



Australian National Coastal Ocean Modelling System (ANCOMS)

Emlyn Jones (CSIRO) on behalf of the ANCOMS FOO/NMSP-R4 working group

Co-chairs:

Emlyn Jones - CSIRO
Mike Herzfeld - CSIRO

Members:

Paul van Ruth (IMOS)
Natalia Santos (IMOS)
Frank Colbert (BoM)
Clothilde Langlais (CSIRO)
Vanessa Hernaman (CSIRO)
Ivica Janekovic (UWA)
Matt Hipsey (UWA)
Matt Rayson (UWA)
Hugo Bastos de Oliveira (SARDI)
Charles James (SARDI)
Mark Doubell (SARDI)
Hemerson Tonin (AIMS)

Barbra Robson (AIMS)
Jessica Benthuisen (AIMS)
Severine Choukroun (JCU)
Collette Kerry (UNSW)
David Gwyther (UQ)
Ashley Barnes (ANU)

NCRIS Facility Leads:

Michelle Heupel (IMOS)
Andy Hogg (ACCESS-NRI)
Moninya Roughan (SEA-COFS/UNSW)

Background: NMSP 2015-2025

“coordinated”

“National Collaborative Research Facility”

“suite of national marine system models”

National marine modelling and forecast centre

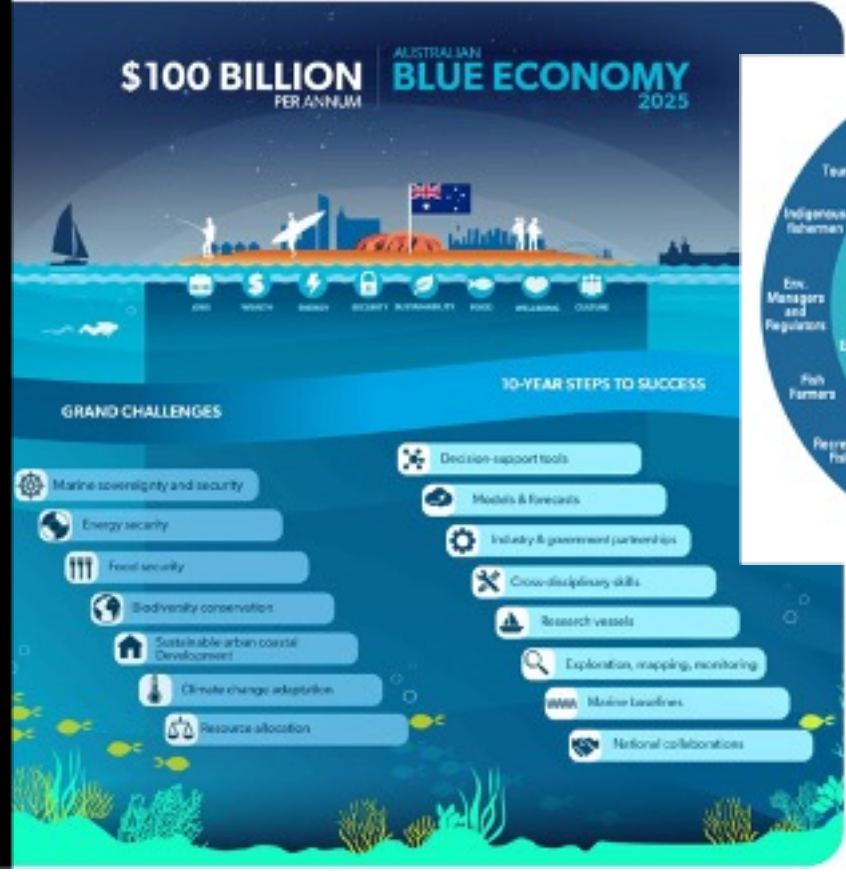
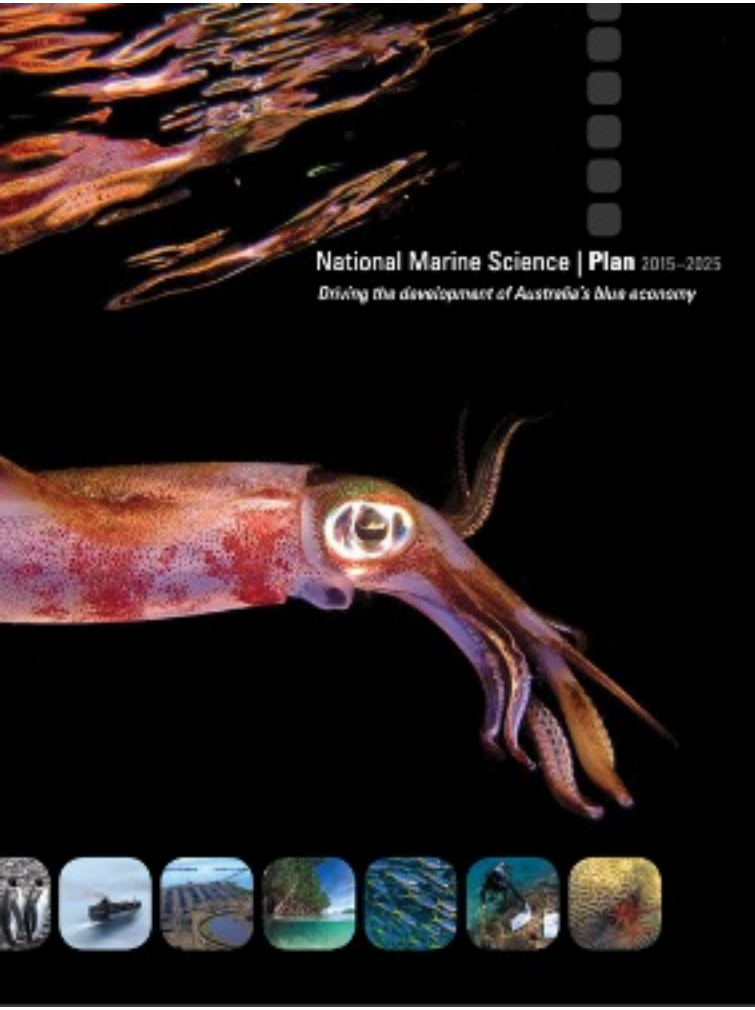
This Plan highlights the need for a coordinated national marine environment and socioeconomic modelling system. A National Collaborative Research Facility akin to IMOS, and dedicated to developing and using a suite of national marine system models, would provide the next important step in managing our marine estate.

4. Create a National Oceanographic Modelling System to supply the accurate, detailed knowledge and predictions of ocean state that defence, industry and government need.

This modelling system would serve the broad range of Australian Government regulators and operational agencies, marine industry sectors (offshore oil and gas, shipping, fisheries, aquaculture and tourism) and public users that require accurate, detailed knowledge and predictions of ocean state, including currents, waves, temperature, salinity, pH and productivity.

