

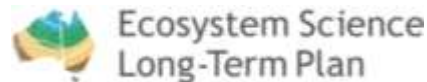
2015 International Ocean Colour Science
(IOCS), San Francisco June 15-18

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

Stuart Phinn and Chris Roelfsema



..



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 :



IOCCG
International Ocean-Colour Coordinating Group

An Affiliated Program of SCOR

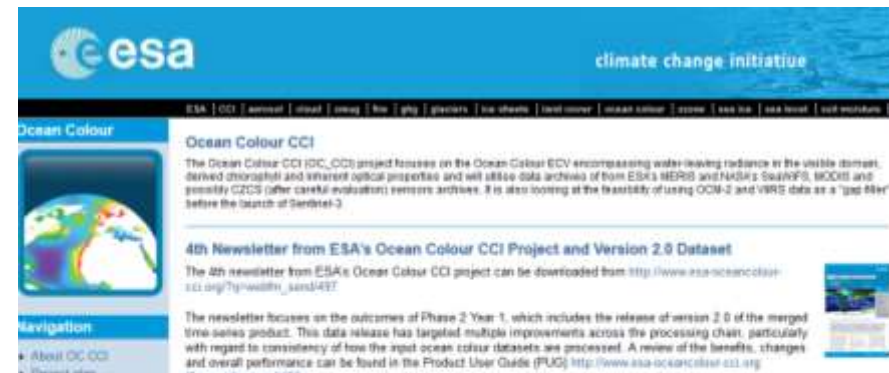
Contact Us

Feature Image

IOCCOMS image showing Yangtze River discharge near South Korea (click on image for larger view)

Promoting the application of remotely-sensed ocean-colour data through coordination, training, liaison between providers and users, advocacy and

- About IOCCG
- Ocean-Colour News
- IOCCG Working Groups
- Training & Education
- Publications
- Ocean-Colour Data & Services
- Ocean-Colour Workshops
- Employment Programs
- Ocean-Colour Meetings



esa climate change initiative

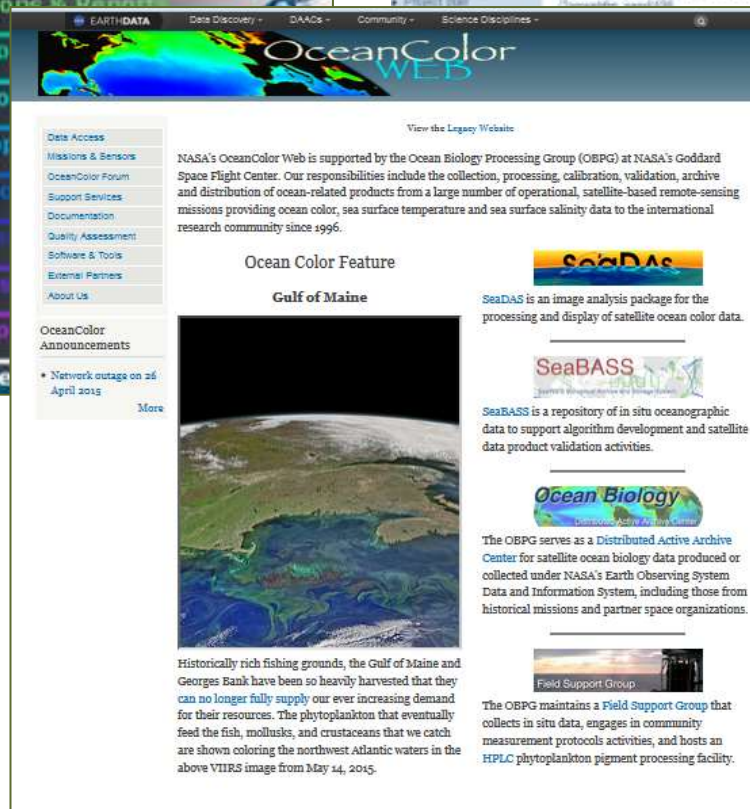
Ocean Colour CCI

The Ocean Colour CCI (OC_CCI) project focuses on the Ocean Colour ECV encompassing water-leaving radiance in the visible domain, derived chlorophyll and inherent optical properties and will archive data archives of from ESA's MERIS and NASA's SeaWiFS, MODIS and possibly CZCS (after careful evaluation) sensors archives. It is also looking at the feasibility of using OCM-2 and VIIRS data as a "gap filler" before the launch of Sentinel-3.

4th Newsletter from ESA's Ocean Colour CCI Project and Version 2.0 Dataset

The 4th newsletter from ESA's Ocean Colour CCI project can be downloaded from http://www.esa-oceancolour-cci.org/typewebdir_sens3/43/

The newsletter focuses on the outcomes of Phase 2 Year 1, which includes the release of version 2.0 of the merged time series product. This data release has targeted multiple improvements across the processing chain, particularly with regard to consistency of how the input ocean colour datasets are processed. A review of the benefits, changes and overall performance can be found in the Product User Guide (PUG) http://www.esa-oceancolour-cci.org/typewebdir_sens3/43/



EARTHDATA Data Discovery DAACS Community Science Disciplines

OceanColor WEB

View the Legacy Website

Data Access

- Missions & Sensors
- OceanColor Forum
- Support Services
- Documentation
- Quality Assessment
- Software & Tools
- External Partners
- About Us

NASA's OceanColor Web is supported by the Ocean Biology Processing Group (OBPG) at NASA's Goddard Space Flight Center. Our responsibilities include the collection, processing, calibration, validation, archive and distribution of ocean-related products from a large number of operational, satellite-based remote-sensing missions providing ocean color, sea surface temperature and sea surface salinity data to the international research community since 1996.

Ocean Color Feature

Gulf of Maine

Historically rich fishing grounds, the Gulf of Maine and Georges Bank have been so heavily harvested that they can no longer fully supply our ever increasing demand for their resources. The phytoplankton that eventually feed the fish, mollusks, and crustaceans that we catch are shown coloring the northwest Atlantic waters in the above VIIRS image from May 14, 2015.

OceanColor Announcements

- Network outage on 26 April 2015

SeaDAS

SeaDAS is an image analysis package for the processing and display of satellite ocean color data.

SeaBASS

SeaBASS is a repository of in situ oceanographic data to support algorithm development and satellite data product validation activities.

Ocean Biology

The OBPG serves as a Distributed Active Archive Center for satellite ocean biology data produced or collected under NASA's Earth Observing System Data and Information System, including those from historical missions and partner space organizations.

Field Support Group

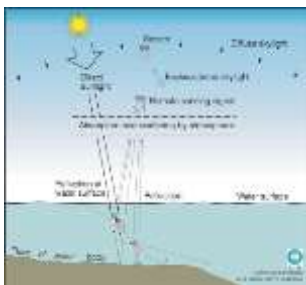
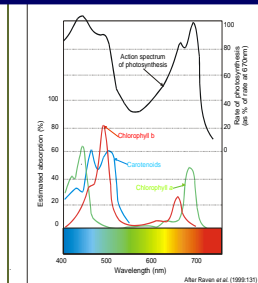
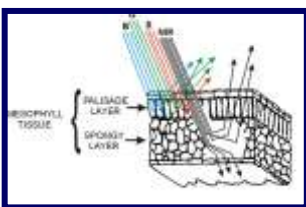
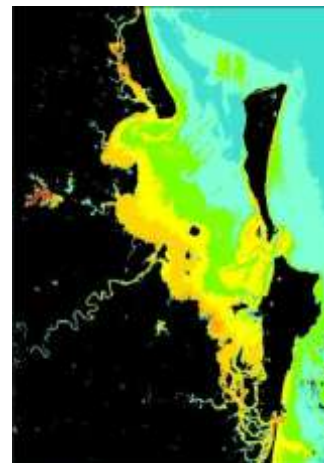
The OBPG maintains a Field Support Group that collects in situ data, engages in community measurement protocols activities, and hosts an HPLC phytoplankton pigment processing facility.



