Project Manta

East Australian Current (EAC) Region: Oceanographic conditions report

July 2013

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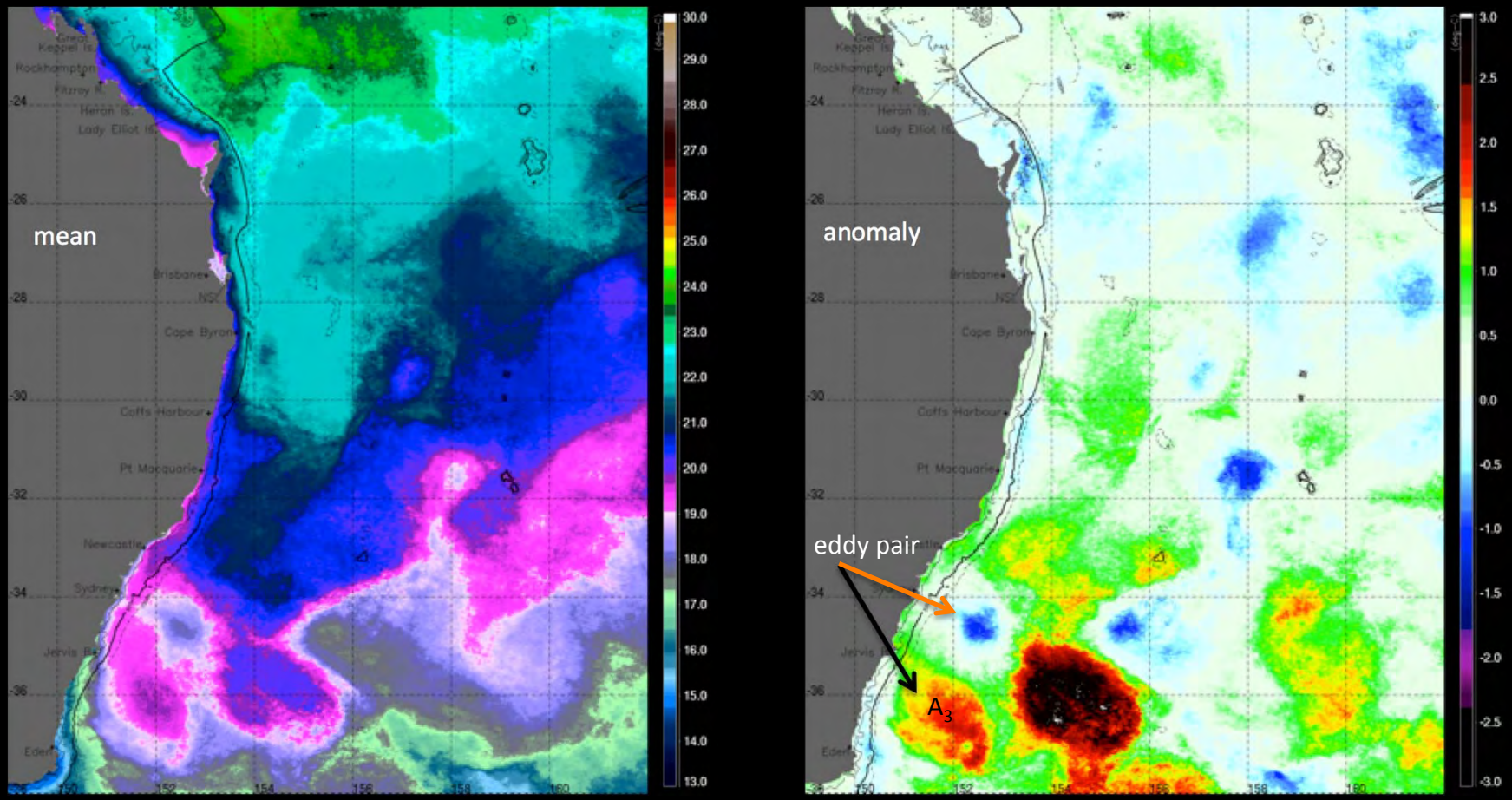
Overview: July 2013

