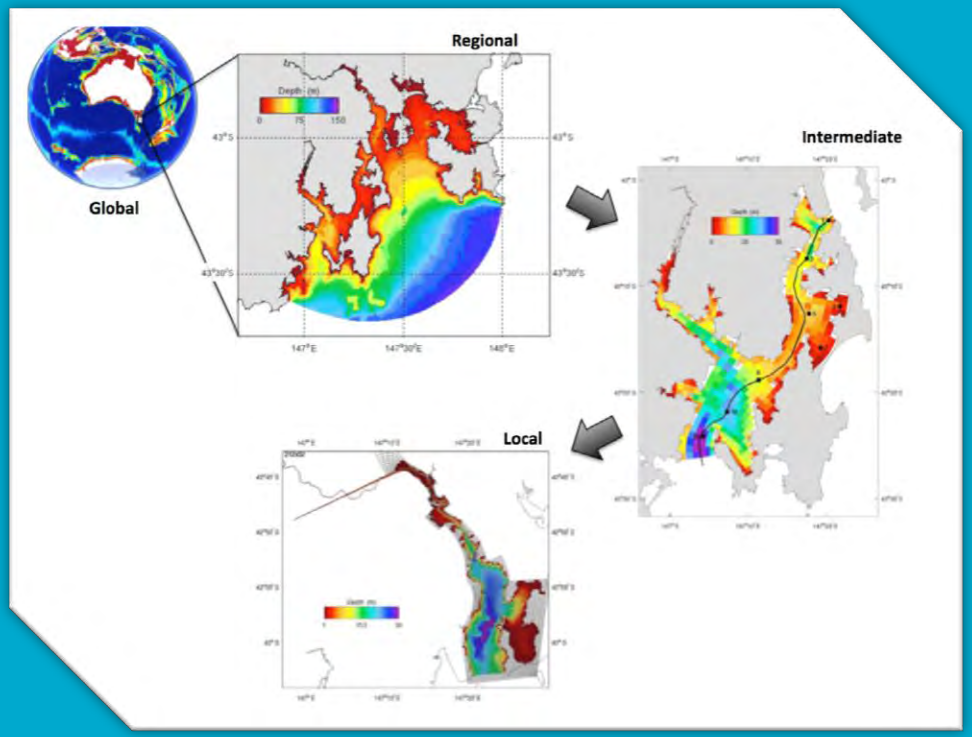


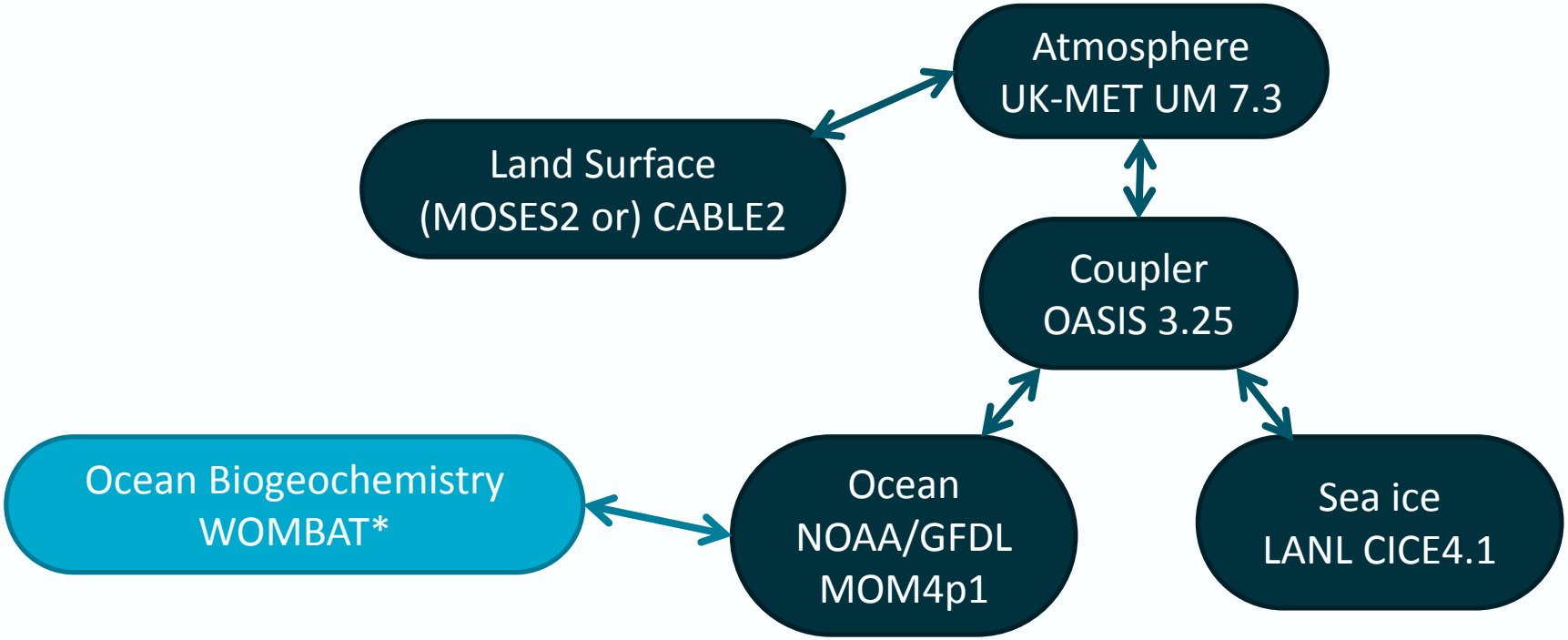
Models linking climate to lower tropic levels: an Australian perspective

Beth Fulton, **Andrew Lenton, Richard Matear, Mark Baird, Karen Wild-Allen**
2014

The modellers

ACCESS

- CSIRO and Australian Bureau of Meteorology
- Australian Community Climate and Earth System Simulator coupled model

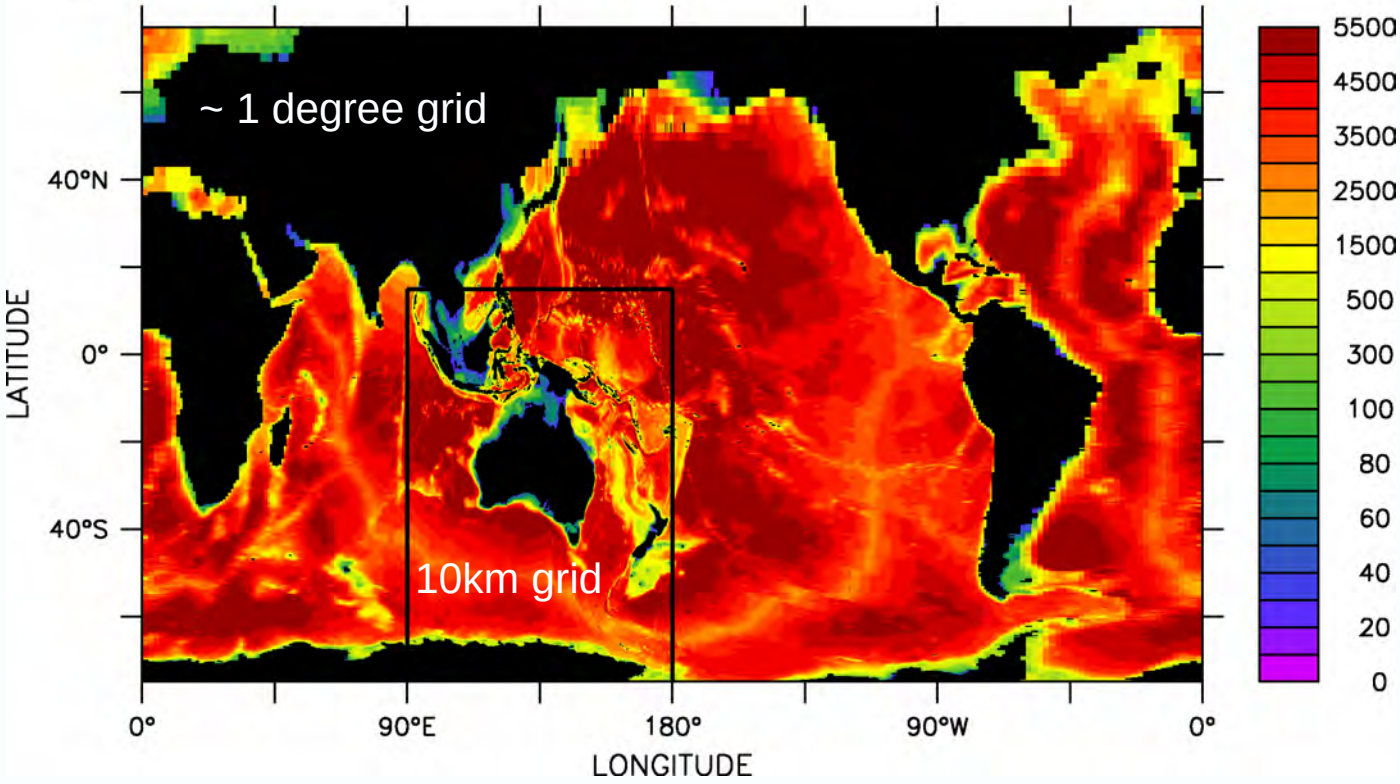


* World Ocean Model with Biogeochemistry and Trophic dynamics

Bi et al 2012

Nested

- Coarser global grid, finer Australian grid
- SRES, RCP scenarios (anomalies) force eddy resolving model (2060s)



