SatBałtyk system
as a tool supporting assessment
of the marine environment
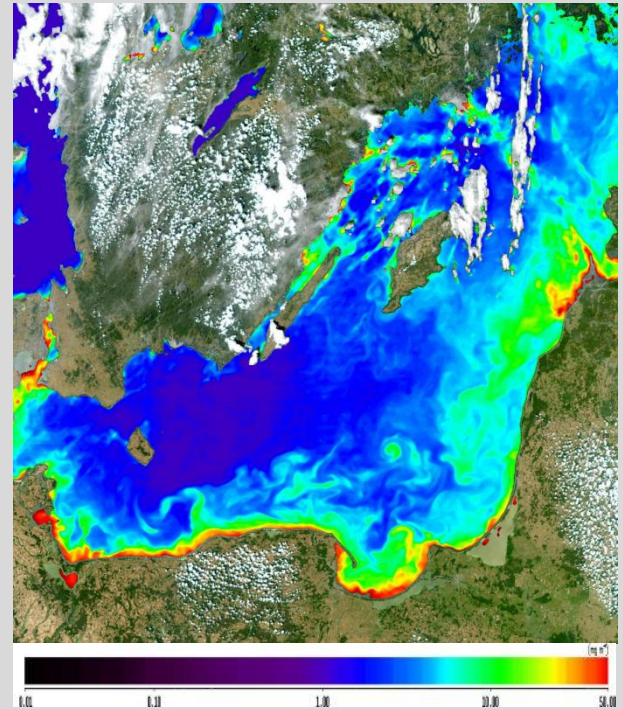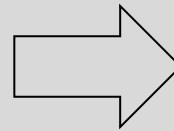
Miroslaw Darecki

**Institute of Oceanology Polish Academy of Sciences
Sopot, Poland**

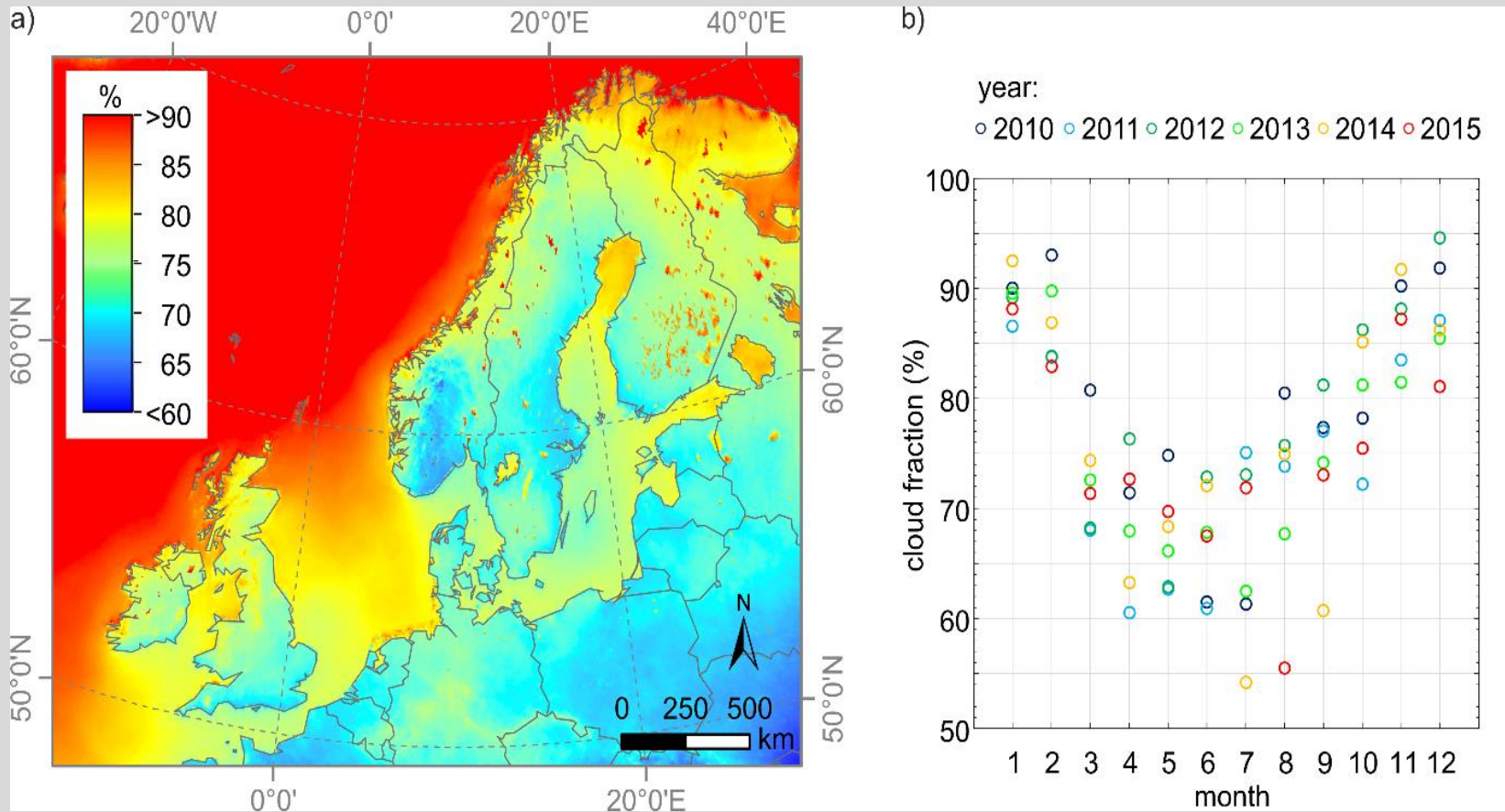# Observing ⇨ measuring ocean from space

Satellite true color image

Chlorophyll a spatial variability

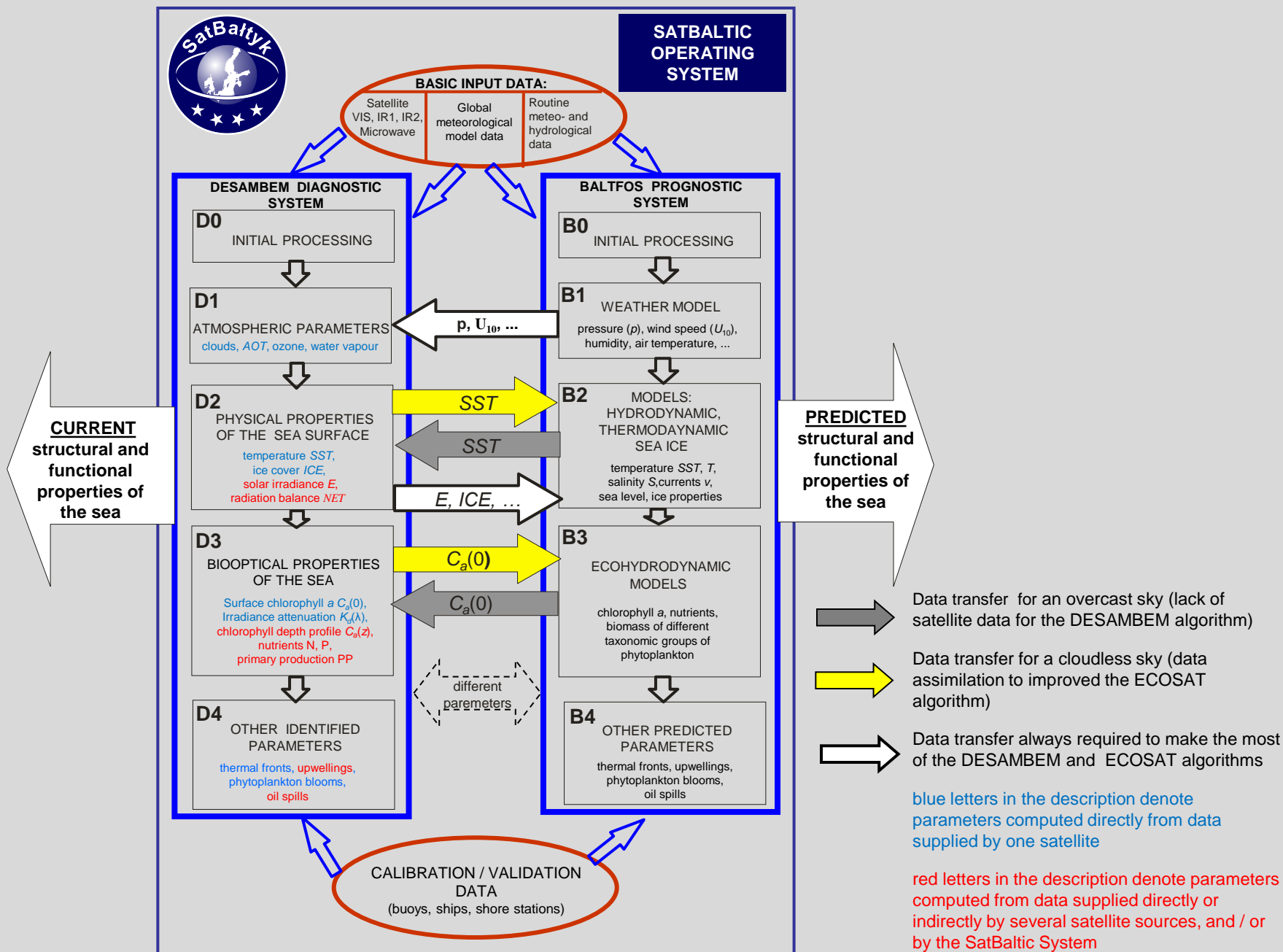# Variability of the cloud fraction in the Baltic Sea region

(a) spatial distribution of the annual mean (averaged for the years 2010-2015)
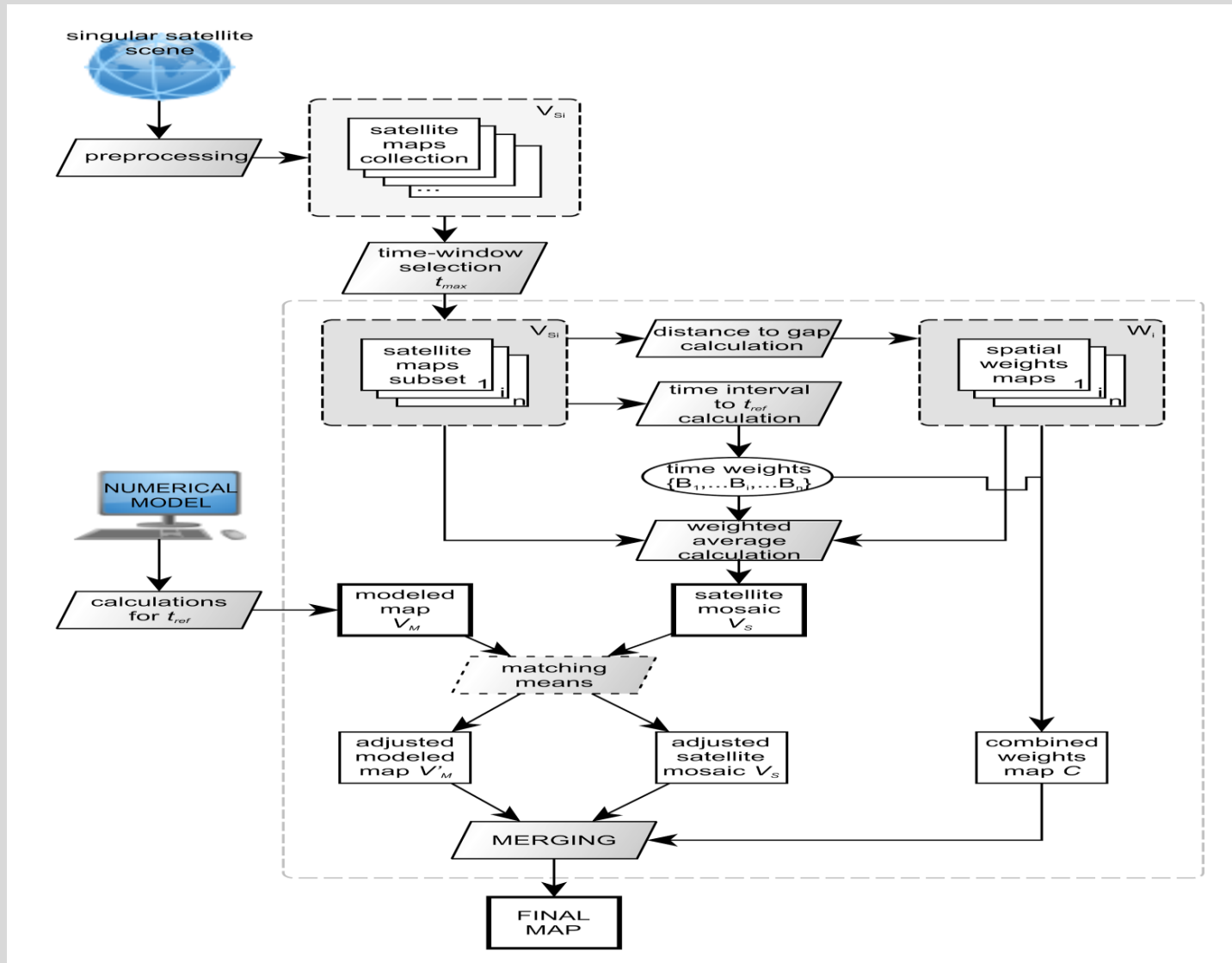(b) monthly means averaged for different years

