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TARPTAUTINIS MOKSLINIS – PRAKTINIS SEMINARAS
„Nuotoliniai metodai gamtinių ekosistemų tyrimuose: privalumai ir iššūkiai“ 2021 m. spalio mėn. 12 d., Vilnius

„Nuotolinio stebėjimo metodų taikymas vandens kokybės vertinime ir valdyme“

Remote sensing solutions in water quality monitoring and management

Diana Vaičiūtė[a*], Martynas Bučas[a], Mariano Bresciani[b], Toma Dabulevičienė[a], Jonas Gintauskas[a], Jovita Mėžinė[a], Edvinas Tiškus[a], Georg Umgiesser[c,a], Julius Morkūnas[a], Francesca De Santi[b] and Marco Bartoli[a,d]

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SOLUTION No. 1.

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Hot moments and hotspots of cyanobacteria hyperblooms in the Curonian Lagoon (SE Baltic Sea) revealed via remote sensing-based retrospective analysis

Diana Vaičiūtė [a,*], Martynas Bučas [a], Mariano Bresciani [b], Toma Dabulevičienė [a], Jonas Gintauskas [a], Jovita Mėžinė [a], Edvinas Tiškus [a], Georg Umgiesser [c,a], Julius Morkūnas [a], Francesca De Santi [b], Marco Bartoli [a,d]

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Satellite remote sensing-based information fill the gap in spatial and temporal data about the past and present ecological status of water bodies;

We performed the retrospective analysis of cyanobacteria blooms in the Curonian Lagoon during the period from 1985 to 2018 using **historical** satellite data.

