IMOS Integrated **Marine Observing** System

FACILITY 7: Australian Coastal Ocean Radar Network (ACORN)

The Capricorn Eddy and its potential impact on Fisheries - a quick look

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Abstract

The Capricorn Eddy is an intermittent feature of flow at the shelf edge of the Capricorn Bunker Group of the Southern Great Barrier Reef. The possible influence of this eddy on fisheries on the shelf is being explored. This report looks at the potential use of HF radar data from the IMOS ACORN radar pair at Tannum Sands and Lady Elliot Island to contribute to this study. This is a very preliminary report and comes to no specific conclusions.

1 Introduction

There have been a number of published studies of the Capricorn Eddy. Weeks et al. [2010] included an example seen in satellite data from Sept 2008. An example of surface currents measured with the ACORN HF radars in the Southern Great Barrier Reef at the time of this example is shown in Fig. 1. Mao and Luick [2014] includes several examples from 2008 and 2010. For these cases HF radar surface currents measurements were averaged over several days to remove tides and reveal the eddy structure. The Queensland Department of Agriculture, Fisheries and Forestry are working on a research project (FRDC 2013/020) on 'Physical oceanographic influences on Queensland reef fish and scallops' with a particular interest in quantifying the presence/absence of the Capricorn Eddy and how this might relate to scallop abundance and catch rates. This report comments on the potential use of the HF radar data to support that project.

2 Analysis

Requirements:

- find characteristic features that will identify the CE;
- determine how to identify these features in the radar data;
- hypothesise mechanisms by which the eddy may influence catches on the lagoon;

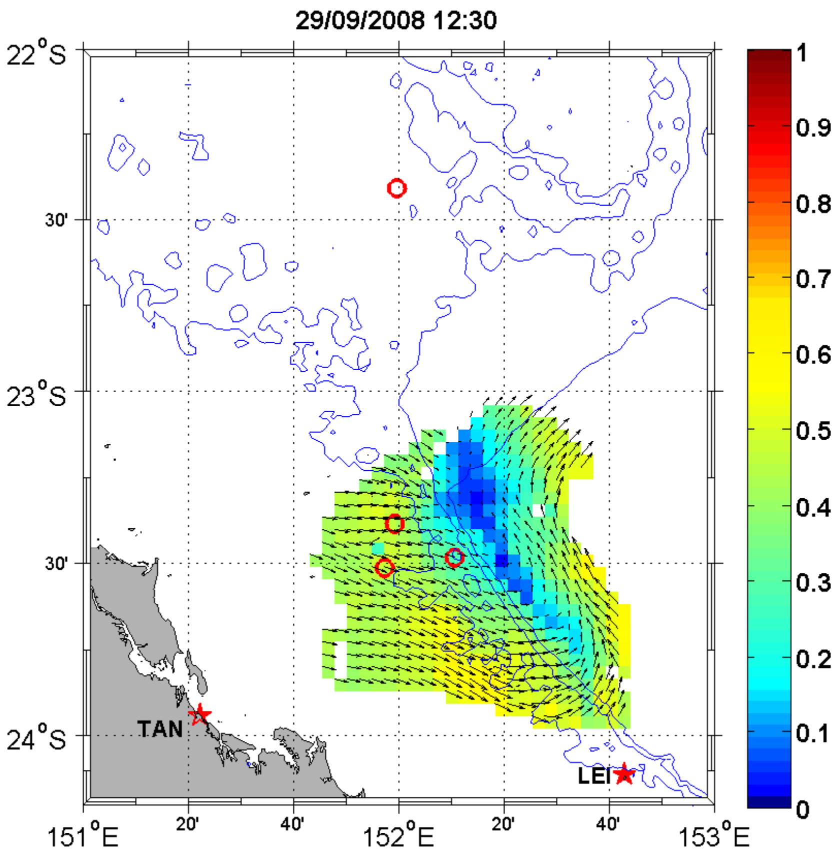

Figure 1: Surface currents on 29/9/2008 @ 12:30.

- determine if there are significant cross-correlations between catch figures and CE features/presence and for what lags.

