

Climate Linked Atlantic Sector Science



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Task 2.2: Ellett Array

- History of the Ellett Line (1975->2017)
- Evolution to the Ellett Array (2018->)
- Recent OSNAP Results (2014-2017)
- Deliverables for CLASS

Underpinning Activities

WP2: Sustained Observations
Task 2.2: Ellett Array

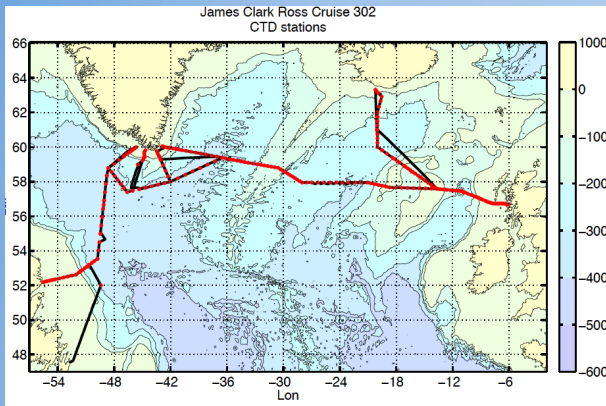
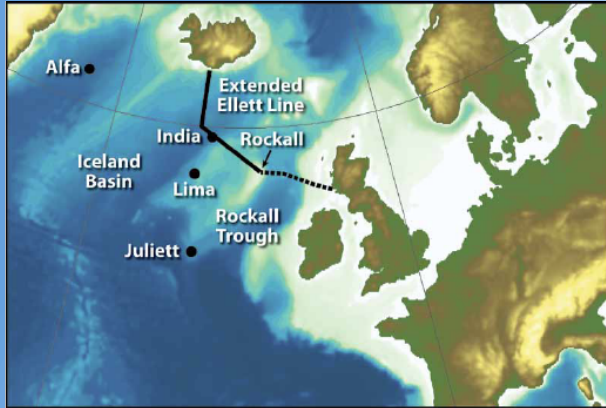
Science Programme

WP1: The Changing Atlantic
Theme 1.1: Ocean Salinity
and the Hydrological Cycle

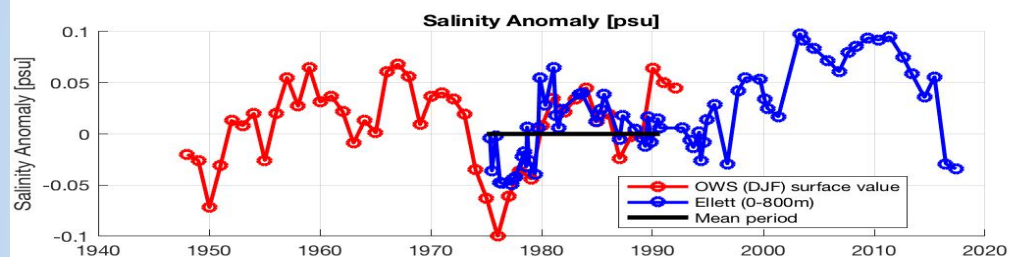
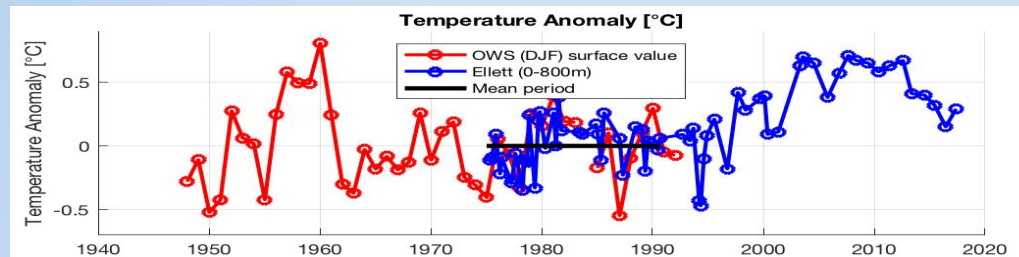
Ellett Array
Contributes to



History of the Ellett Line



1. Ocean Weather Ship Surface Sampling (1948-1992).
2. The Ellett Line to Rockall (1976-1996). ~Quarterly.
3. The Extended Ellett Line to Iceland (1996-2017). ~Annual.
4. The Extended Ellett Line (2010-2017). ~Annual winter Seaglider Sections.
5. GO-SHIP: A25/AR07 @ ~57°N (2014, 2022). ~Quinquennial.
6. The Ellett Array (2018-). Moorings and Gliders.