- Monthly and weekly MODIS sea surface temperature (SST) means & anomalies showing East Australian Current (EAC) and eddy dynamics
- Weekly maps of sea level anomalies showing the ocean topography related to the EAC and eddy activity in the region
- MODIS chlorophyll means for southern GBR region highlighting the oceanographic conditions around Lady Elliot Island (LEI) and summary of selected Manta sightings at LEI for July 2013
- Frontal analysis of MODIS chlorophyll coincident with intense manta feeding at LEI

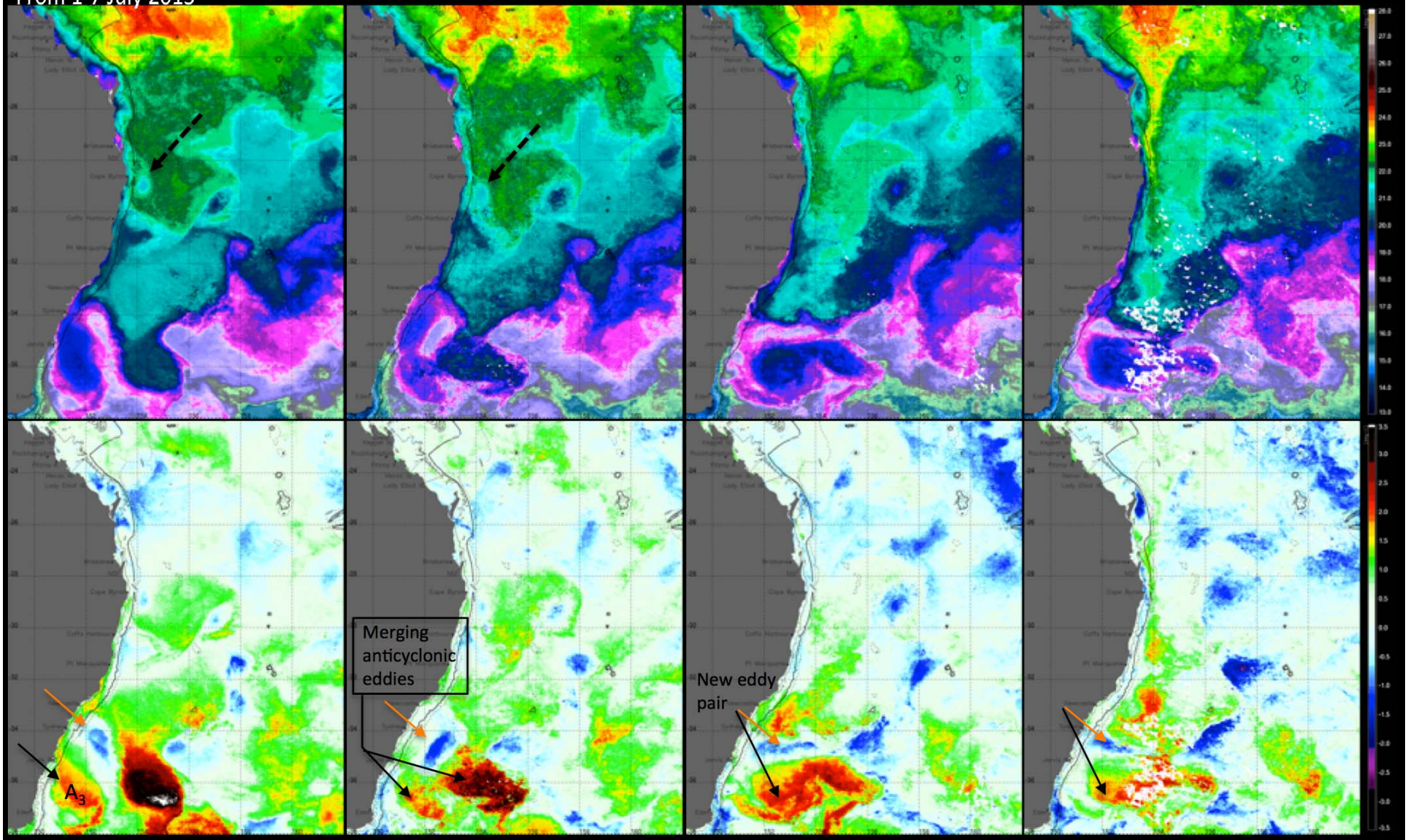
EAC monthly MODIS SST (D+N): July 2013



- Weak and broad EAC primary flow associated with mostly average conditions
- Intense positive SST anomalies associated with:
  - Anticyclonic eddy (A_3) that has persisted for few months, moved further south of Sydney during July (centered at 36.25°S and 152°E). Similar to June, the eddy has surface core waters that are +1.5°C warmer than surrounding waters
