Coastal Oceanography

THE UNIVERSITY OF WESTERN AUSTRALIA

Application of Oceanographic Drift Models

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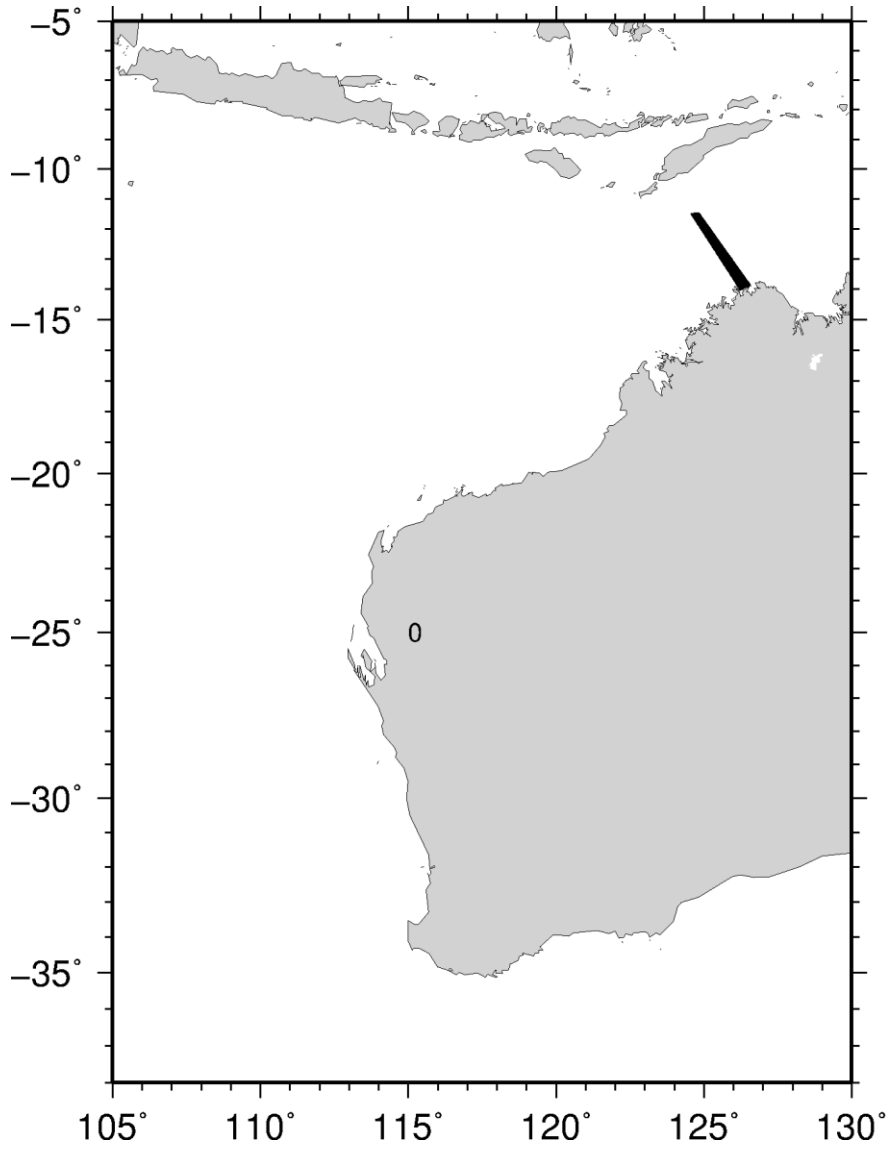

Tracking parcels of water

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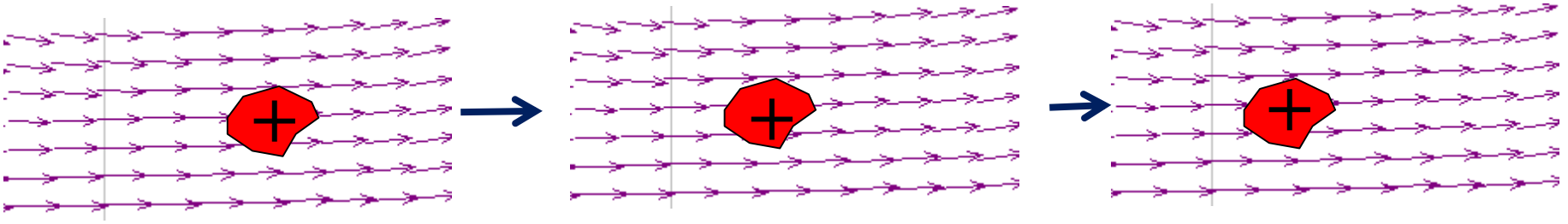
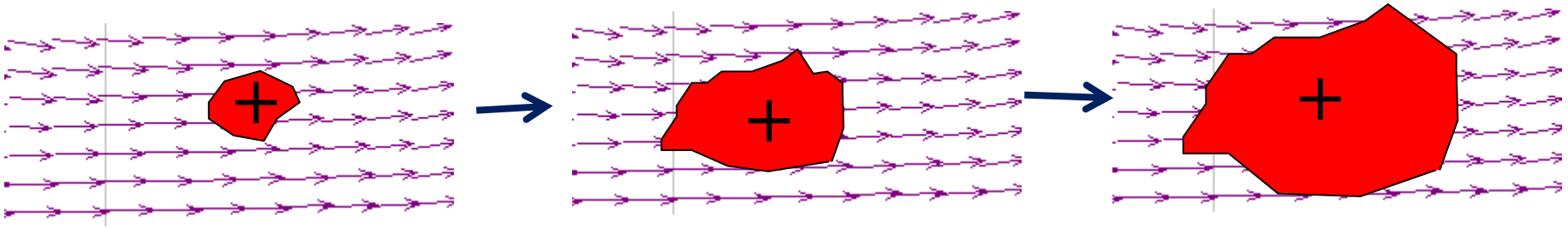
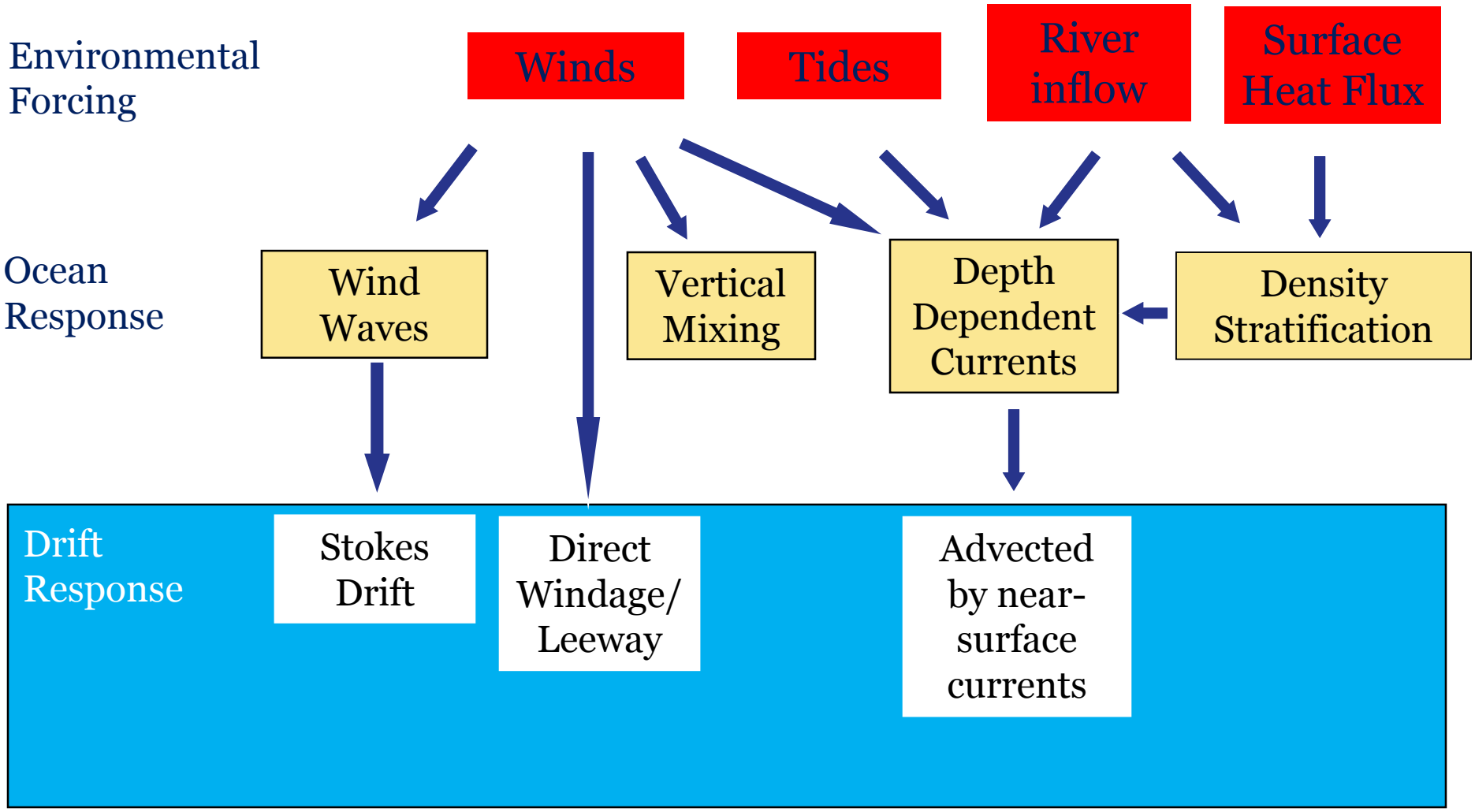
Advection



