



WESTERN AUSTRALIAN
MARINE SCIENCE
INSTITUTION

Better science **Better decisions**

Dr Luke Twomey, CEO

Developing a SEAF
for Cockburn Sound
and Owen Anchorage



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WAMSI is the trusted independent facilitator and advocate for marine science research that builds environmental, social and economic value for Western Australians



Government of **Western Australia**
Department of **Primary Industries
and Regional Development**



Government of **Western Australia**
Department of **Jobs, Tourism,
Science and Innovation** (Funder)



Government of **Western Australia**
Department of **Biodiversity,
Conservation and Attractions**



Australian Government



AUSTRALIAN INSTITUTE
OF MARINE SCIENCE



THE UNIVERSITY OF
**WESTERN
AUSTRALIA**



Murdoch
UNIVERSITY



Curtin University

ChemCentre
EXPERT SOLUTIONS



Government of **Western Australia**
Department of **Water and Environmental Regulation**



**WESTERN
AUSTRALIAN
MUSEUM**

Blueprint for Marine Science

Research directions to enhance industry competitiveness and government effectiveness in the marine environment off Western Australia

- End user defined priorities for marine science
- Protecting biodiversity
- Supporting sustainable marine industries
- Accessible science data
- Traditional Owner participation
- Empowering the community with marine science knowledge





USE

DECISION SUPPORT TOOLS:
Environmental Impact Assessment processes (including cumulative impacts), environment management, monitoring

REPORTING:
State of Environment reporting, environmental economic accounts, Sustainability Development Goals (SDGs)

PUBLIC TRUST AND TRANSPARENCY:
Quality-assured public data and tools

ANALYSE

Multi-domain and -scale modelling inc for cumulative impact

Standards for models and model linkage

Scenarios

Model traceability, reproducibility and stewardship

Assurance and uncertainty methods

INTEGRATE

Ecosystem and related science

Conceptual frameworks and methods for modelling

Standards and systems for data sharing and exchange

Indigenous knowledge

Provenance and lineage

CURATE

Managed data sets, layers and products

Data curation and QA/QC standards

Taxonomy and vocabularies

Annotations and corrections

Socio-economic contextual data

COLLECT

Observations and measurements

Collection systems and protocols

Data descriptions, metadata and fitness for purpose

Reference samples

Data catalogues

CULTURE

Legal, policy and program incentives

Computation, storage and security

Culture of open access, interoperability and reuse

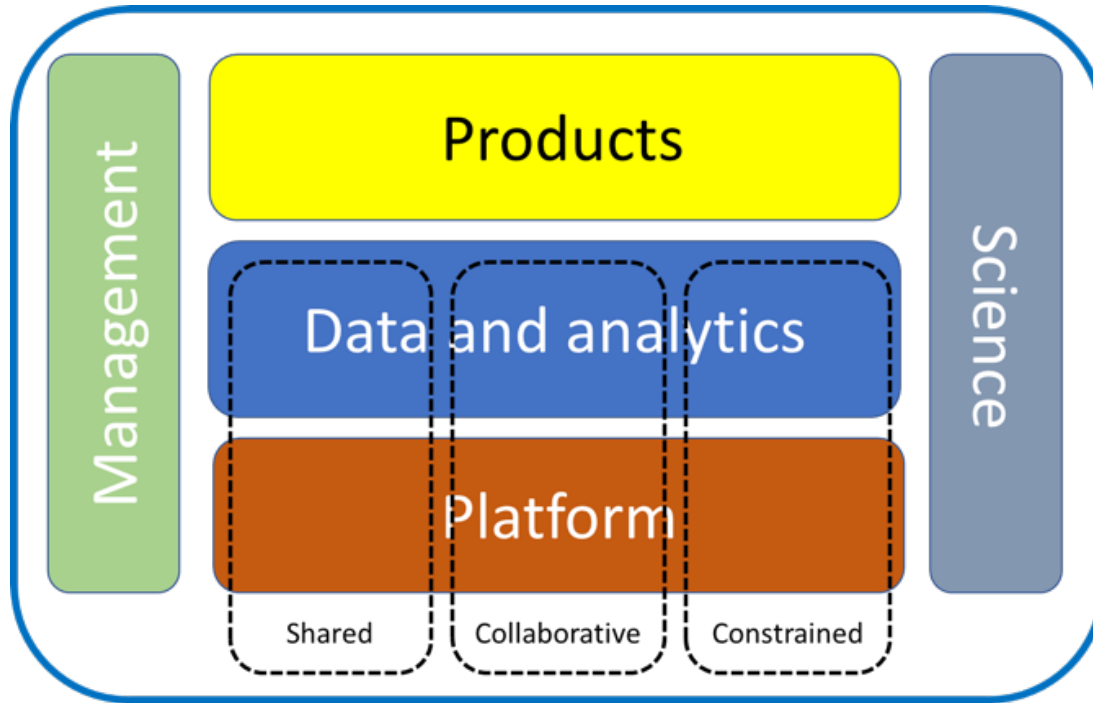
Governance, communication and communities of practice

