Mid-latitude Pathways to Indian Summer Monsoon

Climate Variability and Prediction

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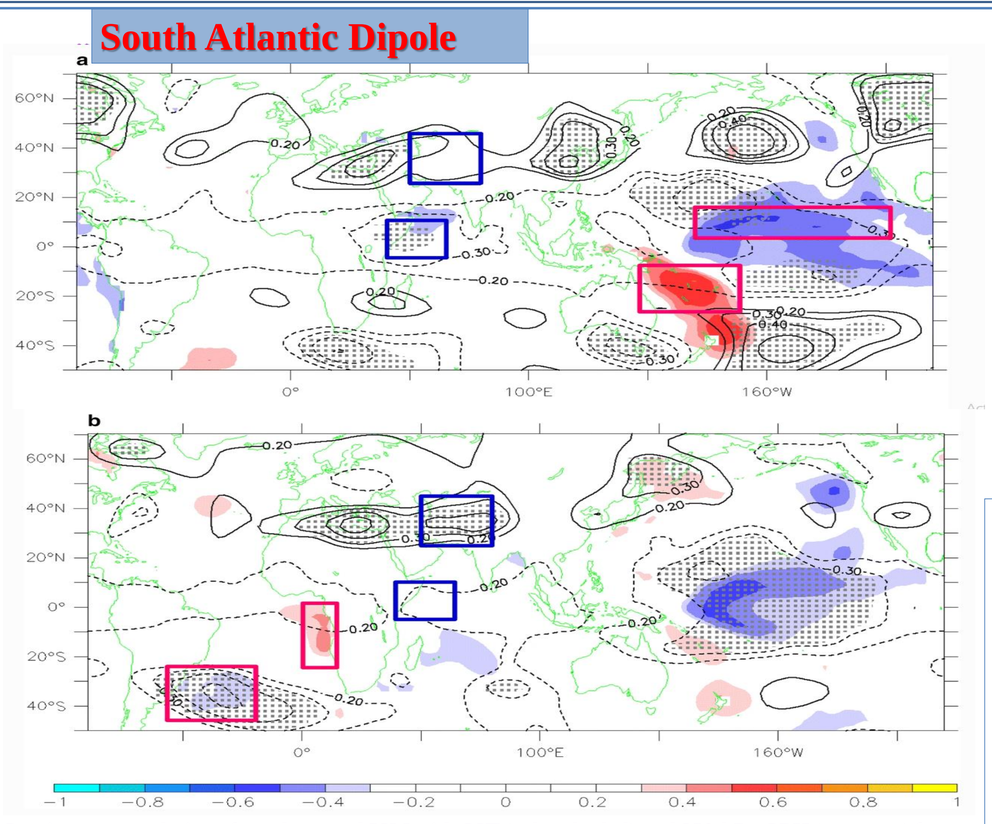
Motivation

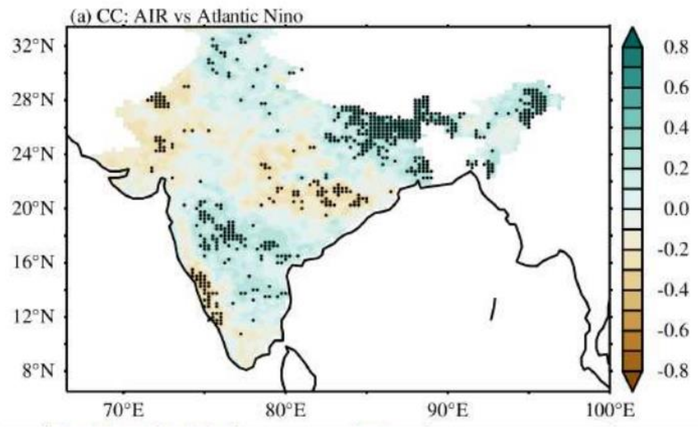
The northern part of Indian subcontinent experiences the mid-latitude teleconnections influence during Indian summer monsoon which has not been given much attention despite being a dominant factor in recent decades. Therefore, to understand a bit of this teleconnection, few studies have been carried out.

