CROSSROAD

Climatic ROle of Subpolar Slopes: a Regional Observational Array off NewfoundlanD

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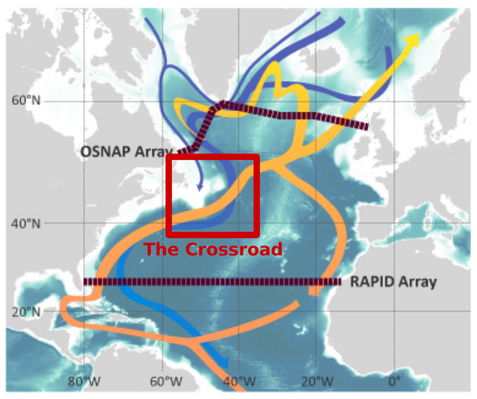
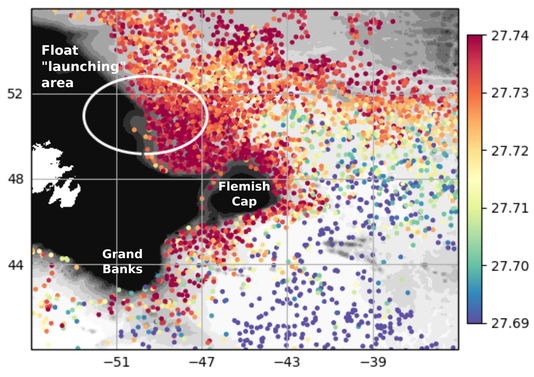
CONTEXT



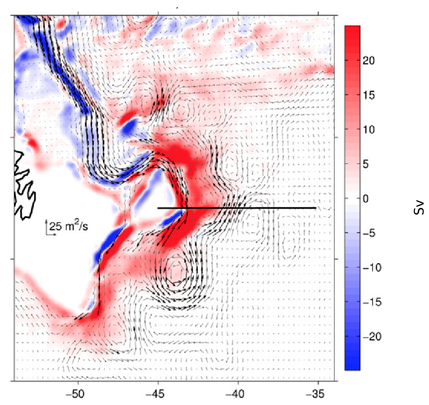
A choke point of subpolar-subtropical oceanic gyres...

Located between the subtropical RAPID and subpolar OSNAP mooring arrays, the "Crossroad" (CR) represents a choke point for the North Atlantic Current (NAC) and the Deep Western Boundary Current (DWBC) - two key components of the upper (orange) and lower (blue) limbs of the Atlantic Meridional Overturning Circulation (AMOC).



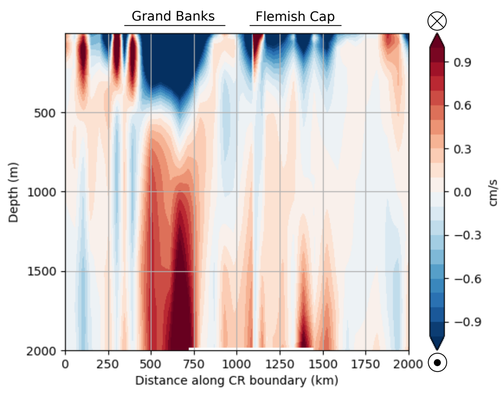
....controlling deep water mass distribution ?

At the CR, newly-formed deep water masses (e.g. Labrador Sea Water, LSW) advected southward within the confined DWBC are transformed and dispersed within the whole North Atlantic. Shown here is potential density at 1000m measured by 84 Argo floats drifitng at 1000m as they disperse from the boundary current in the vicinity of the CR zone (i.e. all floats originate from the white circle).



Mixing-induced transformation...

Diapycnal volume flux is the key quantity behind the density-spaced AMOC. Within the CR, mixing between the cold DWBC and the warm NAC induces a significant dense-to-light water mass transformation of water masses along the boundary. Shown here is the mixing-driven transformation of LSW in a numerical model (Xu et al, 2018).



