Copernicus Hackathon challenge
Watching our Water from Space

Lake Erie USA, 2011 MERIS (7,5,2 RGB)

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Introduction

Coastal and maritime tourism is the largest maritime activity in Europe and employs almost 3.2 million people, generating a total of € 183 billion in gross value added and representing over one third of the maritime economy.

In Sweden there is about 96 000 lake ranging from lake Vänern the largest in the European union to small size lakes than are two acres. The scale of economic dependency on lakes and water bodies gives an indicator of the extent of the ecological damage that can be caused by human activities. A comprehensive water quality monitoring system is essential to guarantee sustainable use of water resources. Water quality monitoring for large scale water bodies is a challenging operation that can be expensive and time consuming.

Satellite imagery availability in both public and private domains and the rapid development in cloud computing infrastructure and big data analysis algorithms and technique are providing opportunities to various stakeholders to utilize such developments. Local authorities, state level intuitions, and private entities can benefit from portals, applications, and services that provides near to real time observation, analysis and prognosis on water quality status.

Background

An example of water quality monitoring application is measurement of algal bloom in spring and summer. Harmful algal blooms (HABs) occur when algae — simple photosynthetic organisms that live in the sea and freshwater — grow out of control while producing toxic or harmful effects on people, fish, shellfish, marine mammals, and birds. Such blooms my result in higher cost for the community's lives alongside lakes and coastal areas in shape of higher cost to treat drinking water, preventing people from enjoying fishing swimming, and visiting the shoreline which would affect the tourism industry. Despite algal bloom being a natural phenomenon but some conditions as rising seawater temperature and high nutrient loading from fertilizers (due to agricultural activities) can favor and intensify algal blooms.

How to measure from space

Remote sensing of water bodies relies on the varying color of natural water that corresponds to different spectral reflectance, assuming that these variations depend on the water constituents. Visible and near infrared are the commonly used to create models that estimate biological quantities based on measurement from instruments carried on earth observation satellites.

Indices to measure

- Chlorophyll a concentration
- Density of cyanobacteria
- Water turbidity

The challenge

The goal of this challenge is to utilize the publicly available earth observation data (especially from ESA's Copernicus program) to develop solutions to help varies stakeholders to mitigate and adapt with the increase occurrence and intensity of harmful algal bloom. Integration of space generated data with measurements from the ground by volunteering citizen, governmental worker, or private sector.

- The technical part of the challenge
  - Acquire the proper (calibrated) satellite imageries and calculate water quality indices.
  - Develop an early alert system that provide near real time alert base on risk level (green, yellow, red).
  - Add a tool to facilitate integration of in-situ measurements.
  - Build a platform (web portal, app, etc.) to present the data.
- Business solution
  - Identifying the potential users with emphasis on introducing users from outside the public sector
  - Designing a format that reduce the complexity of the data sets and algorithm that backing the solution
  - Highlighting the added value of the solution in comparison to available solutions

Data
Sentinel-2 (a, b) and Landsat-8 imageries are to be used in this challenge. The data is available as part of ONDA DIAS archive.

Computing infrastructure
Virtual machines equipped with SNAP and QGIS software to process and manipulate satellite imagery. The virtual machines are also available for a period before the hackathon date to give the participants the opportunity to get familiar with the data and the tools.

Programming skills
Python, web GIS programming, and knowledge about Jupyter notebook are needed to complete the task.

Reference:

https://ec.europa.eu/maritimeaffairs/sites/maritimeaffairs/files/docs/body/coastal-and-maritime-tourism_en.pdf

http://www.un-spider.org/links-and-resources/data-sources/daotm-HABs

https://www.noaa.gov/media-release/noaa-partners-predict-large-summer-harmful-algal-bloom-for-western-lake-erie