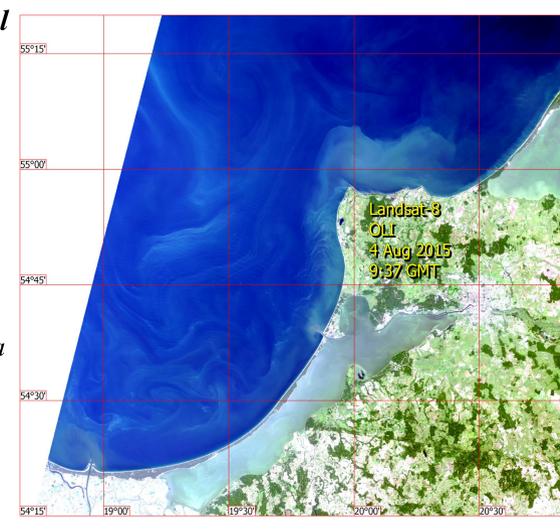
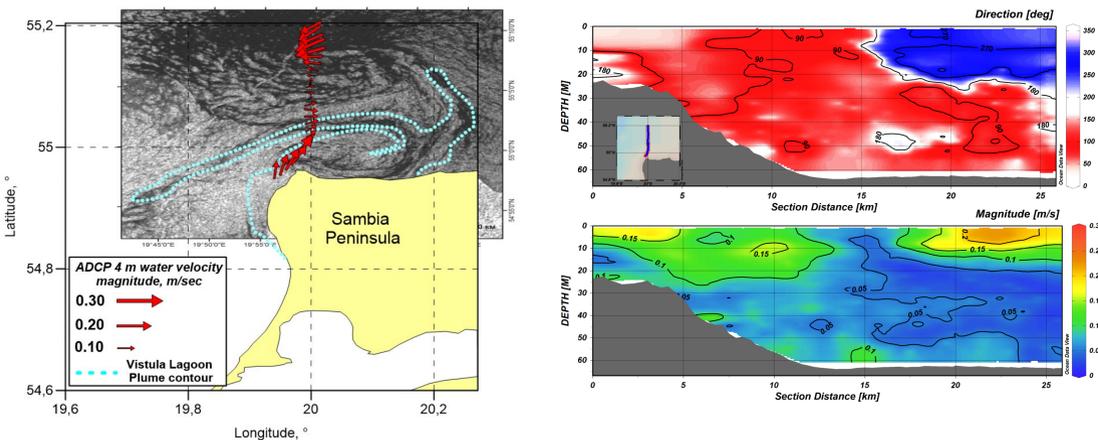


One of the main aims of marine ecological monitoring is not only understanding of a real pollution rate in water but also forecasting of pollution propagation offshore. Correct forecast of pollution propagation within the sea is possible by implementation lots of methods: numerical modelling, remote sensing data and in-situ monitoring in the region of interest.

Each year in a summer time during 2014-2016 Space Research Institute held oceanographic experiments in the south-eastern part of the Baltic Sea along Russian coast of Kaliningrad region. The main aim of oceanographic experiments is to provide comprehensive in-situ monitoring for satellite data verification. Our laboratory has a huge experience of satellite data analysis, but for a comprehensive analysis of received images they should be correctly verified by methods of oceanographic researches. Another aim of our oceanographic research was to understand the influence of different hydrodynamic and meteorological processes on turbid water outflow from Vistula Lagoon offshore the Baltic Sea.



