



**Digital Earth
AFRICA**

**Digital Earth Africa helps assess
changes in water levels in Lake
Ngami, Botswana**

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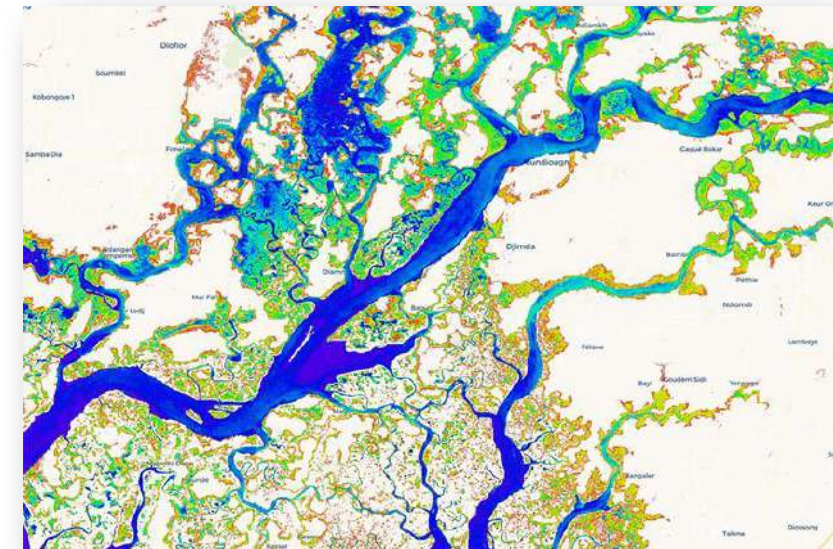
Dr. Kenneth Mubea, Edward
Boamah - Digital Earth Africa

Digital Earth Africa helps assess changes in water levels in Lake Ngami, Botswana

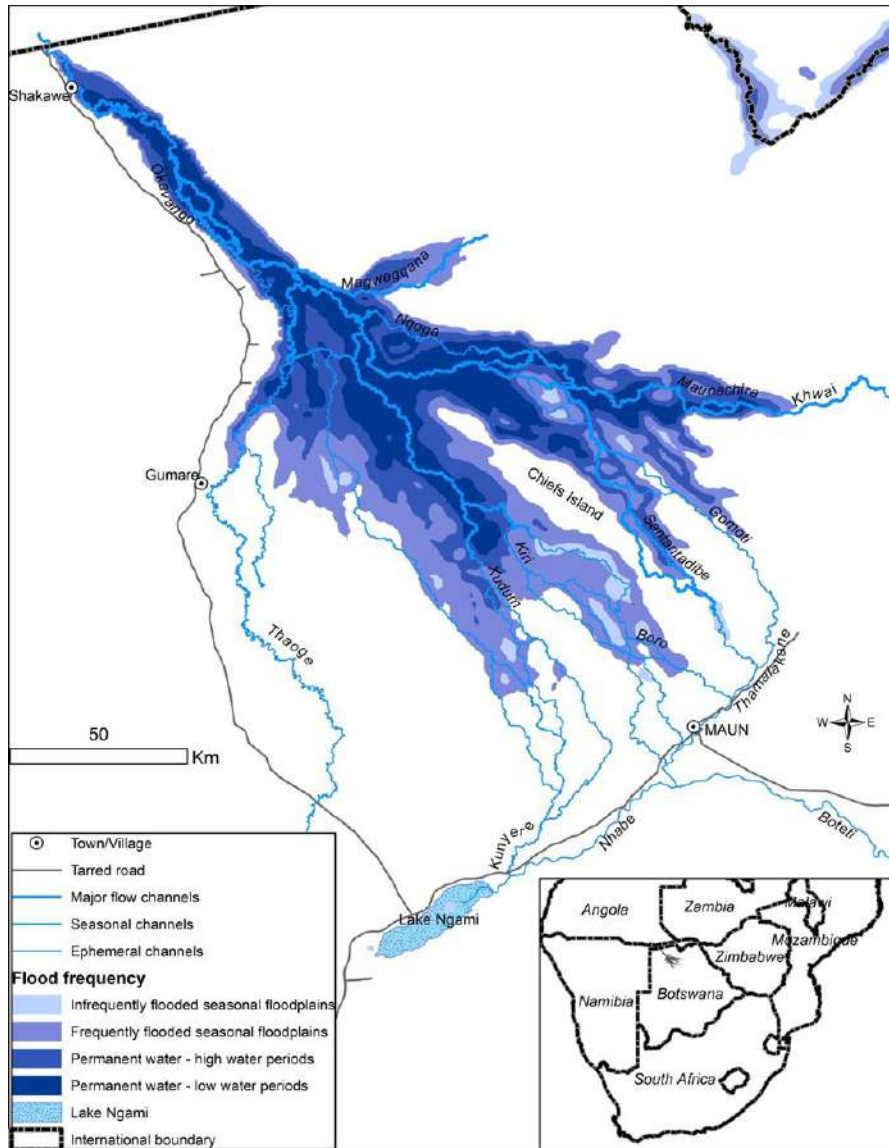


Presentation outline

- Introduction
- Methodology
- Results
- Conclusion



Water Assessment and Monitoring in the Lake Ngami



Introduction

- Lake Ngami is an endorheic lacustrine system located at the western part of the lower Okavango Delta. It is an indicator for environmental change and climate variability in the Okavango Basin.
- Furthermore, it supports the livelihoods of communities around it through provisional services. The lake provides fish for commercial and subsistence purposes and water for livestock during inundation periods.
- Digital Earth Africa provided the Water Observation from Space (WOfS) product derived from Landsat 8 at 30 metres and water extent assessment using Sentinel 2 at 10 metres to evaluate water variability in Lake Ngami, Botswana from the year 2017 to 2021

Water Assessment and Monitoring in the Lake Ngami



Methodology

- The Digital Earth Africa (DE Africa) Water Observations from Space (WOfS) are a suite of surface water products, which are generated using the WOfS classification algorithm on Landsat 8 satellite data at 30 metres.
- Lake Ngami extents are at latitude 20.39 to 20.51 South and longitude 22.73 to 22.88 East.
- WOfS is best visualized using the Digital Earth Africa Maps from the year 2013 to 2019.

