Assessing the Impacts of Climate Change on Streamflow in Malaba River Catchment in Uganda

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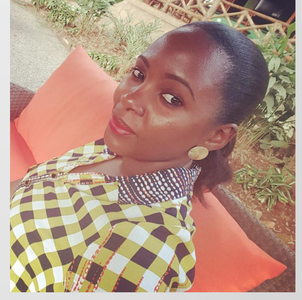
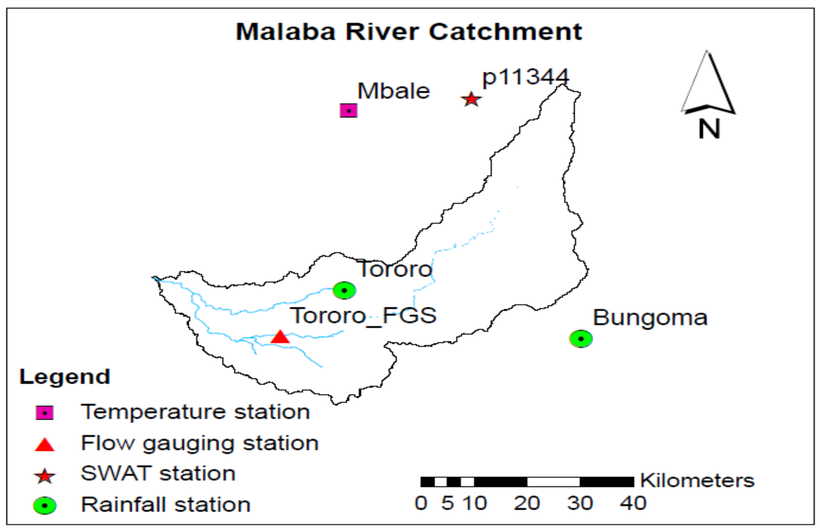


Study Area



Problem Statement

- Our water resources, the only essential part of life are endangered by climate change and increasing population. About 65% of the African population will be at risk of water stress by 2025
- Malaba river is vulnerable to climate change due to its heavy reliance on rainfall as its major flow contributor.
- In 2005/06, there were registered low flows in Malaba River in January and February which led to a substantial water deficit to the surrounding irrigation and town water supply schemes.

Objectives

Assess the impacts of future climate change on Malaba river

- Project climate change variables
- Simulate streamflow using SWAT
- Analyze impacts of future climate change on surface water flow

Significance

- Findings will empower stakeholders in Kyoga Water Management Zone.
- Ministry of Water and Environment, Uganda will be in position to strengthen the catchment planning process.
- Availability of more publications on climate change

Scope

- Catchments response to stresses of climate change interms of water quantity. Indirectly takes into account Demographic trends, Socio economic development and Technological development.
- Land use change was not considered in simulation of future streamflow under changing climate.

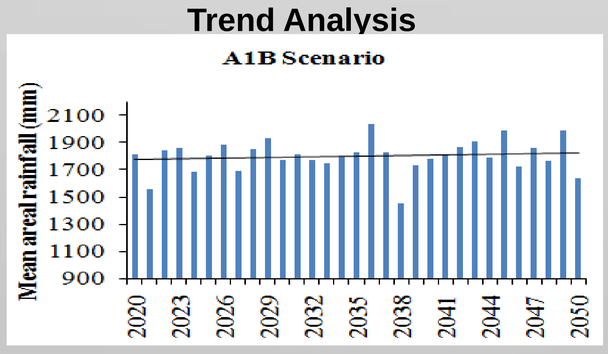
LARS-WG Model

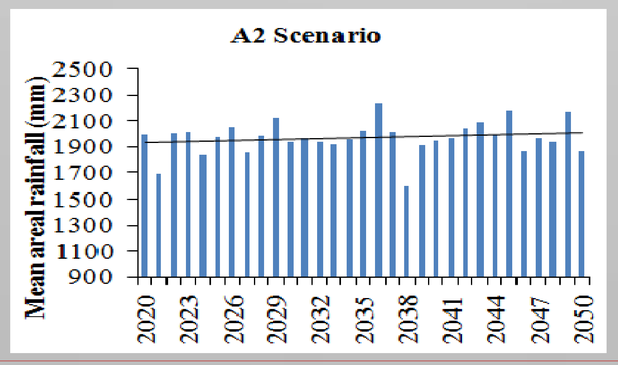
- During calibration and validation, results from statistical tests at a significant level of 5% showed that LARS-WG generated climate that is most likely to be the same as the 'true' climate.
- Therefore this is an indication of the suitability of LARS-WG for the climate downscaling in Malaba River catchment

