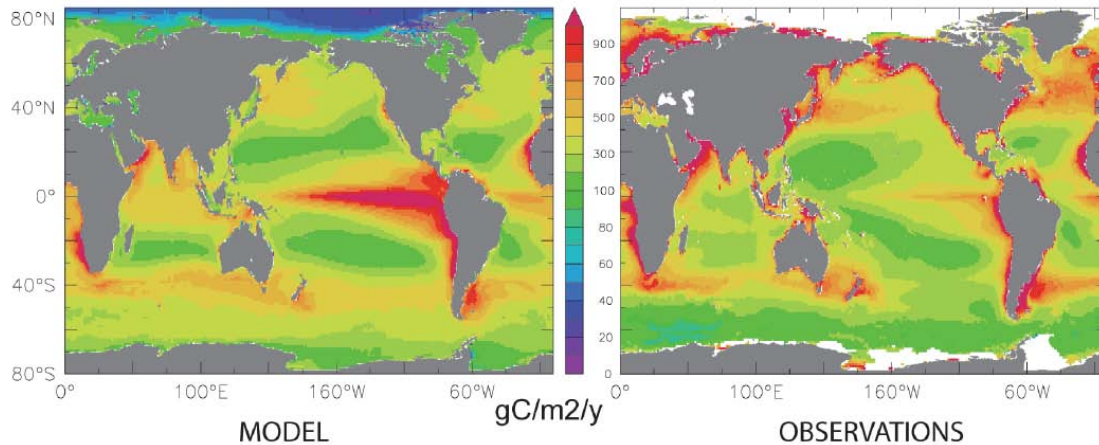
MIROC-ESM: Watanabe et al, GMD, 2011

# Interaction between ocean colour and biogeochemical modelling

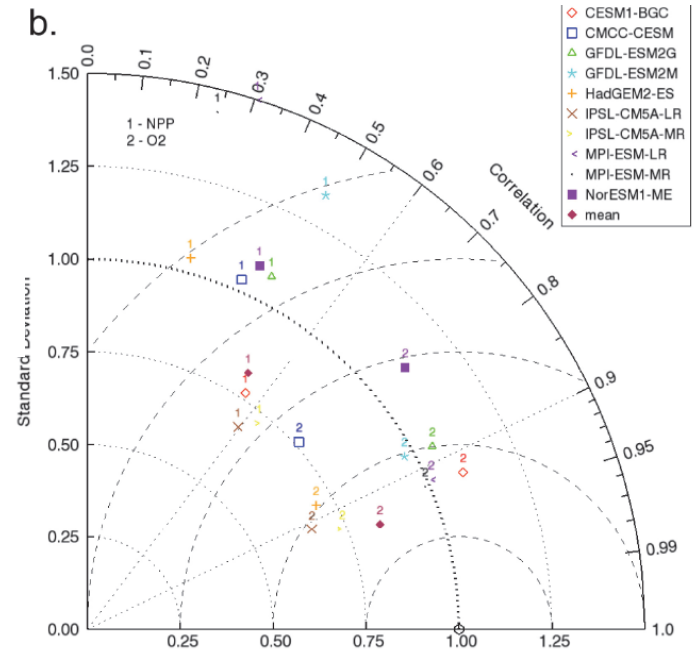
## A) Modellers as end users of Ocean Colour:

- model validation: IPCC AR5

d. Integrated net primary productivity



10 Model Mean



Bopp et al, BGD, 2013

### A) Modellers as end users of Ocean Colour:

AR5: Validating - mostly at climatological level: bias, variances, timings  
(not inter-annual variability or trends)

What about AR6?

### A) Modellers as end users of Ocean Colour:

AR6: - simpler carbon models??