The retrospective analysis of cyanobacteria blooms

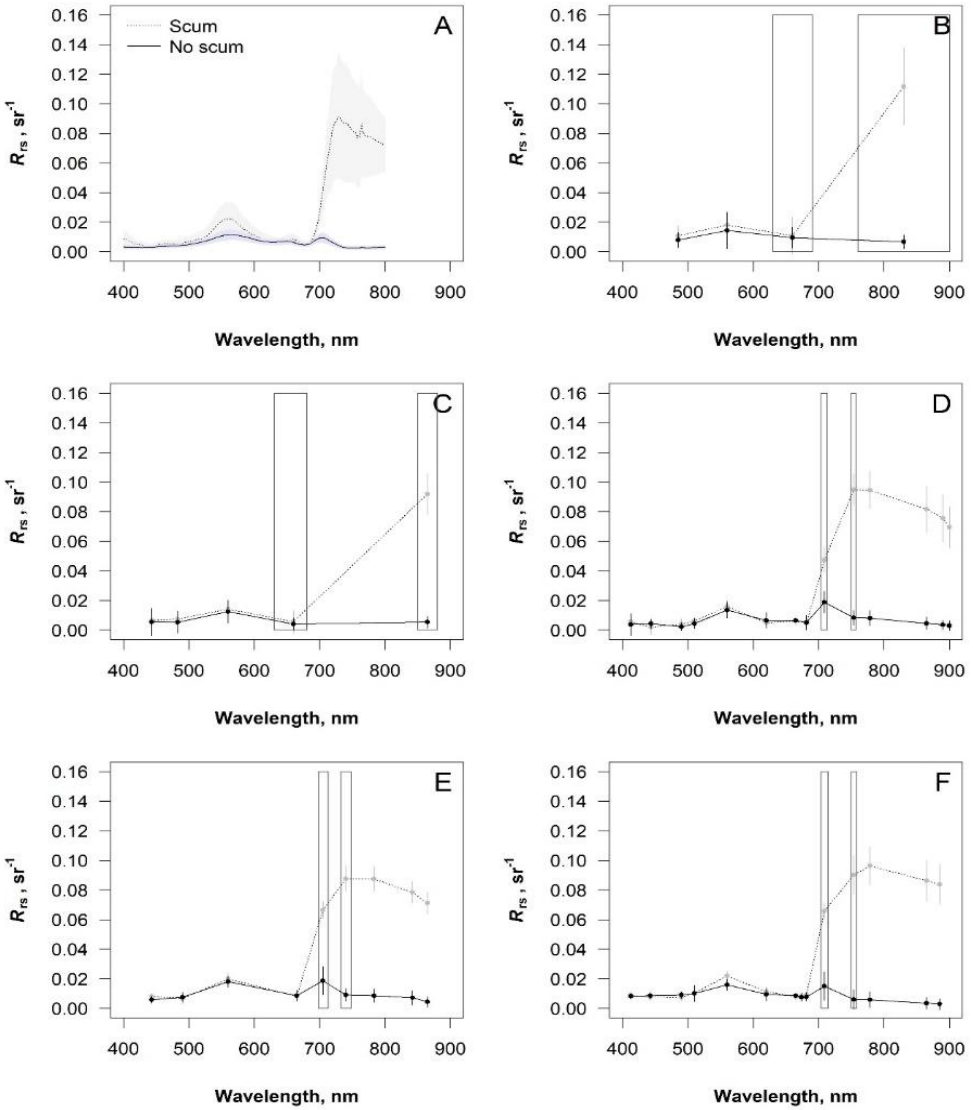
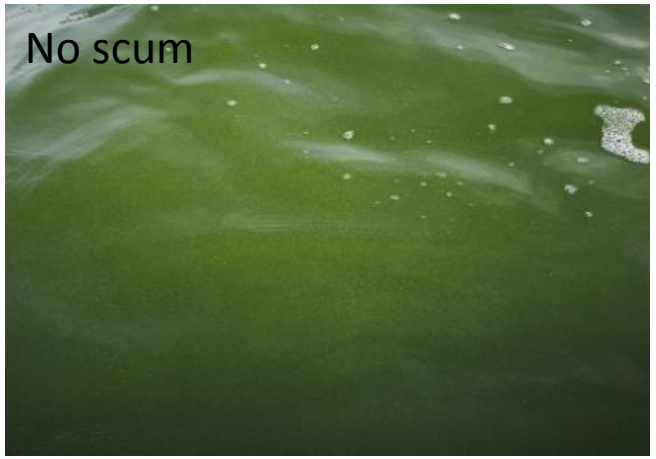
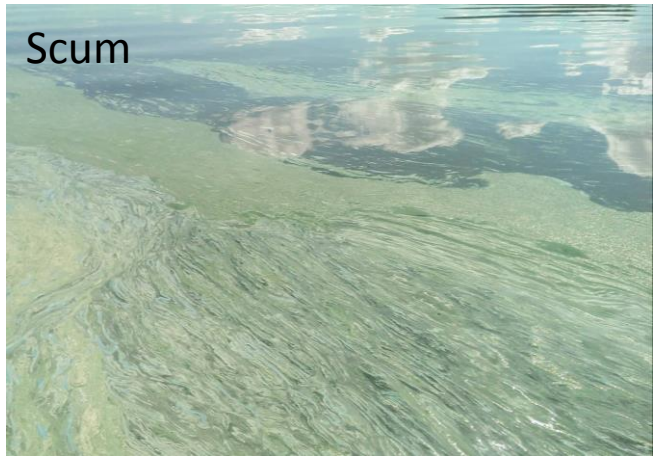


Fig. 2. R_{rs} values measured in situ using the WISP-3 instrument and retrieved from AC satellite imaes (B-F).





Optical sensors differ in architecture of spectral bands and spatial resolution. Cyanobacteria scum detection algorithm was originally developed for MERIS/Envisat satellite images. We have performed a tuning (cal/val) of the algorithm for Landsat and Sentinel‘s data series (Vaičiūtė et al., 2021).

Cyanobacteria scum phenomena is highly dynamic in space and time, however, we hypothesize that well-established spatial and temporal patterns of cyanobacteria hyperblooms exist. We have tested, how the diffuse and point sources of nutrients, together with hydro-meteorological conditions are altering the presence and spatial distribution of cyanobacteria scums.

