Global Partnership for Sustainable Development Data

AfricaGIS 2019
Innovations in Geospatial Technologies for Ac
Sustainable Development Goals in Africa

AFRICA REGIONAL DATA CUBE

AfricaGIS 2019
18 – 22 November 2019

Mapping Lake Turkana Extent and Quality using the Africa Regional Data Cube (ARDC)

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Global Partnership for Sustainable Development Data; NASA Langley Research Centre; Kenya Space Agency

#AfDataCube @Data4S

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Mapping Lake Turkana Extent and Quality using the Africa Regional Data Cube (ARDC)

6 CLEAN WATER AND SANITATION

- Lake Turkana is the largest desert lake and lies on the Kenyan Rift Valley and ends in Ethiopia.
- Threatened by the construction of Gilgel Gibe III Dam in Ethiopia due to the damming of the Omo river, which supplies most of the lake's water.
- Need to monitor the water quality and extent of lake over time.
- Kenya Space Agency is using ARDC to map water extent and quality in Lake Turkana.

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CEOS Committee on Earth Observation Satellites

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Mapping Lake Turkana Extent and Quality using the ARDC

- The extents of Lake Turkana range from latitude 2.3248, 4.6859 and longitude 35.7751 to 36.7639
- The ARDC was used to monitor water quality and extent from Jan 2000 to Jan 2015.
- ARDC is able to help countries report on the water in terms of providing the statistics in water extent and quality (hot spots).

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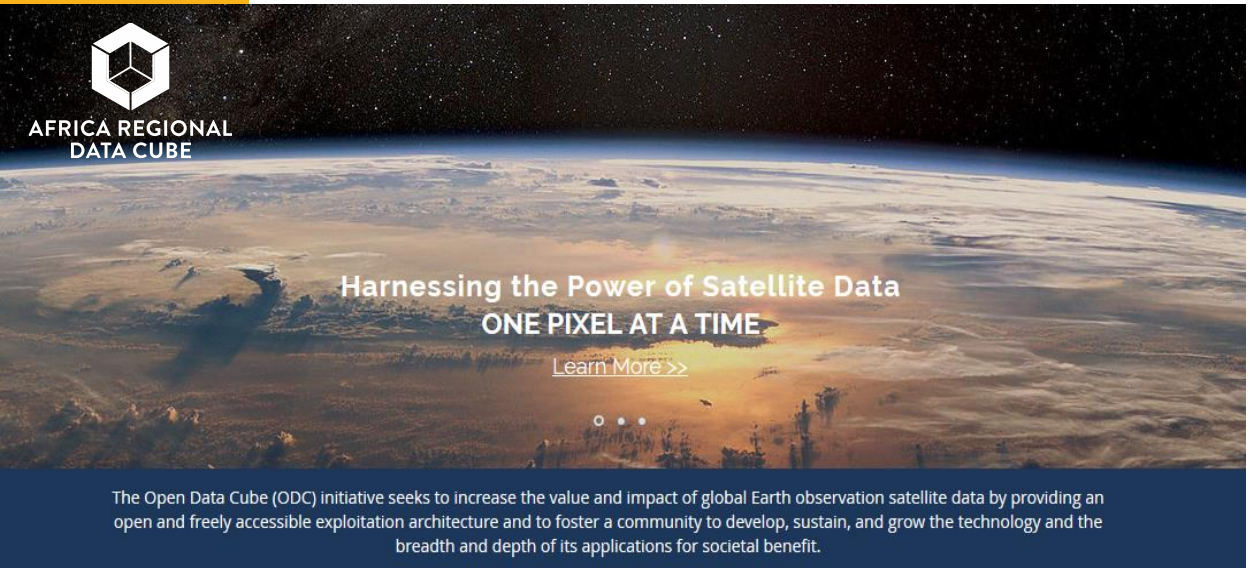
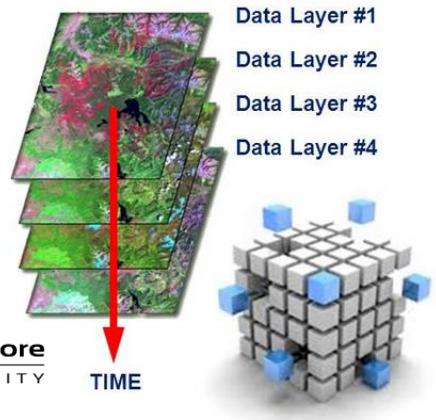
Africa Regional Data Cube - ARDC

