Agricultural & Environmental Landscape Monitoring to Minimise Reef Impact

Water for a Healthy Country, Wealth from Oceans, Sustainable Agriculture Flagships

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National Research FLAGSHIPS

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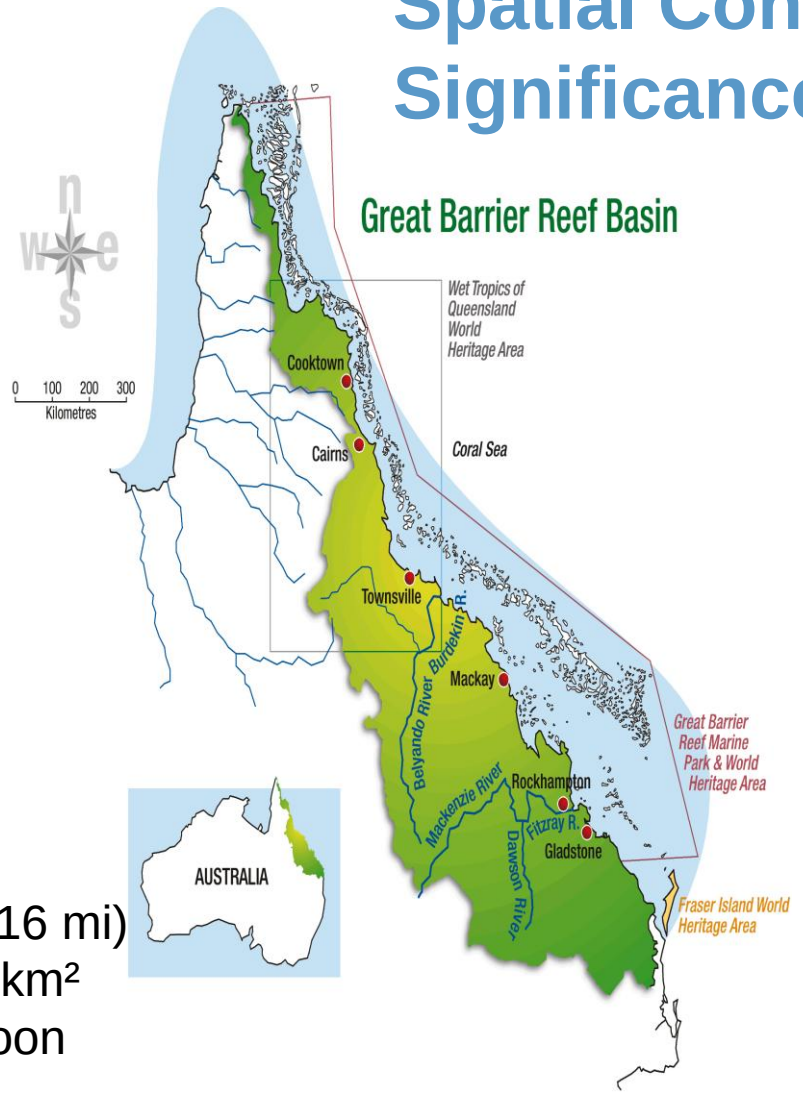
Outline

- Recap: “an icon – Australia’s Great Barrier Reef” & “the outlook”
- Issues for GBR
  - science strategy
  - impacts from remote sensing research
  - ongoing research projects
- Key issues for environmental earth observation for the GBR
- Major drivers for building capability
- Future science directions
- Collaborative investment aspirations
  - what should success look like

Recap: An icon - Australia's Great Barrier Reef

Spatial Context & Significance



- world's largest coral reef system
- 3,000 individual reefs
- 900 islands
- stretches for 2,600 kilometres (1,616 mi)
- covers an area of approx 344,400 km²
- 28 catchments drain into GBR lagoon

