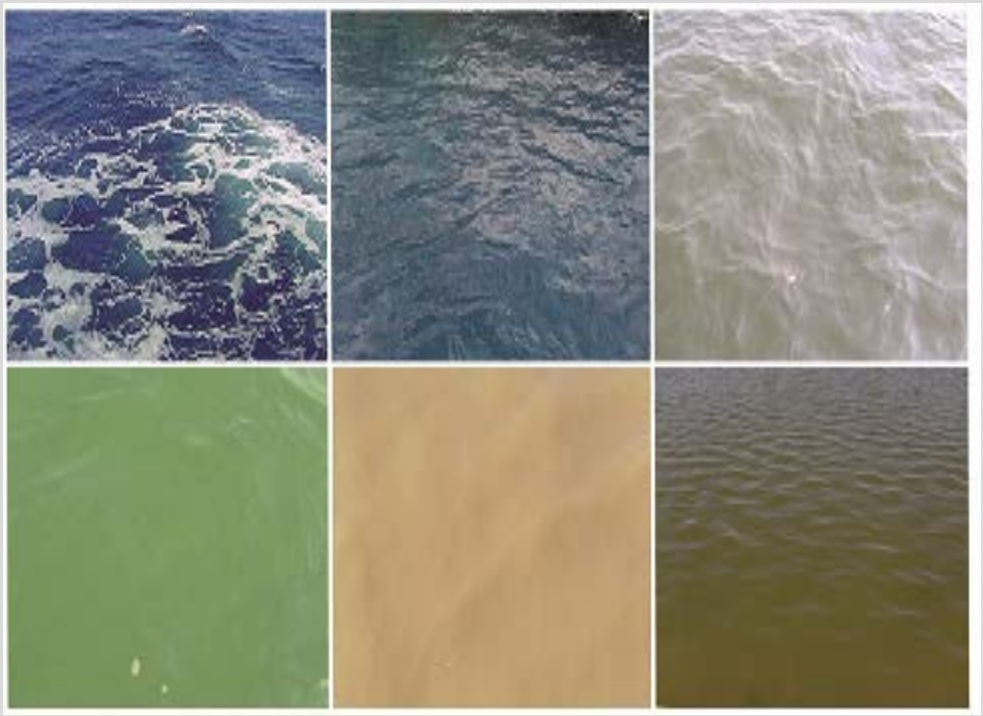
SatBaltyk System

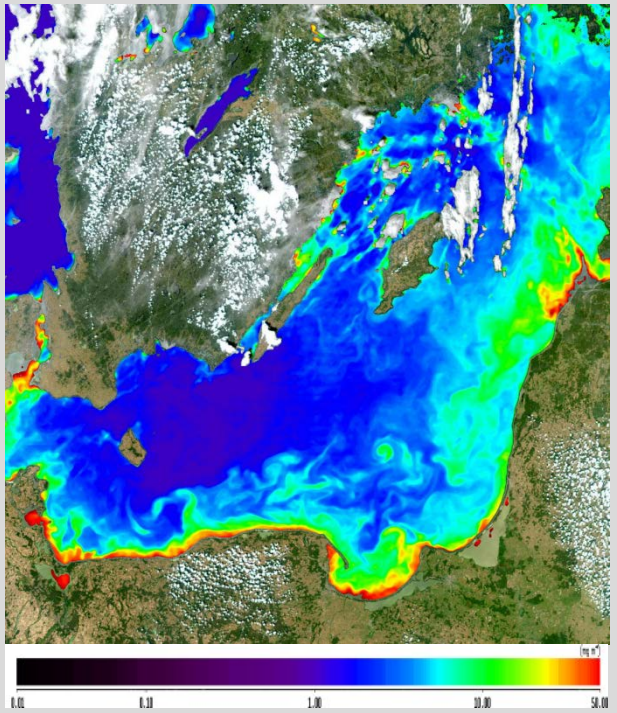
Mirosław Darecki

Institute of Oceanology Polish Academy of Sciences
Sopot

Ocean color:
observing ocean color from space



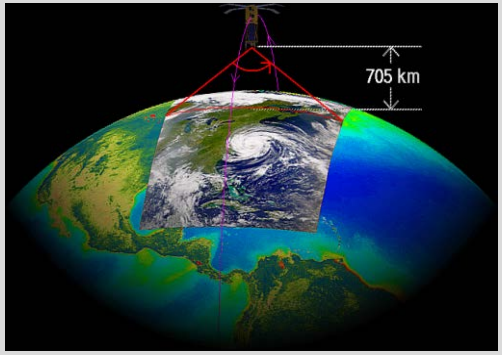
Observing ⇨ measuring ocean from space

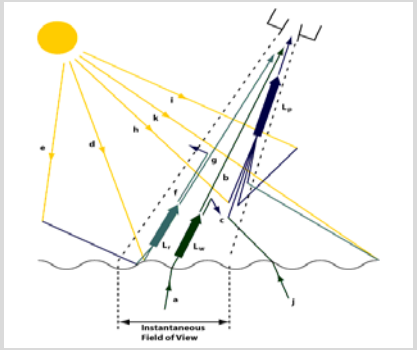


Satellite true color image

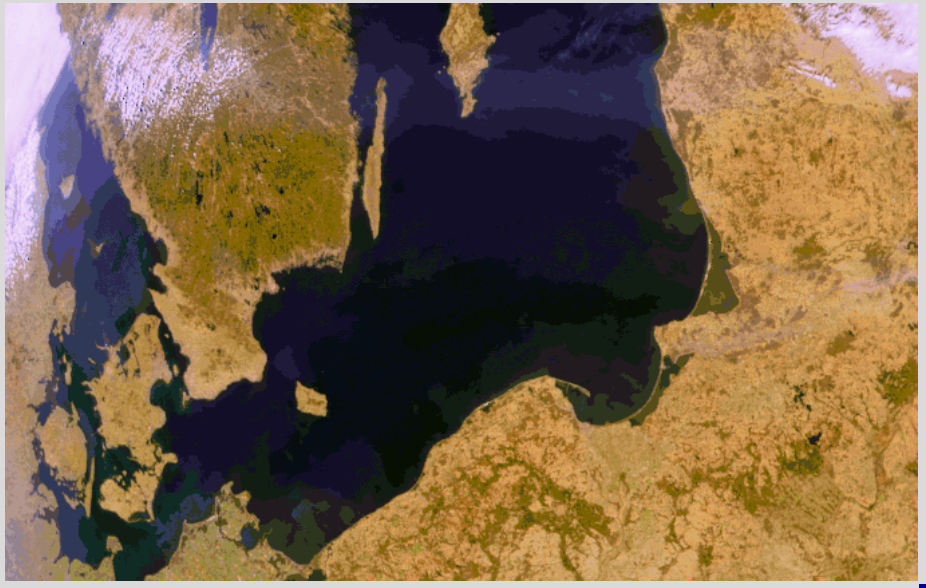
Chlorophyll a spatial variability

Satellite radiometry

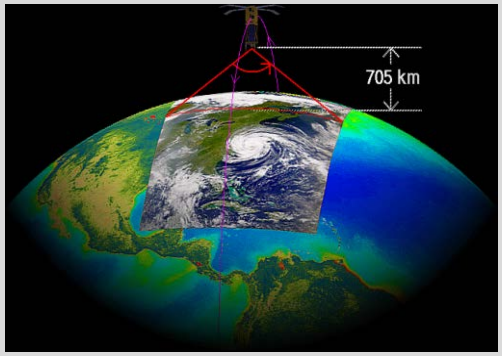


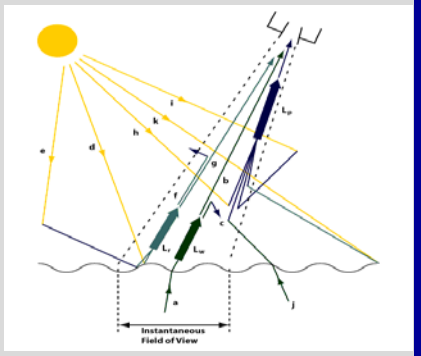


Satellite radiometry

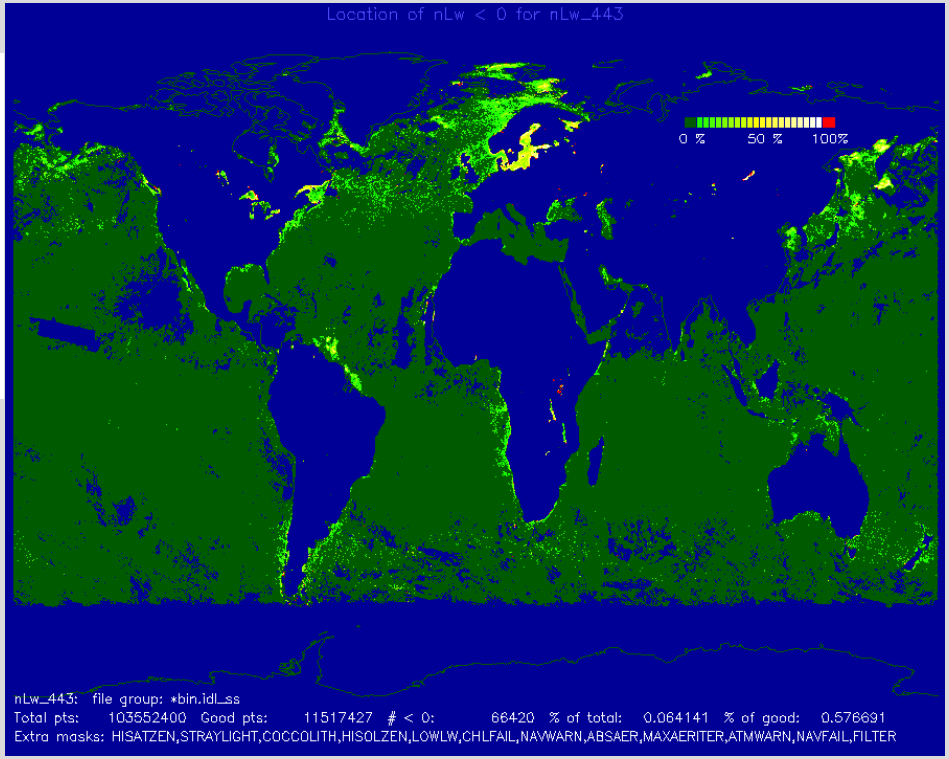


Baltic Sea – difficult target for ocean color remote sensing

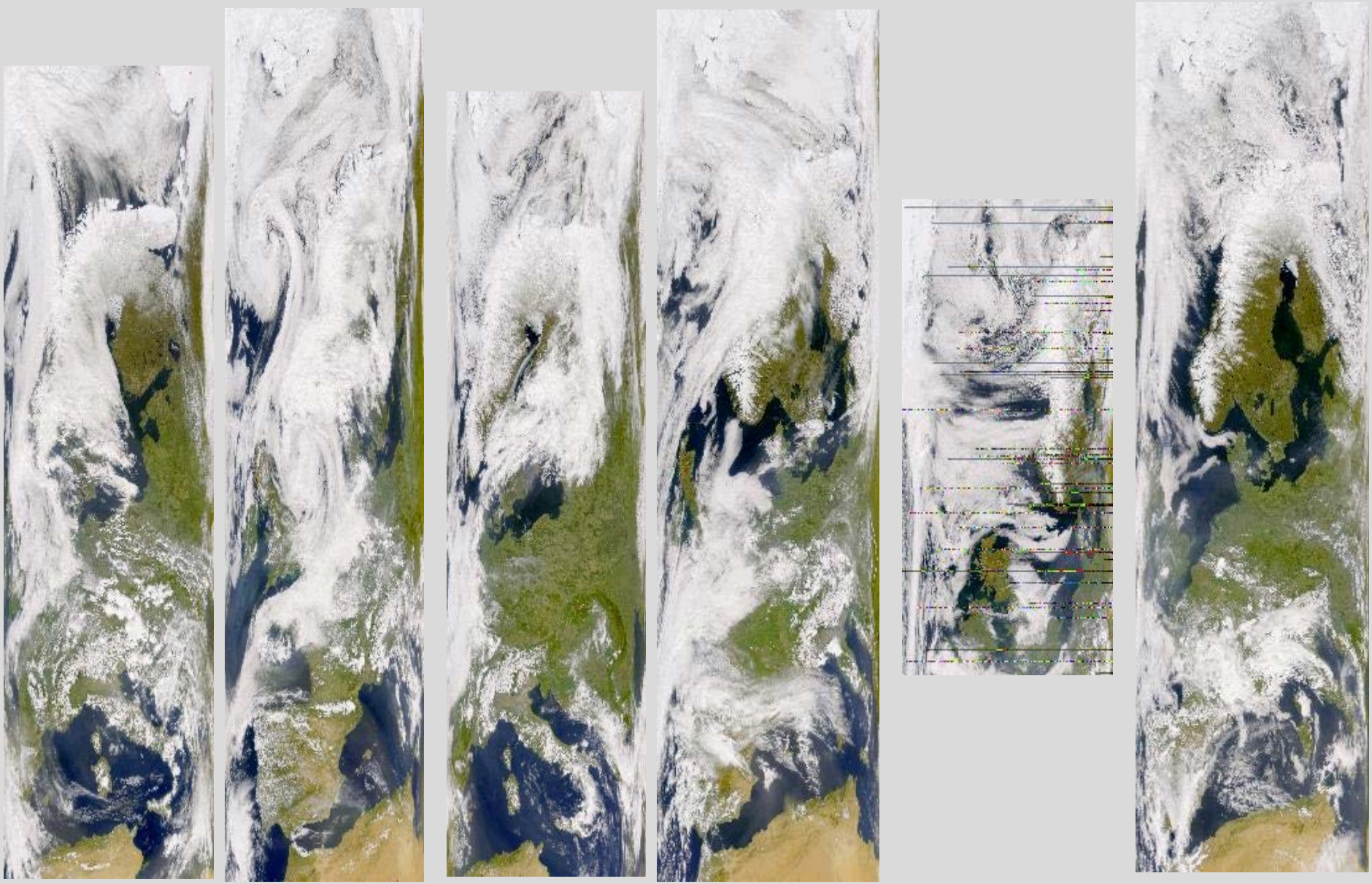




Problems with atmospheric correction
e.g. % of nLw(443nm) <0
after last reprocessing

