Ocean Science
Discussions

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Interactive comment on "Residual circulation and fresh-water transport in the Dutch Wadden Sea: a numerical modeling study" *by* M. Duran-Matute et al.

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We would like to thank Referee #1 for his/her comments. Below, we address all the comments and suggestions individually.

> Page 218, line 3: I think that the phrase "the term tidal prism should not be thought of as a quantity characterized by the tides alone.." is on the right track...

The tidal prism is defined as the difference between the volumes at high and low tides. Since the definition is based on the tides, the name is consistent and follows common practice. However, its actual value at every tidal period is strongly influenced by non-tidal effects, notably wind forcing, which causes it to be highly variable. This part has

been rephrased for clarity.

> Later the idea of the exchange caused by wind and tides is re-introduced, around the top of page 222. I like this section, and feel it is the main novel point of the paper, besides just a detailed model description and validation. Is it possible to separate these effects out? Perhaps doing a tidal analysis on the transport can isolate those exchanges due to each tidal constituent. The residual would be due to the wind. If this is not possible, for some reason, it should be explained in the text

It is technically possible to separate the tides in the sense that one can mathematically decompose the signal into harmonic components and a residual. However, it is difficult to interpret physically the meaning of the residual since there are several non-linear effects, and harmonic analysis is a linear approach. The non-linear effects can be due, for example, to wind (e.g. the speed of propagation of the tidal wave at a given moment is influenced by the set-up induced by the wind), to local stratification, or to interaction with the bathymetry.In fact, for the watershed the harmonic analysis fails completely since the signal is highly non-linear. This is quite probably due to the shallowness of the transect and the complex system of channels and gullies. In other words, it is not possible to reliably assign the 'residual' signal exclusively to the wind. We will mention this briefly and also refer to the end of section 3.1 (p213, lines 3-8), where the same issue is at stake.

Minor comments > Page 198, line 22: "For pathways of fresh water, the same watershed turns out to be.." It is not immediately clear what the 'same' watershed is here.

We have specified that we refer to the Terschelling watershed.

> Page 199, line 9: should be 'estuarine dynamic'. The whole phrase is a bit awkward, and should be rewritten.

This sentence now reads: In terms of water movement, it presents a complex estuarine dynamic due to a complex bathymetry, tides, wind surges, and fresh-water flows.

> Page 201, line 28: "(neither from measurements or numerical)" is grammatically incorrect. The whole phase is awkward and should be rewritten.

The first lines of this paragraph now read: With respect to the fate of the fresh water, two important aspects have still to be addressed. The first aspect is the quantification of the actual export of fresh water through the different tidal inlets. Although it was previously shown that the fresh water goes towards the Texel and Vlie inlets (Zimmerman 1976b), no previous estimates (from measurements or numerical simulations) of the net export exist.

> Page 217, line 3: "accidentally" is perhaps better as 'coincidentally'

It has been changed.

> Page 219, line 18: "flood matches" is not clear to me. Explain this in more detail.

This paragraph now reads: During a tidal cycle, the actual volume goes up and down, matching the reference volume at a certain moment during ebb, and at a certain moment during flood. The tidal period (over which residuals will be calculated) is defined as the interval between two consecutive moments when the instantaneous volume matches the long-term average volume during flood.

> Page 219, line 24: Just say 'and vice versa.'

This sentence now reads: As can be seen in Fig. 12, for certain tidal periods the minimum is larger or the maximum is smaller than the average volume.

> Page 223, line 5: "Speaking of ..." is awkward. Perhaps 'In describing ...' is better.

It has been changed.

> Page 224, line 5: "... but the freshness itself" What on earth does this mean?

This sentence has been deleted. We now refer to the tracers instead of referring to the freshness.

> Page 227, equation 17: Why use the inverse flushing time? Especially, when these are all converted and discussed in terms of residence times below?

The problem of computing and plotting the flushing time (as opposed to the flushing frequency) for every tidal period is that the flushing time goes to infinity for periods with zero outflow. In addition, there are periods with negative flushing frequency that does not allow to use a logarithmic plot. Plotting a time series of flushing frequency is then much easier and correct. On the other hand, the discussion is done in terms of the flushing times because previous results were presented in such terms. In that case, it was possible to do so without a problem due to the conditions during the measurements.

> Page 230, equation A1: Note that W mean a weight here, but in Appendix B means a width. Perhaps use another variable name.

We have substituted "W" by "K".

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