North Atlantic Circulation and European Climate

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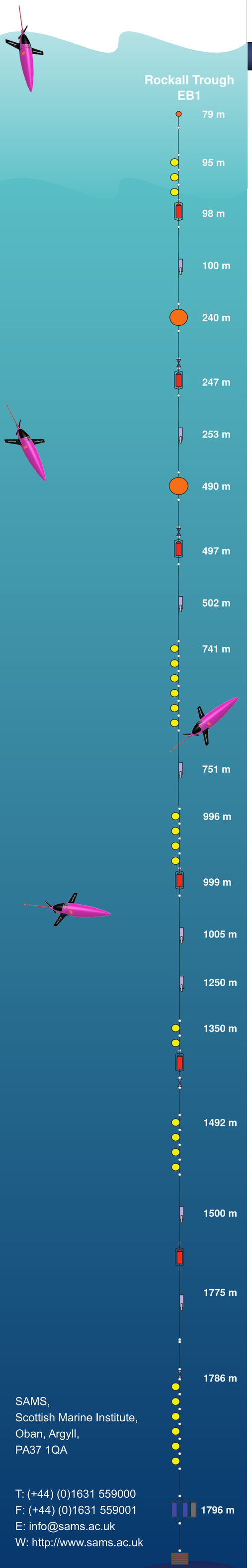
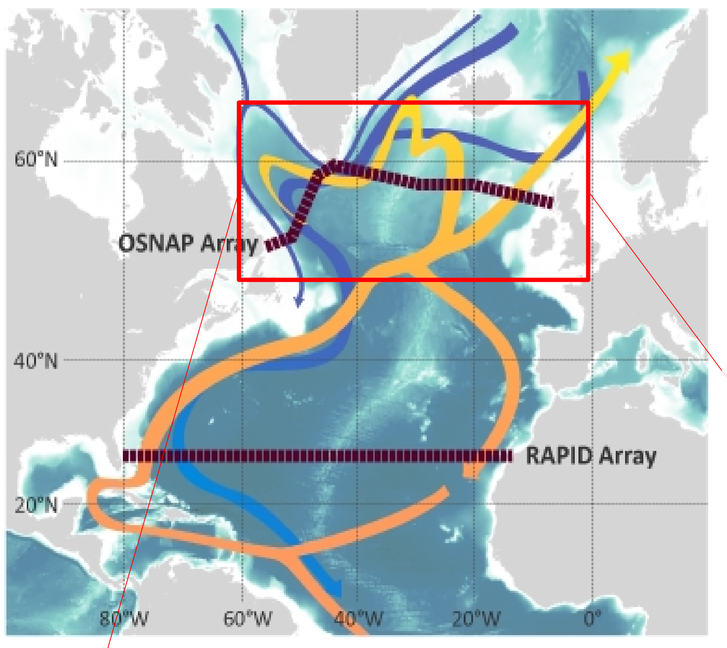


Why study the North Atlantic Ocean?

There is mounting evidence of the importance of the transports of heat and freshwater by the North Atlantic Subpolar Gyre for **impacts on European and global climate** via temperature, precipitation and wind strength. It is also highly significant for the region's **marine ecosystems**, the formation of **hurricanes**, and rainfall in the Sahel, the Amazon and parts of the USA.

The Subpolar Gyre is presently inadequately measured, and no ocean general circulation or climate model represents it accurately.

How to measure the Subpolar Gyre?



UK-OSNAP[1] is a partnership between SAMS[2], NOC[3], and the Universities of Oxford and Liverpool. The UK-OSNAP team is developing a **new observing system** and **innovative modelling techniques** to characterise the **ocean circulation** and **fluxes** of the **North Atlantic Subpolar Gyre**. The first aim of the programme is to provide a **continuous record for four years** (2014–18) of full-depth, **trans-basin mass**, **heat**, and **freshwater fluxes** in the Subpolar Gyre.

The second aim of OSNAP is to quantify and understand the response of circulation, and heat and freshwater fluxes to local (e.g. Greenland ice sheet melting) and remote forcing (e.g. Agulhas leakage), within the conceptual framework of the **AMOC**[4].

Figure 1: Location of the OSNAP and RAPID arrays with the mean warm surface circulation in orange and the mean bottom circulation in blue.

UK-OSNAP is part of an international collaboration to establish **a transoceanic observing system** in the **subpolar North Atlantic** (the **OSNAP** array). International OSNAP is led by USA and includes 10 further partner groups in Canada, France, Germany, the Netherlands and China. The OSNAP array is designed to complement the **RAPID** array and **NACLIM**[5] observations, thereby providing measurements to evaluate inter-gyre connectivity within the North Atlantic.