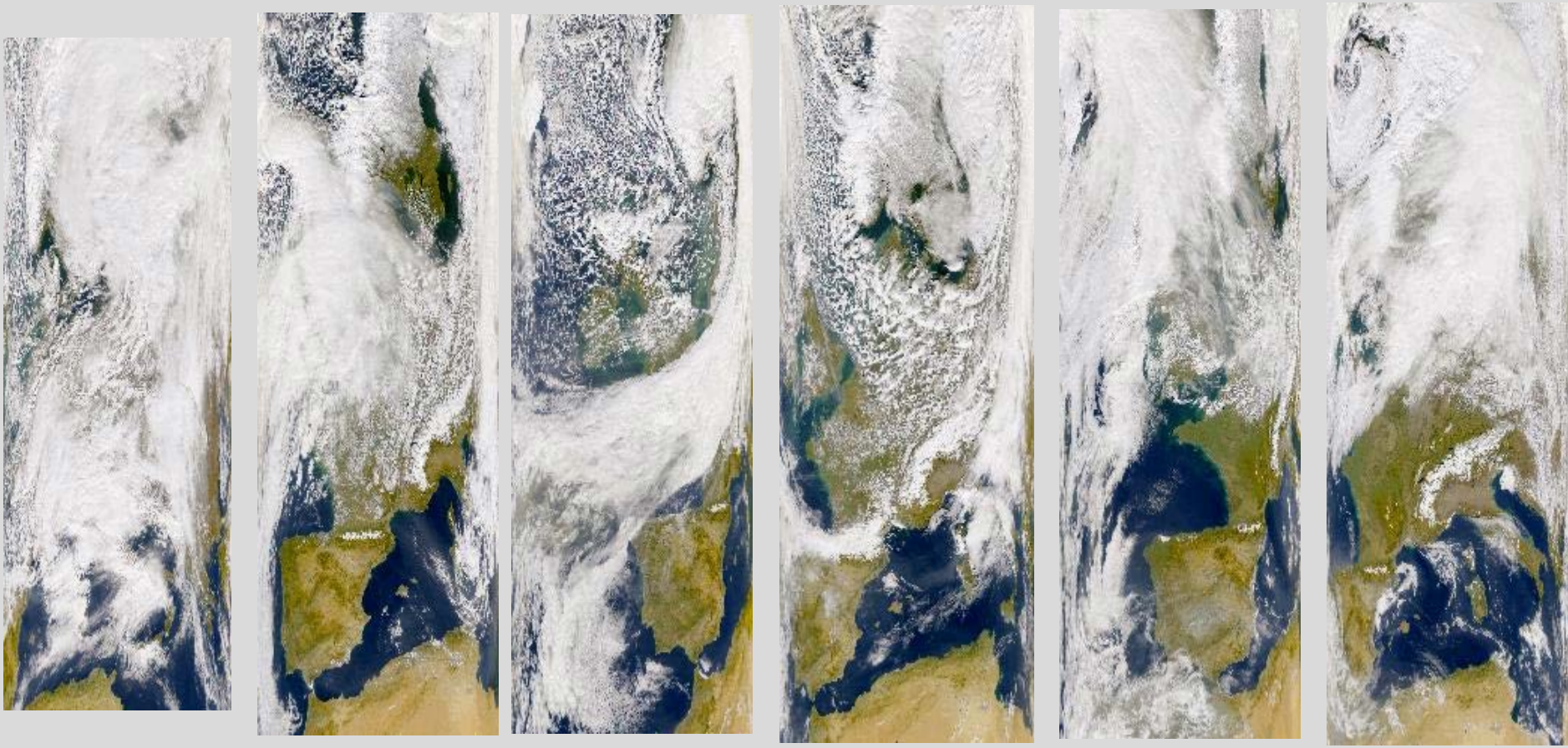


Baltic, one week in May



‘One’ week in March

Baltic Sea – difficult target for ocean color remote sensing

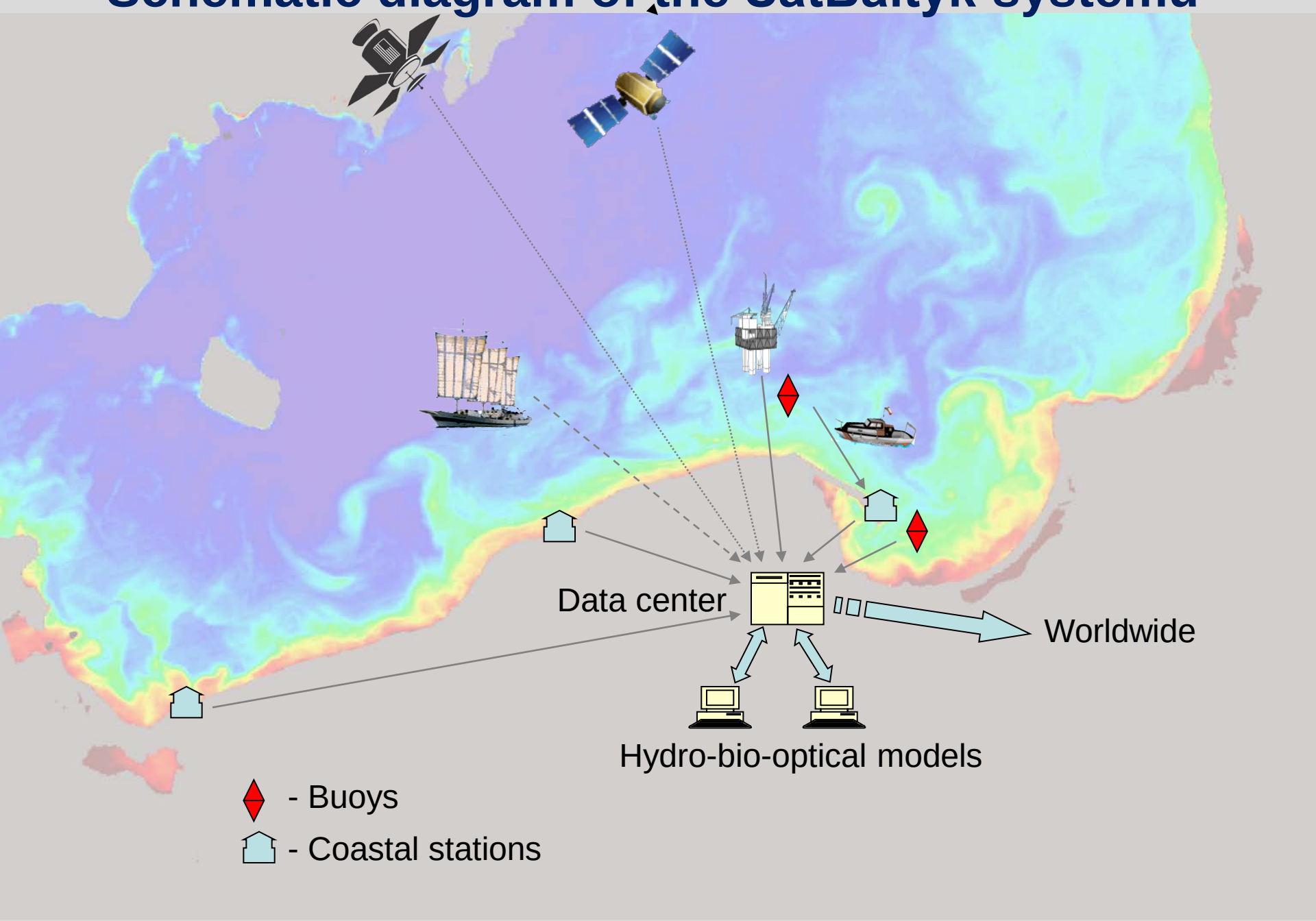


SatBaltic: – A BALTIC ENVIRONMENTAL SATELLITE REMOTE SENSING SYSTEM

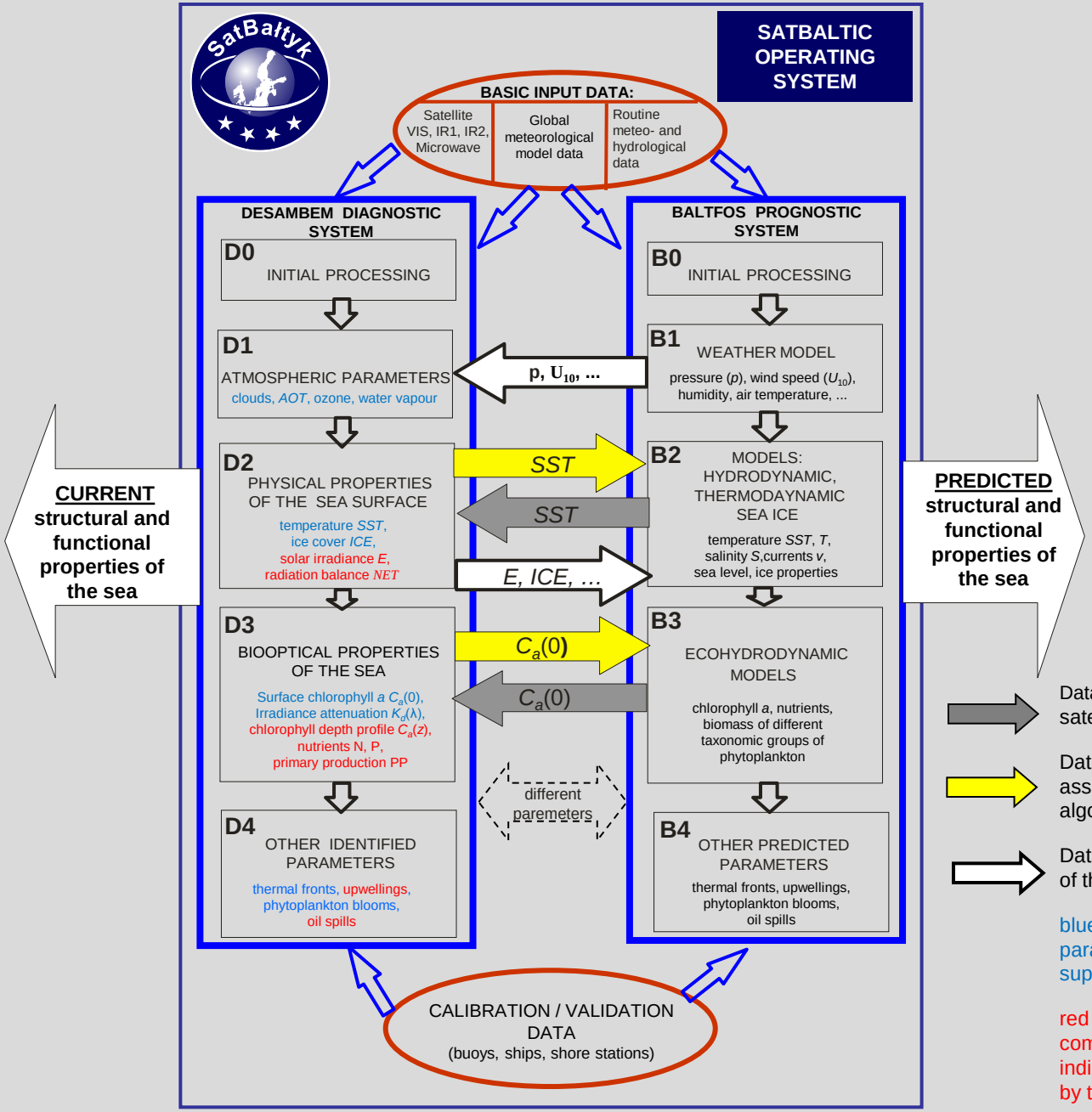
The aim of project:

Establish monitoring system for the Baltic Sea, based on the satellite remote sensing data and eco-hydrodynamical models

Schematic diagram of the SatBałtyk systemu



Block diagram of the SatBaltic Operating System



Data transfer for an overcast sky (lack of satellite data for the DESAMBEM algorithm)

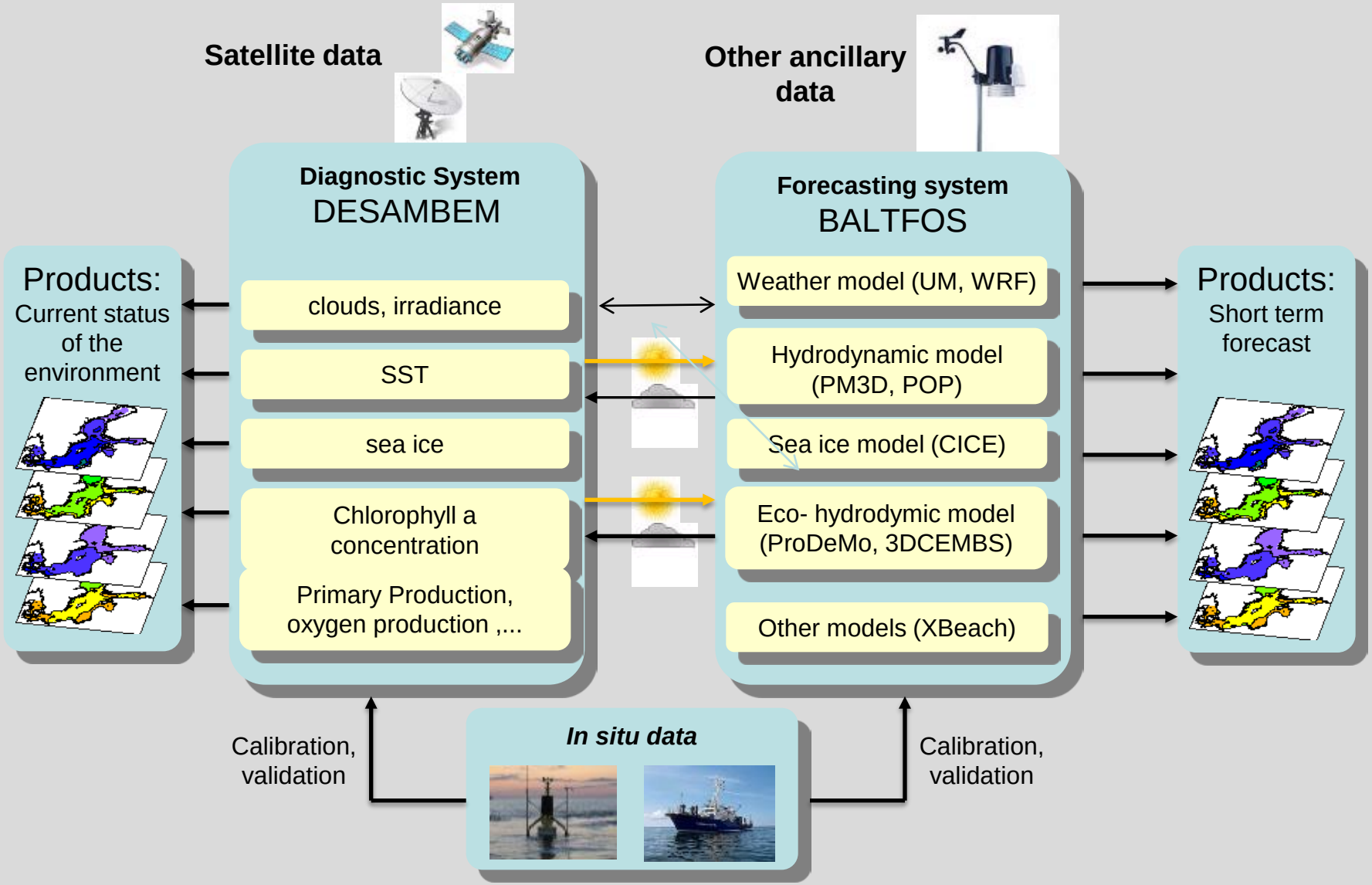
Data transfer for a cloudless sky (data assimilation to improved the ECOSAT algorithm)

Data transfer always required to make the most of the DESAMBEM and ECOSAT algorithms

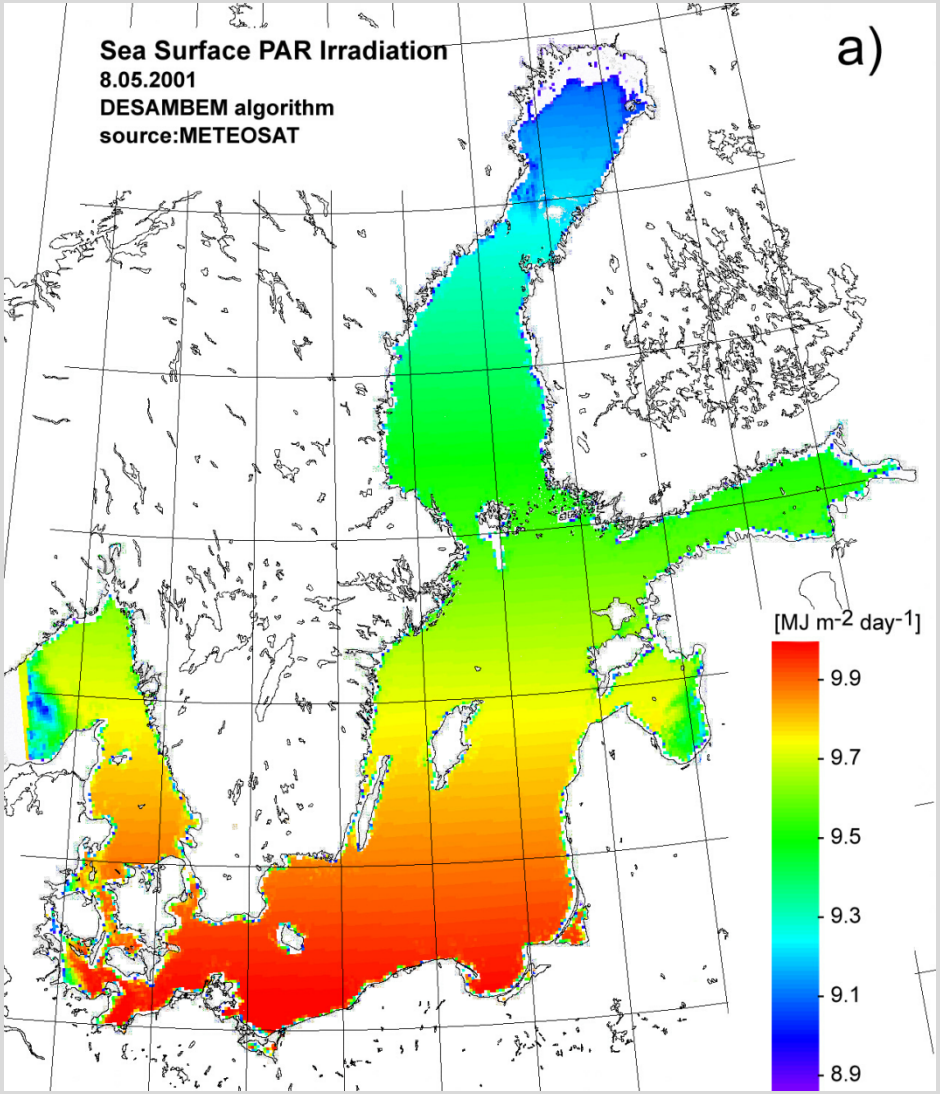
blue letters in the description denote parameters computed directly from data supplied by one satellite

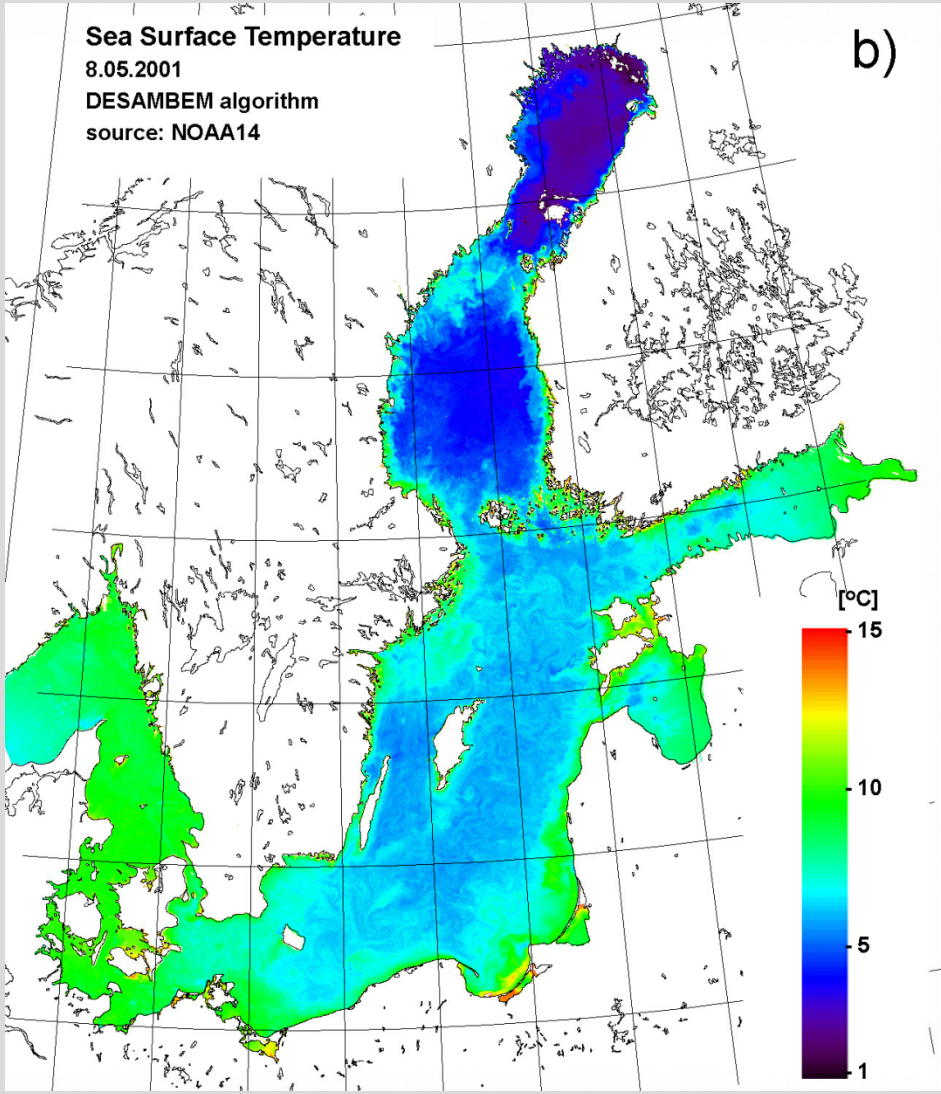
red letters in the description denote parameters computed from data supplied directly or indirectly by several satellite sources, and / or by the SatBaltic System