Contents

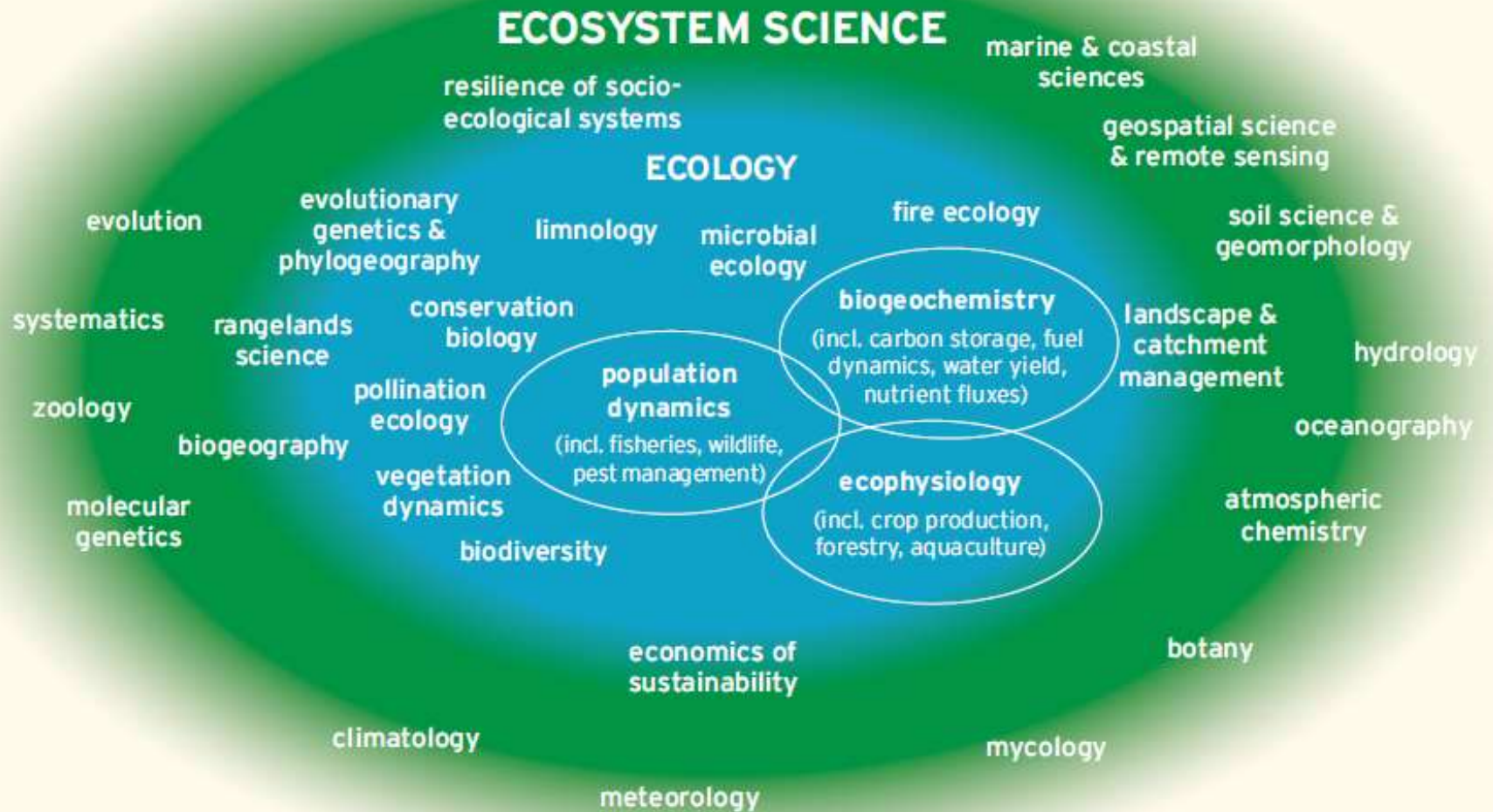
- Some context for the talk.....
- Introduction
 - **Designing sustainable and collaborative, long term scientific infrastructure**
- Starting the Design of National Collaborative Infrastructure
- Coastal and Coral Reef Monitoring and Management: Needs + Status
- Establishing Collaborative National Research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

- Some context what we try to do:

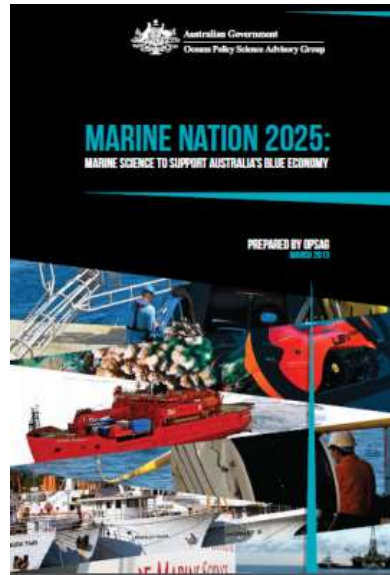




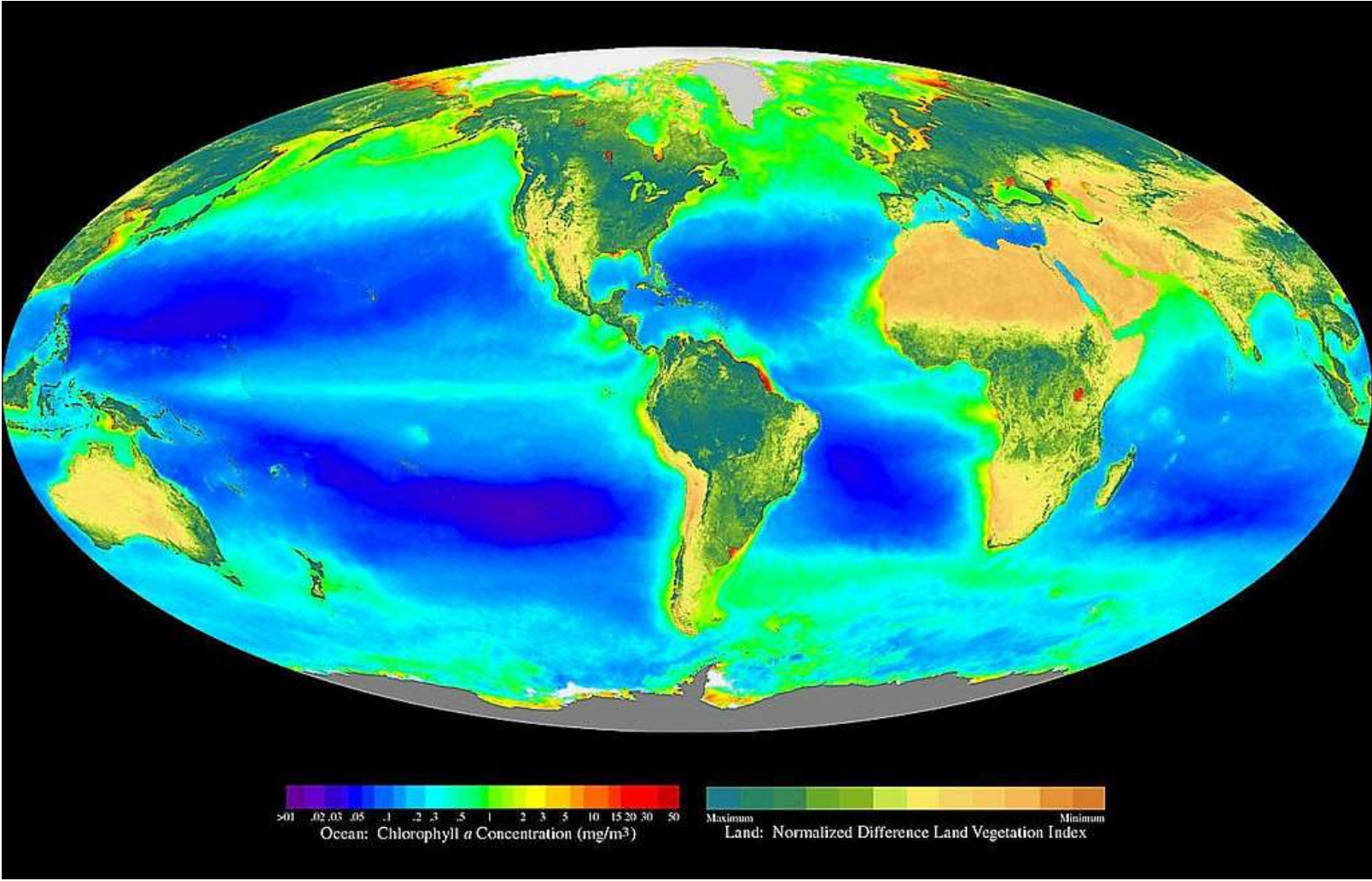
- Some contextEngaging ecosystem science



