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Spatio-temporal Distribution of Groundwater Recharge under Climate Change in the Namngum++ River Basin

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INTRODUCTION

Groundwater contributes to one third of global consumption and critical to global ecological supplies, economic and societal needs

Increased groundwater abstraction for domestic, industrial and irrigation consumption attributed by burgeoning population further stressed by climate change

Climate change though indirectly influences groundwater through alerting the infiltrating water through soil, deep percolation and evaporating demands

Imperative need to study climate change impact on groundwater resources for progressive and sustainable water resources management, especially in Namgmum ++ basin of Lower Mekong where groundwater potentially remains untapped resource and surface water threatened by erratic rainfall and prolonged droughts.

STUDY AREA

Namngum++ Basin: Transboundary river basin that transcends Laos (major part) and Northern part of Thailand

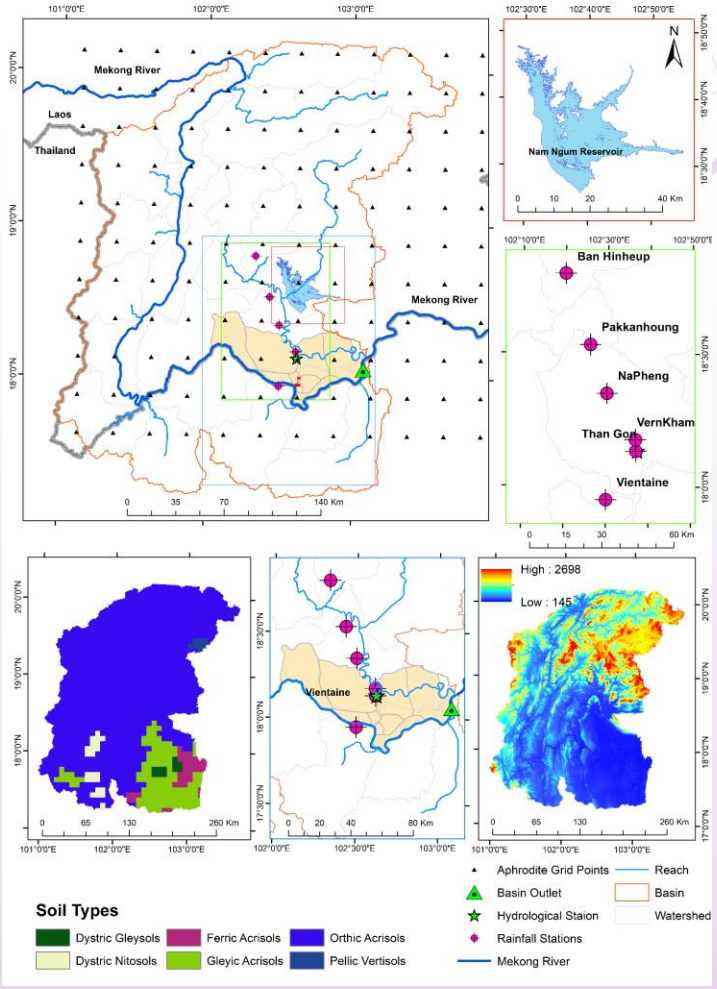
Topography: Relatively flat terrain towards south and undulating terrain in the north (elevation ranging between 145 m to 2695m

Climate: tropical climate with distinct wet (June to September) and dry (October to April) seasons

