Variability of precipitation associated with LPS over Indo-Gangetic Belt in recent decades

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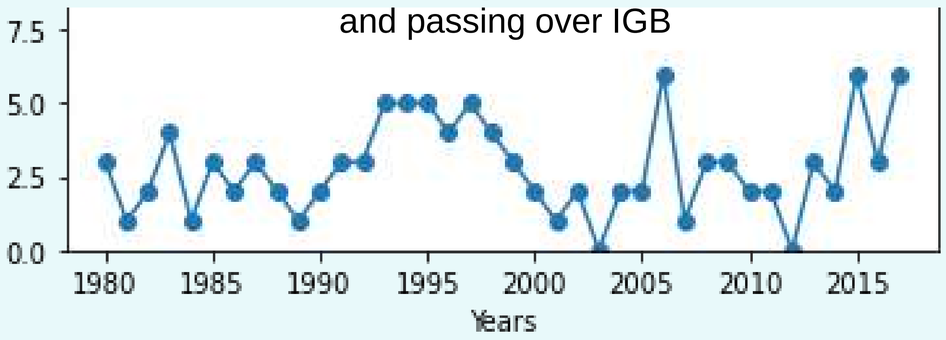
Introduction and motivation

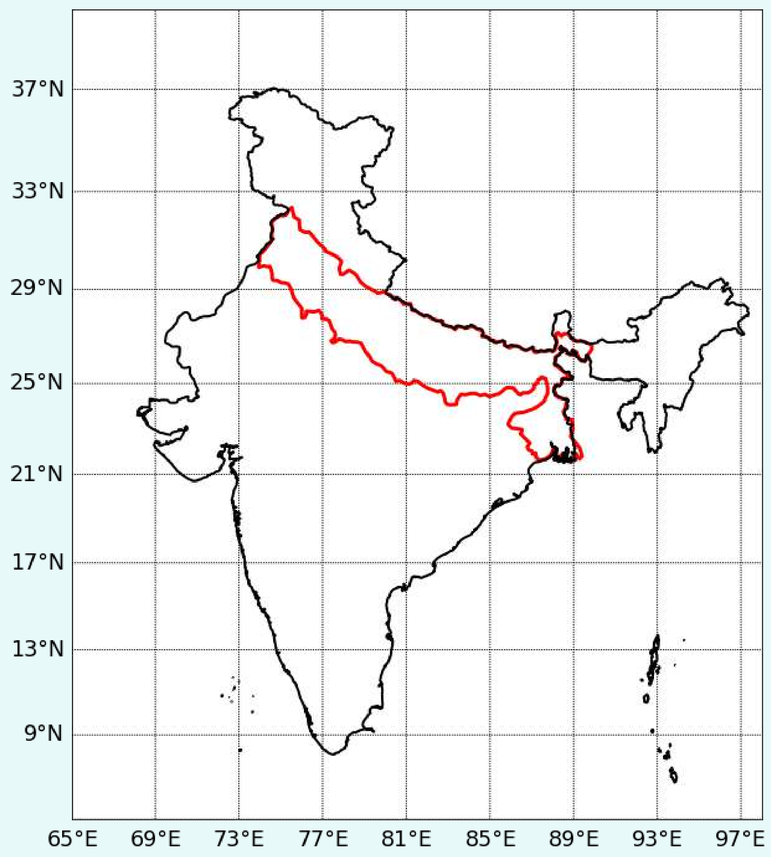
Low Pressure Systems (LPS)

- Low pressure regions that are transient in both space and time.
- Typically originate over the Bay of Bengal or over surrounding land and travel towards northwest India over the IGB (Hurley et al., 2014, Sikka archive).
- They contribute nearly 60% of the rainfall received by the IGB, including extreme weather events (Thomas et al., 2021), especially during the summer monsoon season (JJAS).

