

# A decade of SatBałtyk system

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w Sopocie

Earth and Planetary Research Centre

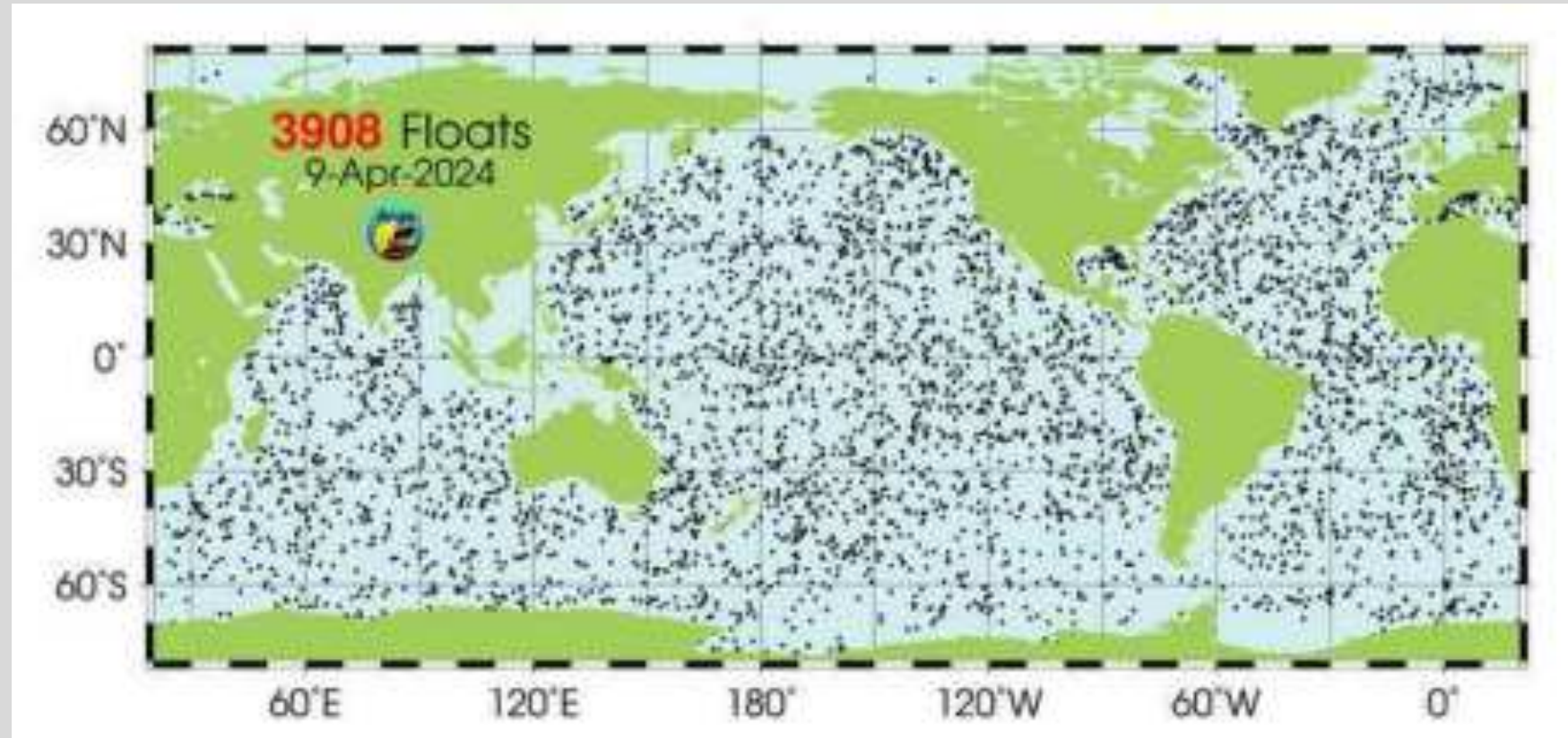








# Argo: Global ocean observing program.



<http://www.argo.net/>

# Earth observations from space.



## The origins

Experience of the IOPAN in the field of marine optics, remote sensing of the sea, and research on photosynthesis in the marine environment.

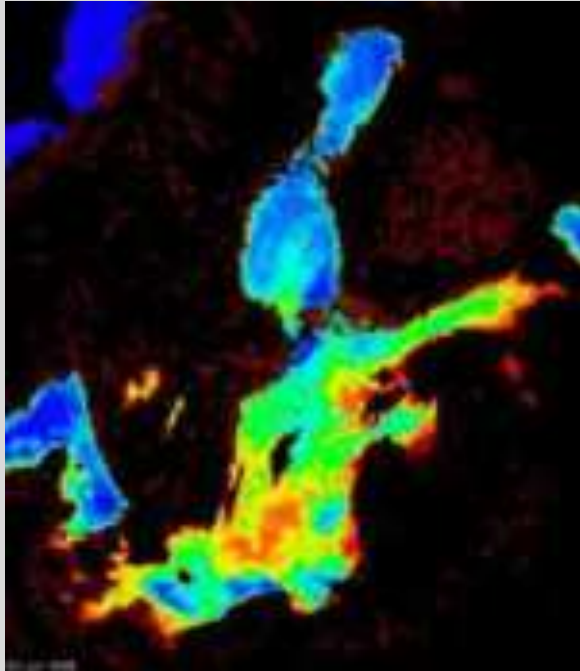
2001-2005

DESAMBEM Project (DEvelopment of a SAteellite Method for Baltic Ecosystem Monitoring; project No. PBZKBN 56/P04/20014

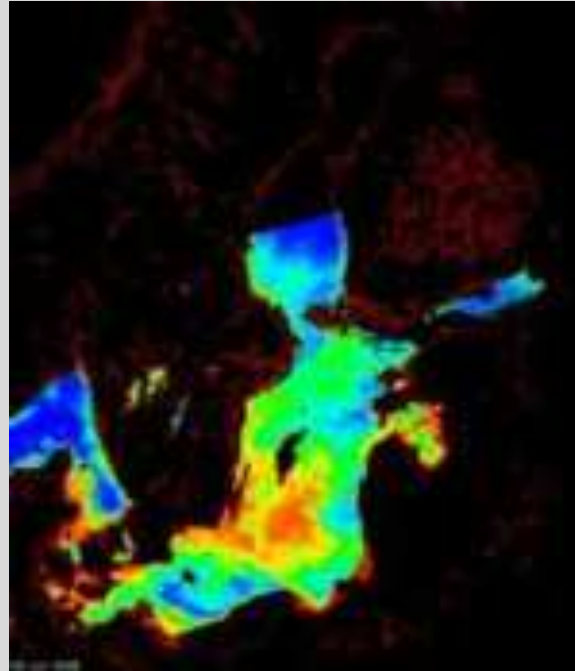
- Institute of Oceanology PAS
- Institute of Oceanography (University of Gdańsk),
- Pedagogical Academy, Słupsk,
- Sea Fisheries Institute, Gdynia

## Constraints:

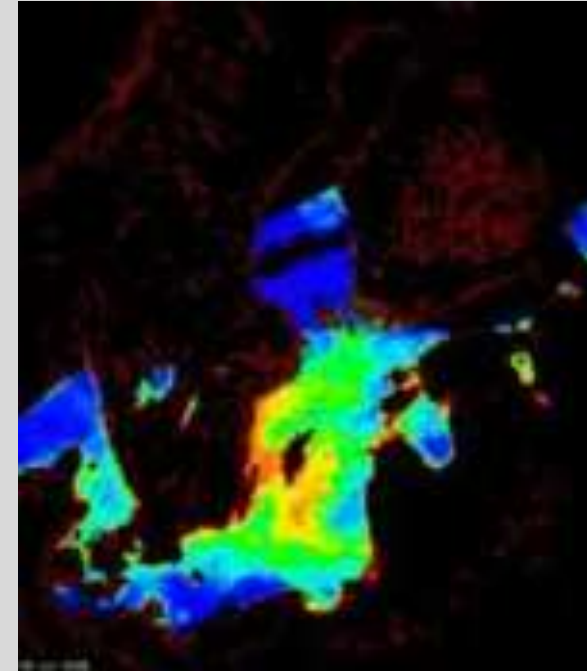
strong spatial and temporal variability of the bio-optical properties of the Baltic Sea



*4th July*



*5th July*



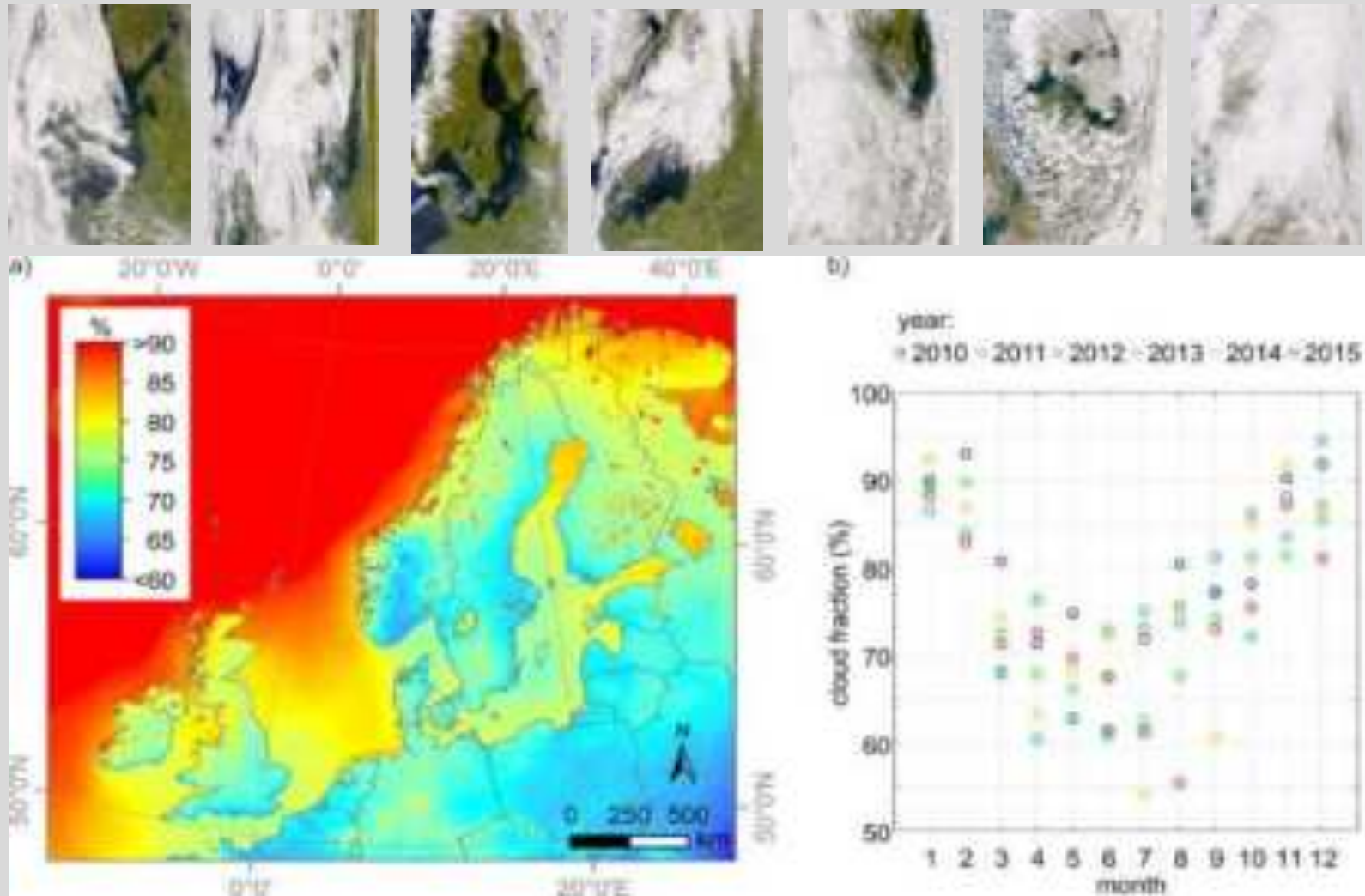
*6th July*

*- Information should be provided at least once a day*



## Constraints:

Cloud cover over the Baltic region, a key limitation in the operational use of satellite data.