There are a number of published studies on eddy detection (e.g. Nenciolu et al. [2010]) that could be used to inform this work although noting that there may be difficulty applying some of these approaches since the full eddy is not covered by the radar measurements. A simple approach is to note that when the eddy is present there is north-westward flow on its south-west flank and north-eastward flow further north, i.e. a cyclonic circulation. Thus the U component of velocity changes sign from south to north across the eddy flank whereas the V component is positive throughout. This has been tested with HF radar hourly mean surface current measurements for 2008 to 2012 which have been downloaded from the IMOS Thredds server:
http://thredds.aodn.org.au/thredds/catalog/IMOS/ACORN/catalog.html.

Daily averages of these data have been determined and further averaged over 0.1° latitude and longitude bins. Data from the most easterly two bins of the radar coverage region, i.e between 152.5°E and 152.7°E , have been used to test the simple eddy detection method. The data for 2008 are shown in Fig. 2. Marked on these plots is the period of 27th Sept to 6th October that was identifed in Weeks et al. [2010] and Mao and Luick [2014]. During this period the U component is negative (blue-green colours) to the south, positive (yellow-red colours) to the north and the V component is positive throughout consistent with the presence of an eddy. The eddy structure seems to start before 27th Sept and continue after Oct 6th as seen in Fig. 3 The only other clear example in 2008 is at the beginning of the year and Fig. 4 shows one hourly averaged flow pattern during this period

The other examples in Mao and Luick [2014] are in 2010, 1-7 May and 14-16 July. The data for this period is show in Fig. 5, the two eddy periods are identified as before and the typical eddy structure can be seen. The May data shows the eddy in the northern part of the region extending onto the shelf, as was shown by Mao and Luick [2014]. The 1 hourly averaged data (no spatial averaging) at this time are rather noisy and it is difficult to get a clear picture of the eddy. There may be some indication of it in Fig. 6 which shows eastward flow north of the shelf edge but it is difficult to be sure that it is in fact an eddy. The 1 hourly averaged data for the July period is even less clear. Towards the end of 2010 there is another period seen in Fig. 5 with the characteristic eddy pattern and an example from this period is shown in Fig. 7. A few examples have been identified in the 2009, 2011 and 2012 time series but again the 1 hourly averaged data do not often provide compelling evidence. Longer averaging, as in Mao and Luick [2014], may present a clearer picture.

3 Discussion

The Queensland Department of Agriculture, Fisheries and Forestry have provided data on scallop catches for the years 2010 to 2012. Fig. 8 shows the average annual catch for the period 1989-2013. The project is aiming to relate the variability in these catches, and perhaps those elsewhere in the region, to the presence or absence of the eddy. Given the difficulty of identifying the eddy based on partial information (i.e just the western flank), the HF radar data set is unlikely to be very helpful on its own, although longer averaging may help. Satellite observations are more likely to be able to identify periods when the eddy is present and then the radar data can be used to validate this and to assess the strength of the eddy. It is also worth noting that based on the simple analysis, as shown in Fig 2 and Fig 5 and found in similar figures for 2009, 2011 and 2012, the eddy does not appear to be a particularly common event. Averaging may reveal the feature more clearly and more regularly.

It would be advantageous to hypothesise some mechanisms by which the eddy may influence fisheries on the shelf (this may already have been done) to inform a strategy for relating catch data to oceanographic data. In the meantime the only approach seems to be to get a clear indicator of eddy presence and its strength and do a lagged correlation analysis with the catch data to see if this can identify time and spatial scales for impact.

Further work with the HF radar data should include assessing the impact of longer averaging on eddy detection perhaps using both vector data (as here) and radial data from Lady Elliot Island (which may provide more continuous coverage but haven't been used here because the data in the files are not on a grid so extra work is needed to align the measurements). Other eddy detection methods could also be assessed with these data.