Selection of GCM

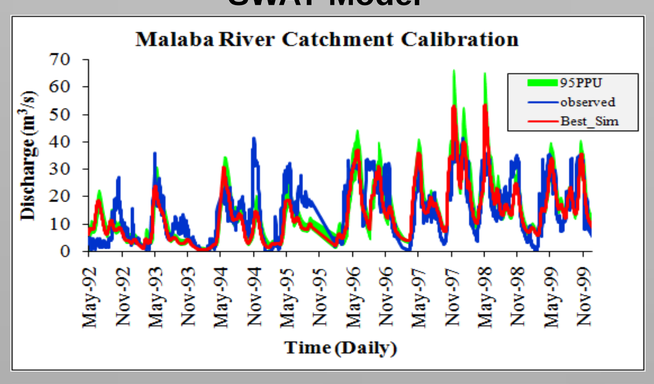
AIB Scenario			
Parameter	HADCM3	HADGEM	EMPH5
Rainfall	0.37	0.66	0.56
Maximum	0.39	0.46	0.53
Minimum	0.49	0.25	0.62
A2 Scenario			
Parameter	HADCM3	HADGEM	EMPH5
Rainfall	0.3	0.54	0.5
Maximum	0.45	0.55	0.56
Minimum	0.3	0.34	0.44

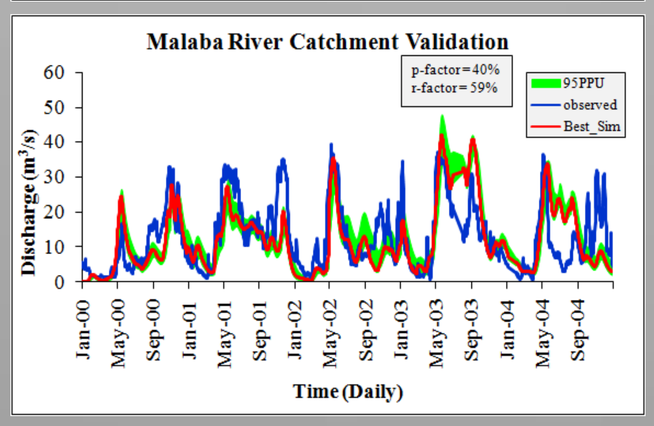
Trend Analysis





SWAT Model



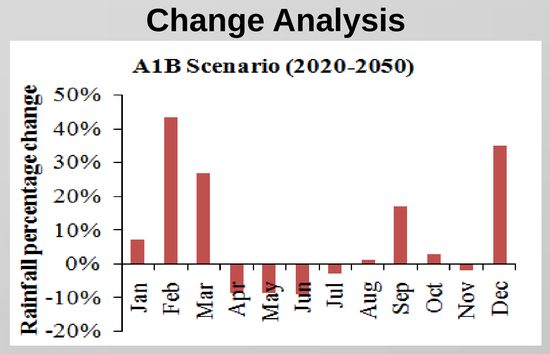


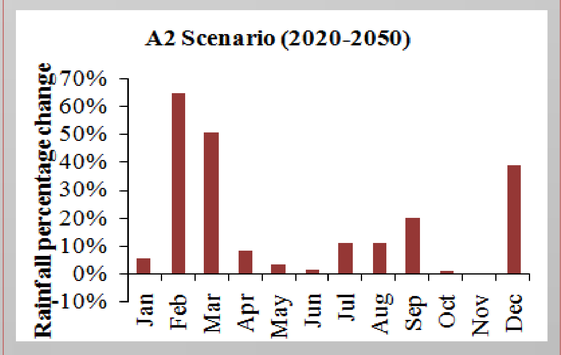
Observed Vs LARS-WG Downscaled data

Type of data	Station	Parameters	K-S test	p-value	Accuracy
Observed (1980-2004)	Tororo	Rainfall	0.59	0.99	Good
	ID11344		0.05	1.00	Very good
	Bungoma		0.13	0.94	Good
	Mbale	Maximum Temperature	0.08	0.99	Good
		Minimum Temperature	0.08	0.99	Good
Downscaled (2020-2050)	Tororo	Rainfall	0.07	1.00	Very good
	ID11344		0.06	1.00	Very good
	Bungoma		0.11	0.92	Good
	Mbale	Maximum Temperature	0.07	1.00	Very good
		Minimum Temperature	0.06	1.00	Very good

