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Introduction

The Indian summer monsoon (ISM) is the most cardinal phenomenon that occurs between June to September. During this summer monsoon season at 850 hPa the low-level jet (LLJ) be present over the Indian Ocean (Joseph and Raman, 1966; Findlater 1969a, b). LLJ has strong horizontal shear and is important for convective rainfall. LLJ transports moisture from the oceanic region to the monsoon area (Sagalgile et al. 2018).

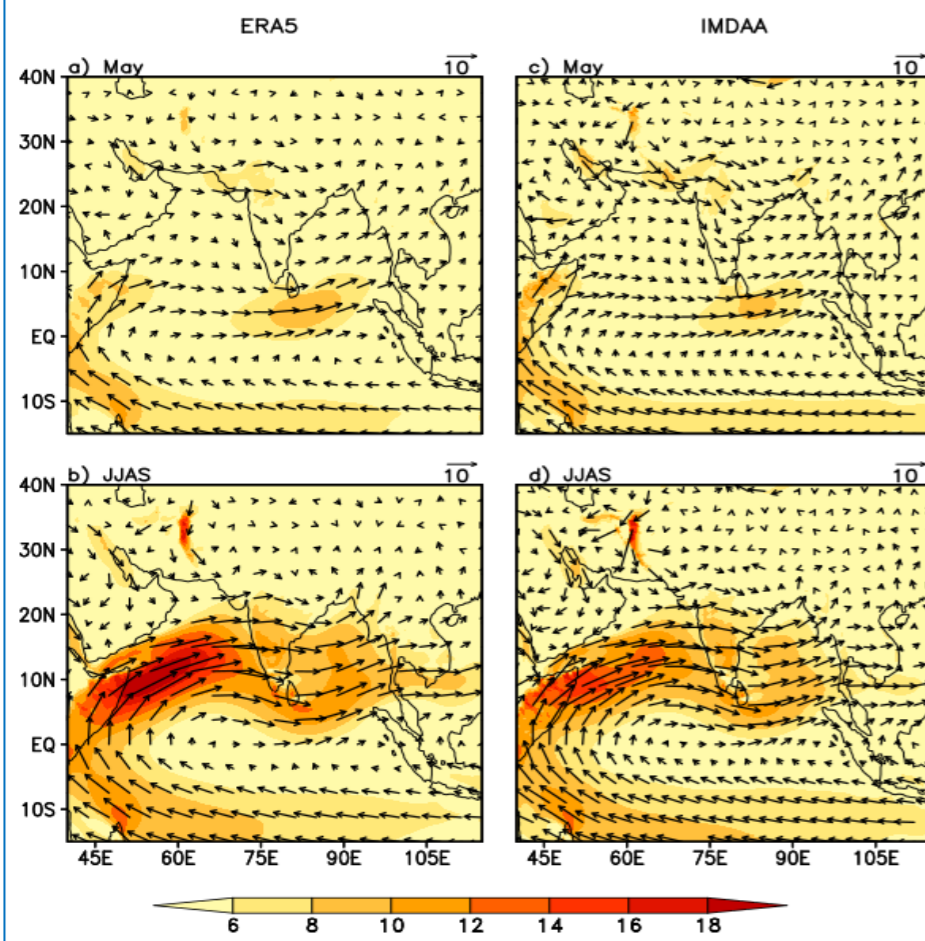


Figure 1: The mean climatology of 850 (hPa) for spatial distributions left panels (ERA5) (a) May (b) June–September (JJAS) over the Indian region and right panels (IMDAA) (c) May (d) June–September (JJAS). The shaded represent wind magnitude and arrows represent direction. Units of wind speed is m/s.

Objectives

To know the climatological features of Low-level jet (LLJ) during ISM rainfall season (June-September) using two different high resolution observational reanalysis data sets (ERA5 and IMDAA).

Data & Methodology

The Copernicus Climate Change Service (C3S), European Center for Medium Range Forecasts (ECMWF) is producing the ERA5 reanalysis data sets which is established on the on the Integrated Forecasting System (IFS) Cy41r2. Indian Monsoon Data Assimilation and Analysis reanalysis (IMDAA) is fundamentally a satellite-era high-resolution reanalysis for South Asia regions using data assimilation and numerical weather prediction (NWP) systems. Student's t test is carried out to know the significance difference in the data set.

Table 1:- Description of different reanalysis data sets and variables used.