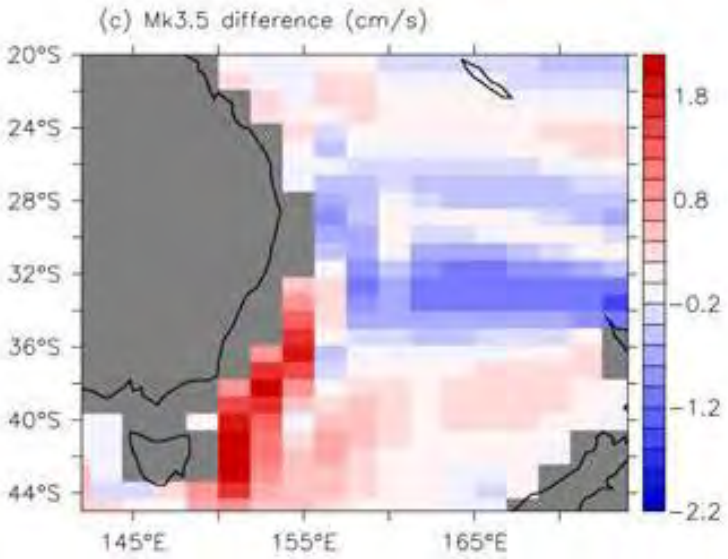
- Multiple models (CSIRO Mk 3.5, ACCESS, OFAM, SHOC, EMS)

Chamberlain et al. 2012

Global Ocean – Resolution

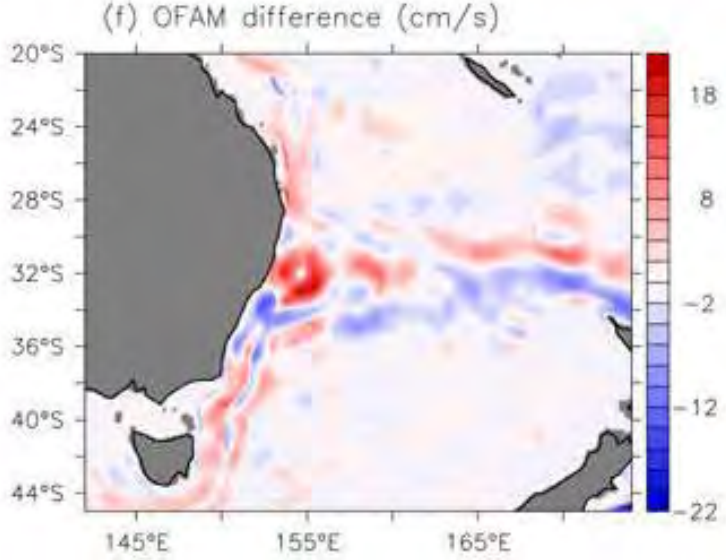
- GCM captures large-scale ocean circulation, misses the boundary currents (GCM has the increased flow, misses that its from eddies)

GCM



OEM

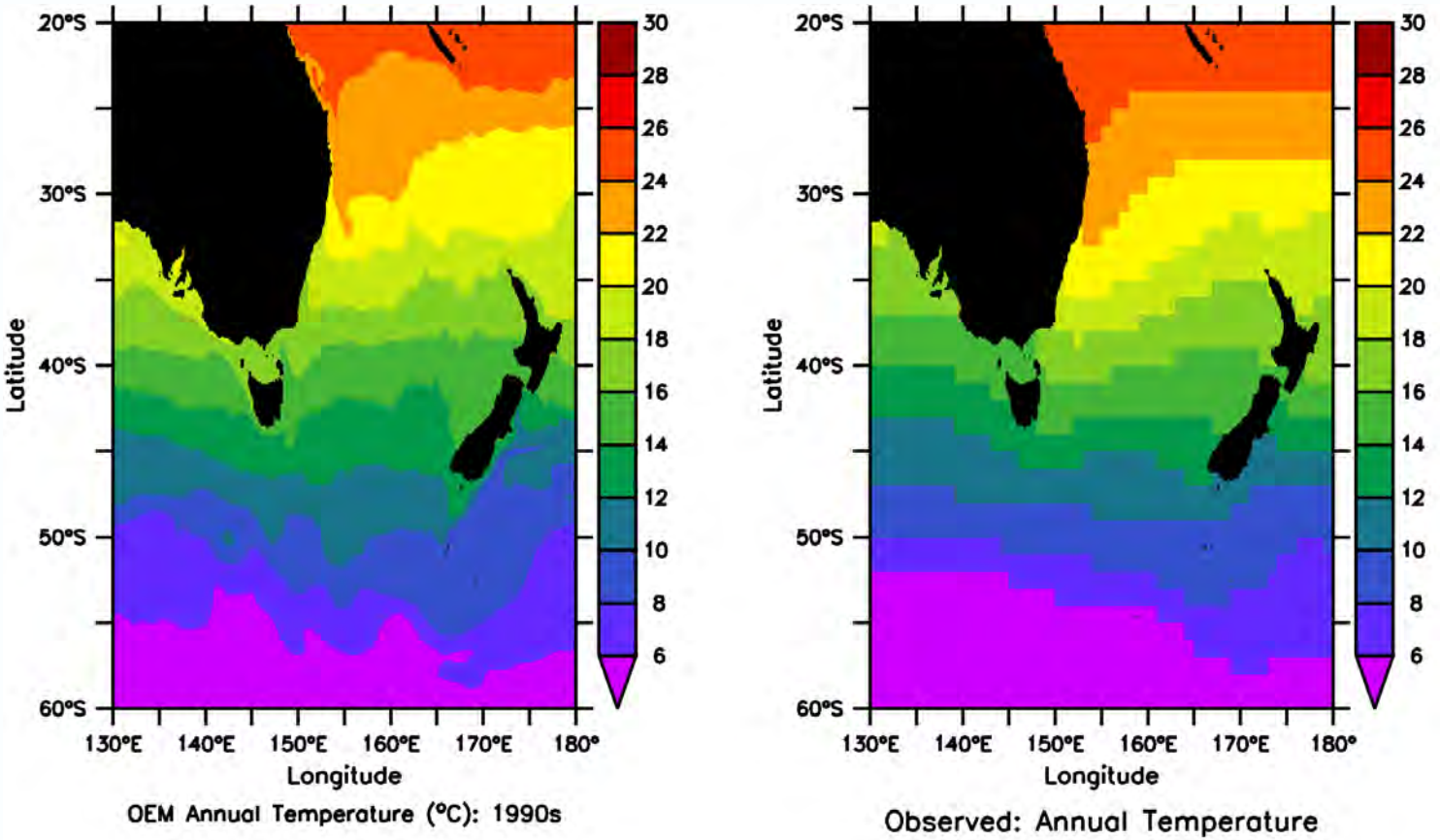
Multi-year averages



Sun et al. 2012.

