IMOS Integrated **Marine Observing** System

The Australian Integrated Marine Observing System: Present and Future Possibilities

Roger Proctor, IMOS/eMII
eMarine Information Infrastructure

An Australian Government Initiative

National Collaborative Research Infrastructure Strategy

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

What is IMOS?

IMOS is an initiative of the Australian Government,
a 5-year project (2006-2011) AUD$50M + similar co-funding = ~AUD$100M*
to establish an observing system which can be maintained in the long term
to inform on climate change in the ocean

Principles

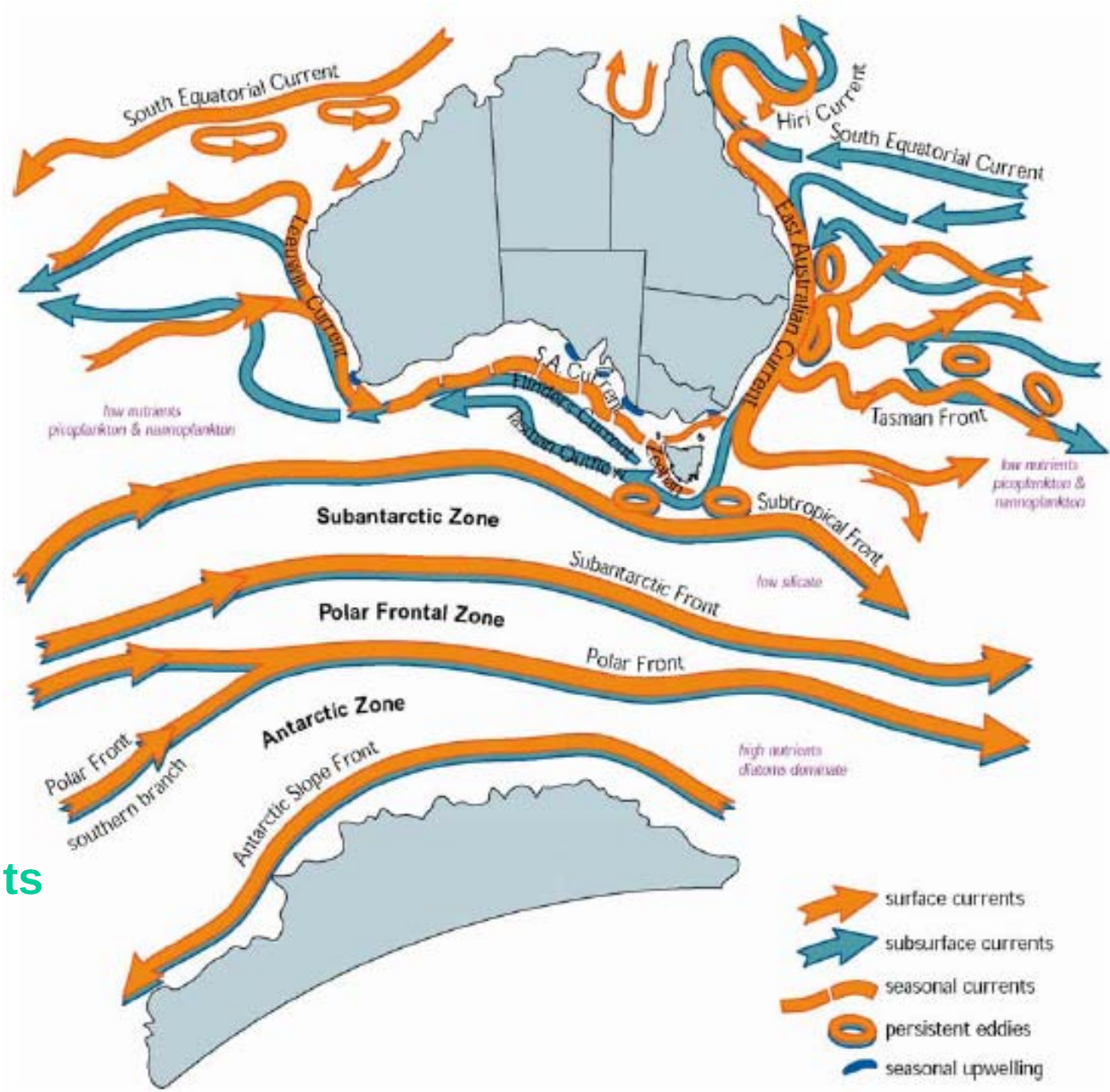
- Service — a national system
- Data streams — free, open and timely
- Integrated — coordinated, multi-platform, multi-disciplinary
- Sustained — systematic, repeated, long term

