ANALYSIS OF PROJECTED WET AND DRY EVENTS AND THEIR IMPACT ON THE HYDROLOGY OF UGANDAN LAKES

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Introduction

- Lakes provide a multitude of services to millions of **lives** & **ecosystem functionality**
- Recent variations on their hydrological characteristics are posing significant concerns on; **Societies**, **economies** & **ecosystem**
- SW availability in many of the lakes is expected to vary considerably

Cont…

- This trend is likely to **continue** in **future** & **projected** to affect various **human** & **ecological** system functioning

- In Uganda, there is still insufficient information on the expected **impacts** of **CC** on hydrology of lakes

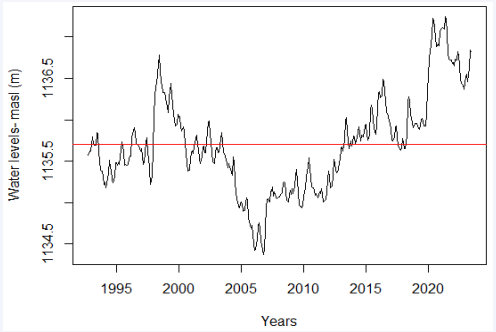
- Thus, this study aimed to reduce the gap by using an **integrated approach** to analyse the impacts of **projected wet** & **dry events** on the hydrology of Ugandan lakes

Credit: New Vision

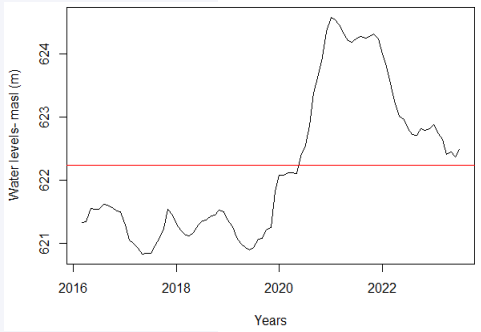
Study area

- **Four** Ugandan major lakes were considered for this study;

