

## ***Interactive comment on “Assessment of the nuclear power plant “Hanhikivi-1” influence on the local hydrological conditions in the Bothnian Bay, Baltic Sea” by Anton Dvornikov et al.***

### **Anonymous Referee #1**

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The MS presents the results of an environmental impact study of nuclear power plant (NPP), planned on the coast of Bothnian Bay, Baltic Sea, on the marine conditions. A number of numerical experiments with different models have been carried out, covering the periods of exceptionally cold year (2010) and warm year (2014). The impact of NPP is constrained to the thermal pollution. In addition, hazardous oceanographic conditions (extreme sea levels, waves, ice conditions) near NPP are assessed using Baltic-wide operational ocean forecast models and dedicated local-area oceanographic models. In this way, the study goes beyond the frames of routine environmental impact assessment (EIA) and it has some scientifically interesting results.

The used models are: circulation model POM, sea-ice and snow distribution model

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by Haapala, wind waves model SWAN. The models have been implemented locally in the Bothnian Bay on curvilinear grid, with smaller grid steps near the focus area. These local models were forced by atmospheric fields provided by the HIRLAM weather forecast model, and oceanographic boundary conditions provided by the operational HIROMB model. The results of the local model are validated against observational data (coastal time series, vertical profiles from BED database) and compared with the results of the Baltic-wide HIROMB model that runs and delivers the results daily on the routine basis. The MS shows that the local model produces a bit more accurate results than the Baltic-wide routine model.

Finding the MS partly interesting, I consider that the value of MS can be substantially improved by moderate rewriting of the text and introducing some more statistical model skill evaluations.

The MS is technically well prepared. My general concerns are as follows.

1) The title, introduction and conclusion give quite a lot the focus on NPP. This focus is not that much supported by the methods, results and discussions parts, except for the thermal pollution / waste heat. Most of the study comprises investigation and modelling of local oceanographic conditions in a defined region. Why the defined region is selected (is there a plan for NPP, paper mill, airport or other installation), does not influence the content and results of this type of study. There is only one paper cited with direct NPP relevance (von Hippel, 2010). Other citations refer to observational data obtained for the EIA procedure, or preliminary modelling results of the same EIA. All the other citations are from oceanography. I suggest condensing of the NPP-related wording.

2) The study presents a good example, how "core services" in operational oceanography, covering the full basins with reasonable resolution, can be used to provide custom-tailored "downstream" results with sufficiently high local resolution. This philosophy, developed over decades by EuroGOOS and several EU projects,

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is now realized as Copernicus Marine Environment Monitoring Service (CMEMS) <http://marine.copernicus.eu/> . The core oceanographic products can be directly obtained in real time via CMEMS portal by everybody. The MS used the earlier approach of CMEMS where the authors obtained the results from core national services by bilateral agreements, but the physical and numerical approaches to the service provision are essentially the same. Within the parallel use of "core" and "downstream" products, it is important to know how much local model improves the forecast/nowcast skill of basic oceanographic variables, such as sea level, temperature and salinity (incl stratification), waves, ice conditions. The MS concludes qualitatively "the models gave the consistent results and reproduced the sea level changes correctly", "POM reproduces the observed vertical profiles of temperature slightly better than HIROMB". Here quantitative comparison (validation) of model data from core and downstream versions against observational data would be of great value and would ensure novelty that is a precondition of scientific publication.

3) Regarding the transport of thermal pollution, the region under study is unique, with almost missing tides but with strong ice cover during the winter. It would be interesting if these results will be compared with the patterns apparent in tidal areas where most of the NPP are located.

4) Conclusions do not present new information. Everybody knows that coastal NPP-s can be significantly affected by extreme sea conditions. It is nice to know, that thermal impact of NPP extends over 2 km of sea area, but there should be scientific conclusion(s) as well.

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