- **Some contextEngaging ecosystem science communities**

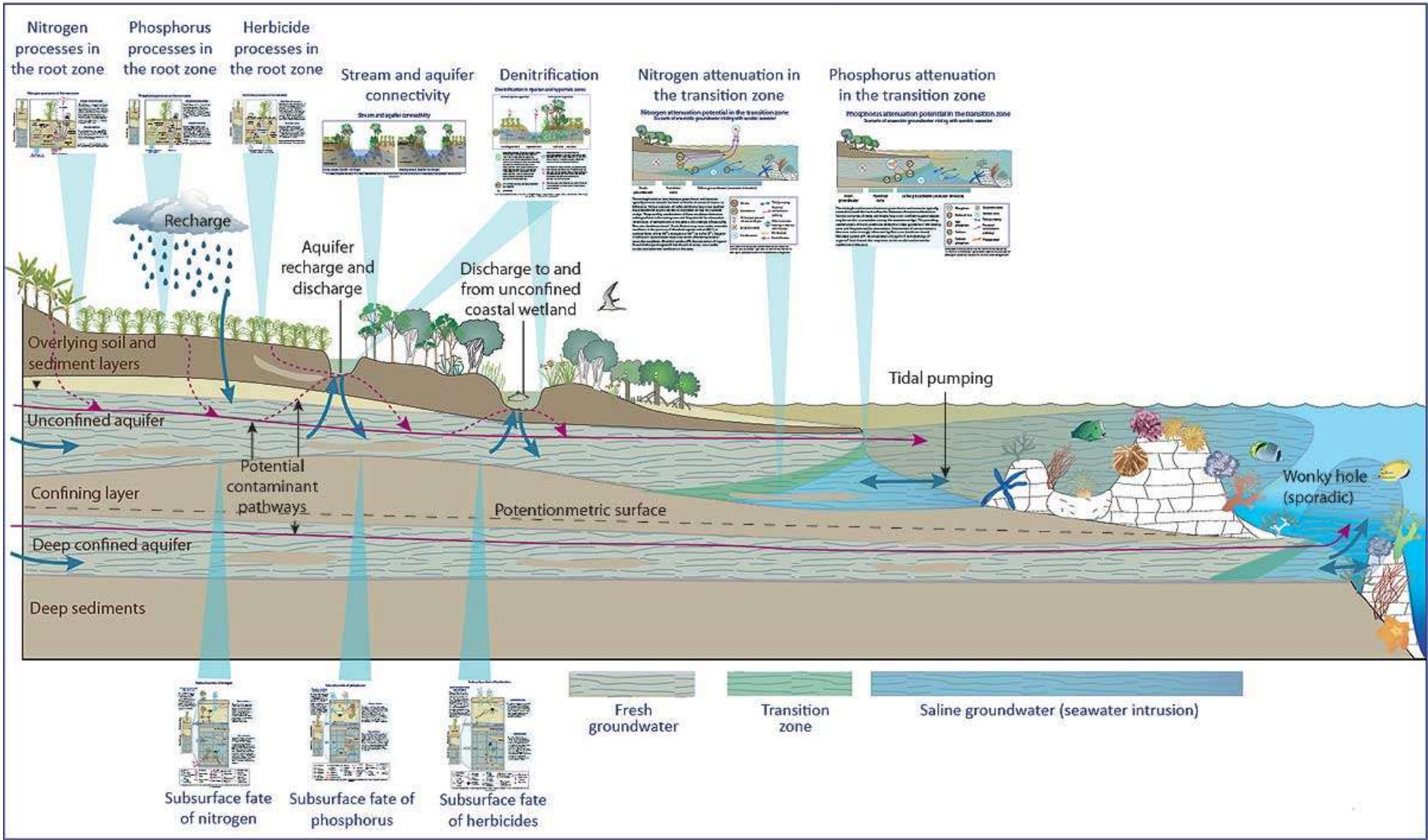


- Some context Australian marine and terrestrial ecosystems



Some context Australian marine and terrestrial ecosystems

Nitrogen, phosphorus and herbicides in groundwater flows to the Reef Overview of transport, transformation and attenuation processes



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'.

Contents

- Some context for the talk.....

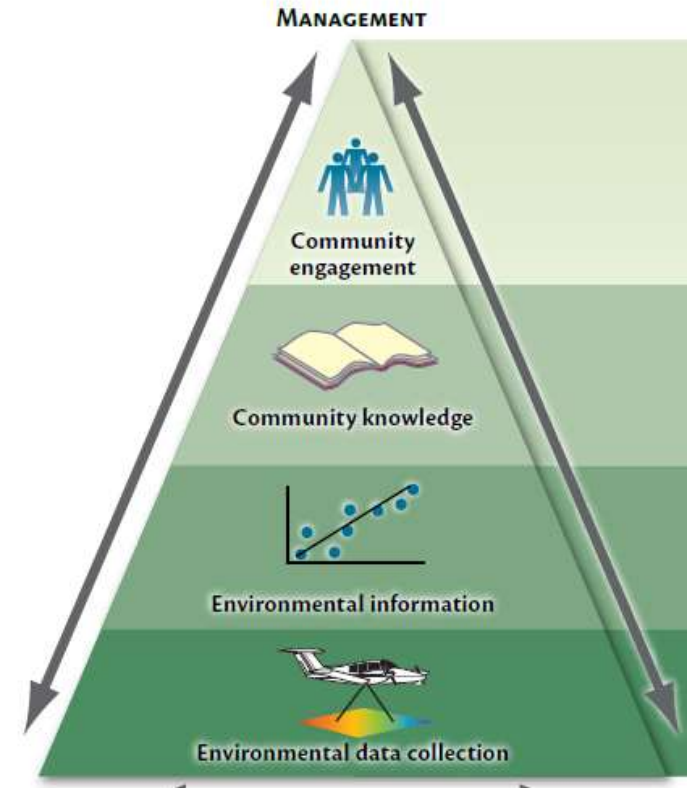
- Introduction

Designing sustainable and collaborative, long term research infrastructure

- Starting the Design of National Collaborative Infrastructure
- Coastal and Coral Reef Monitoring and Management: Needs- + Status
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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

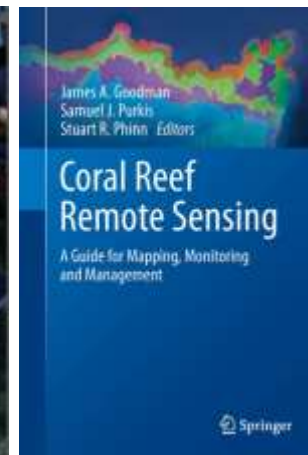
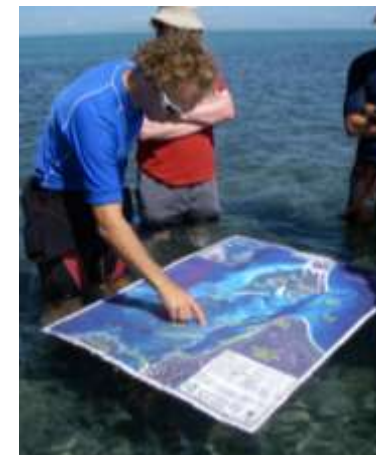


Source: Longstaff, B.J., T.J.B. Carruthers, W.C. Dennison, T.R. Lookingbill, J.M. Hawkey, J.E. Thomas, E.C. Wicks, and J. Woerner (eds) Integrating and applying science: A handbook for effective coastal ecosystem assessment. IAN Press, Cambridge, Maryland.U.S.A.,