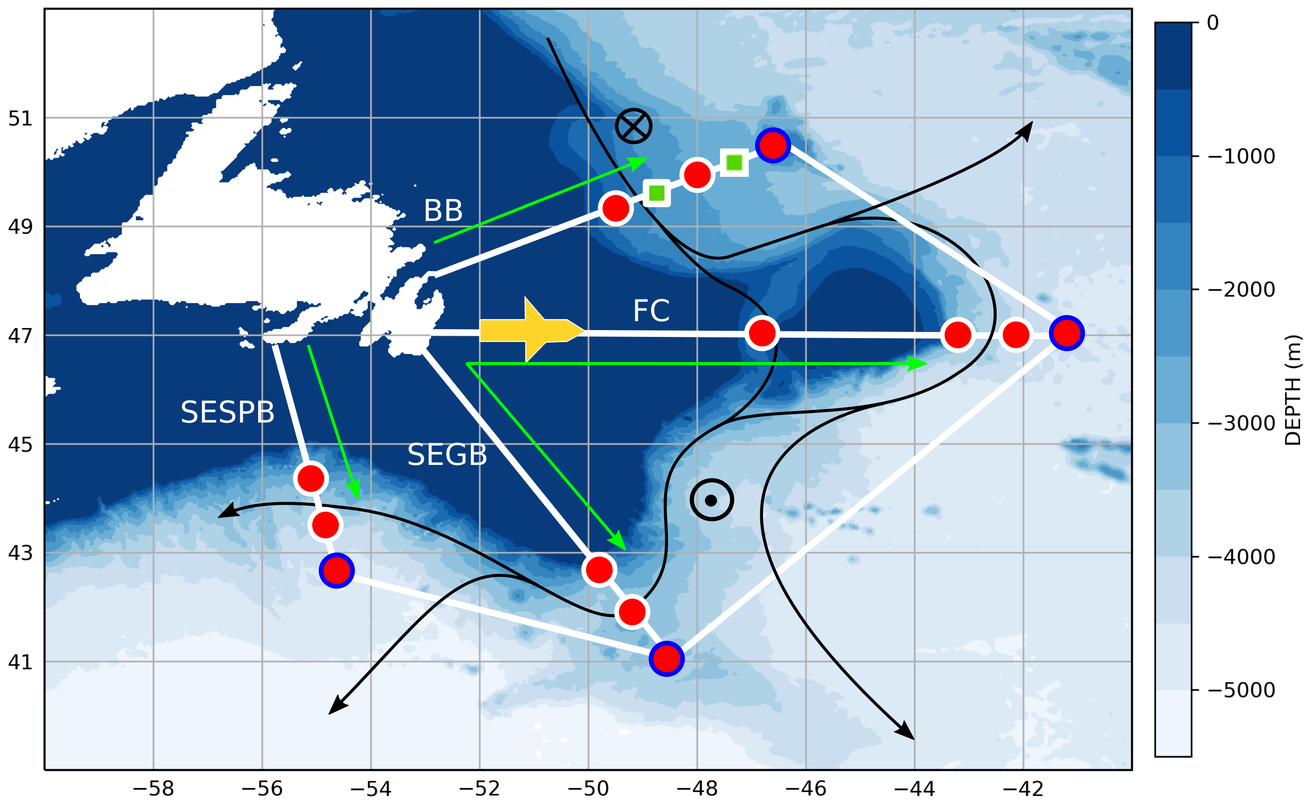
...driving boundary upwelling ?

The along-stream mixing-driven warming of the DWBC imposes through geostrophy and mass conservation a cross-shore current and a net upwelling (Spall, 2010). Shown here are Argo-derived cross-shore geostrophic velocities referenced locally to impose no normal flow. Offshore surface flow (blue) and inshore deep flow (red) induce a significant upwelling of 3 Sv along the CR boundary.

How does the North Atlantic CROSSROAD imprint the AMOC and large-scale deep ocean properties ?

EXPERIMENTAL PLAN

Deep flow connectivity, diapycnal and vertical motions, and shelf–slope–interior exchanges will be studied with repeat hydrography, moorings, profiling floats, and gliders. Numerical modeling will complement the observational analysis. Cruises to be held in 2022 and 2024.



BB — Full-depth high-resolution CTD and ADCP measurements along four AZMP lines for evaluating DWBC structure along the boundary and for closing volume and thermohaline budgets

Full-depth moorings equipped with ADCP, CTD and CM for sampling the DWBC at key locations and depth levels along the CR continental slopes.

End-point C-PIES for estimating integrated transports of deep export routes (retroflections from DWBC).

ASFAR systems for automatic Argo float releases withn the DWBC to investigate lagrangian dispersion at different depth levels and water mass property changes.

On-shelf repeated glider transects to investigate shelf-slope-interior exchanges.

Scientific and experimental collaborations with NOCS (UK), DFO (Canada), and IUP (Germany)