Global Ocean – Performance

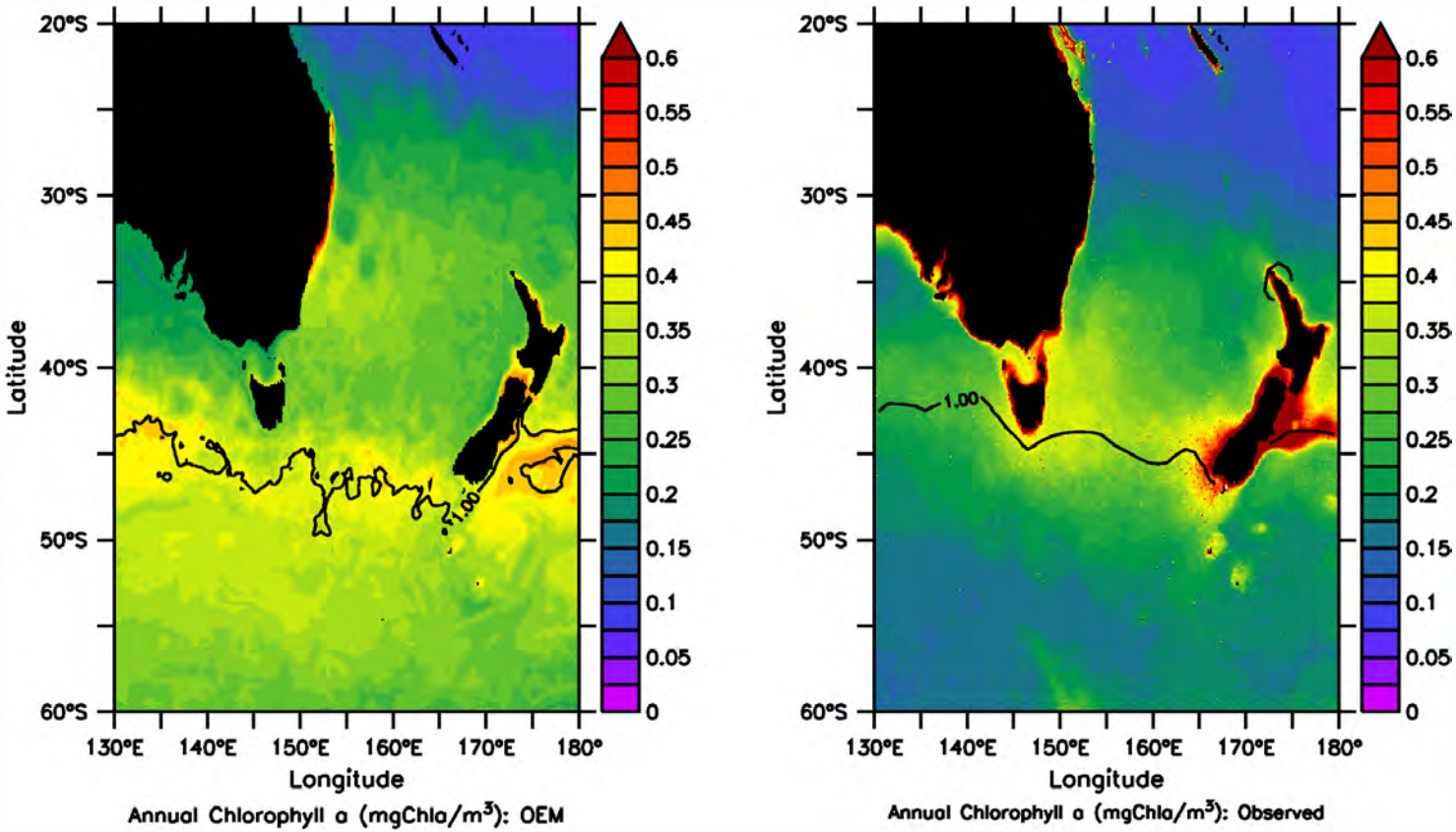
- Physical properties perform well



Matear et al. 2013, JGR

Global Ocean – Performance

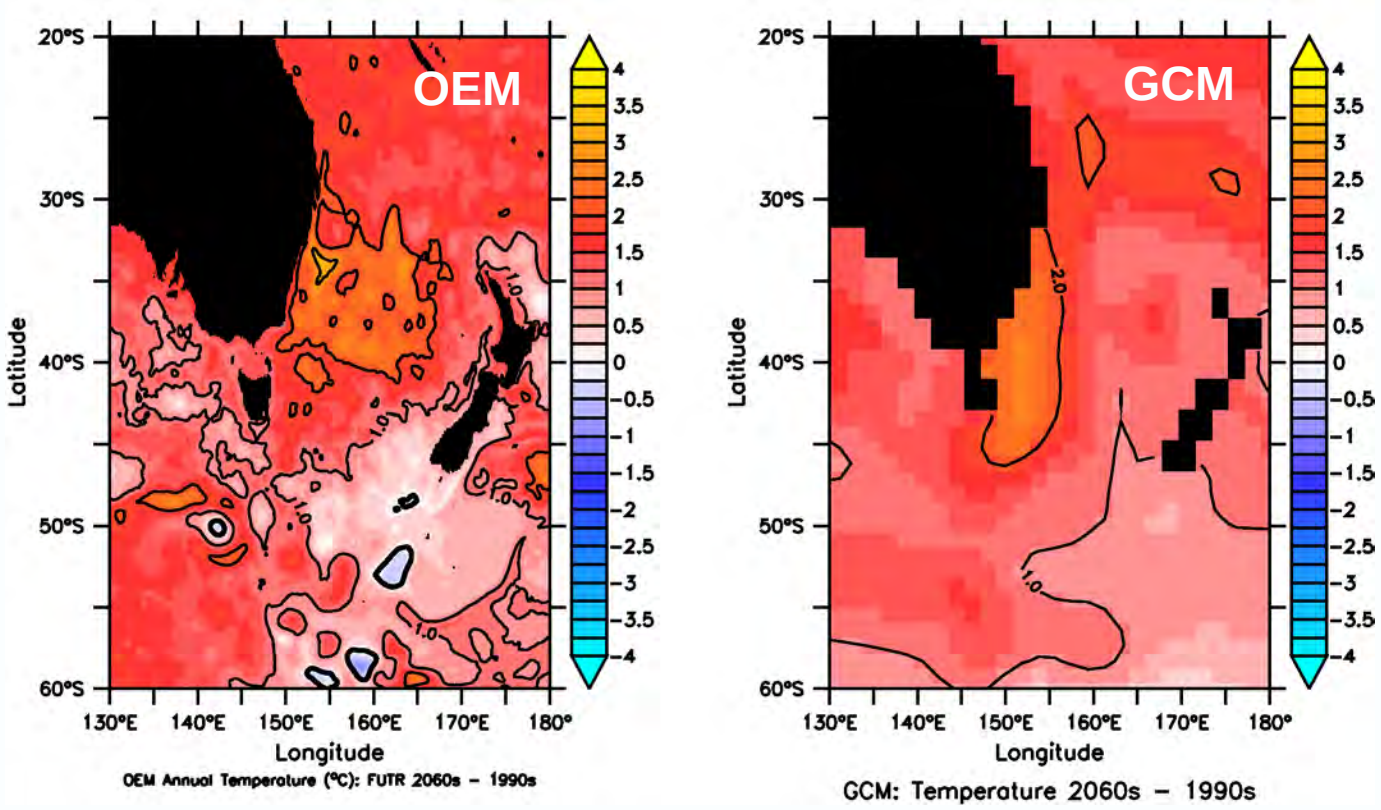
- Physical properties perform well, had to grapple hard to get NPZD working as well (now shifting to more biological resolution)



Matear et al. 2013, JGR

Global Ocean – Performance

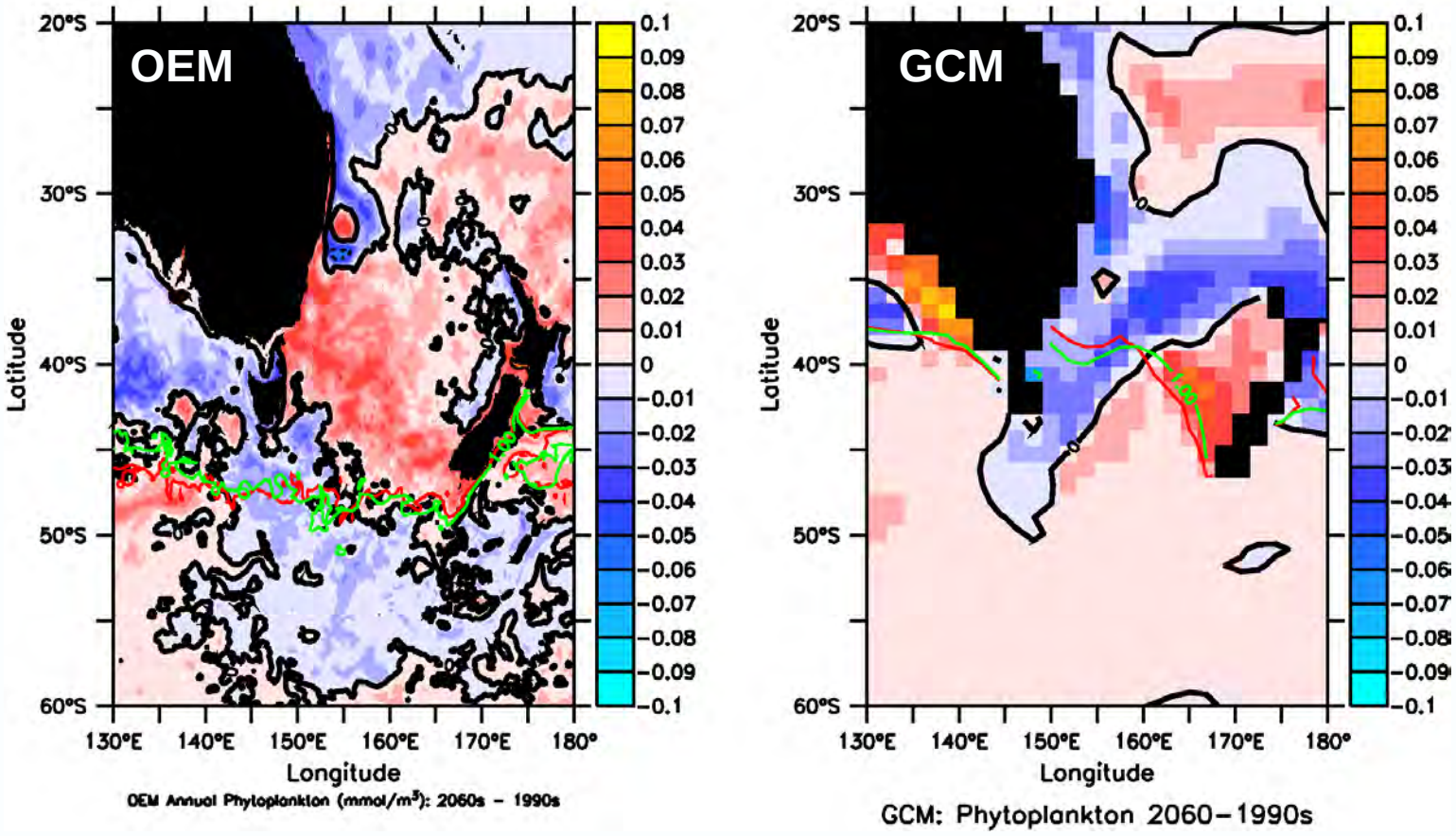
- Warming in Tasman ~ observed (OEM correlation = 0.74)
- Mixed layer depth changes = striking feature



Matear et al. 2013, JGR

Global Ocean – Planktonic Futures

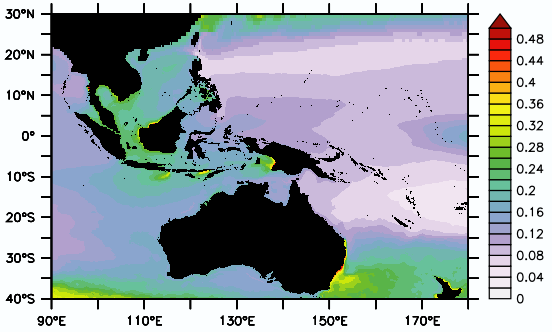
- Alternative perspective on spatial production shifts (eddy pumping)
- Larger interseasonal variability