(Finkensieper et al., 2016)

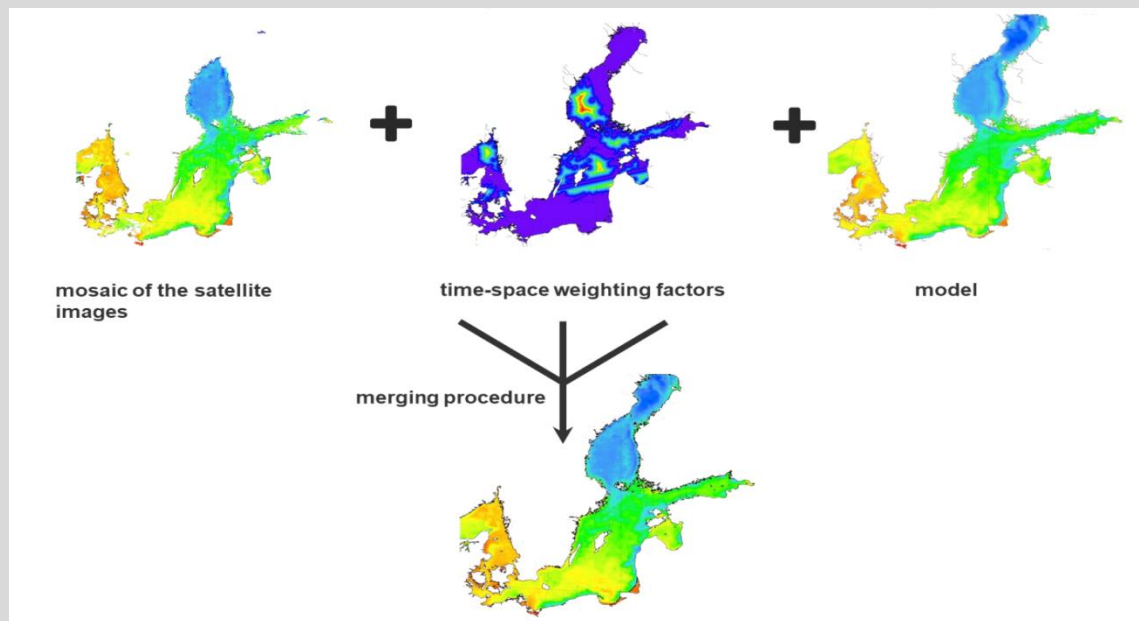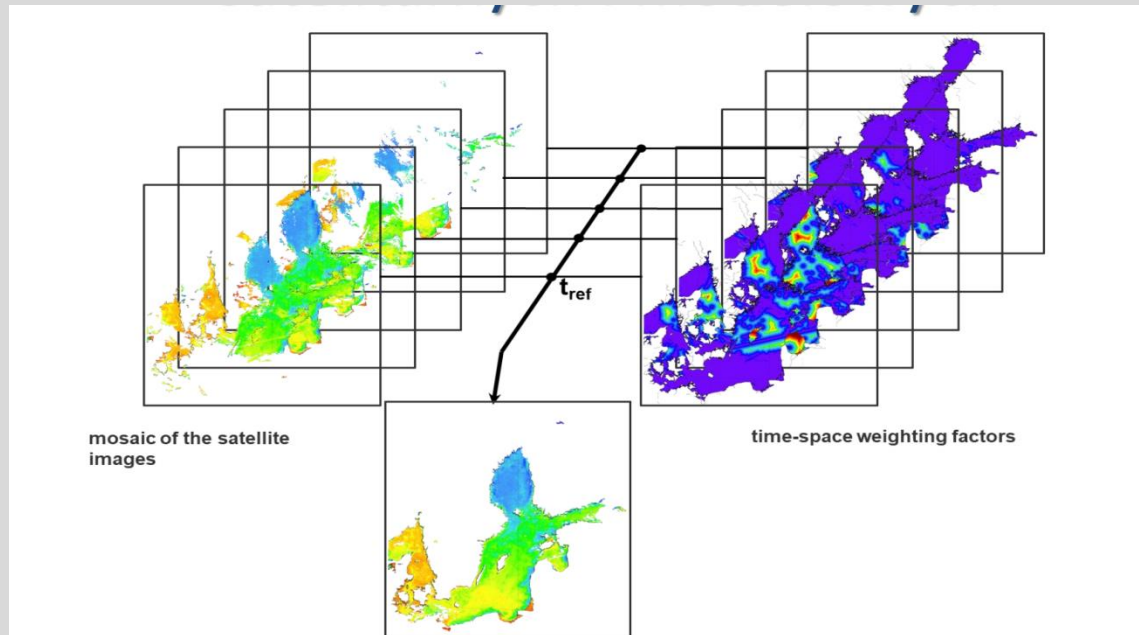# Block diagram of the SatBaltic Operating System
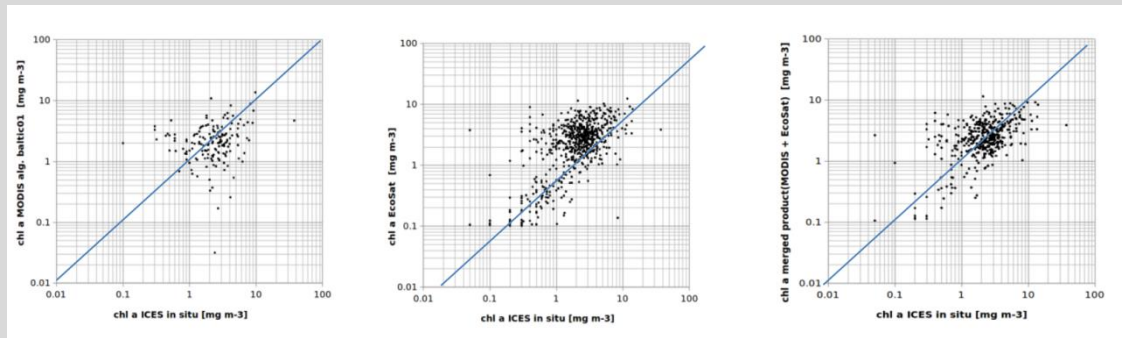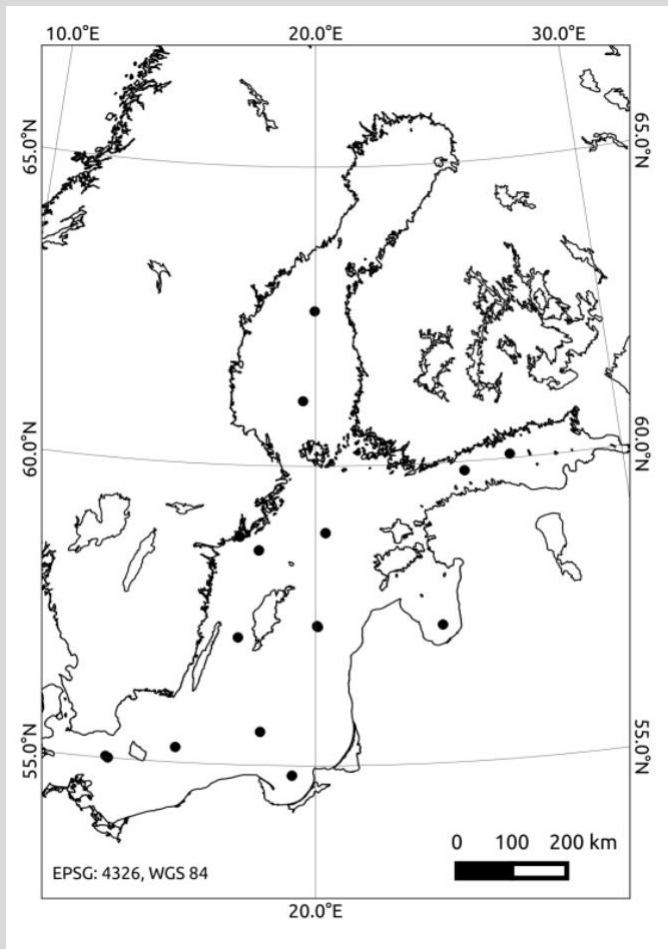
Merging data - processing chain

More details in : M. Konik, M. Kowalewski, K. Bradtke, M. Darecki
The operational method of filling information gaps in satellite imagery using numerical models
International Journal of Applied Earth Observations and Geoinformation, 2019, 75, 68-82.

Merging data - processing chain

mosaic of the satellite images

t_{ref}

time-space weighting factors

mosaic of the satellite images

time-space weighting factors

model

merging procedure

Assessment of the method performance
- on chlorophyll a concentration example

|	Arithmetic statistics			Logarithmic statistics				
	Systematic error	RMSE	Correlation coefficient	Lower bound	Error factor	Upper bound	Mean systematic error	Count
	$<\varepsilon>$ [mg/m^3]	σ [mg/m^3]	r	σ- [%]	x [mg/m^3]	σ+ [%]	$<\varepsilon>_g$ [%]	
Satellite data(MODIS)	-0.42	3.26	0.29	-7.6%	2.55	154.5%	-60.7%	161
EcoSat model	0.15	2.46	0.42	1.4%	2.28	128.3%	-56.2%	637
Merged product	-0.46	1.8	0.75	-6.0%	2.10	109.9%	-52.4%	424