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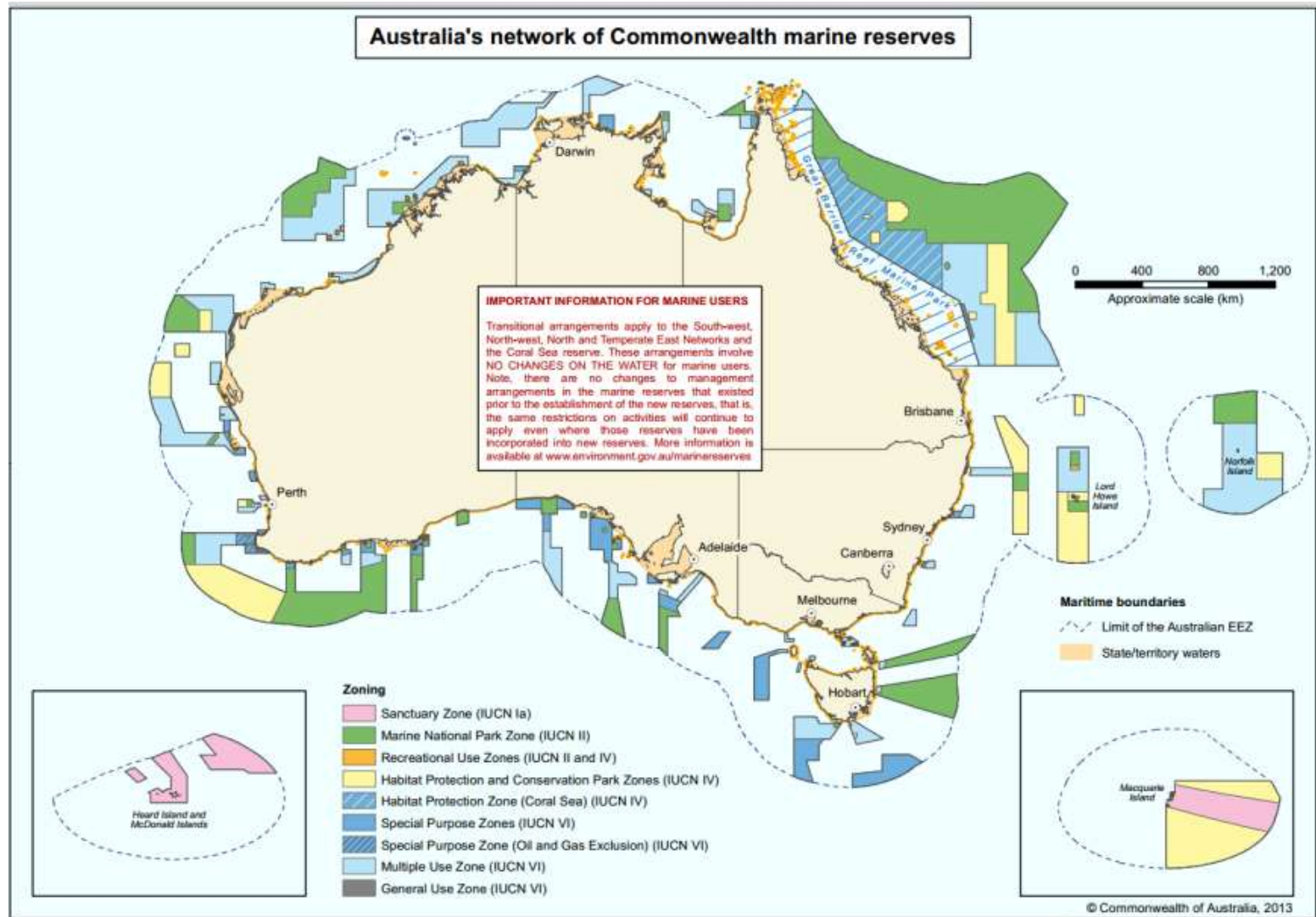
- **Building national collaborative research infrastructure assumed versus reality?**
- Existing cooperative networks were in place and engaged with key groups across science and management.
- Methods/protocols for data collection, analysis, and distribution were established.
- Common data and meta-data 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 .



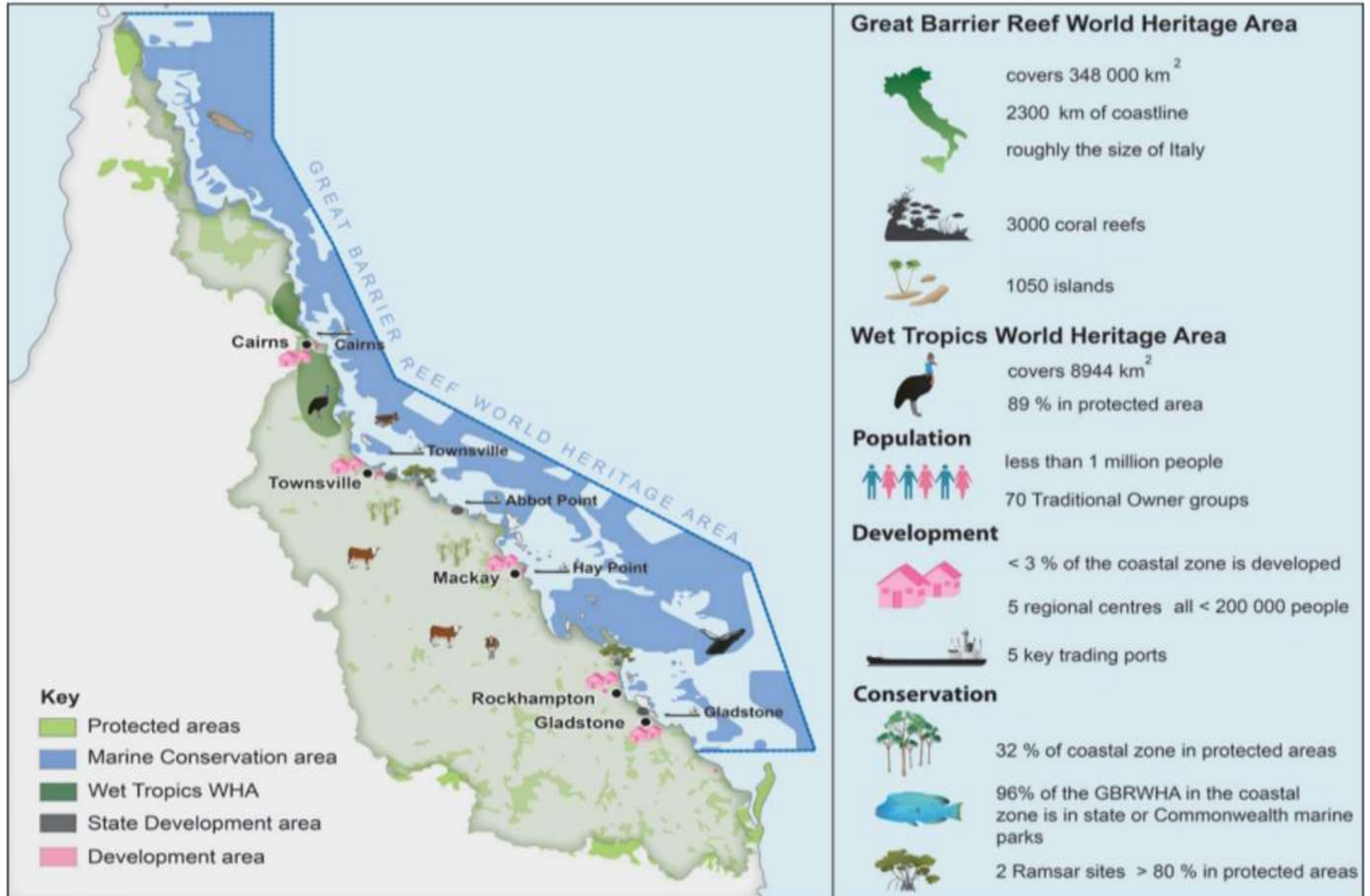
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- Monitoring coasts and coral reef waters:
Jurisdictions and overlaps - spanned by infrastructure:



- Monitoring coasts and coral reef waters:
Jurisdictions and overlaps: terrestrial-coastal-marine