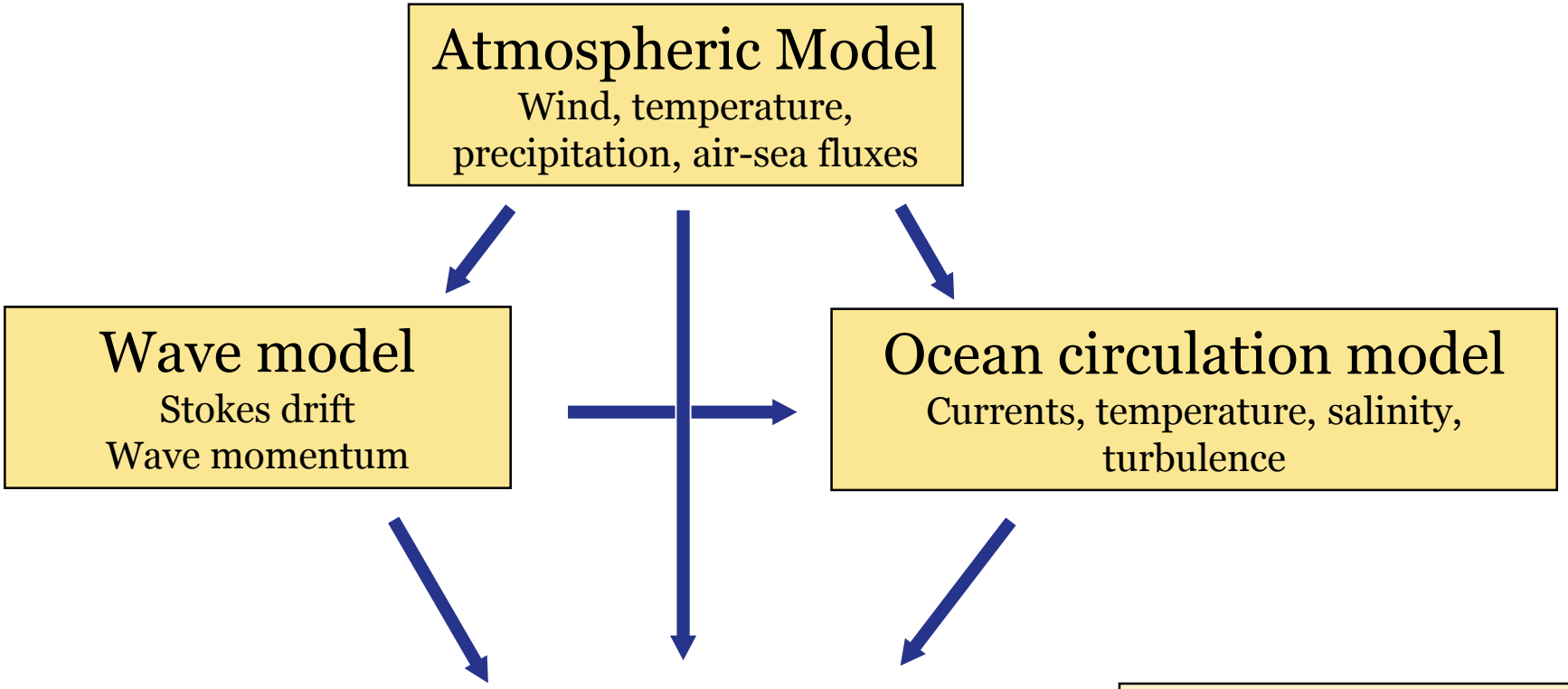
Advection + Diffusion



Surface Drift Dynamics



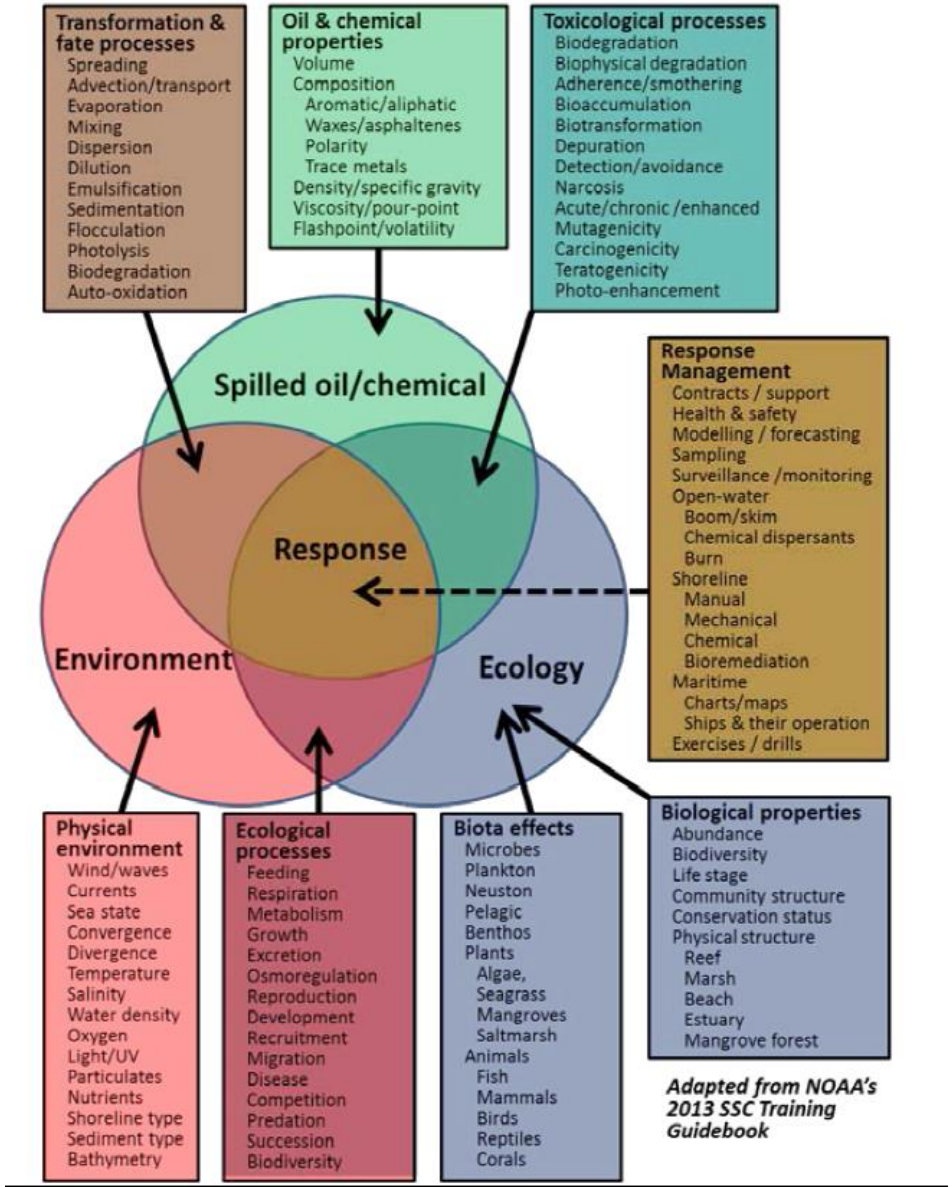
Drift Modelling



Gnome
response.restoration.noaa.gov

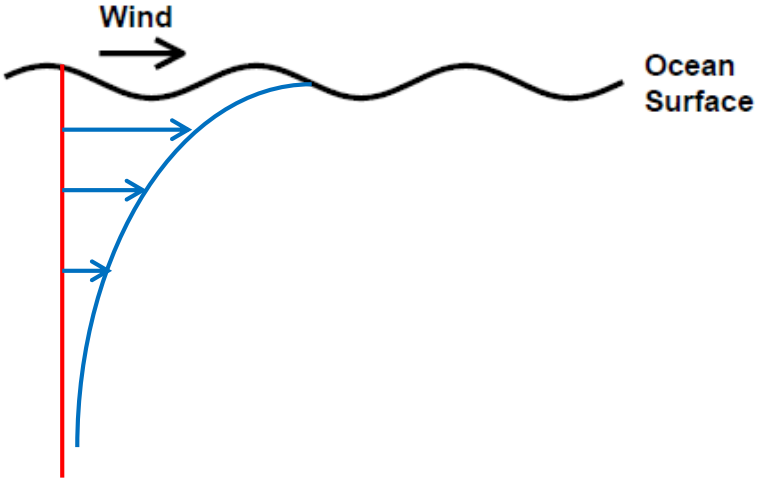
Ichthyop
www.ichthyop.org

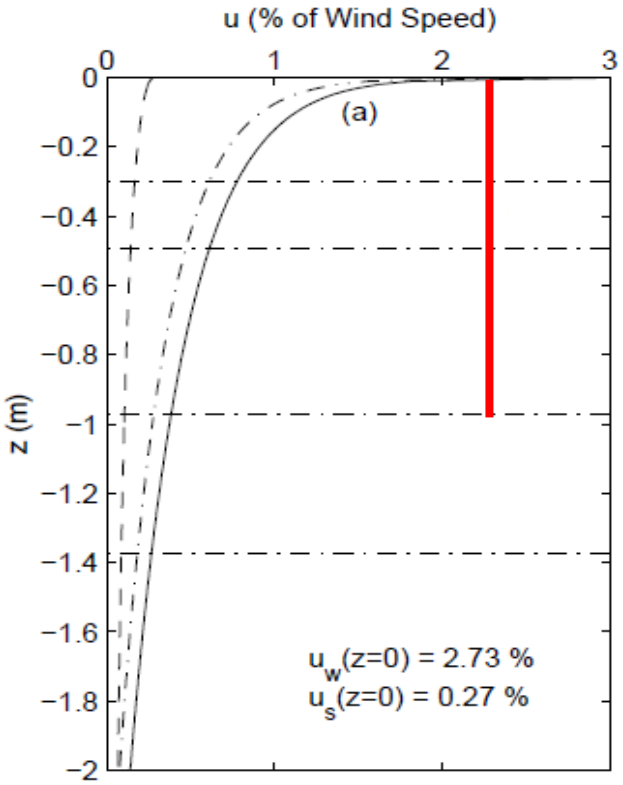
Particle tracking model

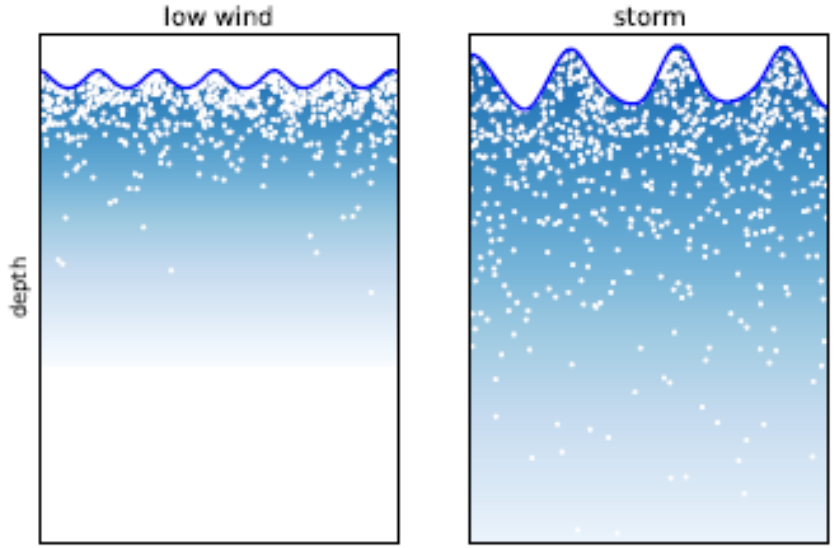


Paul Irving, 2015

Drift Modelling: wind effects

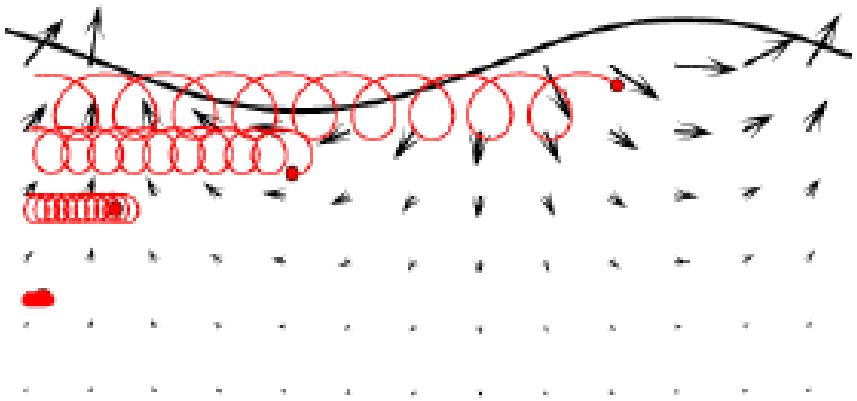


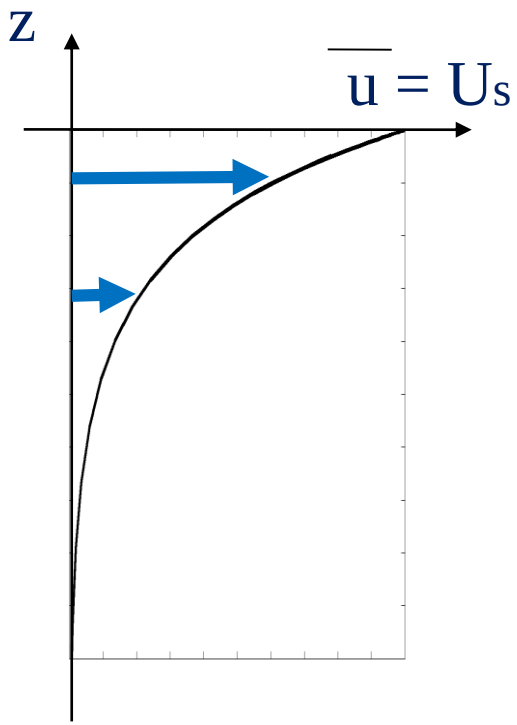




Drift Modelling: Stokes drift

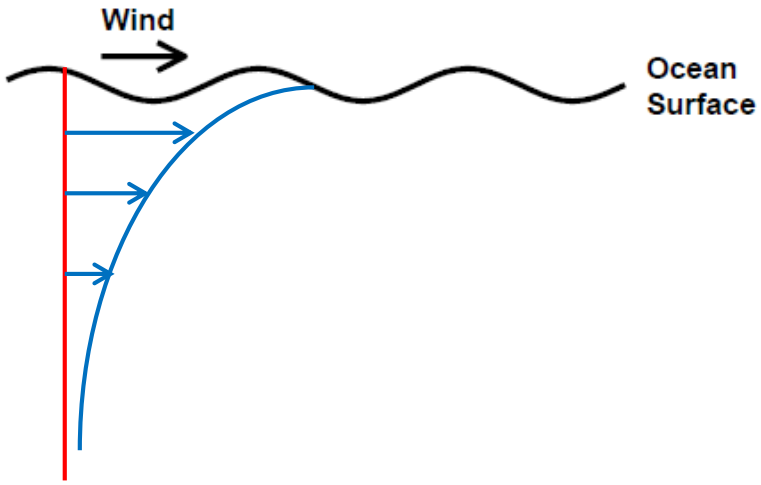
Mass transport due to waves





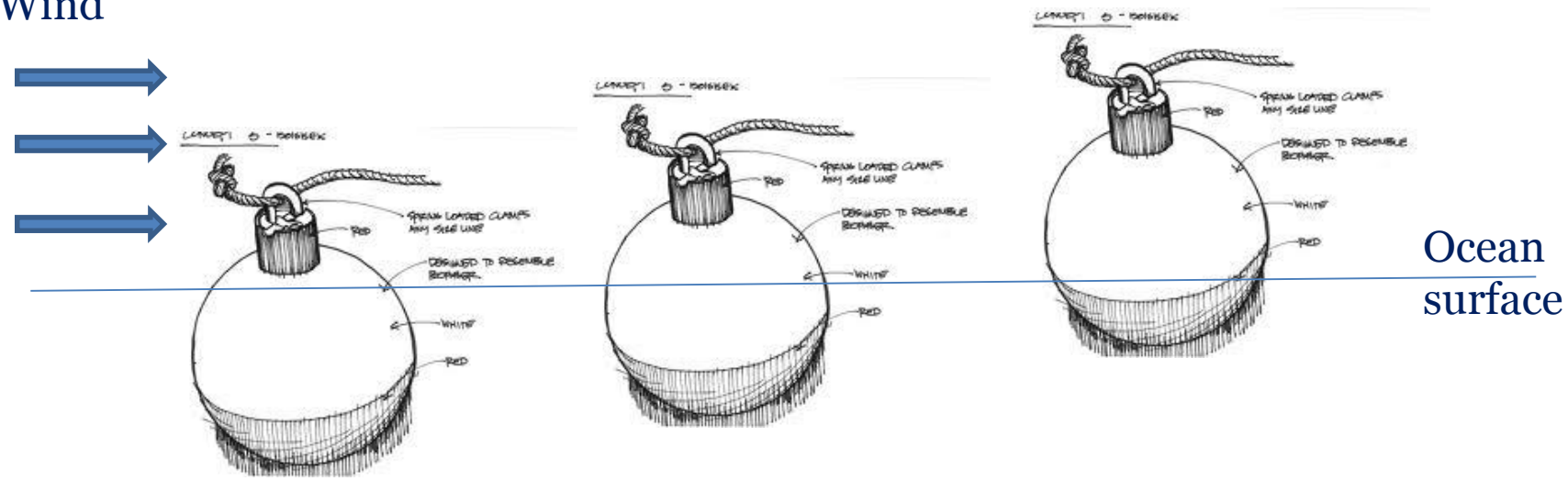
Drift Modelling: wind effects

- Surface drift due to the wind : 2 - 3% of U_{10}
- The Ekman currents at the surface strongly depend on the vertical mixing K_z : 0.5 to 4% of U_{10}
- Stokes drift of waves of same magnitude order : 3% of U_{10}



Windage

Wind



Low windage,
object sitting deep in water

Photo: Charles Moore

Medium windage,
object sitting half in water

Photo: Randal Reeves

High windage,
object sitting high on water

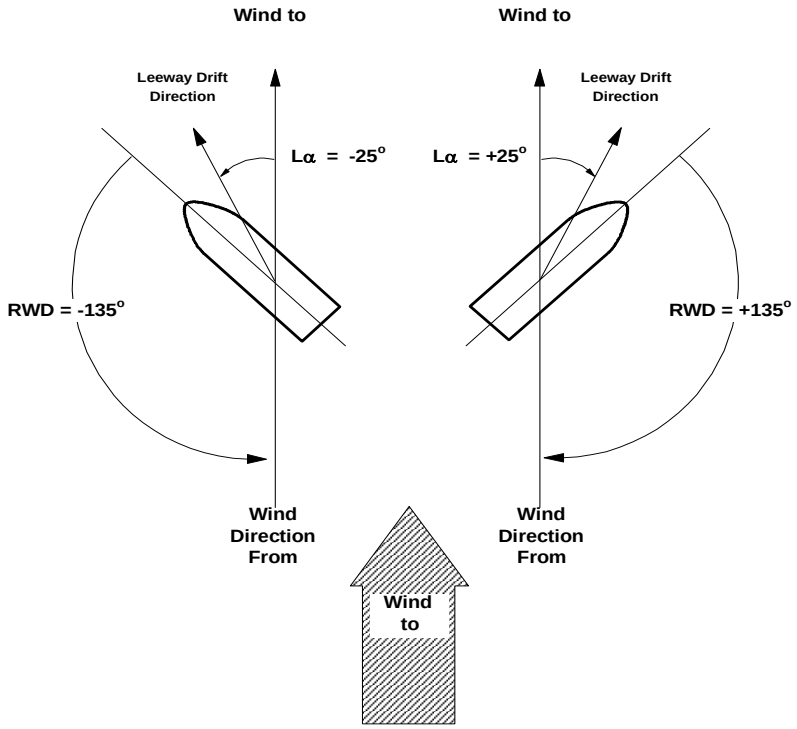
Photo: S/V “Tregoning”

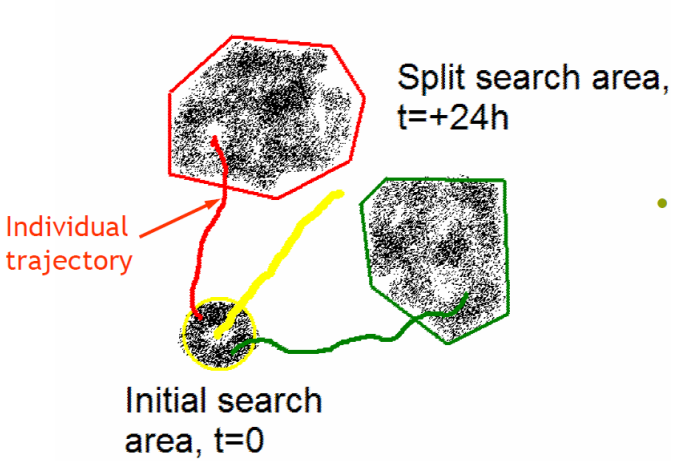
For example 5% windage means an object is moving with the current + 5% wind speed

Leeway divergence

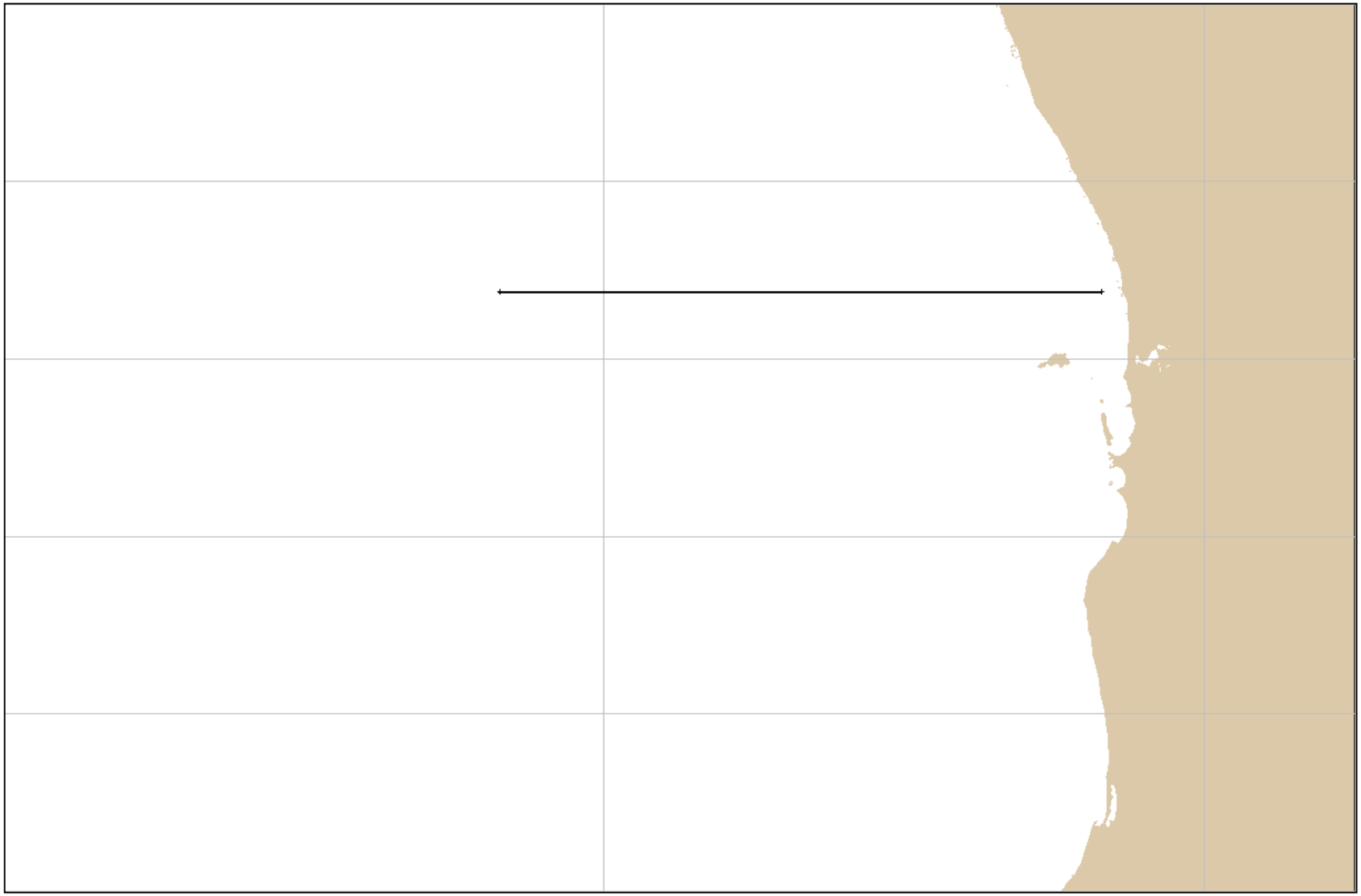
- Leeway divergence tranport objects at an angle relative to downwind
- Symmetry allows stable drift left and right of downwind (little jibing is observed).

