Update on IOCCG Working Group:

Ocean Colour Applications for Biogeochemical, Ecosystem and Climate Modeling

Stephanie Dutkiewicz and WG members (Feb 2016)

Update on IOCCG Working Group:

~~**Ocean Colour Applications for Biogeochemical, Ecosystem and Climate Modeling**~~

The Role of Ocean Colour in Biogeochemical, Ecosystem and Climate Modelling

Stephanie Dutkiewicz and WG members (Feb 2016)

History:

- WG first suggested at IOCCG committee meeting   Feb 2015

- WG proposal submitted   June 2015

- WG accepted by Exec Committee   July 2015

- WG kick-off meeting   19-20 Feb 2016

Working Group Members;

Stephanie Dutkiewicz, Chair (MIT, USA)
Icarus Allen (PML, UK)
Mark Baird (CSIRO, Australia)
Fei Chai (University of Maine, USA)
Alessandro Crise (OGS, Italy)
Marion Gehlen (IPSL/LSCE, CNRS, France)
Stephanie Henson (NOC, UK)
Colleen Mouw (Michigan Technological University, USA)
Cecile Rousseaux (Goddard, NASA, USA)
Charlie Stock (GFDL, NOAA, USA)
Jerry Wiggert (University of Southern Mississippi, USA)

Terms of Reference:

1) What types of models use ocean colour products?
2) What ocean colour products are being used?
3) How do numerical modellers deal with ocean colour product uncertainty?
4) How is ocean colour being use in model evaluations?
5) How is ocean colour being use in data assimilation?
6) How can models help ocean colour community?
7) How can clearer links between satellite products and model output be facilitated?
8) Recommendations

Kick-Off Meeting
(French Quarter, New Orleans 19-20 Feb):

Stephanie Henson, Colleen Mouw, Mark Baird, Stephanie Dutkiewicz, Fei Chai
Charlie Stock, Jerry Wiggert, Icarus Allen, Cecile Rousseaux

Attending but not in photo: Marion Gehlen
Regrets: Alessandro Crise

Kick-Off Meeting
(French Quarter, New Orleans 19-20 Feb):

Day 1: Talks by all participants

Day 2: Discussion
          Draft outline report

OUTLINE OF REPORT:

1: Introduction

2: Model Applications for Science and Society

3. Ocean Colour Products

4. How are Model Output and Ocean Colour Products Linked? (They are not always the same)

5. Model Skill Assessment

6. Ocean Colour Assimilation

7. Models Driven by Ocean Colour Products

8. Integrated Use of Ocean Colour and Model Output

9. Models Informing Ocean Colour

10. Summary and Recommendations

OUTLINE OF REPORT:

1: Introduction *(StephD)*
    purpose of models
    definitions

2: Model Applications for Science and Society *(StephD)*
    short primer on models (resolution, temporal scales)
    applications
    access to model output (e.g. CMIP5)
    recommendations

OUTLINE OF REPORT:

3. Ocean Colour Products
   (Colleen, Cecile, Jeremy Werdell)

    agencies, satellite missions, instruments
    products - imagery levels, different algorithms
    Table of "derivedness"
    uncertainty
    access and file types
    potential future products
    recommendations

OUTLINE OF REPORT:

4. How are Model Output and Ocean Colour Products Linked? (They are not always the same)
(Fei/StephD, Icarus, Mark, Marion)

