Trends of Hydro-meteorological Indices in Tendaho Catchment Part of Awash River Basin, Ethiopia

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Presentation Layout

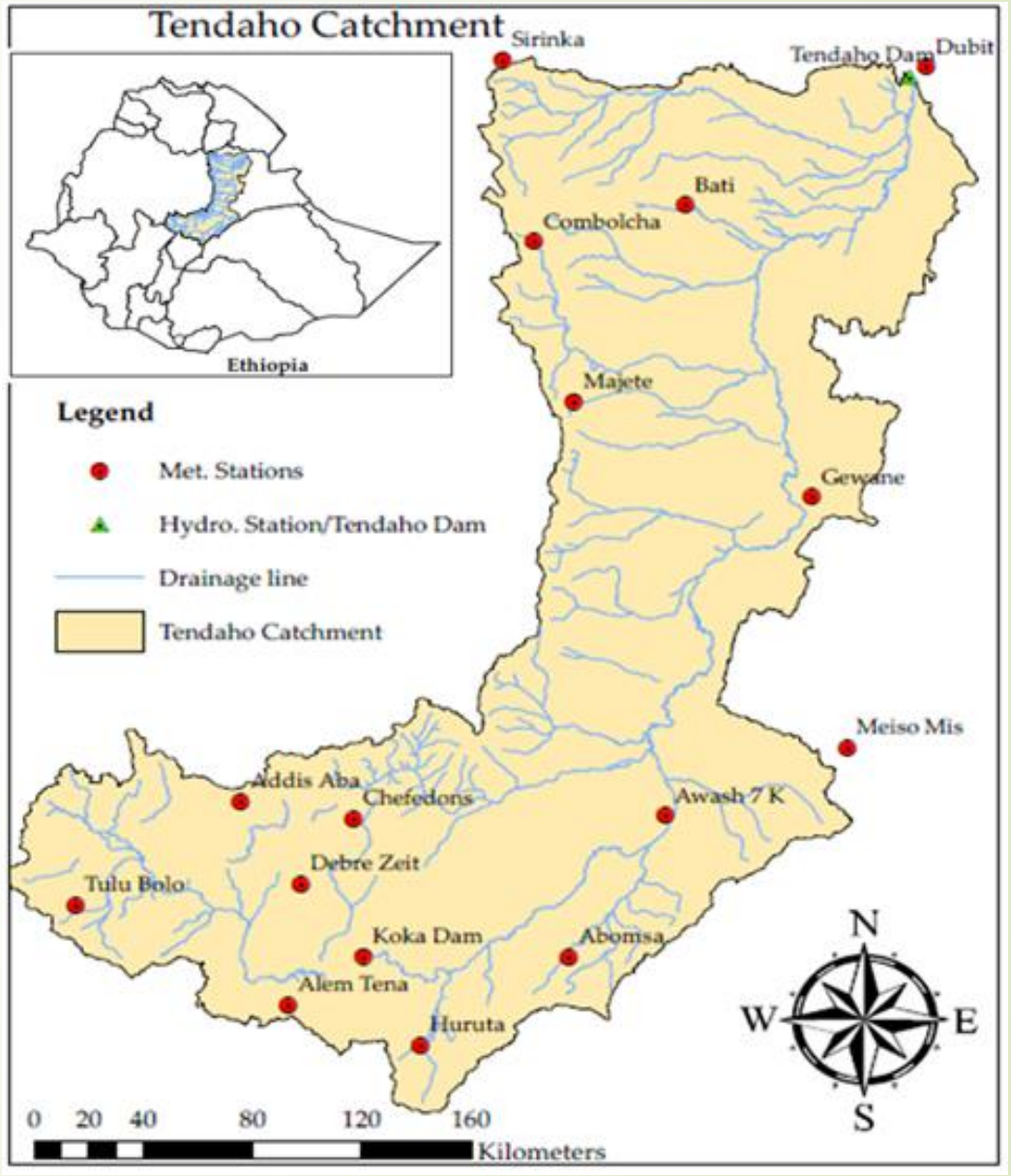
- Introduction
- Objectives
- Methodology
- Results
- Conclusion

Introduction

- The spatial and temporal variability of the hydro-meteorological indices have an enormous impact on water resources management and infrastructure safety.
- During the 20th century, the intensity and frequency of extreme events have significantly altered globally due to climate change.
- A large spatial and temporal variability of rainfall leads to an increasing incidence of extreme events like floods and droughts.
- Trend identification has a significant purpose in climate change studies to make future predictions about possible consequences.
- The **main purposes** of the study are analyzing the temporal trends and spatial patterns of hydro-meteorological variables of Tendaho Catchment.