→Diverging search areas with time

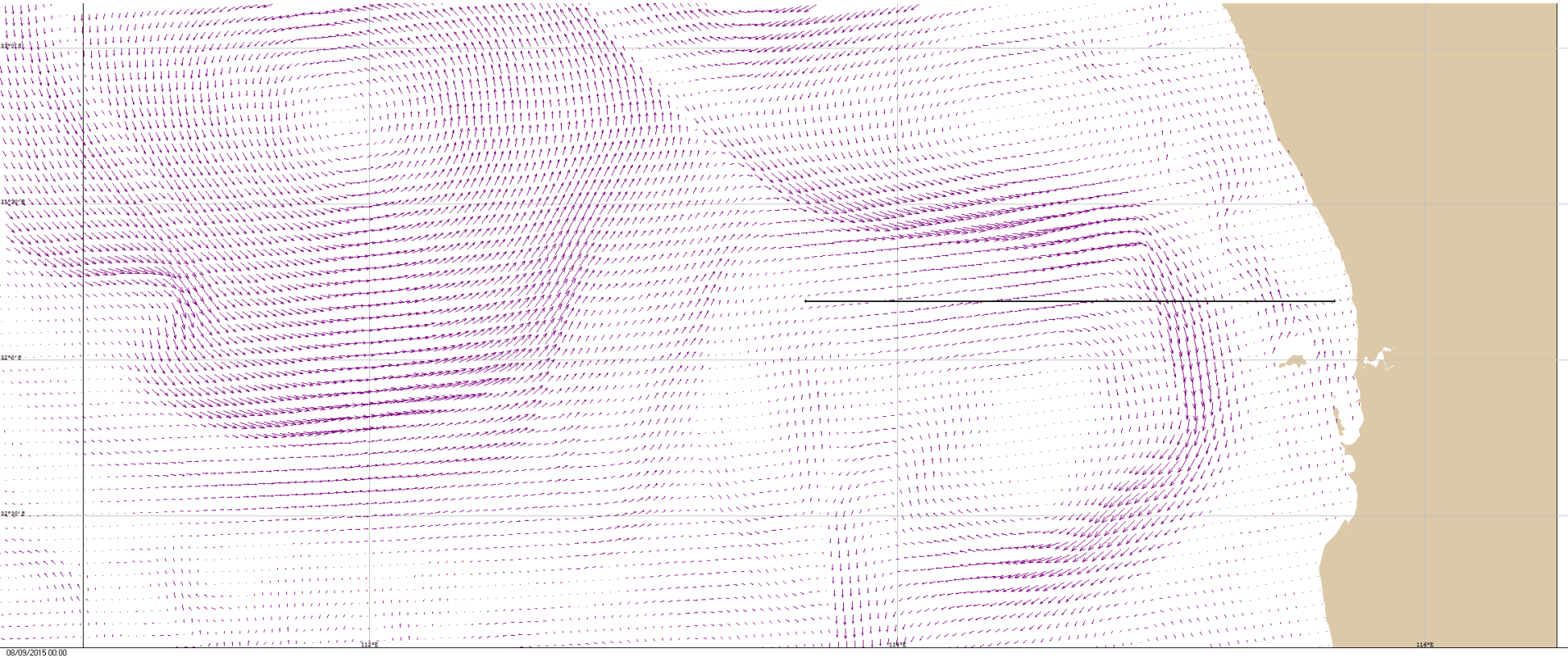




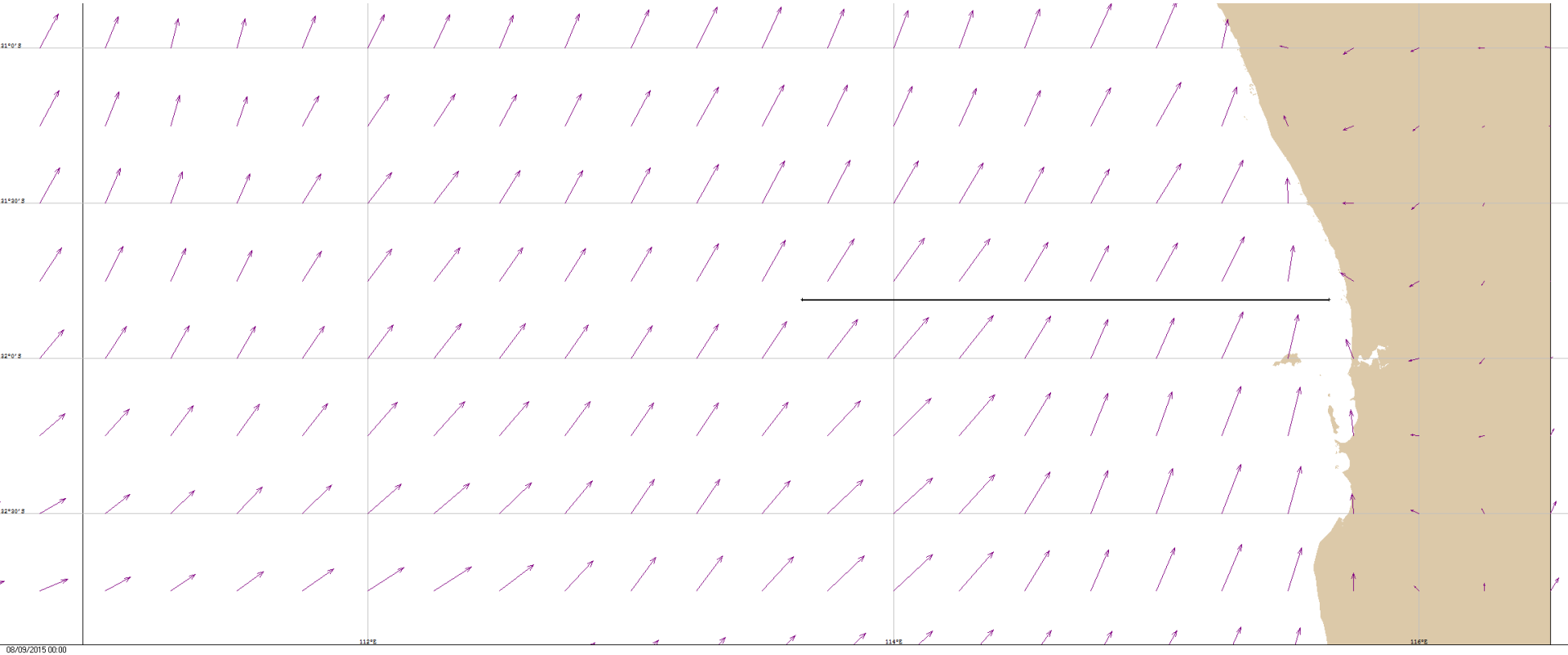
Demo: initial conditions



Demo: advection by currents



Demo: advection by wind



Demo: advection by wind/currents

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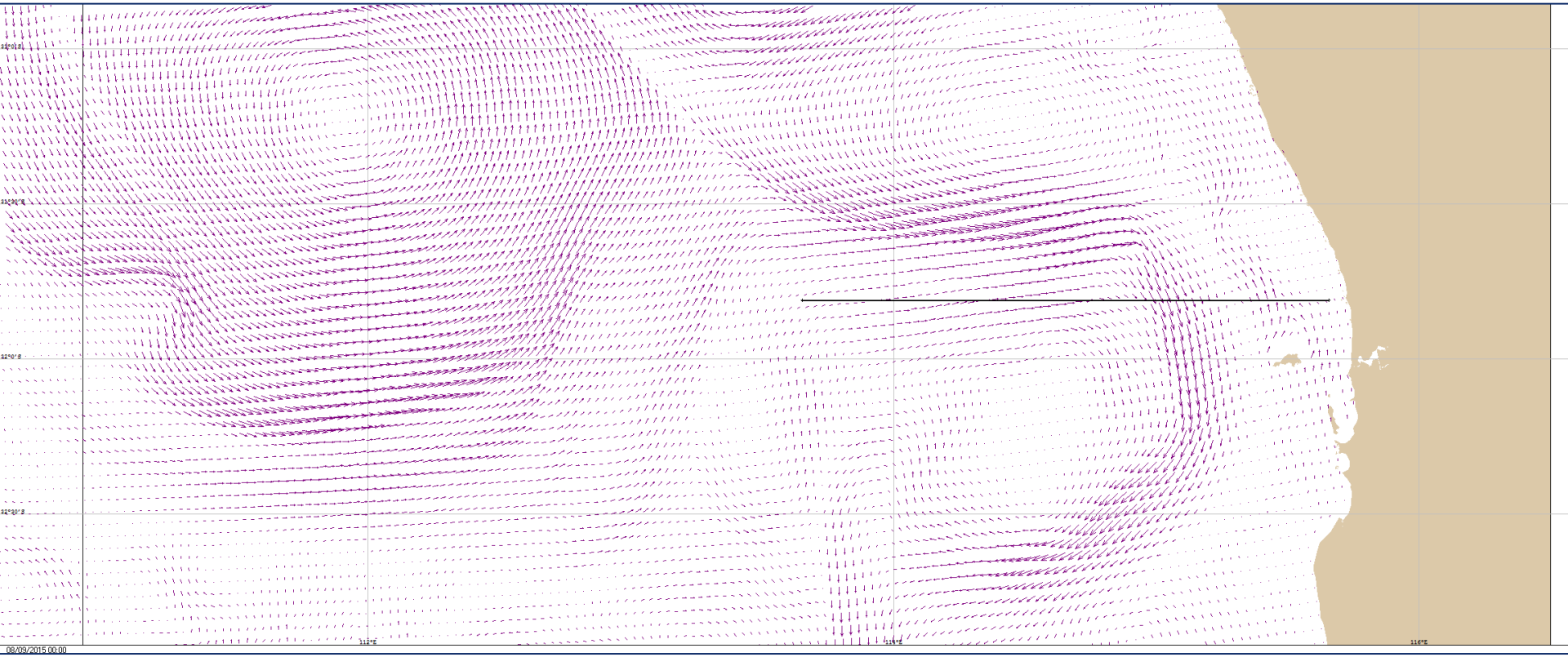

Demo: advection by wind/currents

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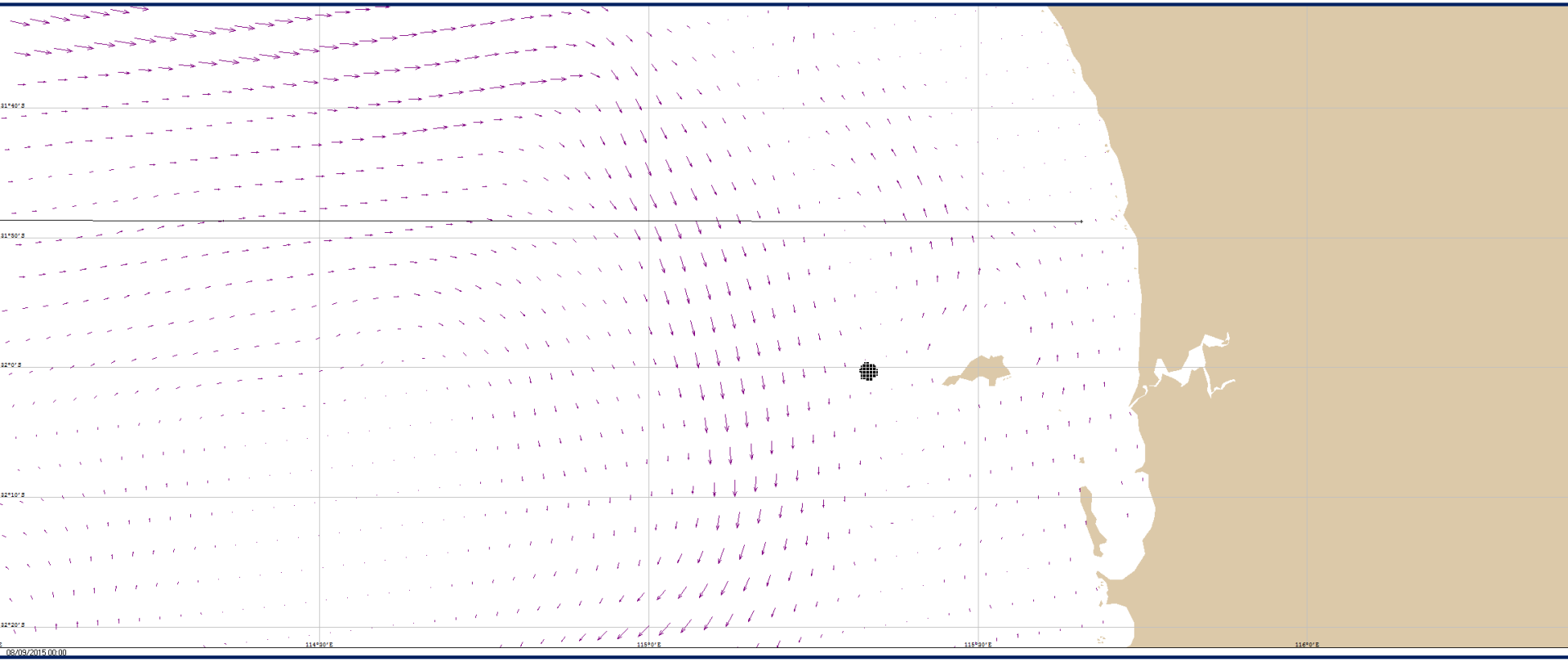

Demo: advection by wind/currents

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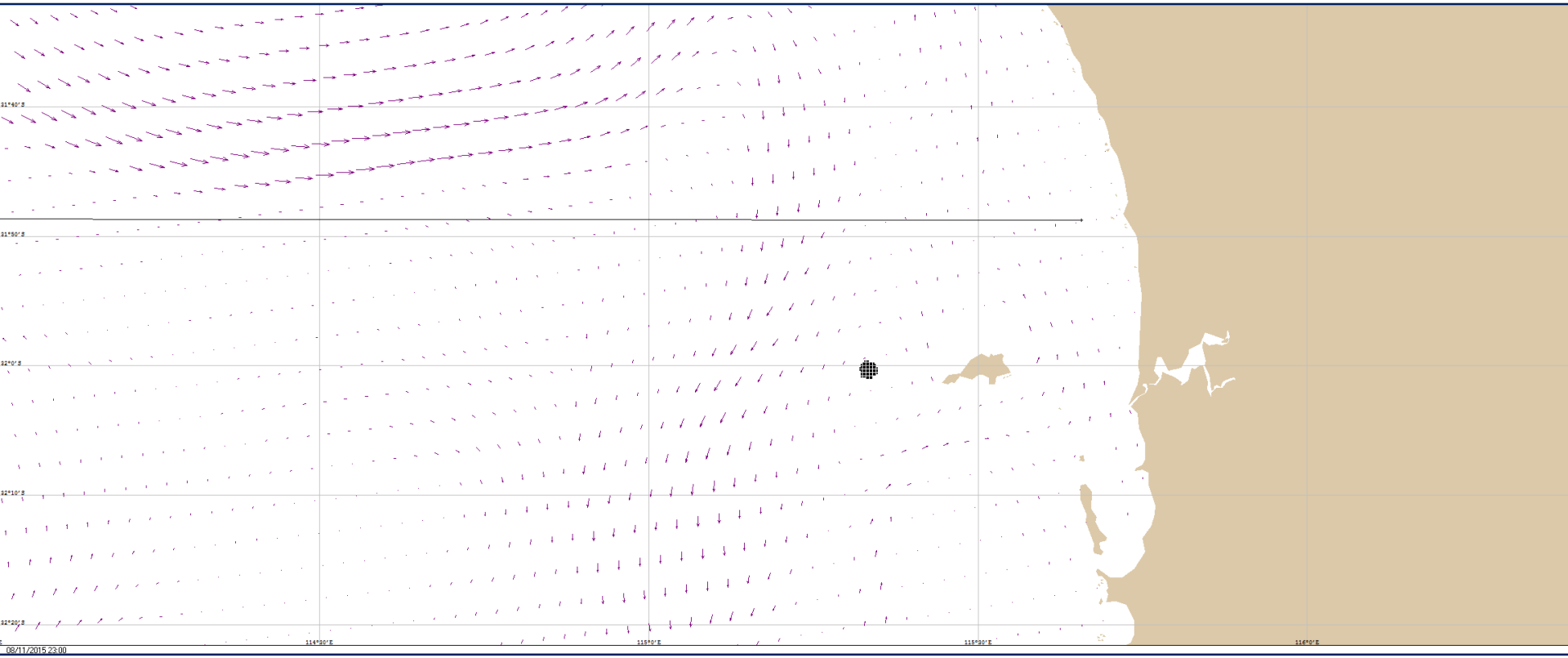