The retrospective analysis of cyanobacteria blooms

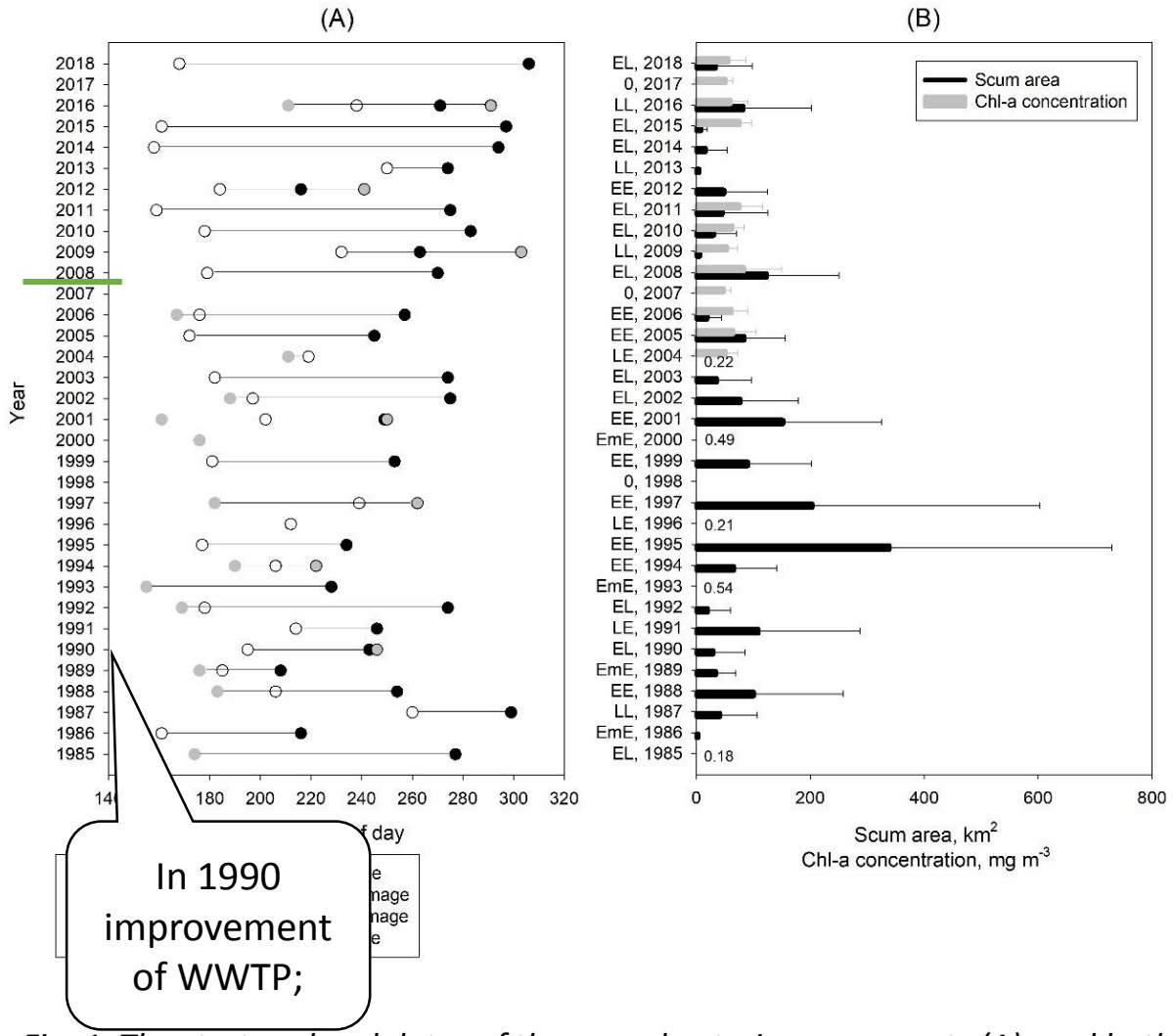


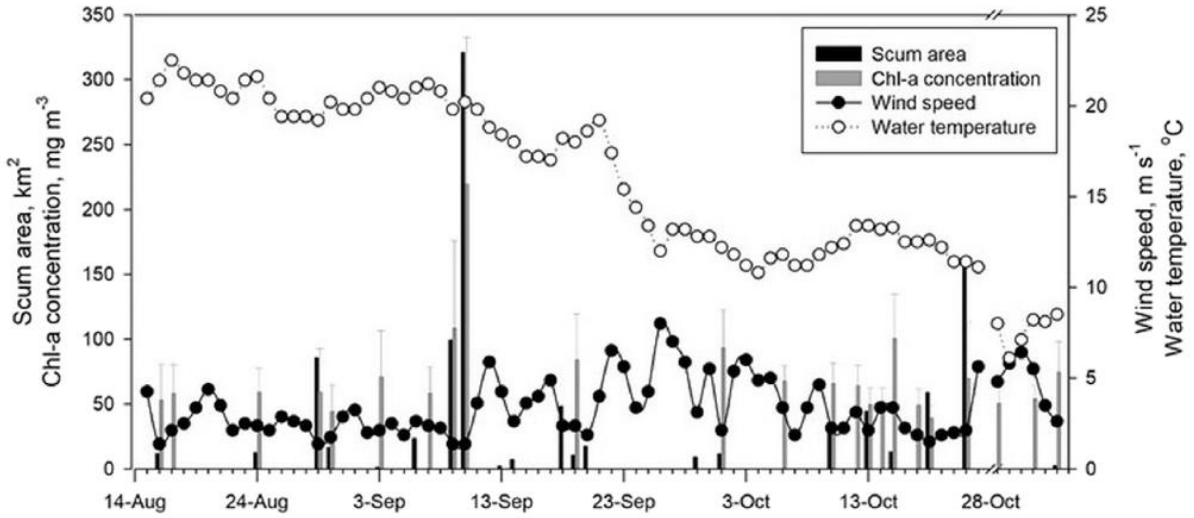
Fig. 1. The start and end dates of the cyanobacteria scum events (A), and both the annual mean area covered by scum (km^2) and the mean annual Chl-a concentration (mg m^{-3}) (B), derived from satellite images during June–November 1985–2018.

The yearly duration of scum events differed, ranging from one or a few days (in 1996 and 2004) to more than 3 months, i.e., the entire vegetative period (Fig. 1);

The cyanobacteria scum events usually started in June–early July and ended in August–middle of September – the hot moments of cyanobacteria hyperblooms.

The regime shift analysis determined changes in means between the periods of 1985–2007 and 2008–2018. This suggests that, starting from 2008, the period during which cyanobacteria scum events were present is consistently getting longer (Fig. 1). The annual mean area affected by cyanobacteria scum is getting smaller starting from 2002.

The most important factors for the occurrence of, and area covered by, scum on a temporal basis were the standing stock of cyanobacteria biomass and the ambient wind conditions (example from 2018).