Funding

Shared Analytic Framework for the Environment



Shared Environment Analytic Facility (SEAF)



1. Products

- Reporting, decision support, prediction
- For industry, govt, community

2. Data and analytics

- Data from diverse sources
- Shared/ collaborative/ constrained data and analytics
- Validated analytic tools, improved over time – science feedback loop
- Robust, repeatable and transparent

3. Platform

- Open source, cloud based, scalable across SEAFs

4. Science

- Pipeline from science to operations and back
- Science underpinning dependencies and impacts

5. Management and governance

- Customers, product delivery; policy, legislative standards and requirements
- Oversight.

Cockburn Sound and Owen Anchorage

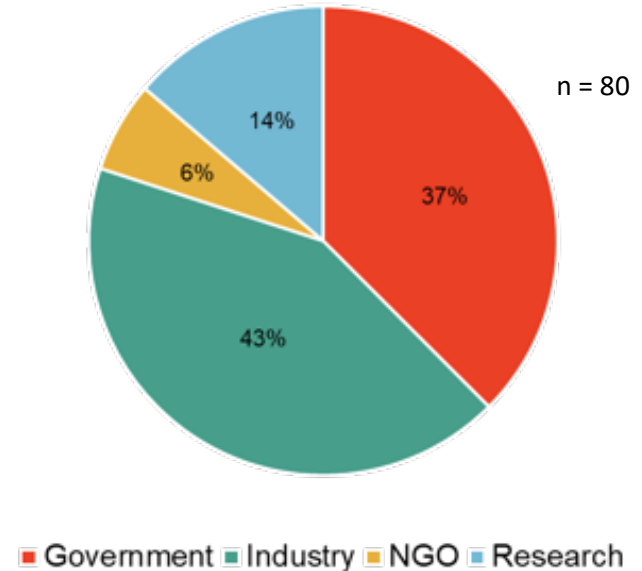
- Major environmental impact legacy
- Highly contested space
 - Westport
 - 7 major projects in the next decade
 - >\$15billion of proposed projects
- Cumulative Environmental Impact Assessment



Data Collation

Historical data audit of Cockburn Sound

- Data audit conducted for Cockburn Sound dating back to 1930s
- Scope covers data collected by industry, government and researchers, as well as any reviews or management plans
- Access granted to previously unpublished data reports, often related to EPA conditions around environmental monitoring
- Majority of data listed in the data audit is in a report format
- BMT were engaged to compile an audit of their data/reports (n ~ 460)
- For the entire audit:
 - Total number of reports/published papers/datasets ~ 1700
 - Total number of different proponents/stakeholders ~ 80



Data Collation

1965

An estimated **\$65m of data spanning ~1500 projects has been collected** from the marine and coastal environment of Cockburn Sound since 1965

- Industry
- Research
- Government





2021






WAMSI Westport Marine Science Program is spending another **~\$5m on data collection over the next 3 yrs**