WOfS includes: annual summary and all time summary described below.

WOfS Annual Summary: The ratio (%) of wet to clear observations from each calendar year

WOfS All-Time Summary: The ratio (%) of wet to clear observations over all time

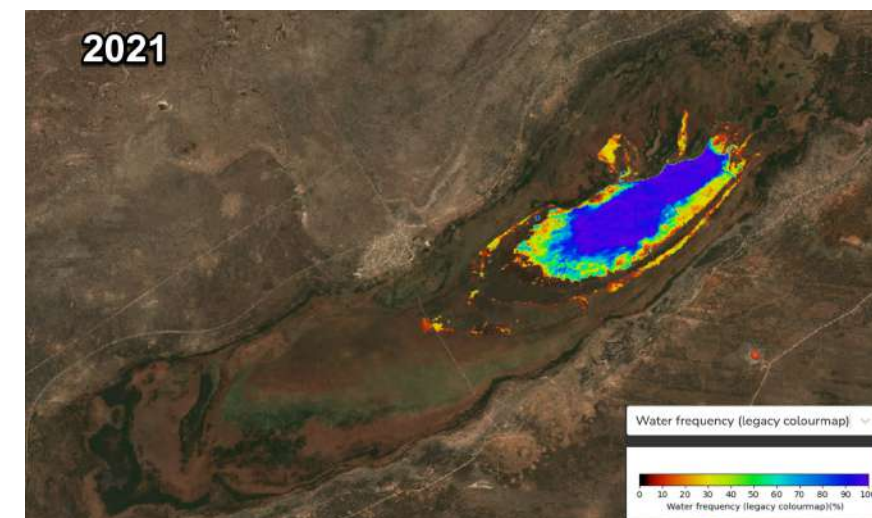
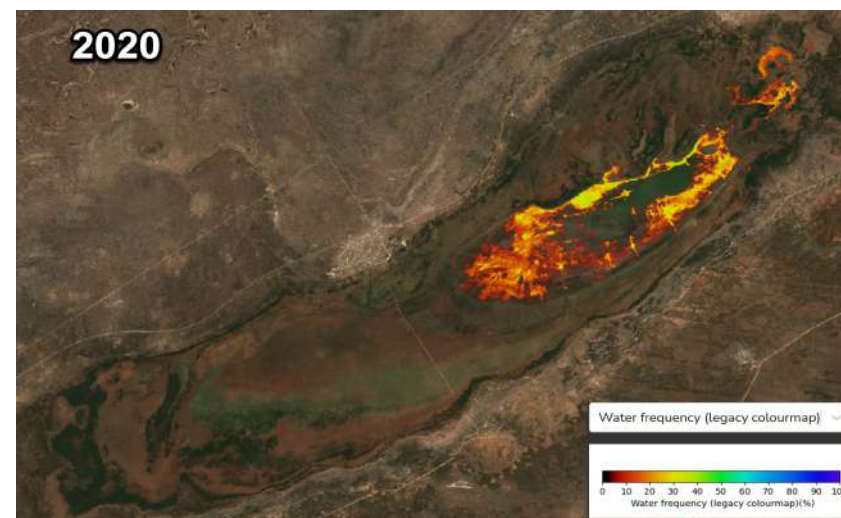
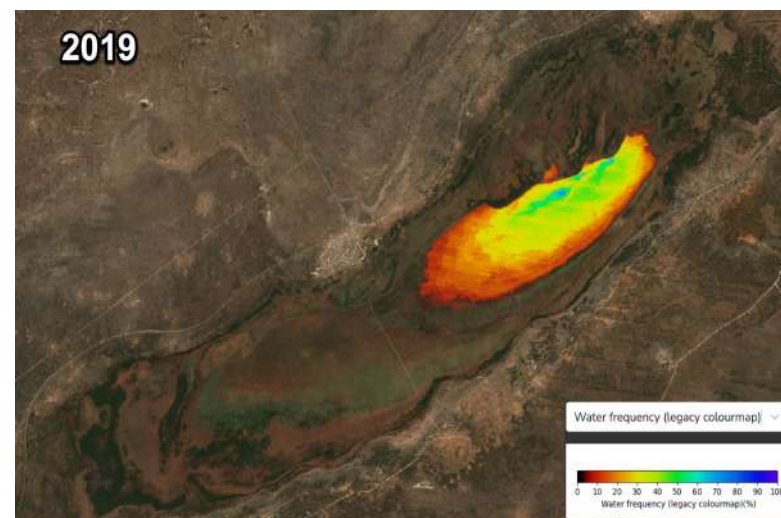
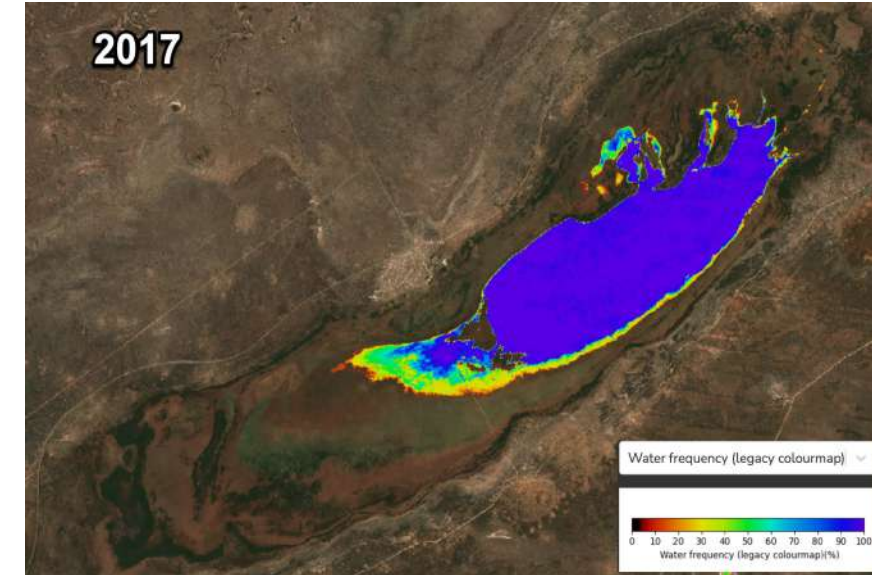
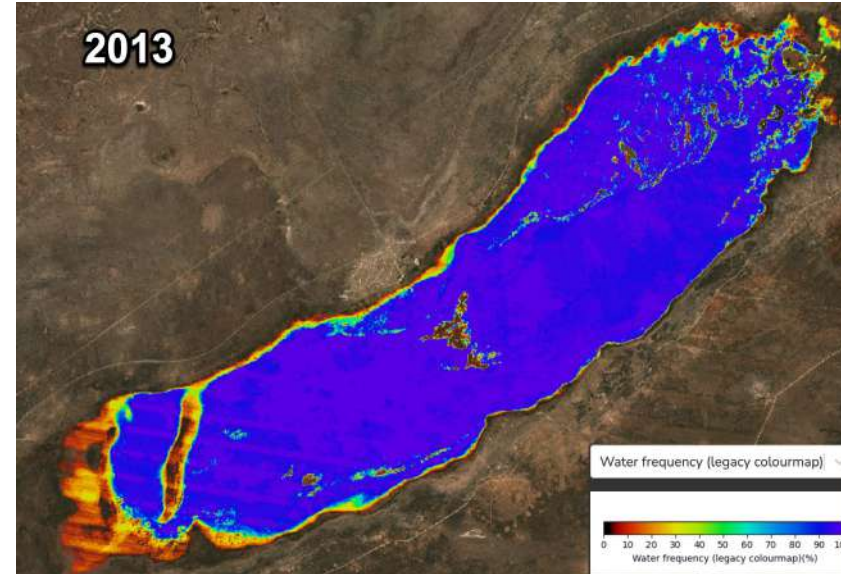
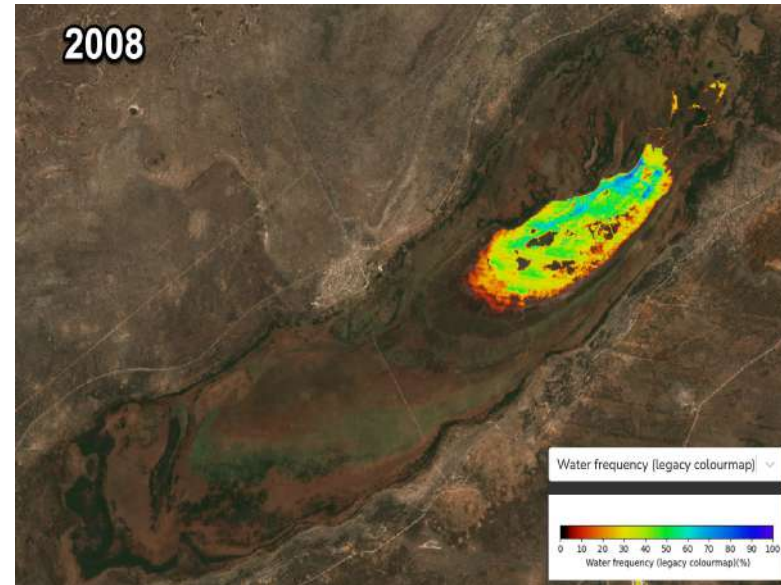
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Results and Discussions

