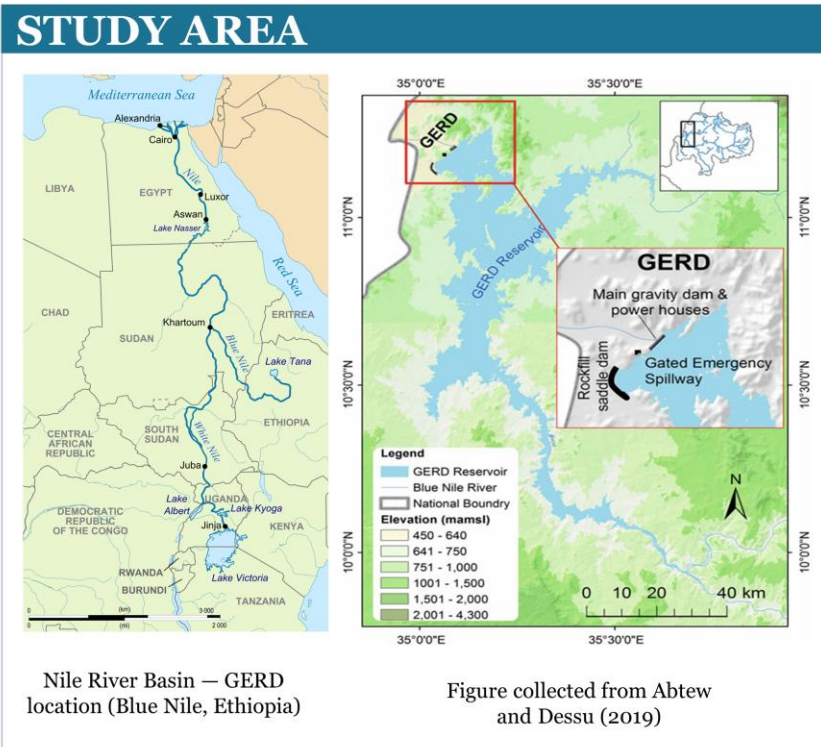
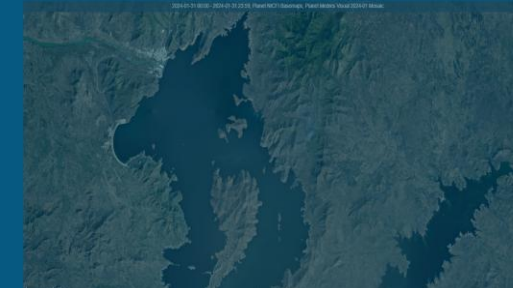


# Tracking the GERD Impoundment Stages Using SWOT and Other Radar Altimetry Products

Mahir Tazwar<sup>1</sup> · Roelof Rietbroek<sup>2</sup> · Ben H.P. Maathuis<sup>2</sup> · Amin Shakya<sup>2</sup>

<sup>1</sup> Dept. of Oceanography & Coastal Sciences, Louisiana State University, USA · <sup>2</sup> Faculty of ITC, University of Twente, Netherlands



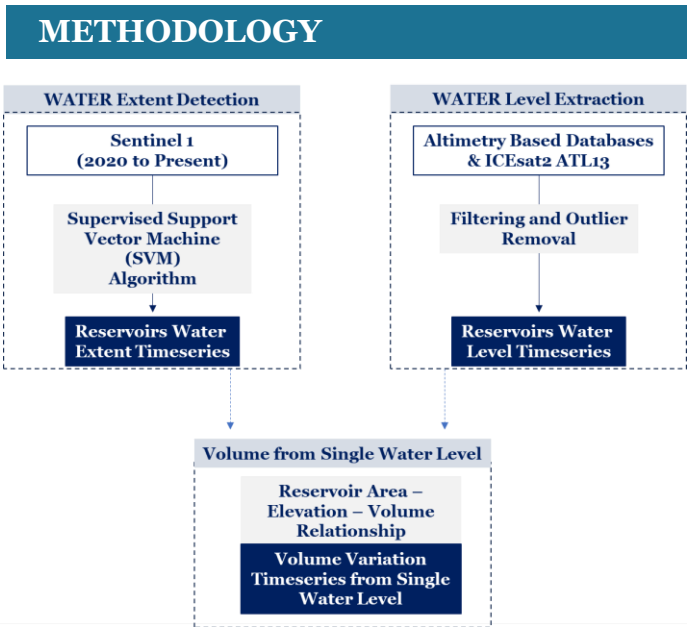
Phase	Period	Season
Phase 1	Jul–Aug 2020	Rainy
Phase 2	Jul–Aug 2021	Rainy
Phase 3	Jul–Aug 2022	Rainy
Phase 4	Jul–Sep 2023	Rainy

