Project Manta

East Australian Current (EAC) Region: Oceanographic conditions report

December 2012 – January 2013

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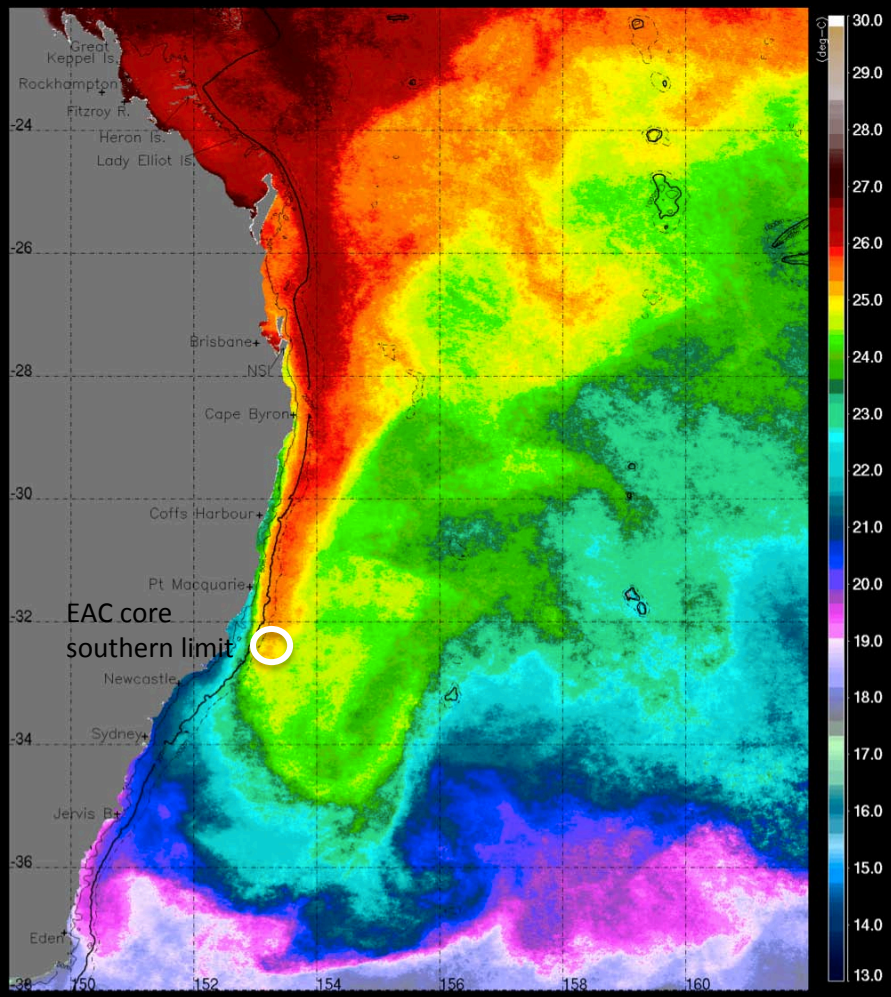
In this report:

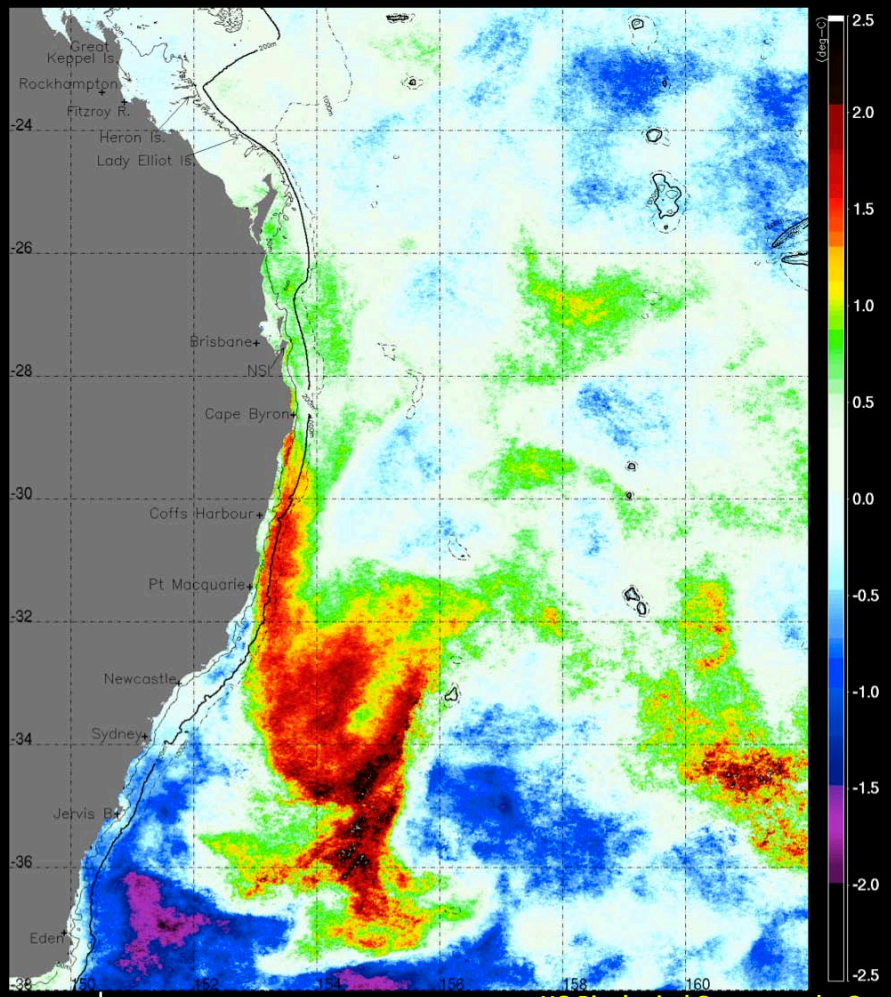
- December – January physical dynamics of East Australian Current inferred from MODIS SST and Chlorophyll and currents from Oceanmaps
- Manta sightings report – off North Stradbroke Island and the influence of EAC
- Manta feeding frenzy off Lady Elliot Island and the role played by Tropical Cyclone Oswald

EAC Monthly MODIS SST (D+N): December 2012

- December mean SST shows the mean EAC flow extending further south compared to the previous month
- Intense positive SST anomalies (~2°C) very close inshore south of Cape Byron, corresponding to an intensified EAC southern limb
- On the shelf, the most intense positive SST anomalies due to EAC encroachment are evident between ~30-32°S
- Core EAC separation point from the continental shelf at ~32.5°S , where EAC retroflects to form an anticyclonic eddy with SST anomalies of 2°C+