South Atlantic Dipole

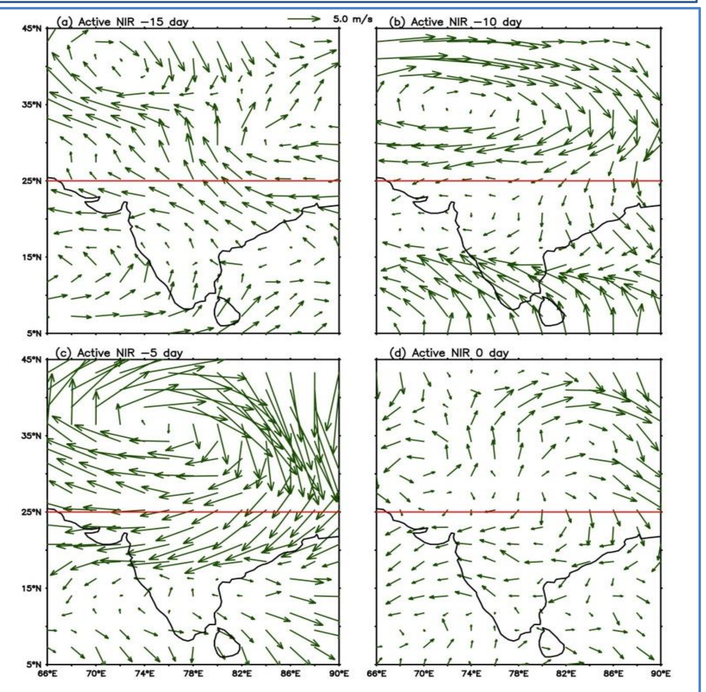


Contiguous correlation of north central ISM with SST (color shaded) and 250-hPa GPH (contours) for the (a) period 1 and (b) period 2. The blue boxes depict the 250-hPa pressure gradient regions and pink boxes SST dipoles. The color shade and grey dots of contours are above 95% significant level

- Before 1979, ENSO-monsoon teleconnection was stronger and 250-hPa low pressure anomaly was significant at west tropical Indian Ocean
- **After 1979, the south Atlantic shows a distinctive SST dipole pattern which is referred to as the sub-tropical south Atlantic dipole**
- **The CGT creates positive GPH anomalies over mid-latitude/extra-tropics, favorable for north central ISM rainfall.**

