

Modeled surface salinity and satellite data as proxy for Secchi depth and watercolor of the Gulf of Riga



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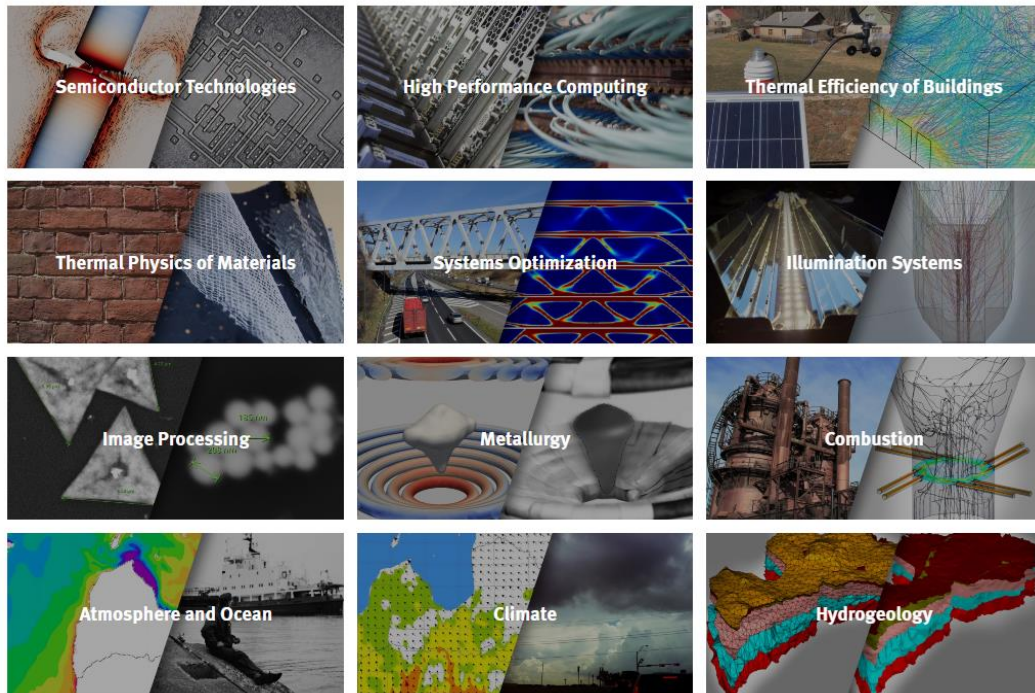
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ĪEGULDĪJUMS TAVĀ NĀKOTNĒ

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Introduction. Institute of Numerical modelling University of Latvia

FIELDS OF RESEARCH



Personell: 40 (in total);

Laboratory of Environmental processes: operational oceanography; longshore sediment transport; port siltation modelling; hydrogeology; climate; wind forecasts etc.



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Introduction. Evolution of the research questions

Involvement in operational oceanographic forecasting of the Baltic Sea in Latvia



Enhancing drift modelling for pollution spill elimination and search and rescue



Drifting microplastics simulating «particles» on GoR surface



Joining Ce2Coast project together with Latvian Institute of Aquatic ecology – the responsible organization for marine environment monitoring in Latvia: www.ce2coast.com, within "Joint Transnational Call on Next Generation Climate Science in Europe for Oceans" initiated by JPI Climate and Oceans



Darkening of the coastal marine area as a threat for underwater vegetation in the Gulf of Riga

Is it so; what are the causes and what can be done?

Introduction. The Gulf of Riga

Depth: (0-58 m);

Salinity: (4-6 PSU in its upper and 7-6 PSU in its bottom layer);

Ice cover: December/January– March/April;

Submerged vegetation:
in vicinity of the coast only;

Tides: < 10 cm amplitude;