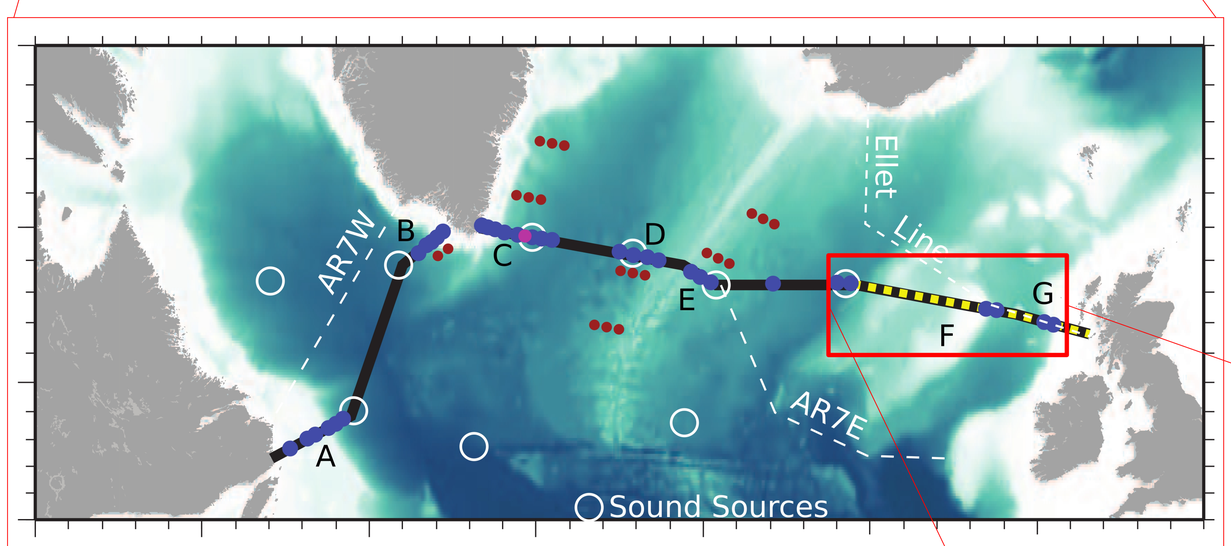


Figure 2: The OSNAP line, comprising:
(A) German 53°N western boundary array and Canadian shelfbreak array;
(B) US West Greenland boundary array;
(C) US/UK East Greenland boundary array;
(D) Netherlands western Mid-Atlantic Ridge array;
(E) US eastern Mid-Atlantic Ridge array;
(F) UK-SAMS glider survey over the Hatton-Rockall Bank and Rockall Trough;
(G) UK-SAMS Rockall Trough current array.
Red dots: US float launch sites.
Purple dot: US OOI[6] Irminger Sea global node.
White circles: US sound sources.
*To be added in 2015: Glider survey across the Iceland basin by the Ocean University of China

The Eastern Boundary array (figure 3) will:
(i) quantify the flux of northward-flowing warm and saline water through the Rockall Trough and across the Rockall-Hatton Plateau, and
(ii) determine the magnitude and variability of the cold overflow across the Wyville-Thomson Ridge.

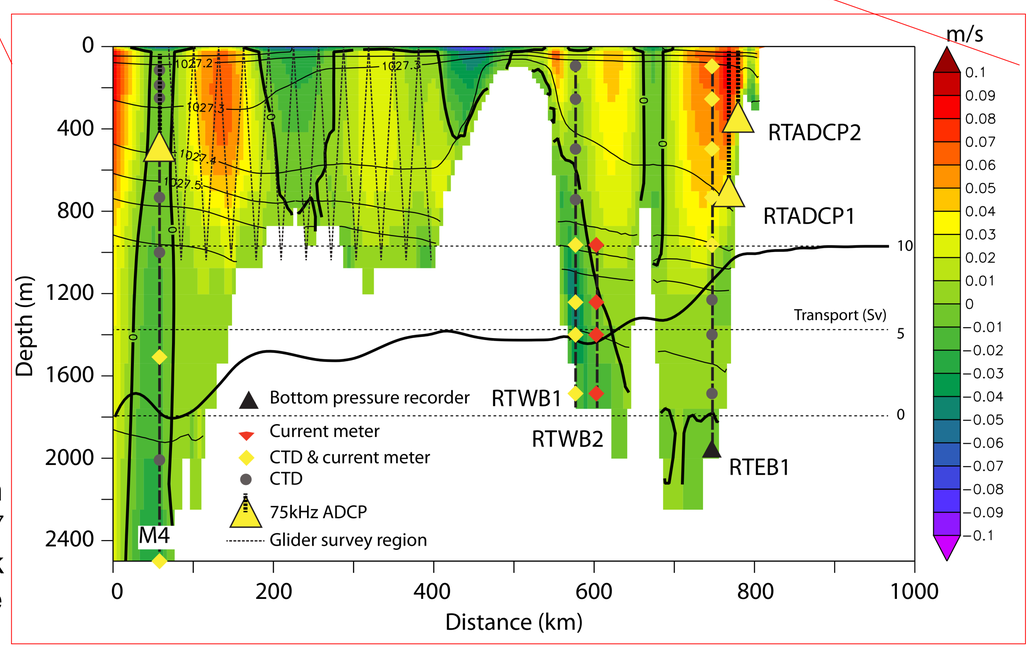


Figure 3: Eastern boundary array. Colour contours: 15-year mean meridional velocity (cm.s^{-1}, +ve northward) from the FLAME[7] 1/12°OSSE[8] model. Thin black contours: potential density (kg.m^{-3}). Thick black line: meridional transport integrated eastwards from zero in the west. Mooring M4: US Iceland Basin end-point mooring. Zig-zag line glider patrol over Rockall-Hatton Plateau. Rockall Trough moorings: RTWB1, RTWB2, RTEB1 measure end-point density and the Wyville-Thomson Overflow; RTEB1, RTADCP1, RTADCP2 measure the Shelf Edge Current. The Rockall Trough section will be surveyed by glider ~6 times per year.

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Acronyms:

1. UK-OSNAP: UK - Overturning in Subpolar North Atlantic Programme
2. SAMS: Scottish Association for Marine Sciences
3. NOC: National Oceanography Centre
4. AMOC: Atlantic Meridional Overturning Circulation
5. NACLIM: North Atlantic CLIMate project
6. OOI: Ocean Observatories Initiative
7. FLAME: Family of Linked Atlantic Modeling Experiments
8. OSSE: Observing System Simulation Experiment