Examples of merged SST maps, in relation to SST derived from AVHRR data
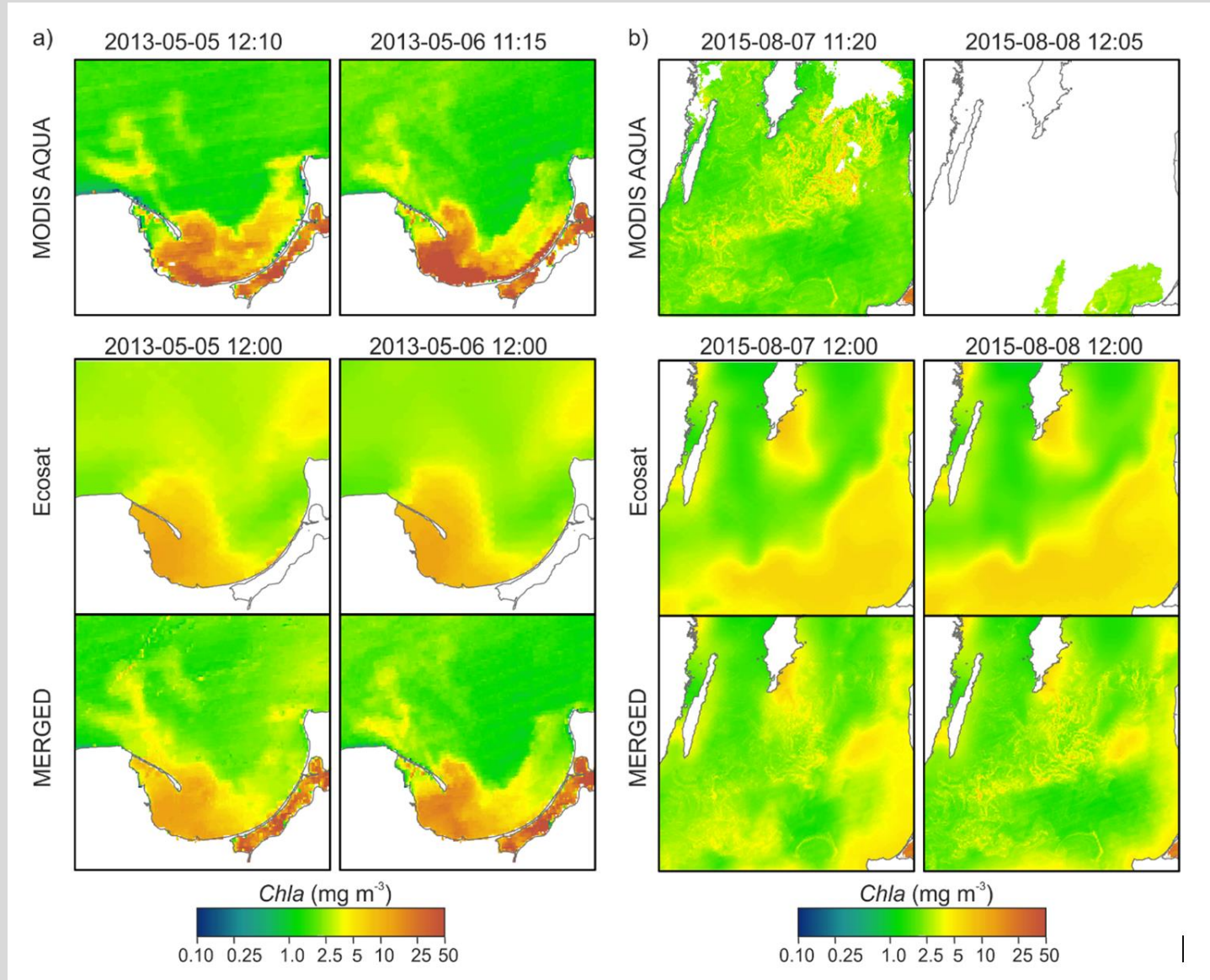

AVHRR PM3D MERGED
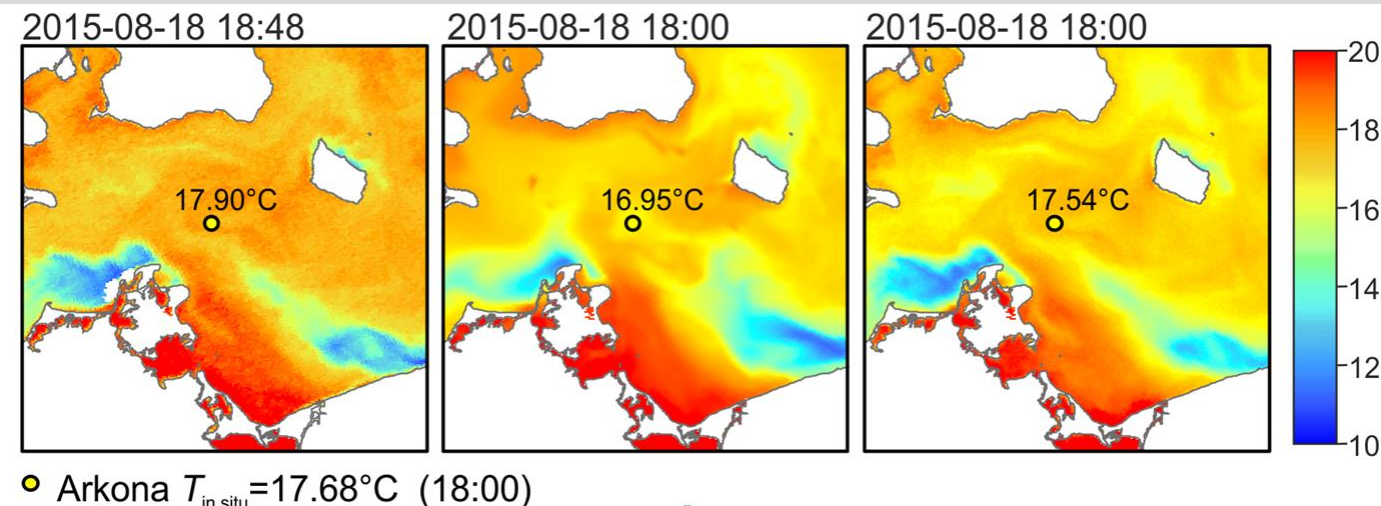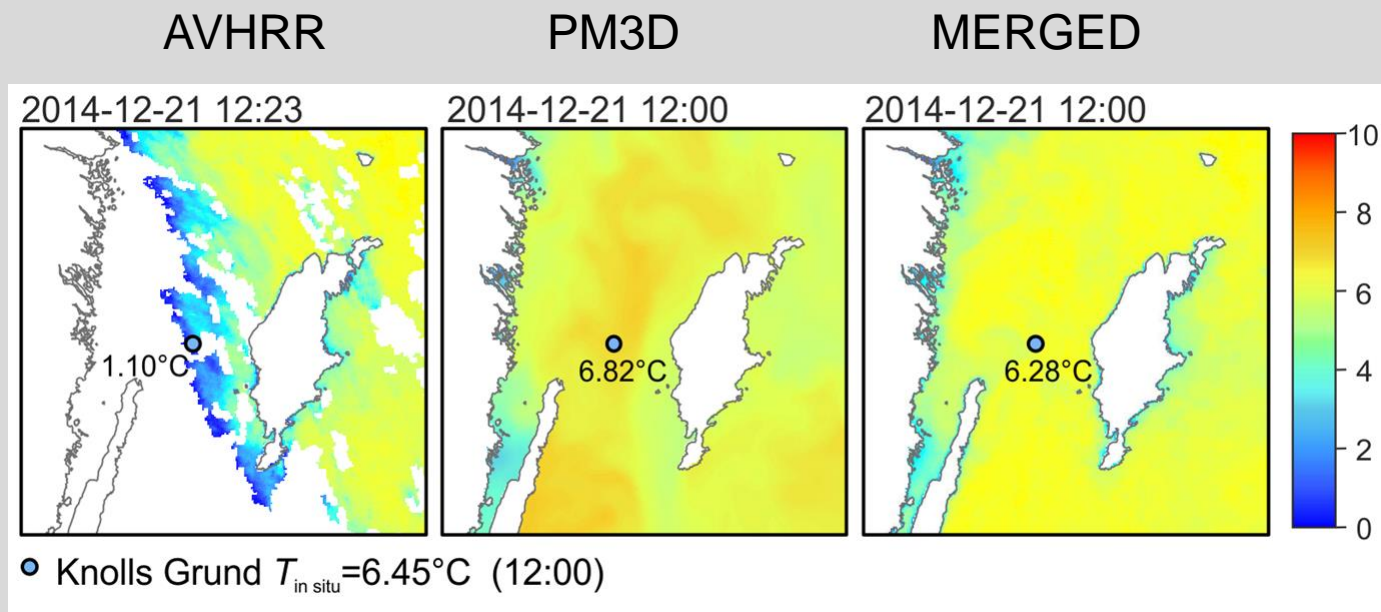
Examples of merged SST maps in comparison to ones derived from AVHRR data
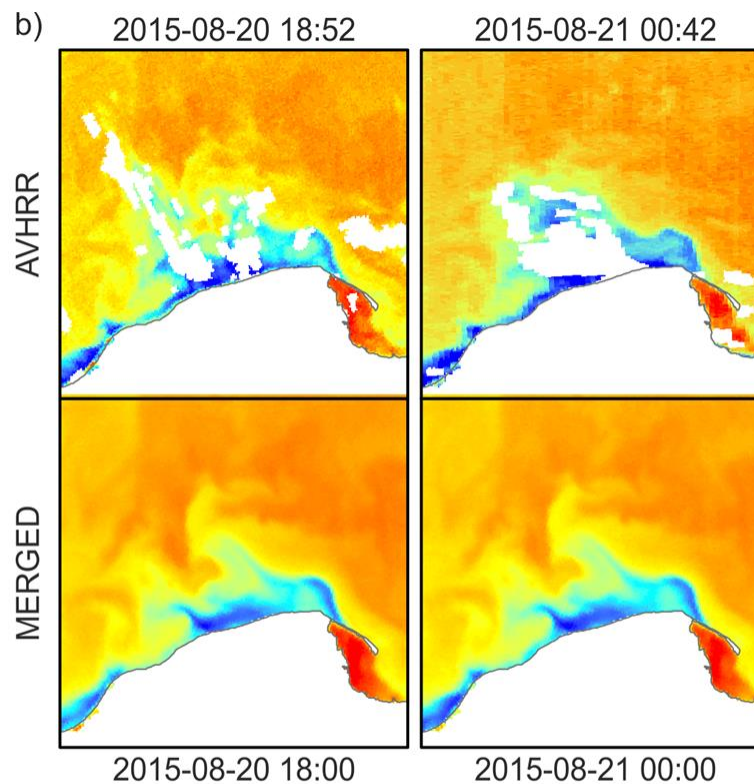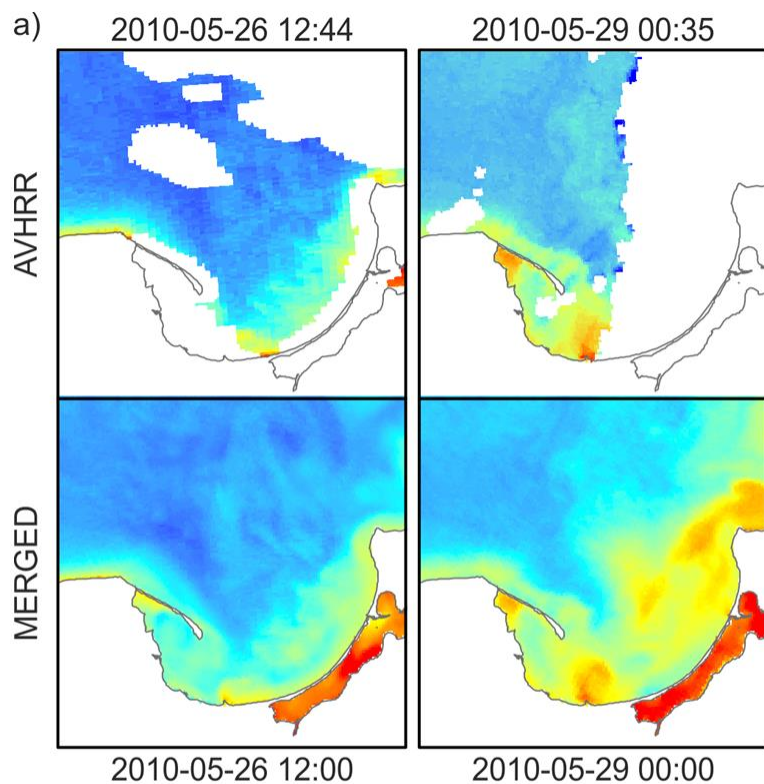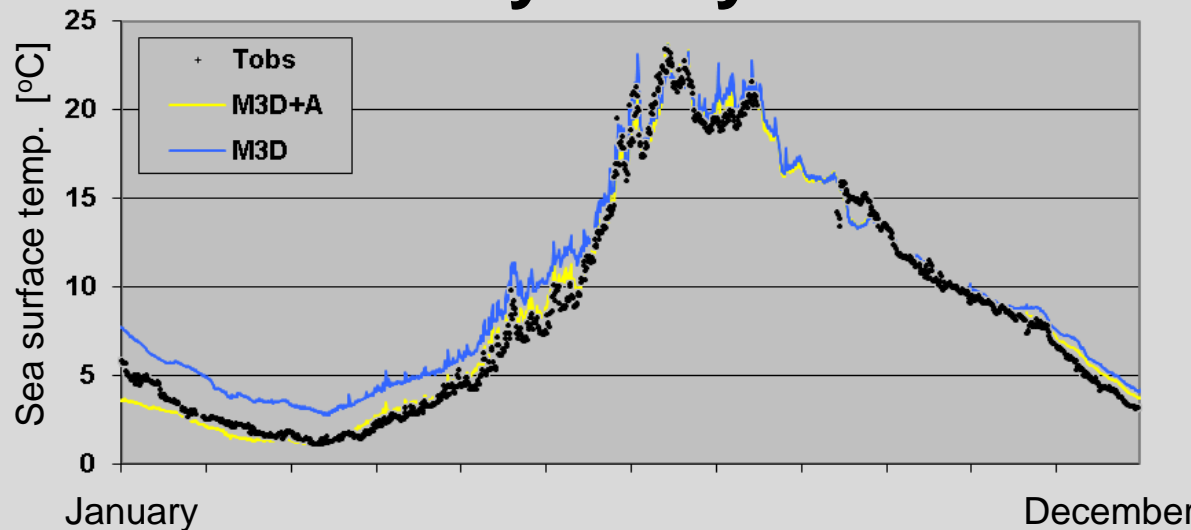
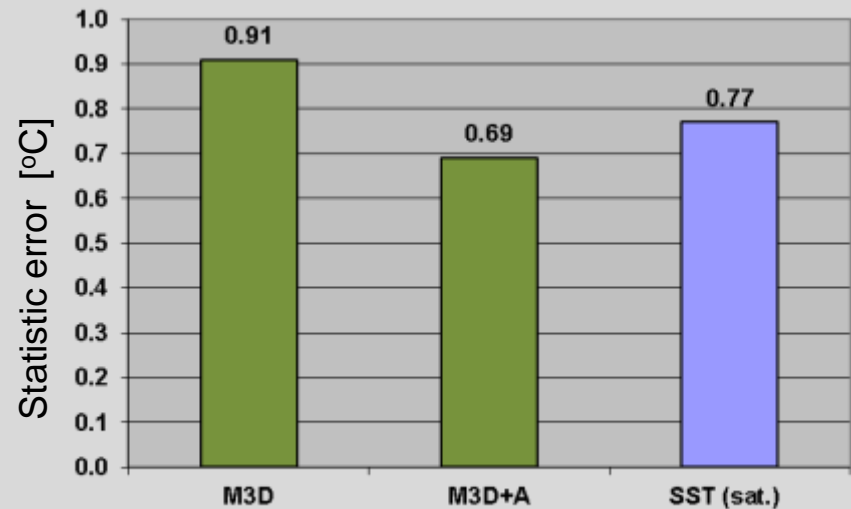# Examples of merged chlorophyll *a* concentration maps
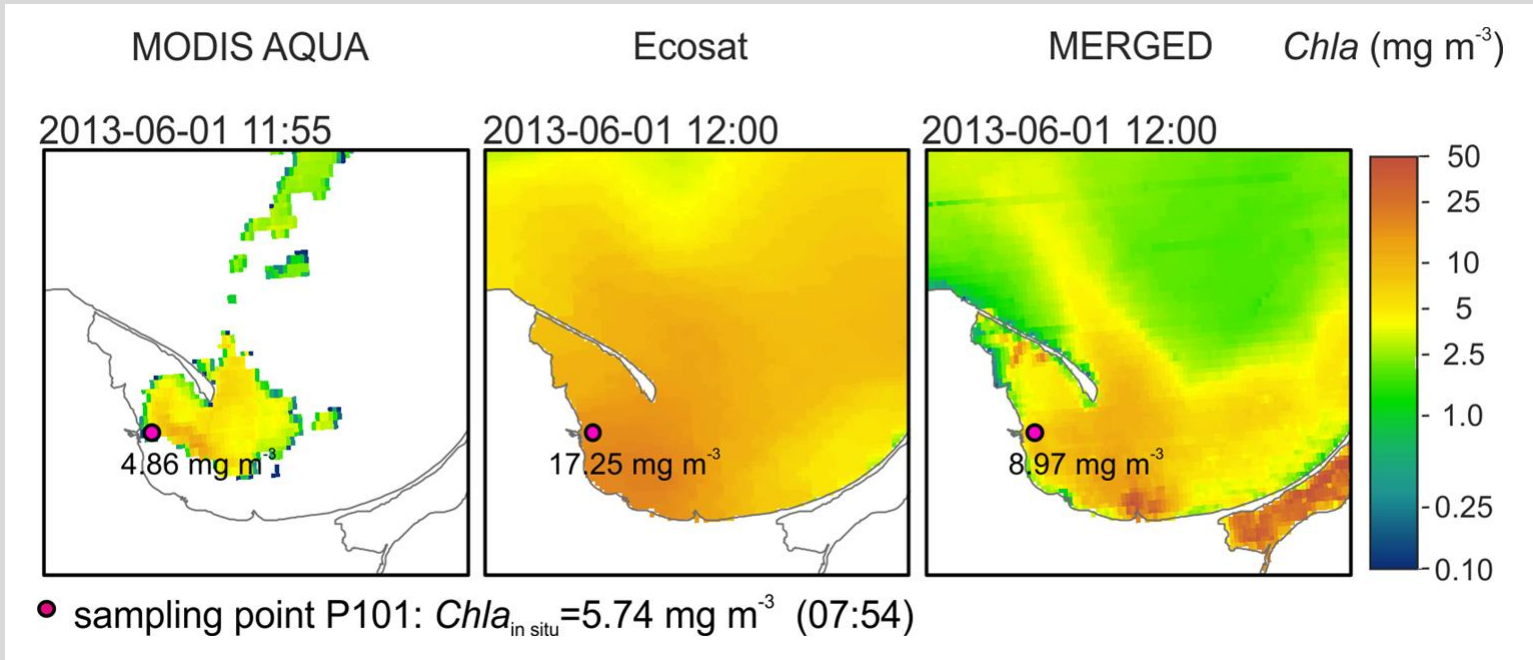
Examples of merged chlorophyll *a* concentration maps

