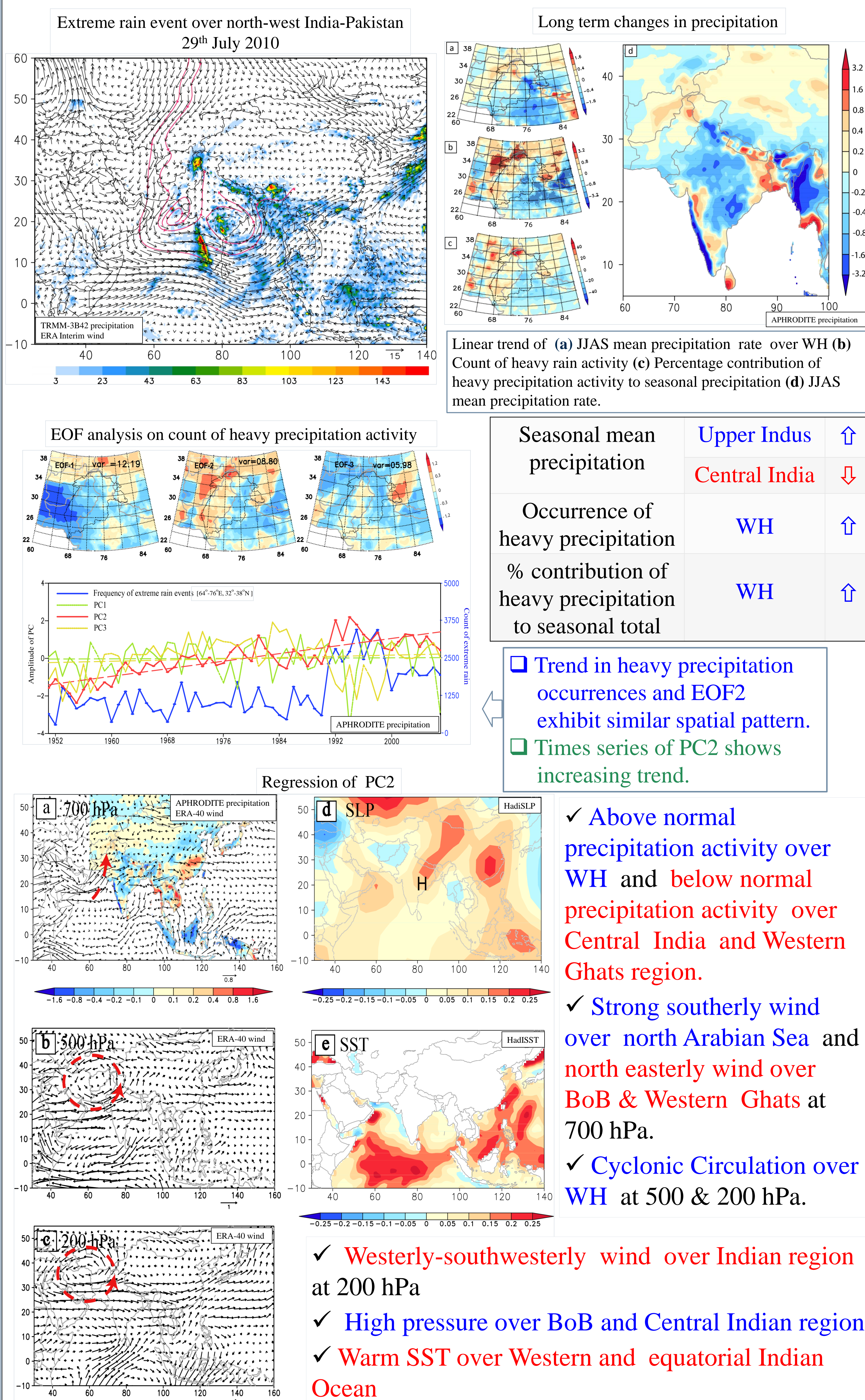


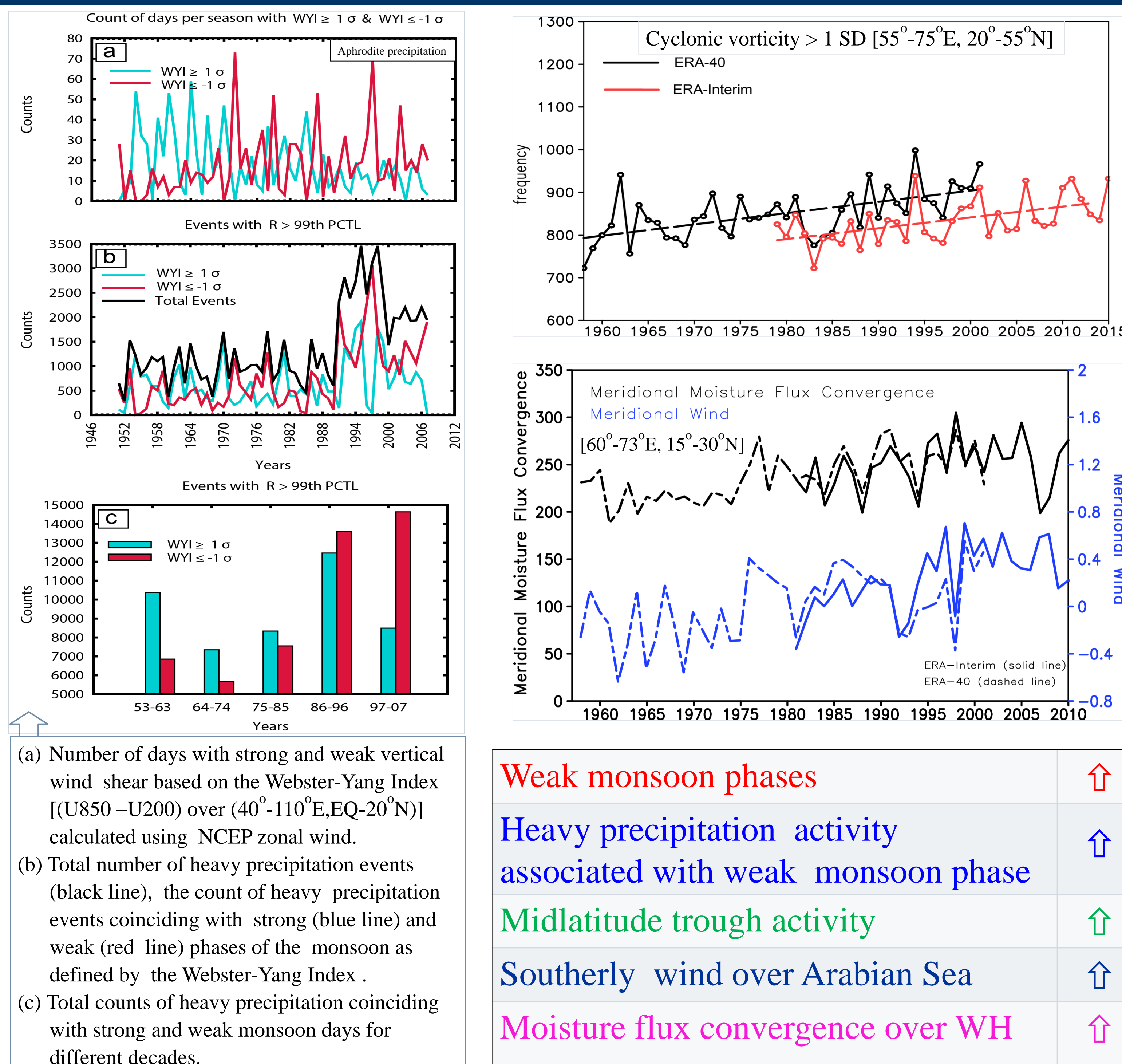
## Abstract

Historical rainfall records reveal that the frequency and intensity of extreme precipitation events, during the summer monsoon (June to September) season, have significantly risen over the Western Himalayas (WH) and adjoining upper Indus basin since 1950s. Using multiple datasets, the present study investigates the possible coincidences between an increasing trend of precipitation extremes over WH and changes in background flow climatology. The present findings suggest that the combined effects of a weakened southwest monsoon circulation, increased activity of transient upper-air westerly troughs over the WH region, enhanced moisture supply by southerly winds from the Arabian Sea into the Indus basin have likely provided favorable conditions for an increased frequency of certain types of extreme precipitation events over the WH region in recent decades.

## Results



## Results



## Conclusion

- Positive trend in the occurrence of heavy precipitation activity is located primarily over the upper Indus basin while the trend is opposite in the lower eastern Indus basin and adjoining Indian landmass.
- The spatially non-homogeneous pattern of trends in daily precipitation extremes is captured by the second EOF/PC component of the frequency of heavy precipitation.
- A significant decreasing trend in the overall seasonal summer monsoon precipitation over India and a weakening trend of the monsoon large-scale circulation is evident in our analysis of the post-1950s.
- Changes in background flow climatology facilitated the enhancement of cyclonic trough activity over the WH and increases moisture convergence over the WH region associated with stronger southerly flows from the Arabian Sea during the recent decades.
- These two results suggest an increasing probability of the type of extreme precipitation event that results from the combination of large-scale moisture flux (associated with a westward extended monsoonal trough) and a southward protruding midlatitude westerly trough.