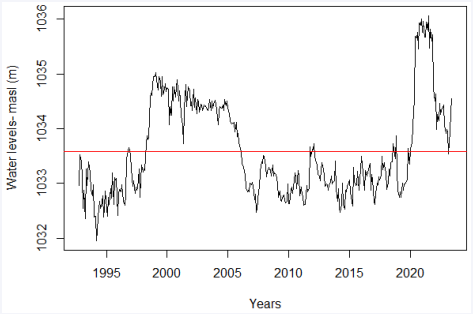
Lake Victoria



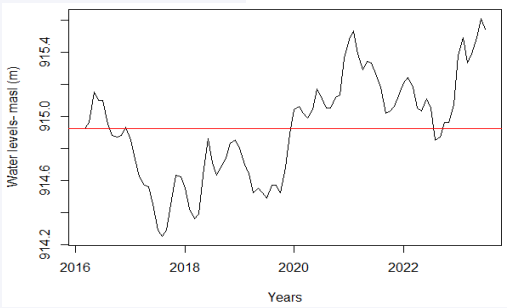
Lake Albert

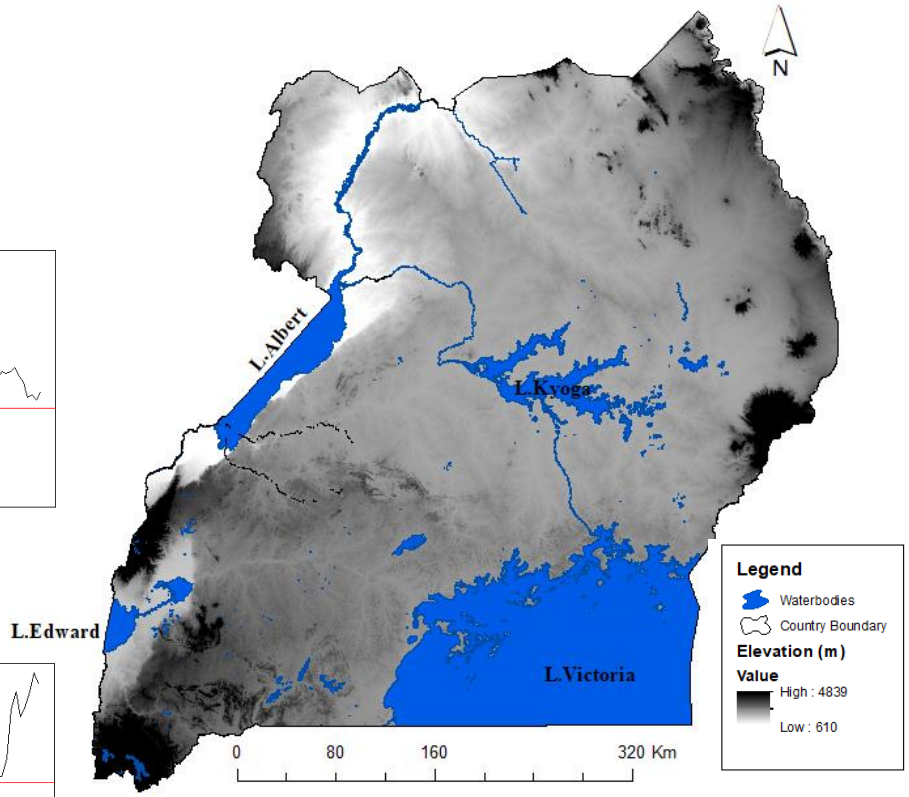


Lake Kyoga



Lake Edward





Datasets

- Satellite rainfall data
  - ✓ Climate Hazards Group InfraRed Precipitation with Stations (CHIRPS) (0.05°) 1993-2022 (ClimateSERV- Map (servirglobal.net) used to bias correct CORDEX data
  - ✓ Coordinated Regional Downscaling Experiments (CORDEX) (0.44°) for the period 2023-2040 under two Representative Concentration Pathway (RCP4.5 & RCP8.5) scenarios (MPI-ESM-LR)
- Satellite water level data
  - ✓ Lake water level from Global Water Monitor (nasa.gov) (https://blueice.gsfc.nasa.gov/gwm) from 1993-2022 for Lake Victoria & Kyoga, 2016-2022 for L. Albert & Edward

Data Analysis

- **Standardized Anomaly Index (SAI)**
  - ✓ Python: Generate wet and dry events from CORDEX data

- **Projected lake water levels**
  - ✓ R-based ARIMA Model:

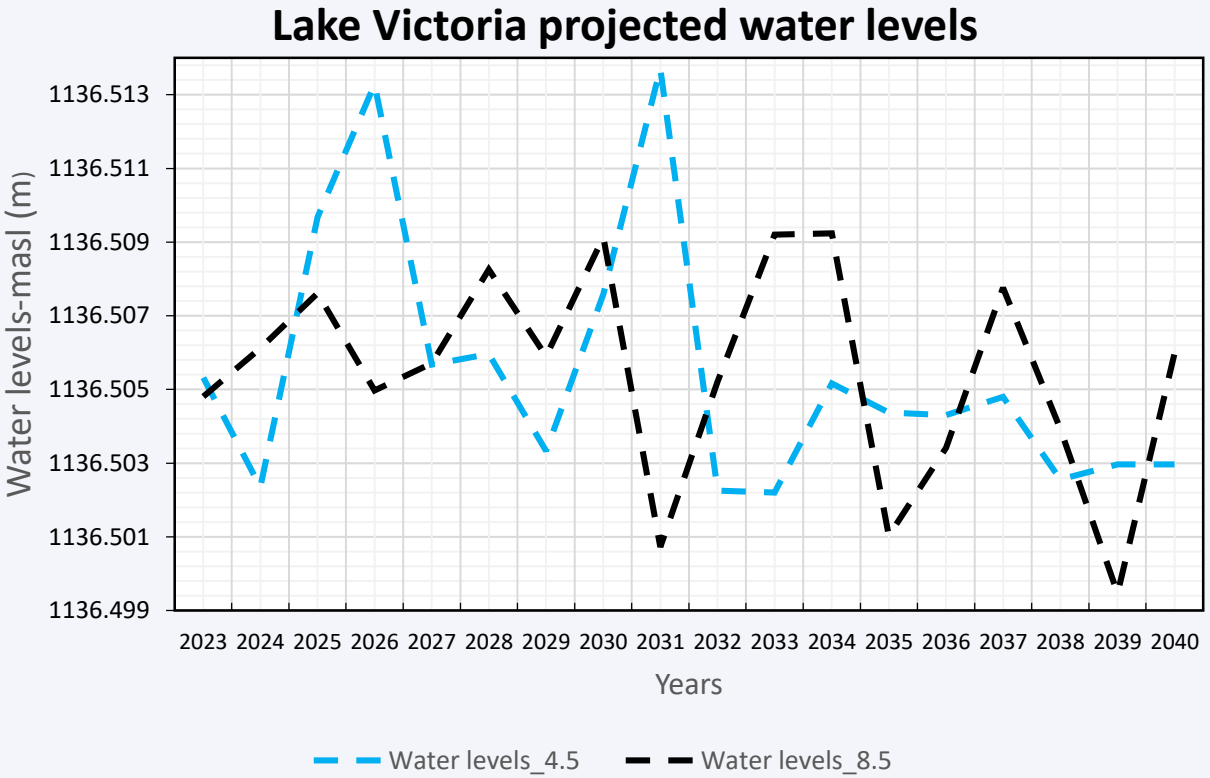
    Generate future water levels

    using historical water level datasets

Classification	SAI Value ranges
Extremely wet	2.00 and above
Very wet	1.50 to 1.99
Moderately wet	1.00 to 1.49
Normal	-0.99 to 0.99
Moderately dry	-1.00 to 1.49
Very dry	-1.50 to 1.99
Extremely dry	-2.00 and less

Key findings

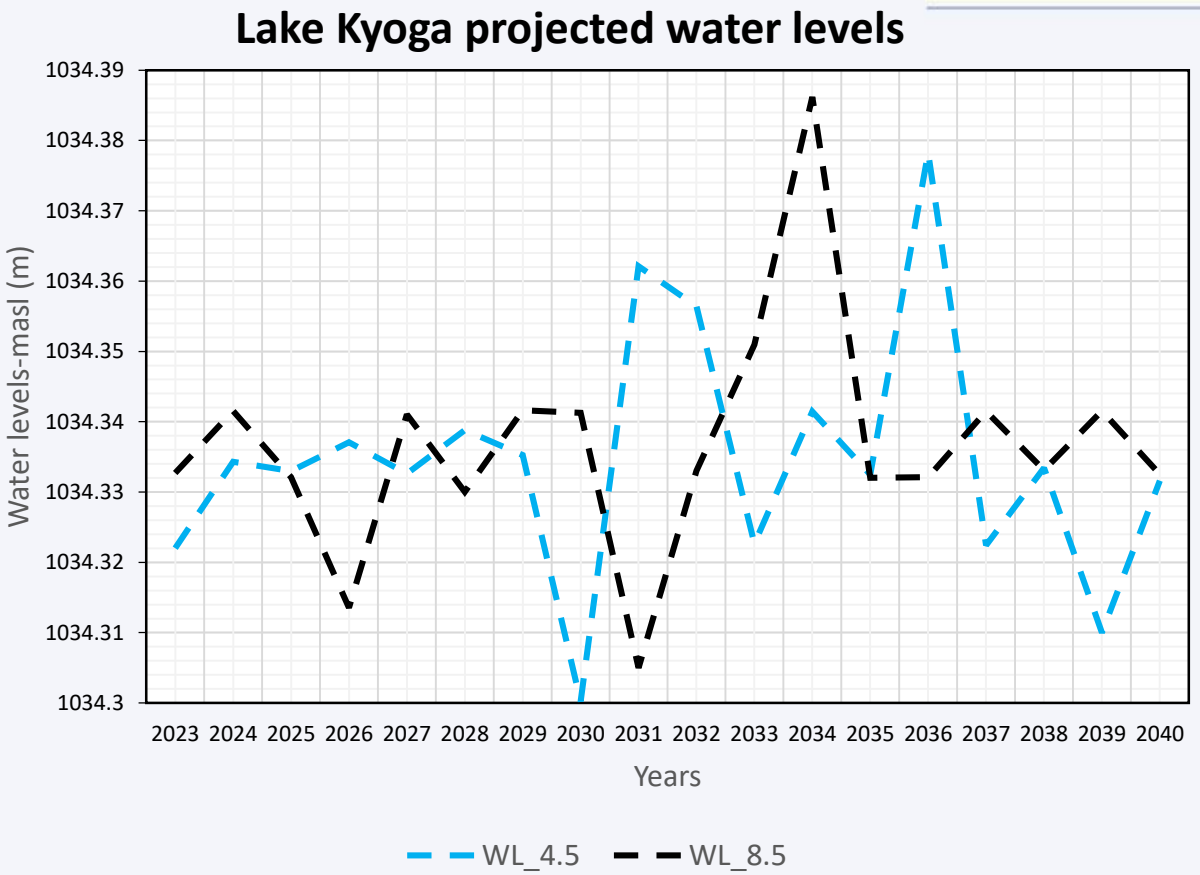
Year	SAI_4.5	SAI_8.5
2023	-0.04306	-0.2263
2024	-0.8876	0.222113
2025	1.195042	0.730289
2026	2.21801	-0.17044
2027	0.05898	0.081998
2028	0.139645	0.950393
2029	-0.60848	0.146777
2030	0.601148	1.251677
2031	2.337964	-1.62101
2032	-0.91264	-0.08695
2033	-0.92719	1.274843
2034	-0.08659	1.286121
2035	-0.31132	-1.51703
2036	-0.33237	-0.70178
2037	-0.19016	0.782634
2038	-0.82671	-0.52551
2039	-0.71233	-2.05216
2040	-0.71233	0.174334