mean



anomaly

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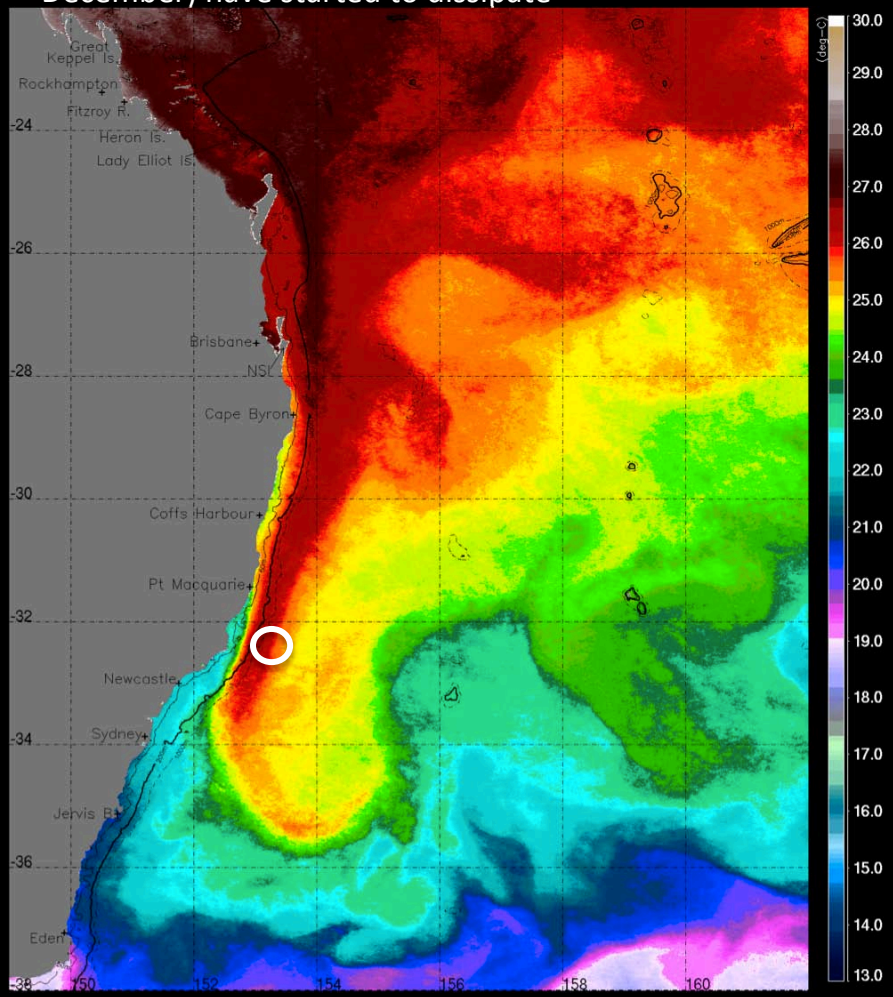
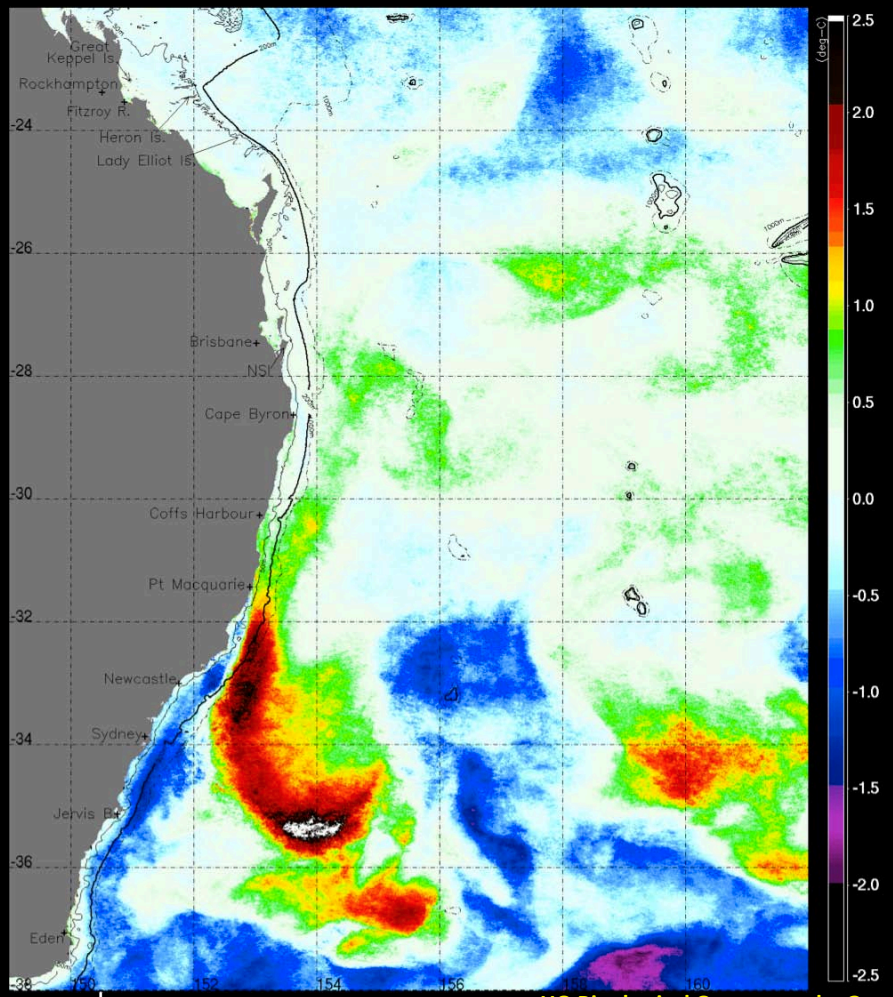
EAC Monthly MODIS SST (D+N): January 2013

- An intensified EAC mean flow apparent in January SST mean – core SST waters of ~27°C hugging the shelf as far south as Cape Byron
- Current separation point from the shelf edge has migrated further south by ~100km compared to December
- Intense positive SST anomalies limited to the portion of the current southward of Port Macquarie while moderate positive SST anomalies also evident further offshore
- Intense positive SST anomalies (2. 5°C+) on shelf between Coffs Harbour and Port Macquarie (due to EAC encroachment in December) have started to dissipate



mean



anomaly

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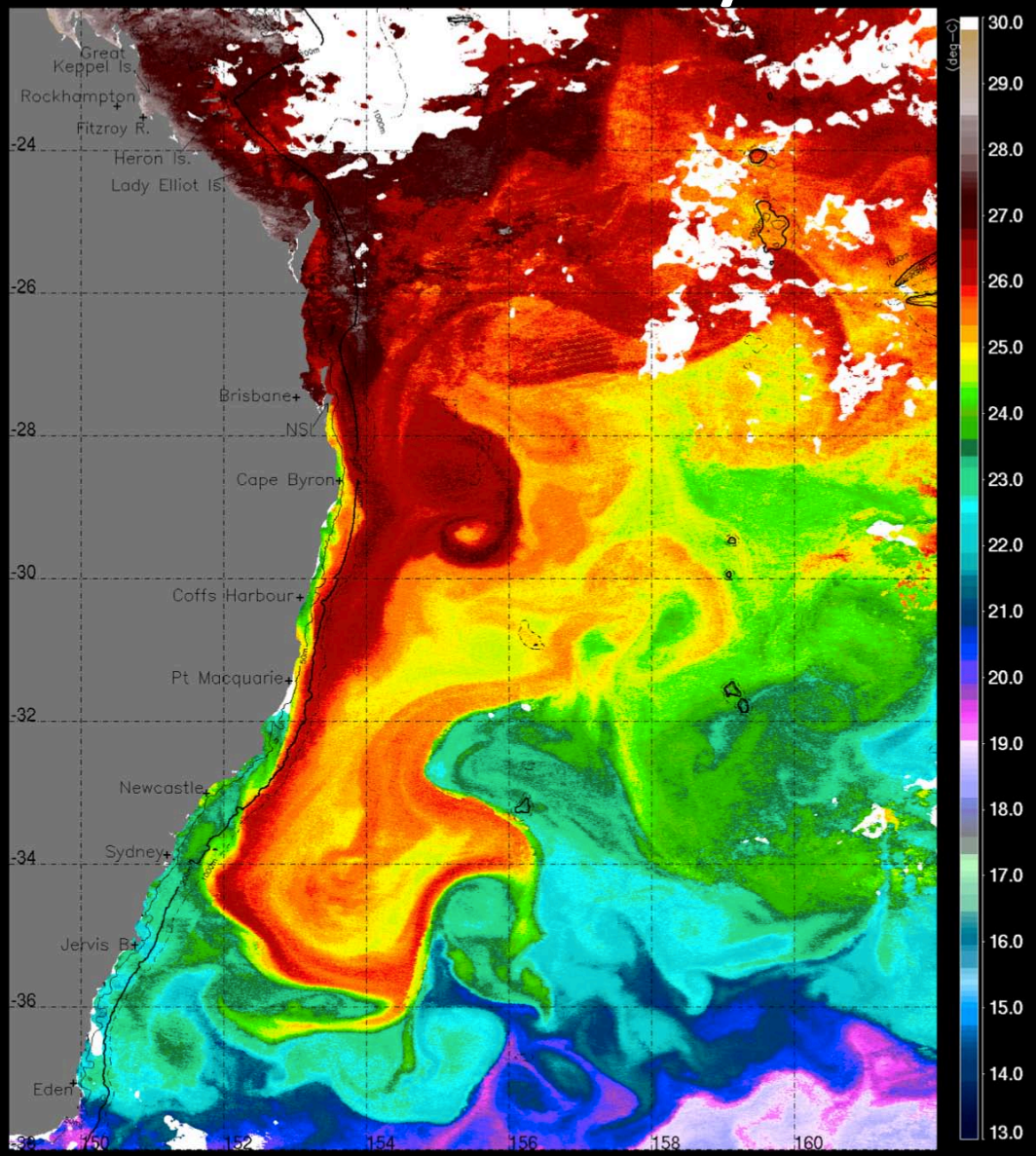
SST: 18 January 2013