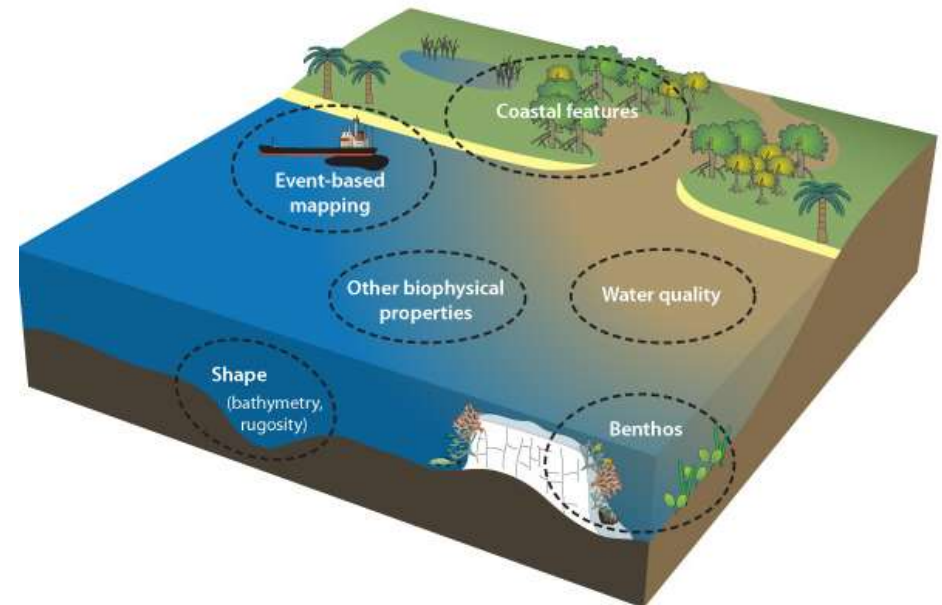
- Requirements for coastal and coral reef science and monitoring in Australia

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



- Sources:

- Image
- Field
- Modelled

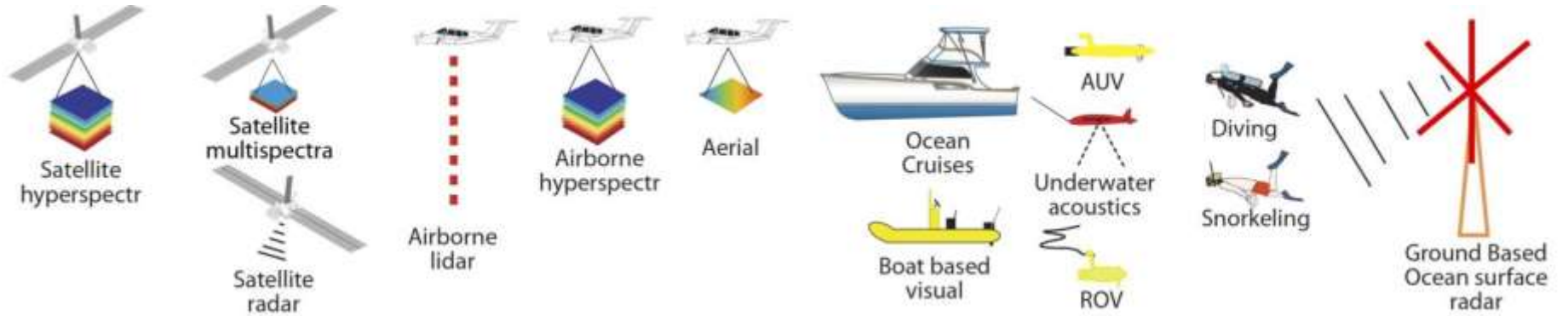


• **Essential water quality variables from remote sensing** (A.Dekker)

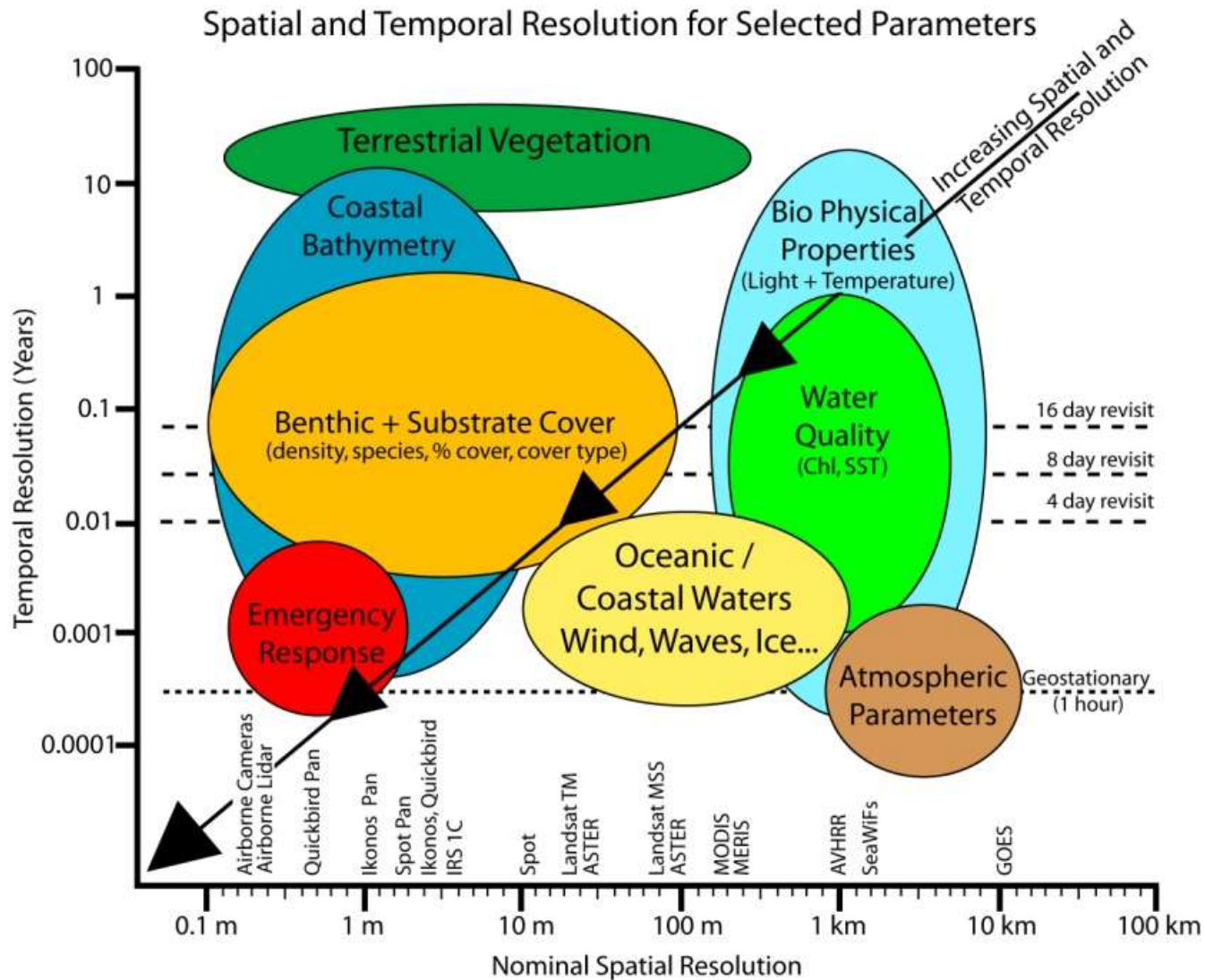
WATER QUALITY INFORMATION	WATER QUALITY VARIABLE
<p>Primary production and eutrophication status Aquatic carbon content, carbon fluxes</p>	<p>CHL CPC (cyanobacterial pigment) CPE(cyanobacterial pigment) Surface algal blooms</p>
<p>Aquatic carbon content, carbon fluxes</p>	<p>CDOM</p>
<p>Erosion, re-suspension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