(a) spatial distribution of the average annual cloud cover (2010-2015)  
(b) monthly averages for particular years





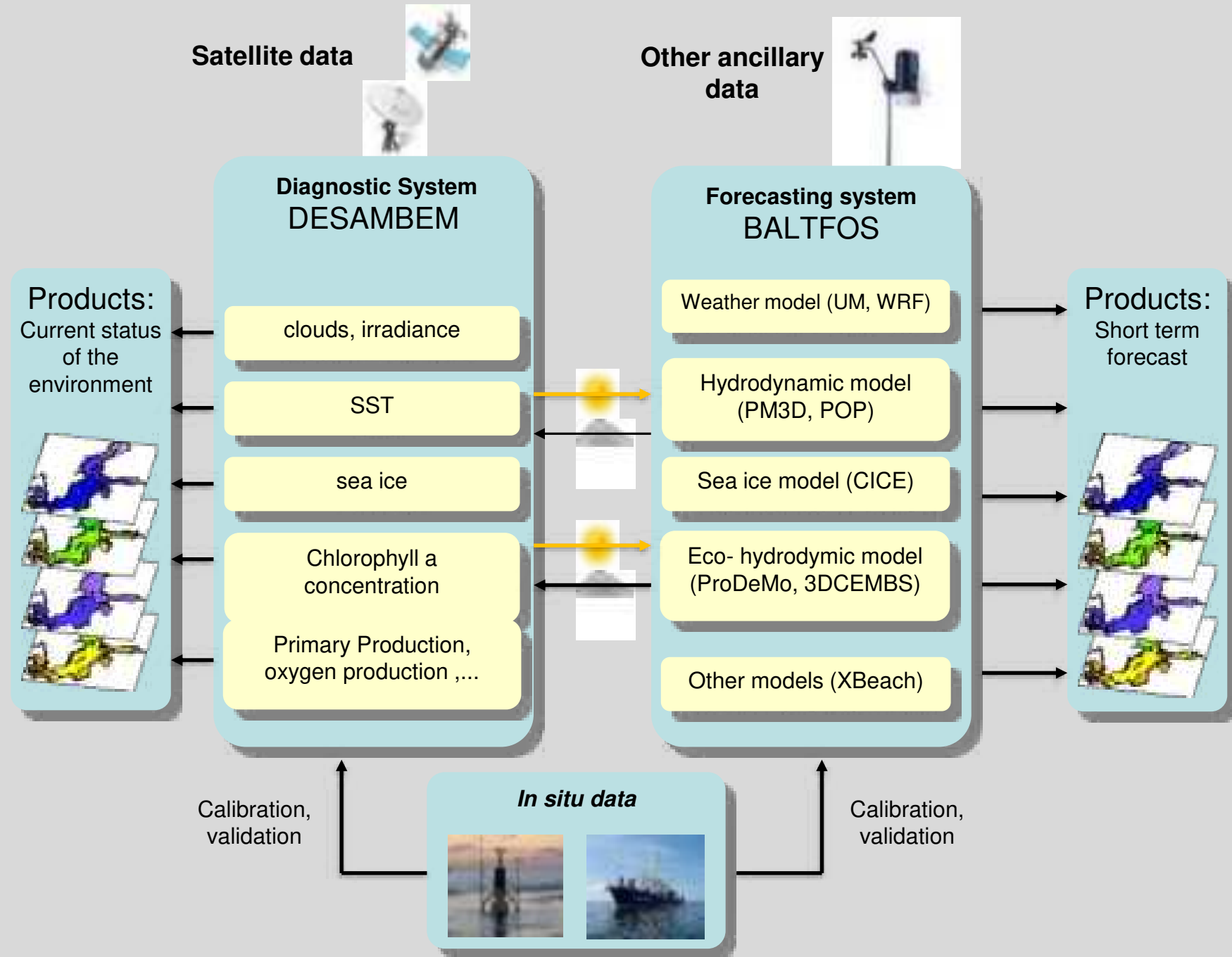
**Program Operacyjny Innowacyjna Gospodarka  
POIG.01.01.02-22-011/09 (2010-2015)**

# **System SatBałtyk satelitarny monitoring środowiska Morza Bałtyckiego**

## **Consortium:**

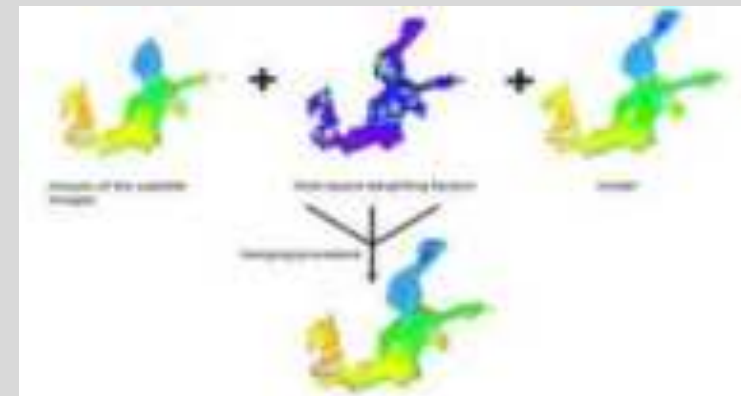
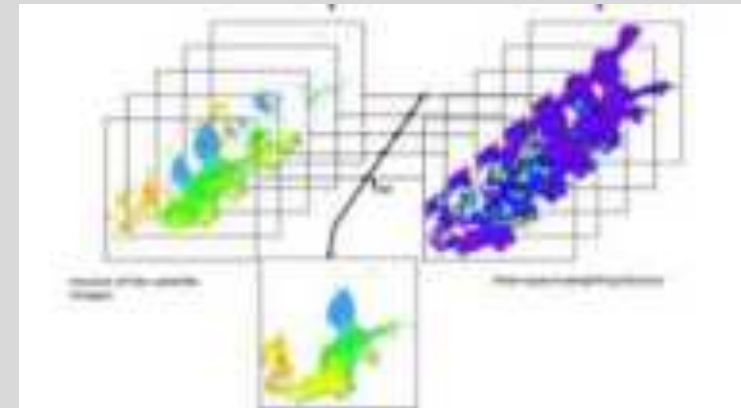
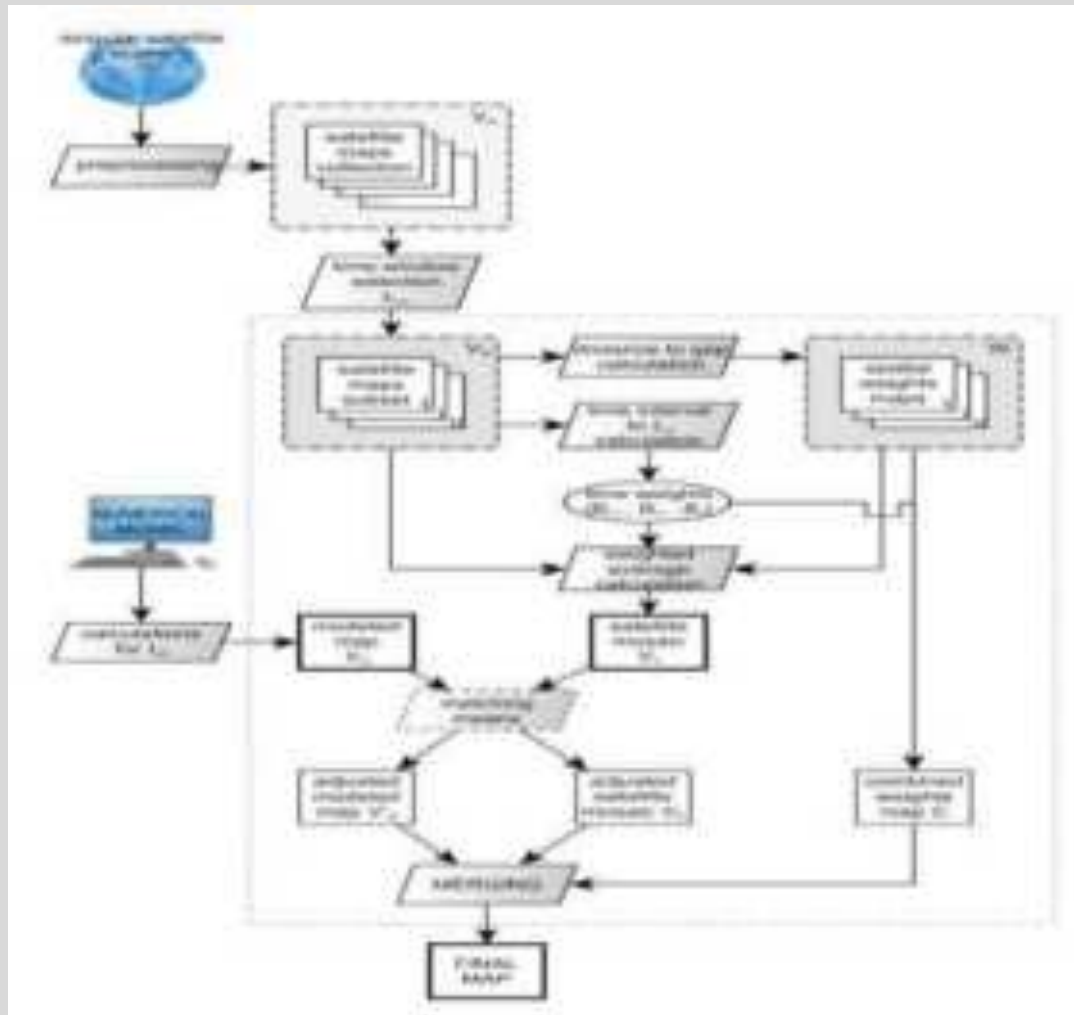
- Institute of Oceanology of the Polish Academy of Sciences in Sopot
- Institute of Oceanography of the University of Gdańsk
- Pomeranian Academy in Słupsk
- Institute of Marine Sciences of the US

