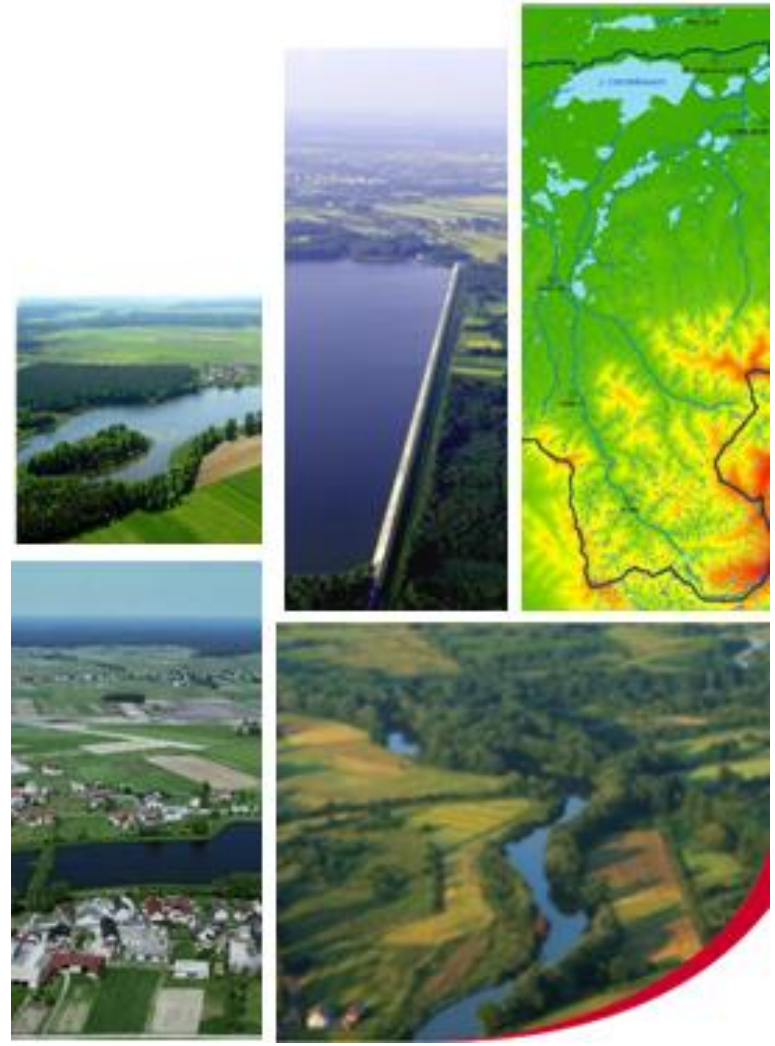
Complex River Basin Information System - CRIS

Alternative data sources for water resources management



Jan Karud
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The project *Sustainable water strategy by means of tight-knit approach to water cycle in river catchment* is funded from Norway Grants in the Polish-Norwegian Research Programme operated by the National Centre for Research and Development

Water quality parameters derived from optical satellite images

- The most important water quality parameter possible to observe by satellite is chlorophyll-a concentration, which is a crucial biological quality element. Physical and chemical conditions, such as and Secchi depth and Turbidity, are support parameters. Turbidity can be derived from TSM (Total Suspended Matter).

- Secchi depth
- Chloropyll-a
- TSM / Turbidity

- A combination of these parameters will support in situ measurements and fulfil the requirements for monitoring of the waterbodies in accordance with the Water Framework Directive.

Alternative data sources for water resources management

LANDSAT 8

- In operation since 2013
- High resolution 30m and good quality
- Not optimized for Chlorophyll-ac

Availability

- Products of LANDSAT-8 are available as level 1T products for download at no charge from GloViS, EarthExplorer or via the LandsatLook Viewer

Alternative data sources for water resources management

- New high resolution satellites
- SENTINEL-2 (2015) (20m) Launch date: 11 june 2015 (data available after commisioning phase 2015/2016
- SENTINEL-3 (2015/2016) (300m)

  Replacement for MERIS
- Availability: Open. National mirror sites are under preparation

Keeping an eye on Sentinel-2

SENTINEL-2 capabilities:

- Allow mapping of small inland waters
- Down to 10 m resolution
- 2-3 days revisit time
- Products will support implementation of EU Water Framework Directive

