

Gliders reach places other techniques cannot....



Professor Karen J Heywood

Centre for Ocean and Atmospheric
Sciences (COAS)
School of Environmental Sciences
University of East Anglia

k.heywood@uea.ac.uk

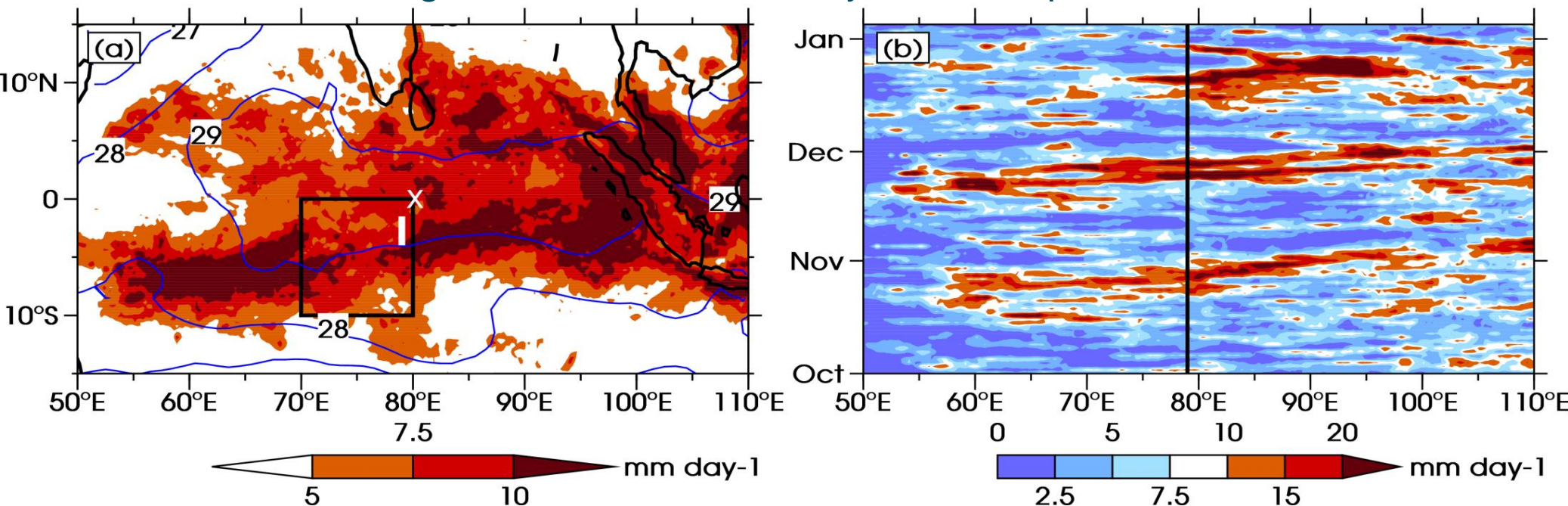
www.ueaglider.uea.ac.uk

1. Indian Ocean
2. Antarctica
3. Indian Ocean

CINDY/DYNAMO 2011/12 study area

Climate and Madden Julian Oscillation (MJO) variability

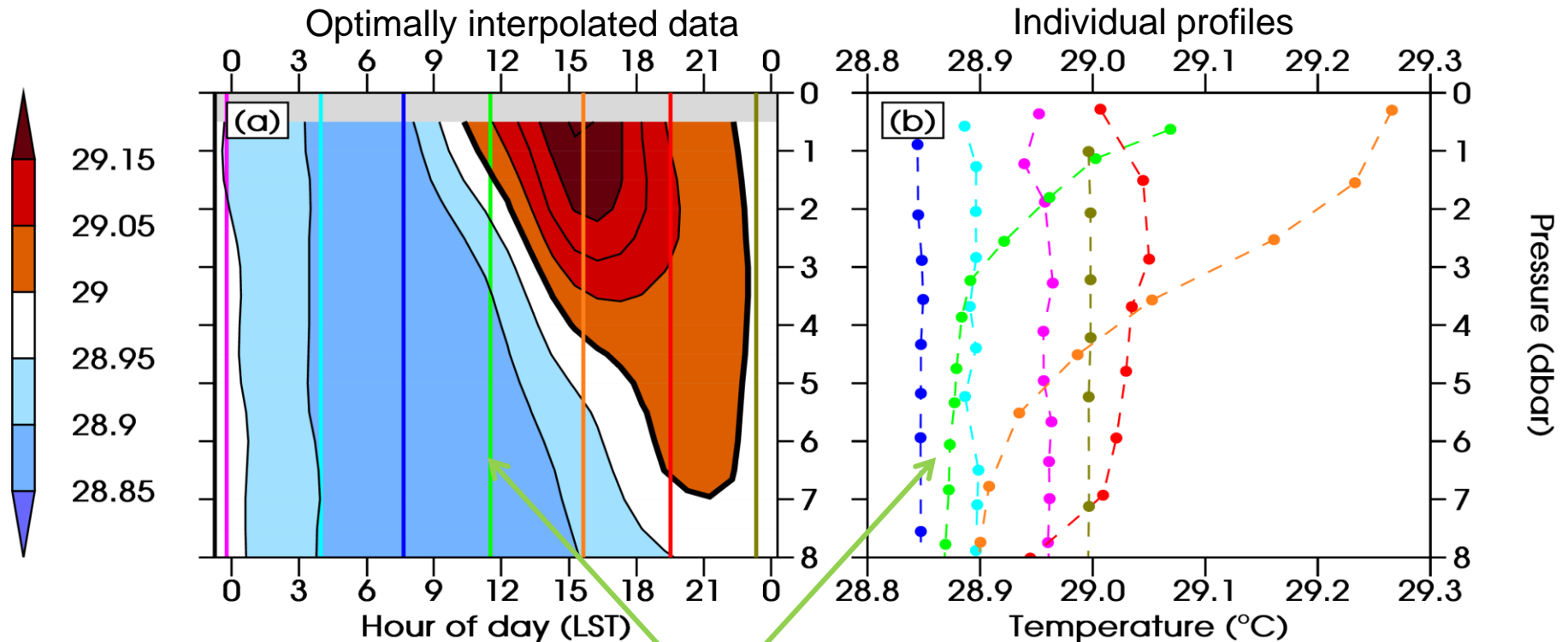
- ✦ Glider deployed at heart of tropical warm pool in the Indian Ocean
- ✦ ~100 days measurements
- ✦ Highly stratified, especially near-surface which is challenging to measure
- ✦ 3 MJO events in study period
- ✦ Different regimes in which diurnal cycle develops



