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Discussions

Interactive comment on "Processing of water level derived from water pressure data at the Time Series Station Spiekeroog" *by* L. Holinde et al.

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GENERAL COMMENTS :

Thank you for this comprehensive work. Maintaining a sea level station is a lot of effort and it is important to take time to quality check the data series in order to make it available to as many applications as possible. In your case, it is unfortunate that regular quality controls have not allowed correcting the sensor drift and preserving a vertical reference. Indeed, as you mentioned, it is not usable for climate change studies or extreme level statistics. Local Storm detection is a good idea but without a vertical reference attached to the ground datum it not possible to make comparisons with ground references. However, it is a good work for calculating harmonic constituents that do

not include meteorological effects and long term trend. The constituents can be then referred to the lowest astronomical tide (LAT). For the coming years, it is highly recommended that a more reliable sensor (like radar sensor) is installed and a vertical reference adopted in order to fully benefit from the Spiekeroog station.

As it is said in the other referee comments, I found dangerous to keep interpolated points over 7h in the final series. It is common to interpolate small gap over 1h using Spline interpolation but you can miss a lot of local phenomena in 7h. Indeed, a future user may not be able to distinguish real measurements from interpolated data and this can be misleading in case of a study on a local phenomenon. Your interpolation using a nearby station is still interesting and allows calculating a FFT on a continuous series that can lead to better results than other methods. On this topic, you may want to use academic Tidal analysis tools : Please, refer to http://www.psmsl.org/train_and_info/software/analysis.php. Once you have done the FFT, I am not sure interpolated points should remain in the final dataset. That is why I think it was a good idea you have created the three different datasets L1, L2 and L3.

Concerning the 20 minute delay between Spiekeroog and Neuharlingersiel, you may have to check that both instruments are well synchronized in time, but, if it is the case, it may be explained by shallow water effects that slow down dramatically the tide propagation at the coast like in estuaries. General tide models may sometimes not take into account such local effects and that is why in-situ observations are so much important. Moreover this delay may significantly (from 5 to 30 min) change between Spring and Neap periods, that is why it is not very representative to give only one value.

SPECIFIC COMMENTS :

1 Introduction :

As it is said in the other referee comments, it would be necessary to give a larger description of the installation (sensor?, datalogger?, transmissions?), the acquisition parameters (what is the vertical reference and is it linked to the ground ? Time ref-

erence? Averaging period?) and the maintenance procedures (How the vertical and time reference are controlled, what kind of maintenance is done on the sensor?). In particular, if you have vertical controls done during every maintenance, you may prefer use the trend between two controls, rather than an overall period trend in order to keep closer to the reference.

2 Methods :

2.1 :

- Regarding Figure 2, it is clear that the sensor drift is not constant over the whole period. Is there a correlation between the sensor drift and the brand or serial number of the installed sensors?

- Please, could you precise how you calculate your short and long term trends? Do you compute daily mean sea levels? Monthly? What are your criteria to differentiate these two trends?

2.3 :

- You should precise that Neuharlingersiel sensor falls dry during "Spring" low tide only and not at every low tide. Indeed, that is why it was possible to interpolate at Neap low tide in your example.

- What do you mean by similarities between the two sites : I assume you perform a linear regression on High & Low tide in order to determine an offset and a scale factor? Please can you develop this part?

2.4 :

Could you precise what is the maximum gap authorized for spline interpolation. You refer to a "tidal cycle" but for me a tidal cycle is 12h25min. . .

2.5 :

- As a quality control, you could have compared tidal analysis over every one-year period and check discrepancies between the results (assuming, tidal constituents are constant over a 10 year period).

- If you have the tools to make your own predictions, you can also detect the storm signals using the residual observations-predictions.

3 Results

3.1

- Figure 4, bottom graph : Can you explain the event around march 2008 (I suppose it is the storm Emma) that is clearly visible in red but not in blue. It may put into question the correlation between the two sites. However, it seems on figure 7 that the storm Emma (n° 6) reaches approximately the same range at both sites and is detected as a weak storm flood.

- You give the results of the correlation but what are the results of the height comparisons? Is there a scale factor between the two sites? Does that mean that no height correction is applied to Neuharlingersiel values when creating the supporting points?

3.2

- I am not an expert on FFT but FFT is not supposed to work on non-continuous data series. Can you explain how has it worked on the dataset that contains gaps? Usually, for dataset with gaps, I use a kind of root mean square error adjustment.

4 Discussion

4.1

You will have fewer problems if you use a radar sensor that is above the sea surface. Using the digital output also avoids the natural drifting of the analog components.

4.2

- The Figure 3 is essential to validate your threshold. You should clearly precise that for another site this threshold may have to be adjusted with regards to the local tidal range. For example, in France, at Saint-Malo, with a tidal range of 14m at Spring tides, you can reach a gradient of around 6cm/min at mid-tide.

4.4

- To validate your interpolation method, you could have made artificial gaps by removing some points of your series and then make error statistics comparing the original observed data and the interpolations.

4.5

- It is possible that working on a continuous series can improve significantly the result of the FFT.

TECHNICAL CORRECTIONS :

2.2 :

Figure 3, the unit of the gradient should be .10-1m/min

3.2 :

- You can delete the "probably" in the sentence "The highest peak in the original time series is directly at beginning of the graph probably representing the mean of data."

- I would add an "s" at "floods" in the sentence "Table1 shows the water level during the storm floods above the mean high tide and the name of the storms."