(not as much need for ocean colour)

- ocean colour inform on physics  
(e.g. to get correct seasonal cycles)

- ocean colour inform on temporal  
resolution of model output (Henson et al, BGD, 2013)

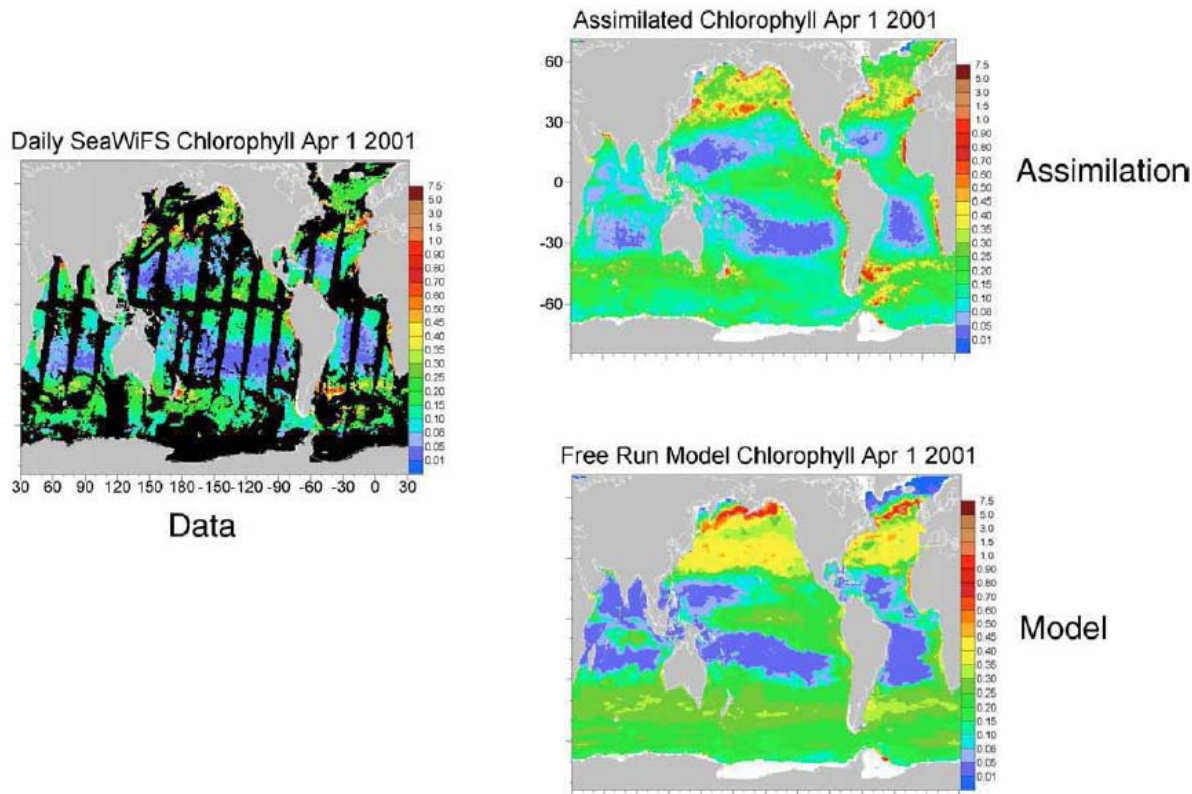
- ocean colour maybe used more in  
WG2 (impacts) than in WG1 (climate)

