

Increased Summer Monsoon Rainfall over Western India caused by Hadley Cell Expansion and Indian Ocean warming.

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Introduction

The supplementary materials contain a detailed description of Figure 1D and figures that support the scientific conclusions of the paper. The figures are based on the Data and Methods described in the main text (section 2). Figure S3 is another version of Figure 1b, showing the real values of the frequency of rainfall events in the first and last decade, which helps in understanding the distribution of rainfall over the NWI region.

Moisture transport budget analysis

The vertically integrated moisture transport (VIMT) budget analysis is shown in Figure 1d. We used the following approach to calculate VIMT at each boundary of the NWI region:

$$VIMT_{west} = \int_{21N}^{28N} VIMT^+_{69E}$$

$$VIMT_{east} = \int_{21N}^{28N} VIMT^+_{77E}$$

$$VIMT_{north} = \int_{69E}^{77E} VIMT^*_{28N}$$

$$VIMT_{south} = \int_{69^E}^{77^E} VIMT^*_{21N}$$

here $VIMT^+$ and $VIMT^*$ are the eastward and northward components of VIMT respectively.

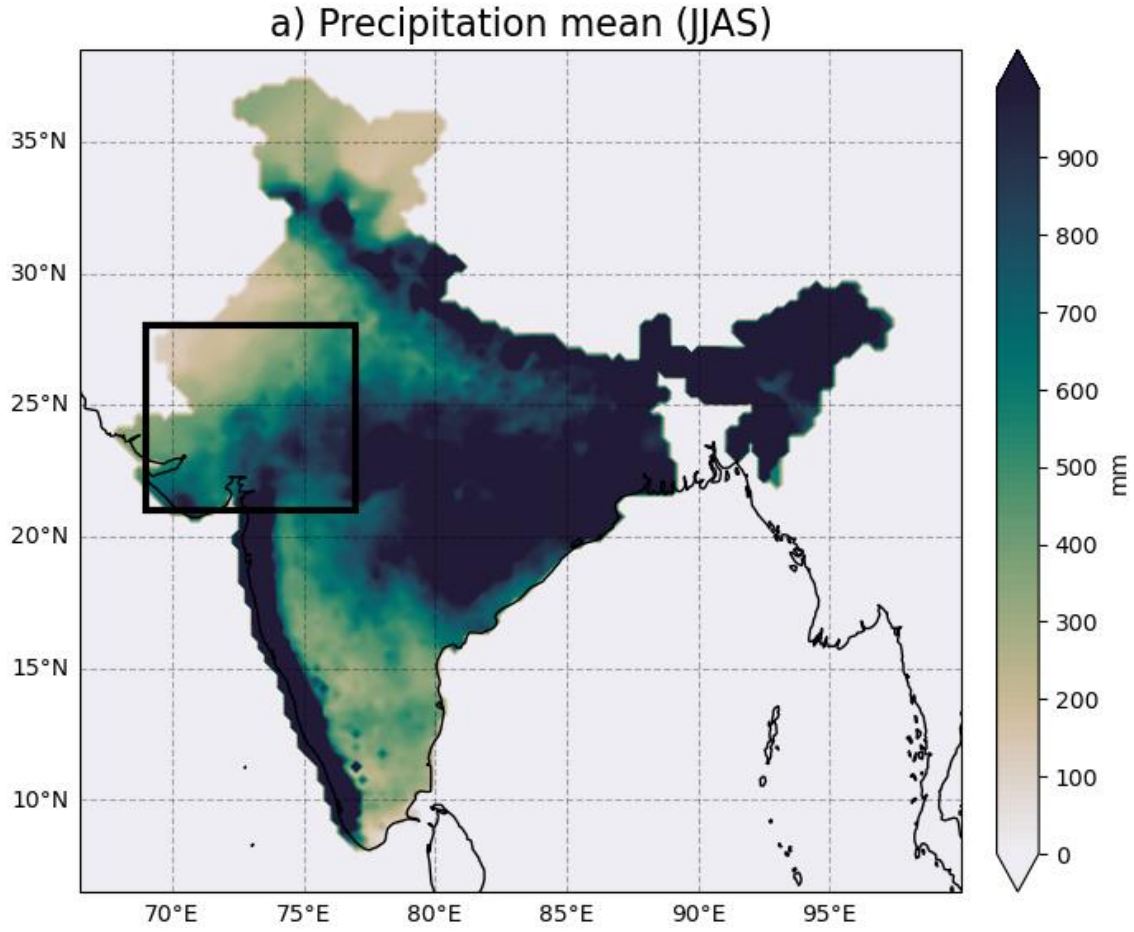


Figure S1. JJAS mean of precipitation using IMD dataset.

