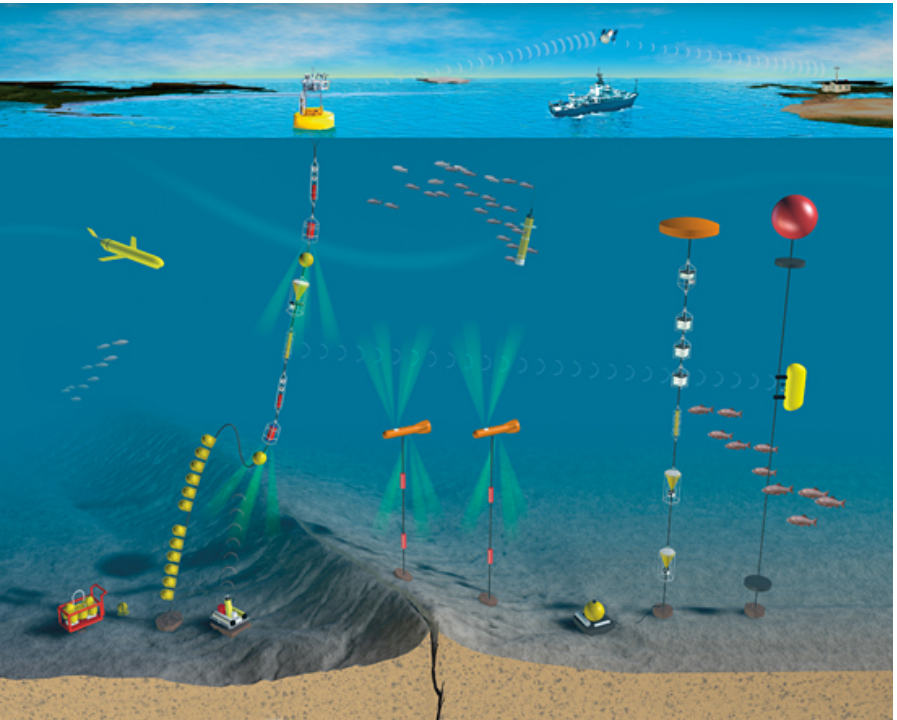
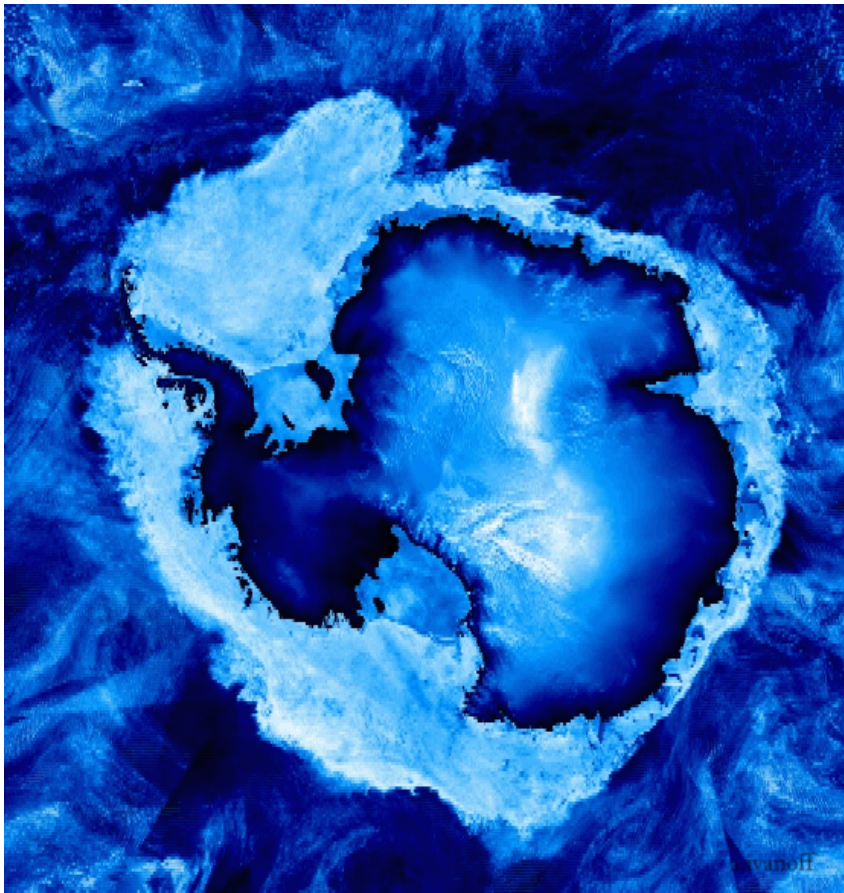
OASIIS workshop
Bremerhaven June 2017

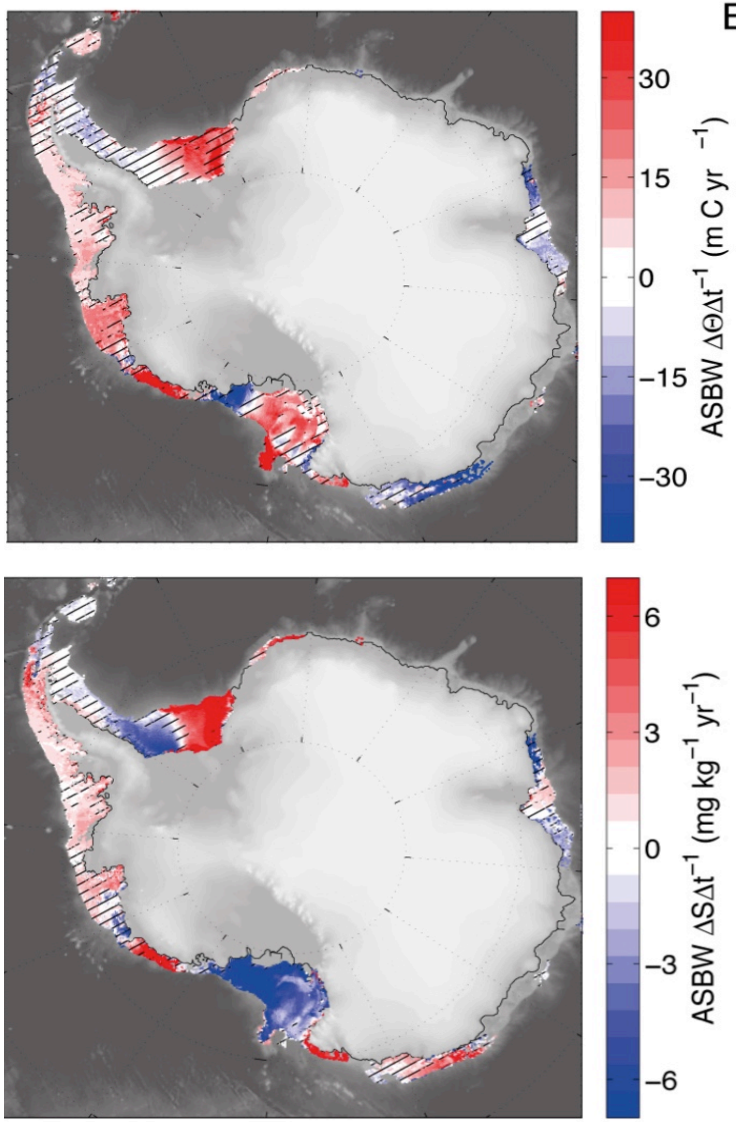
Centre for Ocean and Atmospheric Sciences
University of East Anglia

How do we get year-round measurements on the Antarctic continental shelf?