Concurrent industry projects and monitoring **at least another ~\$5m**

2024

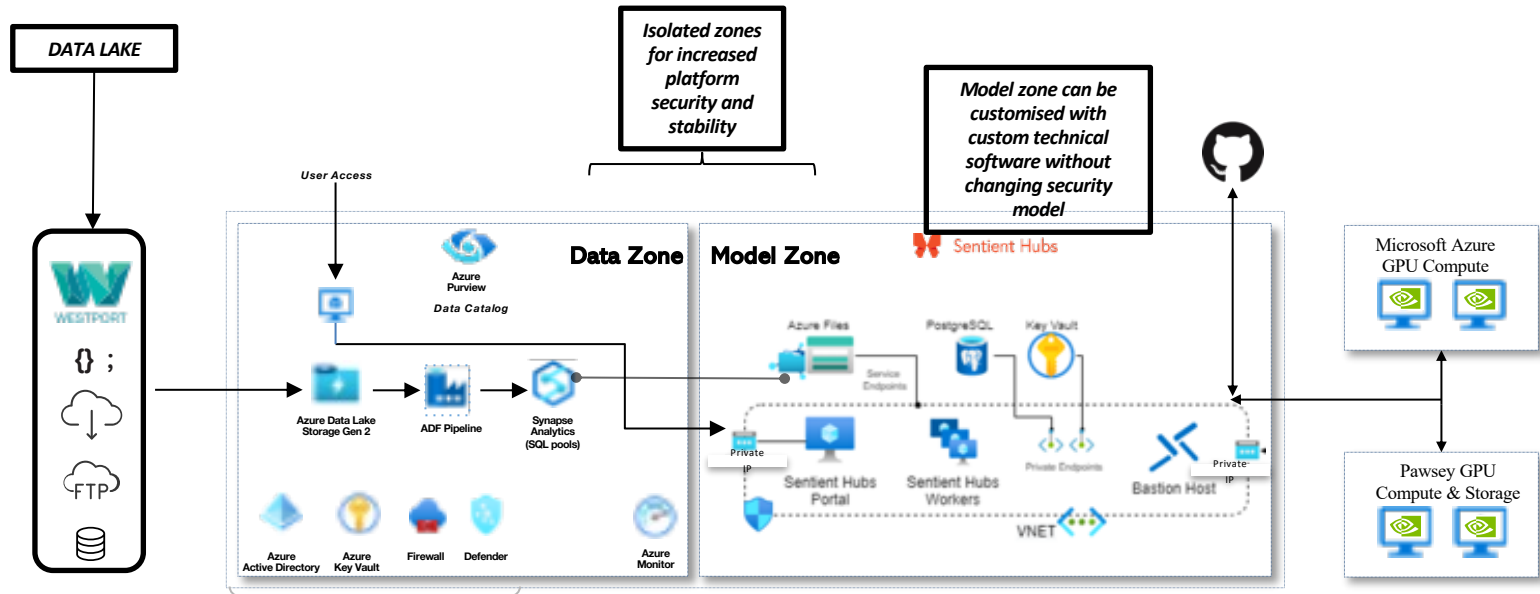
New knowledge

Theme	Objective	Projects
 Ecosystem modelling	Develop an ecosystem model to understand how water quality and habitats may change under various possible future scenarios.	1.1 Integrated ecosystem model platform. 1.2 Pathway to productivity: Development of a water quality response model for Cockburn Sound. 1.3 Characterise the trophic structure, ecosystem attributes and functioning of Cockburn Sound, using conceptual, qualitative, and quantitative ecosystem models.
 Benthic habitats and communities	Improve our understanding of benthic communities and processes, with a focus on seagrass rehabilitation and restoration.	2.1 Benthic habitat mapping. 2.2 Pressure-response relationships, building resilience and future proofing seagrass meadows. 2.3 Seagrass restoration program. 2.4 Benthic communities in soft-sediment and hard substrates (baseline data, pressure-response relationships of key biota for Environmental Impact Assessment (EIA), and mitigation strategies for artificial reefs.
 Water and sediment quality	Develop a comprehensive environmental baseline and understand contaminants, nutrient sources and recycling.	3.1 Water and sediment quality monitoring. 3.2 Processes governing nutrient and contaminant cycling in Cockburn Sound. 3.3 Elements of the groundwater/surface water flux into Cockburn Sound.
 Fisheries and aquatic resources	Understand seasonal movements of key species, the habitats they seek out and the food they rely on.	4.1 Snapper connectivity and evaluation of juvenile stocking. 4.2.1 Spatial distribution and temporal variability in life stages of key fish species in Cockburn Sound. 4.2.2 Zooplankton in Cockburn Sound. 4.2.3 Trophic pathways and food web structure. 4.2 Investigating effects of climate change on biota in Cockburn Sound. 4.3 Effects of total suspended solids on key fish species. 4.4 Investigating effect of port development on invasive species risks to Cockburn Sound.

