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Interactive comment on "Multi-sensor in situ observations to resolve the sub-mesoscale in the stratified Gulf of Finland, Baltic Sea" *by* U. Lips et al.

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Multi-sensor in situ observations to resolve the sub-mesoscale in the stratified Gulf of Finland, Baltic Sea

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Response to Referee 1 (F. Colijn)

This MS is a very useful contribution to the understanding of physical processes in a coastal sea. The main issue is the use of different observational techniques like moor-

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ings, surveys and Ferryboxes to obtain high resolution high frequency data on physical and biological parameters. The paper is well written and easily understandable. There are some language issues which need to be solved by a native speaker and one point of criticism should be taken on board by the authors.

Response: English is revised.

The paper is very descriptive, thus there is a need to add some questions or hypotheses which were tested by performing this scientific approach.

Response: Descriptive sections are shortened in the revised manuscript. Scientific questions and hypothesis are formulated in a more straightforward way in the revised Introduction section. For instance, the following sentences are added to relevant part of the text: “This suggestion of higher sub-mesoscale activity associated with some types or phases of coastal upwelling has to be analyzed further, and such analysis based on combined Ferrybox, buoy profiler, and Scanfish data is one of the tasks in the present paper.” “The hypothesis that under certain mesoscale conditions, such as development and relaxation of coastal upwelling events in a stratified estuary, the sub-mesoscale processes are more energetic than predicted by the theory of quasi-geostrophic turbulence in the ocean interior is tested.”

It is a pity that there is relatively little connection between the very detailed physical analysis and the potential consequences for the biology, e.g. in the introduction the authors mention that these physical processes might influence the species composition of the phytoplankton. In reality there is just chlorophyll and one bloom forming species is mentioned. If there is more information on the species composition under changing physical conditions of up- and downwelling or intrusions of other water bodies, then this would support the quality of the paper.

Response: We think that a more detailed analysis of impact of physical processes on phytoplankton species composition should be presented in separate papers (as it was done using the data from summer 2010 by Lips and Lips, 2014, referred here). In

this paper we mainly have discussed the Chl a dynamics (and a vertically migrating species Heterocapsa triquetra) when describing the impact of physical processes on phytoplankton.

A final point is the quality of the chlorophyll calibrations: different sensors or fluorimeters were used, how good were the intercalibrations between these different measurement devices and how stable were they. This would be important information for other groups dealing with this problem of data conversion. Were the 11 water samples taken over the week or during one transect?

Response: Since the chlorophyll a fluorescence readings are, besides the chlorophyll a content, influenced by many other factors we have implemented the routines to calibrate the sensors by regular laboratory analysis of water samples. For the Ferrybox system, the samples are collected along the ferry route once a week. During different years, depending on the aims of the measurements, from 11 to 17 samples are collected weekly (once a week). We tried to be more precise in the revised manuscript when describing this procedure. For the buoy profiler, the sampling for sensor calibration is conducted bi-weekly and for the Scanfish it is done in association to each survey. We have used three different sensors (SCUFA, Turner Design; Seapoint fluorimeter; and TriOS microFlu-chl-A fluorimeter) in the present study. Seapoint and Trios sensors have been quite stable over the years and for summer conditions (characterized by certain phytoplankton species composition) only one conversion equation was used. Seasonally fixed conversion equations were used for the Ferrybox fluorescence sensor (as described in the manuscript). We consider that the data acquired with the three sensors fit quite well with each other as seen, for instance, in Fig. 10. A more thorough analysis of performance of chlorophyll sensors attached to the autonomous systems is a topic in a separate study (the results will be available soon).

In Fig. 6 and 8 legends regarding the o- and x- should be added, to avoid any misunderstanding.

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Response: Explanations added to the figure legends.

All figures are of good quality and their legends are clear. I did not check the references but at least they are up-to-date.

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