IMOS is establishing Australia's Sustainable Marine Observing System

The circulation in the oceans around Australia

a country dominated by boundary currents

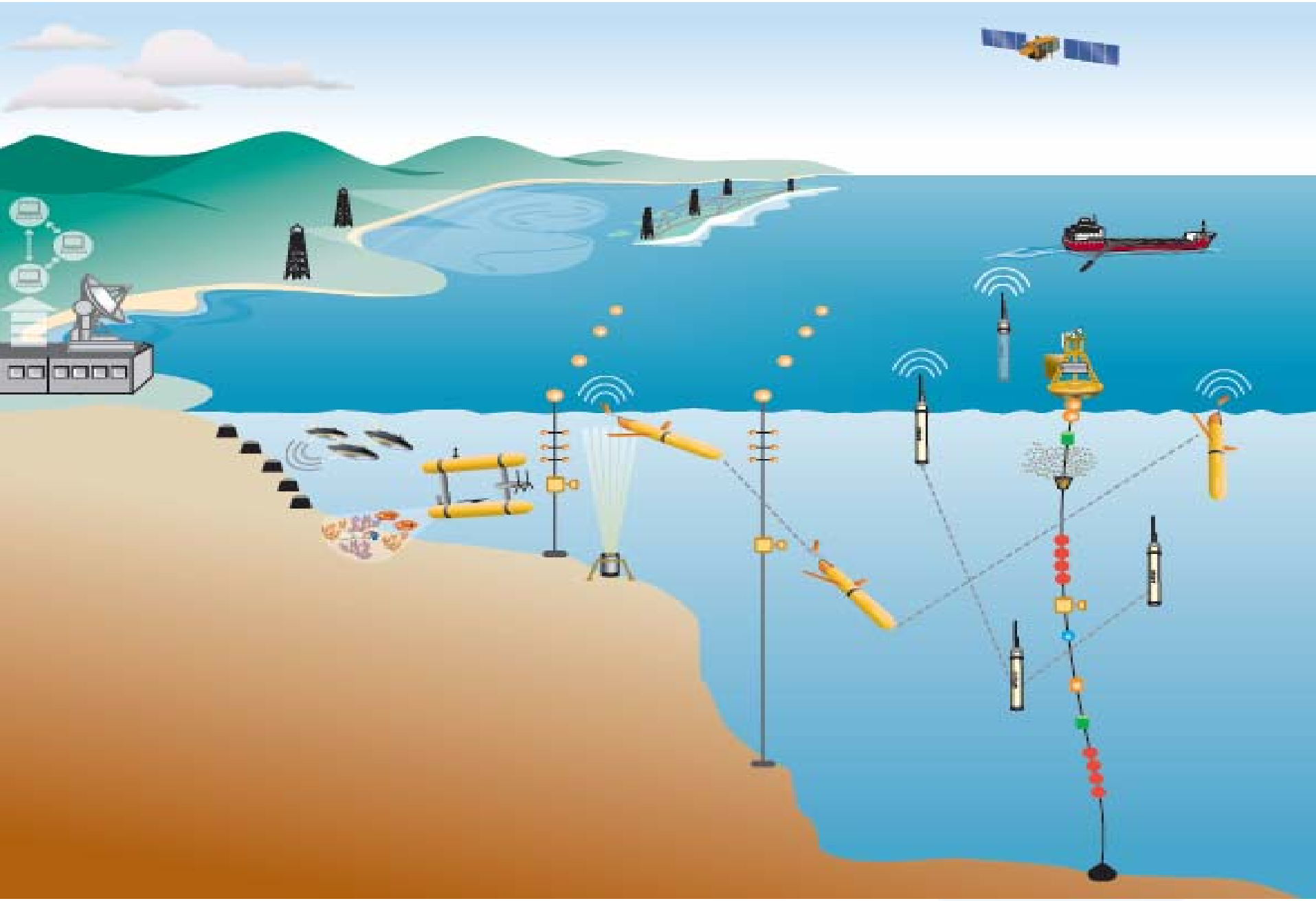
The **surface currents** are shown in **orange** and **subsurface currents** in **green**



What are the objectives of IMOS?

- Improve Australia's capacity to understand ocean variability and regional climate change
- Develop capability to monitor the interaction of the ocean boundary currents with shelf waters
- Deliver systematic capability to understand ocean productivity and macro/meso-scale connections between animal populations
- Provide a marine information system for researchers to easily access new and legacy marine data

Scientific rationale and implementation plan developed by community consultation through four Regional Nodes + the Bluewater Node



Vision of regional monitoring by 11 national facilities—one for each instrument type

IMOS - 11 National Facilities

Provide the information for regional Node science

What and how?

