



eReefs

eReefs is a collaboration between:



GREAT BARRIER REEF
foundation



Australian Government
Bureau of Meteorology



Australian Government



Queensland
Government

Supported by funding from:



CARING
FOR
OUR
COUNTRY



Queensland
Government

SCIENCE AND
INDUSTRY
ENDOWMENT
FUND



bhpbilliton
resourcing the future



BMA
BHP Billiton Mitsubishi Alliance

RECOM. Relocatable Coastal Ocean Model

Mike Herzfeld
April 2016

O&A
www.csiro.au



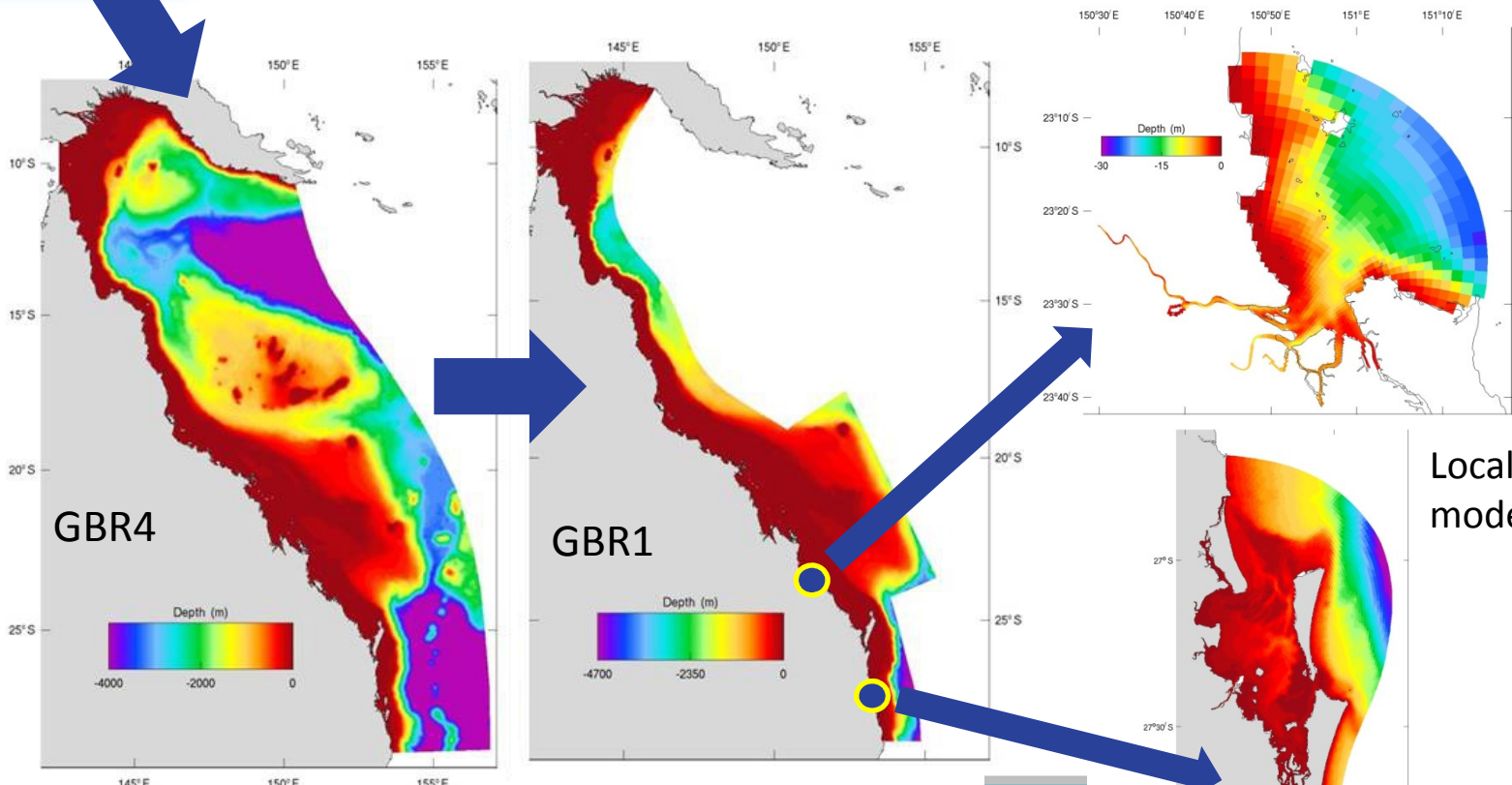
Motivation #1 - more models

- CSIRO CEM has been characterizing coastal scales for 25+ years (back to Port Philip Bay study).
- Cannot hope to gain overall system understanding on a case by case basis.
- Develop a tool to outsource coastal system characterization;
 - Allow increased uptake of coastal models by non-modellers.
 - Generates a pilot model >90% optimized with minimal user inputs.
- Combined integration of many models developed by many people can start to address overall system understanding.
- RECOM is such an automated re-locatable modelling tool for the GBR.

eReefs nested marine modelling suite

Global products:

- OceanMAPS (10km)
- ACCESS-A (12km)



Bridging models (4km)

Hi-res regional (1km)

Local models



Motivation #2 – higher resolution

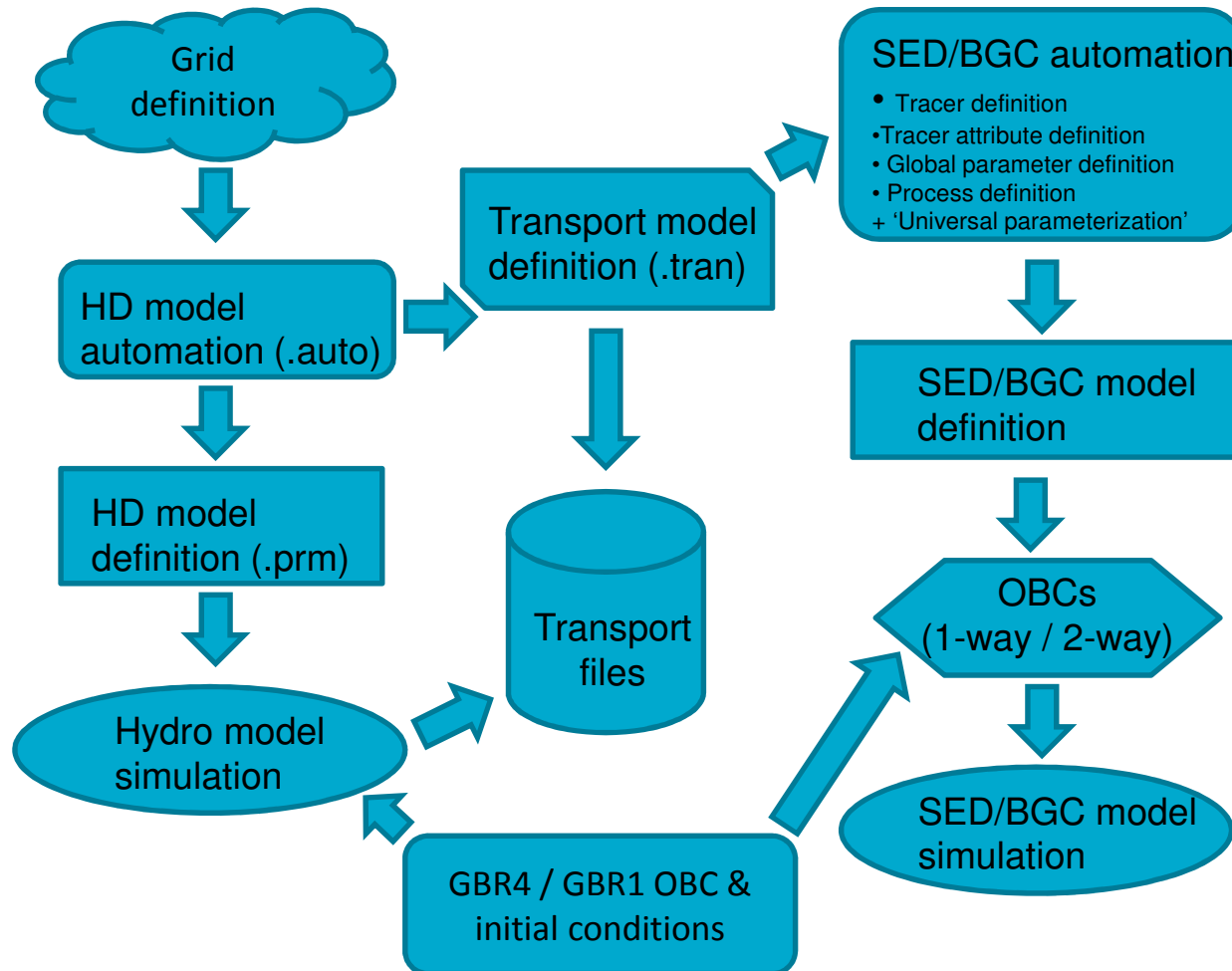
- High resolution models are required around reefs and into estuaries.
- Accepted nesting ratios (5:1 at nesting boundaries) preclude higher resolution than ~1 km using two nests, with one being 4 km;
 - 10 km (OceanMAPS) to 4 km (GBR4) @ 2.5:1
 - 4 km allows fast model runtime – essential for basic calibration and BGC ensemble DA (parameter estimation).
 - 4 km (GBR4) to 1 km (GBR1) @ 4:1
 - 1 km is very computationally expensive – large ensembles difficult.
- RECOM can supply local high resolution domains;
 - Resolution in the domain interior to 10s of metres.
 - Don't have to model the whole GBR in order to study local areas.