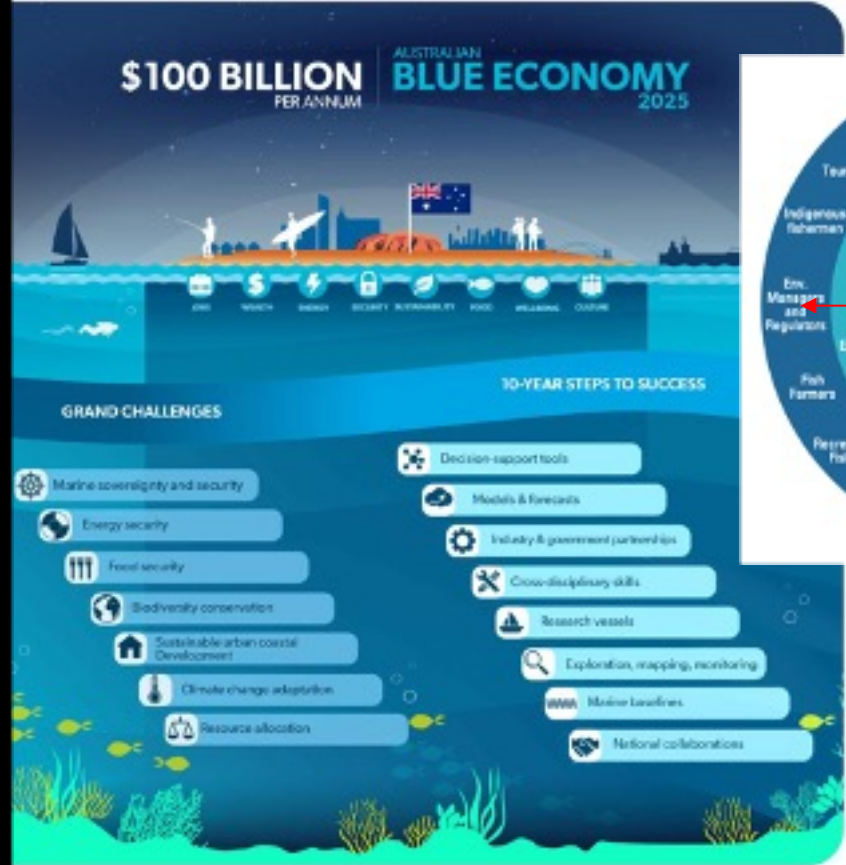
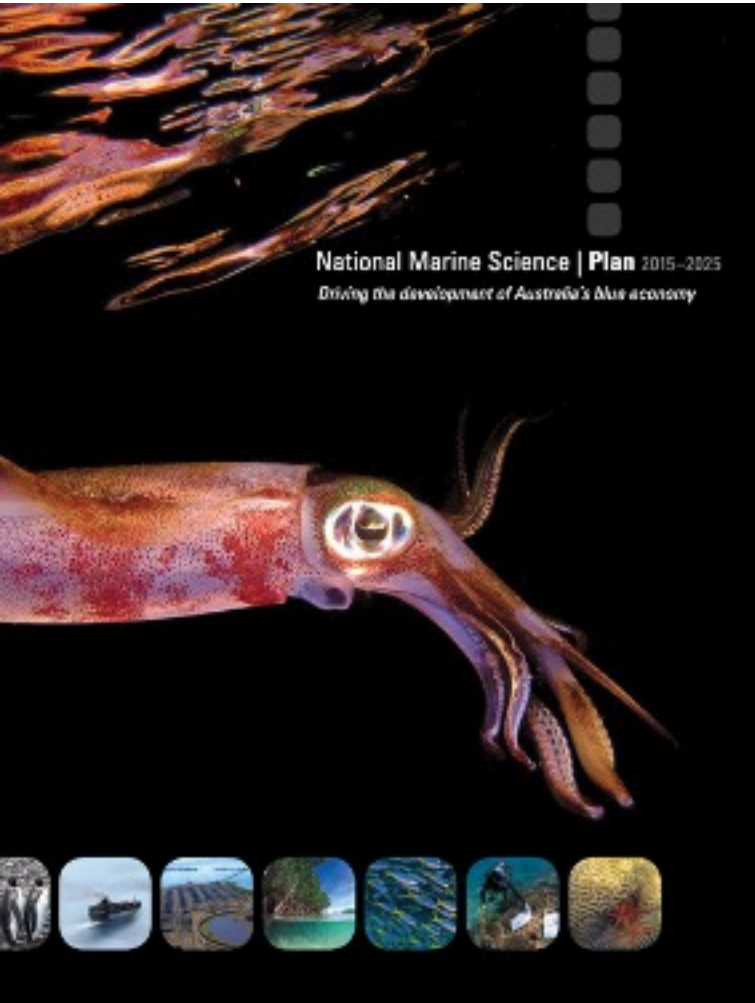
It would use and assimilate data collected by a sustained and expanded IMOS and our national research vessel fleet, and also draw in the significant observational data collected by industry as part of their core business.

Given the scale of this challenge, and the depth of capability across academic institutions and publicly funded research agencies, we recommend that a national research focus on operational oceanography be established to ensure timely delivery of this significant national capability.



Background: NMSP 2015-2025

NMSP 2021 update:
 "Australia has strong ocean modelling capabilities across multiple institutions, including in the tertiary sector. The Bluelink modelling system delivers freely available, daily ocean forecasts. However, there is still no national capability for coastal regions, which remains an important priority.



National marine modelling and forecast centre

This Plan highlights the need for a coordinated national marine environment and socioeconomic modelling system. A National Collaborative Research Facility akin to IMOS, and dedicated to developing and using a suite of national marine system models, would provide the next important step in managing our marine estate.

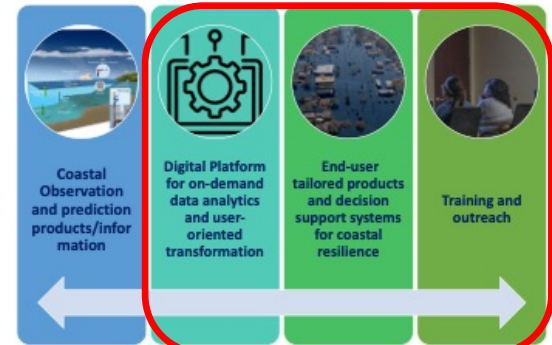
4. Create a National Oceanographic Modelling System to supply the accurate, detailed knowledge and predictions of ocean state that defence, industry and government need.

This modelling system would serve the broad range of Australian Government regulators and operational agencies, marine industry sectors (offshore oil and gas, shipping, fisheries, aquaculture and tourism) and public users that require accurate, detailed knowledge and predictions of ocean state, including currents, waves, temperature, salinity, pH and productivity.