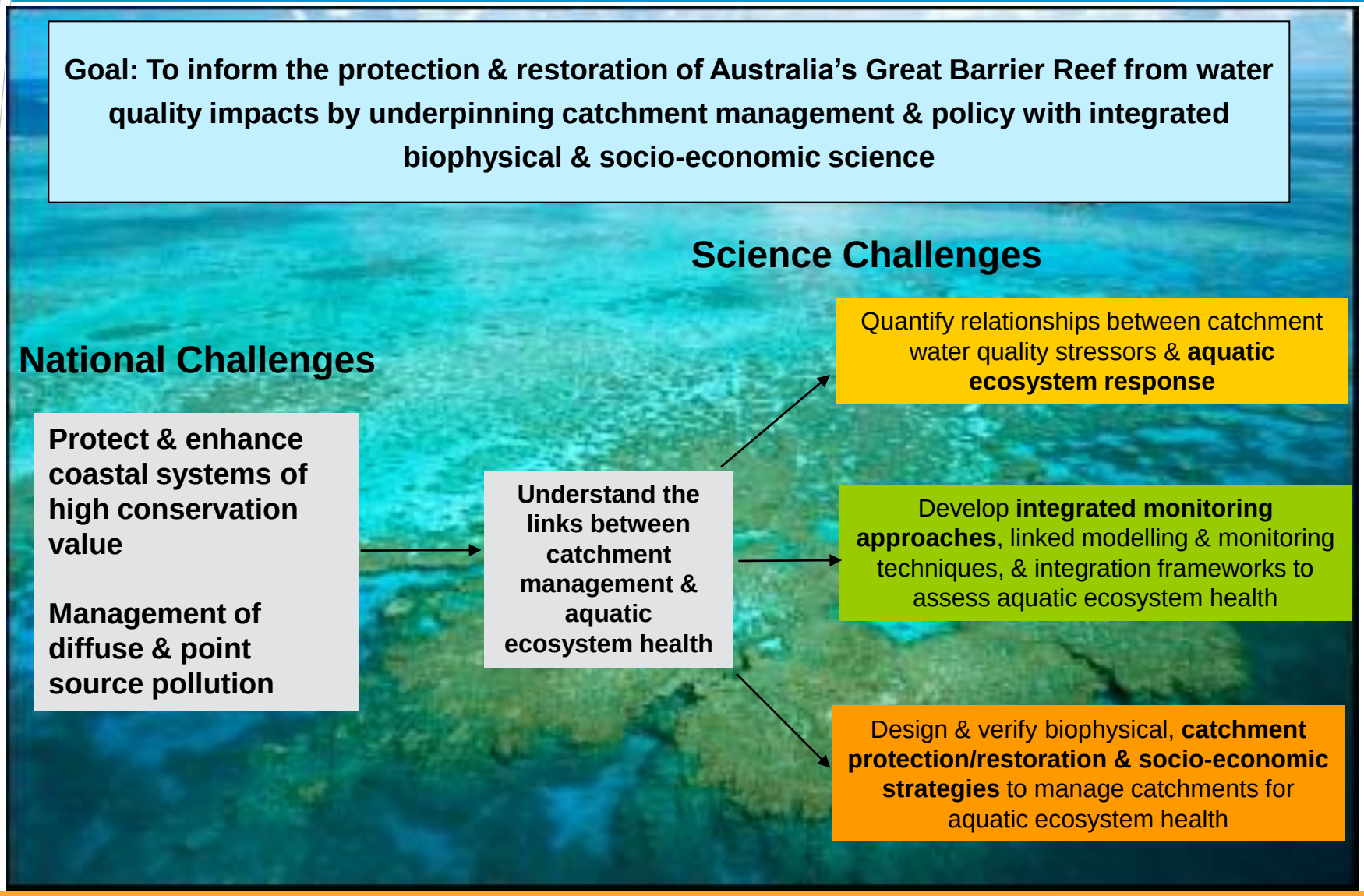
“The Outlook” for the Great Barrier Reef

- The *Great Barrier Reef Outlook Report 2009*
  - tabled in Australian Parliament
  - must be prepared every five years
- Key findings
  - recognised as one of the world's best managed reefs
  - likely to survive better under the pressure of accumulating risks than most reef ecosystems
  - current long-term outlook for the GBR is poor
- Priority issues reducing the resilience of the GBR
  - climate change
  - continued declining water quality from catchment runoff
  - loss of coastal habitats from coastal development
  - small number of impacts from fishing, illegal fishing & poaching

Key issues addressed

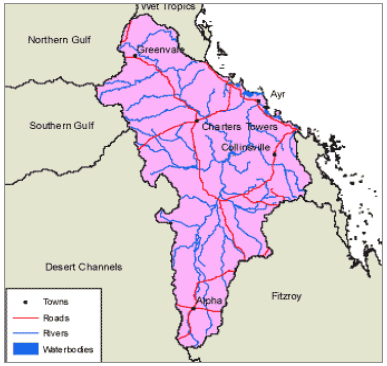
- Research partnerships help safeguard the Great Barrier Reef World Heritage Area, supports sustainable communities & enhances agricultural productivity
  - when & how could we best achieve an improvement in water quality to safeguard the Great Barrier Reef ?
  - how could we support communities & industries to achieve their natural resource management goals while fostering further sustainable development ?