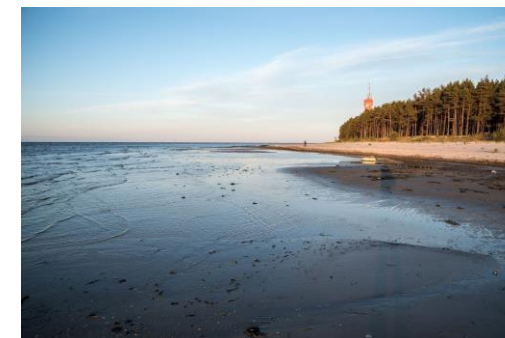
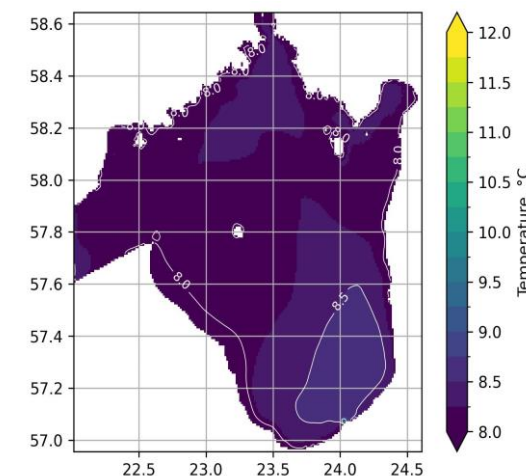
Oxygen conditions: seasonal hypoxia develops in 50% of years during recent 2 decades;

Role in economy:

There is no aquaculture in the Gulf of Riga;

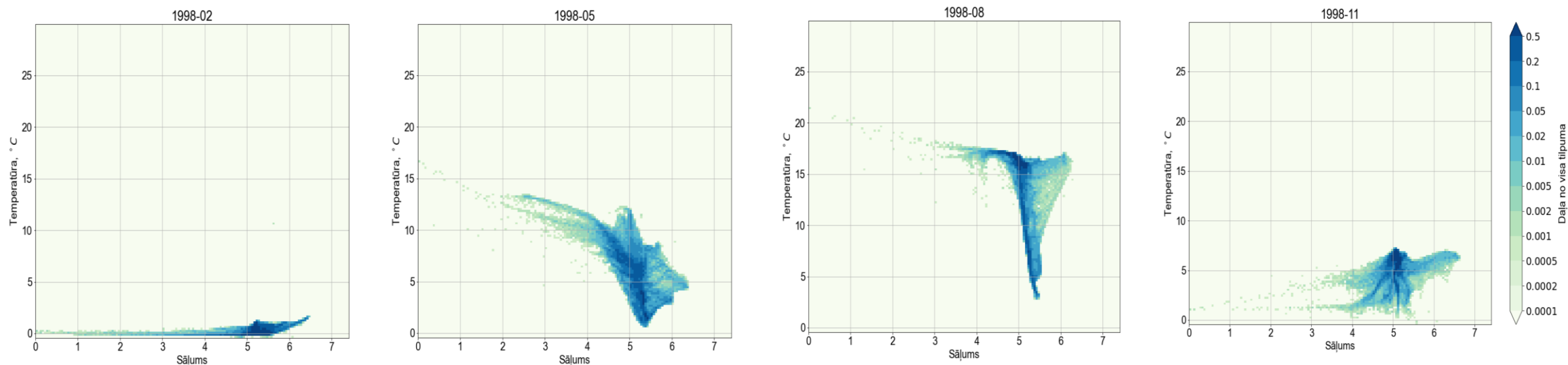
It is important herring spawning site; sandy coastline attractive to tourism (currently - local);

The main port - Riga port (49% of of all seabound cargo handled in Latvian ports; no domestic and international passenger marine transport routes; 99 cruise ships served (2022)).



Climatic average of the SST (top)
The Gulf of Riga near Ragaciems lighthouse. Photo by J.Sennikovs (bottom)

Introduction. Temperature – salinity seasonality in the Gulf of Riga



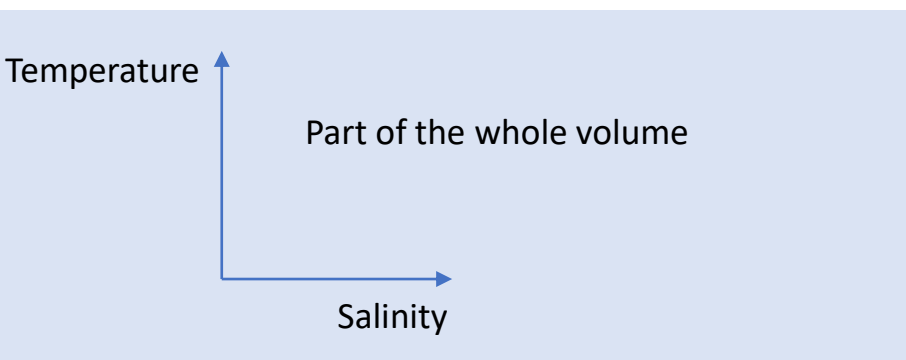
February

May

August

November

Salinity-temperature representation of the Gulf of Riga in a given month in year 1998, part of the whole volume plotted in the scale.