Number of LPS tracks origination over land and ocean and passing over IGB



Indo-Gangetic Belt (IGB)

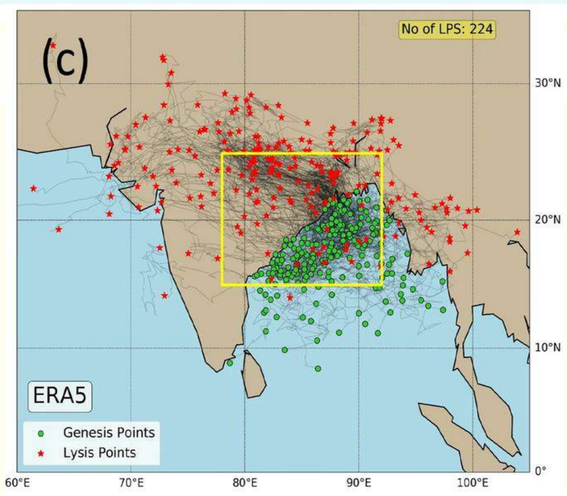


The IGB is a region paralleling the Southern Himalayas.

Significant due to following:

1. Very high population density.
2. Rivers and sediment deposits.
3. Agricultural hub (Singh et al., 2002) food security of not just India but a major part of South Asia.
4. World's one of the largest irrigated regions.

All in all, the extent of IGB is most commonly identified and characterized by the flat topography, nutrient rich soils, and adequate runoff and groundwater



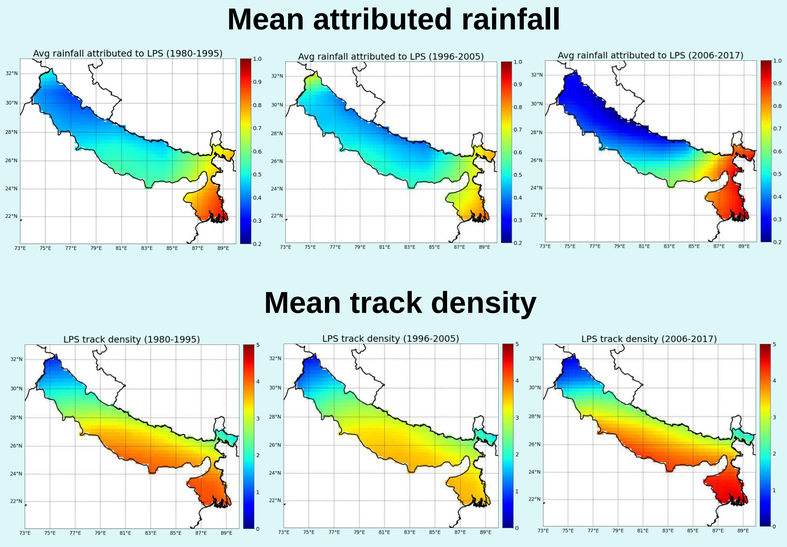
Methodology

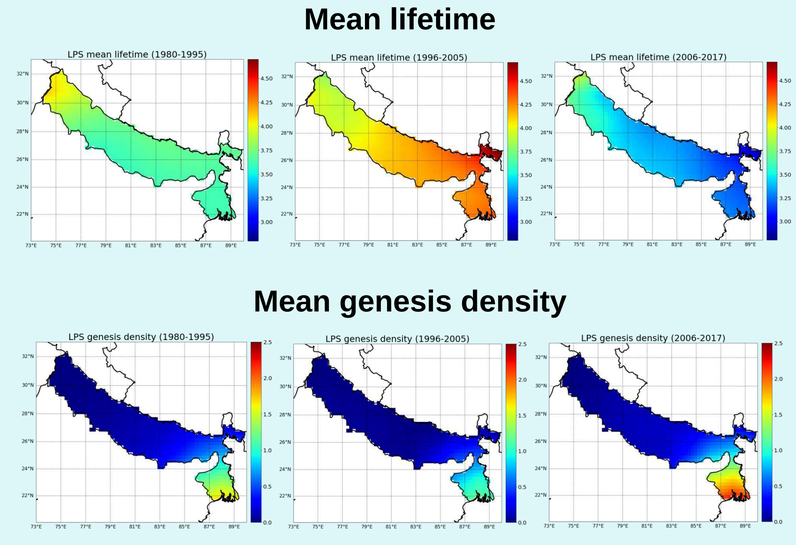
→ The total time period under consideration is 1980 – 2017 (38 years).
→ The 'TRACK' tracking algorithm has been applied to ERA5 reanalysis dataset.
→ The adjacent figure illustrates the result of the tracking algorithm (Image reference: Kumar, Pankaj et al., 2022)
→ The IGB mask was applied to filter out only those tracks passing those this region; only those tracks that sustained themselves for at least three days were retained.
→ Various parameters associated with the LPS were analysed (resolution 0.25° x 0.25°).