Global reanalysis and analysis data sets		
Data set	Lat × Lon	Variable used
ERA5 reanalysis	0.25° × 0.25°	u, v, r, q, t, mslp
IMDAA	0.12° × 0.12°	u, v, r, q*, t, mslp
IMD	0.25° × 0.25°	Rainfall

Table 2:- Correlation between the area average wind and mean JJAS rainfall

Data/ar ea	(50°–70°E, 5°–25°N)	(50°–60°E, 10°–15°N)	(48°–68°E, 6°–16°N)
ERA5	.557**	.494**	.687**
IMDA A	.561**	.534**	.594**

** Correlation is significant at the 0.01 level (2-tailed).

Results & Discussion

Climatology of Rainfall(mm/day) for JJAS

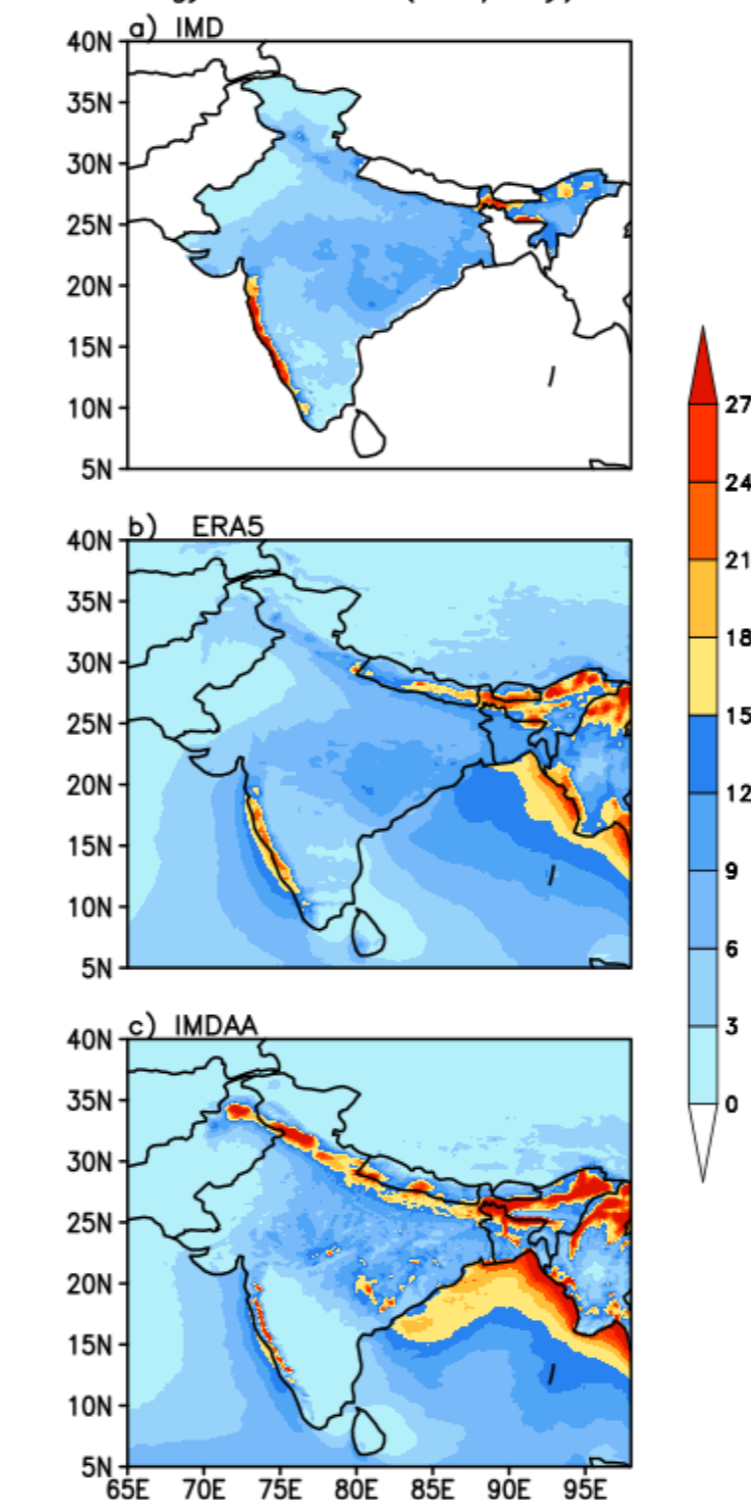


Figure 2: The mean climatology of rainfall (mm/day) spatial distributions for June–September (JJAS) (a) IMD, (b) ERA5 and (c) IMDAA over the Indian region time period (1981–2020).