RECOM provides:

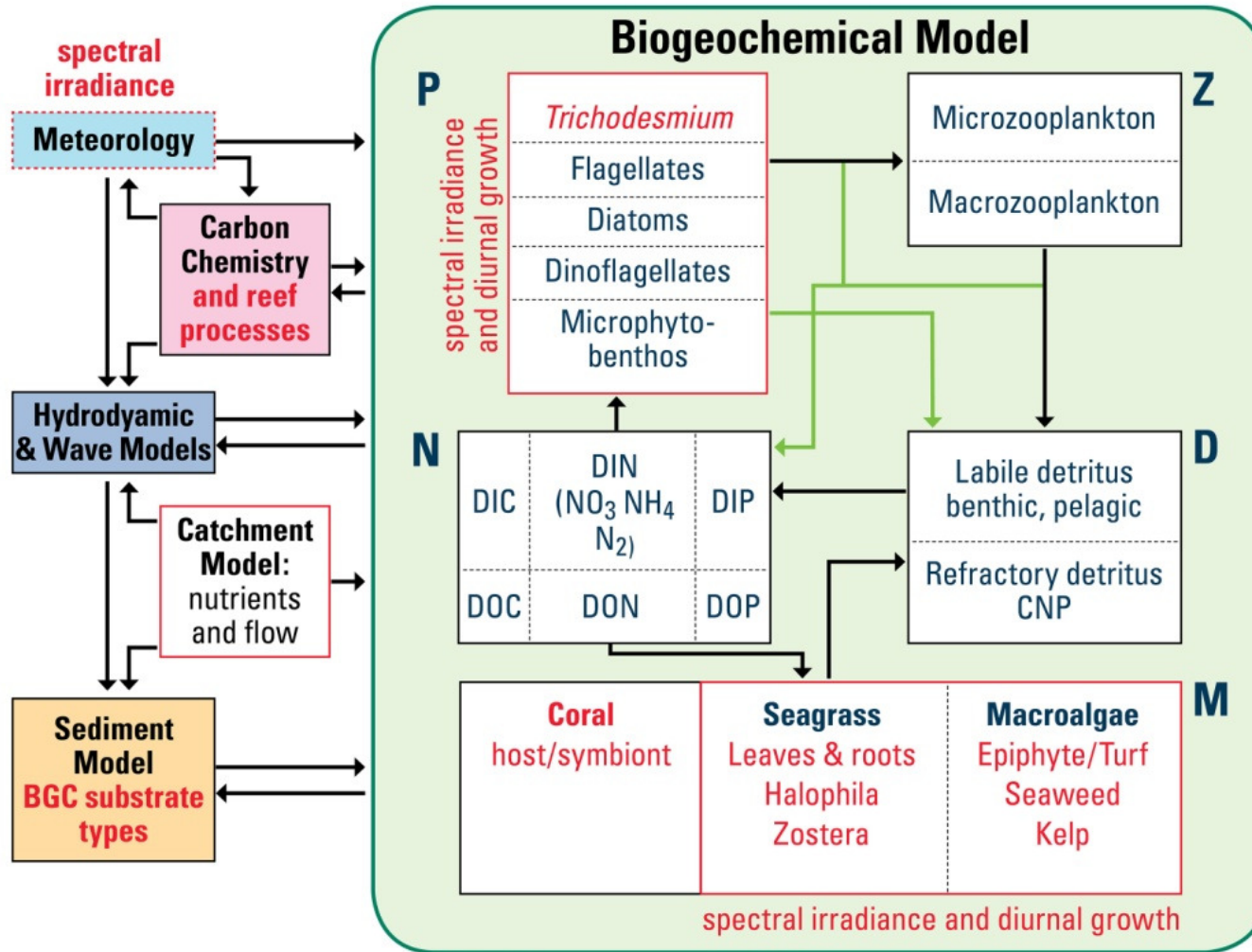
- Hydrodynamic, wave, sediment transport and biogeochemical outputs on a user defined grid.
- Hindcasts possible from 2010 onwards.
- The grid is curvilinear, with multiple branches allowed.
- User optimization of land mask allowed.
- Choice of mask and bathymetry datasets.
- Choice of freshwater inputs.
- Choice of sediment/ BGC parameterisations.
- User interacts via a Google-style interface.
- Inline error handling.
- Hydrodynamics based on ROAM, operated by RAN.

Ocean Dynamics (2009) 59:21–46
DOI 10.1007/s10236-008-0158-1

RECOM workflow



RECOM processes



RECOM uses web based interface

webTRIKE: Model Runs Logged in as: Mike.Herzfeld@csiro.au

[New](#) [Edit](#) [Clone](#) [Delete](#) [Abort](#)

Status Columns

10 model runs per page Search:

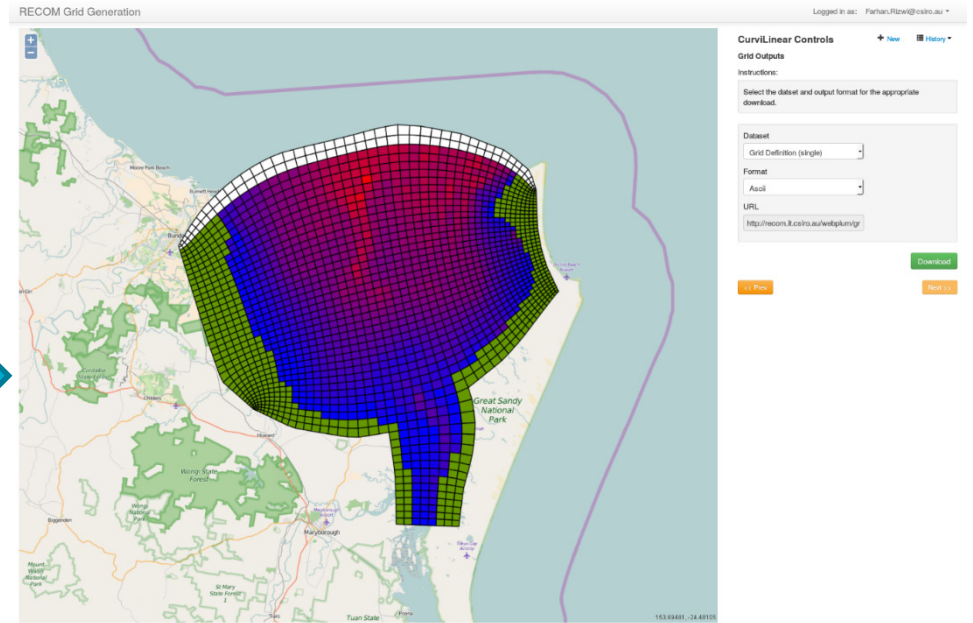
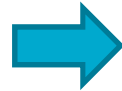
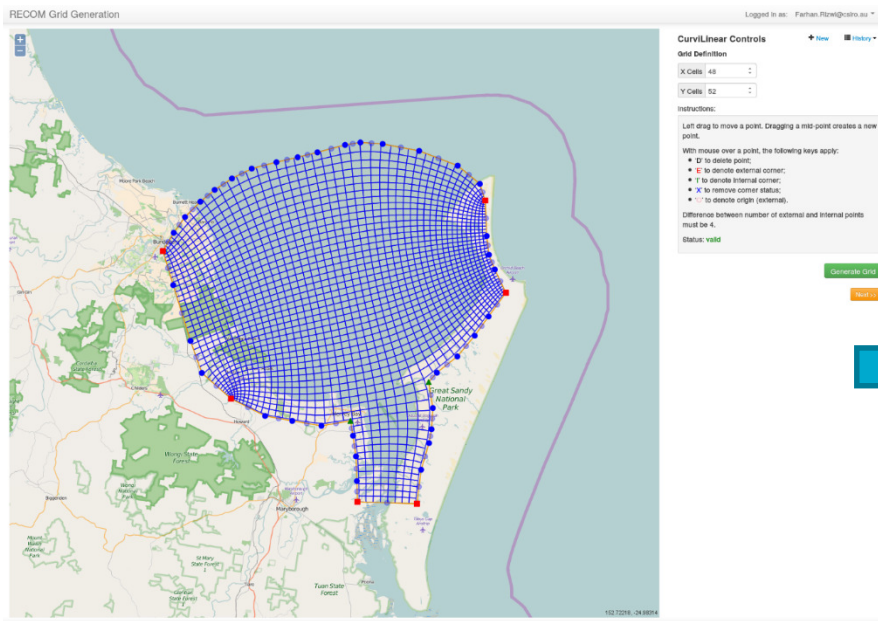
Run ID	Run Name	Model Name	Run Start	Run Stop	Model Start	Model Stop	Status
466	gas_25jan	recom	-	-	2015-01-18 00:00:00	2015-01-19 00:00:00	100.0
465	optics_25jan	recom	2016-01-25 03:20:12	2016-01-25 03:29:41	2015-01-18 00:00:00	2015-01-19 00:00:00	Finished
464	gbr4_25jan	recom	2016-01-25 03:20:13	2016-01-25 03:32:42	2015-01-18 00:00:00	2015-01-19 00:00:00	Finished
463	gas_mon	recom	-	-	2015-01-22 00:00:00	2015-01-23 00:00:00	100.0
462	optics_mon	recom	2016-01-25 01:49:13	2016-01-25 01:59:17	2015-01-22 00:00:00	2015-01-23 00:00:00	Finished
461	gbr4_mon	recom	2016-01-25 01:48:53	2016-01-25 02:02:03	2015-01-22 00:00:00	2015-01-23 00:00:00	Finished
459	gas_only	recom	-	-	2015-01-22 00:00:00	2015-01-23 00:00:00	100.0
458	optics_only	recom	-	-	2015-01-22 00:00:00	2015-01-23 00:00:00	100.0
457	gas_only_callwithoxygen	recom	2016-01-23 09:39:49	2016-01-25 00:11:37	2015-01-07 00:00:00	2015-01-08 00:00:00	Finished
456	gas_only_with_recom_extras	recom	2016-01-23 02:17:47	2016-01-25 00:11:37	2015-01-22 00:00:00	2015-02-24 00:00:00	Finished