      How do we model things that link to OC
          (e.g. Chl, PP, PFTs, C)
          (follow from Table of Derivedness)
     Models that include IOPs, reflectance
     Model uncertainty on these output
     Recommendations
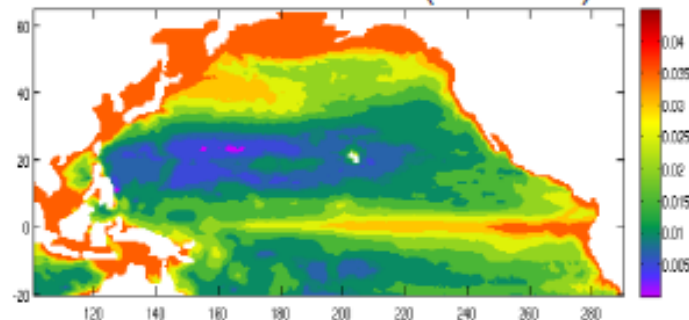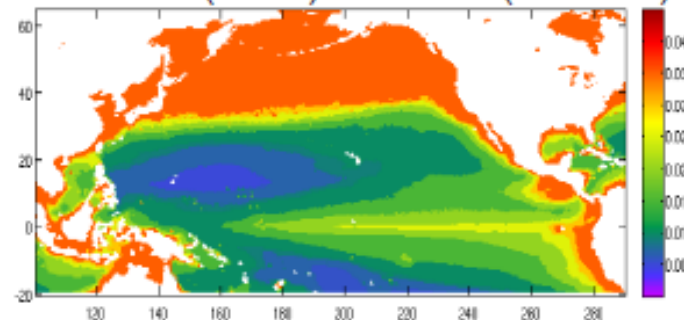
IOPs Comparison (1998-2007)

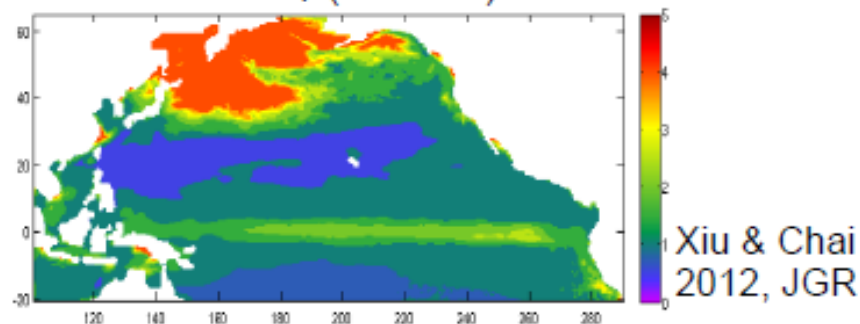
Modeled a_{ph} (440 nm)
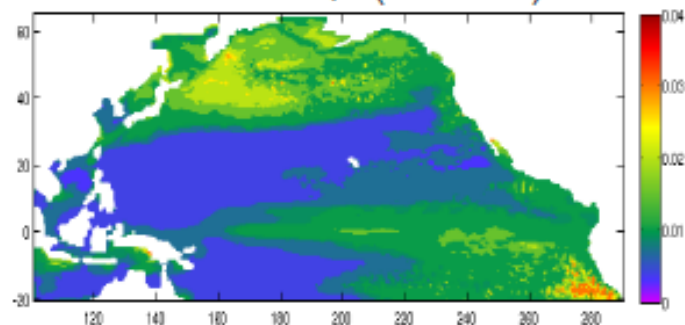
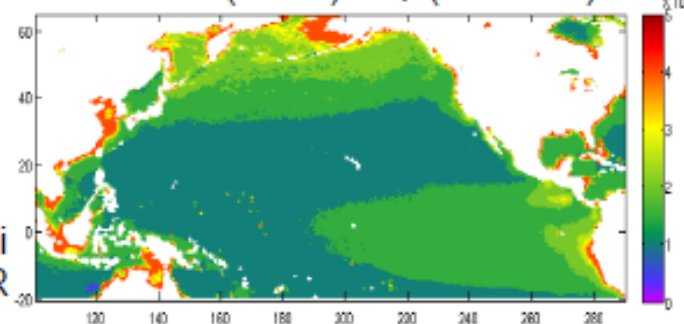SeaWiFS (QAA) a_{ph} (443 nm)
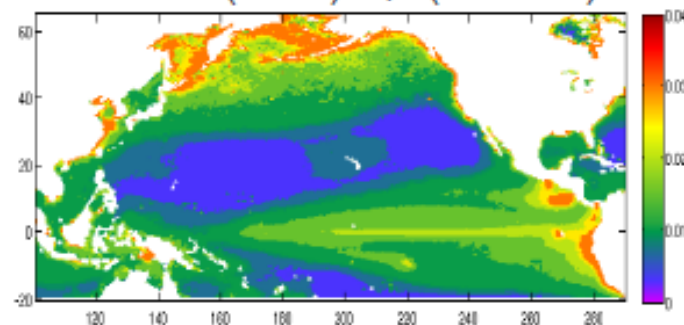
Modeled $a_{cdom+det}$ (410 nm)