# SatBaltyk





# Data merging - processing chain





# Merged Sea Surface Temperature Map

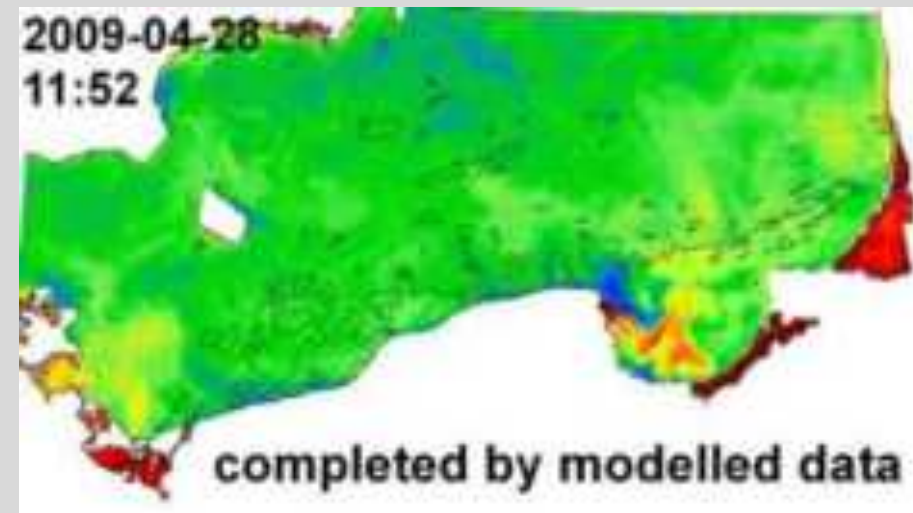
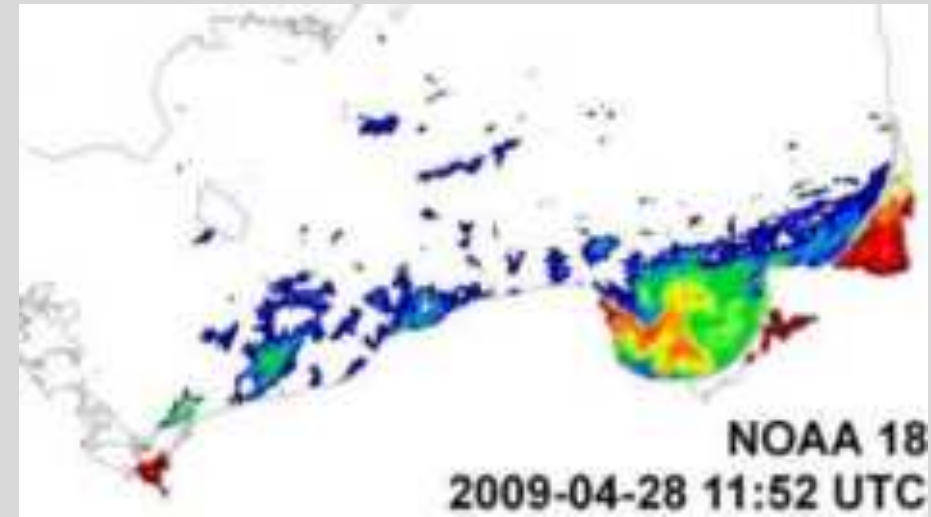
Sea surface temperature determined on the basis of remotely sensed data and the M3D hydrodynamic model (grid resolution 0.5 NM) when a large part of the sky over the sea is overcast

The merged data have the lowest estimation uncertainty (RMSE):

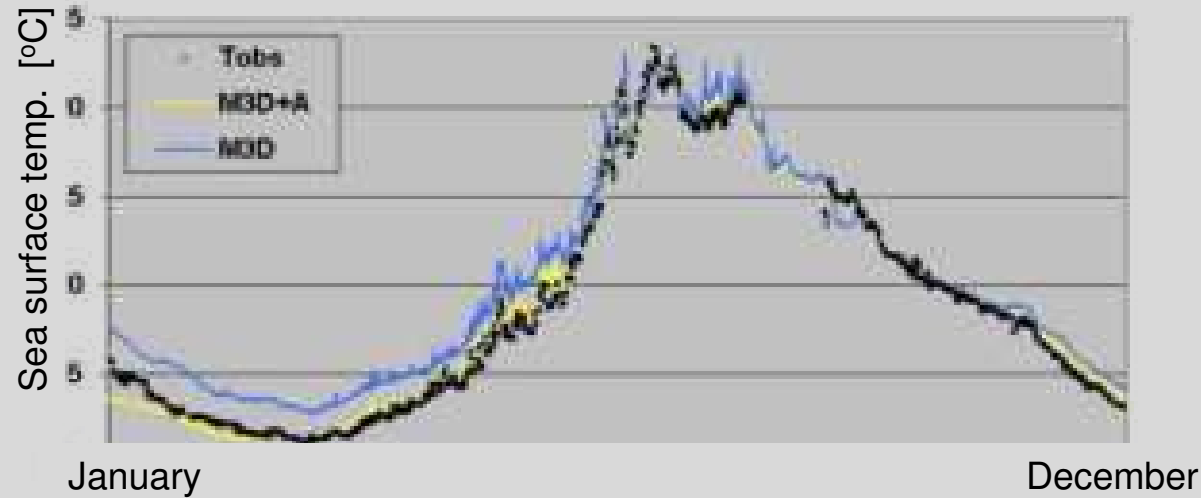
SST sat (AVHRR) 1.263

SST model (asym. sat. data) 0.893

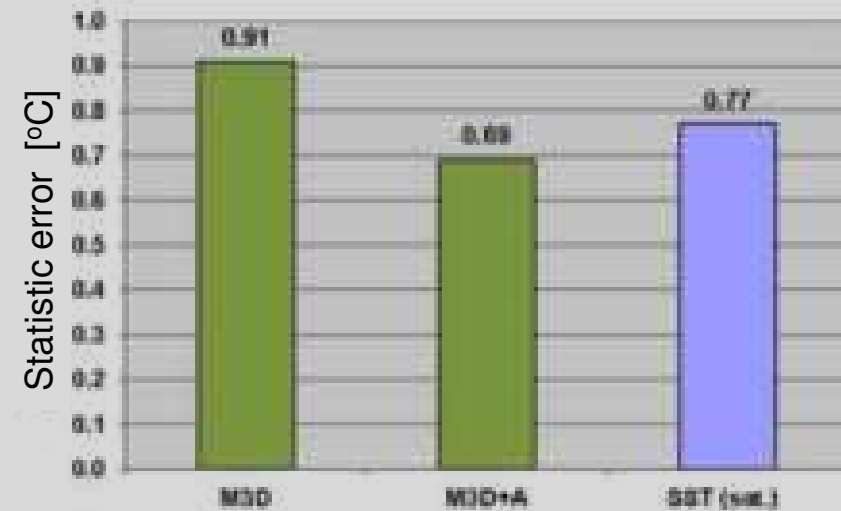
SST combined product 0.733



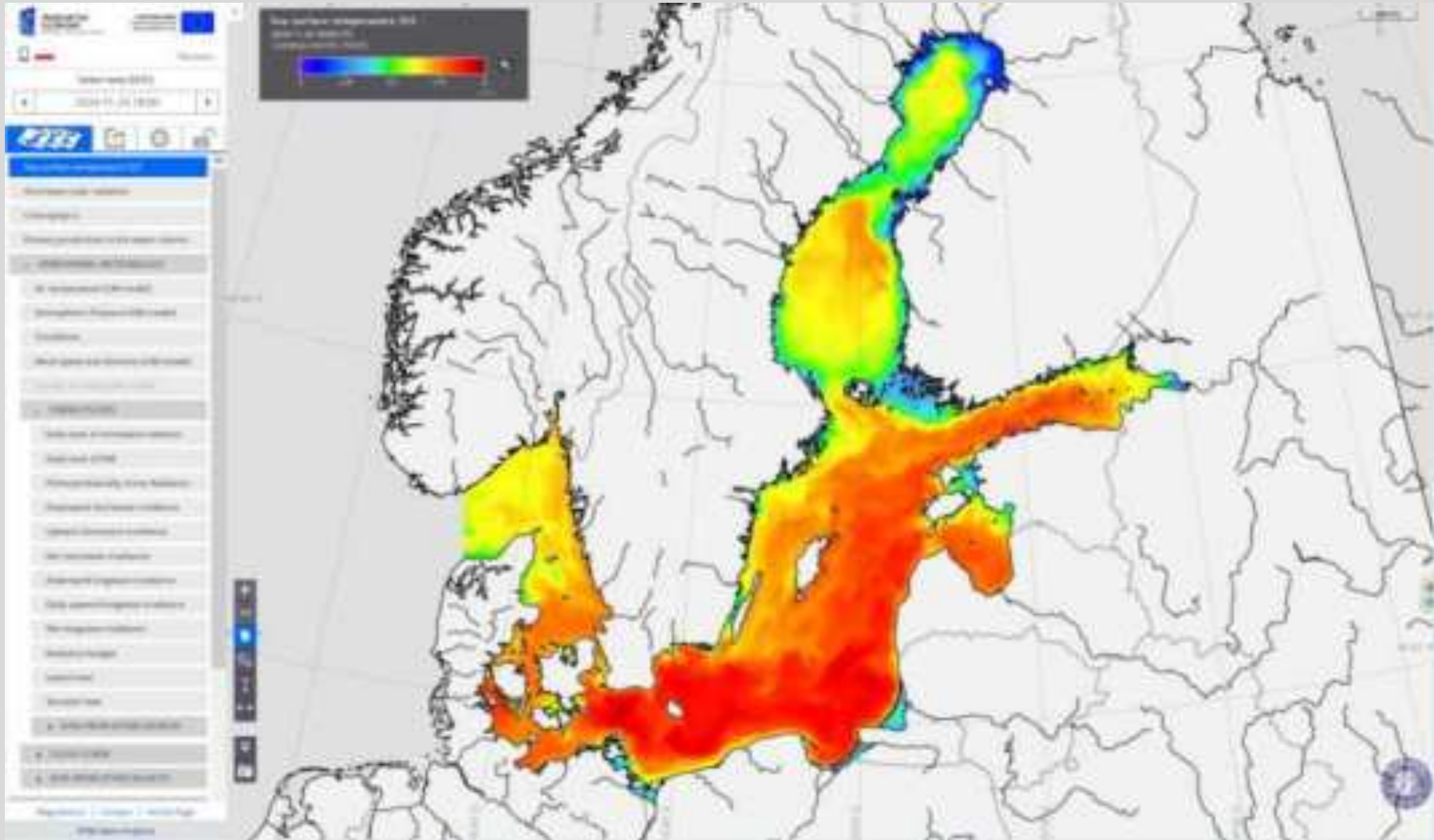
# Assimilation of the satellite data in the hydrodynamic model



Comparison of sea surface temperatures observed in the southern part of the Baltic Sea and modeled with assimilation of satellite SST maps (M3D + A) and without assimilation (M3D)