Showing 1 to 10 of 21 model runs ← Previous 1 2 3 Next →



Hydrodynamic grid generation – simple grids.

Effort required: < 1 hour.



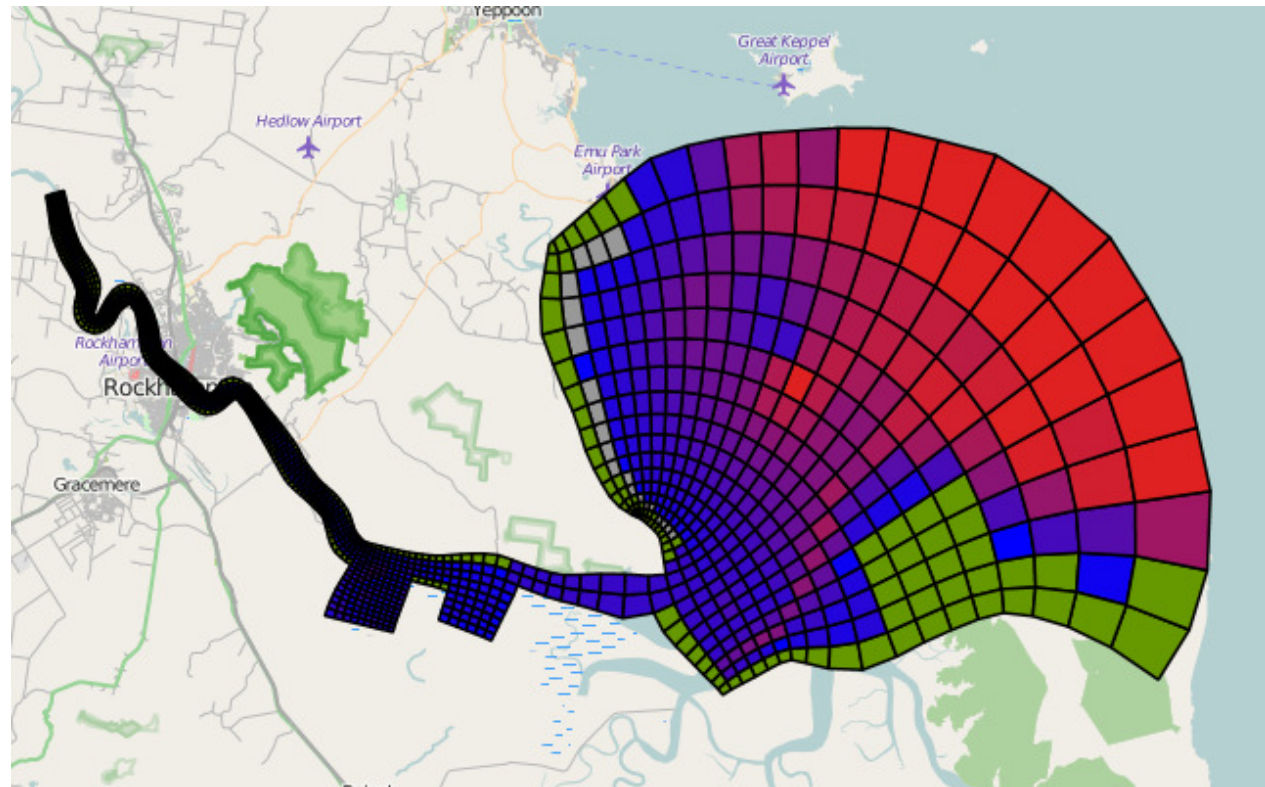
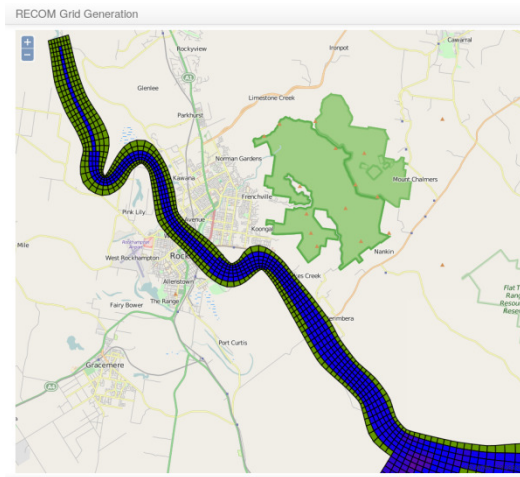
User chooses edge of domain and grid orientation.

RECOM adds land mask and bathymetry.

Complex curvilinear grid generation

Effort required: hours to days.

User adds grid branches, rivers inputs and alters bathymetry.



Grid and mask editing

RECOM Grid Generation Logged in as: Farhan.Rizwi@csiro.au

Curvilinear Controls + New History

Selection Mode

Single Column
 Polygon Row

Selected Cells

#	Depth	Mask
814	53.54	Water
813	61.98	Water
861	58.38	Water
860	59.05	Water
908	51.57	Water
907	41.38	Water
955	54.44	Water
1003	40.54	Water
1002	59.26	Water

Bulk Change

Mask

Depth

Add (%)

Apply

<< Prev Next >>

Model forcing specification

Model Run Specification Fill out the form fields and click next until all tabs are complete. ✕

← Previous Next →

Model **Grid** Temporal Extent and Forcing

Temporal Extent and Forcing Data

Set the temporal extent and select one forcing dataset from each group.

Temporal Extent:

2014-12-02 - 2014-12-21 (19 days)

RECOM initialisation data:

gbr1-recom-init (nest) ✕
Outside Range

gbr4-recom-init (nest) ✕
2014-11-30 - 2014-12-26 (26 days)

Hydro boundary:

gbr1-recom-hydro-bdry (nest) ✕
2014-11-30 - 2014-12-26 (26 days)

gbr4-recom-hydro-bdry (nest) ✕
2014-11-30 - 2014-12-26 (26 days)

BGC boundary:

gbr1-recom-bgc-bdry (nest) ✕
2014-11-30 - 2014-12-12 (12 days)

gbr4-recom-bgc-bdry (nest) ✕
2014-11-30 - 2014-12-26 (26 days)

Global Ocean:

wavewatch3-r (client) ✕
2014-11-27 - 2014-12-26 (29 days)

Global Atmosphere:

access-r-surface (client) ✕
2014-11-27 - 2014-12-26 (29 days)

Model parameter specification

Model Run Specification Fill out the form fields and click next until all tabs are complete.