Glider profiles and optimal interpolation

Diurnal warm layer

Sample day: 3 December 2011

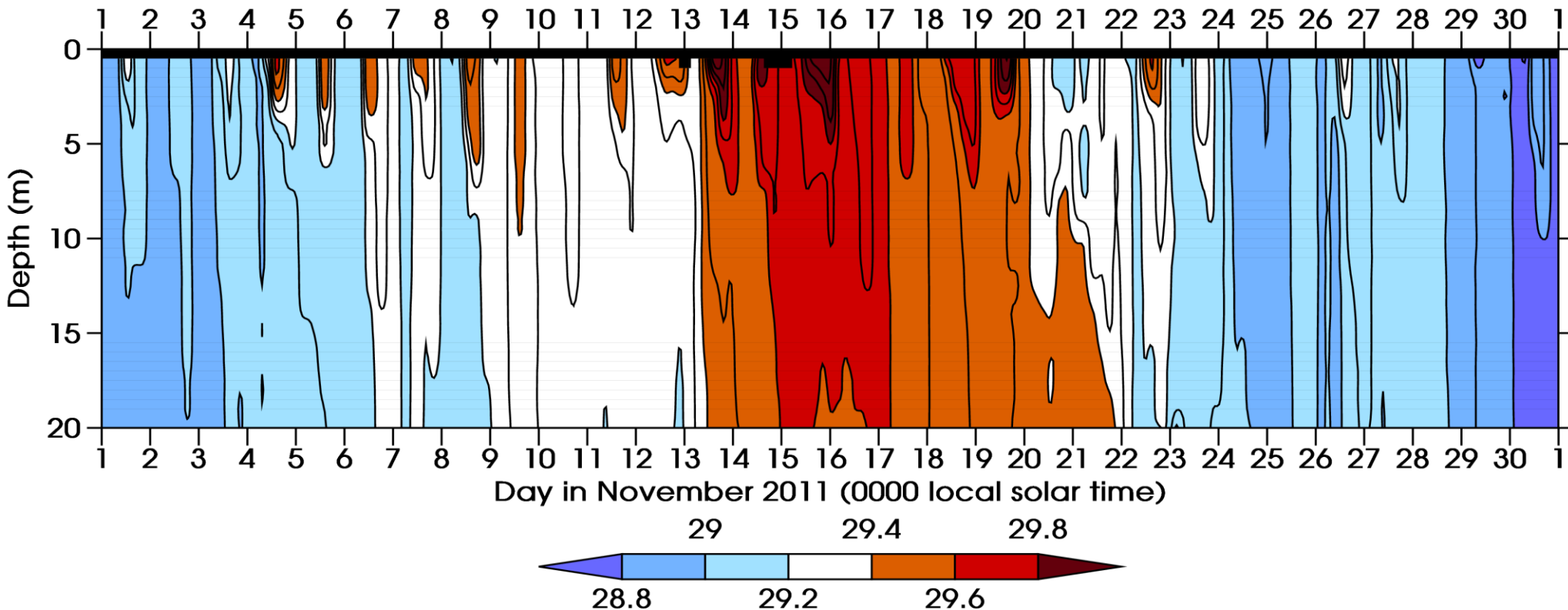


Time of day of individual profiles
shown by line of same colour in
optimal interpolated data