The retrospective analysis of cyanobacteria blooms

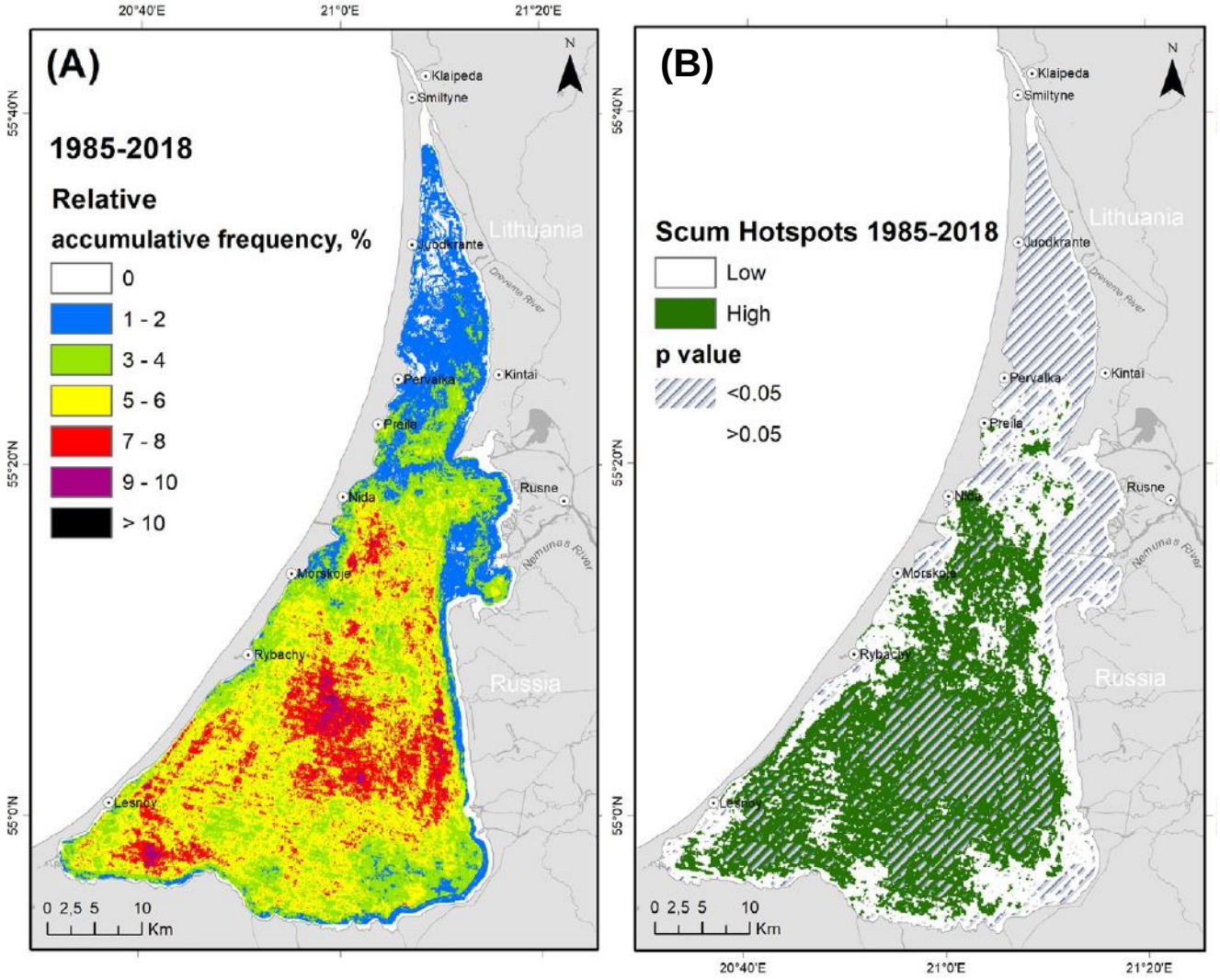


Fig. 2. The RAF of cyanobacteria scum events (% of the total number of events (A), and Hotspots of cyanobacteria scum during the period of June–November from 1985 to 2018.

Variable (correlating variable)	Chi² values
Water renewal time (wind speed, salinity, distance from rivers)	83.74* ↗
Distance from great cormorant locations	22.55* ↘
Distance from muddy sediments	5.90 ↘
Distance from WWTP	9.82* →
Water Surface Temperature	4.92 →
Current speed	32.87* ↘
Current direction	7.82* →
Current speed:direction	41.28*

Cyanobacteria scum events were most frequently distributed in the south, southwestern and central parts of the lagoon. The least affected area was the northern part of the lagoon.

The frequency of scum events occurrence increased almost exponentially with water renewal time, was higher closer to muddy sediments, WWTP and great cormorant locations. The lowest frequency of scum events occurrence was associated with a current speed of >0.2 m s^{-1};

SOLUTION No. 2.

Not only space-based remote sensing solutions fill the gap in spatial and temporal data about the ecological status of water bodies;

We tested the benefit of *in situ* spectroradiometry for chl-a estimation and cyanobacteria bloom detection.

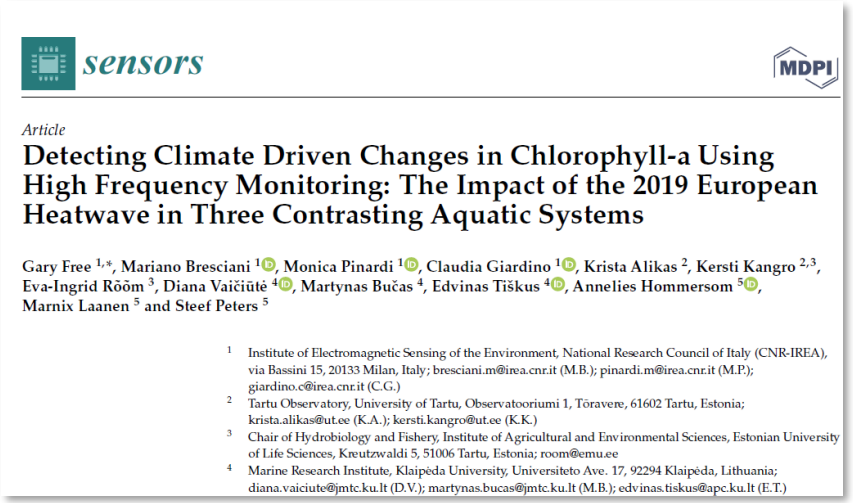
EOMORES

Data can be provided in 15 min interval;

Data can be used for satellite information cal/val;

Data are provided in real time;