A data cube provides analytically ready data across decades allowing for easily accessible geospatial analysis on key issues. The initial focus for the data cube was on algorithms to address priorities identified by GPSDD partners across **5 countries**:

http://52.54.26.108/

Ghana | Kenya | Senegal l Sierra Leone | Tanzania





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esa

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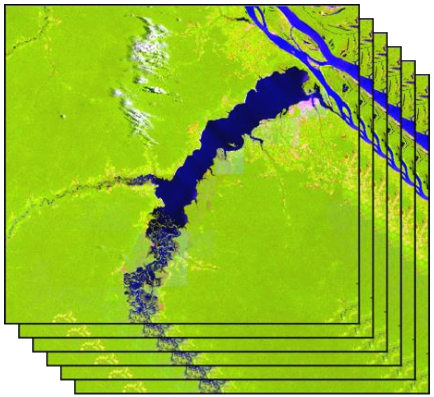
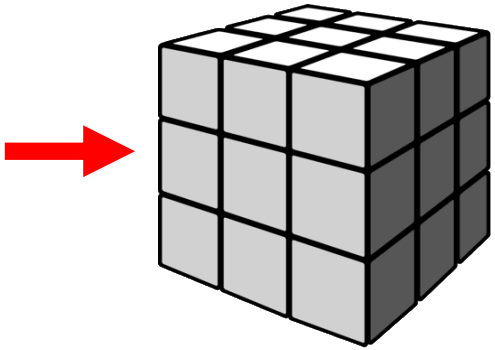
Mapping Lake Turkana Extent and Quality using the ARDC

Open Data Cube (ODC):
https://opendatacube.org

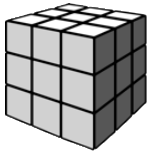
http://52.54.26.108/



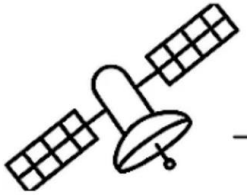
8000 Landsat images over 17 years



1000 Data Cube storage units (1° x 1° x 1 year) Processed and ready!



8x data compression



Satellite Analysis-Ready Data

Open Data Cube Infrastructure

Data Cube Core Code, API, Database and Index

Applications and Tools

Application Library
User Interface

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Mapping Lake Turkana Extent and Quality using the ARDC

- The ARDC give statistics on water extent: SDG 6.6.1 using the Australian Water Observations from Space (WOFS). *The algorithm is significantly better than the Landsat QA water flag or the NDWI index for water identification.*
- The ARDC provides an overview of water quality: total suspended matter (TSM) and chlorophyll contributing to SDG 6.3.2