Temporal variability

Sample month: November 2011

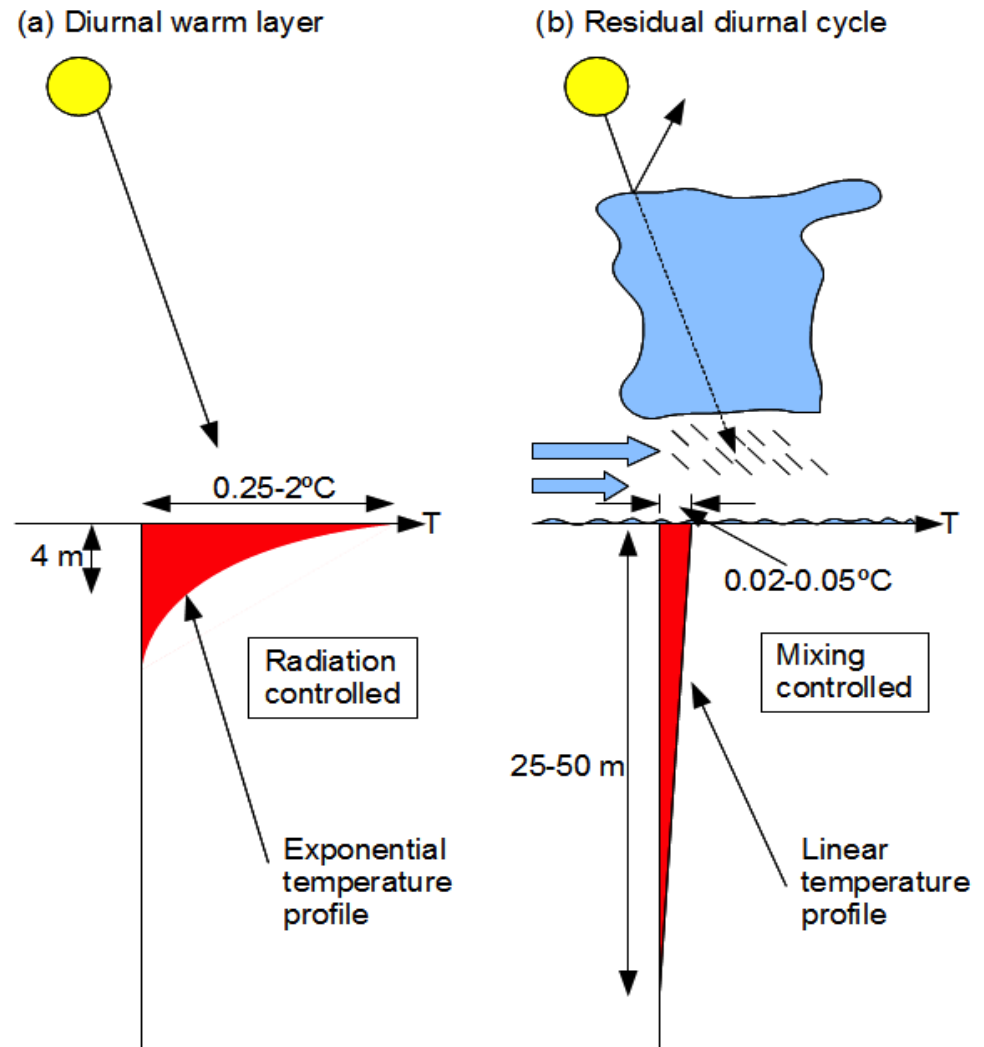
- ✦ Intraseasonal variability, Madden Julian Oscillation
- ✦ Ubiquitous diurnal variability



Gliders get closer to the sea surface

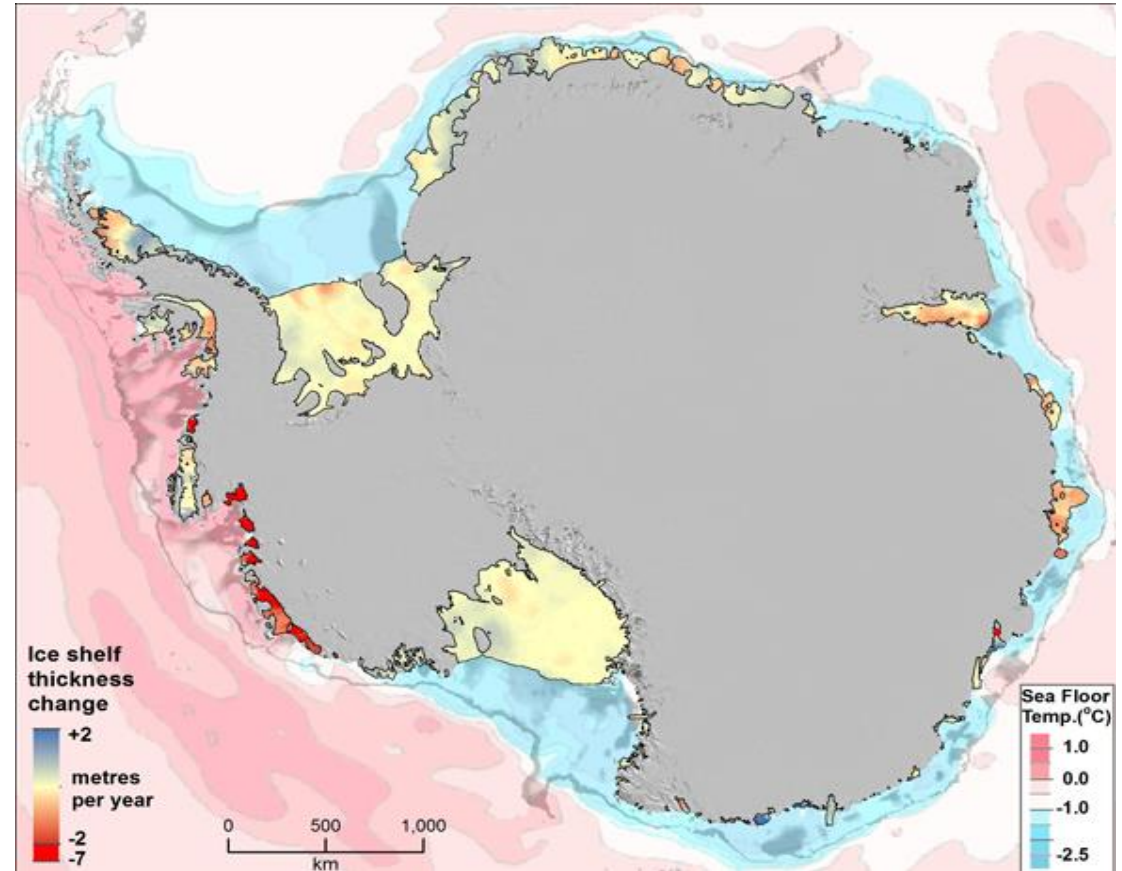
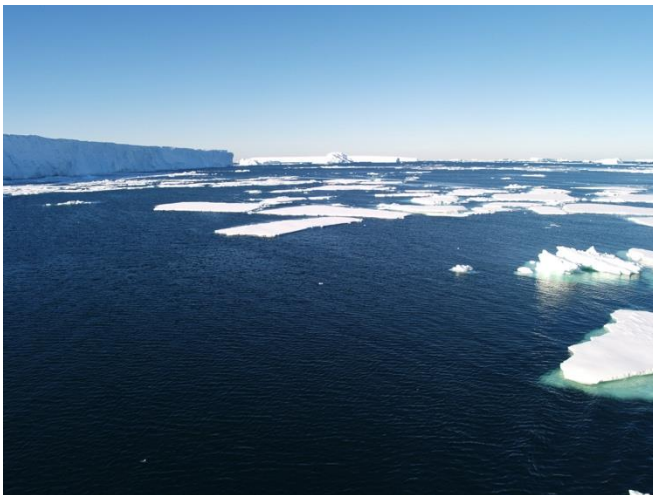
- ✦ Glider data used to develop model of diurnal warm layer
- ✦ Two regimes of diurnal cycle of ocean surface boundary layer
- ✦ Diurnal surface warm layer leads to cooling of ocean ($\sim 4 \text{ W m}^{-2}$)
- ✦ Not resolved in many climate models; a significant omission of ocean to atmosphere heat flux