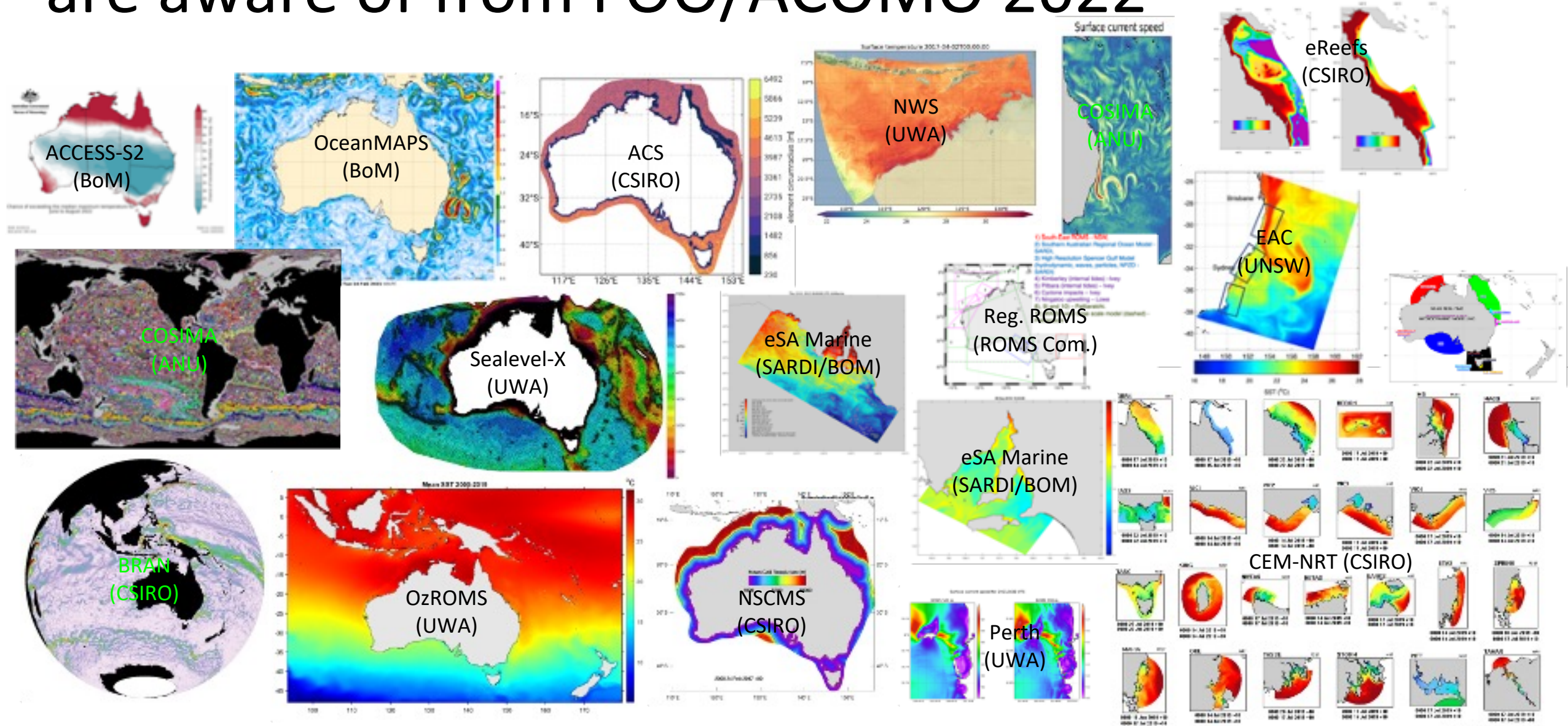


Informatics are required to make products/data accessible to end users

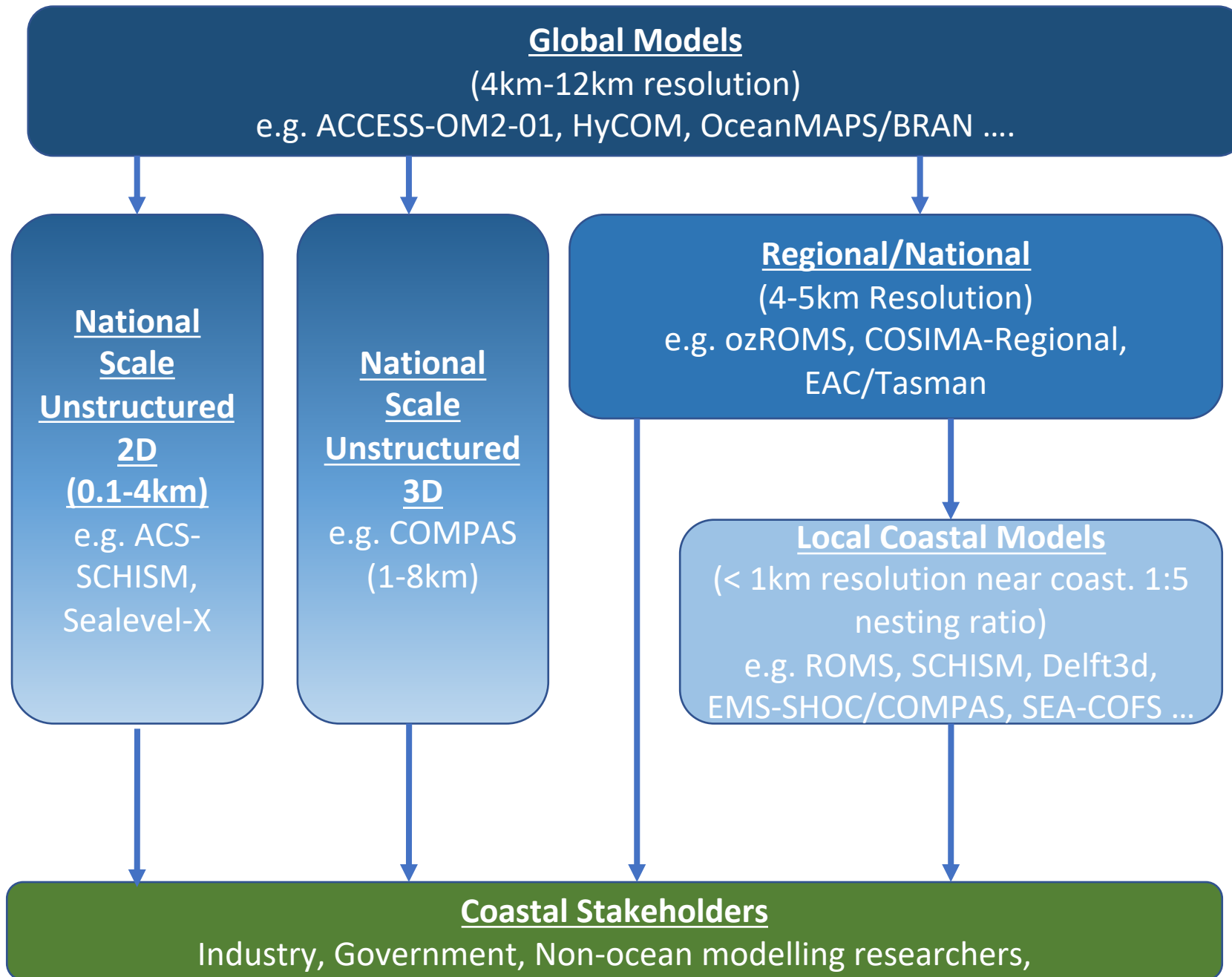
It would use and assimilate data collected by a sustained and expanded IMOS and our national research vessel fleet, and also draw in the significant observational data collected by industry as part of their core business. Given the scale of this challenge, and the depth of capability across academic institutions and publicly funded research agencies, we recommend that a national research focus on operational oceanography be established to ensure timely delivery of this significant national capability.