## STUDY OBJECTIVES

The Grand Ethiopian Renaissance Dam (GERD) is Africa's largest hydropower dam on the Blue Nile, poses critical transboundary water challenges.

### STUDY OBJECTIVES

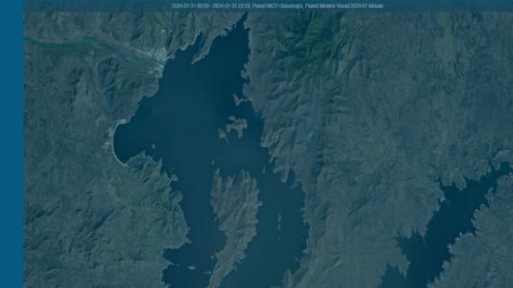
- Map water extent & level variation across 4 operational filling phases (2020–2023)
- Estimate water volume dynamics using DEM contouring and satellite-based methods
- Evaluate SWOT satellite products (LakeSP, Raster, PIXC) for extent & volume estimation



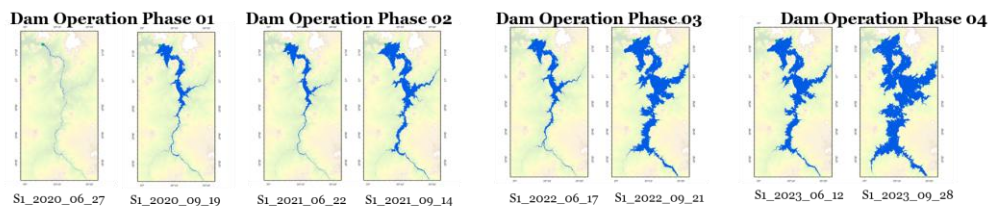
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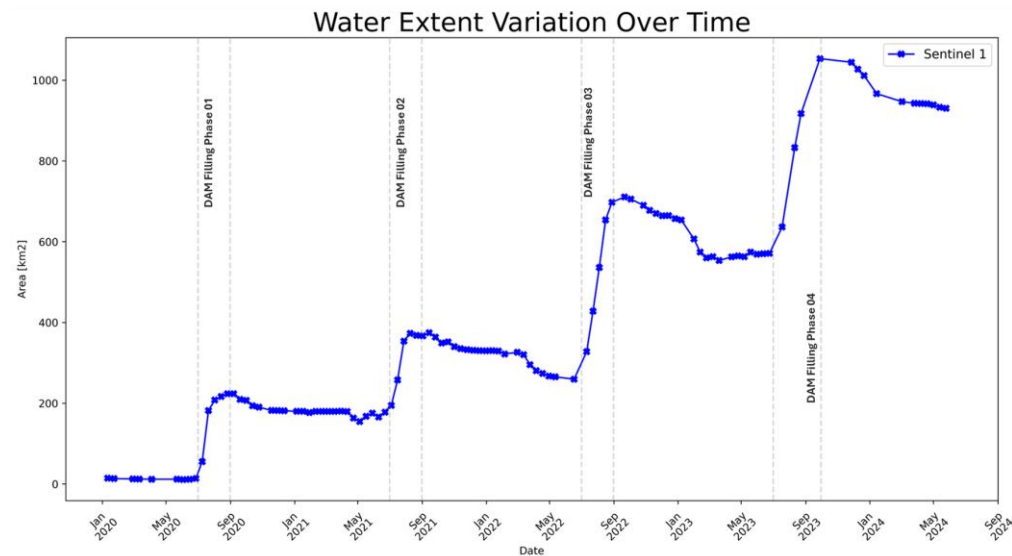