Science strategy



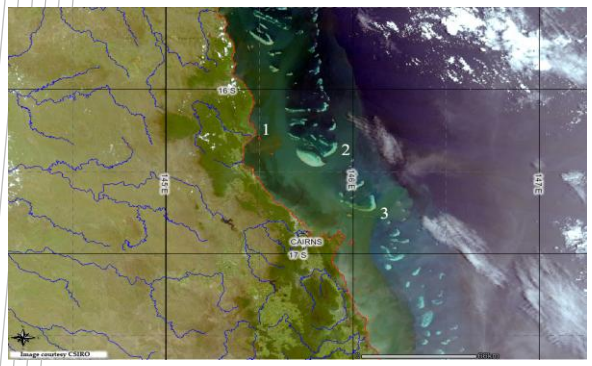
Impacts from remote sensing research

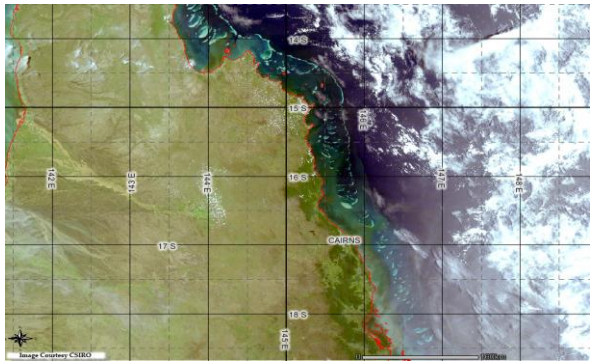
- Informing selection & prioritisation of land management practices
  - decision support tool that uses remote sensing information to efficiently & cost-effectively identify grazing land likely to be a key source of pollutants due to its poor condition

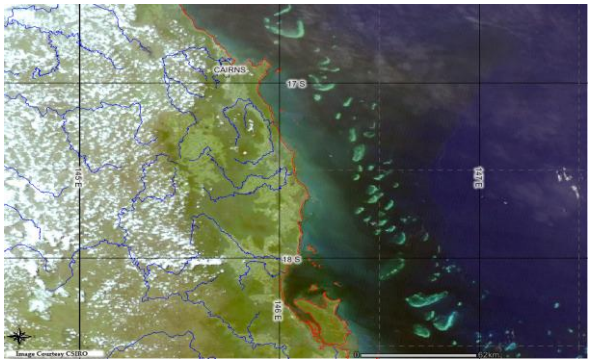


Impacts from remote sensing research

- Monitor, report & adapt to changes identified through established “regional water quality improvement plans”
  - delivering a cost-efficient method to effectively monitor landscape health & marine water quality across large areas over 20+ years

