Century wide hydrologic trends and shifts in Colorado River Basin

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1 INTRODUCTION

Study of temporal and spatial change in hydrologic variables (temperature, precipitation, streamflow) can help in making better water management decisions and preparing for extreme events such as floods and droughts.

2 OBJECTIVE

To evaluate the long-term trends and step (abrupt change) changes in three hydrologic variables: temperature, precipitation, and streamflow over a century wide time frame in Colorado River Basin.

3 STUDY AREA AND DATA

❑ Colorado River Basin (CRB) is a major source of fresh water for 7 states within US namely Colorado, Utah, Wyoming, Arizona, Nevada, New Mexico, California, and Mexico.

It flows through the most arid regions of the country and supplies water for approx. 30 million people.

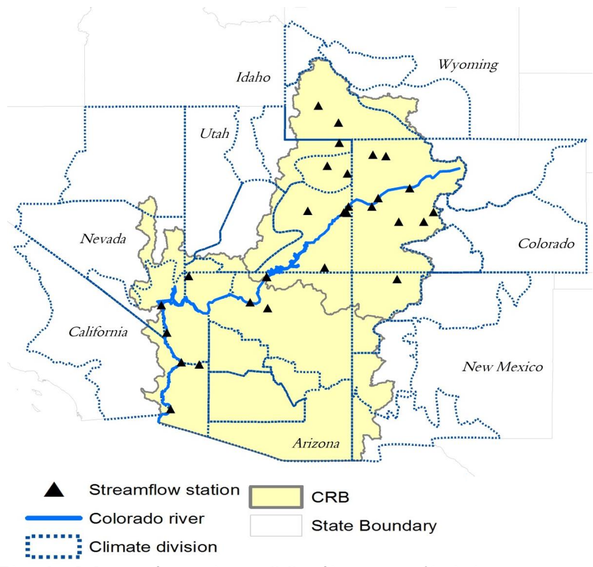

Fig 1: Map showing 29 climate divisions and 29 naturalized streamflow stations.

❑ The monthly temperature, precipitation and streamflow data for a time period of 103 years (1906-2008) for 29 climate divisions and 29 naturalized streamflow stations over CRB is analyzed.

4 METHODS

❑ Statistical trend and step change analysis ($p \leq 0.05$) is performed on average monthly temperature, precipitation and streamflow data.

❑ To understand the effects of short-term and long-term correlations on trends, Mann-Kendall Test with variations for short term (*Trend Free Pre Whitening)* and long term persistence (*LTP*) is used.

❑ Pettit test is used to analyze significant abrupt shifts.

