7th Nile Basin Development Forum - Uganda 2023

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Climate Change and its Impact on Streamflow in the upper Blue Nile River Basin, Ethiopia.

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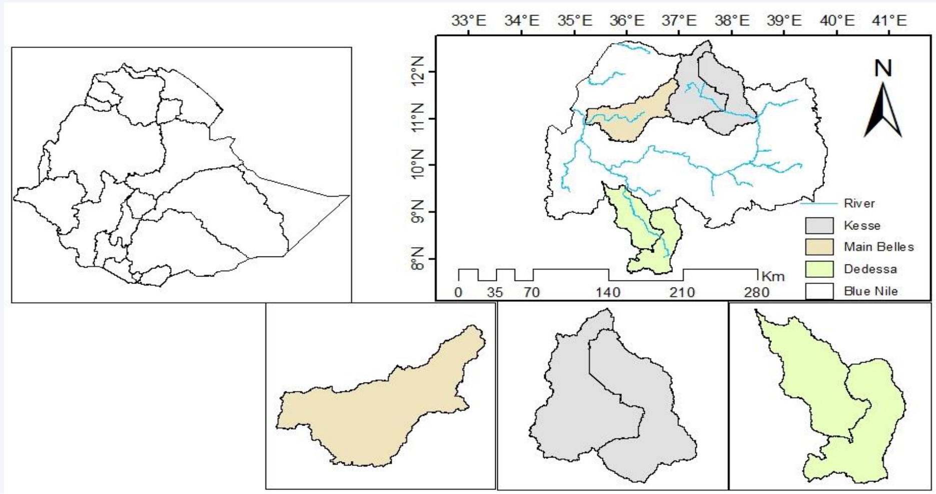
Introduction

- Climate change can cause significant effects on water resources by resulting in changes in the hydrological cycle.
- Significant change in mean annual precipitation and average temperature through various periods are principal implications of climate change; and
- they are the main determinants of the hydrologic cycle, seasonal occurrence and flows of water in rivers, wetlands, and soils in a basin.