Data

- Daily precipitation and temperature data from 16 meteorology stations.
- Daily stream flow data at the catchment outlet station.
- Meteorology data from 1979 to 2017 and stream flow data from 1979 to 2005.



Methodology

- In this study, before use all-time series data were checked for autocorrelation.
- Pre-whitening procedure is performed at a 5% significant level using the modifiedmk package.
- Four non-parametric methods (Mann-Kendall (MK), Sen's slope (SS), Spearman's Rho (SR) and the Sen innovative trend method) were used to detect the trends.
- Three precipitation indices (AP,AMP and MAP), two temperature indices (AMaT and AMiT) and three stream flow indices (MAF, AMaxF and TMAF) were analyzed at a 5% significant level .
- Inverse distance weighting method (IDW) was used to interpolate trends of the available stations in order to produce continued raster surface for Tendaho catchment using ARC-GIS.

Results (Temporal Trends)

a. The annual maximum precipitation (AMP)

- Analyzed using MK, SR and Sen's Slope methods.
- One station (Gewane) shows a statistically significant increasing trend at 5% significant level.
- For the remaining 15 stations, 80% stations shows a slightly increasing trend.
- The remaining 20% stations have a slightly decreasing and statistically non-significant trend.

Station Name	MK-Z	P-value	Sen's Slope	Pre-whitened SS	Var(S)	SR-Z	Sig Trend	Trend type
Abomsa	0.275	0.783	0.058		5841.3	0.389	no	Increasing
Addis Aba	0.490	0.624	0.113		6326	0.506	no	Increasing
Alem Tena	0.490	0.624	0.113		6326	0.506	no	Increasing
Awash 7 K	-1.378	0.168	-0.444		3802.7	-1.441	no	Decreasing
Bati	0.750	0.453	0.388		2841	0.745	no	Increasing
Chefedonsa	-1.597	0.110	-0.289		6326	-1.639	no	Decreasing
Combolcha	0.379	0.704	0.059	0.054	5846	-0.161	no	Increasing
Dubity	0.101	0.920	0.059		6325	-0.161	no	Increasing
Gewane	2.080	0.038	0.727		5844	2.131	yes	Increasing
Huruta	-0.692	0.489	-0.113		6326	-0.735	no	Decreasing
Majete	0.257	0.797	0.187		2562	0.287	no	Increasing
Sirinka	0.257	0.797	0.187		2562	0.287	no	Increasing
Tulu Bolo	-0.541	0.589	-0.541		6319.3	-0.618	no	Decreasing
Meiso	0.022	0.982	0.024		2057.3	0.048	no	Increasing
Koka Dam	0.022	0.982	0.024		2057.3	0.048	no	Increasing
Debre Zeit	1.171	0.241	0.258		4549.3	1.187	no	Increasing

Results (Temporal Trends)

b. The annual precipitation (AP)