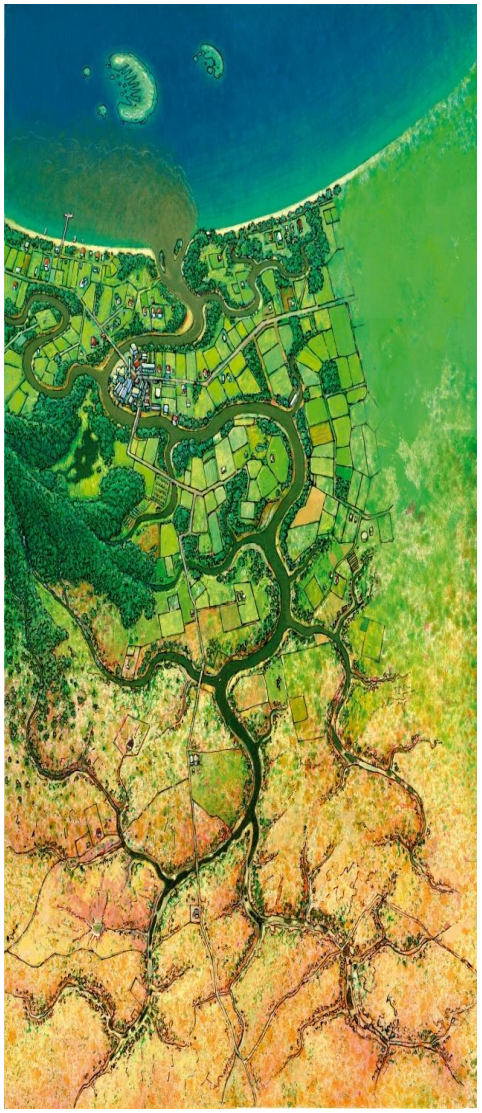






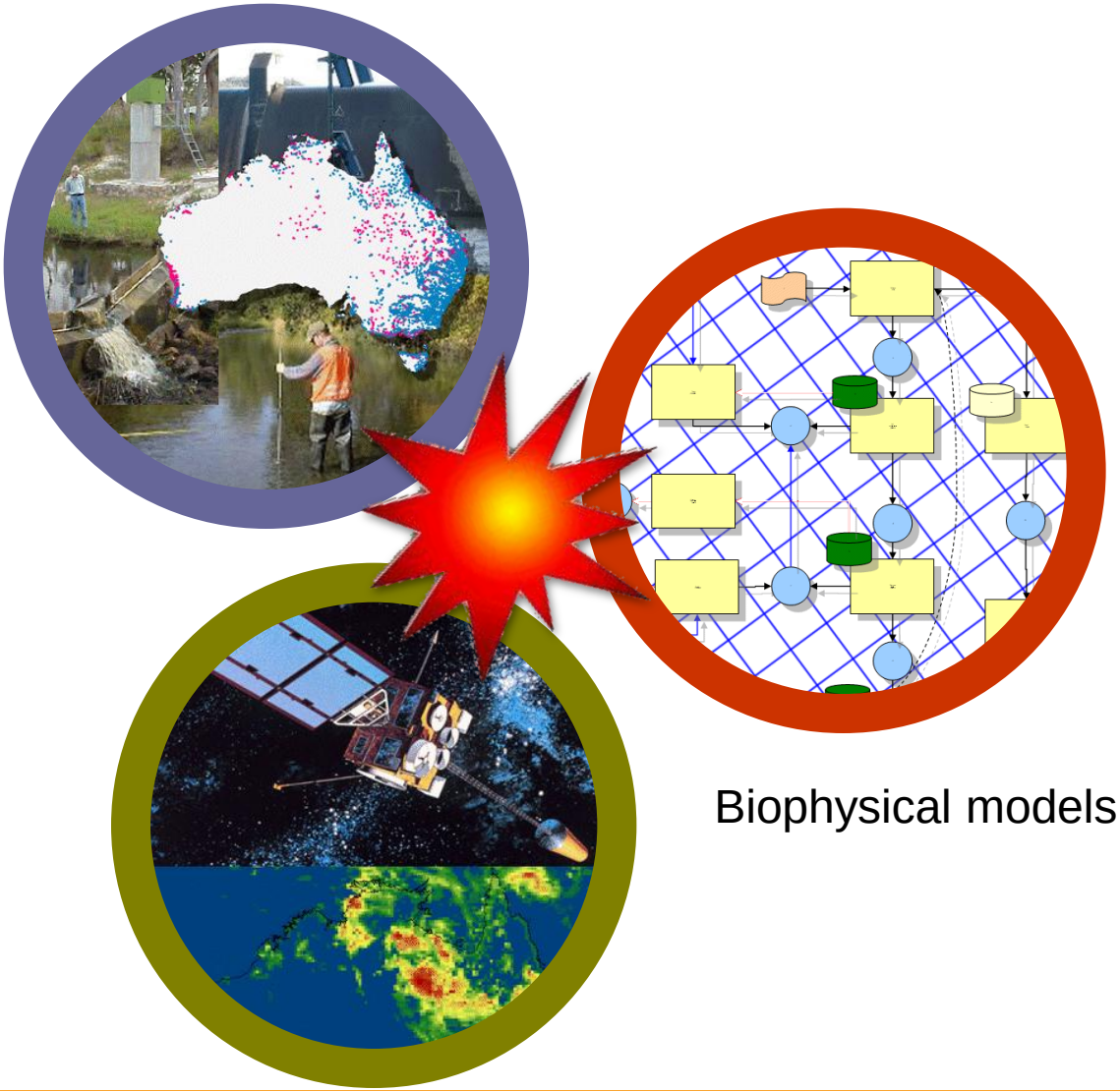
Ongoing research projects

- Great Barrier Reef floodplain renewal
  - research to improve floodplain productivity for coastal communities through sensitive farming approaches that improve water quality & protect the Reef
- Great Barrier Reef sustainable grazing
  - research to support improved economic performance for grazing communities while reducing erosion & improving water quality
- Reef catchment futures research to inform decision making for a sustainable Reef through:
  - understanding the GBR catchment as a system
  - identifying key intervention points & the costs & benefits of different management actions leading to improved water quality in the GBR lagoon



Key issues for environmental earth observation (including consideration of the GBR)