Introduction

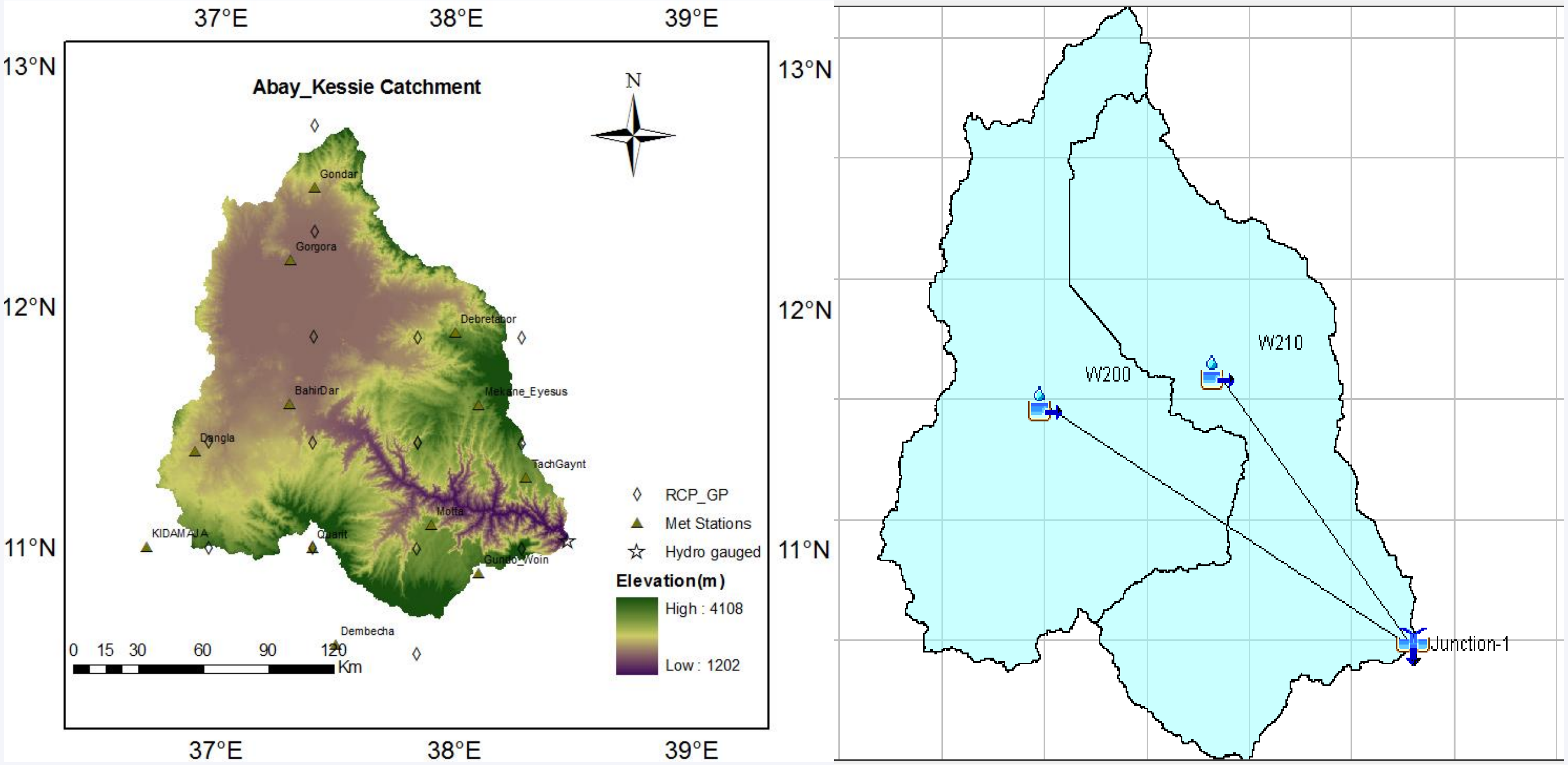
- Different climate model ensemble results are effective in reducing uncertainty in long-term climate simulation that arises from internal variability, boundary conditions, parameter values for a given model structure, or structural uncertainty due to different model formulations.
- The use of GCMs outputs and hydrological modelling is the best method in estimating future plausible streamflow changes due to climate change.

Study Area Description



S.N.	Data type	Resolution		Data sources
		Temporal	Spatial (m)	
1	Historical Climate data	1985-2013		* EMI
2	CMIP5/GCM Climate data	(1981-2005),(2020-2080)		https://esgf-node.llnl.gov/search/cmip5/
3	DEM		30x30	https://earthexplorer.usgs.gov/
4	Flow Data			** MoWIE
5	LULC		30x30	https://earthexplorer.usgs.gov/
6	Soil		30x30	http://www.fao.org/soils-portal/

Hydrological modeling



HEC-HMS4.2 hydrologic modelling basin model physical watershed map for Kessie catchment during calibration.

Result and Discussion

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Precipitation (A) and Evapotranspiration (B) Mann-Kendal trend test statistics

(A)						
Sub-basin	MK test	Obsr	RCP4.5		RCP8.5	
Names	Statistics	(1985-2013)	2050's	2080's	2050's	2080's
	Z	0.73	0.74	0.67	0.76	0.6
Kesse	Slope	1.3	-1.2	2.7	-1.1	-3.8
	Z	0.8	0.002	0.86	0.6	0.5
Didessa	Slope	-1.7	-14.9	-1.1	2.12	2.6
	Z	0.01	0.2	0.6	0.7	0.6
Belless	Slope	9.5	-8.8	-2.7	-1.5	1.22
(B)						
	Z	0.5	0.2	0.2	0.9	0.2
Kesse	Slope	-0.8	2.2	-1.6	0.28	3.2
	Z	0.2	0.2	0.3	0.5	0.8
Didessa	Slope	1.1	1.2	-1.4	0.7	-0.54
	Z	0.5	0.2	0.1	0.4	0.5
Belless	Slope	2.5	2.2	-3.4	1.4	-1.2