## WATER EXTENT DETECTION

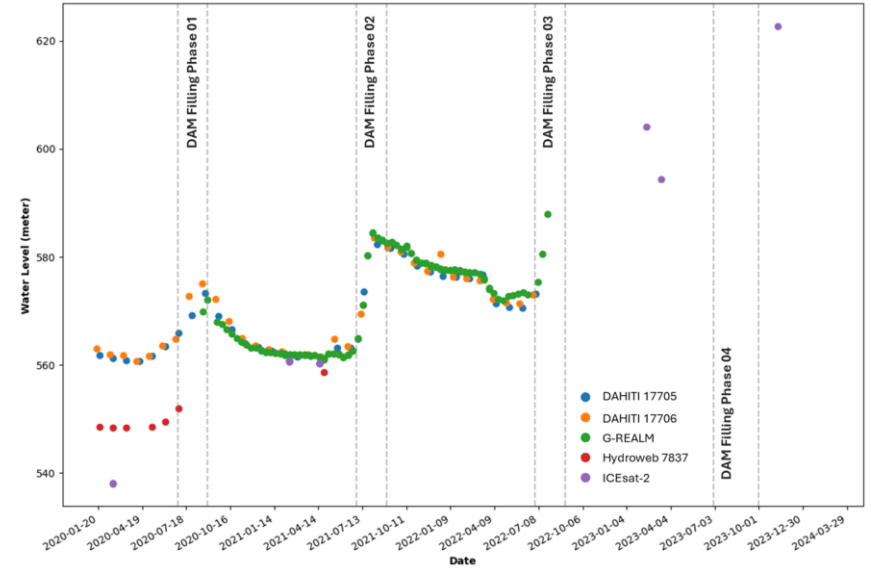


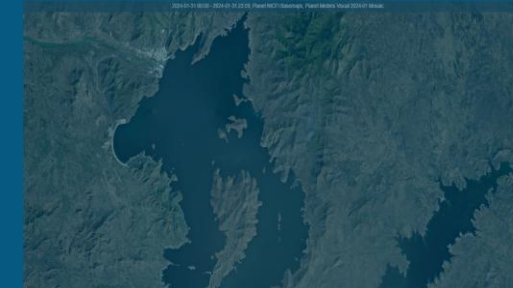
## ALTIMETRY BASED WATER LEVEL TIMESERIES

Datasets	Method
DAHITI	Radar Altimetry Based Water height Database
Hydroweb	
G-REALm	
ICESat-2 (ATL13)	Point observations of In land water levels from ICESat2



GERD Reservoir Water Level Timeseries from Satellite Altimetry Observations





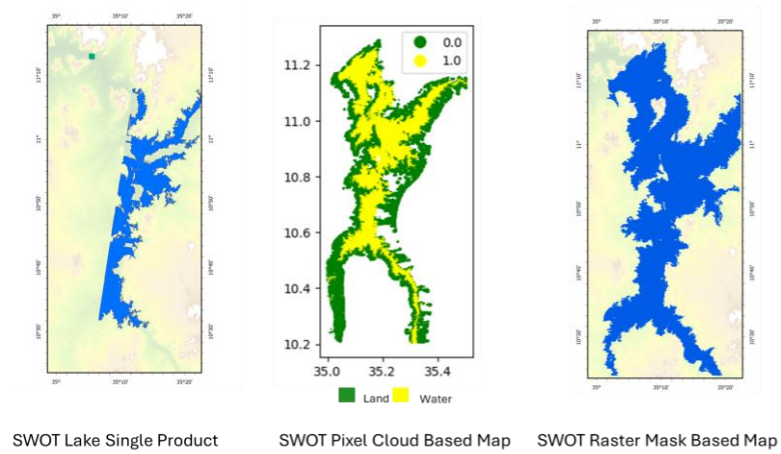
## SWOT BASED WATER EXTENT

**Methodology:** The assessment relied on distribution of 10,000 random points to extract and compare classification values across the different water maps.