SatBałtyk - data streams

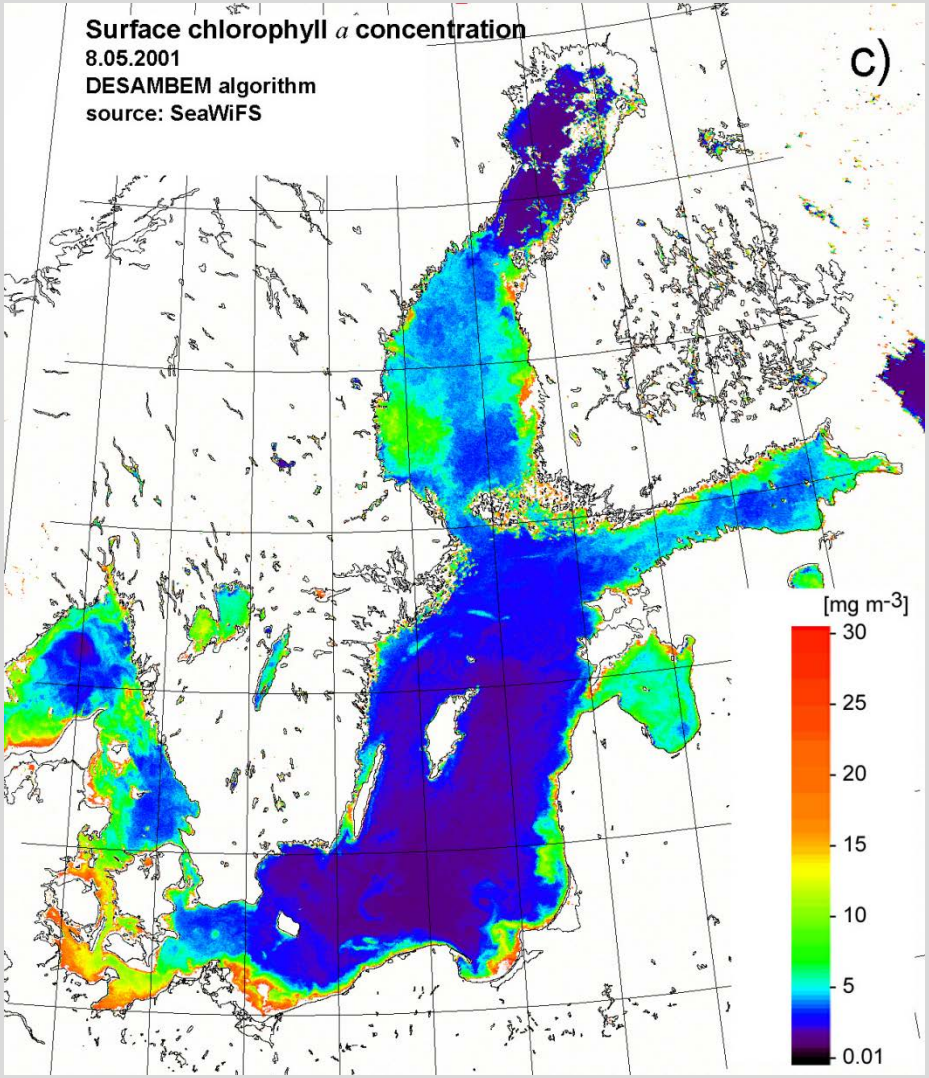


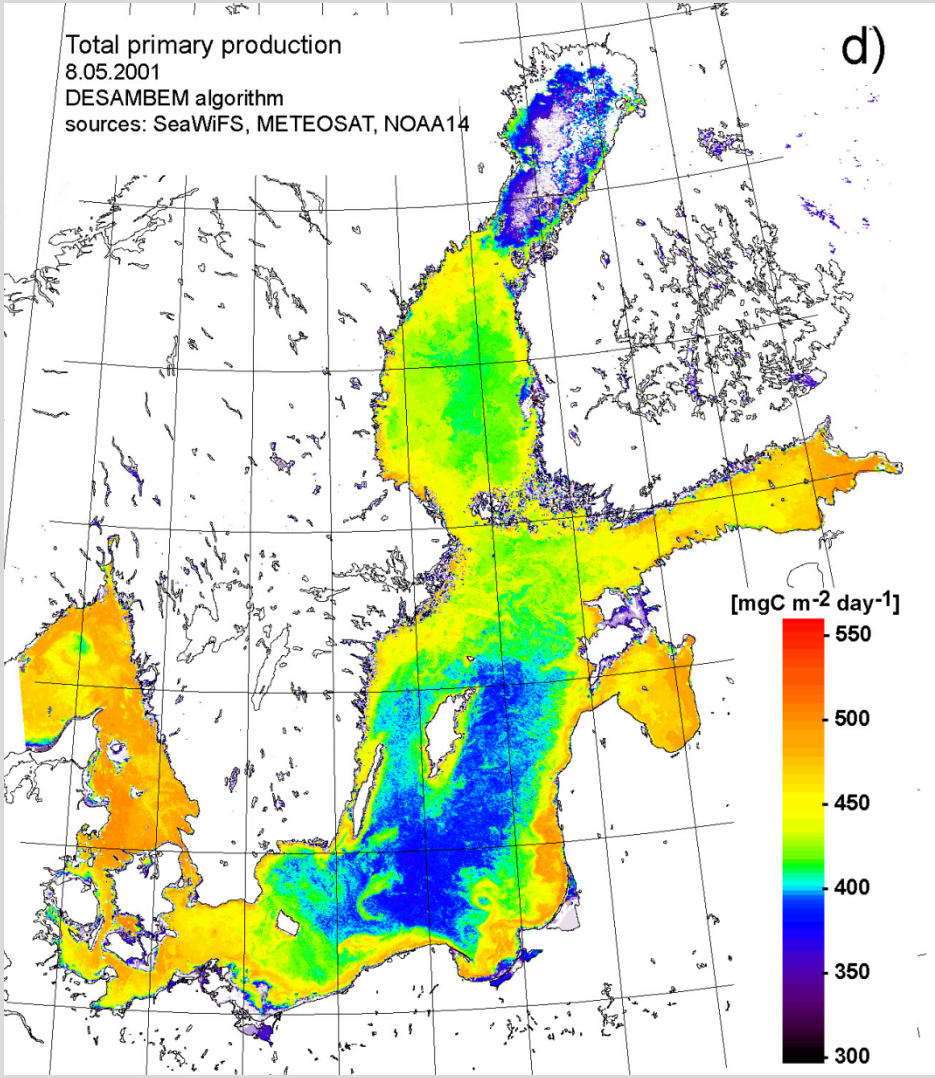
PAR and SST


Sea Surface PAR Irradiation
8.05.2001
DESAMBEM algorithm
source:METEOSAT
a)
[MJ m-2 day-1]
9.9
9.7
9.5
9.3
9.1
8.9

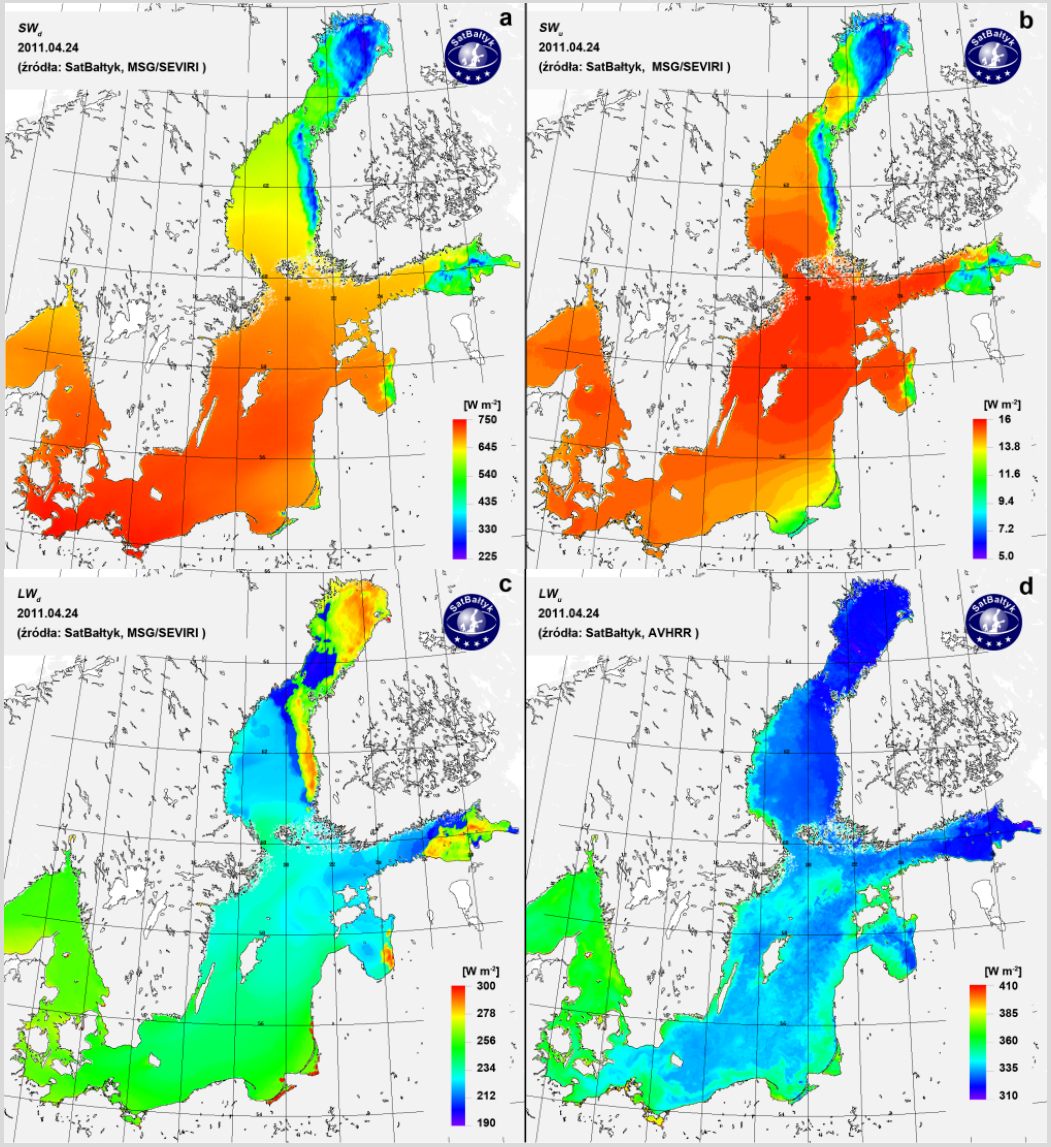

Sea Surface Temperature
8.05.2001
DESAMBEM algorithm
source: NOAA14
b)
[°C]
15
10
5
1

Chl*a and PP*

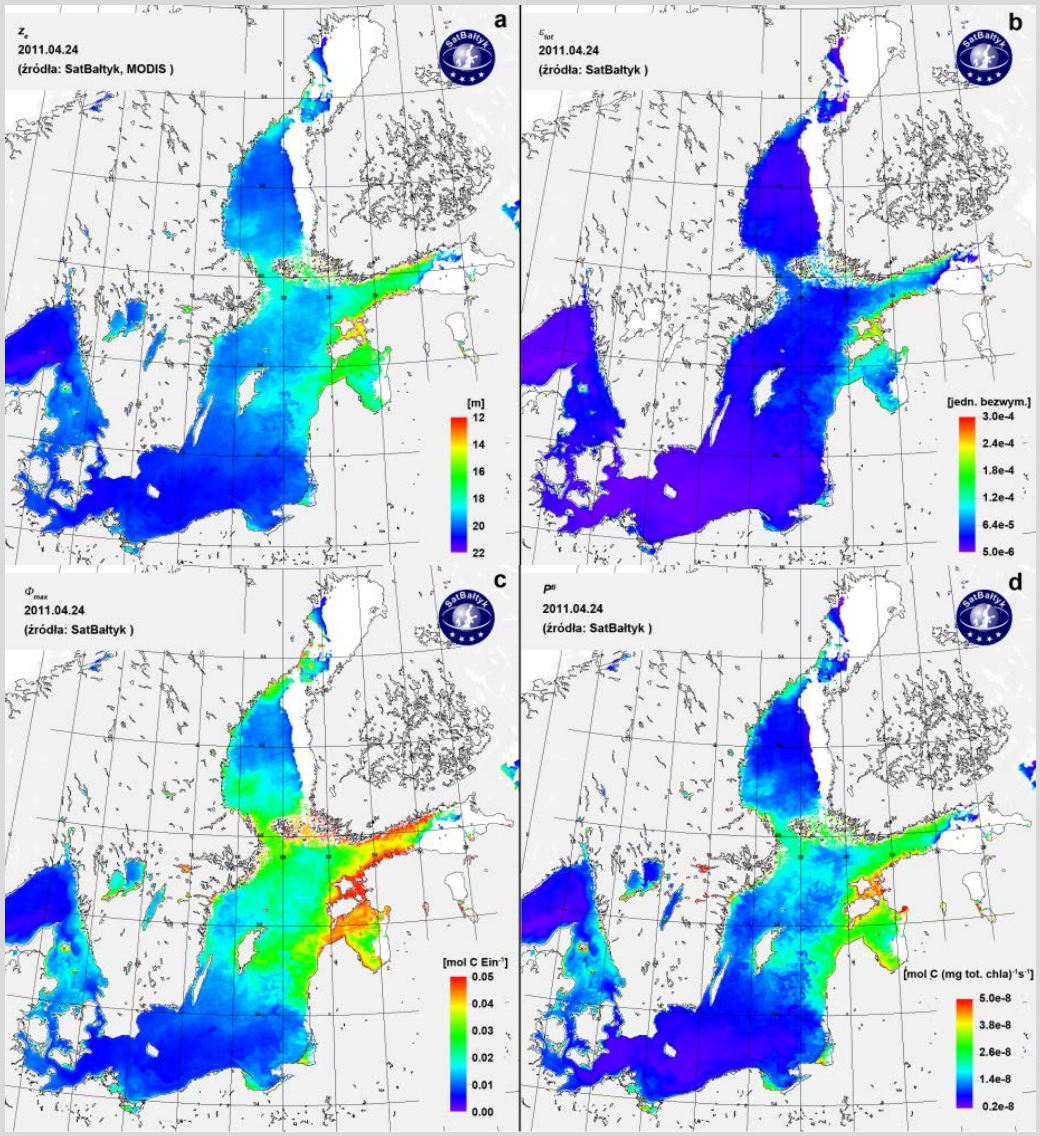

Surface chlorophyll a concentration
8.05.2001
DESAMBEM algorithm
source: SeaWiFS
c)
[mg m-3]
30
25
20
15
10
5
0.01


Total primary production
8.05.2001
DESAMBEM algorithm
sources: SeaWiFS, METEOSAT, NOAA14
d)
[mgC m-2 day-1]
550
500
450
400
350
300

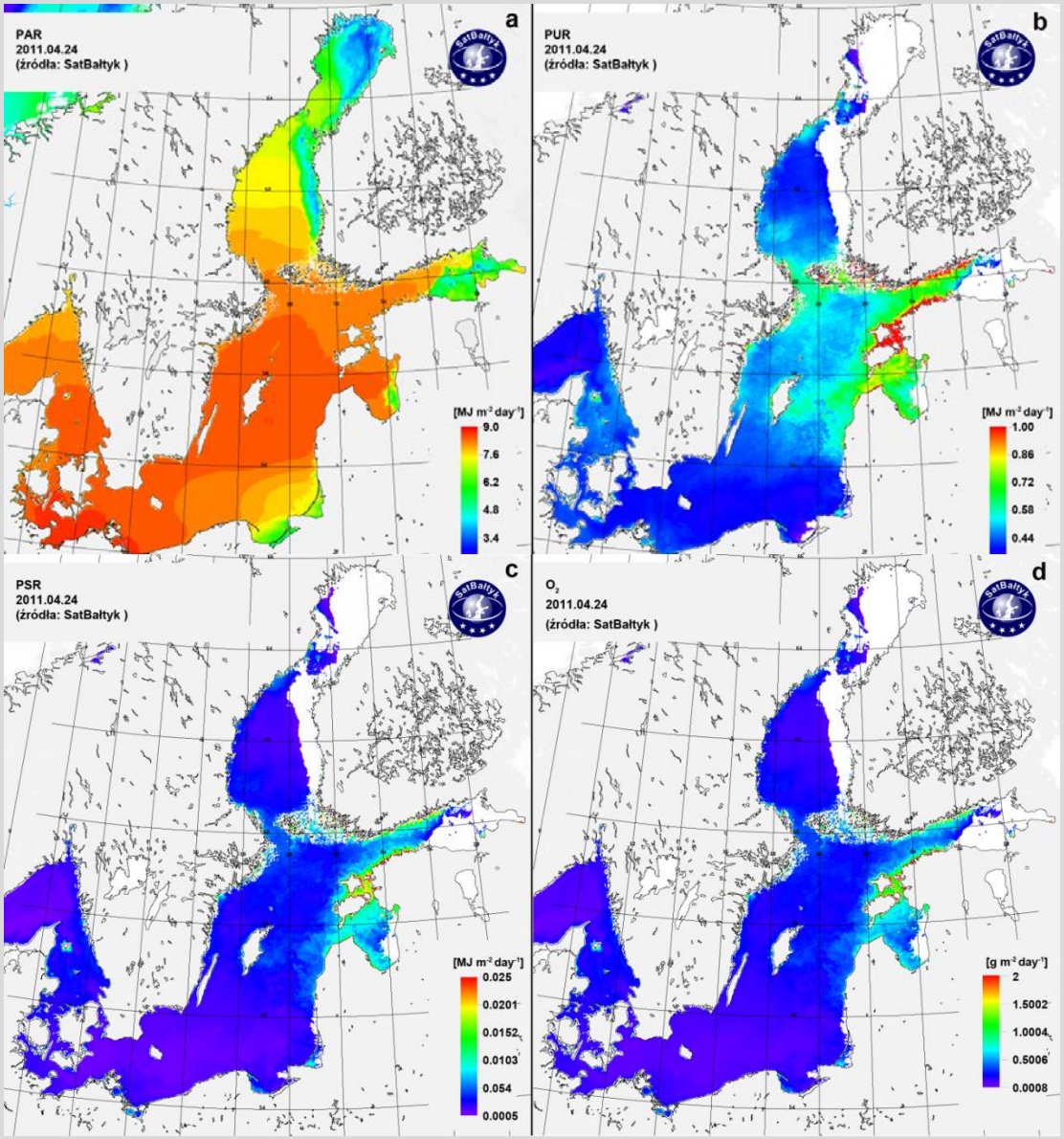
The radiation balance of the sea surface



