Assessing predictions of ocean eddy subsurface structure: A case study in an eddy-rich region over a period of unprecedented data richness (Sept-Nov 2023)

Mesoscale eddies are the “weather” of the global oceans with a myriad of societal and environmental impacts, such as weather, climate, marine ecosystems, fisheries, navigation and search and rescue. These eddies can extend up to 1000m deep and have complex vertical structures with implications for ocean productivity, underwater acoustics, heat transport within eddies, and the prediction of marine heatwaves. Despite the significance of eddy subsurface structure, most ocean prediction efforts have typically focussed on the ocean’s surface. Here we present new insights into eddy structure in the East Australian Current (EAC) gained by combining a state-of-the-art numerical model with ocean observations over a period of unprecedented data richness (Sept-Nov 2023). These include observations from the Surface Water and Ocean Topography (SWOT) mission, providing the first ever synchronous 2D maps of sea-surface height, and observations collected by the Marine National Facility (MNF) Research Cruise, providing the most comprehensive 3-dimensional full depth picture of eddy structure and eddy-eddy interactions in a Western Boundary Current. In the EAC region, we use a high-resolution (2.5-6km) numerical ocean model and 4-dimensional variational data assimilation (the South East Australia Forecasting System) to model the eddy-rich region. We begin by comparing our model predictions that assimilate traditional data streams: satellite derived SST and SSH and (sparse) profiling floats, with the new observations in the context of surface and subsurface eddy structure. Through a comprehensive comparison against assimilated and independent observations we assess the system performance in representing subsurface eddy structure and motivate further system improvements for better subsurface predictions. Preliminary results towards the challenge of assimilating the spatially-dense and temporally-sparse SWOT data, and how this translates below the surface, are also presented.

Colette Kerry1, Moninya Roughan2 , Shane Keating1, Presenting author’s e-mail: c.kerry@unsw.edu.au 1 School of Mathematics and Statistics, UNSW, Sydney, Australia 2 School of Biological, Earth and Environmental Sciences, UNSW, Sydney, Australia