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eReefs publications

Mike Herzfeld

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Publications

Contents lists available at ScienceDirect

Ocean Modelling

journal homepage: www.elsevier.com/locate/ocemod

Active open boundary forcing using dual relaxation time-scales in downscaled ocean models

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M. Herzfeld*

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Continental Shelf Research

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Research papers

Cross-shelf exchanges between the Coral Sea and the Great Barrier Reef lagoon determined from a regional-scale numerical model

Andreas Schiller [a,*], Mike Herzfeld [a], Richard Brinkman [b], Farhan Rizwi [a], John Andrewartha [a]

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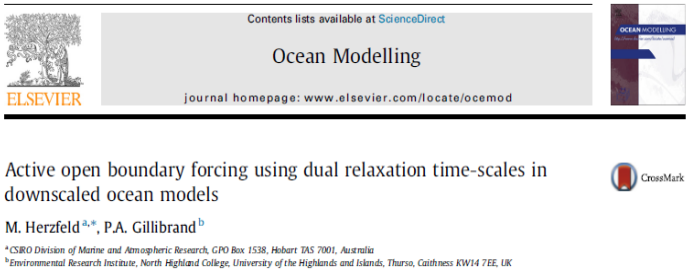
[b] CSIRO Division of Marine and Atmospheric Research, GPO Box 1538, Hobart, Tas. 7001, Australia

Monitoring, Predicting, and Managing One of the Seven Natural Wonders of the World

BY ANDREAS SCHILLER, MIKE HERZFELD, RICHARD BRINKMAN, AND GREG STUART

Open boundaries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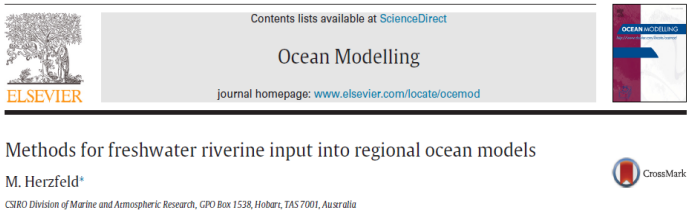
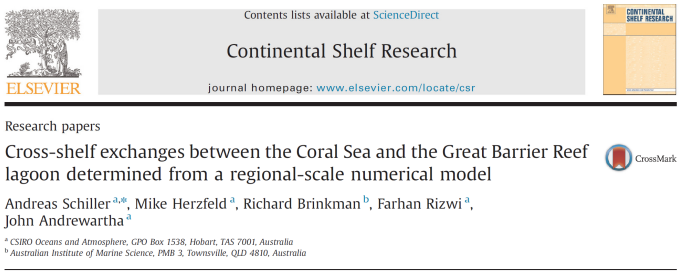
- Open boundaries must supply information to drive the tides,
  - This implies an ‘active’ open boundary, where the model interior responds to the boundary specification.
- Southeast trade winds (Jan – Aug) drive northward flow in the lagoon,
  - This implies a ‘passive’ open boundary, where the boundary responds to the interior forcing.
- Difficult to reconcile these conflicting requirements,
  - Active or passive nature of boundaries usually controlled by unique relaxation time-scales,
  - A ‘dual relaxation’ boundary scheme was developed to cope with this situation.

Freshwater inputs



- Freshwater enters the marine environment at the head of estuaries.
- In regional models estuaries are typically not resolved, and freshwater is input at the coast.
- Input at the coast also can lead to a numerical response in models.
- Input at the coast requires the depth freshwater is distributed over to be prescribed up front.
- A method of inputting freshwater was developed which mimics estuarine behavior at the mouth, and overcomes these issues.

Coral Sea connections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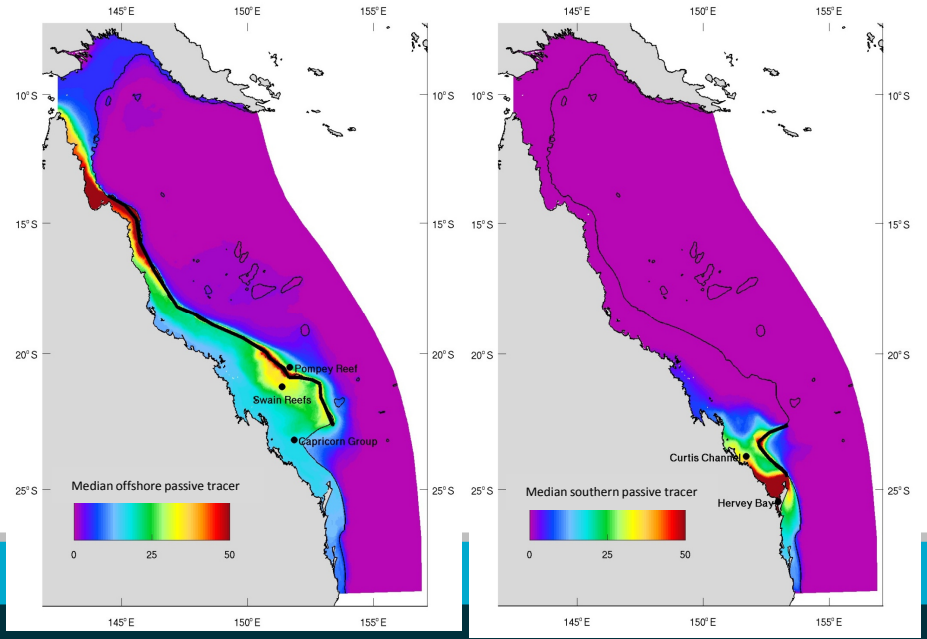
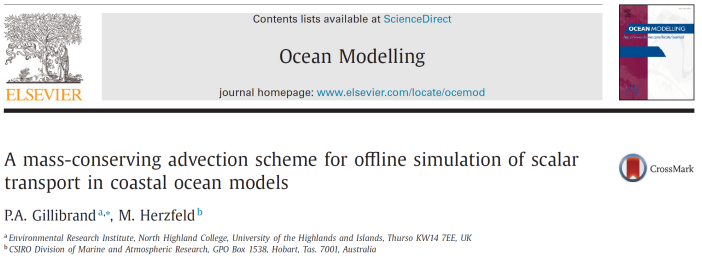
- Investigated the pathways between the Coral sea and GBR lagoon.
- Largest input of heat and salt into the lagoon is due to seasonal fluxes.
- Passive tracer analysis shows ‘hotspots’ where increased exchange occurs (Pompey Reefs and Palm Passage).



Transport model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- Transporting sediment and BGC variables within the hydrodynamic model is too slow.
- A transport model using flow fields saved offline is used to achieve this.
- To increase runtime, long time steps must be used, which implies the use of unconditionally stable semi-Lagrangian advection schemes.
- These schemes are intrinsically non-conservative.
- A Flux Form Semi-Lagrange model used in the meteorology community was adapted to curvilinear grids in the ocean model to allow fast, conservative transport.

In the pipeline

- Implementing autonomous 2-way nesting using existing infrastructure in ocean models, Herzfeld and Rizwi.
- Caveats using SST to infer coral bleaching, Herzfeld, Steinberg, Brinkman.
- Connectivity of GBR catchments. Brinkman, Herzfeld.

Thank you

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