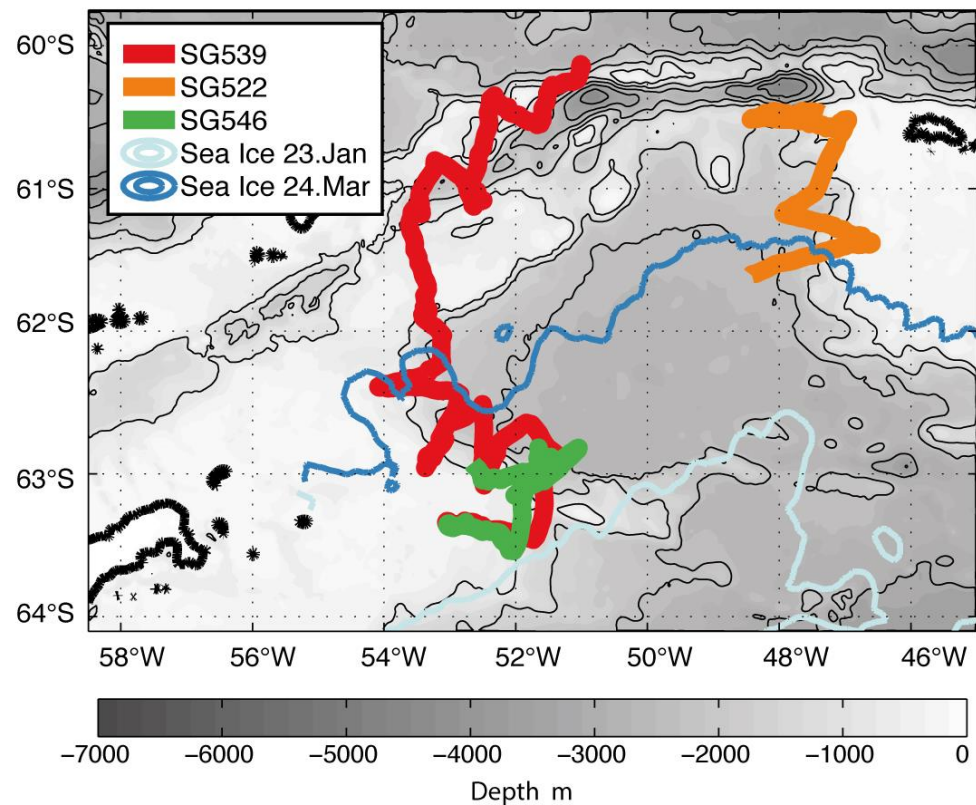
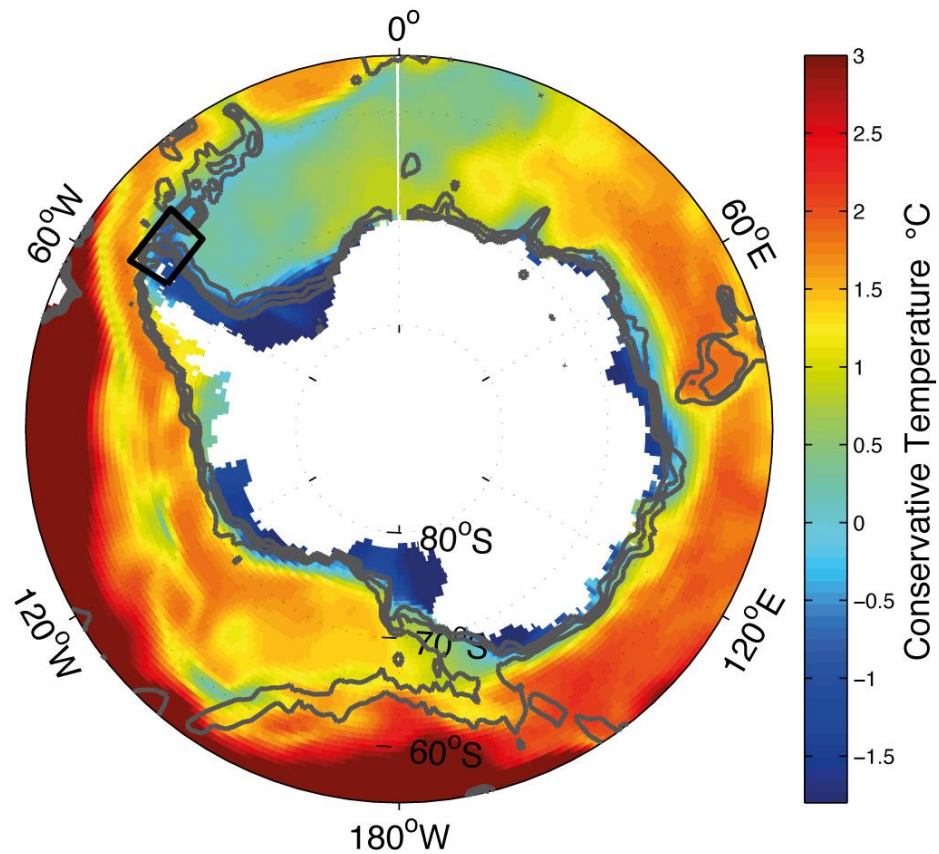
Matthews et al. (2014) *Journal of Climate*



