IMOS and the Tassie Node 2014

Leadership from:

Steering Committee: Smith, Carter, Thompson, Swadling, Sainsbury, Schiller


Tasmania has a large marine research community with diverse interests….
Node structure

TasIMOS Steering Committee
Smith, Carter, Schiller, Sainsbury, Thompson* Swadling*

Neville Barrett
Benthic AUV
6 repeat transects around Tasmania

Peter Thompson
Giders
2 IMOS gliders on repeat transect in Storm Bay

Tim Lynch
NRS
Maria Island National Reference Station

Jayson Semmens
Acoustic Curtains
2 curtains on the east coast of Tasmania

Christopher Watson
Moorings
Moorings in Bass Strait and Storm Bay

Rudy Kloser
Acoustics & CPR on SOOP
Cross Tasman Sea transects + other SOOP

Edward King
Remote sensing
Regional improvements in RS products

John Arnould
Bass Strait

IMOS 2014
2013 in Review

IMOS Office, Facilities and Nodes spent considerable time devising scenarios for ~30% or ~80% bridging funding. There is scope to improve the focus on a national observing system.

What is it about sustained observations that make them valuable? Trends? Temporal variability = future predictions?
IMOS and the Tassie Node philosophy

• Its underlying scientific rationale is to link the physics to the fish, really….

• New
  • IMOS acoustic curtains deployed to monitor movements of key species
  • Stronger links to Victoria and northern Bass Strait primarily through Deakin University

IMOS 2014
Major Node Observations

- National Reference Station at Maria Island (includes CO$_2$)
- Gliders
- Benthic AUV
- Acoustic receivers
Annual Node day

• The Maria Island CO2 Story (Tilbrook)
• CPR Work in Eastern Australia (Davies)
• AUV-based results for Tasmania (Barrett)
• Global microbial observing systems (Bodrossy)
• Comparing two semi-autonomous QC systems (Matlab toolbox and Fuzzy logic) to an expert oceanographer (Lynch)
• A demonstration of the IMOS Ocean Current website and its features (Cahill)
Gliders: IMOS gliders on the route

From 2013 to 2015

6 glider missions per year on this route

• Building capacity to assimilate these data in (near) real time.
• Underpin our hydrodynamic and biogeochemical modelling in this region
• High rate of mission success (glider and data recovery)
TasIMOS Gliders

- Have 2 IMOS gliders available

Using the glider data to improve hydrodynamics

- Vertical structure was dramatically improved in model

- Data – model comparison shows the glider data is valuable to nudge ~ 90% of Storm Bay
TasIMOS acoustic receivers

AATAMS sub facility led by Jayson Semmens at UTas
- 2 curtains
  • Proposal from John Arnould at Deakin University to put in Bass Strait ‘gates’

Issues arising for IMOS:

Temperature loggers on deployed acoustic receivers

Receivers on glider!

CSIRO and UTas funded additional infrastructure
Deployed in January 2012
Monitoring the sea urchin barrens

AUV in TasIMOS

Repeat transects

Neville Barrett
UTas

Craig Johnson
UTas
3D reconstruction of the Hippolytes

Mosaic of stereo images stitched together
Active research group driving some interesting science
OUTPUTS

Rapidly increasing number of outputs that link IMOS observations to impacts, some with global significance.

Resilience and signatures of tropicalization in protected reef fish communities

Amanda E. Bates\textsuperscript{1,2*}, Neville S. Barrett\textsuperscript{1}, Rick D. Stuart-Smith\textsuperscript{1}, Neil J. Holbrook\textsuperscript{1,3}, Peter A. Thompson\textsuperscript{4} and Graham J. Edgar\textsuperscript{1}

One of the reasons for this success is the co-location of different types of observations.