SeaWiFS (QAA) $a_{cdom+det}$ (412 nm)

Modeled b_{bp} (550 nm)

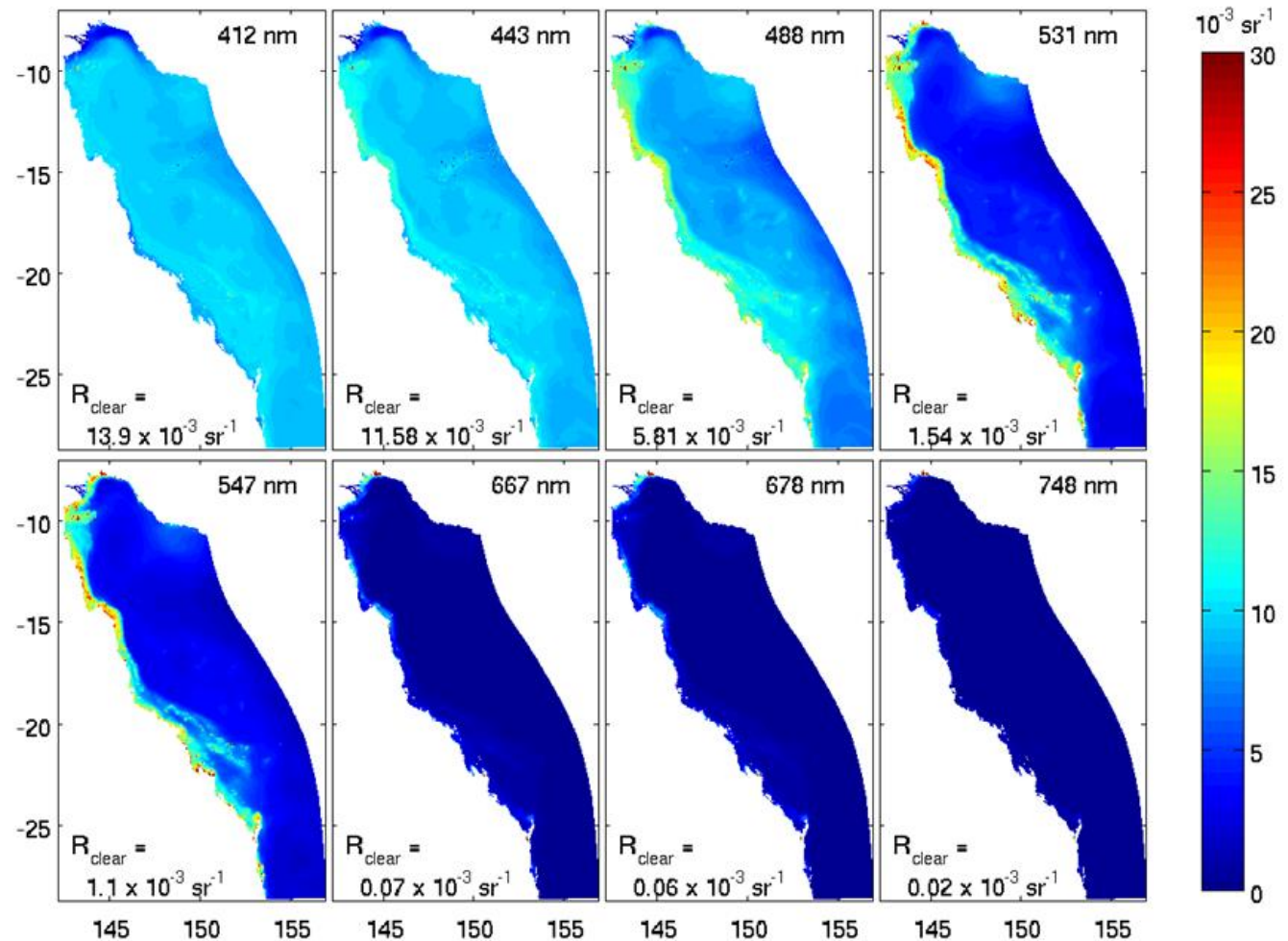SeaWiFS (QAA) b_{bp} (555 nm)

Xiu & Chai 2012, JGR

(Slide Courtesy of Fei Chai)

- Mean simulated remote-sensing reflectance for 2011 at the 8 MODIS ocean colour bands.