# 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)
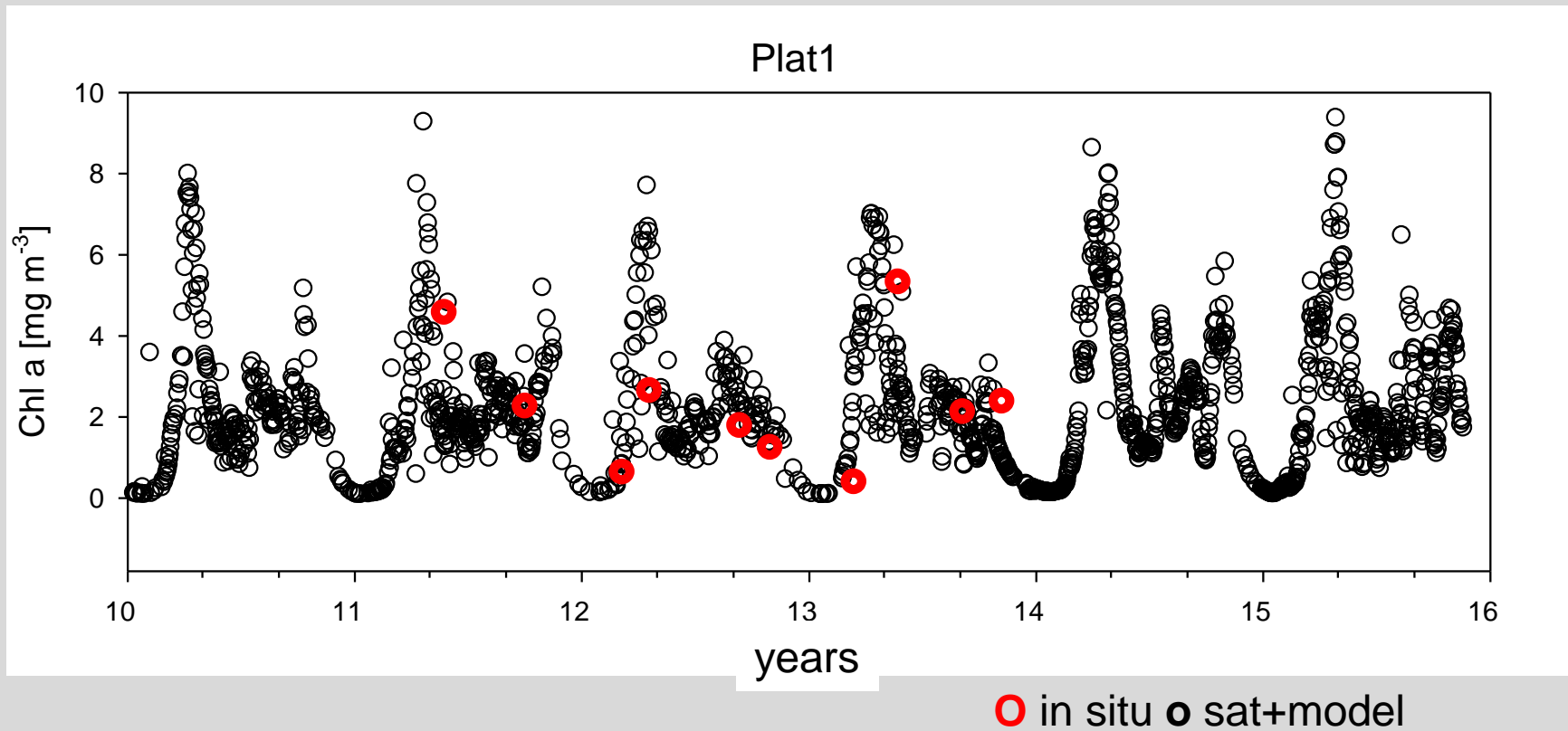
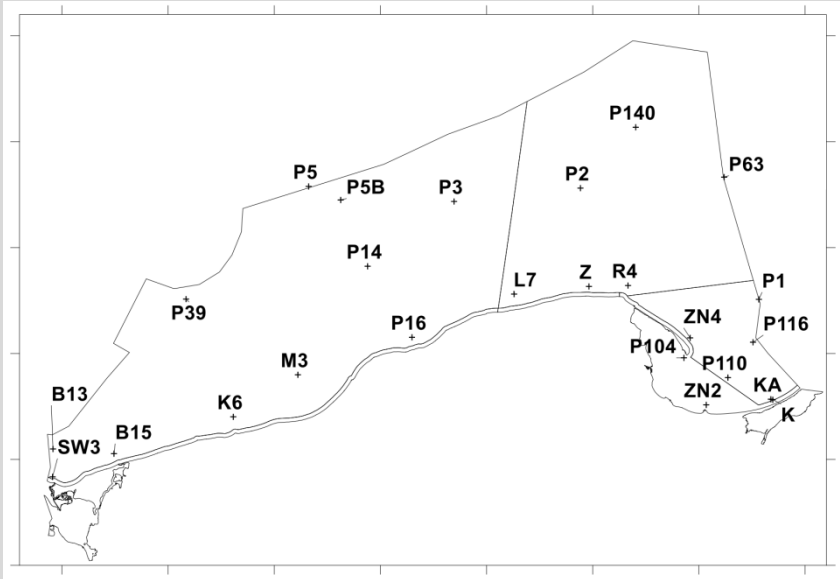# Variability of the sea surface temperature in the Baltic

