
Spatiotemporal modelling & automated *in-situ* sensors to monitor Harmful Algal Blooms(HABs)



Case Study-Lake Victoria

Presenter:

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Introduction

- Toxic Cyanobacteria-rich Harmful Algal Blooms (CyanoHABs) , a phenomenon in which the water body e.g. lakes turns **dark blue-green** due to excessive algal growth; potentially **harming humans and animal**, e.g., Unsightly nuisance, acute liver damage when ingested, irritation, **fish deaths**, etc.
- WHO
- Hence, quantifying the **spatial distributions of CyanoHABs** in L. Victoria on a regular basis is of great significance, which requires high spatiotemporal resolution monitoring abilities- (Sitoki et al., 2012)
- There however exists that niche to support the space observations with a near-real time **geointelligent in-situ monitoring** and **reporting system**.

Problem statement

- The **rapidly escalating demographics** along L. Victoria riparian reserves has negatively impacted water quality through deposits of agricultural, industrial runoff and sewer refuse **eutrophicating** the said region. (Burkholder et al., 2006; MOH)
- Deterioration in water quality initiates ecosystem conflicts, poor economic growth, reduced tourism, poor water quality furthermore baring achievement of **SDG 6 & 14**- Clean Water and Sanitation.
- **Coupling** wide spread spatiotemporal monitoring, and automated in-situ sensors will play a big deal in return. This would inform the **Govt. and the general public the affected zones**, calling for immediate remedy actions.

Justification



Image Source: Courtesy



General and specific objectives

- To monitor and report the occurrence of Harmful Algal Blooms(HABs) and Cyanobacteria in Lake Victoria.
 - To monitor chlorophyll-a(**chl-a**) concentration & Cyanotoxins from L8 OLI images.
 - To monitor Lake Surface Water Temperature(**LSWT**) from L8 TIRS images as another HAB indicator in L. Victoria.
 - To **develop** automated Internet of Things (IoT) *in situ* sensors, Applicable in near real-time to monitor and report **geo-tagged** Water quality data.

