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Is there a clear relationship between the Tropical Easterly Jet and Sahel rainfall?

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The West African Monsoon (WAM) is of great importance for many regions in sub-Saharan West Africa. The WAM is characterized by a pronounced seasonal wind shift initiated by thermodynamic contrasts between the land and ocean and is associated with precipitation changes. One feature of the WAM system is the Tropical Easterly Jet (TEJ), which is a summer-time upper-tropospheric (100-200hPa) easterly wind between 5° and 20°N. It originates in the South Asian Monsoon system over Bay of Bengal, extends westwards to Africa and decays over the tropical Atlantic.

Previous studies found a positive correlation between Sahel rainfall and the strength of the West-African TEJ in the seasonal mean. It was suggested that a strong TEJ can enhance rainfall by increased upper-level divergence. However, it is also possible that a TEJ anomaly is a consequence of increased rainfall or that both are governed by an external quantity. A detailed study of possible physical mechanisms is still missing.

In this study, we want to review the relationship between the TEJ and Sahel rainfall by a more in-depth statistical analysis. In contrast to previous studies, we include also high temporal resolution observations and reanalysis data which is necessary to better understand whether the jet is mainly forcing the rainfall or vice versa. Another focus of our analysis is whether a second independent/regional jet is developing over west Africa indicated by a second local maximum in the TEJ?

Our results show substantial correlations between Sahel rainfall and TEJ strength on decadal time scales. On shorter time scales, the correlations become weaker and the relationship between the TEJ and Sahel rainfall is less clear. On intraseasonal time scales, it seems more that convection anomalies are leading changes in the TEJ by one or two days. The West African and the South Asian parts of the TEJ appear to be mainly independent on intraseasonal time scales. Pronounced wet years in the Sahel often show a distinct second maximum of the TEJ over West Africa near the equator. Both findings suggest that the West African TEJ has a substantial regionally forced component.