Alternative data sources for water resources management

ENVISAT MERIS

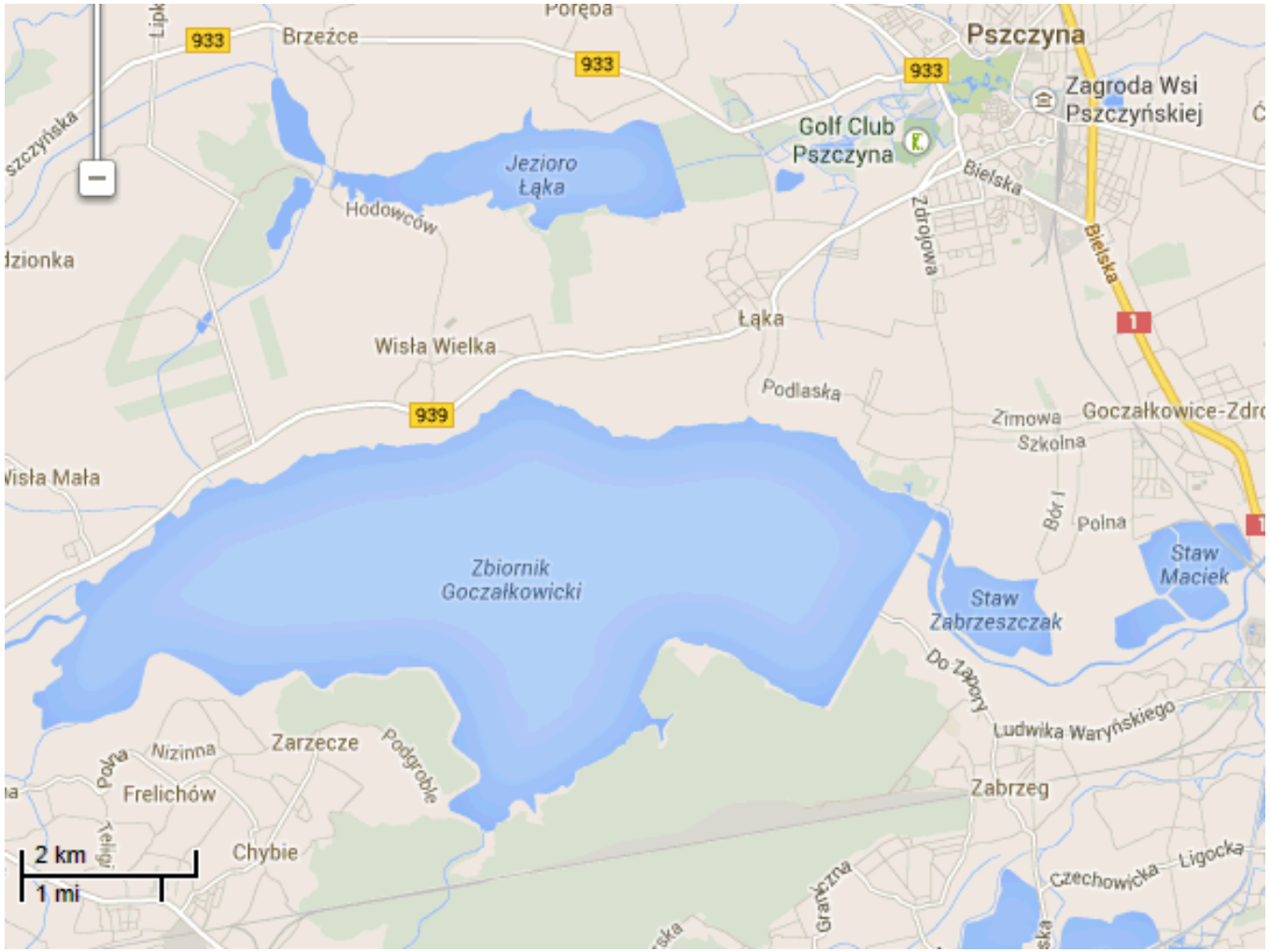
- Out of operation but good quality historical data
- Resolution 300m

Derived products:

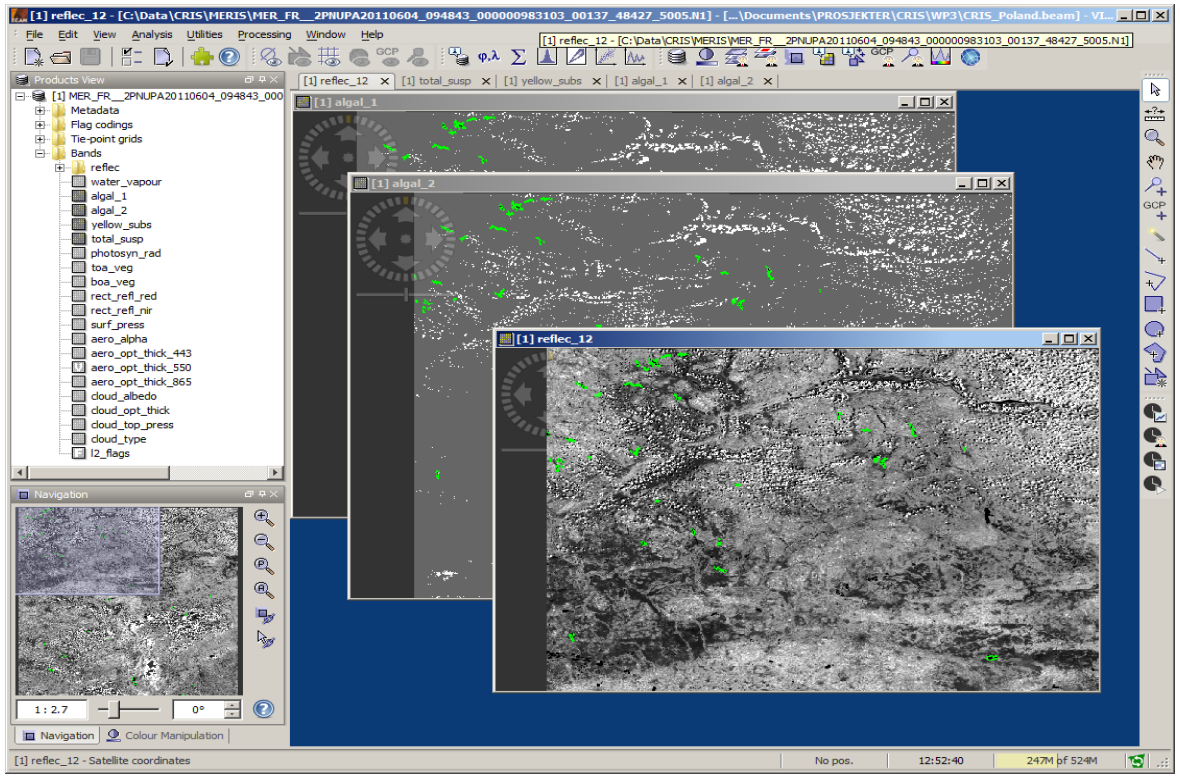
- Secchi depth
- Turidity
- Chlorophyll-a

Availability: Open
Download from ESA EOLi - Earth Observation

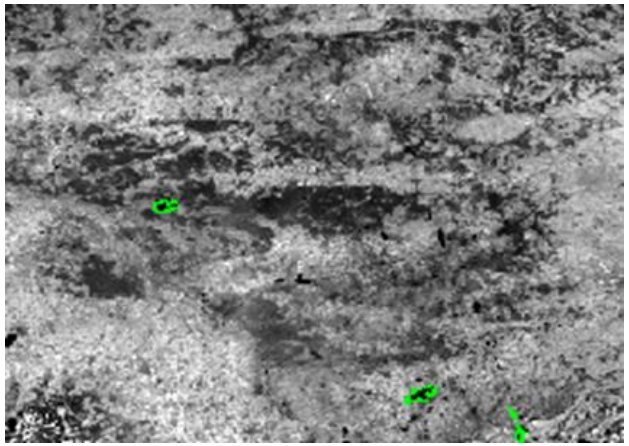
Lake to be measured



Beam (Basic Envisat toolbox for ASTR and MERIS) is an Earth observation toolbox and development platform developed by Brockman Consult for ESA. The software is open source and is a valuable tool for viewing and processing satellite images



- VISAT – Visualization and analysis tools
- Scientific data processors
- Command line tool to execute graphs
- Java API with ready to use plugins