5 RESULTS

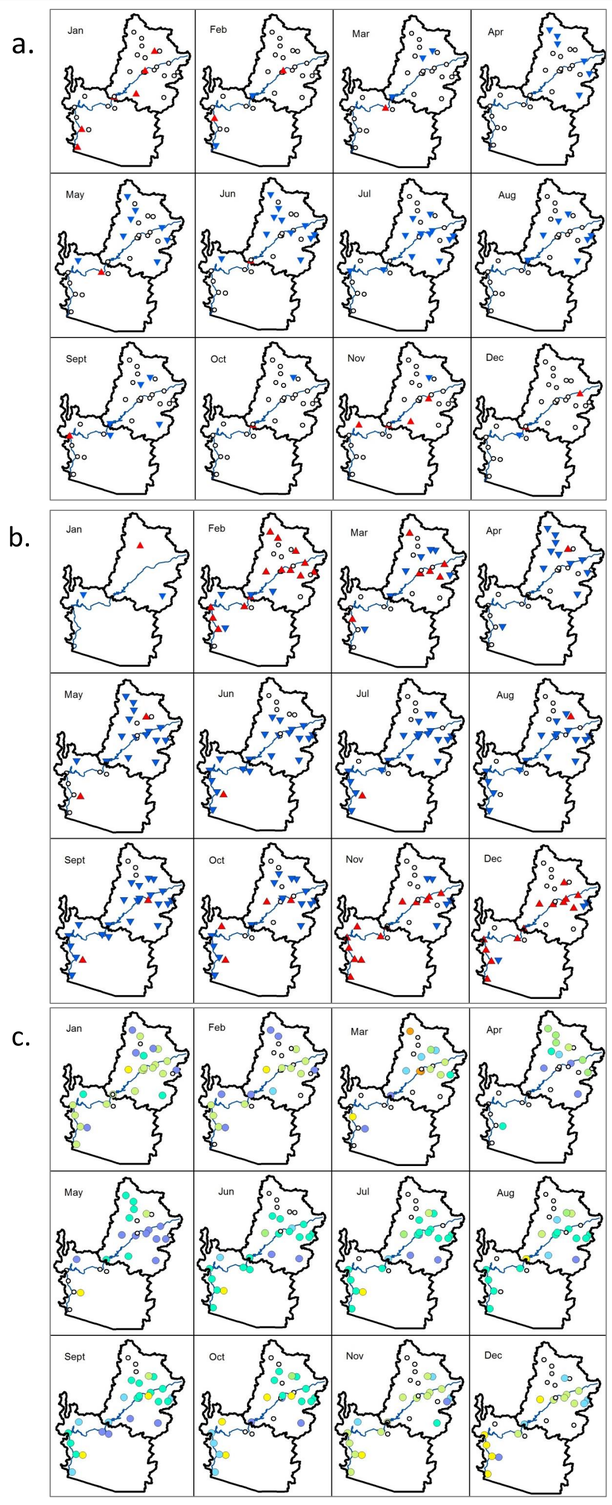

Fig 2: Map showing a)Increasing and decreasing trends, b) Step changes c) Decadal years for step changes in streamflow

❑ Decreasing trends in ***streamflow*** are seen from March to Sept (Fig. 2a).
- More than 50% stations show decreasing trends in June and July.
- Changes in streamflow are more prominent

❑ Increasing step changes are seen in period 1961-1980 and decreasing step changes in period 1921-1950 (Fig 2b,c).

❑ ***Temperature*** trends are increasing over most of the regions in the basin .

❑ March and May to Sept saw more increasing trends, and no decreasing trends were observed .

❑ Decreasing step change was seen in lower regions of Arizona & California in period 1951-1970 .

❑ ***Precipitation*** shows decreasing trends in the months of July.

❑ Increasing trends are seen in the months of Nov, Feb, August and Sept.

❑ Similarity in trends and step changes in precipitation suggests that trends may be due to the shifts .

❑ Comparative rejection of significant trends due to short term correlation is very negligible (Fig. 3).

❑ Long term persistence is more predominant in streamflow.

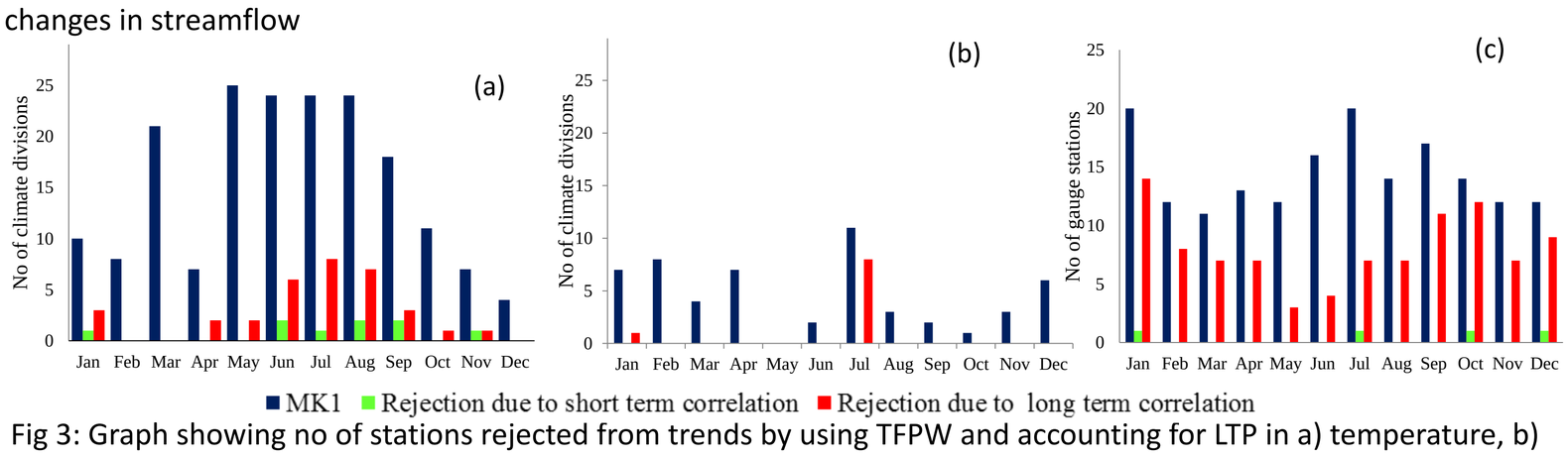

Fig 3: Graph showing no of stations rejected from trends by using TFPW and accounting for LTP in a) temperature, b) precipitation, c) streamflow.

6 CONCLUSIONS

❑ Step changes can help understand the response of hydrologic variables to climate change and whether significant regime shifts prevailed after abrupt changes.

❑ The results highlight the importance of using different variations of MK tests that helped in evaluating the effect of autocorrelation and long term persistence if not accounted can lead to spurious trends.

❑ A plausible explanation for increasing winter streamflow and decreasing peak season streamflow can be earlier snowmelt or precipitation as rainfall instead of snow due to increasing temperature.

❑ The study provides a detailed overview of the past hydrologic trends and changes in Colorado River Basin that may assist water managers in better planning and management of water resource.

7 ACKNOWLEDGEMENT

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