2015 International Ocean Colour Science
(IOCS), San Francisco June 15-18

Collaborative Earth-Observation Infrastructure for Coastal and Coral Reef Monitoring & Management

Stuart Phinn and Chris Roelfsema

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

BIOPHYSICAL
REMOTE SENSING GROUP

..

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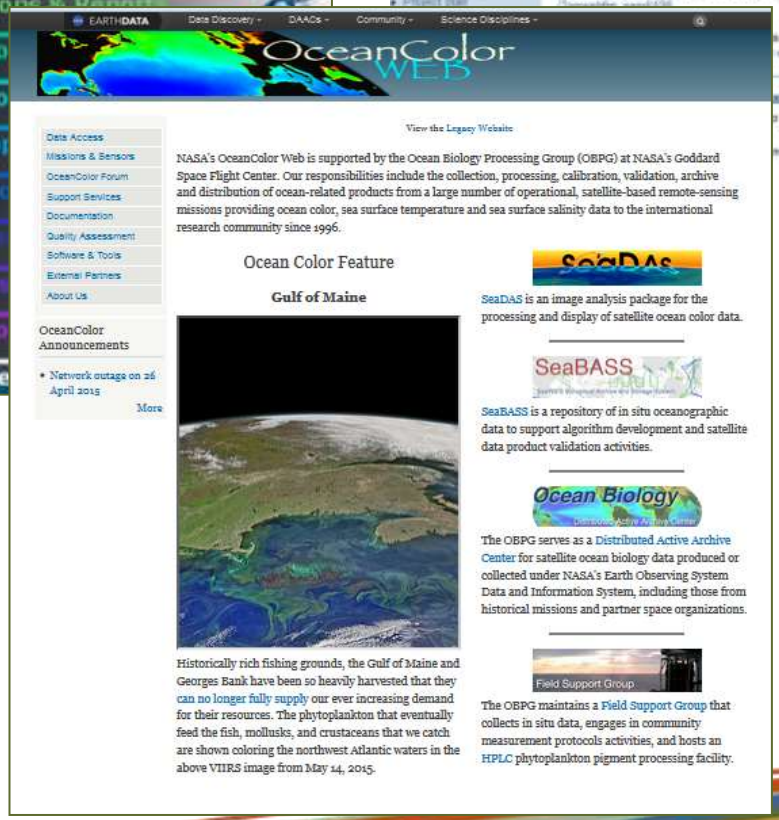
IMOS Integrated Marine Observing System

Ecosystem Science
Long-Term Plan

Aim for today's talk….

To outline lessons learnt in establishing and sustaining coordinated observational science capabilities, especially those linked to satellite monitoring in coastal and coral reef environments.

- **Australia has a lot to learn from the international ocean colour science community :**



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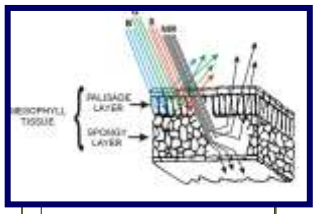
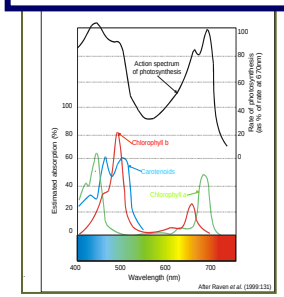
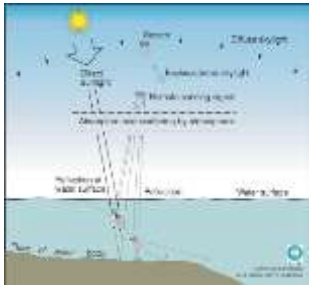
- Some context for the talk…..
- Introduction

  Designing sustainable and collaborative, long term scientific infrastructure
- Starting the Design of National Collaborative Infrastructure
- Coastal and Coral Reef Monitoring and Management: Needs + Status
- Establishing Collaborative National Research Infrastructure
- **Lessons Learnt and Moving Forwards**

- **Some context ……. what we try to do:**







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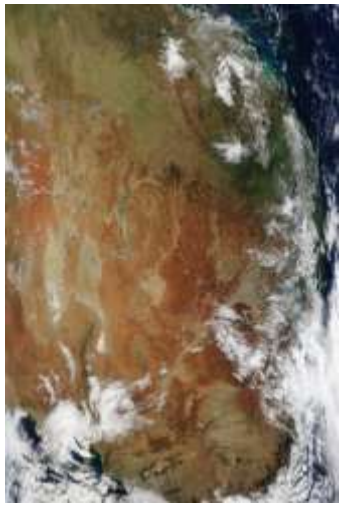
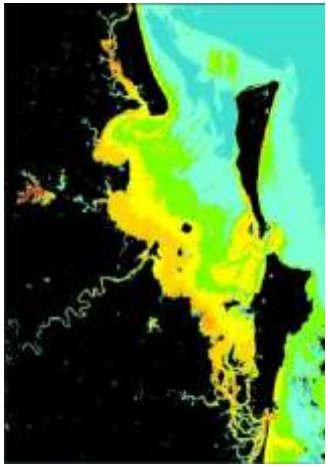
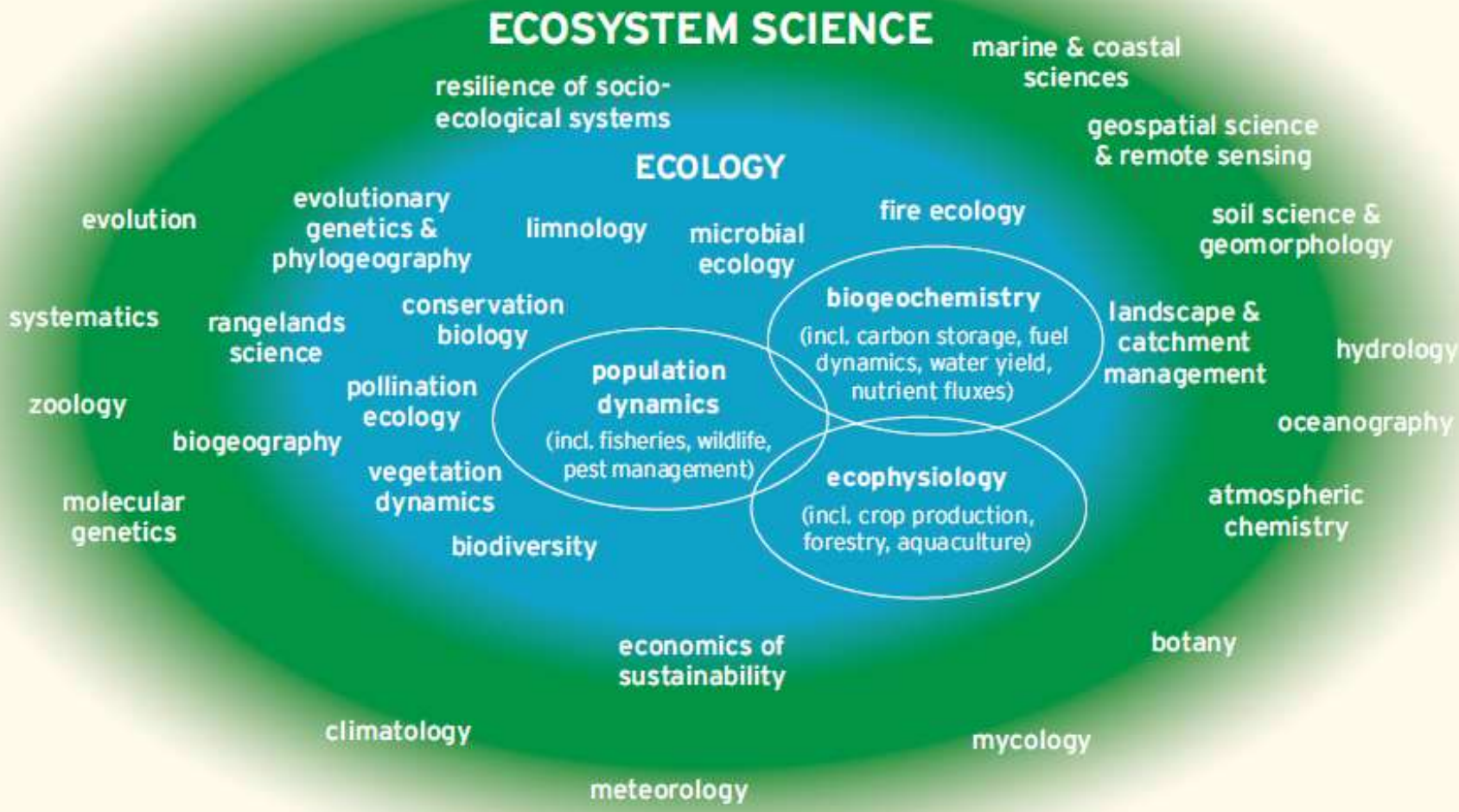


