Spatiotemporal assessment of terrestrial water storage over Indian sub-continent

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Introduction

- Drought is a natural disaster that mainly affects water resources, agriculture, and social and economic development due to its long-term and frequent occurrence
- According to Indian Meteorological Department (IMD), meteorological drought occurs if rainfall deficiency is greater than 26%
- Direct observation of Terrestrial water storage (TWS) from GRACE or its deviation from climatologic mean can be used as a metric for drought characterization
- Combined Climatologic Deviation Index (CCDI) and GRACE-based Drought severity index (GRACE-DSI) are effective for drought characterization

Study area & Data used

- 90 sub-basins within the 25 river basins lying inside the Indian boundary for this study
- Gridded Precipitation data and GRACE-TWSA data.
- Time period – 2002-2017

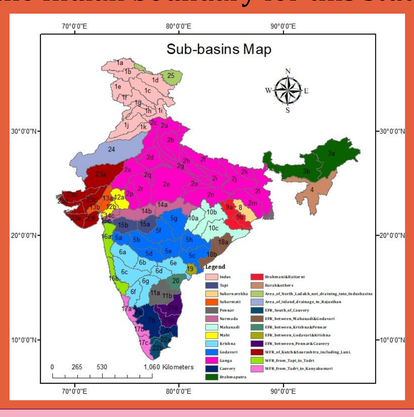


Fig. Study area map including 90 Indian sub-basins

Methodology

- Computation of CCDI and GRACE-DSI indices
- Trends analysis

$$GRACE - DSI_{i,j} = \frac{TWSA_{i,j} - \overline{TWSA}_j}{TWSA_\sigma} \quad (1)$$

$$PA_{i,j} = P_{i,j} - P_\mu \quad (2)$$

$$PAR_{i,j} = PA_{i,j} - \overline{PA}_j \quad (3)$$

$$TWSAR_{i,j} = TWSA_{i,j} - \overline{TWSA}_j \quad (4)$$

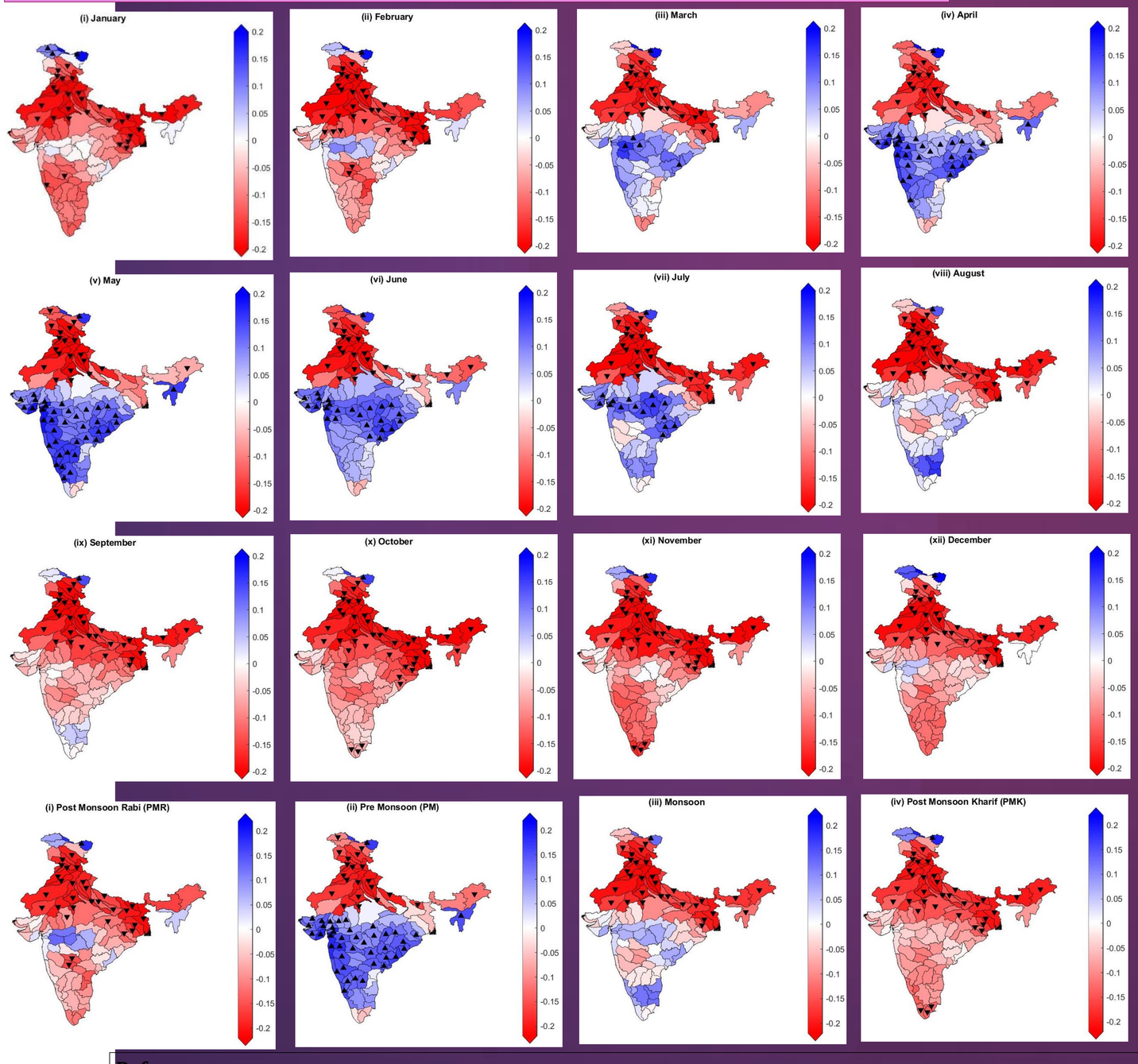
$$CD_{i,j} = TWSAR_{i,j} + PAR_{i,j} \quad (5)$$

