Statement of Proposed Research
Leverhulme Research Fellowship

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1 Background and Motivation

- Background: The MOC moves heat and properties (carbon, oxygen) around the ocean. It has oft been pictured as a conveyor, which has suggests that when it speeds up in one place, it speeds up somewhere else.
- Background: The RAPID 26°N project measures the strength of the MOC in the Atlantic subtropical gyre.
- Background: Numerical model studies have shown that the strength of the MOC is coherent across the subtropics (**?**), but one attempt to link the overturning between 2 latitudes, 26°N and 41°N (**?**) shows a distinct divergence between these two latitudes which contributes to heat content in the Atlantic (**?**) while another attempt to look at just the deep transports at 26°N and 39°N shows an out-of-phase seasonal cycle (**?**). And finally, a last attempt to look at 3 latitudes 26°N, 39°N and 42°N showed no covariability apart from on seasonal timescales (**?**).
- Recent results have shown that the strength of the MOC at this latitude can be related to the winds (**??**).

2 Objectives

Guiding question: What is the relationship between transports at different latitudes?

The aim of the research fellowship would be to develop the methodology to estimate ocean circulation variability on interannual timescales from altimetry, bottom pressure and/or Argo float profile data. In this way, we will have a method to quantify the ocean's role in heat transport and heat flux divergence over the past decades.

1. From *in situ* RAPID observations, we have determined that the dynamic height at 1100 m relative to the bottom is responsible for the interannual variability of the MOC.
2. Using NEMO 1/12 degree numerical simulations
3. What part of the ocean circulation do we recover using altimetry alone? Altimetry and ocean bottom pressure? and with the addition of Argo float profile data?
4. Using Argo float data, how well can we reconstruct the interannual variability of the top 1000 m water column at 26°N (RAPID array)? at 16°N (MOVE array)? at 36°N (Line W array)?
5. Create an interannual time series of meridional overturning transports and heat transports across the subtropical latitudes in the Atlantic, 15–45°N.

3 Methods and Outcomes

1. Approximating the ocean as a 2-layer system recovers much of the variability of the circulation (**?**). In order to determine the 2-layer circulation of the ocean, we need to know the sea surface height, the steric height and the bottom pressure. These can, theoretically, be identified from top 1000 m profiles of temperature and salinity properties, satellite altimetry and bottom pressure.
2. Now that we have seen from RAPID that most of the ocean interannual variability can be recovered from the thermocline displacement, or more accurately the dynamic height anomaly at 1100 m depth, we can apply this simplified approach to other latitudes.
3. The aim of this research would be to verify that the thermocline displacement, bottom pressure and sea surface height anomaly recover the transport variability on interannual timescales. This will be done during preparatory work in Southampton using the NEMO 1/12° model.
4. Armed with these results, and the results at 26°N, the aim would then be to explore the relationship between thermocline displacement from observations, altimetry and bottom pressure at two other latitudes in the subtropical gyre, using observations from the MOVE array at 16°N and 39°N at line W.
5. However, the GRACE ocean bottom pressure product is still in development and the altimetry fields are more accurately used in their native, along-track gridded format. For this work, I will work with altimetry/ocean circulation-expert Josh Willis, and GRACE/ocean circulation-expert Felix Landerer to develop the methodology.

While the sub-annual variability is tied to the local eddy field, (**??**), the interannual variability derives from the winds (**???**).

(**?**) (**?**)