Water Summary using WOfS Annual summary



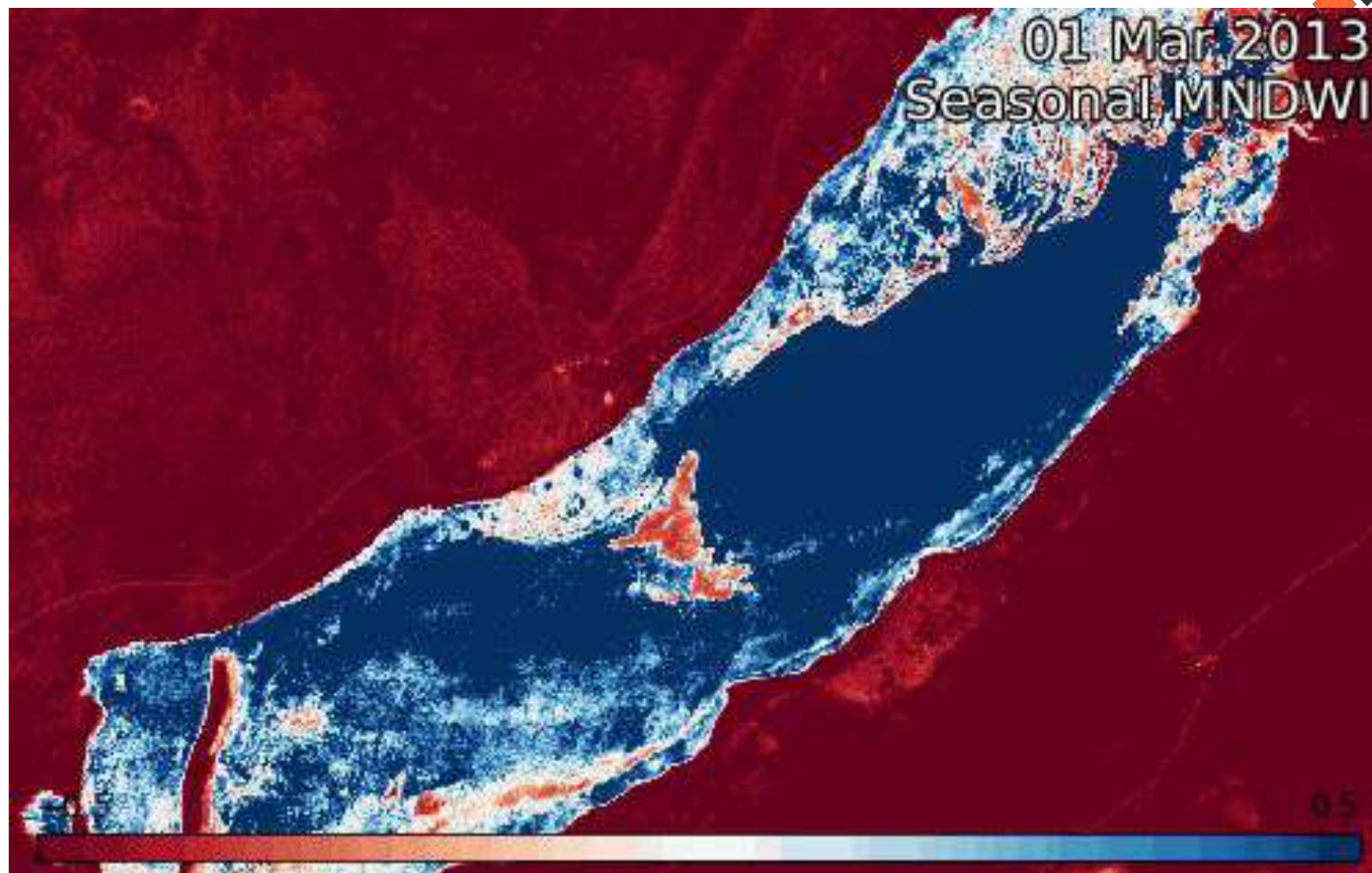
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Water extent using the Modified Normalized Difference Water Index (MNDWI) from Landsat 8: 2013 to 2021

