Ocean Sci. Discuss.,
https://doi.org/10.5194/os-2018-102-RC1, 2018

Ocean Science
Discussions

Interactive comment on "Multidecadal variability in seasonal mean sea level along the North Sea coast" *by* Thomas Frederikse and Theo Gerkema

Anonymous Referee #1

Received and published: 26 September 2018

The manuscripts is focused on the amplitude of decadal and multidecadal variability of sea-level in the North Sea and its connections to the atmospheric forcing. The background motivation is to set a backdrop to frame the observed long-term trends of sea-level rise. The main conclusion is that wind forcing and sea-level-pressure variability are important contributors to the decadal sea-level variability, and that this variability is larger in the winter season. Methodologically, the study tries to separate the local atmospheric forcing from the impact of large-scale atmospheric patterns, and concludes that the relative importance of these two factors varies regionally. Also, the relative impact of the large-scale atmospheric patterns can be different depending on the location of the tide-gauge.

My overall impression of the manuscript is positive. It is in general clearly written and

well structured. The motivation and conclusions should be interesting also for a wider readership. I have only some minor comments that the authors may want to consider in a slightly revised version.

1. My most important and more general comments pertains the separation of the atmospheric drivers between local and large-scale atmospheric patterns. I guess that both are not totally independent, at least the statistical models used doe not explicitly attempt to separate the influence of both. Clearly, the large-scale patterns, such as the NAO, are also related to local changes in sea-level-pressure and local wind-stress, so that the amount of variances explained by local and large-scale patterns partially overlap . Could this overlap be quantified, or could these factors be statistically separated in a statistical model that uses all predictors simultaneously ?

2. Page 2, line 10 The the sea-level response to atmospheric pressure often deviates from the inverse barometer effect (Woodworth, 2017b). I guess the authors mean a purely equilibrium inverse barometer effect, and that this deviation is caused by the time scales considered here (seasonal means) that indicate that the response of sea-level to changes in atmospheric pressure do not reach equilibrium. Is this the cause or are there other causes ? The authors may want to help the reader here.

3. Page 10 line 5 There is a duplication in this paragraph ' generally only explain a small part of the variability explain'

4. Page 8, line 1 It must be noted that the principal components computed here, are not fully interchangeable ... Delete comma after 'here'

5. Figure3. The plots show the gliding linear trends. Actually, these plots do not only show the variability of the trends but also the long-term acceleration (or lack thereof). According to these plots, only the winter records of Oslo and Cuxhaven show an acceleration of the sea-level rate, whereas all for other records the rate is statistically flat. Is this interpretation correct ? If yes, it may be worth a short comment. Also related to this, it may be worth to include in the plot error bars in the estimation of the trends.

These error bars would be dependent on the period and record, but to include a shading around the main lines could clutter the plot. My suggestion would be to include a typical error-bar as side vertical segment just as a guideline for the reader.

6. Figure 10 Related to my previous comment, it seems that after removing the impact of atmospheric forcing, only the Oslo winter record show a long-term acceleration. Would this be statistically significant ? would it be worth mentioning ?

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