Responses to editor comments

We thank the editor for positive and constructive comments.

Editor: The paper is very long, and as noted by both reviewers, it tends to intermingle methods, results and discussion. It would be good if you could read it through again yourselves critically, to see if you can identify any further shifting of material that would make the paper flow more smoothly. I suspect this will help it to be well-cited.

Reply: We are aware that this manuscript is long and will require considerable effort from the reader to gain full benefit. It has two main topics: 1) the ability of satellite altimetry to represent surface velocity and other oceanographic features and 2) the flow patterns, variability, and transport of the IF-inflow. At an early stage, we considered splitting the results into two separate manuscripts, each focusing on one of these topics. We concluded, however, that the two topics are so strongly interlinked that this would not improve the overall product. Before the original submission, we have also considered other versions with different ordering of the content, but ran into difficulties with having to cite results that were presented later in the manuscript. Your comments as well as those of the two referees have clearly helped to link the various parts of the manuscript together and improve the flow, but we do recognize that the text is still long and complicated. We do not see any way to avoid this without losing essential parts. We have, however, added the following paragraph at the end of Sect. 1: "*Several different topics are addressed in this manuscript, although they are interlinked.* ***Readers who do not want all the details may benefit from starting in Sect. 7 and referring to the earlier sections as needed".*** (New lines: 143-144).

Editor: L108-124 This is useful material added, but it feels to me like it is in the wrong place. This is not Introduction – rather it is justification for your choice of methods, so at least some of this should be moved into section 2. Please review which pieces of this material are really introduction, and which are methods.

Reply: The original Sect. 1.3 has been abbreviated by removing the text from original line 104 to original line 124. This section now ends with the added sentence: "*Hansen et al. (2015) therefore decided instead to use the 4 °C isotherm and the 35.0 isohaline to define the boundaries of Atlantic water extent on the N-section*". (New lines: 106-107).

The deleted text in Sect. 1.3 has been moved to a new section (new lines: 248-271) within methods. The new section has the heading: "*2.6 Determination of Atlantic water extent on the monitoring section"* and is introduced by a new paragraph: *"On the N-section, used for transport monitoring, water of Arctic origin is found adjacent to and mixed with the Atlantic water. To enable calculation of Atlantic water transport through the section, this study uses (temporally varying)* ***Atlantic water boundaries,*** *within which all of the water is assumed to be of Atlantic origin, with no Atlantic water outside of the boundaries*". (New lines: 249-252).

Editor: L186. For clarity, add a sentence to say something like "Therefore we use the travel time to deduce the isotherm depth, with results shown in section X.Y".

Reply: We have added the sentence: "*Estimates of travel time from the two PIES deployments will therefore be used to calculate monthly averaged isotherm depth (Sect. 6.3 and Sect. 7.3)*". (New lines: 171-172).

Editor: L329 It would be helpful if you could add a sentence (or two) here summarising the results of section 3 for readers, and/or saying that the implications will be discussed in sections 6 or 7. At the moment each section seems to stop abruptly and the logical connections between sections are not always clear. Signposting would help your readers.

Reply:

The paragraph at the end of Sect. 3 (original lines 327-329) has been rewritten and now ends with the text: "*This result is further discussed in Sect. 7.1. The observational verification of geostrophic balance on monthly timescales when using the new SLA data is also a basic precondition for other results in this manuscript, such as the flow across the IFR (Sect. 5 and Sect. 7.2) and the calculation of transport (Sect. 6 and Sect. 7.3–7.6)*". (New lines: 340-343).

Editor: L17 and L934 You use the phrase conversion factor here, but you never refer to the phrase conversion factor in the text. It will not be clear to readers who just read the abstract or the conclusions what you mean by this, so this should be clarified in both places. One might expect using the standard geostrophic equation f V = g tan(i) that the slope of the sea surface is directly related to the surface geostrophic flow without any need for a "conversion factor", so this needs some clarification.

Reply: On the original lines 17 and 934, the term "*conversion factor*" has been replaced by: "*conversion factor between sea level slope and surface velocity*". (New lines: 17-18 and 950).

In addition, the paragraph at the end of Sect. 3 (original lines 327-329) has been rewritten and now includes a definition of this term: "*The regression coefficient, α_{Reg}, in Table 2 is the observationally determined conversion factor between anomalies of sea level slope and surface velocity, Eq. (3). In the geostrophic approximation, this conversion factor should have the value given by $\alpha_{Th} \equiv g/(f \cdot L)$. Table 2 demonstrates that this is the case when using the new SLA data to calculate sea level slope, but not when the old SLA data are used*". (New lines: 337-340).

The term has also been introduced to the discussion in Sect. 7.1 where the sentence: "*A high correlation between two time series means that they are linearly related, but the coefficients may not necessarily be according to theory*" has been replaced by: "*A high correlation between ADCP surface velocity and SLA-difference means that they are linearly related, but this does not guarantee that the conversion factor between sea level slope and surface velocity is according to theory*". (New lines: 672-673).

Editor: L941 Can you be more quantitative than "slight"? e.g. giving a number for Sv/decade, or % increase? Likewise for the heat transport?

Reply: The sentence: "*Over the 29 years of monitoring, the IF-inflow had a slight increase in volume transport and also an increase in heat transport relative to a temperature of 0 °C*" has been replaced by: "*Over the 29 years of monitoring, the IF-inflow had a slight (9 %) increase in volume transport and also an increase (13 %) in heat transport relative to a temperature of 0* °C". (New line: 957).

Editor: L942 Please replace “an hypothesis” by “the hypothesis proposed by Olson et al. (2016)” so that the conclusions section stands alone.

Reply: The text: “*an hypothesis, previously suggested to explain*” has been replaced by: “*the hypothesis proposed by Olsen et al. (2016) to explain*”. (New lines: 958-959).