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Interactive comment on “Estuarine circulation reversals and related rapid changes in winter near-bottom oxygen conditions in the Gulf of Finland, Baltic Sea” by T. Liblik et al.

Anonymous Referee #2

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General comments

In the presented paper the results of a study of estuarine circulation reversals formation conditions in the Gulf of Finland are considered, and the influence of circulation processes on thermohaline structure of water and oxygen conditions in deep layers of the gulf is analyzed on the basis of field data for the period of December, 2011 - May, 2012 taken at a longitudinal section (thalweg).

In present, the circulation processes in the Gulf of Finland are studied rather well. It is well known that the anoxic-hypoxic conditions occurrence in the Gulf of Finland is related to the inflow of saline and oxygen-poor waters from the Northern Baltic. Some-

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times, the intrusion of saline waters extends far eastwards and reaches the shallow Eastern part of the Gulf of Finland. It leads to negative consequences for the gulf ecosystem state, mainly to strengthening of eutrophication due to the additional input of phosphorus-phosphates from bottom sediments, and to emergence of areas of "dead bottom". The reversal events discovered during the measurements essentially change the structure of water, hypoxic water area and volume. It is shown in the paper that the reversibility is a result of the southwestern winds. As a consequence of this wind influence strong benthic currents occur. Thus, it is demonstrated rather well that the halocline disappearance and the increase in oxygen content in near-bottom layers are mainly caused by advection of oxygen-rich waters from the eastern part of the gulf and that vertical mixing can not be the reason for disappearance of saline and hypoxic waters boundary in deep layers. So, the reversal events discovered during the study play a large role in water circulation in the gulf and make a considerable impact on oxygen conditions in deep waters.

At the same time, such phenomenon as circulation reversals in the Gulf of Finland is studied insufficiently well. The conducted research of estuarine circulation on the basis of field data allows to get the best representation (understanding) of halocline emergence and disappearance mechanisms, time scales of reversal events and a relevant very fast change of oxygen conditions near the bottom in the western and central parts of the gulf during the winter period.

In this regard, the study undoubtedly represents a great scientific interest and can be published in OS. The results of the study presented in the paper include a wide range of oceanographic data obtained by means of modern equipment and methods of measurement. The description of conditions of making experiments and measurements is accurate and clear, all necessary descriptions for making similar observations at sea are provided.

The paper contains a comprehensive analysis of data on temporal variability of hydrophysical characteristics, benthic oxygen contents and currents' structure based on

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collected information that made it possible to draw rather deep and valid conclusions. For example, to assess the frequency and intensity of southwestern winds inducing strong benthic currents the data on NAO longterm variability were involved that made it possible to determine that winds recorded in December, 2011 considerably exceeded mean annual values and pointed quite accurately to the domination of SSW winds. As a result 2 reversal events lasting for 1.5 and 0.5 months were recorded in the Gulf of Finland.

Authors used an extensive list of references which reflects well the state of research in the field of estuarine circulation reversals and the related manifestations – collapse of stratification, re-appearance of halocline, fast oxygenation of near-bottom area, etc. that allows to estimate authors' contribution to research of features of the Gulf of Finland circulation.

The name of the paper reflects fully its contents. Abstract contains a short description of the study and main results.

Presentation is clear and well structured. Also, the description of variability and features of all measured characteristics is consistent and detailed, the analysis of results is carried out and the main conclusions are drawn.

Regarding the use of English language in the paper, in general the revision by a native English-speaker could be recommended. In particular, the special attention should be paid to the use of articles – most of the times they are missing. In my opinion, it would be good generally to improve the language of the paper: there is the incorrect use of some words (for ex., p.14 "...how drastic changes ... could occur..." better to say for ex. "the extent of changes...") and the incorrect order of words in some sentences in the paper (subject and predicate sequence) that often happens when the text is translated into English from the language with different grammar rules.

Detailed Comments

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Page 3, Line 16. “The last remarkable ventilation of the Baltic Proper deep layers was observed after the major inflow in 1993.”

This is incorrectly put because the last inflow that has reached the Gotland Deep and caused a rather strong hypoxia in the Gulf of Finland, occurred as late as in 2003. See, for ex.: Rainer Feistel, Günther Nausch, Wolfgang Matthäus, Eberhard Hagen “Temporal and spatial evolution of the Baltic deep water renewal in spring 2003”, *Oceanologia* 2003, no 45(4), pp. 623-642; Jan Piechura, Agnieszka Beszczyńska-Möller “Inflow waters in the deep regions of the southern Baltic Sea - transport and transformations (corrected version)”, *Oceanologia* 2004, no 46(1), pp. 113-141, Matthaus W (2006) The history of investigation of salt water inflows into the Baltic Sea – from the early beginning to recent results. *Mar Sci Rep* 65:1–73; etc. So, the paragraph is to be rewritten taking into account relevant references.

Page 3, Line 23. The same: the inflow of 1993 is incorrectly referred to as the latest.

Page 4, Line 16. “. . .resulting perhaps also different release rates of phosphorus from sediment”. This assumption needs justification, with relevant references.

Page 18. Line 14. The particular comparison with only the Tokyo Bay circulation effect is not clear, more explanation is needed. In fact, it is well known that in large tidal estuaries the intrusion of saline waters is often a reason for oxygenation of oxygen-poor bottoms.

Fig.3 – very important, but too small, needs to be larger.

Interactive comment on *Ocean Sci. Discuss.*, 10, 727, 2013.

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