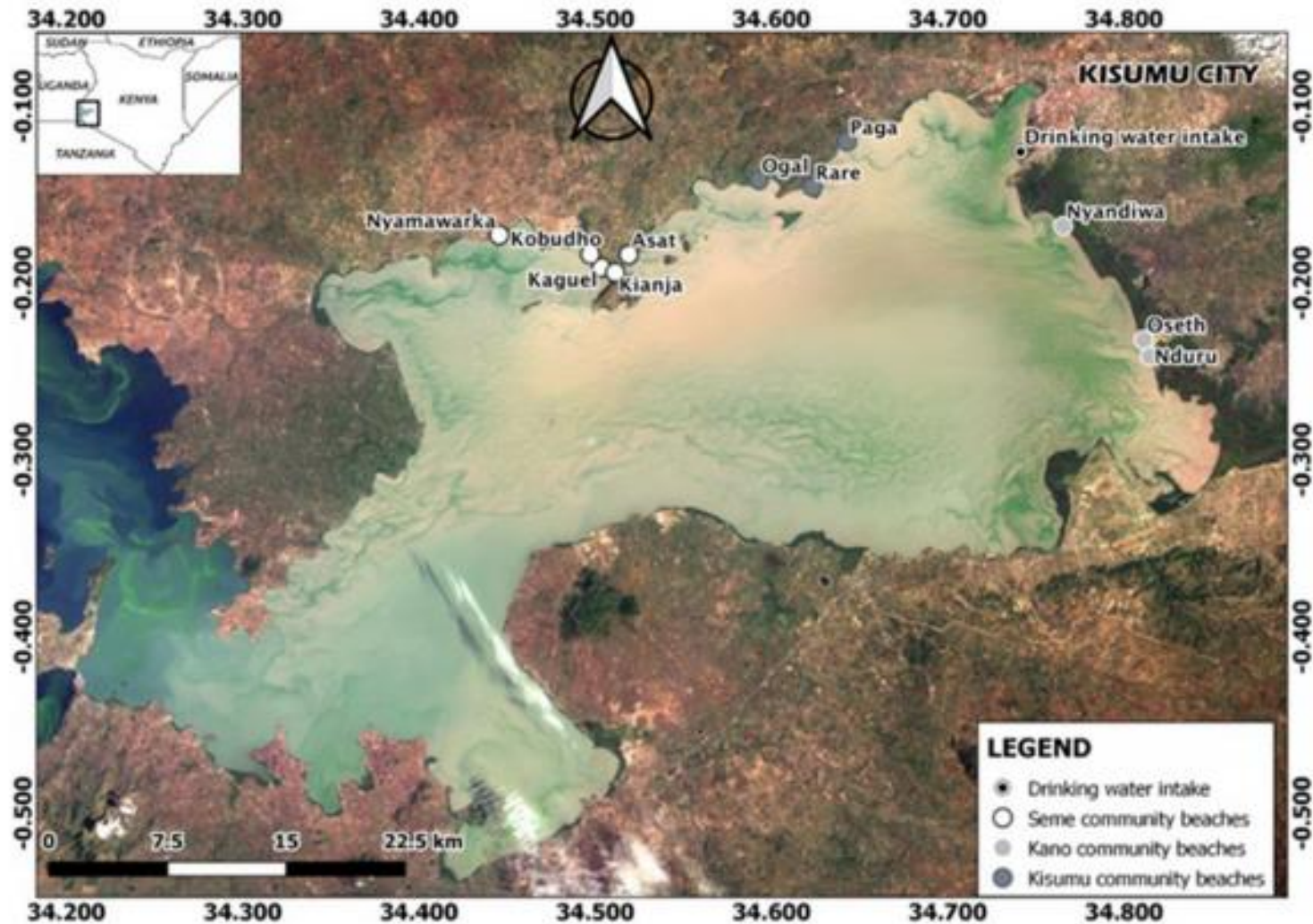


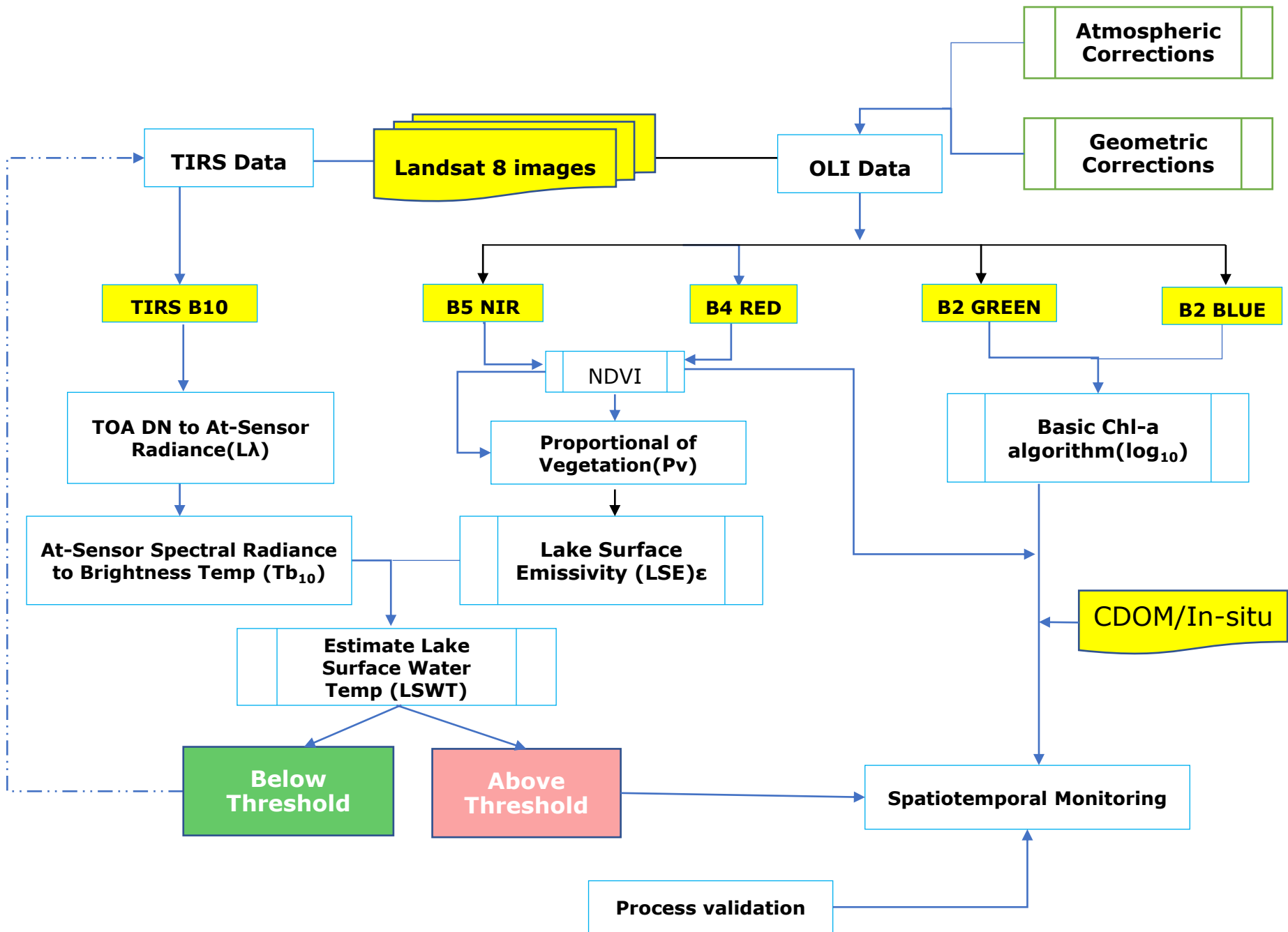
Overall Methodology : Data and Materials

Data Type	Source	Role/Use
Landsat 8 OLI (30m, 16 days)	Google Earth Engine (2015-2020)	Spatiotemporal HAB Monitoring
Landsat 8 TIR (100m, 16 days)	Google Earth Engine (2015-2020)	Lake Surface Water Temperature Monitoring(LSWT)
Meteorological Data	Kenya Marine & Fisheries Research Institute-KMFRI (2015-2020)	Water Quality assessment
Shapefiles	Geodatabase of Global Administrative areas-GADM	Delineate the Study area
In-Situ Data	In-situ Sensors 2021 Onwards	Continued In-Situ Algal Monitoring