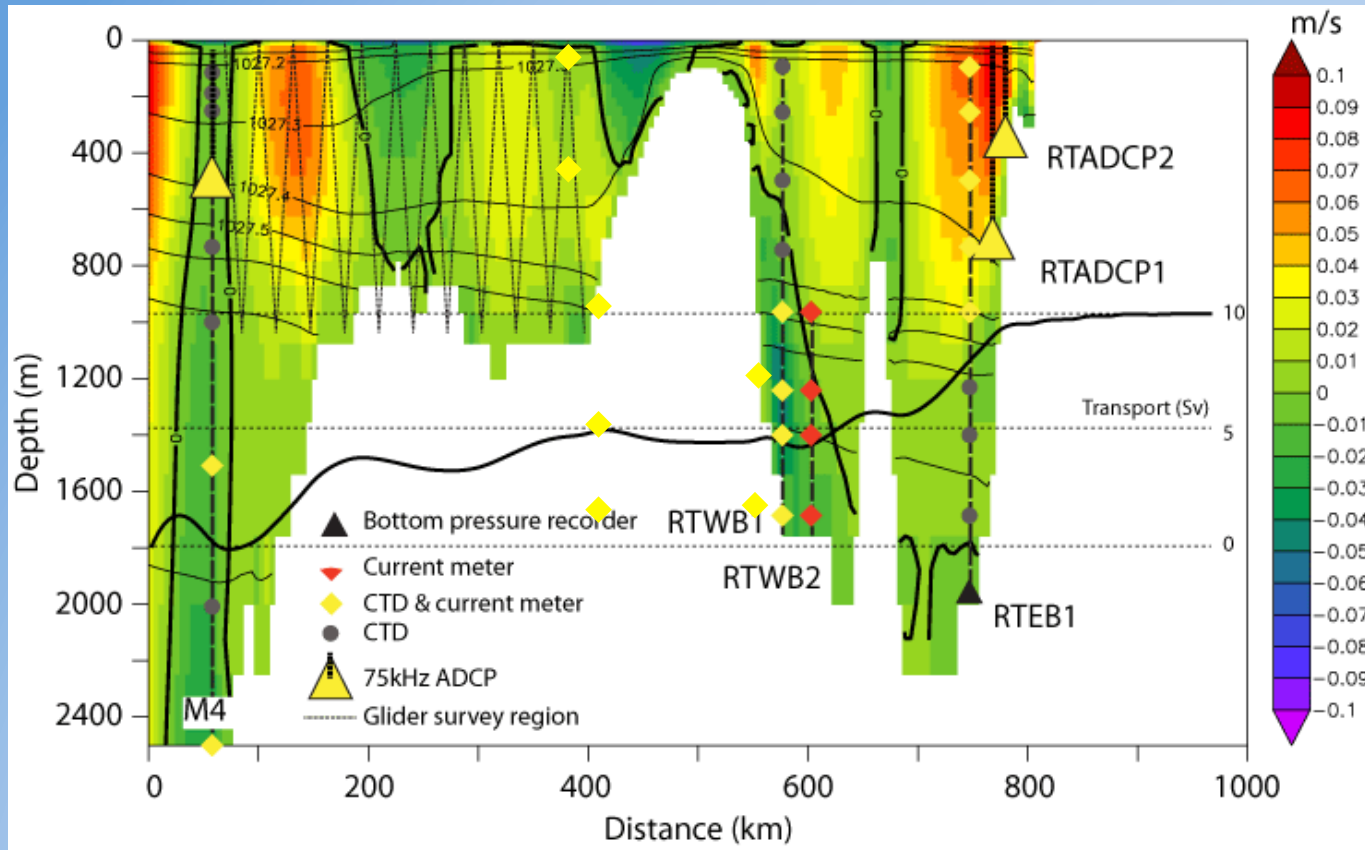


Holliday, N.P., and S.A. Cunningham. 2013. The Extended Ellett Line: Discoveries from 65 years of marine observations west of the UK.