Note; Fair-(0.05-0.1), Good-(0.1-0.8), Very good-(0.8 and above), for K-S and p-values

Change Analysis



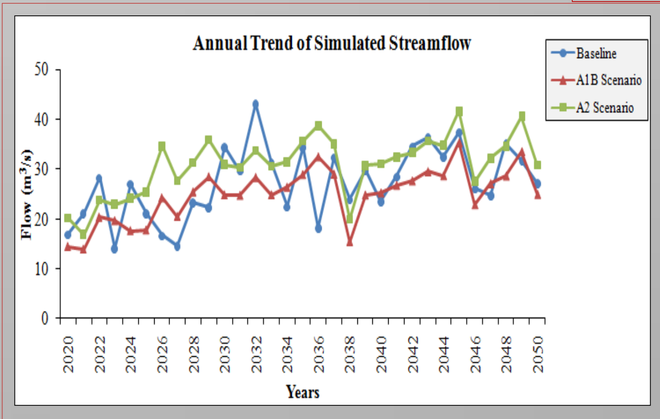


Trend Analysis

- Increasing rainfall trend for A1B and A2 with magnitude of 0.34mm and 0.408 mm annually respectively
- Max. (Min) Temp has decreasing trend of 0.004^{0}C for both A1B (0.001^{0}C) and A2 scenarios (0.002^{0}C).

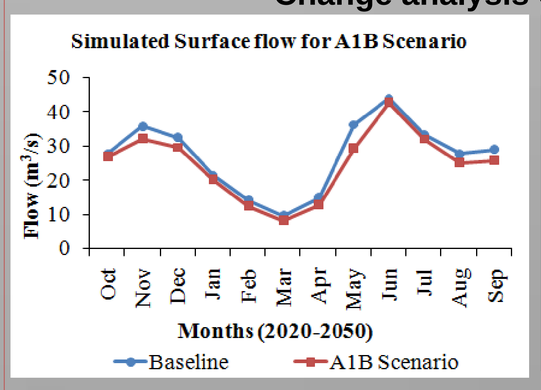
Change Analysis

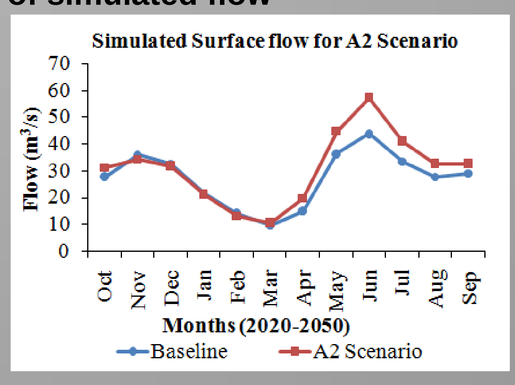
- Rainfall will increase by 8% 18% of the baseline monthly rainfall for A1B and A2.
- Max.Temp (Min.Temp) will increase by atleast 0.2^{0}C (0.1^{0}C) & 0.3^{0}C (0.2^{0}C) for A1B & A2 respectively.



A1B scenario has an increasing annual trend of 0.243 m^3/s and A2 scenario also has an increasing annual trend of 0.264 m^3/s

