Ocean Science
Discussions

Open Access

OSD

Interactive
comment

Interactive comment on "Spatio-temporal
structure of Baltic free sea level oscillations in
barotropic and baroclinic conditions from
hydrodynamic modelling" *by*
Eugeny A. Zakharchuk et al.

Anonymous Referee #2

General comments

In the paper, 3D hydrodynamic model simulations are used to study the free relaxation oscillations that would occur in the Baltic Sea once the meteorological forcing ceases. This is an interesting theoretical analysis of the Baltic Sea level behaviour. Corresponding analyses on the eigenoscillations of the Baltic Sea have mainly been conducted with simpler (barotropic) models, many of them several decades ago. Thus, this new study is a nice addition to the topic.

Printer-friendly version

Discussion paper

The paper is well organised and clearly written. The hydrodynamic model and the methods used for the analyses are well presented. The results are also thoroughly and clearly presented. The conclusions on the nature of the different oscillations form an interesting discussion. I only suggest some minor clarifications, see comments below.

Specific comments

The oscillations studied in this paper occurred in a model where some parameters were adjusted to unrealistic values in order to reduce damping (l. 182-183). It would be interesting to see some discussion on how the results obtained relate to the sea level behaviour in the real Baltic Sea. Is there a possibility that the parameter adjustments affect the oscillation frequencies? How much are such oscillations expected to contribute to the real sea level variability? How fast would they be damped?

Fig. 8: Why is there so much white space in these maps? The areas around the oscillation nodes are apparently excluded due to low amplitude. But why are e.g. phase speeds for the eastern Gulf of Finland missing in Fig. 8b, even if the amplitude of the oscillation should be high (Fig. 7b)?

In a seasonal scale in the baroclinic simulation, after all the external forcing ceases, I would assume that something happens to the temperature and salinity distribution also. Were such processes considered, and how would they affect the surface height?

l. 499-502. Most of the interannual variability in the seasonal sea level fluctuations likely originates directly from the interannual variability in the atmospheric forcing. E.g. the role of the air pressure conditions, the NAO index, etc., have been shown to explain a significant portion of the interannual variability. Thus, I suppose the contribution from the baroclinic free oscillations is minor. (Which might be mentioned.)

Technical corrections

l. 41 and elsewhere: "Bothnia Bay" => Please use either "Bothnian Bay" or "Bay of Bothnia" consistently.

l. 42: Newman => Neumann.

l. 144: "observed (sigma_m) and simulated (sigma_tg)" => "observed (sigma_tg) and simulated (sigma_m)".

l. 144-145: sigma_p is not the relation of sigma_m and sigma_tg (as stated), but sigma_er and sigma_tg.

l. 145-146: Please give the definition of P_m. Now it remains unclear which measure should be <0.674*sigma_tg.

l. 201: ...a_k and b_k are the coefficients...

l. 202: "mean average" => "mean" or "average"

l. 207-211: Is the period P same as T above? If so, please use the same symbol. If not, please explain.

Fig. 4: The original amplitude of the displacement ranges from -50 to +100 cm in Fig. 3. How does this relate to the plots in Fig. 4 starting from around +10-20 cm at every station? What is the vertical axis in these?

Fig. 4: It would ease the comparison of amplitudes if all subplots had the same y axis (as they are very close to each other already).

l. 229 and Fig. 5: What is "standard deviation of amplitudes"? If this is the standard deviation of time series, as Eq. (4) implies, then the word "amplitude" here is misleading.

l. 230: Please check the font size of all subscripts, here and elsewhere.

l. 233: Consider adding locations of Pärnu Bay and Rügen Island to Fig. 1.

l. 235-236: "Oscillations of medium intensity can be noted as over local uplifts in the Baltic Proper as over-bottom depressions..." Please reformulate this sentence.

l. 261: There is a 17-h period listed. However, there are no 17-h peaks in Fig. 6. This

should be 16-h?

l. 310: Leppäranta and Myrberg, 2009

l. 311: From Eq. (13), a range of 12-67 m/s corresponds to depths of 15-458 m. From where does the lowest limit of 15 m come? Please specify.

l. 321: "anemobaric forcing": please specify what is meant by this. Is "anemobaric" a synonym to the entire meteorological forcing described on lines 118-119?

l. 322: "30-35 cm in amplitude" => "in range"? In Fig. 9, the largest range of variations seems to be 35 cm. This is not amplitude, which by definition is half of the total range.

l. 330: "standard deviation of the amplitudes"; see comment above.

l. 336: Ellesmere Island? Please check the name, and add location to Fig. 1.

l. 362: "Free oscillations of 27 h periods in the baroclinic conditions reached the maximum in the narrow zone near the southwest Finland coast". There seems to be a much more apparent maximum in the eastern Gulf of Finland in Fig. 12b, please check this sentence.

l. 382-383: "Dash line on the histogram plots indicates minimum theoretical value of phase speed of baroclinic (Ci) and barotropic (Cg) gravity waves." It looks like the dash line for Ci indicates the maximum value (1.53 m/s), not minimum.

l. 412: May be more specific here: "significantly lower for 358-day waves and belong to the theoretical range for 89-day waves". I see this is what is meant, but "longer" and "shorter" are a bit too generic and it is hard to understand the sentence.

Fig. 15. Line 388 says the Ci range is 0.08-1.53 m/s. Why is the maximum lower here?

l. 467: decreases => increases

l. 479: It would be helpful to mention explicitly the period of inertial oscillations in the area (about 14 hours).

Interactive comment on Ocean Sci. Discuss., https://doi.org/10.5194/os-2020-110, 2020.

OSD

Interactive
comment

[Printer-friendly version]

[Discussion paper]

C5