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

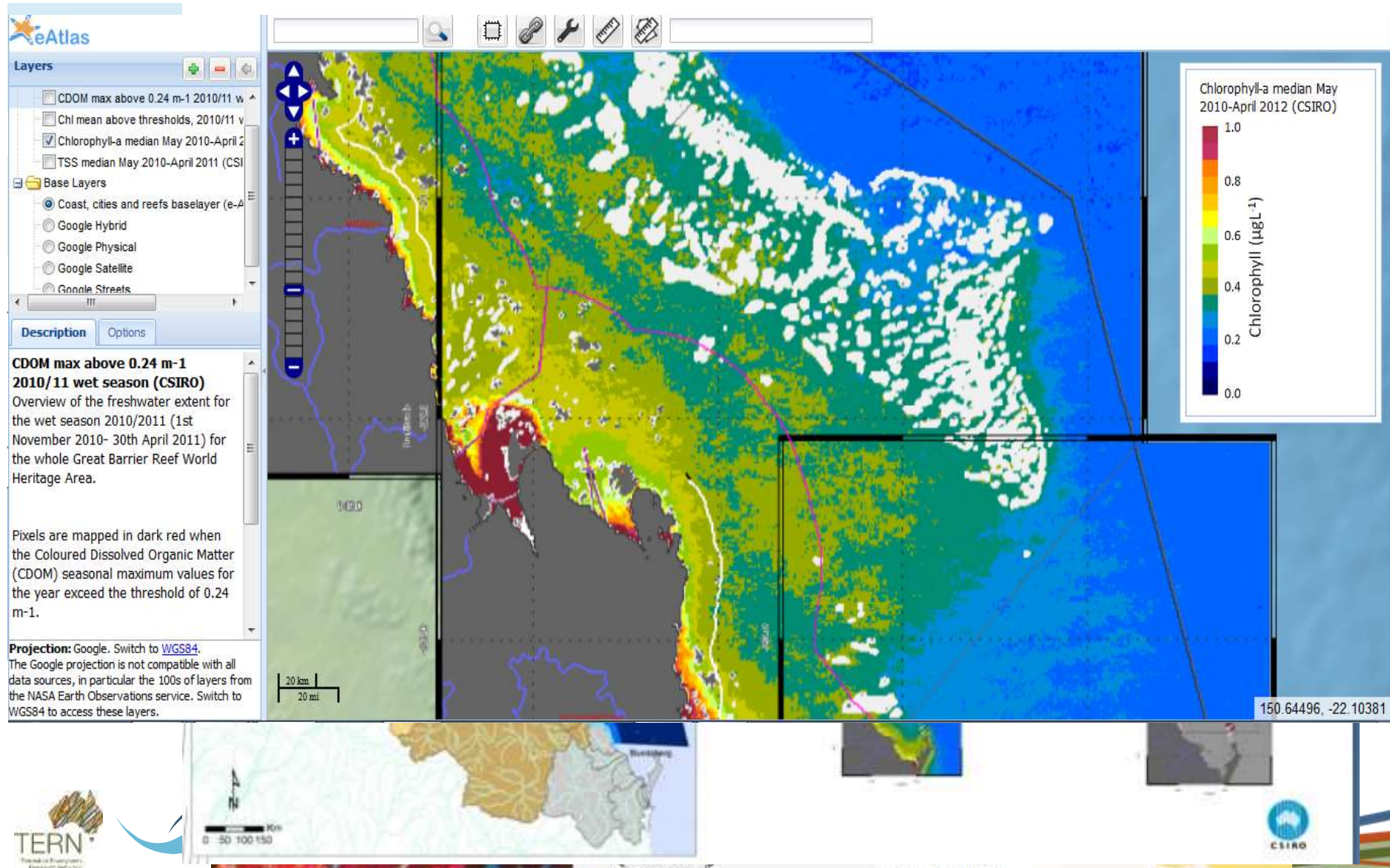
- Operational sensors coastal and reef environments:



- **Suitable spatial and temporal scales**



- Monitoring and managing coasts and coral reef waters



- Monitoring and managing: Citizen science



REEF CHECK AUSTRALIA

QUICK FINDER

SEARCH

HOME

WHO ARE WE?

WHAT DO WE DO?

WHERE DO WE WORK?


WHY DO WE DO IT?

HOW CAN YOU HELP?

Contact us Get involved ALA Apps Search the Atlas Search

Explore the Atlas of Living Australia


Australia's species [View all](#)



Search for Australian flora and fauna species by common, scientific name or search by category.

Browse species


Species by location [View all](#)



Search by pre-defined region, or enter an address or location to find the recorded species nearby.

Browse locations


Collections [View all](#)



Learn about the institution, the collections they hold and view records of specimens that have been databased.


Browse collections

Mapping & analysis [View all](#)




A spatial portal for investigating species occurrences within specified locations and the

Data sets [View all](#)



Refine the list of all the data sets contained within the Atlas by institution, integration status,


Partner Profiles [View all](#)



View our partner profiles and see how our key contributors help grow the Atlas of Living

mail)

LOGIN




What's your Reef IQ?

OUR NEW GAME >

Name Required	Photo Name
Checklist details (date, etc)	Always
Photo	
Comment	Age 1

ata and latest on reports ...

ONLINE NOW! >



Adopt a Reef

ADOPT A REEF >

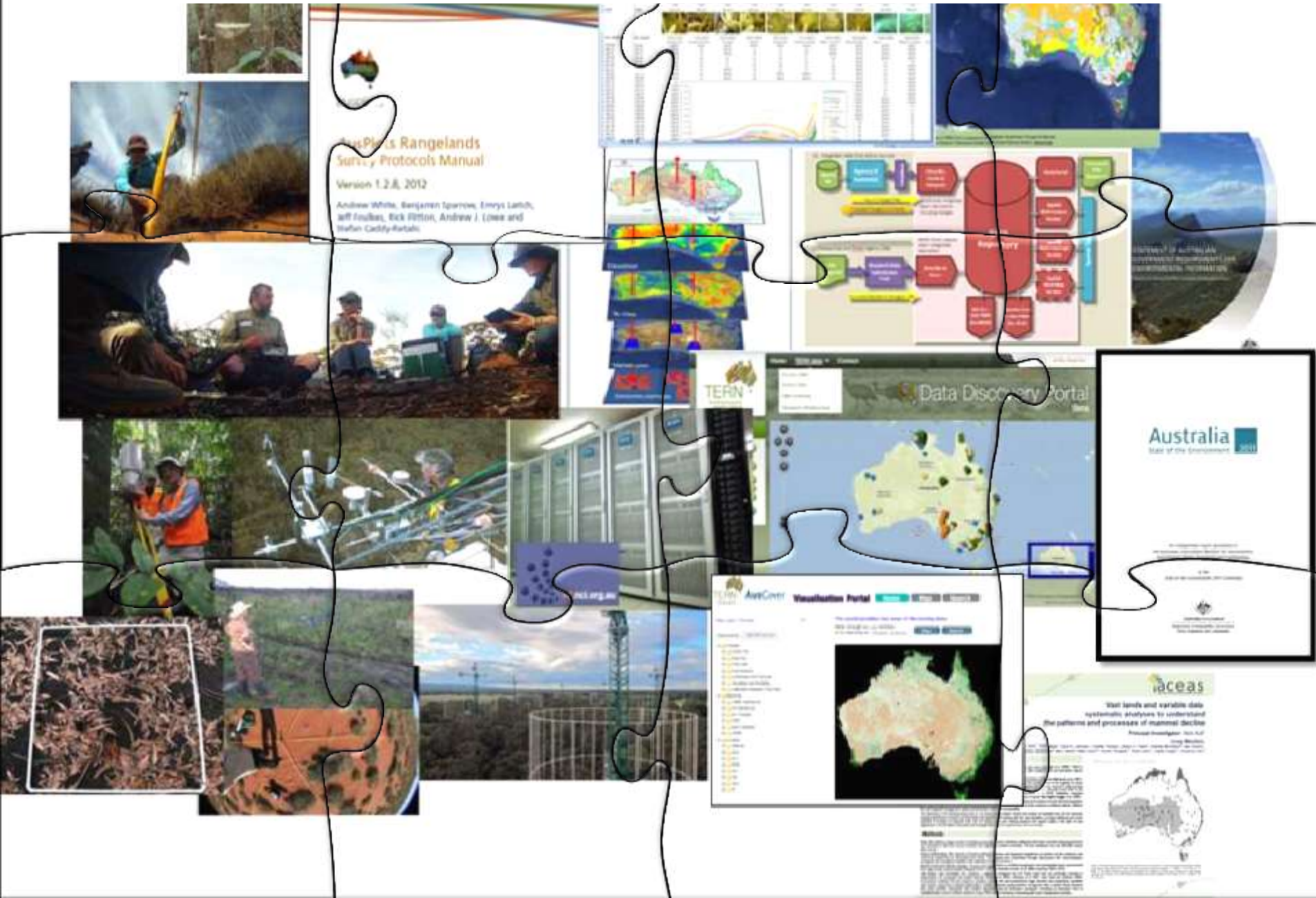
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- **Lessons Learnt and Moving Forwards**