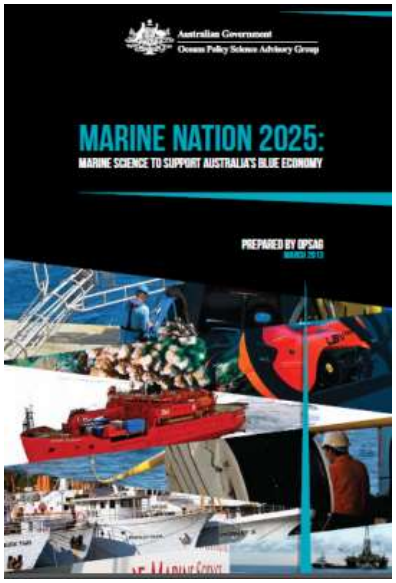



PLAY
THE 7.30 REPORT

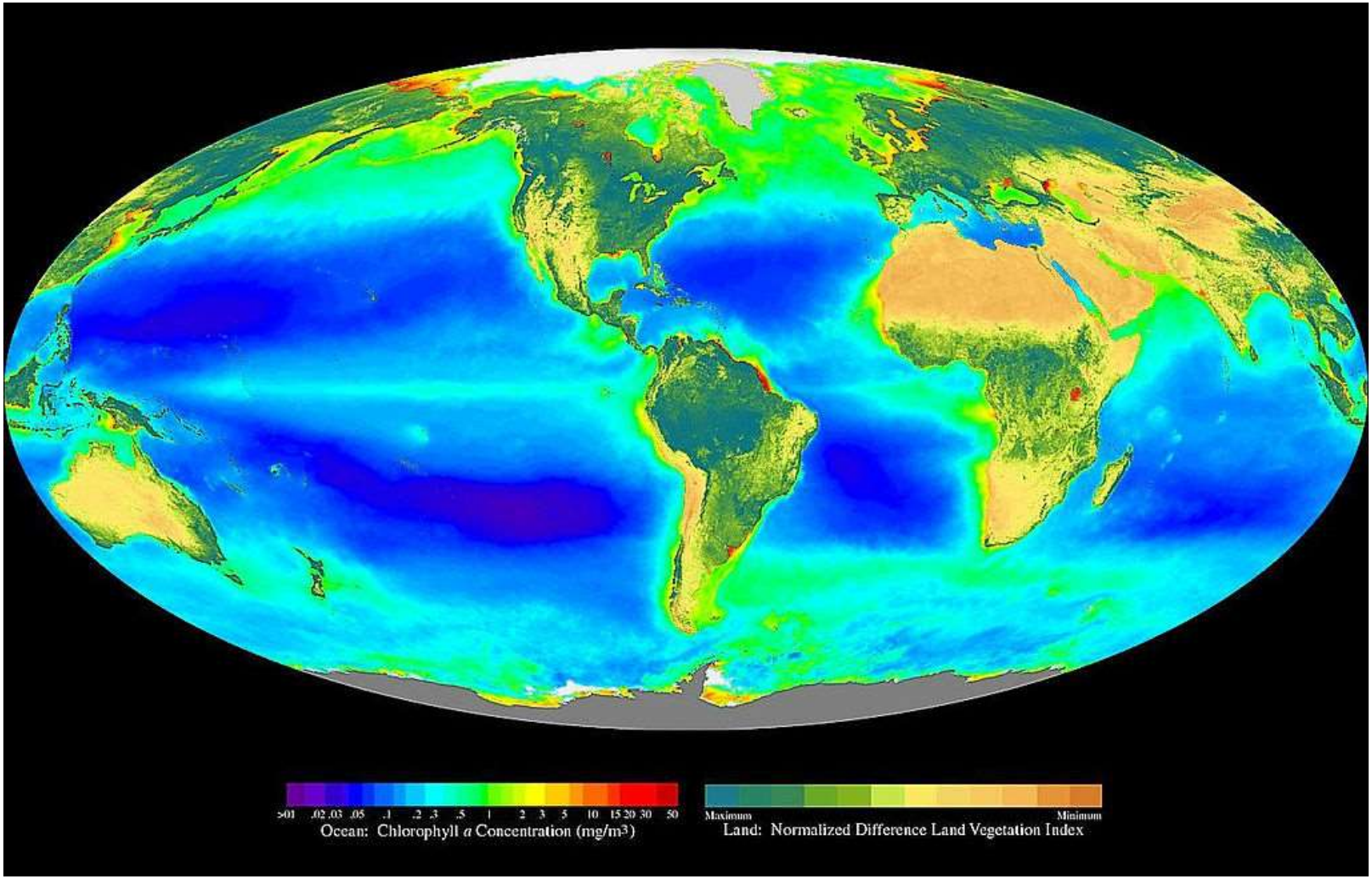
- **Some context** ……Engaging ecosystem science



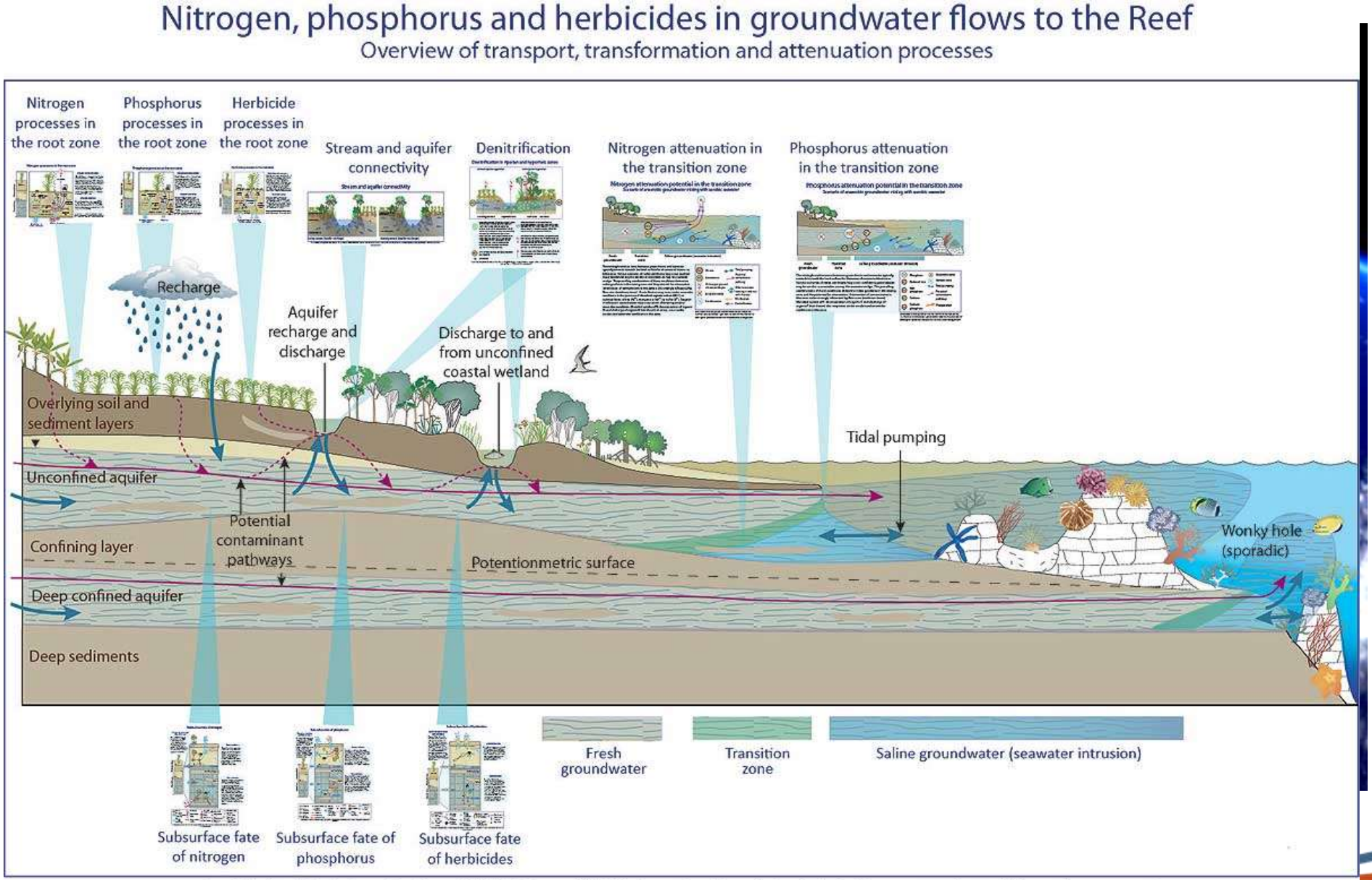
- **Some context … ……Engaging ecosystem science communities**



- **Some context ……. Australian marine and terrestrial ecosystems**



- **Some context ……. Australian marine and terrestrial ecosystems**



Lana Baskerville and Heather Hunter. From: Hunter, HM (2012), 'Nutrients and herbicides in groundwater flows to the Great Barrier Reef lagoon: processes, fluxes and links to on-farm management'.

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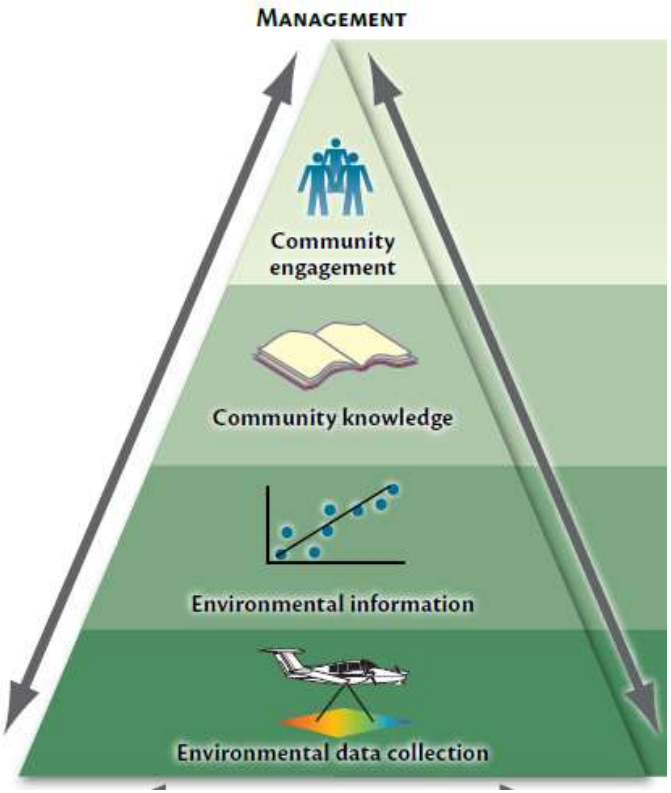
- **"IDEAL"** components of sustainable collaborative long term research infrastructure:

- Identifiable and accessible "community(ies)"
- Clearly defined goals, understanding and use of science
- Agreed processes for cooperation and collaboration
- Accessible and verified protocols for collection + sharing data
- Variety of funding sources
- Established and maintained links with government, industry and community



Source: Longstaff, B.J., T.J.B. Carruthers, W.C. Dennison, T.R. Lookingbill, J.M. Hawkey, J.E. Thomas, E.C. Wicks, and J. Woerner (eds) Integrating and applying science: A handbook for effective coastal ecosystem assessment. IAN Press, Cambridge, Maryland.U.S.A.,

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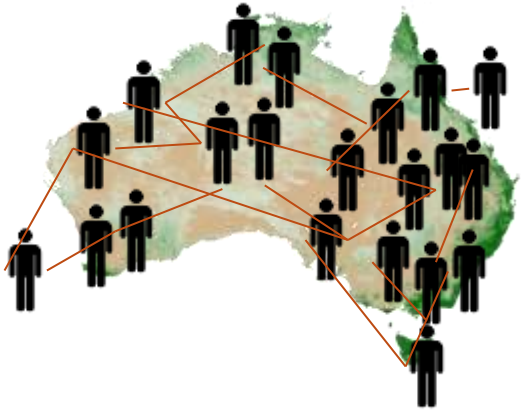
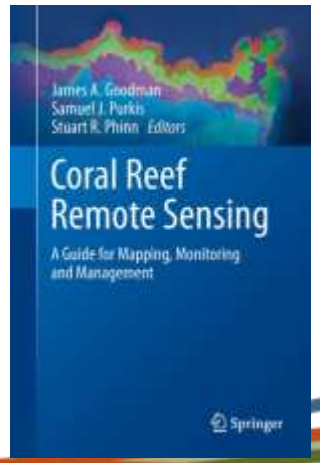
- **Building national collaborative research infrastructure assumed versus reality?**
- Existing cooperative networks were in place and engaged with key groups across science and management.
- Methods/protocols for data collection, analysis, and distribution were established.
- Common data and meta-data file formats were in place and able to be expected.
- People would cooperate and collaborate to develop systems for collection and sharing of data.
- Funding, rewards and national/inter-national priorities aligned with collaborative research infrastructure and research .





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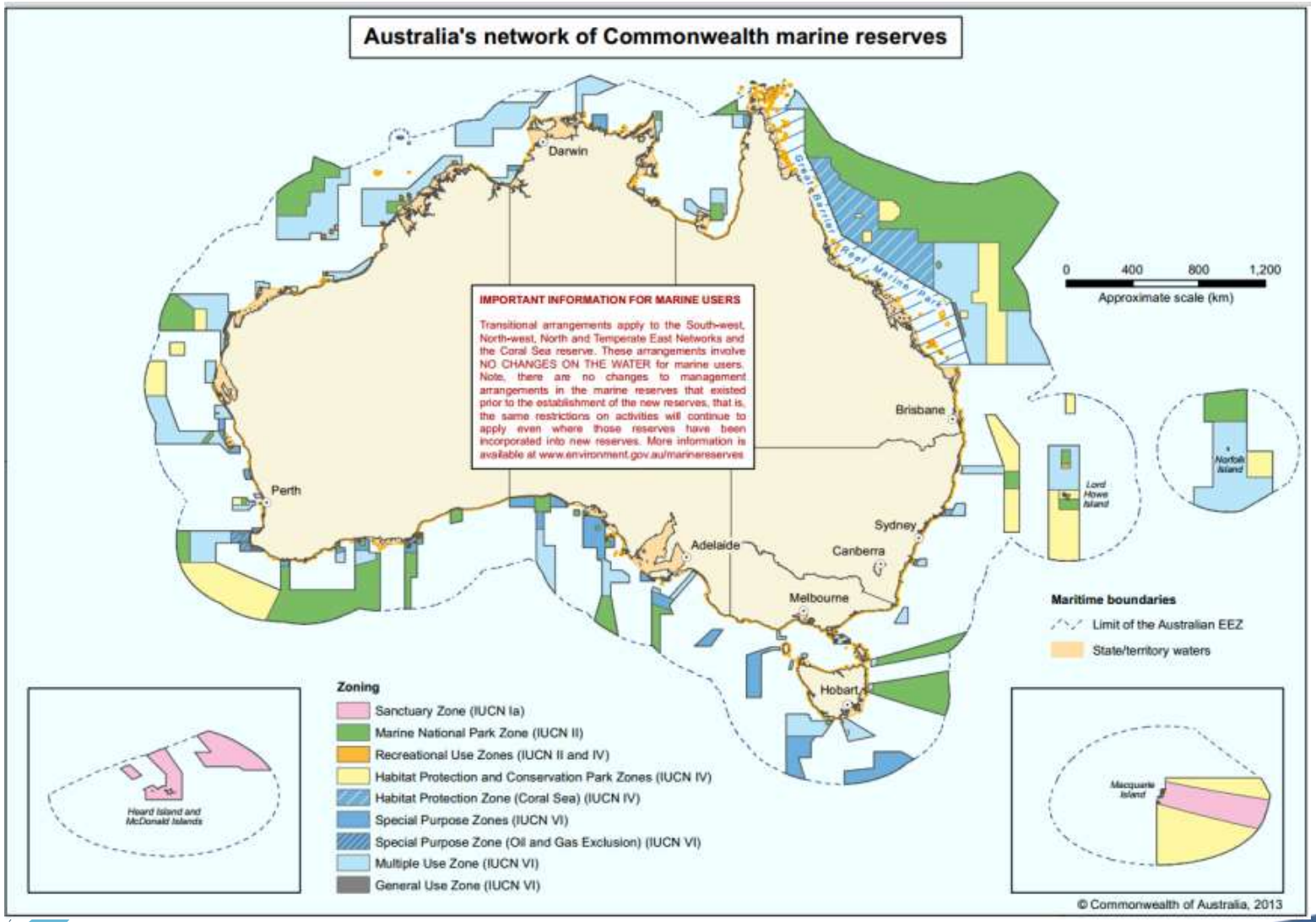
- Monitoring coasts and coral reef waters:

  Jurisdictions and overlaps - spanned by infrastructure:



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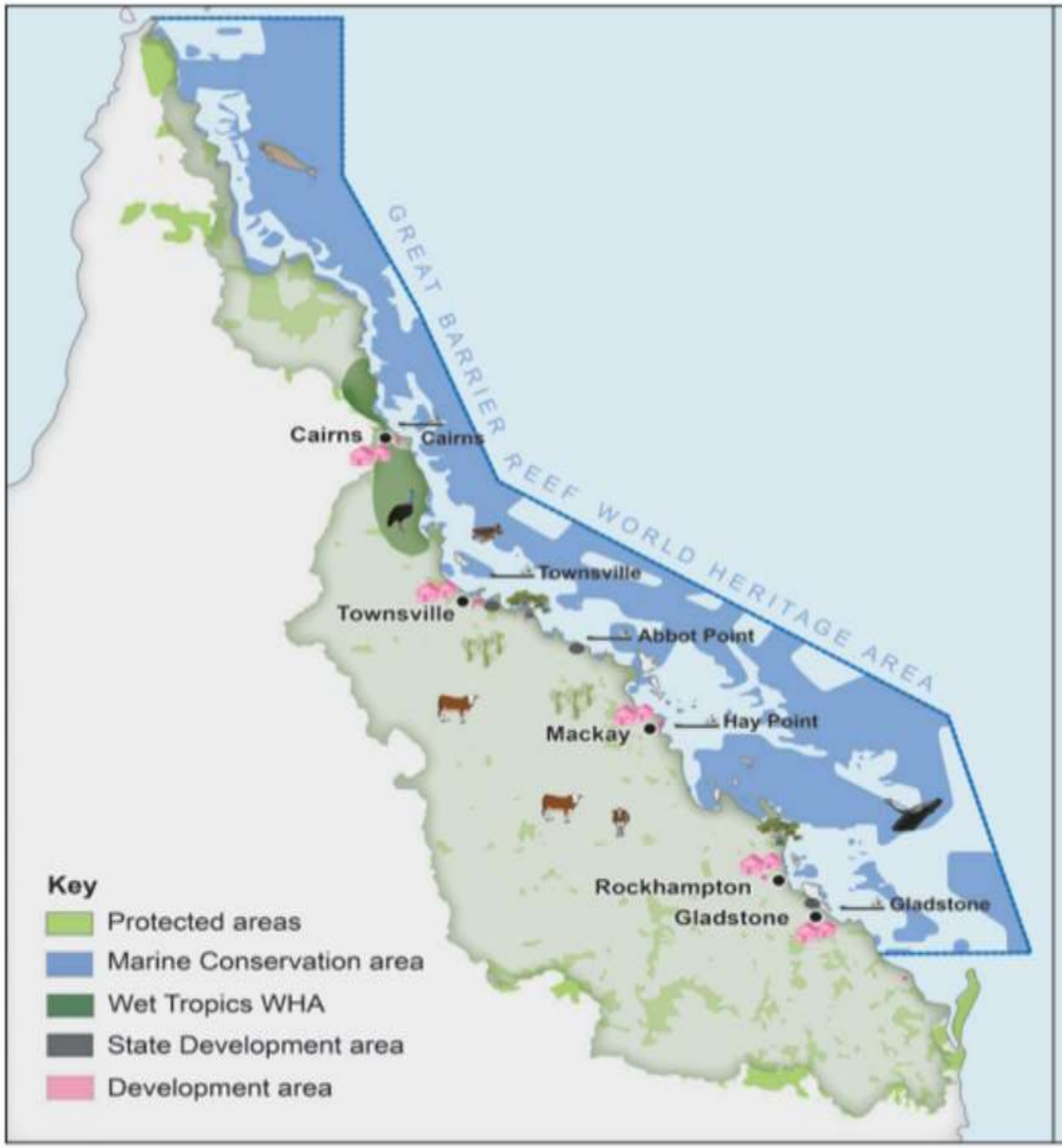
- **Monitoring coasts and coral reef waters:**