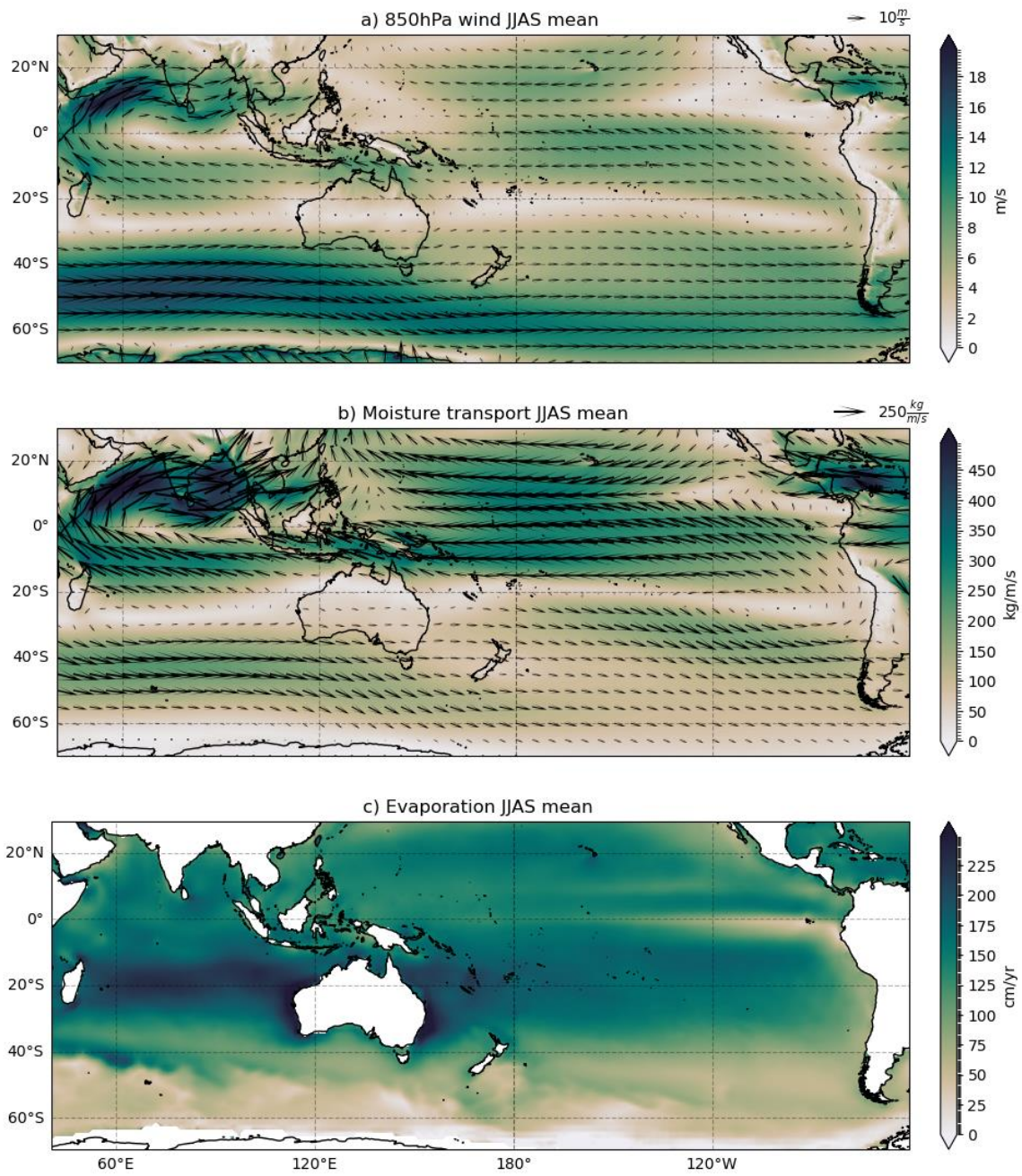


Figure S2. ERA5 JJAS means of a) 850 hPa wind (colors –speed (m/s)), b) vertically integrated water vapor flux (colors-magnitude (kg/m/s)) and c) evaporation rate (cm/yr).