Oceanography,

<http://dx.doi.org/10.5670/oceanog.2013.17>.

OSNAP Eastern Boundary Array OSSE Design Schematic



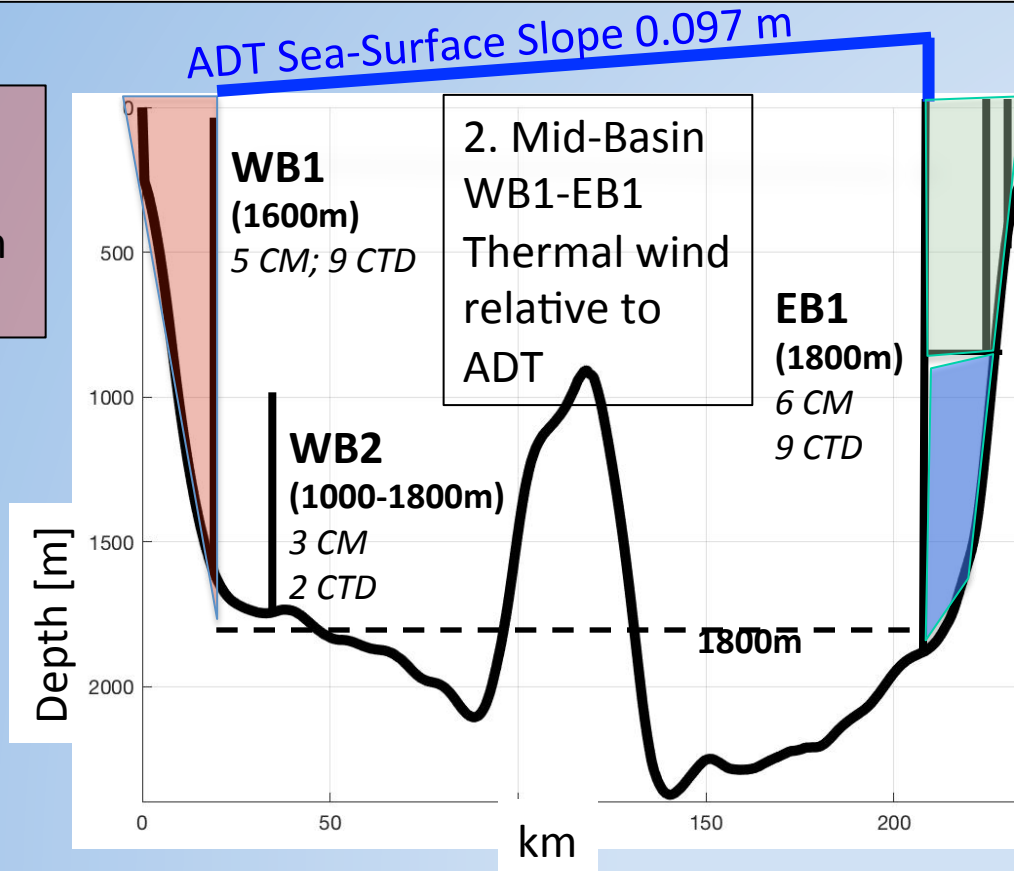
- 15-year mean meridional velocity (m/s, +ve northward) from the FLAME $1/12^\circ$ OSSE model. Thin black contours: potential density (kg m^{-3}).
- Thick black line: meridional transport integrated eastwards from zero in the west from Mooring M4 (scale 0-10 Sv right hand side).
- Zig-zag line: glider-patrol over Rockall-Hatton Plateau ~ 6 times per year.
- Rockall Trough moorings: WB1, WB2, EB1 measure endpoint density and the Wyville-Thomson Overflow; EB1, ADCP1, ADCP2 measure the Shelf Edge Current.