Jurisdictions and overlaps: terrestrial-coastal-marine



Great Barrier Reef World Heritage Area

covers 348 000 km^2

2300 km of coastline

roughly the size of Italy

3000 coral reefs

1050 islands

Wet Tropics World Heritage Area

covers 8944 km^2

89 % in protected area

Population

less than 1 million people

70 Traditional Owner groups

Development

< 3 % of the coastal zone is developed

5 regional centres all < 200 000 people

5 key trading ports

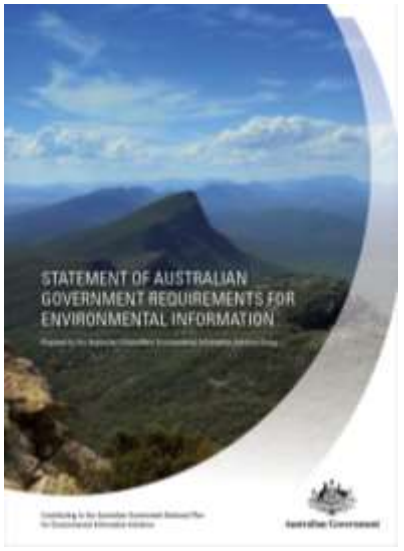
Conservation

32 % of coastal zone in protected areas

96% of the GBRWHA in the coastal zone is in state or Commonwealth marine parks

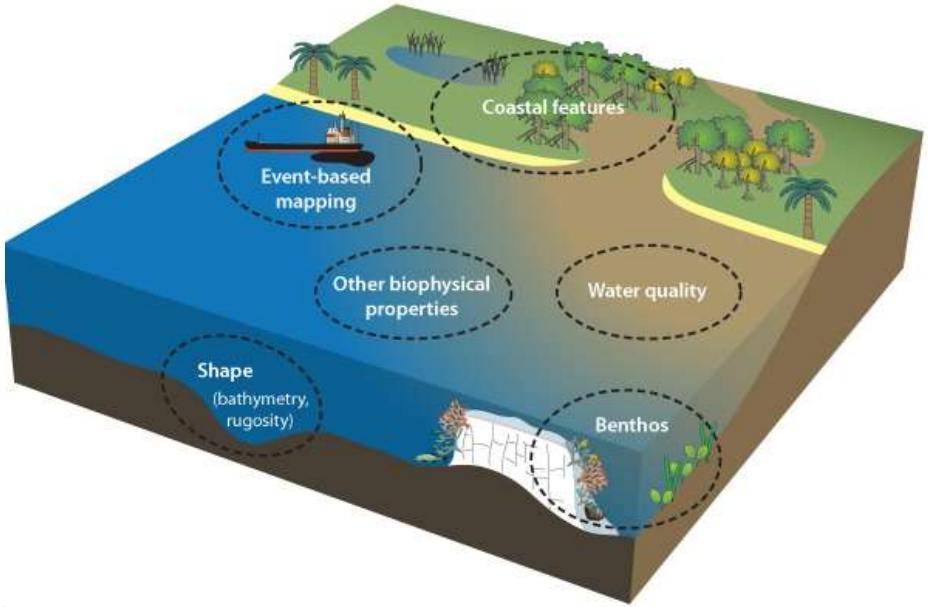
2 Ramsar sites > 80 % in protected areas

- **Requirements for coastal and coral reef science and monitoring in Australia**



- Water surface properties
- Water column properties
- Benthic features+properties

- Sources:
  - Image
  - Field
  - Modelled

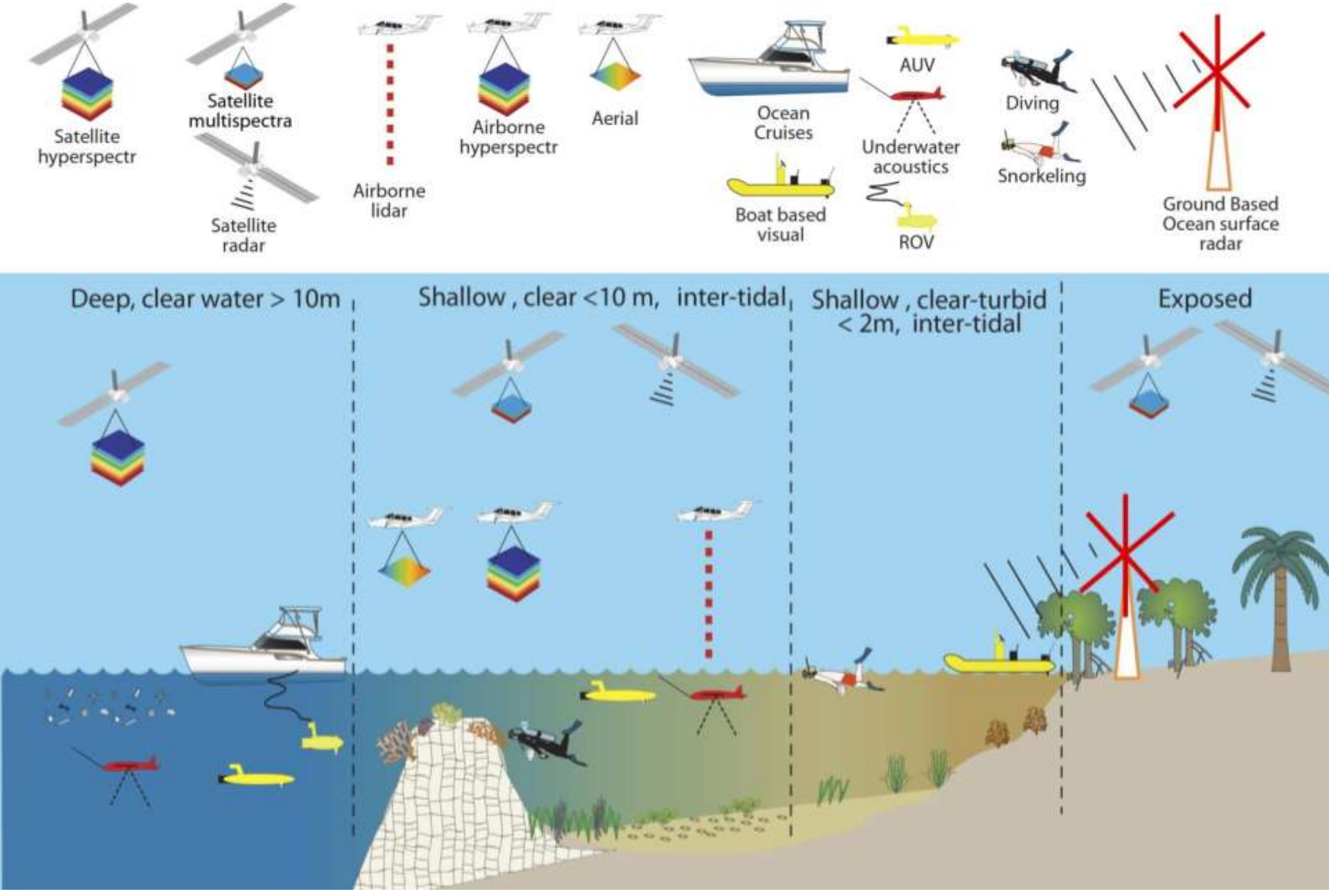


- Essential water quality variables from remote sensing (A.Dekker)

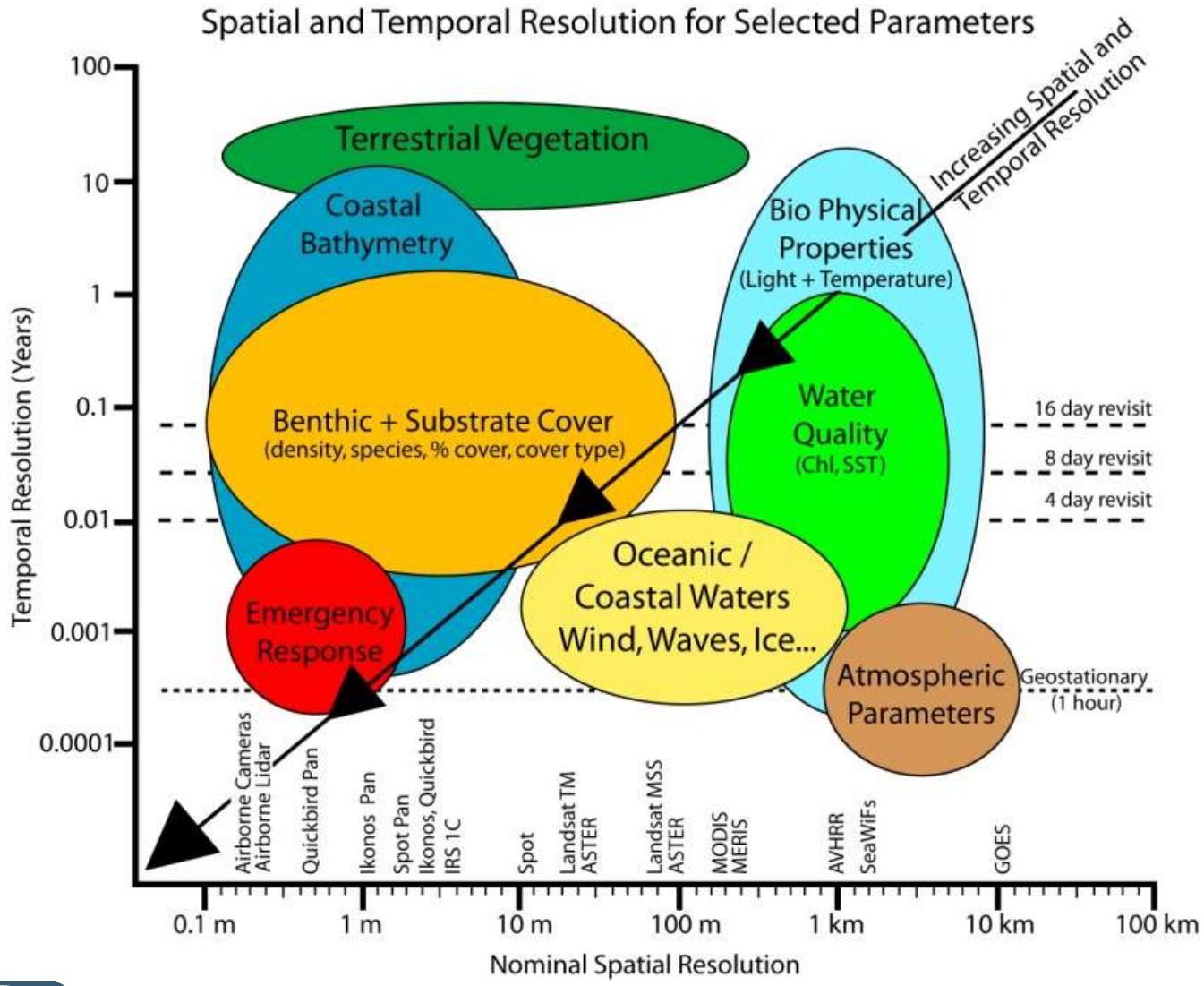
WATER QUALITY INFORMATION	WATER QUALITY VARIABLE
Primary production and eutrophication status Aquatic carbon content, carbon fluxes	CHL
	CPC (cyanobacterial pigment)
	CPE(cyanobacterial pigment)
	Surface algal blooms
Aquatic carbon content, carbon fluxes	CDOM
Erosion, re-suspension and deposition Aquatic carbon content, carbon fluxes	TSM (ΣCHL+NAP)
Light climate information related to the combined effects of algae, CDOM and suspended matter	K_d
	Transparency
	Turbidity
Ecological condition	Emergent macrophytes
	Submerged macrophytes