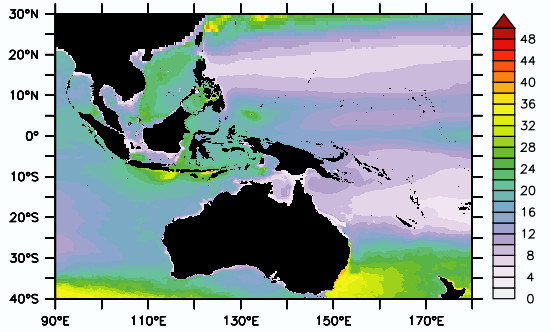
Global ocean – More Broadly

- Shoaling of thermocline makes relative subsurface response greater than surface

2060s

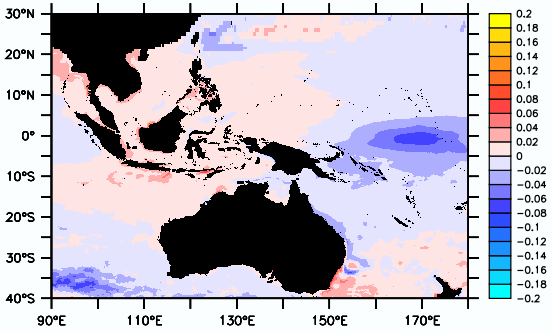


Projected Surface Phytoplankton



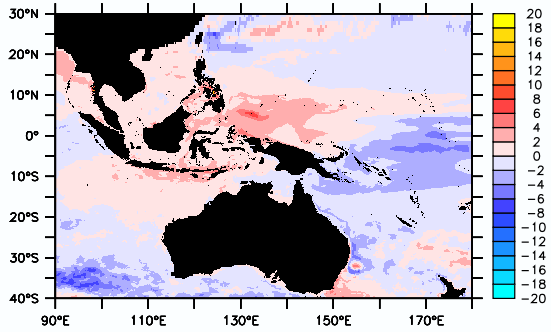
Projected Column Phytoplankton

2060s-1990s



Change in Surface Phytoplankton

mmol(NO3)/m^3

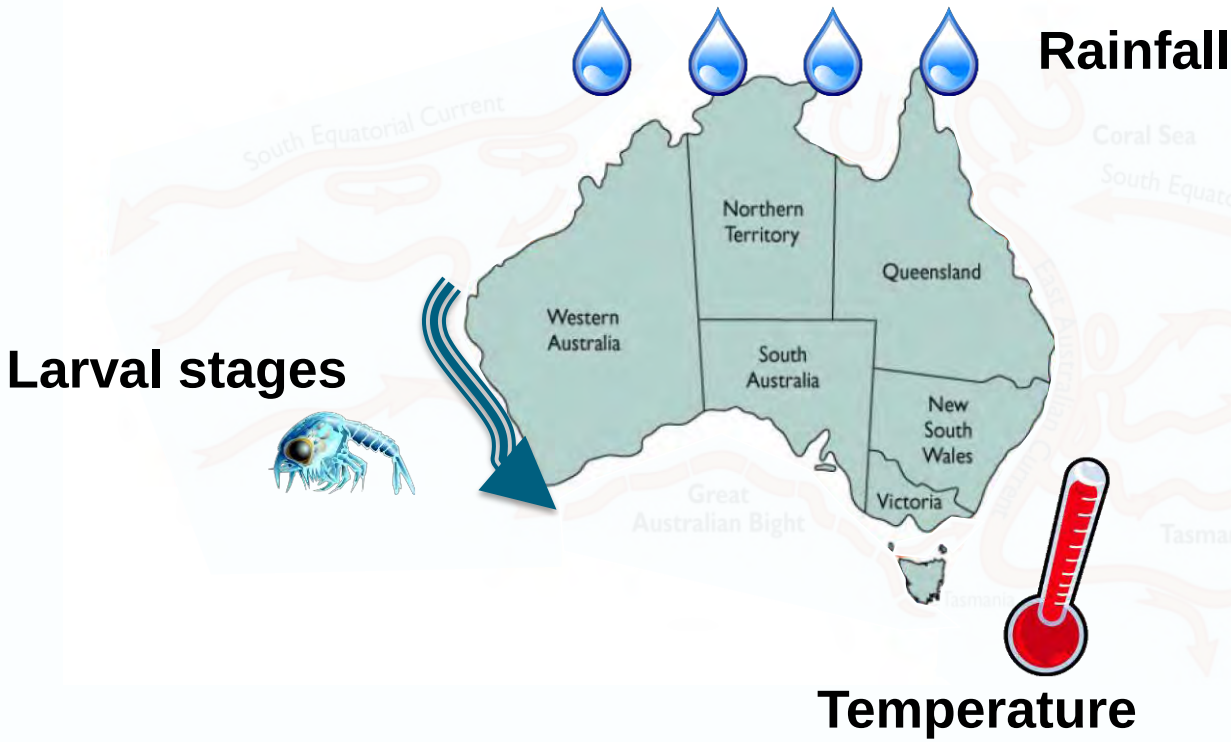


Change in Column Phytoplankton

mmol(NO3)/m^2

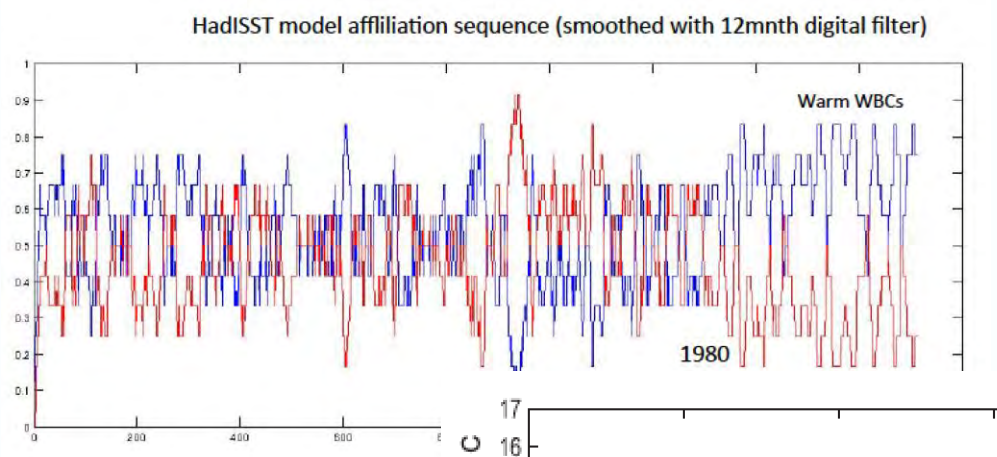
Global ocean – Use

- C cycle
- Process exploration (EAC extension)
- Downscaling & forcing

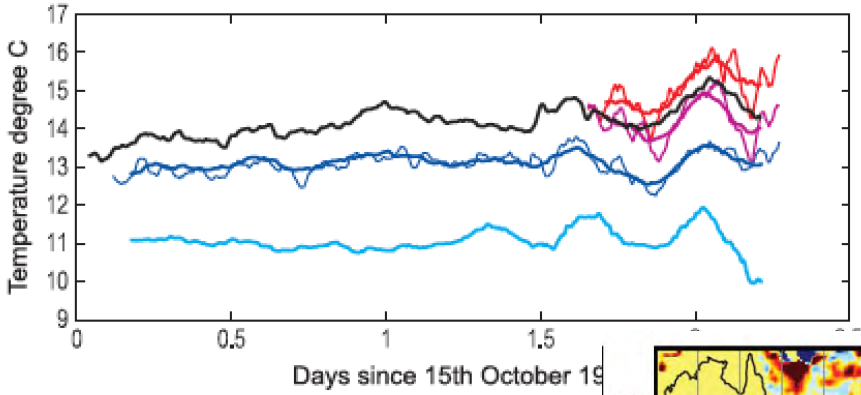


Hobday et al (2008)

