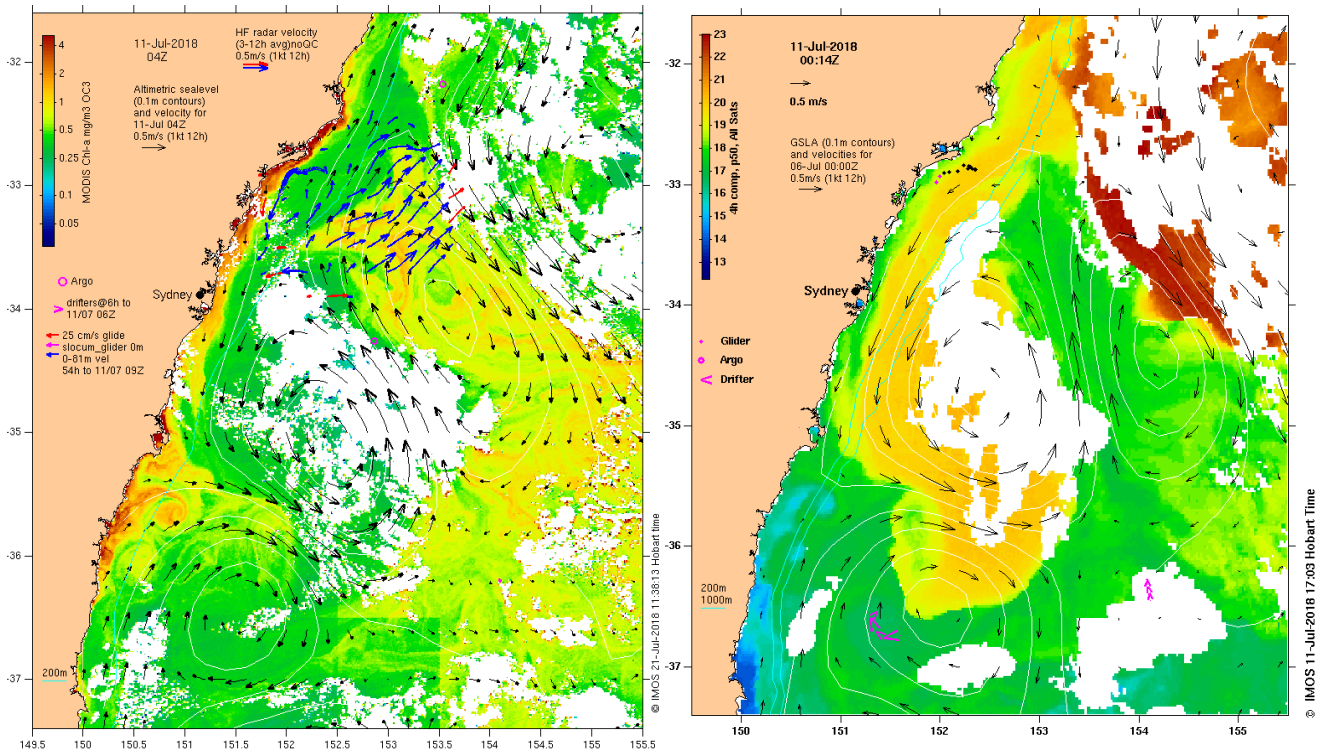
Biogeochemical characteristics and impacts of cyclonic eddies in the East Australia Current System



Brief description of the Project:

Cyclonic eddies are frequent features of the East Australian Current (EAC) system, particularly within the increasingly energetic eddy field south of the typical EAC separation zone (Everett et al., 2012; Li et al., 2022; Malan et al., 2021). Large anticyclonic eddies shed from the EAC have been extensively studied (e.g., Li et al., 2021; Oke et al., 2019; Pilo et al., 2015; Rykova & Oke, 2022) and are projected to increase in number and intensity in the EAC southern extension (Oliver et al., 2015). However, cyclonic eddies have received less attention, and their physical and biogeochemical characteristics remain comparatively poorly understood (Everett et al., 2012; Schaeffer et al., 2017). Previous work on cyclonic frontal eddies has demonstrated their ability to entrain productive shelf waters, uplift isopycnals and nutriclines, enhance chlorophyll-a, and retain planktonic communities (Everett et al., 2015; Mullaney & Suthers, 2013; Suthers et al., 2023). Likewise, larger cold-core cyclonic eddies

can drive strong vertical displacements, upwelling, and enhanced chlorophyll (Everett et al., 2012; Macdonald et al., 2016). However, the broader population of cyclonic eddies, their biogeochemical characteristics, and their role in driving northward flow along the shelf remain poorly understood.

This honours project will investigate the biogeochemical implications of cyclonic eddies in the eddy-dominated region of the EAC separation zone, giving special attention to the region south of 35°S. The study will primarily use available in situ observations, including Argo profiles, glider deployments, and ship-based oceanographic surveys, together with satellite observations. Where observational coverage is insufficient to resolve eddy structure or evolution, output from a 20-year ROMS simulation coupled to the bio_Fennel biogeochemical model (Rocha et al., 2019) may be used to provide complementary dynamical and biogeochemical context.

The student will identify cyclonic eddies and examine their three-dimensional physical and biogeochemical structure, including temperature, salinity, nutrients, chlorophyll-a, vertical circulation, and water-mass signatures. A key objective will be to assess whether these eddies enhance northward flow along the shelf and contribute to the northward advection of Tasman Sea and Bass Strait waters. Remote-sensing products, including sea surface temperature, ocean-colour chlorophyll-a, conventional sea-surface height, and higher resolution SWOT data will be used to identify and characterise eddy surface signatures. Argo floats, gliders, and ship-based observations will provide information on their vertical structure, while model output may be used to investigate processes that cannot be adequately resolved from observations alone.

Skills you will learn:

The student will gain knowledge of cyclonic eddy dynamics and submesoscale biogeochemical processes in the EAC system. They will develop skills in processing and analysing in situ observations, satellite remote-sensing products, and large output datasets from a coupled physical–biogeochemical ocean model. Coding in Python will be central to the project, particularly for working with multidimensional NetCDF datasets, developing reproducible analysis workflows, and producing scientifically accurate figures. The student will also develop scientific communication skills through written and oral presentation of the results.

Background / interest needed

The student should be comfortable coding in Python and have an interest in physical oceanography, marine biogeochemistry, ocean modelling, or marine ecosystems. Experience with NetCDF files, xarray, Linux/bash, or high-performance computing environments would be useful, but not required.

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