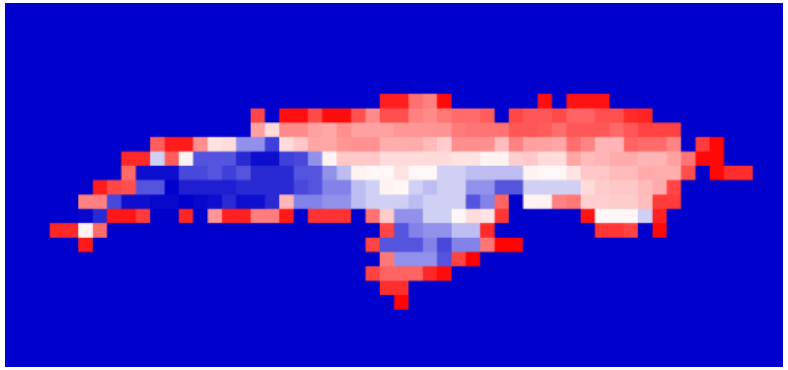
MERIS scene capture

Extraction of MERIS historical data from 2011 (L3_2011-06-01_2011-06-07) downloaded from EOLIS. The Goczalkowice Reservoir is located and zoomed in.

Reflectance (Band 12) from the area around the lake. Using BEAM software to select area and band.