← Previous Next →

Model Grid Temporal Extent and Forcing Run Parameters

Run Parameters

Set the parameters for the model.

undefined

BIOFNAME gbr4
Select ecological parameter values


DO_ECOLOGY YES
Enable ecological processes

DO_SEDIMENTS YES
Select sediment transport

ECO_VARS_ATTS standard
Select ecological tracer attributes

PROCESSFNAME gbr4
Select ecological processes

ROBUST



Robustness Knob. Higher is more robust.

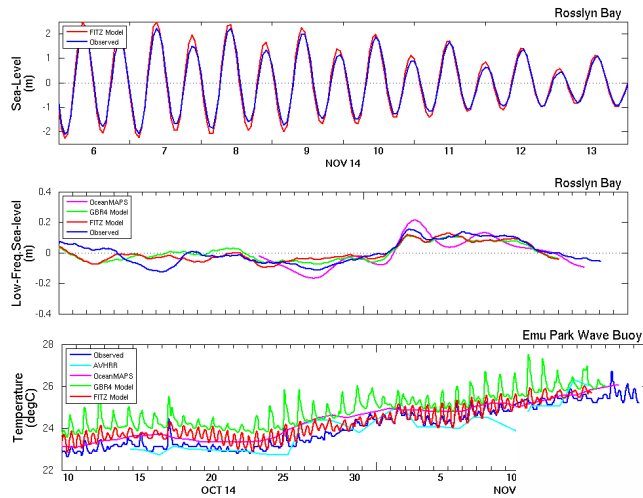
SED_LAYERS 0.005 0.02 0.08 0.32
List of sediment layer thicknesses

SED_VARS Sand Mud FineSed
List of sediment types

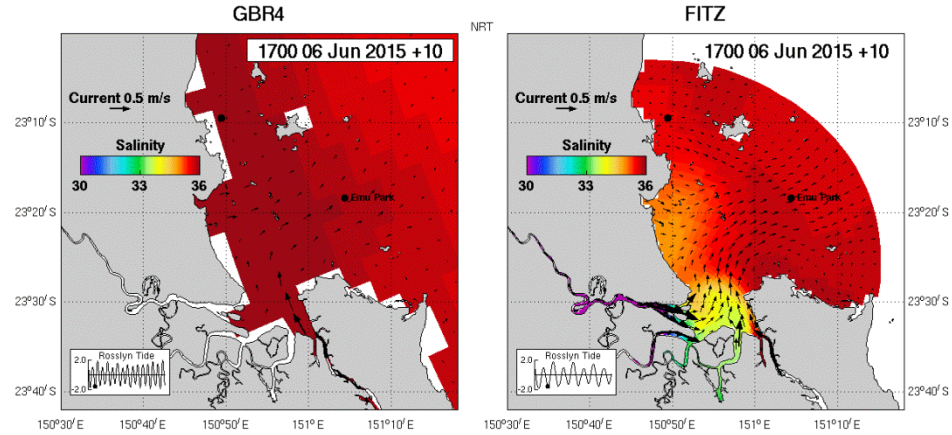
SED_VARS_ATTS standard
Select sediment tracer attributes