CHL=chlorophyll; CPC=cyano-phycocyanin; CPE=cyano-phycoerythrin, CDOM=coloured dissolved organic matter; TSM-total suspended matter; NAP=non-algal particulate matter; K_d=vertical attenuation of light

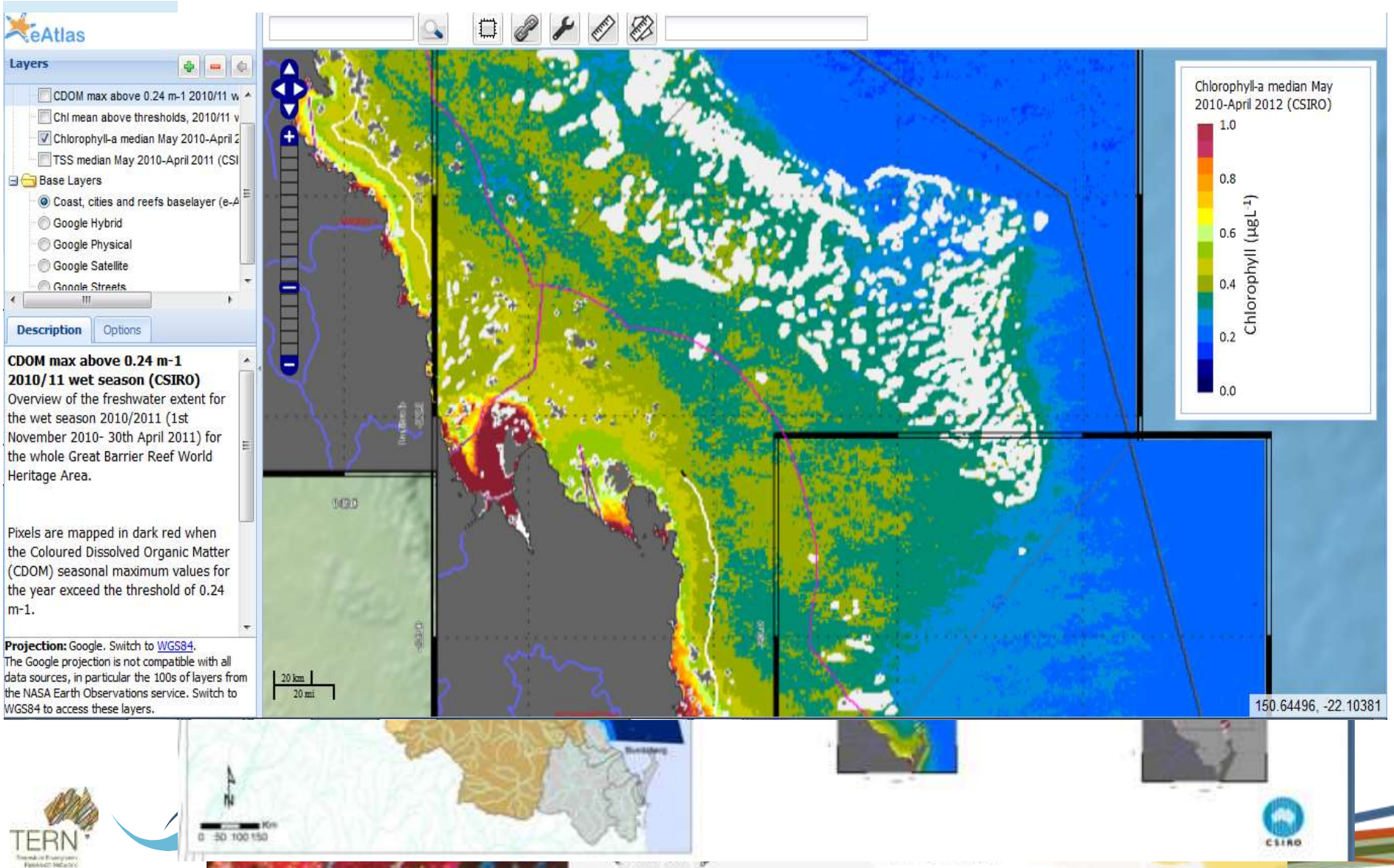
- **Operational sensors coastal and reef environments:**



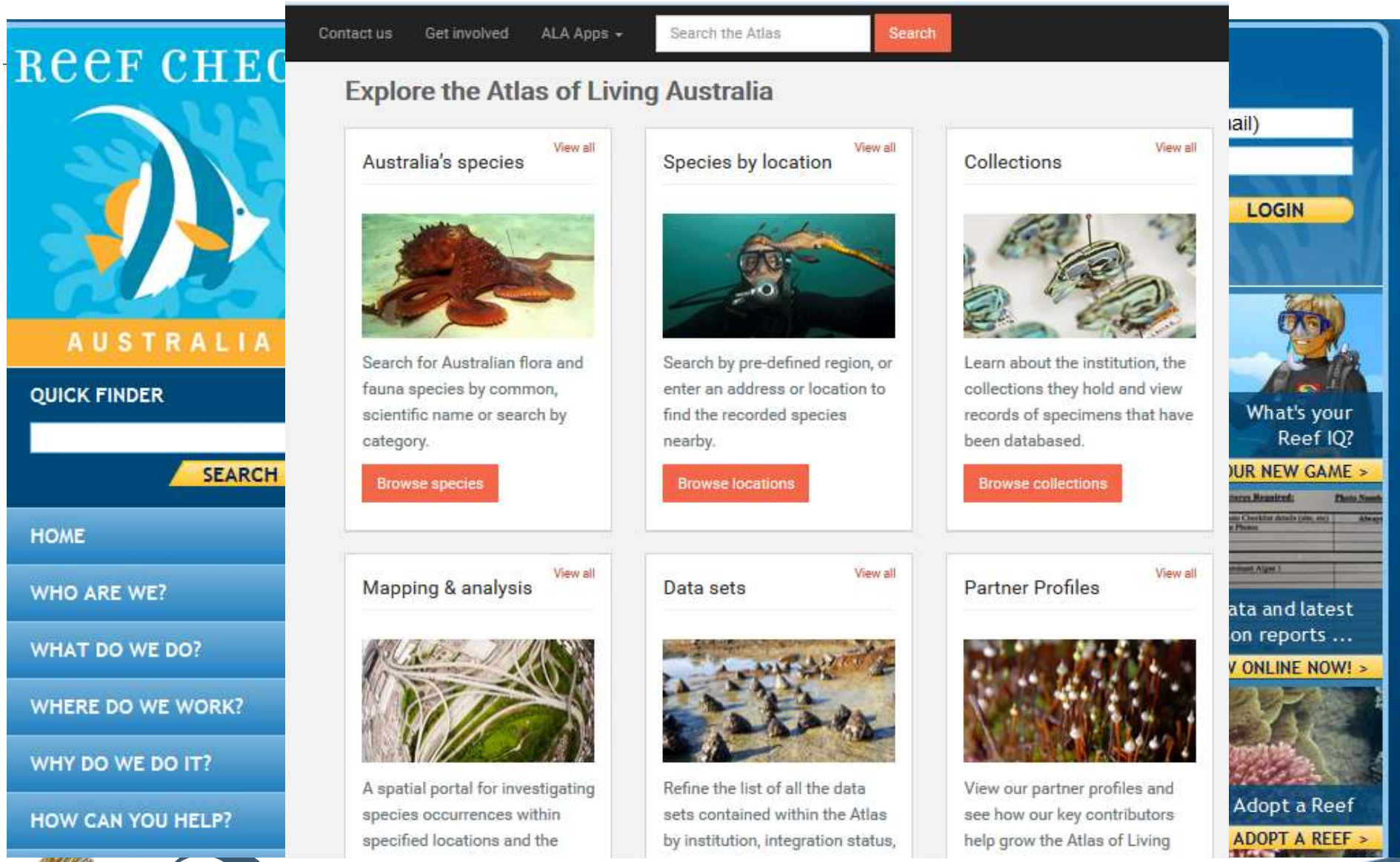
- **Suitable spatial and temporal scales**