Algea consentration in the Goczalkowice Reservoir using MERIS

Shoreline of lake to be measured

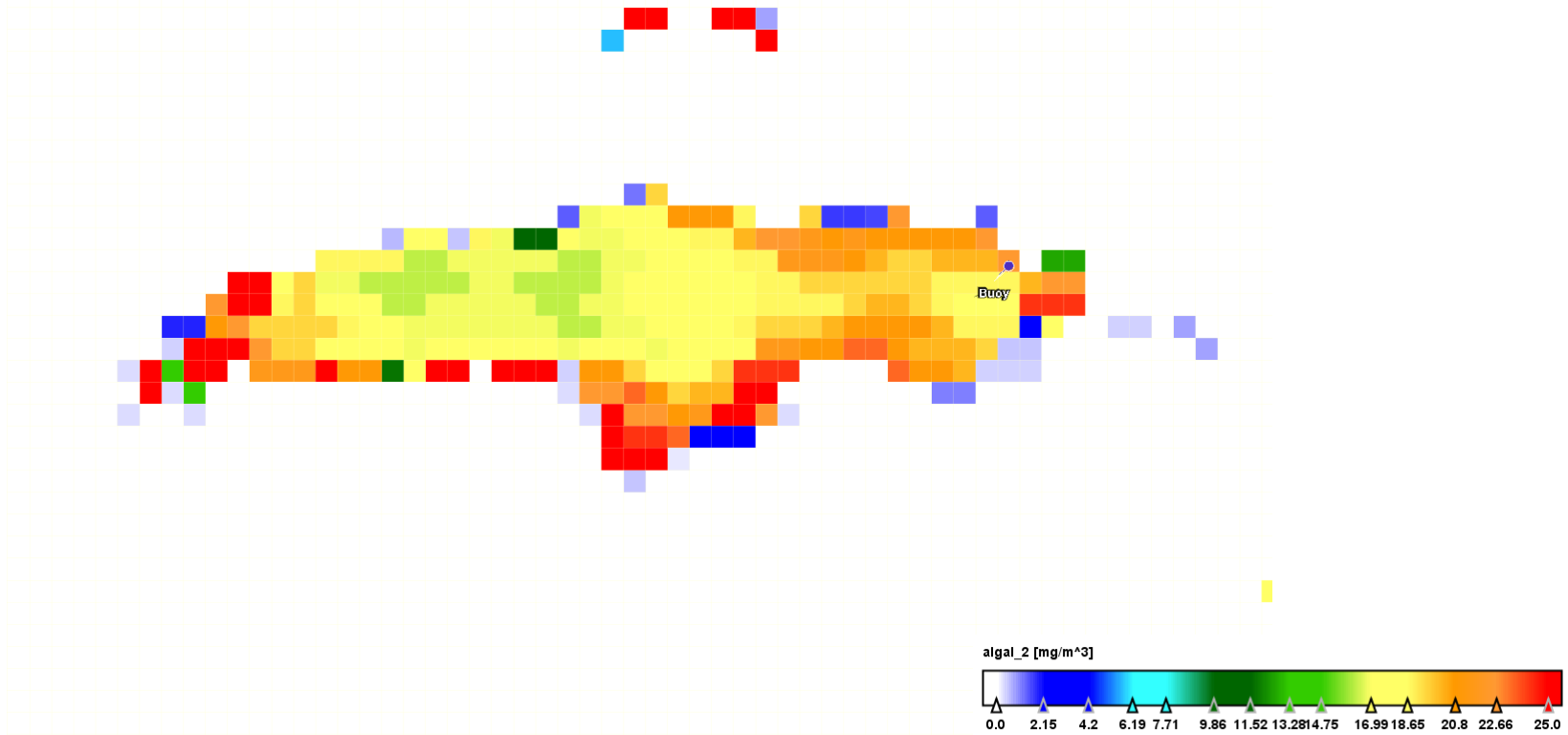


Algal2 (band 16) color-coded image showing chl-a levels (mg/m3)
Corresponds to the geometry in the above map.

Image processing using BEAM and ArcGIS. Image exported to GeoTIFF

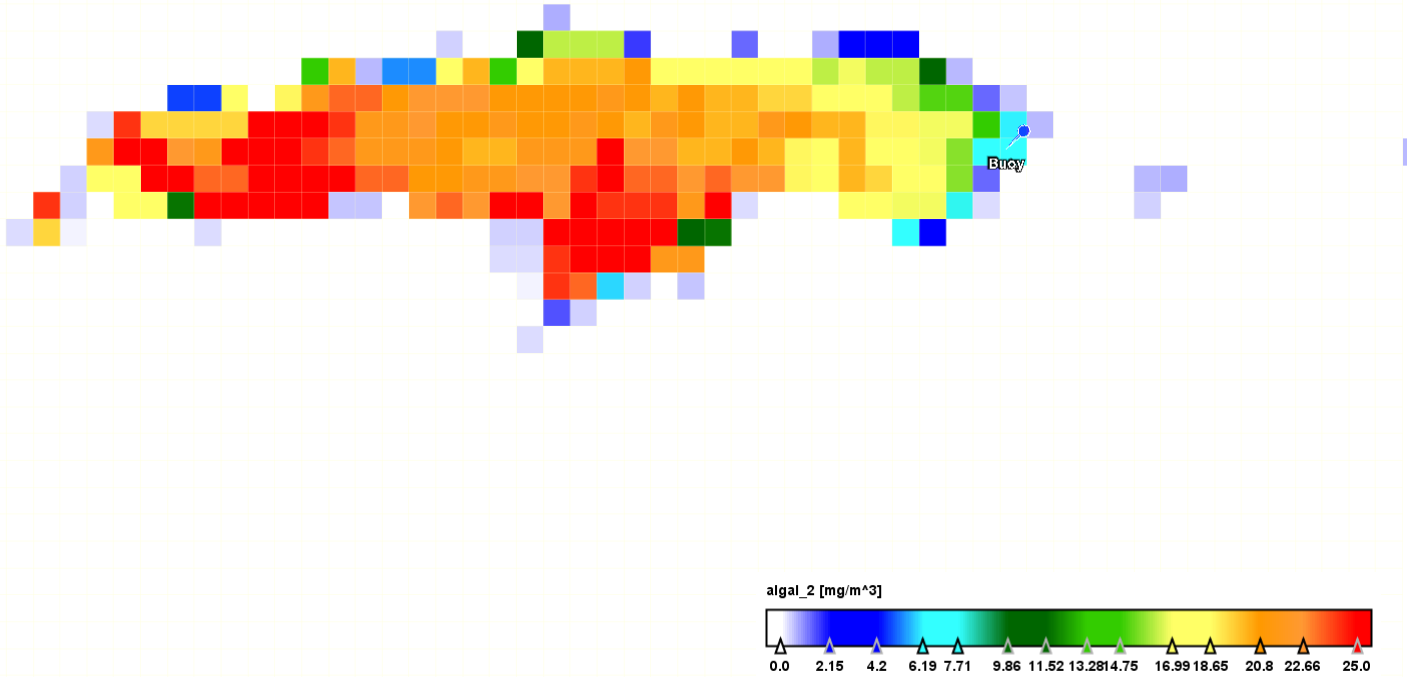
Algea consentration in the Goczalkowice Reservoir using MERIS

