eReefs

RECOM.
Relocatable Coastal Ocean Model

**Mike Herzfeld**
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CSIRO

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.

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eReefs nested marine modelling suite

Global products:
- OceanMAPS (10km)
- ACCESS-A (12km)

GBR4
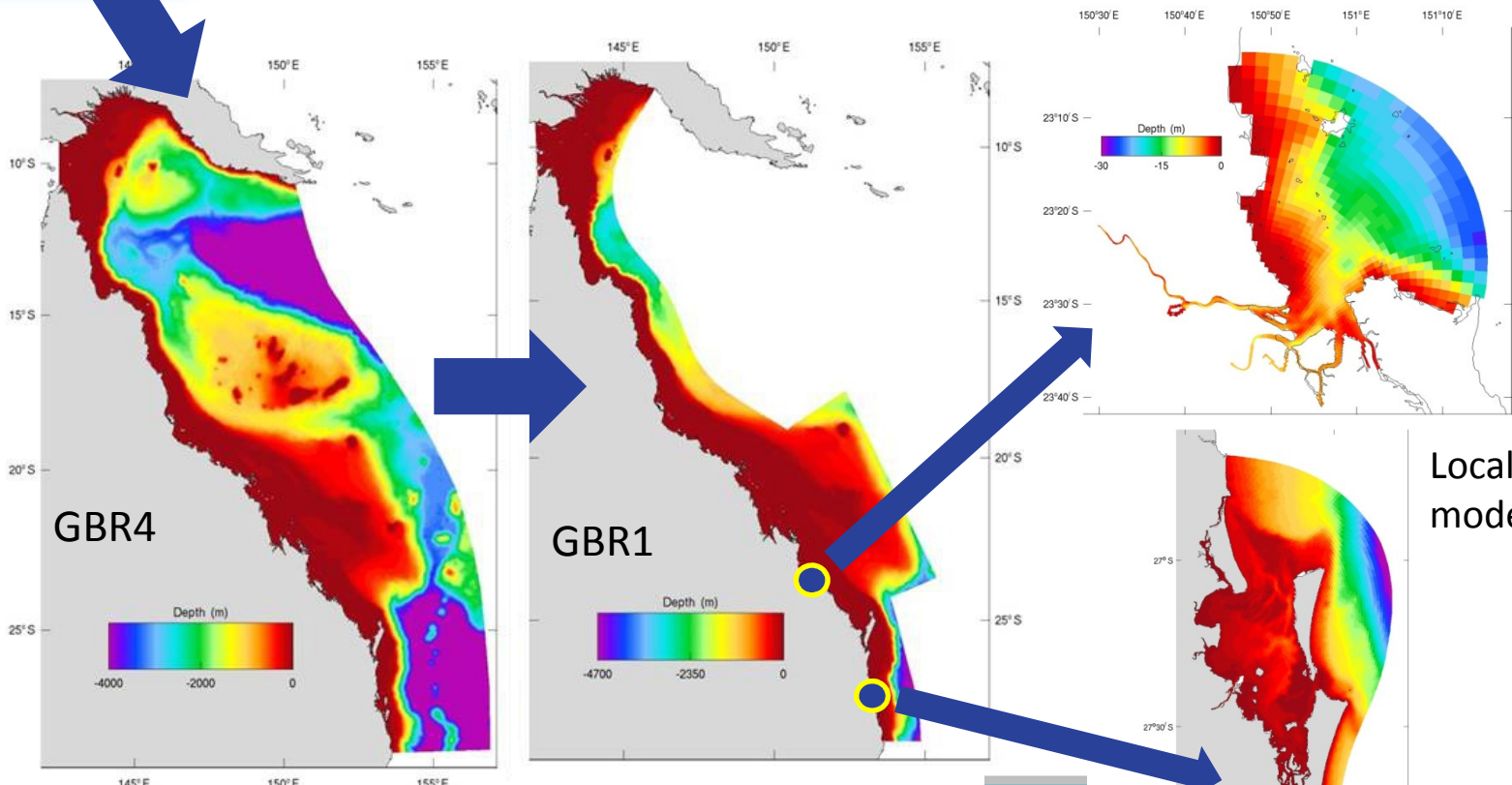
Bridging models (4km)

GBR1

Hi-res regional (1km)