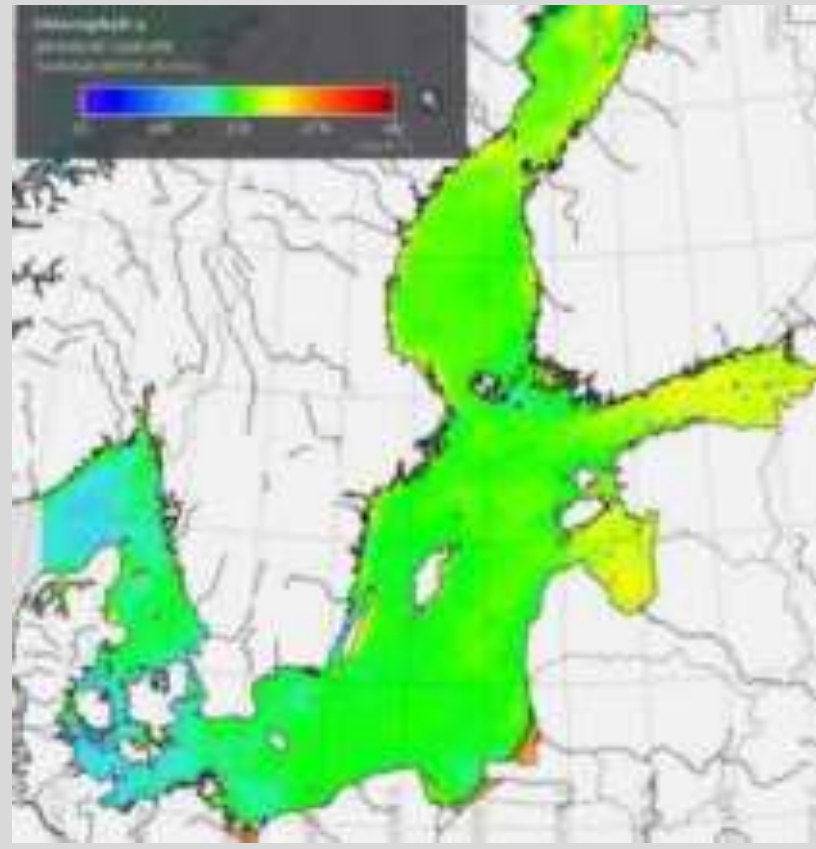
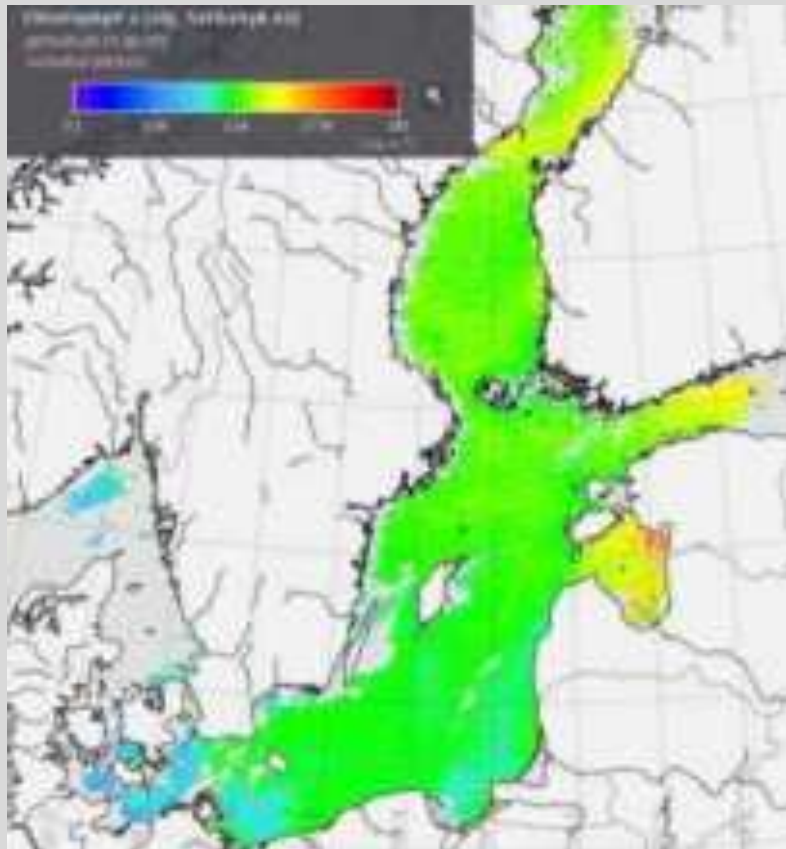
# Home page of the SatBałtyk System





# SatBaltyk System products:

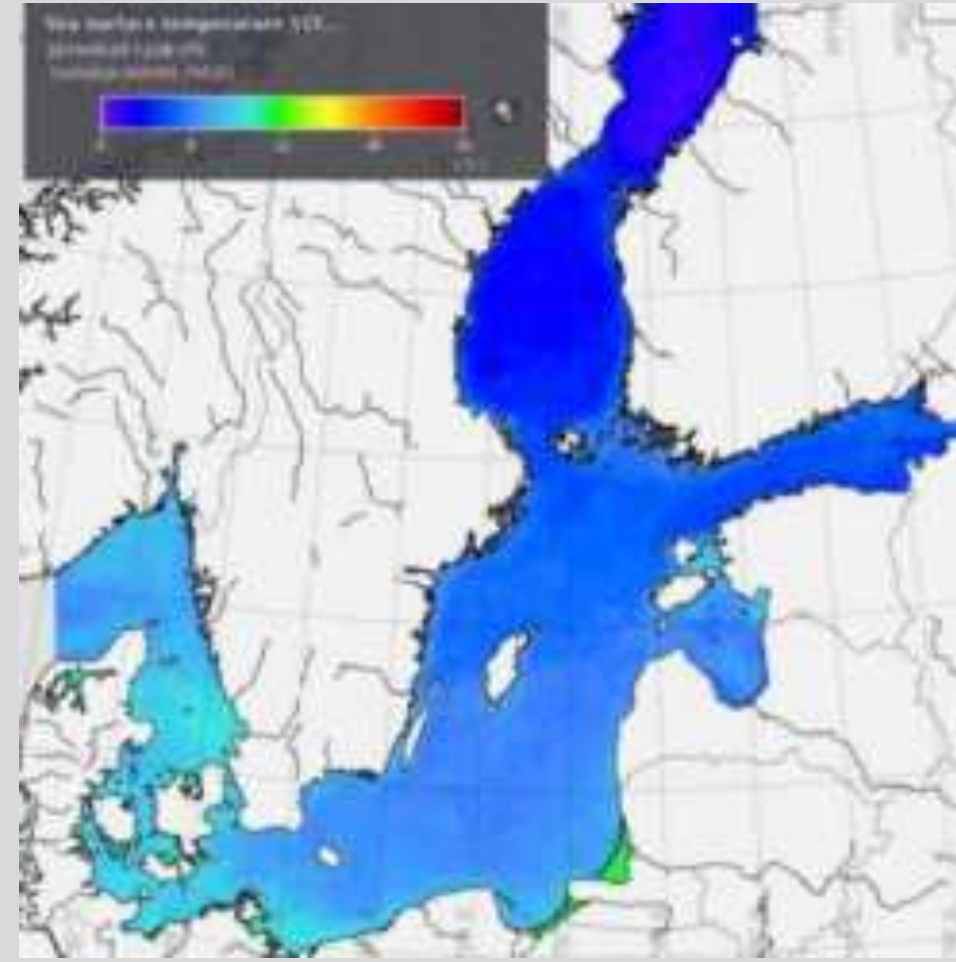
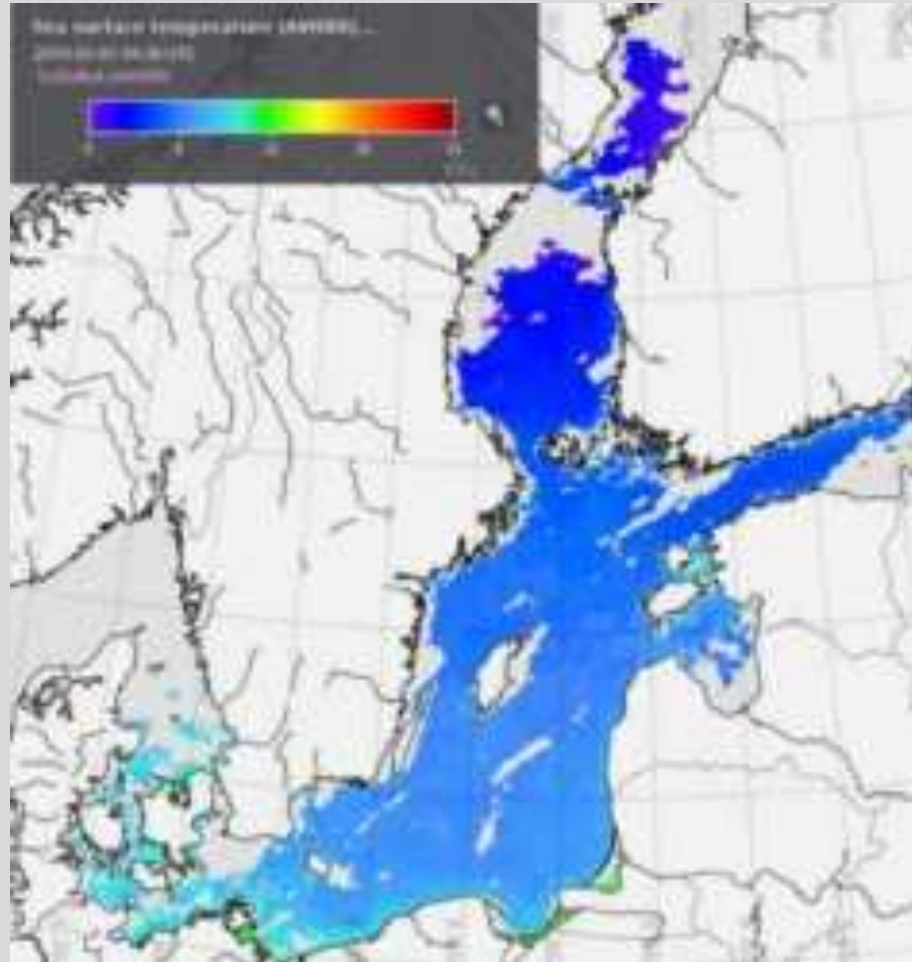
Chlorophyll a concentration, the cloud cover





# SatBaltyk System products:

## SST - Sea surface temperature



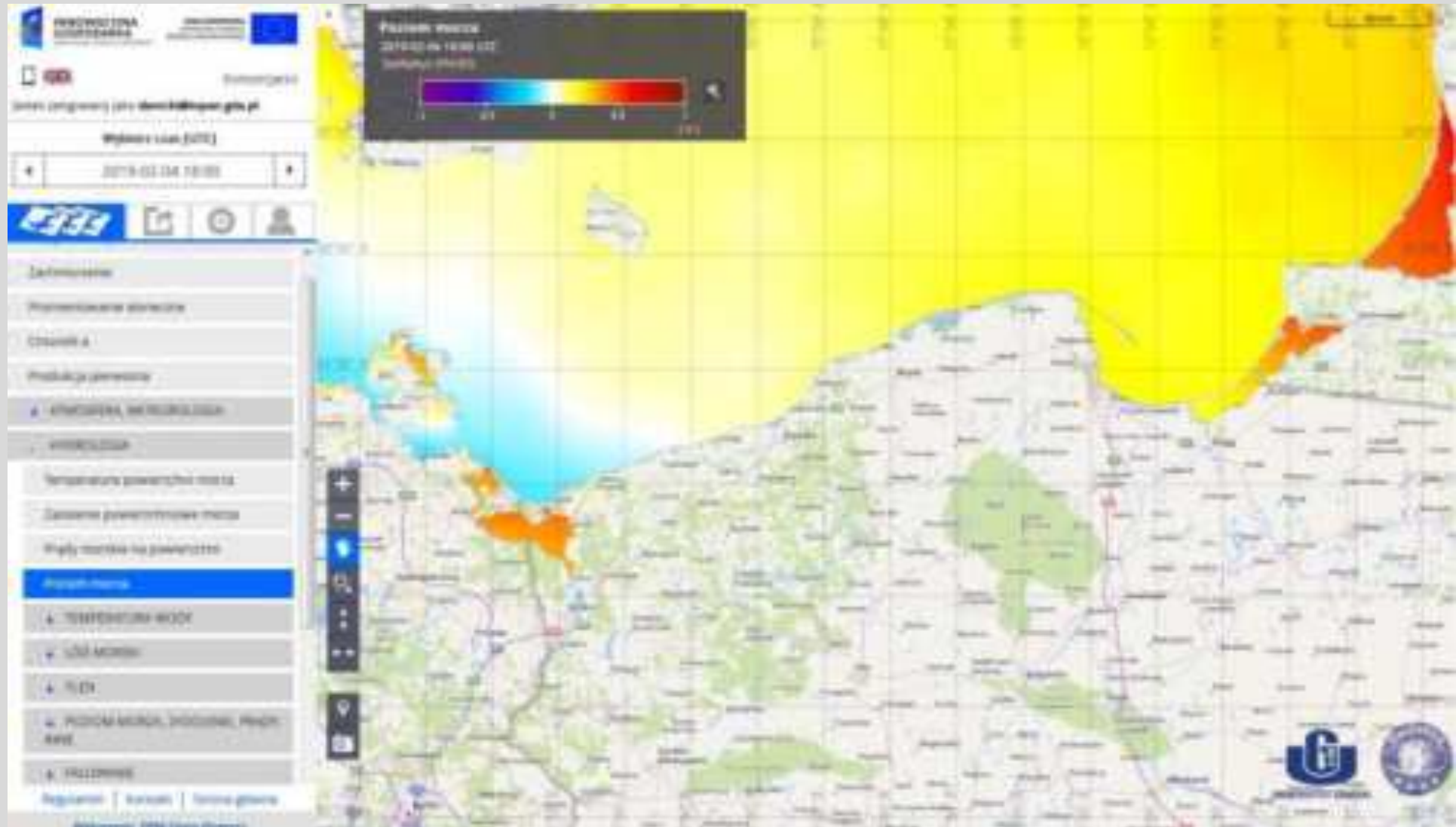
# SatBaltyk System products: wave height