Monthly averages of the sea surface temperature based on PM3D model, satellite AVHRR and merged SatBaltyk product
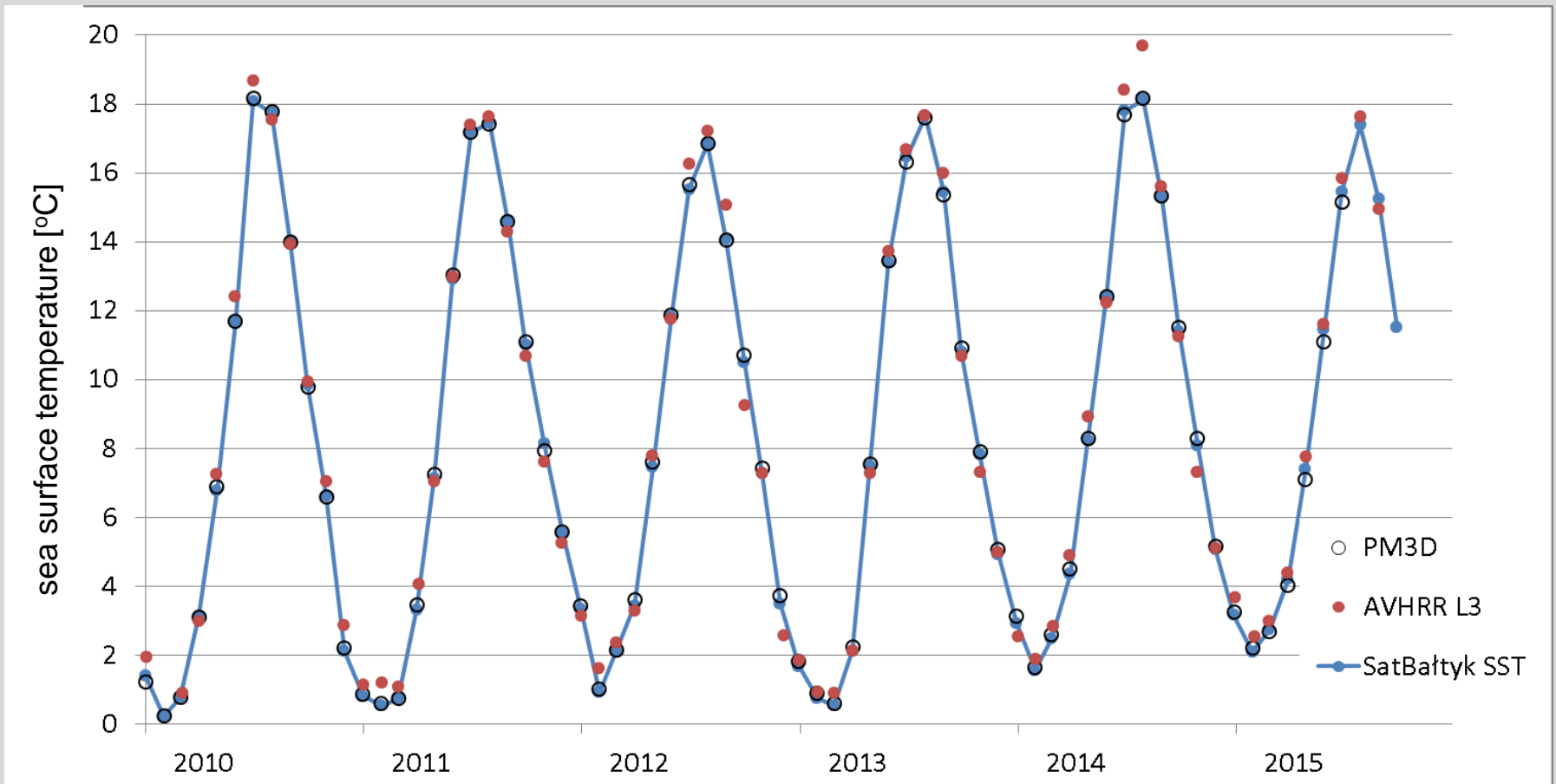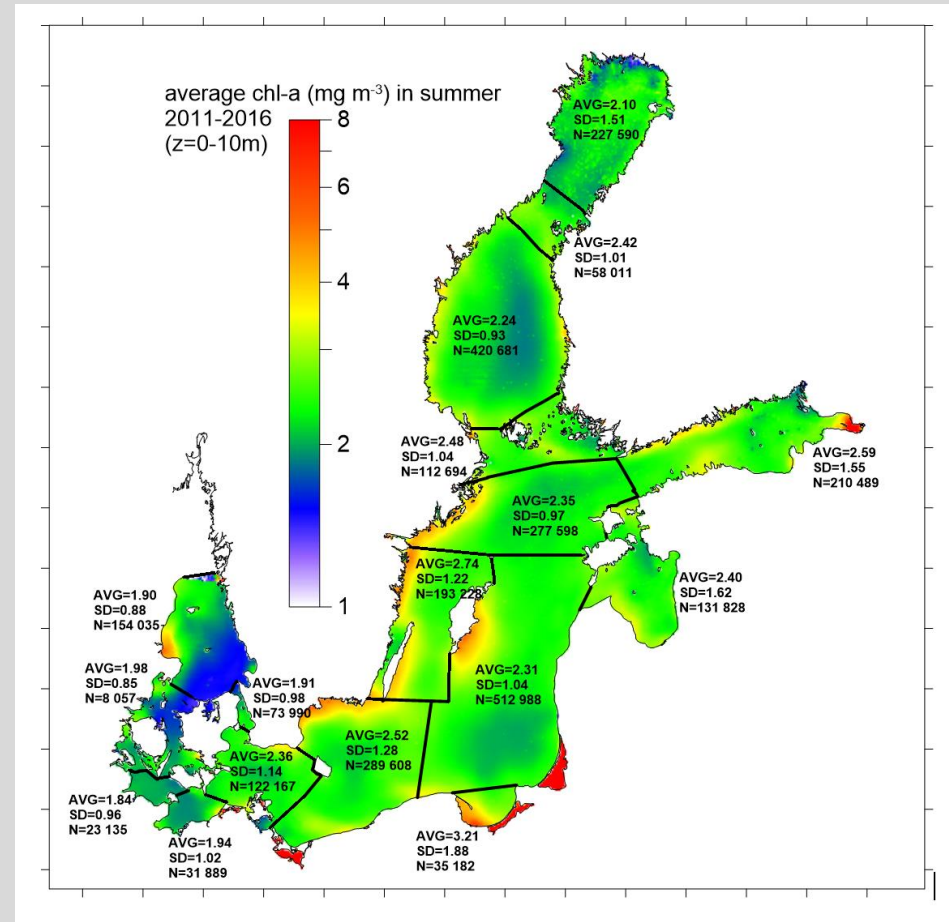
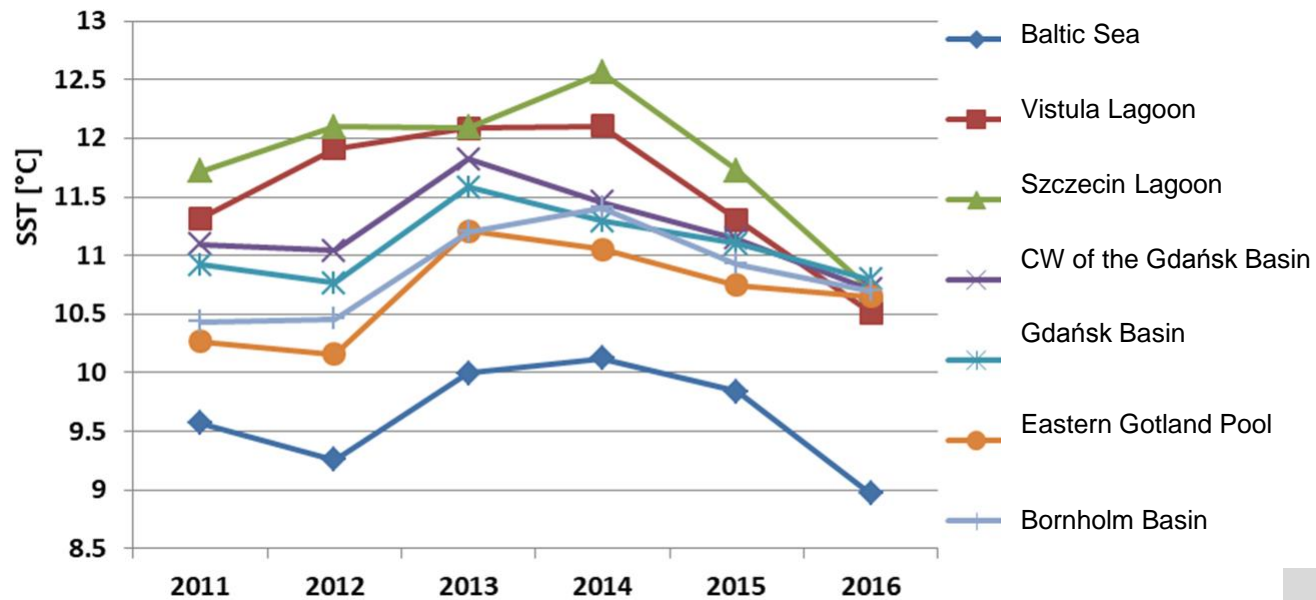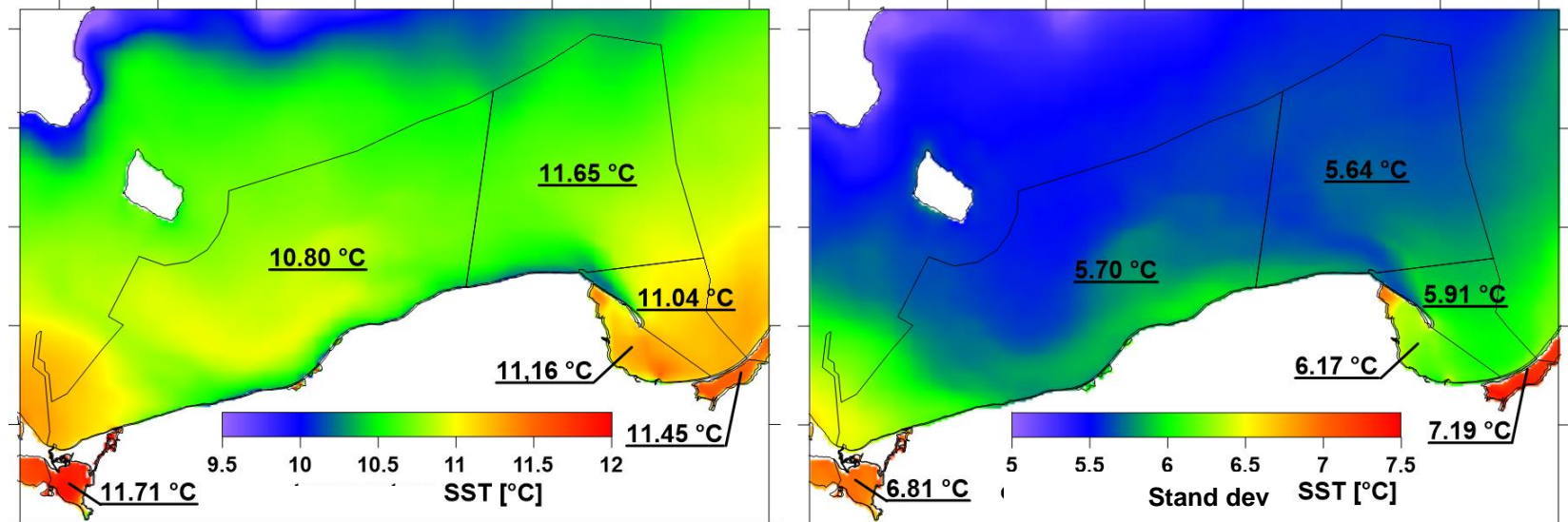# Multi year variability of chl-a on the Plat1 station