- More reflectance at shorter wavelengths.

- On a relatively clear day 1 million plus data points per wavelength, up to twice a day

(Slide Courtesy of Mark Baird)

OUTLINE OF REPORT:

5. Model Skill Assessment
(Charlie, Jerry, Marion, Icarus, Cecile, StephD, Mark, Alessandro, Fei)

Understanding limitations
Range of Quantitative comparison
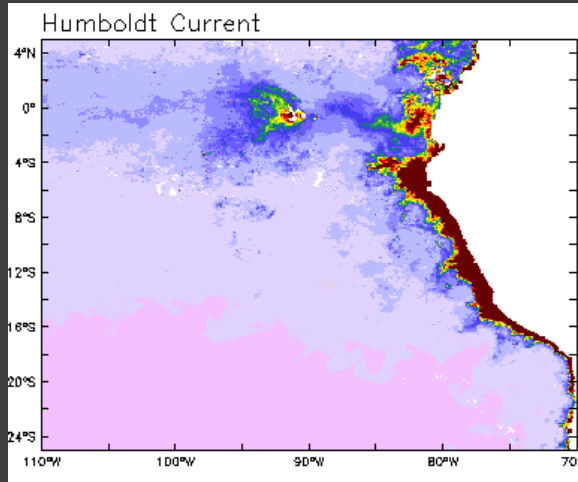-- strengths/weaknesses
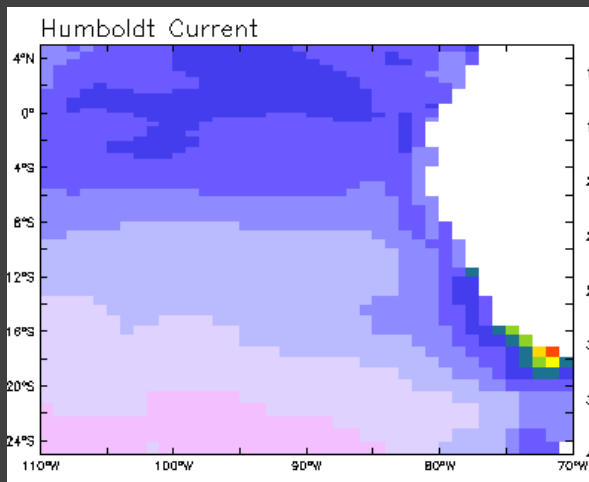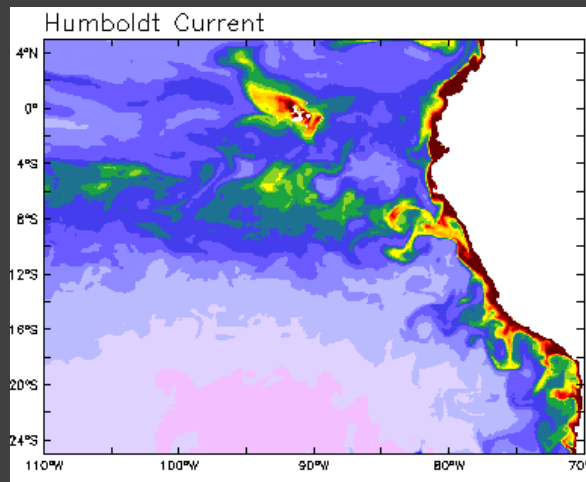-- align with Table of "derivedness"
Examples
Recommendations for best practises

Satellite-based surface Chlorophyll (mg Chl m^{-3})

Humboldt Current

ESM2M

ESM2.6

ESM2.6

- 1/10 deg. Ocean
- 1/2 deg. Atmos
- Ocean and land ecosystem dynamics
- 15744 cores
- 5 model months day^{-1}
- 104 GB/month

(Slide Courtesy of Charlie Stock)

OUTLINE OF REPORT:

6. Ocean Colour Assimilation
   (Mark/Emlyn, Alessandro, Icarus/Steffano, Cecile, Marion) – also maybe Chris Edwards

   Basics of Assimilation
   Role of uncertainty (OC and model)
   State Estimates/Reanalysis
   Examples (align with table of derivedness)
   Recommendations

OUTLINE OF REPORT:

7. Models Driven by Ocean Colour Products
   (Charlie, Icarus, Fei)

      Definition
      HABS - *Clarissa Anderson*
      Food Web – *Simone Libralato*
      Habitat – *William Cheung, Barb Muhling*
      Sea Grass – *Stewart Phinn*
      Recommendations

OUTLINE OF REPORT:
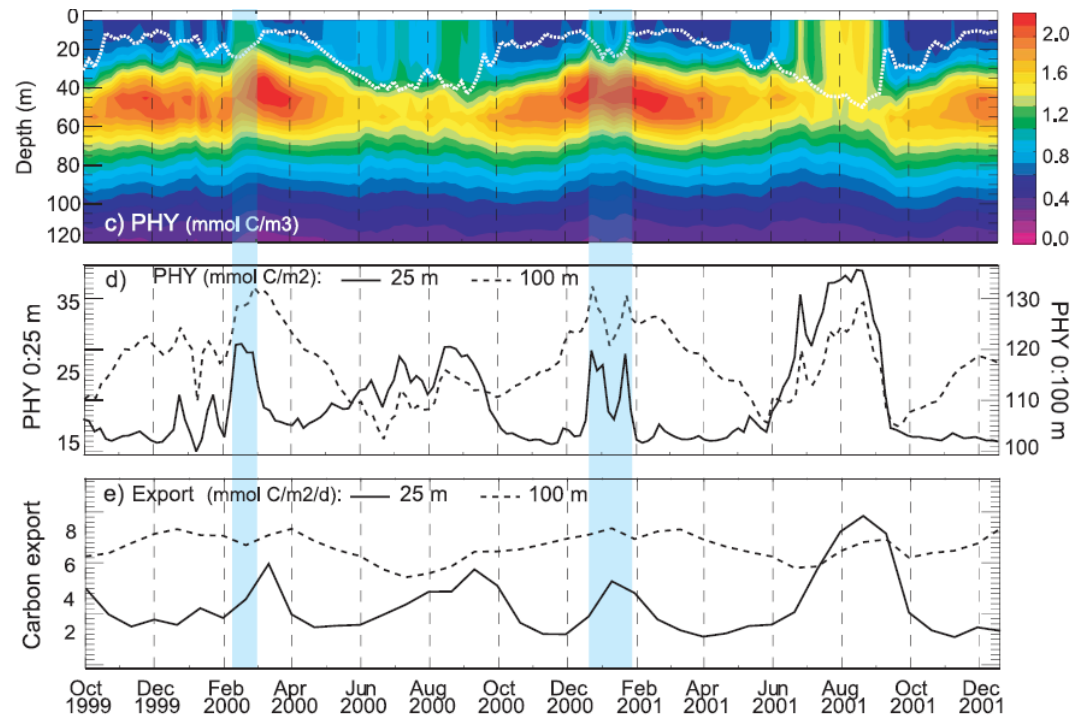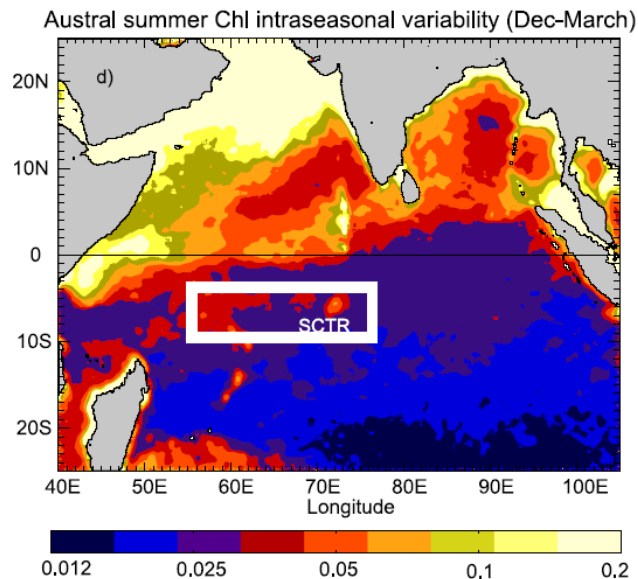
8. Integrated Use of Ocean Colour and Models
(StephH, Jerry, Fei, Colleen, Mark, Steffano, Cecile)