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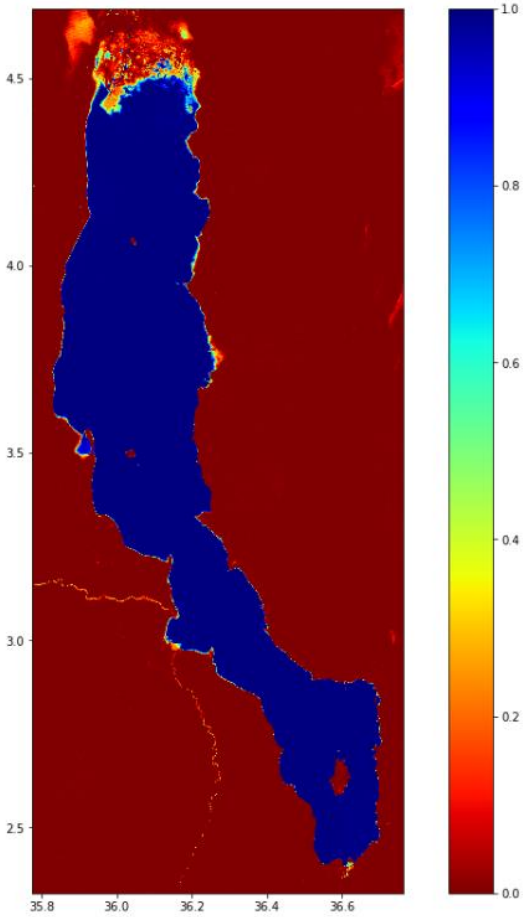
Mapping Lake Turkana Extent using the ARDC



The results show the percent of time that a pixel is classified as water over the entire time series. BLUE = frequent water, RED = infrequent water.

The water extent analysis spanned a period of 15 years (from 2000 to 2015)

The ARDC was able to detect changes in water extent – SDG 6.6.1

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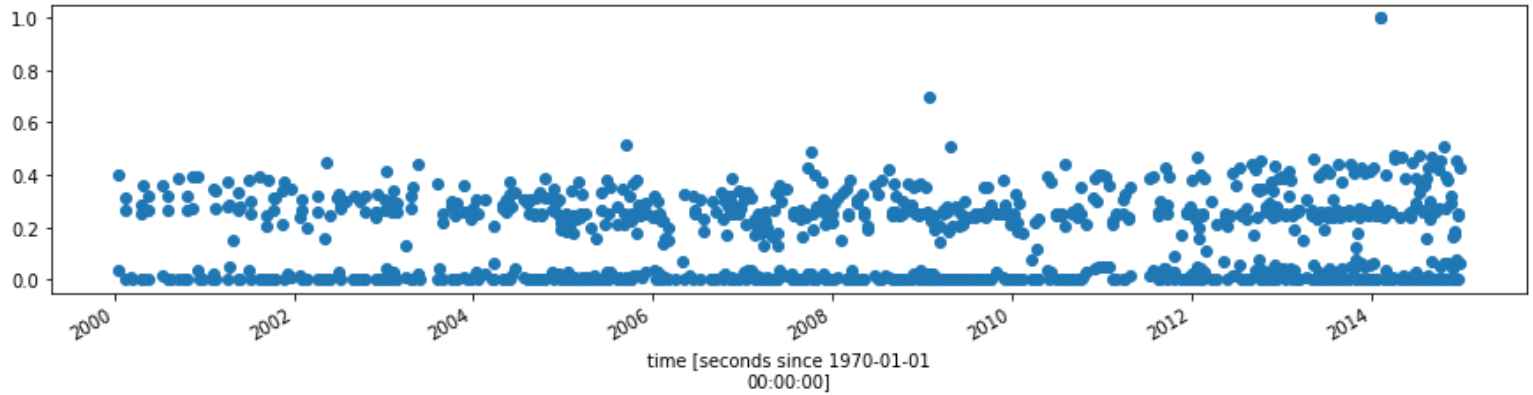
Mapping Lake Turkana Extent using the ARDC



Here we plot the percentage of valid (non-cloudy) pixels that were identified as water for each time slice from 2000 to 2015.

This gives an idea of water variability in the lake for the 15 years due to climate changes etc.