MERIS Alg 2010 June 5 (test image)



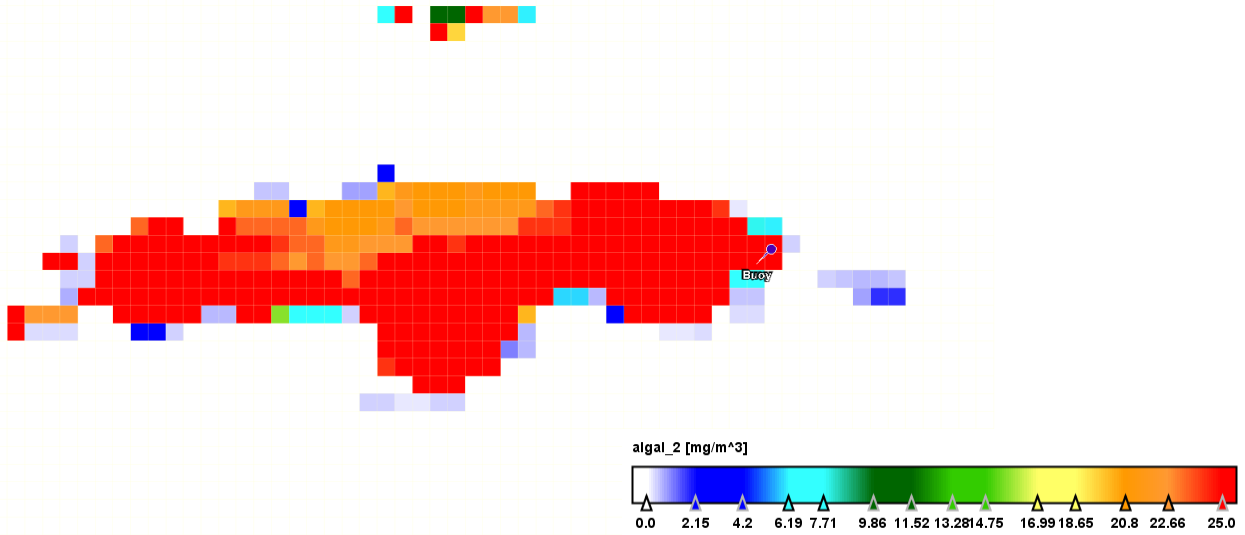
Algea consentration in the Goczalkowice Reservoir using MERIS

MERIS Alg 2010 July 21 (test image)



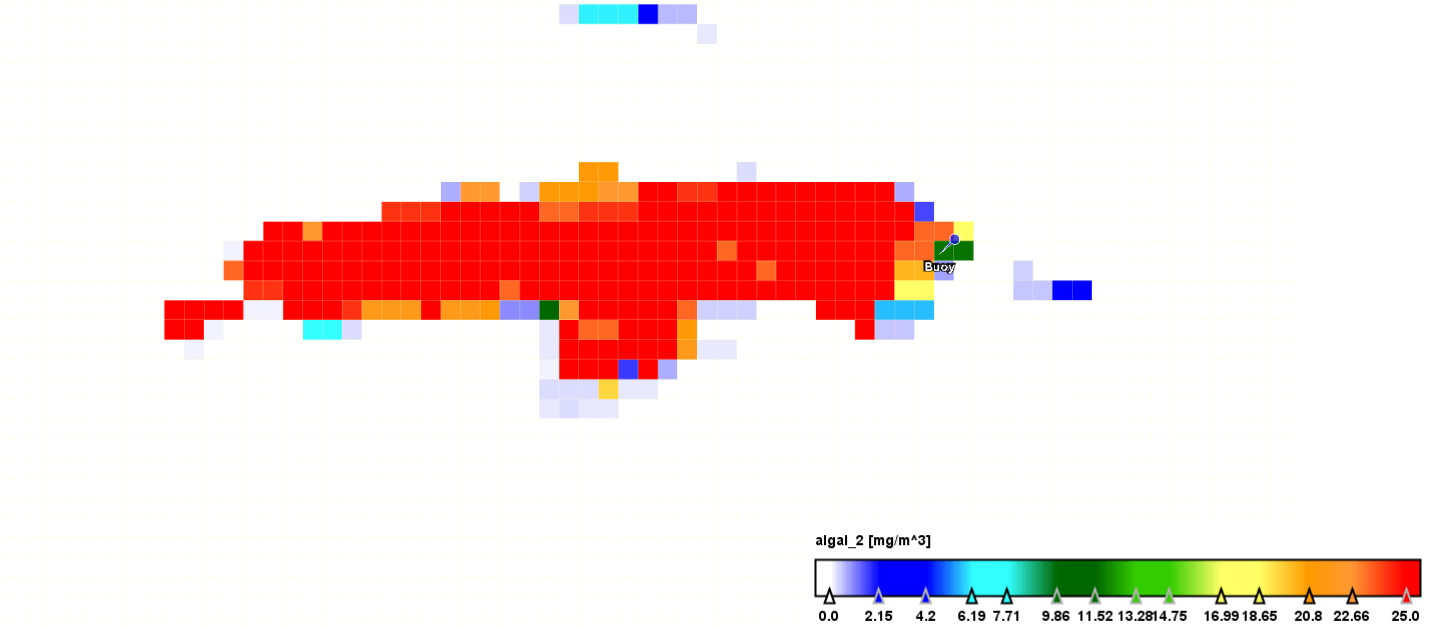
Algea consentration in the Goczalkowice Reservoir using MERIS