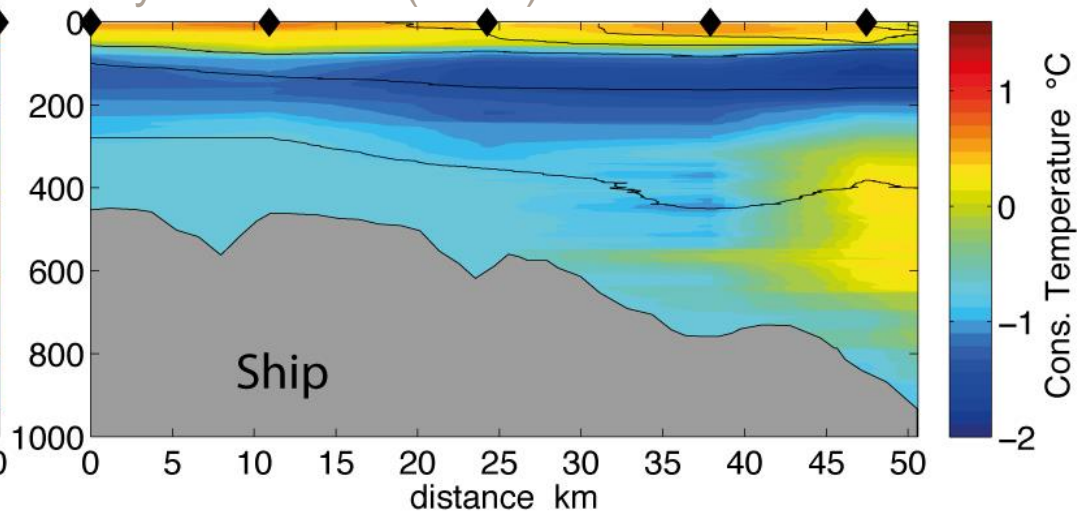
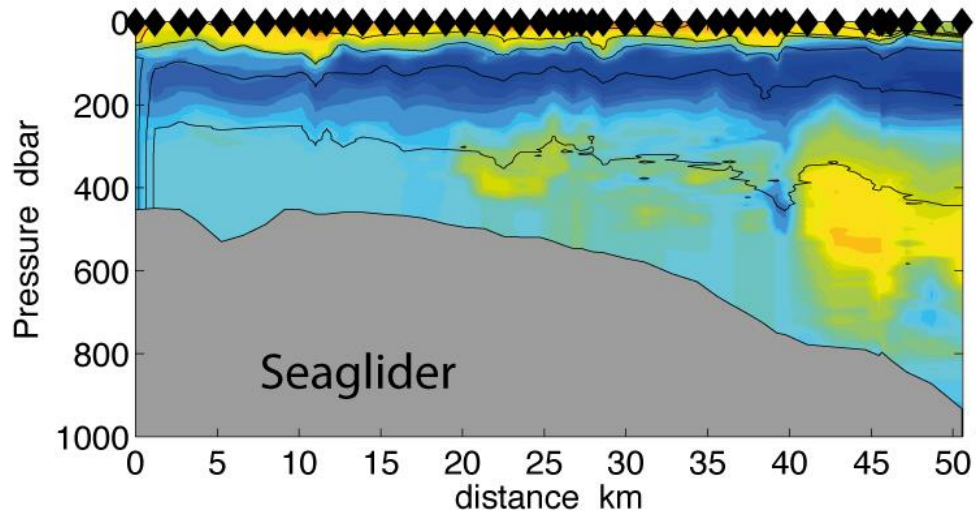
Using gliders to study processes behind sea level rise from Antarctic ice melt