RECOM test areas

- Fitzroy Estuary

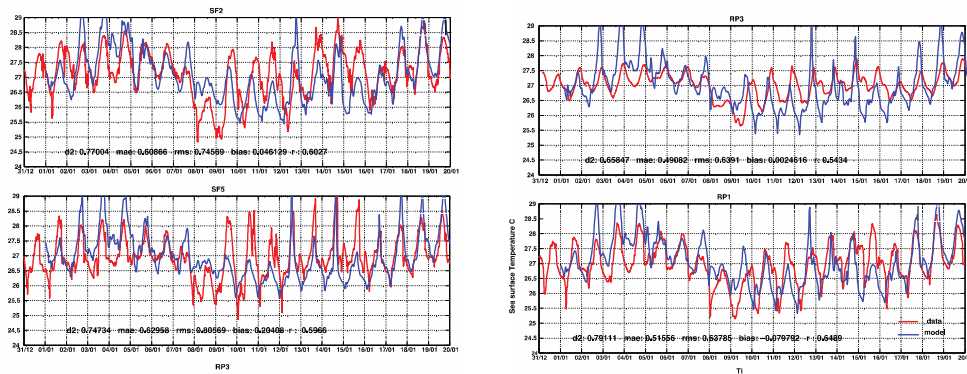


FITZROY RIVER / KEPPEL BAY NEAR REAL-TIME HYDRODYNAMIC MODELLING

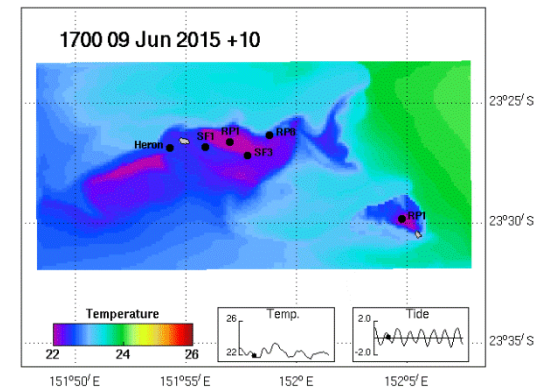


Last updated : 19-Jun-2015 02:07:17

- Heron Island

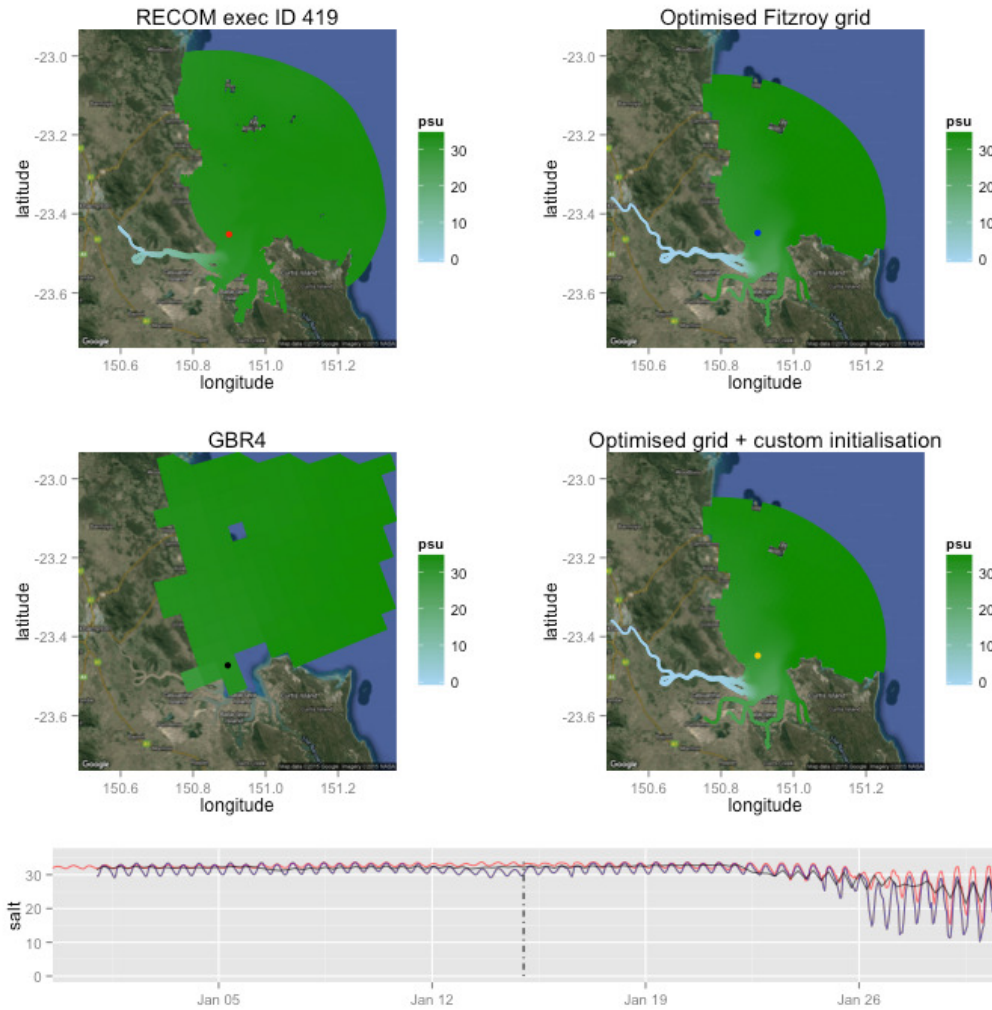


HERON Model



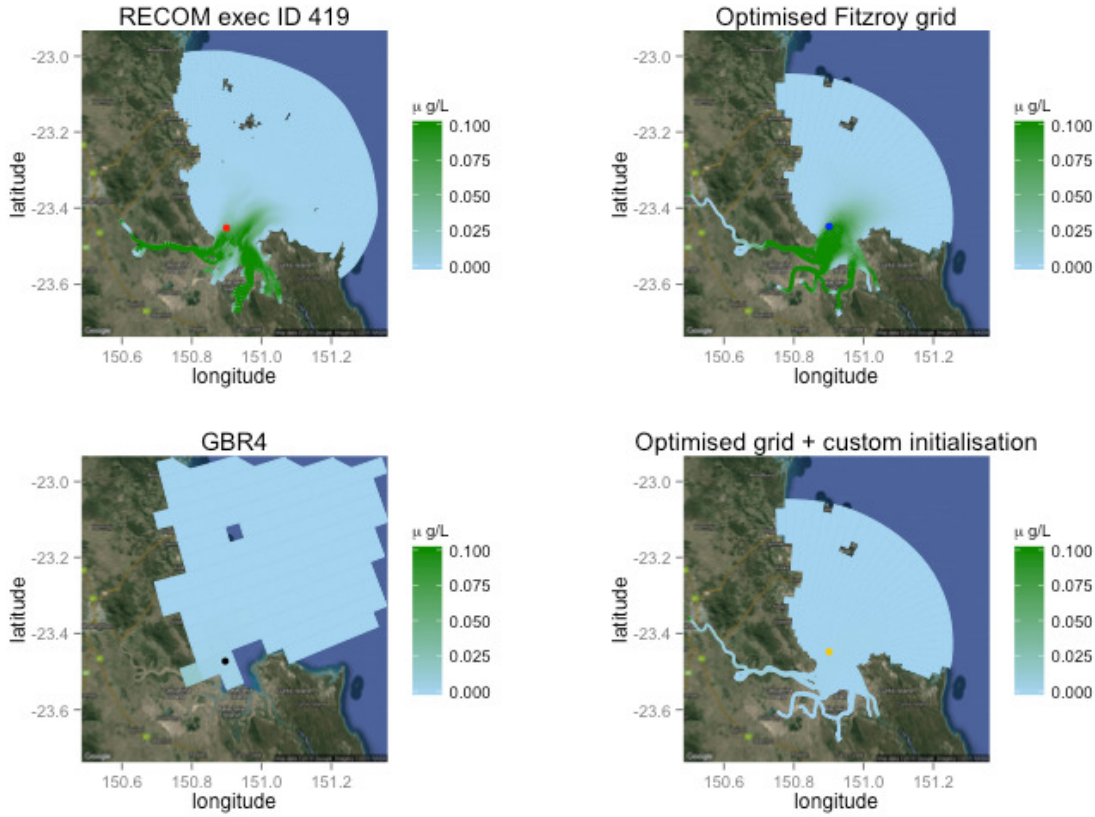
Last updated : 17-Jun-2015 05:04:46

Fitzroy – salinity comparison.

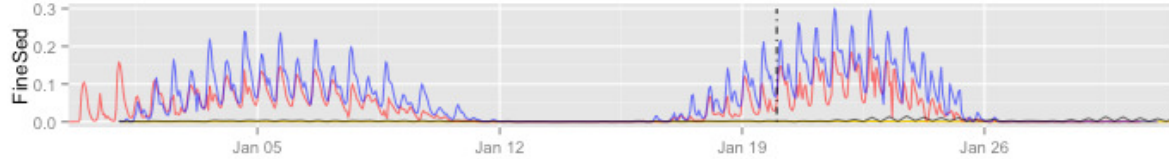


- RECOM
- Optimized
- GBR4
- Optimized + initialized

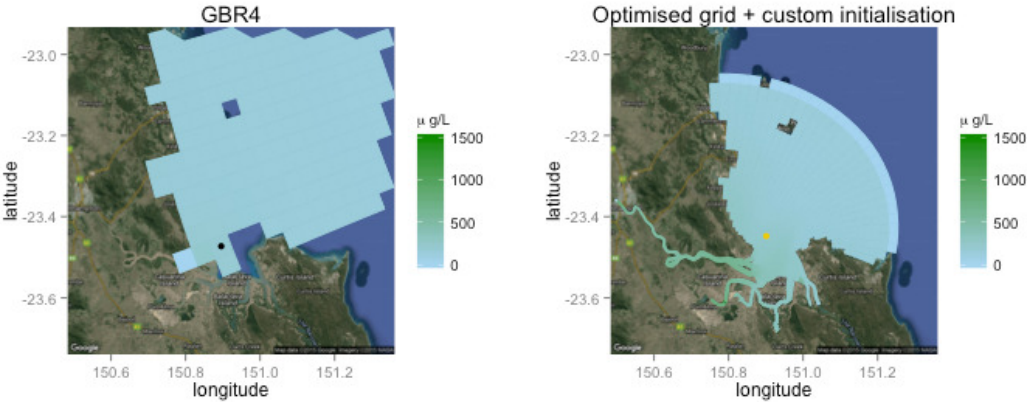
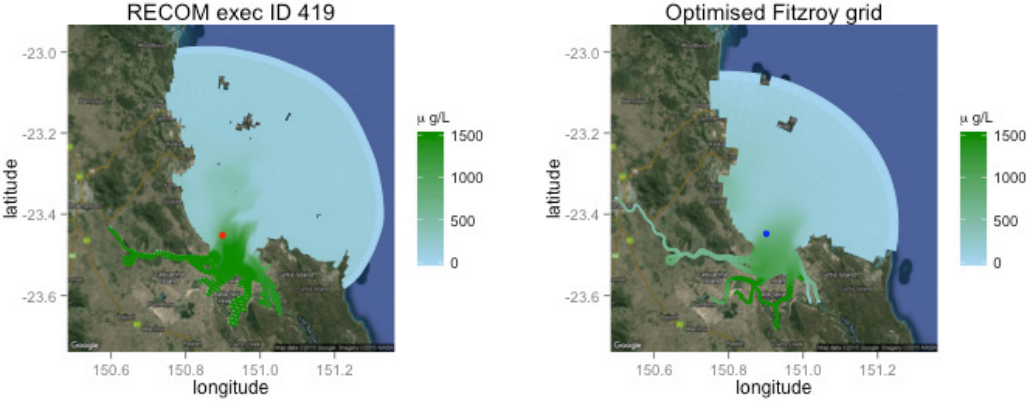
Fitzroy – fine sediment comparison.



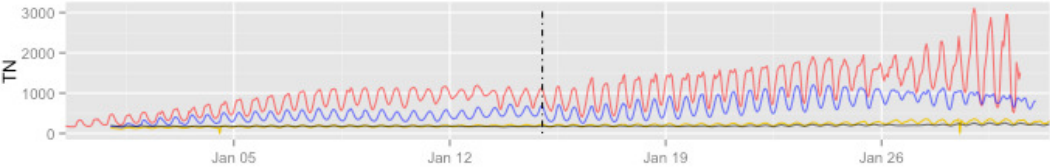
- RECOM
- Optimized
- GBR4
- Optimized + initialized



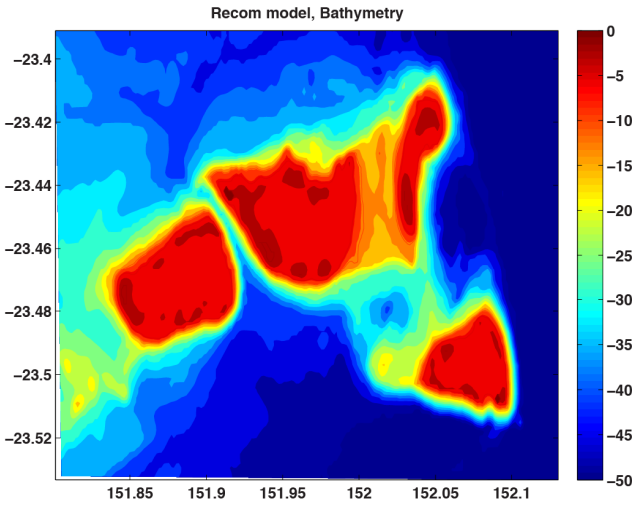
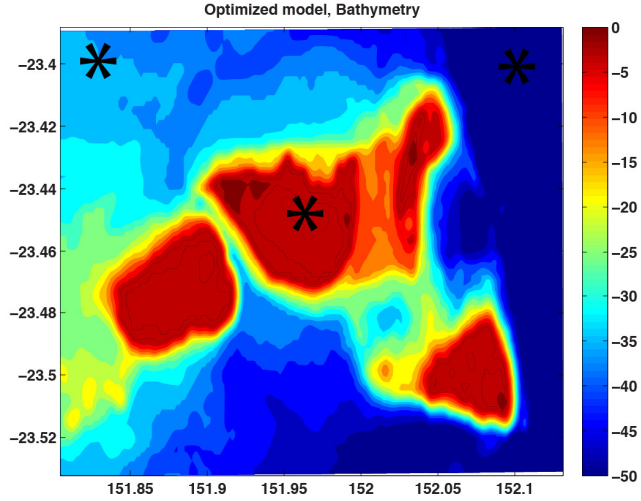
Fitzroy – total nitrogen comparison.