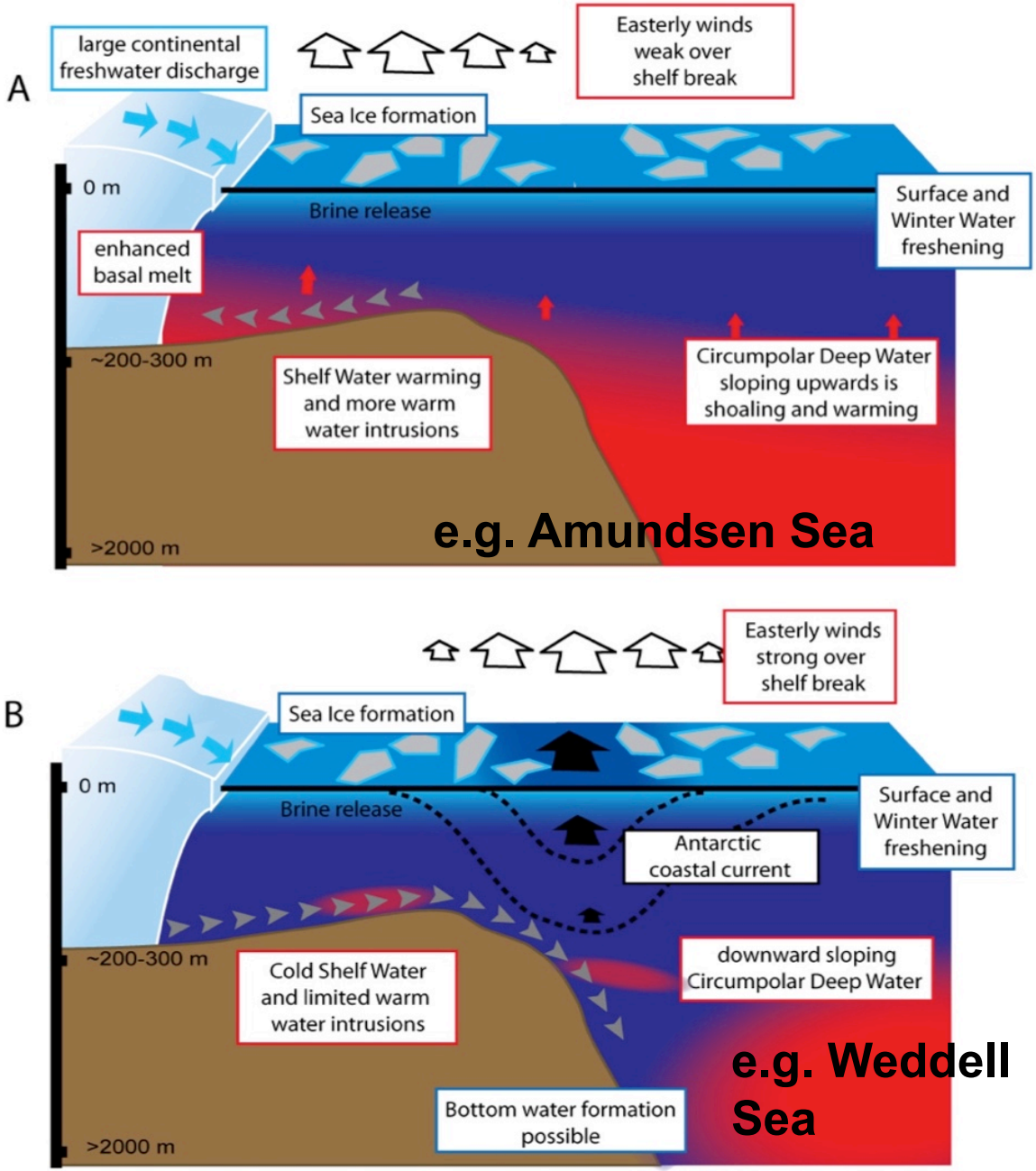
Karen Heywood k.heywood@uea.ac.uk

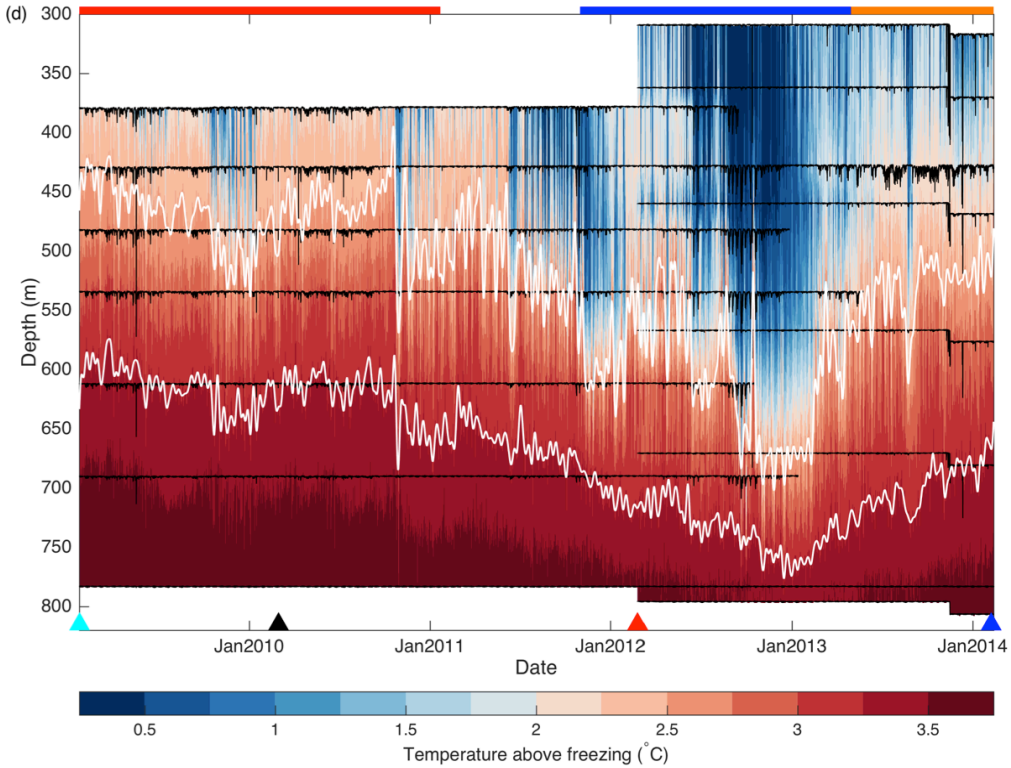






Trends in temperature (top) and salinity (bottom) at sea bed from all available observations (Schmidtko et al. 2014).

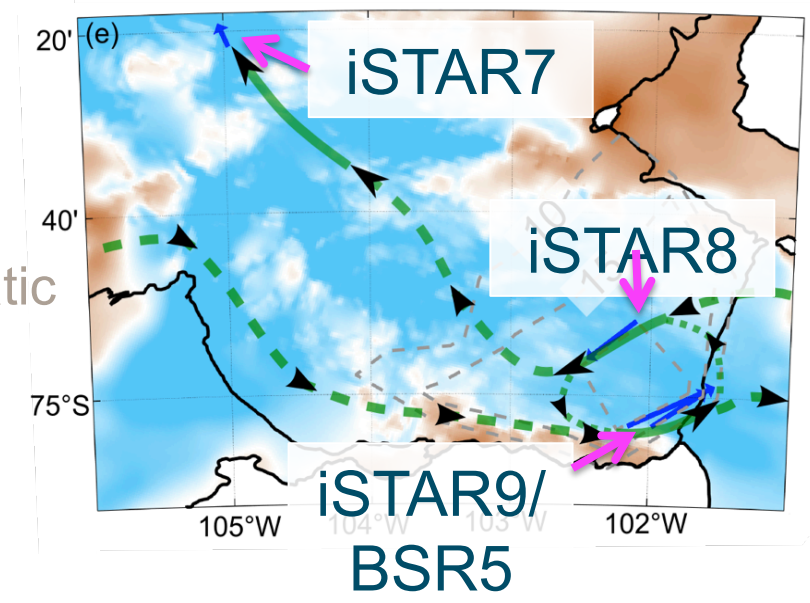


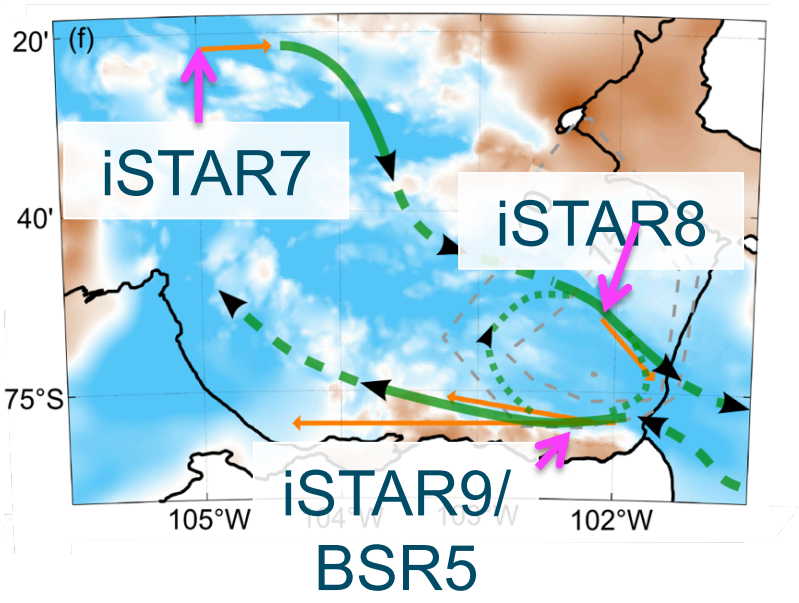


- Moorings give year round measurements and interannual variability
- But we have to avoid instruments within range of icebergs

