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Ocean Science Discussions

Interactive comment on "Upwelling characteristics in the Gulf of Finland (Baltic Sea) as revealed by Ferrybox measurements in 2007–2013" *by* V. Kikas and U. Lips

Anonymous Referee #1

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Note to the editor. I commented on version 11. I see now that version 12 is available, which has a different page numbering. This is somewhat confusing.

Review of "Upwelling characteristics in the Gulf of Finland (Baltic Sea) as revealed by Ferrybox measurements in 2007–2013"

This study presents ferry observations of T and S in the Gulf of Finland. The data is used to document upwelling on both the north and south coasts. However, their findings agree with results by Lehmann et al. (2012). Their explanation why the southerly upwelling coincides with less wind stress than the northerly upwelling was also suggested by Liblik and Lips (2015). Thus, it is unclear what NEW findings this paper

contributes, apart from publishing fascinating ferry observations.

Spatial gradients in wind stress also cause up or downwelling (Ekman pumping). The authors have access to model wind data. Can this data be used to compute Ekman pumping and compare it with coastal upwelling?

Before this work can be published, I suggest improving on the English and clarity of the paper. The discussion section needs some rewriting. The paper would greatly improve if the authors could make their discussing more physical and possibly correlate their findings with some simple dynamical models and sketches of the upwelling phenomena.

Detailed comments:

P6, l16: use 'avoid sediments'

P7, L7: '19 s interval are averaged and recorded as measurements at every 20 s.' This means that every ∼20 samples there is a gap of ∼20 seconds (no data)? Please clarify. Are the data interpolated to 20 seconds?

P8, L14. 'A failure of the system occurred late August 2012 and therefore the data are not available from September 2012 (since 29 August).' Till when was data not available?

P9 L9 'against the daily average temperature values over the entire ferry route'. I find this not very clear. Can you explicitly say that you computed ONE daily mean temperature value, computed over all the recorded temperatures over the entire day. Why did you compute this daily and transect-mean temperature as opposed to a weakly or biweekly mean temperature for each 0.5 km grid cell?

P9, L14. 'For each crossing, a sum of negative temperature deviations'. Does this mean that if there was a positive anomaly it was discarded? Please explain. If so, you may get a bias towards upwelling, if all but one of the 40 cells is positive?

P10, L3. How did you define n1 and n2? What is the end of the upwelling cycle? You cannot have positive UIs, so n2 occurs when CU become zero? I suggest being clear about this.

P10, L24. You use model data, but then only model data that is located close to a meteo station that is ∼50 km from the ferry transect. Why not use an area averaged wind speed locally at the ferry transect? In this paper you ignore the effect of Ekman pumping: vertical velocity w=1/f*(dtau_y/dx - dtau_x/dy), where tau is the wind stress. The horizontal shear in the windstress may be important, especially near topography. The wind model data would provide insight if Ekman pumping is important relative to coastal upwelling w∼V/L, where V = -tau_x/f and L is the distance over which upwelling occurs (in your case ∼20 km).

P12, l5. 'course'; you mean 'trends'?

P12, l24. In Fig4 you show the mean variability within one day. What is the 'value' of using this metric for such a short time? How does this short time scale relate to the upwelling phenomena? Why not plot the deviation from a longer term mean value which is computed over an upwelling time scale? This short time scale explains why the mean temperature is almost flat. However, it is then confusing why the salinity is changing so fast over this short time scale in (b). I assume the ferry leaves Tallinn and then returns to it at the end of the day. Over this day, on average, the salinity has increased. Can this be a bias in the sensor? This bump in salinity on the south shore coincides with the sheltered part of the transect, west of the peninsula. The upwelling and circulation must be greatly affected by this topography. Can you explain why the salinity mean is positive on the South shore?

P12, l25. Can you explicitly say that the deviation is computed from the daily and transect-mean value? At first, I thought that it was the daily-mean value for each grid cell.

P15 l 27. 'We also found the total sum of upwelling indexes (divided by 40) off the

both coasts regardless whether the set upwelling criterion was met or not.' I do not understand what you mean here.

P17, l19 'However, the average along-gulf wind stress was close to zero indicating that the wind from both directions had almost similar occurrence.' I am not sure if this is correct. This would apply to a Gaussian distribution, but if the wind blows with -10 m/s for one hour and +1 m/s for 9 hours, the average is close to zero, but the occurrence is not.

P17, l25. 'It can be concluded that the difference between the wind impulses needed for the generation of coastal upwelling events near the opposite coasts with a comparable intensity in regard of the introduced cumulative upwelling index is related to the average wind stress value in the region.'. It is unclear what the authors are concluding here. Please break up this sentence.

P18, l3 'Daily measurements are too scarce yet to describe the temporal evolution of upwelling events in detail since the inertial period in the Gulf of Finland is approximately 14 h (about half a day).' Please explain the relation between the scarcity of the data and the inertial period.

P19, 8. 'the westward current jet along the front'. Can you provide references or further explanations of the relation between the salinity minimum and the jet?

P20, l5 'the two crossings same day' . . .on the same day

P20, l20 'but we argue that the analysis of temperature deviations along meridional transects is more appropriate in the Gulf of Finland' . . .. than in Uiboupin and Laanemets (2009)'s study?

P20, l23 'and when using meridional transects the results are not biased by the different temporal dynamics of surface layer temperature in the open Baltic Proper and in the relatively narrow Gulf of Finland. For instance, the seasonal warming and cooling are faster in the gulf than in the open Baltic.' These sentences are unclear and need more

explanation.

P21, l7. Use better English: ‘in regard their resolution’

P21, l13: ‘there’ = ‘their’

P21, l16 ‘Partly, this outcome can be explained by the higher position of the thermocline, steeper slope and greater depths in the southern part of the gulf’. Please explain to the reader how depth, slope and thermocline explain this outcome.

P21, l18 ‘However, one could suggest that the thermohaline structure of the Gulf of Finland is adapted to the general prevalence of westerly-south-westerly winds.’ It would be great if the authors could add some more physics in their discussion why southerly upwelling is linked to weaker winds to the west. A conceptual drawing would also greatly help. Is it that SW winds cause a deeper TC on the south side? As soon as these winds relax and become easterly, the TC bounces up and little more easterly wind is needed to cause even more upwelling? The opposite would be true on the north shore, where more westerly winds are needed.

Fig.1. Can you add colorbars, so the reader knows how deep it really is?

Fig.3 labels indicating T and S would make for faster reading.

Fig.5 the small labels are hard to read

Interactive comment on Ocean Sci. Discuss., 12, 2863, 2015.