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Hydrological Modelling and Performance

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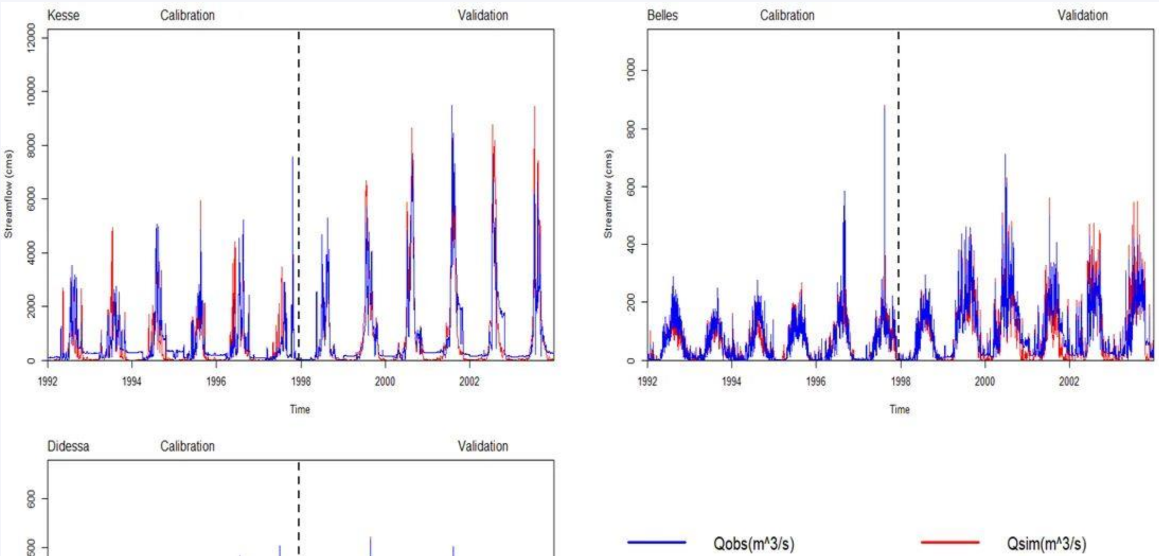

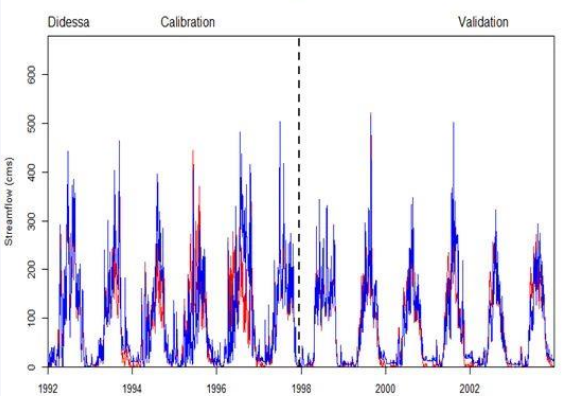

Hydrograph of model performance for calibration and validation of HEC-HMS model

Subbasins	Kesse		Main Belles		Didessa	
	Calib	Valid	Calibration	Valid	Calib	Valid
Objective functions	(1992-1998)	(1999-2003)	(1992-1998)	(1999-2003)	(1992-1998)	(1999-2003)
NSE	0.65	0.67	0.79	0.82	0.75	0.79
RMSE	0.47	0.49	0.33	0.34	0.48	0.47
MAE	0.46	0.40	0.20	0.28	0.30	0.44
R^2	0.67	0.69	0.8	0.83	0.75	0.79