On-ground observations



Biophysical models

Satellite observations

Research goals

- *Helping solve Australia's environmental issues* – notably the sustainable use of Australia's water resources & aquatic & vegetation ecosystems
- *Delivering science & tools* – We achieve this by coupling process knowledge with remote earth observations to create new understanding & improved management tools
- *Addressing issues of scale* – using models, satellite data & sparse in-situ observations to match observational & process scales, in both spatial & temporal domains

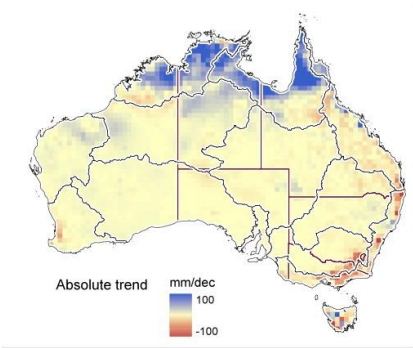
Major drivers for earth observation capability

- Impacts of climate, land use & water management on water availability & water quality
- Development of predictive tools to operationalise resource management
- Constraining model outputs using remotely sensed data
- Technological drivers
- Sustained delivery of accurate & calibrated earth observation products

Research challenges #1

Terrestrial Earth Observation

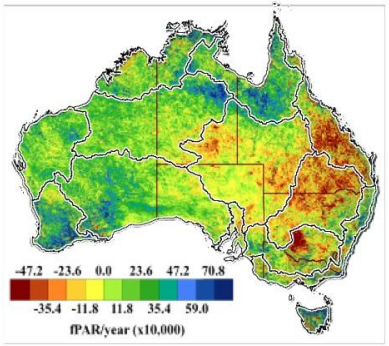
- Ecohydrological time series remote sensing (McVicar, Donohue, Van Neil, & Li)
- Model-data integration (van Dijk, Renzullo, Guerschmann, ...)



Trends in streamflow 1980-2008

Challenges

- Interactions between climate & vegetation & its role in coupling the water & carbon balances are poorly understood
- On-ground data is sparse
- Satellite observations are mostly indirect
- Existing biophysical models are under-constrained & need adaptation to 'accept' remote sensing products

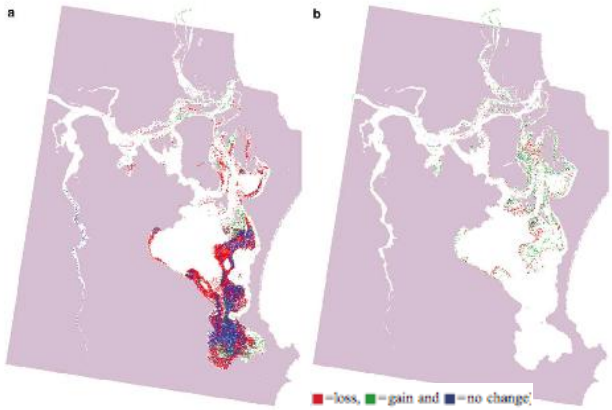


Trends in vegetation biomass 1980-2006
Donohue et al., (2009)

Research challenges #2

Aquatic earth observation

- Shallow water habitats & inland waters (Dekker, Botha, Anstee, Park …)
- Optically complex waters (Brando, Schroeder, Cherukuru …)

