Supplementary Material

1 Tide gauge metadata

Records from eight tide gauges in the Baltic Sea are used in this study (Supplementary Table 1). The monthly sea level data provided from PSMSL and they do not have consecutive gaps of longer than two years.

Table 1 Geographic location of the tide gauges and the data period used in this study.

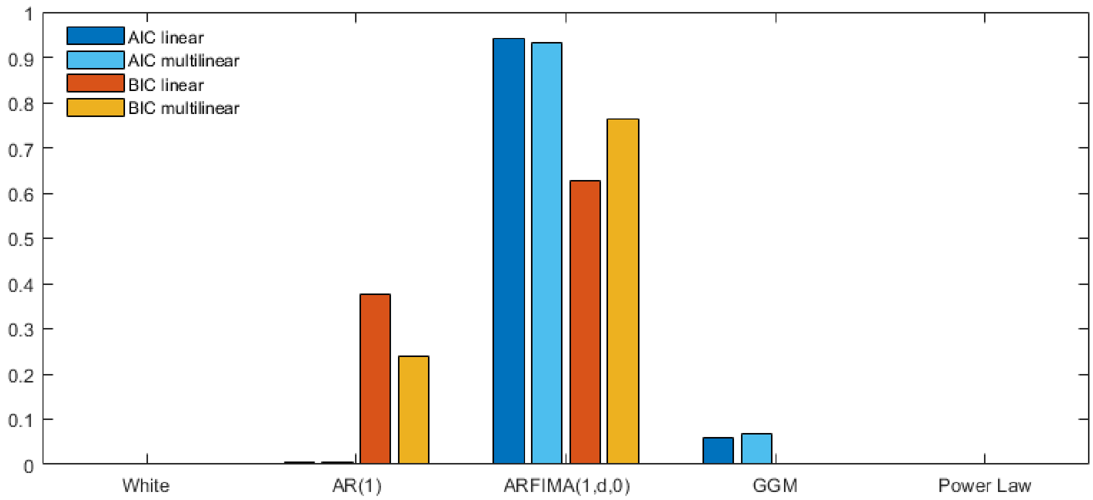
Tide gauge	Latitude	Longitude	Data period
Warnemunde	54.170	12.103	1900-2020
Helsinki	60.154	24.956	1900-2020
Vasa	63.082	21.571	1900-2020
Olands Norra Udde	57.366	17.097	1900-2020
Kungsholmsfort	56.105	15.589	1900-2020
Stockholm	59.324	18.082	1900-2020
Oulu	65.040	25.418	1900-2020
Ratan	63.986	20.895	1900-2020

2 Noise model analyses

To account for temporally correlated noise in the altimetry time series and trend estimations in Eq. 2 and Eq. 3, five different noise models are tested. For long term tide gauge measurements, this analysis has previously done by (Bos et al., 2013b) and Autoregressive model with order 1, AR(1), is determined as the dominant noise model for all tide gauges in the Baltic Sea. To study the noise model in altimetry time series, we use Hector, developed by Bos et al. (2013a). The analysis carries out on both Eq. 2 and Eq. 3 to see if inclusion of climate indices changes the noise model. In order to evaluate the suitability of the noise models, Akaike information criterion (AIC) and Bayesian information criterion (BIC) are used. Power law and white noise models do not show the lowest BIC and AIC in any of altimetry points (Figure S1).

According to AIC results, ARFIMA (1, d, 0) is the best noise model for over 90% of the time series. Generalized Gauss Markov (GGM) model has the lowest AIC in about 10% of the time series. Adding climate indices to the trend estimation model does not change the outcome according to AIC, changing only 2% of the time series to the GGM noise model. The BIC results are in line with AIC in overall although there are two major differences. ARFIMA(1,d,0) shows the lowest BIC in 60% of the time series for Eq. 2 and 78% for Eq. 3. In contrast to AIC, the second proper noise model is AR(1) according to BIC and inclusion of climate indices in the equation has changed nearly 10% of the time series in favor of ARFIMA(1,d,0).

There are different approaches regarding reconciling discrepancies between AIC and BIC. While some studies report that either of them is more proper criterion to evaluate noise model (e.g., (Chakrabarti and Ghosh, 2011), some others have scored their differences with other noise models and then have integrated these to a single indicative to find the best model (e.g., (Royston et al., 2018). Here, since ARFIMA(1,d,0) has the highest proportion among the other models for both criteria and also there is no agreement between two criteria in second place, this model is used as the noise model in both Eq. 2 and Eq. 3. It is worth to note that this is not in agreement with long term tide gauge data which AR(1) is determined as the most suitable model (Bos et al., 2013b).



Supplementary Figure 1, The most proper noise model for altimetry time series according to BIC and IAC. The vertical axis shows the proportion of the bins. ARFIMA(1,d,0) clearly has the lowest BIC and AIC among the altimetry time series.

3 Acceleration

The sea level rise acceleration of each station is estimated in three different periods by adding a quadratic term to Eq. 2 (Supplementary Table 2). The noise model is AR(1) as provided by Bos et al. (2013b). Acceleration figures are considerably higher for the period of 1944 – 2020 when they are compared to the whole data period results.

Supplementary Table 2. Acceleration (mm/year^2) for the stations in different time spans covering two or three of the phases discussed in the article.

	1900 – 2020			1900 – 1978			1944 – 2020		
Warnemünde	0.010	±	0.006	-0.006	±	0.016	0.020	±	0.018
Helsinki	0.028	±	0.014	0.020	±	0.034	0.022	±	0.046
Vasa	0.012	±	0.014	-0.042	±	0.034	0.054	±	0.044
Ölands Norra Udde	0.012	±	0.010	-0.002	±	0.028	0.036	±	0.034
Kungsholmsfort	0.022	±	0.008	0.014	±	0.024	0.024	±	0.030
Stockholm	0.018	±	0.012	-0.014	±	0.03	0.046	±	0.036
Oulu	0.014	±	0.014	-0.016	±	0.038	0.044	±	0.050
Ratan	0.010	±	0.014	-0.036	±	0.034	0.034	±	0.044

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