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Trend and frequency of drought over Ethiopia using observational and model driven indices

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Introduction

❖Drought is commonly defined as a deficiency of precipitation from expected climatological mean that extends over a season or longer period of time (Palmer 1965)

❖ Drought is one of the major weather related disasters and recent events over East Africa have demonstrated the continuing exposure to this natural hazard

❖The impact of drought depends on the severity, duration and spatial extent of the rainfall deficit

•The aim of this work is:
• To quantifies the severity, duration and the spatial extent of drought over this region

•Possible association with large scale phenomenon (SST, global circulation) and local forcing (land use change)

Data and methods

- GPCP and simulated RegCM4 rainfall are used to calculate standardized precipitation index (SPI) and Palmer drought severity index (PDSI)

- Trend empirical orthogonal function (TEOF), is employed to extract the dominant long term component (trend) and its spatial pattern in the raw SPI and PDSI data.

- Wavelet, and regression methods are applied to the dominant trend principal component (TPC) to analyze the periodicity and its trend

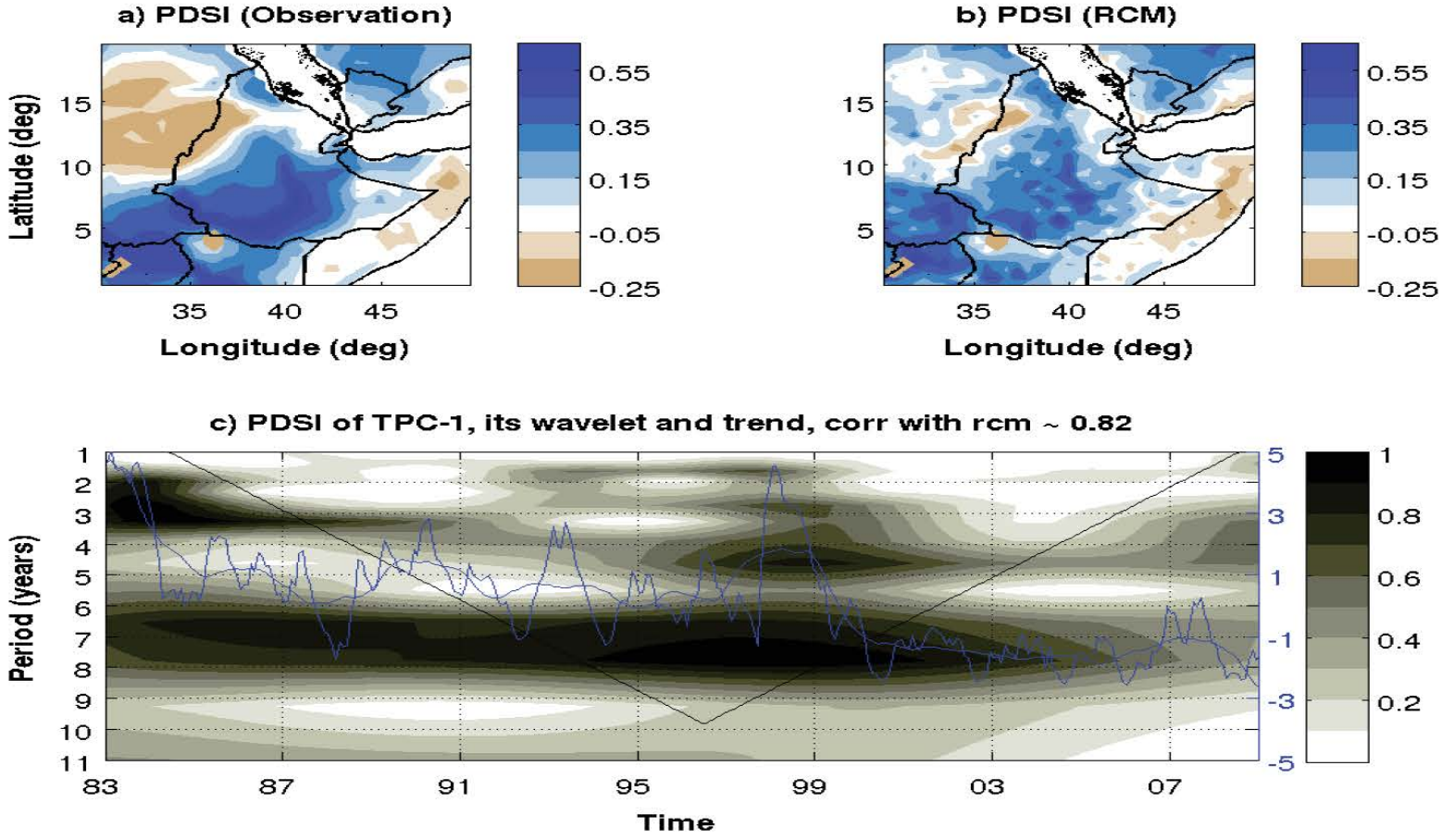
- Extreme drought percentile per sub period is also used to consolidate the wavelet analysis.