IMOS 2014
AUV OUTPUTS


Lucieer, VL and Hill, Nicole and Barrett, NS and Nichol, S (2012). Do marine substrates 'look' and 'sound' the same? Supervised classification of multibeam acoustic data using autonomous underwater vehicle images', *Estuarine, Coastal and Shelf Science* 117: 94-106. ISSN 0272-7714


Seiler, J, Steinberg, A, Steinberg, D, Barrett, N, Williams, A, Holbrook, N. (2012). Automating mapping of continental shelf seafbed habitats based on digital imagery collected by an AUV. *Estuarine, Coastal and Shelf Science.* 45: 87-97


Examples of IMOS Related Student projects

New evidence links changing shelf phytoplankton communities to boundary currents in southeast Tasmania

P. J. Buchanan · K. M. Swadling · R. S. Eriksen · K. Wild-Allen

Comparative analysis of chlorophyll measurement techniques from Maria Island NRS

Environmental drivers of Thaliacean blooms and their ecology in Storm Bay, Tasmania

Hydrodynamic control of plankton in Recherche Bay

Change in size and production of *Nyctiphanes australis* over 30 years

Influence of EAC on plankton in eastern Australia
UPTAKE & USE

• INFORMD
  significant FRDC funded project in SE Tas (salmon industry)

• TasWater
  applied BGC modelling of SE Tas (pulp mill, sewage disposal, smelter)

• Victorian EPA
  • Soon to commence, hydrodynamic modelling of SE Australia
Other facilities are crucial to achieving our vision:

- Argo Floats
- Ships of Opportunity
- Deep water moorings (EAC array)
- Ocean Gliders
- Satellite Remote Sensing
- Other moorings (e.g. sea level height validation)
A decade of Tasman Sea bio-acoustics and ad-hoc sampling

Rudy Kloser

Gordon Keith, Caroline Sutton, Tim Ryan, Ryan Downie, IMOS sub-facility
National Environmental Monitoring Plan

Key Ecological Features (KEFs) from the SE region (after Dambacher et al. 2012).

Very few of these are currently monitored by IMOS observations.
Revising the Tassie Node Plan

Table 7: The variables required to address Ecosystem Responses science questions.

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<tbody>
<tr>
<td>Measured in at least one location in Tasmania.</td>
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<td>Spatial coverage is likely to be sub-optimal in Tasmania.</td>
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<td>Not measured and significance needs further consideration.</td>
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</table>

Spatial coverage seems unlikely to be adequate.
Revised Tassie Node Plan

Table 12: How variables required to address the high-level Continental Shelf and Coastal Processes science questions are delivered at required scales by IMOS facilities. **Blue** = directly measured variable; **Red** = derived variable; **Orange** = could be derived; **Green** = could derive a relative estimate; **Black** = sensors are available for these variables on this platform.

<table>
<thead>
<tr>
<th>Variable</th>
<th>SOOP Tropical RV/ Temperate RV</th>
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<tbody>
<tr>
<td>Temperature - surface</td>
<td>Blue</td>
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<tr>
<td>Temperature - Subsurface</td>
<td>Red</td>
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<tr>
<td>Salinity</td>
<td>Black</td>
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<tr>
<td>Velocity</td>
<td>Black</td>
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<tr>
<td>Sea Surface Height</td>
<td>Blue</td>
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<tr>
<td>Surface waves – amplitude</td>
<td>Orange</td>
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<tr>
<td>Surface waves – spectrum</td>
<td>Blue</td>
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<tr>
<td>Internal waves</td>
<td>Blue</td>
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<tr>
<td>Wind velocity (stress)</td>
<td>Blue</td>
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<tr>
<td>Air-sea fluxes</td>
<td>Blue</td>
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<tr>
<td>Oxygen</td>
<td>Blue</td>
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<tr>
<td>pCO2</td>
<td>Blue</td>
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<tr>
<td>pH</td>
<td>Blue</td>
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<tr>
<td>Total inorganic Carbon</td>
<td>Blue</td>
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<tr>
<td>Alkalinity</td>
<td>Blue</td>
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<tr>
<td>Macronutrient concentration</td>
<td>Blue</td>
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<tr>
<td>Pigment concentration</td>
<td>Black</td>
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<tr>
<td>CDOM and backscatter</td>
<td>Black</td>
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<tr>
<td>Phytoplankton species</td>
<td>Black</td>
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<tr>
<td>Phytoplankton Biomass</td>
<td>Black</td>
</tr>
</tbody>
</table>