MERIS Alg 2010 August 22 (test image)



Algea consentration in the Goczalkowice Reservoir using MERIS

MERIS Alg 2010 September 23 (test image)



LANDSAT-8 measuring particles in the Goczalkowice Reservoir

- Landsat 8 data are provided in GEOTIFF format in tiles of ~185x180 km, and can be acquired free of charge from e.g. landsat8portal.eo.esa.int
- ACOLITE (Atmospheric Correction for OLI 'lite') is a binary distribution of the Landsat-8 (L8) / Operational Land Imager (OLI). Acolite is developed by Royal Belgian Institute of Natural Sciences.

Landsat-8 is excellent for coastal and inland water monitoring, thanks to 30 m resolution and good SNR.

- 16-day track repeat, complements moderate resolution data
- two atmospheric correction schemes were developed at RBINS, using the red+NIR band (VR2014) and the SWIR bands (VR2015).

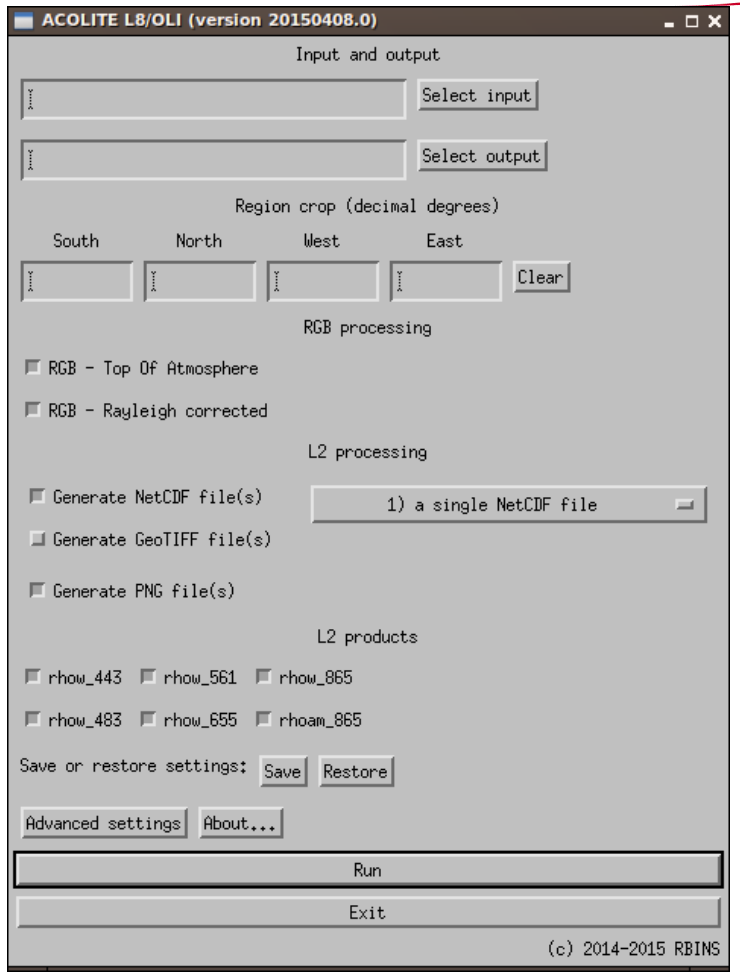
With (very) high resolution imagery:

- Remotely sensed water quality information near the coast and in inland waters (WFD!)
- Small scale features are resolved in coastal and inland waters: e.g. sediment transport, human impacts, algal blooms.