Theme	Objective	Projects
 Hydrodynamic modelling	Understand how water quality and circulation in Cockburn Sound may change due to Westport and climate change.	5.1 Hydrodynamic modelling. 5.2 Wave modelling.
 Social	Identify and understand the community values connected to Cockburn Sound.	6.1 Community values for changes in environmental conditions. 6.2 Opportunities and impacts for recreational fishing from the Westport development. 6.3 Recreation, amenity and aesthetic values. 6.4 Benefit-cost framework for environmental port design features.
 Noise	Develop current and future underwater 'soundscapes' of Cockburn Sound to understand, and manage, the potential effects of underwater noise.	7.1 Baseline soundscape, sound sources and transmission. 7.2 Hearing sensitivity of Australian sea lions, little penguins, and fish. 7.3 Behavioural response of fish to noise.
 Apex predators and iconic species	Improve our understanding of the distribution and seasonal movements of conservation-significant and iconic species, the habitats they seek out and the food sources they rely on.	8.1 Determining the diet, causes of mortality, foraging habitat and home range of little penguins using Cockburn Sound. 8.2 Investigate the abundance, movement, habitat use and diet of Australian sea lions in the Perth Metropolitan area. 8.3 Spatio-temporal distribution of key habitat-uses and key prey species for Indo-Pacific bottlenose dolphins in Owen Anchorage and Cockburn Sound, including a fine-scale understanding of the use of the habitats in the Kwinana Shelf. 8.4 Spatio-temporal distribution of syngnathids (e.g., seahorses) in Cockburn Sound.
 Coastal processes	To better understand patterns and drivers of sediment transport and the processes of beach accretion and erosion in Cockburn Sound and Owen Anchorage.	9.1 Coastal processes and sediment movement in Cockburn Sound and Owen Anchorage.

Cockburn Shared Analytics

Multizonal Approach



ROMS

Regional hydrodynamic conditions



BARRA, WRF

Weather conditions



SWAN, WWM

Wave conditions



GIS

Benthic habitat



Swan Estuary inputs



SCERM

Local discharges/intakes



PSDP, SDOOL,
... Industry ..