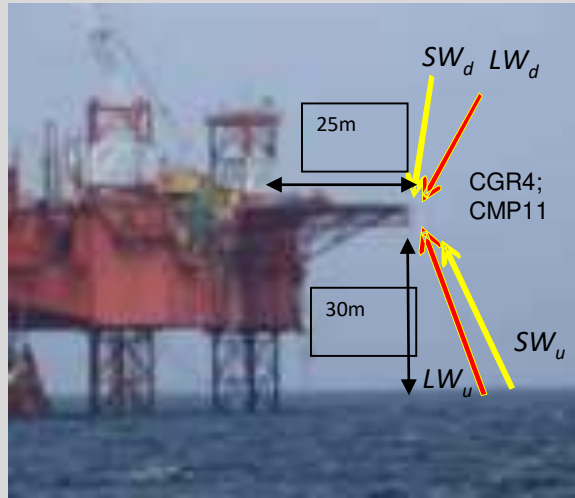
# SatBaltyk System products:

sea level

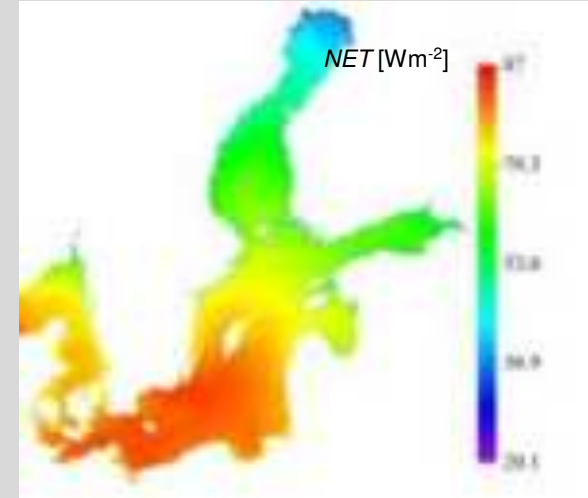


# SatBaltyk system products and their application: NET radiation balance on the sea surface based on the SatBaltyk system

Measurements

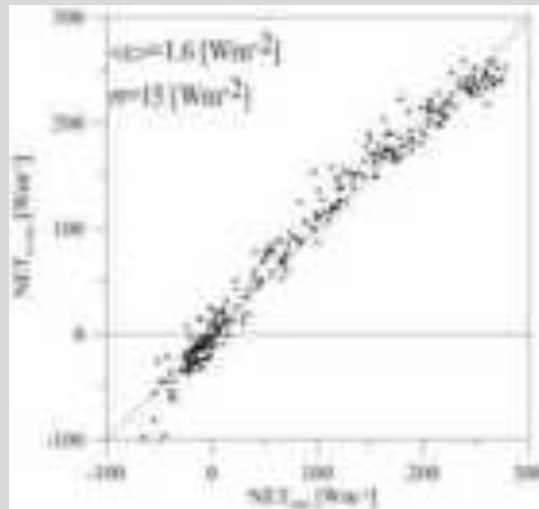


Modeling based  
on satellite data

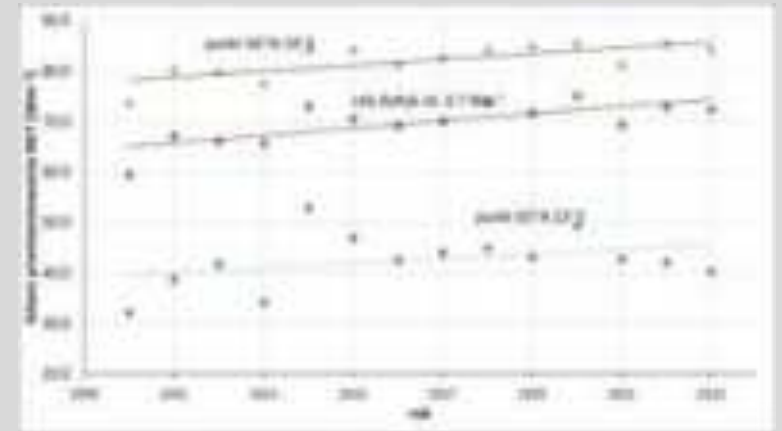


Mean *NET* 2010 – 2023

Empirical validation



Results:  
multi-year NET  
annual averages



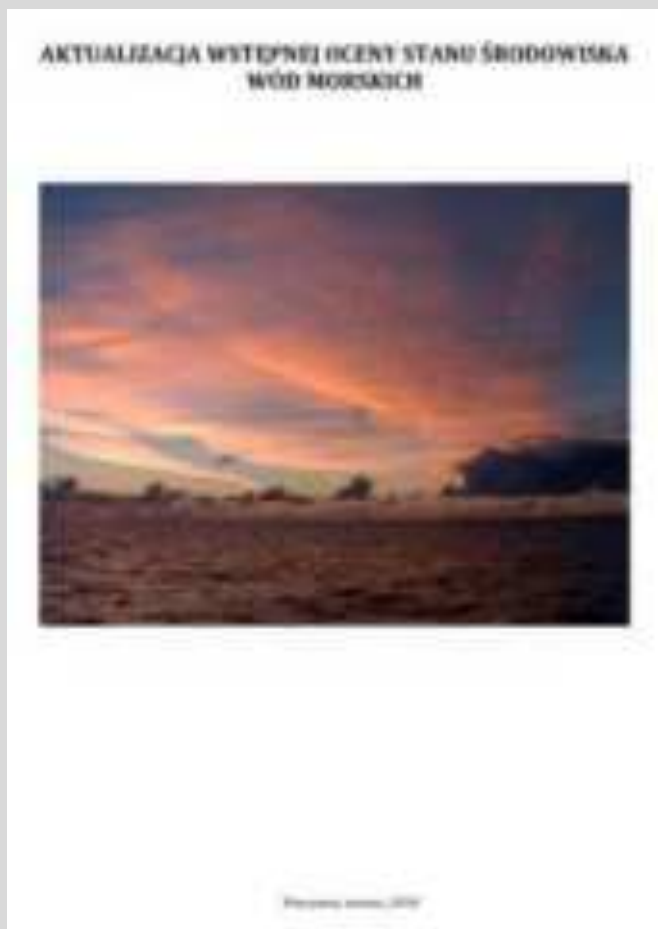


# The SatBałtyk system 'today':

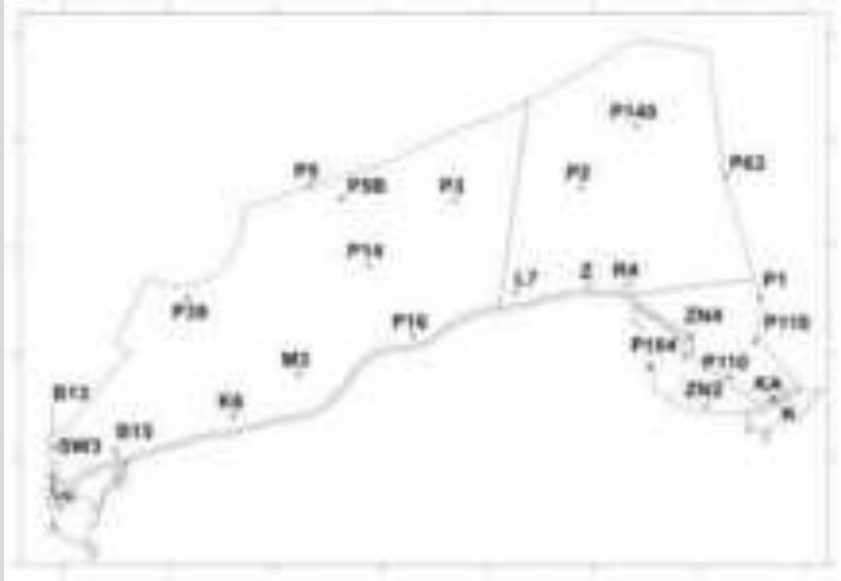
- A source of detailed data and comprehensive knowledge about the Baltic environment
- A widely available tool for analyzing processes in the ecosystem of this sea with its coastal zone and atmosphere
- A database of historical and current data necessary for the rational use of the resources and space of the Baltic Sea.

# Selected examples of previous applications

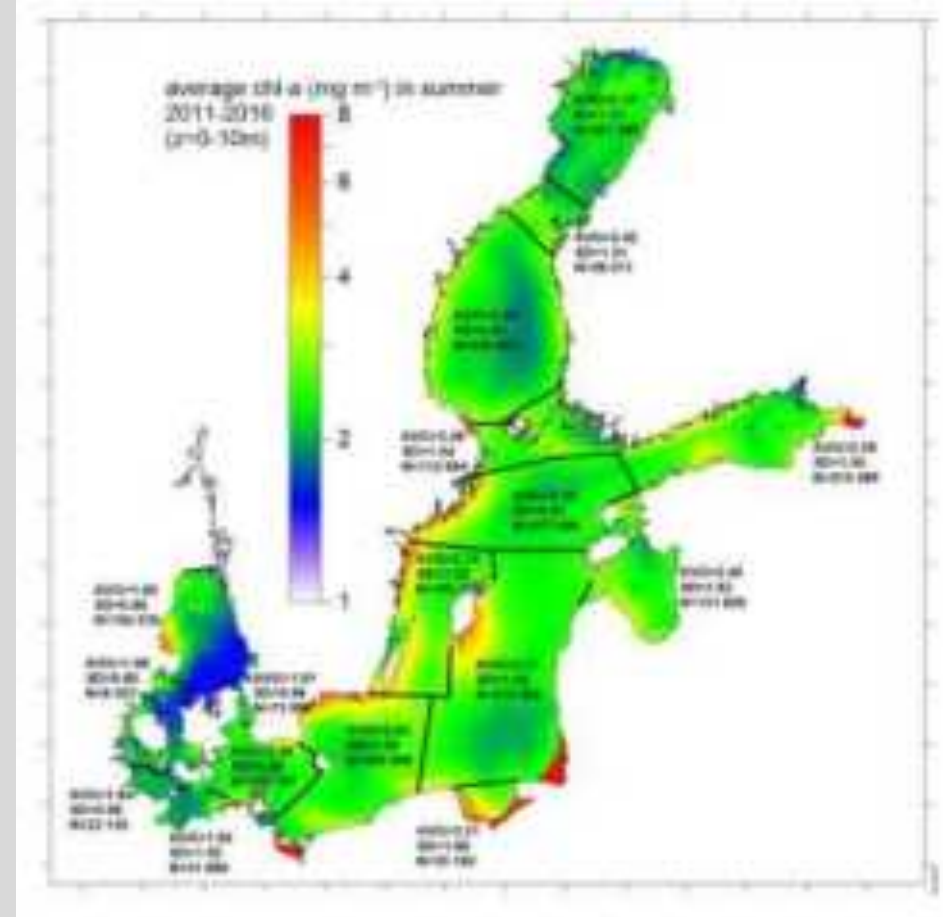
- contribution to the update of the preliminary assessment of the state of the environment ...