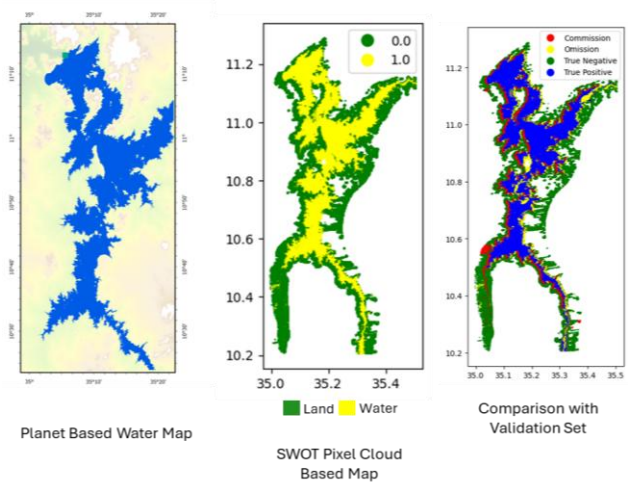
**SWOT LakeSP Performance:** Achieved an Intersection over Union (IoU) value of 0.337, indicating significant room for improvement compared to the ideal score of 1.0.

**Raster Mask & Pixel Cloud Accuracy:** Demonstrated a higher level of reliability, with Overall Accuracy (OA) ranging between 0.78 and 0.88.

**Classification Errors:** Despite the quantitative accuracy, visual inspection revealed that SWOT consistently misclassified areas within land-water transitional zones.



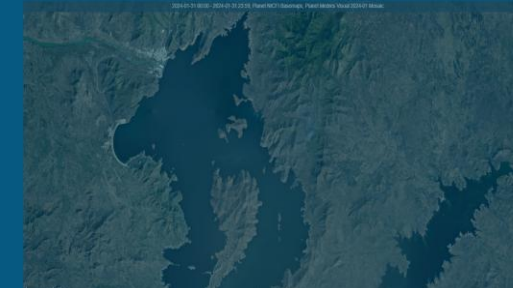
## SWOT Pixel Cloud Product Validation



# Tracking the GERD Impoundment Stages Using SWOT and Other Radar Altimetry Products

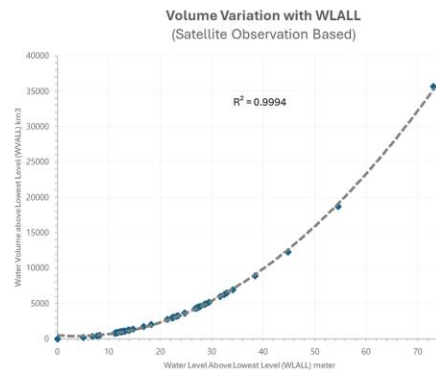
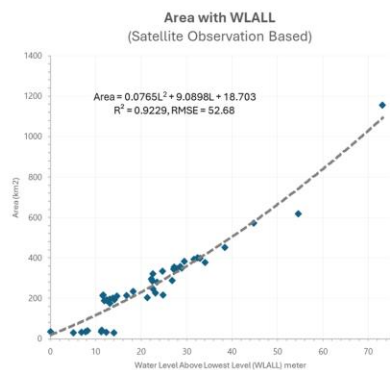
Mahir Tazwar<sup>1</sup> · Roelof Rietbroek<sup>2</sup> · Ben H.P. Maathuis<sup>2</sup> · Amin Shakya<sup>2</sup>