## B) Model-Ocean Colour Synthesis

- assimilation

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- assimilation

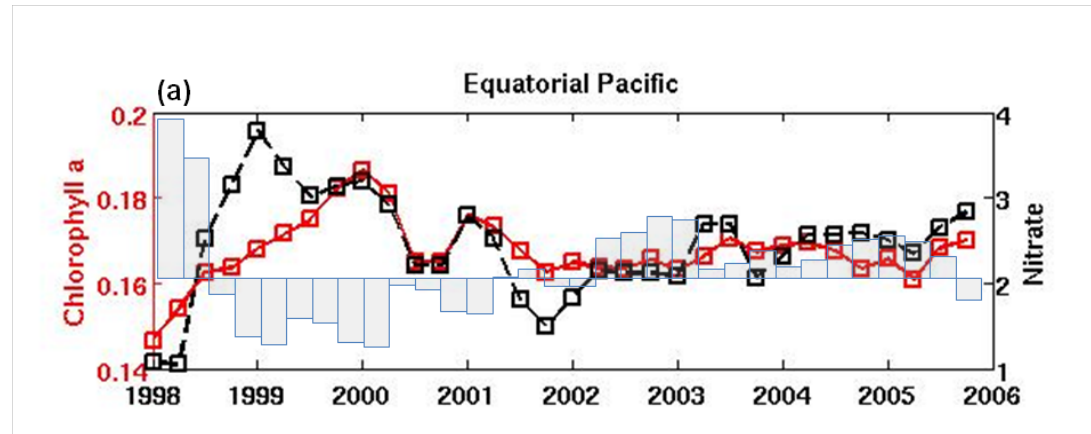


Gregg et al., JMS, 2008

## B) Model-Ocean Colour Synthesis

- assimilation

By “filling in” in space and time can help in studies:  
e.g. interannual variability



Rousseaux et al., JGR, 2012

Model assimilates SeaWiFS, MODIS, VIIRS  
Chlorophyll (bias-correction for seamless products):

But assimilation can exacerbate differences in  
sensors, so might not be best way forward to  
focus on trends



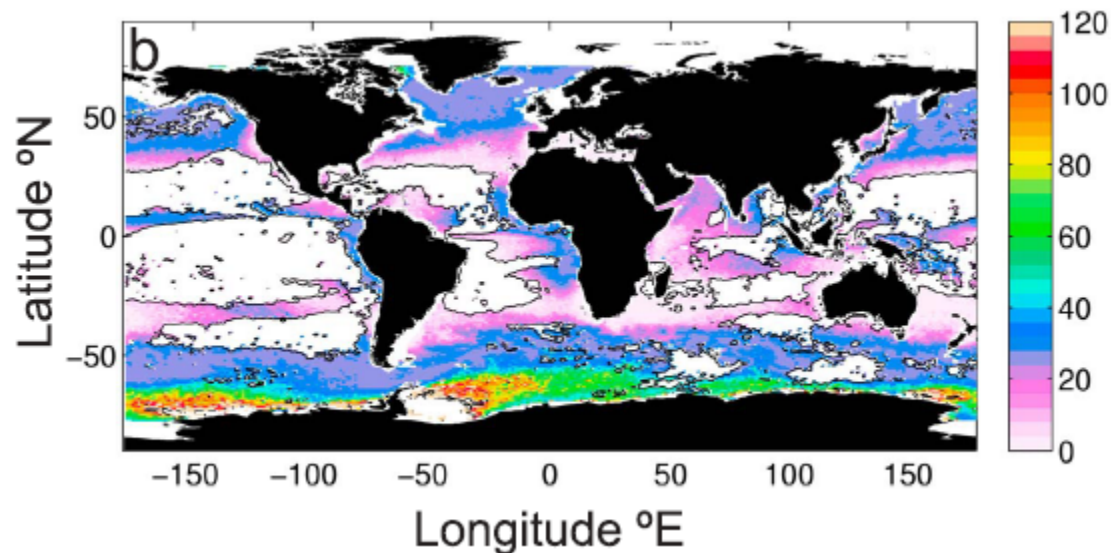
### C) Feedback from models to ocean colour

Models can inform on ocean colour products:

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Models can inform on ocean colour products

- impact of missing data (e.g. Cole et al 2012)