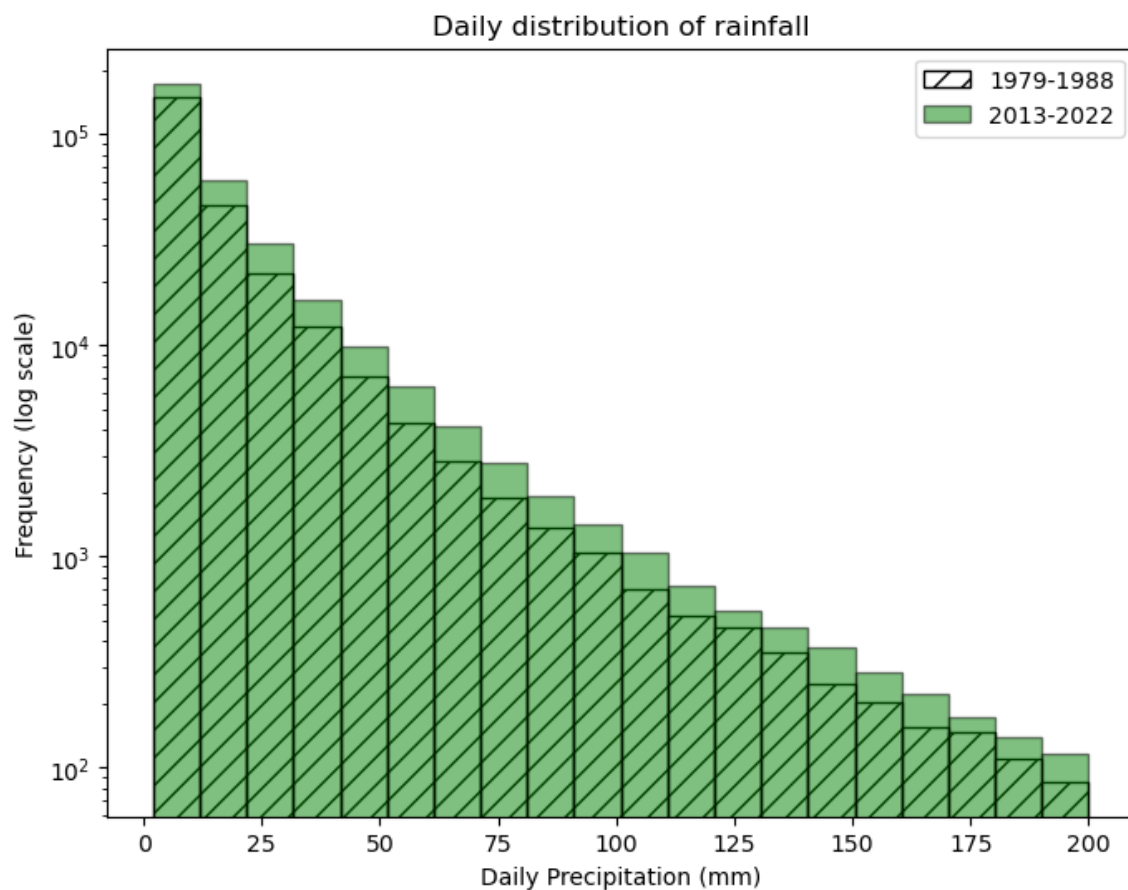


Figure S3: The distribution of daily rainfall (IMD) during 2013-2022 (green), overlaid by the distribution during 1979-1988 (hatches).

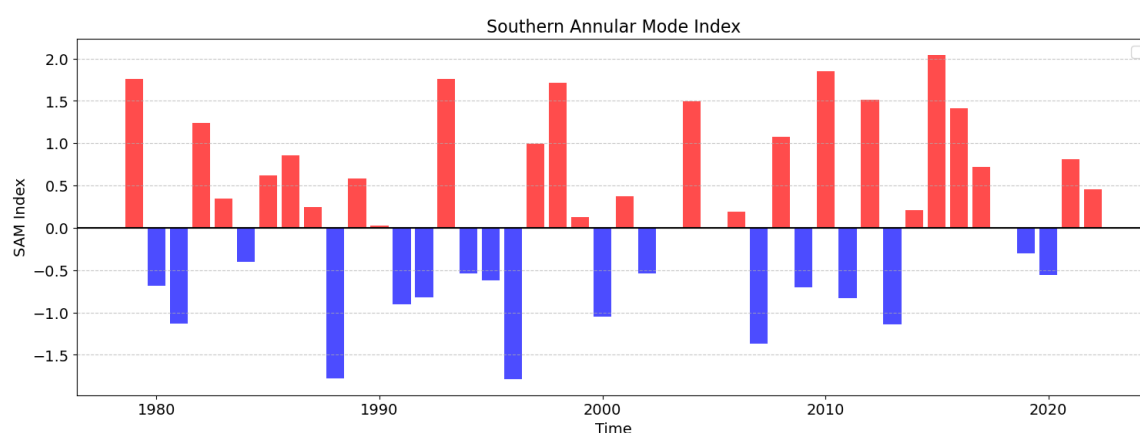


Figure S4: The Marshall Southern Annular Mode (SAM) Index. The positive (negative) values are shown in red (blue). SAM index is calculated as the zonal pressure difference between the latitudes of 40S and 65S (Marshall GJ. 2003).