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Mapping Lake Turkana Quality using the ARDC

- The ARDC uses reports on Total Suspended Matter and Chlorophyll-A on water quality
- We used Landsat 8 from Jan 2015 to Dec 2017 for water quality analysis.
- The water extent analysis spanned a period of 15 years (from 2000 to 2015) using Landsat 7 satellite data.
- The ARDC was able to detect changes in water quality – SDG 6.3.2

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Mapping Lake Turkana Quality using the ARDC

- Change in Water Quality – Chlorophyll concentration – Jan 2015 to Dec 2017 using NASA Ocean Colour Chlorophyll-A OC3 Algorithm
- This will guide ground validation for Water quality

Assumes use of Landsat-8 bands
Equation uses the largest of B1 or B2 (blue)
Concentration in mg/m^3
CLA = Chlorophyll-A
Band ratio Blue (B1 or B2) to Green = BG = (B1 or B2) / B3
* add logic to find maximum B1 or B2 later

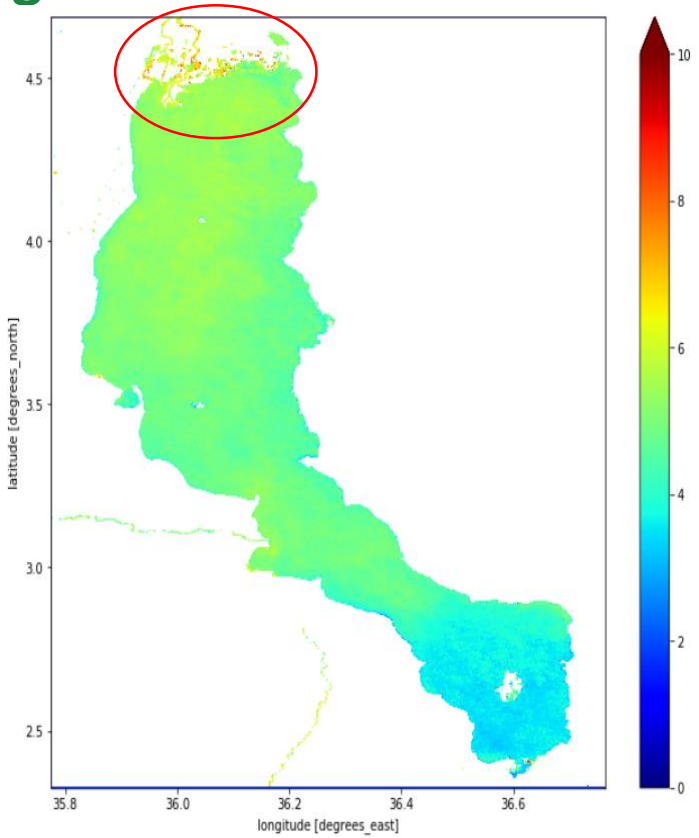

Figure: NASA Ocean Colour Chlorophyll-A OC3 Algorithm

Mapping Lake Turkana Quality using the ARDC

- Change in Water Quality – Chlorophyll concentration – Jan 2015 to Dec 2017 using Watanabe Chlorophyll-A (CLA) Algorithm

Tested using Landsat-8 OLI instrument

Concentration in mg/m^3

NDCI = Normalized Difference Chlorophyll Index

NDCI = (Red - Green) / (Red + Green)