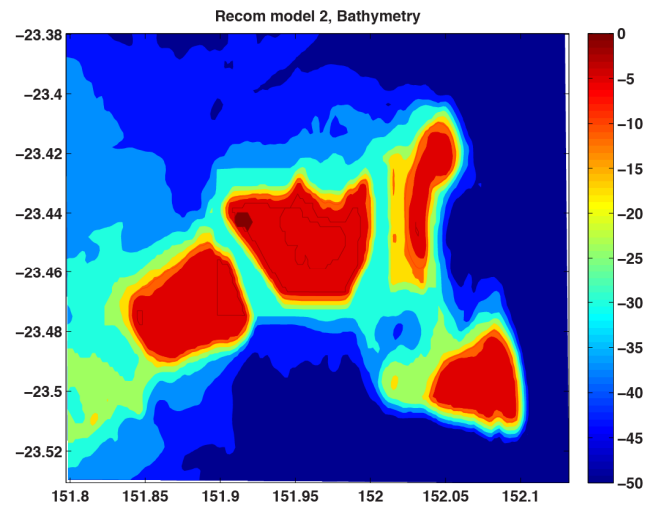
- RECOM
- Optimized
- GBR4
- Optimized + initialized



Heron Island - bathymetry

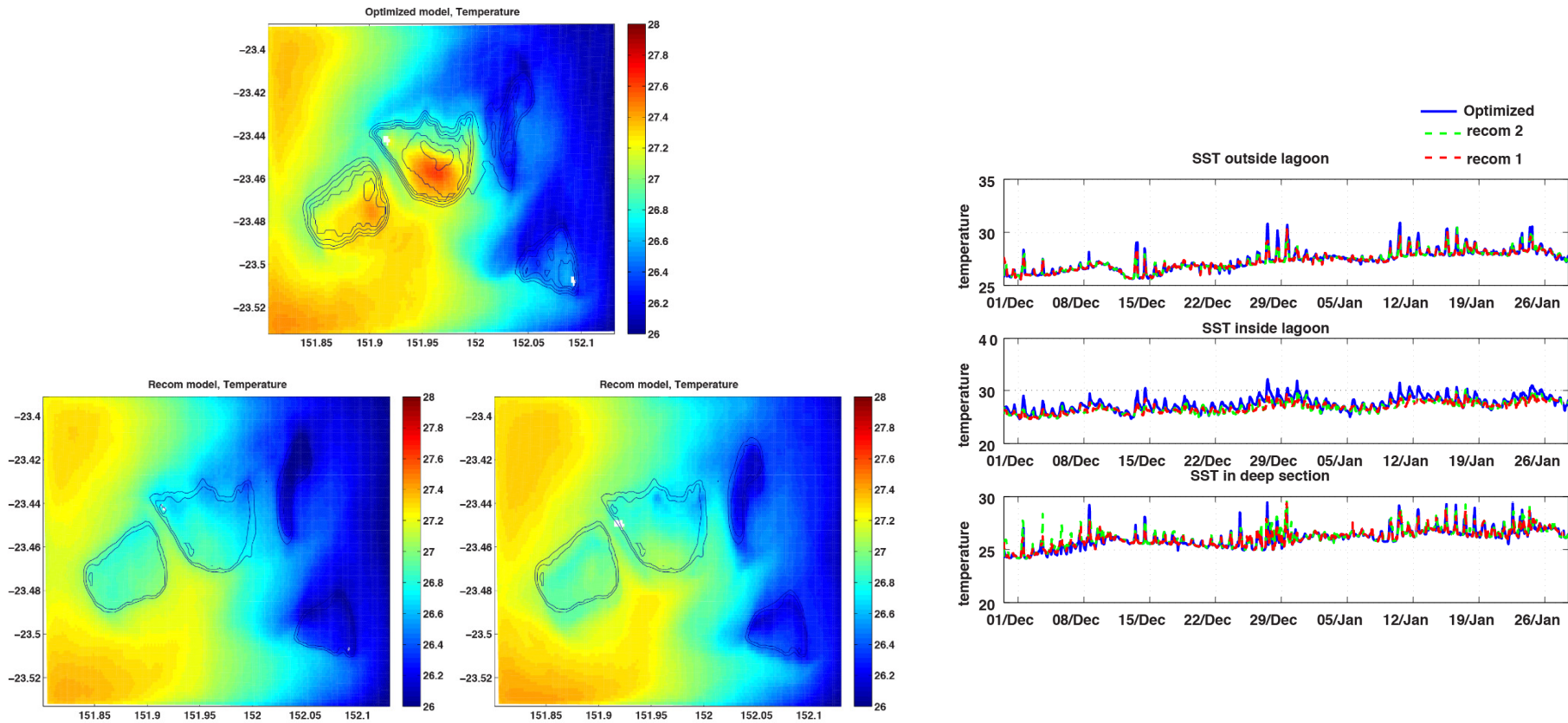


Beaman (2010)

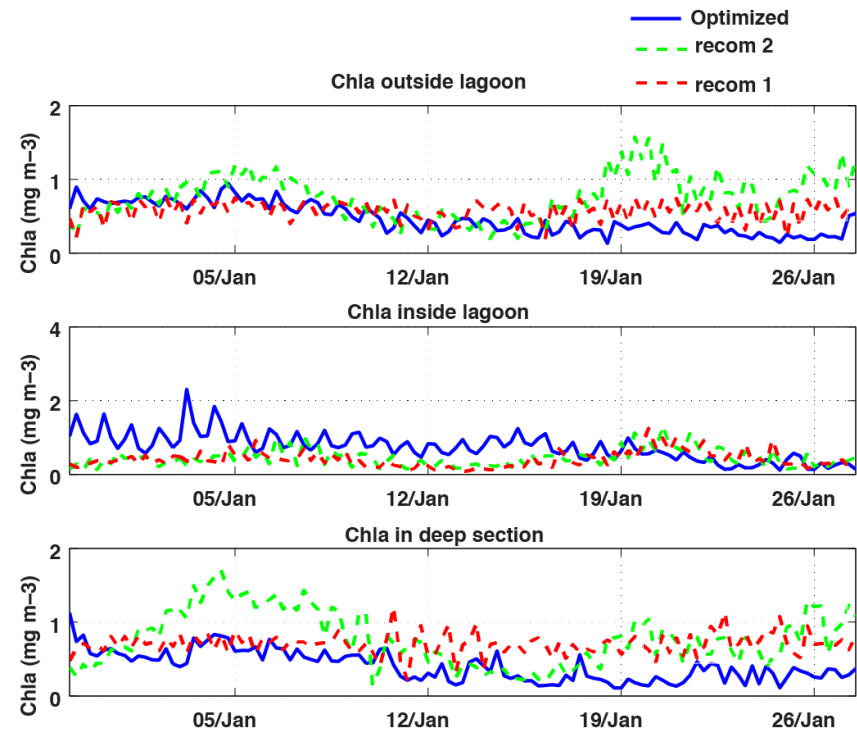
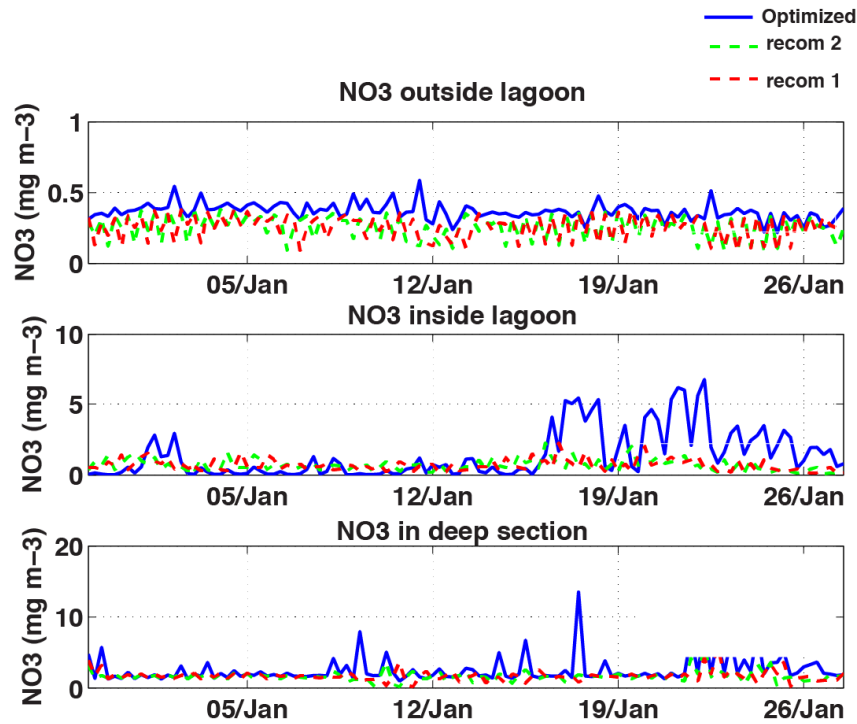