Demo: advection by wind/currents

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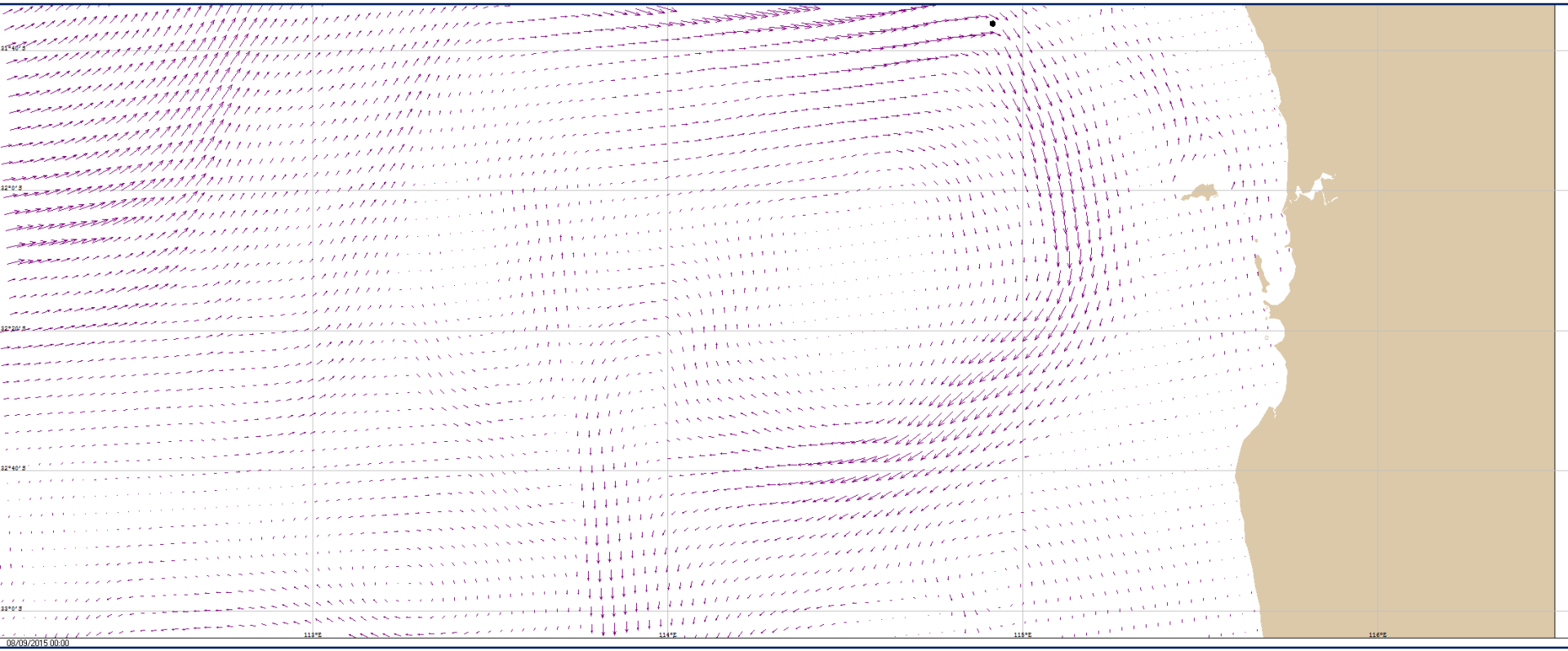
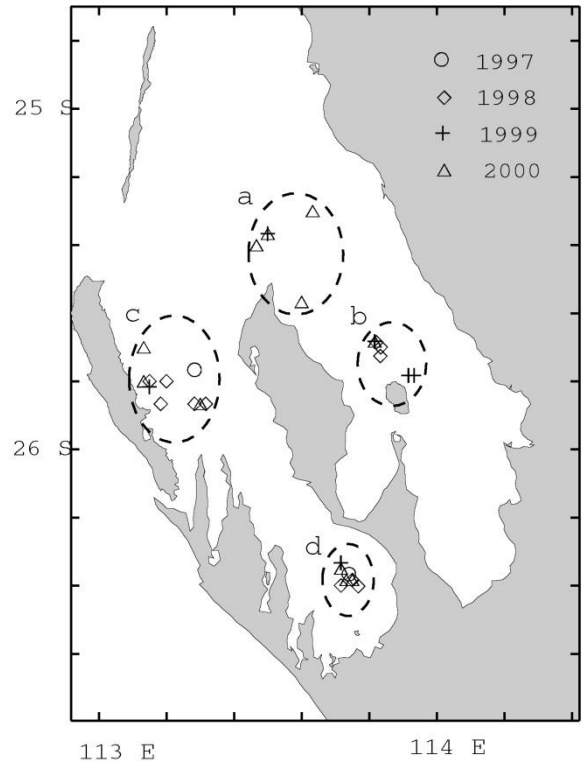
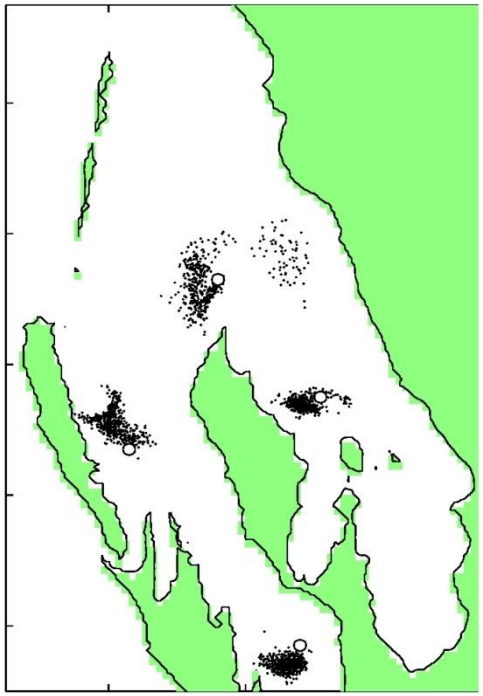
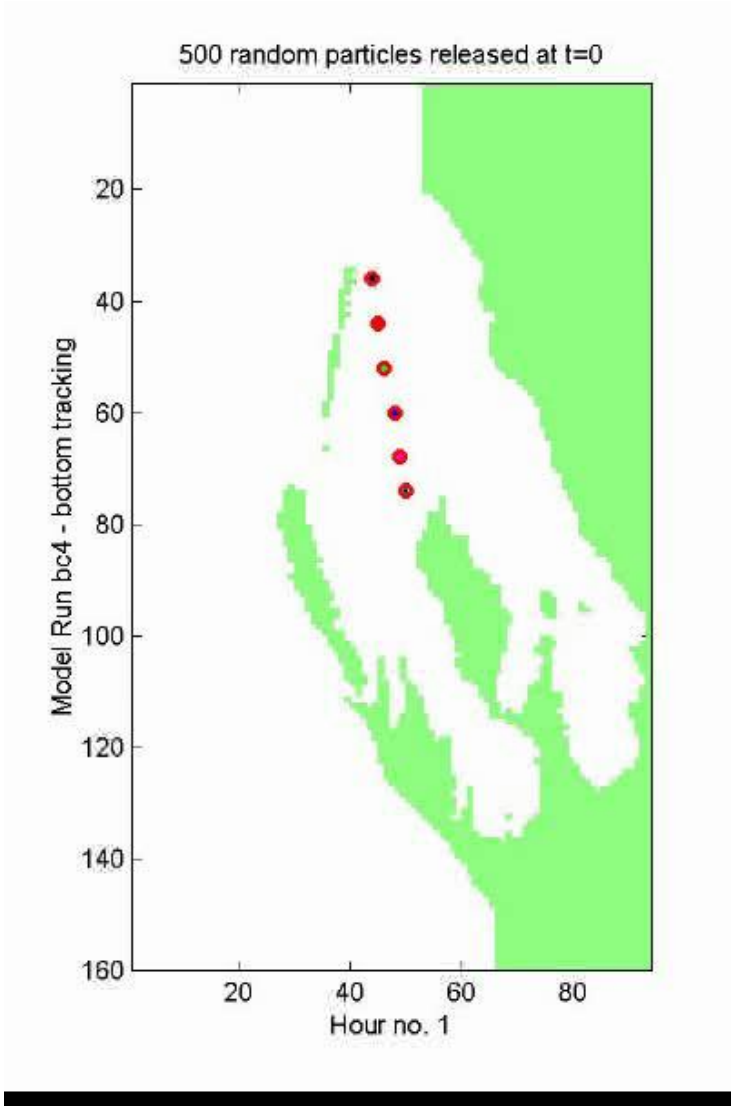


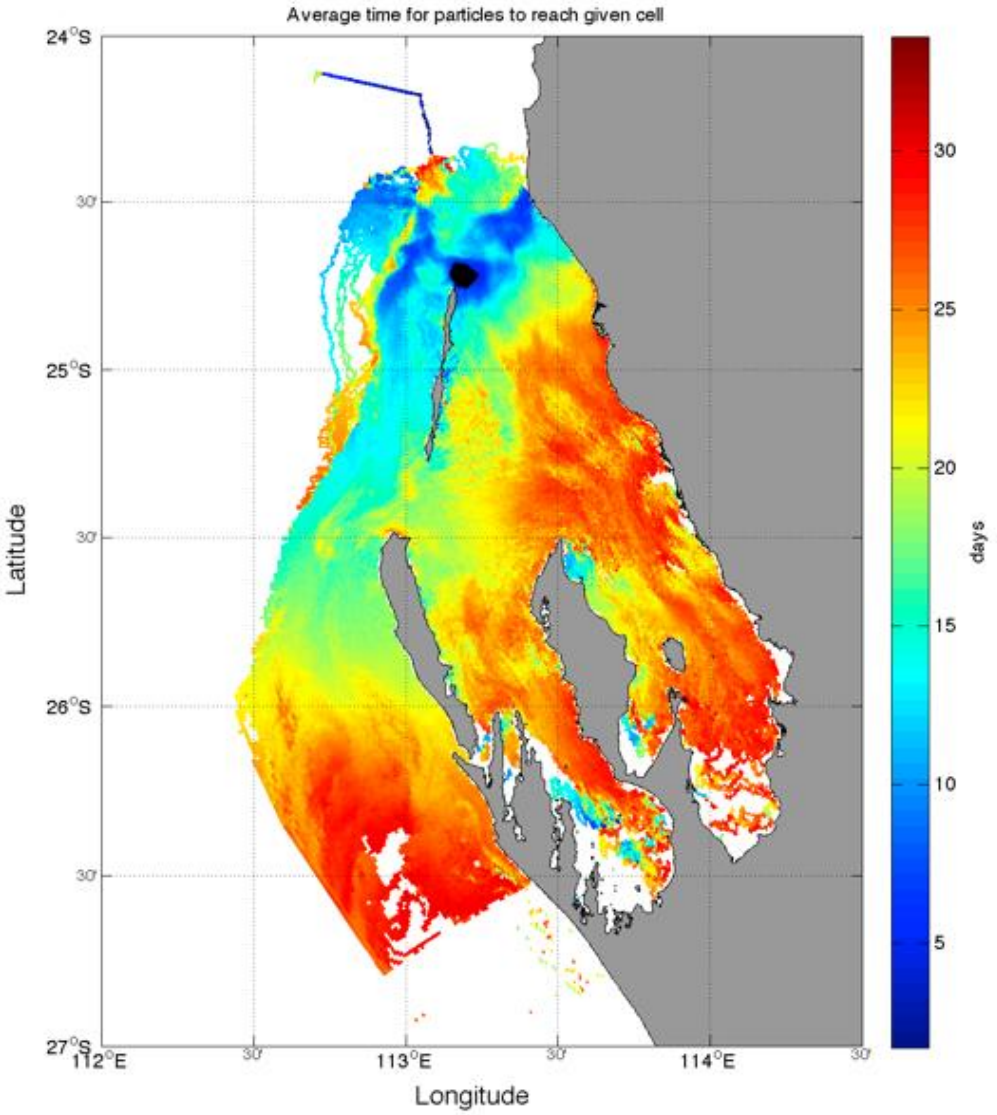
Shark Bay: 2000



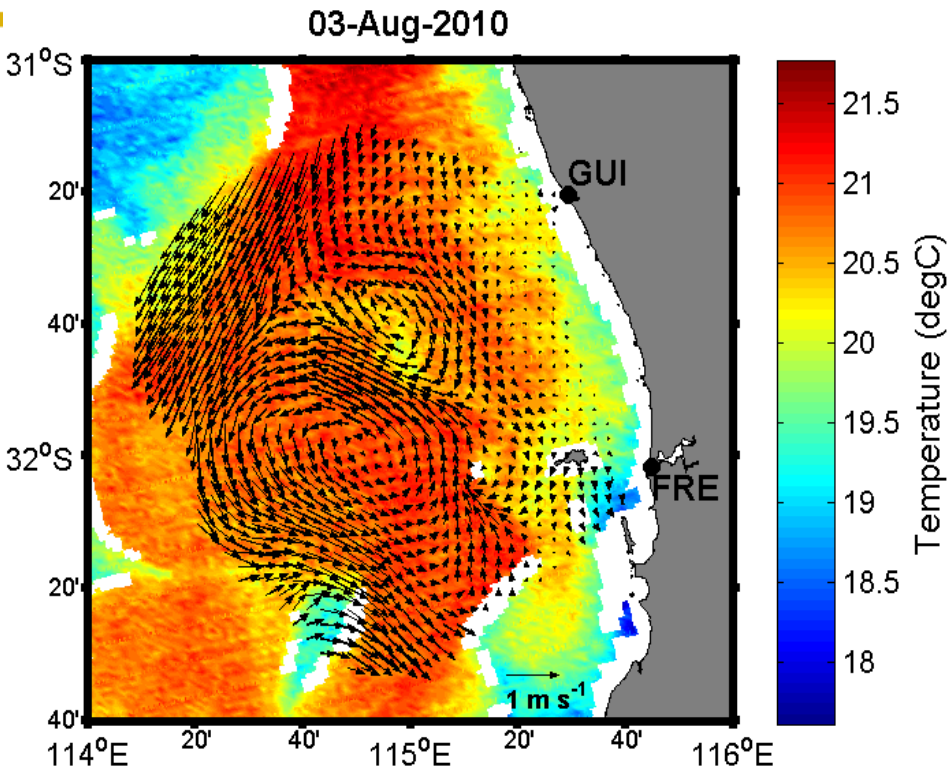


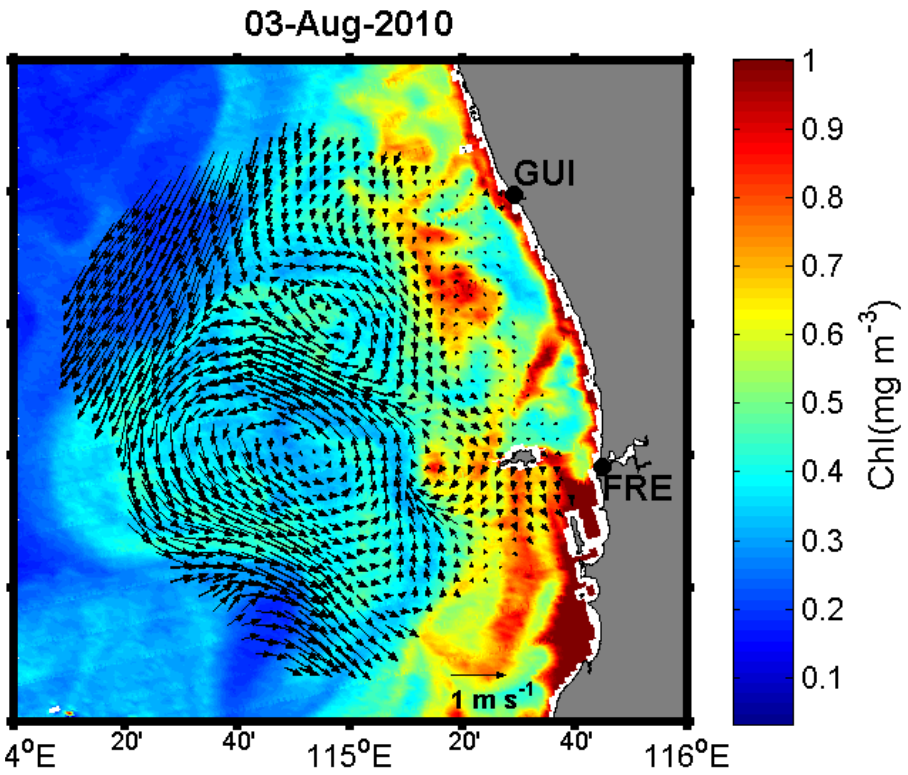


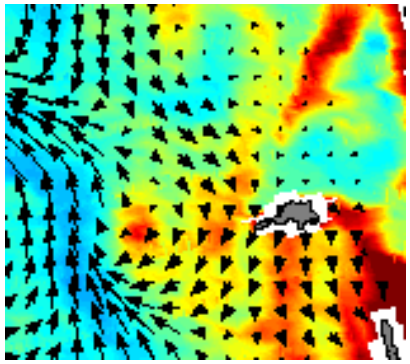
Particle Tracking ('Age')



Peddies: 3 August 2011

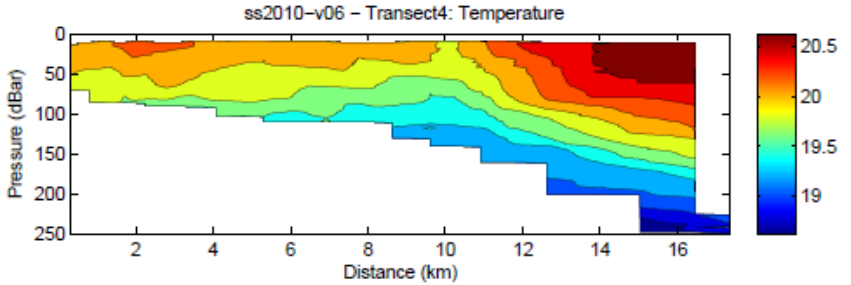


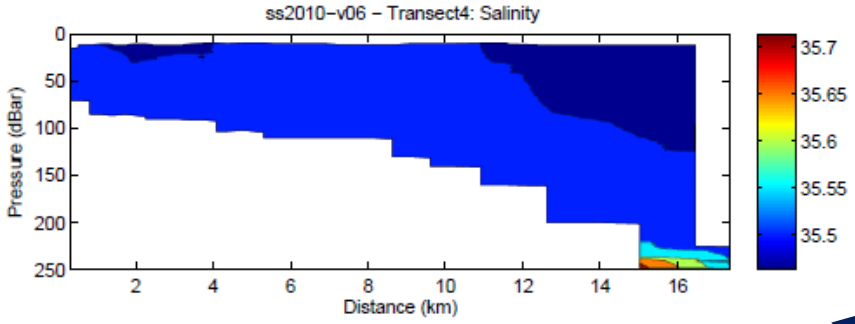


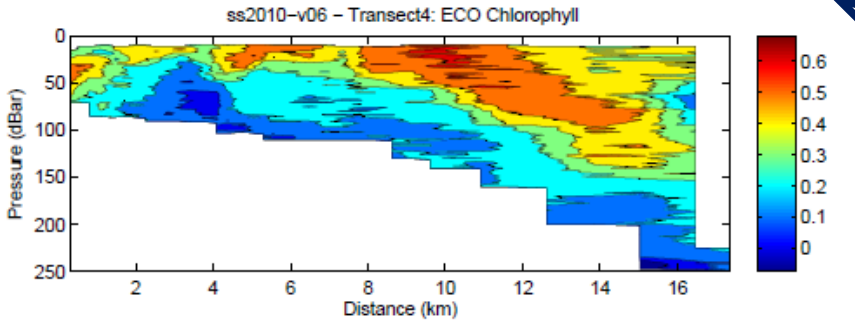


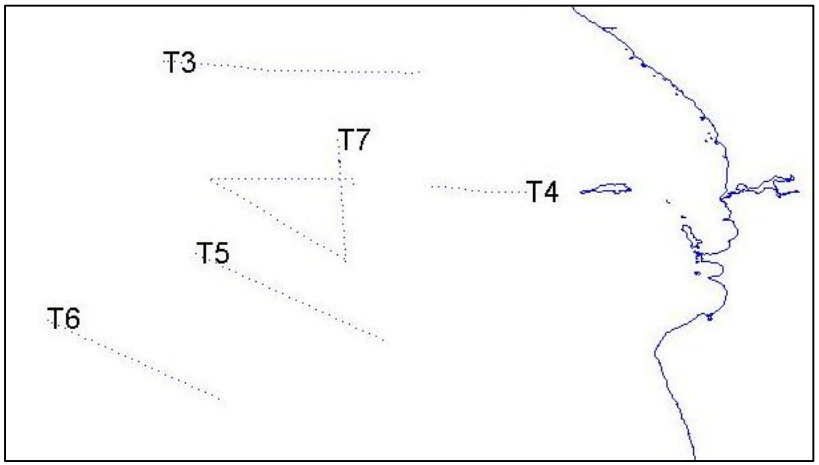
Peddies:
Petite eddies (diameter < 25km)