Temperature: 30 °C to 38 °C

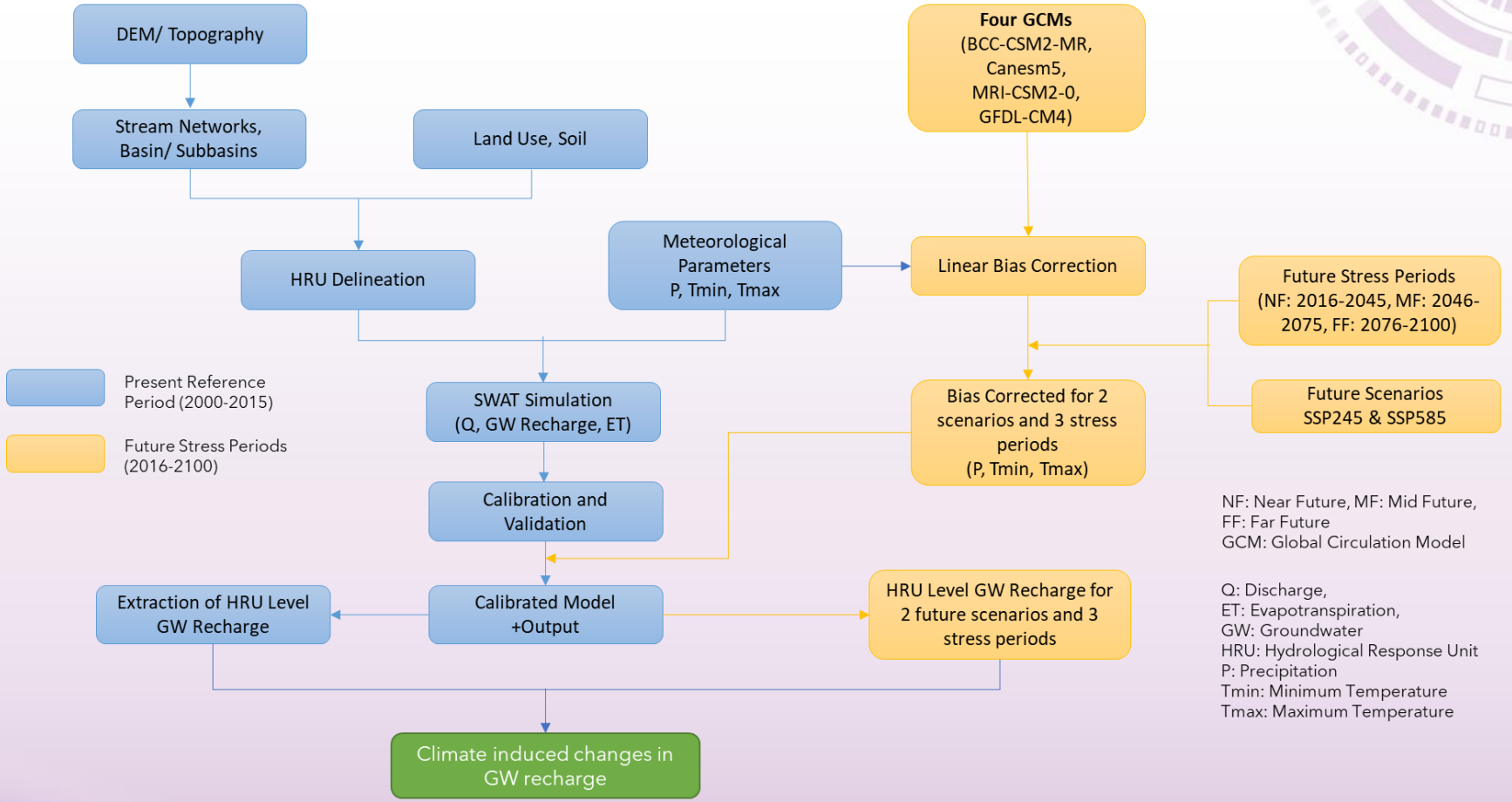
Average annual precipitation ranges between 1101-2759mm with around 1500mm (basin average)

Significant Importance: Houses several reservoirs and hydropower projects



METHODOLOGY

- SWAT run, calibration & validation and HRU level GW extraction for present reference period
- Linearly bias correct 4 GCMs P, Tmin and Tmax and ensemble them
- SWAT run for individual models for 2 scenarios and 3 future stress periods and GW recharge extraction at HRU level and compute ensemble recharge



NF: Near Future, MF: Mid Future,
FF: Far Future
GCM: Global Circulation Model

Q: Discharge,
ET: Evapotranspiration,
GW: Groundwater
HRU: Hydrological Response Unit
P: Precipitation
Tmin: Minimum Temperature
Tmax: Maximum Temperature