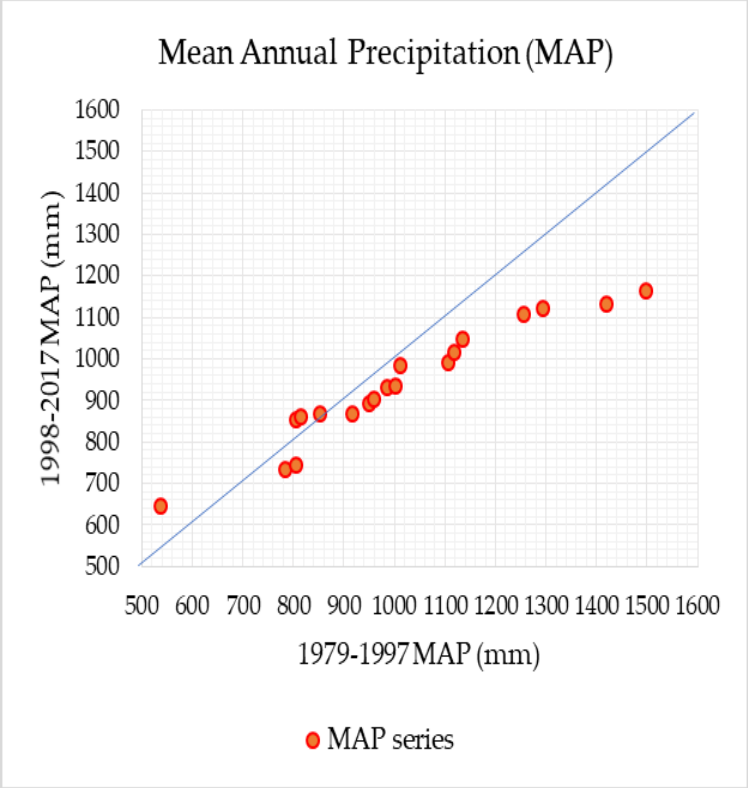
- Three (18.75%) of the stations have statistically significant trend.
- Two (Abomsa and Awash 7kilo) of the stations have a decreasing trend and one (Gewane) station has an increasing trend.
- The remaining 13 (81.25%) stations have no statistically significant trend.

Station Name	MK-Z	P-value	Sen's Slope	Pre-whitened SS	Var(S)	SR-Z	Sig Trend	Trend type
Abomsa	-2.120	0.034	-7.814		2842	-2.111	yes	Decreasing
Addis Aba	1.634	0.102	4.427		6327	1.782	no	Increasing
Alem Tena	0.982	0.326	0.284		3138.7	1.265	no	Increasing
Awash 7 K	-2.108	0.035	-5.541	-4.121	3461.7	-2.604	yes	Decreasing
Bati	-0.581	0.561	-2.324		2842	-0.563	no	Decreasing
Chefedonsa	1.659	0.097	5.100		6327	1.915	no	Increasing
Combolcha	0.589	0.556	7.828	6.402	5846	0.431	no	Increasing
Dubity	0.957	0.339	0.310		2840	1.129	no	Increasing
Gewane	3.283	0.001	11.018		5846	3.031	yes	Increasing
Huruta	0.830	0.407	1.704		6327	0.841	no	Increasing
Majete	-0.083	0.934	-5.814	-0.506	2301	-1.229	no	Decreasing
Sirinka	-0.232	0.817	0.076	-0.046	5390	0.449	no	Decreasing
Tulu Bolo	-0.528	0.597	-2.858		6327	-0.425	no	Decreasing
Meiso	0.970	0.332	4.949		2058.3	0.863	no	Increasing
Koka Dam	-0.510	0.610	-3.418	-1.830	5846	-1.159	no	Decreasing
Debre Zeit	0.356	0.722	0.646		4550.3	0.563	no	Increasing

Results (Temporal Trends)

c. The areal mean annual precipitation (MAP)

- The result from Sen innovative trend and linear trend test indicate that there is a slightly decreasing trend.



