

## ***Interactive comment on “One hundred years of atmospheric and marine observations at Utö Island, the Baltic Sea” by Lauri Laakso et al.***

### **Anonymous Referee #1**

Received and published: 26 February 2018

Laakso et al. One hundred years of atmospheric and marine observations at Utö Island, the Baltic Sea Ocean Sci. Discuss., <https://doi.org/10.5194/os-2017-105>

#### Review

The paper presents long-term meteorological and oceanographic data from the Utö station in the north-eastern part of the Baltic Proper (Archipelago Sea). It is a very valuable source of information for meteorologists, oceanographers, and climate researchers. I strongly recommend publication of the results.

However, the paper could be improved by adding more scientific discussion points. My main concern is that the statistical analysis results are presented, but not properly discussed. Much more can be done/analyzed that would help to put the results into a

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wider context.

Physical processes, which could cause the observed changes in stratification and deep layer characteristics are oversimplified in the analysis – mostly the changes are explained by vertical mixing. As shown in the Gulf of Finland, the stratification very much depends on wind conditions – winds from a certain direction tend to strengthen the stratification and opposite direction weaken it. Thus, bi-directional lateral transport is an important factor. I think, a look at the topography of the study area (and connections, sills between the Utö Deep and Baltic Proper) could be relevant.

Also, as mentioned by the authors, this analysis sets the background for the further studies of biogeochemical changes. But no suggestions are made on this subject in the paper/discussion.

#### Specific comments

##### Abstract

There are some spelling errors in Abstract. Please, correct them.

P1, L14-15: The last sentence of Abstract has to be rephrased. If I understand the results correctly, the ice does not cause large local effects anymore in this new phase. In the present form, the sentence has an opposite meaning that the ice does not reduce local effects. Did it reduce or cause the local effects earlier?

##### 1. Introduction

I miss a broader problem setting. Also, a scientific aim of the study could be formulated.

##### 2. Measurement site and general characteristics

P2, L29: I would avoid using the term “seasonal sea” which is not commonly used in the scientific literature.

P3, Fig. 1: It is quite empty. At least the sub-basins of the Baltic mentioned in the

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text should be shown (Archipelago Sea, Baltic Proper, Gulf of Finland, etc.). Also, consider presenting a local map where the oceanographic measurement site with the topography of the surrounding area could be seen.

P4, L3-5: I agree that saline water inflows and freshwater input keep the stratification strong, but I do not agree that it causes the deep water to be anoxic. It could be opposite – saline water inflows could ventilate the deep layer. Moreover, the main reason for oxygen depletion is consumption of oxygen.

P4, L13-15: It is not obvious how the bottom topography and prevailing winds cause strong currents in the Utö Deep. Please, give a reference or explain it (also providing a map with topography if appropriate).

### 3. Observations and methods

P4, L28-29: Please consider other options for sub-titles, e.g., “Observations and methods” instead of “Observations and methods used in this study”

P6, L25-26: I do not understand the last sentence of this sub-chapter “In aim to keep the focus of this paper solid, we focus on a selection of the variables in stead of all possible seasonal data.” Please, rephrase it.

### 4. Results

P7, L9-13: Is the annual mean NAO index the best parameter to use here? For instance, Lehmann et al. (2011) did use NAO winter index (from December to March). Also, I do not see that the highest negative NAO values and low temperatures are connected (e.g., 2009 has far lowest NAO but not the lowest temperature).

P9, L9 and Fig. 6: Why median values are used here?

P9, L13-14: I do not agree with the suggestion that the relatively strong currents are the reason for the absence of the halocline. Could the bottom topography restrict saltier water transport into the Utö Deep?

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P11, L7-9: What do you mean by “we calculated the top and bottom of mixed layer depths”? I did not find a method in Lips et al. (2016) for that.

P11, L13-16: What could be these other phenomena responsible for deep water temperature increase in the 1980s and 1990s and recent decrease?

P12, L3: Stratification should not be large and small, but rather strong and weak.

P12, L9-11: Do you explain the observed changes in deep water temperature by vertical mixing and stratification only, or is it possible that these changes are related to lateral exchange? Please, explain it because it is not clear what are “these changes . . . responsible for the increased water temperatures at 50 m and 90 m depths”.

P12, L14: What is meant by “We also see a rapid increase in 1940s”?

P13, L7-8: Why these 30-year periods were selected for the comparison. It could be reasonable for the atmospheric data, but not for the oceanographic parameters which revealed a rapid change in the 1990s.

P13, L14-15: Has this sentence (“However, . . .”) the meaning of the previous comment that the chosen periods hide the rapid change after the 1980s?

P14, Table 1: How these averages and standard deviations were estimated?

### 5. Conclusions

P15, L15: The saline water inflows increase salinity in the deep layer, but they could cause either an increase (mostly) or decrease in temperature. This change is not directly connected to the reduced vertical mixing. Do you have any pieces of evidence that the observed decrease in deep water temperature was due to the reduced vertical mixing?

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Interactive comment on Ocean Sci. Discuss., <https://doi.org/10.5194/os-2017-105>, 2018.

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