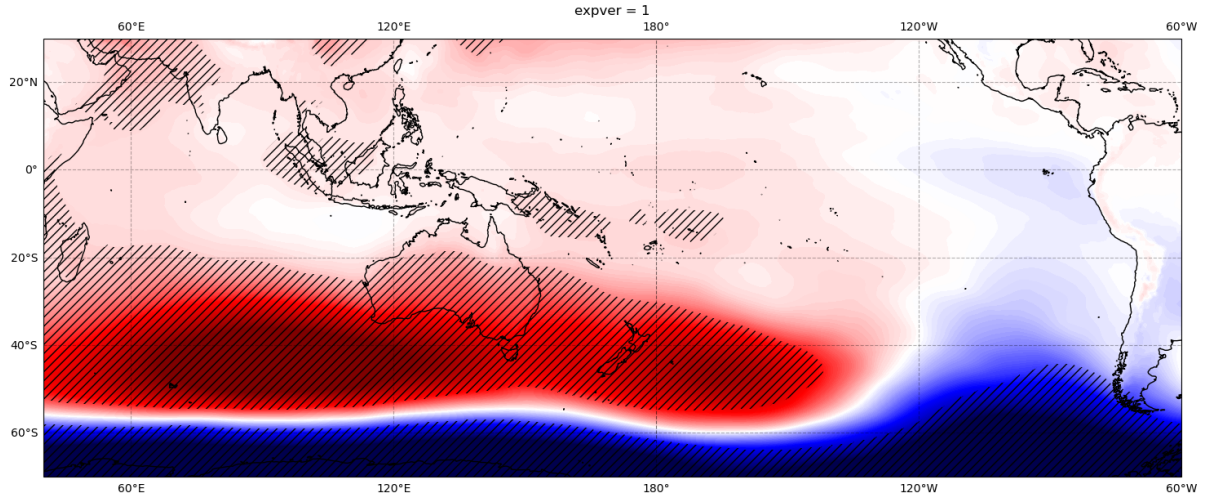


Figure S5: Regression of detrended and ENSO removed JJAS MSLP onto the Southern Annular Mode Index. The hashed regions indicate values that are significant at the 95% confidence level.

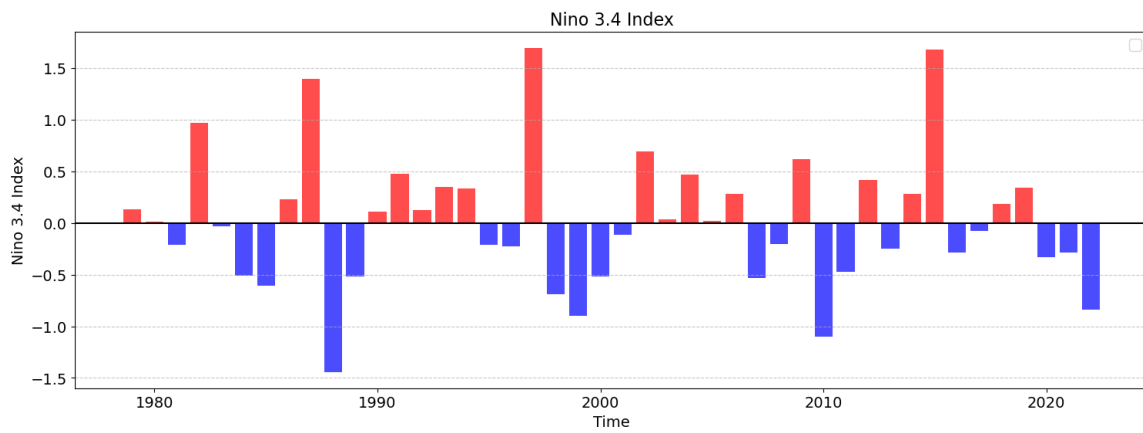


Figure S6: The Niño 3.4 Index. The positive (negative) values are shown in red (blue).