- **ARGO** (Argo Australia) – measures vertical profiles, physical & O_2 0-2000m
- **SOOP** (Ships of Opportunity Programme) – surface & sub-surface physical & biochemical data along ship-tracks
- **SOTS** (Southern Ocean Automated Timeseries Observations) – extreme climate, the southern ocean moorings
- **ANFOG** (Australian National Facility for Ocean Gliders) – gliders, ocean and shelf repeat transects, phys & biol
- **AUV** (Autonomous Underwater Vehicle) – underwater vehicle, close up view of benthic biodiversity + phys
- **ANMN** (Australian National Mooring Network) – coastal (NRS) & shelf-edge moorings, surface, sub-surface & acoustics
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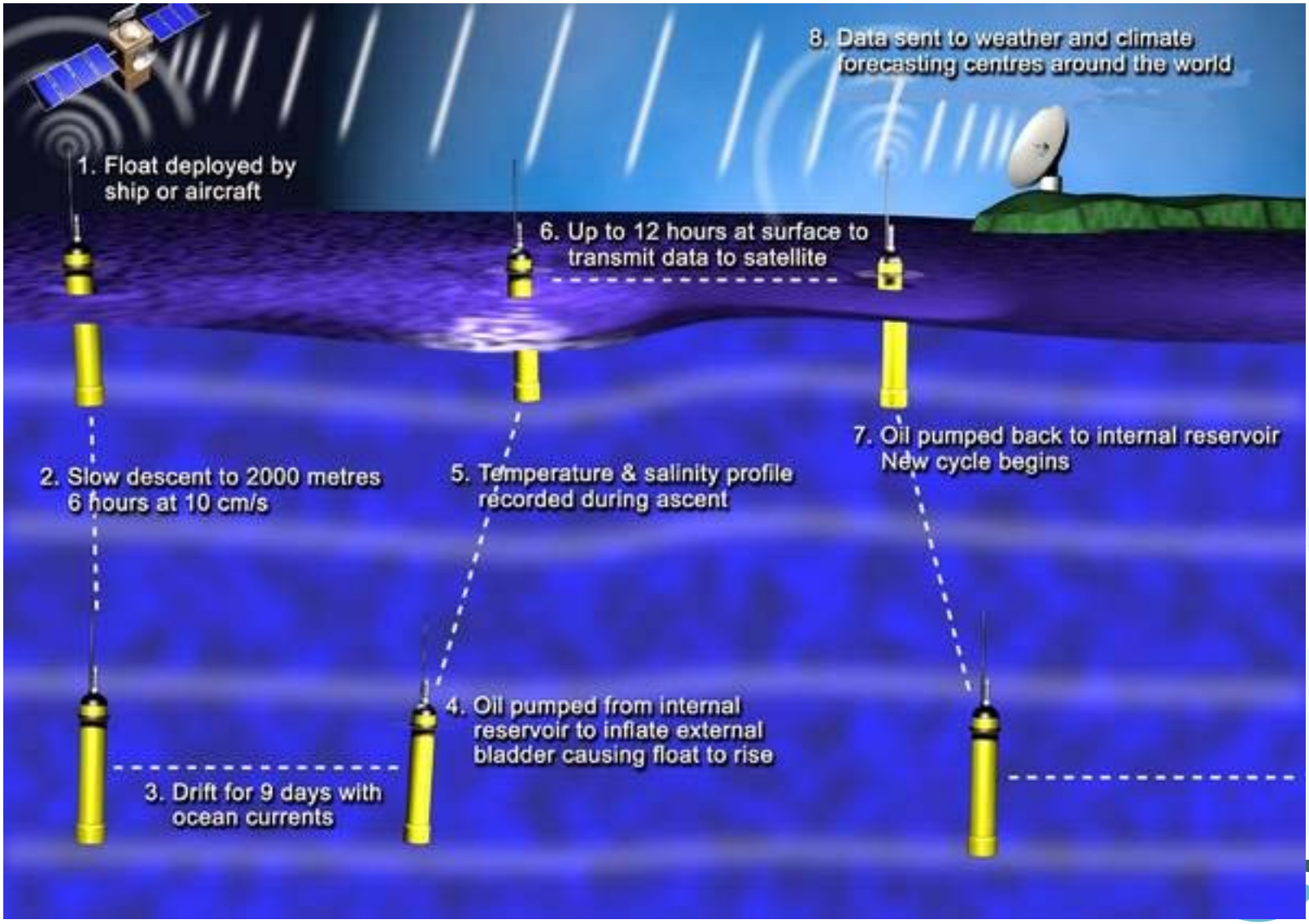
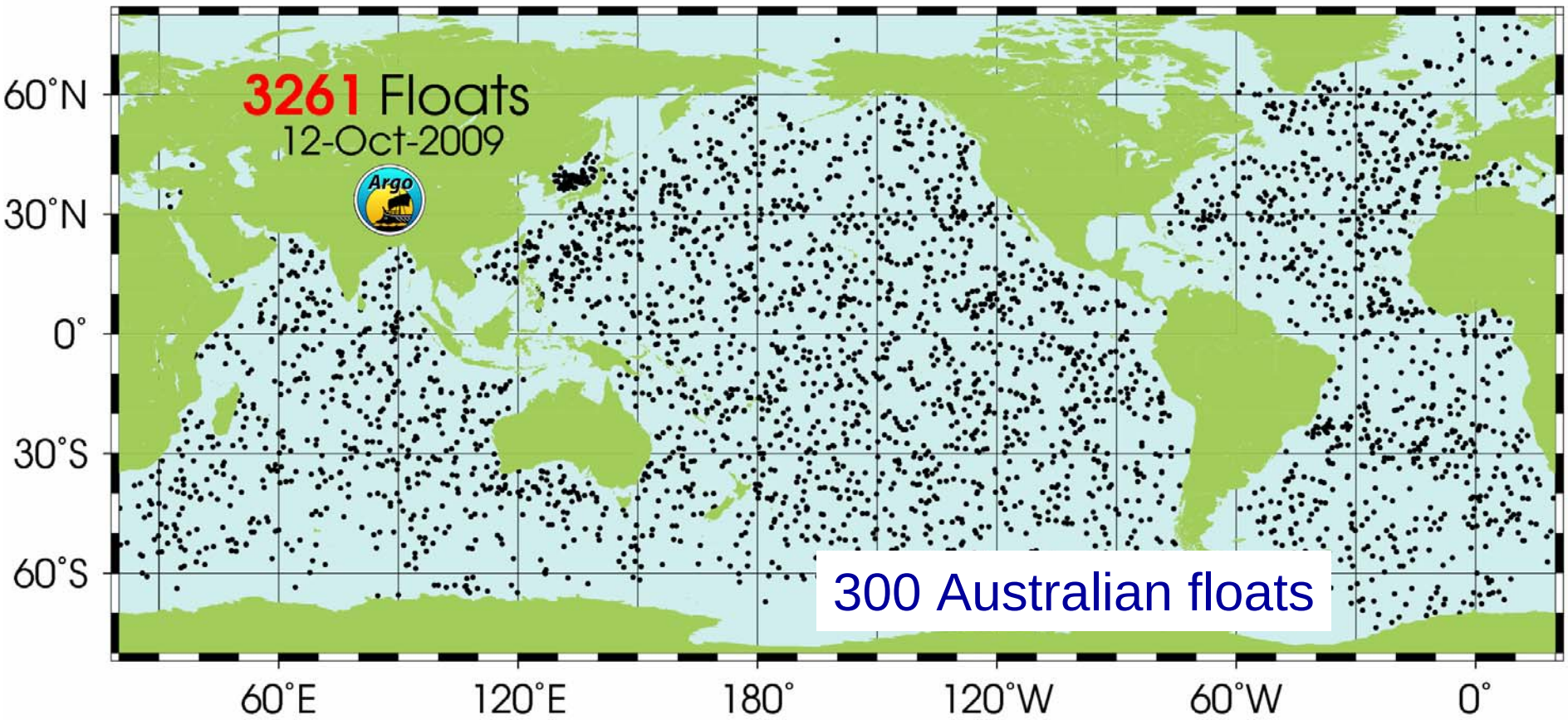
- **FAIMMS** (Facility for Automated Intelligent Monitoring of Marine Systems) – networked sensors on the GBR
- **SRS** (Satellite Remote Sensing) – satellites, SST and ocean colour for Australian region
- **eMII** (eMarine Information Infrastructure) – data management, integration, bringing it all together