Background: Existing Domains/Systems ... that we are aware of from FOO/ACOMO 2022



Background: Conceptual model of existing systems



Responsible Group

COSIMA

Regional teams

ACCESS-NRI (software & frameworks)
IMOS/AODN (Observations & informatics)

There is little integration between systems and teams, or use of consistent forcing data.

Output and products from systems are scattered and can be difficult to find unless you know what you're looking for.

Background: FOO/ACOMO 2022 - Panel Discussion

ACOMO/FOO Panel Discussion

How can we integrate existing models to develop a skilful National Scale Prediction System?

Thanks to all who have contributed slides and information!



Professor Ryan Lowe

Oceans Graduate School
UWA Oceans Institute



David Carter

CEO
Austral Fisheries



Giovanna Lorenzin

Advisor Spatial Intelligence,
Integrated Operations
Response
Australian Maritime Safety
Authority



Greg Williams

Technical Director –
MetOcean
RPS Energy



Dr Vanessa Hernaman

Research Scientist Sea-level,
Waves, and Coastal Extremes,
Oceans & Atmosphere
CSIRO



Dr Claire Spillman

Principal Research Scientist
Bureau of Meteorology

Australian National Coastal Ocean Modelling System (ANCOMS)

GOAL:

Develop an integrated national coastal ocean modelling system to provide the information necessary to support our coastal endeavors that builds upon and adds value to existing Australian modelling and observational initiatives.

OBJECTIVES:

- enhance **predictive capability for coastal zones in the Australian mainland and Tasmanian EEZ (e.g. nominally within 200nm of the coast)**. Australian Offshore territories, and Antarctica are currently out of scope for this proposal.
- provide **fit for purpose information** in the coastal zone using models that capture relevant process from physics to bio-geochemistry (and ideally through to fisheries/ecosystem and socio-economic models) that **span a range of time horizons**: Past, Present, Forecasts and Scenarios (inc climate futures).
- **incorporate an informatics** pipeline so model output and downstream products are discoverable.
- improve the efficiency of model deployment and development via a **shared development environment**.
- integrate coastal observations to improve model configurations and predictions of the coastal ocean.
- encourage **transparent and consistent assessments of model skill** with assessments of uncertainty (where possible) provided to end-users.

The success of this vision depends upon cross-institutional, multi-disciplinary collaboration that leverages the strengths of both national scale and regional/local expertise.

ANCOMS – Phase 1 proposed structure

Impact pathway (from global 2 local, physics 2 phytoplankton, data 2 decisions)

Responsible Group

ANCOMS R&D Stream

Coastal Commons (overlap with COSIMA, ACCESS-NRI and IMOS)

Open Development of configurations
Analysis Scripts, common forcing data,
Bathymetry, Observations

Research to Operations (TRL 1 to 8 pathway)

R&D Stream to transition developments (either within ANCOMS or through partner initiatives) into the ANCOMS system (e.g. development of a super-regional 2km model if deemed important by ANCOMS/COSIMA/ACCESS-NRI)

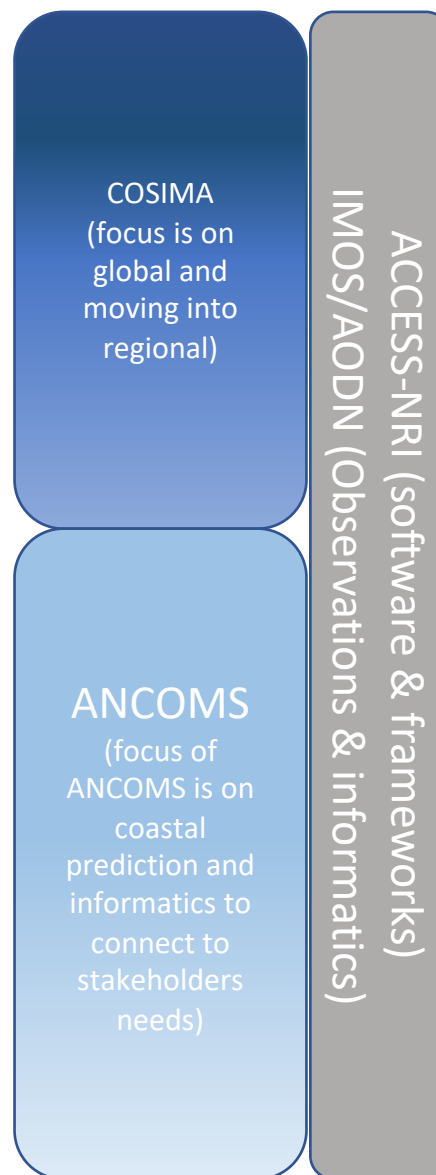
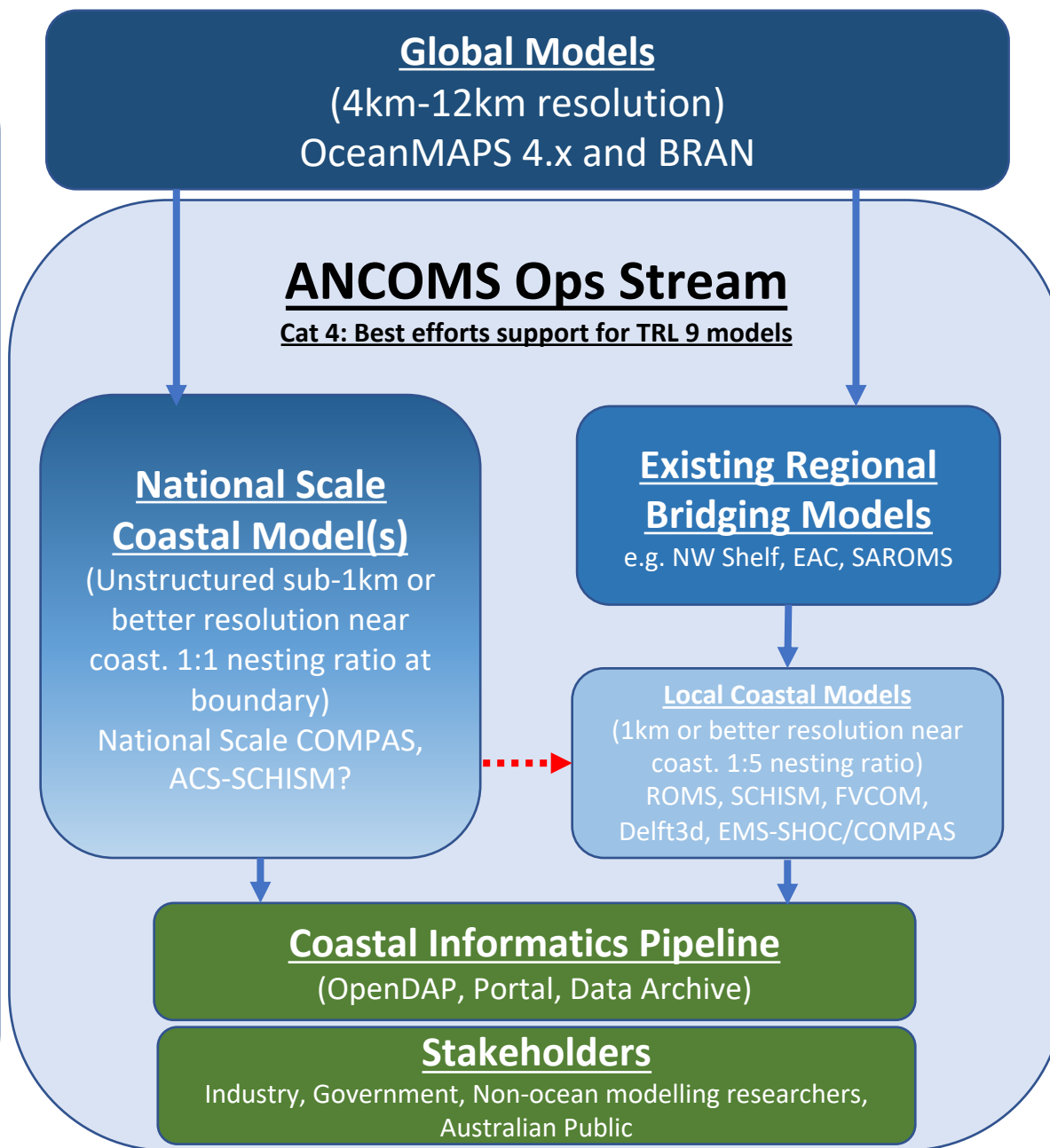
R&D activity 1: Year 1&2 Super-Regional Model Development