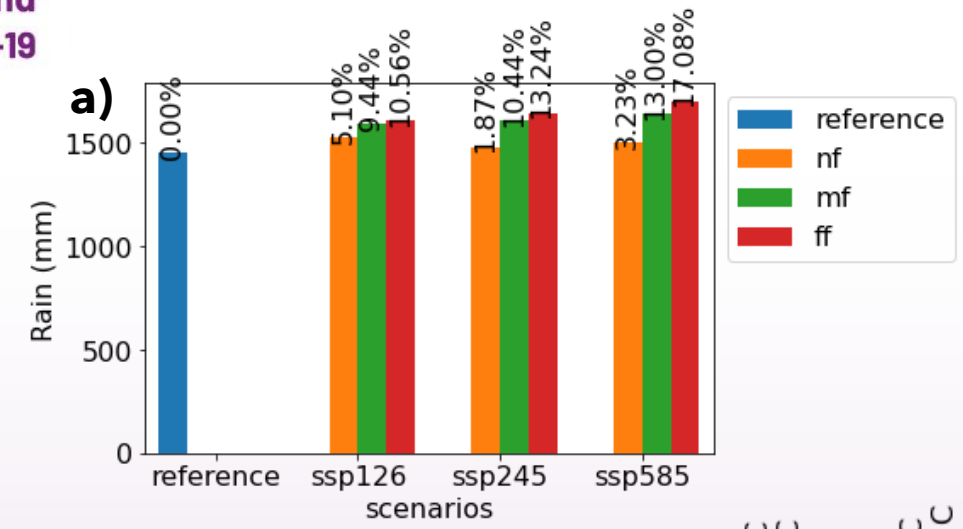
RESULTS- BIAS CORRECTION

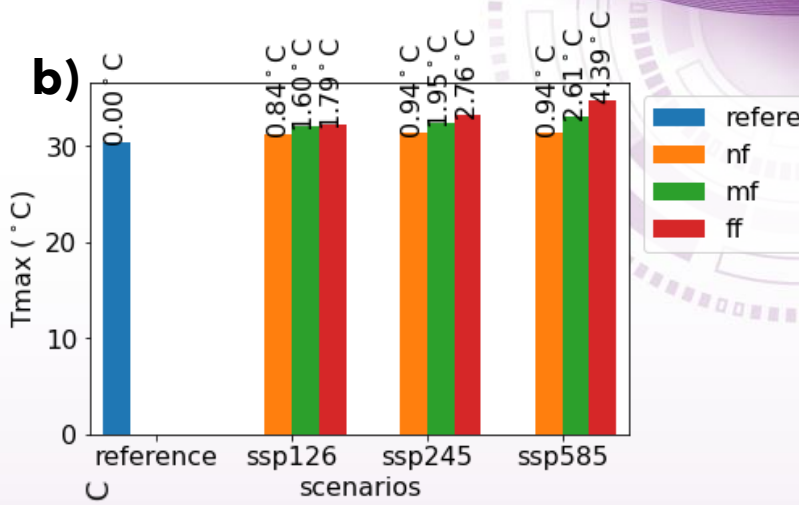
All 3 scenarios and 3 future stress periods demonstrate increase in P, Tmin and Tmax

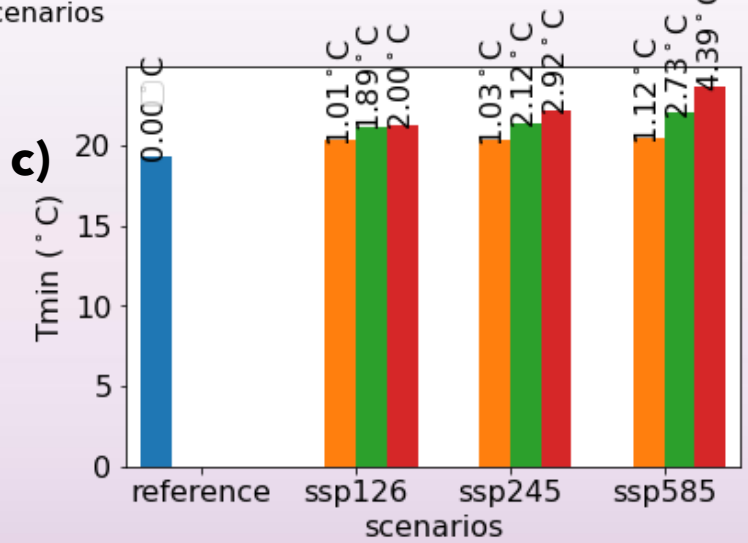
Precipitation increases in the range of 5.10- 17.08% higher in ff (similar results reported by (Jayasekera & Kaluarachi, 2015)

An increase of 2.61° and 4.39 ° for Tmax and 2.12 ° and 4.39 ° for Tmin for mf and ff

Note: Though linear bias correction was done for 3 scenarios, only ssp245 and ssp585 were used for further processing