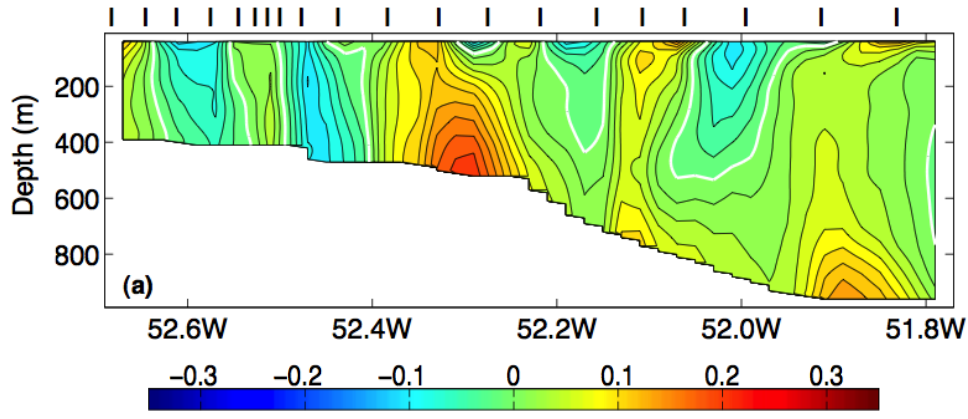
- ✦ The ocean is implicated in the increased melting of Antarctic ice sheets
- ✦ How does the warm water offshore get onto the continental shelf to reach the ice shelves?



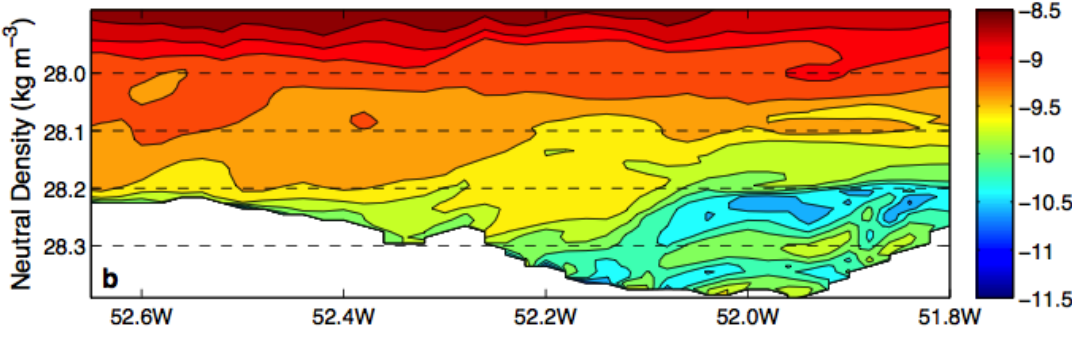
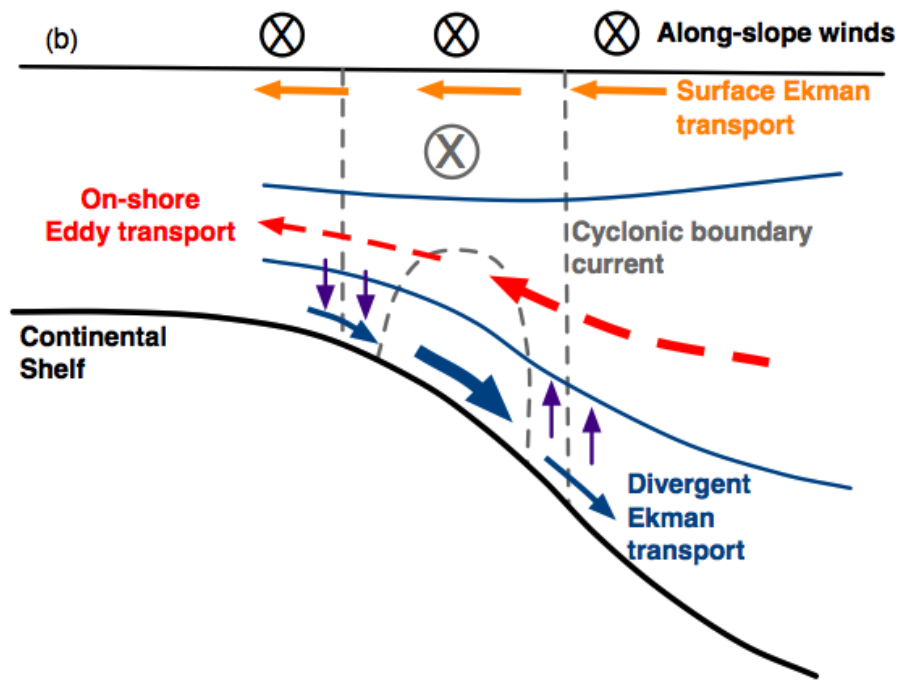
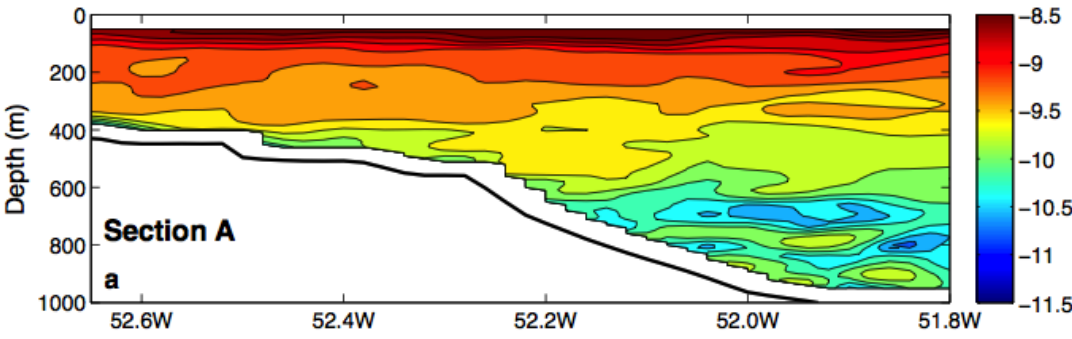