CLA = 693.57 (NDCI) + 40.701

- This will guide ground validation for Water quality

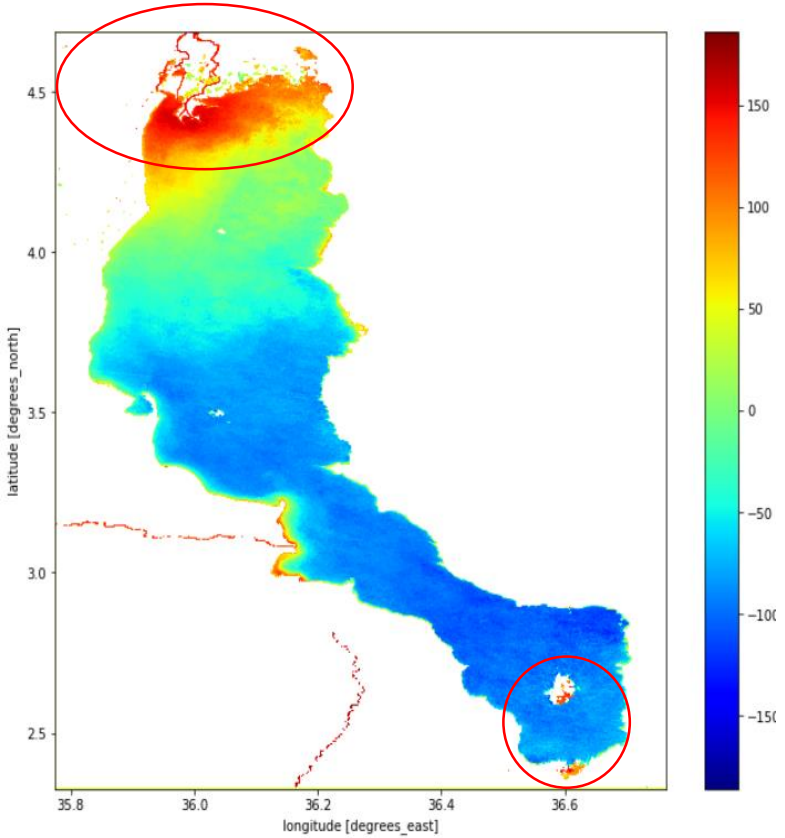

Figure: Watanabe Chlorophyll-A (CLA) Algorithm

Mapping Lake Turkana Quality using the ARDC

Change in Water Quality – Chlorophyll concentration – subset: latitude = (4.3741, 4.6793), longitude = (35.8751, 36.2755)