Research overview

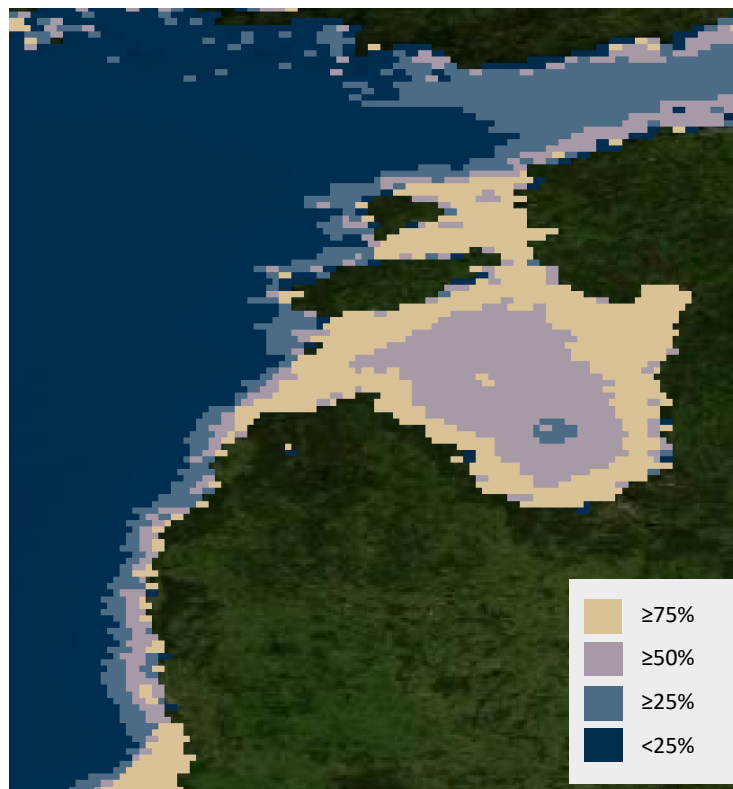
Implemented data sets:

- HIROMB-BOOS based oceanographic model, University of Latvia setup. Physical parameter's monthly means available in *Reanalysis and future climate projections of the physical state of the Gulf of Riga 1993-2100*: <https://zenodo.org/records/8248943>
- Satellite watercolor and Secchi depth on 4 km grid by J. Pitarch, H.J. van der Woerd, R.J.W. Brewin, O. Zielinski, *Twenty years of monthly global maps of Hue angle, Forel-Ule and Secchi disk depth, based on ESA-OC_CCI data*. PANGAEA. (2019): <https://doi.org/10.1594/PANGAEA.904266>
- Watercolor in Forel-Ule scale in situ observations 1998-2018 from 10 open water stations provided by the Latvian Institute of Aquatic Ecology: <http://www.latmare.lhei.lv>

Major addressed questions:

- **Watercolor, Secchi depth and salinity characterisation in the Gulf of Riga**
- **Does watercolor and Secchi depth in satellite data correlate with the modeled salinity?**
- **Agreement with the in situ watercolor observations**
- **Watercolor differences in years – with/without seasonal hypoxia in the Gulf of Riga**