- **Guided by:**
- National research infrastructure priorities
- National research priorities
- Relevant management agency priorities
- Political priorities
- National discipline based coordination
- International discipline based coordination



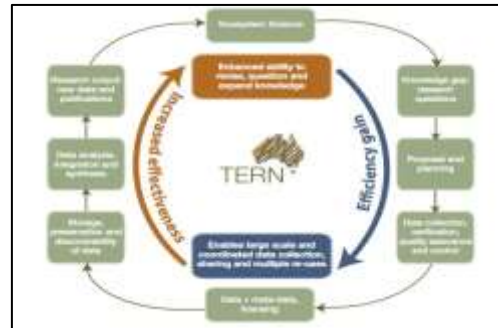
Australia's Terrestrial Ecosystem Research Network (TERN)



• TERN's approach to building collaborative infrastructure

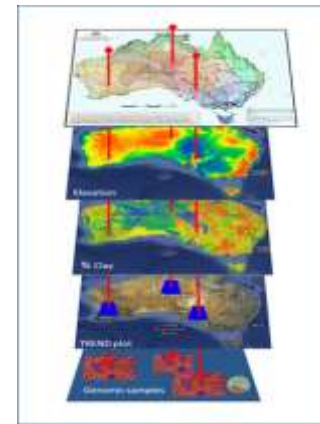


Collection Methods



Data Storage

Data Sharing



Modelling



Policy + Management



Instruments + Sensors

Processing + Analysis

Data Curation + Publishing

Data Searching

Analysis + Synthesis



OS

• Australia's Integrated Marine Observing System

Designed through national science planning, developed by regional science **Nodes**

A 'virtual fleet'

Research
Vessels

Satellite
Remote
Sensing

Calibration & validation, national product suite

IMOS

- National collaborative research infrastructure
- For sustained observing of the marine environment
- Integrated from open ocean to coast
- Integrated across physics, chemistry and biology

AODN

Marine data
from IMOS &
other holders

Australian Ocean Data Network

Marine data that
are discoverable,
accessible, usable
and reusable

IMOS

Information
Infrastructure

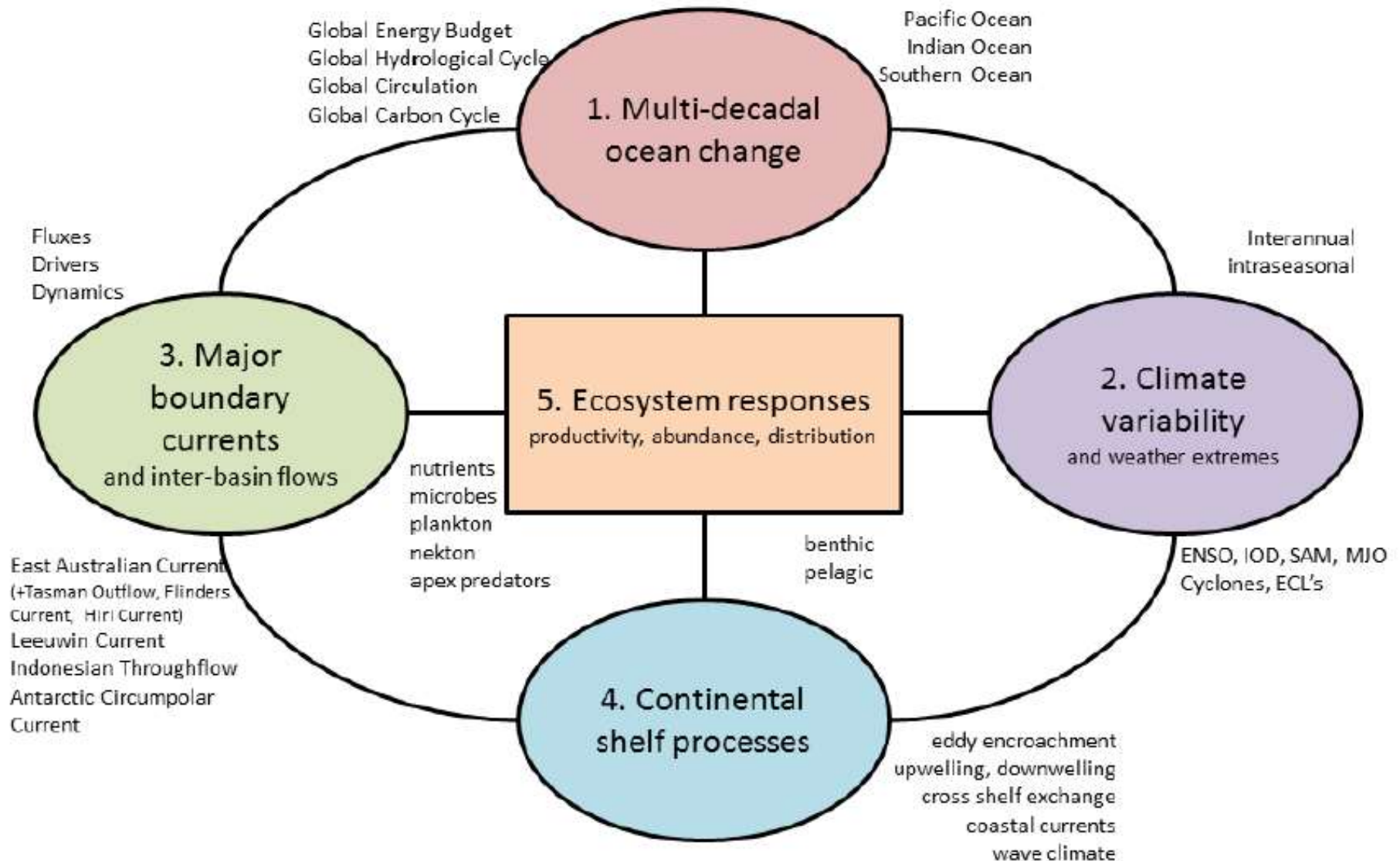
Ocean &
Coastal
MODELLING

Data for
Model Development,
Model Validation,
Data Assimilation,
Obs System Design

Implemented through national, multi-institutional **Facilities**, with **all** data shared

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

IMOS Research Themes



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

1) People

2) Data Collection

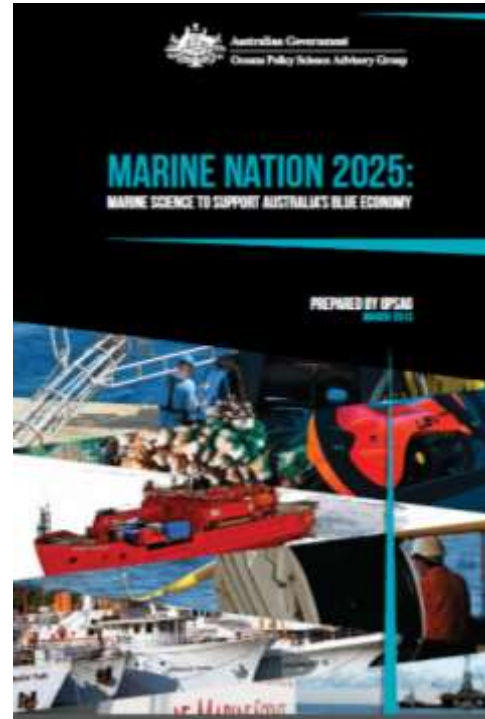
3) Data Processing, Storage and Publication

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.