Collaboration between COSIMA, ACCESS-NRI and ANCOMS

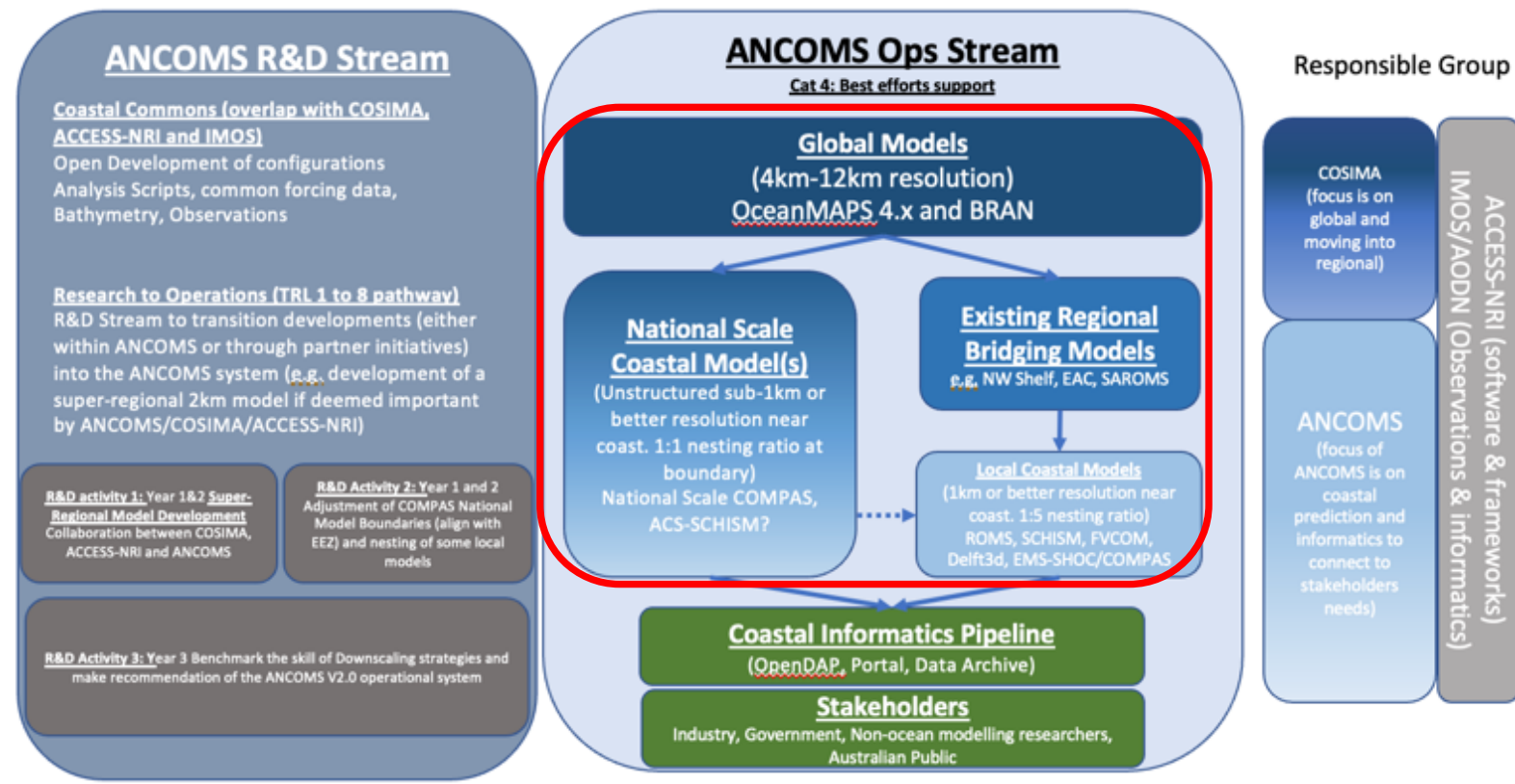
R&D Activity 2: Year 1 and 2

Adjustment of COMPAS National Model Boundaries (align with EEZ) and nesting of some local models

R&D Activity 3: Year 3 Benchmark the skill of Downscaling strategies and make recommendation of the ANCOMS V2.0 operational system