Results. Watercolor in the Gulf of Riga

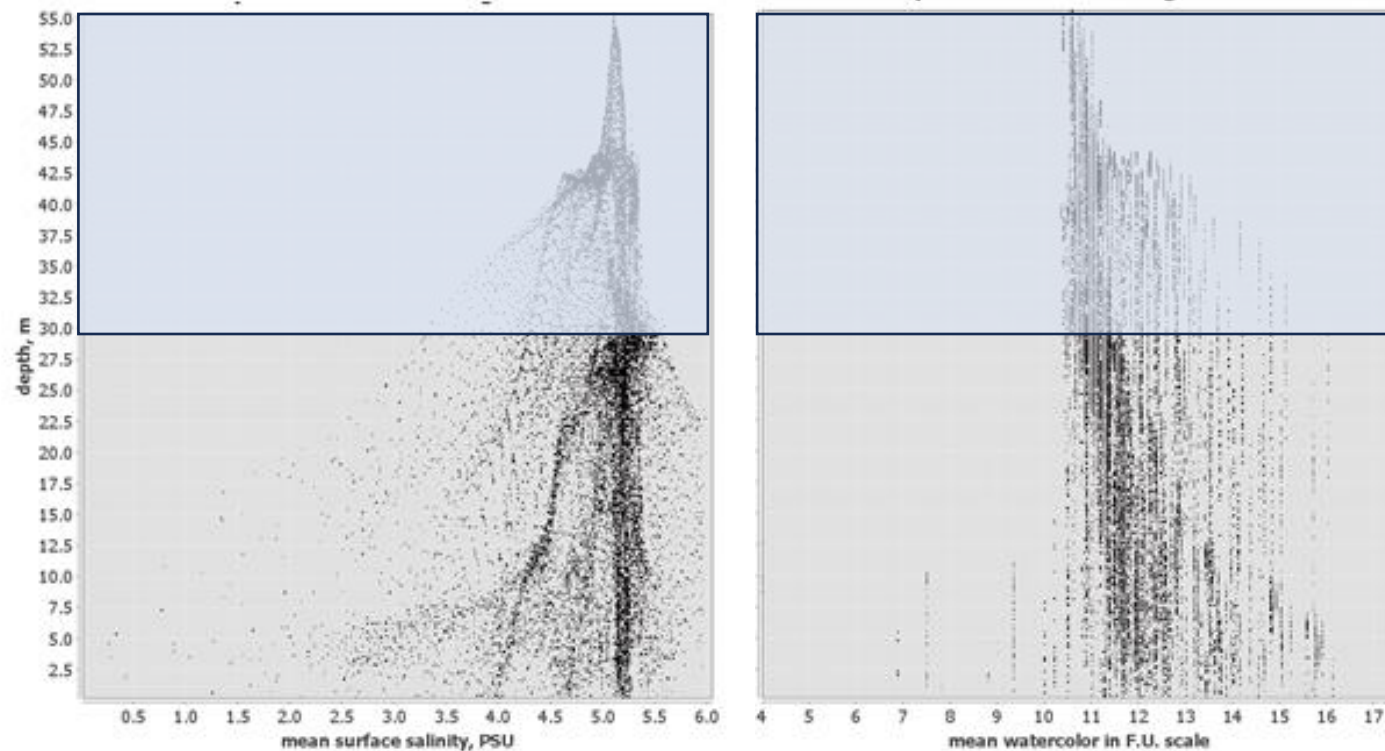
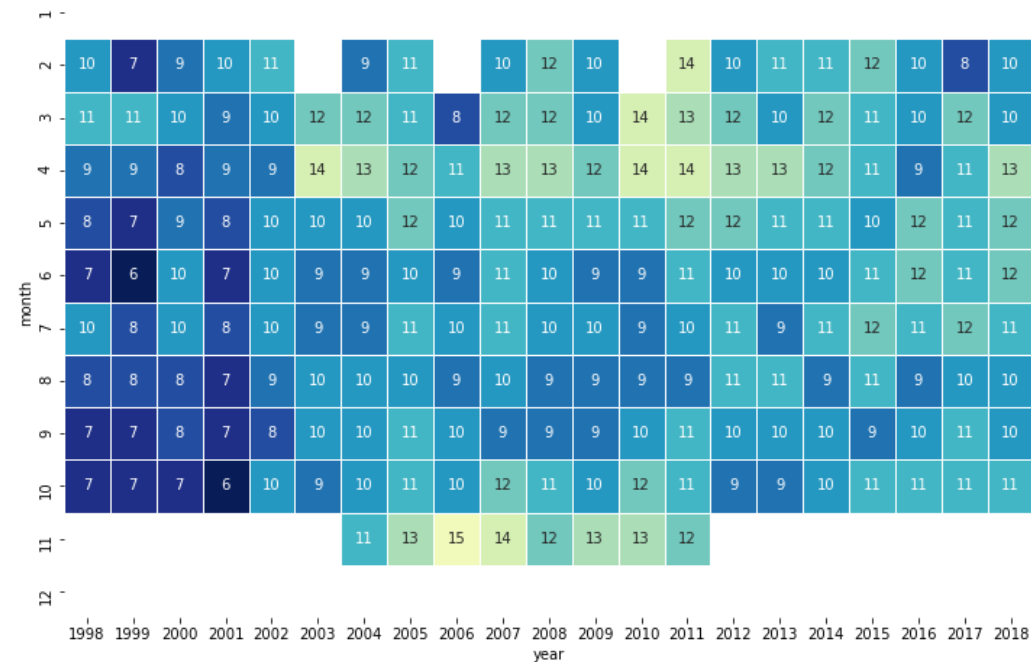


Frequency of the satellite data product measurement (monthly resolution) above the value 9 in 1998-2018.