Result: analysis and plots

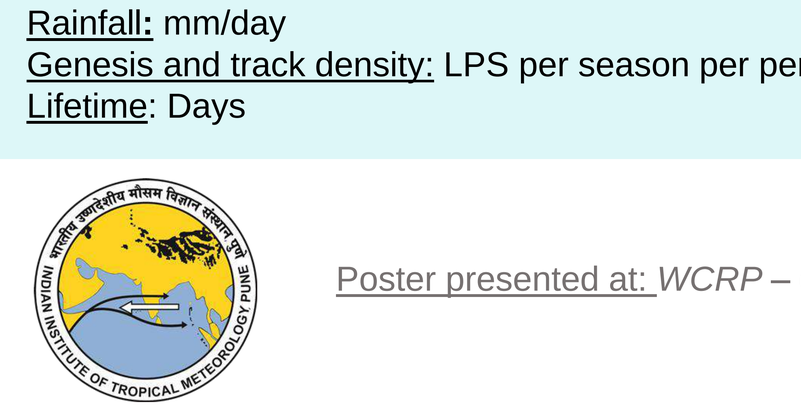
Average precipitation received by a grid cell (0.25° x 0.25°) on the IGB per month during JJAS vs year number during the study period, Two change points detected by Pettitt's test: Change points = (16, 26) → (1995, 2005):

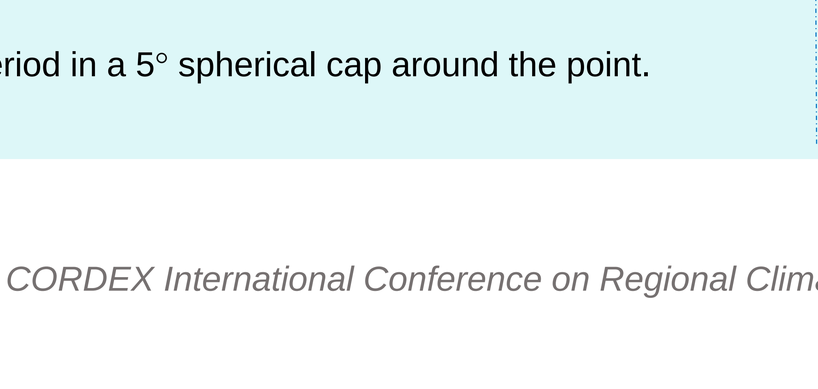
Mean attributed rainfall **Mean lifetime**





Mean track density **Mean genesis density**





Rainfall**:** mm/day
Genesis and track density: LPS per season per period in a 5° spherical cap around the point.
Lifetime: Days

Summary

- Precipitation data analysis over the IGB during 1980-2017 revealed two change points giving rise to three 'periods': P1, P2, P3.

- LPS annual track data is also divided accordingly for analysis.

- The mean rainfall attributed to LPS is the lowest in the upper IGB during P3 (2006-2017). While the genesis and the track density are the least, the mean lifetime of LPS is the greatest during P2 (1996-2003). The attributed rainfall follows the trend of track and genesis densities and not the lifetime.

Selected references

- Kumar, Pankaj, et al. "Regional earth system modelling framework for CORDEX-SA: an integrated model assessment for Indian summer monsoon rainfall." *Climate Dynamics* 59.7-8 (2022): 2409-2428.
- Singh, Nityanand, and N. A. Sontakke. "On climatic fluctuations and environmental changes of the Indo - Gangetic plains, India." *Climatic Change* 52 (2002): 287-313.

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