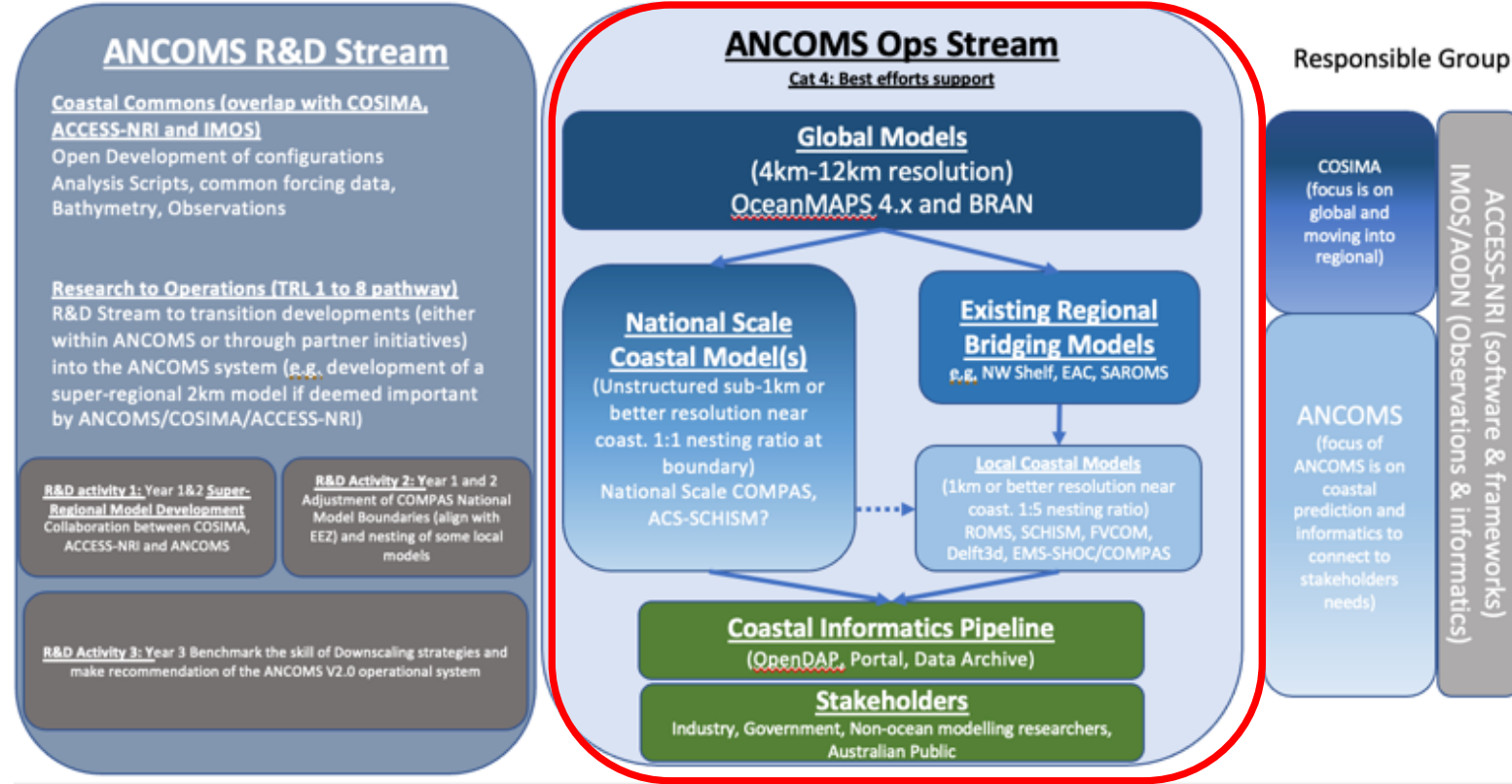
Conceptual Design: From Global to Local



We propose ANCOMS will use a downscaling methodology using a combination of national scale coastal models and local scale coastal models:

- National scale models will be used when consistent national scale solutions are required or in areas where no local models exist.
- Local models will be used where they exist and there is a specific end-user requirement that is local in nature. Further, local models that have been developed and tuned by local experts will be used to refine and improve national scale grids where overlaps exist.

Conceptual Design: Operational Stream



Operational System Definitions (often defined in a service level agreement)

Cat 1: 24hrs/7days/365days supported (e.g. BoM NWP/OceanMAPS)

Cat 2: 8hrs/7days/365 days supported

Cat 3: 8hrs/5 business hours support (e.g. CSIRO ROAM service to Defence)

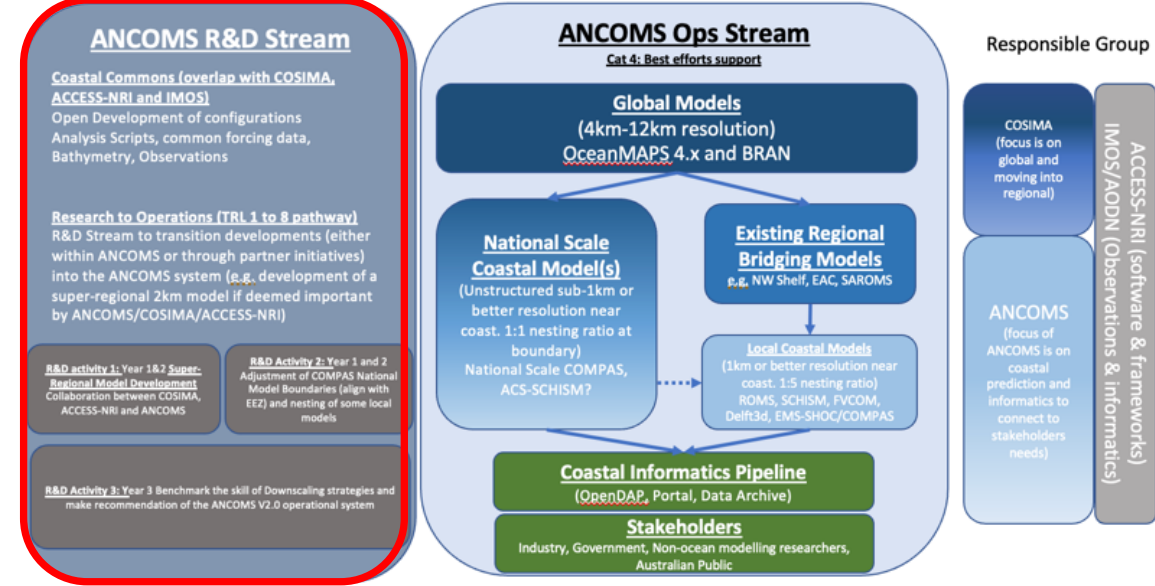
Cat 4: Best efforts during business hours (e.g. IMOS, eReefs)

We propose ANCOMS will establish a Cat 4 operational modelling and information system capability that compliments existing Cat 1-3 systems run by the Bureau. The open development paradigm for model configurations and systems will allow for Bureau or other operational groups* to take them to Cat 1-3 should the need arise.

*OTHER OPERATIONAL GROUPS – is there a role for the commercial sector here?

Conceptual Design

The ANCOMS will have a **variety of model components** available via the open development paradigm (coastal commons).