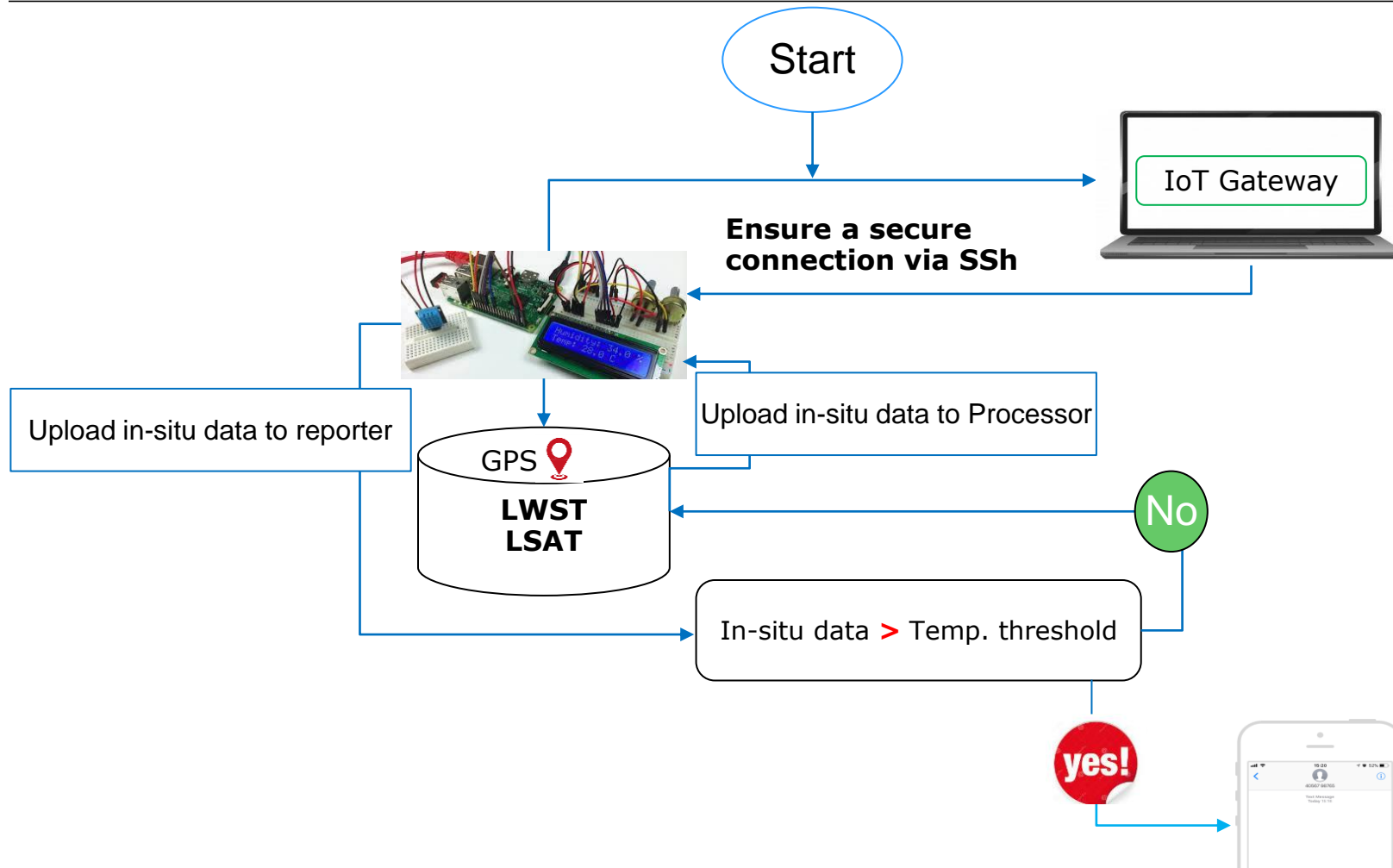
Tool/Material	Role	Availability
Google Earth Engine (GEE)	Geocomputation & Processing	Freely Available
QGIS, R & Python	Further Analysis & Maps	Free
Microcontroller & Sensors	In-Situ data Monitoring	Local Purchase
KiCAD	Design the Schematics & basic Circuits	Free & Open source