Depicting the highly dynamic nature of the EAC on a daily basis

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EAC Monthly MODIS Chlorophyll: December 2012

The EAC is a fast flowing warm current with very low nutrients. The extent of the current (i.e., pink-purple colour) is apparent in the monthly chlorophyll image for December. Close to the coast, chlorophyll values are generally higher due to terrestrial sources, amongst others.

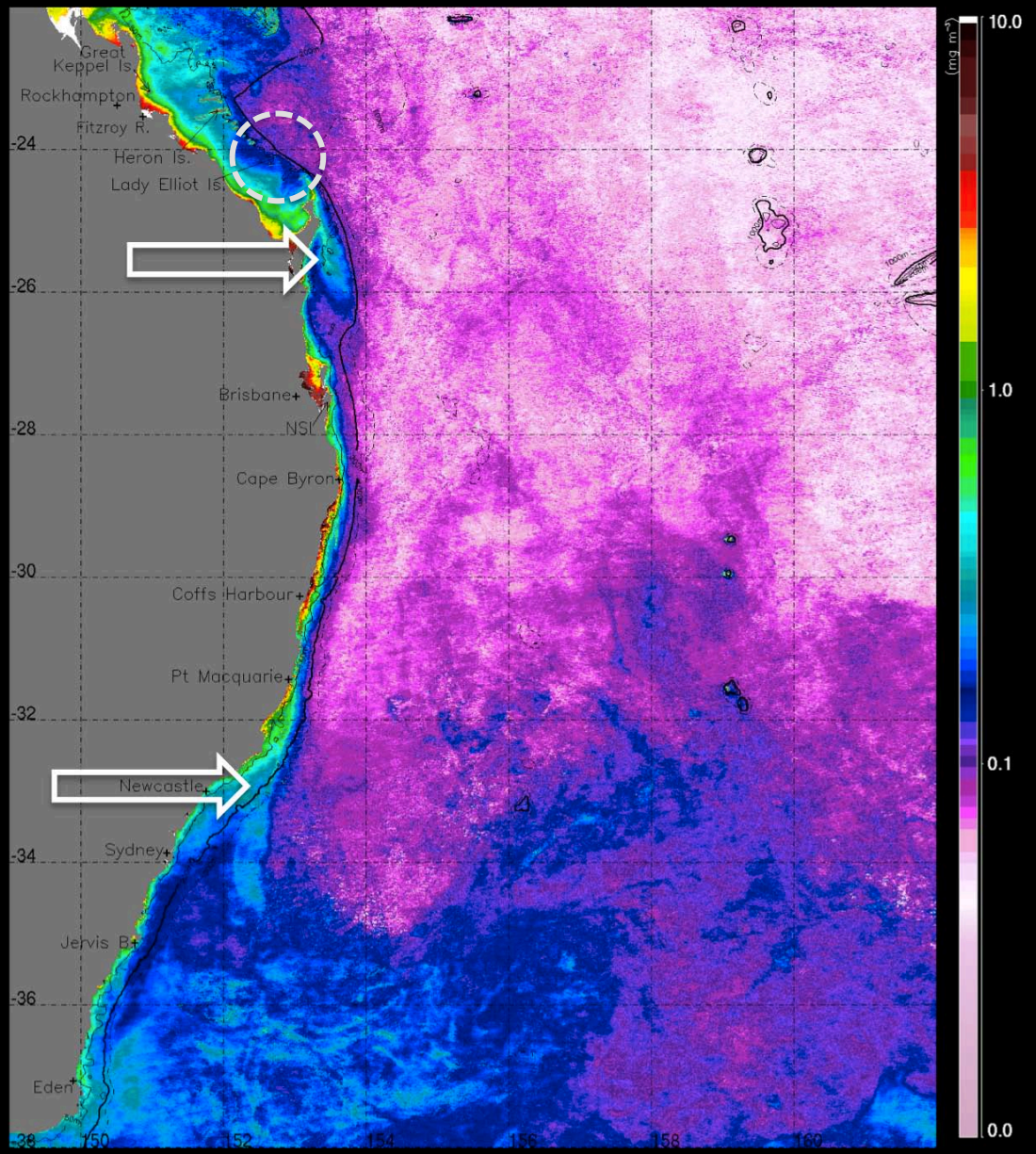
Intrusions of EAC waters onto the shelf and inner reefs are apparent (dashed encircled area)

Arrows denote where EAC dynamics result in upwelling of nutrient rich waters.

Upper arrow: EAC flowing very rapidly close to the continental shelf causing dynamic uplift and entrainment of nutrient-laden deeper waters

Bottom arrow: EAC separates from the coast driving upwelling

In both cases, the newly available nutrients at the surface cause phytoplankton bloom, hence, higher chlorophyll concentrations