Heywood et al. (2014) *Phil. Trans. R. Soc. Lond*



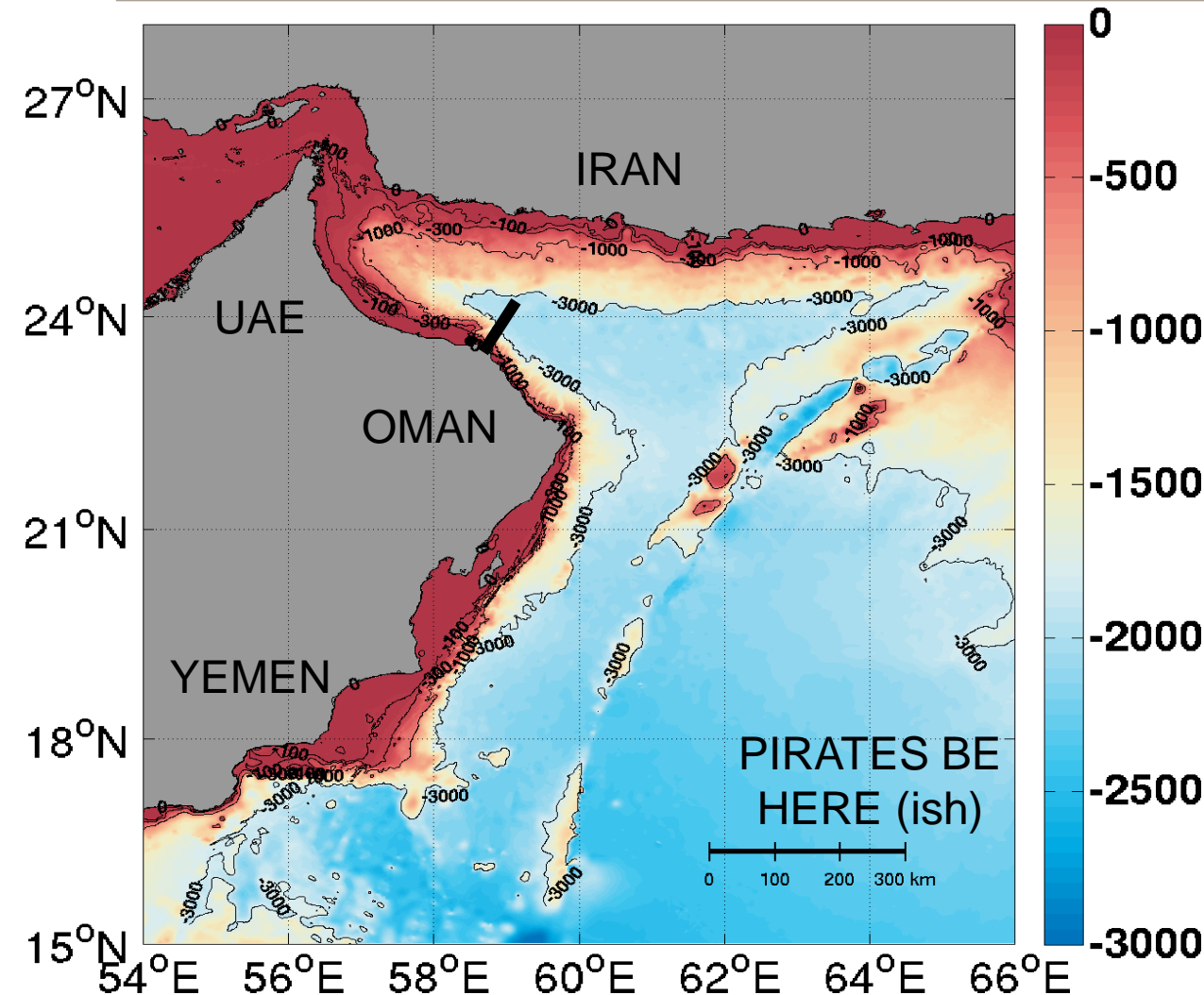


- ✦ Glider-observed density and velocity used to calculate potential vorticity
- ✦ Thickness of layers reveals onshore transport of water across the slope front by eddies



