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Ocean Science
Discussions

Interactive comment on "Sub-basin scale sea level budgets from satellite altimetry, Argo floats and satellite gravimetry in the North Atlantic" *by* Marcel Kleinherenbrink et al.

Anonymous Referee #1

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Review of Sub-basin scale sea level budgets from satellite altimetry, Argo floats and satellite gravimetry in the North Atlantic by Marcel Kleinherenbrink, Riccardo Riva, and Yu Sun. Submitted to Ocean Science.

Reviewed on 19 August 2016.

General comments The paper attempts merging sealevel from altimetry with GRACE gravity fields and steric height from Argo floats to close the sea level budget of sub-basin scale areas in the North Atlantic. Different GRACE products are intercompared with convincing results, both in seasonal and interannual variability and trends. The analysis is thorough and worth publication. In some respect the paper appears quite technical, and it should be noted that main aim of the study is to determine which

GRACE product and data processing method is most appriate to achieve the desired result, i.e. agreement of observed sealevel (from altimetry), and calculated sealevel from mass changes (GRACE) and steric changes (from Argo floats). The selection of the study area (North Atlantic) and its subdivision into smaller polygons is somewhat arbitrary. I was not able to proofread all equations stated by the authors, I assume that all calculations have been made correctly. I have a few general comments, and a number of minor comments regarding spelling, figure layout etc., which I would appreciate to be addressed by the authors.

Specific comments As stated above, the entire paper is quite technical. Physical oceanography and special characteristics of the region are not really addressed; basically it looks like the North Atlantic and the sub-regions have been selected arbitrarily just to have a reasonable area to investigate which GRACE product fits best. This might be made more clear – this is not so much a paper for readers interested in the North Atlantic, but more for those interested in GRACE and sea level studies.

The authors claim that all three underlying datasets (Argo, GRACE, Altimetry) have been specially processed for this study. While GRACE is introduced in comparatively detail, the introduction of the Argo- and especially the Altimetry data could be more thorough.

There are quite a number of different GRACE products, degrees/orders, Wiener filters etc. Sometimes, it is difficult for the reader to keep track. A shorter, clear designation of the different products, and / or splitting the text into shorter sub-sections might help to make the organization of the paper more clear.

The figures are good, clear and appropriate. However, all explanations (units, variables, etc.) are described in the captions only. It might be an idea to write units directly on the axes or colour bars. In case of multi-panel figures, the panels should be labelled with a), b), c) and so on, or write the name of the GRACE product used in the panel (e.g. ITSG). In the present state, the figures look very clear, but it is tedious to find out

and remember what the blue line in the middle right panel stands for.

P3 L19 How is the alongtrack altimetry data processed? E.g. any de-tiding, smoothing, ...? This could be described in more detail.

P4 L6 This statement is confusing: Why don't the Argo floats resurface in the South Atlantic? Moreover, is this relevant at all for the present study of the North Atlantic?

P4 L16-19: This suggest that the variance-covariance matrices are incorrect for at least one of these time periods. Can you state a reference for this claim?

Table 4: How is - 1.21 (i.e. absolute value larger than 1) for NA with CSR96+A. possible? I would expect values to be in the range -1 ... 1, but not beyond. Moreover, I understand -1 to explain 100% of the variability, but in anticorrelation, suggesting that something is seriously wrong in this particular solution.

Technical corrections

P2 L9: Better write "That study..." – "this study" suggests that this study (submitted to OS) is meant.

Fig 1: The colour bars are too narrow, it is hardly possible to assign colours from the maps to certain numbers. Draw the colour bars larger. Use only a few distinct colour levels (e.g. 0 to 10, 10 to 20, 20 to 30 and so on) both in the map and in the colour bar would make visual assignment much clearer than the present continuous colour scale. Write units (mm, or mm/yr) on the colour bars (see general remarks).

P3 L4 write (Kusche, 2007; Kusche et al., 2009)

Fig. 5: The colour bar is too narrow. See remark to Fig. 1.

P14 L20: "Secondly, compared to Scripps the grids, the other two methods are slightly noisier." This sentence is unclear or grammatically wrong.

Fig. 7: Explain the polygons in the first row in the caption. They should also be

explained in the text; I did not find any explanation except on P17 L10. It remains guesswork to the reader to determine what the three polygons should be. Do I see it correctly that they should be a zonally oriented rectangle, a meridionally oriented rectangle, and a square, all partially overlapping? Did you have a particular reason why you chose this particular location in the North Atlantic? The three polygons could be drawn in different colours or in more different linestyles.

P17 L21: Spelling: "Even though" should be in two words.

Fig. 8: Caption: "Portrait" and "landscape" is ok for paper orientation in printers, but not for describing geographical orientation. Use "meridional" and "zonal" instead.

P19 L8 Polygon H is intoduced only in the next section.

P19 L12 spelling: "tongue"

P20 L1 grammar: delete second "on the": "...chosen based on the criterion that the error does not..."

Fig. 10 caption: "the sum of the two components in blue" – unclear what components are meant. Steric + OBP? The letters "A" to "J" are hard to read, they should be larger and/or in bold face.

P23 L7: "even though" in two words

P23 L9: "overestimation" in one word

P26 L10: grammar: write "They also suffer from..." without "s" at the end of "suffer"

P28 L25: Ablain et al. (2015): The list of authors appears to be incomplete. Similarly for Cabanes et al. (2013), Cazenave et al. (2008), Våge et al. (2009).

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