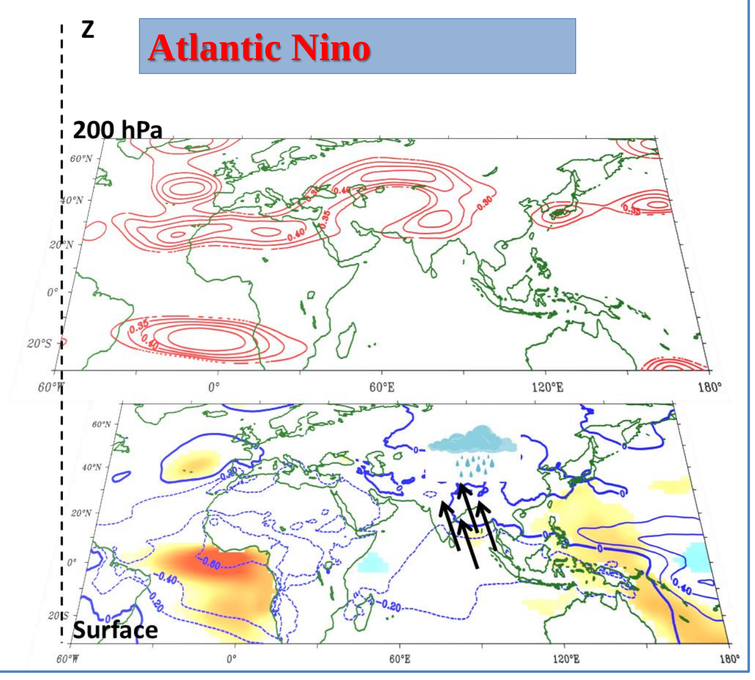


- **Maximum influence of mid-latitude interaction is confined over north to 25^{0}N.**
- **The monsoonal interacts with the upper-troposphere mid-latitude cold and dry air into north India and triggers deep convection**
- **The positive phase of Atlantic Nino intensifies the ITCZ over Atlantic provoking the North Atlantic-Eurasian wave.**
- **It raises the Tibetan high core zone over Northeast India, amplifying the upper-tropospheric divergence**
- This reinforces strong updraft motion at the lower troposphere favoring the convective activities there.

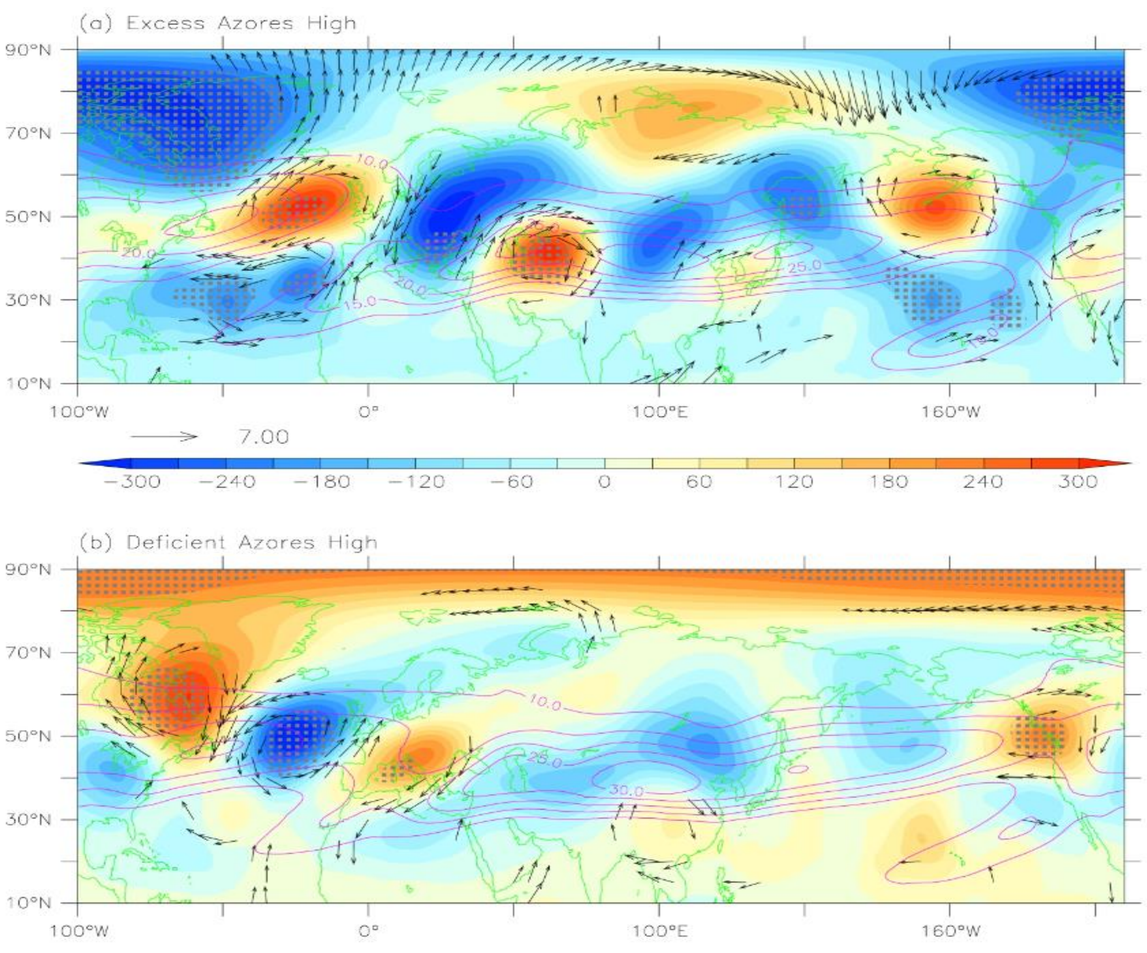


Composite daily anomaly of 200-hPa UV wind from Day −15 to Day 0 during excess years of NIR are shown in (a)–(d), respectively. Day 0 indicates the peak active phase day.