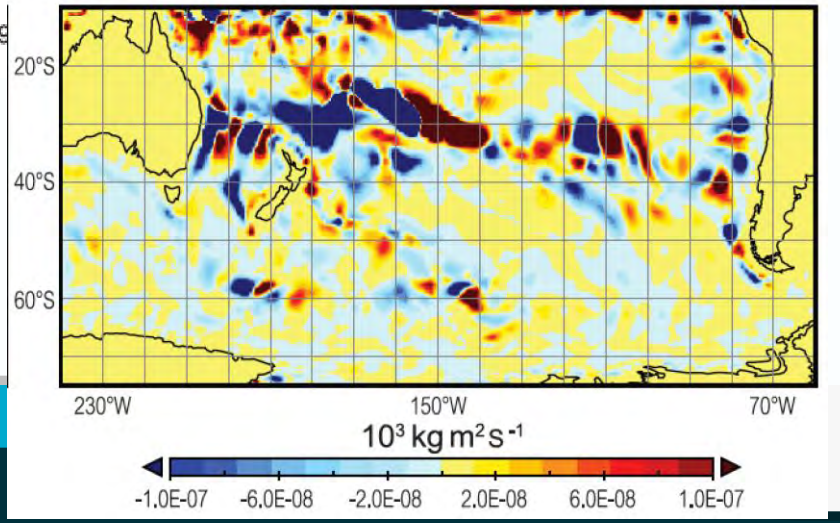
Global ocean – Decadal forecasting



- Late 1970s entered warm state
- 1980s decadal variability amplified

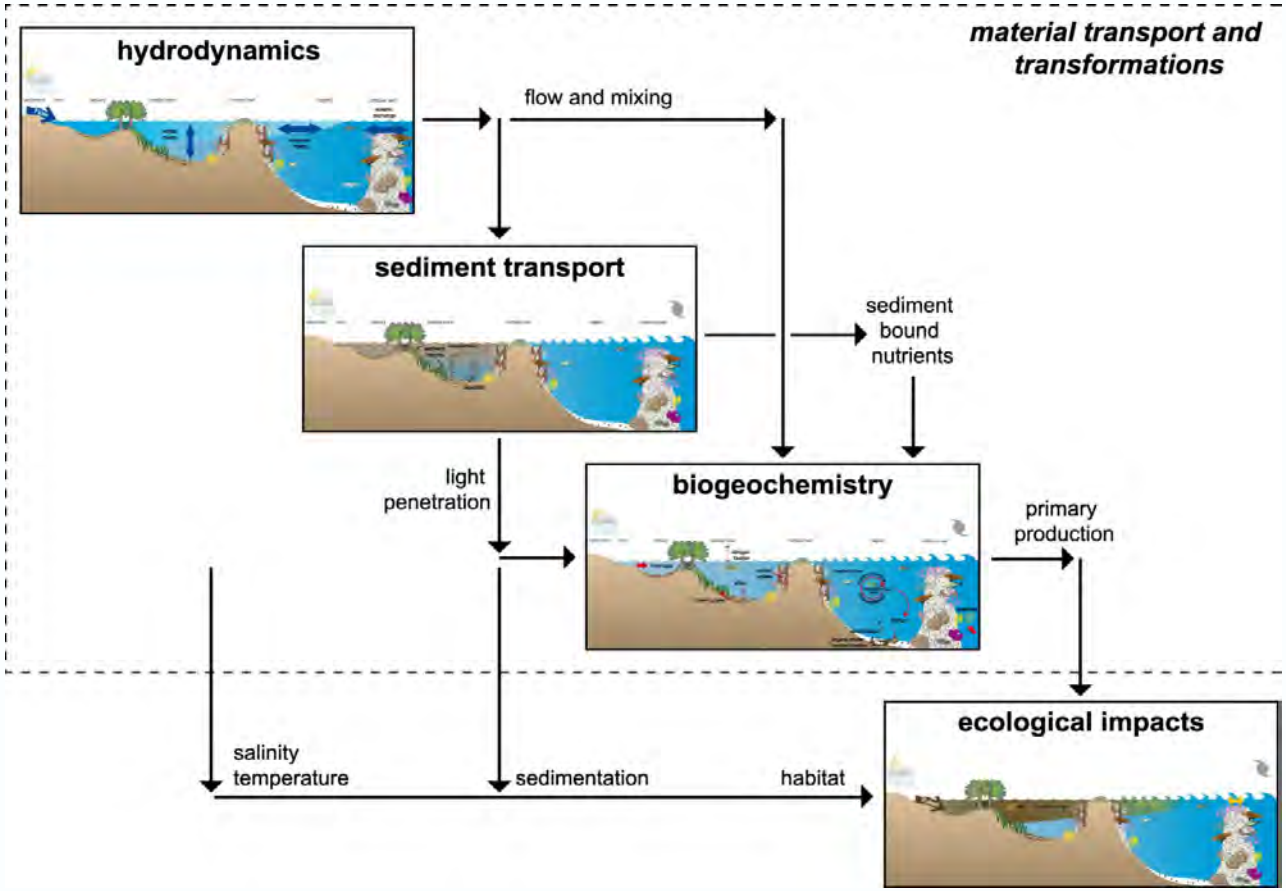


- Wave trains across the Pacific
- Improved decadal forecasting

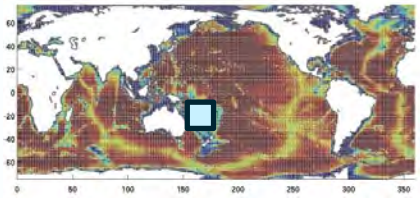


Regional Models – Purpose

- System understanding & Management advice



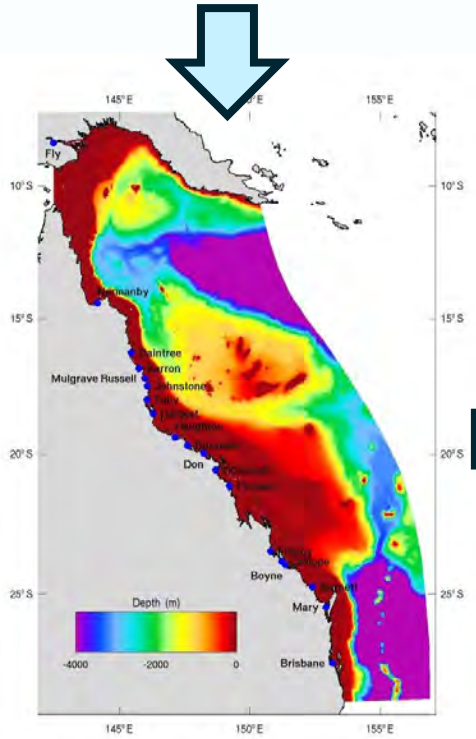
Regional Models – Resolution & Nesting

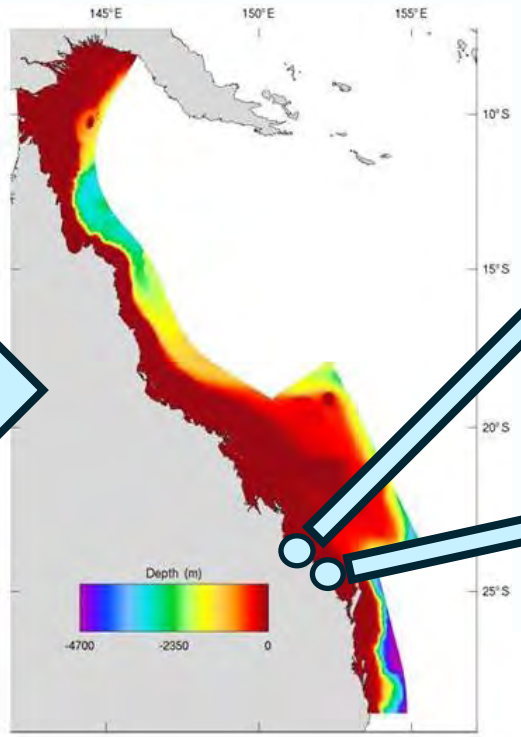


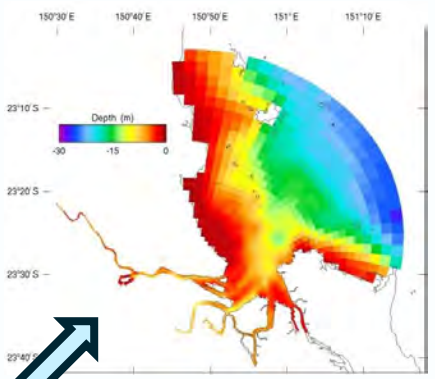
Global products (BoM):

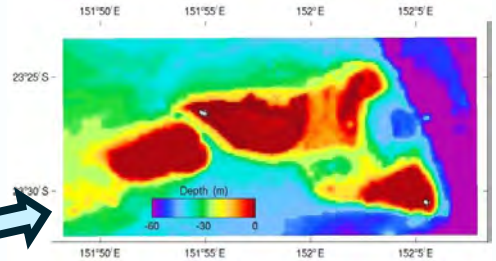
- BLUElink/OceanMAPS (10km)
- ACCESS-A (12km)

- Downscaling to the reef/estuary scale (20 estuaries represented)