Webber et al., 2017, Nature Communications

Cold schematic



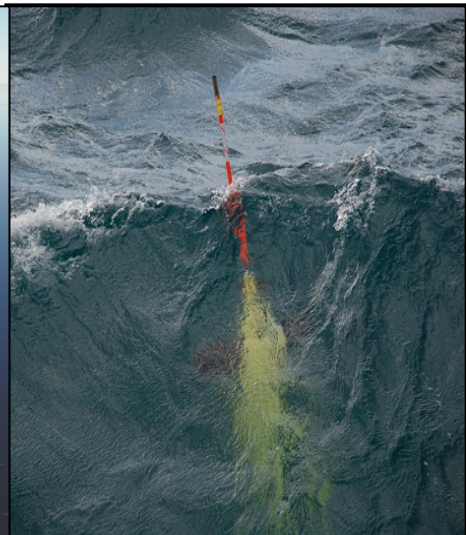


Warm schematic

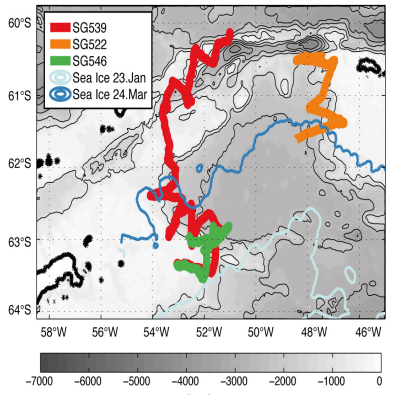
Ocean gliders as part of SOOS strategy

University of East Anglia

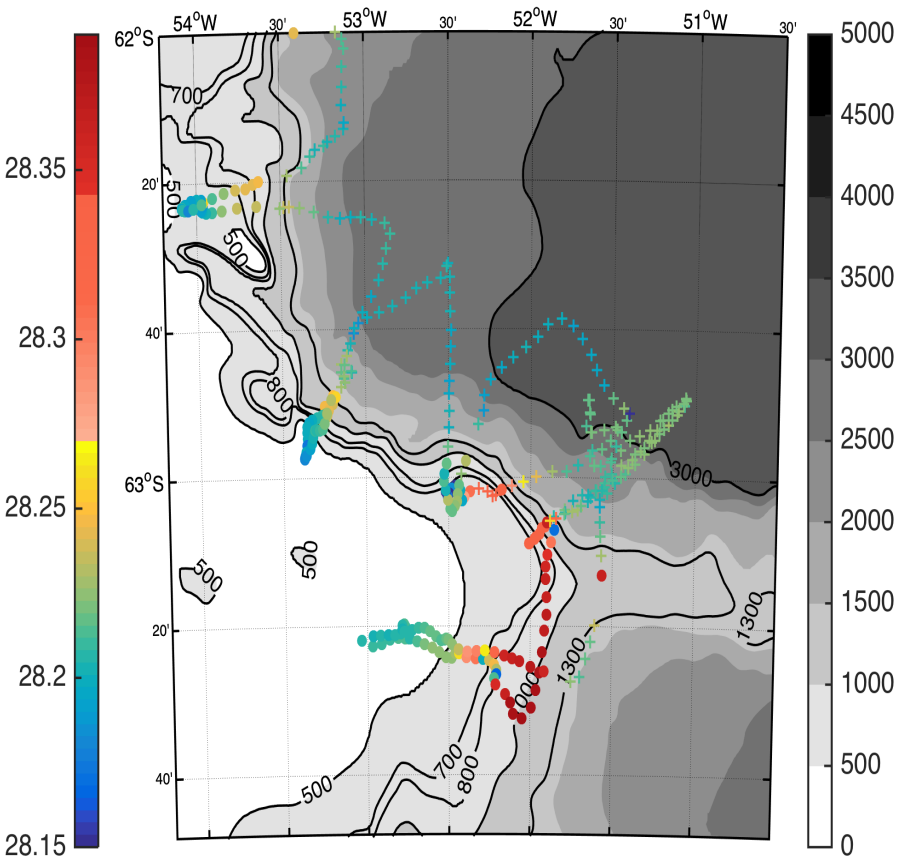
- Gliders offer the possibility for scientific measurements for prolonged periods (~3-12 months) in remote polar locations:
  - rough seas and weather
  - close to calving glacier fronts or icebergs
  - polynyas
  - early and late season
  - Under ice (winter) requires ensonification *(see Craig Lee's talk)*



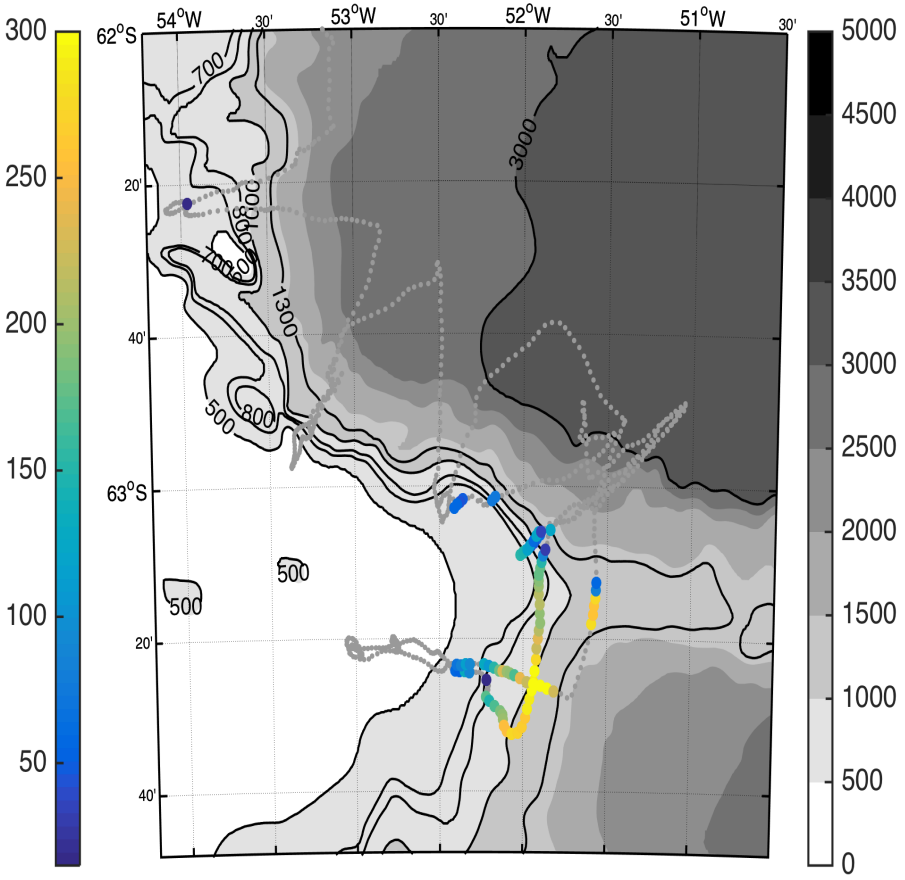
Summer glider measurements of dense water on the slope Northwest Weddell Sea