The image displays two overlapping web interfaces. The background interface is the TERN Data Discovery Portal, featuring a navigation bar with 'Home', 'TERN data', and 'Contact' links. The main content area shows a map of Australia with various data collection points marked. A sidebar on the left lists 'TERN Facilities' including Long Term Ecological Research Network, Australian SuperSite Network, OoFlux, AusCover, Australian Transect Network, and AusPlot and Transect plots. The foreground interface is the IMOS 'Open Access to Ocean Data' portal, which has a dark header with the IMOS logo and the text 'Open Access to Ocean Data'. Below the header is a three-step process: '1 Select a Data Collection', '2 Create a Subset', and '3 Download'. The 'Step 1: Select a Data Collection' section includes filters for Parameter (Physical-Water, Biological, Physical-Atmosphere, Chemical, UV radiation, Backscattering), Organisation, and Platform (Ship, Satellite, Mooring, Biological platform, Radar, Glider). The main content area lists three data collection facilities with their respective parameters and time periods, each with a 'Select' button and a 'continue reading' link.

TERN
Terrestrial Ecosystem Research Network

Home TERN data Contact My My Searches

Data Discovery Portal

TERN Facilities

- Long Term Ecological Research Network
- Australian SuperSite Network
- OoFlux
- AusCover
- Australian Transect Network
- AusPlot and Transect plots

IMOS
Integrated Marine Observing System

Open Access to Ocean Data

1 Select a Data Collection 2 Create a Subset 3 Download

Step 1: Select a Data Collection

Parameter

- Physical-Water (32)
- Biological (26)
- Physical-Atmosphere (12)
- Chemical (11)
- UV radiation (1)
- Backscattering (1)

Organisation

Platform

- Ship (24)
- Satellite (24)
- Mooring (20)
- Biological platform (19)
- Radar (10)
- Glider (3)
- 41 of 79

IMOS - SRS Bio-optical database of Australian Waters (SRS-OC-BOOBAW) Sub-Facility

Pigment, Suspended particulate material
Integrated Marine Observing System (IMOS), CSIRO Land & Water Flagship
1997 - 2015

Select >>> continue reading

IMOS - Australian National Mooring Network (ANMN) Facility - WQM and CTD burst averaged data products

Chlorophyll, Oxygen, Salinity, Temperature, Turbidity, Water pressure
Integrated Marine Observing System (IMOS), CSIRO Oceans & Atmosphere
Flagship - Hobart
Mooring
2006 - 2015

Select >>> continue reading

IMOS - SRS Satellite Altimetry Calibration and Validation Sub-Facility

Current, Salinity, Temperature, Water pressure
Integrated Marine Observing System (IMOS), School of Land and Food (SLF), University of Tasmania (UTAS)

Select >>> continue reading

Page 1 of 12

• 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).

The screenshot shows the TERN Data Discovery Portal. At the top, it says "TERN Data Discovery Portal" and "Delivering open access to Australia's terrestrial ecosystem data". There is a search bar with "Search" and "Map Based Search" buttons. Below, there are sections for "Datasets Published" and "Recently Harvested" with various thumbnail images representing different data sets.

Data Products List

Product Name	Year	Access	Download
...	2011	...	...
...	2012	...	...
...	2013	...	...
...	2014	...	...
...	2015	...	...
...	2016	...	...
...	2017	...	...
...	2018	...	...
...	2019	...	...
...	2020	...	...
...	2021	...	...
...	2022	...	...

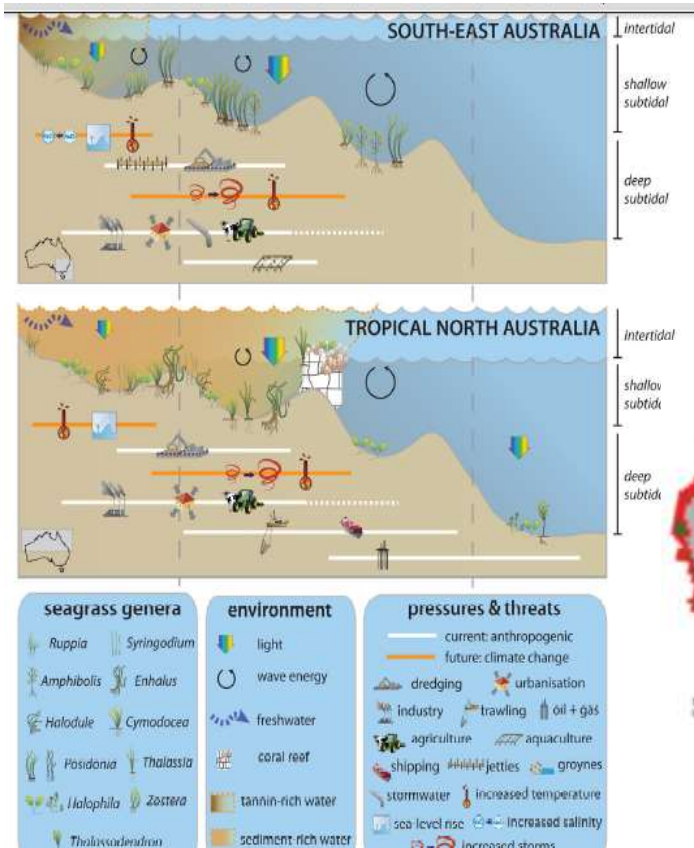
The screenshot shows the Australian Coastal Ecosystems website. The header says "AUSTRALIAN COASTAL ECOSYSTEMS". Below the header, there is a navigation menu and a main content area with text and a map of Australia. Logos for TERN and other organizations are visible at the bottom.

The screenshot shows the IMOS Open Access to Ocean Data website. The header says "IMOS Integrated Marine Observing System" and "Open Access to Ocean Data". There are three main steps: "1 Select a Data Collection", "2 Create a Subset", and "3 Download". Under "Step 1: Select a Data Collection", there are dropdown menus for "Parameter", "Organisation", and "Platform". To the right, there are three data collection options with "Select" and "continue reading" buttons.



• 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.



Spatially explicit risk layers are 'added' using habitat risk assessment tool (InVEST)

Current Risk: chronic and acute nutrient and sediment delivery, sediment resuspension, ports, shipping, industry, oil and gas

Future Risk: temperature, flooding, sea level



• 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:

The collage features several key components:

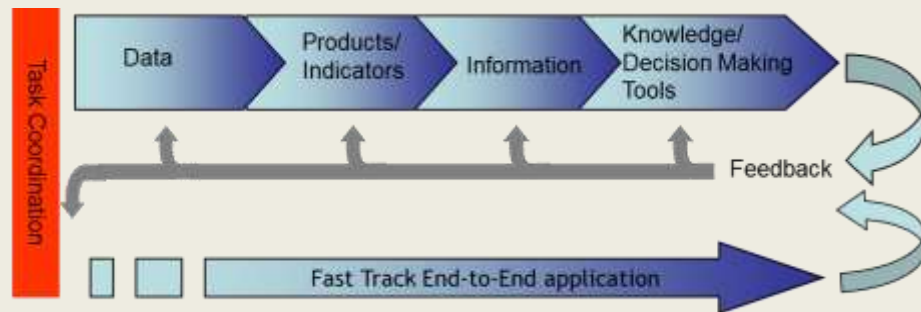
- Google Earth Engine:** A screenshot of the script editor showing a JavaScript script for processing satellite imagery. The script includes comments and code for displaying images with different dynamic ranges and filtering collections.
- HICO Image Processing System:** A screenshot of the HICO web interface, showing a map of Australia with a selected region and a 'Chlorophyll Options' dialog box. The dialog box lists output items such as 'OC4: Chla [mg m-3]' and 'OC4-OC1: Chla [mg m-3]'.
- AusCover Geo-Wiki:** A screenshot of the AusCover Geo-Wiki website, which is part of TERN's Earth observation data facility. The page includes a navigation menu, a description of the Geo-Wiki project, and a map of Australia showing land cover data.
- Logos:** The TERN (Terrestrial Ecosystems Research Network) and IMOS (Integrated Marine Observing System) logos are located at the bottom left of the collage.



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?

Stuart Phinn

s.phinn@uq.edu.au

www.tern.org.au

www.imos.org.au

Australian EO Community Coord. Group:

www.aeoccg.org.au