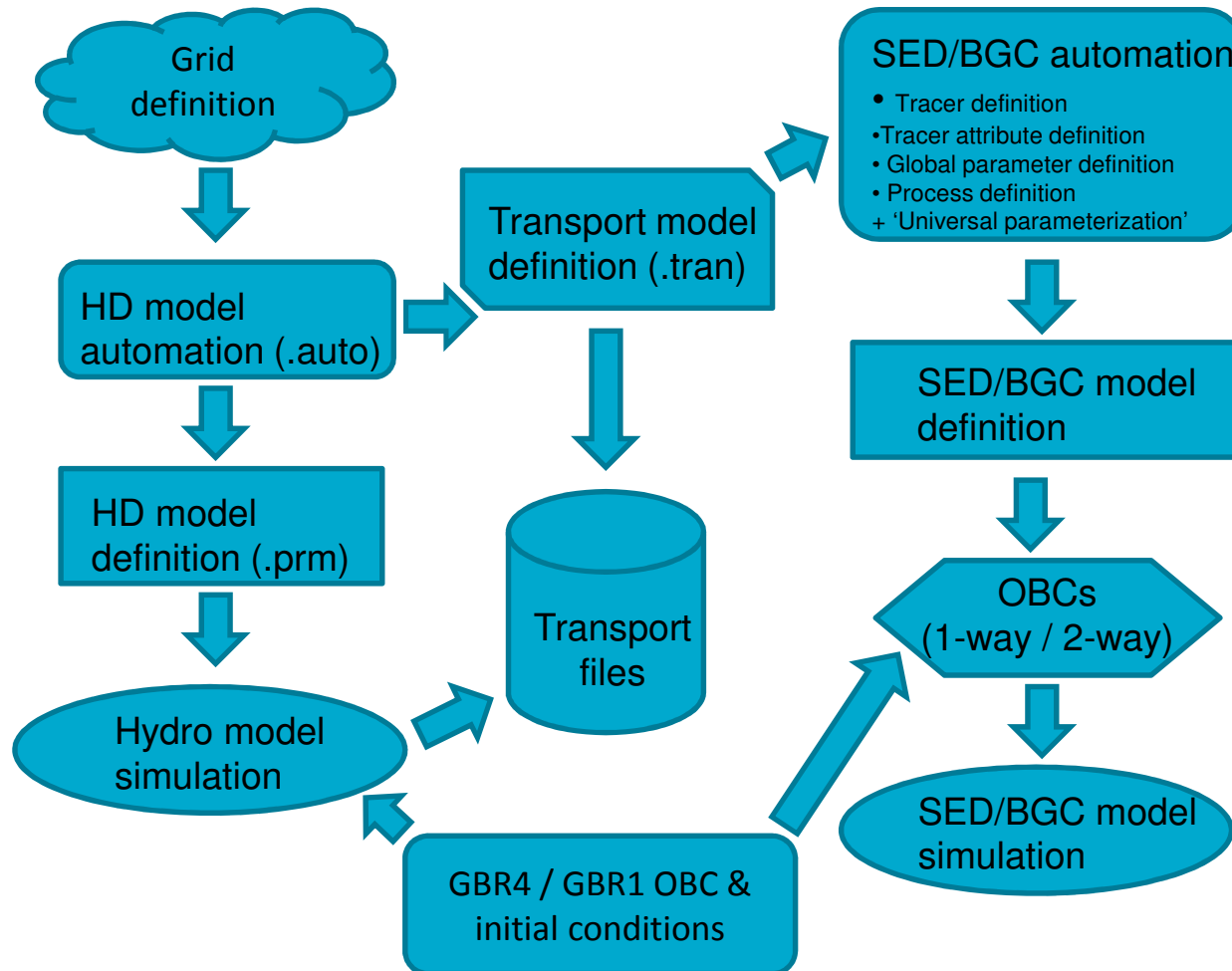Local models

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.
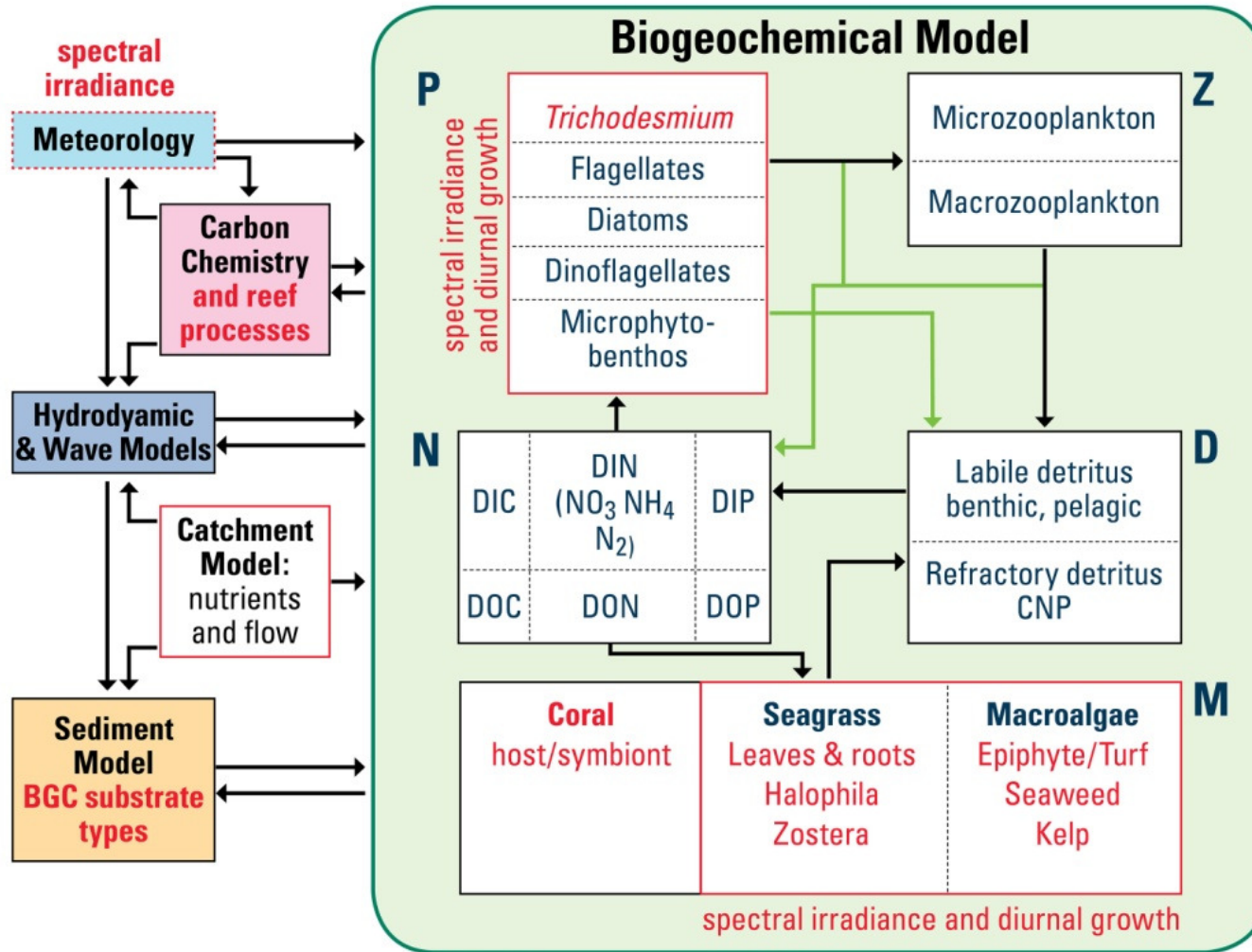
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RECOM provides:

- 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.

Improving stability of regional numerical ocean models

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RECOM workflow

Grid definition

HD model automation (.auto)

Transport model definition (.tran)

SED/BGC automation
- Tracer definition
- Tracer attribute definition
- Global parameter definition
- Process definition
+ 'Universal parameterization'

HD model definition (.prm)

Transport files

SED/BGC model definition

OBCs (1-way / 2-way)

Hydro model simulation

SED/BGC model simulation

GBR4 / GBR1 OBC & initial conditions

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RECOM processes

RECOM uses web based interface

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

| New | Edit | Clone | Delete | Abort |

Status Columns ▾   Select All   Unselect All

10 ▾ model runs per page   Search: [   ]

Run ID	Run Name	Model Name	Run Start	Run Stop	Model Start	Model Stop	Status
466	gas_25jan	❶ recom	-	-	2015-01-18 00:00:00	2015-01-19 00:00:00	100.0
465	optics_25jan	❶ 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	❶ 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	❶ recom	-	-	2015-01-22 00:00:00	2015-01-23 00:00:00	100.0
462	optics_mon	❶ 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	❶ 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	❶ recom	-	-	2015-01-22 00:00:00	2015-01-23 00:00:00	100.0
458	optics_only	❶ recom	-	-	2015-01-22 00:00:00	2015-01-23 00:00:00	100.0
457	gas_only_callwithoxygen	❶ 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	❶ 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.
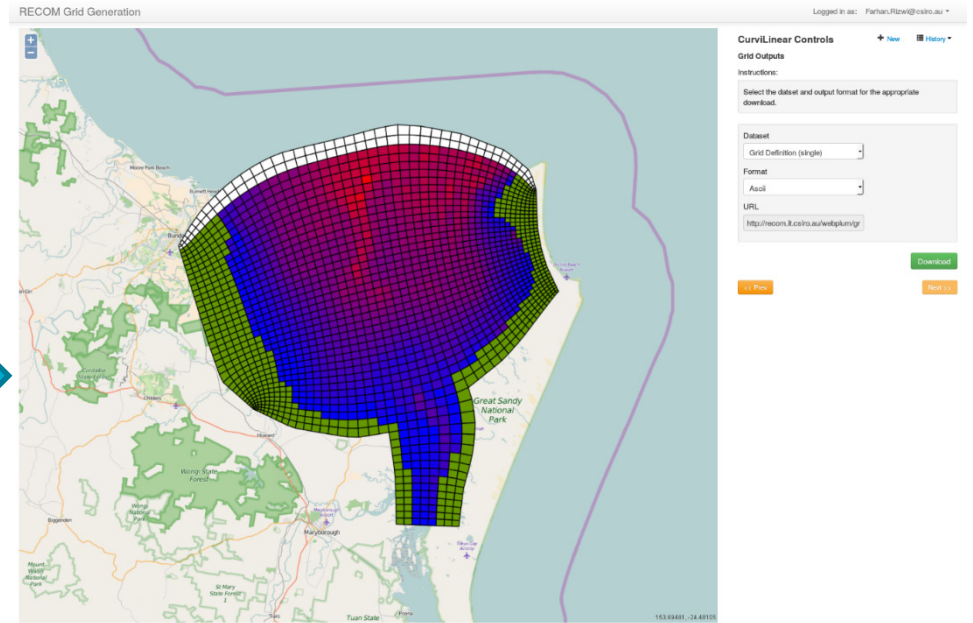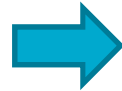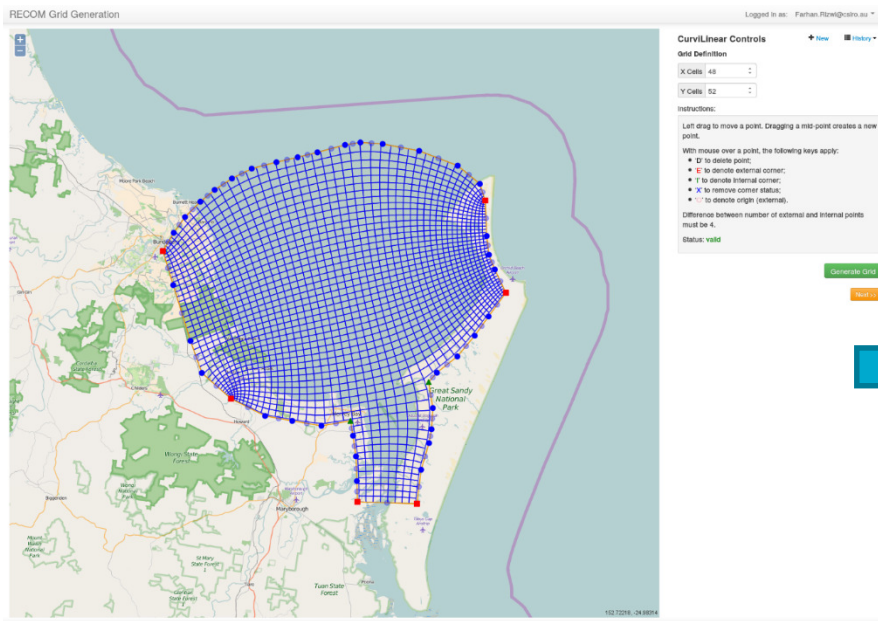
User chooses edge of domain and grid orientation.