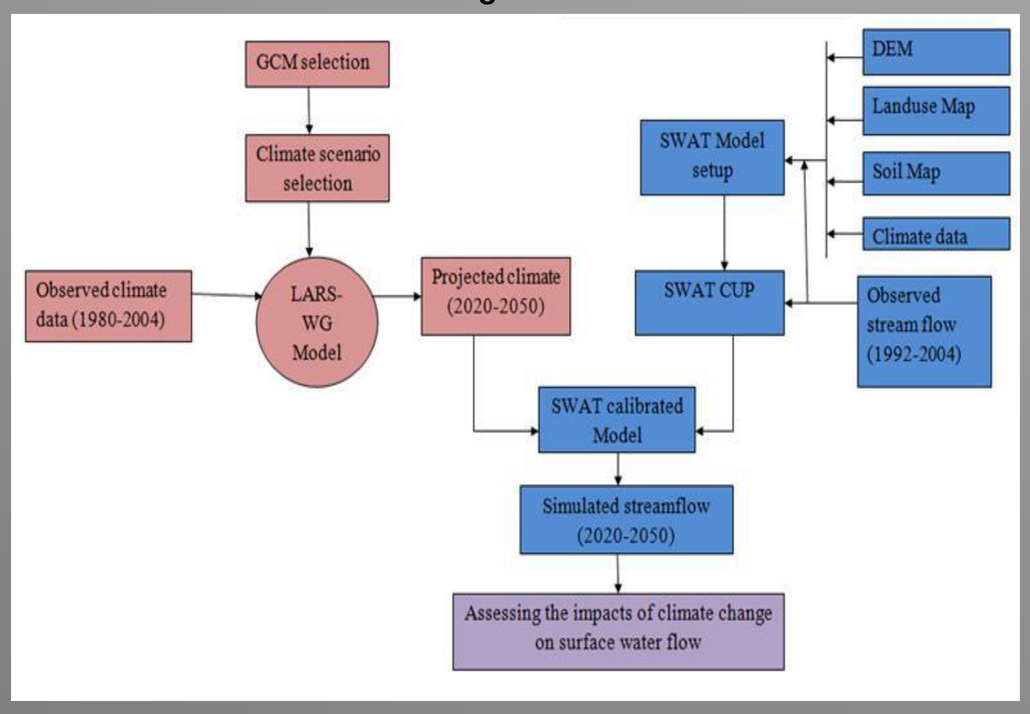
Change analysis of simulated flow

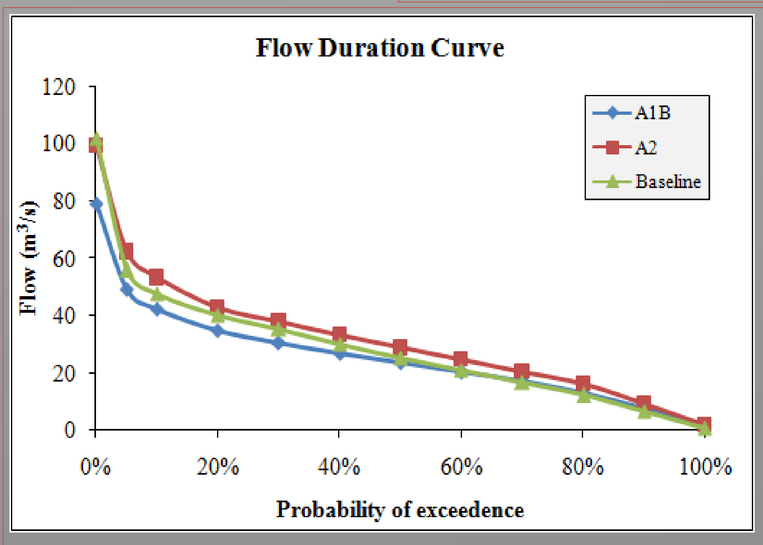




- A1B displays monthly low flows as compared to the baseline with an average of 2.3m^3/s.
- A2 scenario displays simulated surface flow which follows the trend of the baseline period. simulated surface flow is higher than the baseline period by an average of 3.5m^3/s monthly

Modelling Framework





- Higher floods are to occur and the lower flows will increase in A2 scenario as compared to the baseline period. Higher median flows are to also occur in the A2 scenario

Conclusion

- Fluctuations in observed rainfall have an impact on streamflow.
- A2 scenario is most likely going to be experienced which will impact on the streamflow of Malaba River. The simulated flow will start to increase from April and reach its peak in June which is 13.3 m^3/s higher than the value for the baseline period and gradually decrease till it intersects with the baseline period in November.

Recommendations

- A NSE higher than 0.55 for SWAT calibration and validation should be attained.
- Research on the water availability for all water users in Malaba River catchment is proposed.