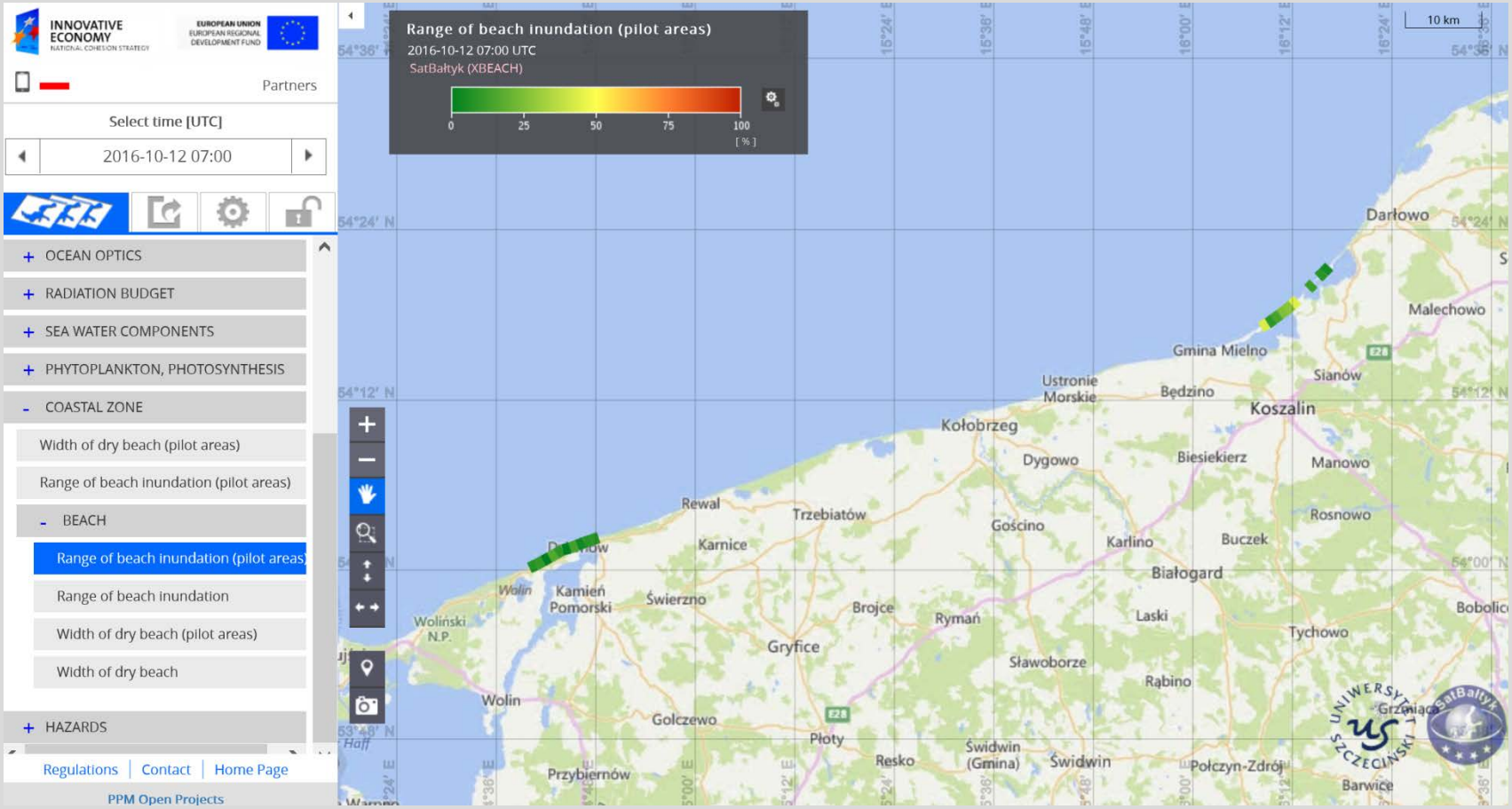
Some optical conditions of photosynthesis of organic matter and condition of marine plant communities



Distribution of the solar radiation energy consumed during various processes in the atmosphere-sea system.



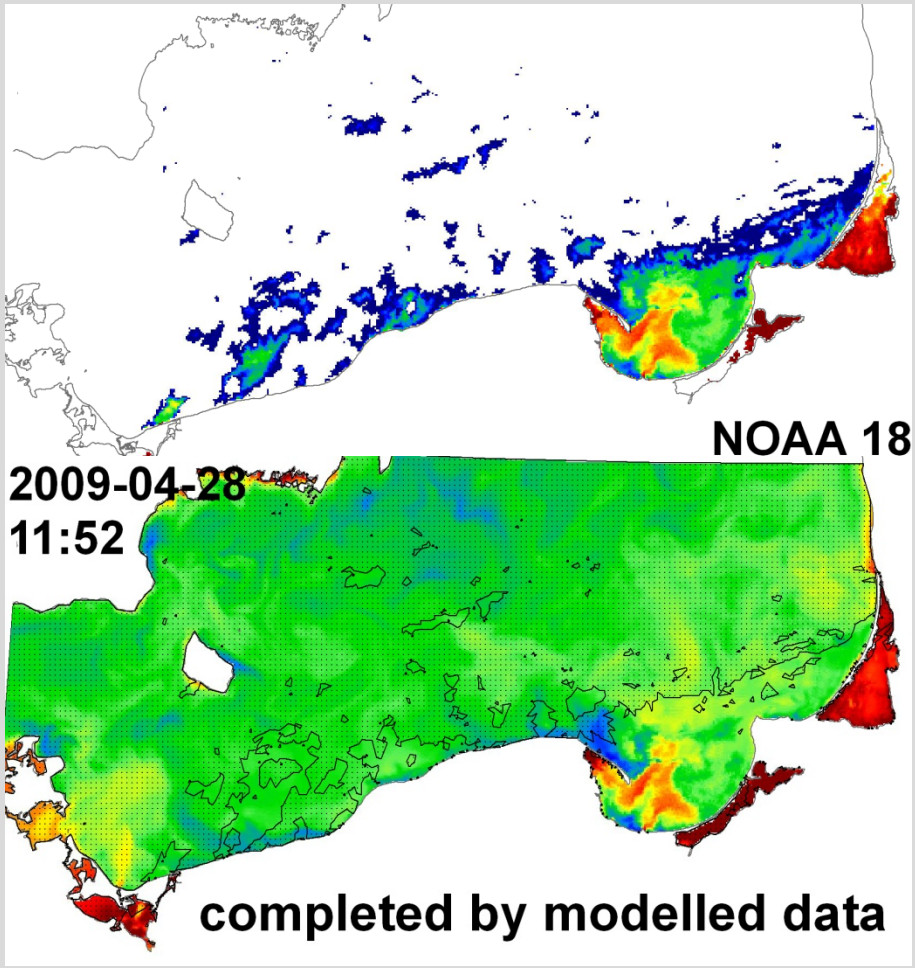
Parameters related to the coastline

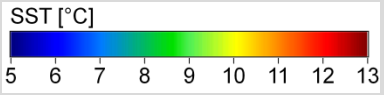


Merging satellite data with modelled data

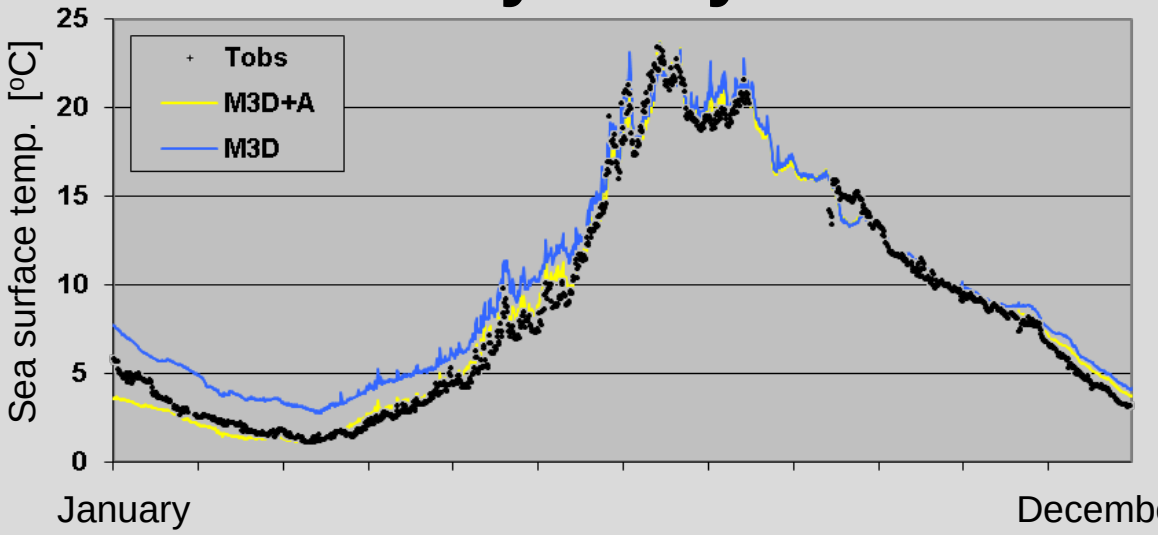
Sea Surface Temperature

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

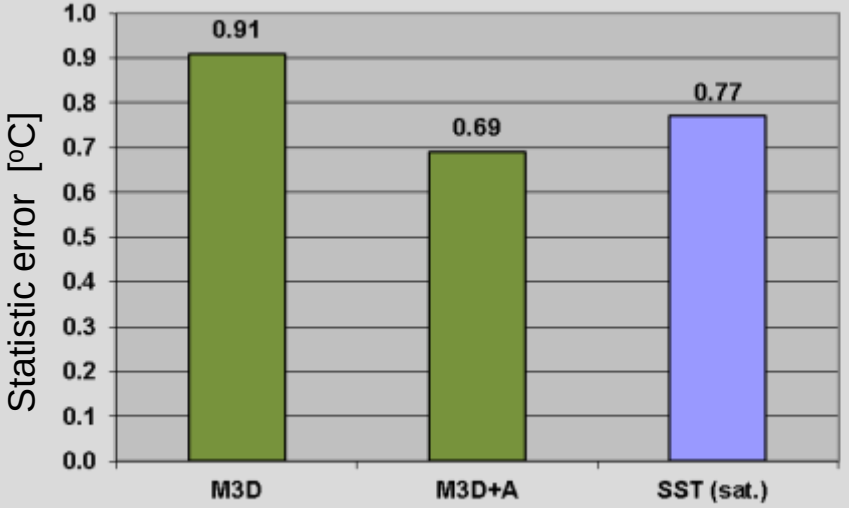




Assimilation of the satellite data in the hydrodynamic model

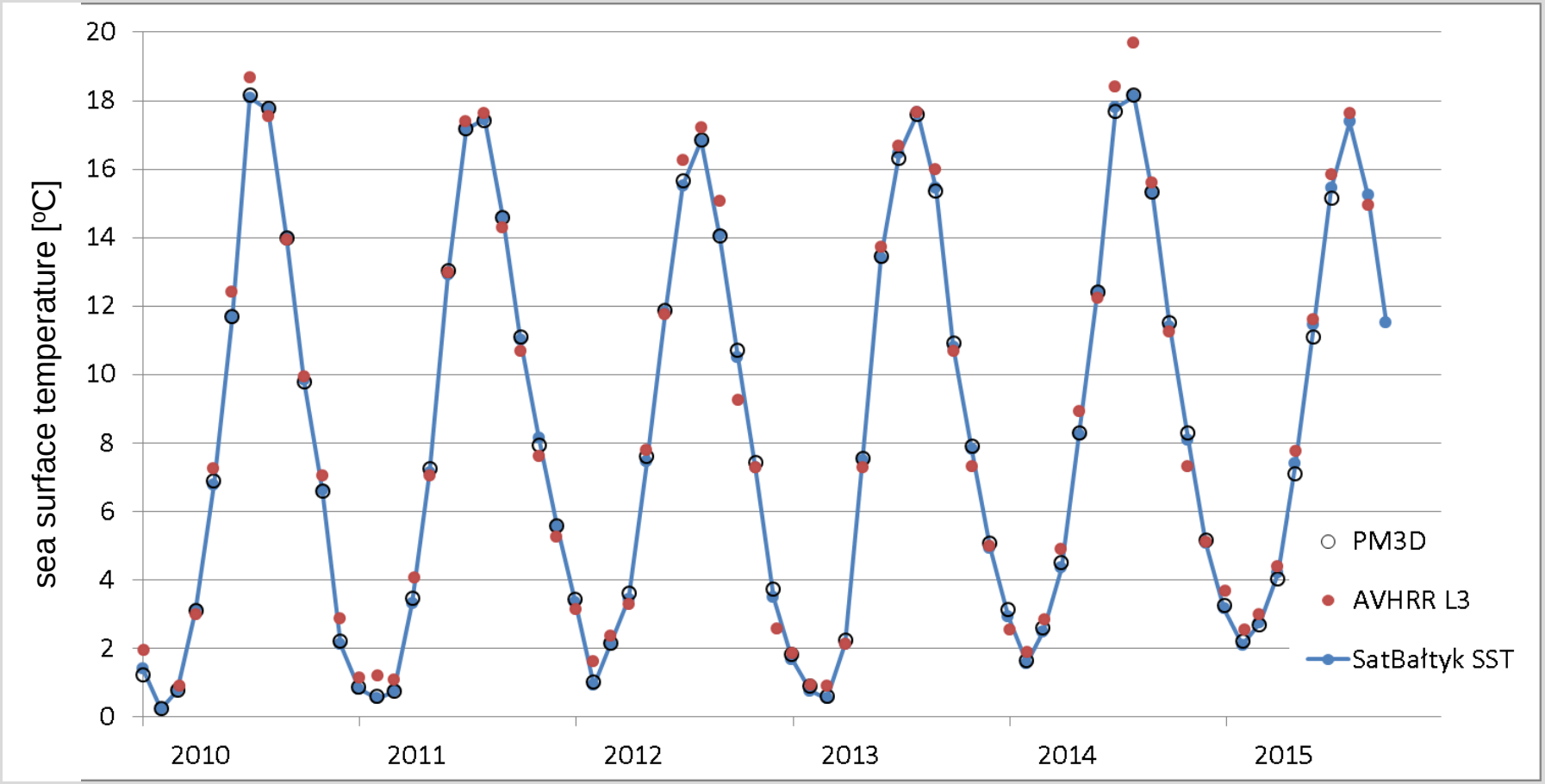


Comparison of sea surface temperatures observed in the southern part of the Baltic Sea and modeled with assimilation of satellite SST maps (M3D + A) and without assimilation (M3D)



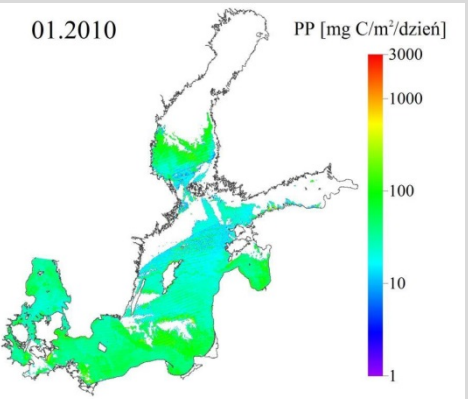
Variability of the sea surface temperature in the Baltic

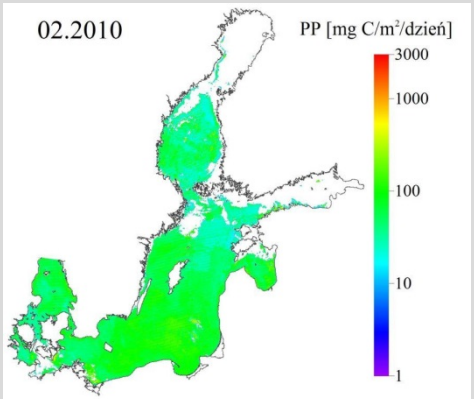
Monthly averages of the sea surface temperature based on PM3D model, satellite AVHRR and merged SatBaltyk product