IMOS

Argo – floats roaming the ocean




3261 Floats
12-Oct-2009
Argo
60°N
30°N
0°
30°S
60°S
60°E
120°E
180°
120°W
60°W
0°
300 Australian floats

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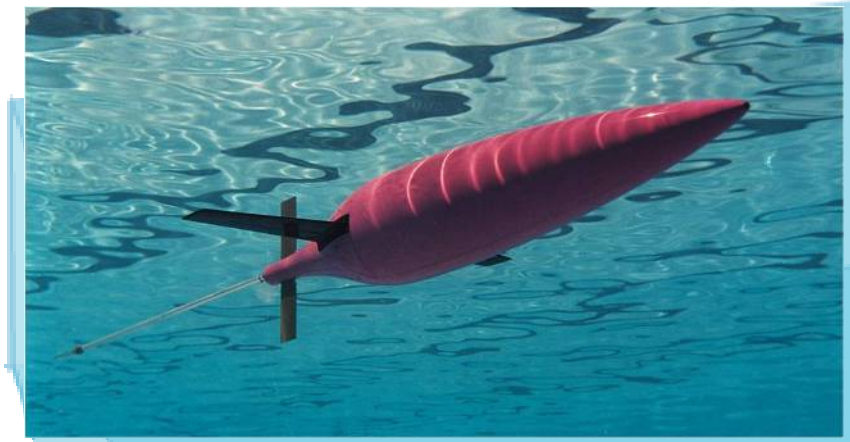
Gliders