- Correlation and wavelet coherence (WTC) methods are also applied to see the possible linkage of TPC-SPI and SST.

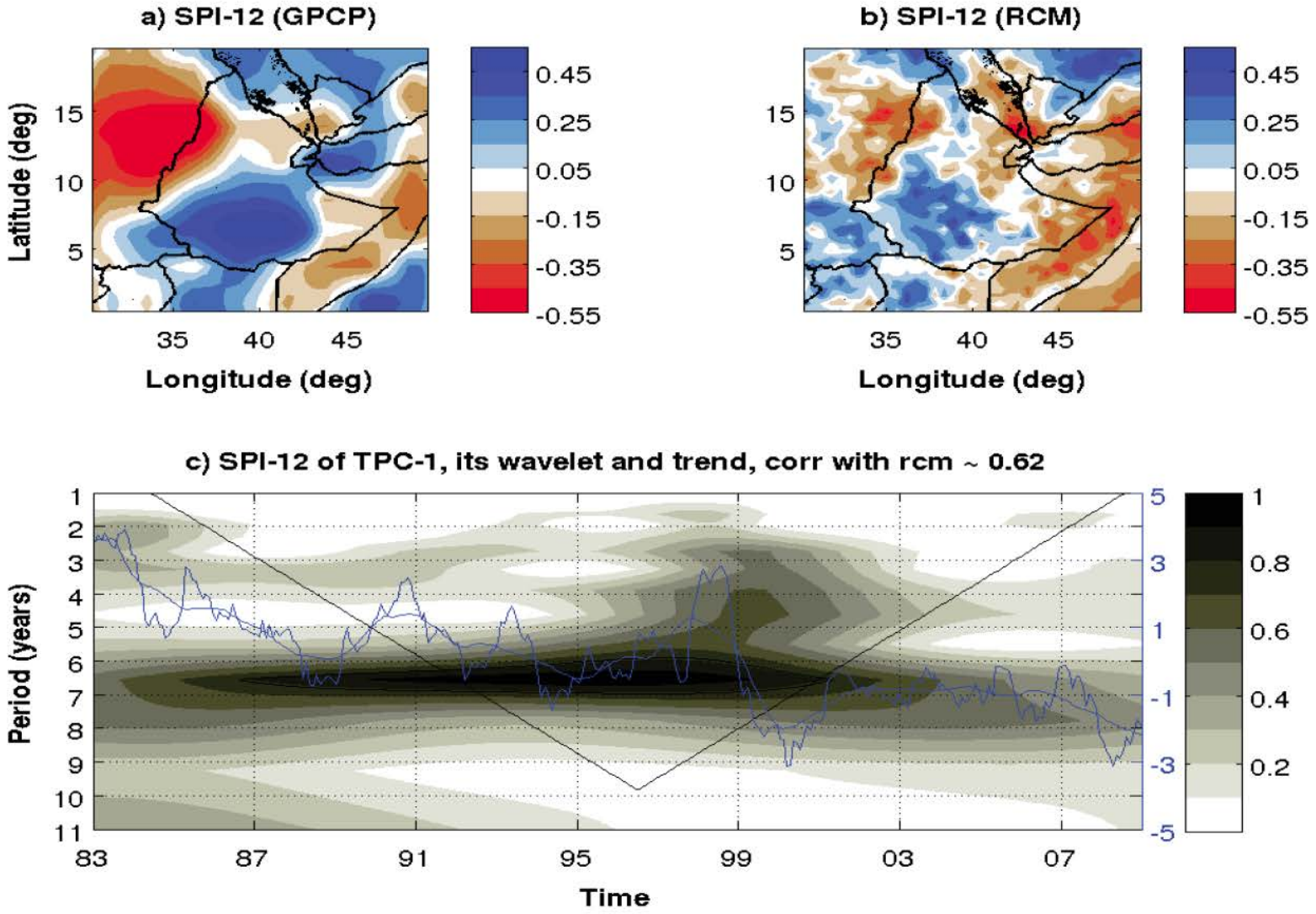
- In addition to TEOF, homogenous regions, time series are used to see the characteristics of drought (Just to solidify the above methods)