Plat1

O in situ o sat+model

Monitoring of the marine environment - two methods

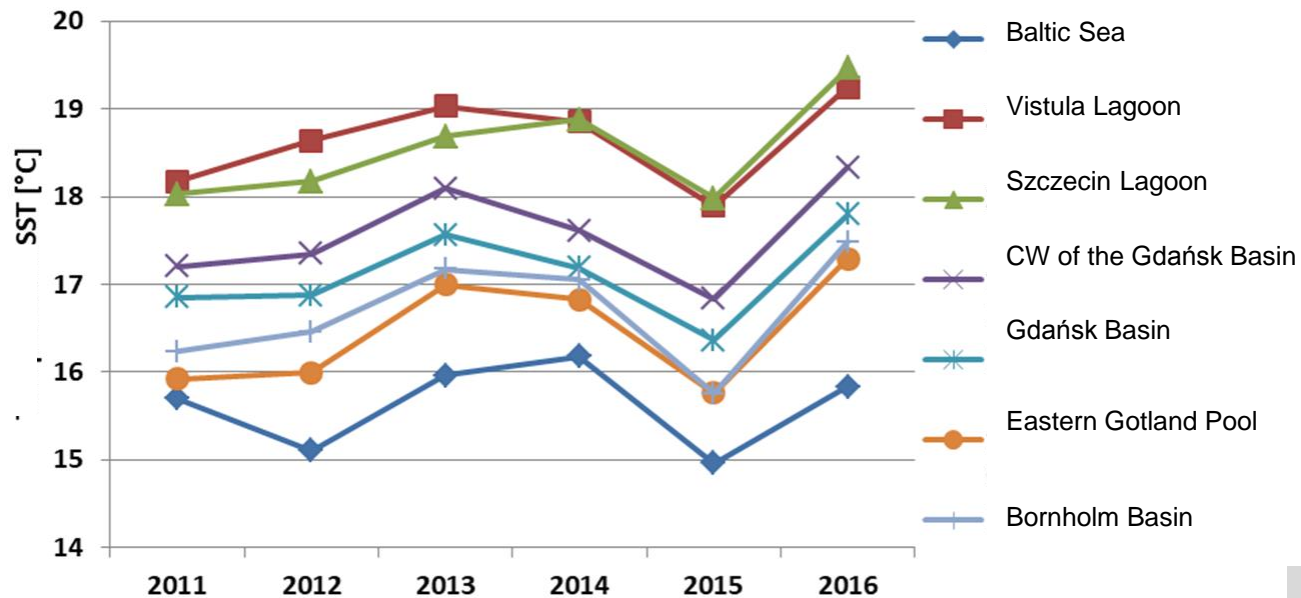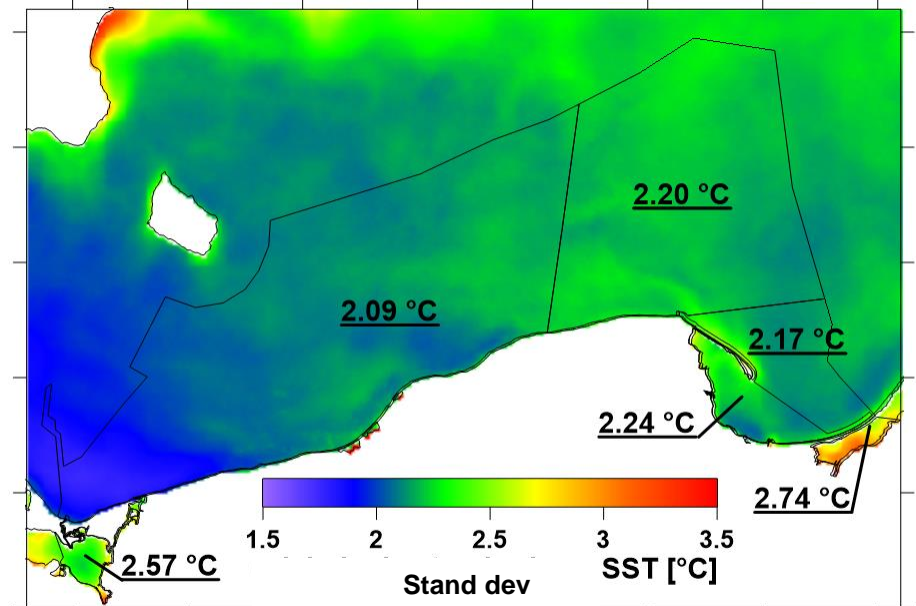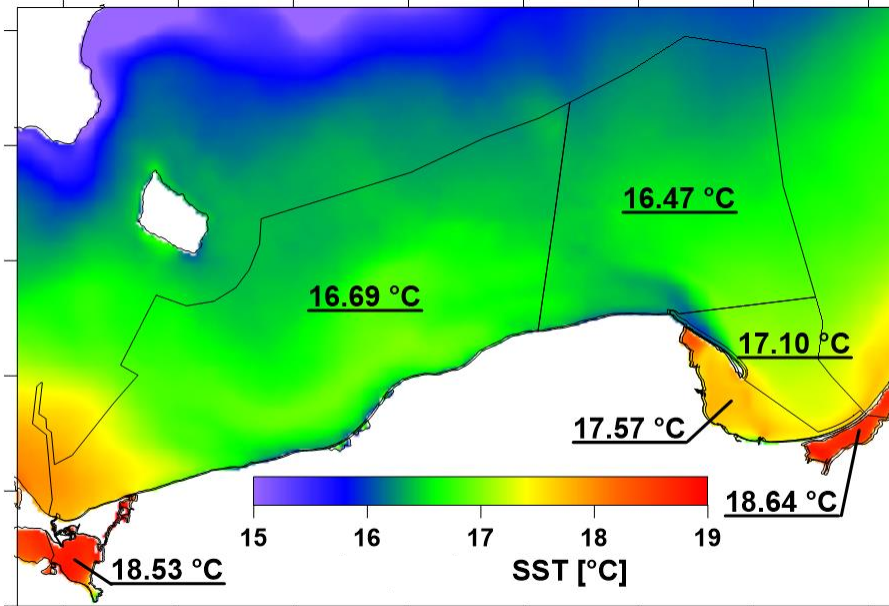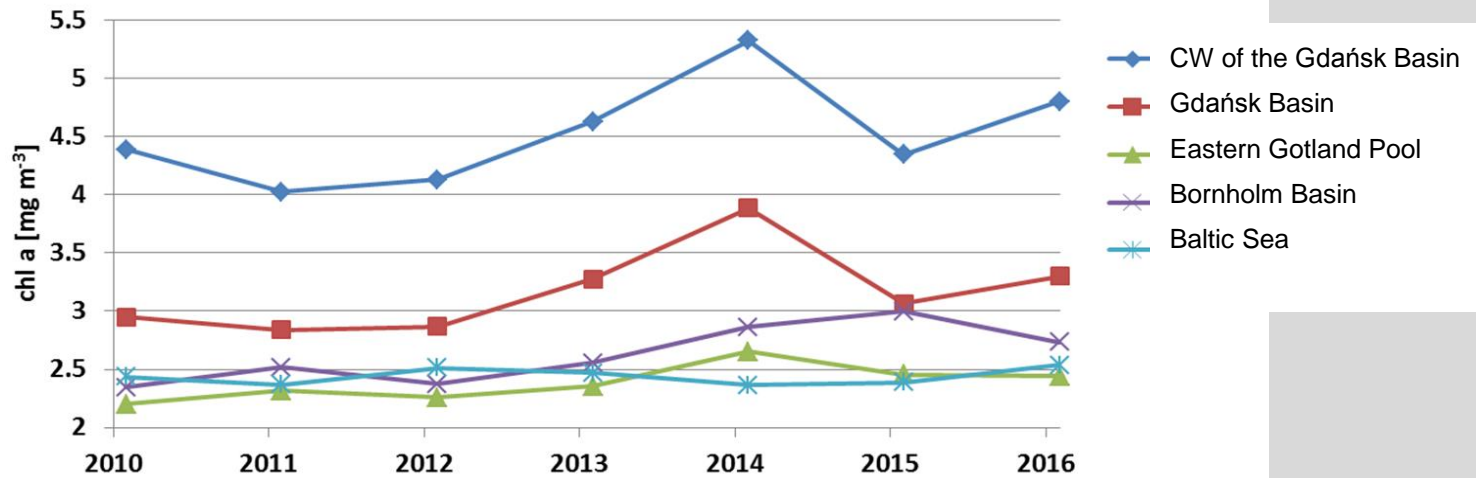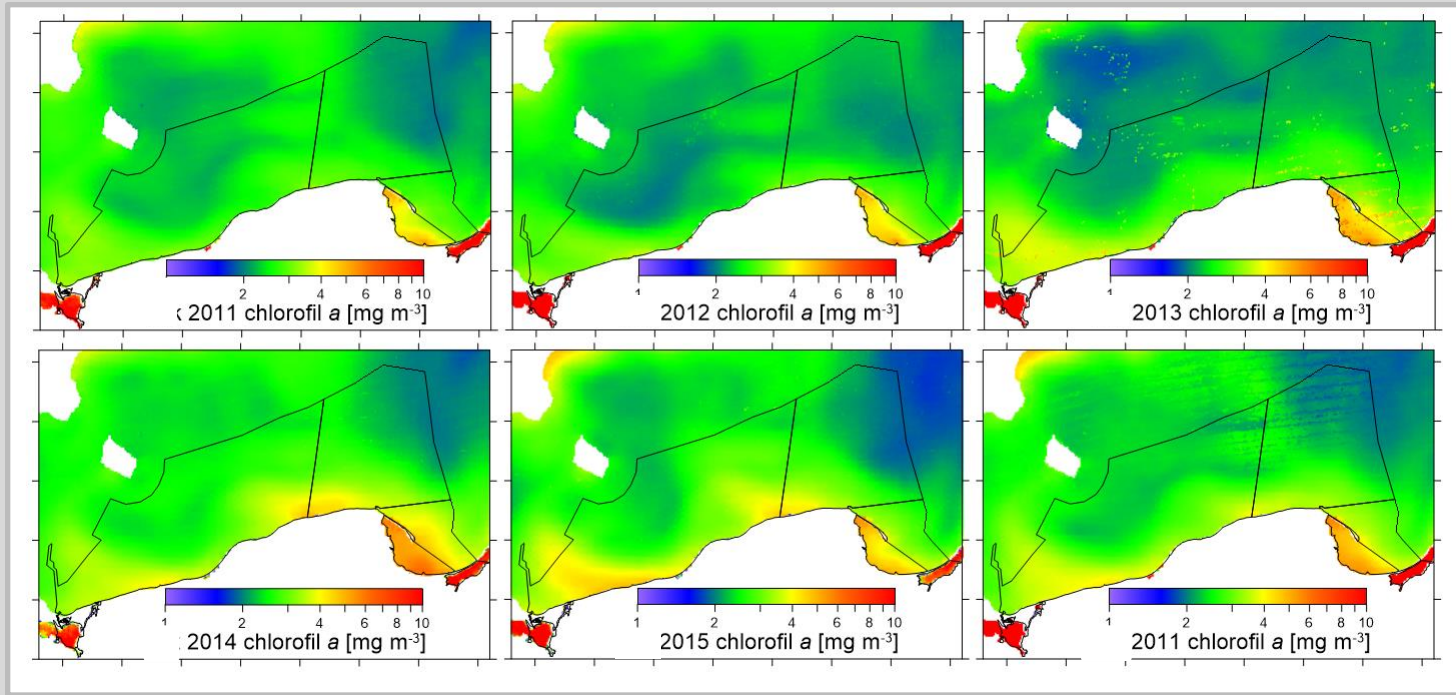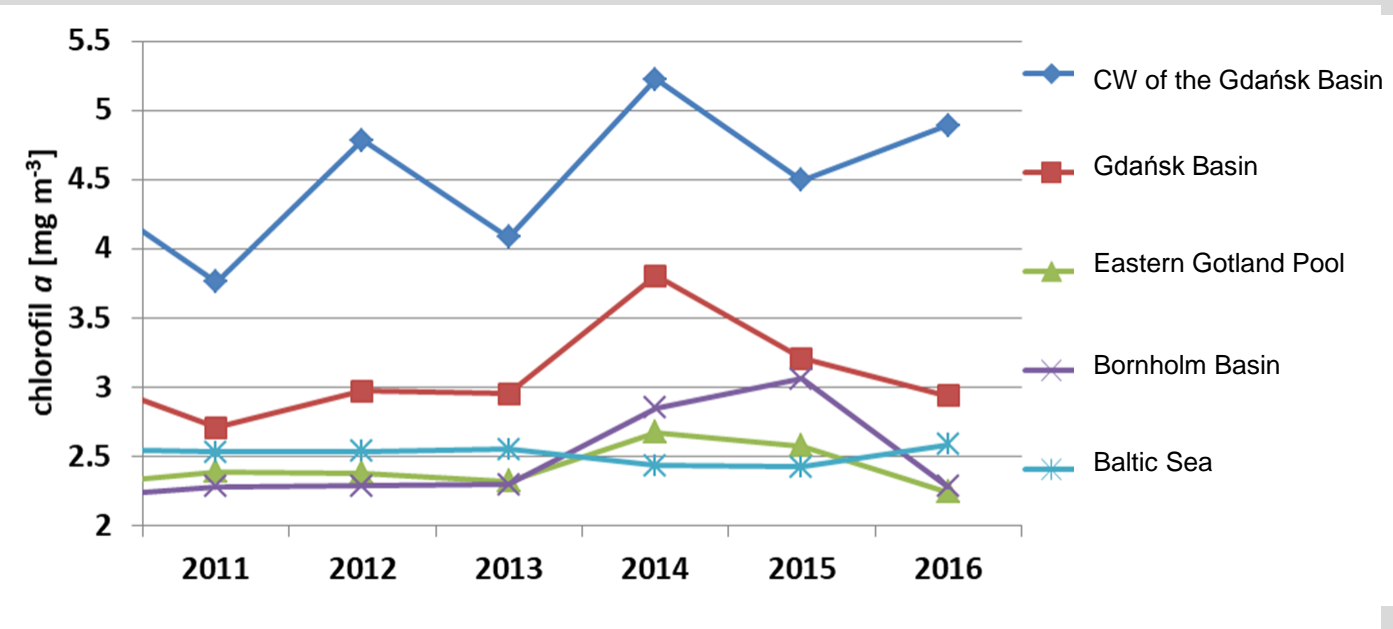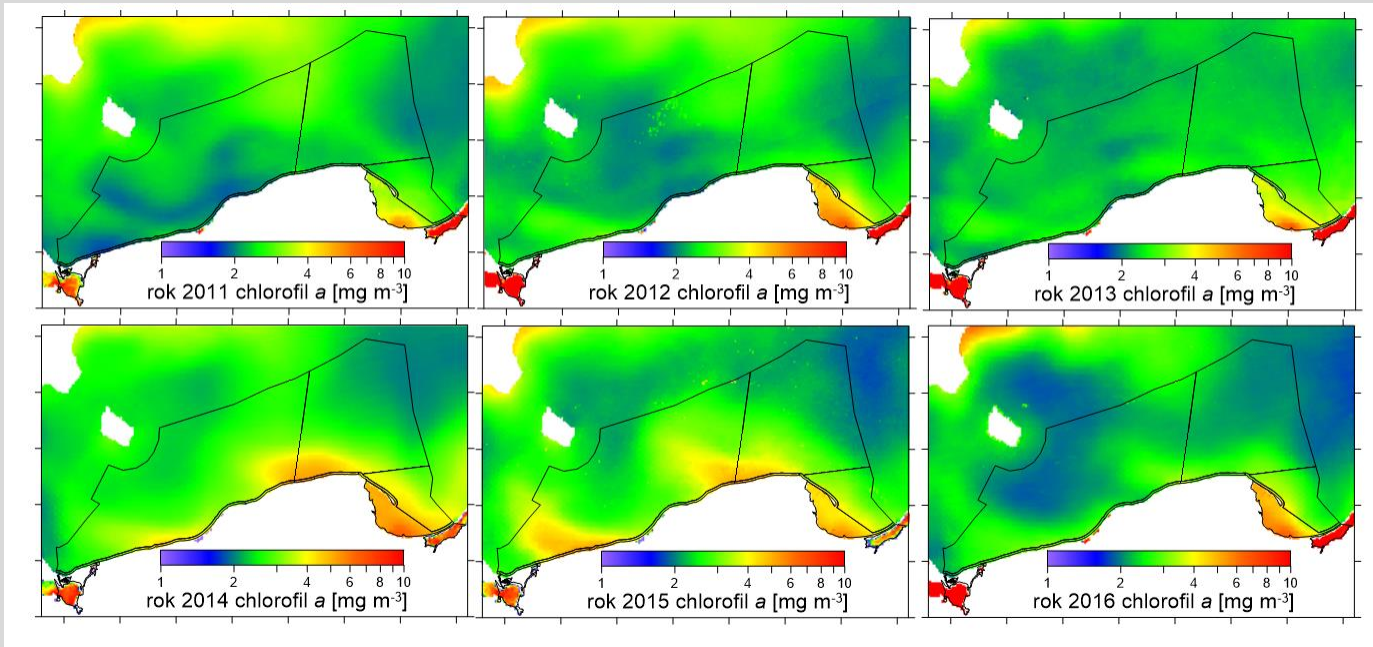Very limited number of measurements per year on some locations