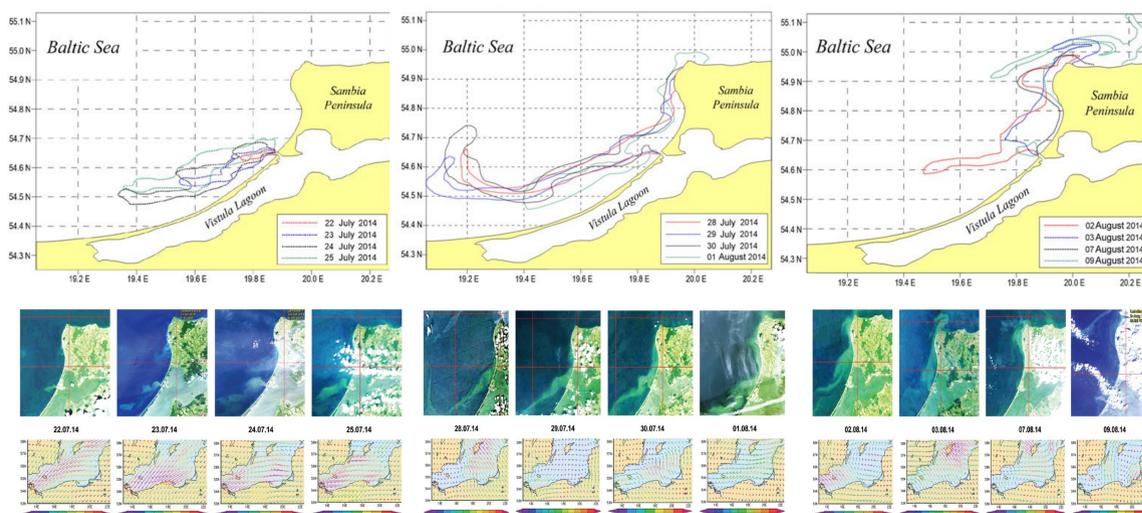
ADCP survey held for description of observed vortex structures in space and time for satellite images date verification



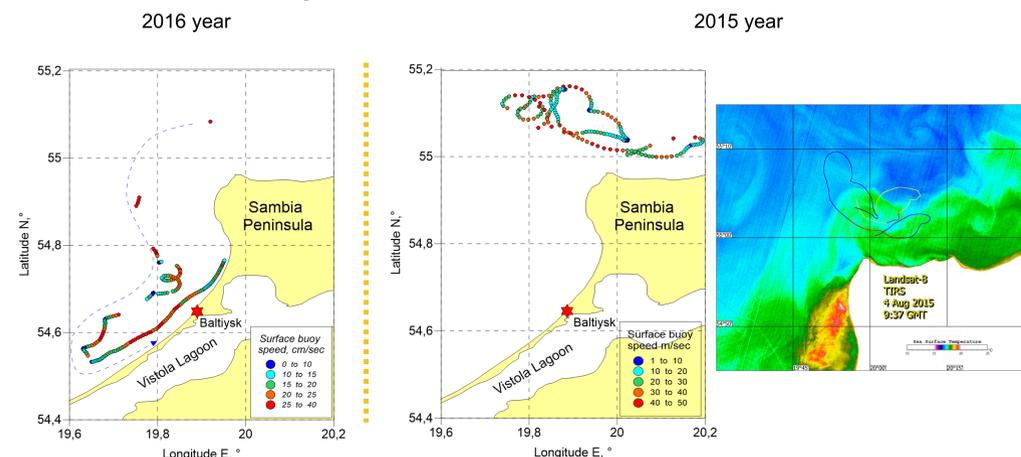
Completed ADCP survey from cape Taran and offshore showed a presence of main currents direction change in the surface layer and both in the intermediate layer. In the northern part of a section currents magnitude was observed as ~ 0,15-0,20 m/sec and with west direction. By moving to cape Taran currents magnitude decreased up to 0.05 m/sec and direction was not stable. Moving closer to cape Taran currents became again stronger up to 0.15 m/sec and had east direction. The presence of a currents change in direction and magnitude gives us data for searching of an eddy, which was observed, by radar data. **As seen on ADCP data this eddy is not a surface manifestation only but influences waters up to 15-20 m depth.**

Vistula Lagoon outflow offshore the Baltic Sea by satellite data

We found out that in certain wind conditions, the lagoon waters can propagate long distances from the Baltiysk Strait mouth both northeast, which is typical of the northern hemisphere, and southwest. We managed to track from ocean color data the spreading of the lagoon water over the Bay of Gdańsk for over two weeks in late July—early August 2014 in almost cloud free weather conditions.