OSNAP Eastern Boundary Array - The Ellett Array

The total transport is the sum of transports in the Western Wedge (T_{WB}), Mid-Basin (T_{MB}) and Eastern Wedge Regions (T_{WB})

- T_{WB} transport from from current meter observations on WB1.**
- T_{MB} Geostrophic shear (from WB1/2 to EB1) referenced to AVISO absolute dynamic sea-surface height.
- T_{EB} transport: i) Deeper than 750m current meter observations on EB1; ii) Shallower than 750m mixed observations/model transports.

1. WB Wedge From CM on WB1



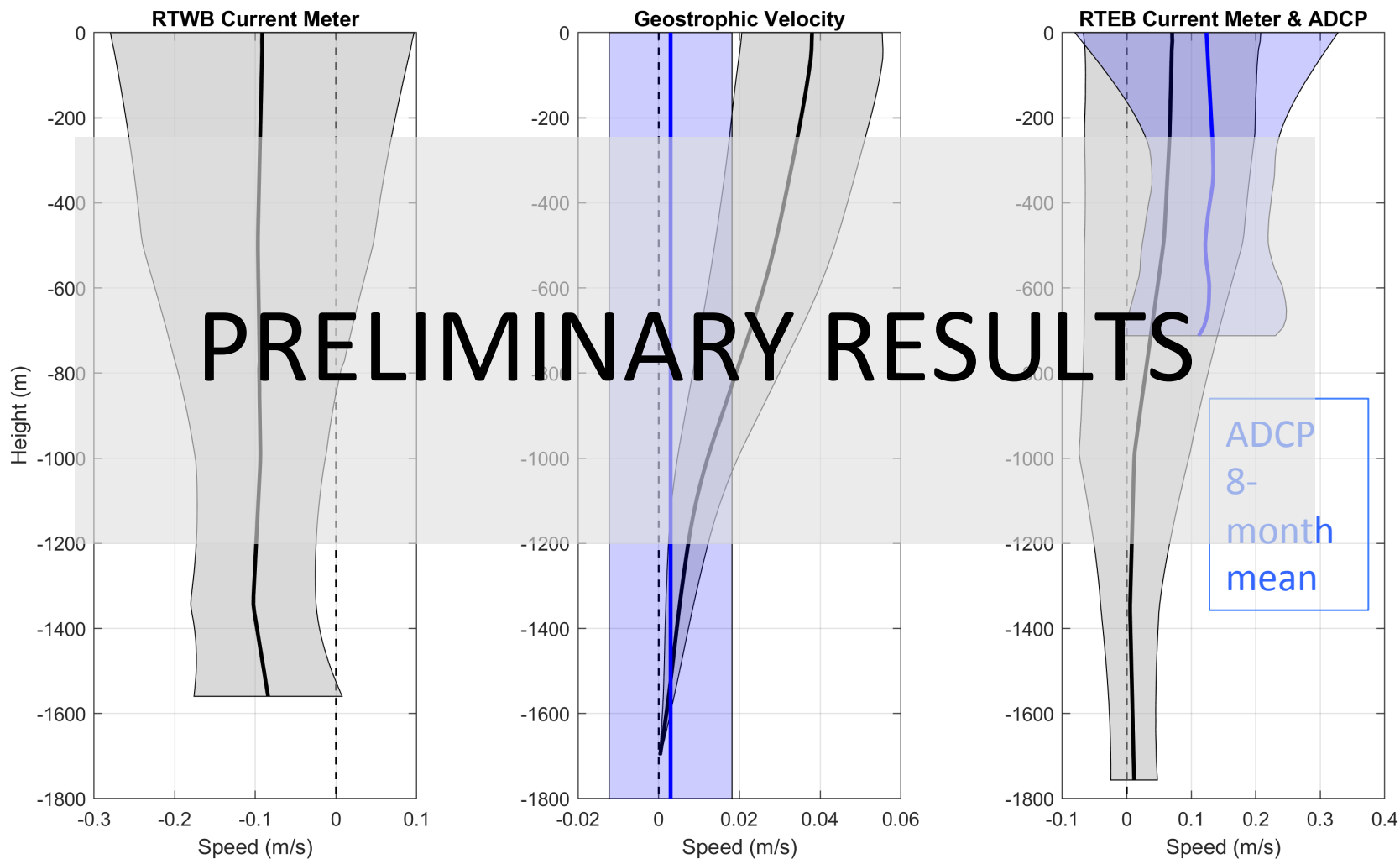
3. EB Wedge <750m

ADCP2
500m

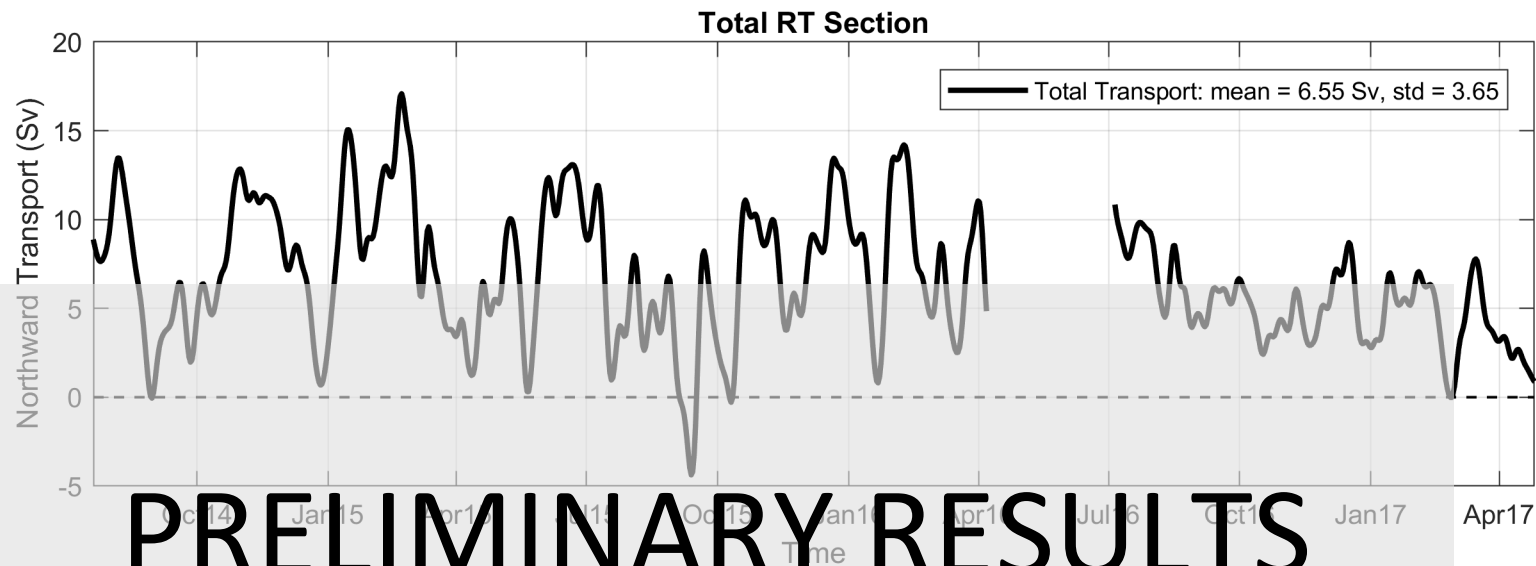
ADCP1
750m

3. EB Wedge >750m from CM on EB1

Velocity Profiles from current meters on moorings WB1, EB1 and ADCP. Mid-Basin (WB1-EB1) Geostrophic velocity and inferred ADT reference velocity
July 2014 to July 2017 : Mean \pm 1SD [m/s]



