Ocean Sci. Discuss.,
https://doi.org/10.5194/os-2020-7-AC2, 2020

Ocean Science
Discussions
Open Access
EGU

Interactive comment on "Seasonal variability of radiation tide in Gulf of Riga" *by* Vilnis Frishfelds et al.

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Received and published: 23 March 2020

> The paper discusses mechanisms behind the diurnal oscillations in the water level in the Gulf of Riga. This is an important topic in Baltic Sea research.

OK

> The paper claims that the Helmholtz oscillations, which are normally discussed as the main reason of oscillations in the literature, can not completely explain the observed phenomenon and argue that the tidal components contribute significantly in the oscillations.

Semi-closed state of Gulf of Riga just ensures that only diurnal components survive there. Tides (astronomical and radiation) must be primary forcing that can drive these

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Discussion paper

periodic oscillations with strong damping. Description improved in text.

> The authors attempt to use numerical modelling instead of an analytical approach to study the origin of the oscillations.

Yes, since it is hard to estimate analytically the damping effect in Irbe strait and particular geometry. Description improved in text.

> However, the paper lacks logic in its structure, is written in the inconsistent matter, and is very difficult to read due to the language problems. The research is not scientifically robust, inconclusive and not well described. Therefore, the paper is not recommended for publication in the Ocean Science journal in its current shape.

Yes, the structure of the paper is improved with better expressed task of the paper. Resonance of the Gulf of Riga is moved to Appendix as its is less essential part for the main task of finding seasonal characteristics of daily pattern of oscillations of water level. Then, there are three principal sections: a) observations of daily water level oscillations, b) case with astronomical tides only, c) inclusion of sea and land breeze and analysis.

> As example of the illogical structure, the authors show the Figure 1 in the introduction as the reason for the presence of the tidal components in the water level variability. However, this figure is based on the modelling results described much later in the paper.

Figure 1 was intended just as example. Of course, we cannot put 60 years of observations as readable figure. Therefore, spectral analysis of observations (1961-2019) will be included. Better description added in text.

> Also, the graph shows the observations without long-term variability, but there is no information about how exactly the long-term components were estimated.

The long term components were studied primarily by spectral analysis. Similar result with maximum contribution of S1 oscillations in May and minimum in September was

obtained by using Lomb-Scargle periodogram and short time Fourier analysis. But they would not yield any better information as simple hourly statistics for the main task (Figure 5 in version 1) and not included in the text. The description of observations is improved.

> The article needs to be significantly re-written following the standard logics of a scientific paper so that in the introduction only the previous research on the topic is discussed, then all the methods, techniques and modelling parameters are discussed, followed by the results presented in the results section. At the moment, almost all the parts of the paper are mixed. The methods should be carefully described in the paper. For example, which modelling parameters were used? How were the long-term components removed?

Yes, the language is improved and task of the paper is being expressed more clearly in the text. Better description of modelling parameters is being added.

> What is the shape of the perturbation introduced in the HBM model? Why was it introduced only at longitude = 11.96? How changing the parameters of the perturbation or their location affect the results?

Perturbation is harmonic with given period. Since there is no other forcing, after few days the system will converge to a solution where any point will oscillate with the period of perturbation but with specific amplitude and phase. Then, basing on the local water level amplitudes we can conclude whether specific part of the basin wants to oscillate with given frequency. Since, the relative amplitude is used with respect to Visby station, then it should not depend on location of perturbation. The same is true also for relative phase. We have used various resolutions and different setups (nested and non-nested) all giving the same picture. The description is improved in the text.

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