Models used to
- Explore processes observed in OC
- Extend OC in space/time
- Depth information for observed OC process
- Nutrient limitation

Recommendations

Example: nutrient supply and export

(Left) SeaWiFS intraseasonal variability
(Right) Modelled phytoplankton biomass and export flux

Intraseasonal variability in study region related to MJO, changing wind
patterns and vertical distribution of phytoplankton, with consequences
for export flux
Resplandy et al. 2009, JGR

(Slide Courtesy of Stephanie Henson)

Remotely Sensed Phytoplankton Fluorescence & Ocean GCM Iron Limitation Distributions (JUN-AUG)
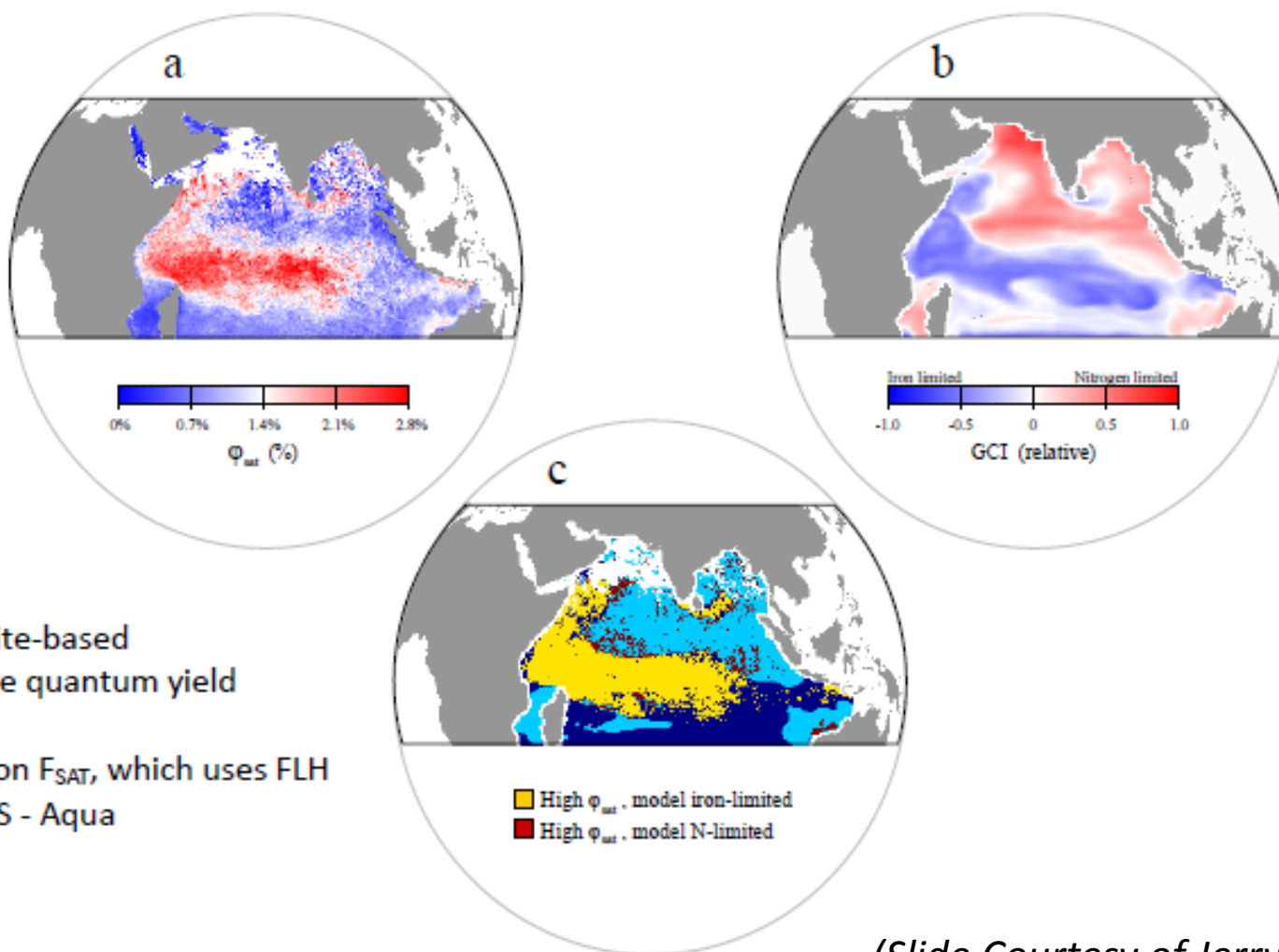
φSAT - satellite-based fluorescence quantum yield