Local groundwater inputs



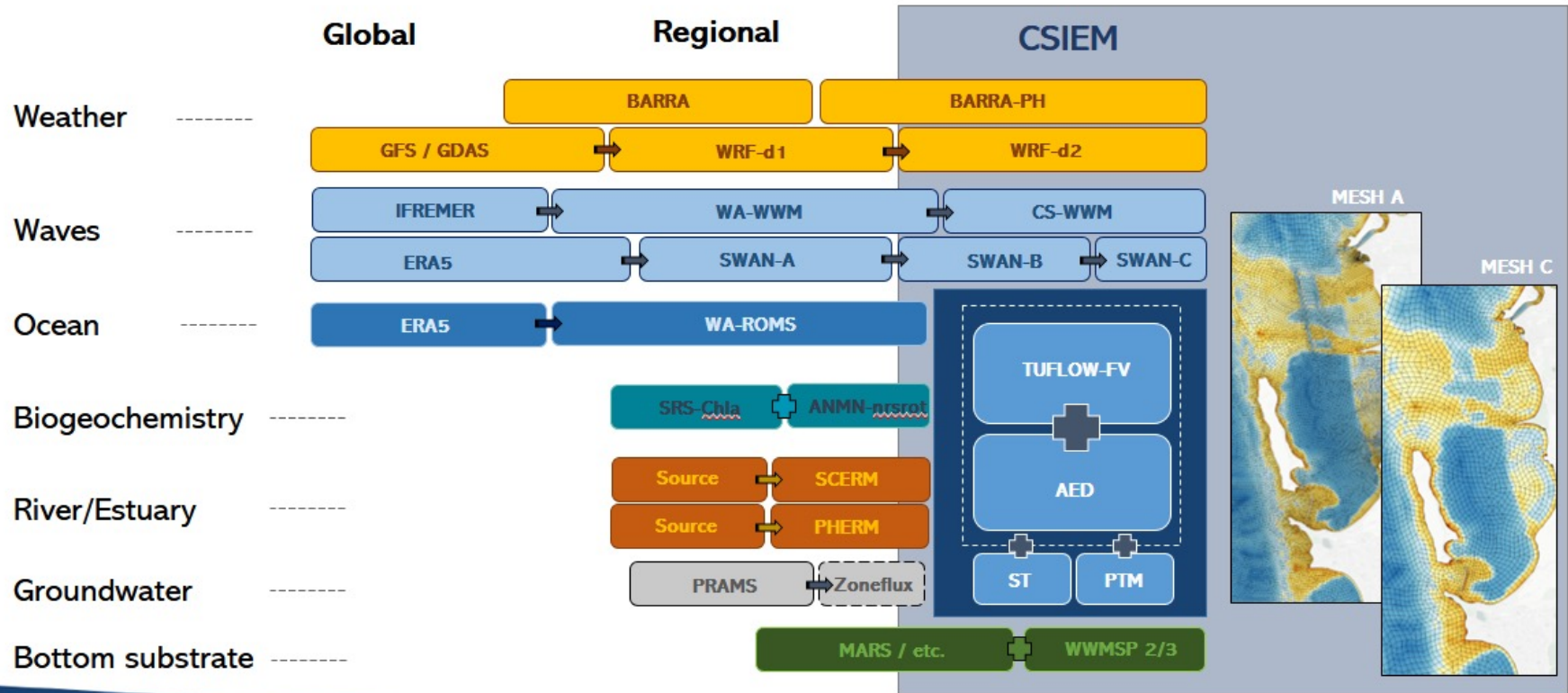
PRAMS

Local activities

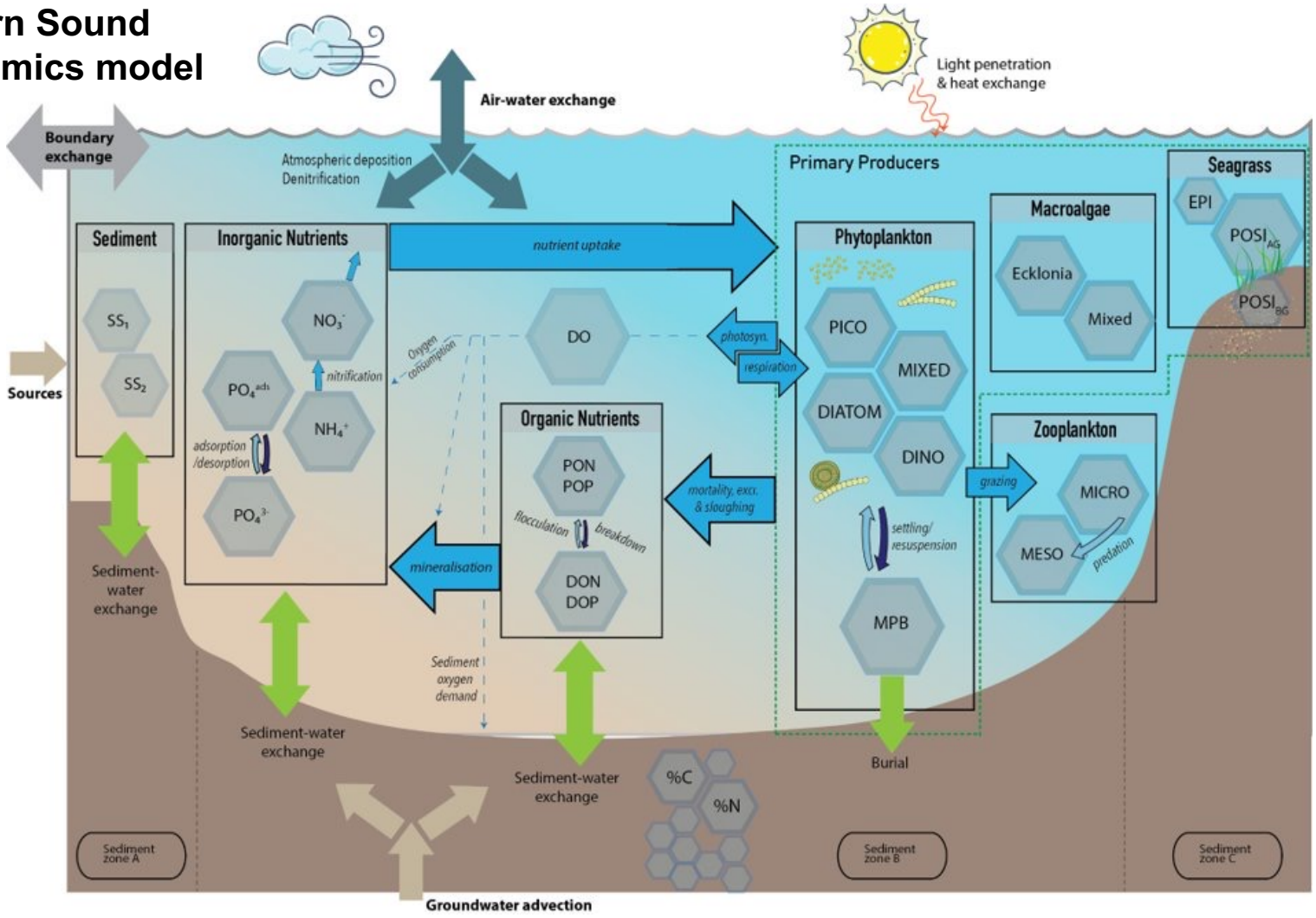


Shipping, Berthing,
Dredging, Spoil,
Aquaculture, etc.