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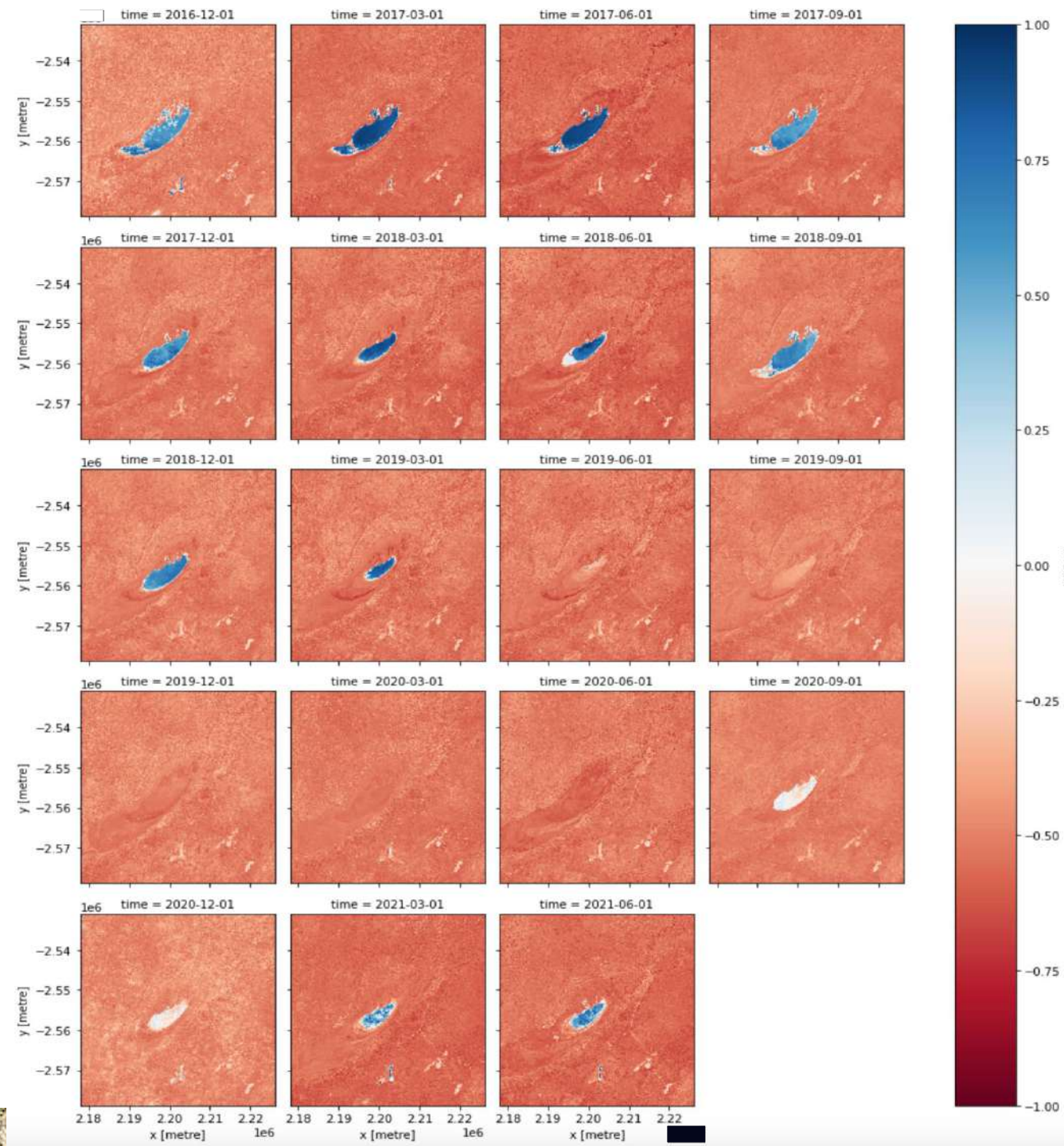