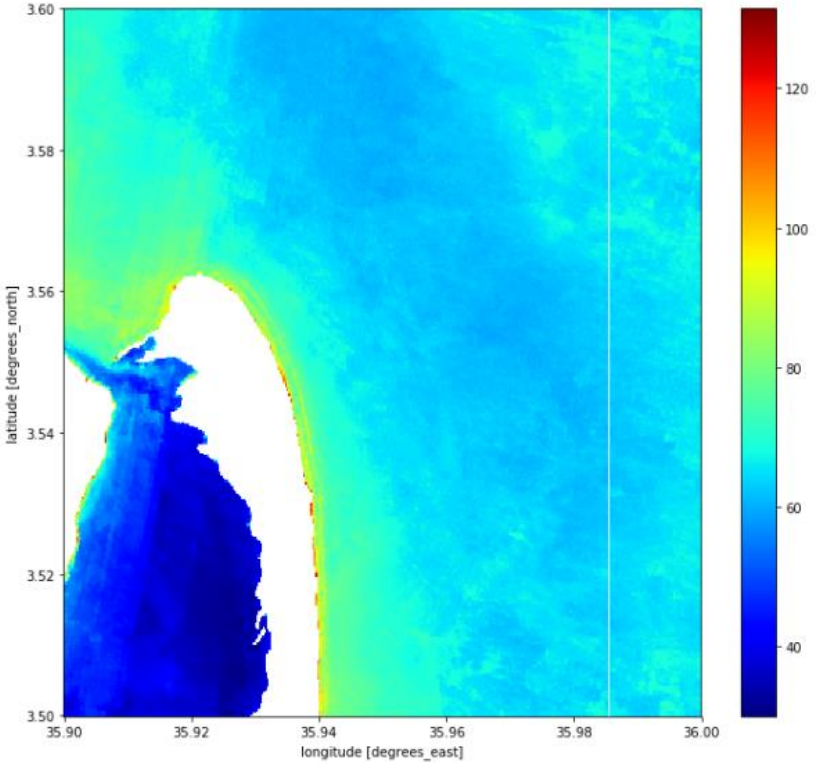

Figure: Lymburner TSM

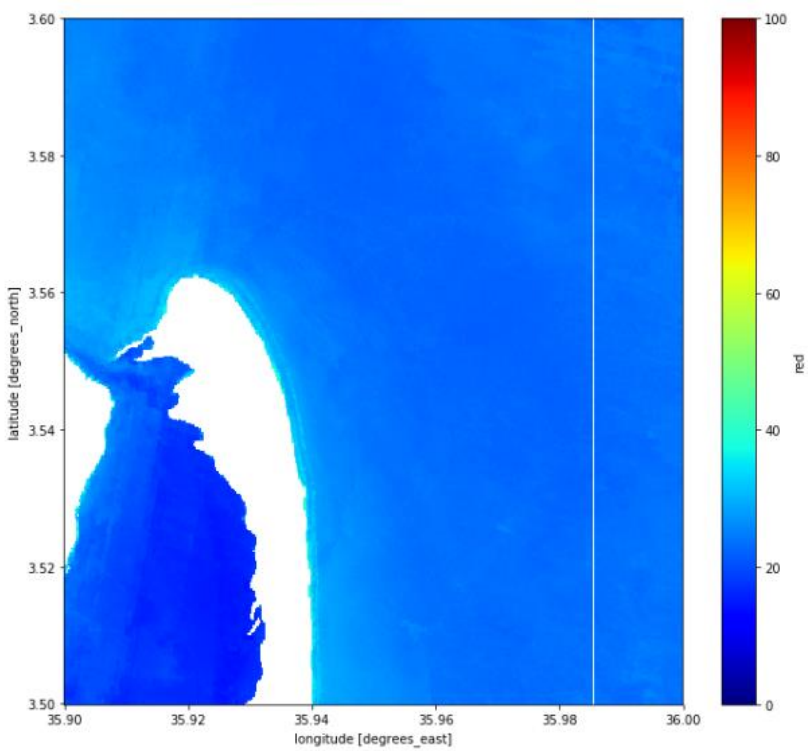

Figure: Quang Total Suspended Solids (TSS)

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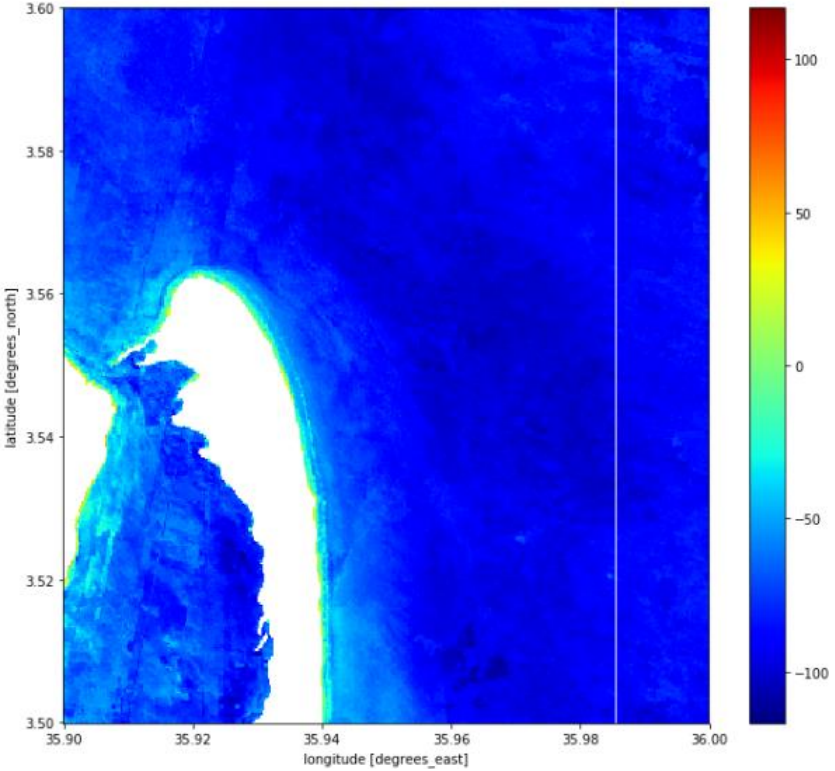