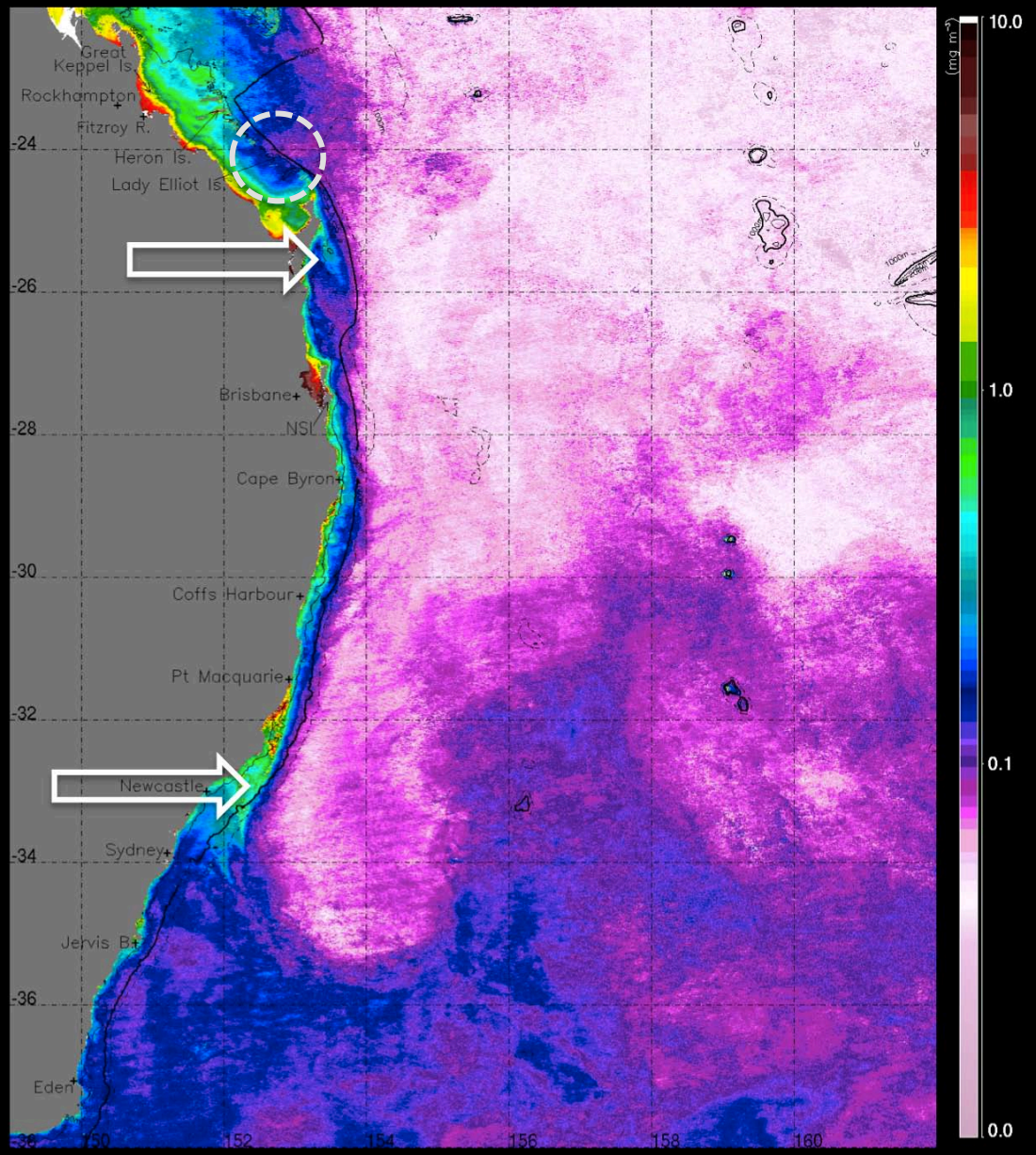
EAC Monthly MODIS Chlorophyll: January 2013

As shown in the SST images, the southern EAC limb intensified further in January

EAC intrusions into the shelf and inner reefs areas are still apparent (dashed encircled area)

Top arrow: Signal south of Fraser Island still pronounced but narrower and weaker compared to December

Bottom arrow: EAC southerly jet more proximal to the coast, inducing uplift of isotherms (upwelling) and manifest in this image as even higher chlorophyll concentrations



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OceanMaps : December 2012 mean

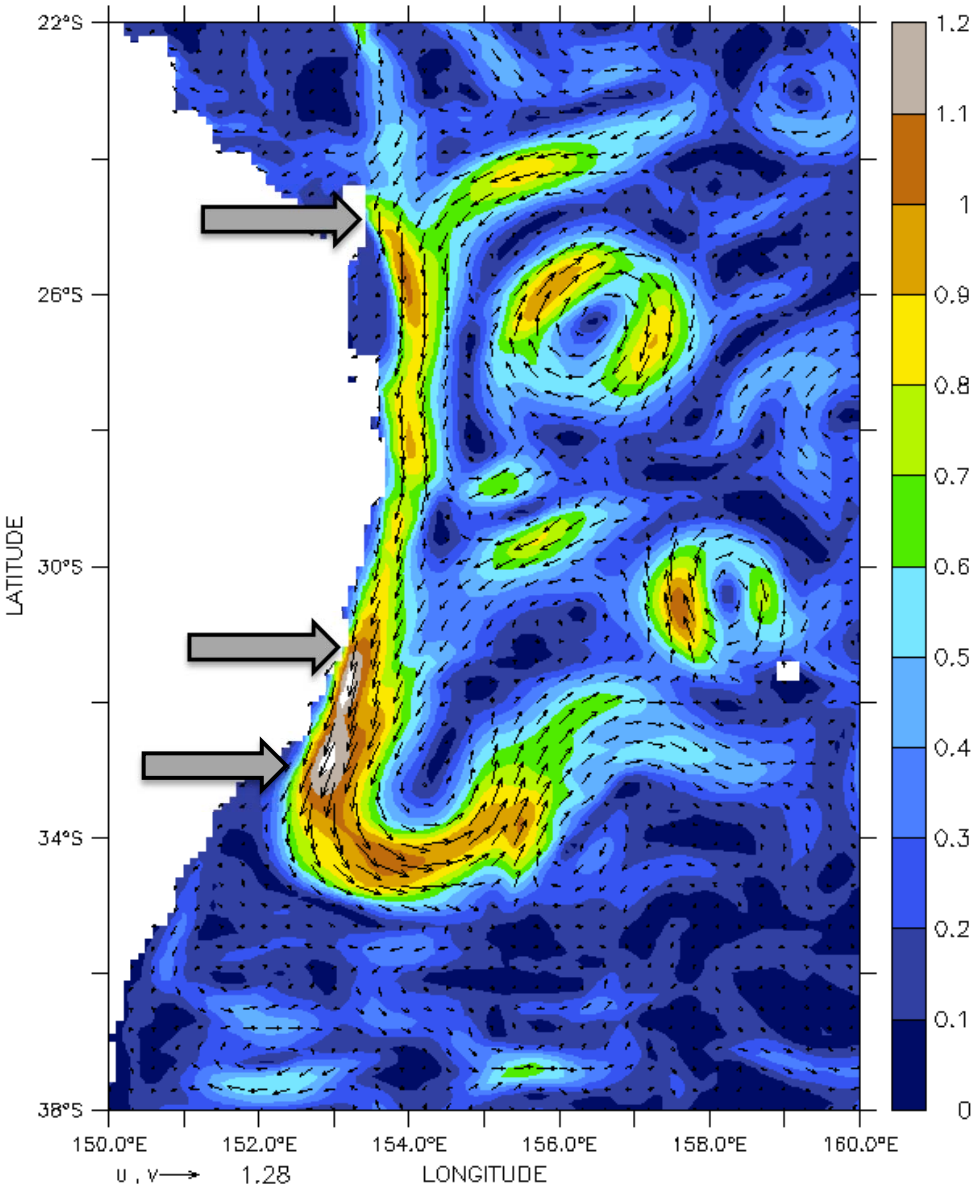
Depth integrated (0-15m) currents from OceanMaps reveal an intensified poleward flowing EAC

Top arrow: EAC reattaching to the shelf at Fraser coast and continuing strongly southward until ~35°S, especially intensified south of ~31°S

Middle arrow: Stronger EAC primary flow encroaching onto the shelf consistent, with the SST and chlorophyll images

Bottom arrow: EAC separating from the coast into the Tasman Sea

Similar to November, high eddy activity in the region corresponding to the dynamics shown in the preceding MODIS SST and Chlorophyll images