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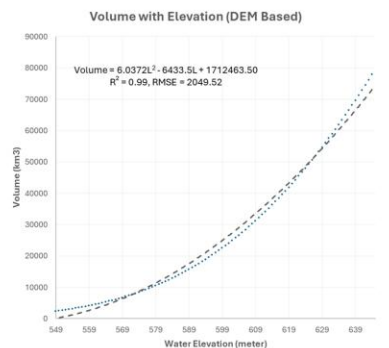
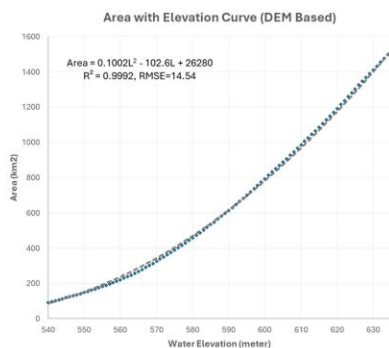


## VOLUME ESTIMATION

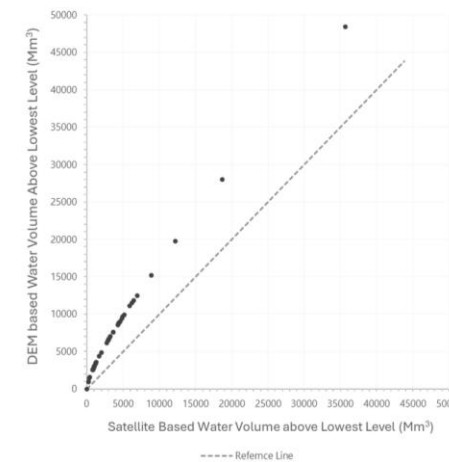
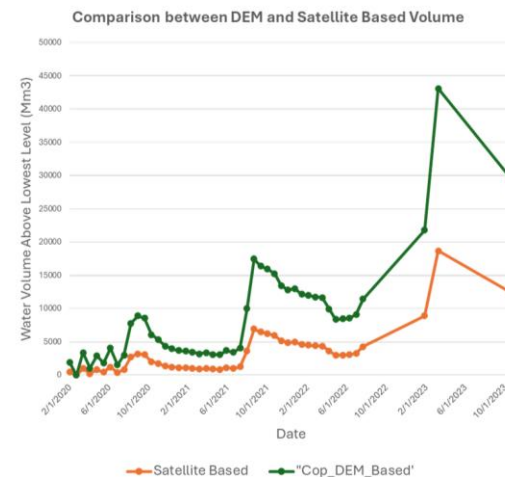
### Satellite Based Volume Estimation