  - 2nd offshore anticyclonic eddy shed from the primary EAC more intense compared to June (+3.0°C warmer than usual)
- Strong negative SST anomalies associated with:
  - cyclonic eddy with core temperatures indicating at least -1.0°C colder than surrounding waters

Weekly MODIS SST means (top panel) and anomalies (bottom panel)

From 1-7 July 2013



- Evolution of cyclonic eddy (stippled arrows, top panel): the eddy originated on the broad shelf south of Fraser Island during May and persisted through June; during July it moved south/shelf-ward during week 1 and became embedded in the EAC from week 3.
- Eddy dynamics – shedding and merging of eddies at the southern limit of the EAC: Anticyclonic eddy (A_3) merging with another offshore anticyclonic eddy during the 2nd week. Zonally elongated anticyclonic eddy during the 3rd & 4th week with core positive SST anomalies subsequently becoming less extreme

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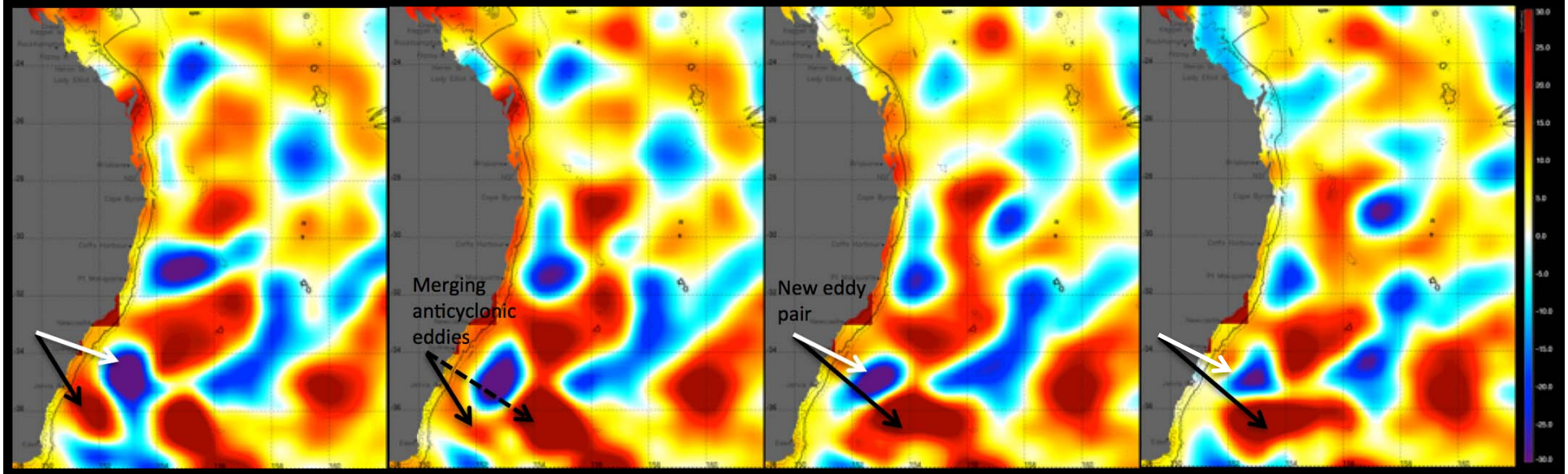
Weekly AVISO Maps of Sea Level Anomalies