- **Wet** events expected in **2025**,**2026** & **2031** for **RCP4.5** while for **RCP8.5**, in **2030**,**2033** & **2034**
- **2031**, **2035** & **2039** are expected to have dry events under RCP8.5

Cont…

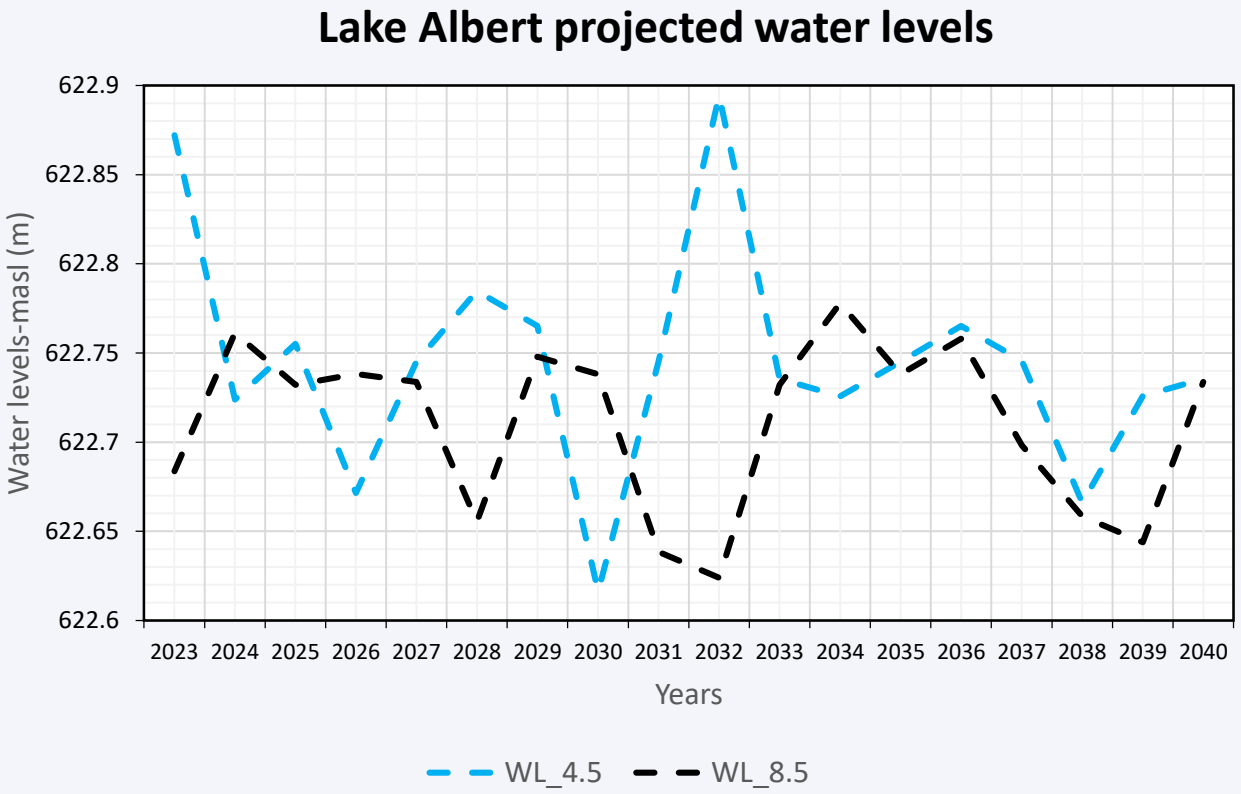
Years	SAI_4.5	SAI_8.5
2023	-0.74678	-0.56654
2024	0.42724	0.489566
2025	0.62847	-0.02505
2026	0.006609	**-1.36198**
2027	0.685663	0.963127
2028	-0.25504	-0.80584
2029	0.281569	0.426868
2030	**-1.99741**	0.746002
2031	**1.523651**	**-1.9236**
2032	**1.176052**	-0.87338
2033	-0.84286	**1.015462**
2034	-0.66262	**2.265396**
2035	0.703641	0.024834
2036	**1.348994**	-0.02501
2037	-0.80608	0.540388
2038	-0.96635	-0.97705
2039	**-1.34341**	0.485067
2040	0.838656	-0.39827



- **Wet** events are expected in **2031**,**2032** & **2036** for **RCP4.5** while for **RCP8.5**, in **2033** & **2034**
- **2030** & **2039** are expected to have dry events under **RCP4.5** while for **RCP8.5** dry events are expected in **2026** & **2031**