But not in winter…

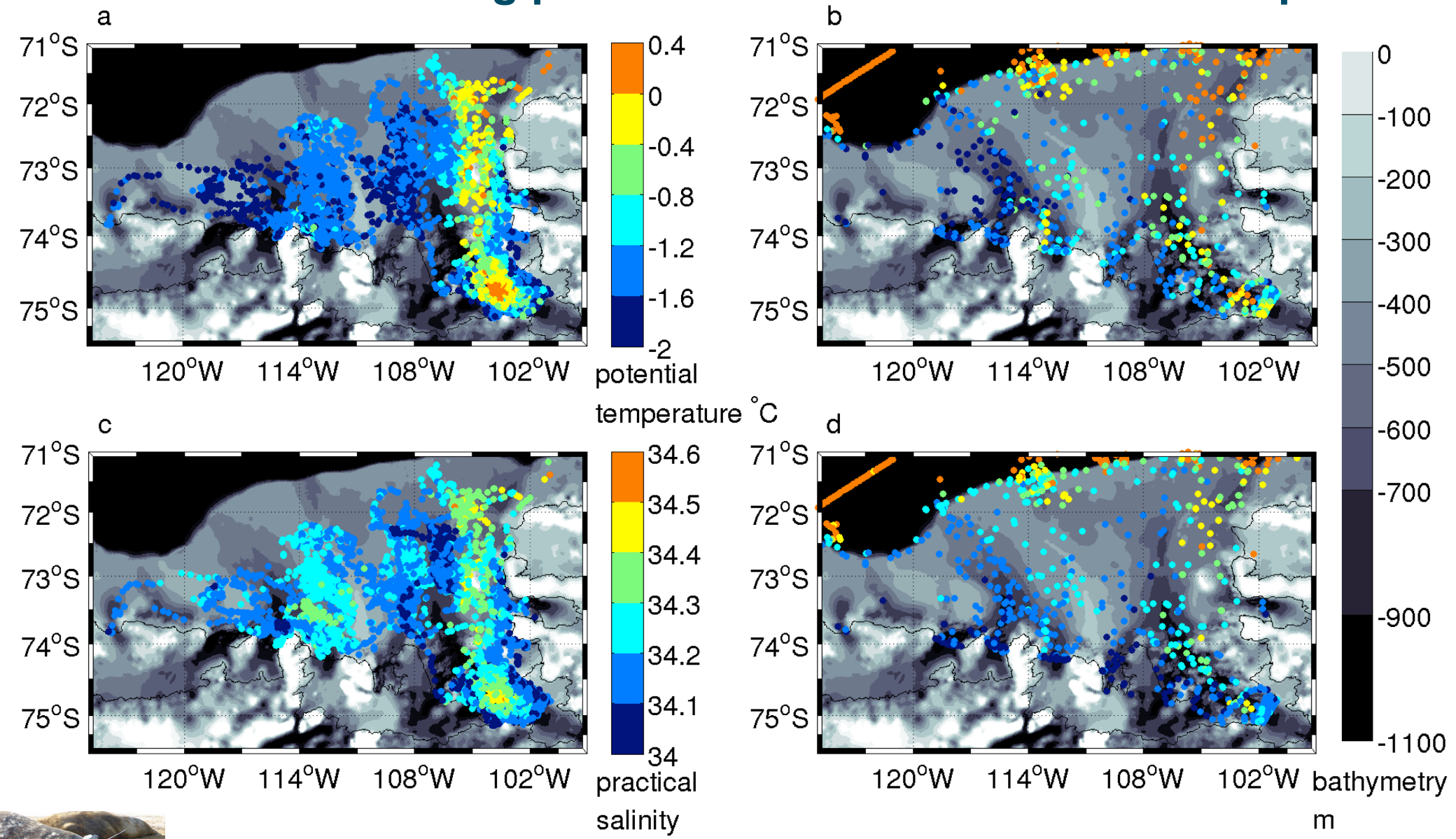


Potential density of the water at the sea bed (circles) or 1000 m (crosses)