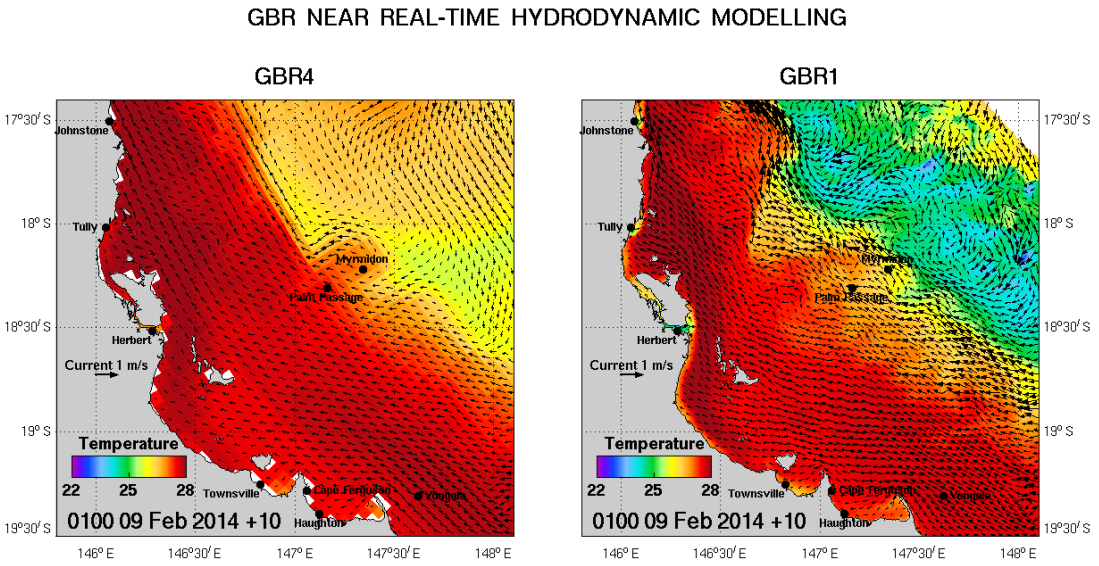


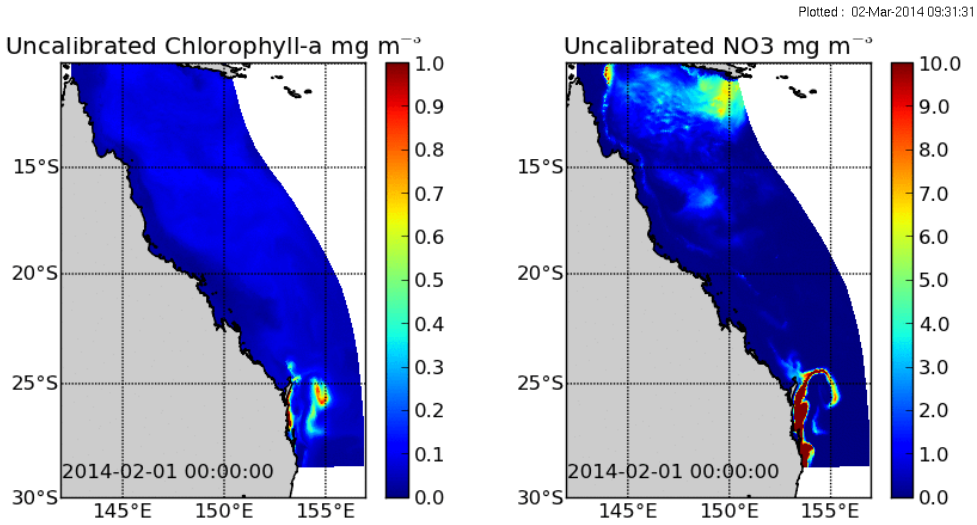
Relocatable local models (200m)

Bridging models (GBR 4km) Hi-res regional (GBR 1km)

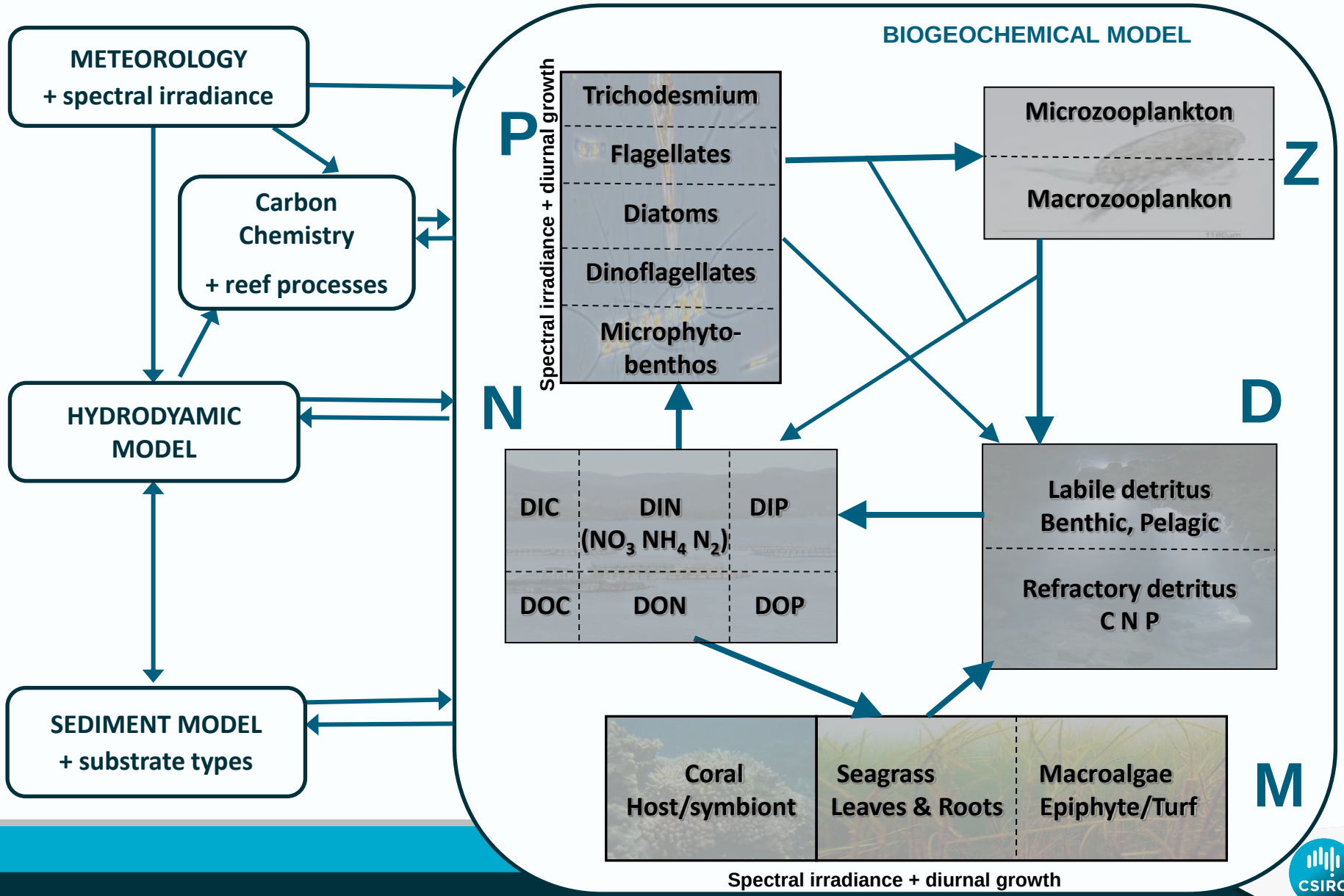
Regional Models – Near real time reporting

- Ocean forecasts
- Industry updates
- Publically accessible

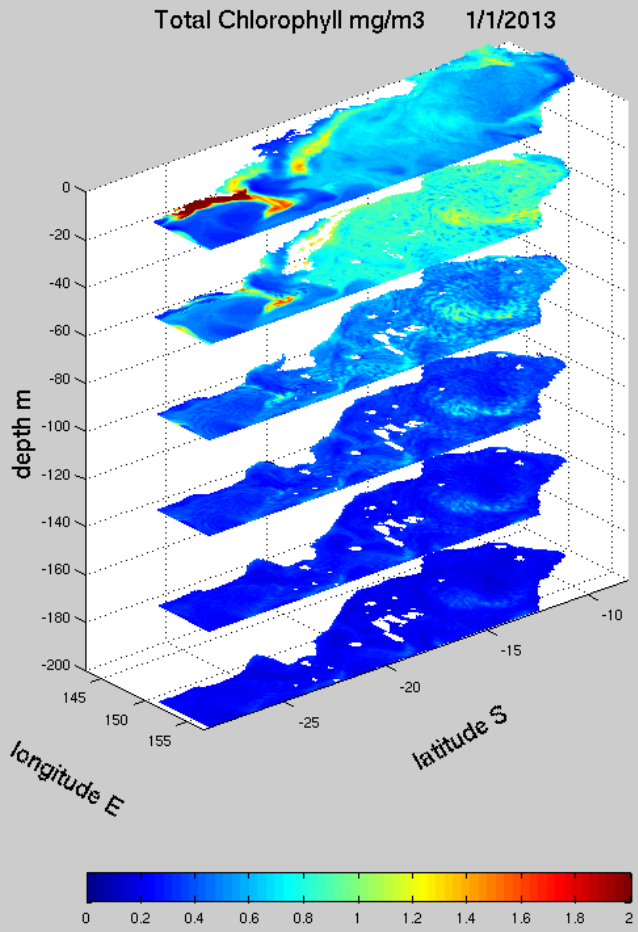


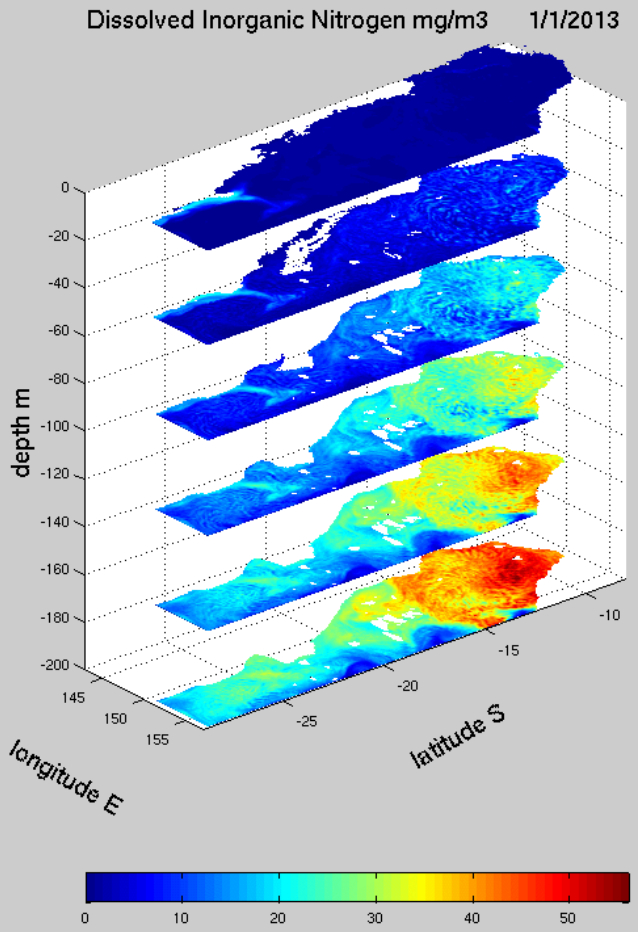


Regional BGC Models – Trophic Structure



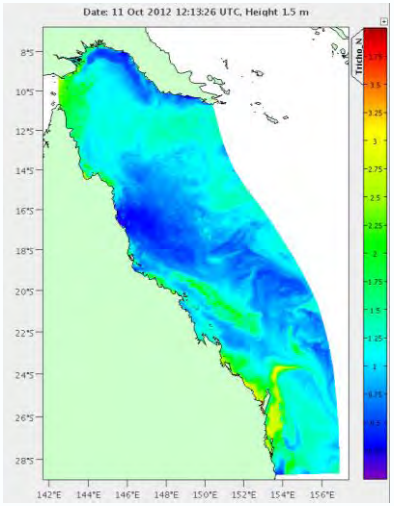
Regional Models – Production & Nutrients