Cont…

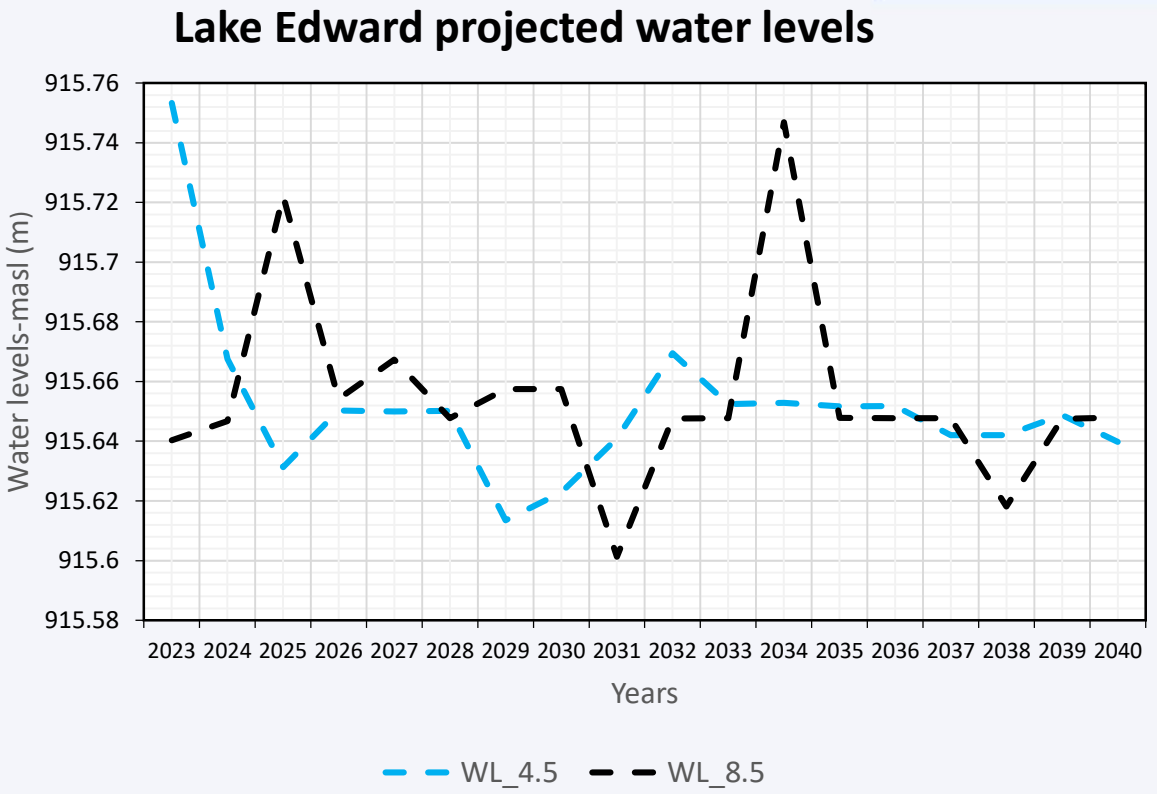
Years	SAI_4.5	SAI_8.5
2023	1.873584	-0.17545
2024	0.043726	1.143756
2025	0.119046	0.391301
2026	-1.05473	-0.61588
2027	0.46934	0.596168
2028	1.374522	-1.19326
2029	0.280129	1.024671
2030	-1.81293	0.69345
2031	-0.11135	-1.59784
2032	1.963302	-1.59346
2033	-0.5194	0.473954
2034	-0.61759	1.196631
2035	0.77688	0.808557
2036	0.266964	1.132596
2037	-0.38851	-0.08875
2038	-1.13164	-1.15402
2039	-0.97705	-1.58193
2040	-0.5543	0.539498



- **Wet** events are expected in **2023**,**2028** & **2032** for **RCP4.5** while for **RCP8.5**, in **2024, 2029, 2034** & **2036**
- **2026, 2030** & **2038** are expected to have dry events under **RCP4.5** while for **RCP8.5** dry events are expected in **2028, 2031, 2032, 2038** & **2039**

Cont…

Year	SAI_4.5	SAI_8.5
2023	**2.610714**	0.267039
2024	0.876944	0.341998
2025	-0.63676	**1.452189**
2026	0.736814	-0.3441
2027	0.939303	0.865383
2028	0.765572	-0.36152
2029	**-1.56594**	0.556641
2030	**-1.03786**	0.535703
2031	0.220472	**-2.05709**
2032	**1.279435**	0.011594
2033	-0.77953	-0.2504
2034	**-1.10905**	**2.3986**
2035	-0.27919	-0.55622
2036	-0.35573	-0.17047
2037	-0.50452	-0.43693
2038	-0.53245	**-1.56426**
2039	-0.36878	0.306803
2040	-0.25944	-0.99496



- **Wet** events are expected in **2023** & **2032** for **RCP4.5** while for **RCP8.5**, in **2025** & **2034**
- **2029, 2030** & **2034** are expected to have dry events under **RCP4.5** while for **RCP8.5** dry events are expected in **2031** & **2038**

Conclusion

- Significant increase in water levels (wet events) are expected on Lakes; Edward, Kyoga & Victoria
- Significant decrease in water levels (dry events) are expected on Lakes; Edward & Victoria particularly under RCP8.5
- Generally, water levels on the four lakes are expected to decrease more under RCP8.5 compared to RCP4.5
- Although rainfall singly cannot influence water levels, results have reflected its influence on water levels

Recommendations

- Increase number of **hydrological monitoring stations** within the lake basins so as to complement & validate satellite based data

- Real time **Early Warning Systems** should be **developed** & initiated to all lake basins within the **NBI**

- Discourage **Deforestation**, **encourage** **Afforestation** & **Re-afforestation** within the lake basins to increase the micro-climate effect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THANK YOU!