

Comment on os-2021-62

Anonymous Referee #1

Referee comment on "Swell hindcast statistics for the Baltic Sea" by Jan-Victor Björkqvist et al., Ocean Sci. Discuss., <https://doi.org/10.5194/os-2021-62-RC1>, 2021

General comments

I have twofold feelings about this manuscript.

On the one hand, it is a nice insight into the structure of wind waves in the Baltic Sea that highlights several interesting features, such as short duration and thus great intermittency of formal swell events, extensive spatial variation in the probability of predominance of formal swell events, low swell heights, overall short periods of swell waves that almost overlap with the typical periods of windseas (most frequently 2–4 s), frequent co-presence of windsea and swell.

On the other hand, some established features strongly signal that attempts of partitioning of the Baltic Sea wave fields into windsea and swell do not necessarily lead to sensible results and may even be deceptive. Even though many such aspects are discussed professionally, the ramifications of possible misunderstandings are not really made clear for the reader.

Specific comments

One of the main results is that the areas where swell wave energy predominate form only a narrow strip along some 50% of the length of coastlines of the Baltic Sea (Fig. 3). This feature is counter-intuitive because energy of (longer) swell waves should decay faster in the shallow area than energy of (shorter) windseas. Also, the (longer) swell waves experience stronger refraction in areas with variable depth than (shorter) windseas. This effect also leads to systematically faster decrease in the energy of swell waves in the nearshore. Differently from the open ocean conditions, the Baltic Sea waves often approach the shore under relatively large angles. It is thus likely that this effect is

stronger in the Baltic Sea compared to its impact on the open ocean shores.

As I am sure that there is nothing wrong with the simulations and the evaluation of the share of swell, the results essentially prove that the definition of swell (that has been derived for the open ocean conditions) is simply not applicable for the Baltic Sea. This aspect should definitely be clarified for the benefit of readers outside the Baltic Sea basin.

An attempt to explain this feature in the last paragraph of Section 3.4 (lines 164–173) is somewhat unfortunate and basically expresses the same point. In particular, I strongly disagree with the statement on line 174 that “The coastal locations are more heavily and constantly tainted by swell” as practically the same wave system that exists a dozen km from the shore approaches the coast – and is just renamed swell because of a decrease in the wind speed in the nearshore. This aspect is mildly expressed in Discussion on lines 182–184 but not really made clear.

A possible misunderstanding is reinforced in Conclusions by saying on line 283: “swell was mostly created simply by a decaying wind, turning the existing wind-sea waves to swell in the partitioning”. It would be correct to say: the wind-sea was just interpreted as swell in the nearshore in the used framework even if its properties did not change. Also the conjecture that the probability of having swell-dominated wave fields (expressed in terms of the correlation between swell and windsea height) substantially changes from offshore to nearshore belongs to the same pool of ideas and apparently reflects the “impact” of the particular swell definition.

In this context, part of Discussion is also deceptive. The text on lines 213–218 relies on the usually distinctly different properties of swell and windseas in the open ocean. The presentation has made clear that “swell waves” is just a name for the same wave system, with the same period; just wind has ceased. Also, Wang et al. (2014) look at the global ocean where swell waves are usually longer and well organized, closed to monochromatic ones – that is typically not the case of Baltic Sea swell (as proved by the authors). The real point to address is formulated on lines 236–237: “We found that in the Baltic Sea even ECMWF’s simple partitioning flagged a minimal amount of energy as swell during the growth phase of the wave field, resulting in spurious non-zero swell weights”.

In general, it seems that the authors are partially victims of the major success of high-resolution wave simulations in the Baltic Sea. The spatial resolution is now so high that effects that are not visible in global wave hindcasts start to play a large role in the interpretation of the local results. The overarching conjecture from the manuscript could perhaps be formulated as follows: the existing separation methods of windsea and swell make only sense for offshore conditions, and should not be used in the nearshore and in archipelago areas.

Based on the above considerations, I recommend reshaping the discussion and conclusions so that the situation would be unambiguously clear for non-experts in the

field. It may make sense to add a few sentences that clarify the difference between citizens' perception of swell as organised, highly directional, and often almost monochromatic wave field and the wave modellers' understanding of swell as some collection of wave components.

Technical issues: A short (not full) list of minor aspects that might need attention:

Line 38: The reference to Semedo et al. (2014) is to a certain extent deceptive as this source is visible only as an abstract. Also, the poster available in internet has a different team of authors: Alvaro Semedo, Roberto Vettor, Oyvind Breivik, Andreas Sterl, Magnar Reistad, Daniela C.A. Lima, Carlos Guedes Soares.

Lines 45–46: The information on these lines is highly cryptic. Please explain the acronyms.

Line 51: The acronym ERA5 also requires an explanation and a reference.

Line 84, Equation (5) and also below: it is recommended to unify the use of "S"/"s" as subscript for quantities that characterize swell.

Line 85: probably "dominated".

Line 99: it is recommended to use the Lithuanian "dotted e" in Klaipėda.

Line 107, also caption to Fig. 1, line 111, 114: the superscript "th" should use normal font, not italics.

Figure 1, explanations to both scales: "H_s" should be in italics; also the upper scale should have a space between H_s and (m).

Caption to Fig. 2: should be "storm"

It is recommended to use "Baltic proper" as it is not really a proper name; however, there exists also a tradition of capitalizing "Proper".

Line 118–119: “the averaged swell direction were” is inconsistent

Lines 128–129: the conjecture “In the Baltic Proper the highest swell weights were along the eastern coastlines, which is expected because of the prevailing southwesterly winds (Karagali et al., 2014)” is only partially true. In fact, the NNW winds also add substantially to the wave fields so that the overall maximum wave height (Björkqvist et al., 2018) and particularly the maximum of wave energy flux (Nilsson, E., Rutgersson, A., Dingwell, A., Björkqvist, J.V., Pettersson, H., Axell, L., Nyberg, J., Stromstedt, E. 2019. Characterization of wave energy potential for the Baltic Sea with focus on the Swedish Exclusive Economic Zone. *Energies*, 12(5), 793, doi: 10.3390/en12050793) are located between Gotland and the Gulf of Gdansk. It might be also mentioned that refraction plays usually a larger role in the propagation of (longer) swell than for (shorter) windseas in the relatively shallow Baltic Sea.

Line 139: please explain the abbreviations NBP and GoF.

Line 237: remove one “the” in the middle of the line.