Some platforms are (arguably) under-developed.
IMOS and the Tassie Node 2014

Node Plan revised:
Measured most of the key variables but apparent weakness was appropriate spatial and temporal coverage

Most obvious solution seemed to be adding more or different sensors to existing platforms (e.g. BIO-ARGO, slocum gliders or SOOP)
Conclusions

• The value of IMOS data streams is rapidly becoming widely recognized

• Still need to do some more work on demonstrating the value of these data streams to address issues of national and international significance

• \( \text{uptake} + \text{impact} = \text{value} \)
UPTAKE: other major initiatives planning to use IMOS data.

- TasWater – Estuarine Discharge – applied BGC modelling of Derwent, D’Entrecasteaux & Huon and Pittwater nested in Storm Bay model. Particular focus on fate and environmental impacts of STP point source loads. Models include hindcast, scenario and near real time implementations.

- FRDC - INFORMD Stage 2 – MSE of aquaculture activities mostly focussed on D’Entrecasteaux Channel; emulator based on BGC model nested in Storm Bay model. Particularly focussed on multiple use management of waterway.

- Victoria – model of local waters
Sub-Facility 11e:
Satellite Altimetry CAL/VAL:

• Commenced operations in July 2010 under EIF funding. Primary aims are the provision of sea surface height (SSH) bias, and bias drift data streams to the NASA/CNES OSTM/Jason-2 satellite mission team.

• The sub-facility operates sites in Bass Strait and Storm Bay where coastal moorings are deployed on the 6 month visit cycle (first deployment October 2010).

• Moorings are designed for precise measurement of SSH and include bottom pressure, temperature and salinity through the column.

• Storm Bay includes a WQM instrument with T, S, PAR, Fl.

• Provisioning and commissioning of the data streams are well on track (details in the SRS Facility talk by Edward King).
Tas IMOS Benthic Observations
mapping the rocky reefs on the east coast
UPTAKE: other major initiatives planning to use IMOS data.

CSIRO Flagship WfO continues to invest in SE Tas as a region for the development of improved models and instrumentation – for future national use.
New $3 million carbon cluster has provided significant funding of University research to align with CSIRO activities in the coastal carbon science.

e-reefs is using IMOS data
Andreas Schiller as the lead CSIRO scientist.

WAMSI 2 Kimberley Node has commenced (~ $25million)
new IMOS investment in WA
projects have explicit links to IMOS.
Gliders

- Have 1 IMOS glider in use
- Expecting a second

Using the glider data to improve hydrodynamic models

- Vertical structure was dramatically improved in model
- Data – model comparison shows the glider data is valuable to nudge ~90% of Storm Bay
Satellite Altimetry Cal/Val

- Tasmania hosts the IMOS altimetry cal/val sub-facility, with moorings in Bass Strait and Storm Bay.

- Cal/val remains an important issue for altimetry mission teams – the international community are gearing up in prep for the launch of Jason-3 (fourth in the series of reference missions for sea level).

- IMOS Sub-facility well situated to make a contribution to the ESA Sentinel-3 altimeter validation team (launching 2014/15).

- The Tasmanian contributions to the mission science team continue to be well recognised and valued.

Black: TOPEX/Jason Reference Missions
Yellow: ENVISAT / SARAL
Red/Pink: Sentinel 3A and 3B
(Note shown: CryoSat-2 (ESA) or Hy-2A (China))
Linkages between trophic groups – bioacoustics
continuous plankton recorder from fishing vessel

Phytoplankton Colour Index August 2010

Copepod density August 2010

PCI
- No colour
- Very pale green
- Pale green
- Green

www.imos.org
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