RECOM adds land mask and bathymetry.

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Complex curvilinear grid generation

Effort required: hours to days.

User adds grid branches, rivers inputs and alters bathymetry.
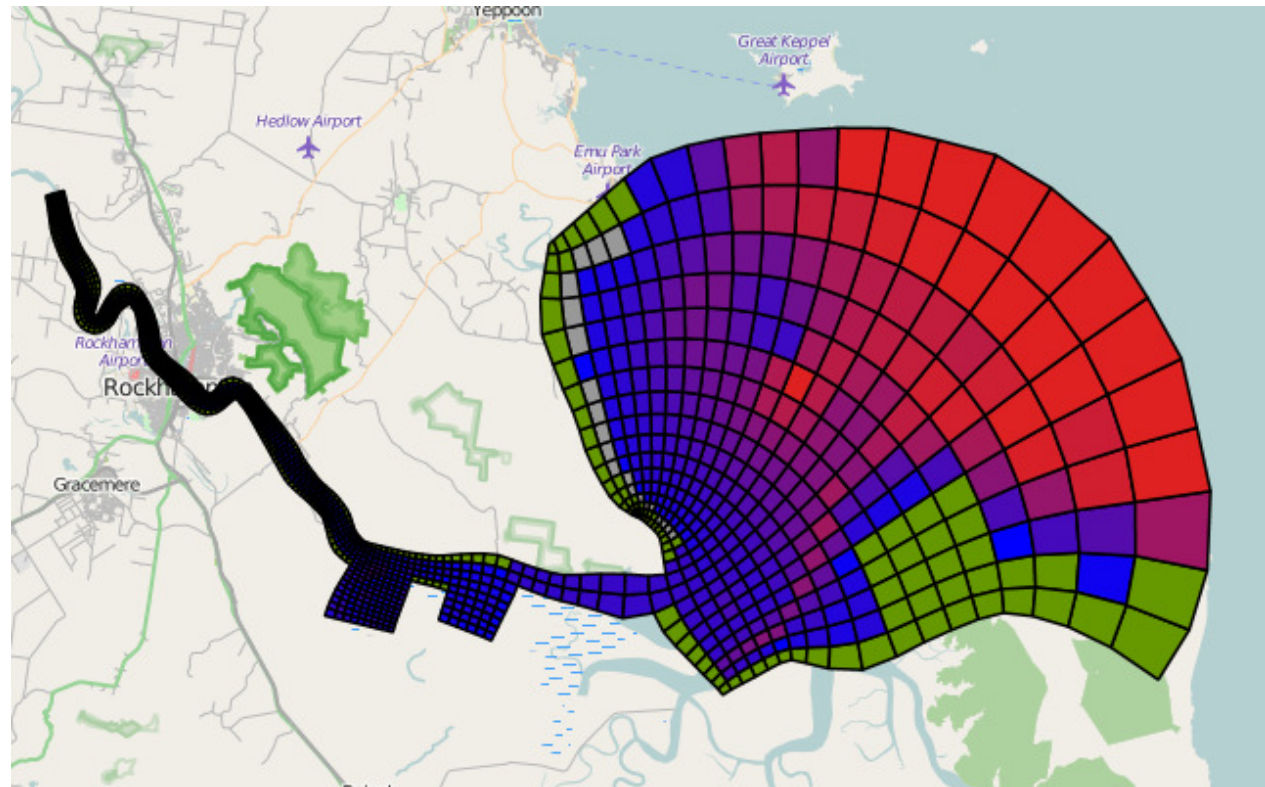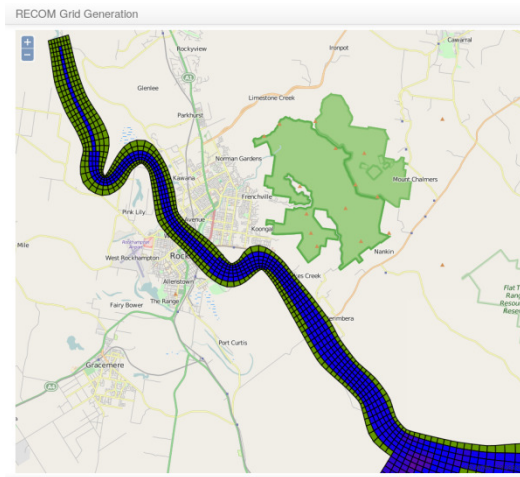
Grid and mask editing