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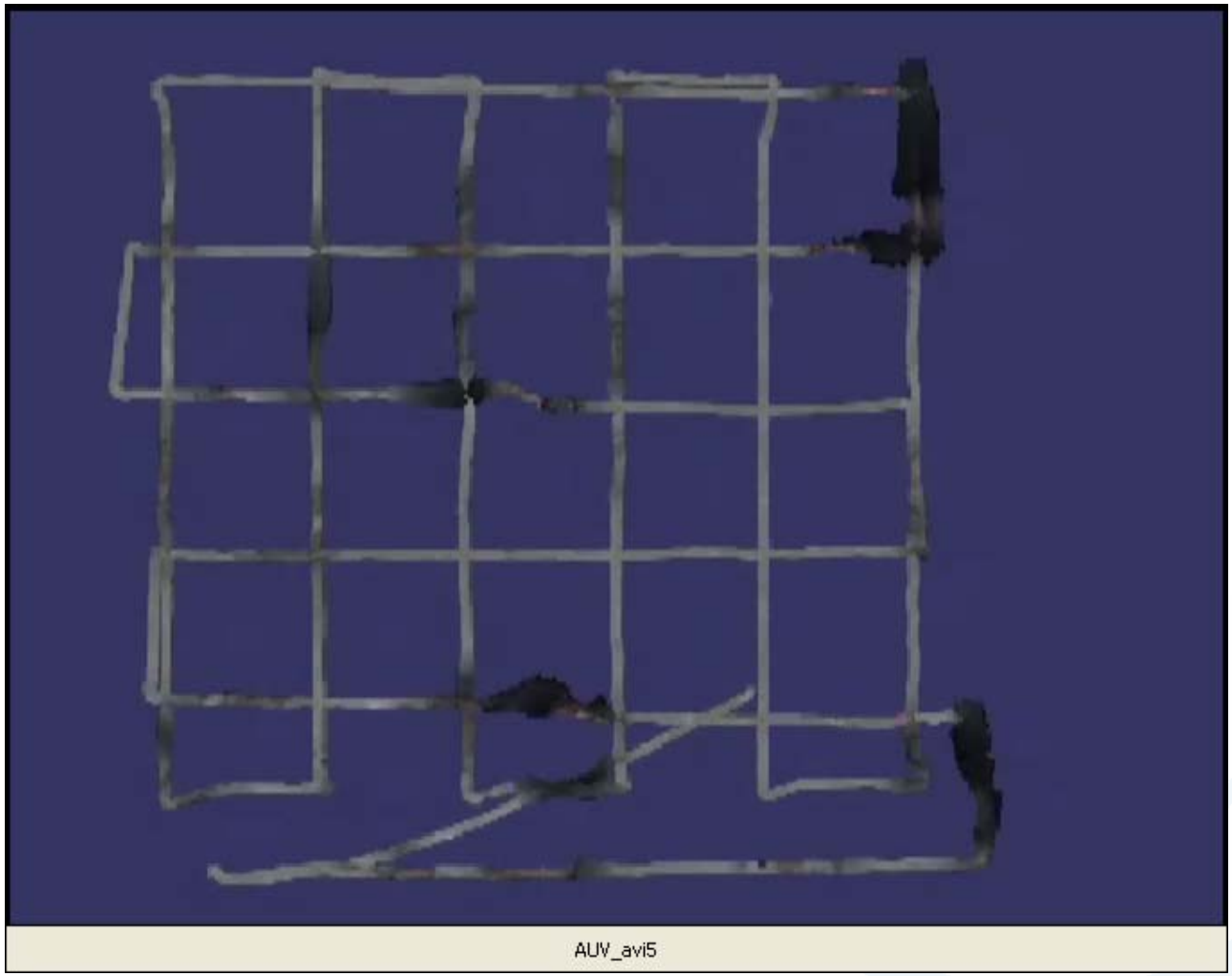