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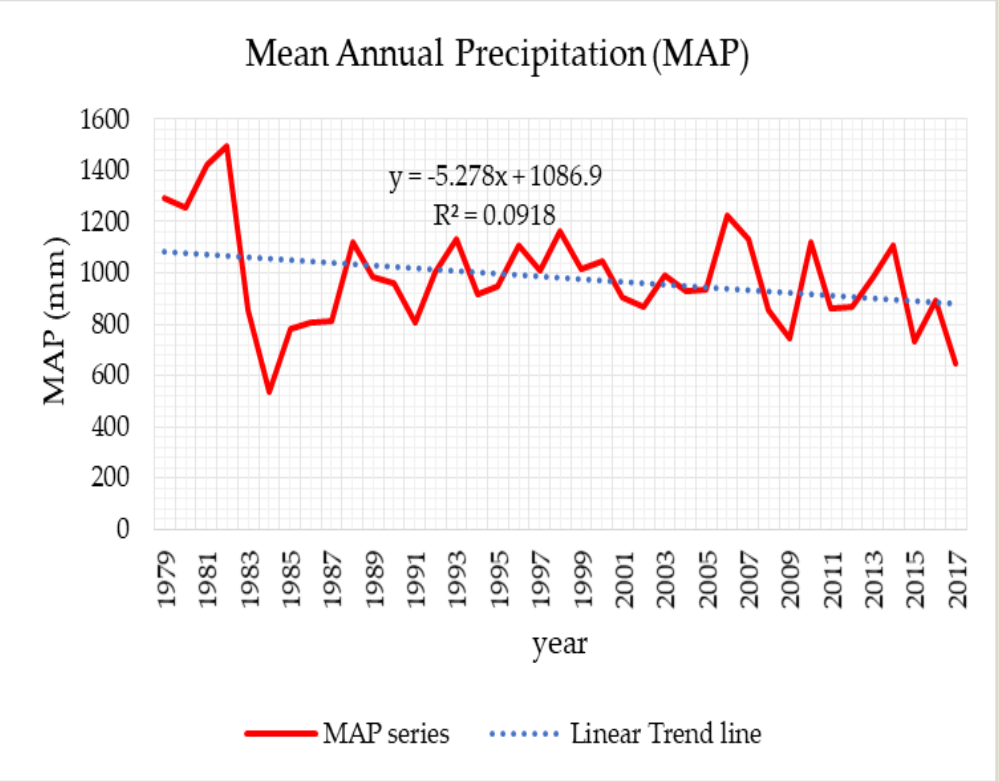


(b)

Results (Temporal Trends)

d. Annual maximum Temperature (AMaT)

- The result of the AMaT using MK and Sen's slope test indicates that nine (56.25%) stations have significant trends;
- The remaining seven (43.75%) stations have no significant trend and a slightly increasing trend for all stations except Combolcha.
- The maximum increment in temperature is 0.061 °C/year.

e. Annual minimum temperature (AMiT)

- The result indicate, half of the stations have statistically significant trend.
- Most of the stations have an increasing trend except Bati, Tulubolo, Koka Dam and Debrezeit.
- The magnitude of the largest increasing trend of AMiT is 0.071 °C/year.

Results (Temporal Trends)

Station Name	Annual Maximum Temprature (AMaT)					Annual Minimum Temprature (AMiT)				
	MK-Z	Sen's Slope	Pre-whitened SS	MK Sig	MK Trend	MK-Z	Sen's Slope	Pre-whitened SS	MK Sig	MK Trend
Abomsa	3.433	0.063	0.061	yes	+	2.045	0.029	0.020	yes	+
Addis Aba	3.746	0.034	0.022	yes	+	1.986	0.058	0.013	yes	+
Alem Tena	1.986	0.058	0.013	yes	+	0.431	0.053	0.009	no	+
Awash 7 K	3.454	0.039	0.031	yes	+	1.411	0.023	0.007	no	+
Bati	0.769	0.039	0.011	no	+	-2.997	-0.046		yes	-
Chefedonsa	0.490	0.145	0.014	no	+	5.424	0.071		yes	+
Combolcha	0.000	0.120	-0.001	no	-	3.294	0.059	0.040	yes	+
Dubity	3.170	0.043	0.033	yes	+	5.424	0.071		yes	+
Gewane	1.766	0.085	0.017	no	+	1.399	0.064	0.029	no	+
Huruta	1.584	0.029	0.009	no	+	3.017	0.067	0.054	yes	+
Majete	4.090	0.053		yes	+	0.250	0.009	0.003	no	+
Sirinka	3.596	0.026		yes	+	0.302	0.002		no	+
Tulu Bolo	1.257	0.062	0.033	no	+	-0.994	0.017	-0.017	no	-
Meiso	3.350	0.050	0.048	yes	+	0.176	0.004	0.008	no	+
Koka Dam	0.114	0.037	0.003	no	+	-2.301	-0.110	-0.042	yes	-
Debre Zeit	2.154	0.023	0.017	yes	+	-0.418	-0.008	-0.005	no	-