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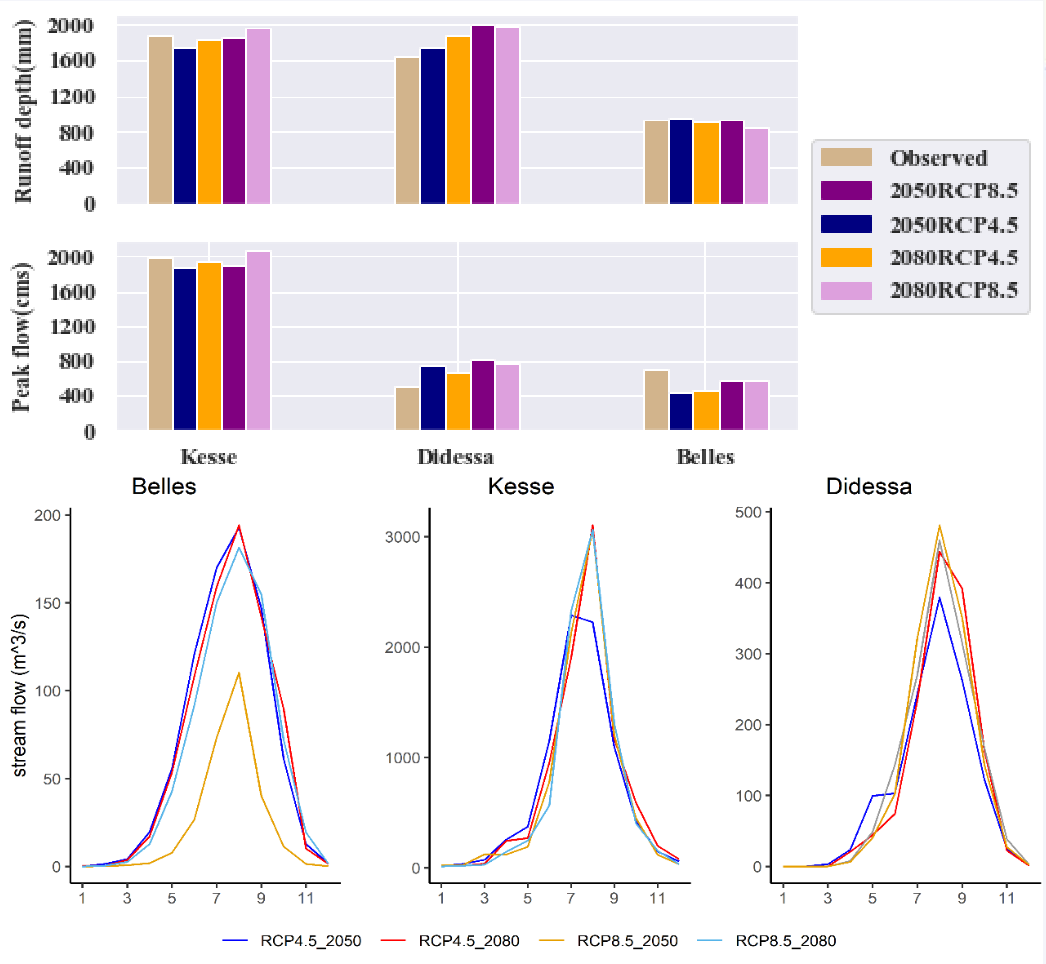
Comparison of peak flow and runoff depth for evaluating mean annual flow volume relative to historical



Future predicted mean monthly runoff in response to climate change in the basin.