$$CCDI_{i,j} = \frac{CD_{i,j} - \overline{CD}}{CD_\sigma} \quad (6)$$

Results & Discussion

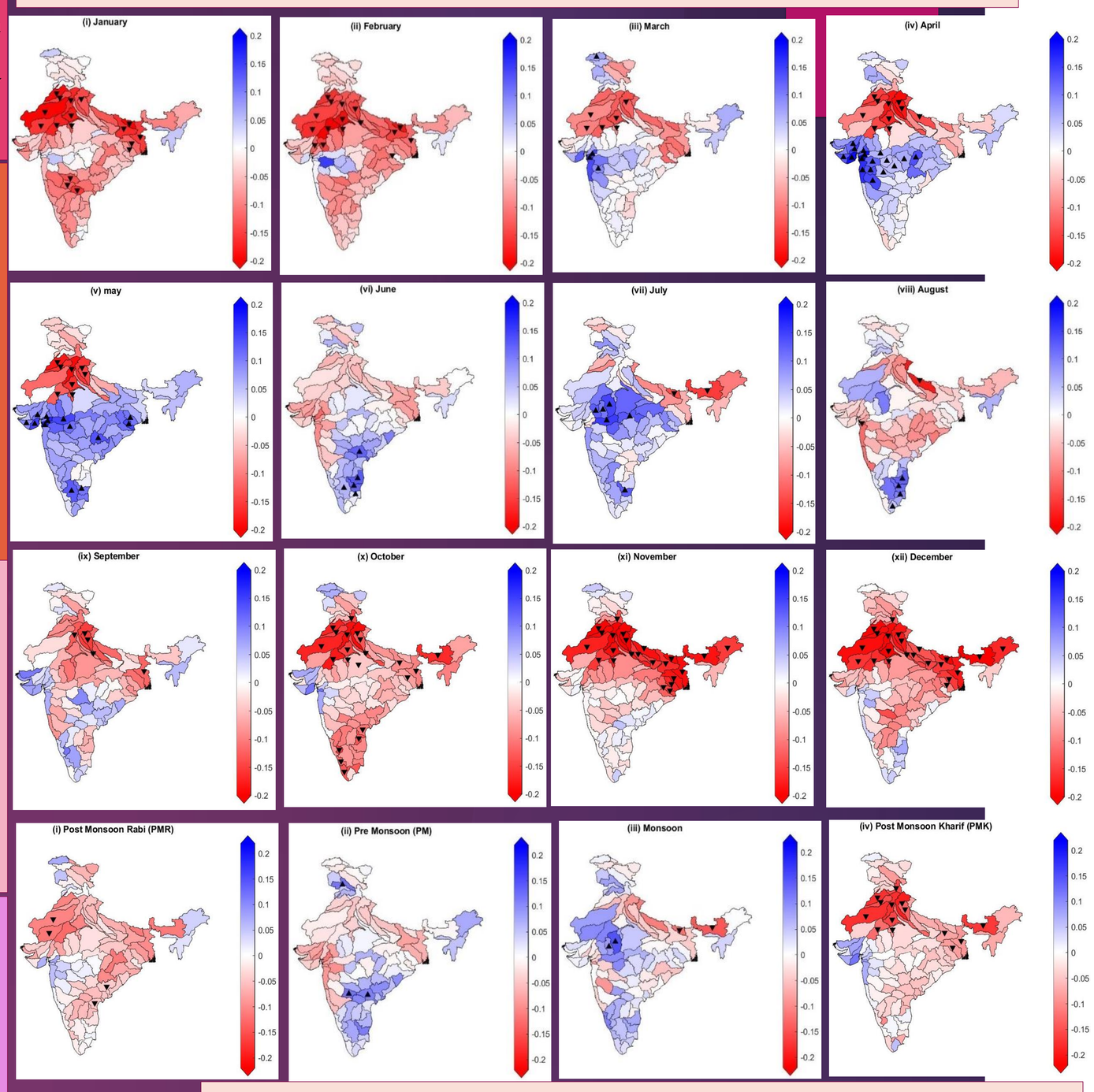
❖ Monthly & Seasonal GRACE-DSI trends

Monthly & Seasonal trend analysis of GRACE-DSI shows that sub-basins of Ganga and Indus have continuous negative trends throughout the months while other sub-basin shows changing trends

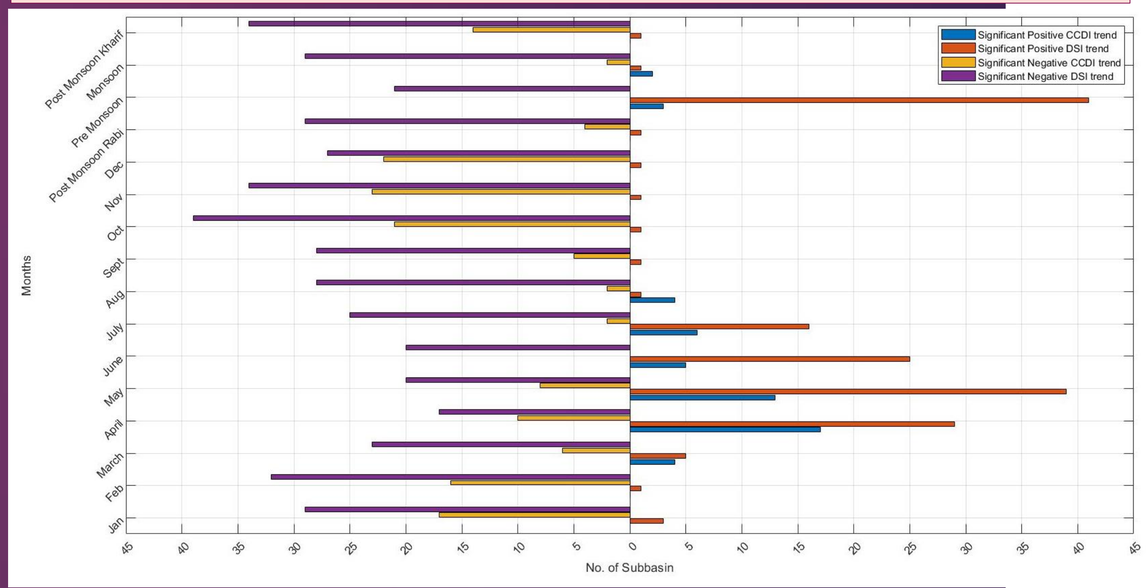


❖ Monthly & Seasonal CCDI trends

CCDI monthly trends for most sub-basins are showing changing trends. Sub-basin which shows significant negative trends for both CCDI and GRACE-DSI conclude that sub-basin getting low or no rainfall due to which TWS continuously depleting



❖ We plot month vs no. of sub-basin showing significant negative or positive trends for GRACE-DSI and CCDI. In Appendix Fig.1, most of the sub-basin shows significant negative trends for both GRACE-DSI and CCDI. The number of sub-basins showing significant negative trends for GRACE-DSI is more than that for CCDI



Conclusions

- GRACE-DSI shows significant negative trends over most of the Indian sub-basins relative to CCDI, indicating that most of the drought events are due to depletion of TWS
- 23 nos. of sub-basins show CCDI significant negative trends for November month and 14 no. of sub-basins show for Post monsoon Kharif season
- 39 nos. of sub-basins show GRACE-DSI significant negative trends for October month and 34 no. of sub-basins show for Post monsoon Kharif season

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