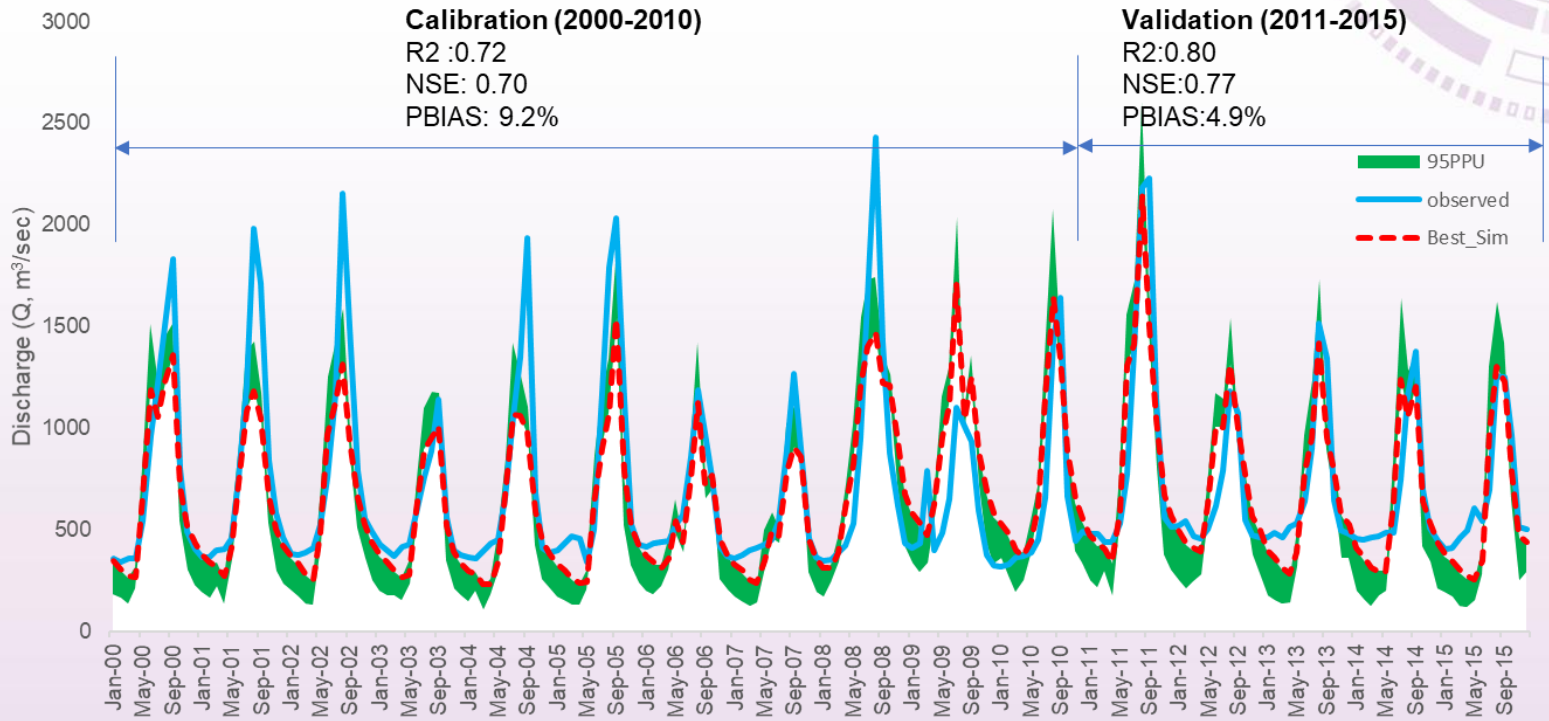
Reference for meteorological parameters : 1985-2015

Basin average of ensemble with relative/absolute changes (on top of graph) a) Rainfall, b) Minimum Temperature and c) Maximum Temperature

RESULTS-SWAT MODELLING

Name	Definition	Range (Default range)	Fitted Value
CN2*	Curve number	-0.15-+0.15	0.055
ALPHA_BF	Baseflow alpha factor	0-1	0.82
GW_DELAY (days)	Groundwater delay time (days)	0-500	168
GWQMN (mm)	Threshold depth of water in the shallow aquifer required for return	0-5000	462.08