Use pattern recognition techniques to map biodiversity

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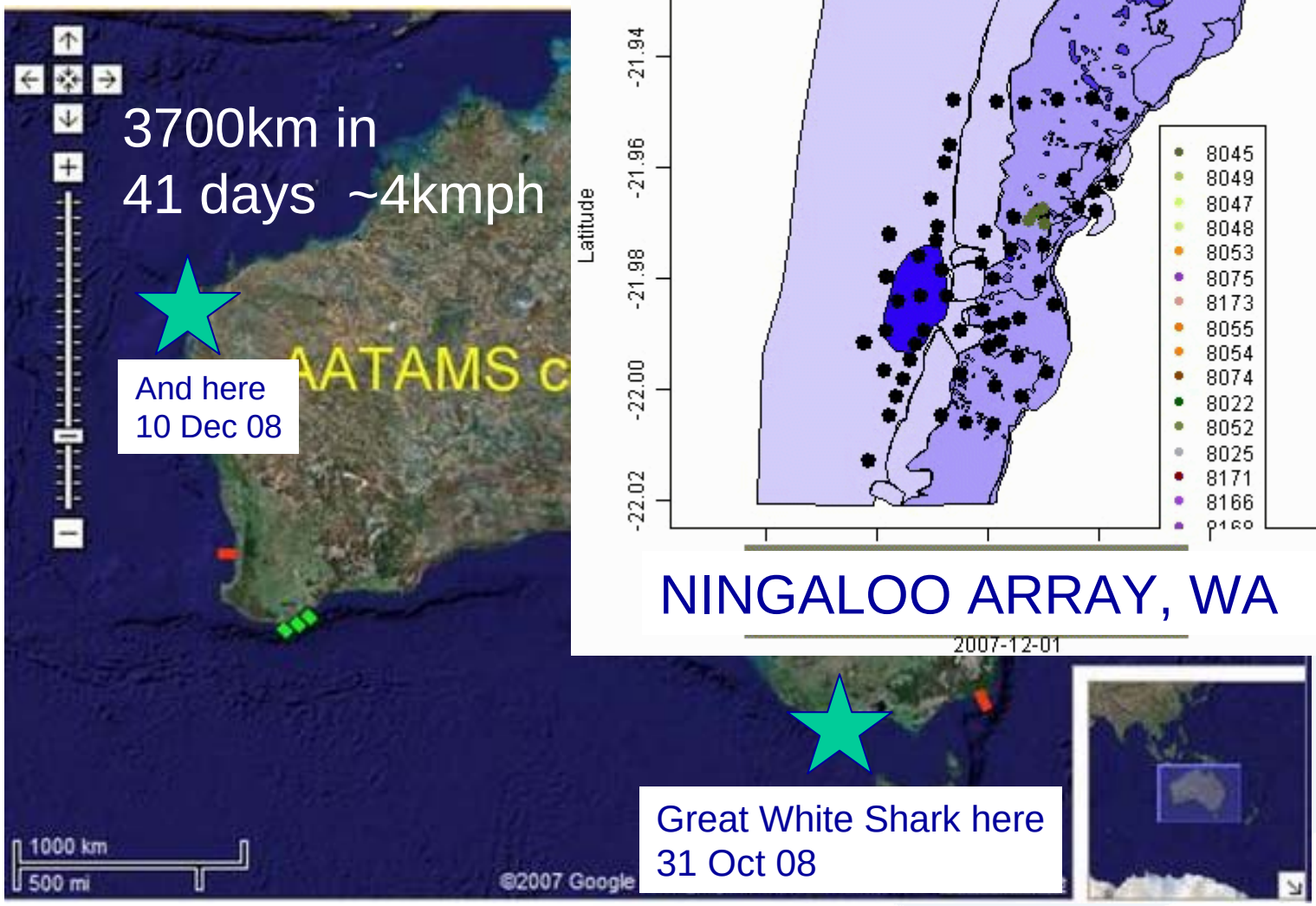
Acoustic Tagging of Fish



NINGALOO ARRAY, WA

Data discovery - The Tools

Open Source, Standards based

- IMOS Metadata Entry and Search Tool (MEST)
  - http://imosmest.aodn.org.au
  - GeoNetwork open source
  - ISO 19115 metadata records, Marine Community Profile
- IMOS Ocean Portal
  - http://imos.aodn.org.au
  - Java framework, Openlayers, WxS, CSW 2.0.2

Access to data through the portal,

either directly to do a simple search of the MEST,

or directly from the MEST for more complex searches

Real-time view - Data Turbine

- DataTurbine is a robust open-source streaming data middleware system that satisfies the core requirements for sensor-based environmental observing systems
- Originally a NASA code, the Open Source DataTurbine Initiative transitioned the system from a proprietary software system to an open source initiative