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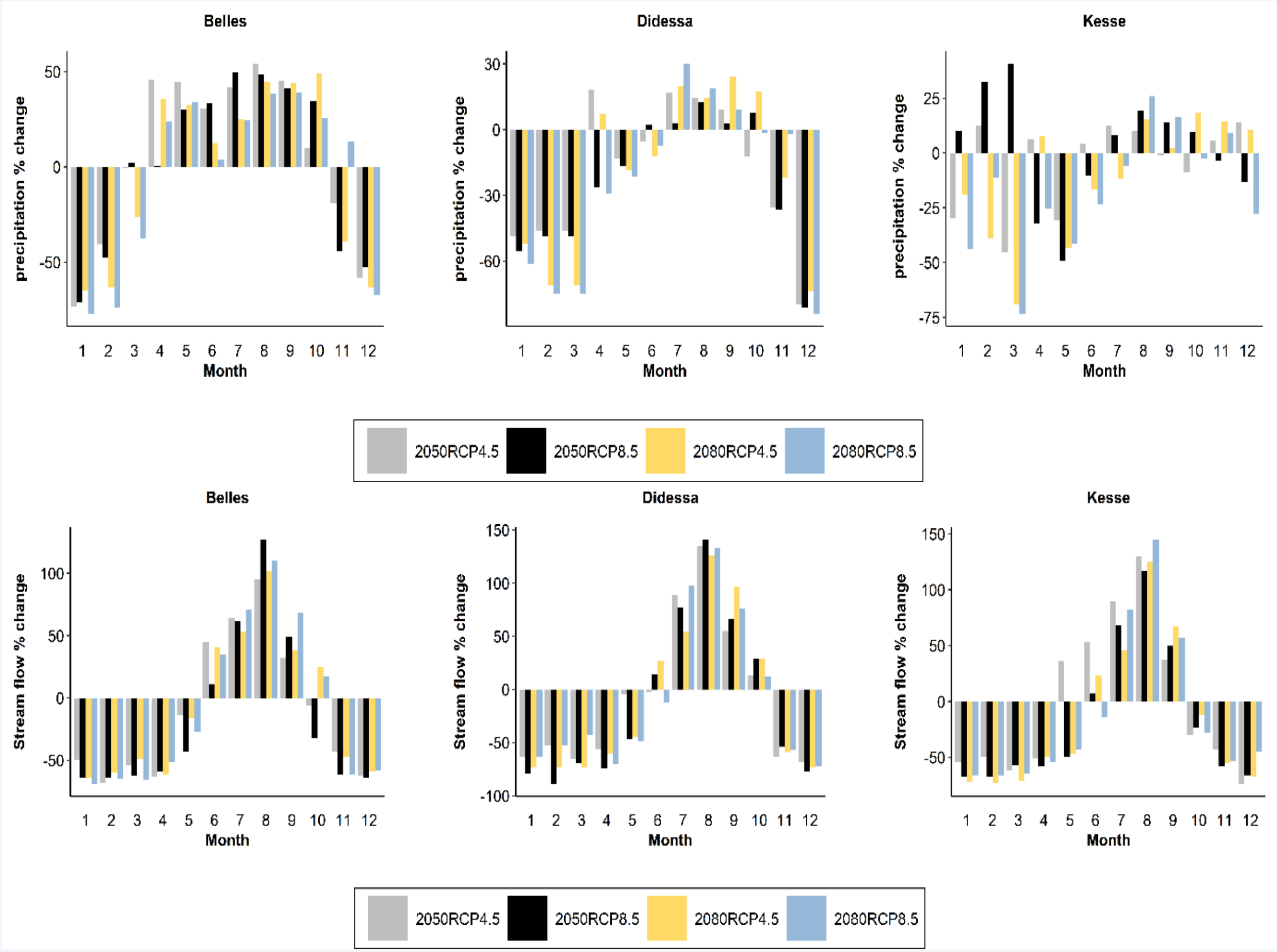
Seasonal stream flow change in response to precipitation change



Conclusion &Recommendations

- Future rainy season (Jun-Aug) precipitation and accompanied runoff becomes highly augmented compared to historical.
- Ensemble mean use of multiple climate data sources and evidences could improve climate uncertainty and runoff prediction in the basin.
- Future wet season (Jun-Aug) flood forecasting and precaution for floodplain areas of the Nile basin should be consolidated.

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THANK YOU!