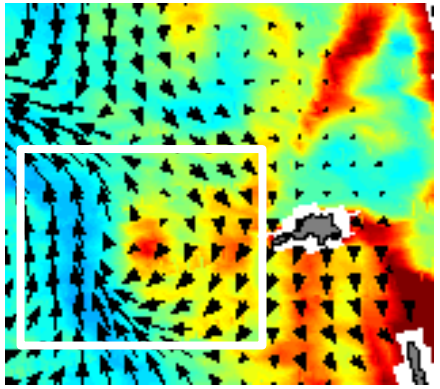
Peddie – 3 August 2010





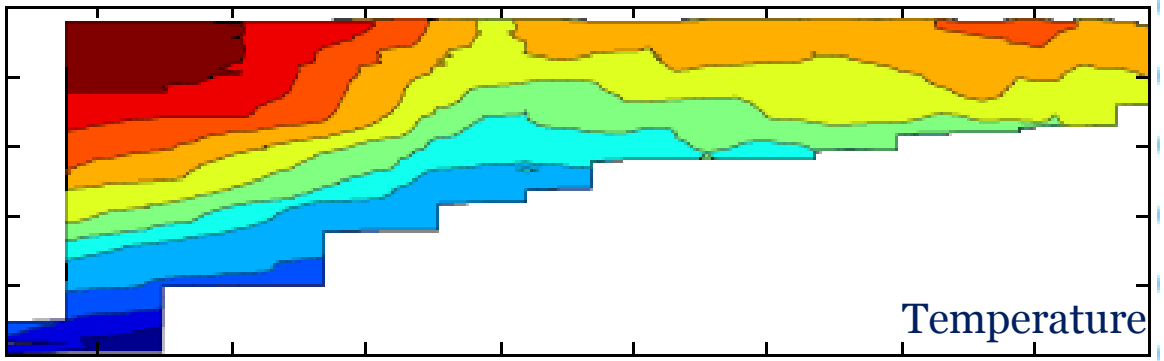


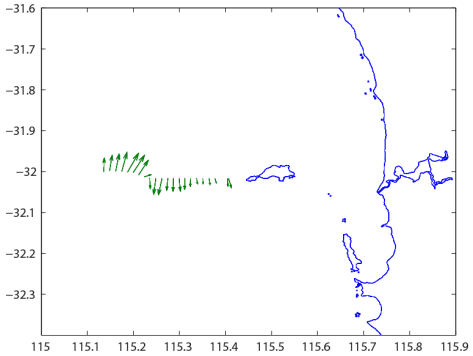


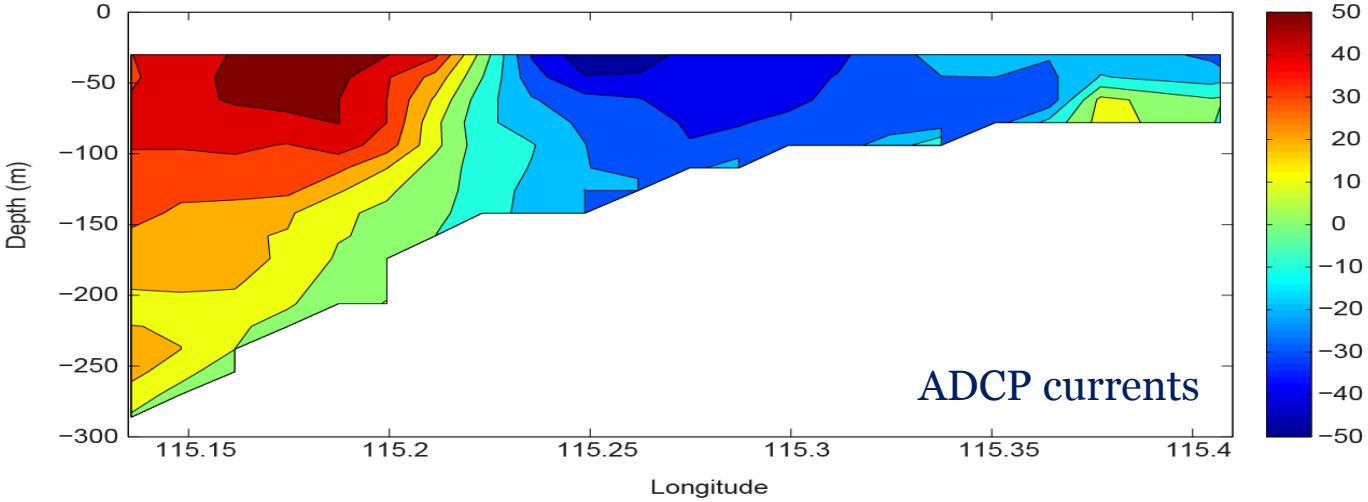


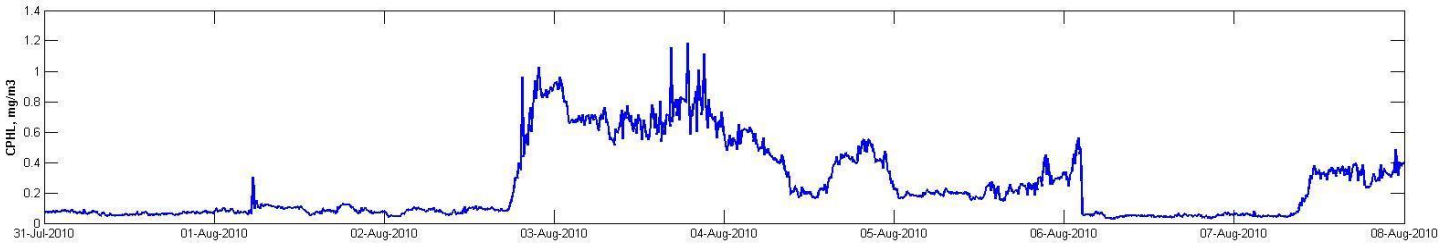
Southern Surveyor Voyage

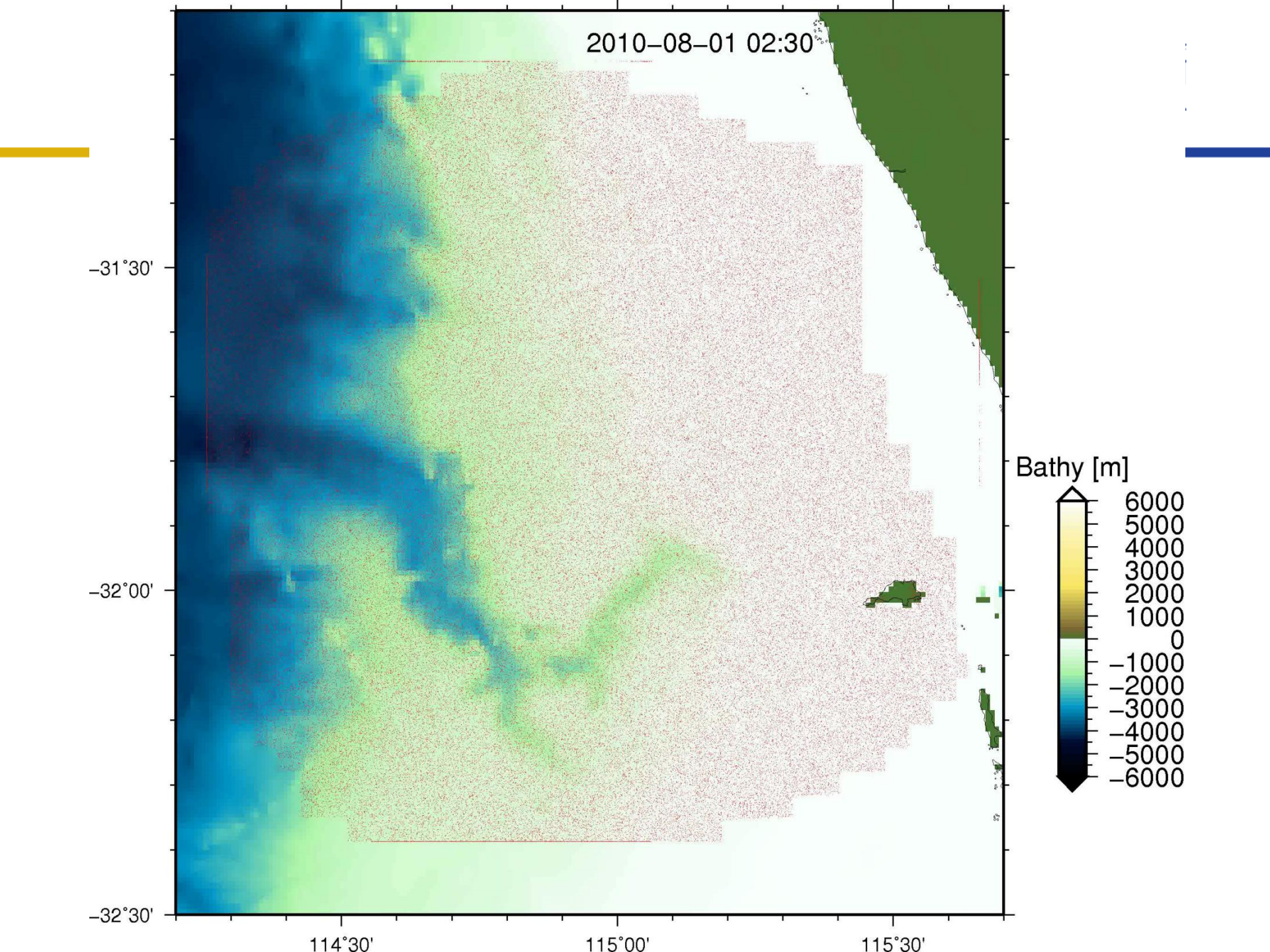
Peddie – 3 August 2010










2010–08–01 02:30
–31°30'
–32°00'
–32°30'
114°30'
115°00'
115°30'
Bathy [m]
6000
5000
4000
3000
2000
1000
0
–1000
–2000
–3000
–4000
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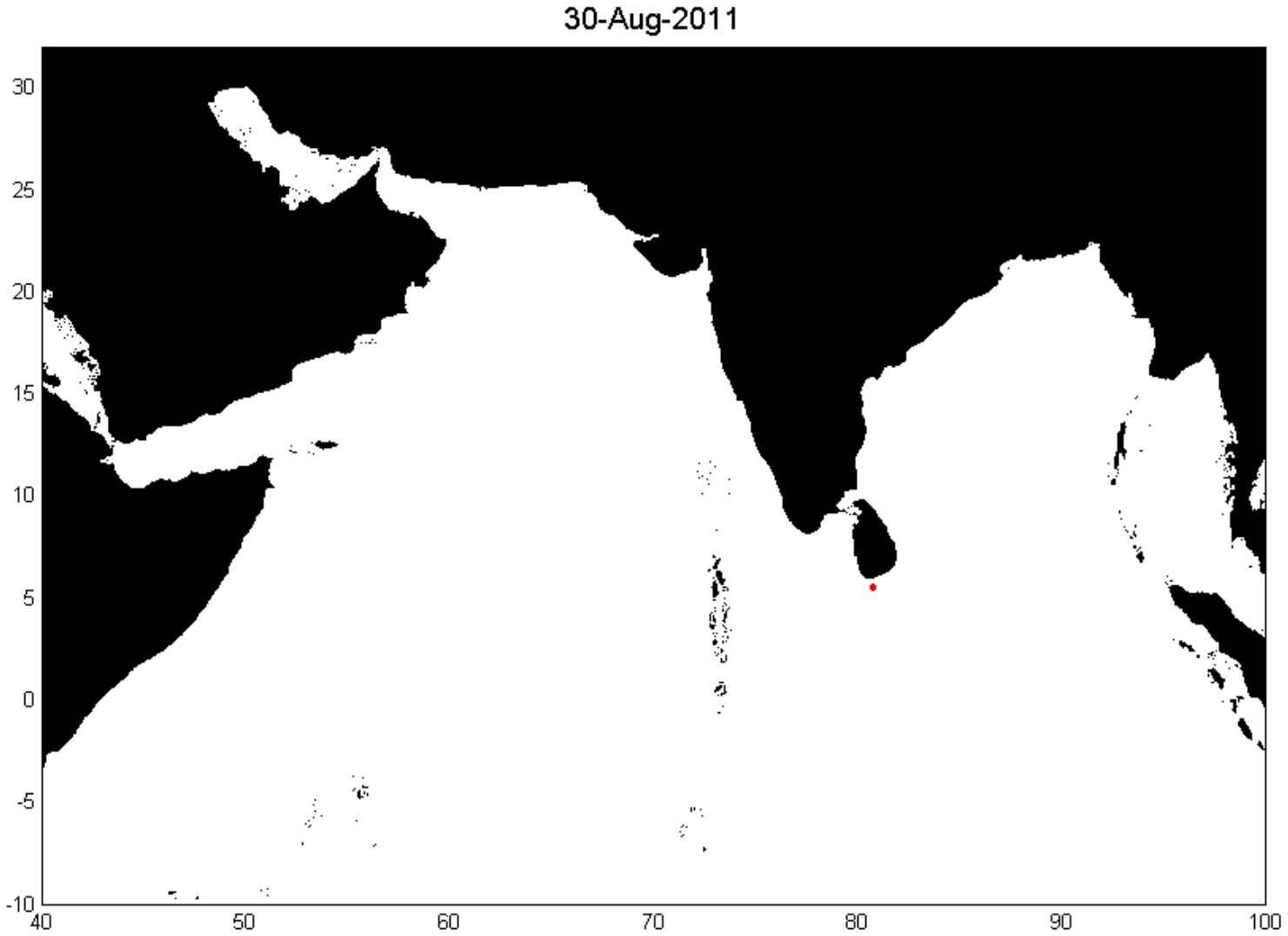
–6000