Model forcing specification

Model parameter specification

RECOM test areas

- Fitzroy Estuary
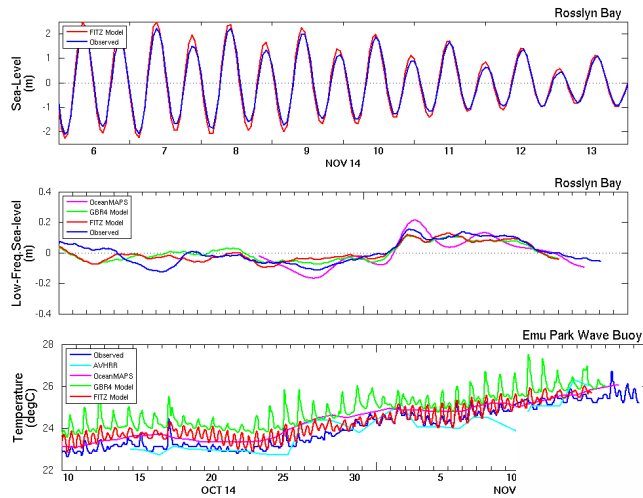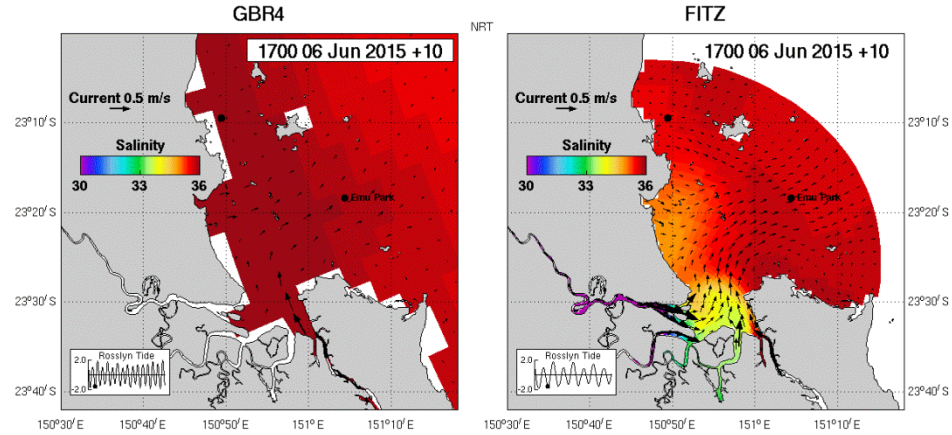
- Heron Island

-
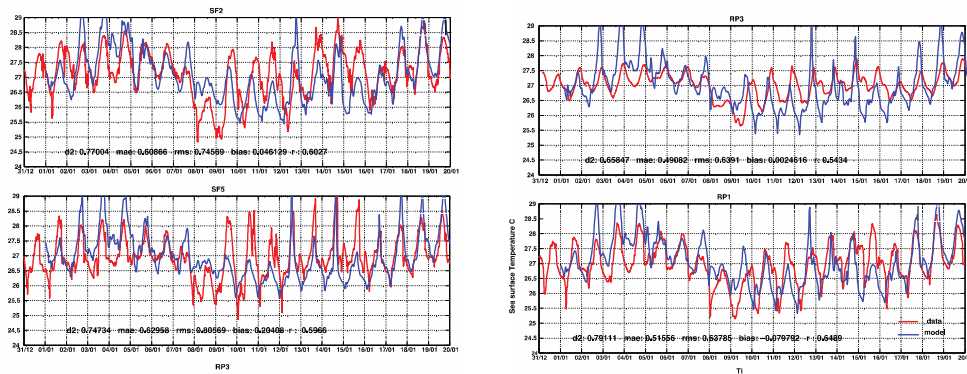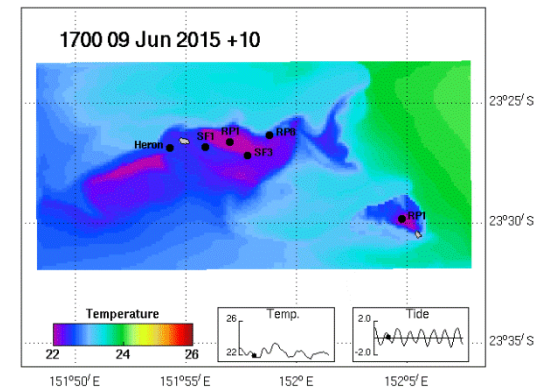
Fitzroy – salinity comparison.
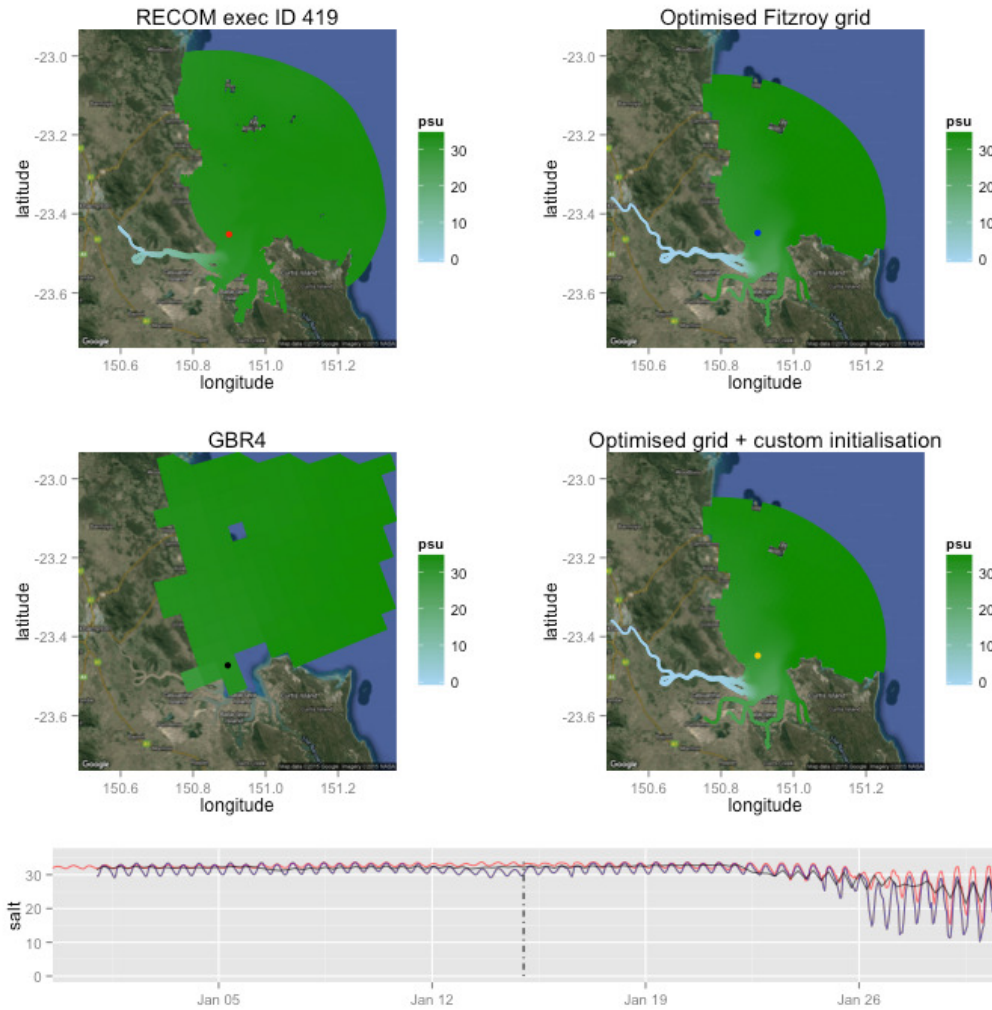
Fitzroy – fine sediment comparison.

