Leveraging on open-source data and platforms to monitor water quality – A case study of Lake Naivasha, Kenya

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Kenya Space Agency

- Kenya Space Agency (KSA) established as a State Corporation on **24th February 2017.**
- **Mandate**
  - Promote, Coordinate and Regulate space related activities
- **Vision**
  - To utilize space for Kenya's economic and social development
- **Mission**
  - To develop and nurture a vibrant and viable domestic space industry

Strategic Plan 2020-2025

- Upstream (Space Engineering)
  - Infrastructure and capacity to launch satellites and locally develop satellites
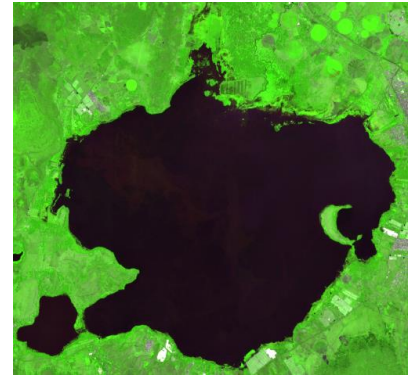- Downstream (Data)
  - Harness and utilize space-derived data to inform and guide the decision making process
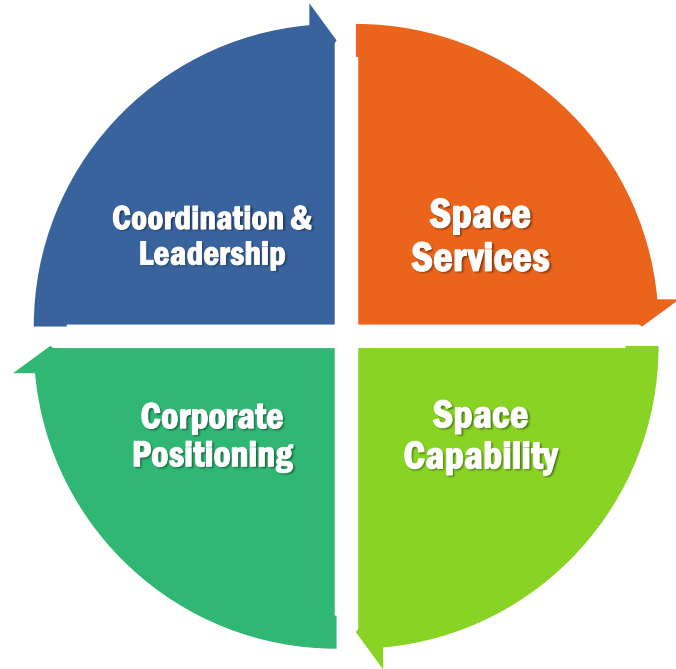
Background

❑ Remote sensing technology ~ mapping and monitoring land cover features.

❑ Water quality is affected by;
  ❑ Suspended solid particles, temperature, dissolved oxygen and human activities etc.

False color band composition (5, 6, 4)