Easy to maintain – the bio-fouling is not an issue for the frequent data retrieval;



sensors

MDPI

Article

Detecting Climate Driven Changes in Chlorophyll-a Using High Frequency Monitoring: The Impact of the 2019 European Heatwave in Three Contrasting Aquatic Systems

Gary Free [1,*], Mariano Bresciani [1], Monica Pinardi [1], Claudia Giardino [1], Krista Alikas [2], Kersti Kangro [2,3], Eva-Ingrid Rõõm [3], Diana Vaičiūtė [4], Martynas Bučas [4], Edvinas Tiškus [4], Annelies Hommersom [5], Marnix Laanen [5] and Steef Peters [5]

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Curonian Lagoon
Baltic Sea
Klaipeda
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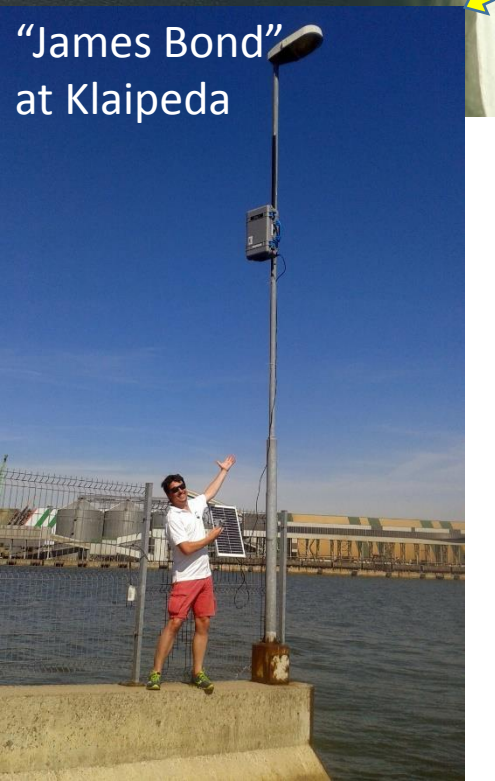
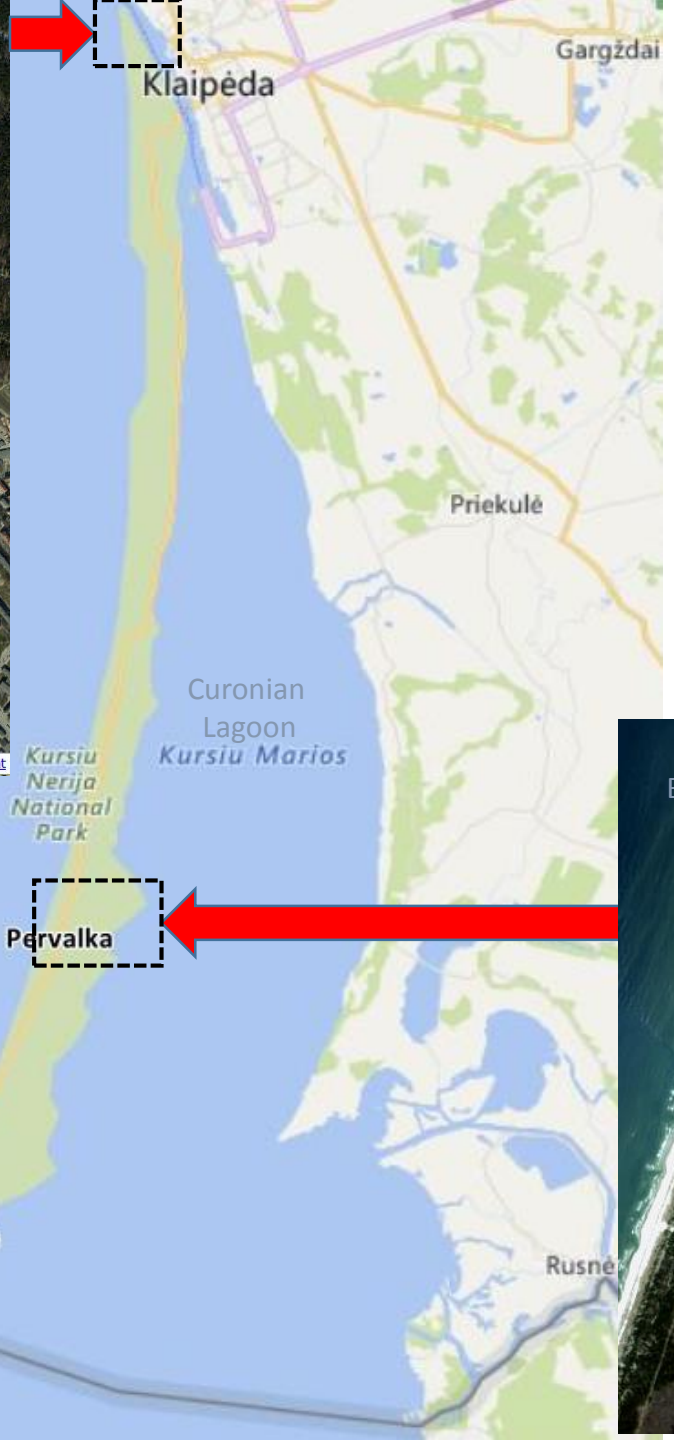
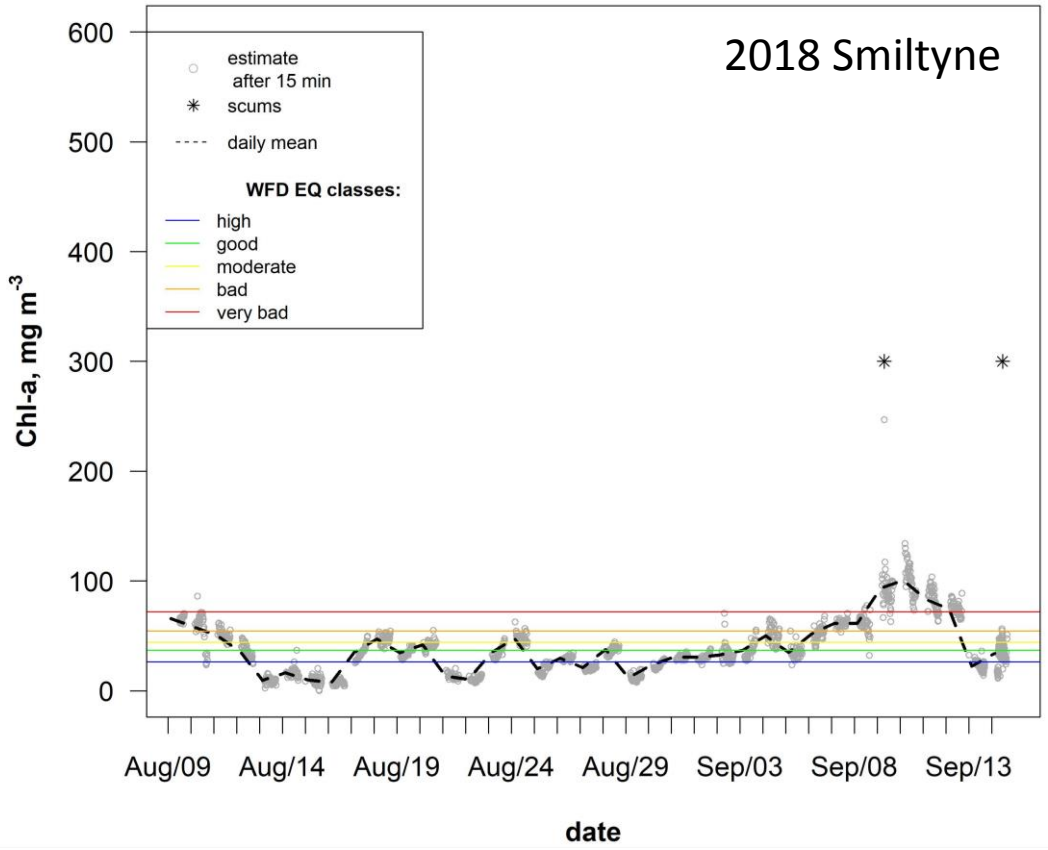