The ERA5 reanalysis data shows close and very fine characteristics as that of observed IMD rainfall data. The IMDAA reanalysis data do not show similar characteristics when compared with IMD and IMDAA data set. Comparison between IMDAA data and ERA5 reanalysis data sets the IMDAA is showing slightly overestimated rainfall over the Central eastern India. Hence, the two reanalysis datasets are approximately close to the observed rainfall during 1981–2020.

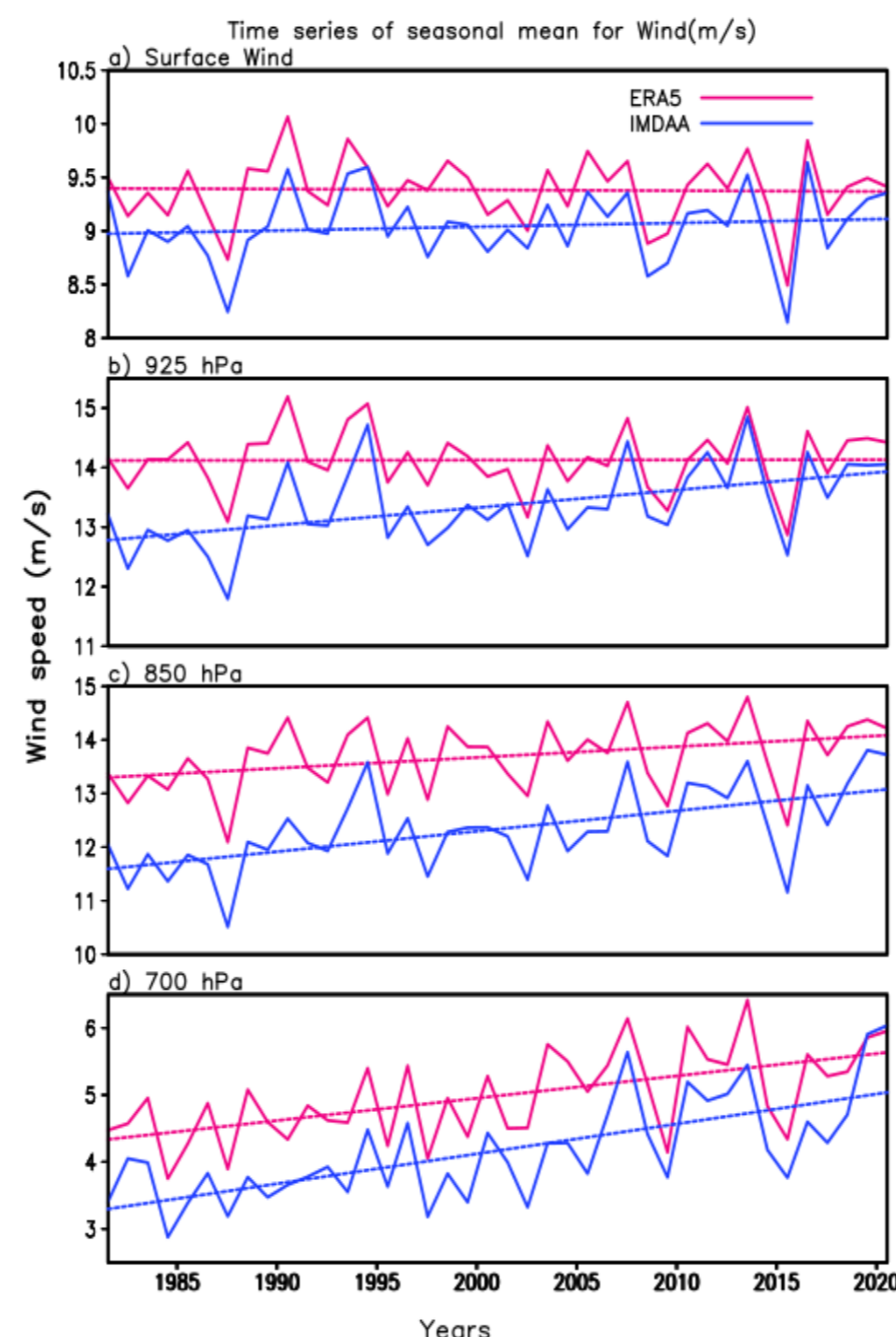


Figure 3: Time series of ERA5 and IMDAA winds averaged over the core region of LLJ (48°E–68°E to 6°N–16°N) at (a) Surface, (b) 925 hPa, (c) 850 hPa, and (d) 700 hPa levels.