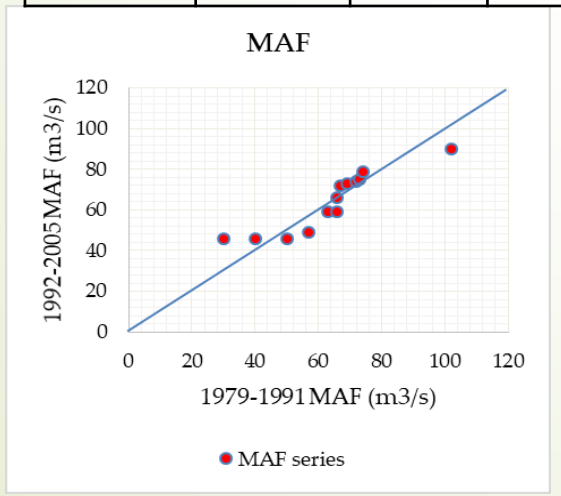
(+) indicates an increasing trend and (-) indicates a decreasing trend type

Results (Temporal Trends)

f. Observed stream flow

- The result of MAF, AMaxF and TMAF indicates that there were no statistically significant trend. But there was slightly decreasing trends.

Indices	MK-Z	P-value	Sen's Slope	Pre-whitened SS	MK Sig	MK Trend	SR-Z	SR sig	SR Trend
MAF	-0.669	0.504	-0.333		no	Decreasing	-0.738	no	Decreasing
AMaxF	-0.573	0.567	-6.630	-2.91	no	Decreasing	-1.382	no	Decreasing
TMAF	-0.750	0.453	-3.889		no	Decreasing	-0.772	no	Decreasing



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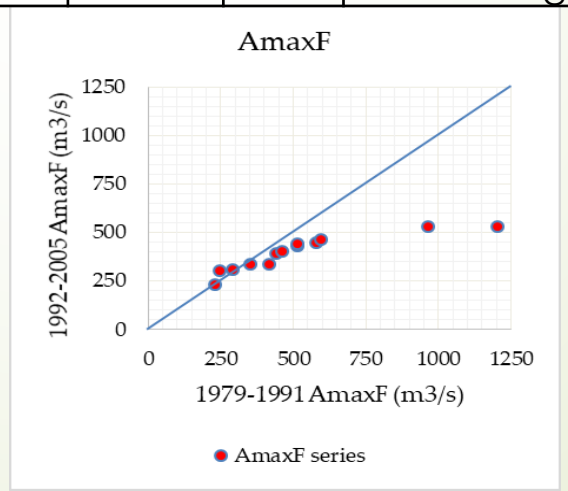

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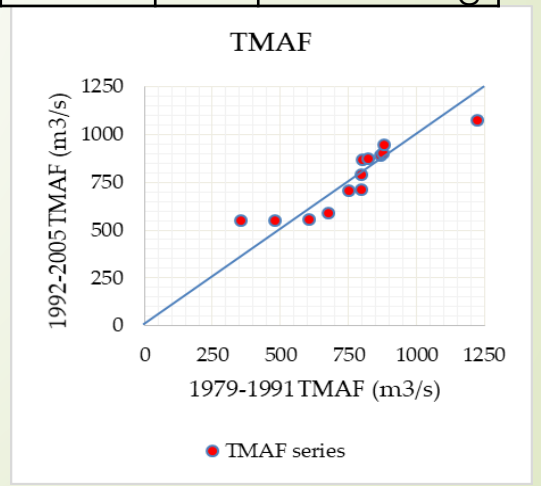
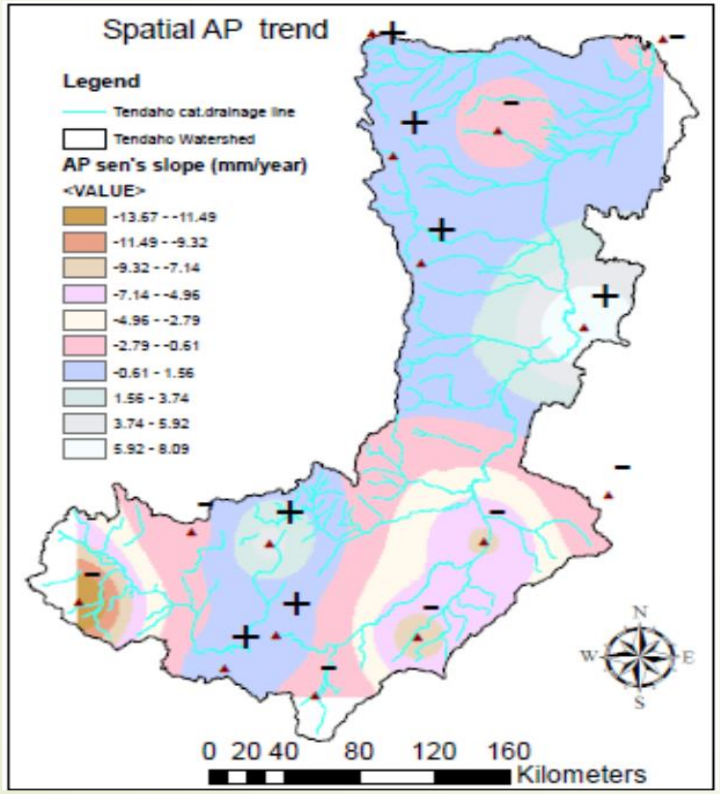