- Monitoring and managing coasts and coral reef waters



- Monitoring and managing: Citizen science



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- **Guided by:**

- National research infrastructure priorities
- National research priorities
- Relevant management agency priorities

- Political priorities

- National discipline based coordination
- International discipline based coordination

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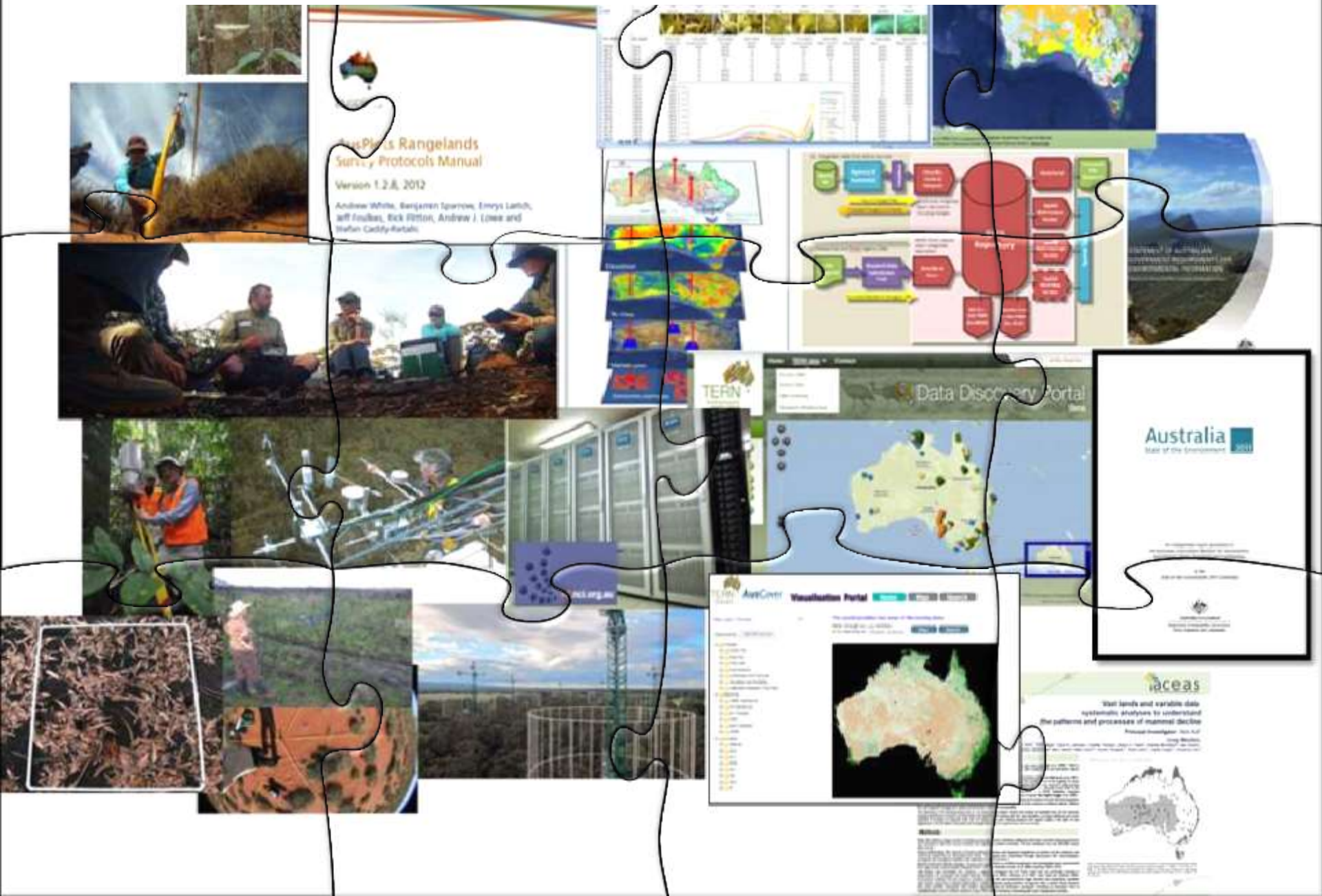
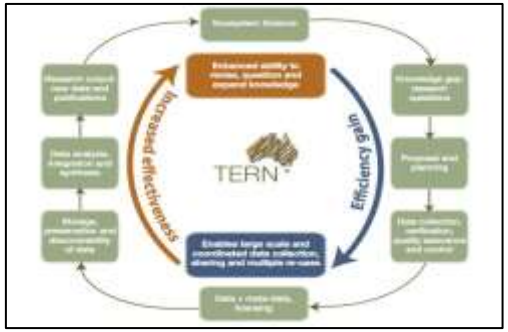
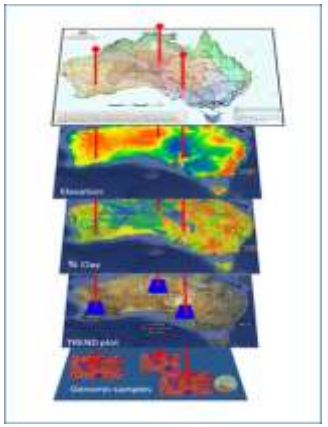
- **Australia's Terrestrial Ecosystem Research Network (TERN)**



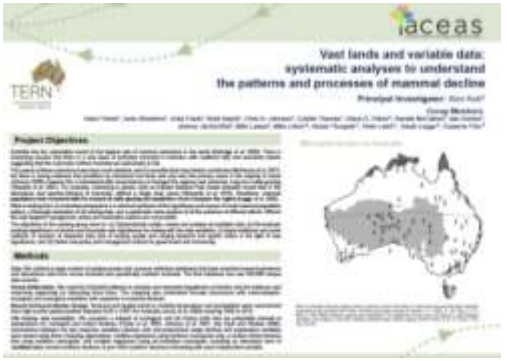
• TERN's approach to building collaborative infrastructure

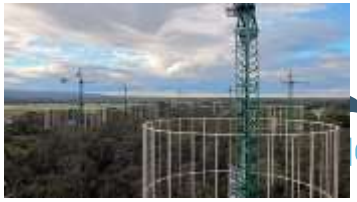




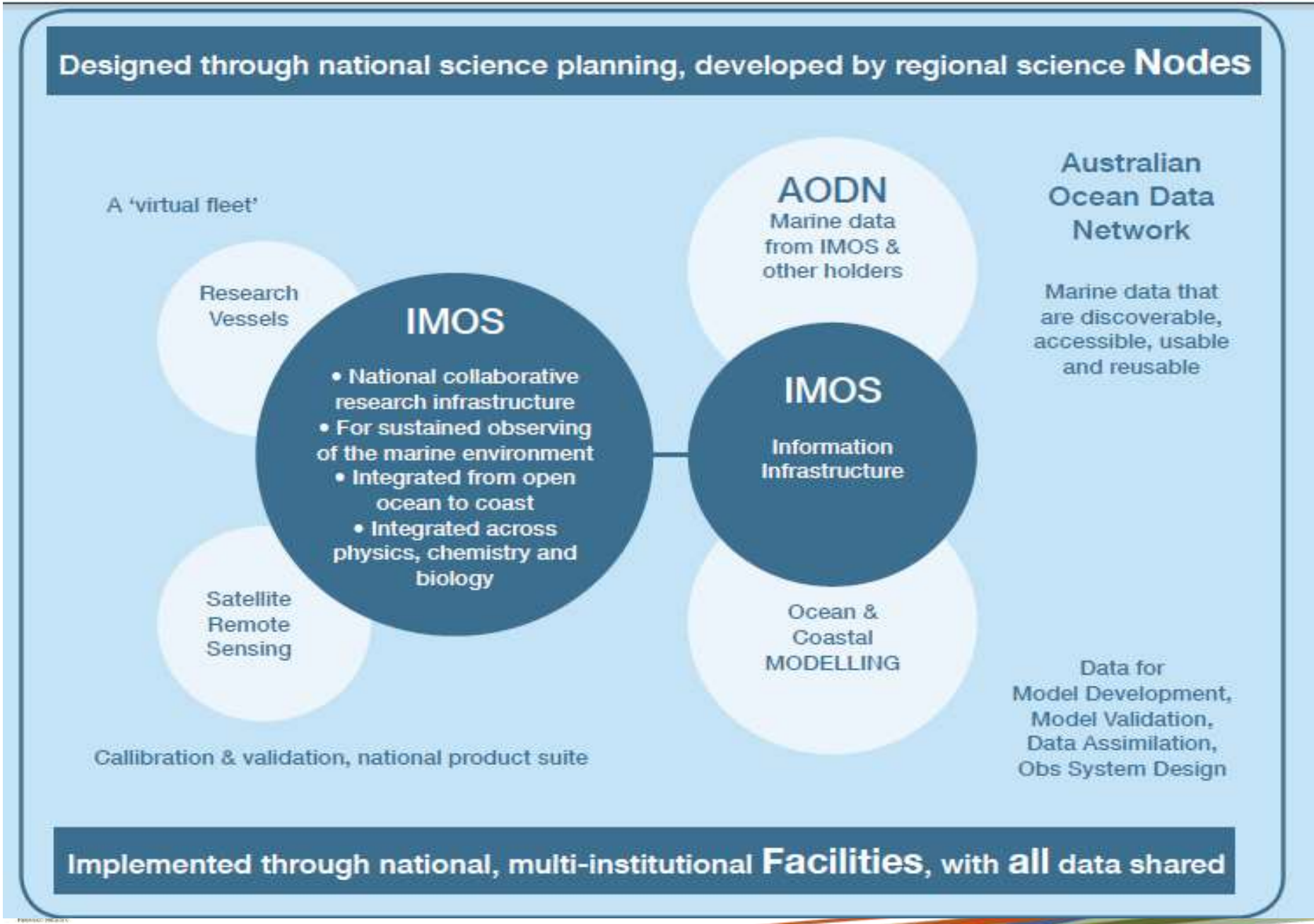
Collection Methods | **Data Storage** | **Data Sharing** | **Modelling** | **Policy + Management**