Fitzroy – total nitrogen comparison.
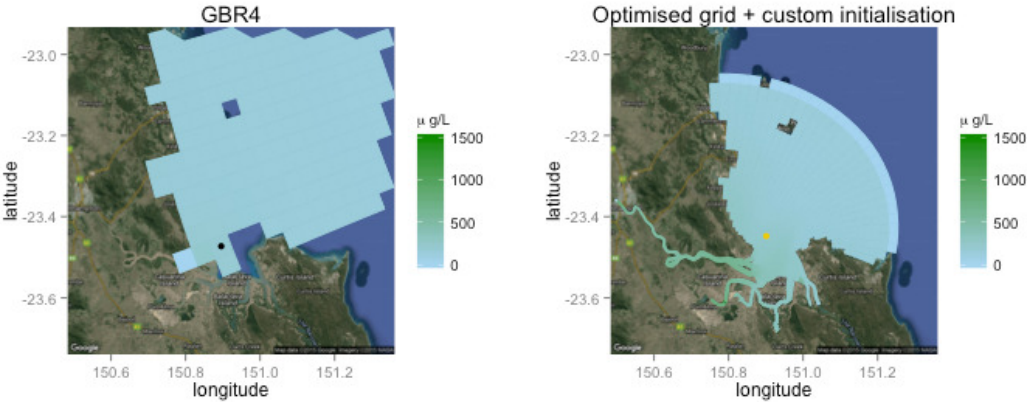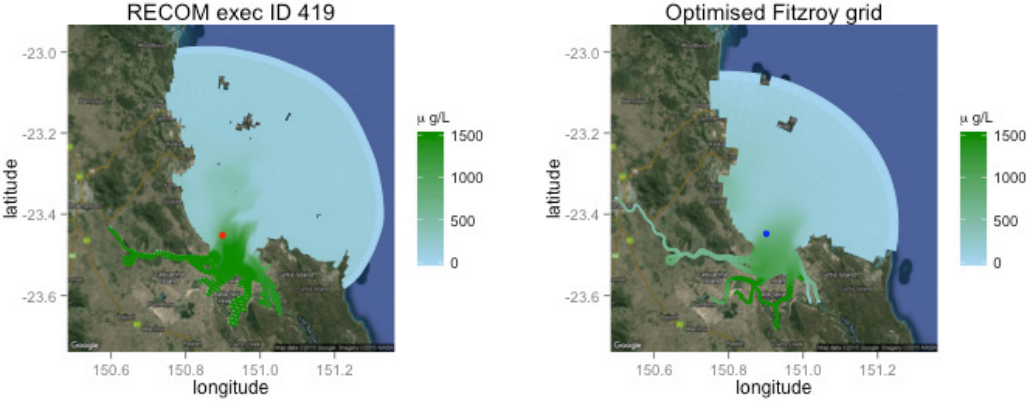
RECOM — (red)
Optimized — (blue)
GBR4 — (black)
Optimized + initialized — (yellow)
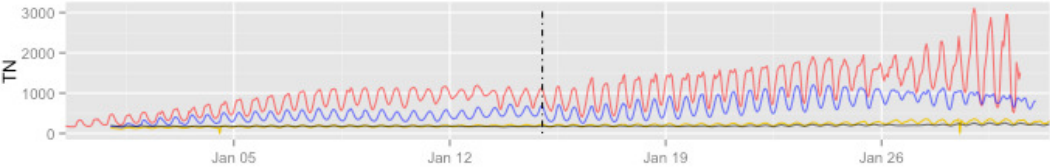
Heron Island - bathymetry

Optimized model, Bathymetry

Recom model, Bathymetry

Beaman (2010)