❑ Multispectral Remote Sensing ~ can be used to determine water pixels and monitor the quality of inland waters via;
  ❑ Modified Normalized Difference Water Index - MNDWI
  ❑ Normalized Difference Vegetation Index - NDVI
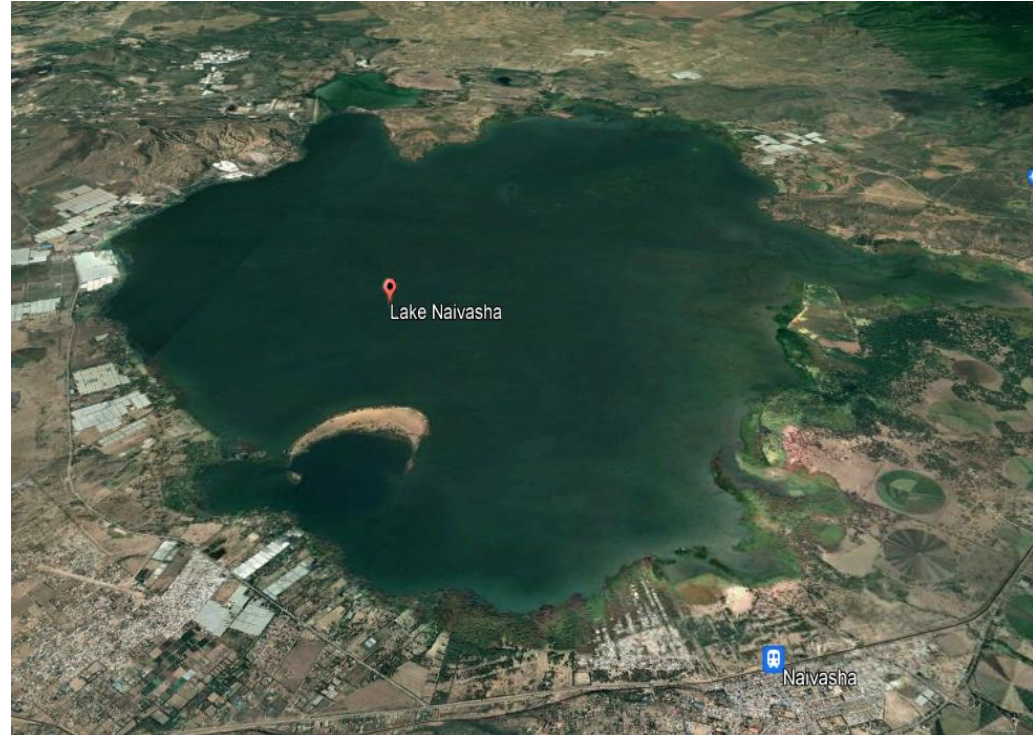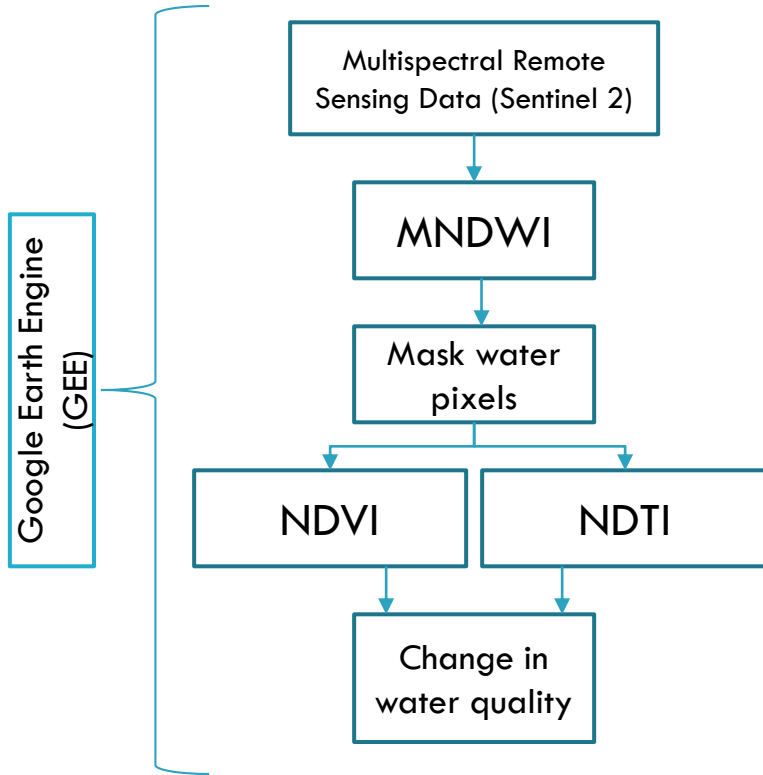 ❑ Normalized Difference Turbidity Index - NDTI

Water boundary as depicted from MNDWI

Area of study

□ Lake Naivasha is situated in the Eastern Rift Valley, covering approximately 150 km^2.

□ With the growing population around the region, the lake has come to face a number of challenges that influences the quality of water found in the lake.