Watercolor values above 9 in Forel-Ule scale more than 50% of the month in the years 1998-2018 are characteristic in the central part; more than 75% of the measured month in the coastal part. Frequencies <25% seen in the Eastern Gotland basin of the Baltic Sea.

Is the threshold watercolor ≥ 10 in Forel-Ule scale a reasonable choice for characterising the coastal waters and the region of the freshwater influence in case of the Gulf of Riga?

Watercolor in open waters of the Gulf of Riga

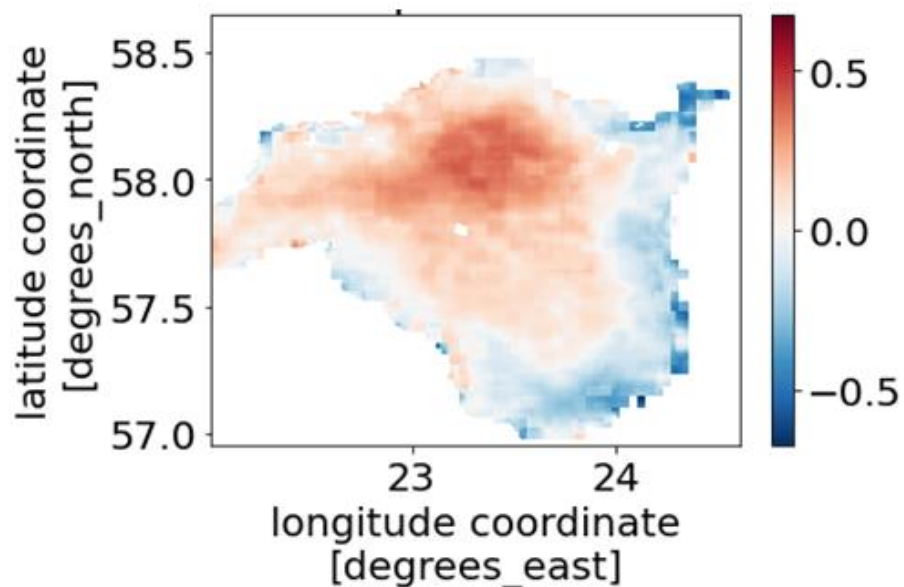


Sea surface salinity vs depth (left). Watercolor vs depth (right). Mean in April.

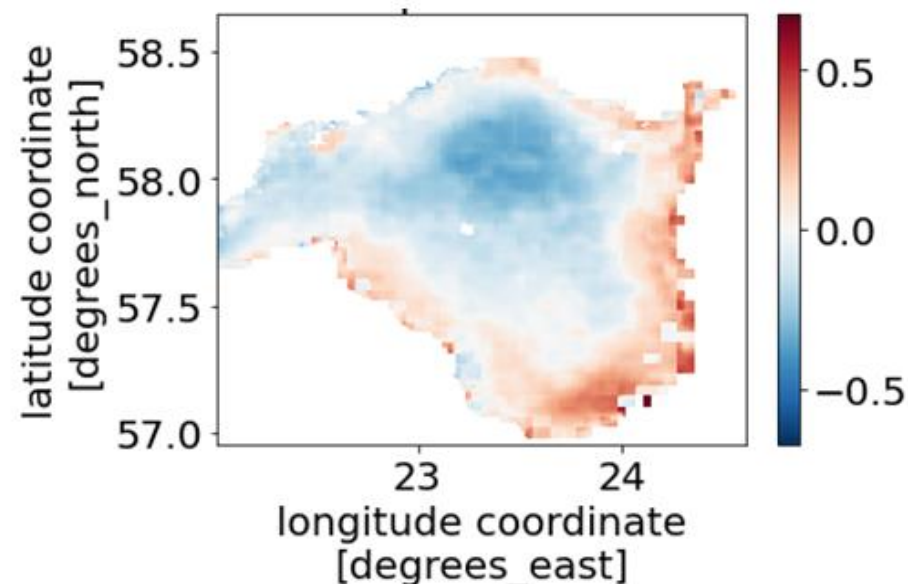
In this study the open waters are defined based on the depth > 30 m (*shaded* in the figure on the right).

Salinity and watercolor means in April show the least dispersion in areas that are deeper than 40 m.