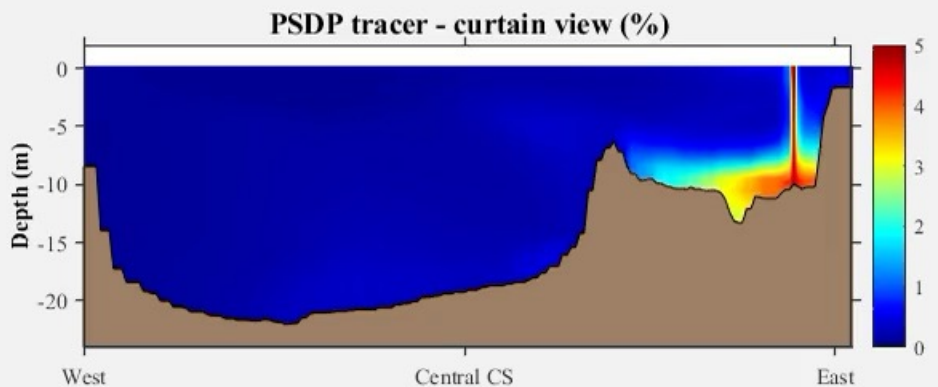
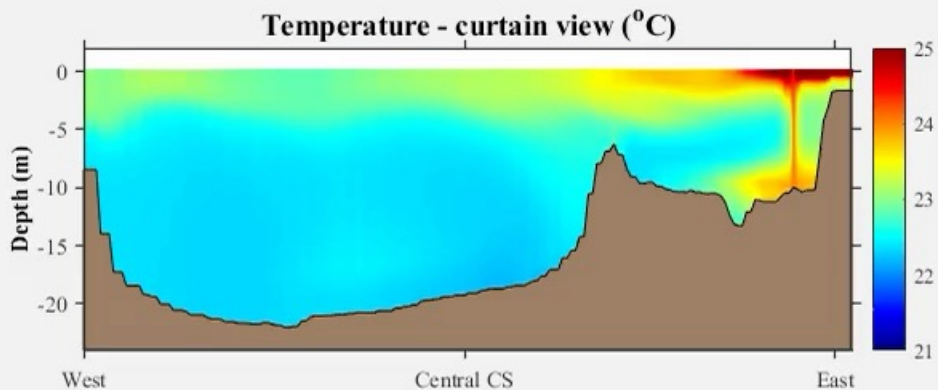
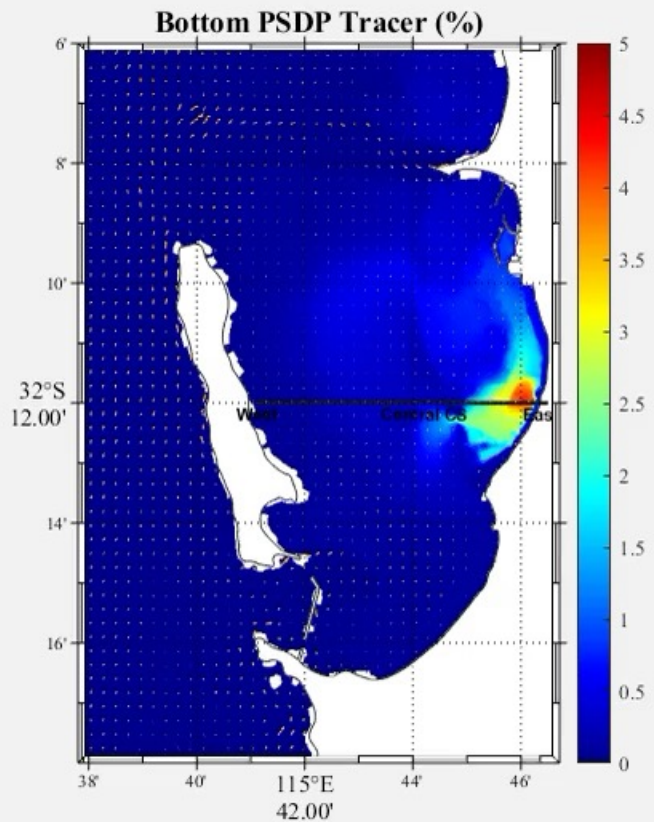
Resolving Met-Ocean & Biogeochemistry across scales