http://godae.bom.gov.au/oceanmaps_analysis/ocean_diag_brt/ocean_diag.shtml

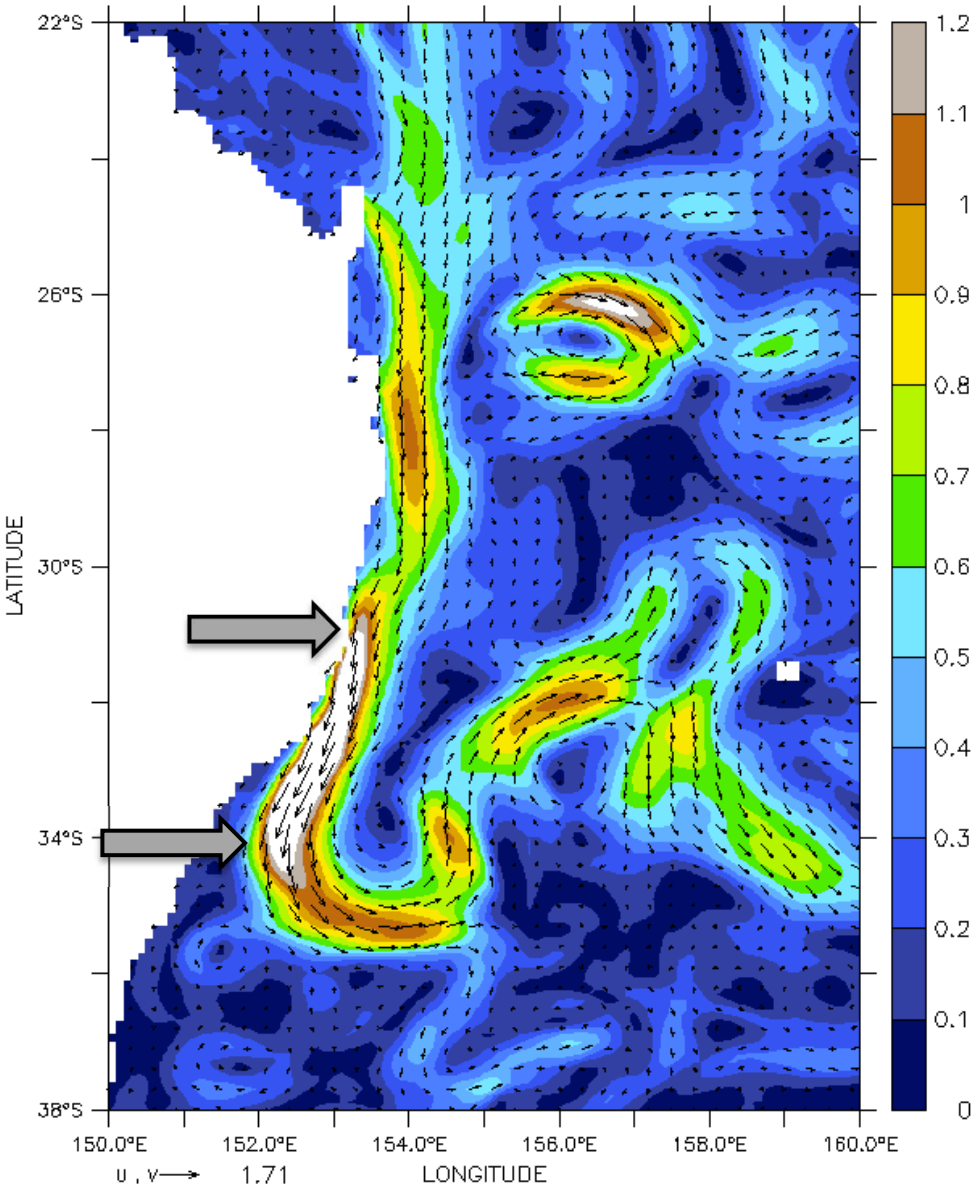
OceanMaps : January 2013 mean

Depth integrated (0-15m) currents from OceanMaps reveal a further intensified poleward flowing EAC

Upper arrow: Stronger EAC primary flow encroaching right onto the shelf, consistent with the SST and chlorophyll images.

Bottom arrow: EAC separation point located further south but more proximal to the coast compared to previous month

Consistently high eddy activity in the region, corresponding to the dynamics shown in the preceding MODIS SST and Chlorophyll images

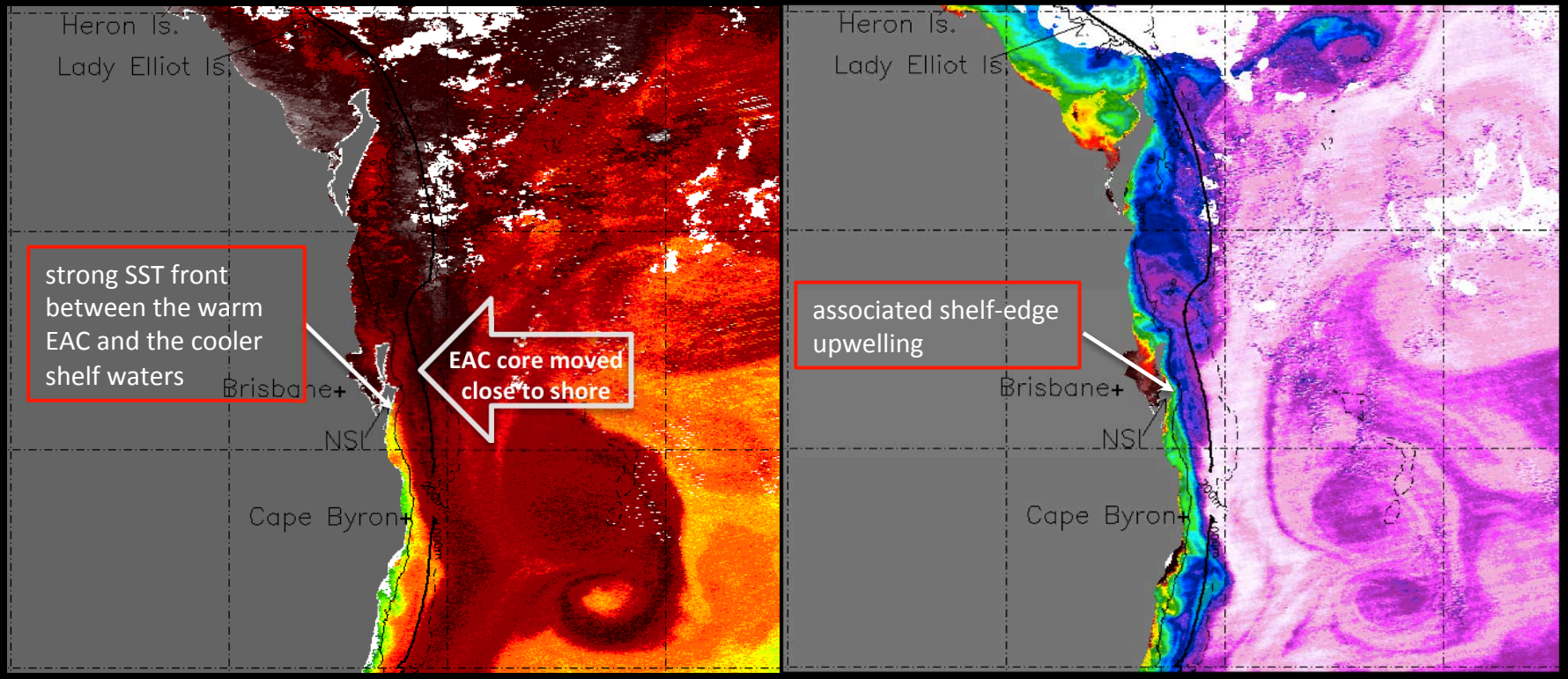


http://godae.bom.gov.au/oceanmaps_analysis/ocean_diag_brt/ocean_diag.shtml

Manta sightings report (14-21 January 2013)

LARGE NUMBER OF MANTA REPORTED OFF NORTH STRADBROKE ISLAND (NSI)

SST and Chlorophyll: 18 Jan 2013



- Strong EAC core encroaching onto shelf (see SST image) causing uplift of isotherms. Nutrient-laden colder deeper waters brought onto surface layer (shelf-edge upwelling, chlorophyll image) → phytoplankton bloom

- High food availability == numerous feeding mantas!