“James Bond”
at Klaipeda

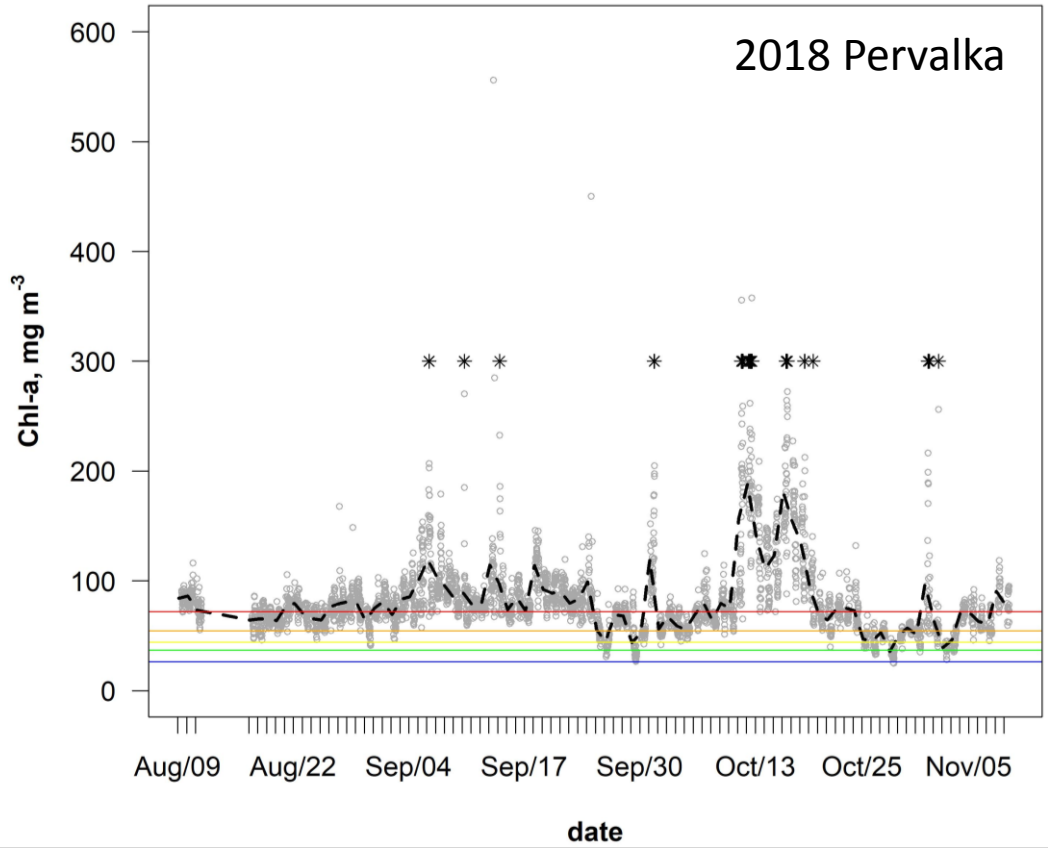

Klaipėda
Gargždai
Priekulė
Curonian Lagoon
Kursiu Marios
Kursiu Nerija National Park
Pervalka
Baltic Sea
Nida
Rusnė
Curonian Spit


“Vilius”
at Pervalka


Baltic Sea
Pervalka
Curonian Lagoon

In situ spectroradiometry for chl-a estimation





Water quality in Smiltyne is highly affected by the inflow of the Baltic Sea waters resulting in lower Chl-a concentration. Significantly higher Chl-a values have been observed in Pervalka;

High diurnal fluctuations of Chl-a concentration have been observed: from less then 20 mg m^{-3} in the morning, up to more then 100 mg m^{-3} in the afternoon;

Cyanobacteria surface accumulations can be identified also from in situ spectroradiometry data;

Take home messages

Historical satellite data is valuable, however unexplored information for waterbodies monitoring and trend analysis. This information can significantly support the understanding of the past ecological status. In conjunction with most recent Sentinel‘s data an appropriate management solution can be applied. The major issue is the processing approach; Future perspective - to hindcast the water quality changes and cyanobacteria blooms in the other waterbodies of Lithuania by adapting the methodology, in order to link with the environmental and anthropogenic stressors.

Clear links between cyanobacteria blooms and hydrodynamic features such as water renewal time and current patterns, and with potential nutrient sources such as muddy sediments or large colonies of water birds, highlight that all of these factors co-regulate the magnitude and persistence of these blooms and provide indications of the locations of accumulation;

In situ spectroradiometry serves as high frequency monitoring for water quality assessment, primary production estimation, and cyanobacteria bloom onset detection.

EOMORES

H2020 EOMORES - Earth Observation (EO) based services for Monitoring and Reporting of Ecological Status

esa

TODAY