## A classic method for assessing the state of the marine environment compared to the capabilities of satellite data.

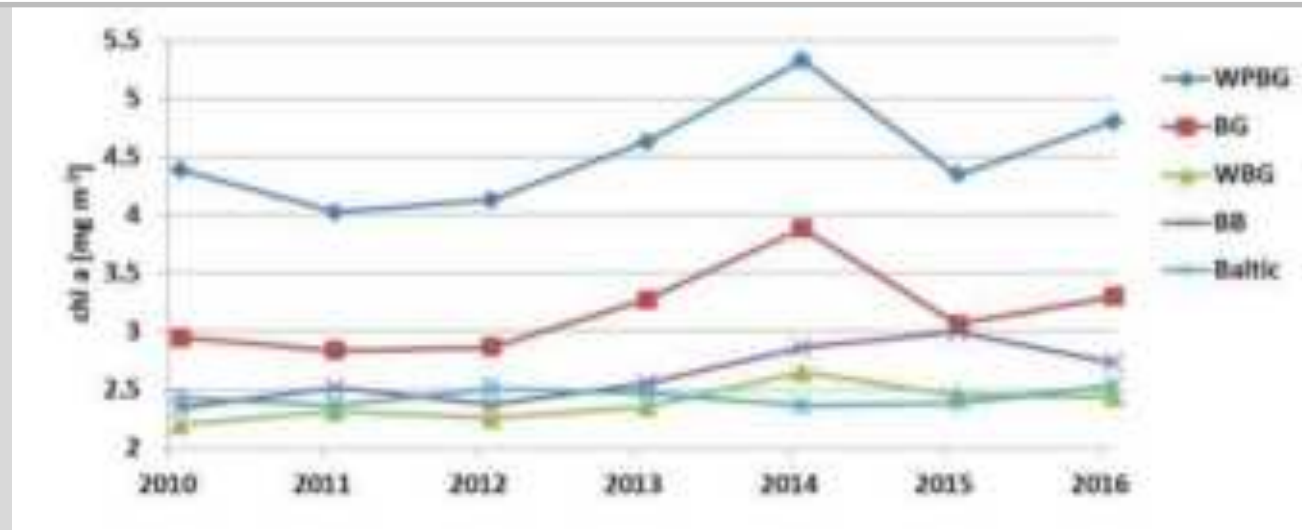
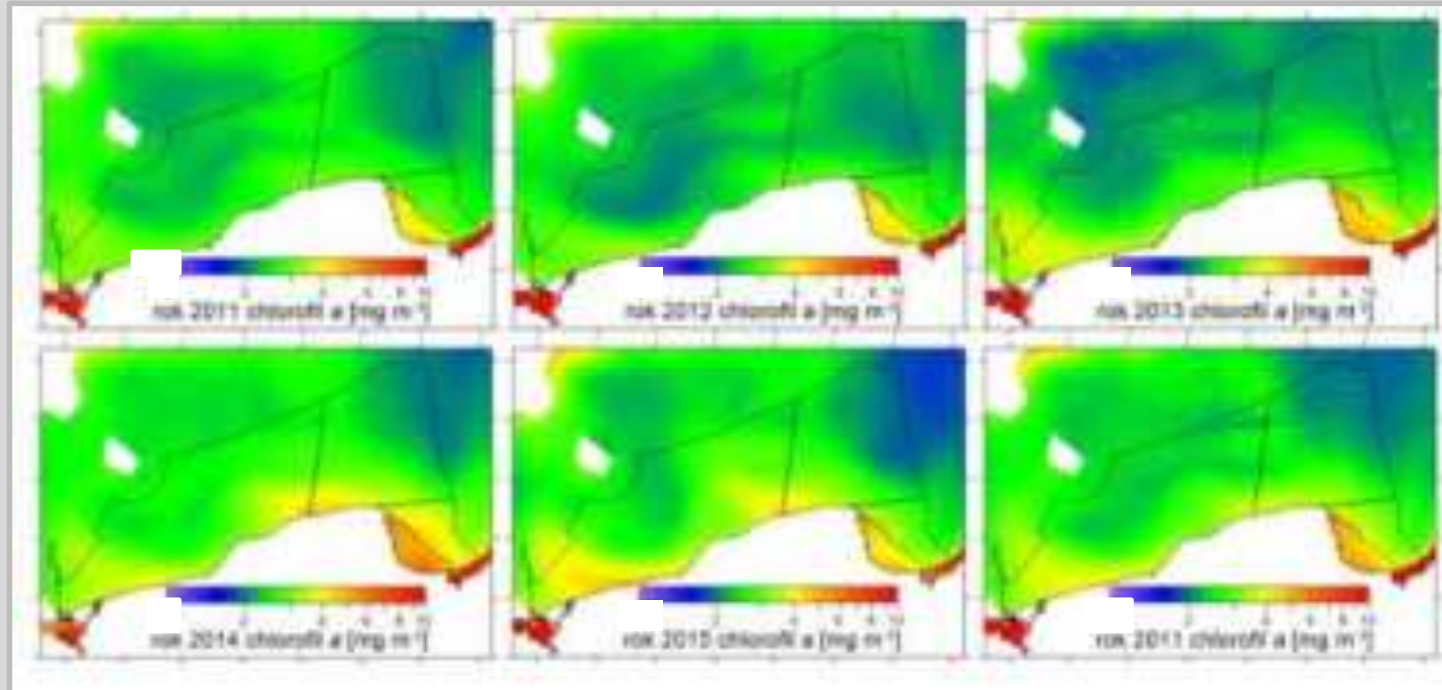


A limited number of measurements per year at selected locations.



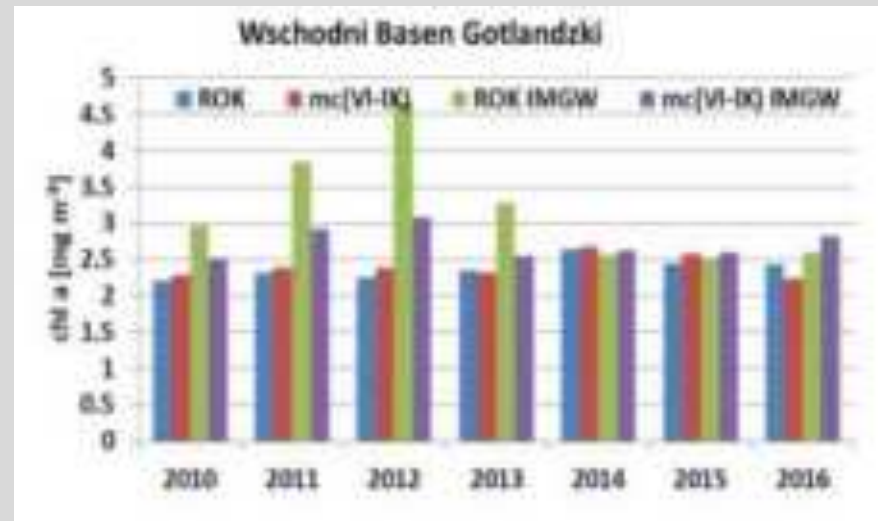
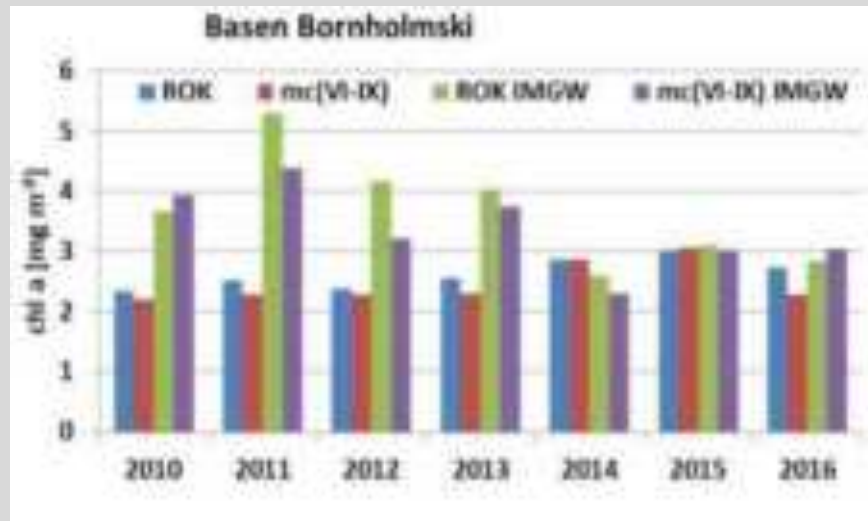
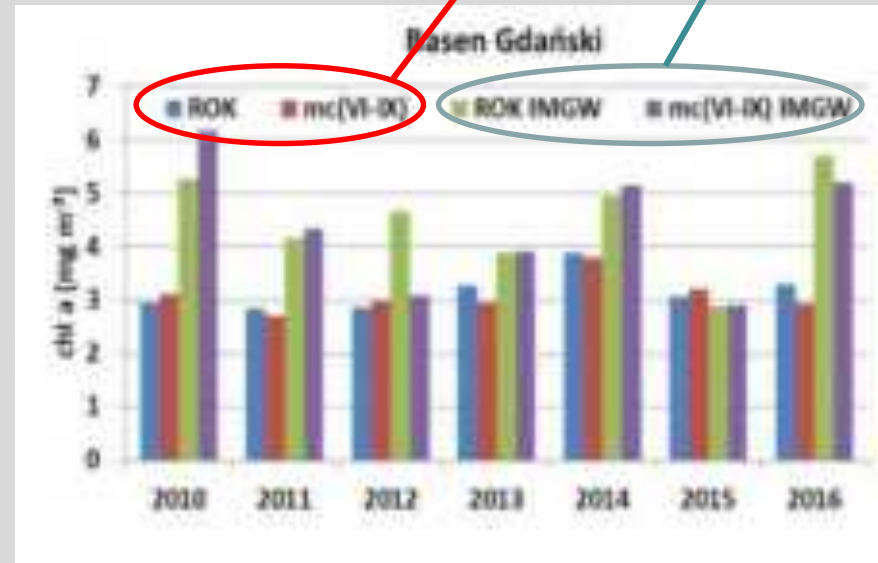
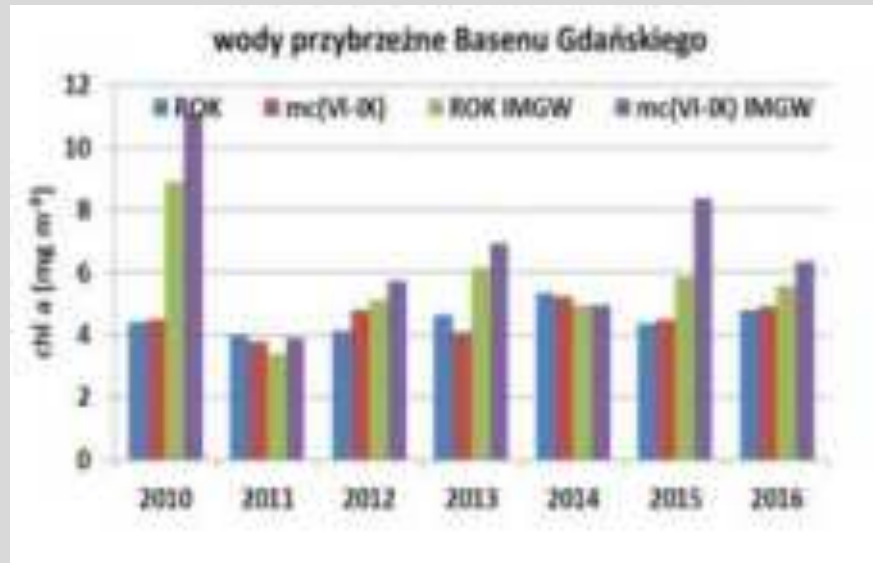
Daily parameter determination on a spatial grid evenly distributed in the area.