Acknowledgment

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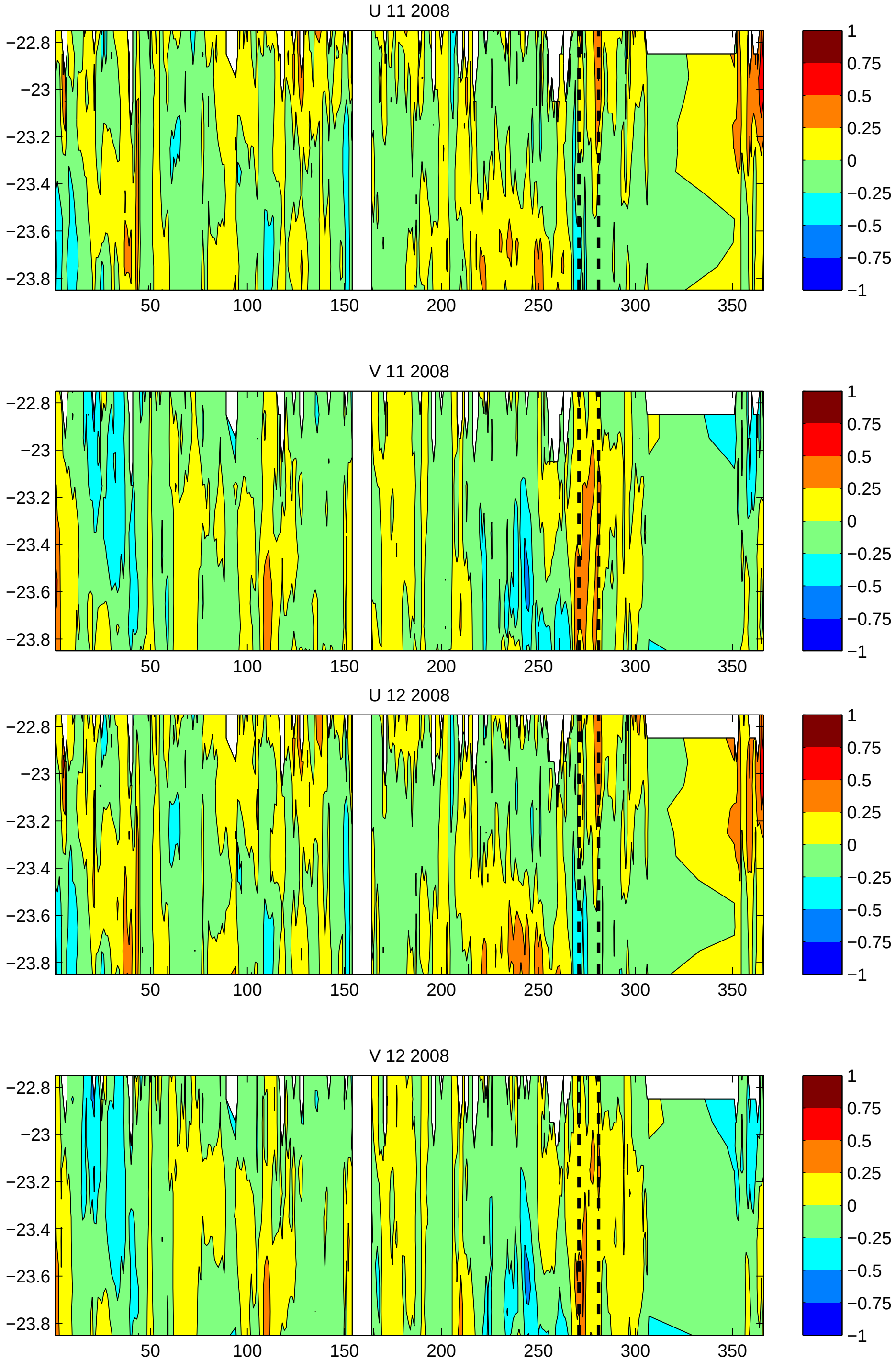

Figure 2: 2008 U and V components for daily averages over 152.5°E to 152.6°E. (above) and 152.6°E to 152.7°E (below).