Average SST for years 2011-2016
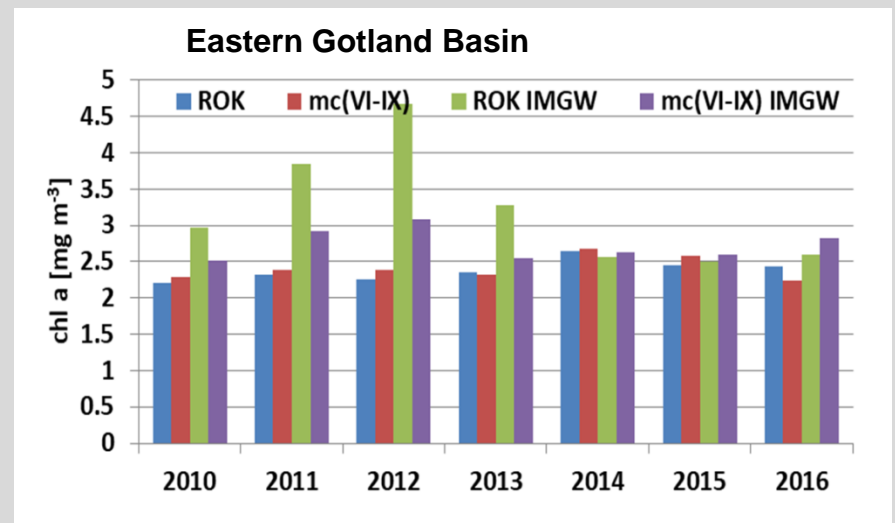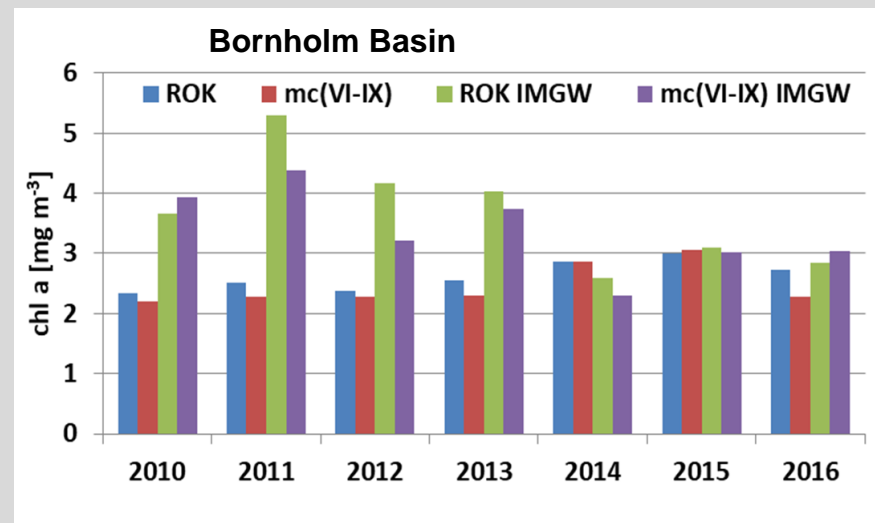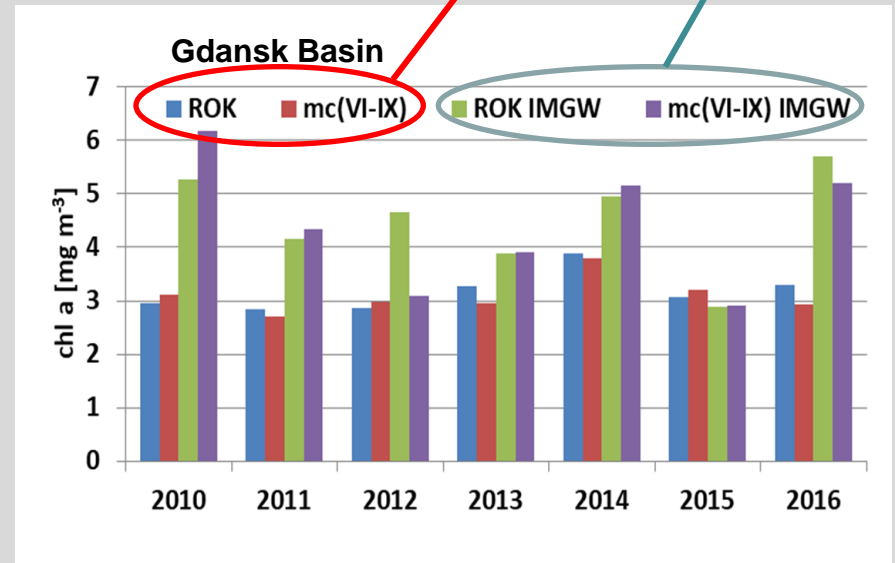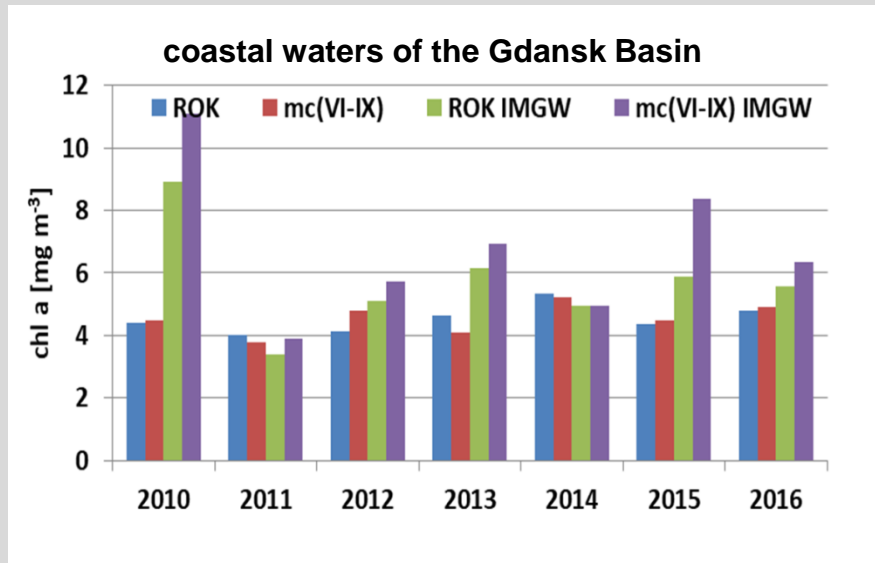
Average SST for the summer in years 2011-2016