# Average chlorophyll a concentration for 2011-2016.



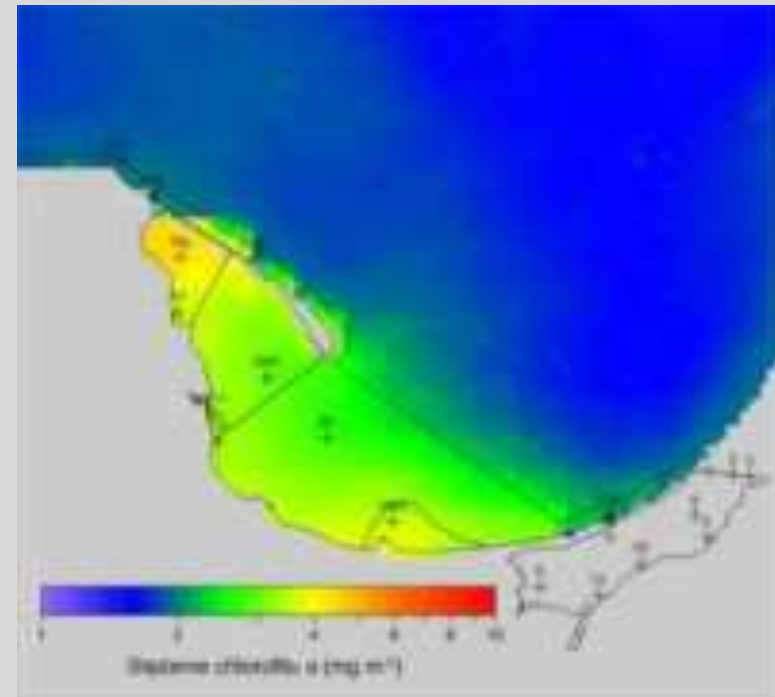
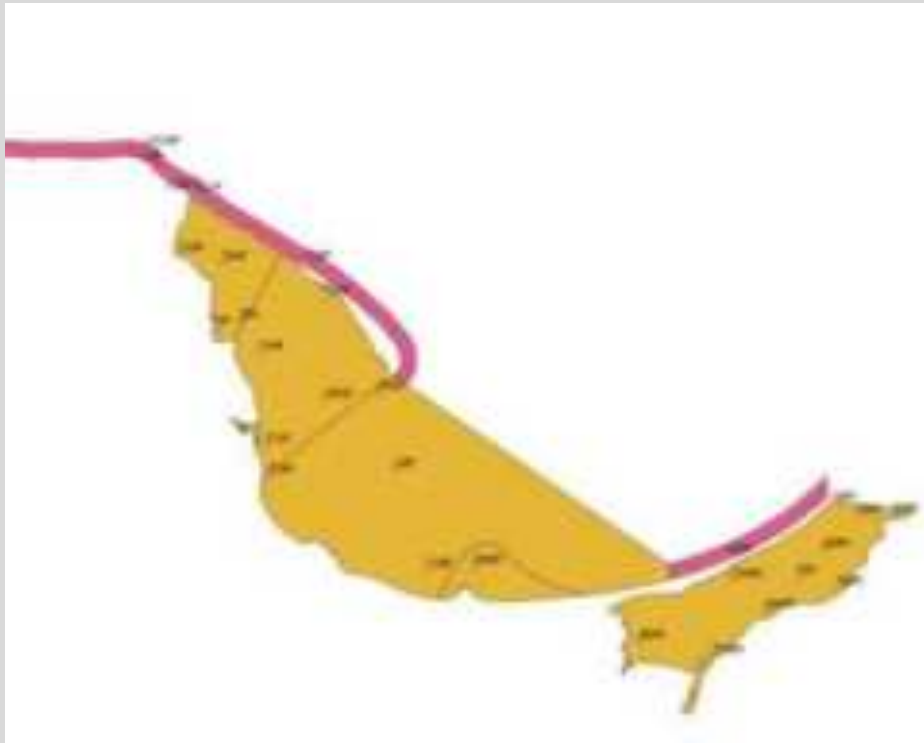


# A comparison with the results of 'classic' monitoring.



**Selected examples of previous applications: assessment of the representativeness of measurement sites in transitional and coastal waters for diagnostic and research monitoring.**

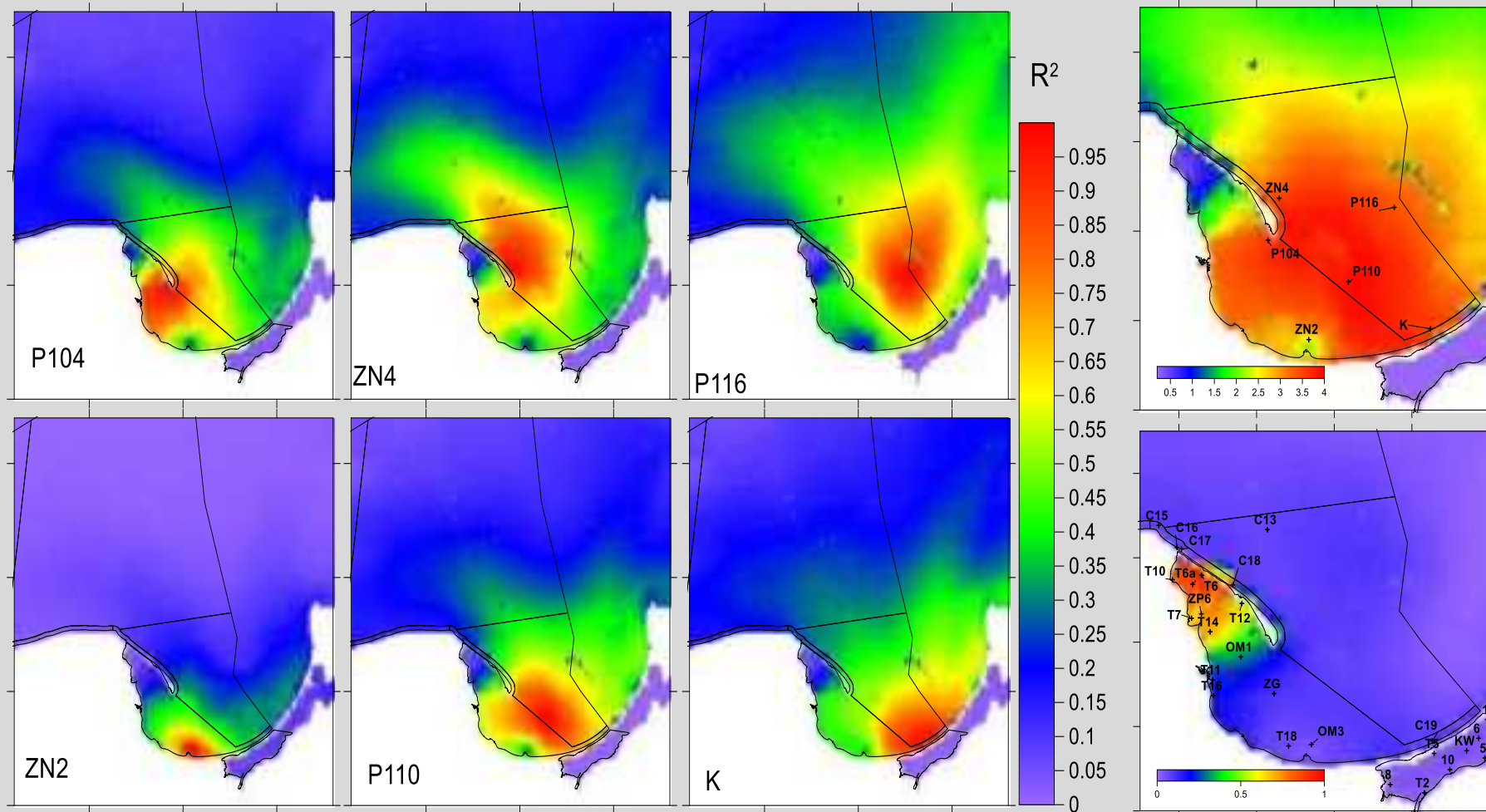
### **Chief Inspectorate for Environmental Protection**



The average monthly chlorophyll a concentration in August 2016 calculated based on data from the SatBałyk System.