### DEM Based Volume Estimation



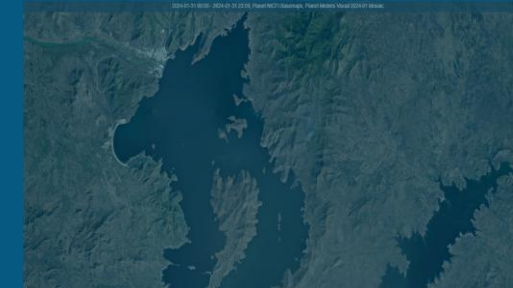
### Comparison of Volume Estimations



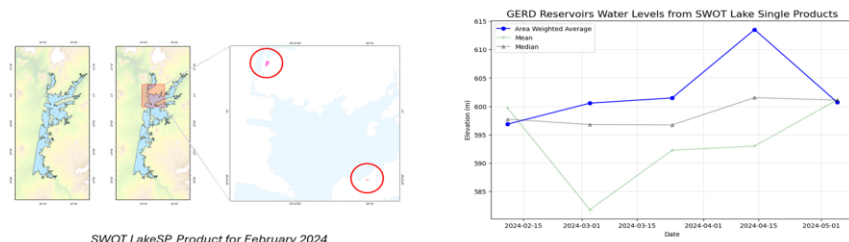
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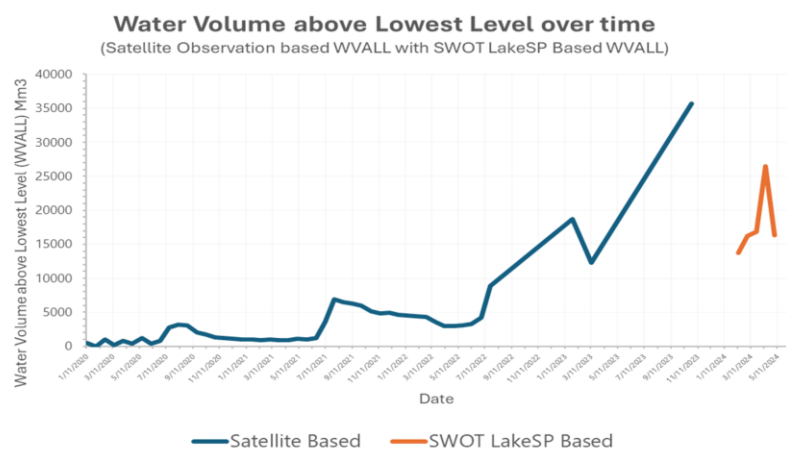
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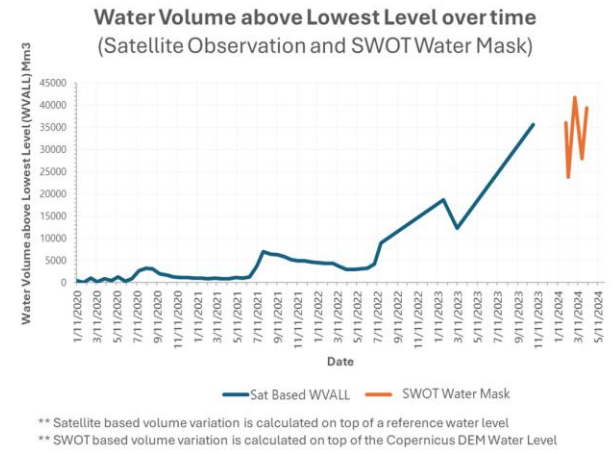
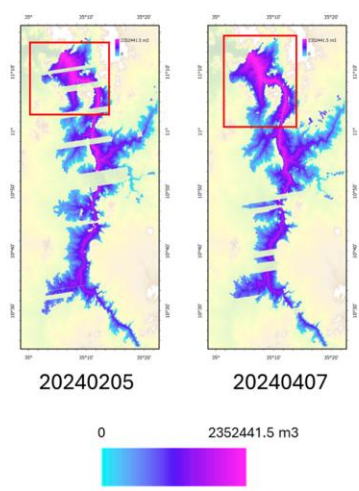
## SWOT LakeSP BASED WATER VOLUME



By utilizing the developed equation from Satellite Observations  
 $Volume = 0.0255L^3 + 4.5449L^2 + 18.703L$



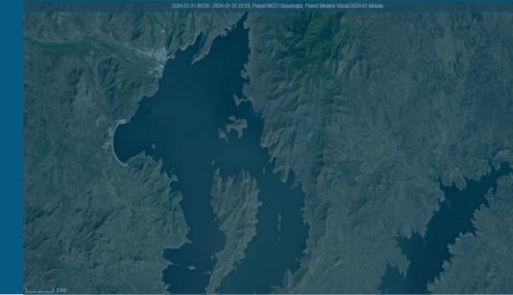
## SWOT RasterMask BASED WATER VOLUME



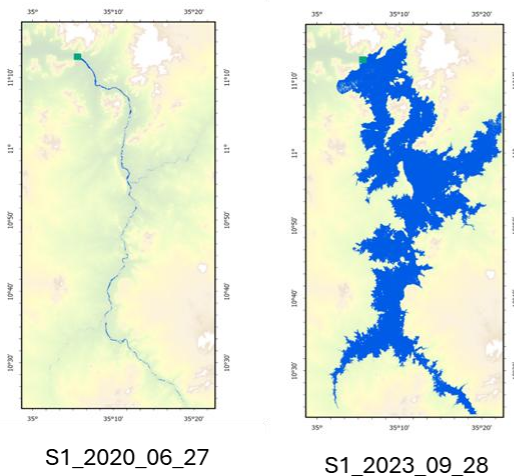
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## CONCLUDING REMARKS



**1125 km<sup>2</sup> Increase of Water Extent**