Study Area





Overall methodology

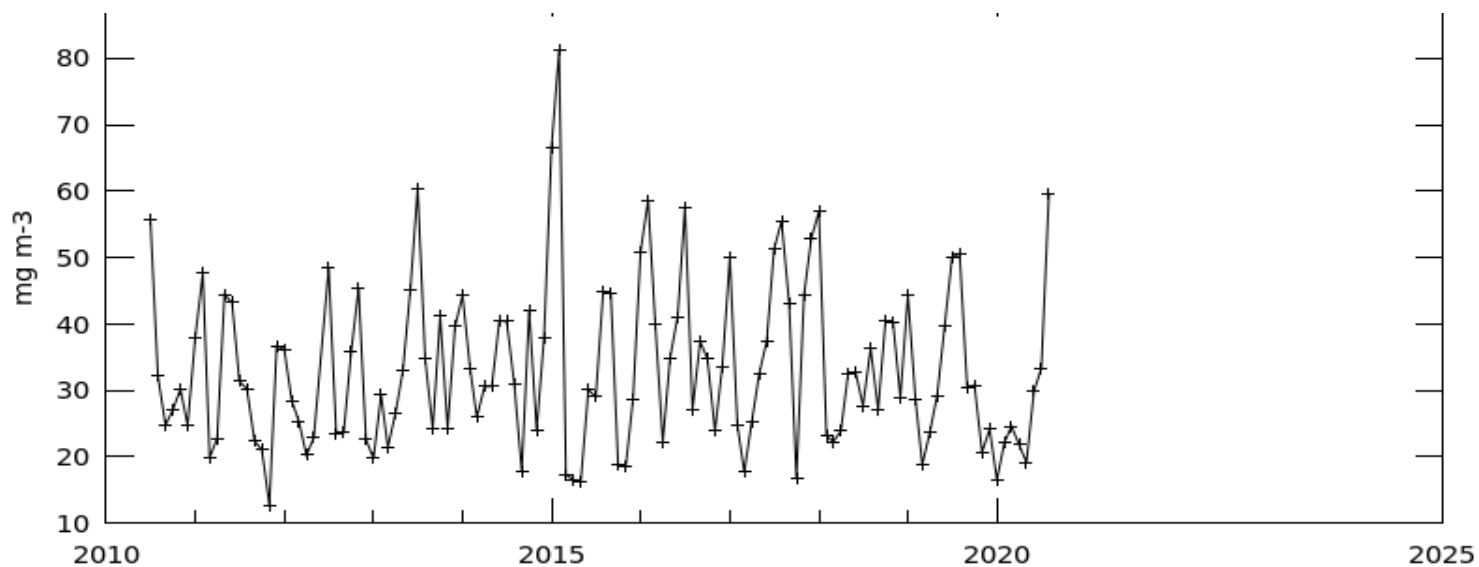
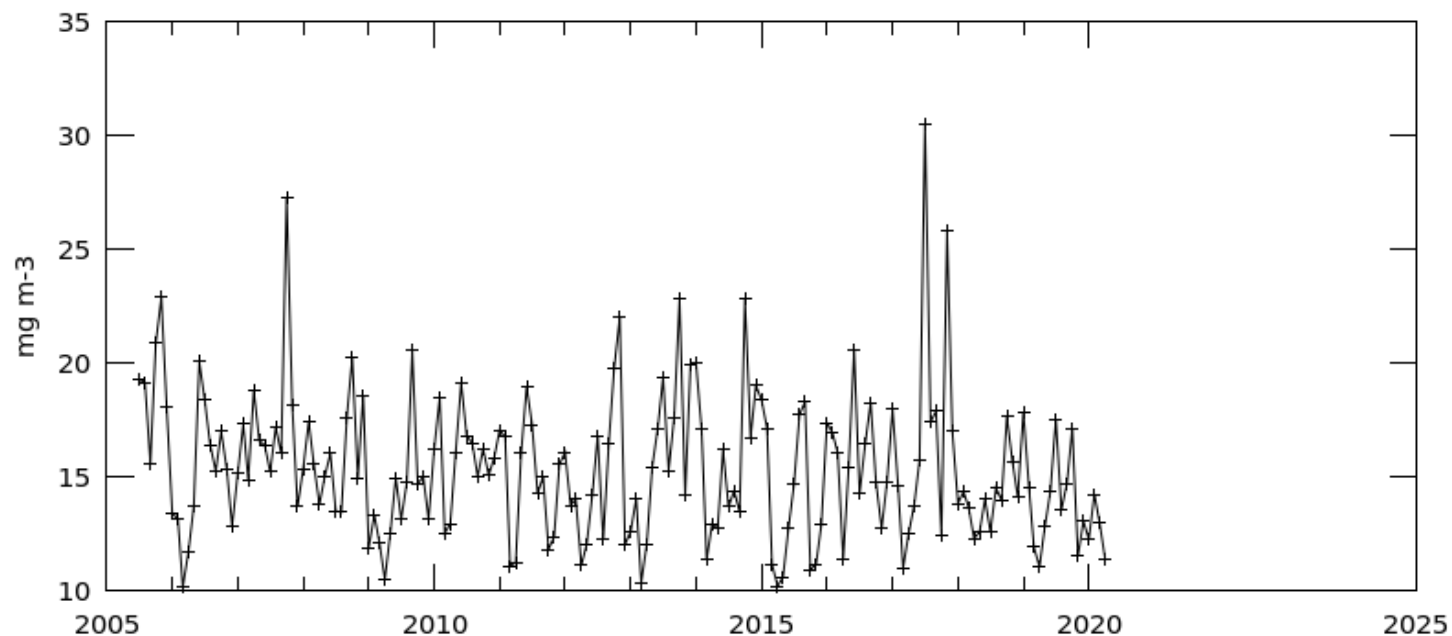