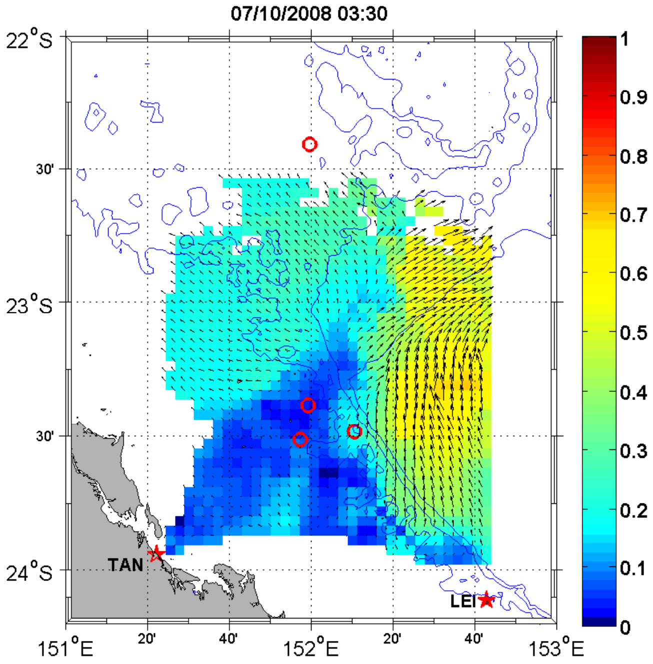

Figure 3: Surface currents on 07/10/2008 @ 03:30.

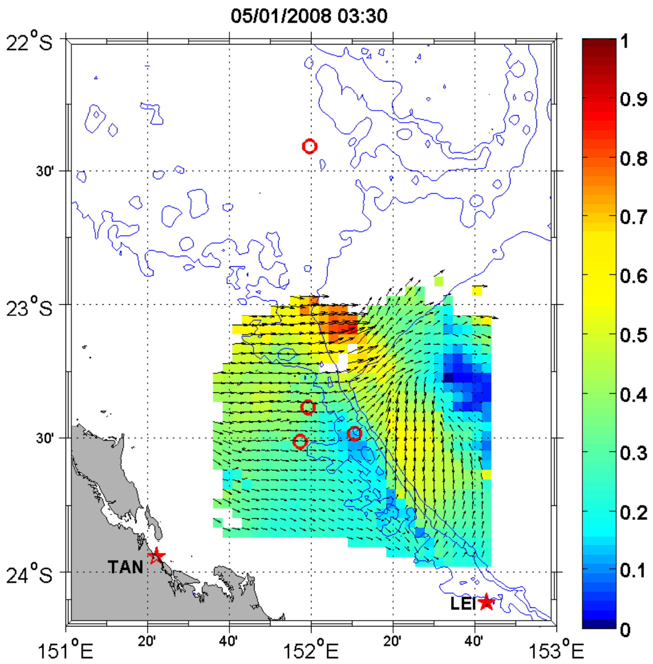

Figure 4: Surface currents on 05/01/2008 @ 03:30.