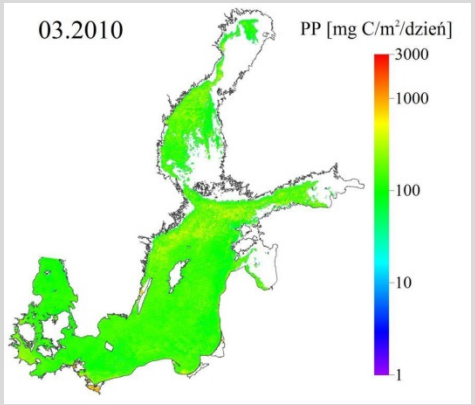


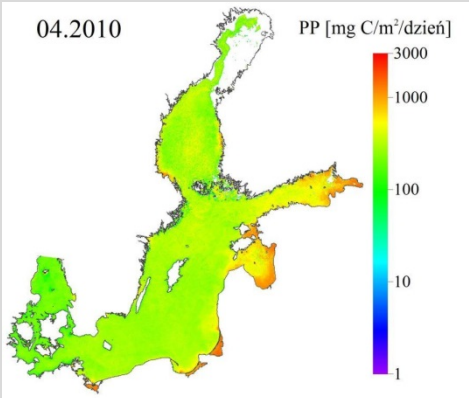
System components, calibration and validation

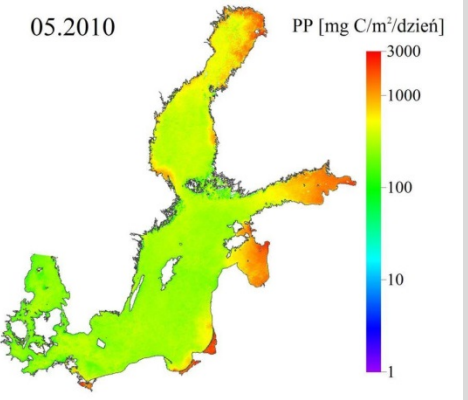
Monthly averages of daily primary production in 2010

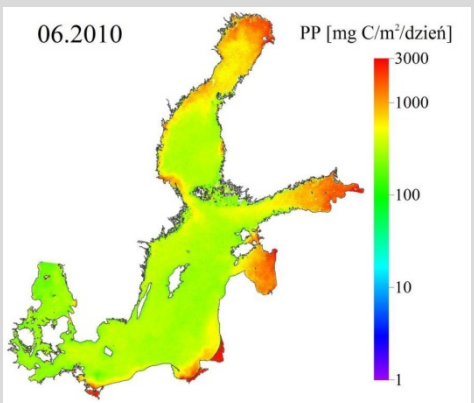


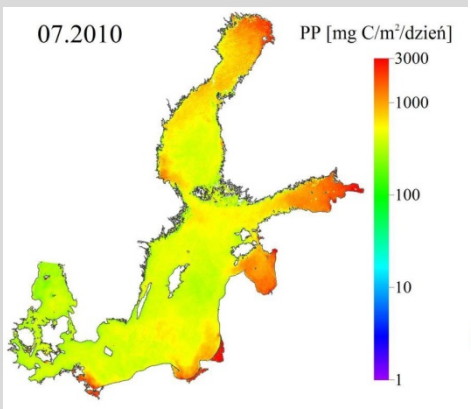


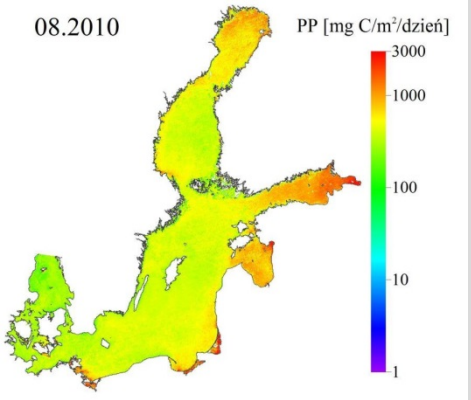


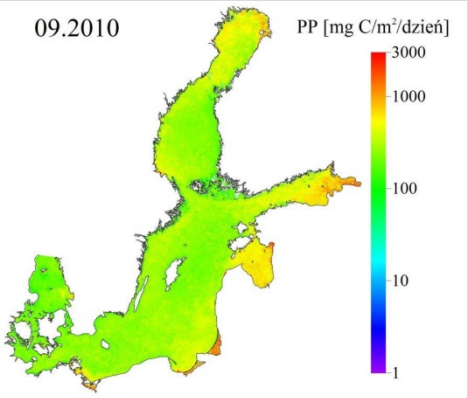


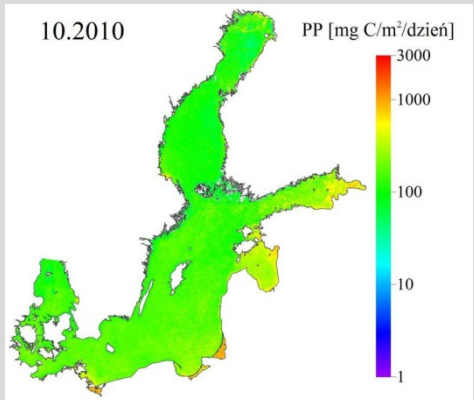


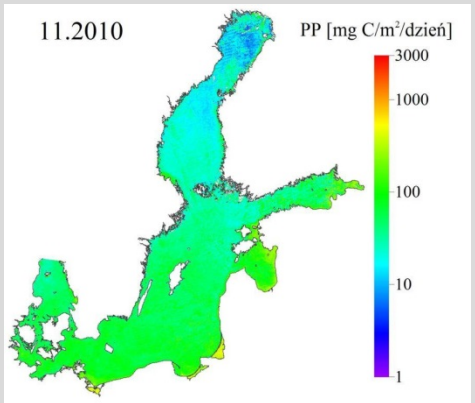


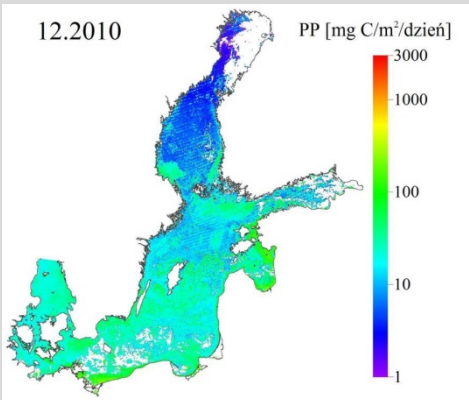




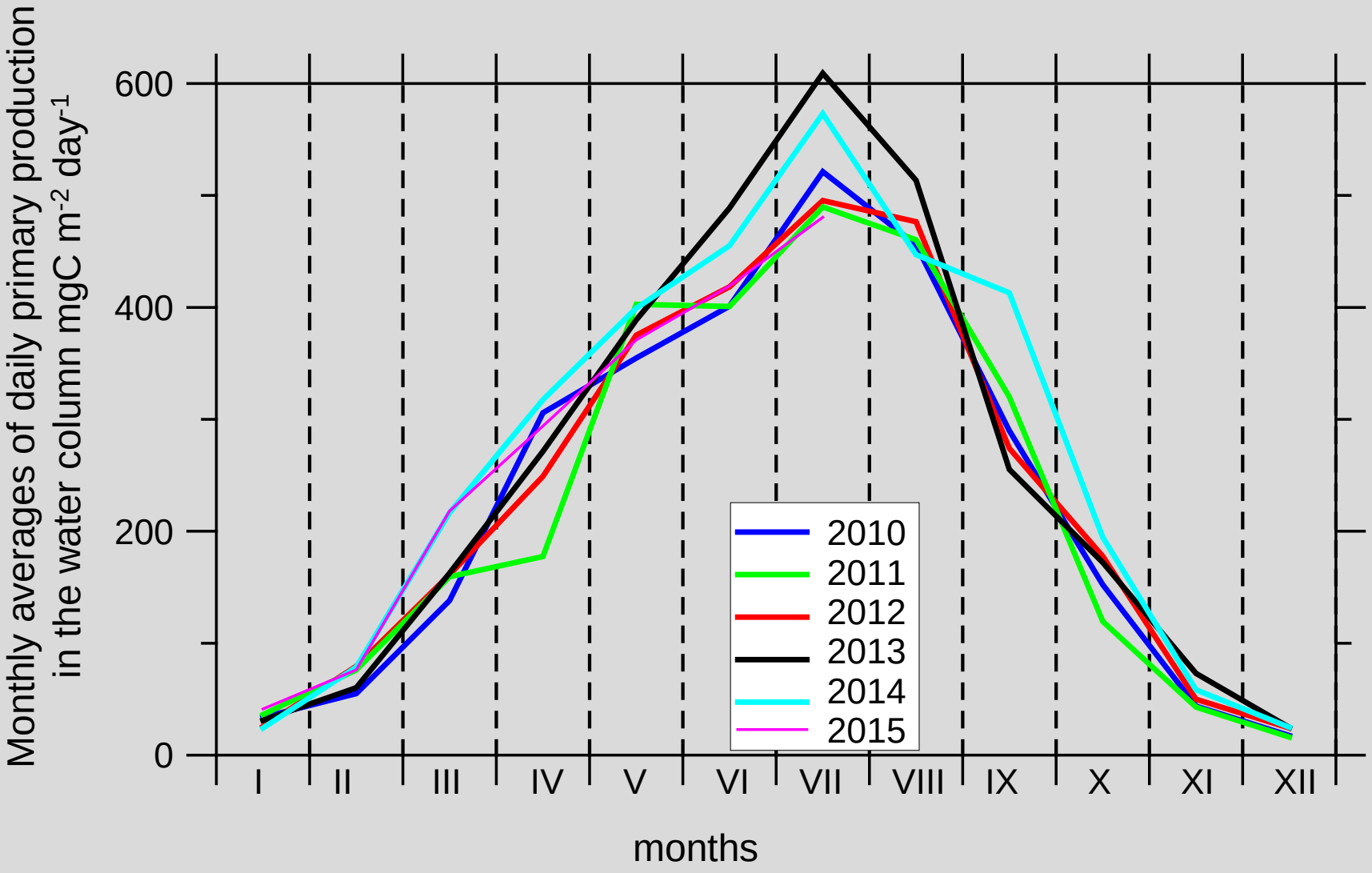




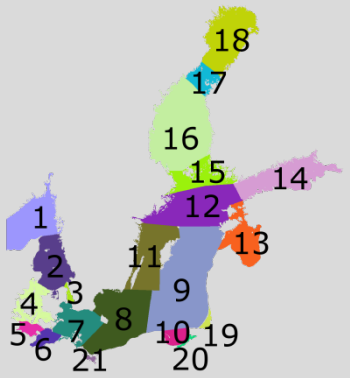


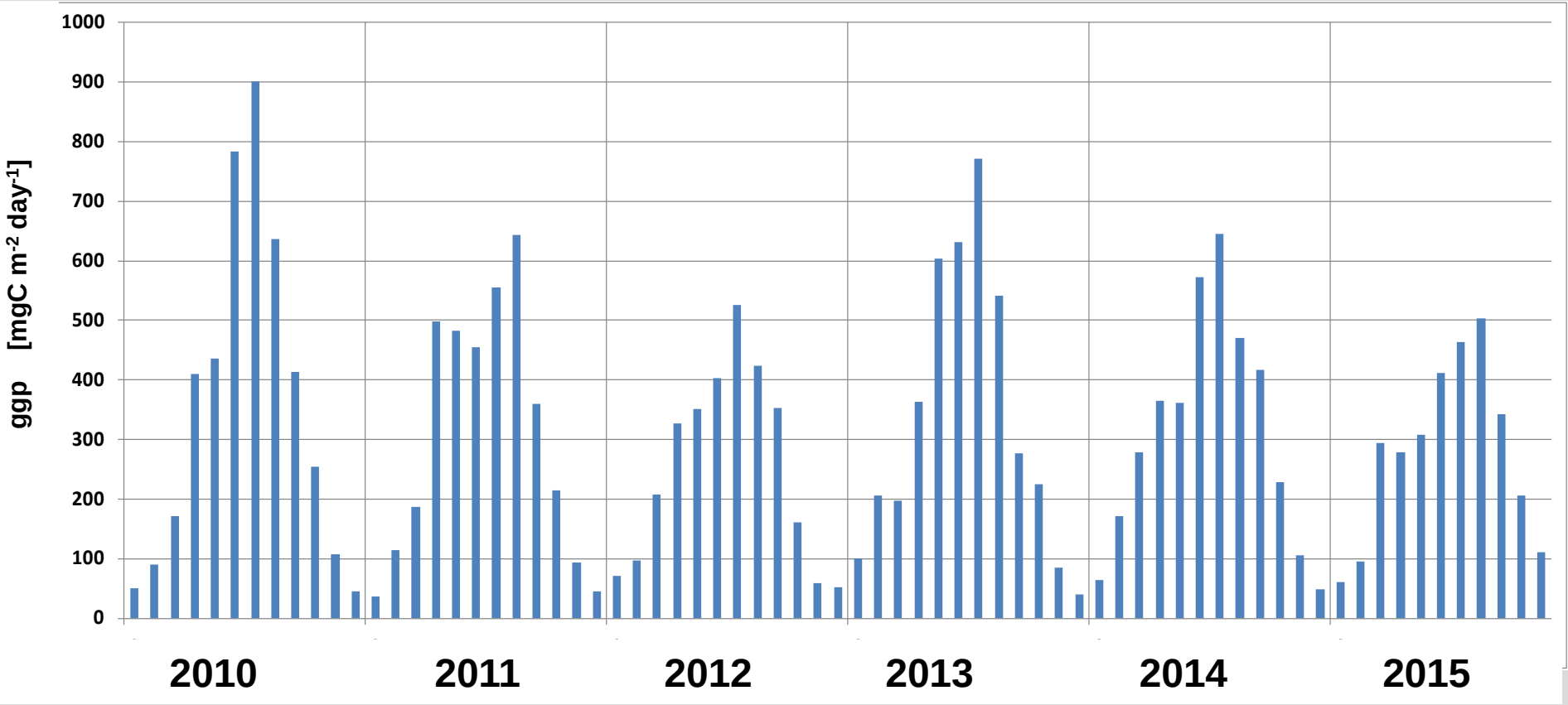


Monthly averages of daily primary production in 2010 -2015



Monthly averages of daily primary production in 2010 -2015 In Gdansk Bay



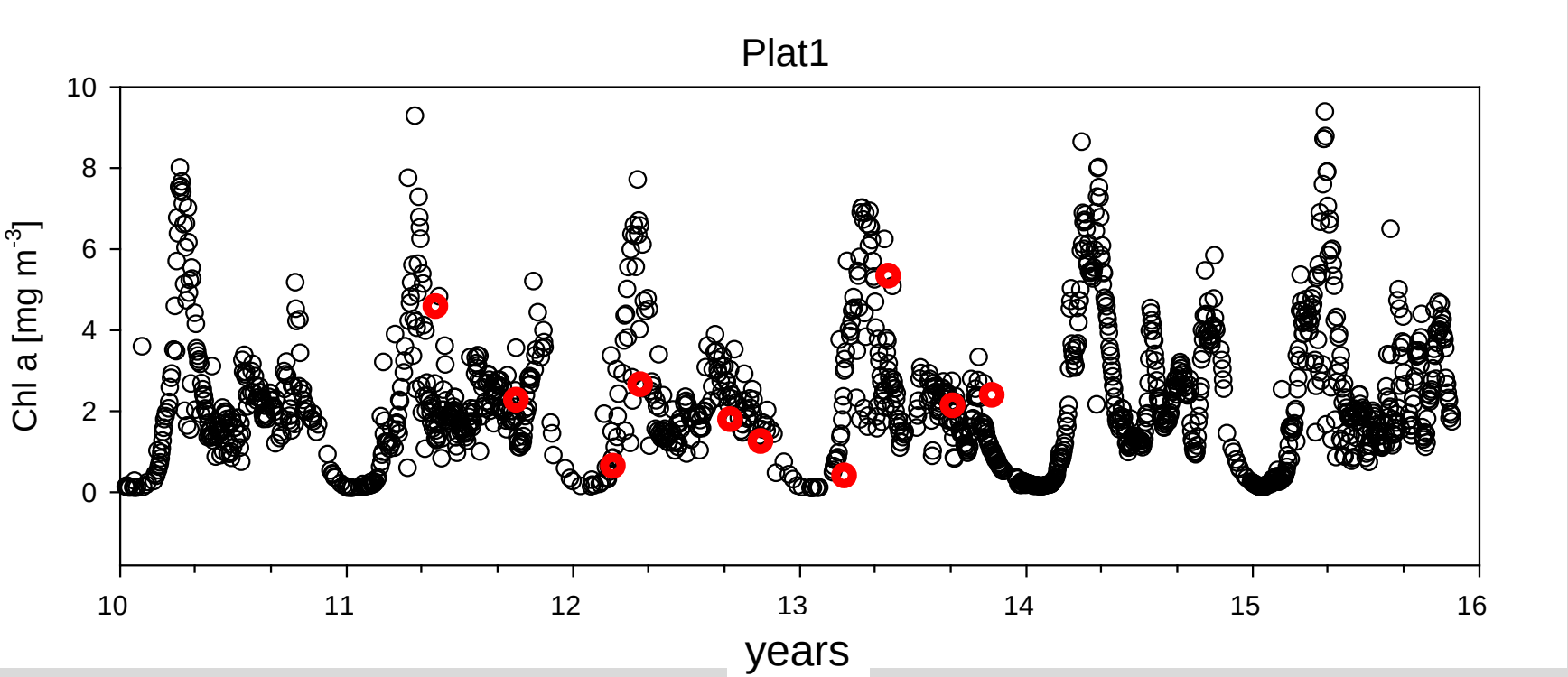


Total primary production

Year	PP [10^6 tons C/year]
2010	33.3
2011	33.8
2012	32.5
2013	36.7
2014	38.6
Average	35.0