*relative change

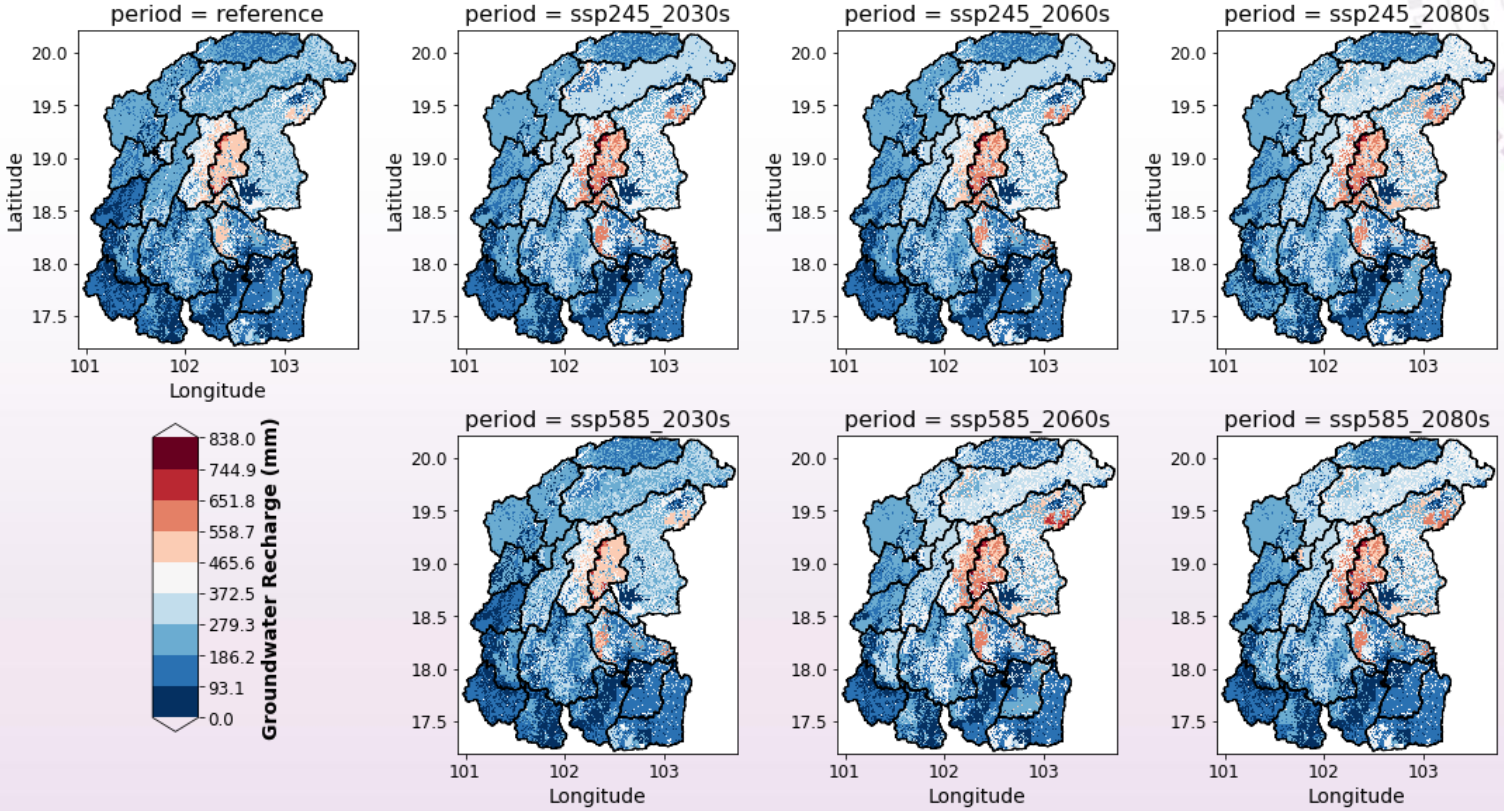


Monthly hydrographs of SWAT model during calibration and validation period

RESULTS- SWAT MODELLING

Recharge ranges between near to 0mm in the lower region to 838 mm in middle part of the basin