Northern Indian Ocean

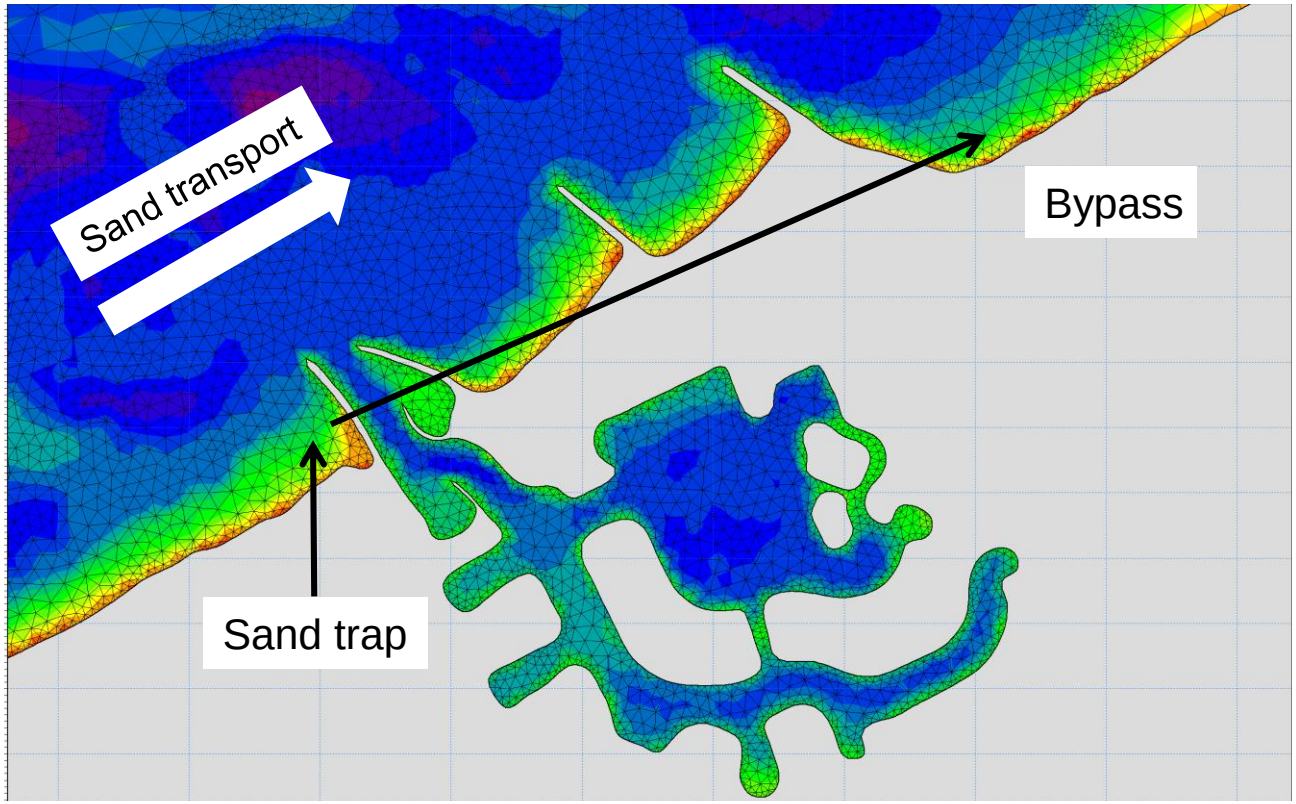


Port Geographe

Location & Concept Plan

PORT GEOGRAPHE CONCEPT PLAN

Location & Concept Plan



Port Geographe: 24 Aug 2015

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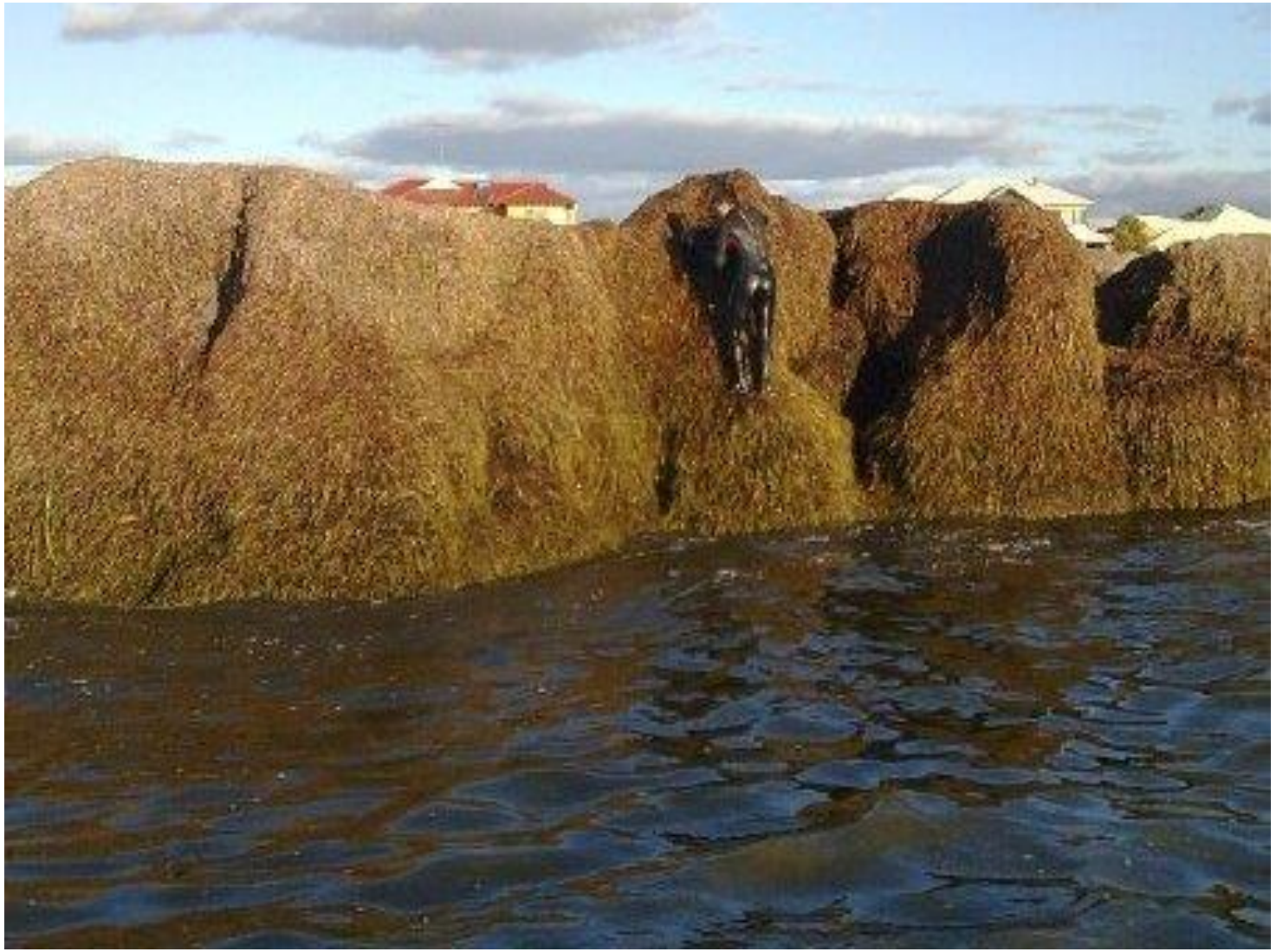
Location & Concept Plan

Port Geographe: August 2011

The Problem

The Problem



Oldham et al., 2010

Seagrass Wrack

Wrack Dynamics

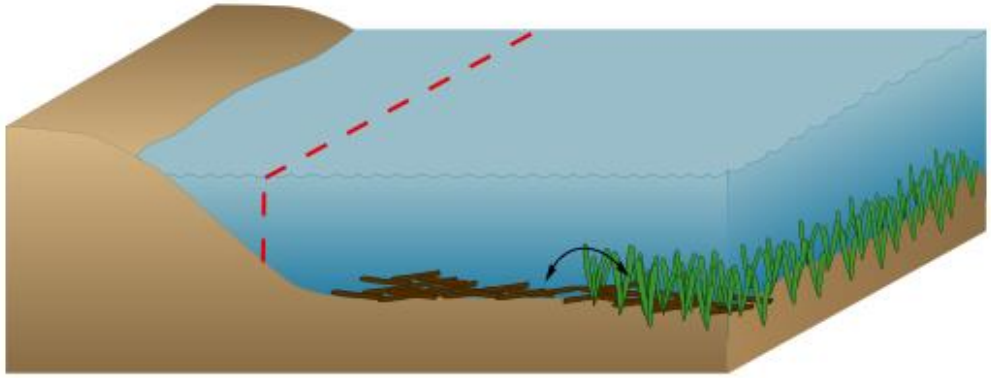
No detailed information available on wrack dynamics

Observations: Wrack present on beaches from May to October
Naturally 'disappear' in October/November

Hydrodynamics: Mode of transport (suspended/bedload ?)
Settling velocity ?
Critical shear stress ?

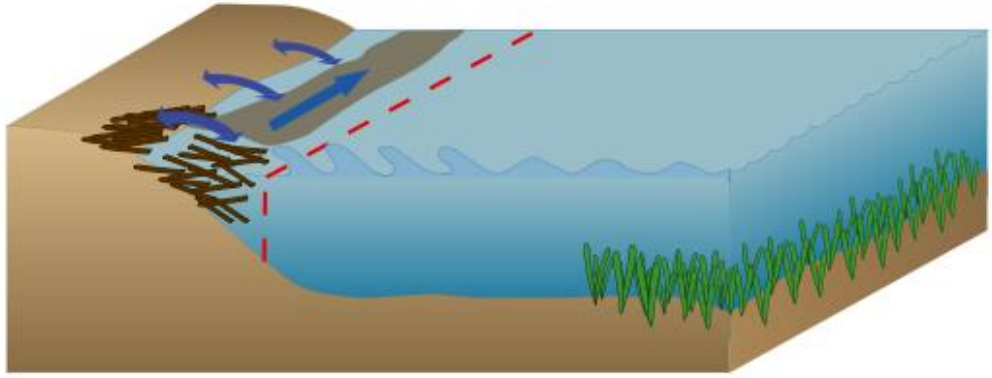
Stage 1 Study:
Oldham C.E., Lavery P., Pattiaratchi C and Chiffings A. (2010) Research Study into Seagrass Wrack Movement in Geographe Bay

Wrack 'life-cycle'



'Summer' - quiescent period.

Wrack accumulates offshore in meadows and adjacent un-vegetated areas.



'Winter' - storm period.

Wrack is moved into surf-zone & beach. Whilst in the surf-zone, subject to long-shore transport.

Late Winter/Spring.

Wrack is removed from naturally from the beaches.

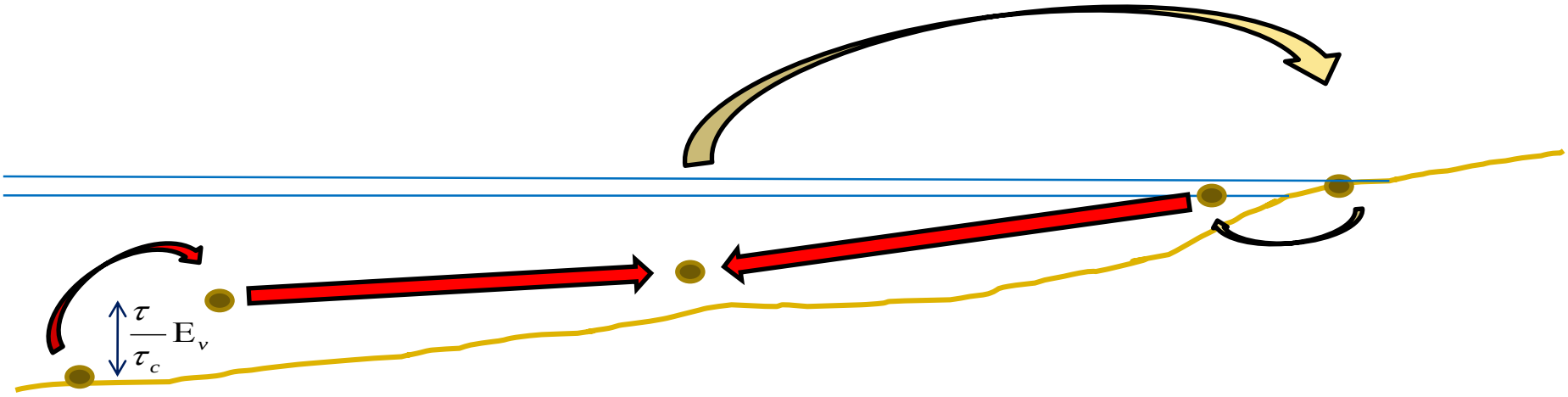
Particle conceptual model

Resuspension

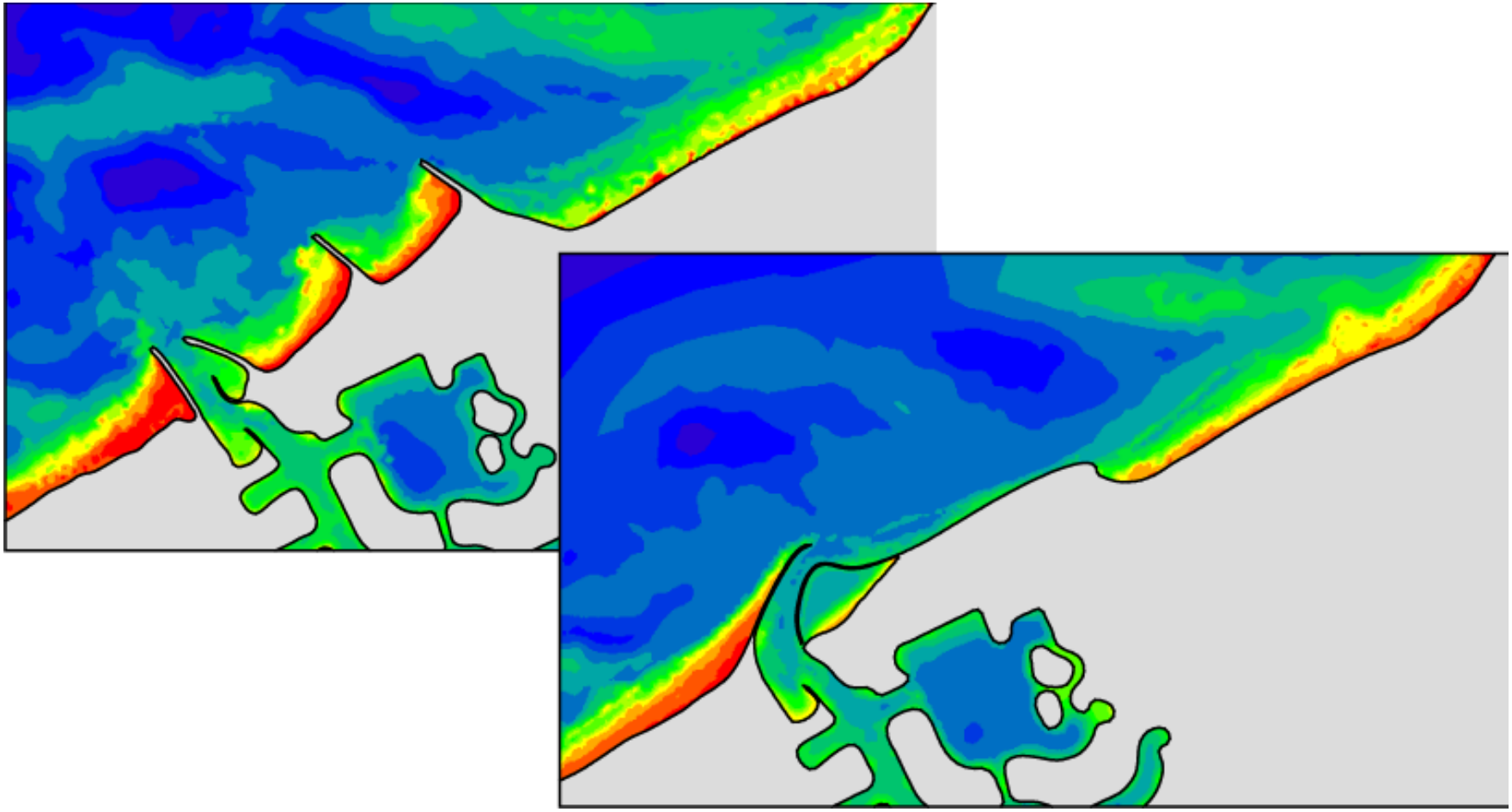
Transport (Currents, Stokes drift, Diffusion)
Deposition (when $z_p <= z_o$)

Beach accumulation (τ_c increase and $w_s=0$)

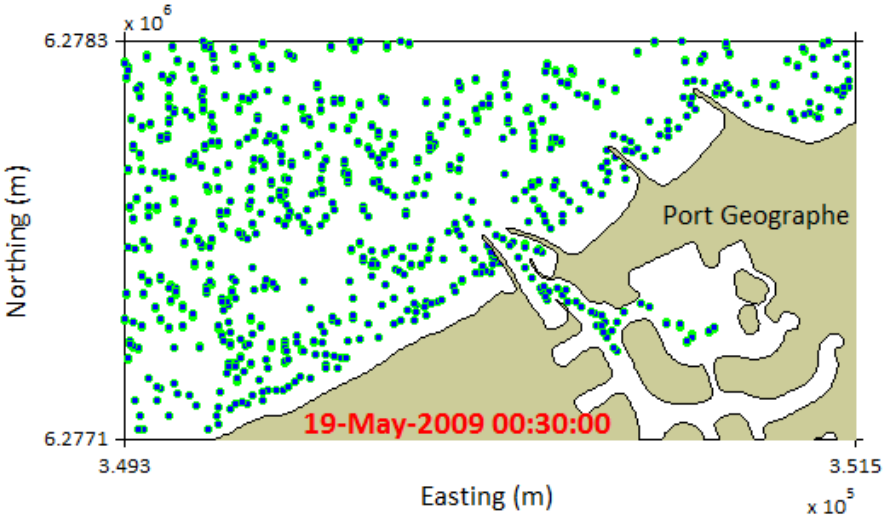
Resuspension from the beach (w_s decrease back to initial)