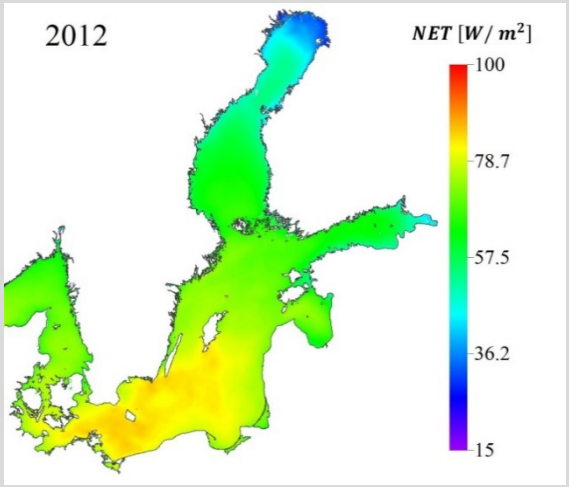
36.27 [10^6 tons C/year] (Renk, 1989)

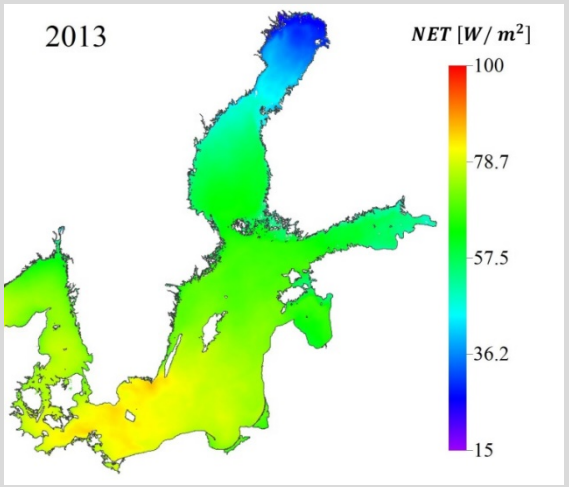
Multi year variability of chl-a on the Plat1 station

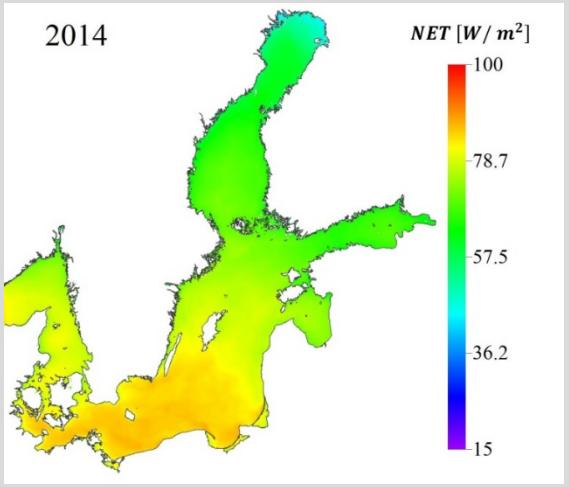


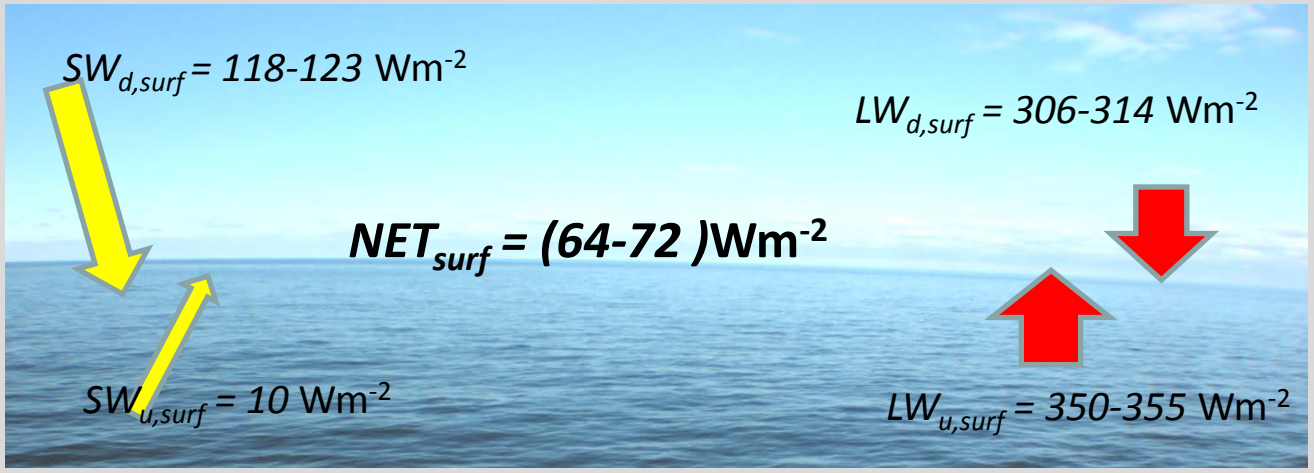
O in situ **o** sat+model

Radiation budget at the sea surface









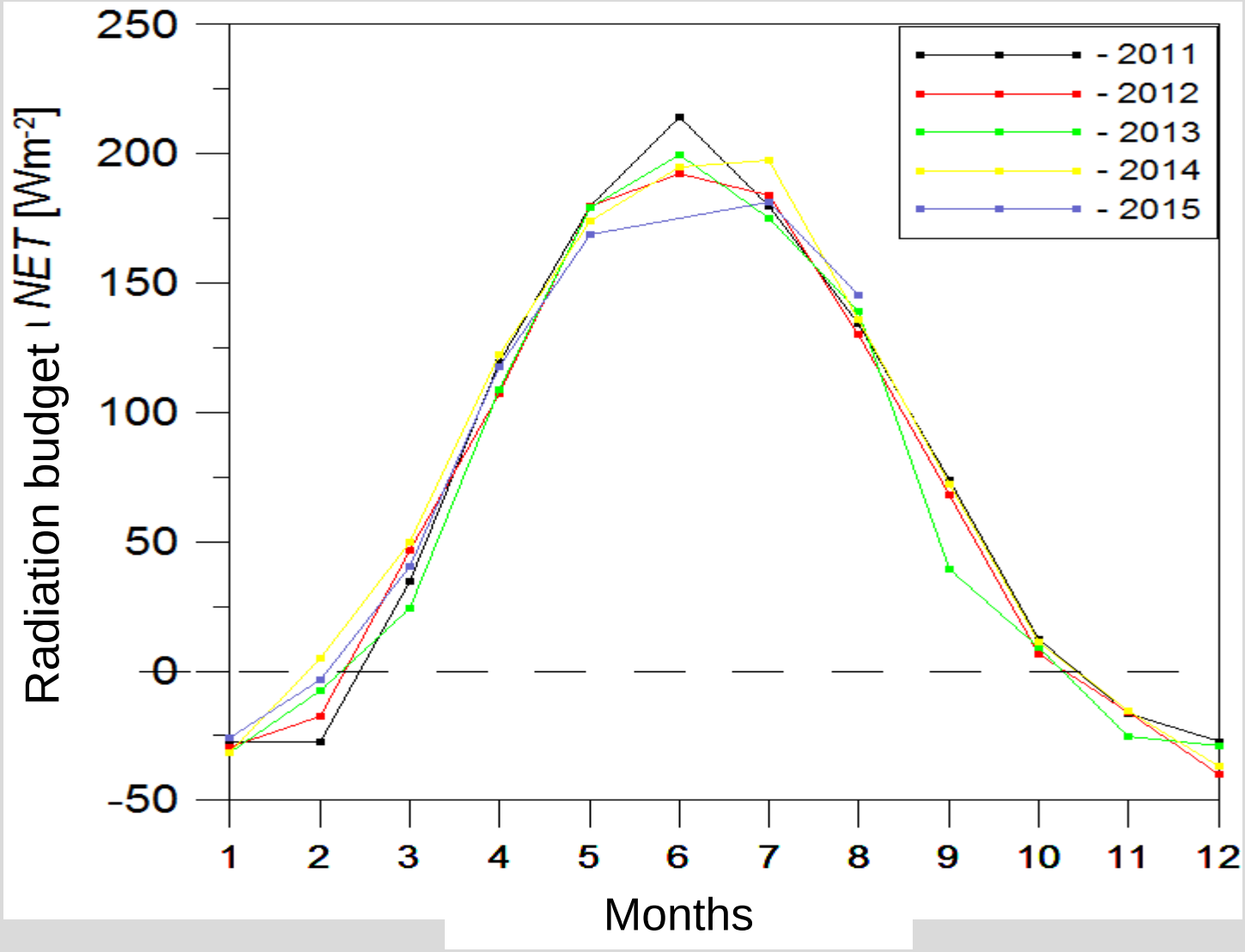
$$NET = SW_{NET} + LW_{NET}$$
$$SW_{NET} = SW_d - SW_u$$
$$LW_{NET} = LW_d - LW_u$$

SW – shortwave radiation

LW – longwave radiation

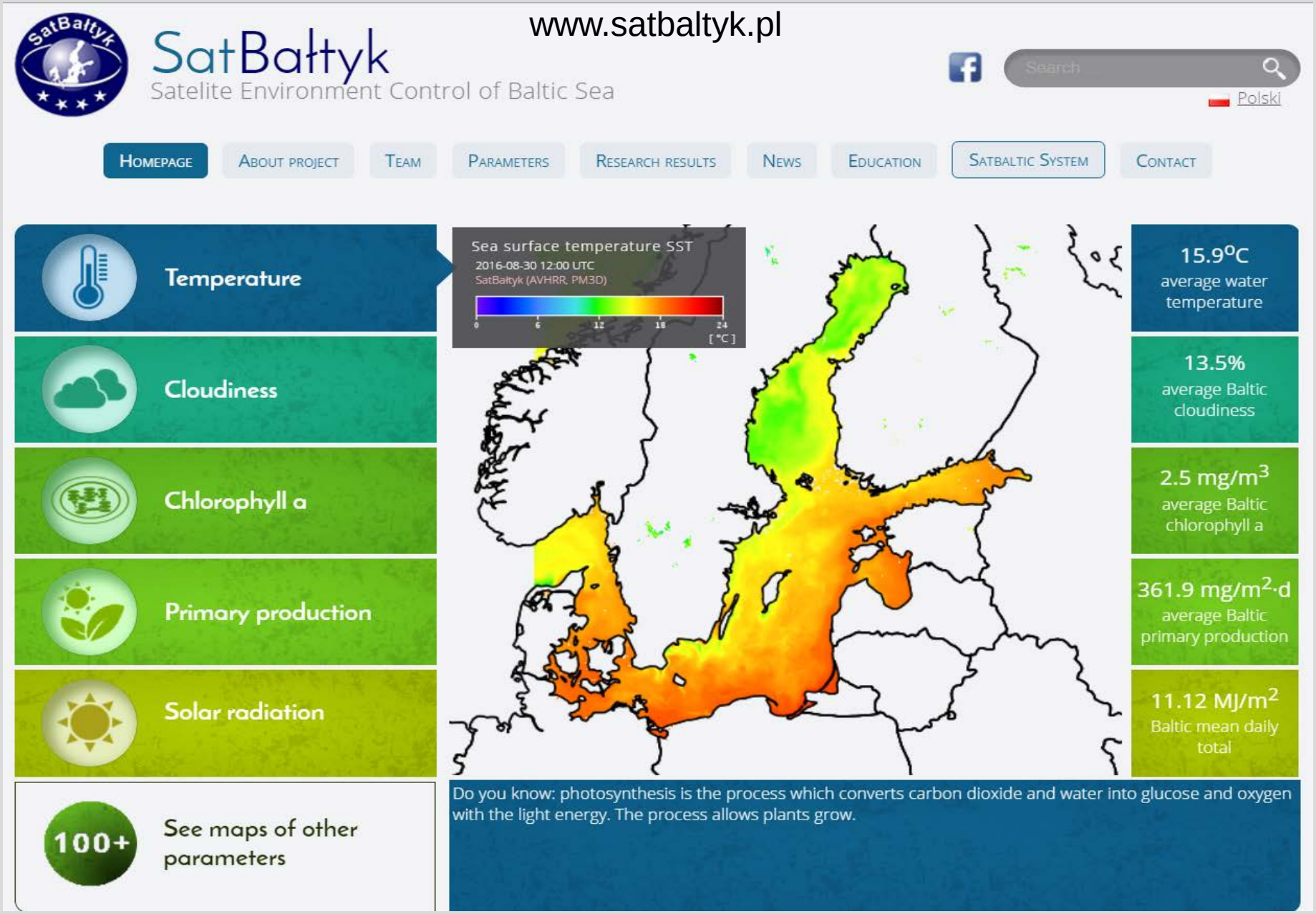
Zapadka T., Krężel A., Paszkuta M., Darecki M., 2015, Daily radiation budget of the baltic sea surface from satellite data, Polish Maritime Research, 22(3), 50-56, DOI 10.1515/pomr-2015-0056.

Monthly averages of net radiation budget 2010 -2015

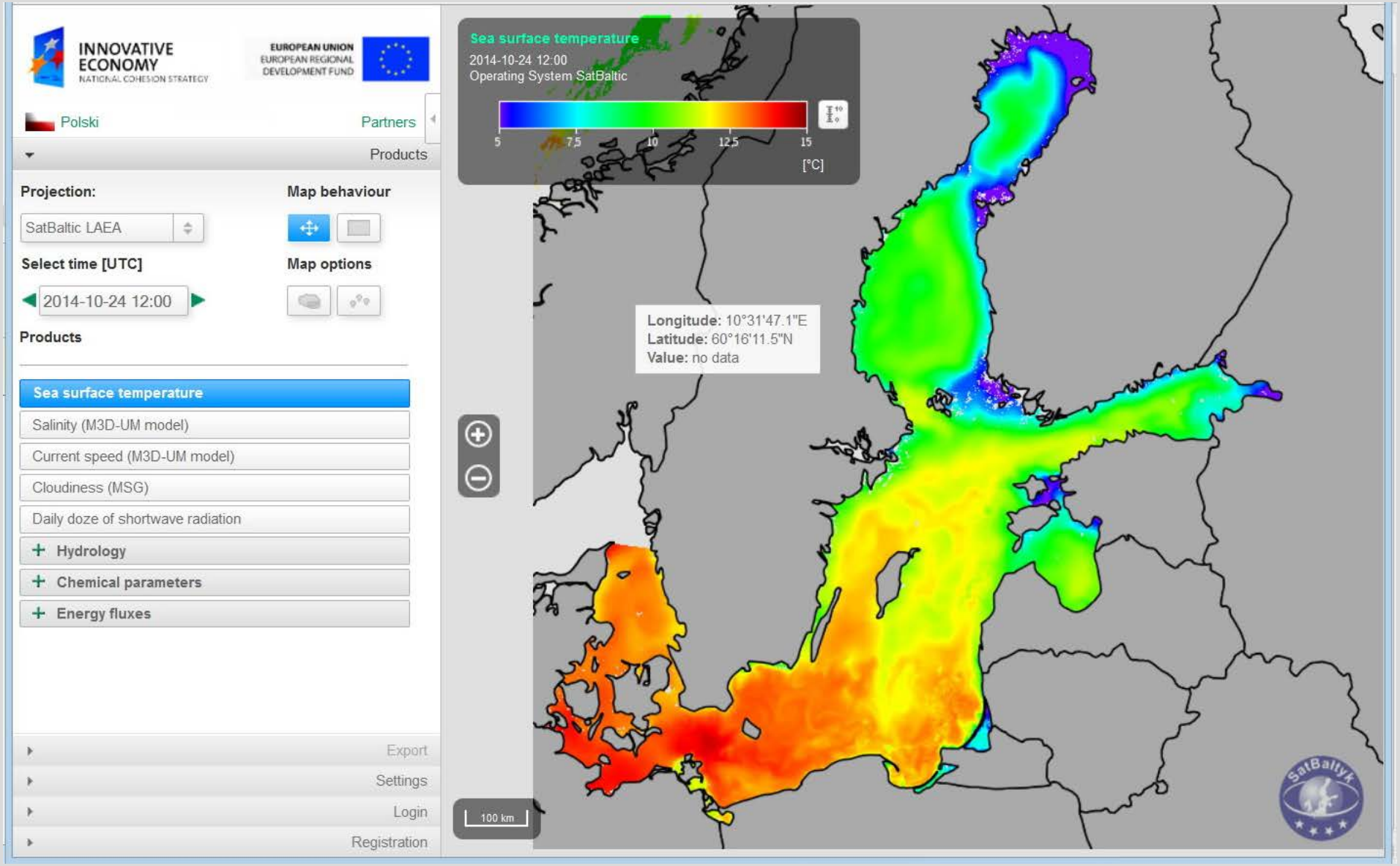


SatBaltyk Project Portal

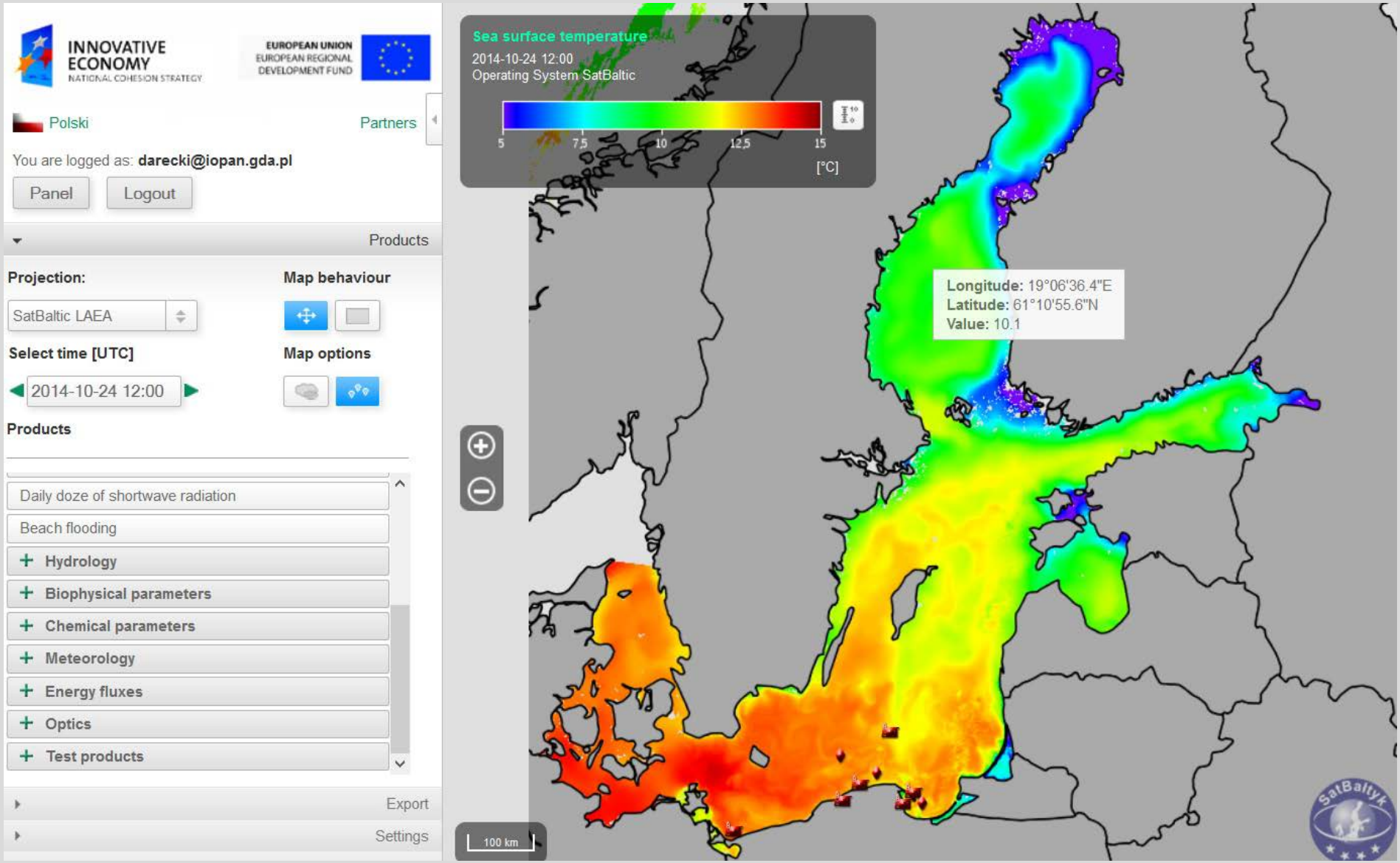
www.satbaltyk.pl



SatBaltyk product portal



SatBaltyk product portal



What next?