Ring Buffer

- Circular buffer stores a predefined amount of the latest data
- Can be used for numeric data, still images or video
- Data can also be written to a database or archived on disk

http://www.dataturbine.org

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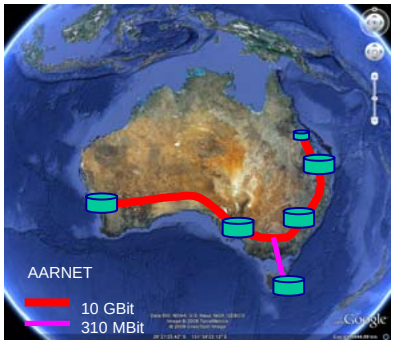
The IMOS distributed data system (with ARCS support)



Based around AARNET 10Gbit fibre links on mainland
Limited data stored at TPAC due to Basslink

IMOS data types
- Arrays
- Timeseries
- Images
- Documents

SA – eRSA

QLD – QCIF

WA - iVEC

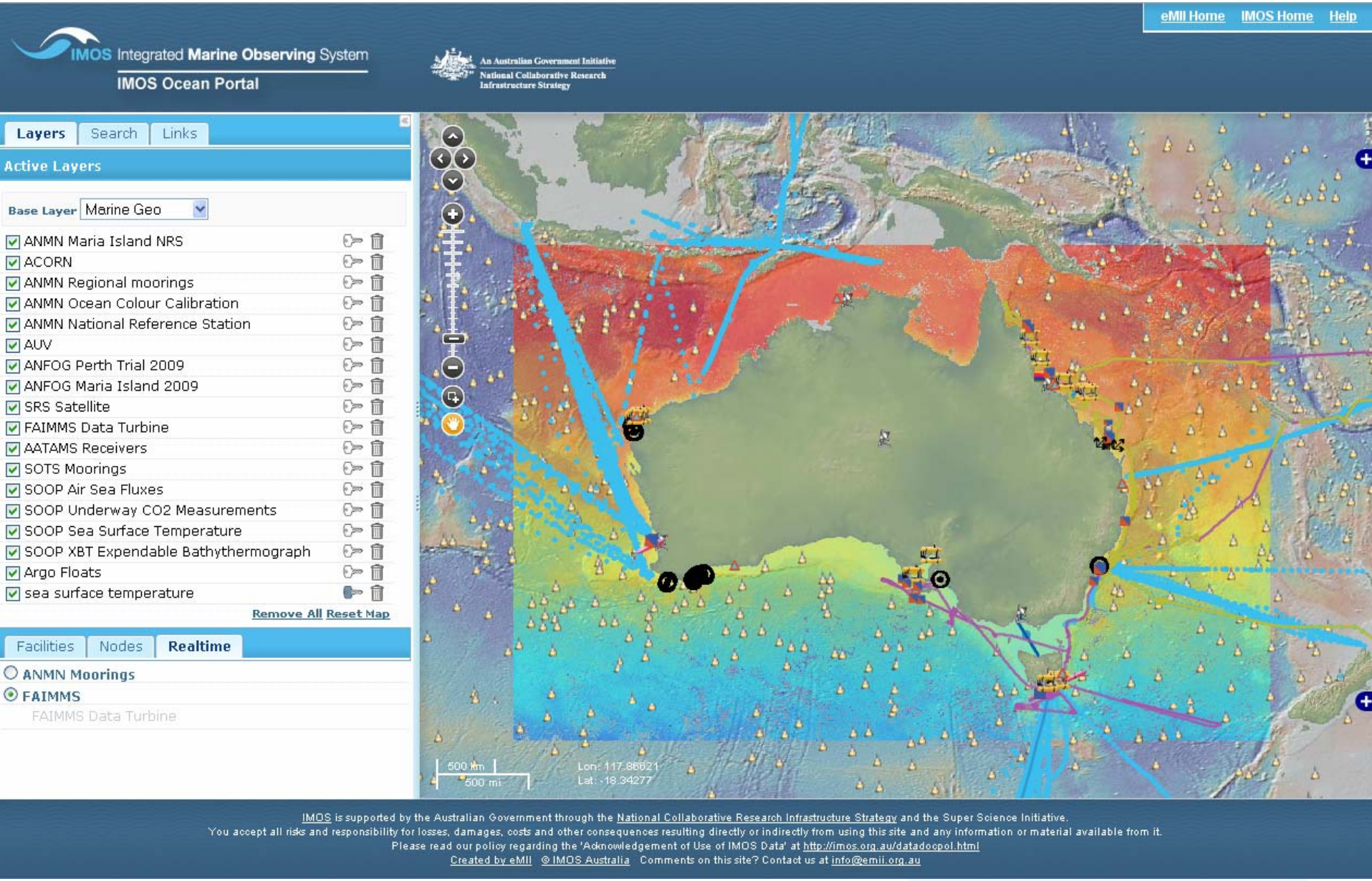
NSW - Intersect

Data Fabric – cloud storage
OPeNDAP/THREDDS
MEST
DataTurbine

IMOS Ocean Portal

TAS - TPAC

EMII HQ
MEST (master) (harvest records from local MESTS)
DataTurbine (master)