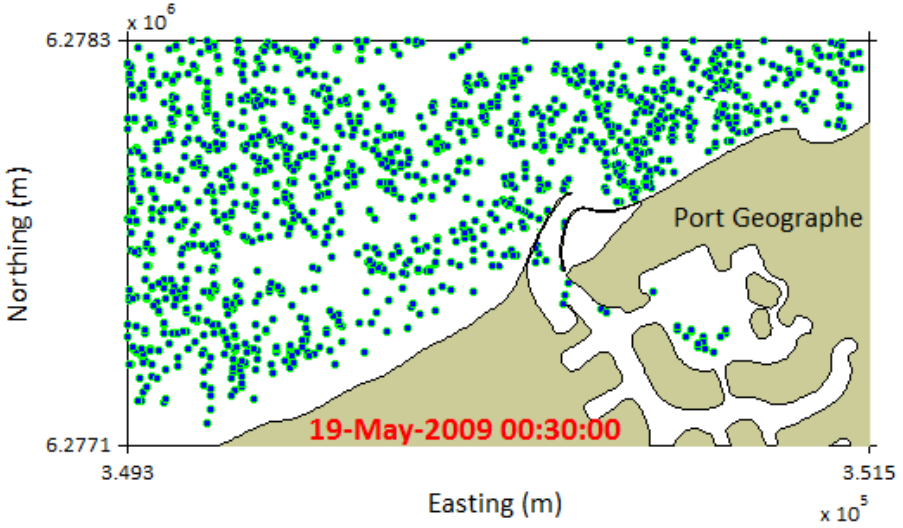


Bathymetry: existing/proposed



Wrack transport



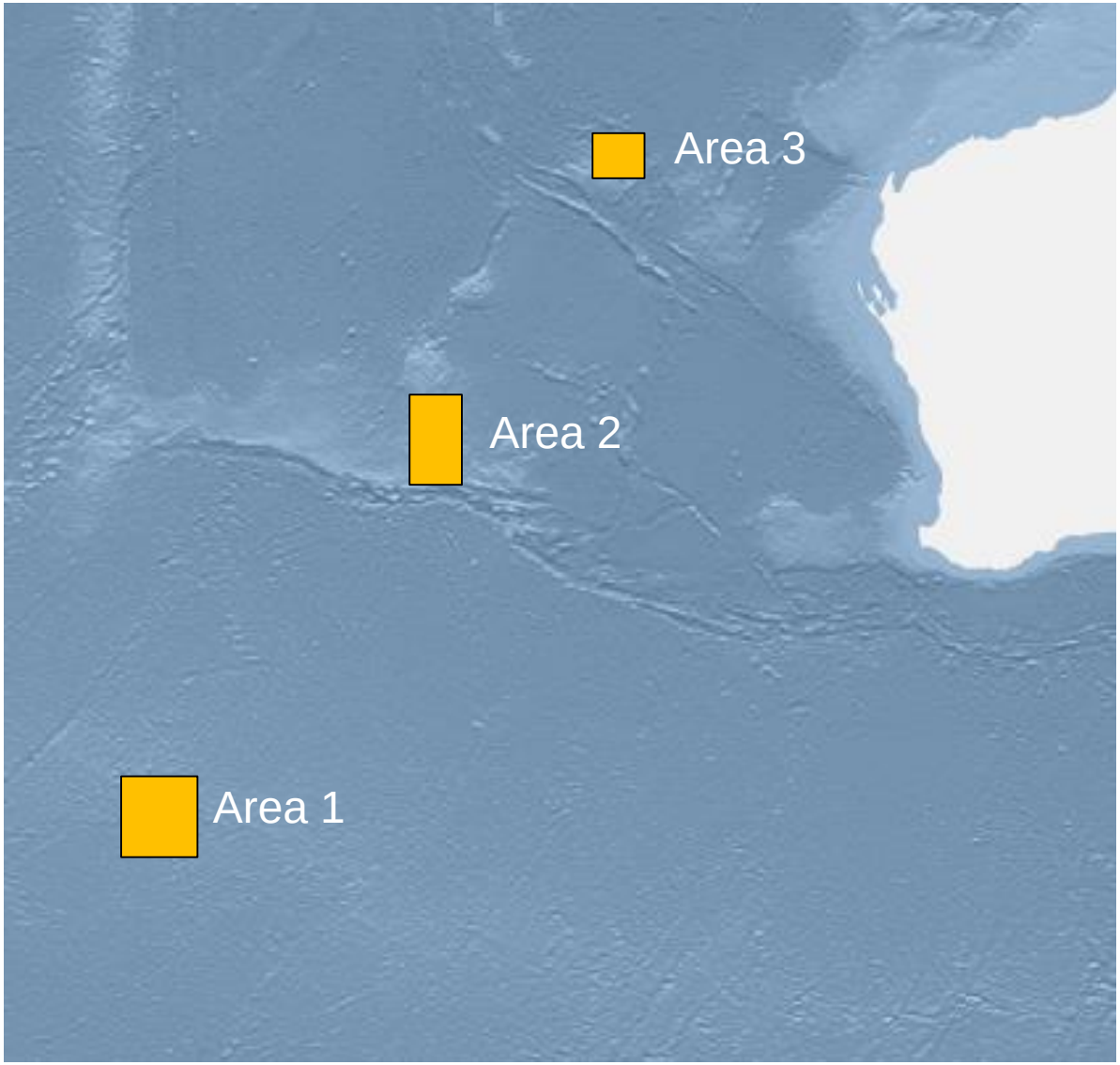


Post construction

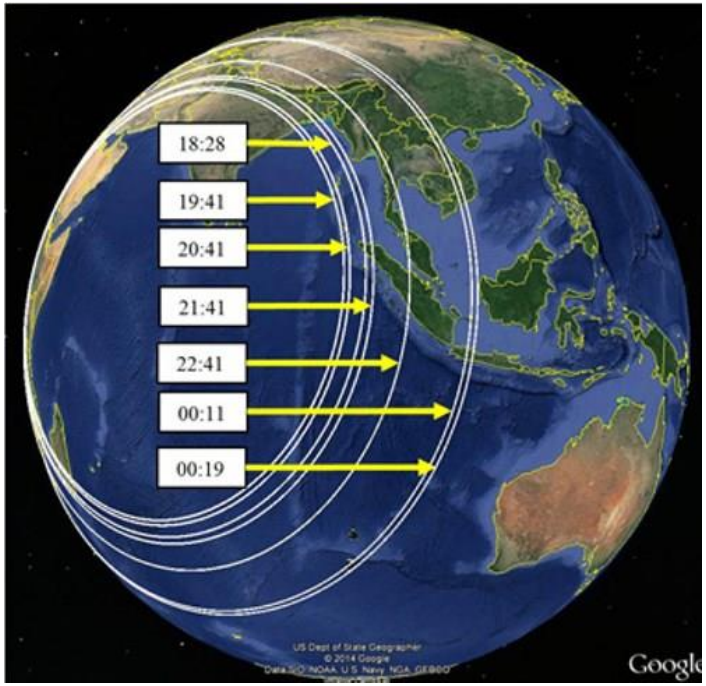
Construction completed in June 2014: ~ $27 million

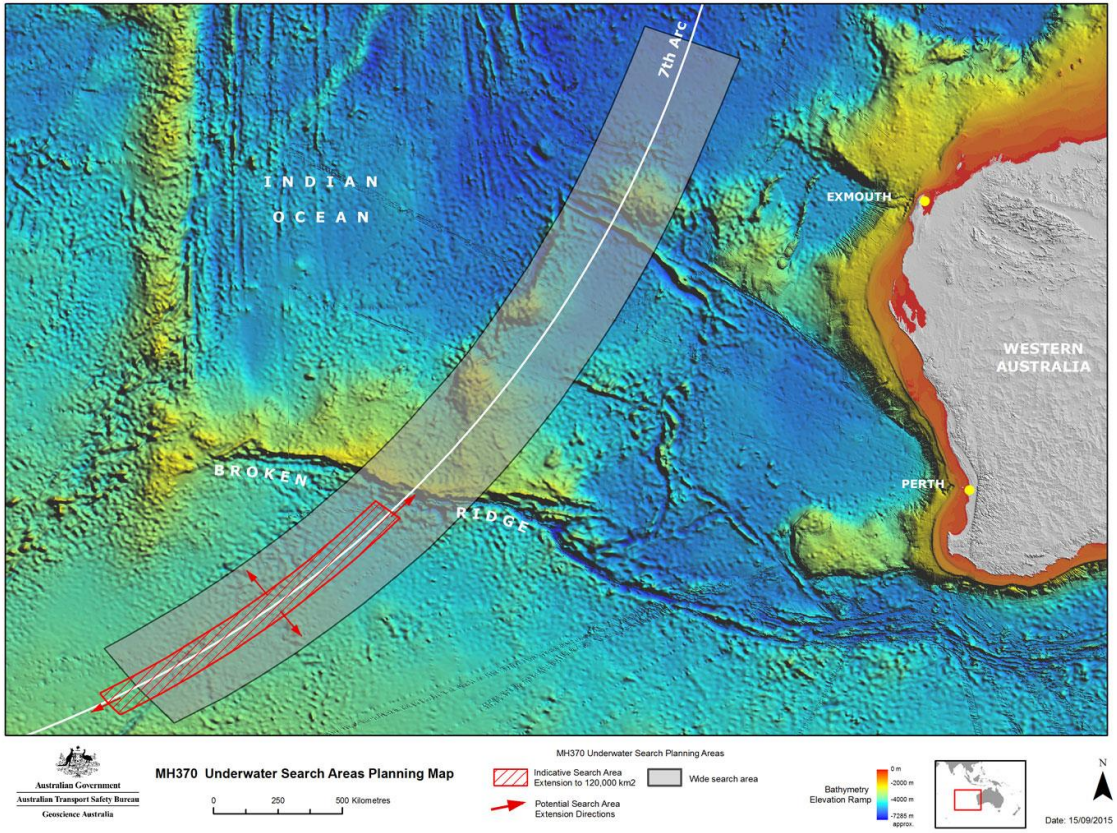
Search for MH370

MH370: initial search areas



Search for MH370





Predictions: August 2014

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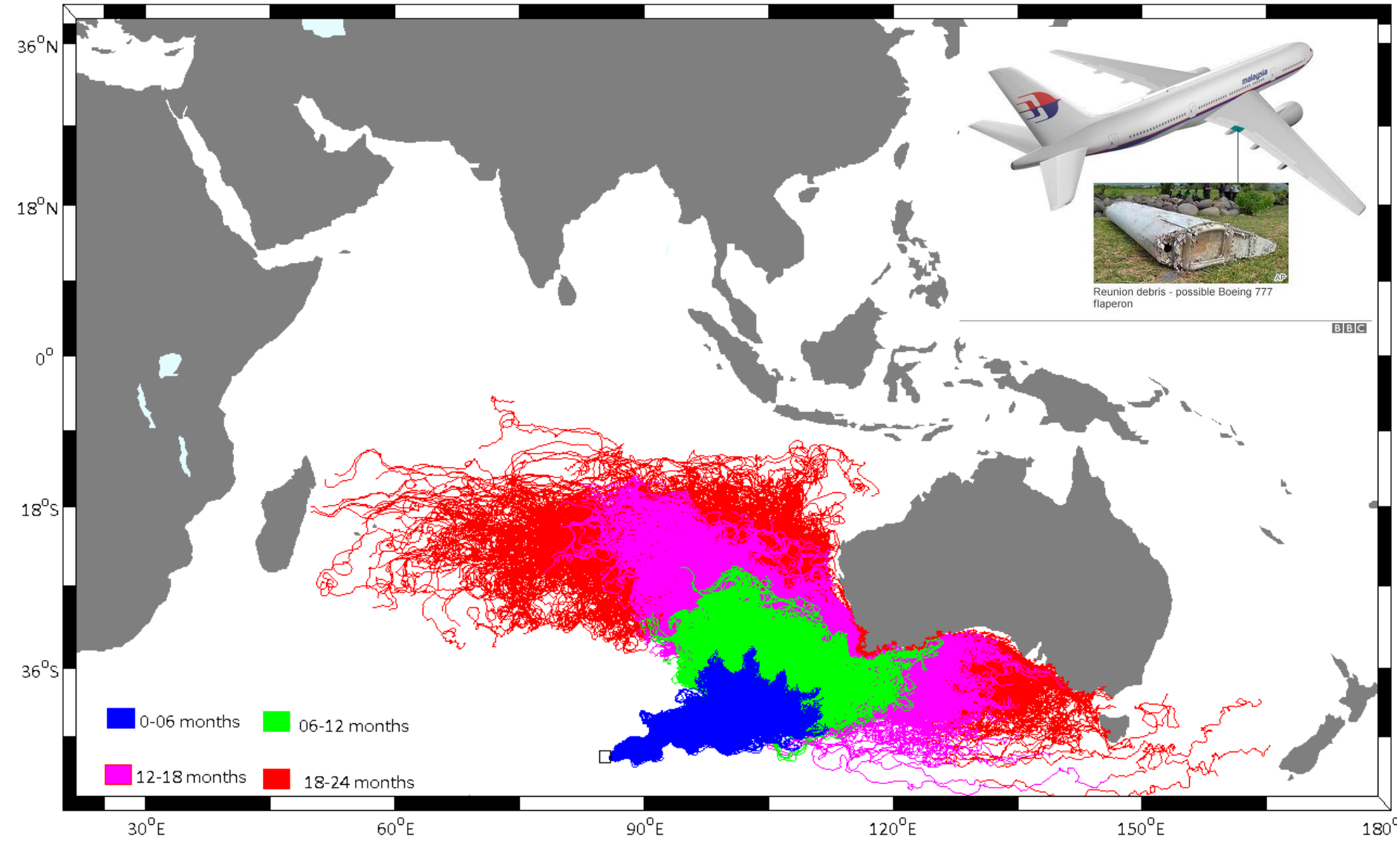
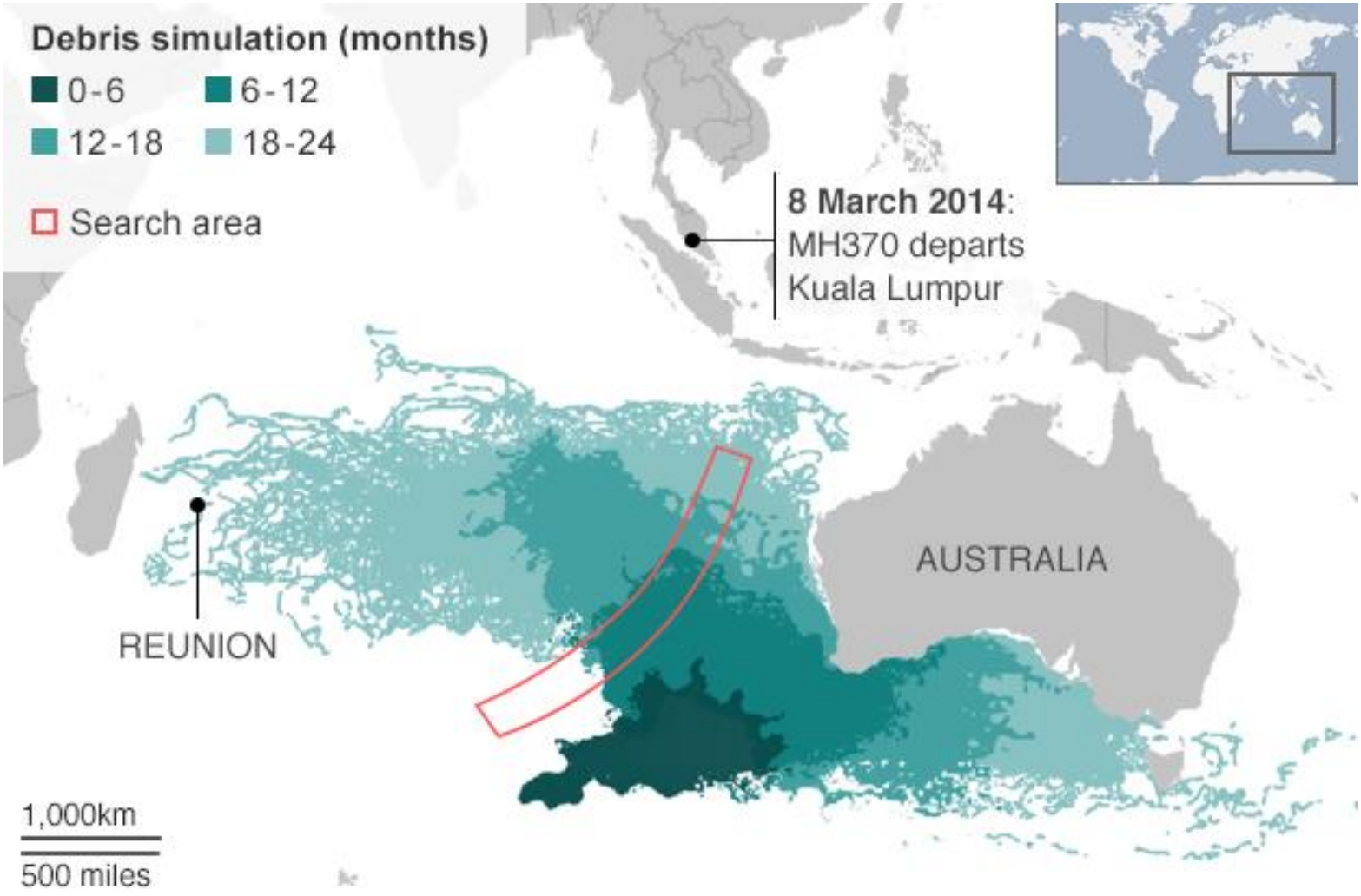


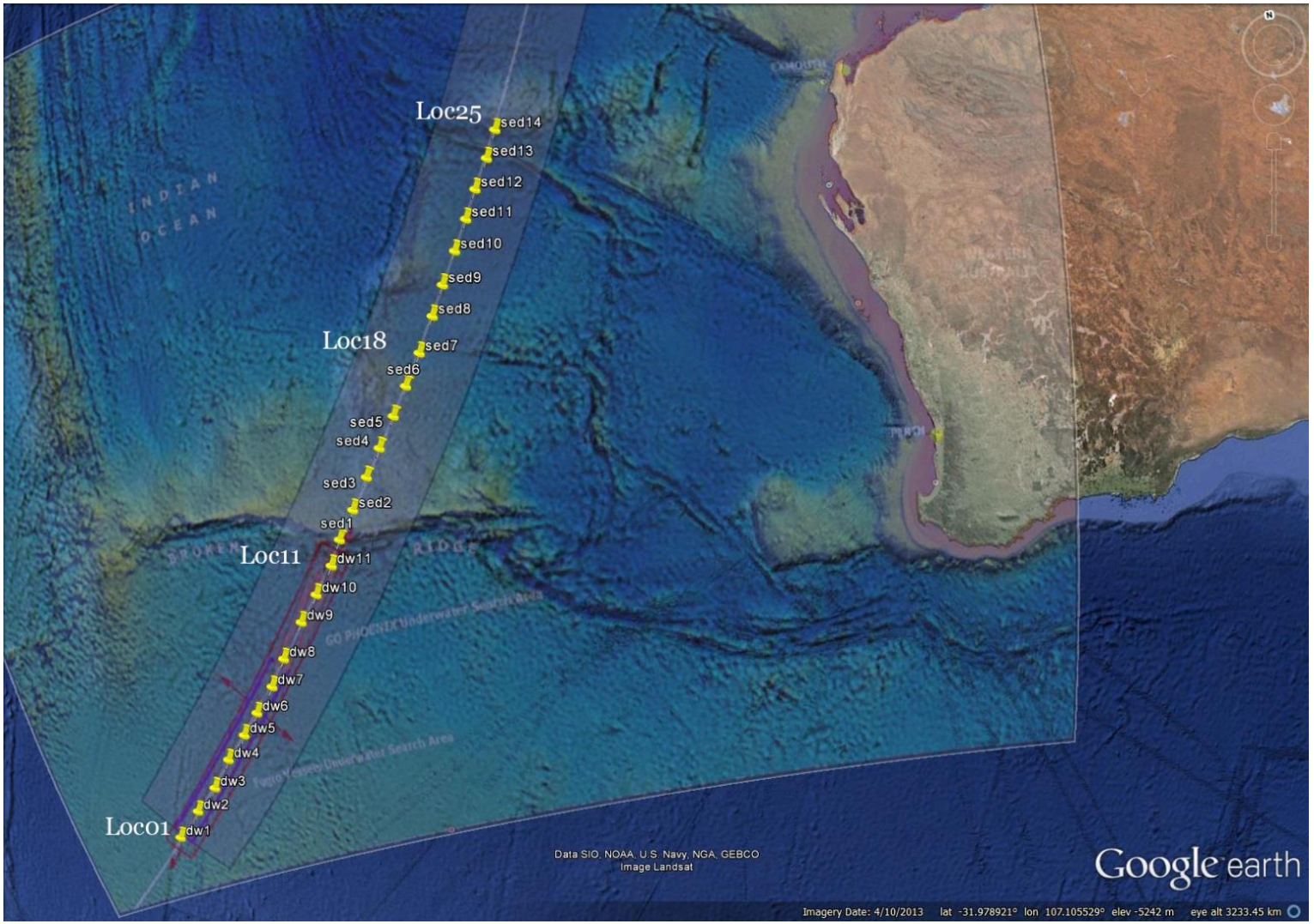
Predictions: August 2014



Source: Professor of Coastal Oceanography, Charitha Pattiaratchi
School of Civil, Environmental and Mining Engineering & UWA Oceans Institute