Later, Sentinel 2 imagery was used in the water extent analysis: 2017 to 2021

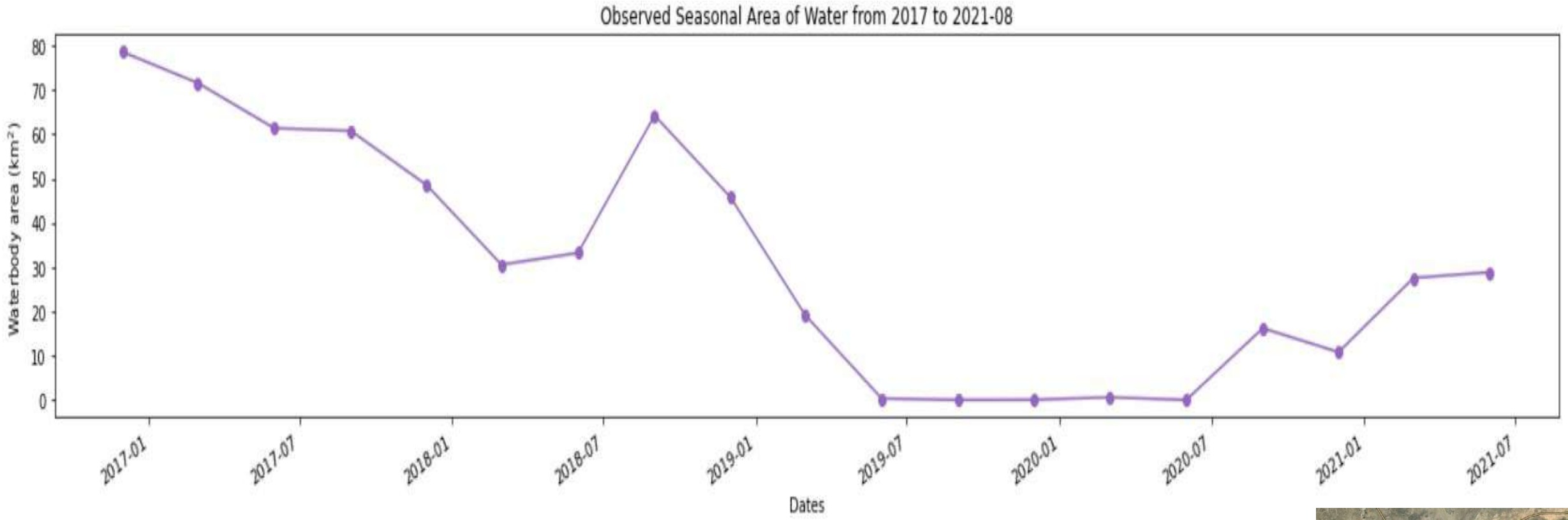
- The Digital Earth Africa Sandbox has an algorithm which performs water extent in support of the UN SDG Goals SDG 6.6.1, “The spatial extent of water-related ecosystems”
- The water extent uses the water index Modified Normalized Difference Water Index (MNDWI).
- **MNDWI = (Green - SWIR) / (Green + SWIR)**
- The algorithm completes the following steps:
 1. Resample the time-series of MNDWI to seasonal medians
 2. Generate an animation of the water extent time-series
 3. Calculate and plot a time series of seasonal water extent (in square kilometres)
 4. Find the minimum and maximum water extents in the time-series and plot them.
 5. Compare two nominated time-periods, and plot where the water-body extent has changed.

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- Lake Ngami extent using Water extent algorithm, which uses MNDWI using Sentinel 2: 2017 to 2021.
- Water variability is visualized over the four years, with low levels witnessed in June 2019, September 2019, December 2019, June 2020.
- High volumes are witnessed in December 2016, March 2017, June 2017, September 2017 and September 2018.
- This can be attributed to extreme weather events namely drought (low volumes) and floods (high volumes).



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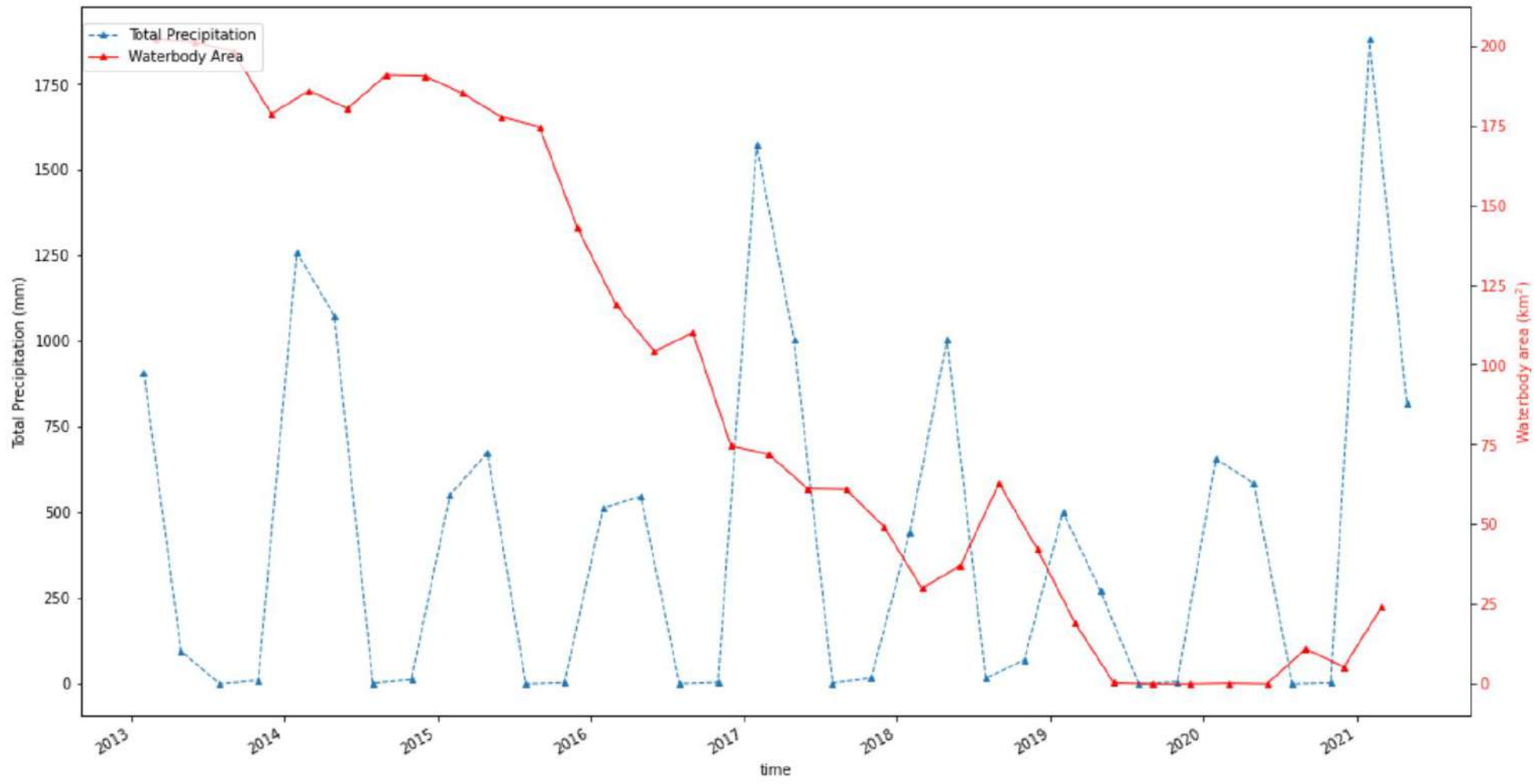