Average chlorophyll a concentration for years 2011-2016
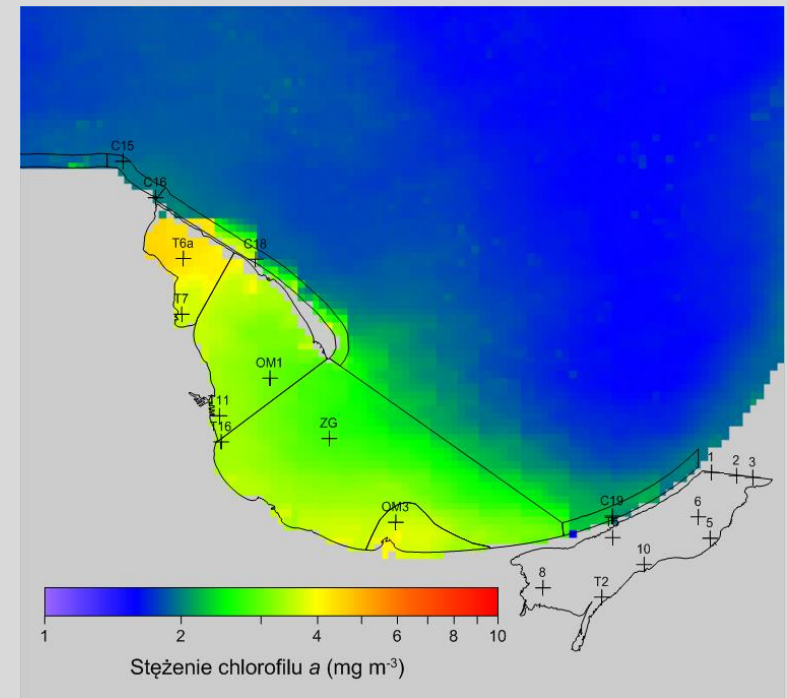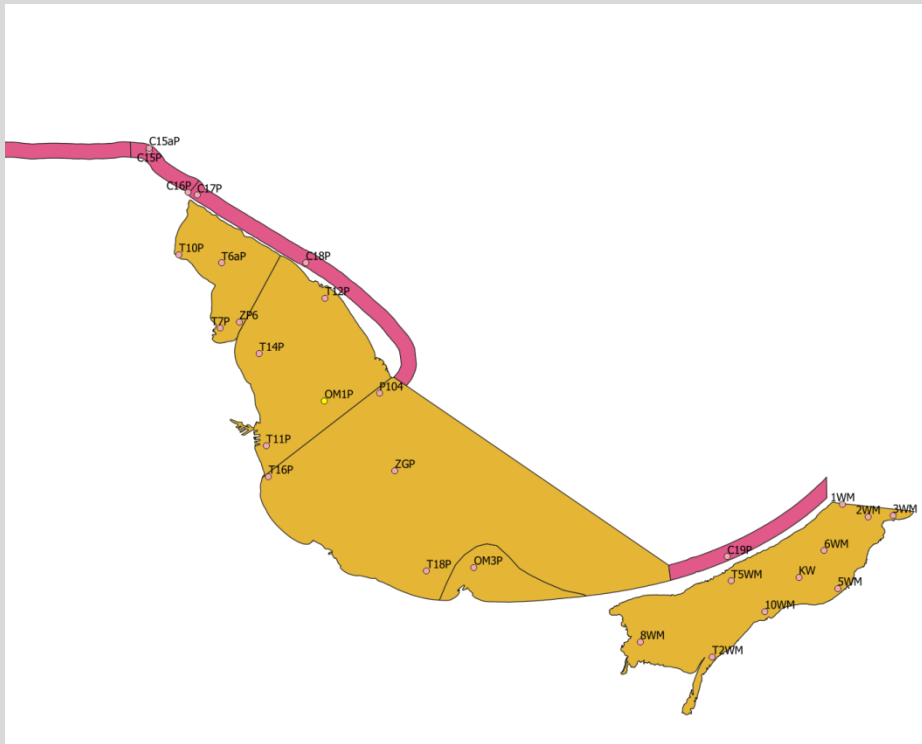
Average summer chlorophyll a concentration for years 2011-2016

Comparison with traditional monitoring

An assessment of representativeness of monitoring stations in transitional and coastal waters
(granted by Inspectorate for Environmental Protection)

Average monthly concentration of chlorophyll a in August 2016 calculated on data from the SatBałtyk System

Analysis of spatial distributions of the coefficient of determination

Spatial distribution of coefficients of determination (R2) of chlorophyll a concentrations, calculated for selected monitoring stations
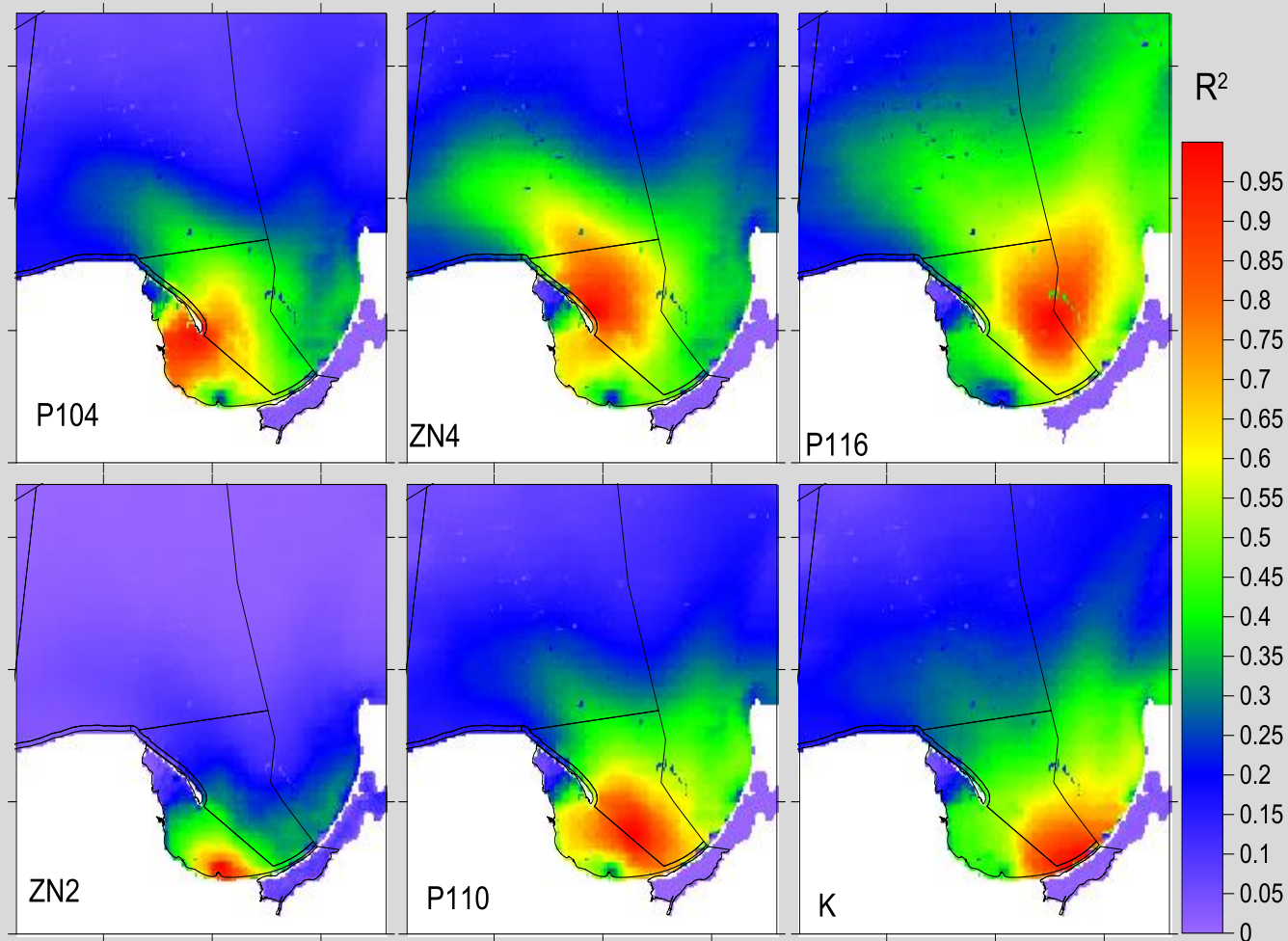
Results of evaluation of the monitoring stations
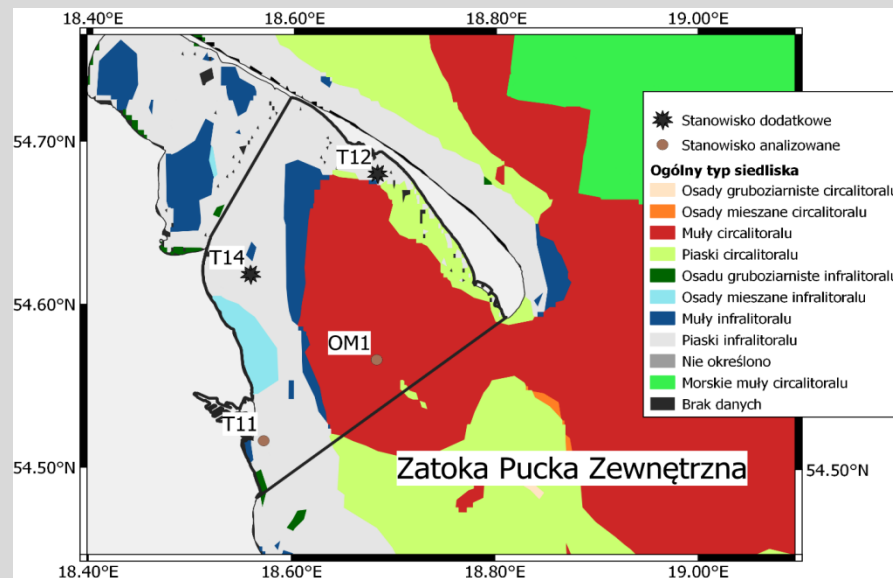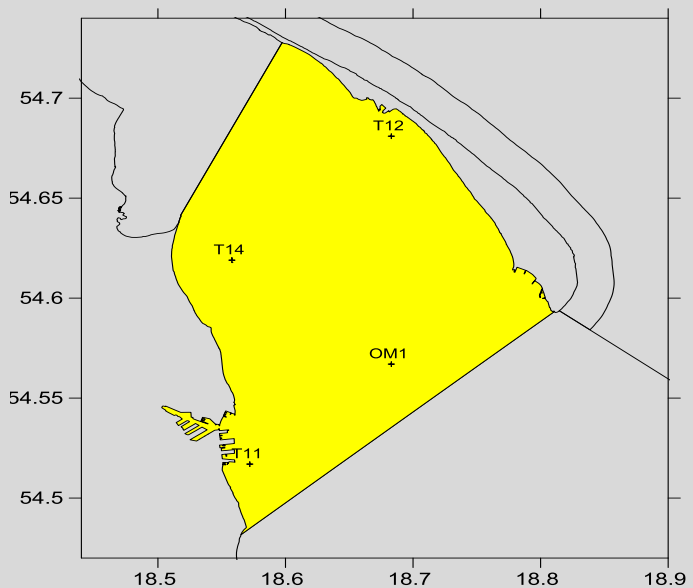## - Puck Bay External

Phytoplankton, existing stations   OM1, T11, T12, T14
- remove T12 and T14

Nutrients, existing stations   OM1, T11, T12, T14
- remove T11

Makrozoobentos, existing stations - T11 and OM1
- no change

Summary

- proposed system/algorithm utilizes the advantages of both satellite and numerical simulation data, while at the same time reducing their errors

- methods can be used in the assessment of the ecosystem health of the Baltic Sea, providing more statistically confirmed results

- data from the system can be also used for validation how in situ monitoring locations are representative for the area

Thank you !

http://www.satbaltyk.pl