φSAT based on FSAT, which uses FLH from MODIS - Aqua

(Slide Courtesy of Jerry Wiggert)

Behrenfeld et al., (2009), Biogeosci., 6, 779-794.

OUTLINE OF REPORT:

9. Models inform Ocean Colour
   (StephD/StephH, Colleen, Cecile, Jerry)

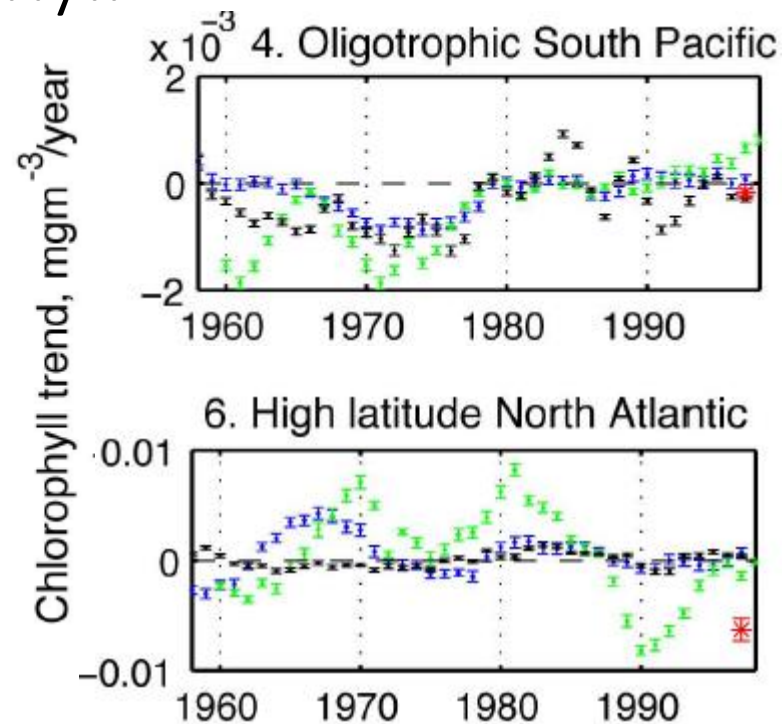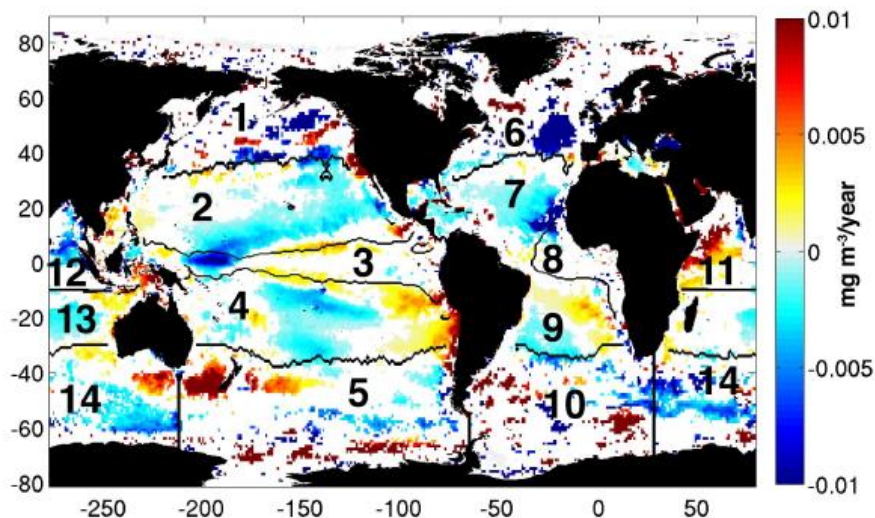   Hindcast/future simulations
   - inform on detection and attribution in OC records
   - understanding characteristics needed for trend
     dectection
   Help design in situ sampling strategy (OSSE)
   Recommendations