Seasonal changes over time from 2017 to 2021



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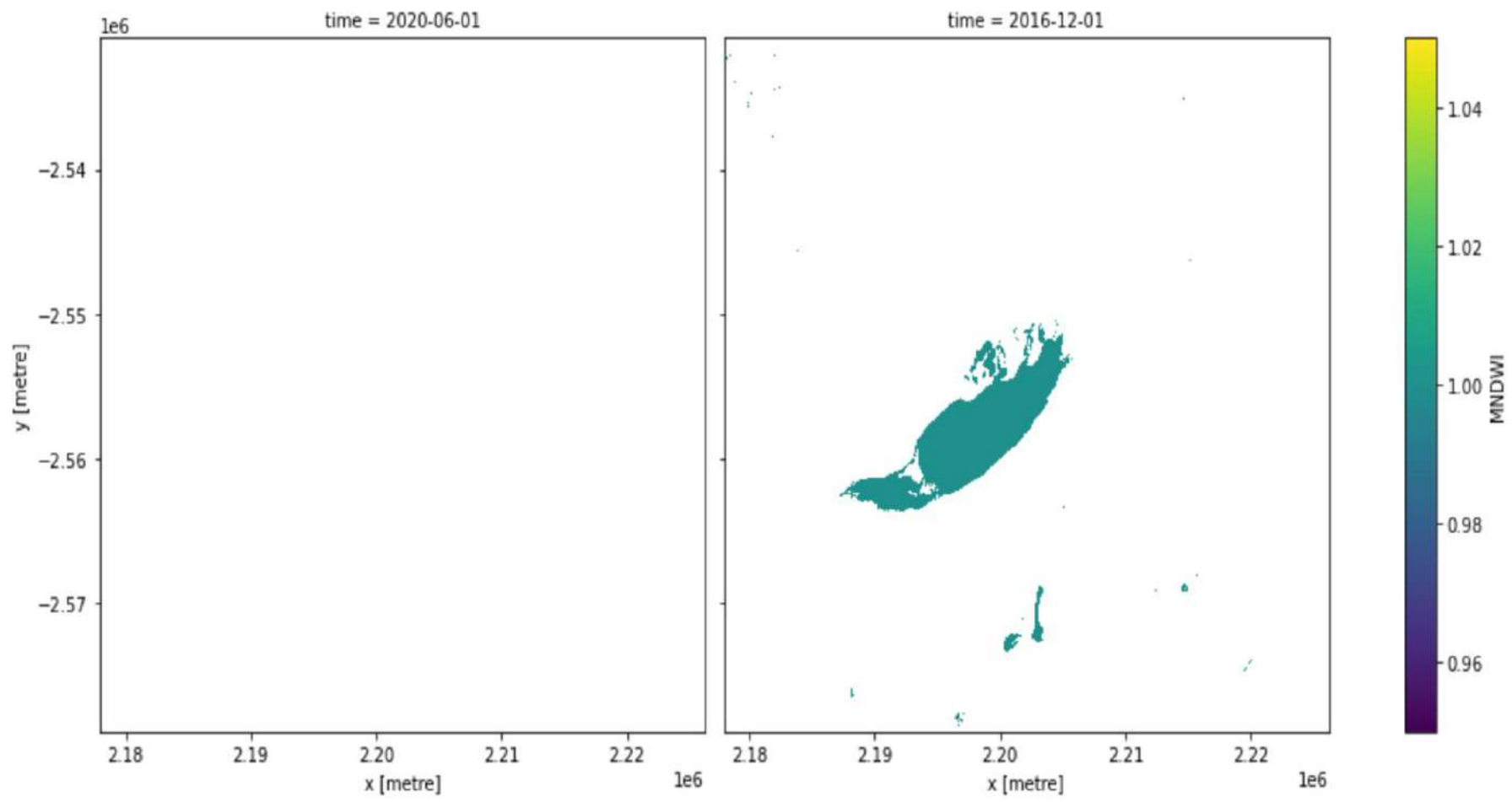
Evolution of Lake surface area, compared to catchment rainfall (ERA5) over time from 2013 to 2021-03



Seasonal changes over time from 2017 to 2021 plotted against precipitation data (ERA5)



