Climate teleconnection and predictability over Midlatitude Precipitation

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(a) Purpose of study or research hypothesis
The principal goals of this study are to analyze the characteristics of monthly precipitation variability over the United States, and to predict the monthly precipitation patterns based on global/regional-scale climate indicators. This study will address research question such as: "What impacts do large-scale climate indices have on the monthly precipitation over the United States?". The hypothesis of the study is that there are strongly significant correlations between the two variabilities and noticeable far-reaching effects, i.e., teleconnection, with statistically significant predictability on a monthly basis.

(b) Key issue(s) or problem(s) addressed
Climate change is expected to lead to a more active hydro-climatic circulation, including more total precipitation and more frequent high intensity precipitation events. Precipitation amounts and intensities increased on average in the United States during the 20th century, and according to climate change models they are expected to continue to increase during the 21st century. Extreme weather events will always be dangerous, but the brunt of the costs can be lessened by strategic planning and implementing innovative designs based on accurate forecasting database. The US has significant research capabilities in understanding the effects of extreme events, but this work is currently conducted with little attention to various climate indicators. As a result, we are missing an important opportunity to mitigate the effects of extreme events associated with climate variation.

(c) Methodology or approach used
Spatiotemporal variability, teleconnection, and predictability of the US precipitation related to large scale climate indices were examined based on leading patterns of observed monthly extreme and total precipitation through an empirical orthogonal teleconnection (EOT). Cross-correlation and lag regression analyses for the leading modes and global atmospheric circulation dataset were employed on a monthly basis.

(d) Results or conclusions derived from the project
The spatiotemporal evolution of the leading EOT modes exhibits increasing trends during summer season and decadal variability for winter season with central inland mode for summer and a southeastern coastal mode in winter. The tropical ENSO forcing has a coherent teleconnection with winter and spring precipitation patterns, while the Indian Ocean dipole is identified as a driver for precipitation variability in fall season. The monsoon circulation over the western North Pacific also exhibits a significant negative correlation with winter precipitation EOTs, while tropical cyclone indices are positively correlated with the fall precipitation EOTs. The leading patterns of the August and December extreme precipitation time series are predictable at up to six month lead time from the tropical Pacific sea surface temperatures (SSTs), while a somewhat weak predictable response from Indian Ocean SSTs was only detected at longer lead times.

(e) Implications of the project relevant to congress themes
For building resilience systems for climate change, this study contributes the public long-term goals of

providing the essential and highest quality environmental information vital to our nation's safety, prosperity and resilience by advancing spatiotemporal understanding and predictability of extreme climate and its impact over midlatitude. Specifically, for reducing disaster risks, it advances the climate adaptation by providing region-specific climate information based on large scale climate indices to support the resident's preparedness for managing water resources minimizing climate impacts. Also, it supports forecasting and pre-emptive action information that can cope with the demand of necessary and urgent needs in the untoward events.