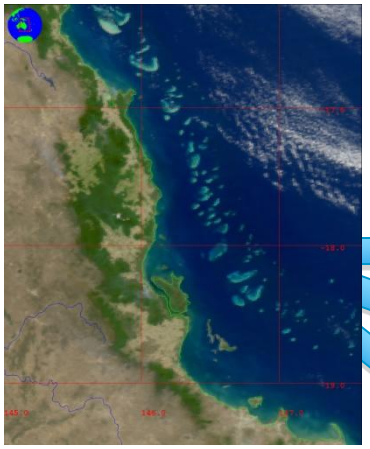


<u>Posidonia</u> seagrass cover, Wallis Lakes, 1988-2001 – Dekker et al. 2005

Challenges

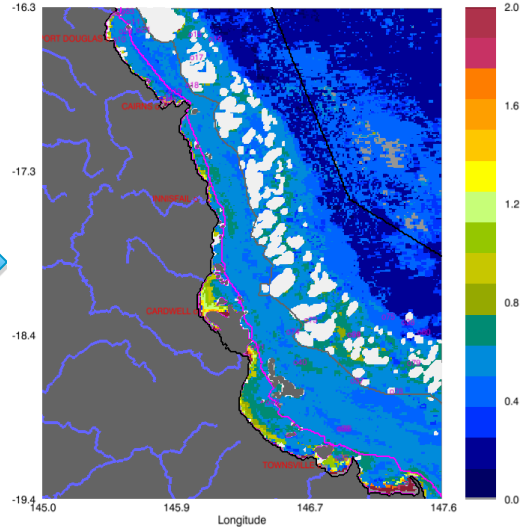
- Governing physical processes are complex - global ocean colour products lack accuracy in coastal environments
- In situ optical data are ultra-sparse
- The spatial processes driving turbidity, primary production & water quality in inland & coastal waters are dynamic & regionally variable
- Constraining of biogeochemical models is in its infancy
- Long-term trends in regional water quality & benthic habitats are understudied

Examples of aquatic work

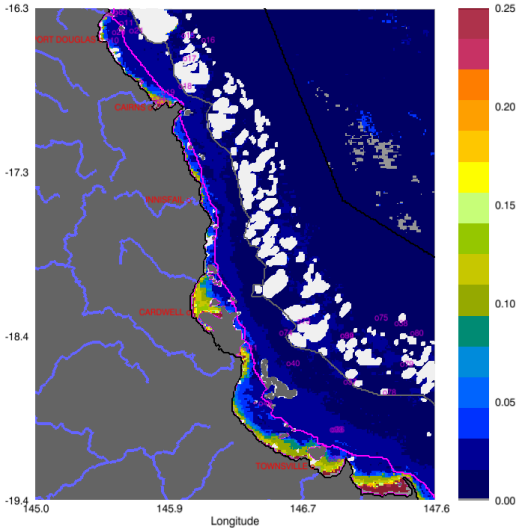


MODIS 20 September 2007

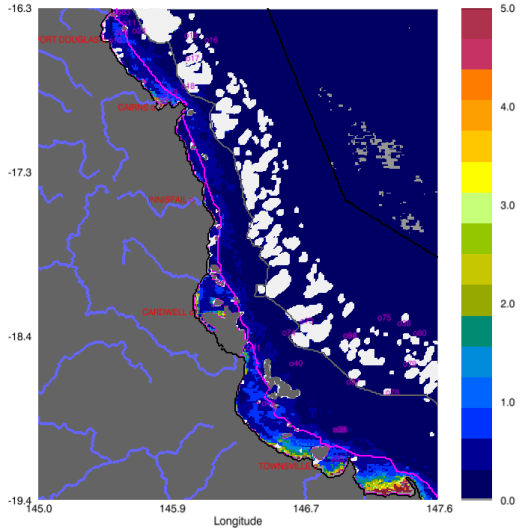
Simultaneous physics-based inversion



CHL [μgL^{-1}]

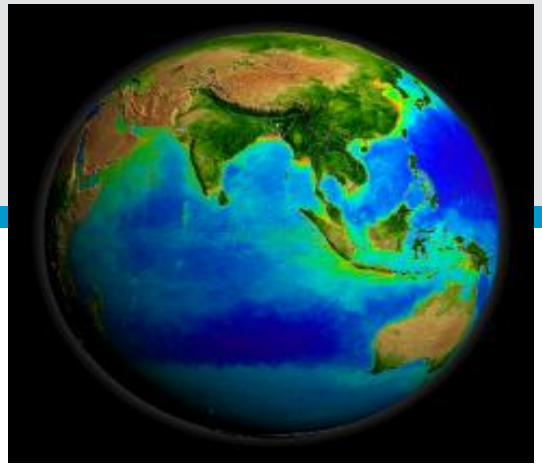


$a_{CDOM}(440)$ [m^{-1}]



TSS [mgL^{-1}]