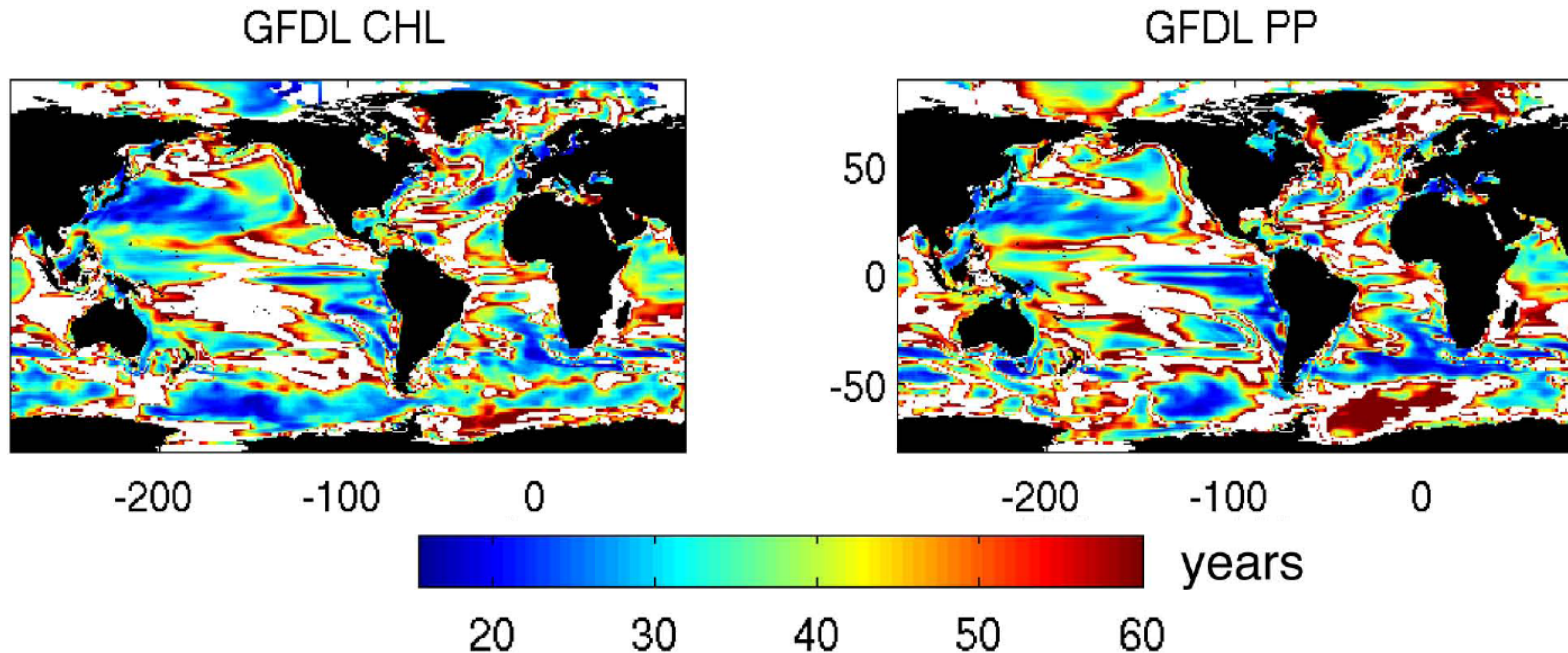


Uncertainty (in days) of bloom timing because of missing data

## C) Feedback from models to ocean colour

Models can inform on ocean colour products

- needs of continuity (e.g. Henson et al, BG, 2010)



How does the numerical modelling community use ocean colour?

### 1) What products are used?

- limited types of products

### 2) How are these products used?

A) end users:

- mostly evaluation Chl/PP

B) synthesis:

- combining ocean colour and models to “fill in” in space and time for missing data

C) feedback:

- models can help inform ocean colour requirements and limitations

Some additional feedback from modelling community:

- Need to link better to below surface (BioArgo?)
- Additional vetting of additional ocean colour products before modellers likely to use them
- Better documentation (and determination) of uncertainties in ocean colour products