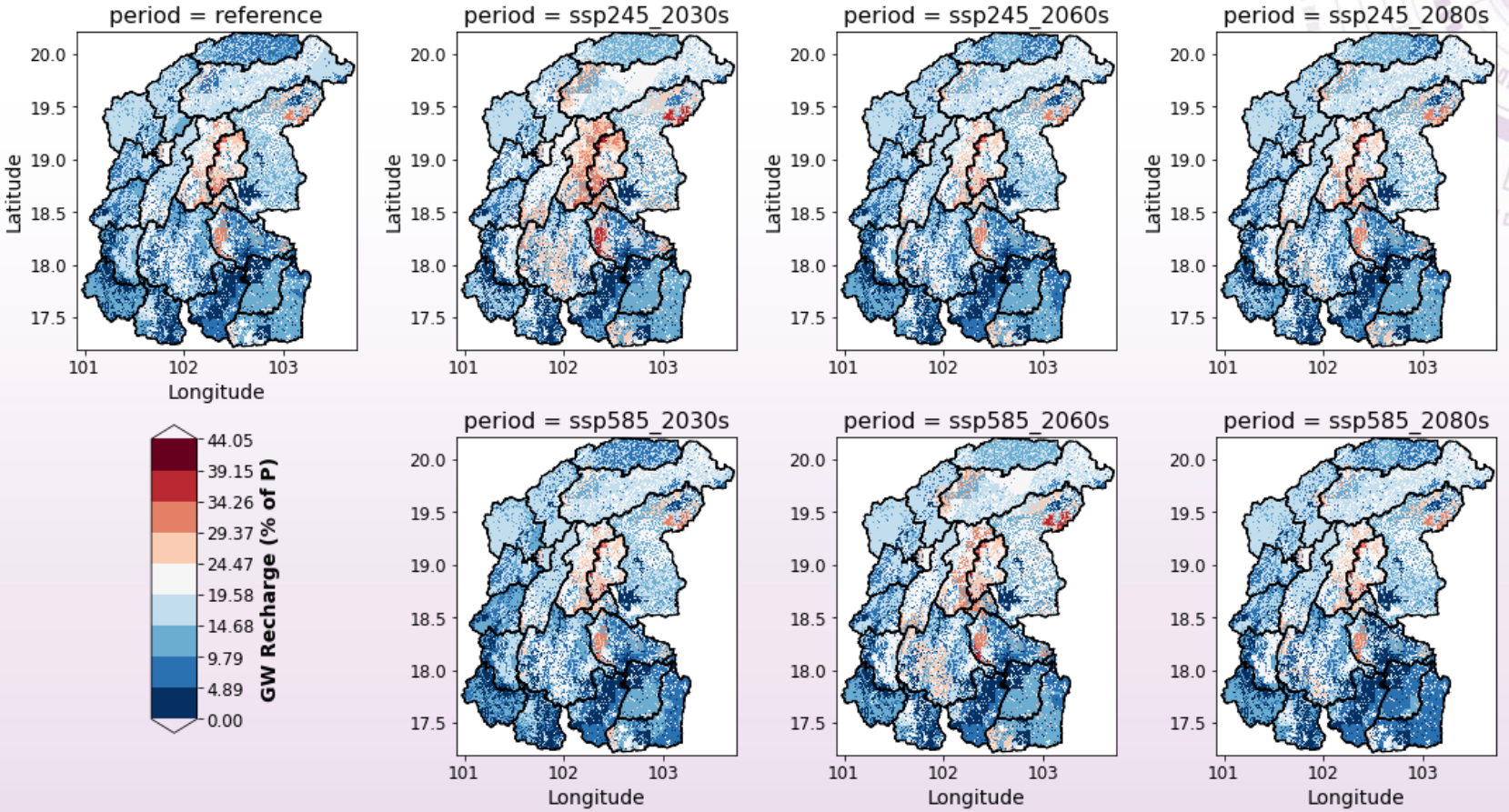
Slight increase in recharge is observed across the basin except for the lower right flank



Spatial distribution of HRU level groundwater recharge across the basin for SSP245 and SSP585 scenarios for 3 future stress periods against the reference period

RESULTS

GW recharge as % of P ranges between 0- 20 % for most part basin except middle section (exceeding 35 %). Similar results were reported by Lacombe et. al., (2017).