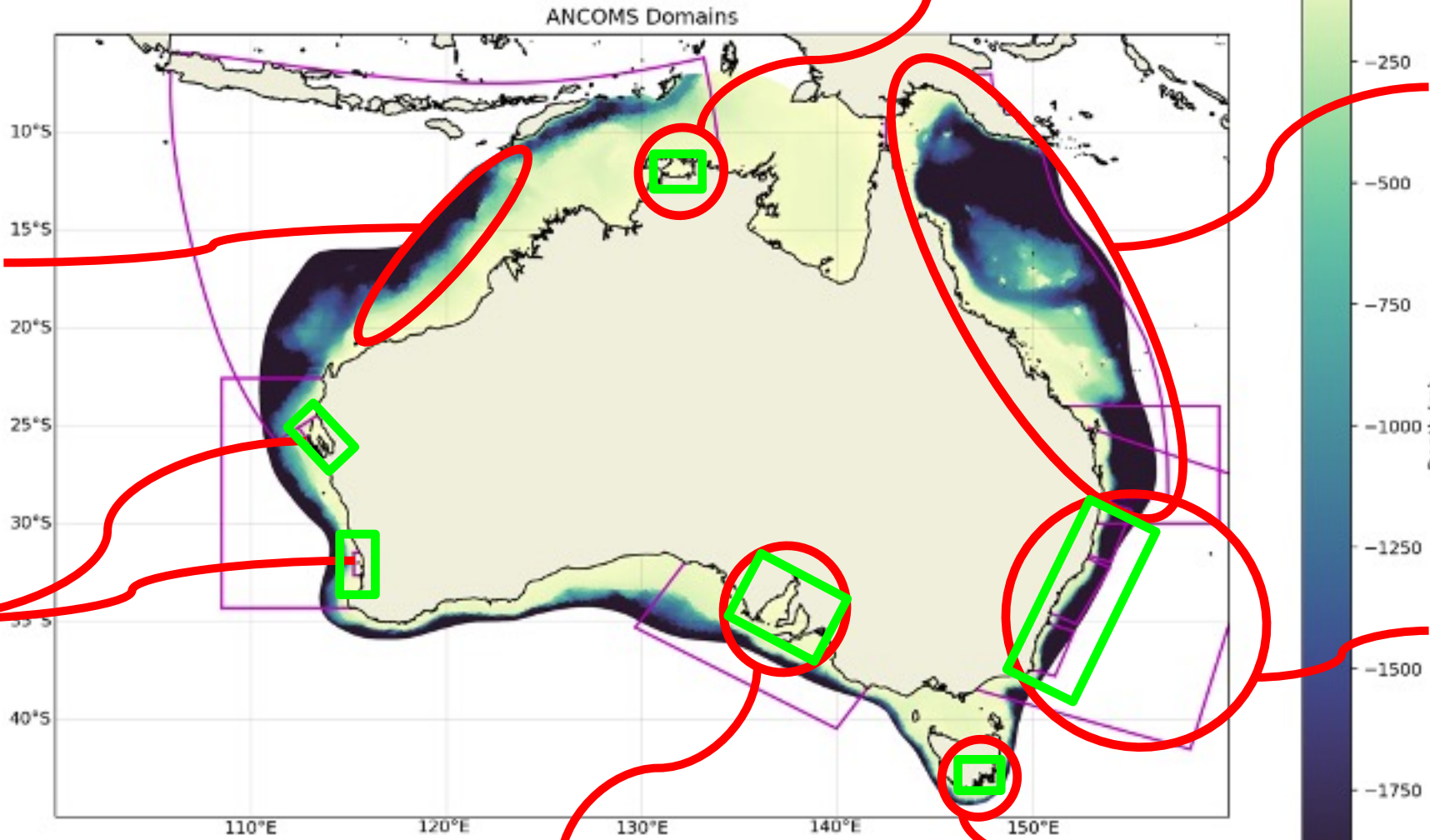
ANCOMS will establish a shared place for co-development of model configurations, product generation methods and **transparent and consistent model skill metrics**. This will be referred to as the ANCOMS Coastal Commons.

ANCOMS will have a dedicated R&D stream that will allow **new methods and improved approaches to be transitioned into operations** with oversight from an Technical Advisory Group (TAG) driven by needs identified by through stakeholder engagement (e.g. CoastRI)

A focus of the R&D stream will be to establish **best practice downscaling strategies** to be implemented in ANCOMS Phase 2 to achieve additional integration between modelling components.

Proposed ANCOMS Phase 1 Configuration

Phase 1: Darwin Harbor model nested within National Scale Model



Include NWS-ROMS. Nest Perth and Shark Bay in National COMPAS model.

eReefs?

SEA-COFS (UNSW)

Phase 1 R&D

Question: If the COMPAS boundary is moved offshore, is the EAC grid needed for the coastal nests?

Phase 1: Shark Bay and Perth models nested within the National Unstructured Grid

Phase 1: Include SA-ROMS and two-gulfs models. R&D investigate nesting within National COMPAS – does this improve skill? What is National COMPAS missing?

Phase 1: Storm Bay nested within National Scale Model?

ANCOMS Phase 2



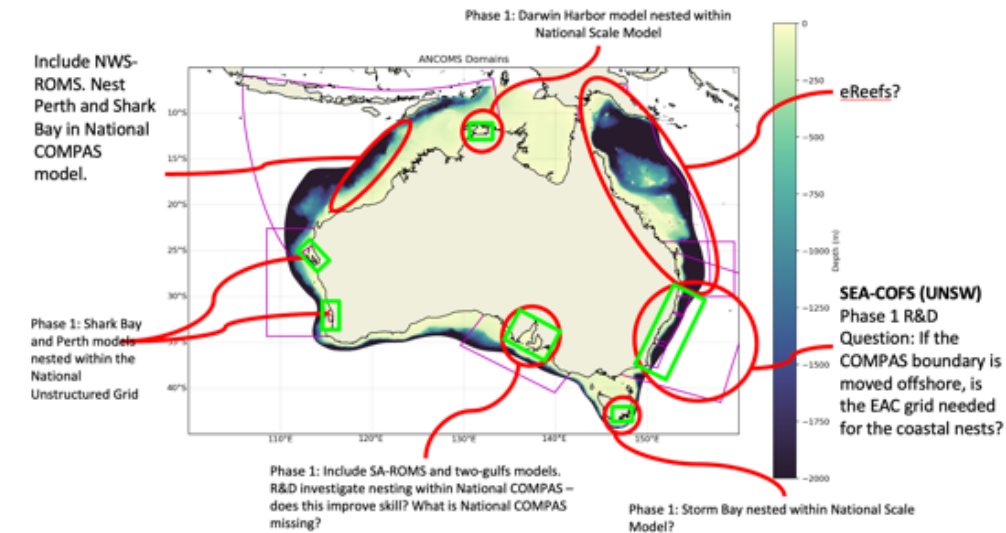
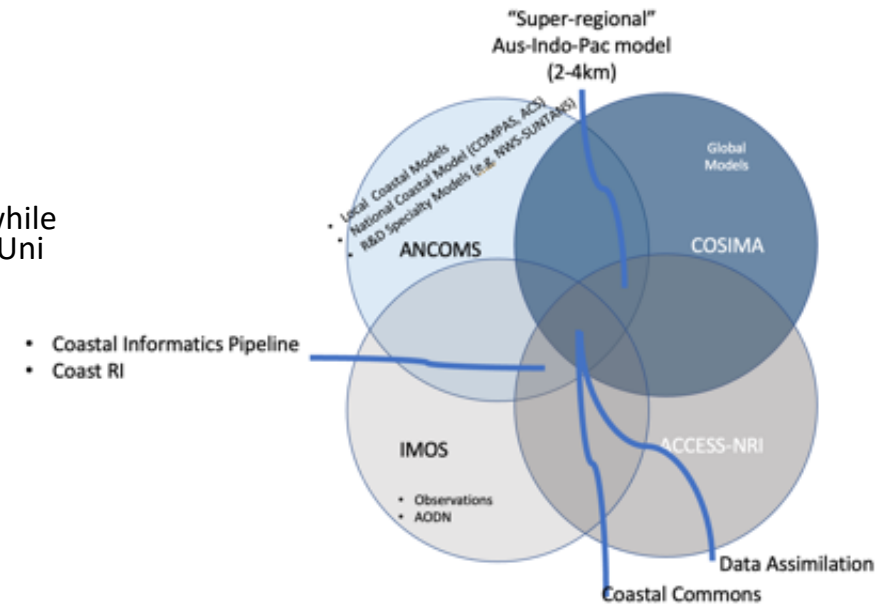
Phase 2 design to be guided by R&D activities completed during Phase 1.