From 1-7 July 2013



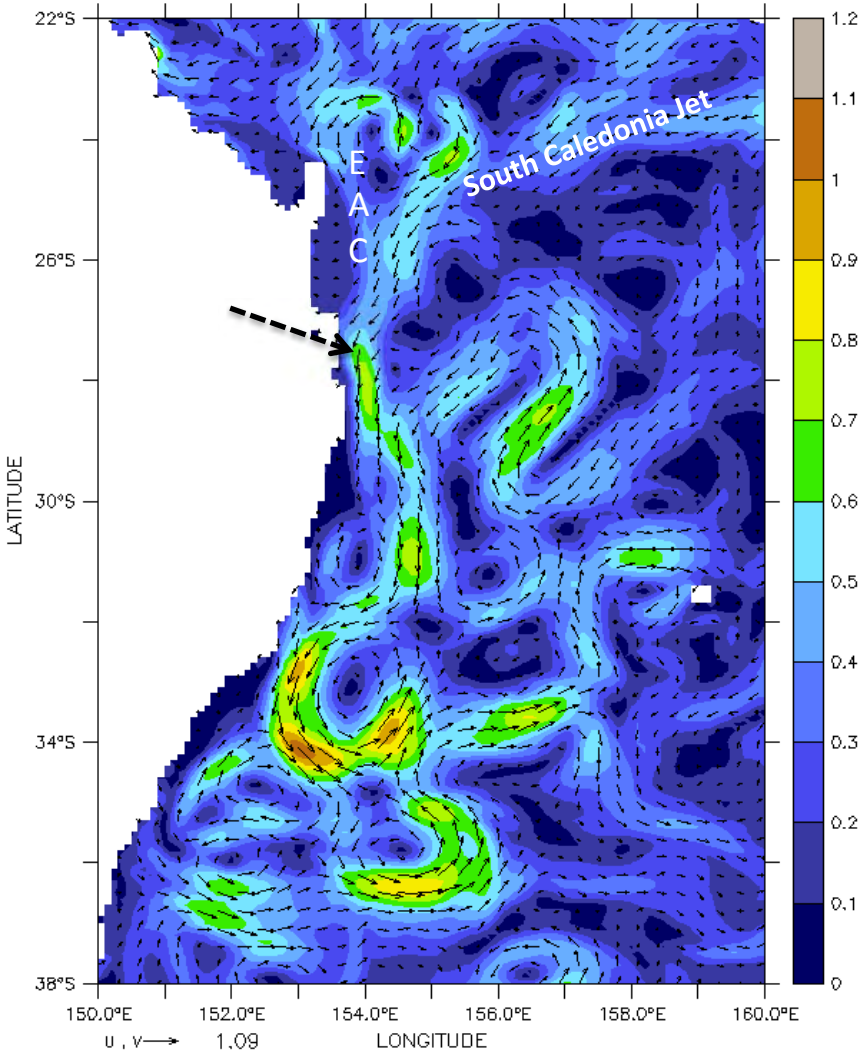
- Weekly sea surface height anomalies showing the:
  - Persistent eddy pair off Sydney and Jervis Bay
  - Merging anticyclonic eddies in week 2
  - New eddy pair evident during week 3

Sea level anomaly patterns agrees with MODIS images

Note: yellow to red = positive sea level anomalies

OceanMaps 15m Depth Integrated Currents

July 2013



Depth integrated (0-15m) currents from OceanMaps reveal:

- Weak EAC flow north of 27.5°S mainly fed by the South Caledonia Jet
- EAC intensified off Cape Byron (stippled arrow) with primary flow meandering seaward, feeding a weak cyclonic circulation inshore (centered at 31°S,154°E)
- Further south, intensified southern limits of the EAC advects eastward into the Tasman Sea, associated with recirculation in the large anticyclonic eddy

Manta sightings @ Lady Elliot Island in July 2013

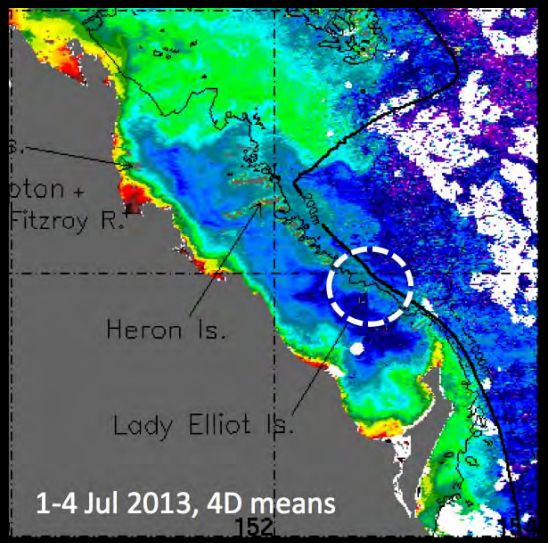
Day	Number of Manta sighted	Animal Behaviour
2-4	20 – 100+	Feeding, high PD, southerly current
5-7	5 – 40+	Feeding, med PD, northerly current
10-13	2 – 20+	Feeding, med to high PD, northerly current to southerly current
19	**72 – 82**	Feeding @Coral Gardens, @Light House and @Sunset Drift
20	100+	Feeding @Kyms Spot, LHB, southerly current
21	50+	Feeding @Kyms, Coral Gardens, southerly, high PD
22	**60+**	Feeding @Kyms Spot – LHB
24	25 – 100+	Feeding @LHB – Sev Wreck, very high PD, northerly current direction
25	50+	Feeding @LHB – Sunset, northerly current, very high PD
26	30+	Feeding @M1-Sunset, southward current, very high PD
27	**60+**	Feeding @Sunset – LHB, @LHB – Second Reef, northerly current, very high PD
29	30+	Feeding @LHB, northerly current, high PD