Instruments + Sensors | **Processing + Analysis** | **Data Curation + Publishing** | **Data Searching** | **Analysis + Synthesis**

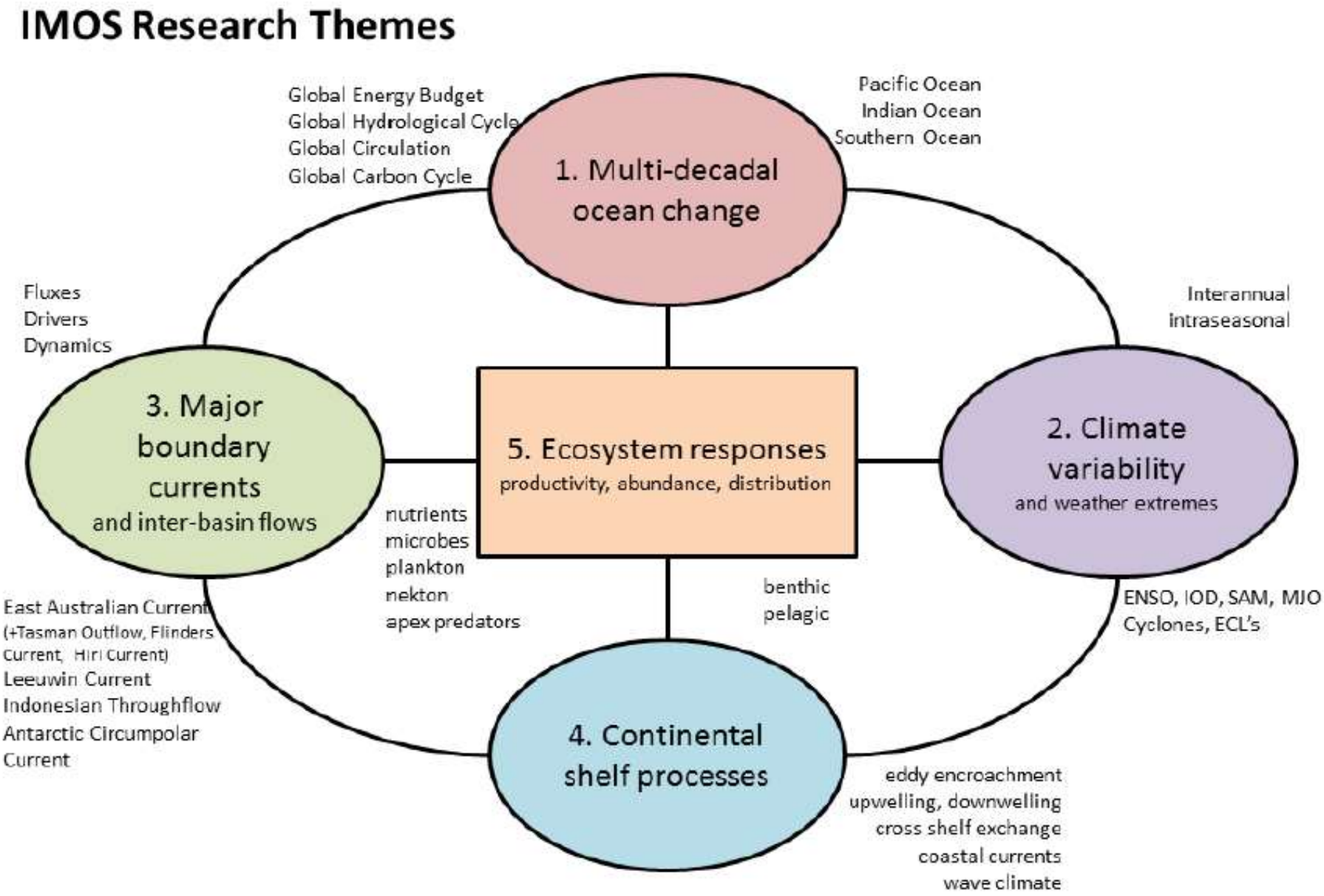




• Australia's Integrated Marine Observing System



- Monitoring and managing our coasts and coral reef waters: Jurisdictions and overlaps - spanned by infrastructure:



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- **Establishing Collaborative National Research Infrastructure requires:**

1) People

2) Data Collection

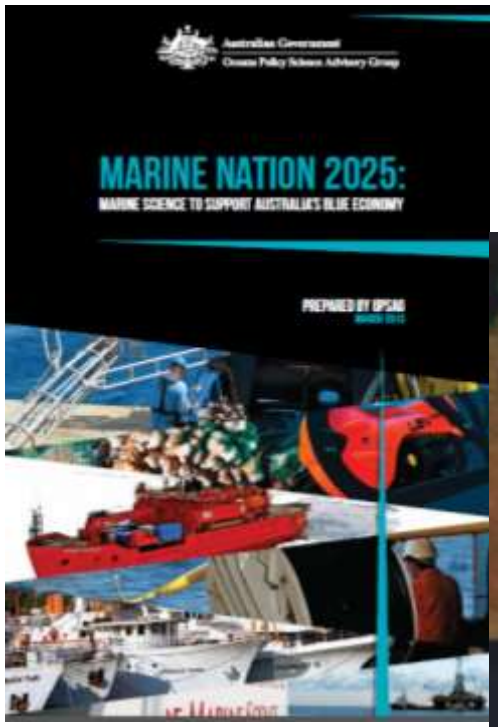
3) Data Processing, Storage and Publication

4) Integration, Analysis and Synthesis

5) Linkages

- **People……**

……. in a collaborative, coordinated, networked approach to ecosystem science using a multi-disciplinary community of skilled personnel, alongside development and sharing of knowledge and skills.

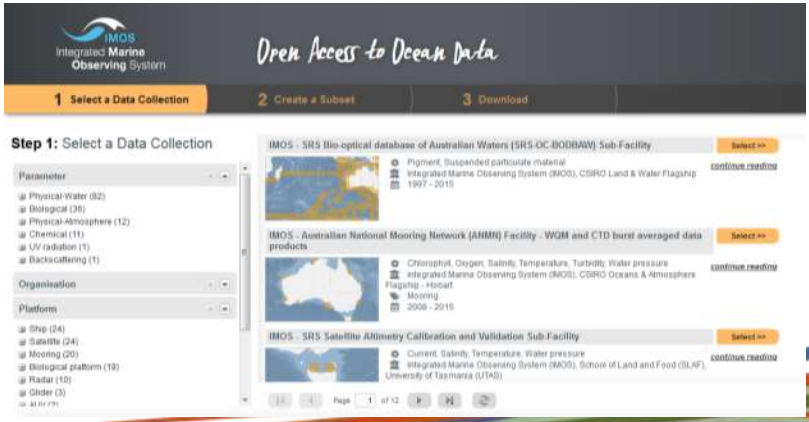


- **Data collection**

……that expands on existing data collection infrastructure and processes to collect data on essential ecosystem variables across time and space.

- **Data processing, storage and publication,**

……. to ensure it is discoverable, accessible, reusable and citable (ensuring it contains enough contextual information to determine if the data are fit for use).



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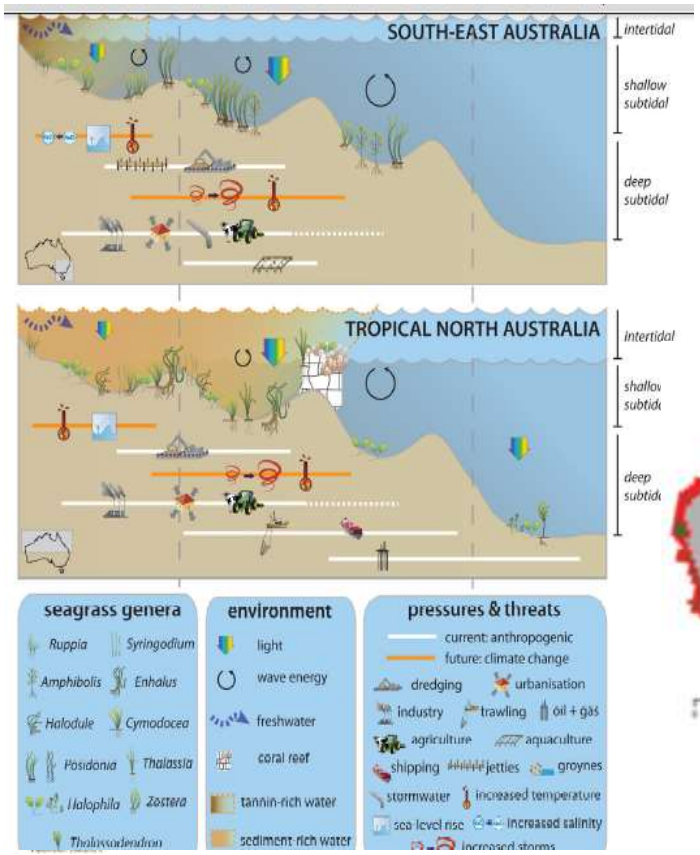
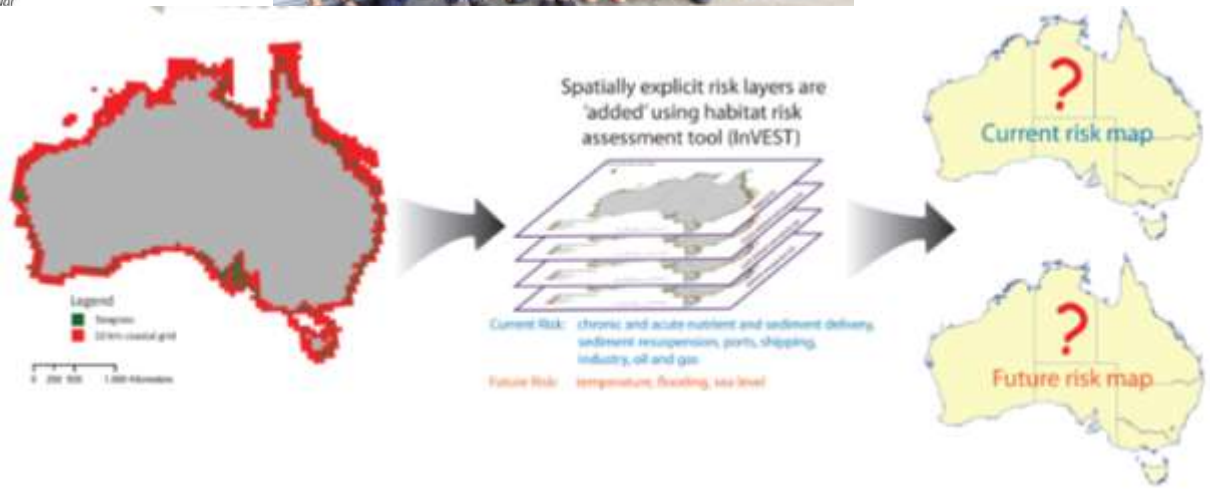
- **Integration, analysis and synthesis**

…….activities that extend capabilities for integration and processing of data at various levels to provide data products required for ecosystem science.