Beaman (2010) + custom Heron

Heron Island – Temperature comparison

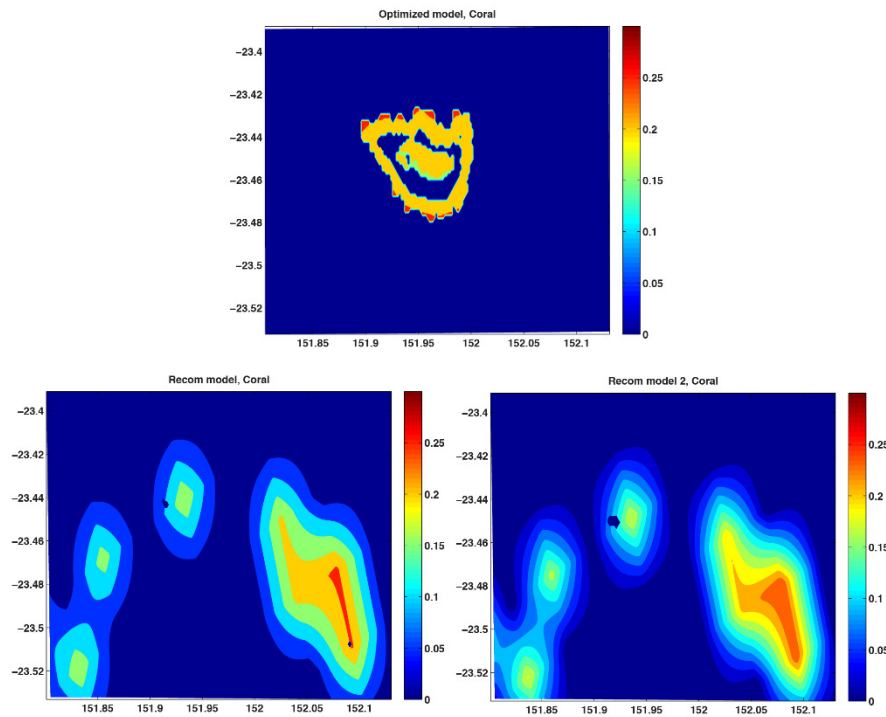


Heron Island – BGC comparison

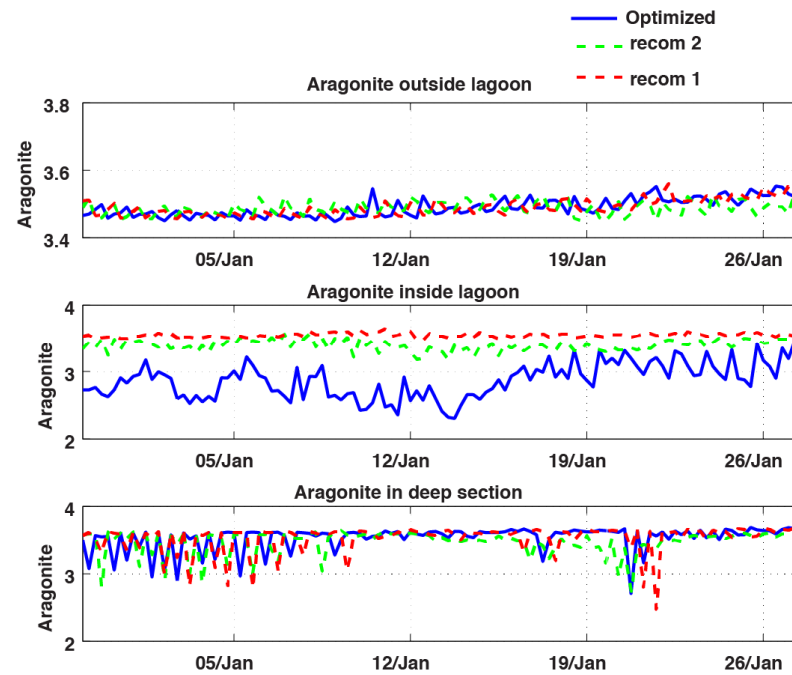


Heron Island - Corals

Initial conditions

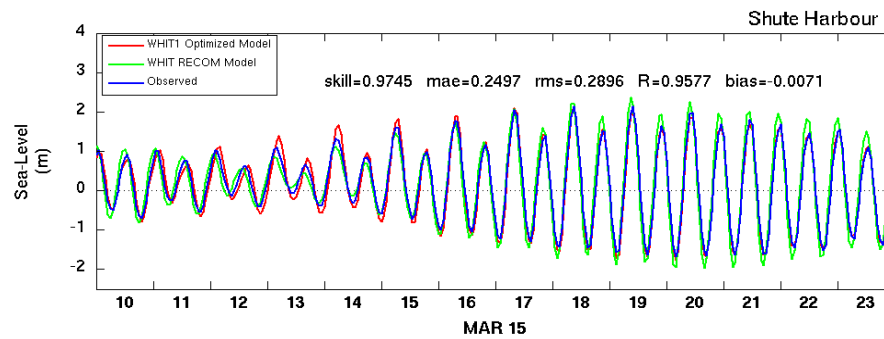
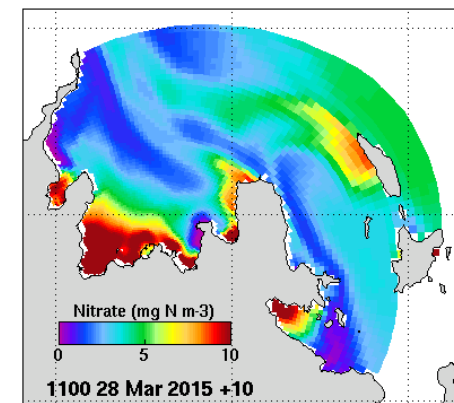
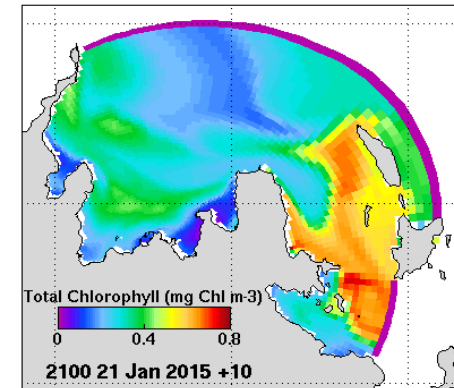
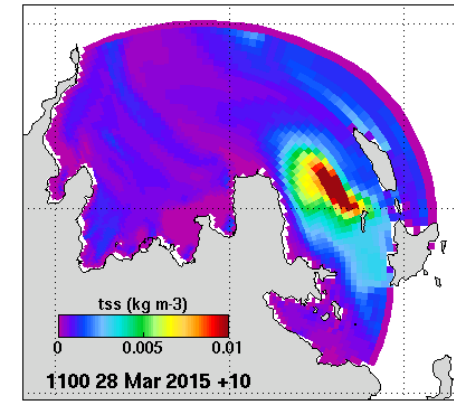
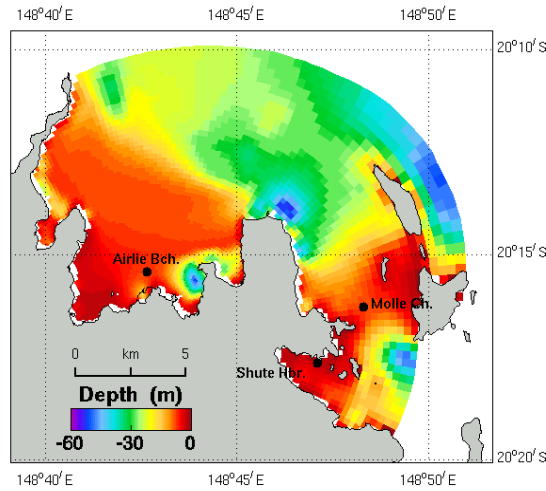
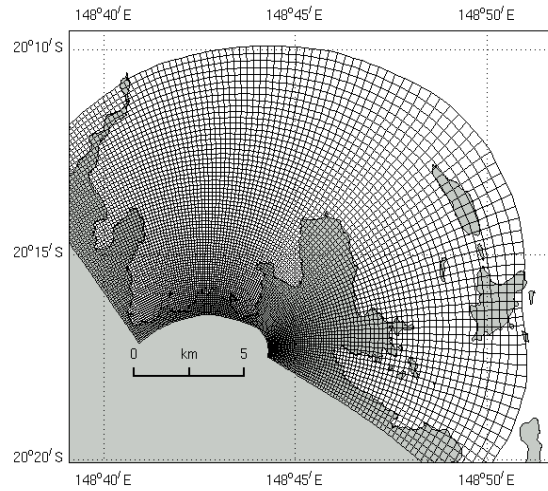


