Unveiling North Atlantic Deep Water pathways using nonlinear dynamics techniques

P. Miron[1], F. J. Beron-Vera[1], M. J. Olascoaga[1], L. Helfmann[2], P. Koltai[2] and S. Lozier[3]
[1]University of Miami, Miami
[2]Freie Universität, Berlin
[3]Duke University, Durham
philippemiron

Introduction

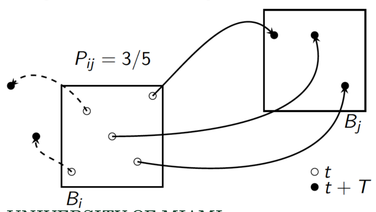
The North Atlantic Deep water equatorward spreads from high latitudes was expected to be largely contained along the Deep Western Boundary Current.

New observations from moorings and floats instead showed multiple interior pathways. We propose to analyze deep water circulation from historical Lagrangian observations datasets (Argo and RAFOS floats).

Markov Chain

The information contains in the float trajectories is combined into a transition matrix P representing a Markov Chain of the underlying dynamics. The domain is subdivided into boxes and the entries of P are equal to the conditional transition probabilities between them.

$$P_{ij} = \mathbb{P}(x_{t+T} \in B_j \mid x_t \in B_i)$$



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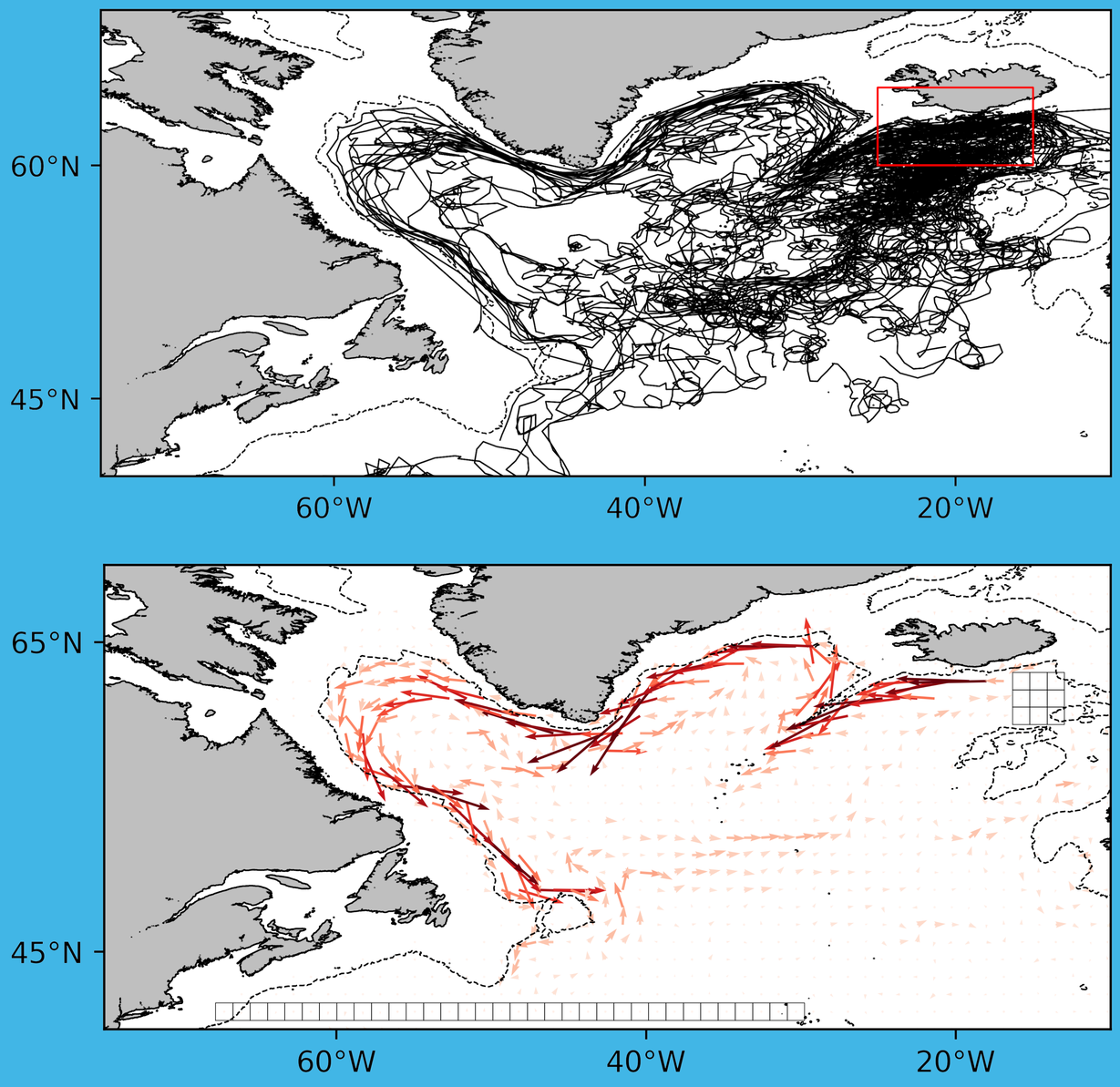
Is the **lower limb** of the AMOC strictly a **boundary current** ?



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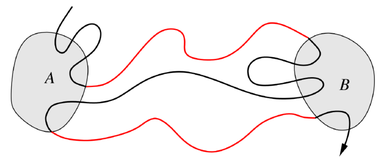
Take a picture to follow the project updates.

Transition Path Theory

From the constructed Markov Chain on the space $\mathbb{S}$, we are interested in the connection between A and B, two subsets of the space $\mathbb{S}$. Using techniques from transition path theory, we can extract how this transition takes place, where trajectories spend more time and what are the main channels. Below in red are the reactive trajectories, segments that connect directly sets A to B.



Future work

From surface drifters, deep floats and model outputs, we will investigate the different limbs of the AMOC to characterize the connections between the North Atlantic, where deep water masses are formed, and their sources in the South Atlantic.

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