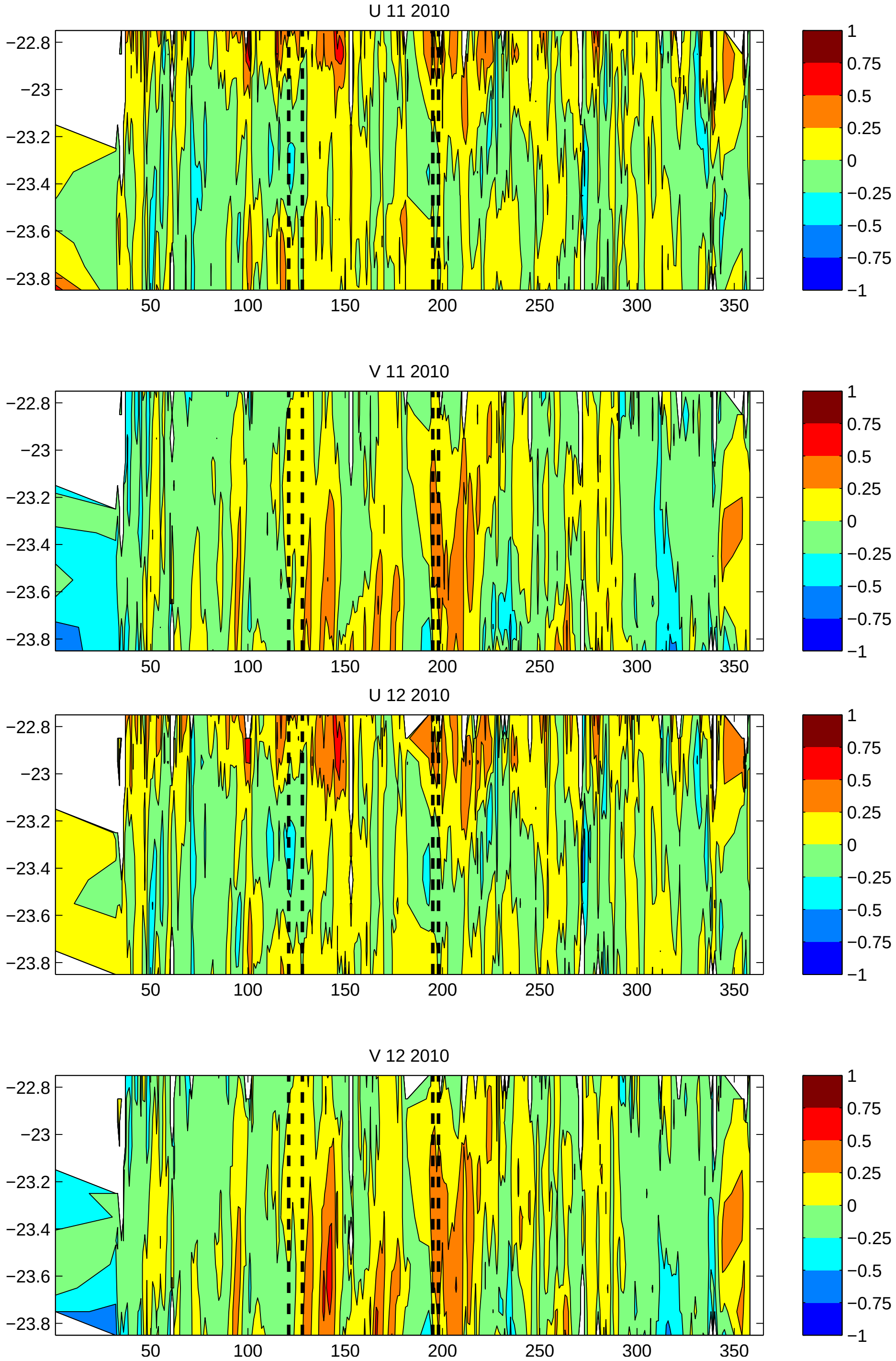

Figure 5: 2010 U and V components for daily averages over 152.5°E to 152.6°E. (above) and 152.6°E to 152.7°E (below).

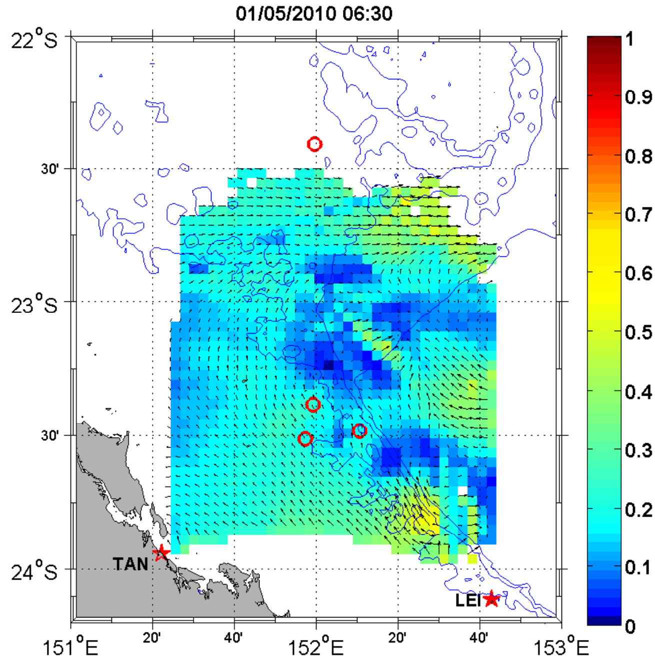

Figure 6: Surface currents on 01/05/2010 @ 03:30.