Figure: Watanabe Chlorophyll-A (CLA) Algorithm

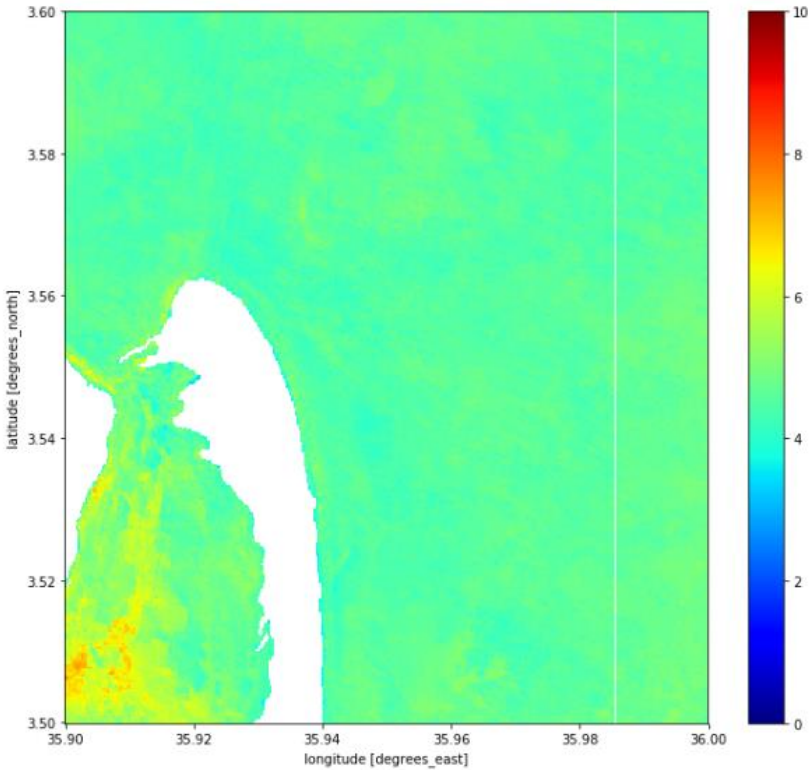

Figure: NASA Ocean Color Chlorophyll-A OC3 Algorithm

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Not secure | www.data4sdgs.org/resources/ardc-lessons-learned-one-year-post-launch

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ABOUT COUNTRIES PARTNERS RESOURCES INITIATIVES SDGS

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RESOURCES

ARDC Lessons Learned One Year Post-Launch

http://www.data4sdgs.org/resources/ardc-lessons-learned-one-year-post-launch

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The Africa Regional Data Cube (ARDC), based on the Open Data Cube infrastructure, is a technological innovation that layers 17 years of satellite imagery and Earth observation data for five African countries: Ghana, Kenya, Senegal, Sierra Leone, and Tanzania. It stacks imagery across a time series and makes the data – which is compressed, geocoded, and analysis-ready – accessible via an online user interface and Python application notebooks. The ARDC was created in response to data needs and gaps identified by partner countries and based on examples of some countries' successful usage of Open Data Cube technology. It is a solution that can help address countries' respective needs and fill data gaps. However, once adopted as a solution, it takes a significant commitment of time and resources to effectively build capacity and increase use.

Join the conversation

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Conclusion

- ARDC is helping Kenya in monitoring water quality and extents.
- ARDC presents great algorithms for water: Water Observation from Space (WOFS) algorithm from Geoscience Australia and NASA algorithm on water quality.
- Currently working on validating some of the results using ground data and exploring partnerships to close data gaps..
- The results will help inform decision making in terms of natural resource management and SDG reporting 6.3.2 and SDG 6.6.1

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