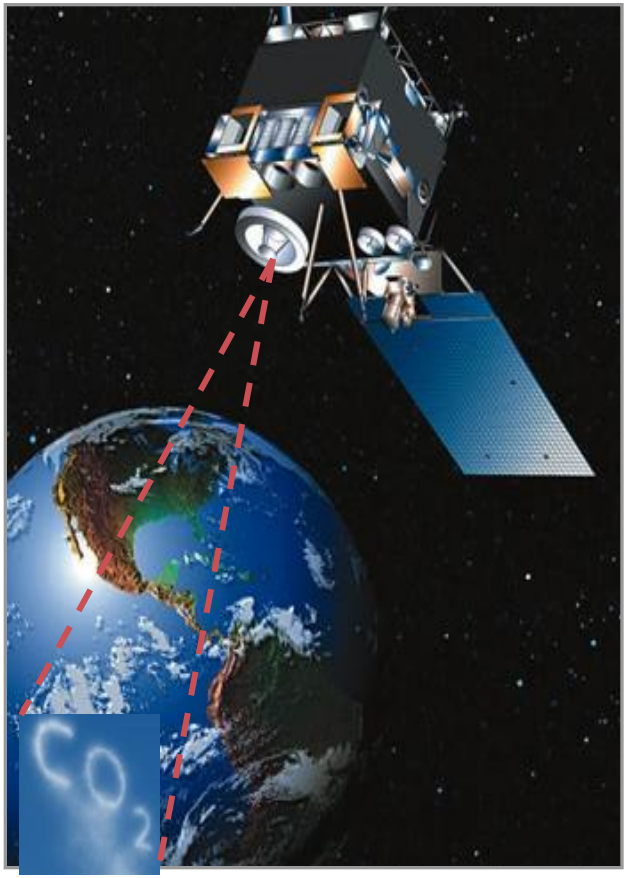
Future science directions for environmental earth observation



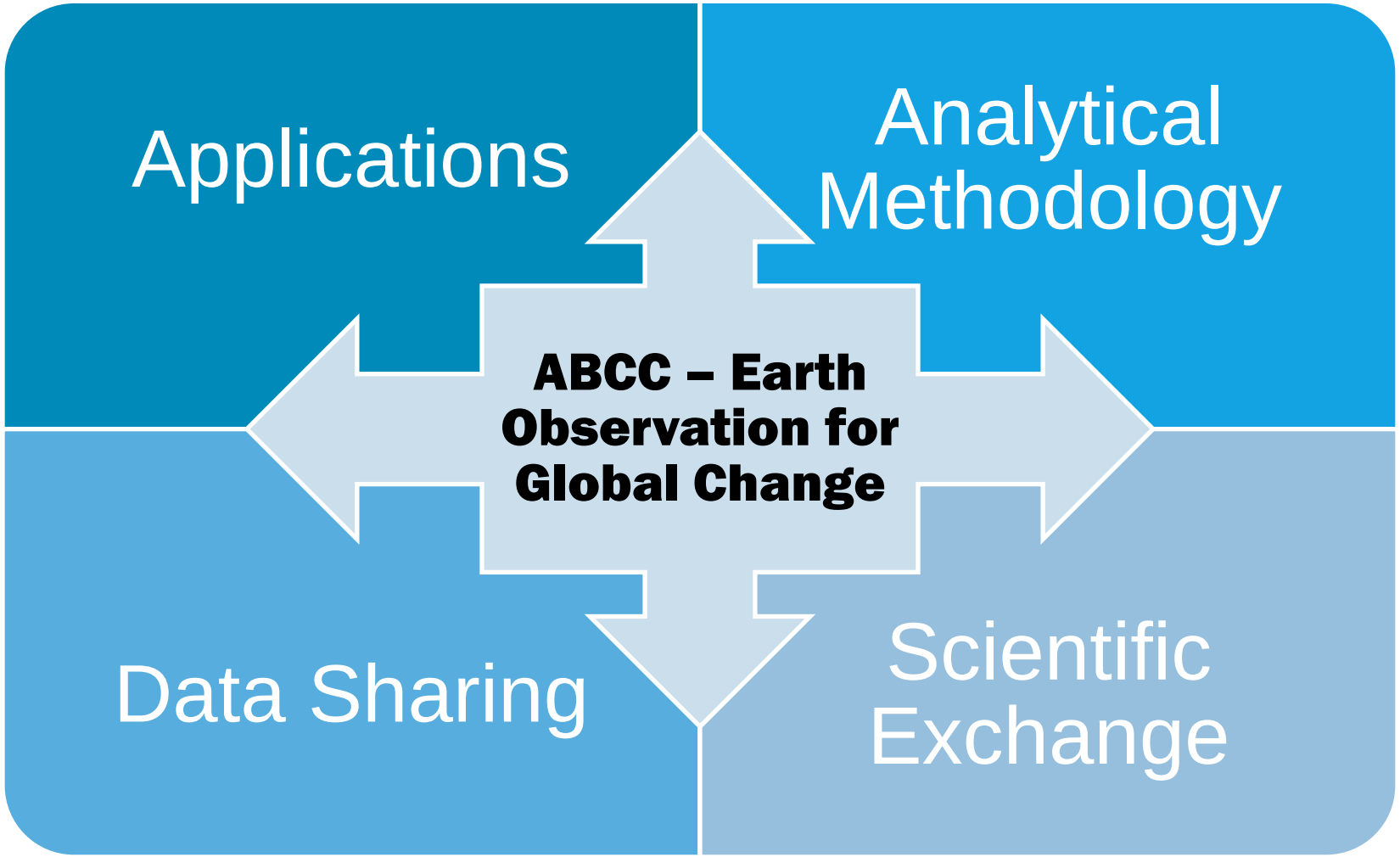
- Key opportunities
  - Data assimilation & modeling tools
  - Multiple sensor data fusion
  - Generational increment in satellite capabilities
  - Integrated observing networks (from the ground to space)
  - Driving down the uncertainties
- ‘Catchment to ocean’ integrated applications
- Constraining & calibrating models for water & carbon accounting
- Separation of climate variability from climate change
- Development of cal/val facilities & expertise
- ‘Future proofing’ current EO data products & outputs
- Inland & estuarine water quality