From the time series, annual and seasonal variability of LLJ and winds averaged over 48°–68°E, 6°–16°N at four different heights (surface, 925, 850, and 700 hPa levels) is observed in both reanalysis data sets. It shows significant increasing trend in the strength of the winds at all analyzed levels using IMDAA reanalysis data whereas for ERA5 surface and 925 hPa shows slightly decreasing trend.

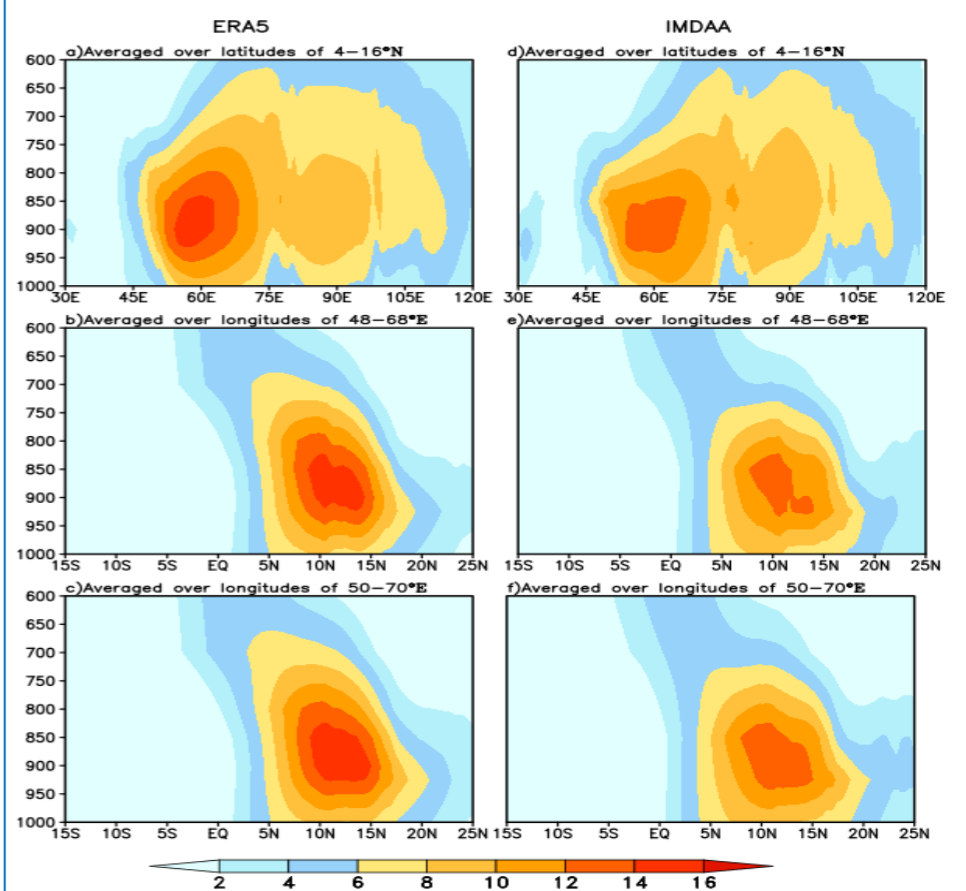


Figure 4: Pressure latitude and longitude sections of 40-year mean JJAS winds from ERA5 (left panels) and IMDAA (right panels). Zonal wind magnitude shown in shaded.

Summary/Conclusion

- Statistically significant spatial variation is noted in the studied meteorological parameters in both reanalysis data sets.
- ERA5 and IMDAA reanalysis both suggest wetter rainfall patterns over the Himalayan foothills during the monsoon season.
- Both the ERA5 and IMDAA reanalysis data sets can capture LLJ features, however the amplitude of wind in the IMDAA reanalysis data set is lower than in the ERA5 reanalysis data sets.
- Except for 925 hPa in ERA5 reanalysis data, both data sets show a substantial increasing trend in wind strength at all studied levels.
- The LLJ's core zone is located between 10°–15°N and 50°–60°E, and it extends vertically up to 700 hPa, with maximal core winds lingering at 900–850 hPa.
- Over the Indian region, ERA5 performs slightly better than the IMDAA reanalysis.

Acknowledgements & References

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