Thickness (m) of the layer with neutral density > 28.27

Amundsen Sea seal tag profiles in 2014 and historical CTD profiles

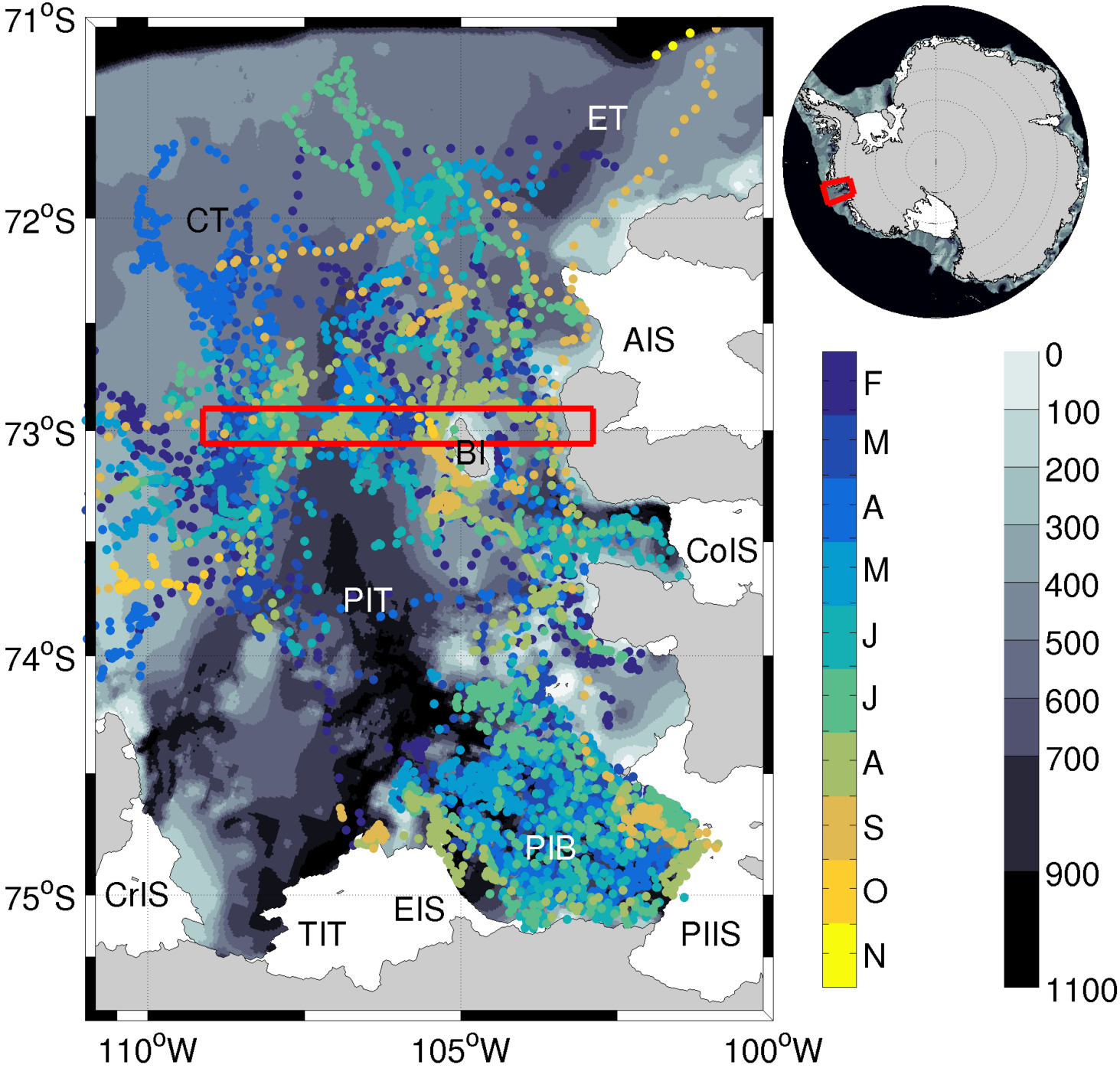


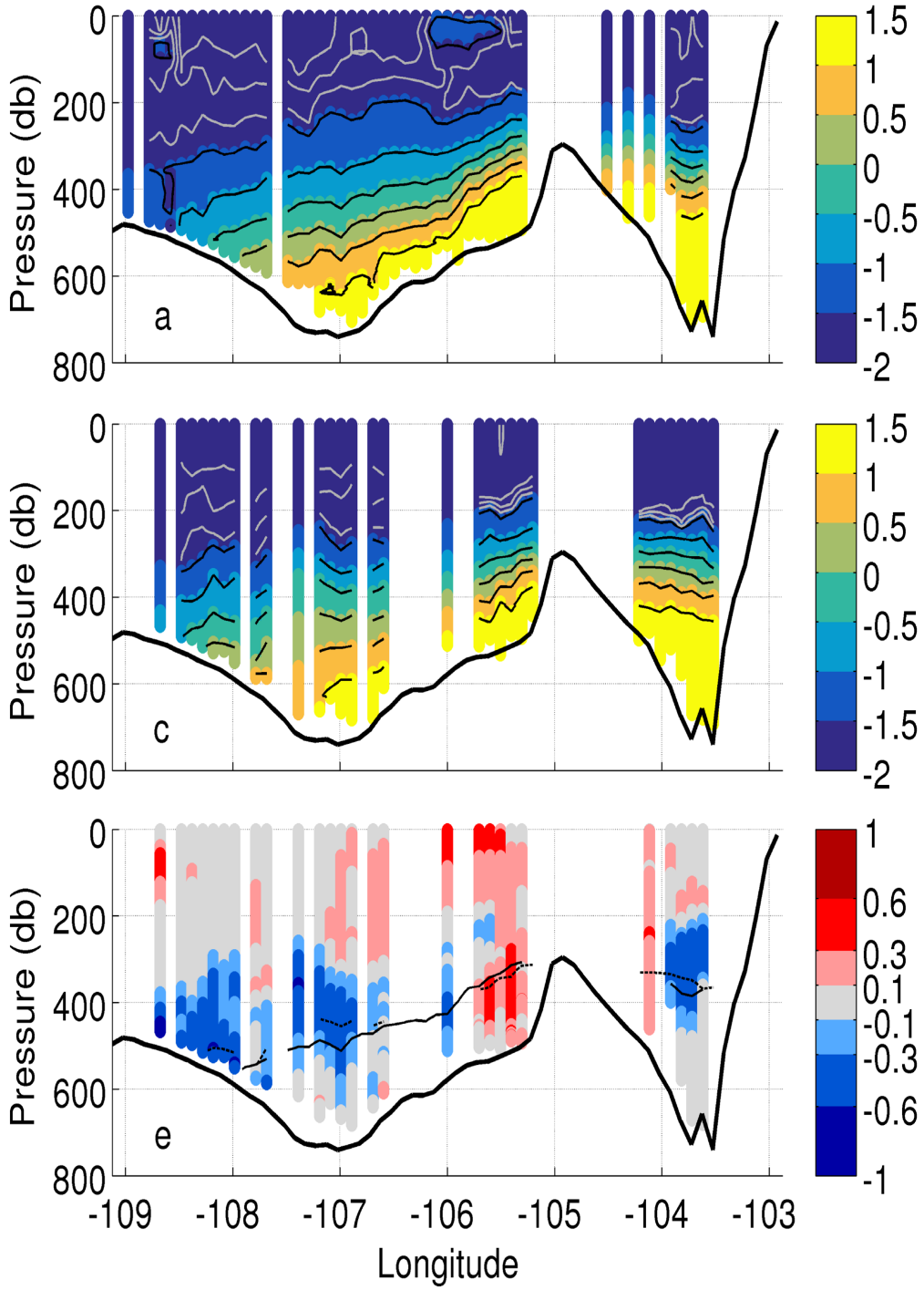
Properties at 300 m

Heywood et al., 2016, *Oceanography*

Amundsen Sea, 2014

> 10000 profiles of temperature and salinity from seal tags



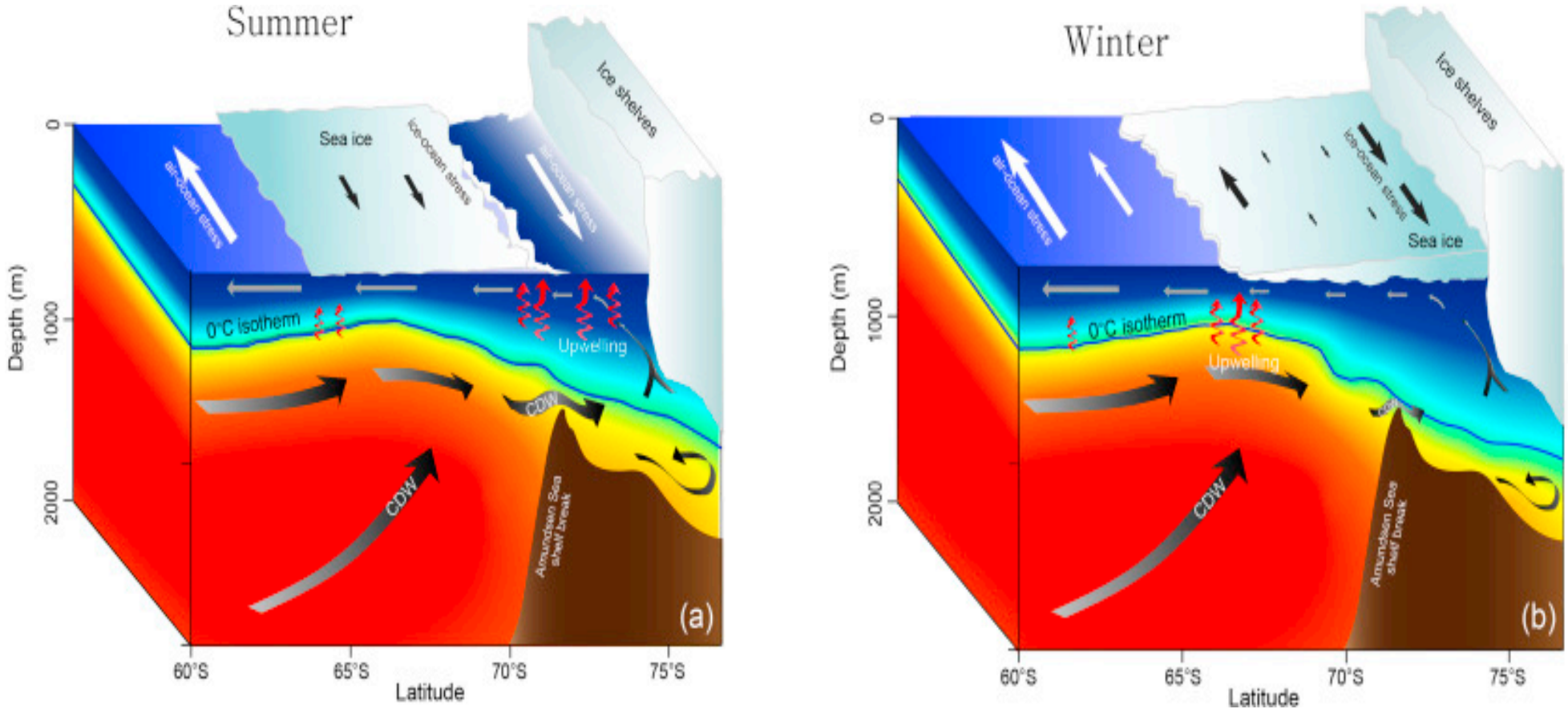


Temperature in summer (FMAM)

Temperature in winter (JJASO)

Summer minus winter

CDW warmer in winter on pressure surfaces.



Not consistent with Dotson Trough further west

Kim et al. (2017) Is Ekman pumping responsible for the seasonal variation of warm CDW in the Amundsen Sea, Continental Shelf Research

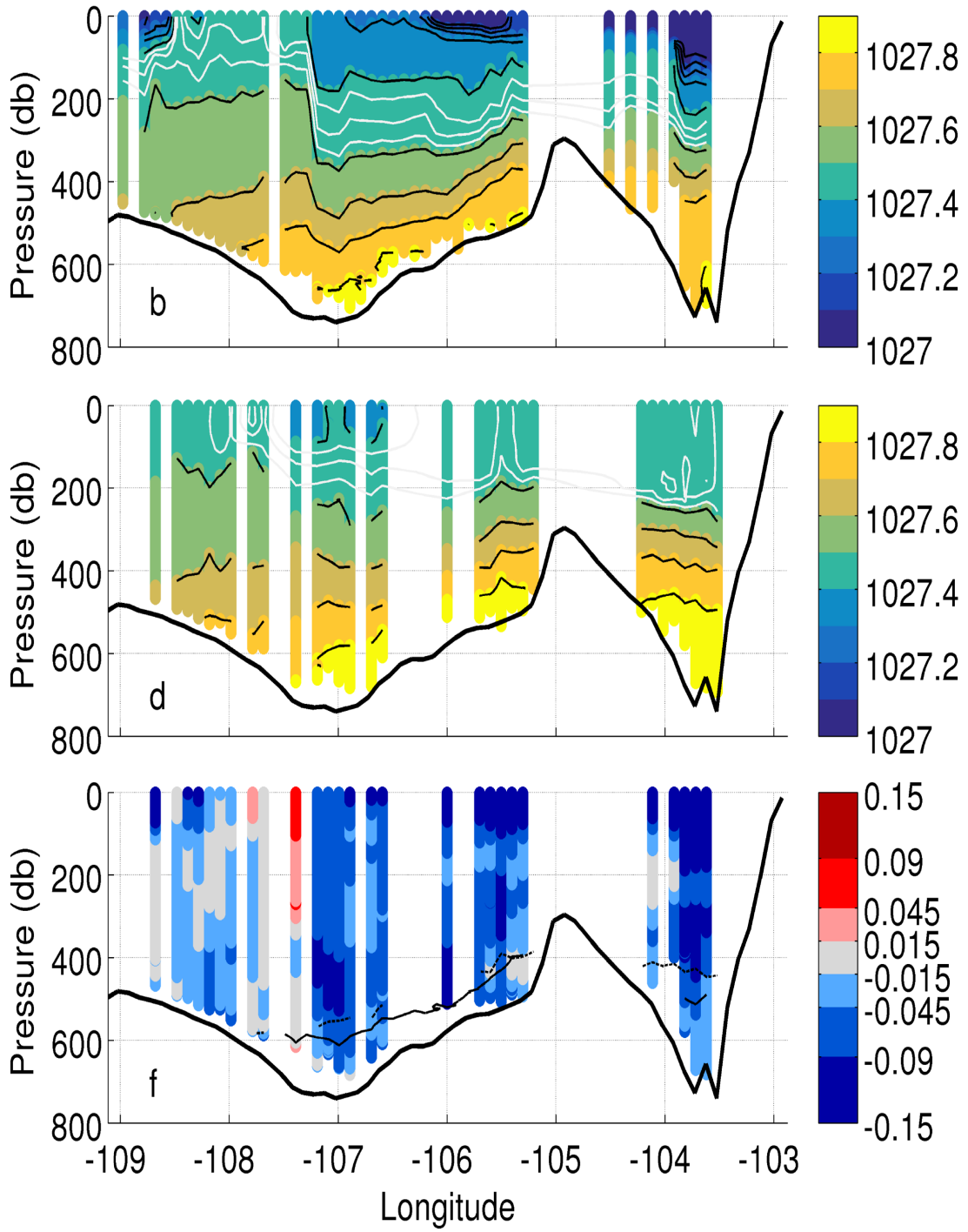
Density in summer (FMAM)

Density in winter (JJASO)

Summer minus winter

Density (and salinity) greater at all depths in winter.