Considerations for ongoing collaboration

- stimulate new partnerships
  - seed funding; co-investment by ABCC partners
- enhance relationships and productivity of teams in existing relationships
  - co-investment by ABCC govt & global institutions
- ABCC collaboration
  - enhancing national outcomes
  - partners in developing global systems science and knowledge



Key areas for collaboration



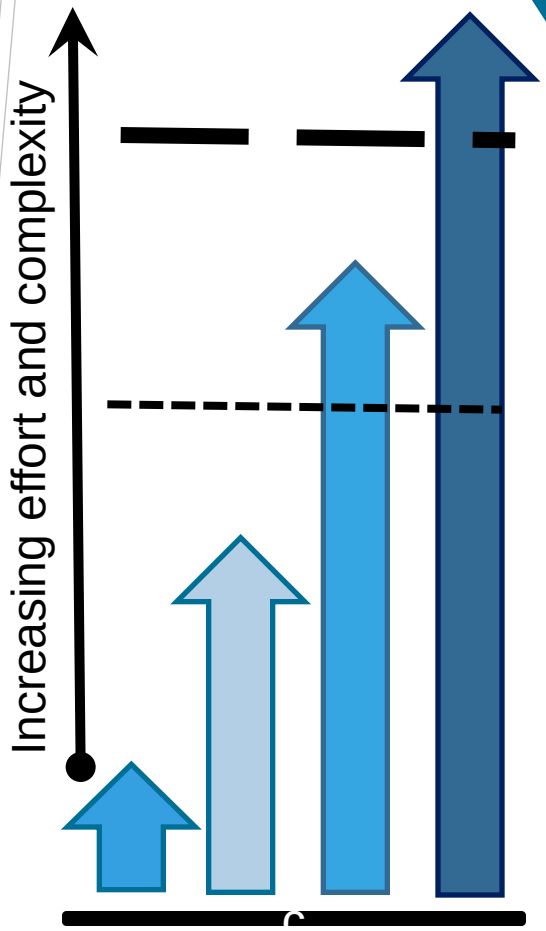
		Applications					
		A1 Carbon Cycle	*A2 Water & Ecosystems*	*A3 Land Use & Land Cover*	*A4 Disaster & Resource Monitoring*	*A5 Environmental Monitoring*	
Analytical Methodology	M1 fusion of radar & optical	**X**					**X**
	M2 Aaa					**X**	
	M3 BBB						
						X	

		Applications					
		A1 Carbon Cycle	A2 Water & Ecosystems	A3 Land Use & Land Cover	A4 Disaster & Resource Monitoring	A5 Environmental Monitoring	
Data Sharing	Australia						
	Brazil	X				X	
	Canada						
	China	X				X	

		Applications					
		A1 Carbon Cycle	*A2 Water & Ecosystems*	*A3 Land Use & Land Cover*	*A4 Disaster & Resource Monitoring*	*A5 Environmental Monitoring*	
Scientific Exchange - Australia	M1 fusion of radar & optical	X					X
	M2 AAA					X	
	M3 BBB						

What would success look like?

- 3rd party funding
- Increased rate of publication
- Enhanced capability of staff



co-investment from global institutions

co-investment from ABCC governments

co-investment from ABCC partners

seeds funds

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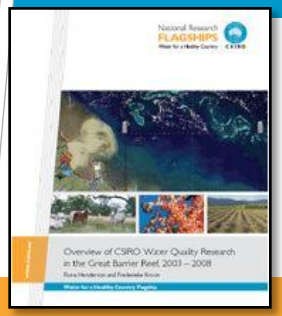
Thank you



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