Ocean Sci. Discuss., 9, C452–C455, 2012
www.ocean-sci-discuss.net/9/C452/2012/

Ocean Science Discussions

Interactive comment on "Short-term variations of thermohaline structure in the Gulf of Finland" *by* T. Liblik and U. Lips

T. Liblik and U. Lips

taavi.liblik@gmail.com

Received and published: 5 June 2012

Thank you for the review and helpful comments!

We agree that in order to complete the analysis the horizontal variability should be taken into account. We have daily data from the surface layer recorded by a ferrybox system Tallinn-Helsinki (across the gulf, see Lips et al., 2011; cited in the manuscript) but not enough data to describe the along-gulf variability. Thus we used in the present analysis some average/characteristic values of horizontal gradients to explain the observed changes of vertical TS-distributions and stratification. Since our interest was restricted to the temporal scales of days to weeks, the horizontal gradients used in the calculations were taken from the previous studies where the estimates of mean gradients in the Gulf of Finland were published (e.g. Alenius et al., 1998). Gradients of

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

the same magnitude were found by an analysis of CTD data from 1987-2008 (Liblik and Lips, 2011) and estimated from the along-gulf CTD sections in 2008, 2010-2011 (unpublished data).

The autonomous buoy profiler used for the observations is a unique system that we started to apply in 2009. We have now experience of working with this system for three summers. A special paper will be published about the applications, reliability, advantages and problems of the system soon. We do not like to expand the present paper with this information. We will apply two more similar systems equipped with additional sensors and with improved reliability in 2013.

We use Ocean Seven 16 Plus (Idronaut S.r.l) CTD probe with SEAPOINT OEM fluorometer (Seapoint Sensors Inc.) at buoy station and according to the comparison with parallel measurements aboard research vessel, accuracy of sensors is acceptable. However, since the platform (buoy) is quite light, vertical movements under stormy conditions can cause some peaks in data. Although the vertical resolution of sampling is 10 cm, we have used in the analysis pre-processed data with the vertical resolution of 50 cm to avoid the problems with data quality (main problem is related to variable lowering speed due to waves and different time constants of sensors).

Profiler wasn't seriously affected by currents. Even if there was very strong current and CTD-probe dived with an angle, there was still enough cable available to reach the chosen depth (45-50 m).

There are two major gaps in data: in the middle of July and in the beginning of August. Of course, we can't describe short-term dynamics within those periods, but general tendencies are still detectable (see e.g. Fig. 2 in Lips et al., 2011, where blanking was applied for the periods when data were missing for 24 hours or more).

Relative magnitudes of different terms were estimated. These results and discussion on the matter will be added to the manuscript. The relative magnitudes of terms (explaining the estimated changes in energy anomaly) for the considered period were: 7

OSD

9, C452–C455, 2012

% due to heating/cooling, 15 % due to wind mixing, 55 % due to wind induced transport and 23 % due to estuarine (along-gulf) transport.

We agree that some errors in the estimates could be related to the vertical mixing due to the current shear. Since we didn't have the current data from the whole period under consideration we did not include this term into the analysis. Furthermore, we think that the major error which causes the found discrepancies between the observed and estimated potential energy anomaly were caused by the water movements across the gulf and corresponding vertical displacement of isopycnals due to the coastal upwelling or downwelling events (which did expand to the study site).

We have used the formula according to Oey et al., 1987, since we don't have the ADCP data for the whole study period. In order to assess the applicability of the used formula, an additional analysis was conducted. An average change in potential energy anomaly for the time step of 3 hours of -0.12 J m-3 was found if taking into account the third and fourth terms in equation 2 (wind induced transport and estuarine transport, -0.72 and 0.60 J m-3, respectively). If calculating sum of these terms, applying the same horizontal density gradient and observed difference in along-gulf currents in the upper layer and below the thermocline, the estimate of -0.32 J m-3 was obtained.

We agree that to account for wind mixing more accurately a variable mixing efficiency could be considered. However, in this manuscript the standard value of 10-3 was applied for simplicity. As seen from the estimates of magnitudes of terms and analysis presented in the manuscript the wind induced transport is is more important and the first step to improve the descriptive model is to take into account the across gulf transport and corresponding vertical displacement of isopycnals.

We corrected Se unit.

Minor points

Average values in the second paragraph of the introduction are calculated on the basis

OSD

9, C452–C455, 2012

of data collected from June to August 1987-2008. CTD profiles were collected during various research projects and monitoring programs mainly in the western half of the Gulf. In subchapter 3.1.1 2009 monthly mean values at buoy station were compared with monthly mean values calculated from 1987-2008 data. We updated text to avoid misunderstanding.

We added texts “Latitude” and “Longitude” to the axes as suggested.

We revised the text according to your suggestion and replaced the term “gradient” by “difference” where relevant.

We revised Fig. 2 and added also the north component.

We changed the y-axis in Fig. 6 as recommended.

The suggestions improving the language have been taken into account.

Interactive comment on Ocean Sci. Discuss., 9, 877, 2012.