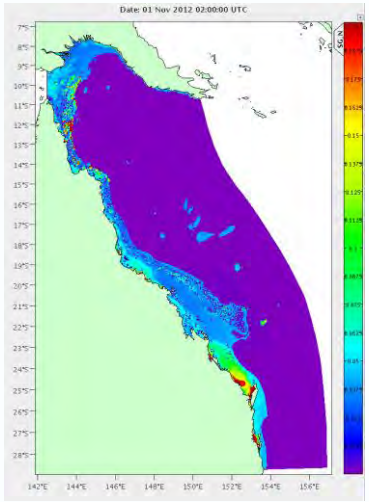


Regional Models – Habitats

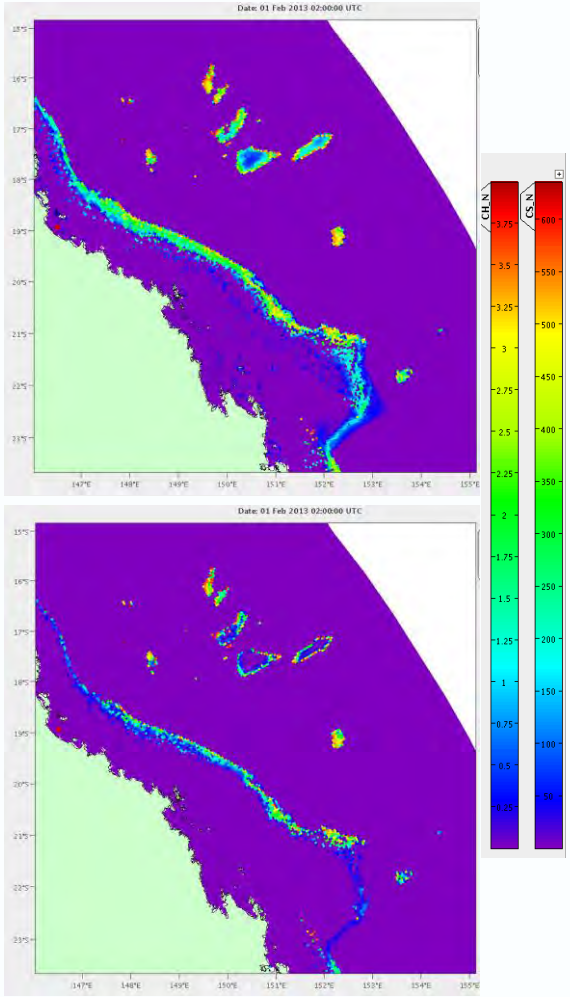
Trichodesmium

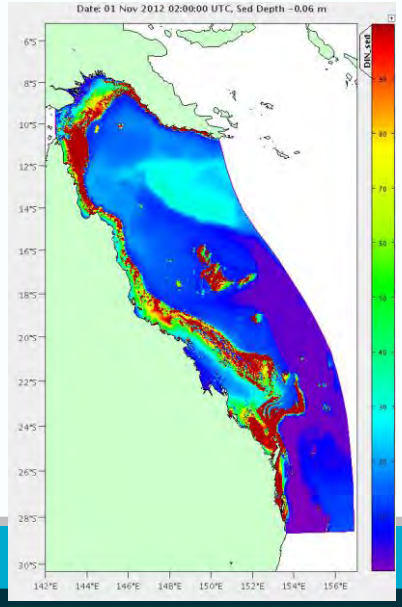


Seagrass leaves



Coral host



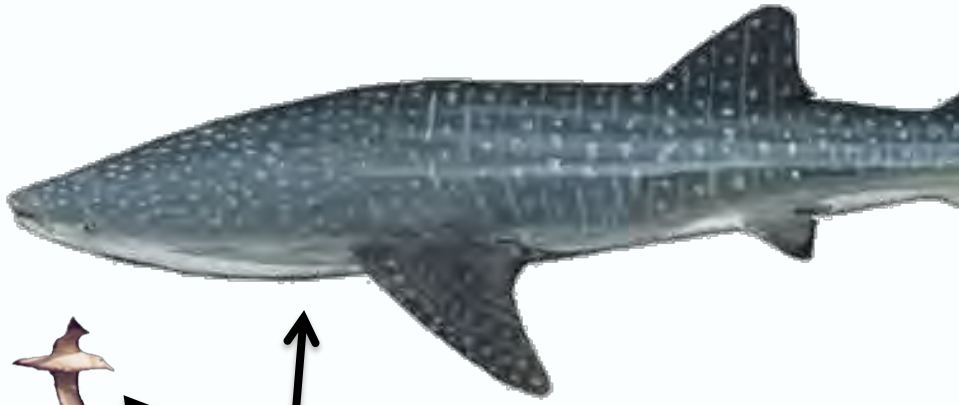


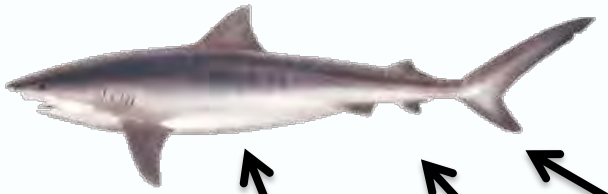
Sediment DIN

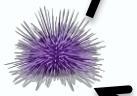
Coral symbiont

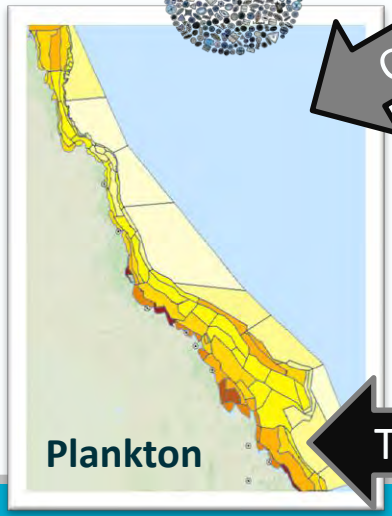
- Fairly fine spatial resolution
- Process resolution (explore acclimation)