(c)

Results (Spatial Trends)

- The result indicate that there is no particular pattern in the spatial distribution of AP, MAP and AMiT on the majority of the stations.
- The AMaT shows an increasing pattern except in the downstream eastern part of the catchment with significant trend.



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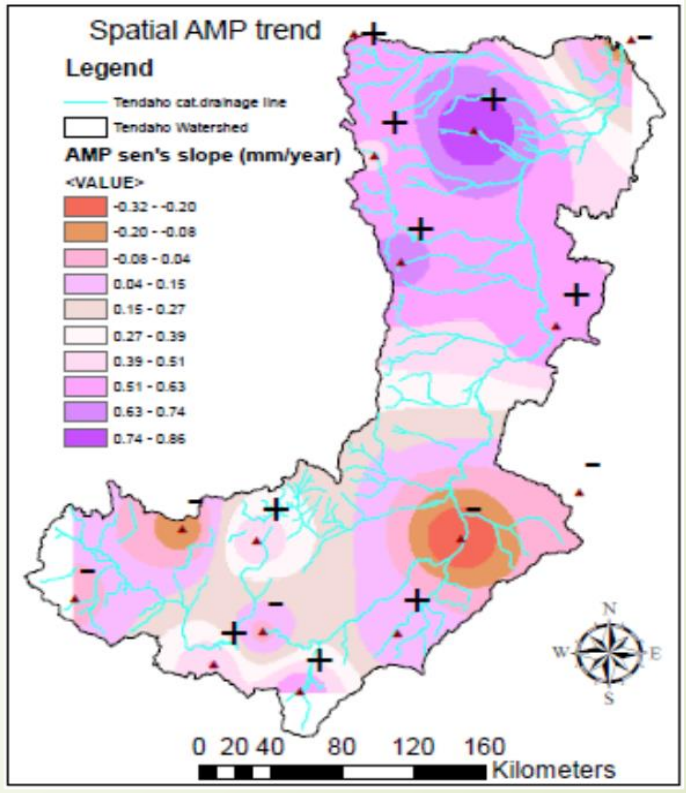