Lake Naivasha
Naivasha

Methodology

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Google Earth Engine
(GEE)
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┌─────────────────────────────┐
│ Multispectral Remote        │
│ Sensing Data (Sentinel 2)   │
└─────────────────────────────┘
              ↓
┌─────────────────────────────┐
│          MNDWI              │
└─────────────────────────────┘
              ↓
┌─────────────────────────────┐
│       Mask water            │
│         pixels              │
└─────────────────────────────┘
        ↙           ↘
┌──────────────┐ ┌──────────────┐
│    NDVI      │ │    NDTI      │
└──────────────┘ └──────────────┘
        ↓             ↓
┌─────────────────────────────┐
│       Change in             │
│     water quality           │
└─────────────────────────────┘
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☐ Satellite image ~ Sentinel 2 for the year 2020

☐ MNDWI ~ Green band (B3) and Short Wave Infrared band (B11).

☐ From MNDWI water pixels are identified and masked together.

☐ NDVI ~ NIR (B8) and Red (B4) bands.

☐ NDTI – Red band (B4) and Green band (B3).

☐ Change in water quality is obtained through graphical variation of the three indices MNDWI, NDVI & NDTI values for the study period.

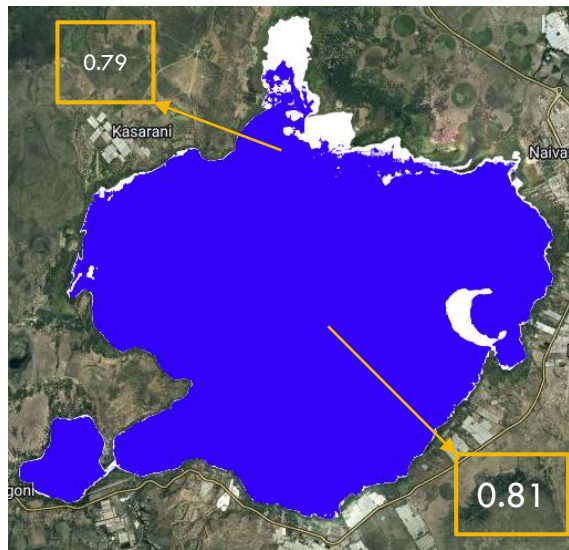# MNDWI, NDVI & NDTI variation graph

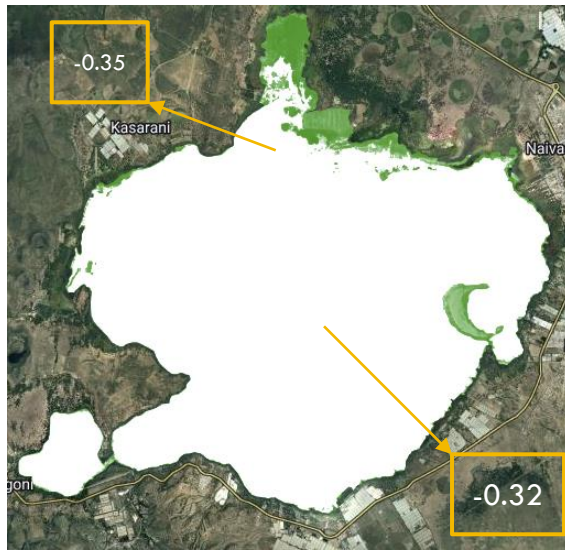Water Quality Time Series Chart
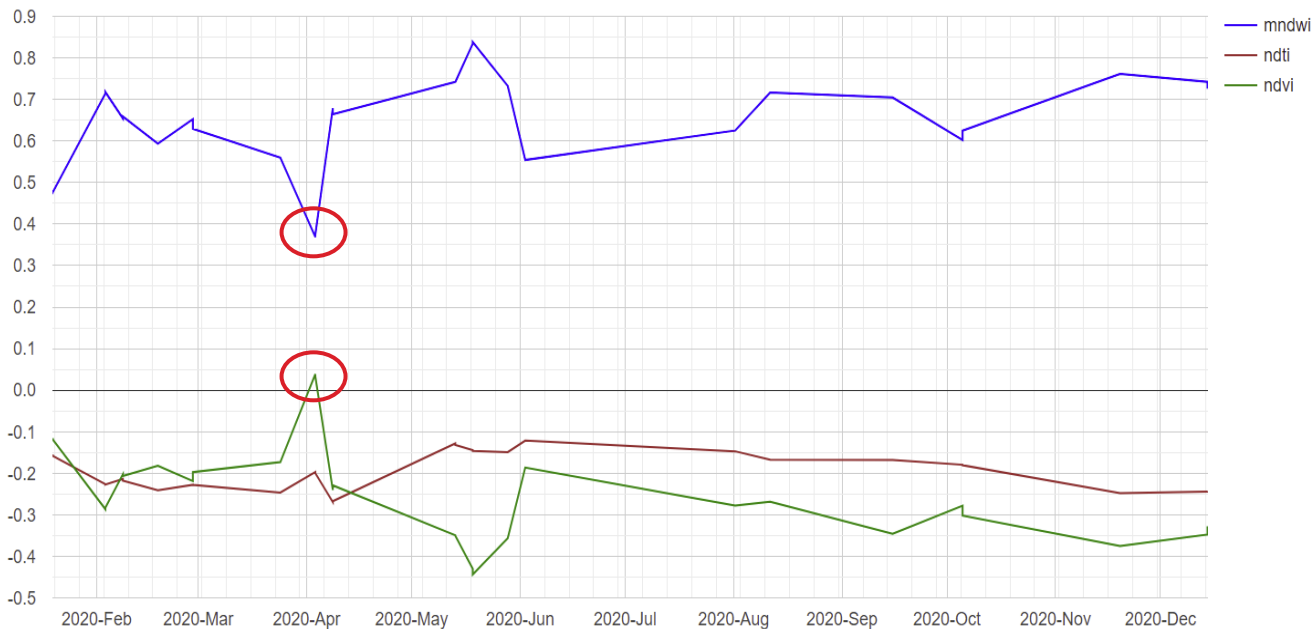
❑ For MNDWI ~ water > 0.5