Manta sightings report (January 2013)

FEEDING FRENZY IN LADY ELLIOT ISLAND AND THE ROLE OF THE TROPICAL CYCLONE OSWALD

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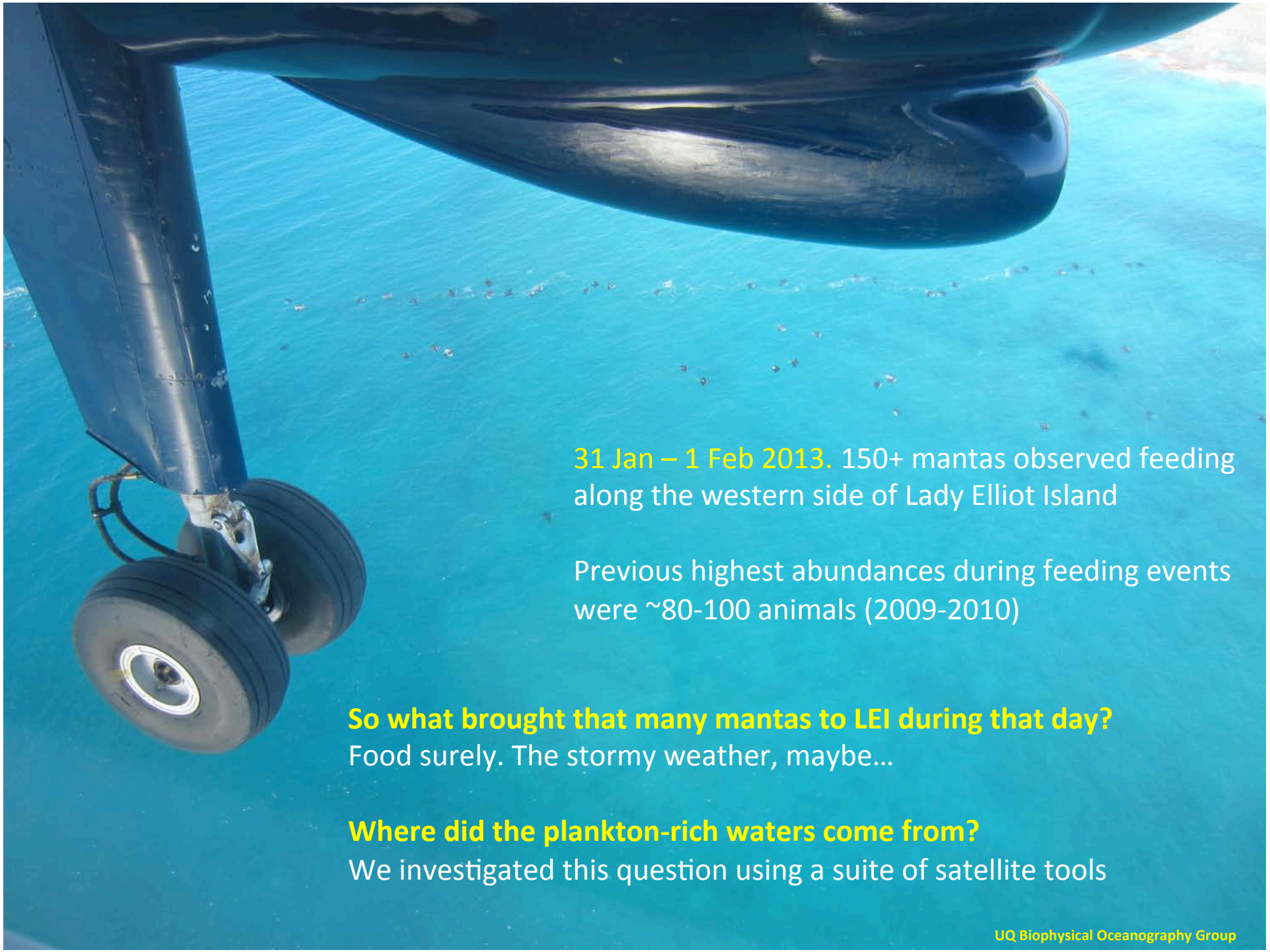
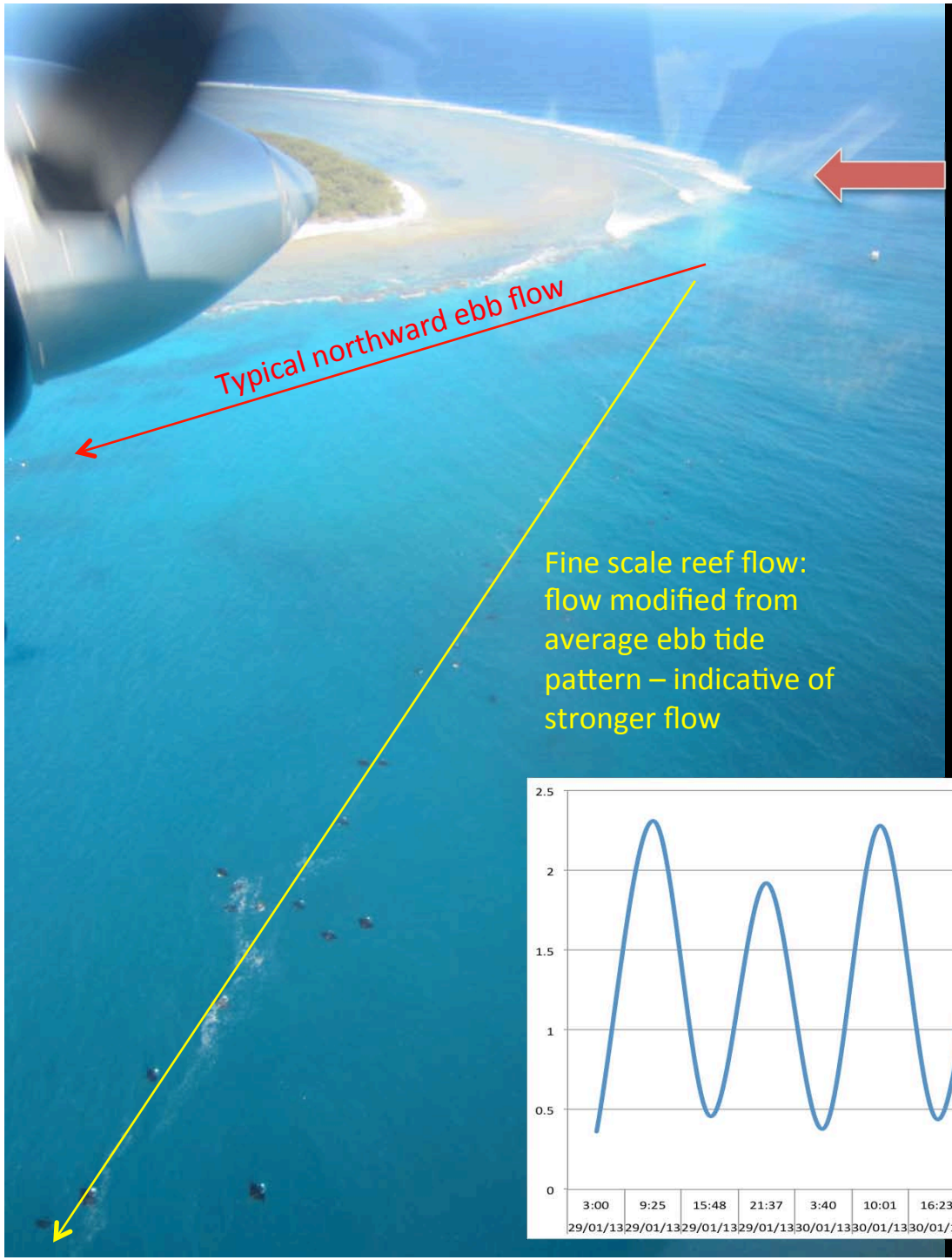


31 Jan – 1 Feb 2013. 150+ mantas observed feeding along the western side of Lady Elliot Island

Previous highest abundances during feeding events were ~80-100 animals (2009-2010)

So what brought that many mantas to LEI during that day?
Food surely. The stormy weather, maybe…

Where did the plankton-rich waters come from?
We investigated this question using a suite of satellite tools