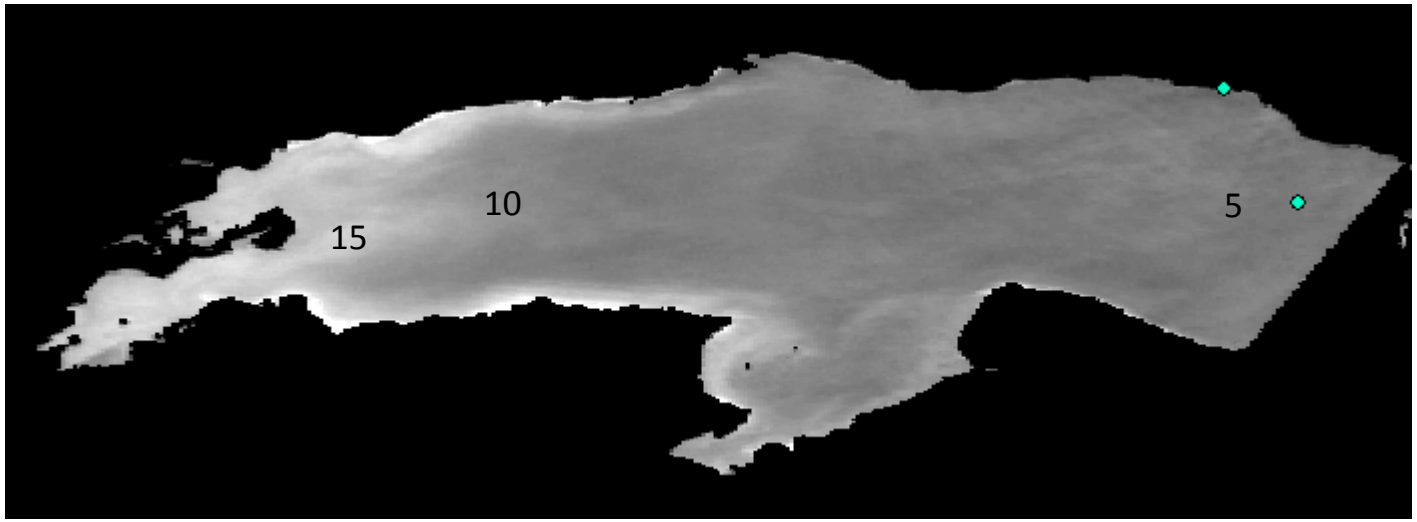
Akolite software for processing Landsat-8 images

ACOLITE

- Fast L8 image processing
- full tile or cropped to region
- batch mode option
- Makes RGB images
- TOA or Rayleigh corrected
- Pan-sharpening
- V&R NIR or SWIR atmospheric correction
- Output in NetCDF / GeoTIFF / PNG
- Possible outputs:
- marine reflectance
- aerosol reflectance
- extra: rtoa, rrc**, spm**, t, chl_oc, fai, ndvi …



LANDSAT-8 / Acolite SPM (mg/l) 20 August 2015



Values in test image correspond with in situ measurements

Costal areas tend to be high due to shallow water

Satellite monitoring of small lakes - challenges

- “New application” – high resolution
- Noise - weak signals from water (compared to land)
- Difficult signals along shoreline
- Clouds – for Europe: 1 day every 2 weeks cloud free.
- Problems with atmospheric correction / local conditions
- Mountain shadows
- Forest reflection

Satellite monitoring for CRIS - summing up

+ Quick overview
+ Visually integrated with other data/maps
+ Support model outputs
+ Validate models
+ Free of charge
+ Increasingly better resolution
+ Parameters supporting WFD

− Needs cloud free weather
− Not real time
− Manual inspection required
− Needs calibration from in situ measurements

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