Three-year long transport timeseries for the Rockall Trough

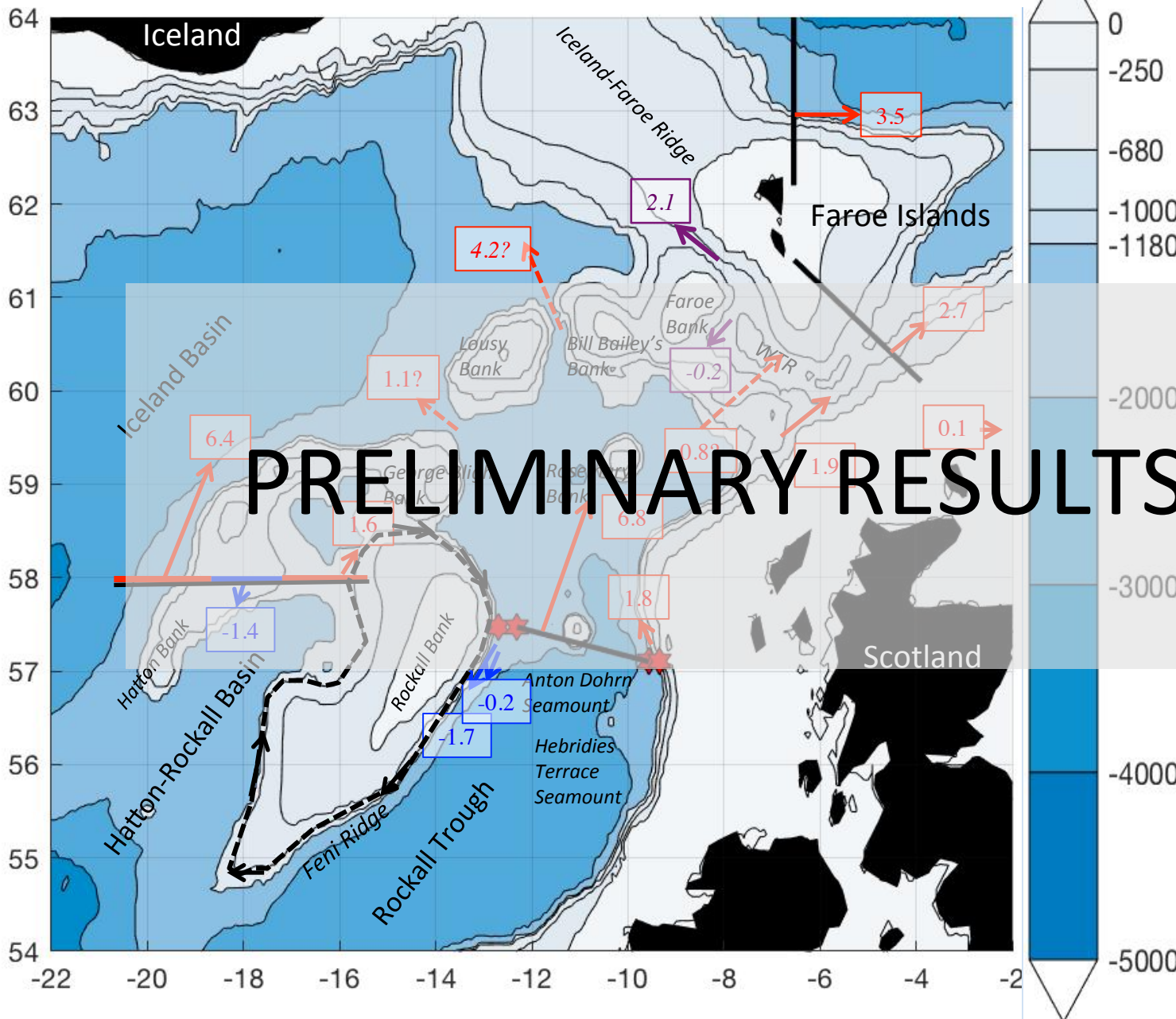


PRELIMINARY RESULTS

Region	Mean	SD	Min	Max	Range
TOTAL [Sv]	6.6	3.7	-4.5	17.1	21.5

~100% larger than previous hydrographic estimates (66 cruises), based on several decades of observations [Ellet and Martin, 1973; Holliday et al., 2000, 2015].