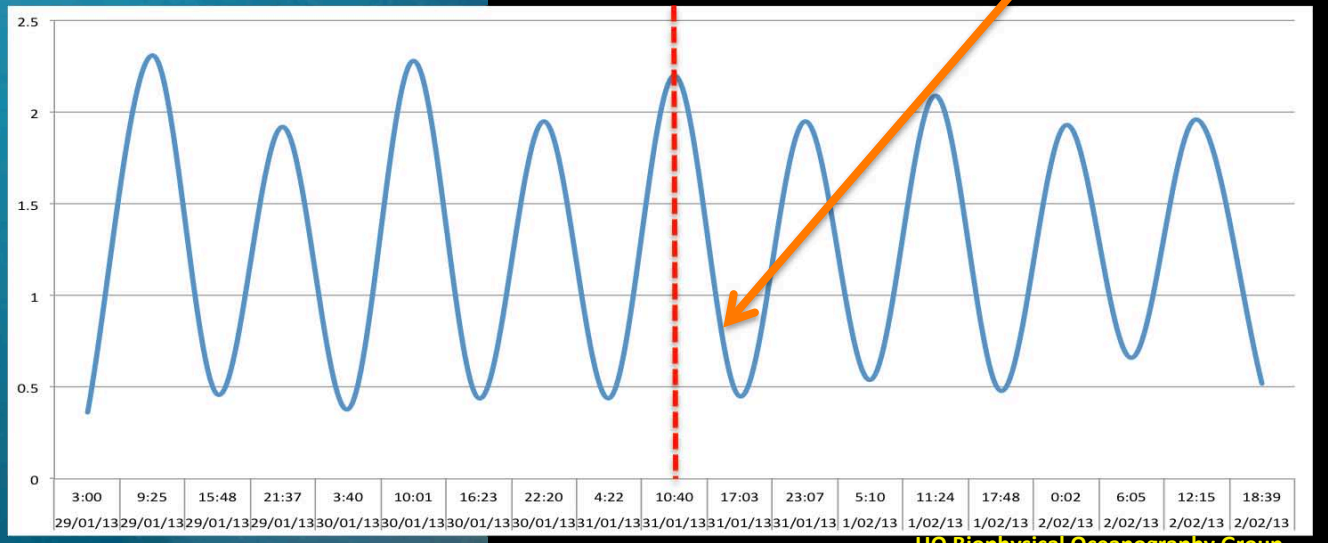
Localised flow

Southern tip of the island
Sunset Drift / Encounters

Conditions from LEI Watersports:
- 27°C water temperature
- 10-15 SE
- Calm surface, very strong currents

Spring tides during that period…
High tide @ 10:40am - 2.20m (red dashed line)

Manta train sighted at 16.00pm (~5 hours into the ebb tide = strongest current)



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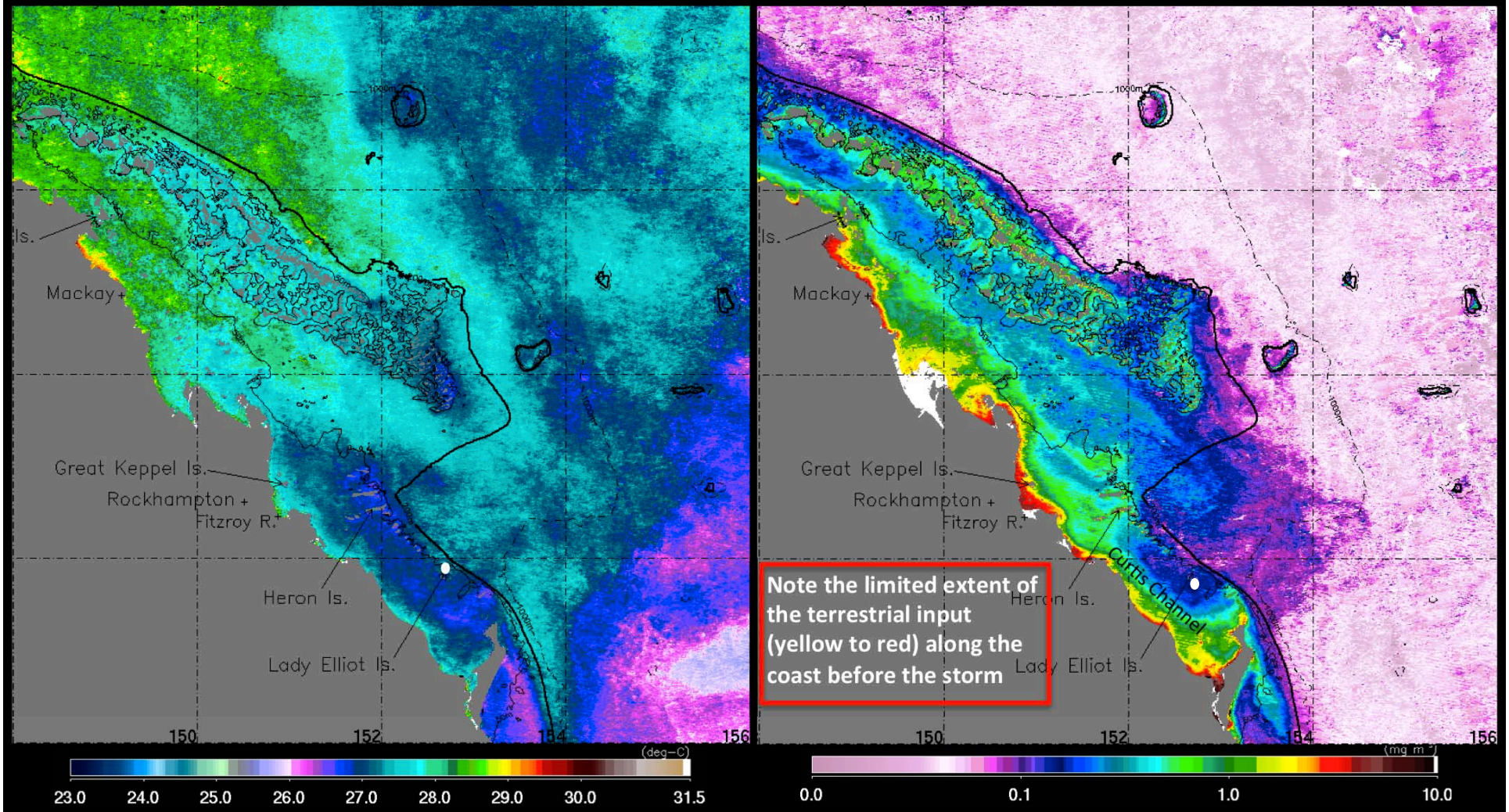
Before the storm: Overview of conditions