Expected Results

- I. Chlorophyll-a Geographical **Maps** associating the occurrence of the Harmful Algal Blooms and Cyanobacteria.
- II. Lake Surface Water Temperature(**LSWT**) Maps associating the presence of HABs.
- III. **Autonomous** system that monitors and reports **geo-tagged** data in near-real time the ***in-situ* status** from the sensors.

SAMPLE RESULTS: Time series Average of Chl-a conc. monthly 4-Km MODIS L3m



Sample Results: Obtaining GPS Location for Sensors

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VNC Viewer
192.168.1.100
[Use Neo 6M GPS I
pi@raspberrypi:~$

File Edit Tabs Help

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VNC Viewer
192.168.1.100
[Use Neo 6M GPS I
pi@raspberrypi:~$

File Edit Tabs Help

pi@raspberrypi:~/192.168_micros/piStudios/NEO6M_Ublox $ nano neo6m.py
pi@raspberrypi:~/192.168_micros/piStudios/NEO6M_Ublox $ python neo6m.py
File "neo6m.py", line 14
SyntaxError: Non-ASCII character '\xe2' in file neo6m.py on line 14,
pi@raspberrypi:~/192.168_micros/piStudios/NEO6M_Ublox $ nano neo6m.py
pi@raspberrypi:~/192.168_micros/piStudios/NEO6M_Ublox $ y
bash: y: command not found
pi@raspberrypi:~/192.168_micros/piStudios/NEO6M_Ublox $ python neo6m.py
Traceback (most recent call last):
  File "neo6m.py", line 10, in <module>
    ser = serial.Serial(port,baudrate=9600,timeout=0.5)
  File "/usr/lib/python2.7/dist-packages/serial/serialutil.py", line 244, in __init__
    self.open()
  File "/usr/lib/python2.7/dist-packages/serial/serialposix.py", line 59, in open
    raise SerialException(msg.errno, "could not open port {}: {}".format(self._port, msg))
serial.serialutil.SerialException: [Errno 2] could not open port ...
pi@raspberrypi:~/192.168_micros/piStudios/NEO6M_Ublox $ nano neo6m.py
pi@raspberrypi:~/192.168_micros/piStudios/NEO6M_Ublox $ python neo6m.py
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Project Timeline

	June - July	August 	Sep	Oct	Nov	Dec
Chl-a	Literature Rev (Restructure)	Data Acquisition	Chl-a spatiotemporal Maps			
LSWT	Literature Rev (Restructure)		Chl-a spatiotemporal Maps			
IoT	Literature Rev. Acquire all sensors	Unit tests	Long Range comm.		Full Data Acquisition	

Thank you for your attention! Questions?