Results. Correlation between the satellite data and surface salinity



Watercolor and surface salinity correlation



Secchi depth and surface salinity correlation

Moderate correlation as expected (negative for watercolor/salinity and positive for Secchi depth/salinity) seen in parts in the southern, eastern, north-eastern regions.

Is situation independent of oxygen conditions (seasonal hypoxia)?

Take away messages

Reanalysis of the Gulf of Riga 1998-2018 have been used to analyse surface salinity relation to the watercolor satellite data product. Moderate negative correlation had been seen in the coastal zone (the highest correlation in Spring);

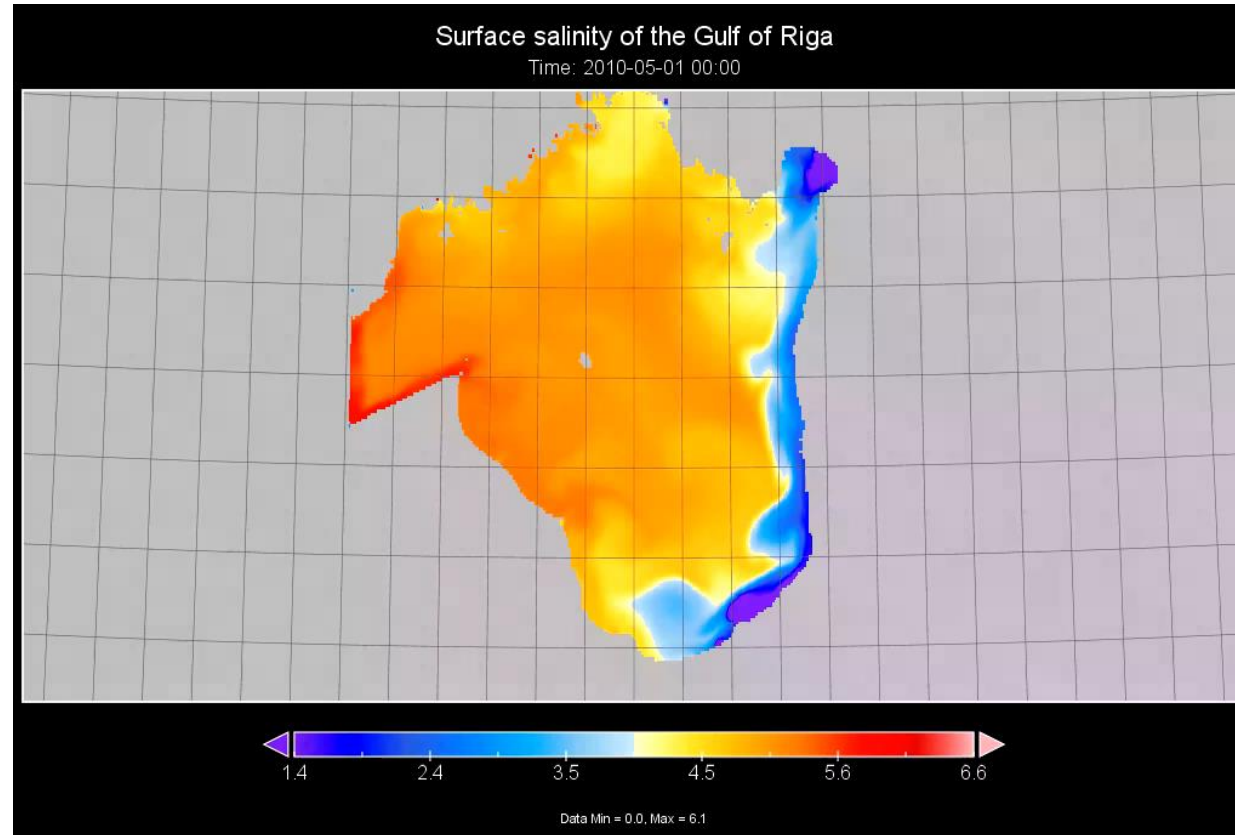
Watercolors in years with and without seasonal hypoxia has been reported;

Monthly resolved data sets and the visualisations of the physical parameters of the Gulf of Riga are available:
<http://www.modlab.lv/Meteo/FimarWeb/ce2coast/index.html>;

Research regarding the freshwater influence and salinity-temperature representation in the Gulf of Riga will be further extended (incl. citizen science);

Paying attention to the sea (and nature) remain meaningful!

Thank you for attention!



Modeled surface (0-2 m) salinity in Spring. May 2010