Revised Cockburn Sound Aquatic Ecodynamics model



Time: 2013/04/09 00:00



DRAFT SEAF 'Spoke' Feasibility Approach

Spoke Lifecycle

Spoke Work streams and packages

1 Industry Development Work Stream

1.1 Industry Operation and Growth Model

Feasibility

Finalise concept and feasibility

Establishment

Establish Industry Projects Database & update process

Operate

Operate Industry Projects Database

Review / Adapt

2 Groundwater Work Stream

2.1 Industrial Area Groundwater Model

Finalise concept and feasibility

Science Package 2

Integration of groundwater model in SEAF

Operation of model, including iterative updates, validation and peer review

3 Hydrodynamics & Sediment Work Stream

3.1 Hydrodynamic and Sediment Transport Models and Maps

Finalise concept and feasibility

Integration of hydrodynamic and sediments models & maps in SEAF

Operation of hydrodynamic and sediment models and maps, including iterative updates, validation and peer review

Science Package 3

4 Marine Ecosystem Work Stream

4.1 Integrated Marine Ecosystem Models (biogeochemistry and ecological models) and Maps

Finalise concept and feasibility

Integration of biogeochemical models and maps in SEAF

Integration of underwater noise and ecological models and maps in SEAF

Operation of models and maps, including iterative updates, validation and peer review

Science Package 4

5 Terrestrial Work Stream

5.1 Terrestrial Ecosystem and Emissions Models and Maps

Finalise concept and feasibility

Integration of terrestrial ecosystem and emissions models and maps in SEAF

Operation of models & maps, including iterative updates, validation & peer review

Science Package 5

6 DPSIR Work Stream

6.1 Cockburn Sound DPSIR Reporting Model

Finalise concept and feasibility

Develop DPSIR reporting in SEAF

Update DPSIR

Year 0

Year 1

Year 2

Year 3

Year 4

Year 5

Cockburn Sound SEAF

How are we tracking?

- Data collation
- Data sharing systems
- Tools (sharing – model)
- Not plain sailing – Legal issues of sharing
 - Industry data
 - Government data
- Benefits case needs to be socialised





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