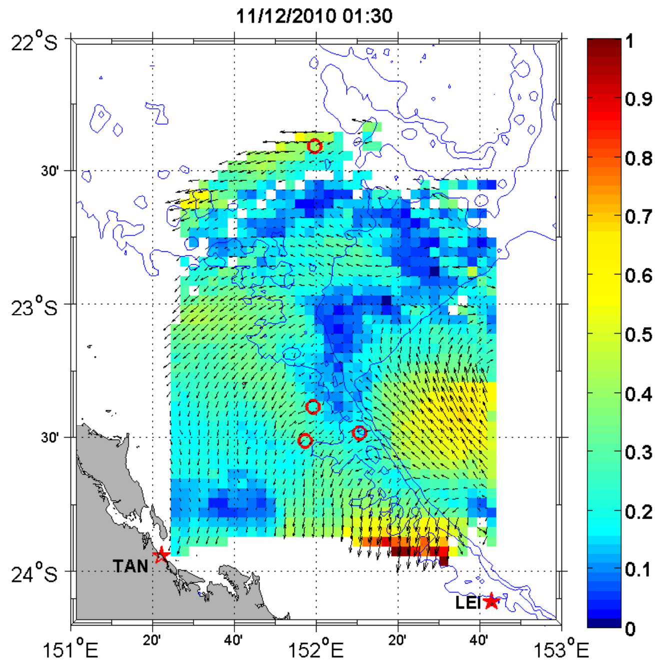

Figure 7: Surface currents on 11/12/2010 @ 01:30.

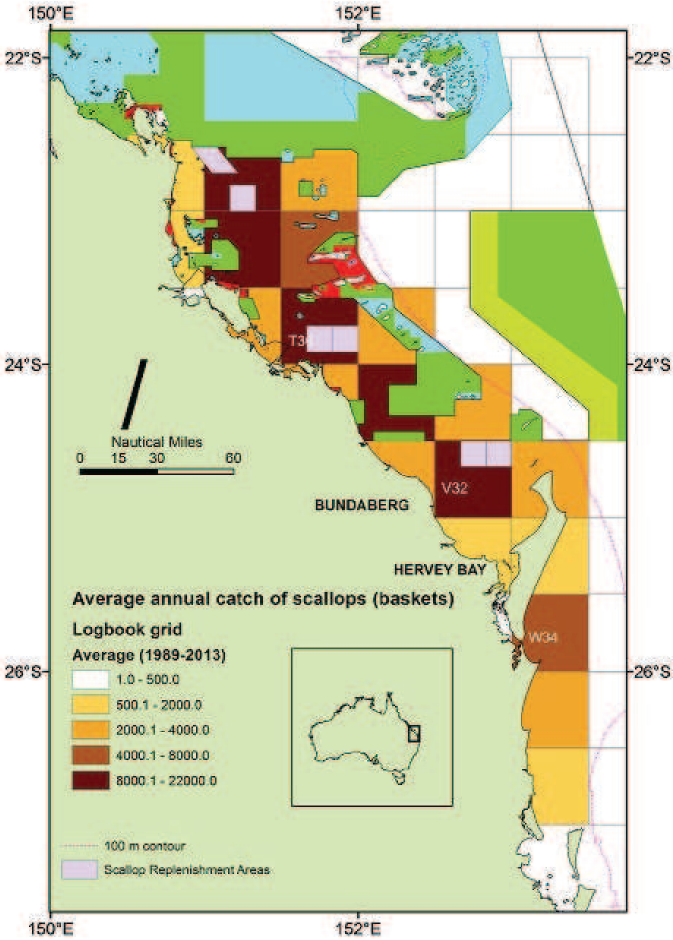

Figure 8: Average annual scallop catch for 1989 to 2013.