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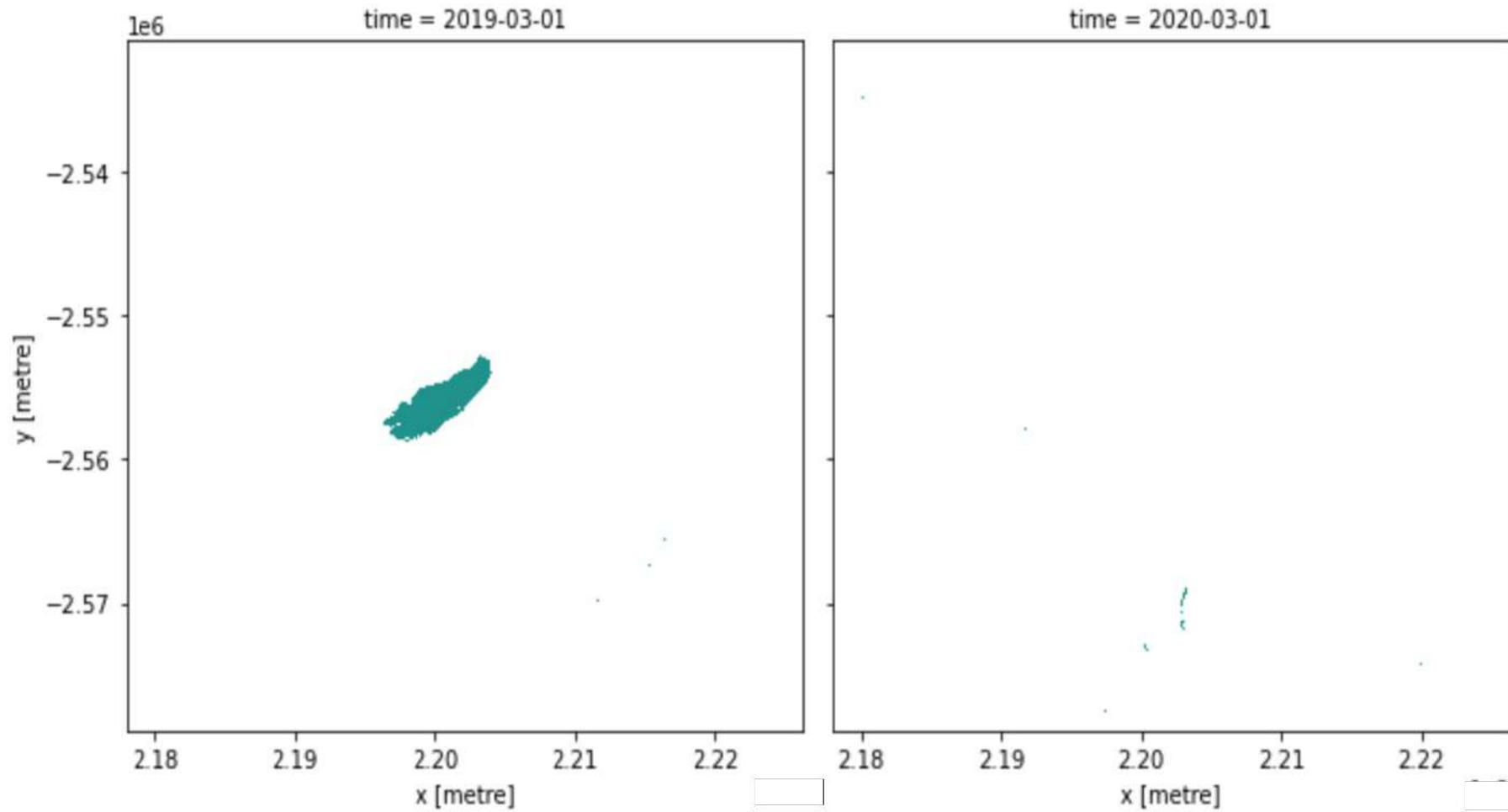


Maximum water levels were witnessed in December 2016 (relatively high water level) and the lowest water levels in June 2020 (drought)

Minimum and maximum water levels: 2016-2020



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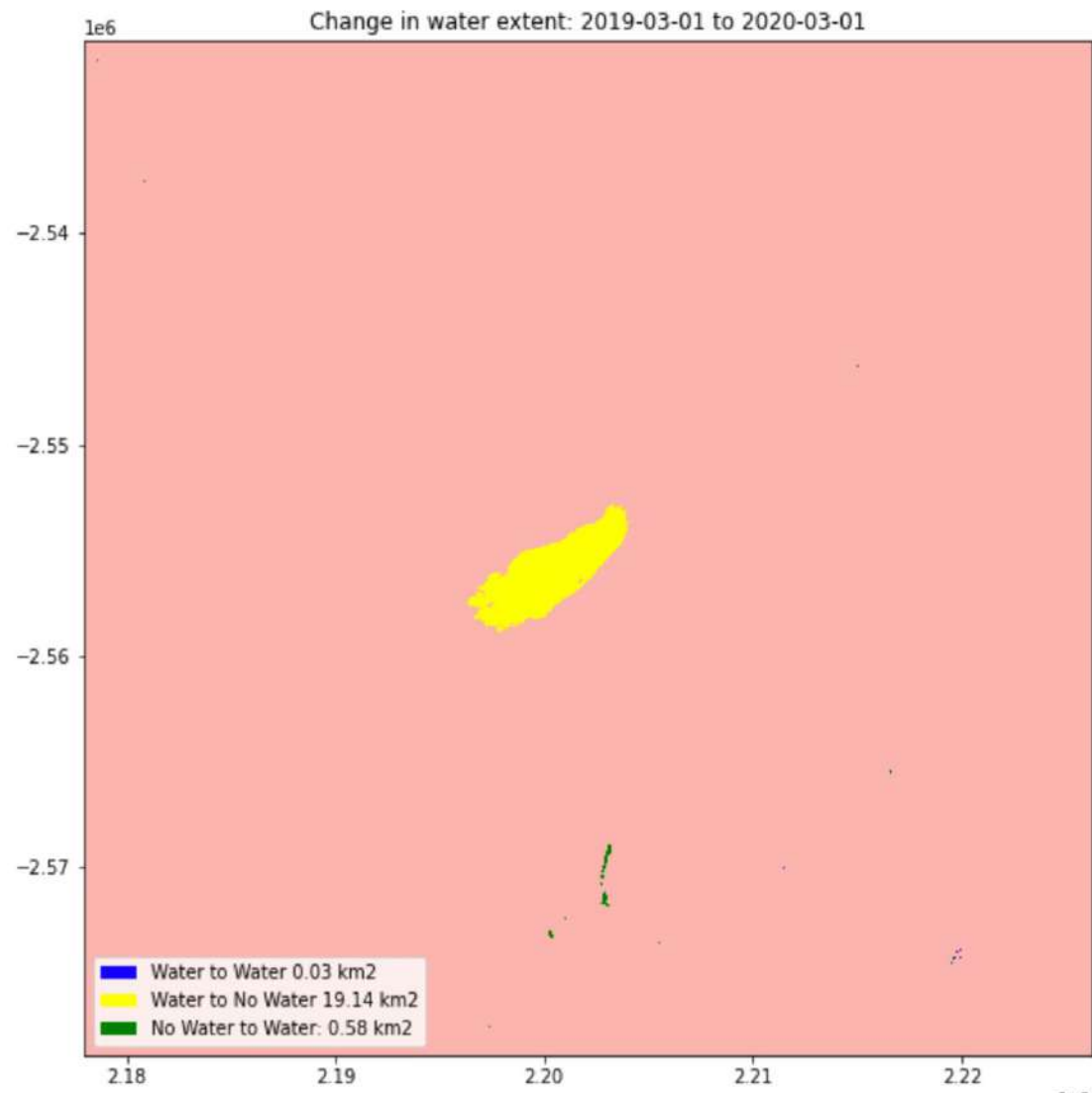