End-to-end Models





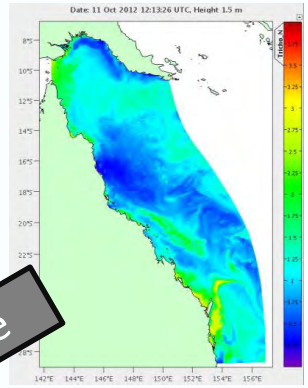


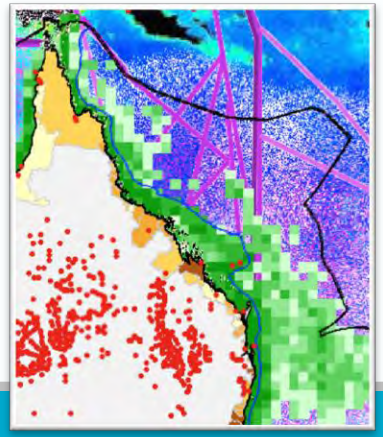


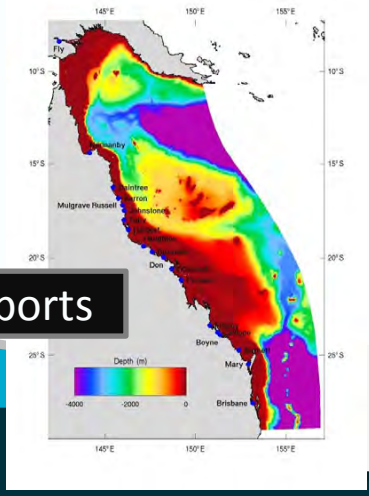
Human Use

Compare

Transports



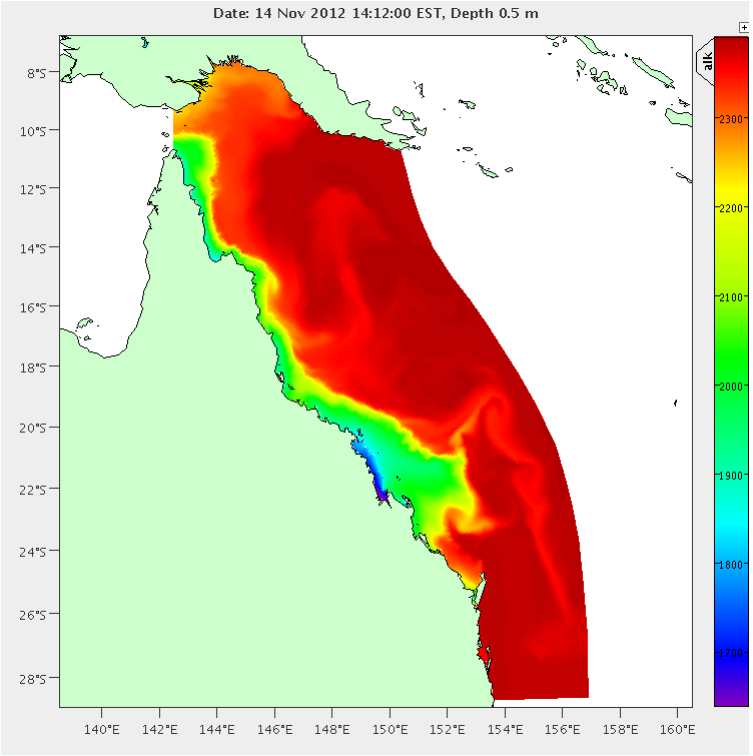




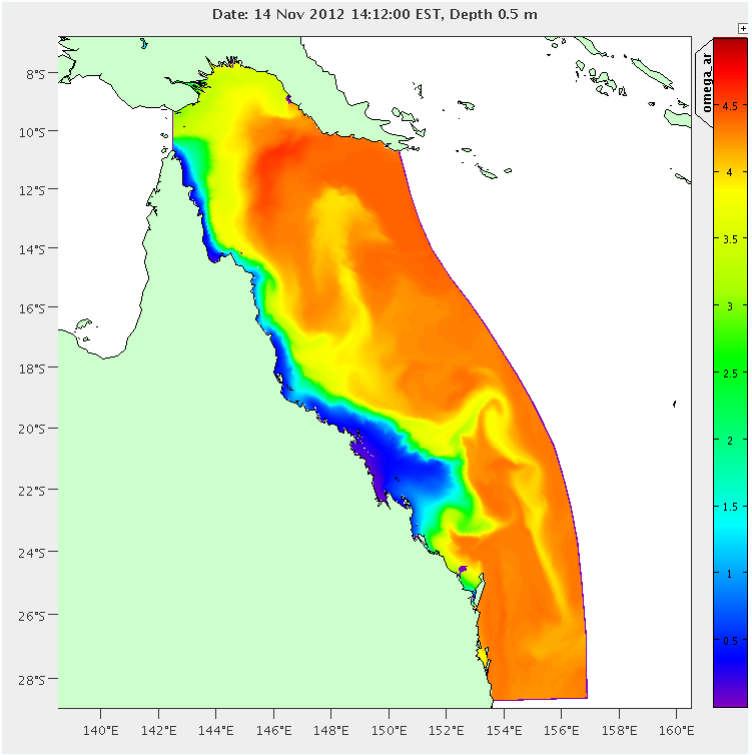
Regional/Local Model – Explore Acidification

- Physical dynamics (residence times of water bodies)
- Looking at the role of biological processes

Surface Alkalinity



Aragonite Saturation



Regional/Local Model – Explore Acidification

- Physical dynamics (residence times of water bodies)
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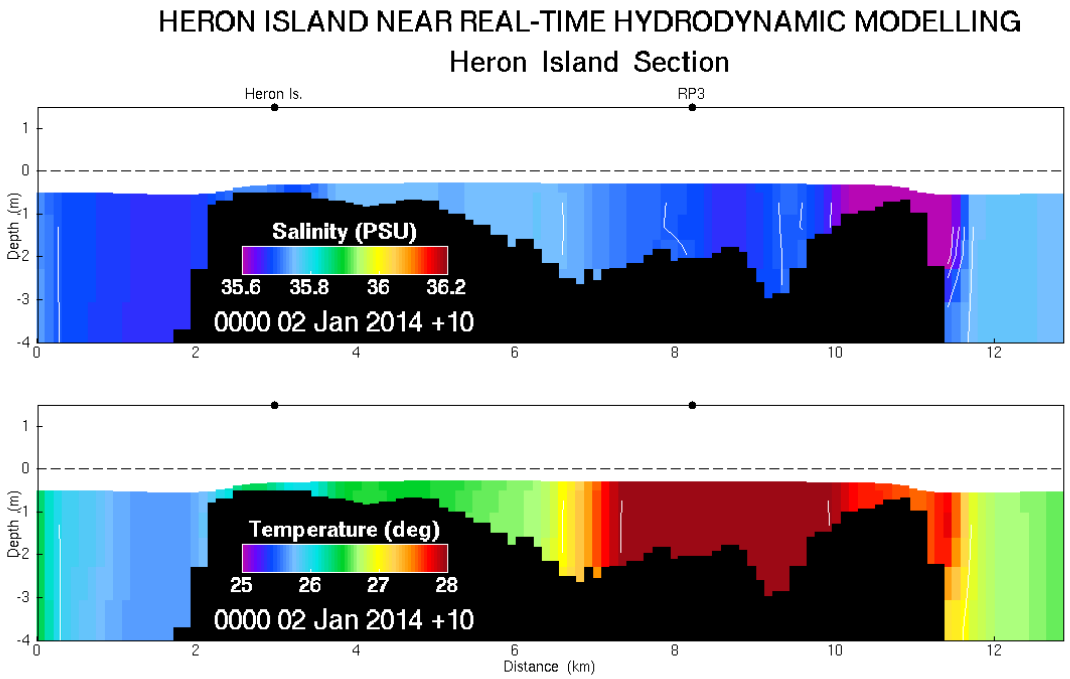
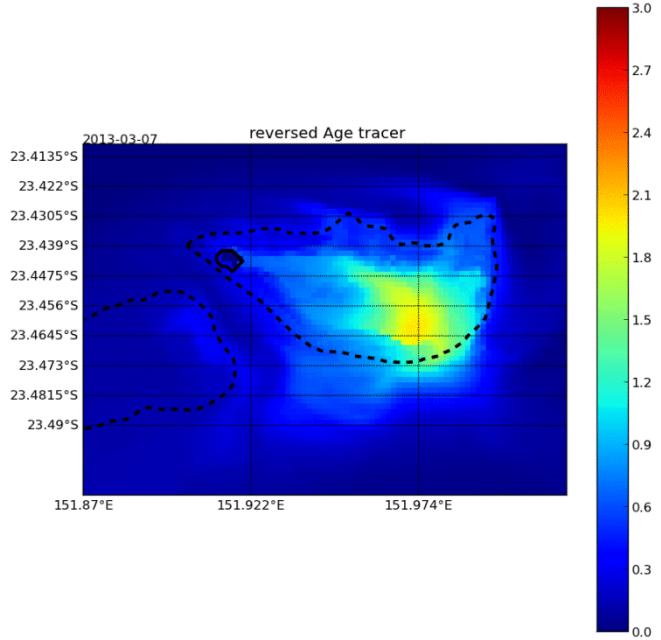




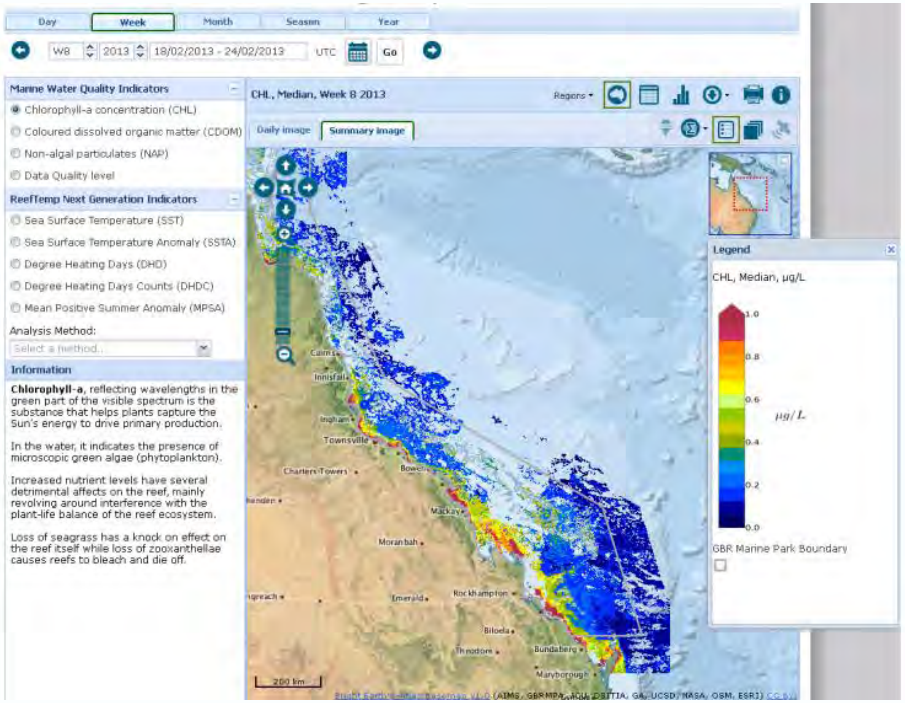
Plotted : 20-Jan-2014 09:40:02

Regional Model – Threat Identification

- Crown-of-thorns outbreaks
- Irukandji forecasts

Model Status

- Global models: refining and extending processes
- Regional models: extending and coupling up the food web
- New approaches: emulators, Bayesian inference
- Data visualisation: increasingly publically available
- Strategic e2e models: regional, extending functionality
- Fish-MIP



Fish-MIP

- Industries = Intersectoral Impact Model Intercomparison Project (ISI-MIP)
- Fisheries = Fish-MIP
- More heterogeneity than other MIPs
  - Many global models use size related relationships
  - Otherwise lots of variety…

Global Models	Regional Models
Size structured BLING	EwE
EcoOcean	Atlantis
Maxent & Aquamap	OSMOSE
Madingley	
DPBM (size-based)	Multispecies?
SS-DBEM	ESAM?
APECOSM (& PISCES)	FEAST?
SEAPODYM	
BOATS (bioeconomic)	
POEM	
MAREMIP	
Global catch and effort	

Thank you

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Head of Ecosystem Modelling

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