Coral interpolated from GBR4



Whitsundays

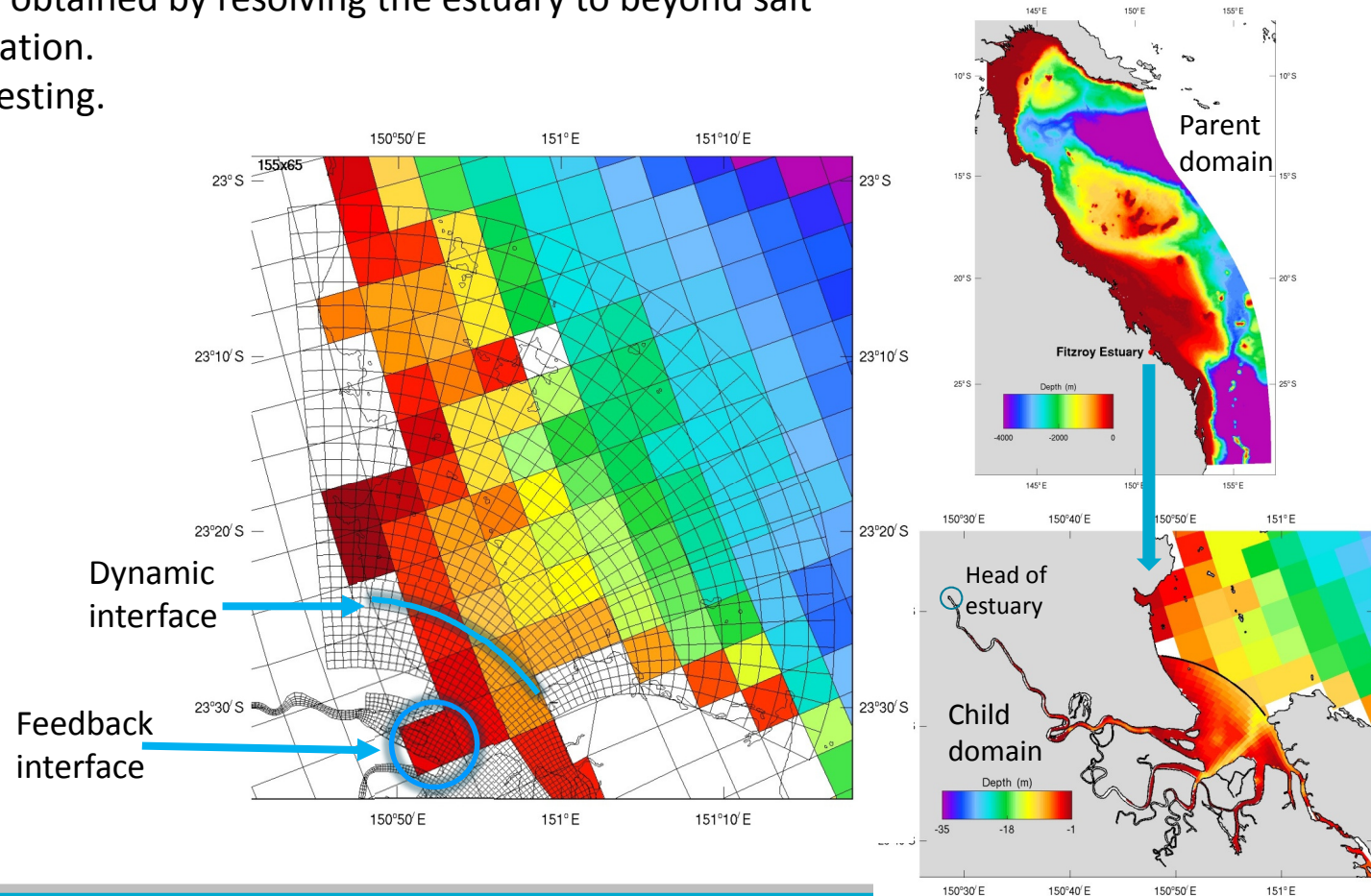
Grid and bathymetry



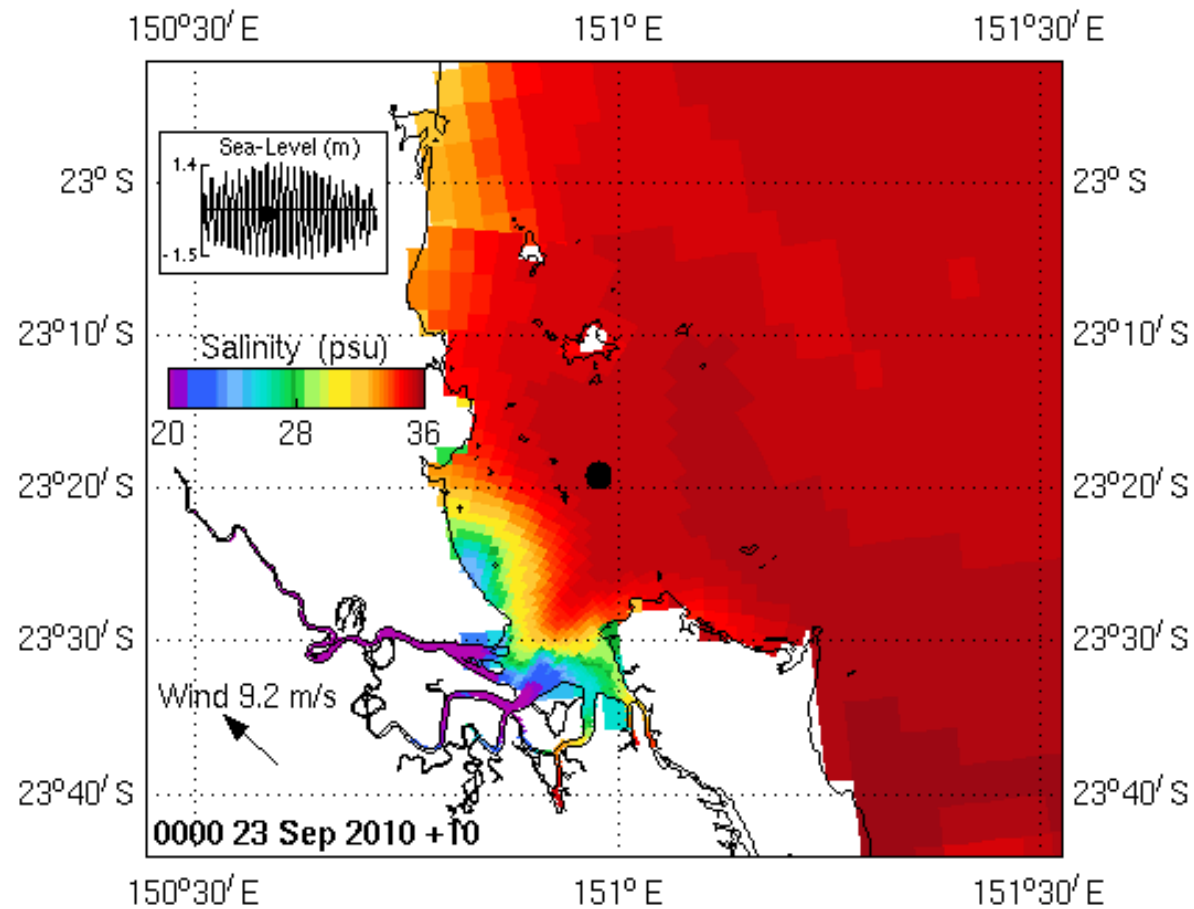
Sea level comparisons

Improved estuaries – 2-way nesting

- Dynamic freshwater input does OK at approximating salinity at the estuary mouth.
- Better result obtained by resolving the estuary to beyond salt wedge penetration.
- Use 2-way nesting.



Two way nesting salinity solution



RECOM conclusions

- RECOM is easily configurable by non-specialists.
- RECOM delivers stable and robust solutions.
- Hydrodynamics delivers a comparable solution to optimized models.
- Model skill degrades through sediment transport to BGC,
 - Primarily attributed to initial condition distributions in the sediment.
- Require the ability to customize initial sediment distributions in RECOM.
- RECOM delivers a good first order view of a system,
 - Further optimization requires specialist intervention,
 - RECOM is only as good as the forcing applied to it (river inflow, benthic distributions...).

Thank you

Coastal Development and Management
Mike Herzfeld

t +61 3 6232 5167

e mike.herzfelde@csiro.au

w <http://www.emg.cmar.csiro.au/www/en/emg.html>

OCEANS AND ATMOSPHERES

www.csiro.au