Gliders are ideal for piracy regions

Glider deployed off Oman since March 2015

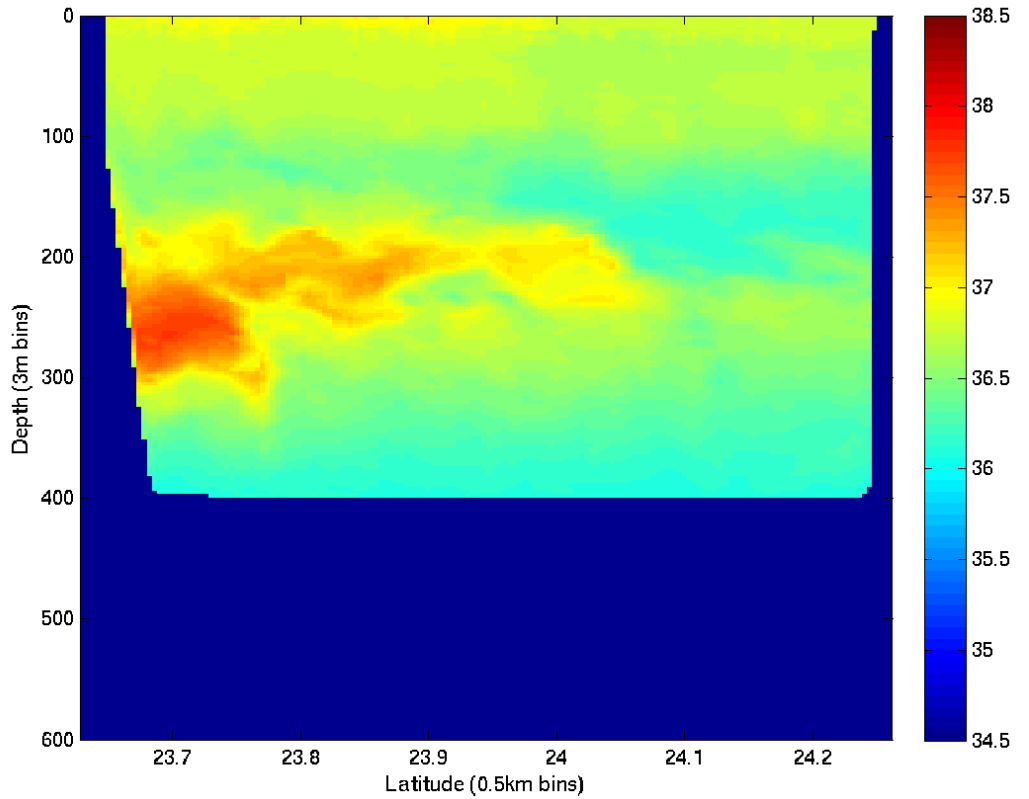
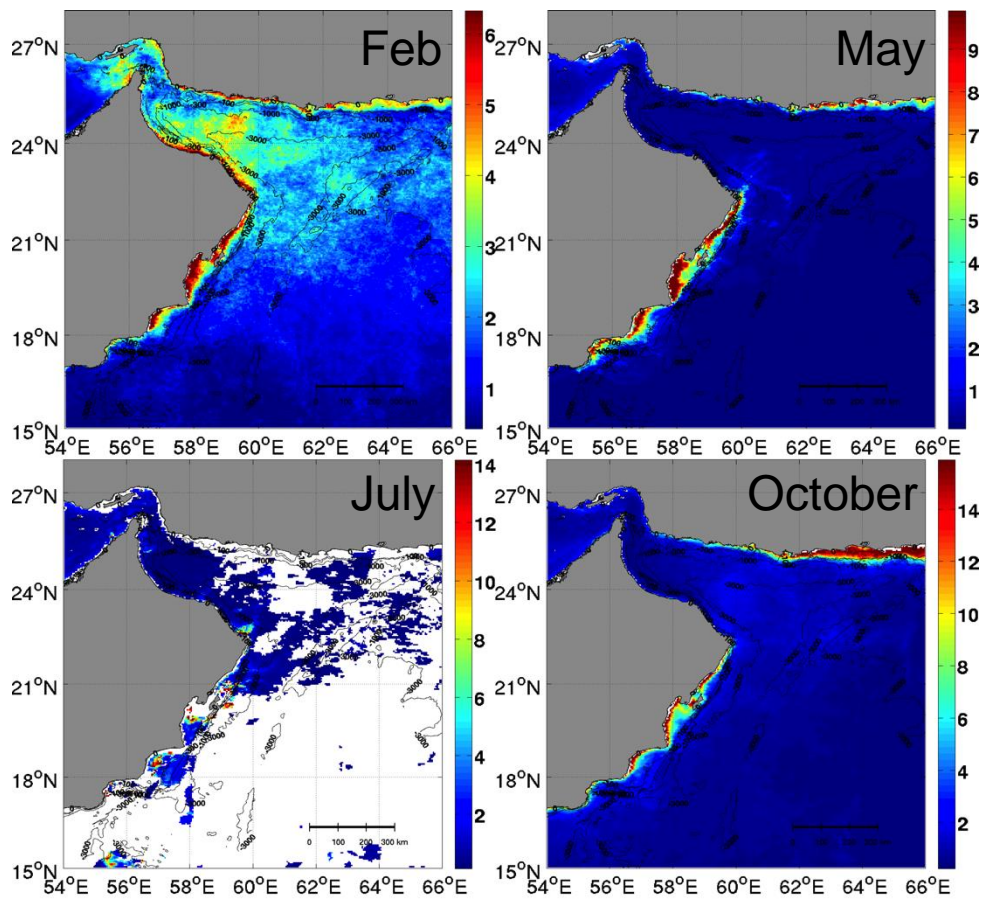


- ✦ Collaboration with SQU
- ✦ Bioluminescence
- ✦ Harmful algal blooms and low oxygen events
- ✦ Glider surveys for ~ 1 year





- ✦ Monsoon cycle of upwelling
- ✦ Gliders are measuring physical and biogeochemical parameters
- ✦ Persian Gulf outflow



Conclusions

Ocean Gliders offer new opportunities

- ✦ Gliders offer the possibility for measurements in locations not otherwise possible
 - ✦ Rough seas and weather
 - ✦ Polynyas
 - ✦ Regions afflicted by piracy or wars
 - ✦ Close to the sea surface
 - ✦ Remote locations
- ✦ Quickly and easily deployed from any platform: large/small ships, workboats, sea ice,....so can react to emergencies or opportunities
- ✦ Piloting just requires a laptop or phone, anywhere; no large infrastructure needed
- ✦ Up to ~9 months surveying the ocean at high resolution temporally and spatially
- ✦ Quiet for detecting marine life or noise
- ✦ Great potential for multidisciplinary science
- ✦ Importance of new sensor development and trials, e.g. carbon
- ✦ Glider community is growing, and keen to collaborate and share expertise.
- ✦ Likely to be a key contribution to ocean observing systems such as SOOS