# Analysis of spatial distributions of the coefficient of determination.

Spatial distribution of the coefficients of determination ( $R^2$ ) of chlorophyll a concentrations, calculated for selected monitoring stations



## Positions and PPKs proposed for relocation or removal

### Zatoka Pucka Zewnętrzna

phytoplankton - sites : OM1, T11, T12, T14

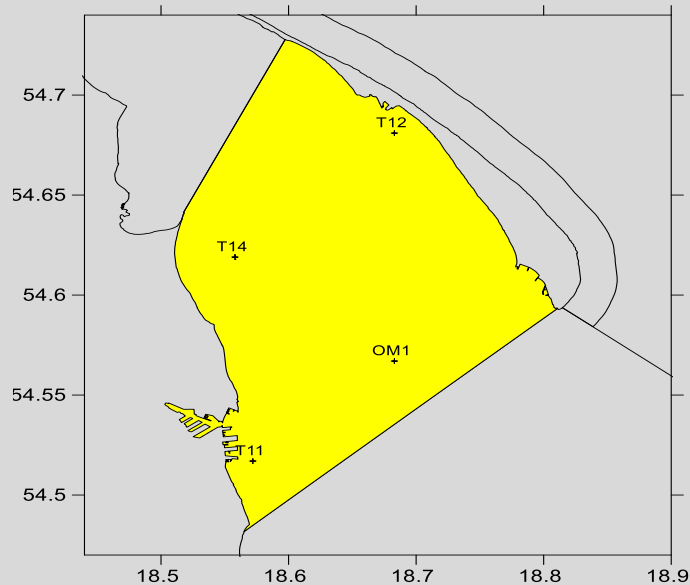
– T12 i T14 remove

nutrients: sites OM1, T11, T12, T14

- T11 remove

macrozoobenthos – sites T11 i OM1

- no changes



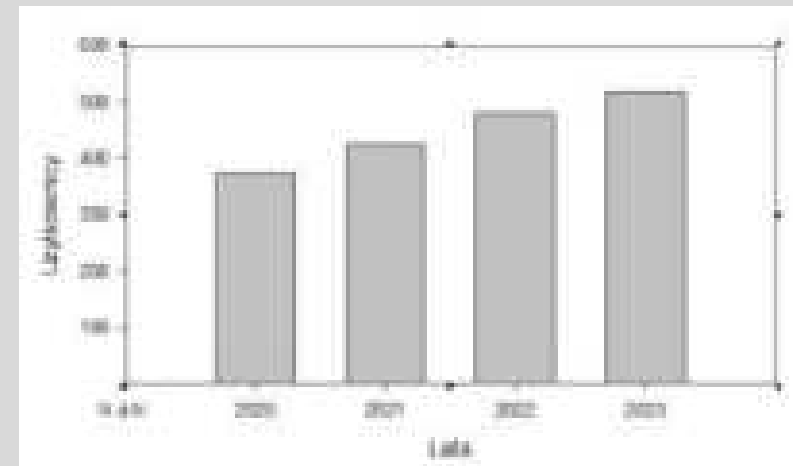
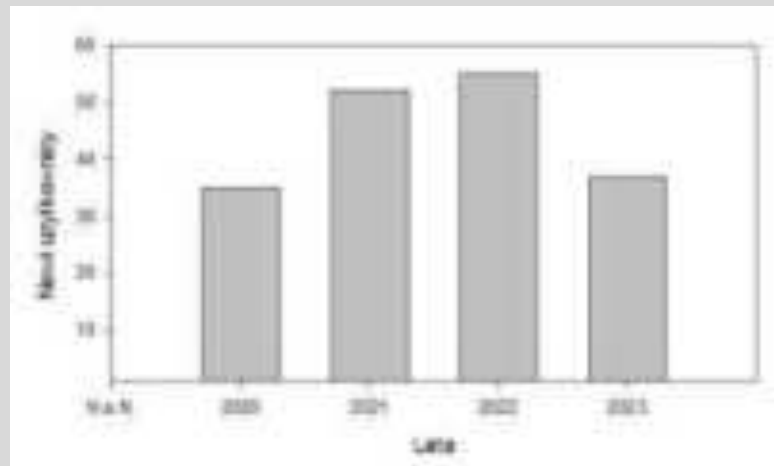


## Use of the system by external users:

System usage statistics for the last 24 months:



Registered users:



## Recognition of the system.

SatBałtyk is described in the textbook "Satellite Data for Public Administration" (ed. B. Hejmanowska and P. Wężyk, Warsaw 2020, ISBN: 978-83-945436-2-4).

"National Satellite Information System" portal run by the Polish Space Agency, SatBałtyk is listed as the basic national thematic service concerning maritime areas.

Several dozen scientific publications

Data from the SatBałtyk system are an important element of the implementation of many national and international projects, in 2025 we already know about 5 national projects and 4(5) international projects

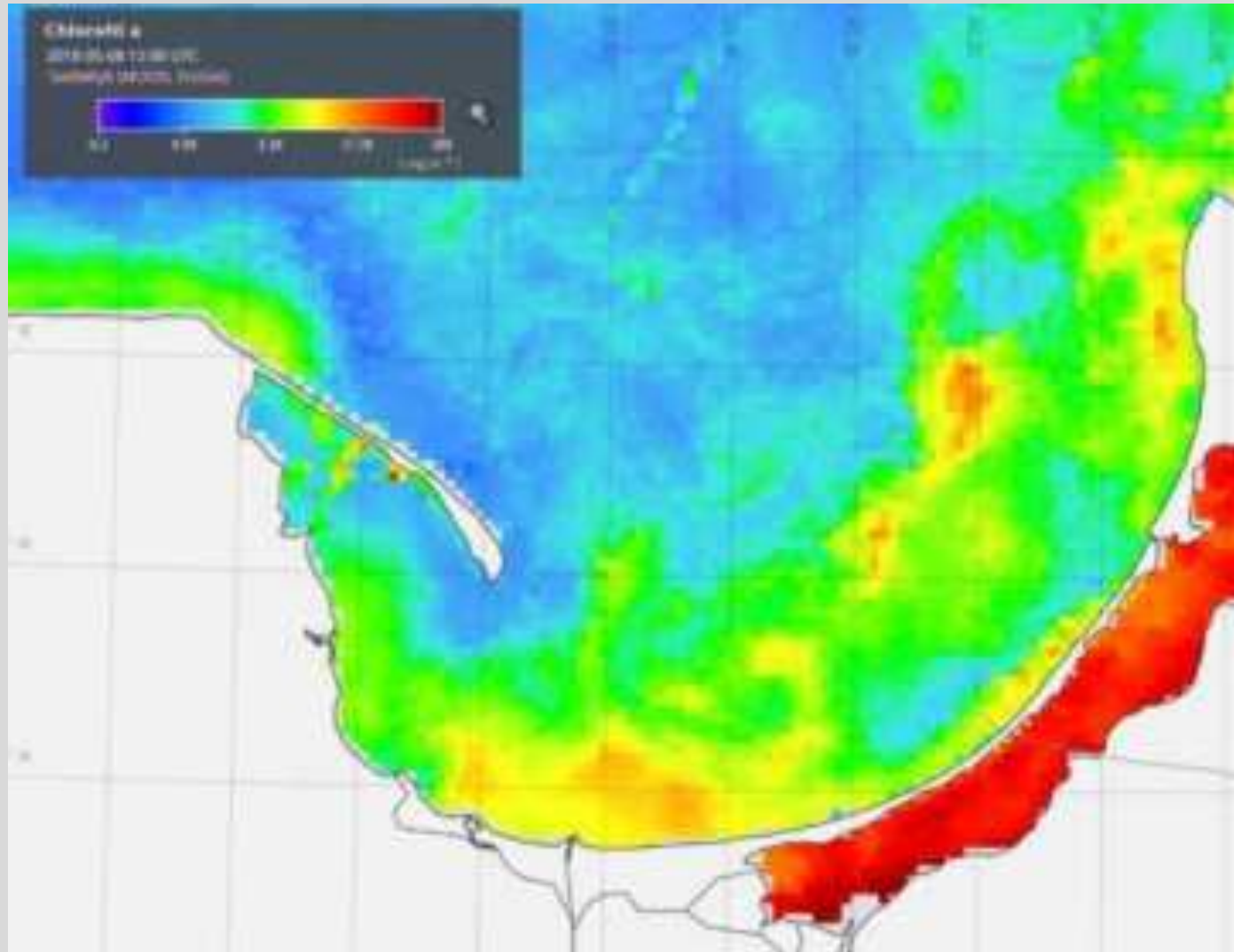
Included in the eCUDO system.

## **Actions planned for the near future**

arrangements aimed at systemic inclusion of SatBałtyk service data in the new system implemented in the Maritime Rescue Coordination Centre for managing rescue operations at sea

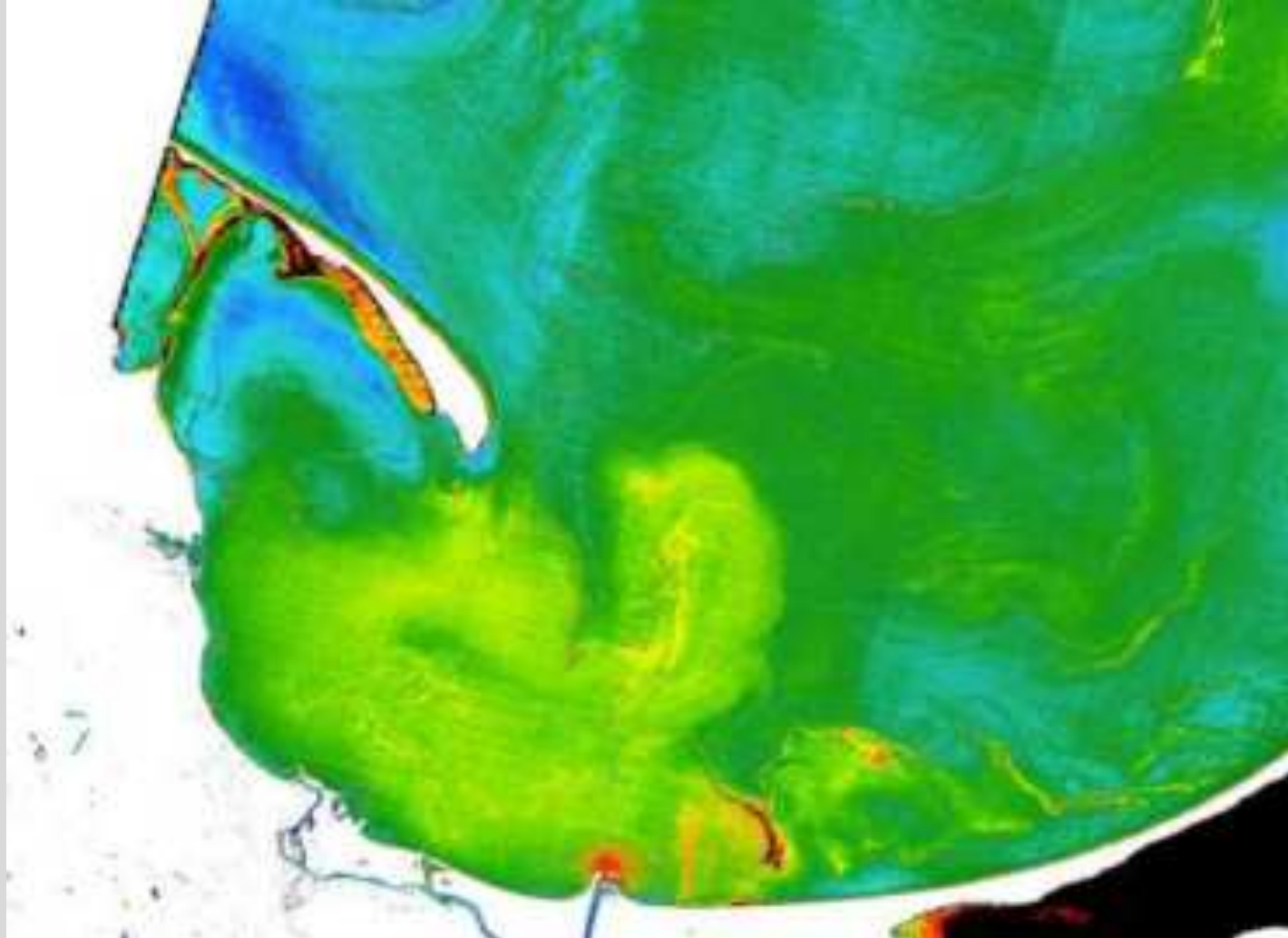
Integration with the NSIS platform - National Satellite Information System (Polish Space Agency)

## Perspective of the subsystem for the Gulf of Gdansk





## Satellite sensorss with a higher spatial resolution (e.g. 10m) - new possibilities



2018-05-13 – near-surface suspended solids concentration (Sentinel2)

Thank you for your attention

**<http://www.satbaltyk.pl>**



# System SatBaltyk produkty: zasięg zalewania plaży





# System SatBaltyk produkty: zasięg zalewania plaży(2)