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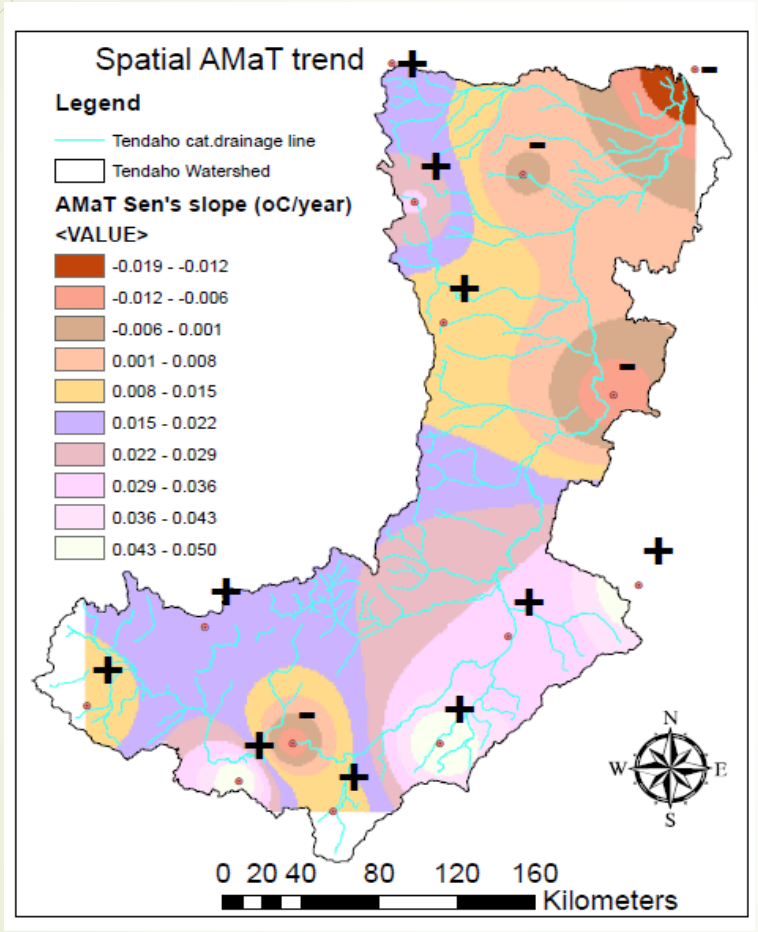
Results (Spatial Trends)



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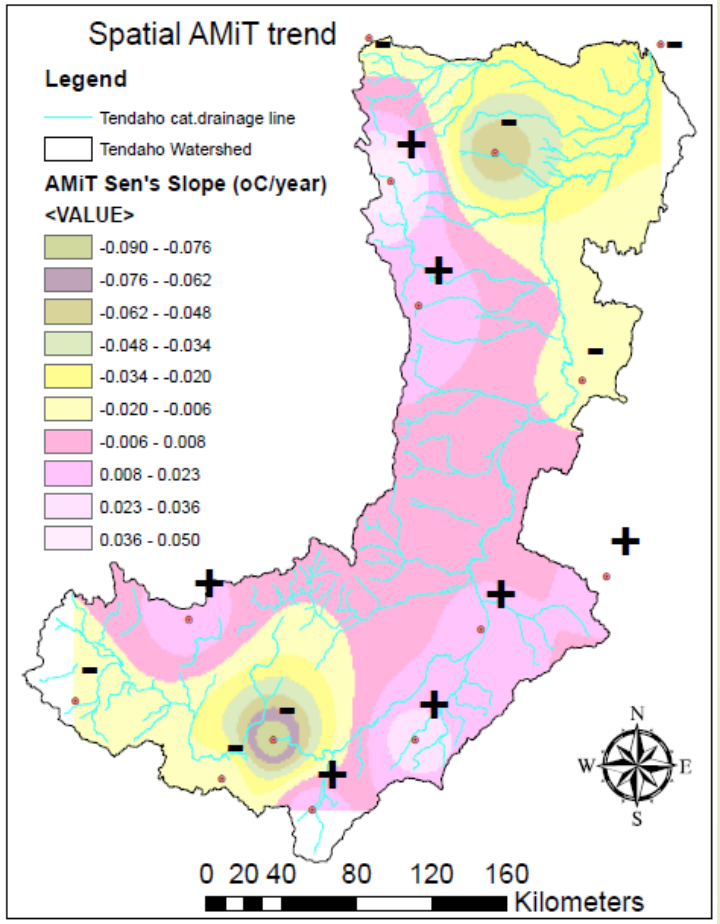

(d)

(+) indicate slightly increasing trend and (–) slightly decreasing trend pattern.

Conclusion

- For the precipitation indices (AP,AMP and MAP) the majority stations indicate statistically non-significant trend with slightly increasing trend of AP and AMP and a slightly decreasing trend of MAP.
- For the temperature indices (AMaT and AMiT) the majority of the stations shown a significant increasing trend.
- The stream flow indices (MAF, AMaxF and TMAF) indicate that there is statistically non-significant trend and a slightly decreasing trend.
- For the spatial trend, the detected AMP, AP and AMiT trends do not form systematic pattern.
- On the other hand the spatial trend of the AMaT indicates an increasing (+) Pattern except the lower eastern catchment area.
- The results of this study can be used as a reference to adoptive water resource management by local government and different stakeholders.

THANK YOU.