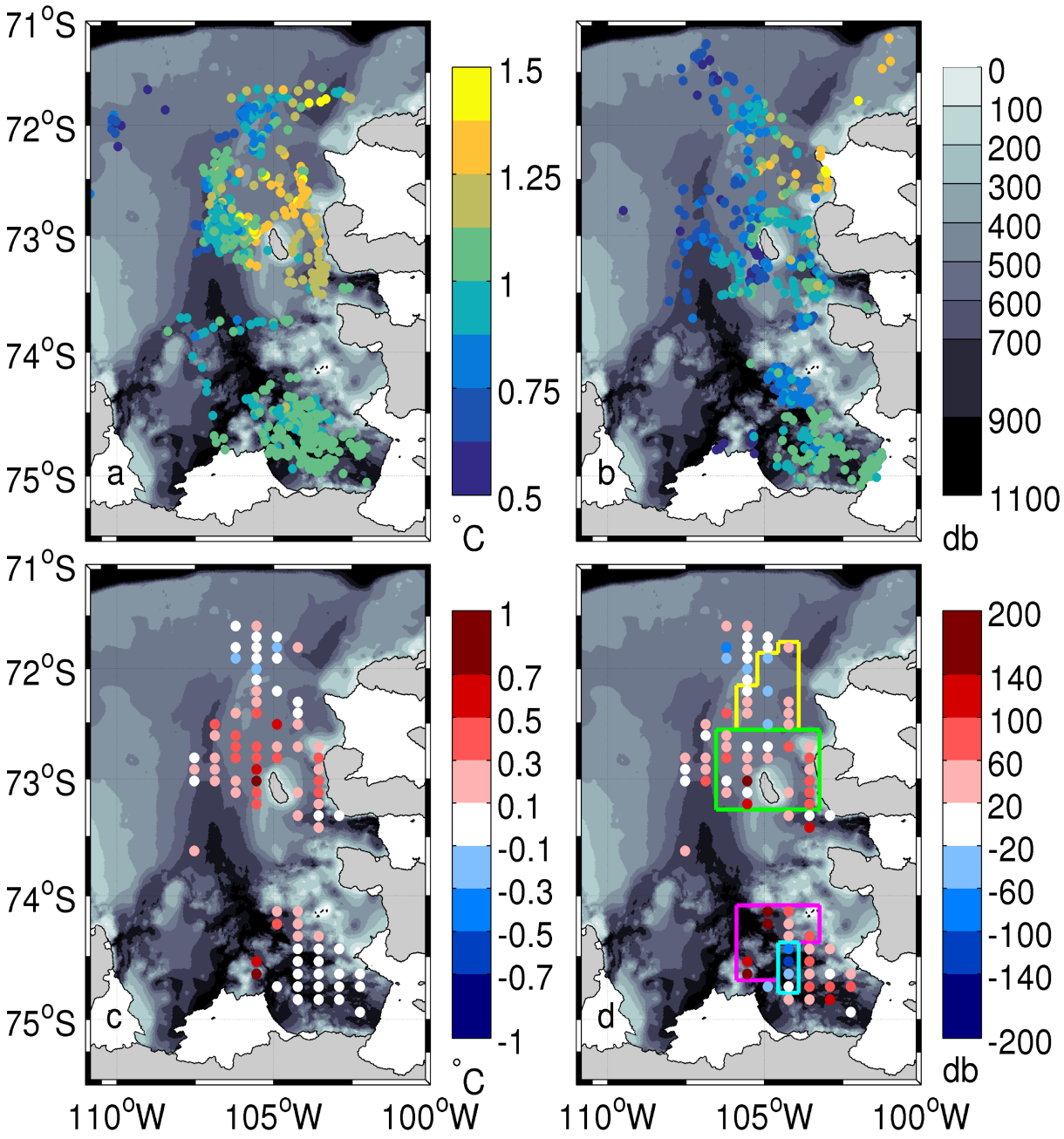
Always stratified.



Temperature on 27.76 isopycnal

Summer (FMAM)