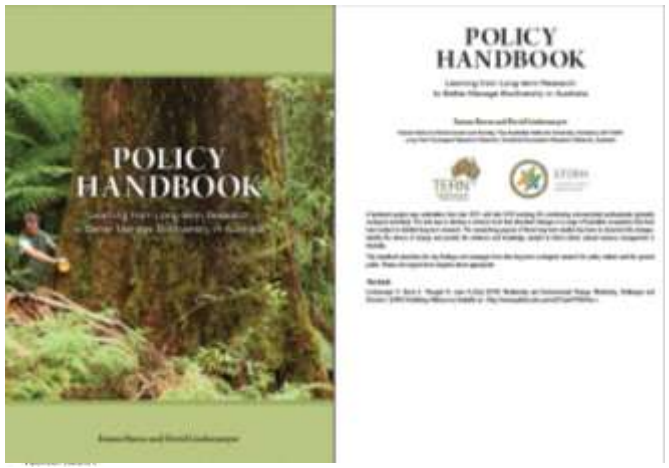


- **Linkages**

……focus on ‘soft’ infrastructure, particularly in knowledge brokering, to provide an effective interface between science, policy, management and industry to:

(1) improve uptake of science in policy-making and management processes; and

(2) enable policy and management needs to inform the design and implementation of science activities.



What did work ?

- coordinated data collection ;
- collect data relevant to key science + management questions;
- standards for data collection, checking and storage formats;
- flexible, and standardised meta-data that is fit for purpose;
- appropriate data licensing;
- data publishing procedures to Australian and international standards;
- discipline- or application-based code and model libraries; and

- a capacity for translating the results of science so that they are relevant, use-able, and have maximum impact for policy and management.

What did not work ?

- directly imposing new data collection, processing and distribution guidelines;
- excessive reporting;
- progress without consultation and discussion;
- limited time for evaluation and critiques;
- accepting the current situation without constructive criticism;
- not developing shared goals; and
- accommodating “excessive egos” and “rock star” scientists and top down academic/discipline hierarchy.

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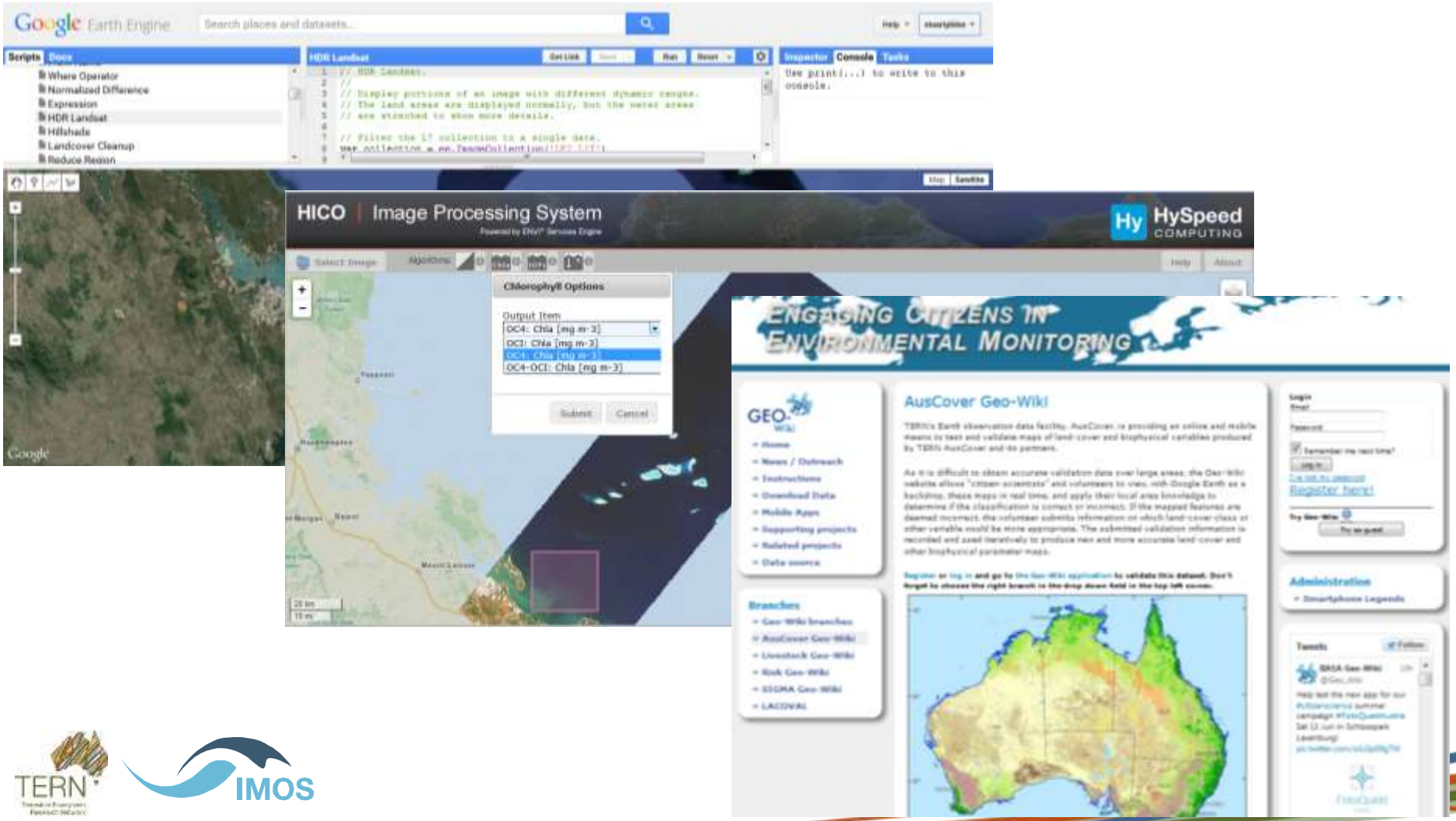
Moving forwards – sustaining long term science

- Coastal and coral reef environments are in a unique “space”
- Institutional and discipline gaps and overlaps
- Work still needed in terrestrial, coastal and marine communities

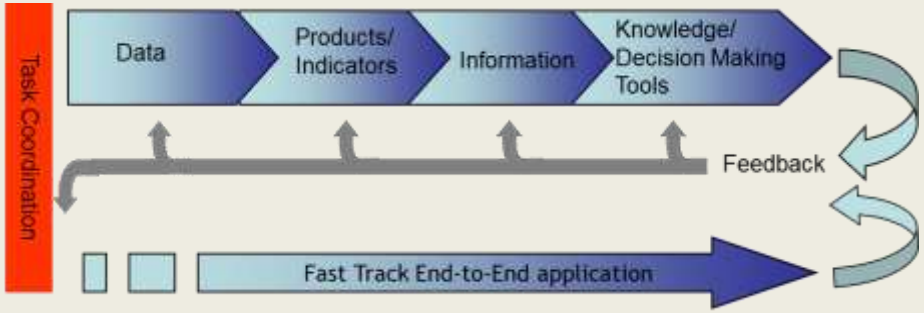
Moving forwards – sustaining long term science

- Global shift to collaborative data , algorithms and participatory resources:



C4 Global Water Quality Products and Services

Overall GEO WQ Task Goal: Develop, implement and maintain a global inland and coastal water quality monitoring and forecasting service. This task will be facilitated by ***a newly implemented GEO Water Quality (GEO-WaQ) Community of Practice***.
The goal of this component is to develop an international operational water quality information system based on Earth observation



Lakes Mendota & Monona -University of Wisconsin SSEC image

Moving forwards –
sustaining long term science (incl. infrastructure)

- Recognise and build on existing areas and programs
- Work across government levels for > 5 years support
- Communicate and engage clearly + openly

International Partners

TERN is supported by the Australian Government through the National Collaborative Research Infrastructure Strategy and the Super Science Initiative

Acknowledgements

- Tim Moltman, IMOS Director
- Arnold Dekker, Vittorio Brando, Tim Malthus and Alex Held, CSIRO
- Ed King CSIRO (IMOS, TERN)
- Peter Scarth, Jo Edkins, Kasper Johansen UQ
- Geoscience Australia
- Australian Research Council
- Great Barrier Reef Marine Park Authority
- Australian National Collaborative Research Infrastructure Program
- The University of Queensland
- All Australian State and Territory Governments

Questions?

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www.imos.org.au

Australian EO Community Coord. Group:

www.aeoccg.org.au