LEADING MODES OF PRECIPITATION VARIABILITY OVER KSA

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Jeddah
INTRODUCTION

• The study of Global teleconnections associated with the inter-annual variability of Kingdom of Saudi Arabia (KSA) precipitation is important for the predictability of temperature and precipitation

• Principal Component Analysis (PCA) is a simple method for the identification of leading modes of variability over a particular region

• KSA can be divided into two seasons, based on Precipitation regimes : Wet (Nov. to Apr) and Dry (May to Oct.). Results for only wet season are presented.
KSA mean monthly Precipitation (mm/month)

Annual Cycle (1985-2018)
KSA wet season rainfall index
Principal Component Analysis (PCA)

33 wet seasons (1985-2018)

Correlations of KSA-Rainall Index with:

NINO1.2 = 0.37
NINO3.4 = 0.3
PDO = 0.3
BEST = 0.41
CircumGlobal Wave Train

Corr PC-1 with HGT 250 hPa (1985–2018)
Conditional PCA Analysis:

Precipitation $\text{pre}^*(x, y, t)$ as a function of space $(x, y)$ and time $(t)$, and a time series, wet season ENSO index $\text{SEI}(t)$ as a function of time only.

The unwanted signal by subtracting the regressed value of each employed field that depends on SEI, therefore we get new variables $\text{pre}(x, y, t)$, in which the signal covariant with SEI from $\text{pre}^*$ is removed, thus,

$$\text{pre} = \text{pre}^* - \text{SEI} \times \text{cov(\text{pre}^*, \text{SEI})} / \text{var(\text{SEI})}$$
Moisture Transport:

Vertically integrated Zonal and Meridional moisture transport

(kg m\(^{-1}\) s\(^{-1}\))

\[
ZMT = \frac{1}{g} \int_{p_s}^{p_{300}} (uq)dp.
\]

\[
MMT = \frac{1}{g} \int_{p_s}^{p_{300}} (vq)dp.
\]

Where \(u\) and \(v\) are the zonal and meridional wind speed and \(q\) is the specific humidity, \(g\) is the acceleration due to gravity, \(p_s\) and \(p_{300}\) are the surface and 300 hPa pressure levels respectively.
Moisture Transport \( (\text{kg m}^{-1} \text{ s}^{-1}) \)

Correlations and Composites
SUMMARY AND CONCLUSIONS

• KSA receives most of its precipitation during winter (Nov. to April), named as wet season

• El-Nino Southern Oscillation (ENSO) is the dominating mode causing variability in the wet season rainfall over KSA

• CircumGlobal wavetrain (CGT) is also associated with rainfall variability over KSA, however it manifest on intra-seasonal time scale

• Pacific Decadal Oscillation (PDO) show significant correlation with KSA wet season rainfall and its role on longer time scales need to be studied

• During El-Nino years meridional moisture transport is enhanced causing more moisture to flow towards KSA from the Arabian and Red sea, results in increased rainfall.