Bathymetry and Fluxes in the Eastern Subpolar North Atlantic



PRELIMINARY RESULTS

Wyville-Thomson Ridge (WTR)
 GBB-RB
 GBB-LB-BBB
 RT closed contour to north

1. Observed Northward/Southward Fluxes.
2. Overflows (Purple).
3. Dashed: Inferred circulations from Glider Depth Average Currents and Argo Float Trajectories.

WP2: Task 2.2 Ellett Array, Deliverables

Task	PI	Deliverable at 2.5 years	Deliverable at 5 years
2.2 Ellett Array	Stuart Cunningham	<ol style="list-style-type: none">1. Completion of 2018 Ellett Array Cruise to turn round moorings.2. Delivery of continuous (10-day mean) volume, temperature and salinity transports through Rockall Trough.	<ol style="list-style-type: none">1. Completion of 2020 and 2022 Ellett Array Cruises to turn around moorings.2. Delivery of biannual (summer and winter) high resolution hydrographic glider sections measuring temperature, salinity and currents between the surface and 1000m depth.

Fieldwork:

- Biennial Mooring Cruises (Rockall Trough).
- Annual ADCP mooring refurbishments in the Shelf-Edge Current.
- Biannual Seaglider hydrographic sections (Scotland to Iceland Basin).

Outputs of the Ellett Line (1979->)

- Journal Articles: 52
- Books & Reviewed Reports: 16
- Climate Status Reports (*IPCC, MCCIP, OSPAR, MSS, DEFRA*): 24
- Other Reports: 24
- Ph.D. Thesis: 17
- Collaboration and Training the Next Generation: 15 Universities & Institutes
- A platform for opportunistic sampling: *e.g. AR30 this July: Silicate and DI-Nitrogen Isotopes for Antonia Doncila, University of Edinburgh (NERC Ph.D. Student); Oxygen, Nutrients, DIC, Total Alkalinity for Clare Johnson, SAMS (EU Atlas); Colonizing Invertebrates (microplastics) for Winnie Courtney-Jones, (Ph.D. student, SAMS).*

The Extended Ellett Line Web Page
<http://prj.noc.ac.uk/ExtendedEllettLine/>

1. Crocket, K.C. et al., 2018, ***Rare Earth Element Distribution in the NE Atlantic: Evidence for Benthic Sources, Longevity of the Seawater Signal, and Biogeochemical Cycling***, *Frontiers in Marine Science*.
2. Hatun, H. et al., 2017. ***The subpolar gyre regulates silicate concentrations in the North Atlantic.*** , *Nature Scientific Reports*.
3. Pacariz, S.V. et al., 2016, ***Nutrient-driven poleward expansion of the Northeast Atlantic mackerel (*Scomber scombrus*) stock: a new hypothesis***, *Elementa*.
4. Courtney-Jones, W. et al., 2017, ***Microplastics pollution identified in deep-sea water and ingested by benthic invertebrates in the Rockall Trough, North Atlantic***, 2017, *Environmental Pollution*.
5. Main, C.E. et al., 2017 ***Simulating pathways of subsurface oil in the Faroe–Shetland Channel using an ocean general circulation model***. *Marine Pollution Bulletin*.
6. Lozier, M. et al., 2017 ***Overturning in the Subpolar North Atlantic Program: a new international ocean observing system***. *BAMS*.
7. Johnson, C. et al., 2017 ***Transports and pathways of overflow water in the Rockall Trough***. *DSR*.
8. Gary, S. F. et al.. 2018, ***Seasonal cycles of oceanic transport in the eastern subpolar North Atlantic***. *JGRO*.
9. Humphreys, M.P. et al., 2016, ***Multi-decadal accumulation of anthropogenic and remineralized dissolved inorganic carbon along the Extended Ellett Line in the northeast Atlantic Ocean***, *GBC*.

Dave Ellett (1993) commenting on Matthew Maury (1860) noted *“it may be felt better to liken our north-east Atlantic central heating system to a storage heater receiving its power both from a far-flung grid and locally, and for which the winds and evaporation provide a fan to progressively extract heat from deeper and deeper levels until stopped by increasing density”*



The Changing Atlantic ...