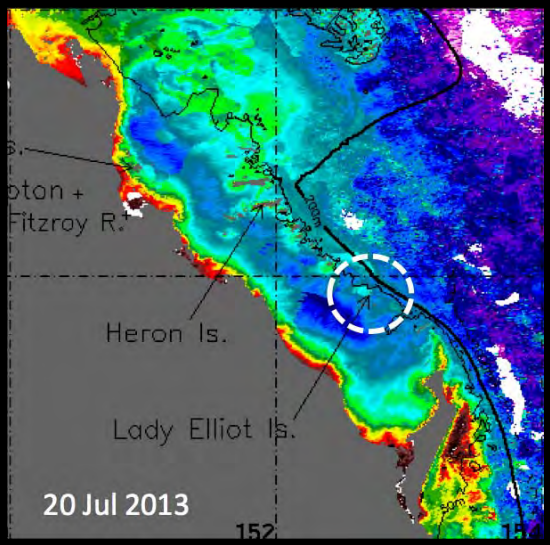
PD = plankton density

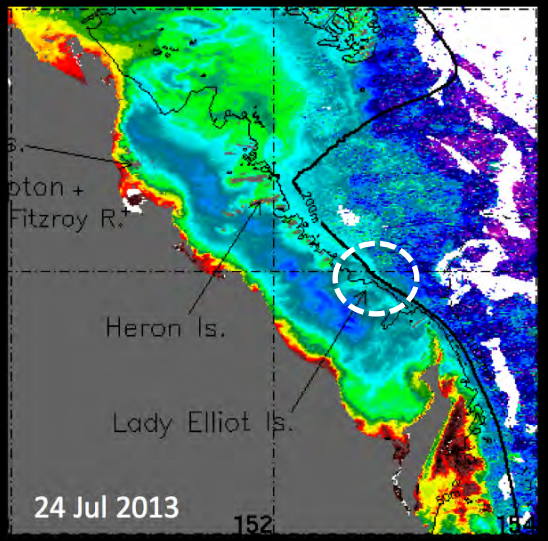
High number of manta rays recorded at LEI throughout this month.

Three intense manta feeding events: 3rd, 20th and 24th where over a hundred animals were sighted feeding

MODIS Chlorophyll means



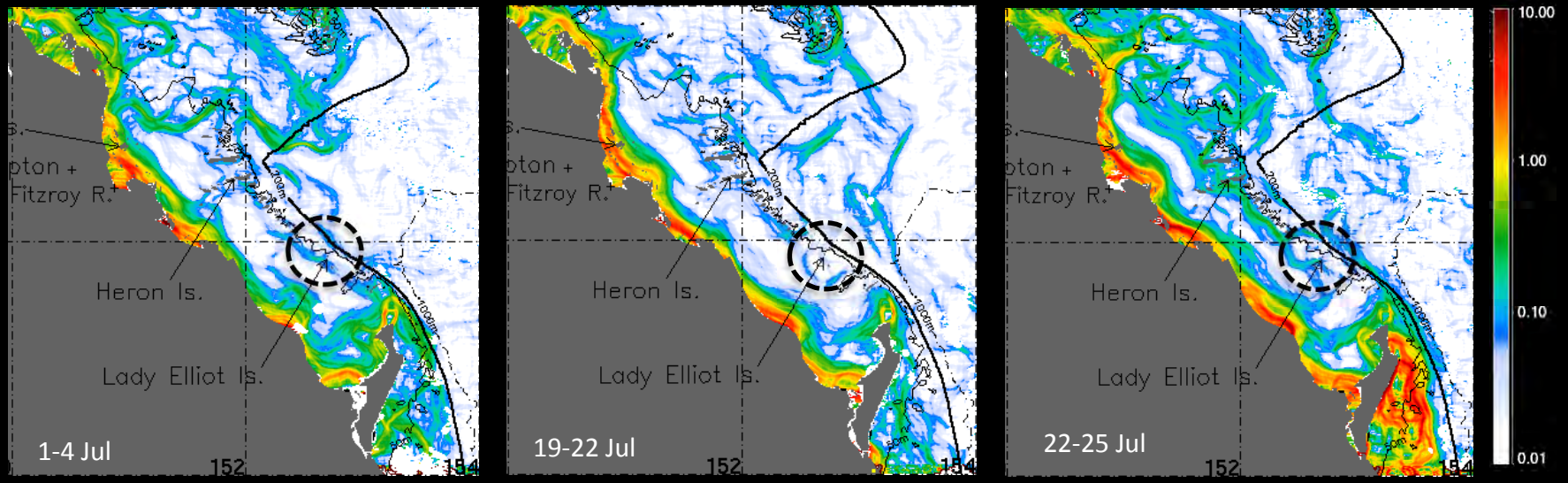




Intense feeding at LEI for this month coincident with very high chlorophyll concentrations around the Island. What physical mechanism could be driving these high chlorophyll levels? (see next slide)

Manta sightings @ Lady Elliot Island in July 2013

Frontal Analysis using MODIS Chlorophyll



Maps above indicate the position of oceanic fronts - the colour denotes the chlorophyll gradient per kilometer (mg m^{-3}/km).

Analysis for periods coincident to intense feeding show that LEI sits along a strong frontal feature often characterised by enhanced primary production which attracts marine animals including manta rays