Summer minus winter, temperature on 27.76 isopycnal

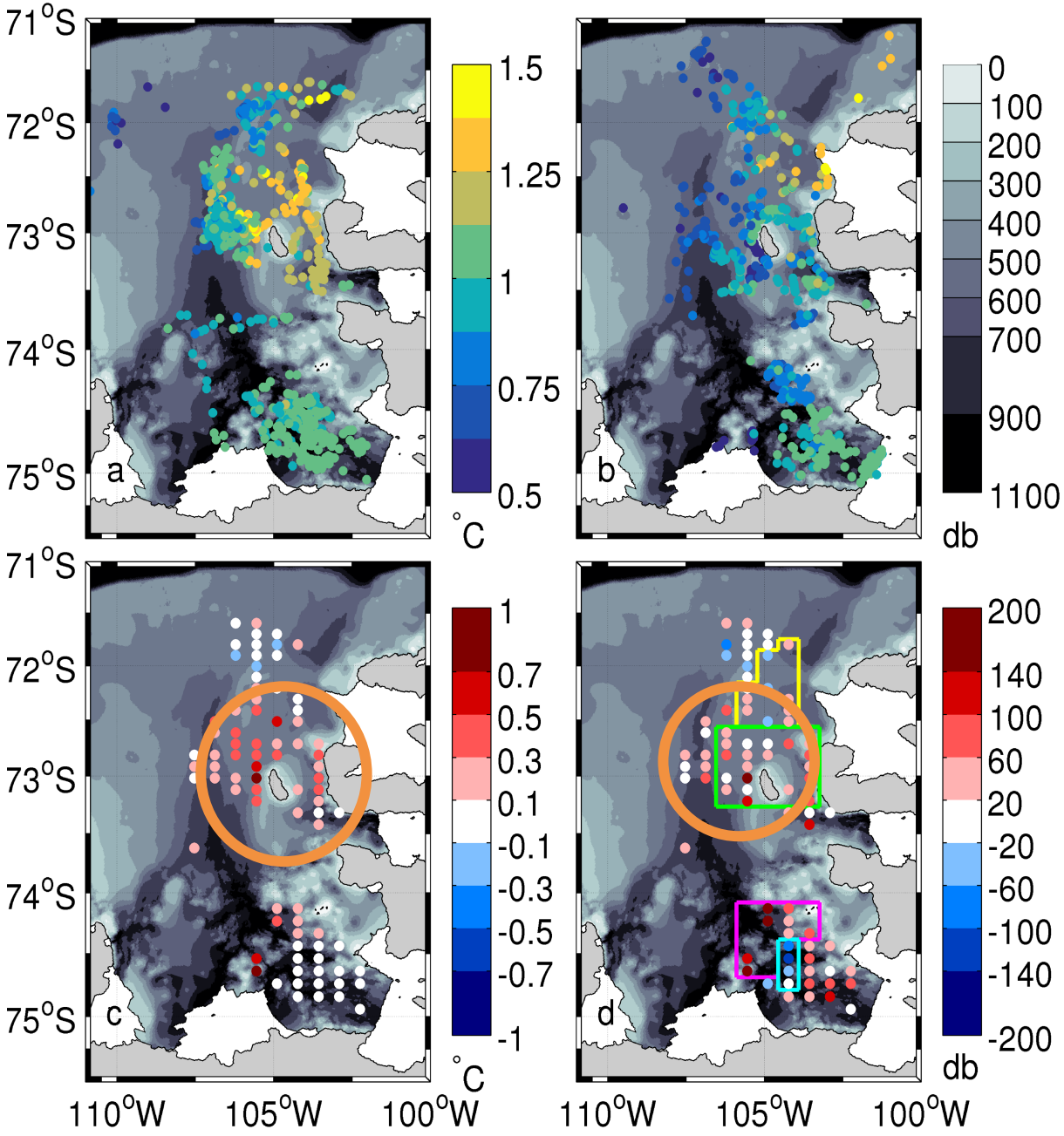


Temperature on 27.76 isopycnal

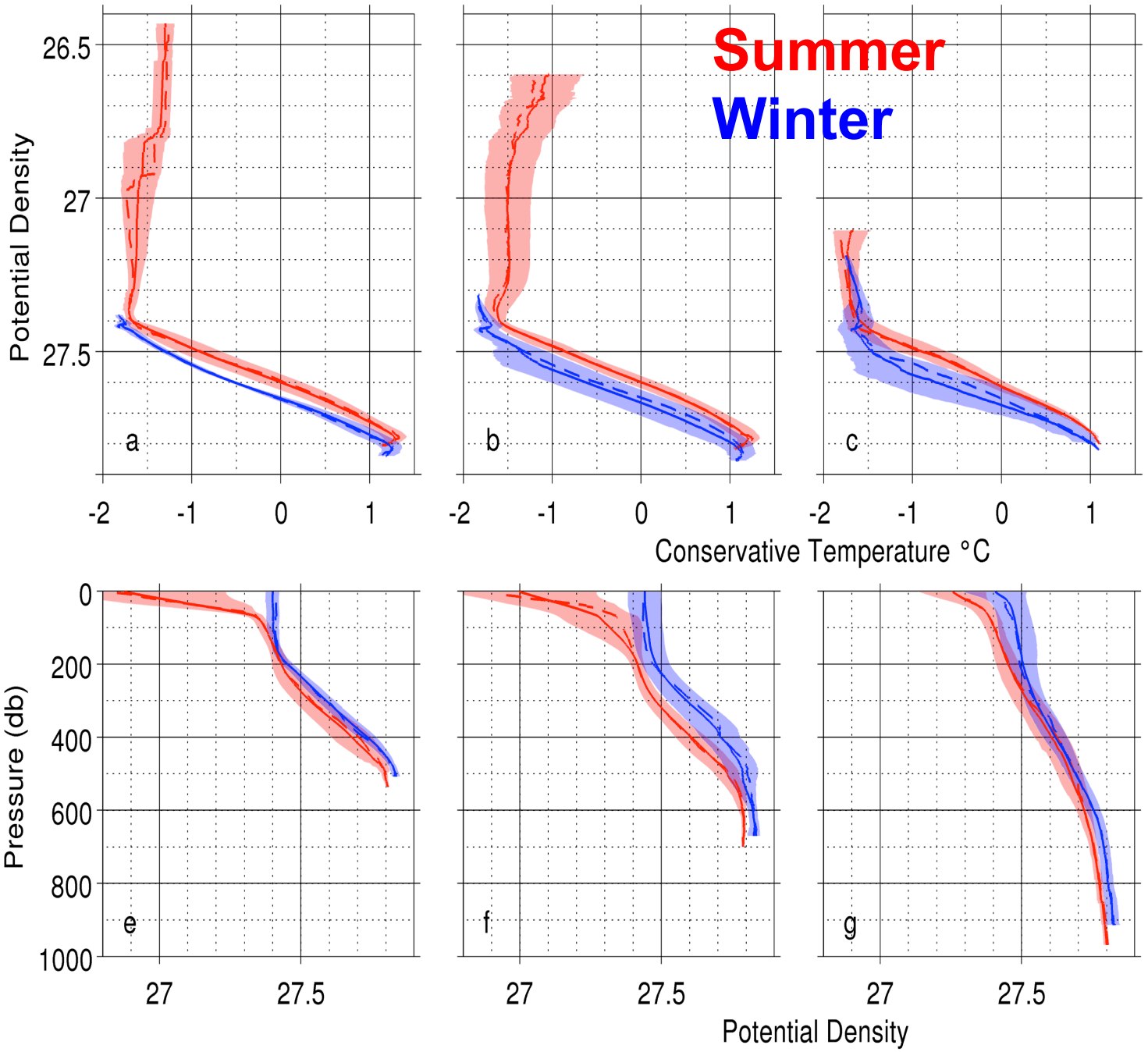
Winter (JJASO)

Summer minus winter, pressure (depth) of 27.76 isopycnal

Colder (and fresher) in winter on density surface



Density surface is shallower in winter



Consistently colder in winter at all CDW densities

Consistently shallower isopycnals in winter; CDW layer is thicker in winter.

So…

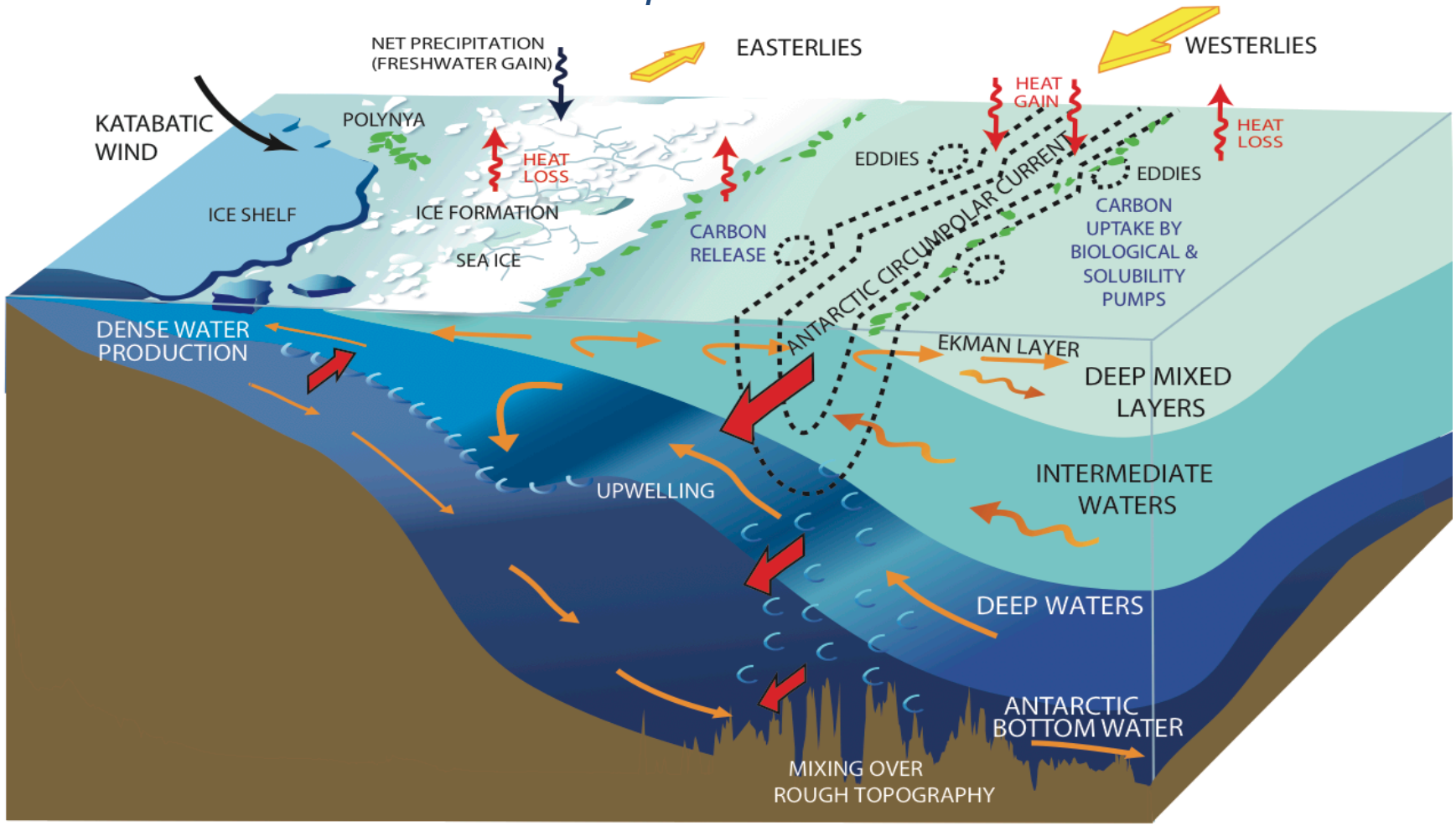
University of East Anglia

- The winter seal tag data give us exciting information about the interactions between ocean, ice and atmosphere in winter, and dynamical flow changes
- Moorings complement the spatial coverage nicely and give multi-year time series at targeted locations

- How else can we get measurements beneath the ice?

Climate-relevant Ocean Measurements and Processes on the Antarctic continental Shelf and Slope (COMPASS)

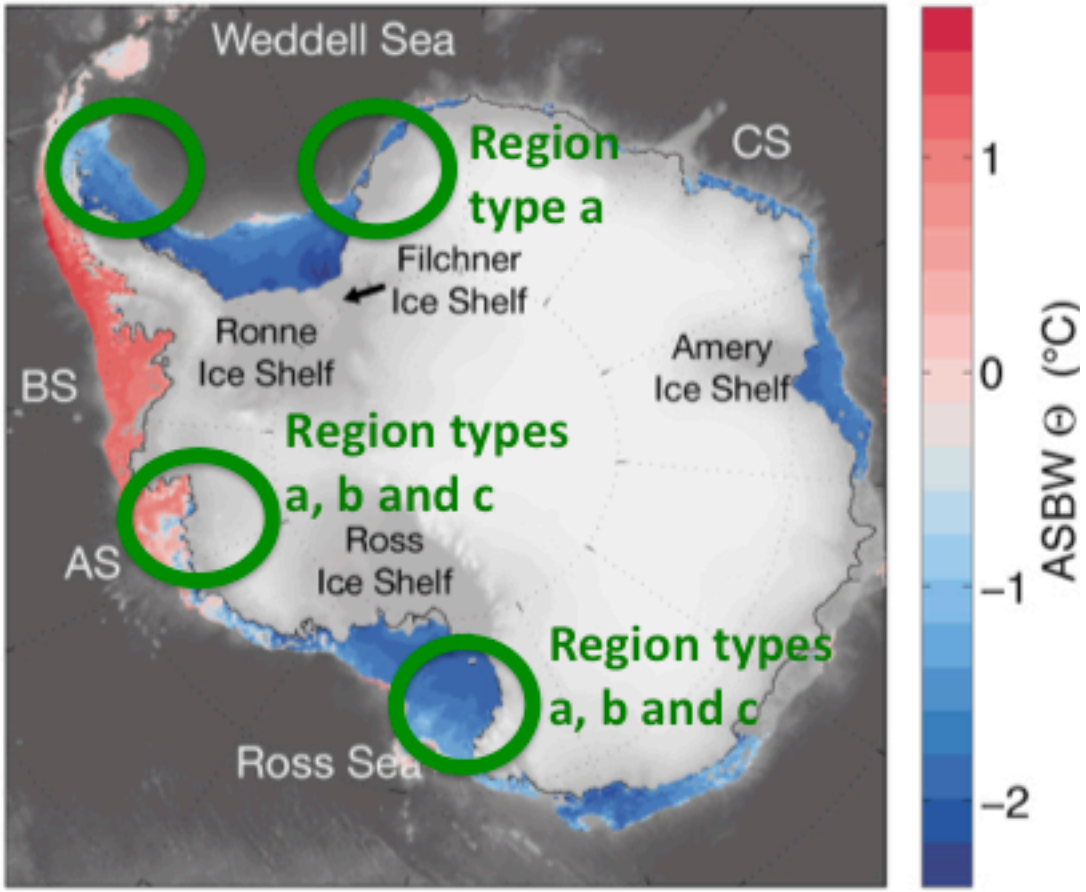
- New project, 2017-2022
- to *advance our understanding of the climate-relevant oceanographic processes on the continental shelf and slope of Antarctica*.