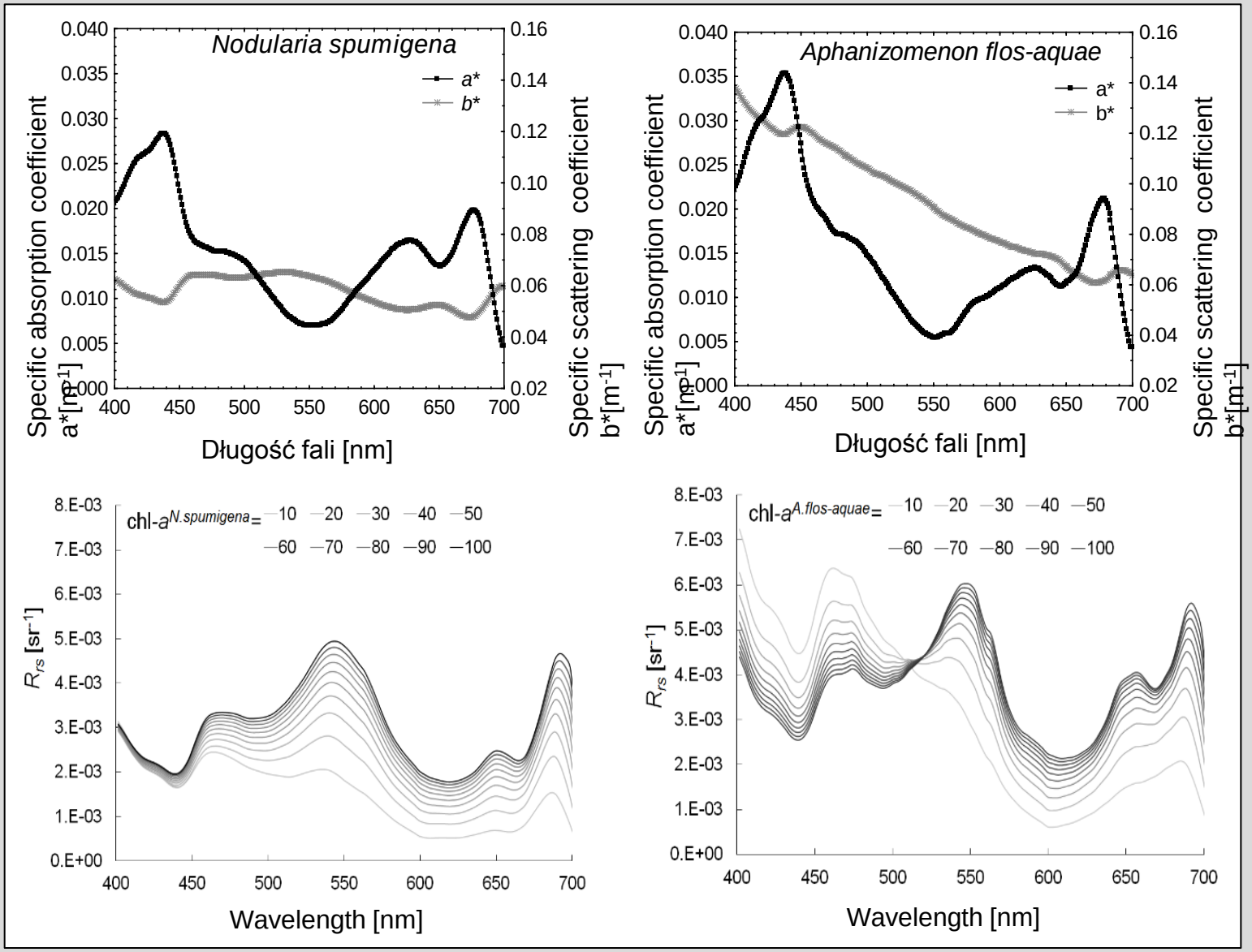
- keep it alive !
- extend temporal coverage
- still increase accuracy
- extend number of parameter (WFD, MSFD)
- develop new parameters
- increase recognitions and internal cooperation

What next?

- keep it alive !
- extend temporal coverage
- still increase accuracy
- extend number of parameter (WFD, MSFD)
- develop new parameters
- increase recognitions and internal cooperation

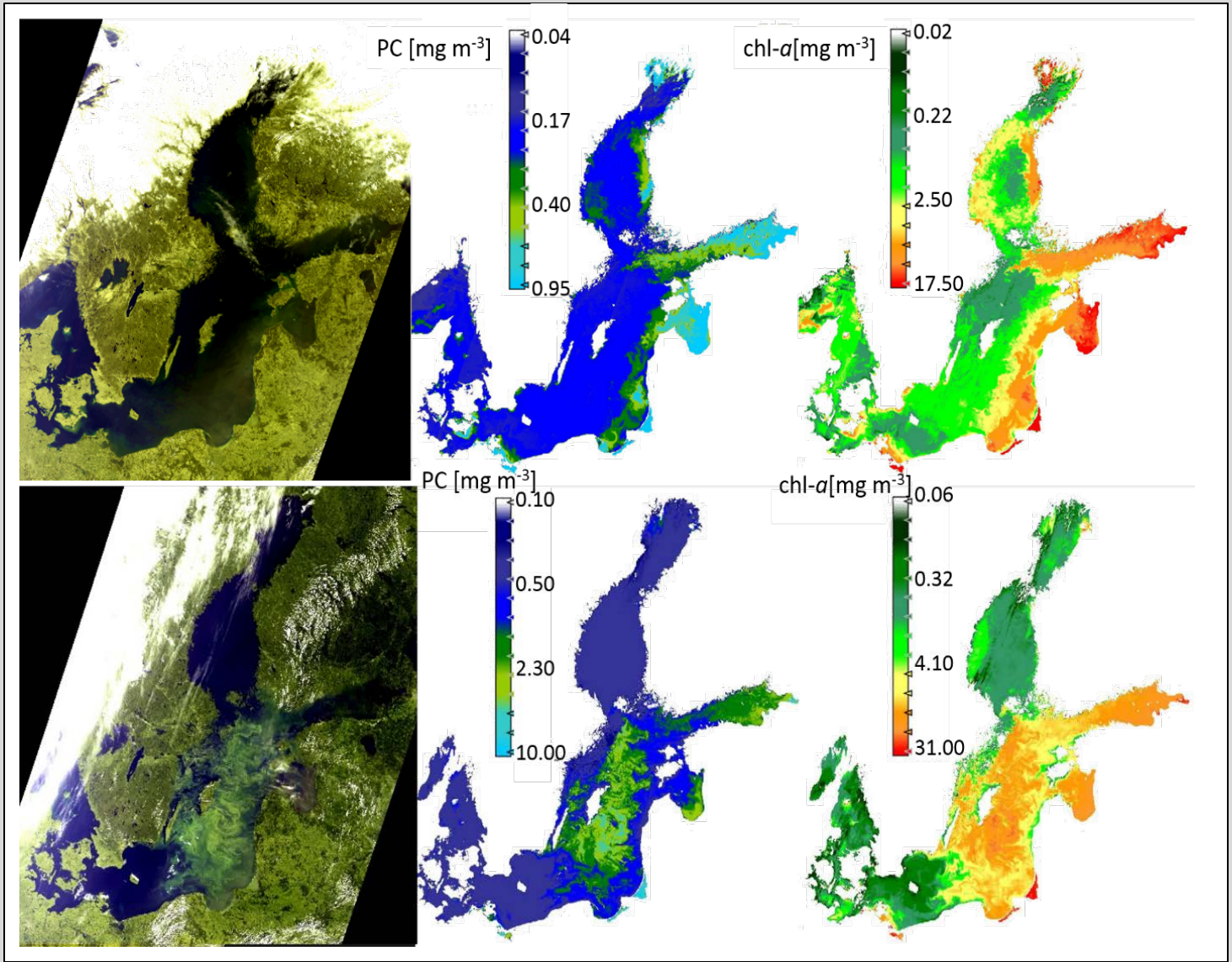
Any science left?

Variability of absorption and scattering of phytoplankton species – potential for remote sensing

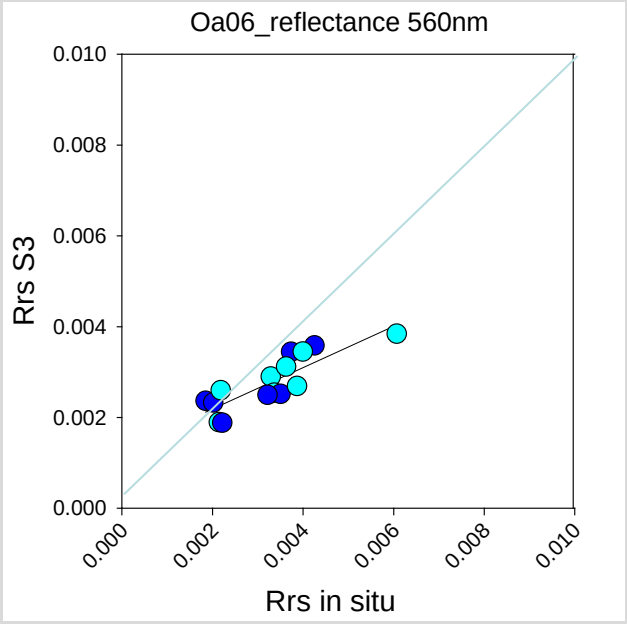


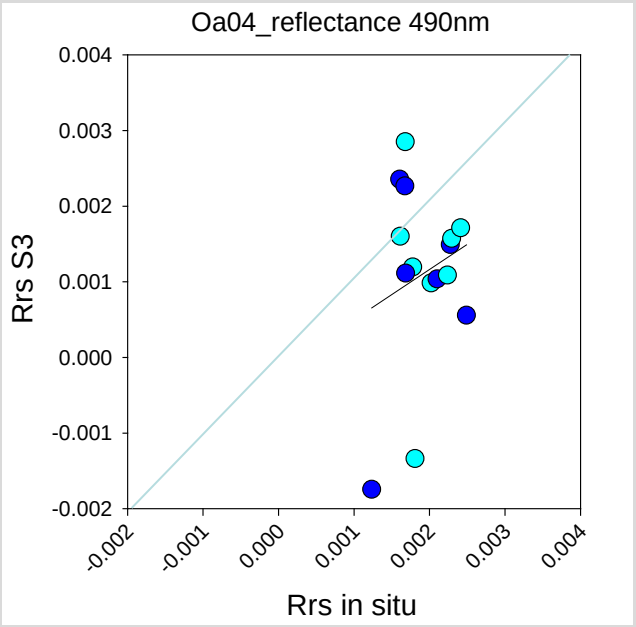
Wojtasiewicz (2012), Woźniak M. (2014)

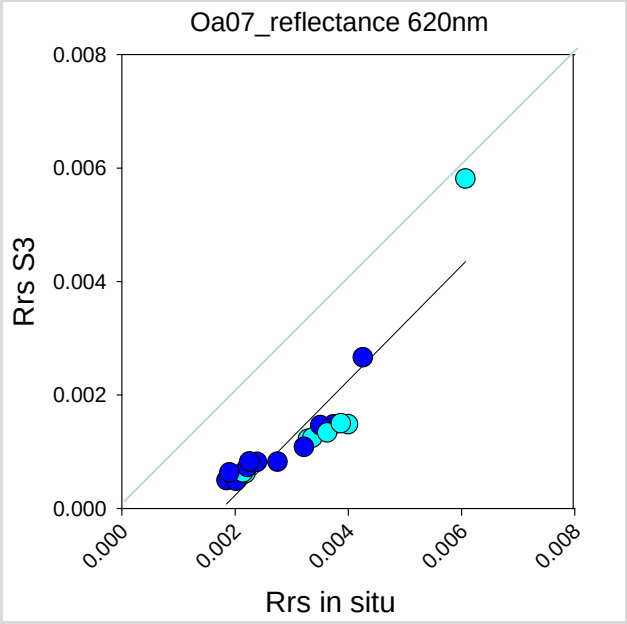
Remote sensing of phycobilin (PC) – spatial distribution of cyanobacteria blooms