IMOS Ocean Portal: http://imos.aodn.org.au

Facility	Equipment	Collaboration
Argo	US	International (inc US)
Ships of Opportunity	US	International (inc US)
Southern Ocean sites	US	International (inc US)
Gliders	US	Europe/US
AUV	US	US
Mooring network	US	Canada
Coastal radar	US/Europe	Europe/US
Acoustic tagging	US/Canada	International (inc US)
Sensor networks	US	International (inc US)
Satellite remote sensing	US/Europe	International (inc US)

Pan Pacific interaction: Dependence and collaboration

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eResearch - present

- Common metadata and data standards
  - ISO 19115
  - CF-netCDF, geoTIFF etc.
  - Interoperability
- OGC standards for search, discovery & visualisation
  - GeoNetwork Metadata Entry and Search Tool (Catalog)
  - Openlayers, WxS, CSW
- Standards for data delivery
  - ARCS Cloud storage / OPeNDAP-THREDDS
  - DataTurbine

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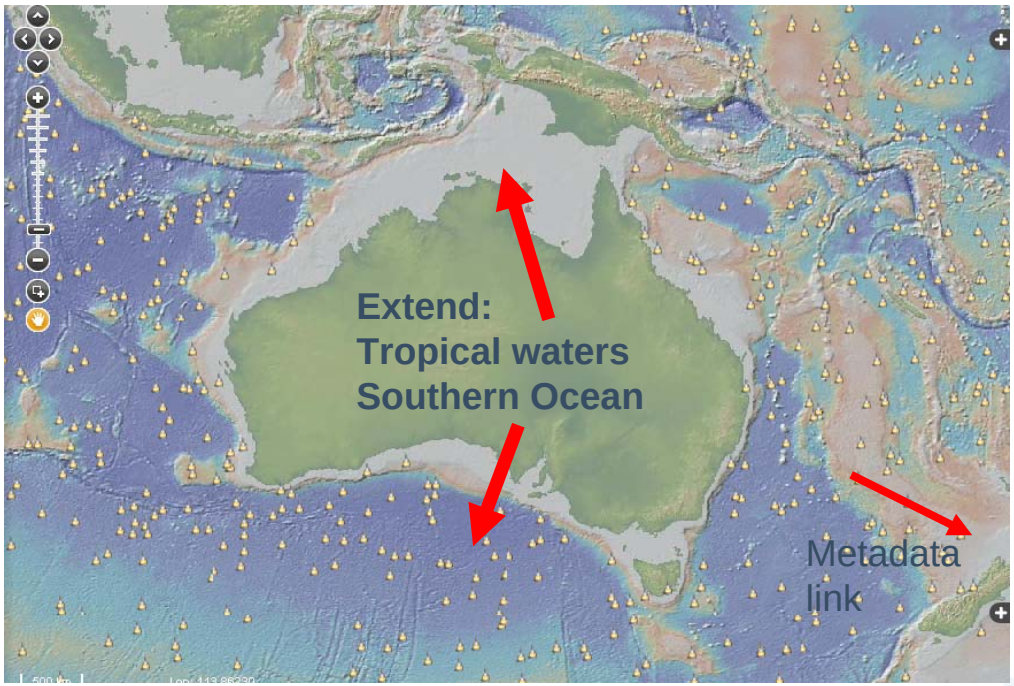
Where next for IMOS?

Additional AUD$52M in 2009 from the “Super Science Initiative” to enhance and extend IMOS to June 2013



Enhance:
Biochemical & biological
Ocean and coastal

Integration with
Ocean Forecasting –
BLUElink

Potential new Facilities:
Drifting Buoys, Sediment deposition, Microbial Observatory, Bio-acoustics, Fast Ice

Potential new data types:
Floc imagery, gene sequences, sound spectra, ice properties

eResearch – future potentials

- Common metadata and data standards
  - Working with US-IOOS & EU-MyOcean … OOI?
  - Interoperability
- OGC standards for search, discovery & visualisation
  - GeoNetwork Metadata Entry and Search Tool (Catalog)
  - Openlayers, WxS, CSW
  - 3D visualisation … NASA Worldwind?
- Standards for data delivery
  - ARCS Cloud storage / OPeNDAP-THREDDS … RAMADDA
  - DataTurbine
  - Sensor Observation Service / Sensor Web Enablement
- Cloud computing
  - Work flows for interactive data analysis/integration, modelling

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