Principal 1: We should be aiming for enhanced system integration. Will some bridging models be replaced by the super-regional model, or national scale unstructured model? An open question that will have some quantitative metrics from the coastal commons and skill assessments

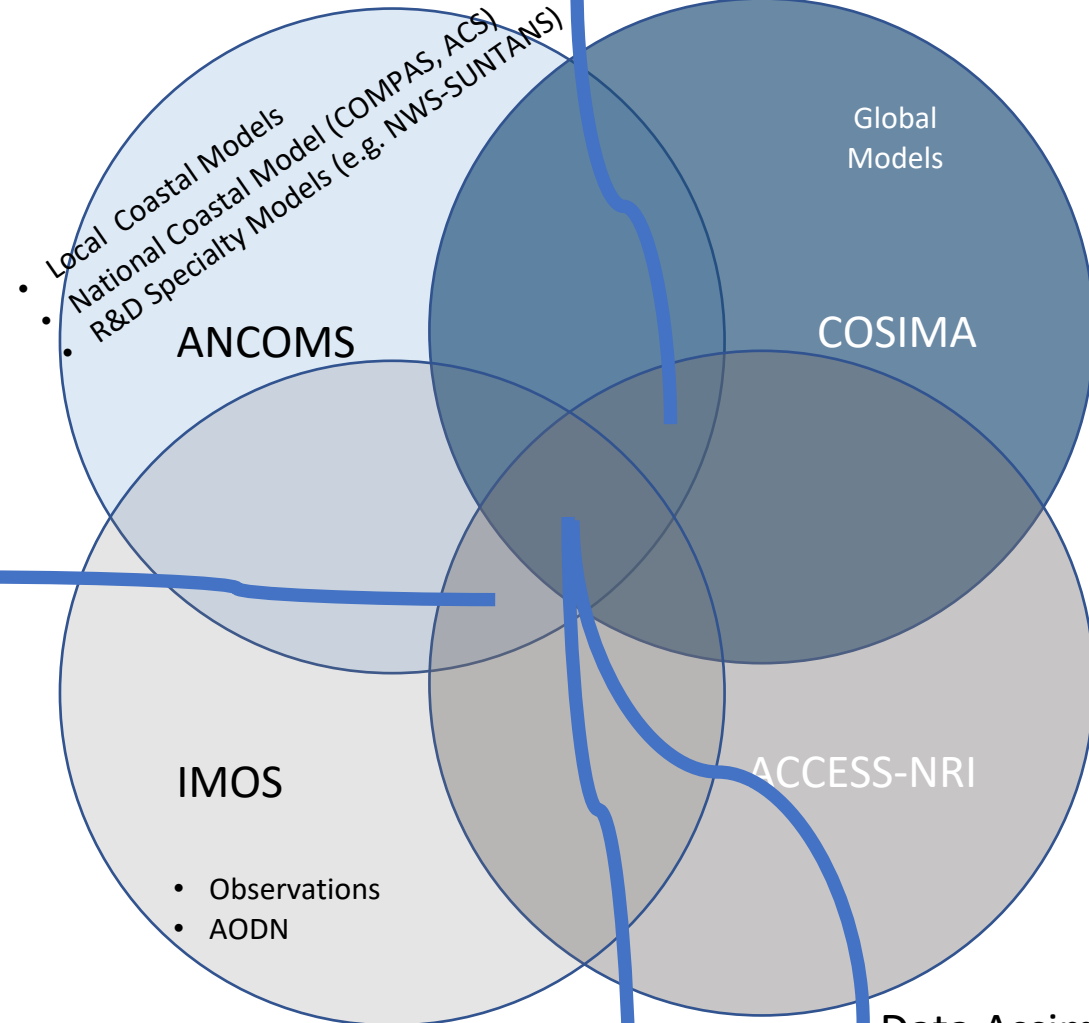
Principal 2: We should apply Occams Razor principal to the whole system – where can it be simplified? Both in terms of models, but also what simplification and efficiencies can be made with respect to the informatics pipeline? E.g. consolidation of infrastructure?

Summary

- The ANCOMS working group has been established – our aim is to be as inclusive as possible, while remaining small enough to make progress. There is good representation from PFRA's and the Uni sector. No representation from commercial sector (should this be done via the URG)?
- Draft an implementation plan (UNDERWAY) that considers:
 - **COORDINATION!**
 - Phased Approach to realise the system outlined in the vision document.
 - Combination of national scale and regional/local scale model components.
 - The current maturity of existing systems.
 - A pathway for new technology and systems to be developed.
 - Path to impact (via informatics)
- Challenges:
 - The group is lacking representation from the commercial sector – is there interest to join? Do the open development principals align with commercial interests?
 - How does this fit in with existing initiatives (e.g. CoastRI)? Need to avoid duplication.
 - Is Operational Cat4 sufficient/desirable?
 - There is freely available ocean data available via the EU Copernicus system (it may not be fit for purpose, but its free!). Realising the NMSP-R4 is going to cost money. What are the funding options?
 - Government (Federal/State) investment?
 - User Pays – Subscription, pay per download?
 - The system is a mix of research and operations. Should research \$ pay for operational systems?
- Opportunities
 - Alignment with CoastRI – could ANCOMS form part of the predictive modelling component?
 - Alignment with IMOS via the Node and Facility structure – how might ANCOMS contribute to the IMOS goals?
- Open Questions
 - How far up estuaries should this system go?
 - Should waves be included, or is this covered by existing systems (AusWAVE-G3, IMOS Surface waves working group)?
 - River flows and loads – good opportunity to work closely with the hydrological modelling group at BoM (e.g. Christoph Rudiger)?



“Super-regional”
Aus-Indo-Pac model
(2-4km)



- Local Coastal Models
- National Coastal Model (COMPAS, ACS)
- R&D Specialty Models (e.g. NWS-SUNTANS)

Global Models

ANCOMS

COSIMA

IMOS

ACCESS-NRI

- Observations
- AODN

Data Assimilation

Coastal Commons

- Coastal Informatics Pipeline
- Coast RI