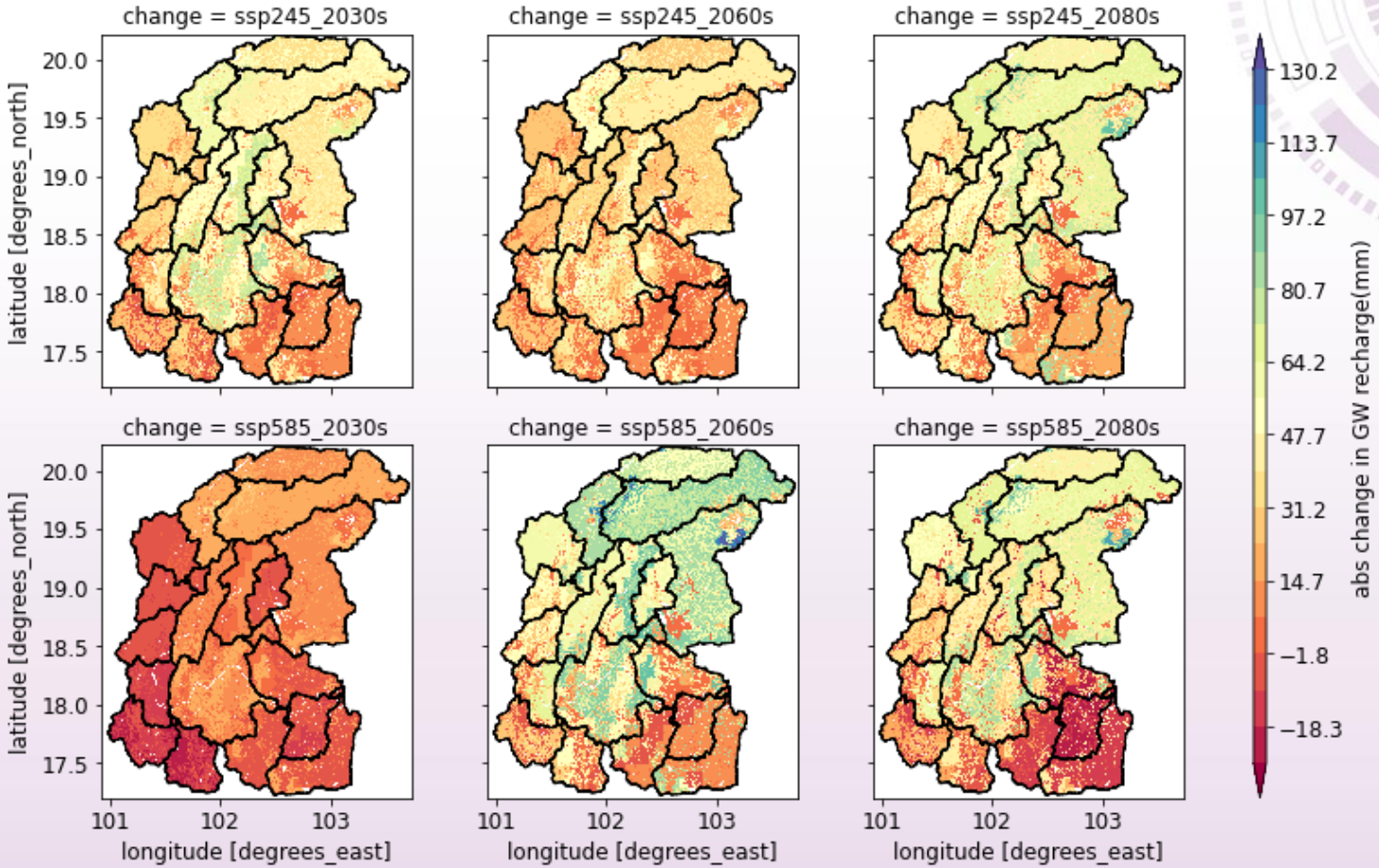


Groundwater recharge as percentage of Precipitation across the basin for SSP245 and SSP585 scenarios for 3 future stress periods against the reference period

RESULTS

NF and FF for **SSP245** shows **increase** in recharge except for lower right flank of the basin

In contrast, **decreased ground for NF** and **increase GW** (except lower right flank) for **MF and FF with highest increase in MF** in the **SSP585**



Spatial distribution of absolute change in groundwater recharge HRU level groundwater recharge across the basin for SSP245 and SSP585 scenarios for 3 future stress periods against the reference period

CONCLUSIONS

- HRU level recharge shows the finer detail of spatial distribution of the groundwater recharge in the basin
- Climate change is likely to influence the groundwater recharge in the basin in both the SSP scenarios
- Increasing groundwater recharge in the upper subbasins and decreasing across the lower part in future stress periods (especially in far future) indicate the need for sustainable and coordinated water management strategies

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THANK YOU