Recom model 2, Bathymetry
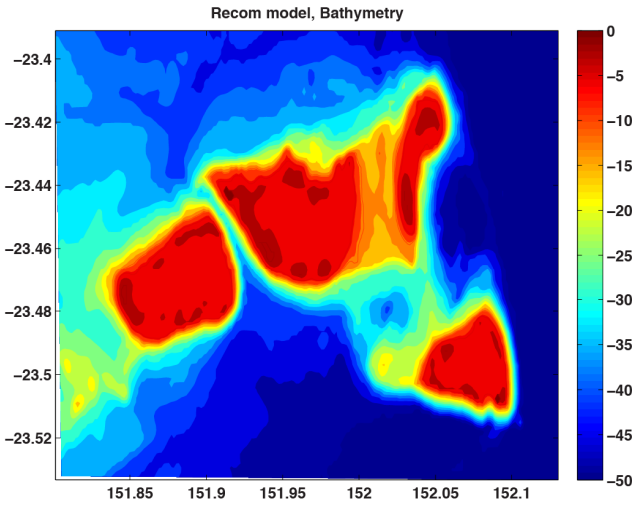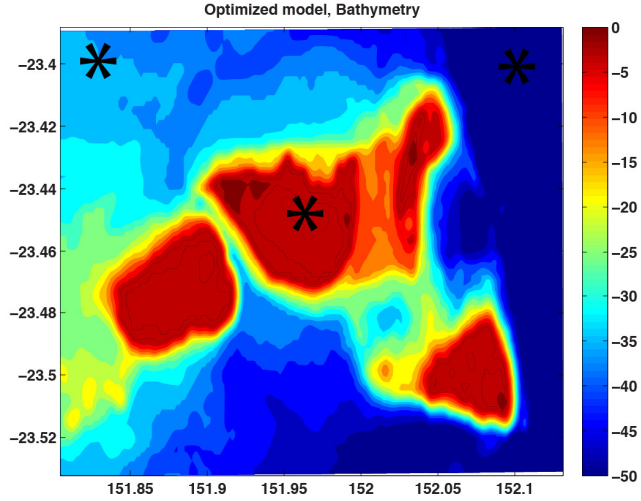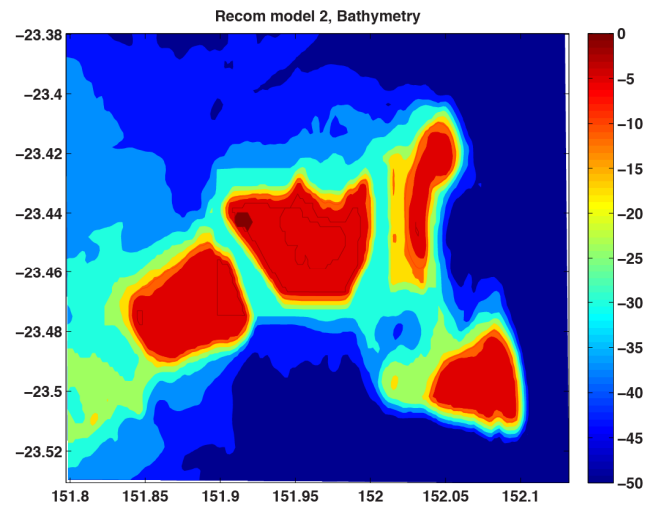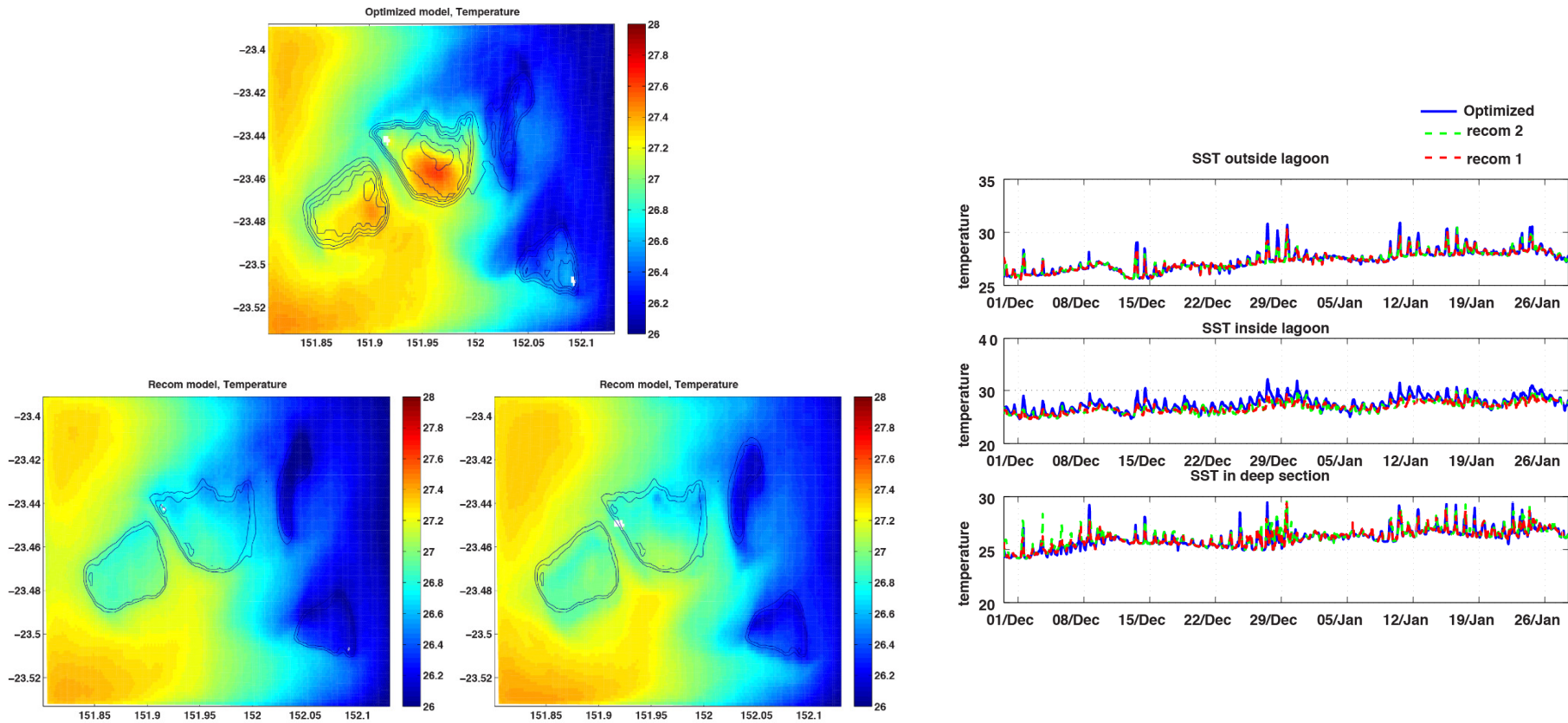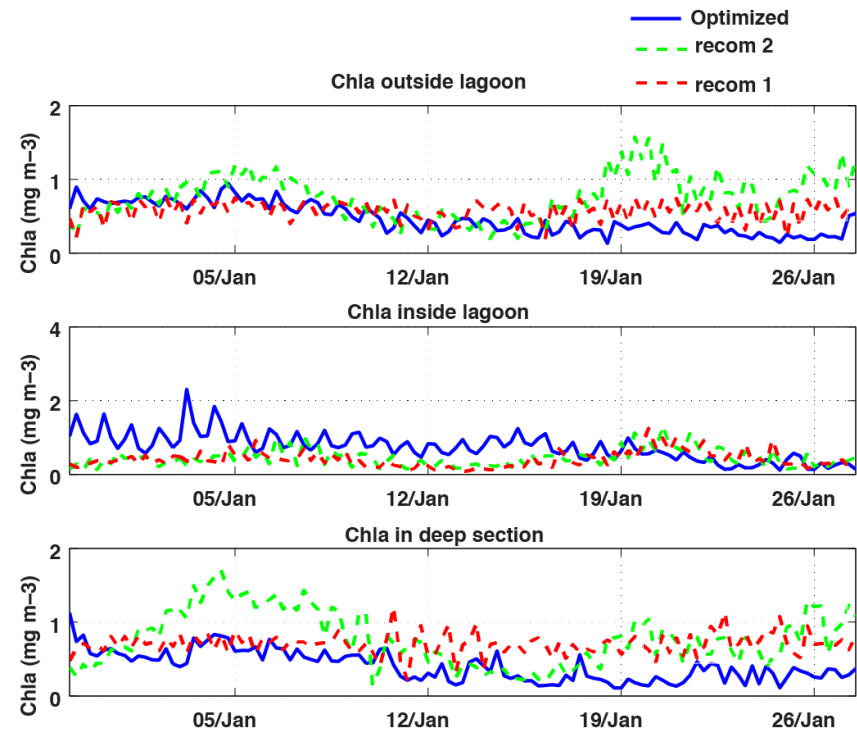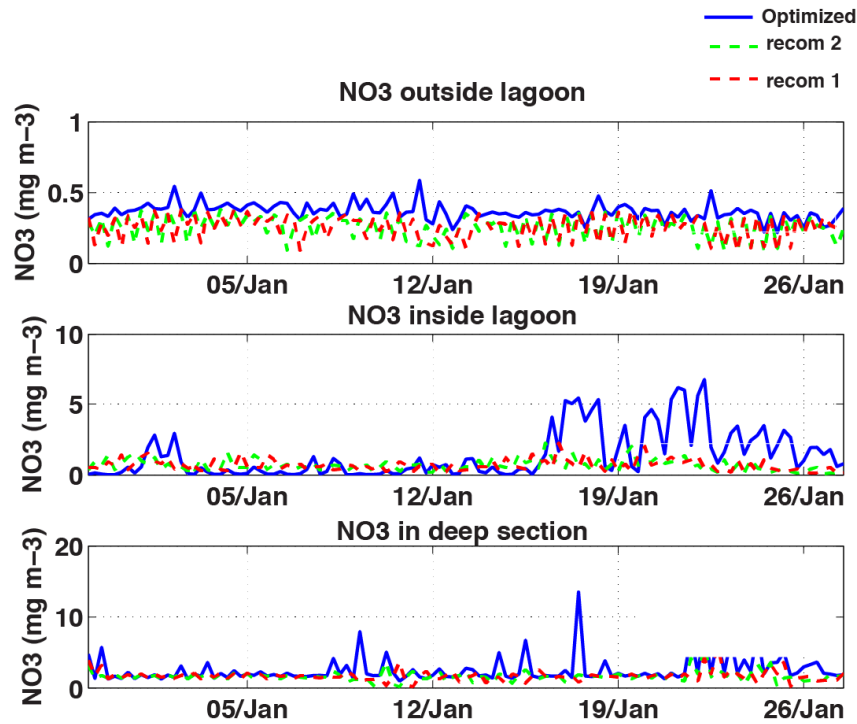
Beaman (2010) + custom Heron

