

## ***Interactive comment on “Pending recovery in the strength of the meridional overturning circulation at 26° N” by Ben I. Moat et al.***

### **Anonymous Referee #2**

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Review of Moat et al. “Pending recovery in the strength of the meridional overturning circulation at 26°N”, submitted to Ocean Science. The paper presents the latest data from the RAPID-MOCHA array, extending the time series for the overturning circulation at 26N to over 14 years. The data are analysed spectrally, and using techniques such as change point analysis and autoregressive modelling. The time series is compared to the overturning based on GloSea5 reanalysis at the equivalent location and 45N, as well as the AMV signal in sea surface temperature, to place observed changes in the context of our current understanding of Atlantic circulation. The authors find that the expected increase in the overturning signal at 26N cannot be detected by the RAPID observations at this stage.

These are important results, and it is crucial that the up-to-date RAPID time series is

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published and made available to the ocean and climate communities. I found the paper clearly written with nice, appropriate figures. The time series analysis techniques (CP and AR) were both innovative and insightful. However, I have some issues with the central scientific focus of the paper and felt that the general thrust of the argument was often misguided. I therefore think significant re-writing is required before publication.

### Major comments

1. My overall impression from this paper was that the authors tried, retrospectively, to formulate a compelling question such that the updated RAPID time series is the answer. I am not sure that this sort of hypothesis driven structure is really required when the main purpose of the paper is to present the new data (the value of which cannot be overstated). Besides, the attempt to fit the results into a wider narrative on North Atlantic circulation does not really showcase the value of the data since the RAPID time series neither contradicts nor substantiates the working hypothesis. Comparison with climate indices such as the AMV and NAO is appropriate but does not warrant being the central focus, given the relatively short timescale and inconclusive findings.

2. I think the GloSea5 data is overused and overly trusted to give a realistic representation of the ocean. The authors attempt to reconcile the results with the 45N time series from Debruyeres et al. (2019), but I think too much respect is paid towards these results which are not of comparable stature. It is a worthy discussion point, but the authors need to make it clear that the overturning at 45N remains poorly constrained compared to 26N. I am unconvinced, from figure 6a, that GloSea5 does a sufficiently good job at 26N given the small number of degrees of freedom in the filtered time series. This then calls into question how well the product is likely to capture the meridional connectivity of the two sections (which underpins much of the argument). Are there other reanalysis products and/or models which corroborate the lead/lag relationships from GloSea5? I feel it's needed.

In broader terms, the writing could do more to promote RAPID as the principal source

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of our understanding of the overturning circulation, rather than another piece of the puzzle. The presentation of GloSea5 and Desbruyeres et al. (2019) as comparable data sources serves only to undermine the RAPID project itself.

### Minor Comments

Line 27: “Comparing the two latitudes, the AMOC at 26°N is higher than its previous low” this sentence needs to better distinguish spatial and temporal changes. Line 35: Slightly clumsy sentence, repetition of “on” Line 71: “Guided by”. This language ties directly into point 2. RAPID should lead, not follow. Line 83: missing “to” Line 89: The heat and freshwater fluxes are mentioned here but neither shown nor discussed. Perhaps a sentence explaining why? Line 95: Are the CTD-Os a subset of the CTDs? Line 107: “net the” Line 109: GloSea5 should be mentioned here. Line 132: missing “use” Line 150: Should say “Results” Line 158: why is “anti-correlated” repeated inside the brackets? Line 158: Clarify: there is no correlation information in the spectral plot. Line 169: Use the LNADW acronym Line 172: “that a reductions” Lin3 186: This sentence could be improved, just state the maximum and minimum values/times for comparison. Line 210: All this tells us is that GloSea5 is dynamically consistent with itself. It could still be wrong. I assume GloSea5 changes are forced by Lab sea deep convection, which we know many models get wrong, even if it does assimilate observations. Line 218: An excellent point, and an example of where it is appropriate to turn to reanalysis. Line 232: You can, but I think this analysis seems uncoupled from the RAPID results. Line 256: Be quantitative. What is the minimum fraction of the mean? Line 266: This is the first mention of the 34.5S array (in the conclusions). Line 272: Insert “within a reanalysis framework”. Line 288: Perhaps substitute “understanding” for “knowledge”. Figure 1: Red text on green very hard to read for colour blind people.

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