Reply on RC1
Johan van der Molen et al.

Author comment on "Imminent reversal of the residual flow through the Marsdiep tidal inlet into the Dutch Wadden Sea based on multiyear ferry-borne acoustic Doppler current profiler (ADCP) observations" by Johan van der Molen et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-730-AC1, 2022

General comments

The paper presents an analysis of the long-term measurements using ADCPs installed on the ferry crossing the Marsdiep tidal inlet in the Dutch Wadden Sea. The analysis finds a significant trend in the residual flow, with decreasing export to the North Sea, and with occasional imports observed in recent years. This is an important finding as the trend has significant effects for the morphodynamics and ecosystem of the western Wadden Sea. Therefore, I support the publication of the paper after proper revision.

A: We thank the reviewer for the time taken to review the manuscript, and for the suggestions and support.

The paper also infers that the trend is caused by the change in the tides in the North Sea related to global warming. For me this part is not yet such convincing that it can be presented as conclusion in the paper. As already mentioned in the paper, at lease the significant change of the O1 component in the horizontal tide should be verified by analyzing the tidal gauge observations. Moreover, it is still not clear to me why larger O1 amplitude causes the observed trend in the residual flow.

A: It was not our intention to suggest that O1 is the main driver for the trend in the residual flow. We merely observe and report that O1 is the only constituent with a consistent and significant trend in the data. We will improve the text to make this clearer.

The correlation between the residual flux and the air temperature does not say much. Given the fact that the temperature had an increasing trend any trend of any process in the same period would probably show a correlation with the temperature. I would suggest two possible revisions: (1) complete the analysis and present more convincing evidence for the conclusion concerning the cause of the observed trend; (2) admit that the cause of the trend is not yet clear and present a series of possible causes / hypotheses.

A: We agree that our conclusions may be too strong at this stage. We would very much like to and are indeed planning to do a more complete analysis. As this will take considerable effort, and the currently observed trends are new and worth reportin, we consider such analyses one or more separate pieces of work. We will revise the discussion to frame our conclusions more as a hypothesis, and address all potential causes: wind
stress (unlikely as already argued), changes in basin morphology, changes in fresh-water discharge (the volume is substantially smaller than historic residual, and can’t reverse) and changes in tides. We still think that the latter is the most plausible or dominant cause, but indeed all can contribute. We will remove Figure 9.

Specific comments

Line 43-44: Please specify what type of tidal asymmetry you refer to when saying flood-dominant or ebb-dominant (residual flow, peak velocity, or duration of slack tides?). The same in lines 235-236.

A: We have added this.

Lines 65-66: The previous research did not conclude that the system reached a new dynamic equilibrium, but concluded that the closure of the Zuiderzee still influences the morphological development of the western Dutch Wadden Sea, see also Wang et al. (2018).

A: We think the reviewer is mistaken, or means a different paper than we found. Wang et al. (2018) (Neth. J. Geosci 97, 183-214) make a similar statement as we do in the current manuscript, citing the same source (p. 192, last paragraph in the left column): “the morphodynamic changes in these areas are reaching a nearequilibrium state (see Elias & Van der Spek, 2017, for an analysis of Texel Inlet)”.

Lines 181-184: I am curious about the development of the other tidal constituents.

A: Unfortunately, as indicated, O1 was the only constituent with a statistically significant trend in our analysis. So we can't make meaningful statements about other constituents at this stage. However, as we indicate at the end of Section 4.1, ADCP observations are not the most accurate way to measure changes in tides. We are confident that more detail can be obtained through an in-depth study of the local tide-gauge records (as also stated).

Details

Line 11 (and many more through the paper): “sediment balance”? This term was first presented in Dutch (sedimentbalans) and later it is translated as “sediment budget” in English publications. Personally I think that this is the right translation.

A: Thanks, we will change this.

Line 53: Please change “the waves” to “the sand waves” to avoid confusion.

A: we will change this.

Lines 59-60: Please give more elaboration. The sentence is difficult to follow now.

A: We agree that the sentence is difficult to understand. We will remove the last part ‘in agreement with their seasonal variability’.

Lines 138-139: Please check the sentence. It seems suggesting that the flow velocity is used through the whole water depth.

A: we will improve the formulation.

Lines 166: reference error.
A: we will correct this.

Line 177: “residual depth”?
A: we will remove ‘residual’.

Lines 253: Please specify who does “They” refer to.
A: we will replace this with the reference: Jänicke e