10. Summary and Recommendations

Example: trends in chlorophyll

(Left) Trends in SeaWiFS chl 1997-2007
(Right) Comparison of modelled and observed trends

Observed trends are currently within the range of decadal variability and so may not represent climate change trends

Henson et al. 2010, Biogeosciences

(Slide Courtesy of Stephanie Henson)

OPTICAL SIGNATURE OF CLIMATE CHANGE

Note: this is climate model, interannual variability timing (e.g. El Nino) do not match actual years
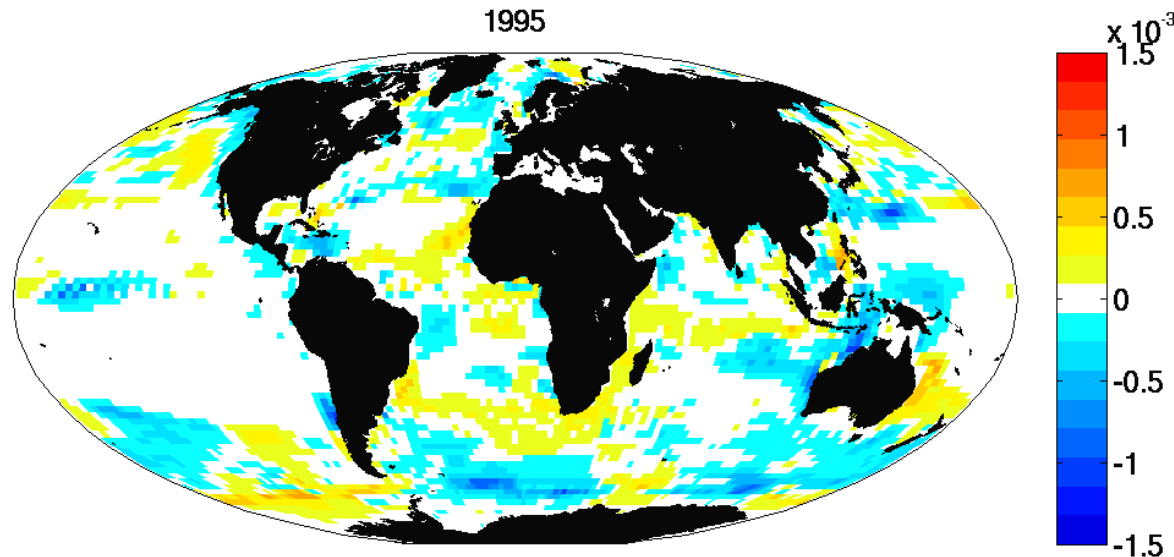
Simulation of change in reflectance at 475nm (1/sr) relative to current day 16 year mean (1998-2015)

Projected Time Line:

July 2015:	Birth of WG
Feb 2016:	**Kick-Off Meeting**
Apr(?) 2016:	Abstract for session at ASLO 2017
Jun 2016:	**MEAP-TT meeting (California)**
	(meeting of Ch 6 authors)
	Outline Ch 6
Jul 2016:	Outlines Ch 8 and 9
Sep 2016:	Outline Ch 3, 5 and 7
	Skype call Ch 3, 4, 5 discussion
Sep 2016:	**CLEO meeting (Rome)**
Nov 2016:	Outline all chapters, Skype call
Feb/Mar 2017:	**ASLO meeting (Hawaii)**
	special session
	1 day WG meeting (funding?)
May 2017:	first draft all chapters, Skype call
June 2017:	**IOCS meeting (Lisbon)**
July 2017:	**AMEMR meeting (Plymouth)**
	special session
Aug 2017:	second draft, Skype call
Nov 2017:	finalise report