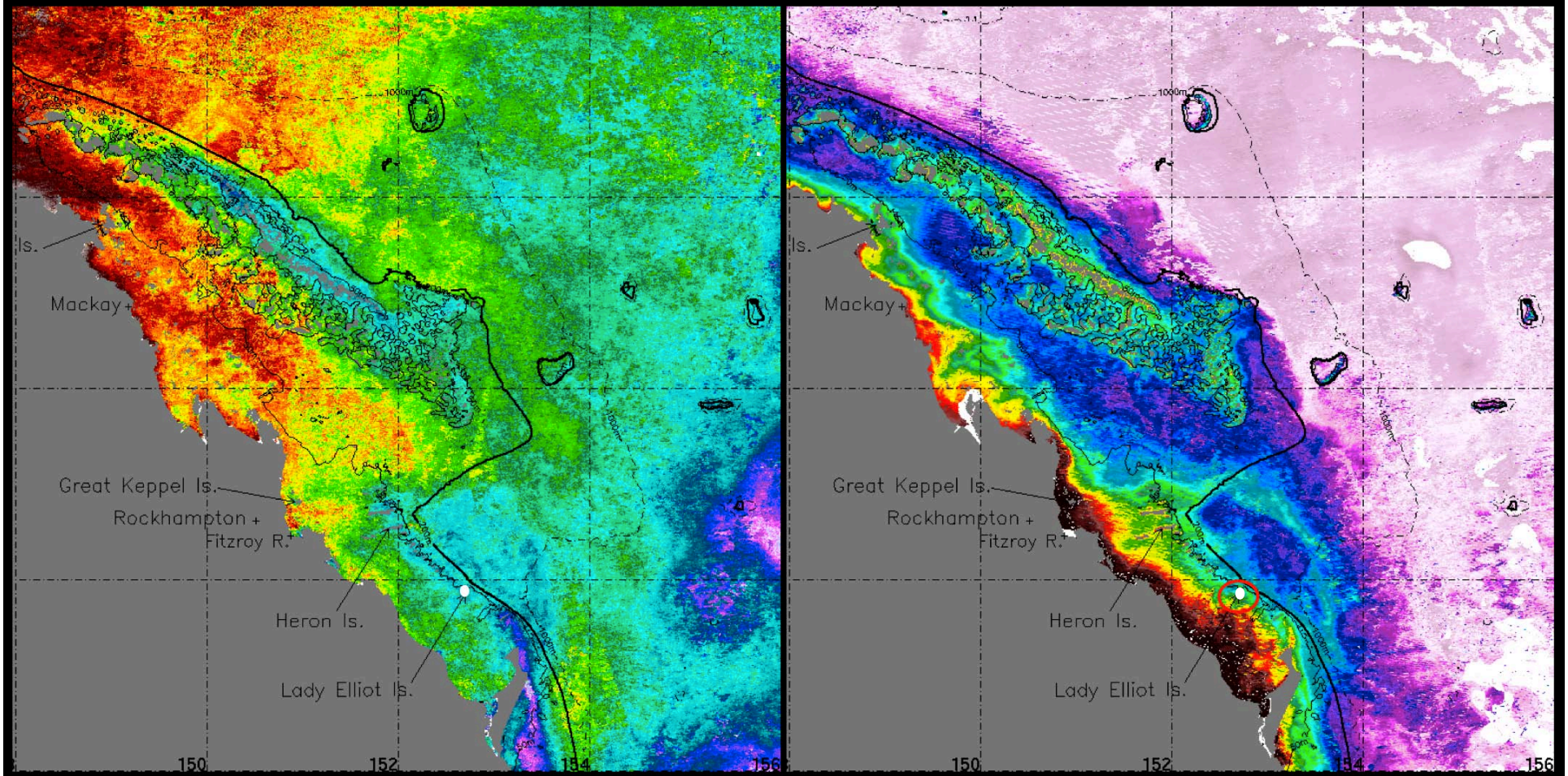
Sea Surface Temperature and Chlorophyll 7-day mean: 8-14 Jan 2013



- Strong East Australian Current intrusions (pink in right panel) into the Curtis Channel as the Capricorn Eddy developed
- Cooler waters evident inside the channel
- Nutrient input from terrestrial outflow / re-suspended sediment limited to close inshore

After the storm: Overview of conditions

Sea Surface Temperature and Chlorophyll 7-day mean: 29 Jan-3 Feb 2013



- Re-suspended sediment signal (yellow to red in right panel) originating from terrestrial run-off reached further offshore into the Capricorn Bunker Group forming a sediment-laden water body along the western stretch of the Curtis Channel
- The high chlorophyll concentration entrained into the Capricorn Eddy and re-circulated back via the eddy dynamics (i.e., intrusions)
- Strong front clearly apparent between these two water bodies – **LEI positioned right on the front!!!**
- Visibility likely dropped as entire area awash with high nutrients – a manta feast!

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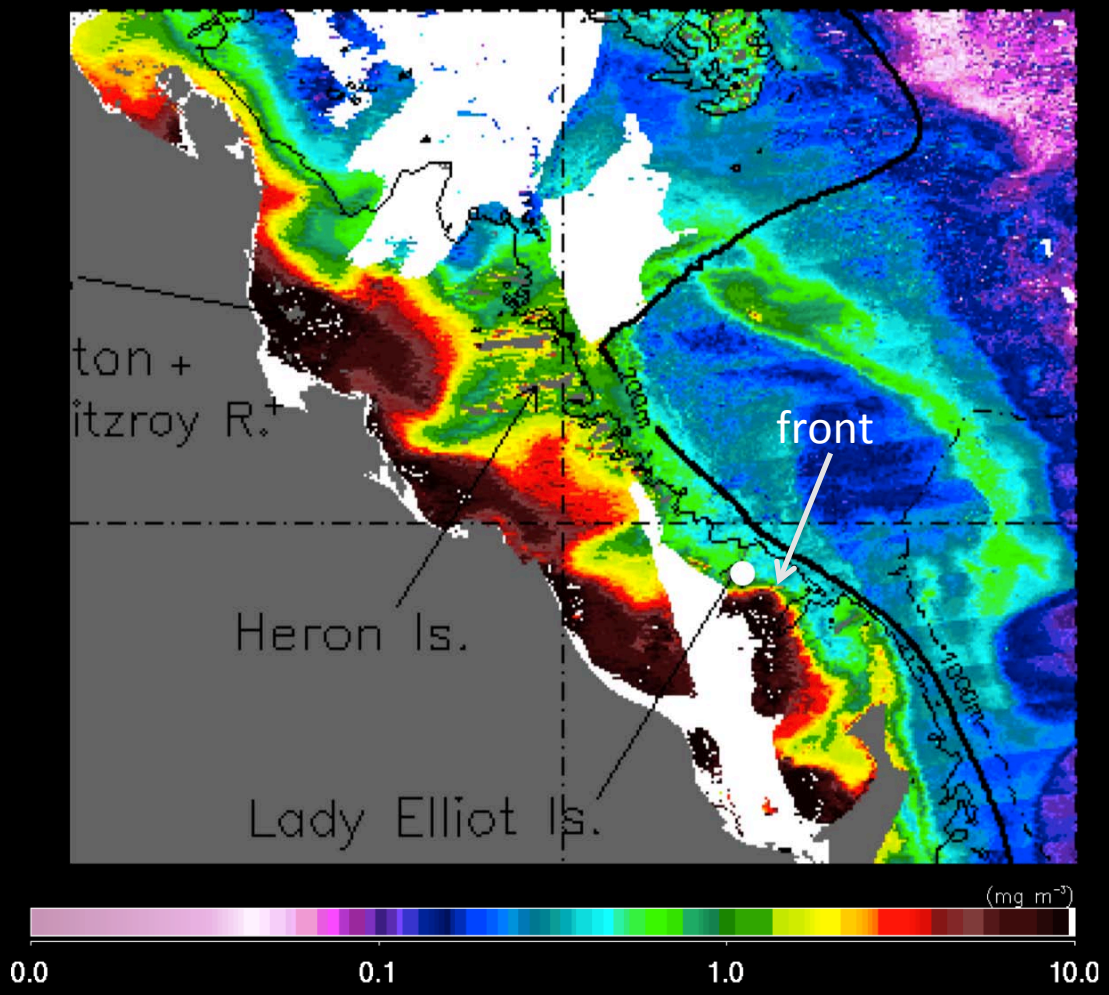
During the storm – zooming in….

Chlorophyll 7-day mean: 29 Jan – 1 Feb 2013



Note: white alongshore is where nutrient values have exceeded our scale! (white regions offshore are due to extensive cloud cover)

- Brown / red = large volume of riverine input and strong vertical mixing (due to wind) causing sediment resuspension. Result was enormous nutrient input approached Lady Elliot Island (white dot). Note strong front – this would be especially pronounced during the spring ebb tide