Results

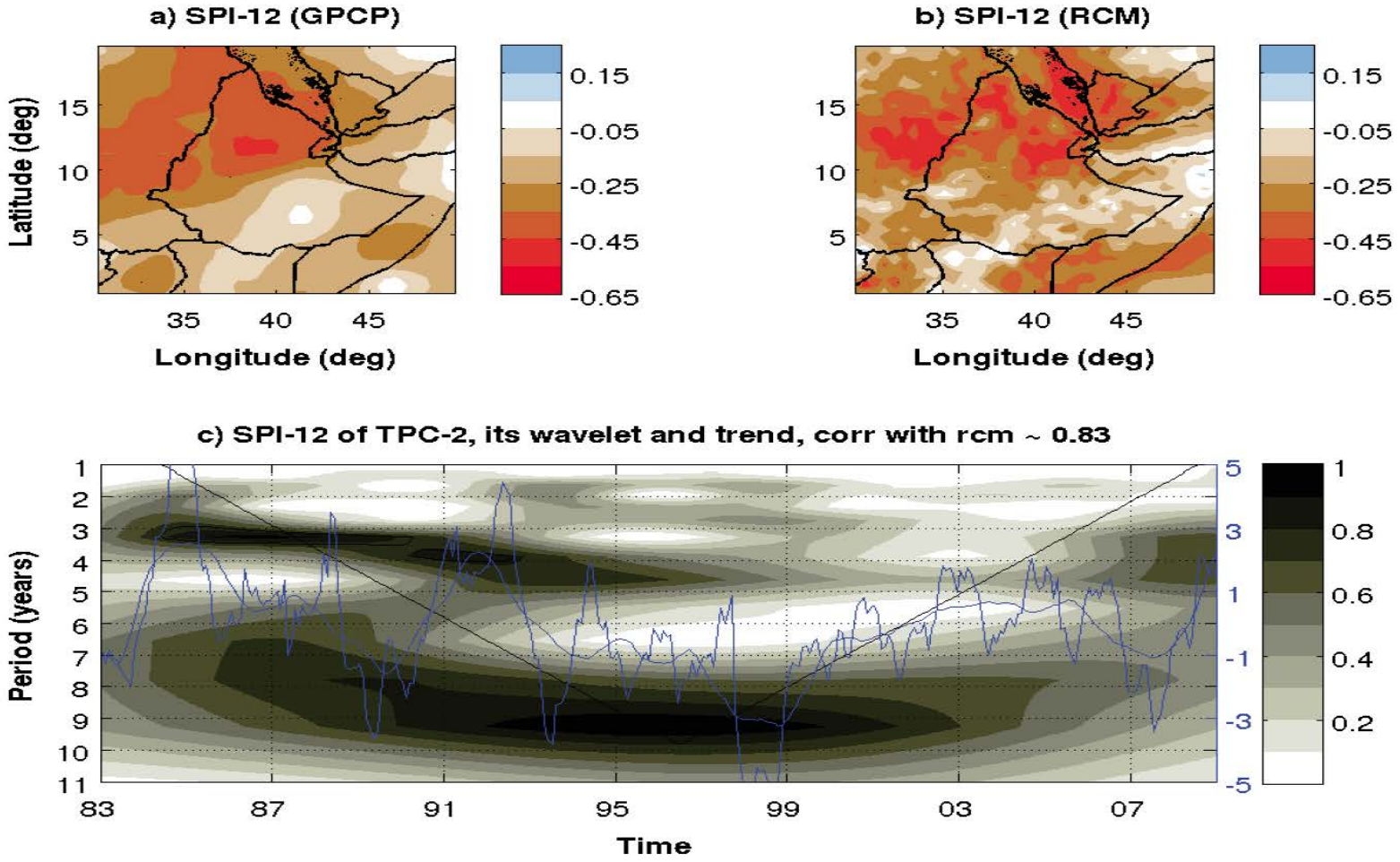
- The 1st Dominant Pattern of TEOF which explain the southern regions, exhibits significant dry trend over the southern regions
- After 1997/98 the southern regions seems to be drought area, even if 2006/07 showed small recovery from existing condition
- Frequent and intense ! Model driven PDSI high correlation with observation

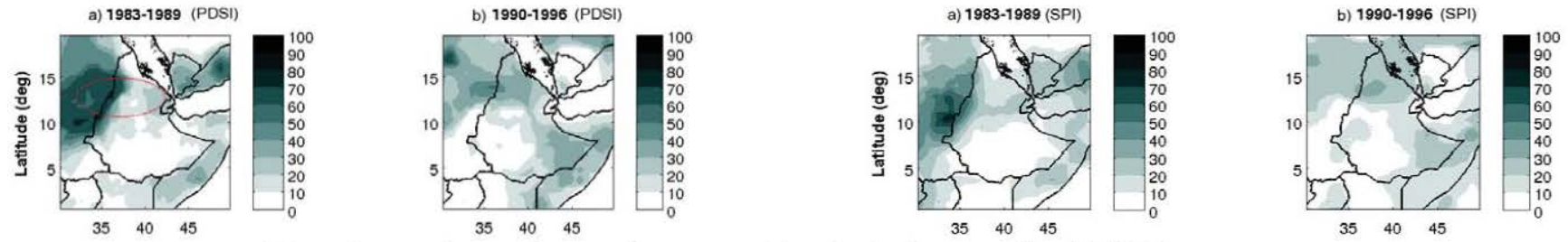


- The same result is obtained using SPI
- 6-7 period signals are high significant power
- The pattern and time component are reproduced by the model