Maximum water levels in the drought year -2019 to 2020 was witnessed in March 2019 and the lowest water levels in March 2020 (drought)

Plot of water extent of the MNDWI product for the two chosen periods: March 2019 and March 2020



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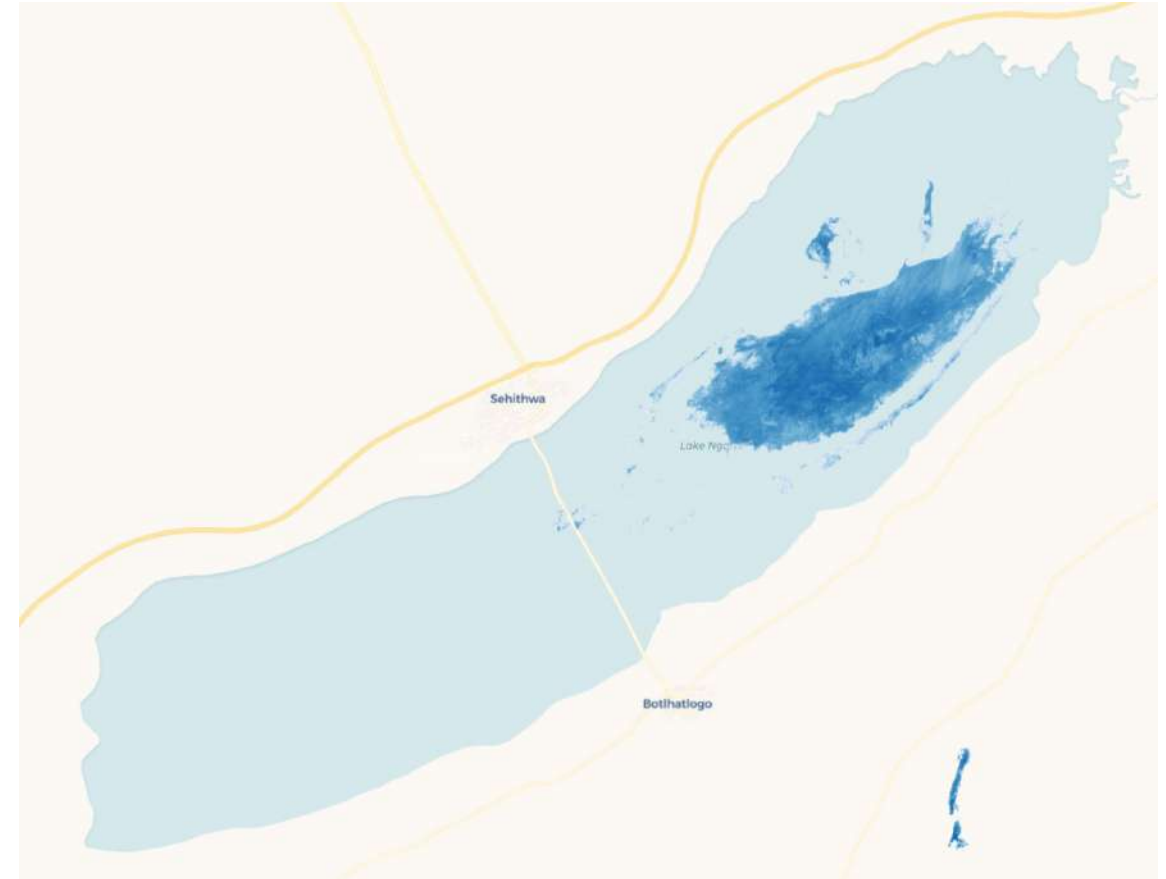
Changes in water extent due to evaporation during the drought year-2019 to 2020 was about 19.14km² and there was negligible water input from local rainfall into the Lake Ngami.

Observed changes in water extent in area: March 2019 to March 2020

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Sentinel 2 image captured on 23 August 2021, shows the variability of water in Lake Ngami



Sentinel 2 imagery captured on 23 August 2021 and viewed in Digital Earth Africa Map with the MNDWI index (Source:

<https://maps.digitalearth.africa/#share=s-ltq7s9z8GDiw2UJmhuzRSc20lk3>)

Water Assessment and Monitoring in the Lake Ngami



Call to Action

- Digital Earth Africa provided insights into changes in the waterbody over time.
- The results indicate the need for an integrated watershed plan that encompasses the whole Okavango Delta system.
- The effects of climate change have affected water variability in Lake Ngami.
- The results are useful for policy makers and will assist with engaging multidisciplinary stakeholders in the Okavango Delta.
- Let us make the Africa we want as we join efforts in the conservation of the Okavango watershed, *leave no one behind*.



Acknowledgements



THANK YOU

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