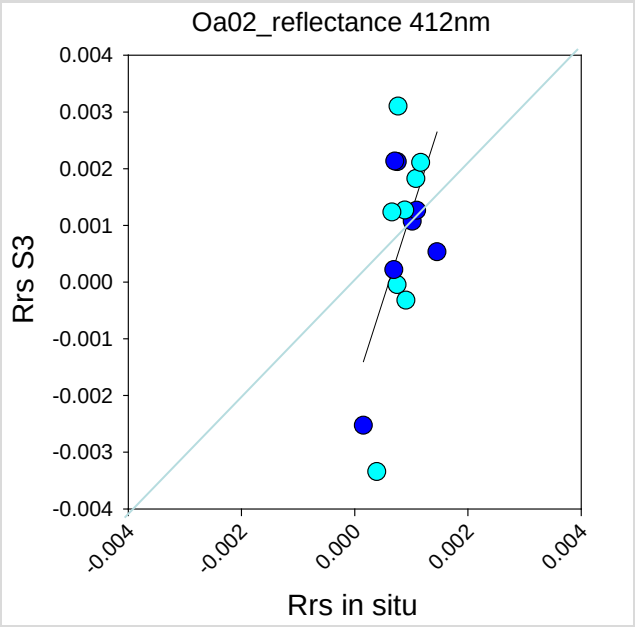


S3 OLCI Reflectances

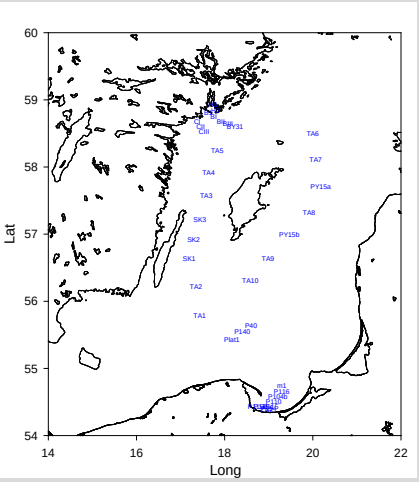


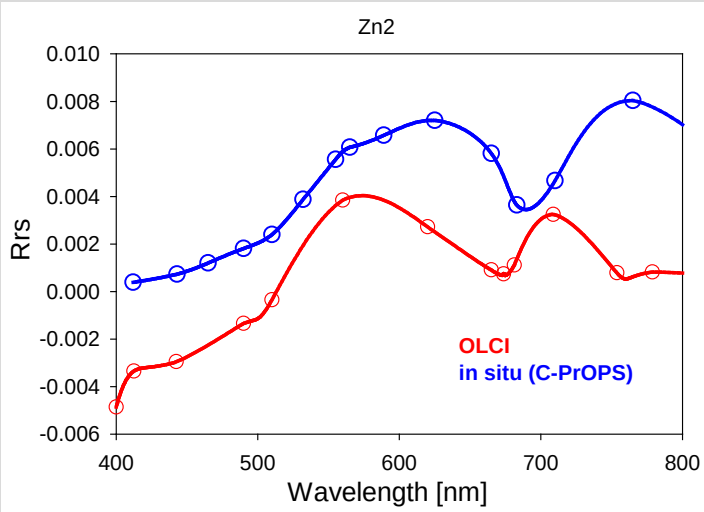


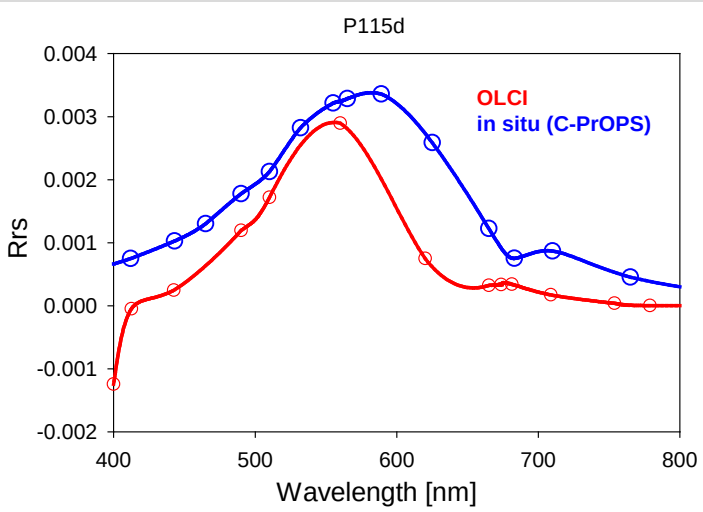


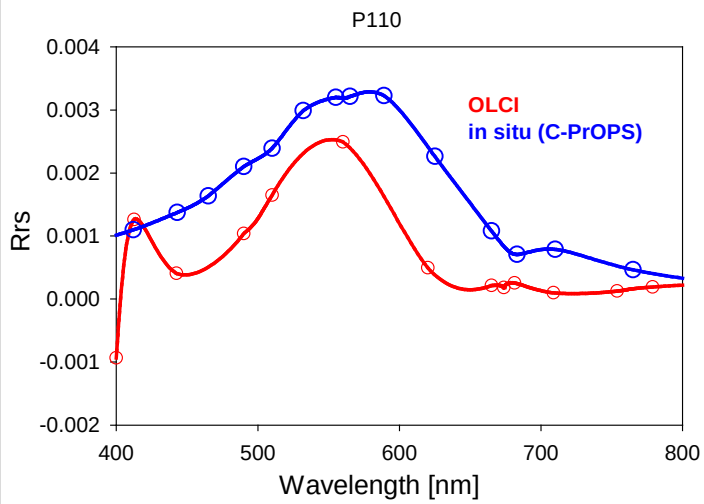


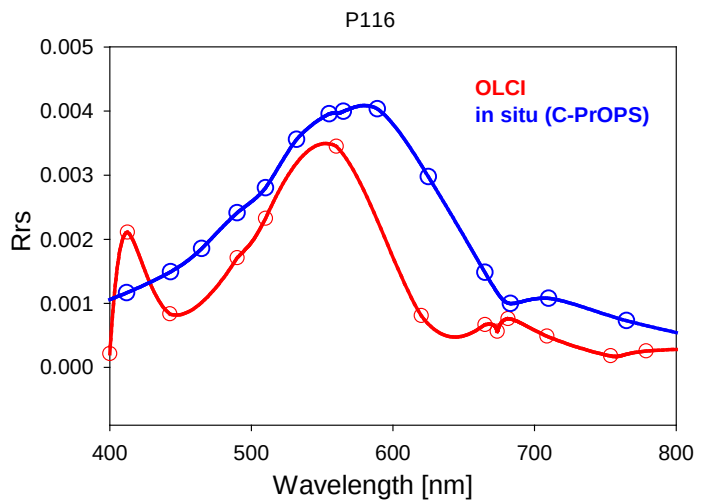
S3 OLCI Reflectances



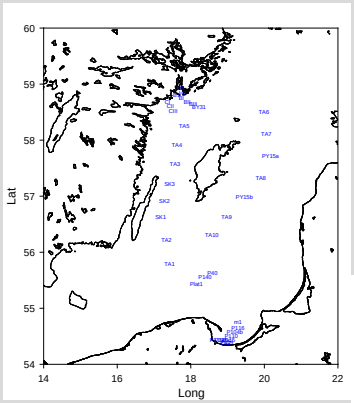


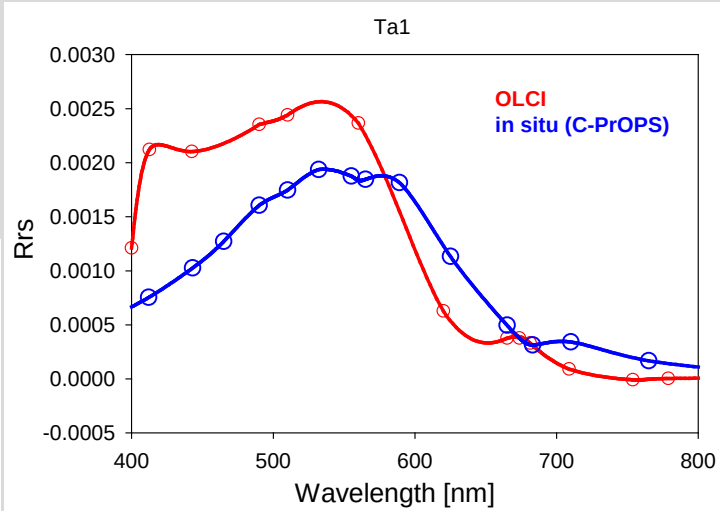


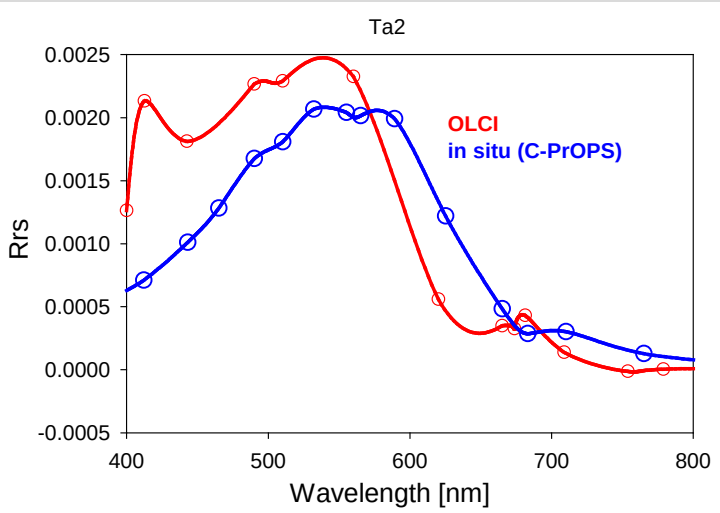


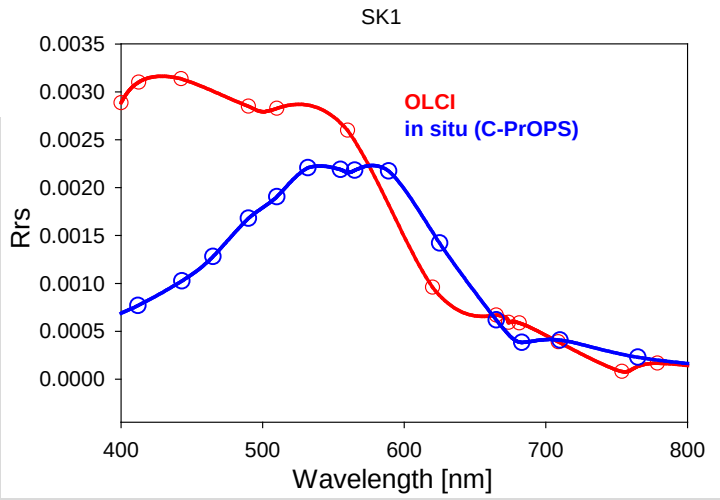


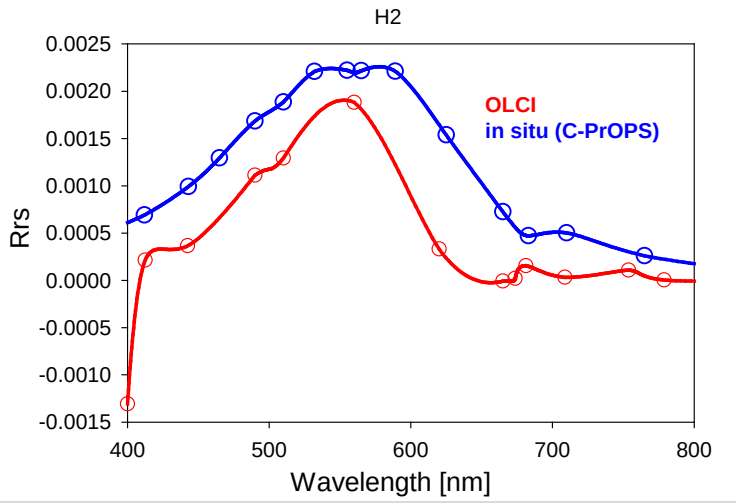
S3 OLCI Reflectances



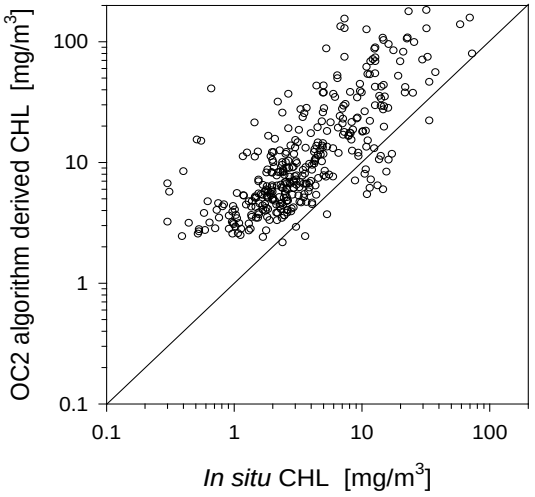


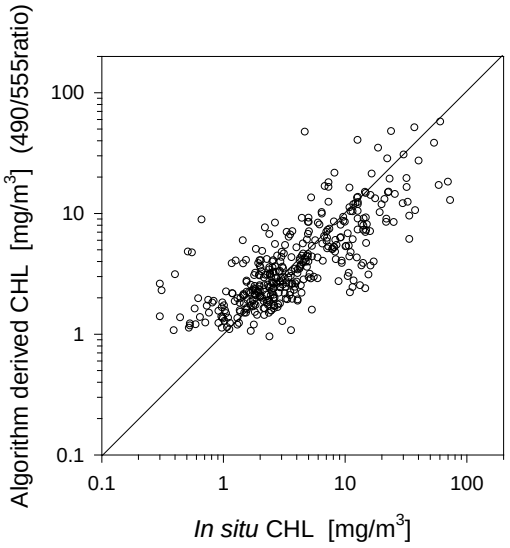


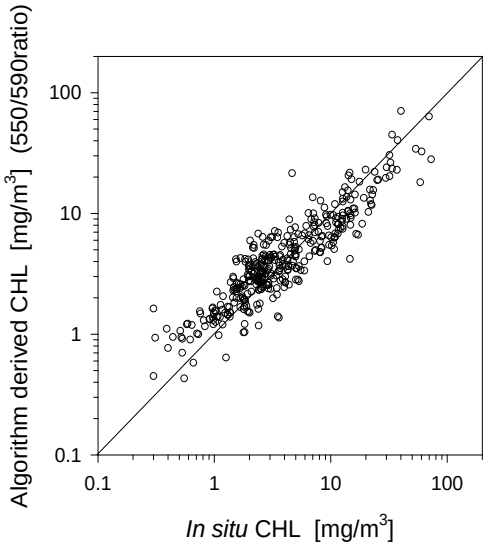


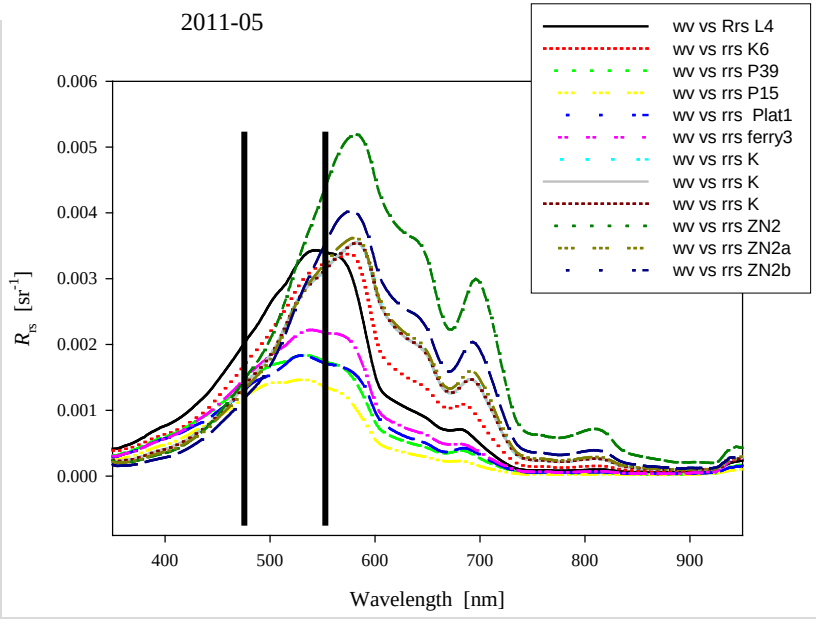


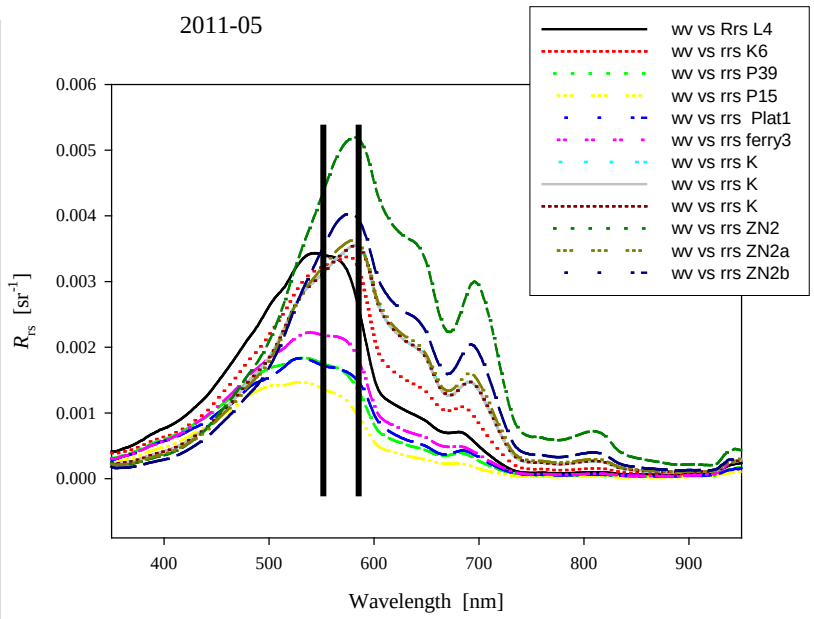
Still place to algorithm development












Thank you !
http://www.satbaltyk.pl

Validation

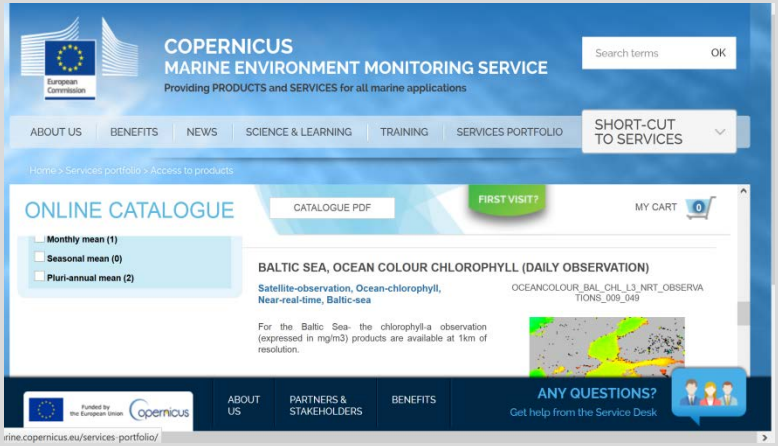
	Arithmetic statistics		Logarithmic statistics		
	Systematic error	Statistical error	Systematic error	Standard error factor	Statistical error
Quantity	Relative $<\varepsilon>$	Relative σ_ε	$<\varepsilon>_g$ [%]	x	σ_- [%]
Chl a (C_a)	9.9 [%]	±56.6 [%]	-3.2	1.68	-40.5
Dose PAR	2.44 [%]	±23.3 [%]	0.24	1.22	-18.3
Daily O_2	2.00 [%]	±60.6 [%]	-14.6	1.72	-41.7
	Absolute $<\varepsilon'>$	Absolute σ_ε'			
SST	Δt = 0.37 [°C]	σ = ±1.05 [°C]			
Net radiation: LW SW	1 [Wm^{-2}] 14 [Wm^{-2}]	±29.7 [Wm^{-2}] ±38.7 [Wm^{-2}]			

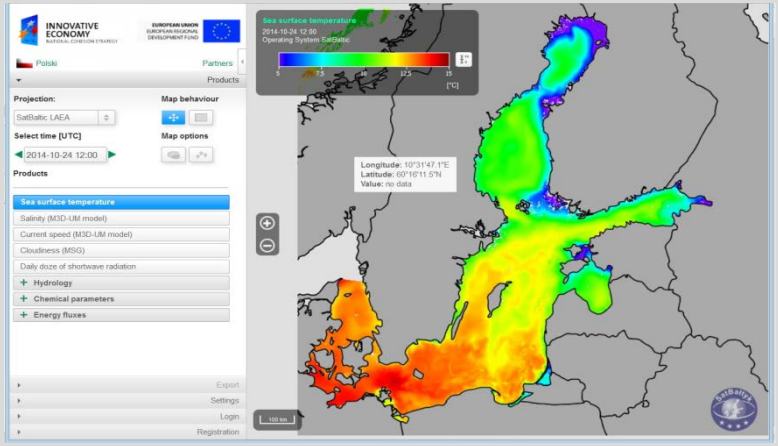
Errors in the remotely sensed estimation of selected quantities with SatBaltic System at its present stage.

Copernicus Marine Environment Monitoring Service

vs

SatBaltic: – Baltic Environmental Satellite Remote Sensing System





+ long time support by EC
+ all European marine waters

+ much more extended number of parameters
+ merged satellite and modeling products = everyday product


Thank you !