European Research Council
Established by the European Commission

COMPASS uses gliders to study three types of Antarctic region:

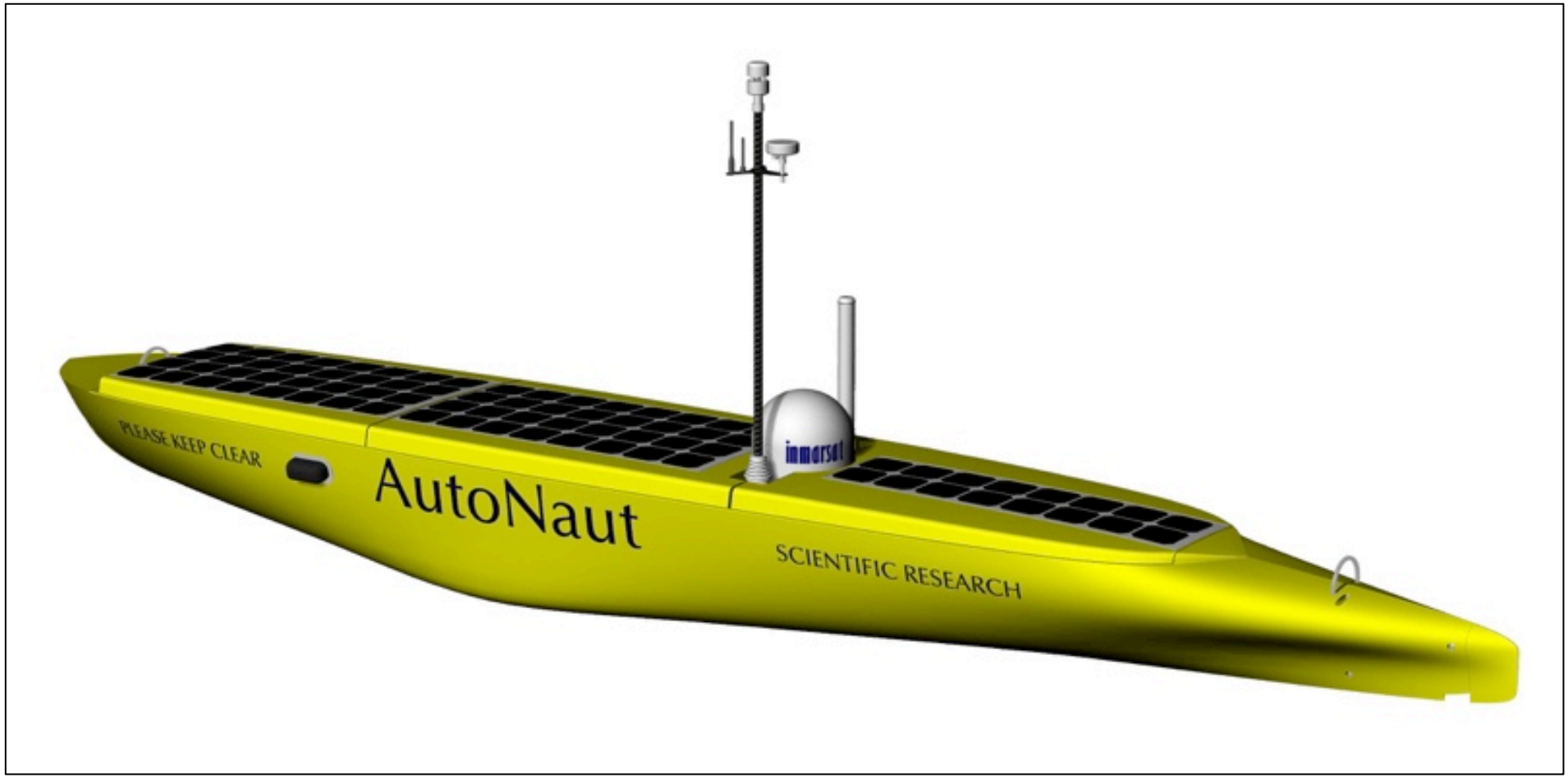
a. the *continental slope and shelf break*, to look at along-slope transport, and cross-slope exchange processes
b. *polynyas*, to look at water mass transformation processes, through exchanges of heat, momentum and freshwater between ocean, sea-ice and atmosphere;
c. near *ice shelves*, to look at exchange processes at the ice shelf front.



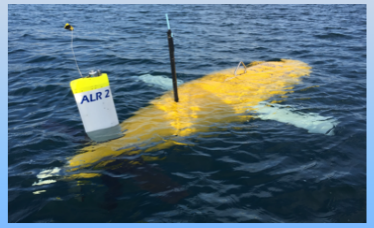
With collaborators from New Zealand and South Korea, amongst others

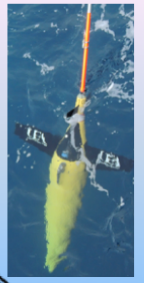
AutoNaut surface vehicle funded through COMPASS

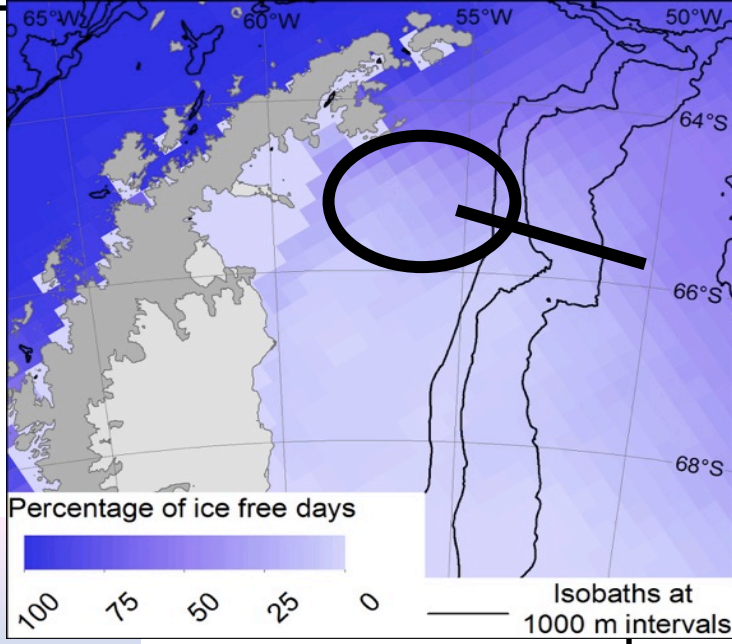
- To devise a way of delivering a Seaglider to remote locations
- To devise ways to make AutoNaut withstand sea ice
- Ultimately to initiate Seaglider campaigns in polynyas in early spring



PICCOLO







Year-round observations

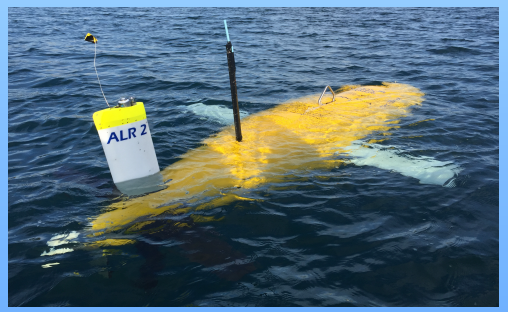
Novel technologies and data

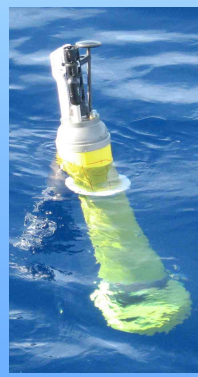
Shelf

PICCOLO is part of the UK's RoSES programme, designed to improve lower limb carbon processes in Earth System models.

Emphasis on new sensors for biogeochemistry on floats and seals.

Year-round observations





Shelf

Weddell Gyre

Autosub Long Range for PICCOLO
aka Boaty McBoatface

University of East Anglia

- Will anchor to the sea bed in late summer and hibernate over winter
- Release anchor and rendezvous with ship in spring
- Overwinter measurements of physical, chemical and biological parameters
- Water sampler