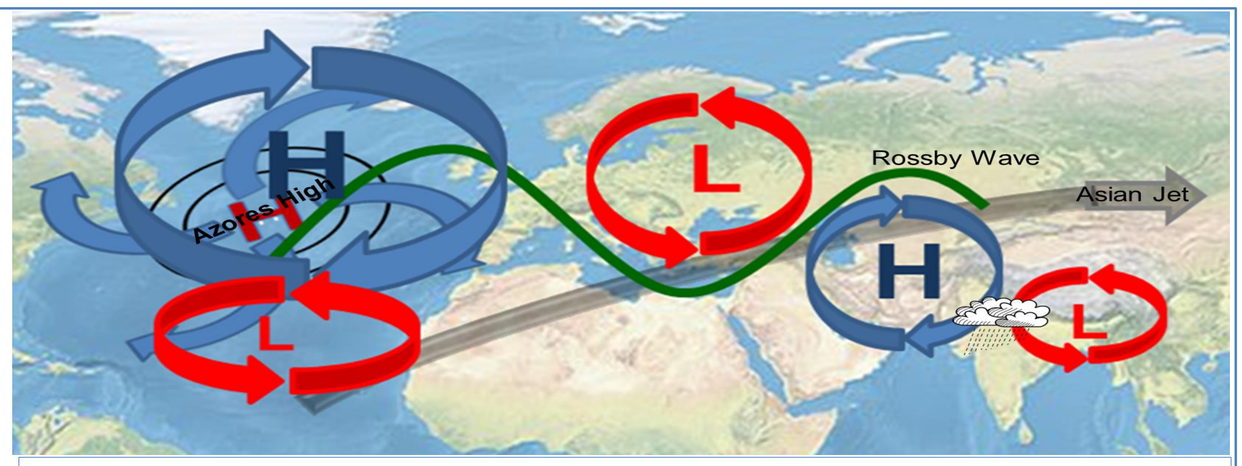
Atlantic Nino



Azores High



Composite anomaly of 200-hPa GPH (shaded), 95% statistical significance of composite of GPH (grey dots) and wind (black arrows) and composite of zonal wind >5 ms−1 (Cray contours) for a excess and b deficient years of AH, respectively.



- **Above normal rainfall towards west and central India is related to the vigorous Azores High.**
- **Azores High is accompanied by enhanced subsidence resulting in widespread upper-troposphere convergence.**
- Rossby wave train imposes successive negative, positive and negative Geopotential height anomalies over north Mediterranean, northwest and northeast of India, respectively.
- **It increases the Asian jet strengthening the monsoonal circulation over western and central India through the silk road pattern.**

References

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- Sahoo, Monalisa, and Ramesh Kumar Yadav. "Role of equatorial central Pacific sea surface temperature in modulating rainfall over north India during Indian summer monsoon." International Journal of Climatology 41.13 (2021): 6017-6030.
- Yadav, Ramesh Kumar, et al. "Swapping of the Pacific and Atlantic Niño influences on north central India summer monsoon." Climate Dynamics 54 (2020): 4005-4020.

Future scopes

- **Along with the interannual variation, we are now exploring the decadal variability of Northwest India summer rainfall as the shift of monsoon trough towards westward during recent decades has caused in increased rainfall trend over there.**
- **More detailed studies will be done for the Azores high influence on Indian summer monsoon in decadal scales and dynamical model skills in capturing this teleconnections will also be explored.**