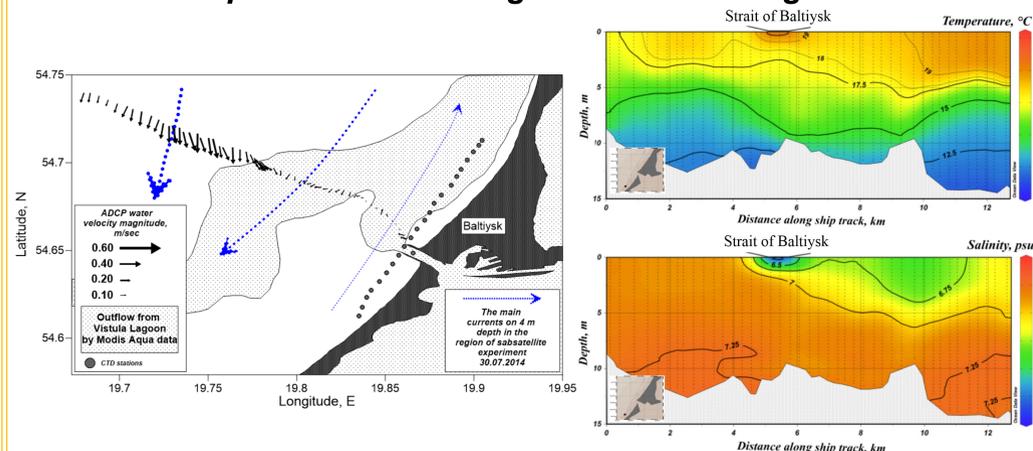
Lagrangian buoys survey for long-term study of dynamic processes in the Baltic Sea



In 2015 and 2016 expeditions included lagrangian buoys survey with remote GSM transmitting link providing its position in real-time. In 2015 and 2016 it was launched 2 drifters each year near cape Taran. Results of drifters drift showed interesting features of formation in surface current layer. in 2015 both drifters during long time (7 days) were drifting near the region of launch but next year starting from the same area drifters were drifting on a large territory offshore and showing complex hydrodynamic oscillations and unpredictable direction changes.

In 2015 drift was influenced by a hydrodynamic eddy presented in the area of study holding the drifter in a certain area. In 2016 there were no any hydrodynamic structures in the area and drifter was mostly influenced by local winds.

Coastal experiment in the region of Vistula Lagoon outflow



In 2014 there was a coastal oceanographic experiment near town Baltiysk in the region of Vistula Lagoon outflow. The experiment let us study local coastal circulation near the region of outflow and compare data with satellite images. Additionally thermohaline structure near the outflow was studied. The results showed that outflow propagates to the depth of 5 m and local circulation are complicated with a common influence of hydrodynamics and wind conditions in the region of outflow.

Main results:

- Space Research Institute held 3 oceanographic expeditions in the Baltic Sea and could consolidate a big data set of oceanographic and dynamic conditions of the coastal water of the Baltic sea in summer time.
- We could verify satellite images by ADCP data and confirm that some eddies clearly seen on SAR images aren't only a thin surface process but influence water mass up to thermocline. We could find that Vistula Lagoon outflow could be tracked on huge territories within a short period of time (week) and that this outflow propagates not as a thin surface layer but influence waters up to 5 m depth.
- We could launch several sets of GSM drifters and get comprehensive information of current structures in the region, prepared data for future numerical modelling studies.
- You can read more about our work in the paper *Lavrova Olga; Krayushkin Evgeny; Golenko Maria; Golenko Nikolay. Effect of Wind and Hydrographic Conditions on the Transport of Vistula Lagoon Waters Into the Baltic Sea: Results of a Combined Experiment // IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 2016, Vol. 9, Issue 9, DOI 10.1109/JSTARS.2016.2580602, Jun 29 2016.*