Heron Island – Temperature comparison

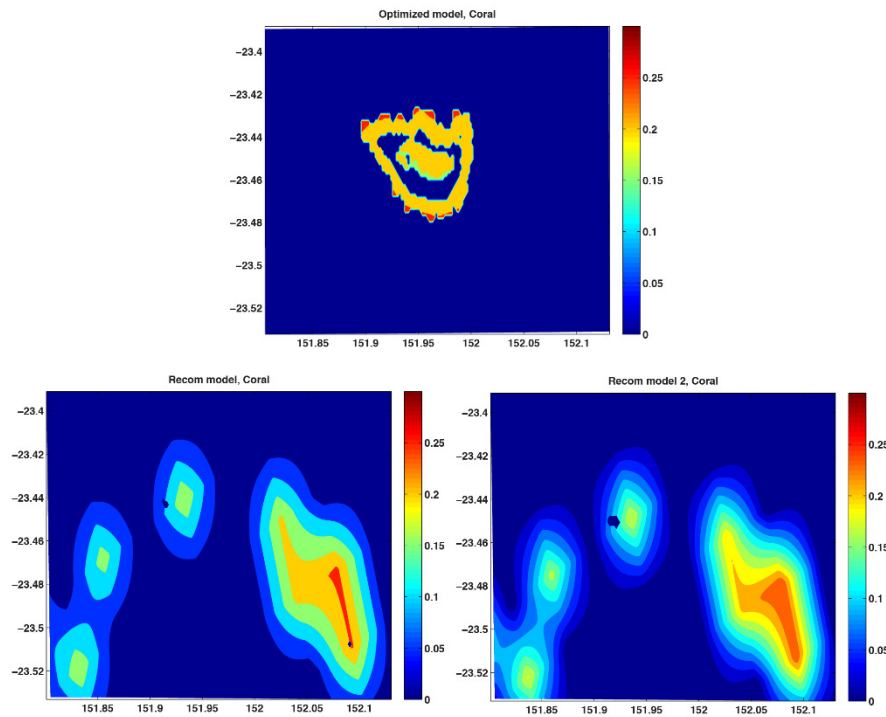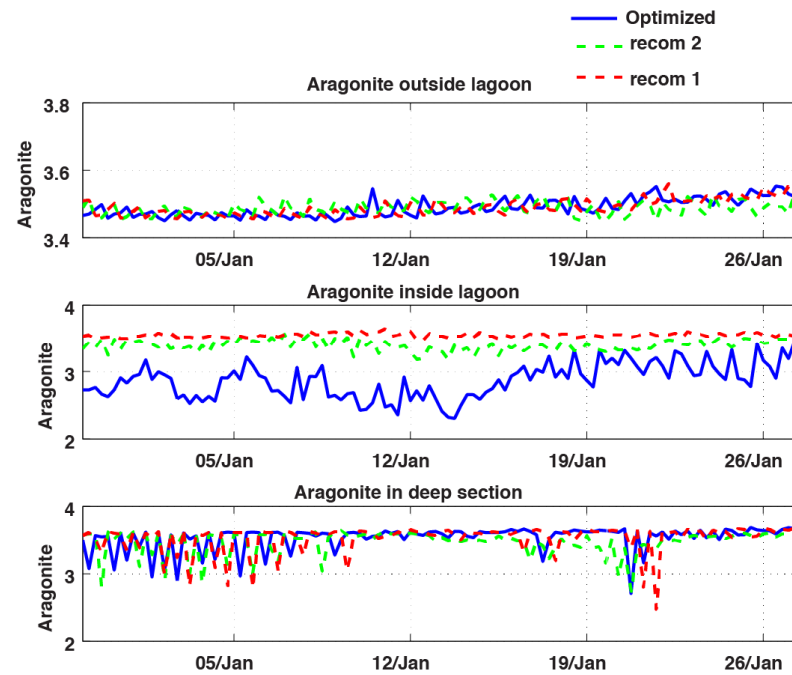# Heron Island – BGC comparison
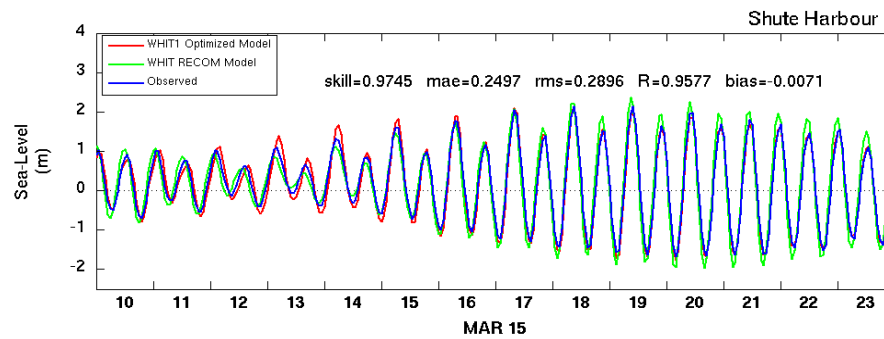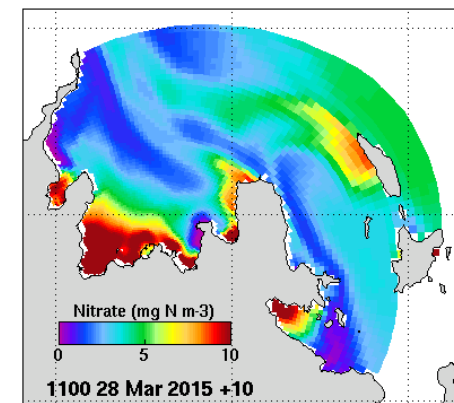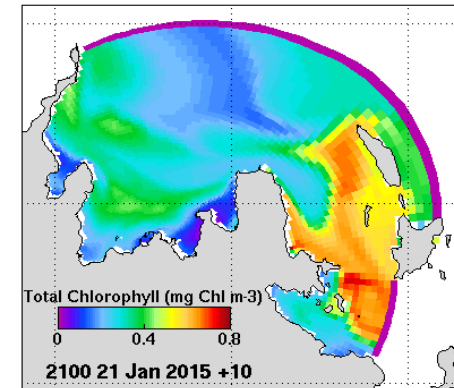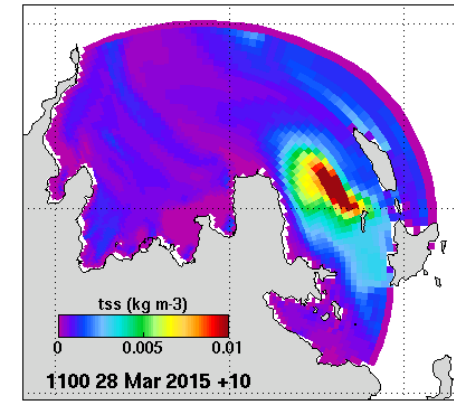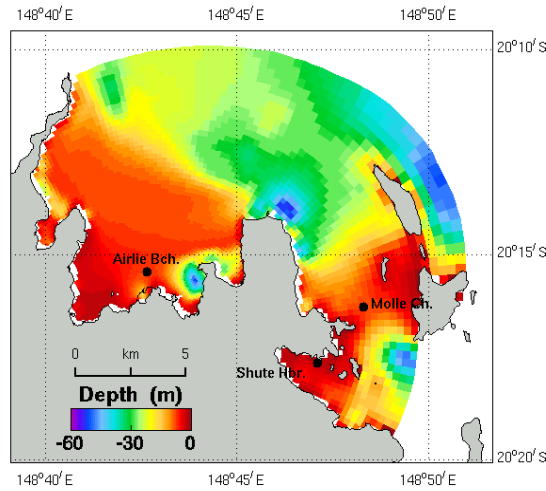
Heron Island - Corals

