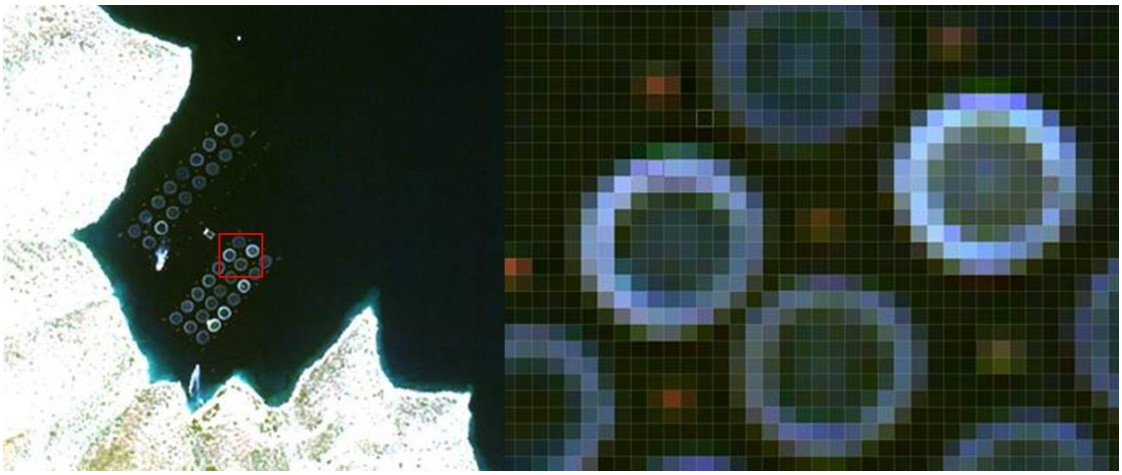

Deriving water quality indicators from high resolution satellite data using statistical models: application to aquaculture operations

MSc Internship supervised by Dr. Ghada El Serafy, Sandra Gaytan Aguilar, Lőrinc Mészáros, Anna Spinosa (to be confirmed)

Internship to take place at Deltares in Delft, The Netherlands (remotely, due to COVID-19)

Abstract

Satellite-based imagery is important for various environmental applications. Satellite remote sensing technology has been widely used to estimate ecological indicators in both marine and terrestrial ecosystems. Despite recent improvements, at present, the availability of high-spatial resolution water quality information in coastal zones is limited. In order to satisfy data needs for very-high resolution information on the coastal zone, more specifically at aquaculture operations, the derivation of water quality indices is required. The newly available very high resolution (~2 m) optical data can fill this knowledge gap, however, these datasets only contain spectral reflectances (wave lengths of the reflected light in various bands). Consequently, new so-called "band-math" or "spectral-math" algorithms should be developed to map the reflectance values into water quality indicators. These algorithms may range from simpler linear statistical models to non-linear machine learning models.

The findings of this Msc thesis will contribute to the HiSea project (https://hiseaproject.com/), which is an EU-funded project that aims to develop, test and demonstrate information services that provides high resolution data of water quality at sea. The services offered by HiSea will incorporate and process data that are being obtained through the marine, land and climate services of COPERNICUS (the EU Earth Observation and Monitoring service). The HiSea project will improve operation, planning and management of different marine activities, with a focus on the usage in the port and aquaculture sectors.

In this MSc thesis, the student will review existing spectral math algorithms, with special attention devoted to similar applications. The techniques will be assessed and compared in terms of their advantages and limitations (assumptions, accuracy, understandability, speed). The identified methods will be applied to the high-resolution data set at hand. The workflow includes discovery and download of datasets, calibration and validation of algorithms.

Keywords: statistical models, spectral-math, satellite remote sensing, high-resolution, environmental data

1. Methodology

1) Literature review on state-of-the-art spectral math techniques (e.g. map existing methods, algorithms, tools) mainly.

2) Comprehensive assessment and comparison of identified techniques in terms of their advantages and limitations.

3) Collection and sorting of various relevant remote sensing data sources and products within a selected case study area. Investigation into the spatial and temporal variability within collected data sets including its quality. Preparing an inventory of training, and validation datasets including indicators.

List of potential satellites (to be reviewed):

Satellite name	Spatial Resolution
Pleiades	2.8 m (Multispectral), 0.7 m (Panchromatic)
SuperView	
WorldView	1.24 m (Multispectral), 3.7 m (short wave infrared resolution [SWIR])
TripleSat	3.2 m (Multispectral), 0.8 m (Panchromatic)
Spot 6	6 m (Multispectral), 1.5 m (Panchromatic)
Kompsat	1.6 m (Multispectral), 0.4 m (Panchromatic)

List of potential indicators (to be reviewed):

Indicator group	Indicators
Basic indicators	
	Chlorophyll-a concentration
	Total Suspended Matter
Other optical properties	
	CDOM
	KD90
	PAR
	Fluorescence line height (FLH) INDEX
	MERIS maximum chlorophyll (MCI) INDEX
Indicators of algal bloom events	
	Floating Algal Index (FAI)
	Cyanobacteria Index (CI)
	Red Tide Index (RTI)
	Red Band Difference Index (RBDI)
	Karenia Brevis Bloom Index (KBBI)

4) Application of selected techniques on relevant remote sensing data. Assessment of the accuracy level of the methods as well as problems and future trends associated with these methods.

2. Deliverables

1) Report on spectral math techniques for marine water quality data. Assessment of the current state of the art methods for deriving water quality indicators from optical remote sensing data.

2) A database or repository containing identified relevant remote sensing data sources and products.

3) Report on accuracy and comparison of applied techniques.

3. Relevant literature

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