❑ For NDVI ~ Water < 0.0

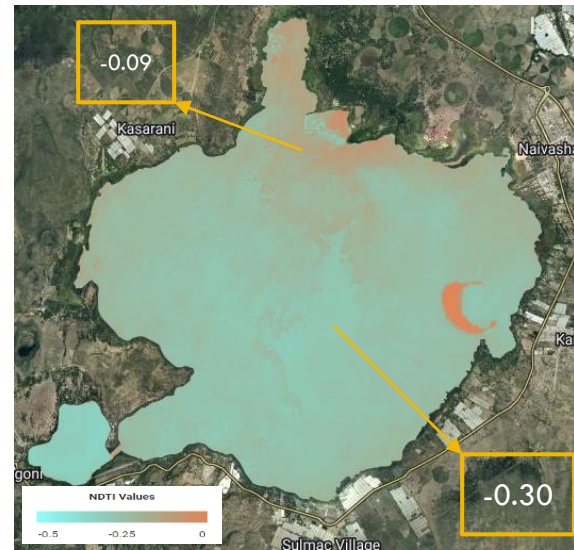❑ For NDTI ~ High turbidity >- 0.25< Low turbidity

MNDWI, NDVI & NDTI MAPS

MNDWI map

NDVI map

NDTI map

Discussion

❑ The month of April 2020 had the least MNDWI value at 0.374 and highest NDVI value at 0.039. This indicated the presence of suspended solid particles in the lake.

☐ The specific sampled regions depicted the difference in the quality of water found in the lake. First region had NDTI value of -0.090 indicating higher water turbidity whereas the second region had NDTI value of -0.30 indicating lower water turbidity.

Conclusion

- The MNDWI, NDVI and NDTI indices derived from satellite data are very useful in mapping water bodies and estimating the turbidity of water in a reliable manner.

- Based on the findings it can also be deduced that in the absence of ground observed data, remote sensing approach can be used for preliminary estimates of water quality.

Way forward..

- ☐ The use of turbidity parameter (NDTI) of remote sensing datasets for monitoring water to generate ancillary data to inform on the quality of surface water.

- ☐ The use of very high spatial, spectral and temporal resolution satellite imagery datasets to improve the accuracy of the remote sensing approach for water quality monitoring.

- ☐ Collaborating with other stakeholders in the water sector to scale up the project for all water bodies in the country.

Lake Naivasha, Kenya

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