Initial conditions

Coral interpolated from GBR4

Whitsundays

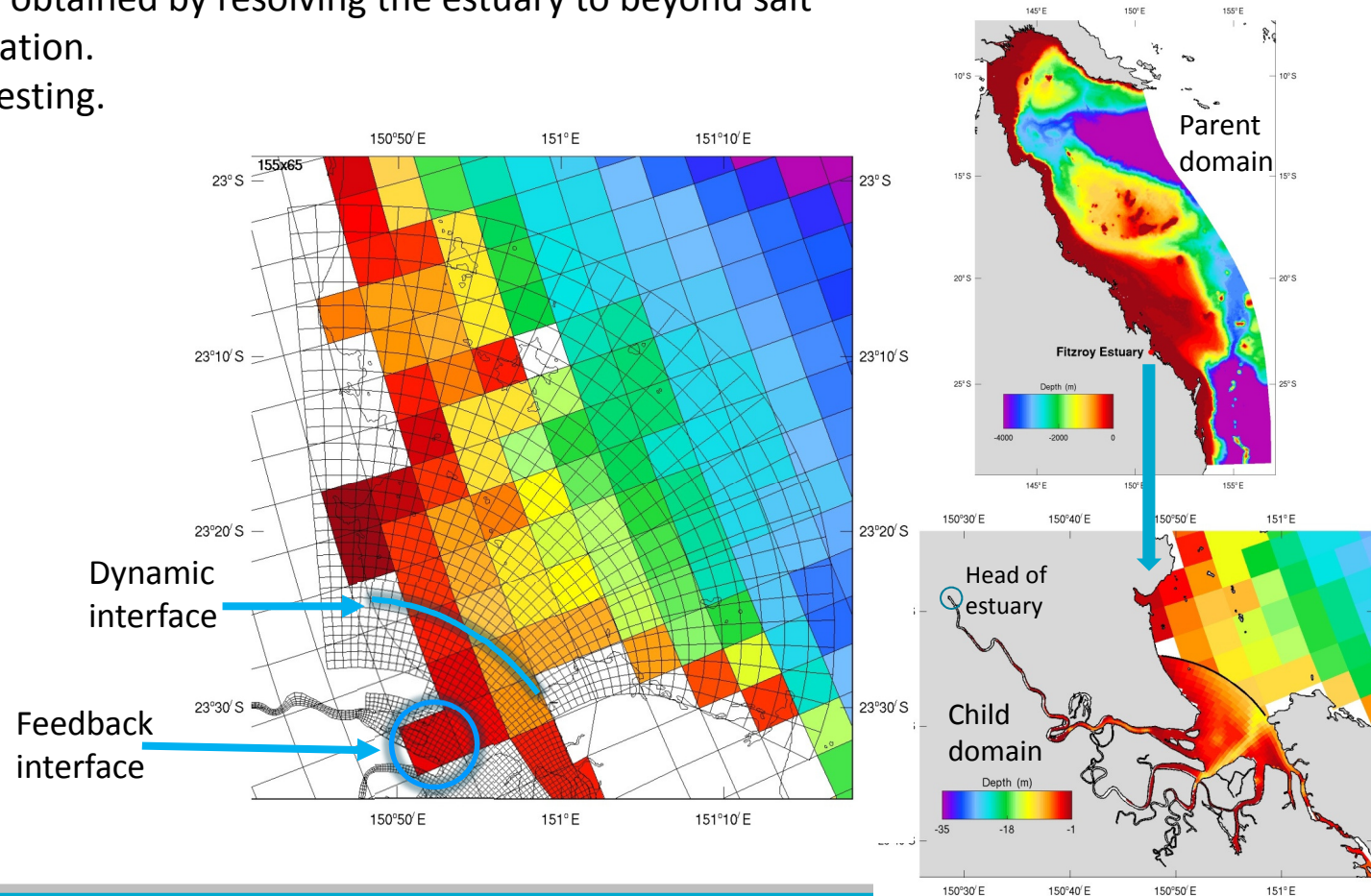## Grid and bathymetry
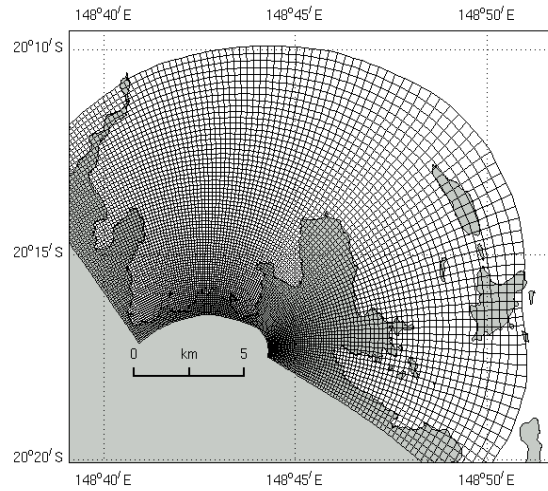
Sea level comparisons

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.

Dynamic interface

Feedback interface

Parent domain

Head of estuary

Child domain

Two way nesting salinity solution
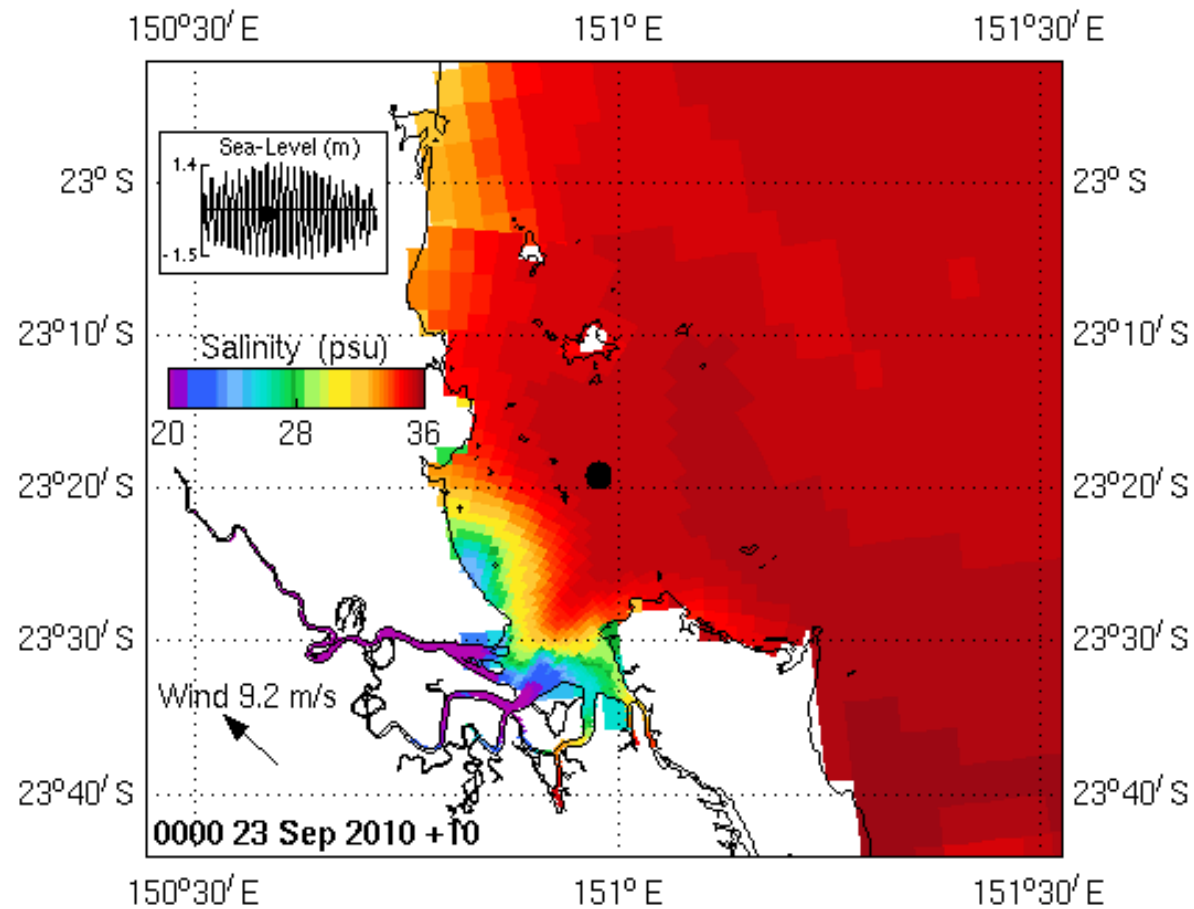
RECOM conclusions

- 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…).

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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

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