BBC

MH370: simulations



Pawsey Supercomputing Centre

MH370: simulations

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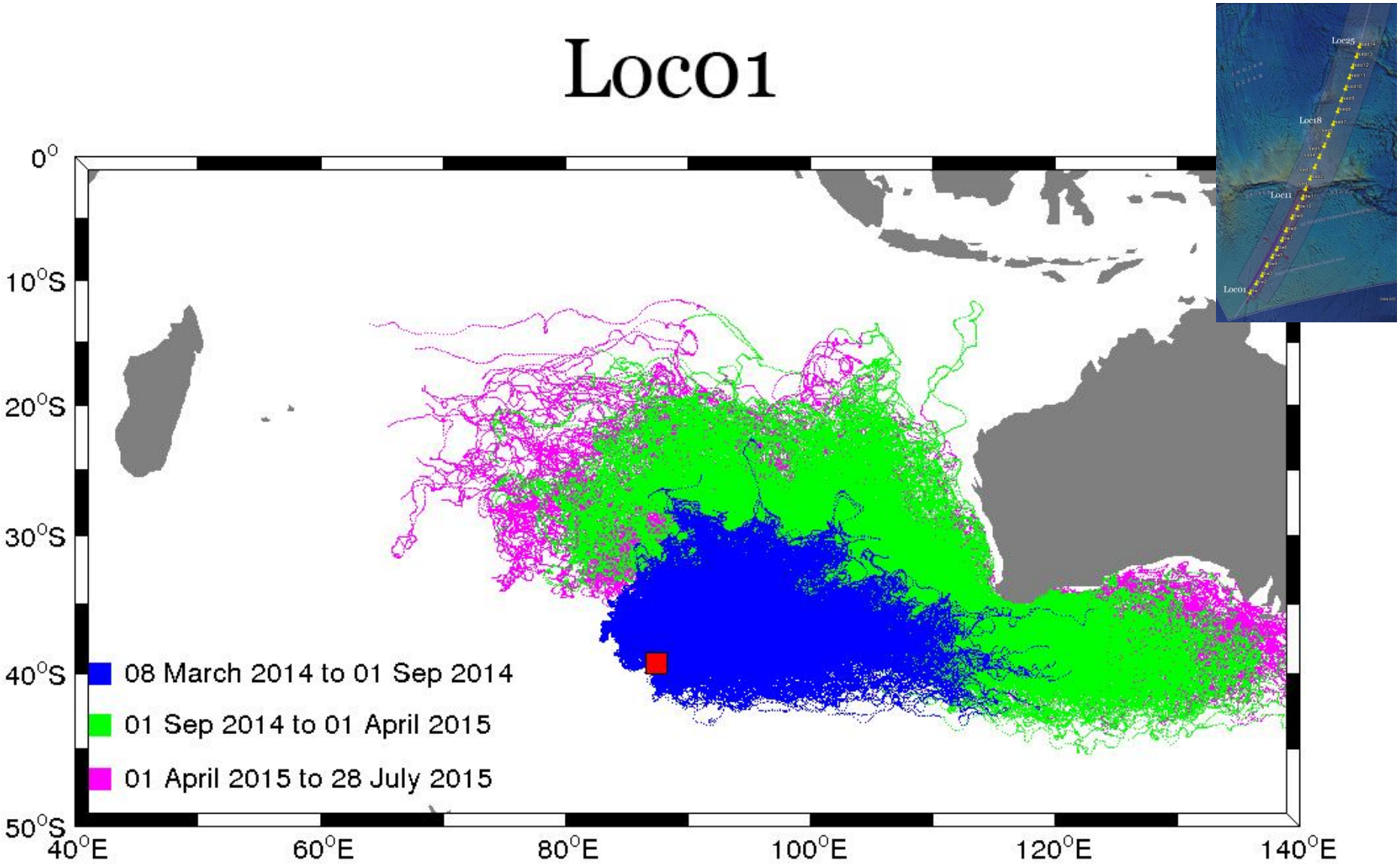
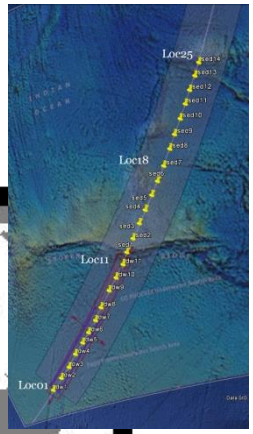


Loc11



0°
10°S
20°S
30°S
40°S
50°S
40°E
60°E
80°E
100°E
120°E
140°E

08 March 2014 to 01 Sep 2014
01 Sep 2014 to 01 April 2015
01 April 2015 to 28 July 2015

MH370: simulations

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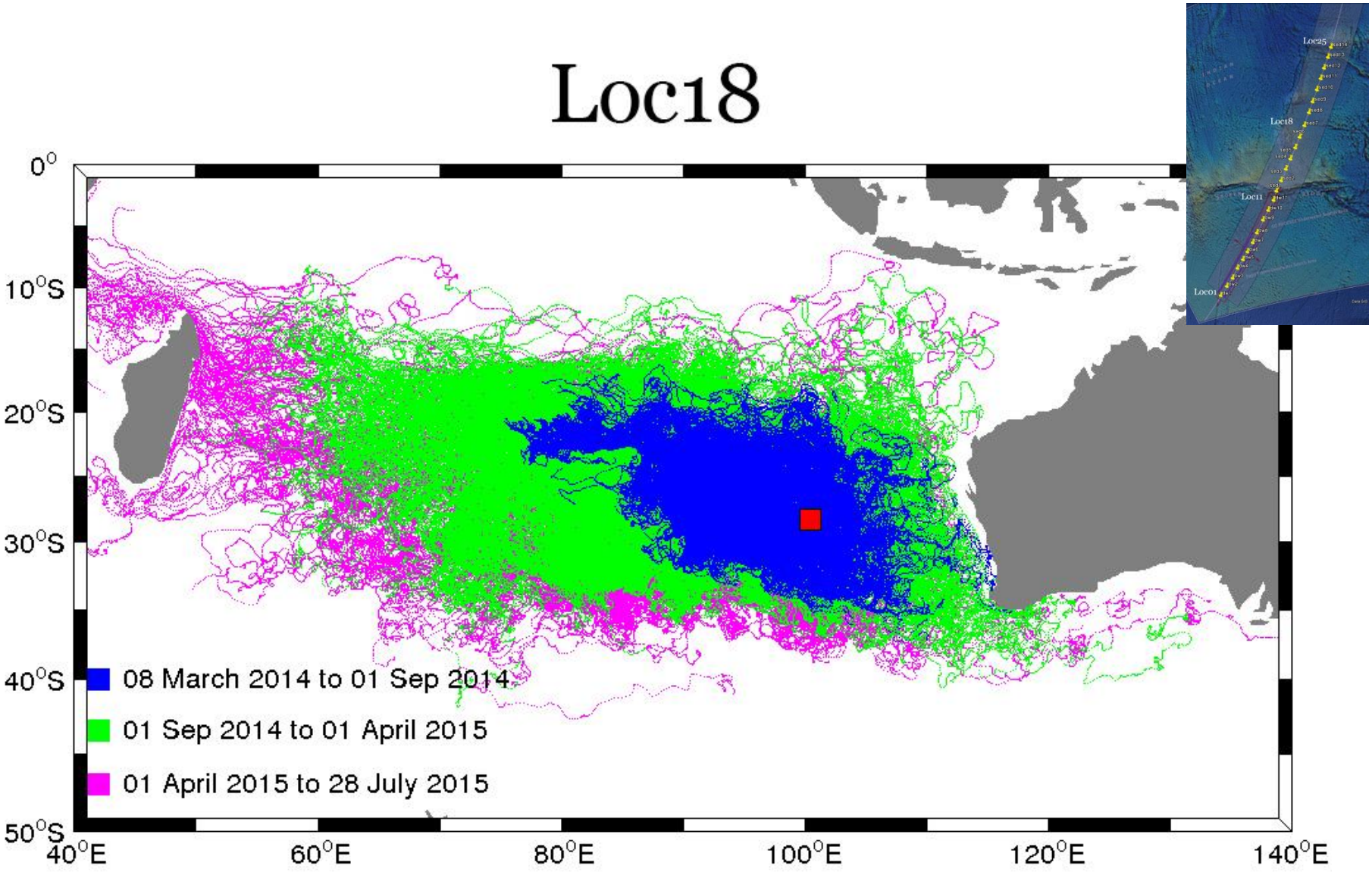
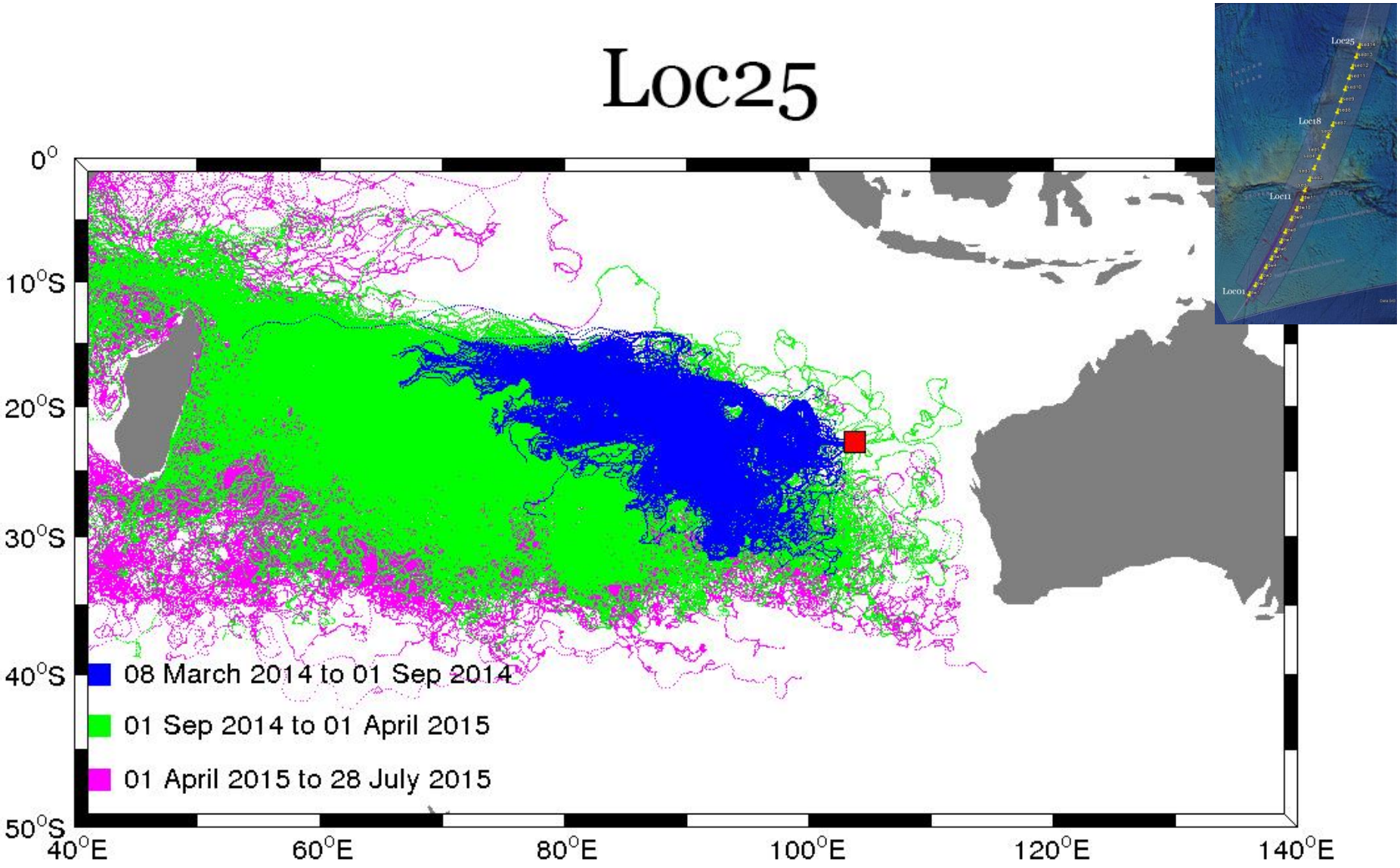
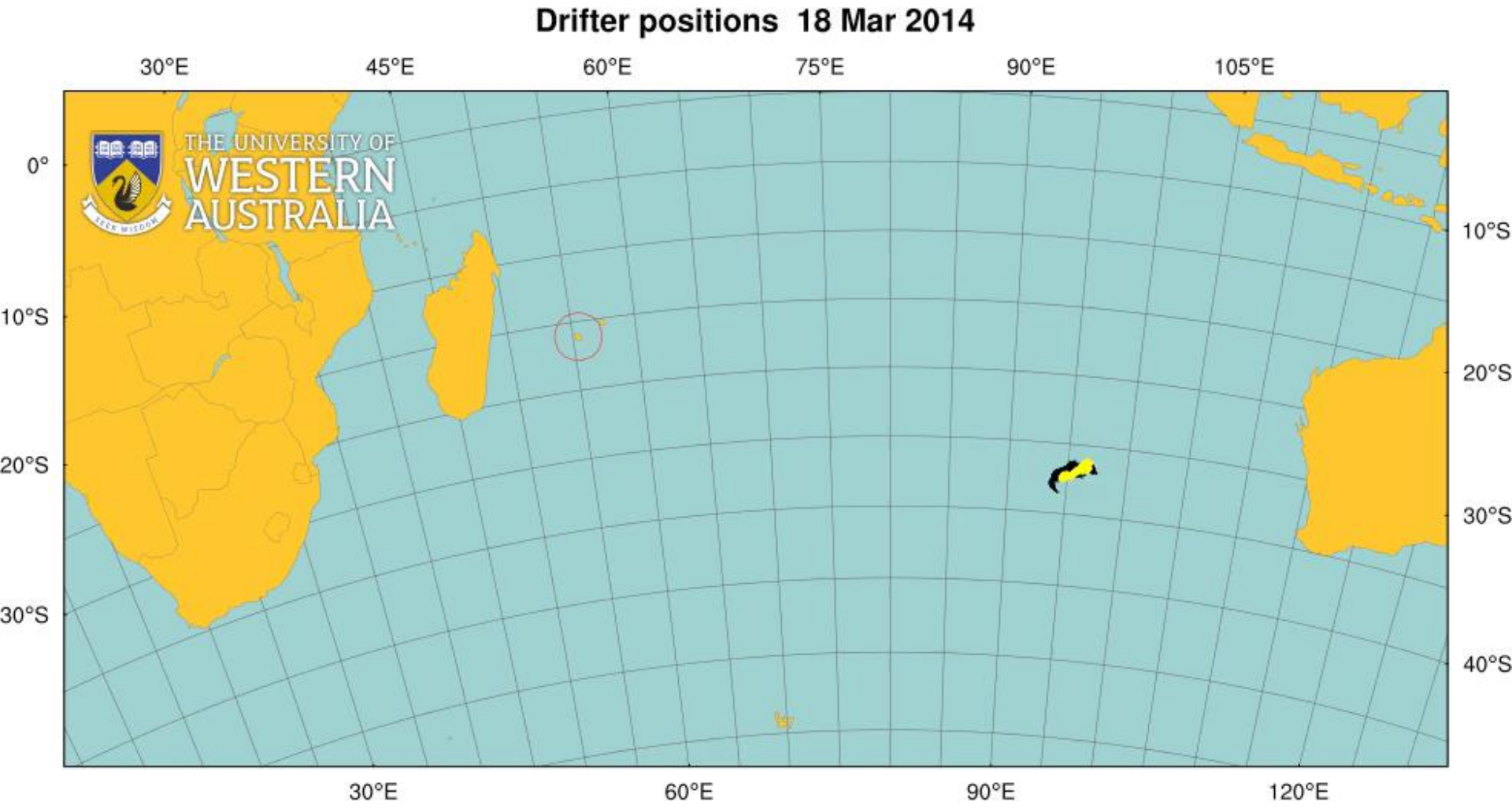


MH370: simulations



Thank you


Drifter positions 18 Mar 2014
30°E
45°E
60°E
75°E
90°E
105°E
0°
10°S
20°S
30°S
10°S
20°S
30°S
40°S
30°E
60°E
90°E
120°E
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