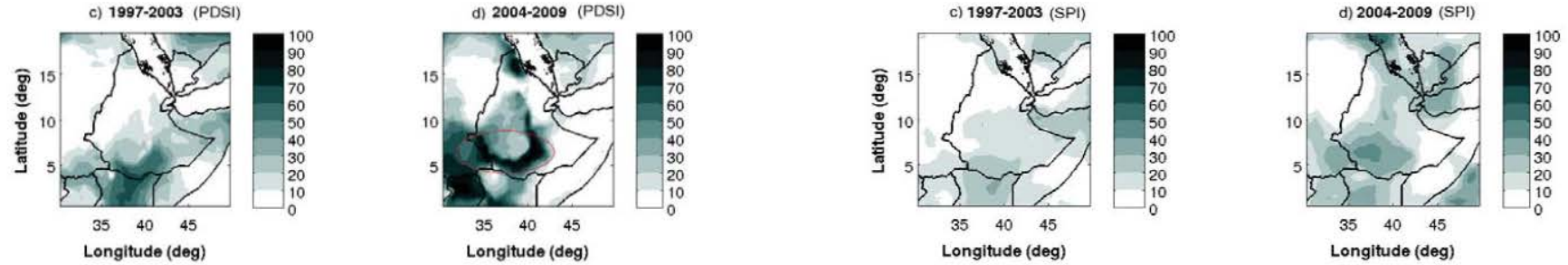


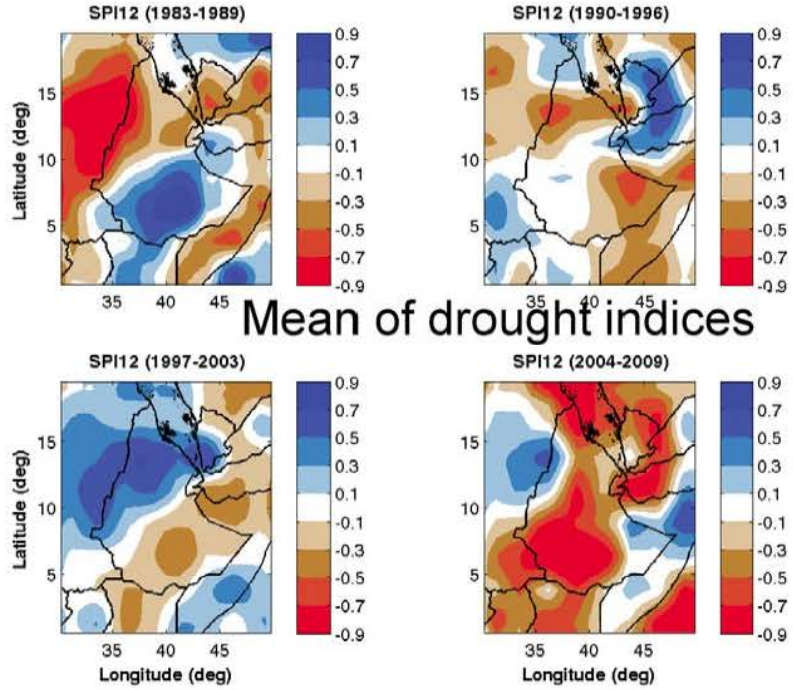
- The 2nd Dominant Pattern of TEOF explain the northern regions, which superimposed very low frequency signals and increasing dry trend up to ~1998 /decreasing dry trend since ~1998
- ~1982/83, ~1990,~1994/95,~1997, ~2002/03 and ~2008 drought years for northern regions. Whereas ~1985,~1988,~1991/92,~2003 and ~2005 relatively wet years.





P = (number drought months/total months)*100



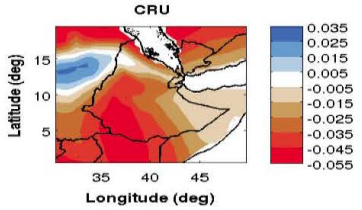


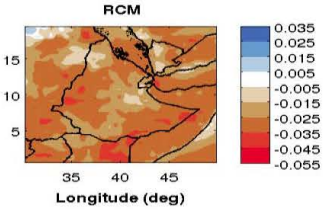
Mean of drought indices

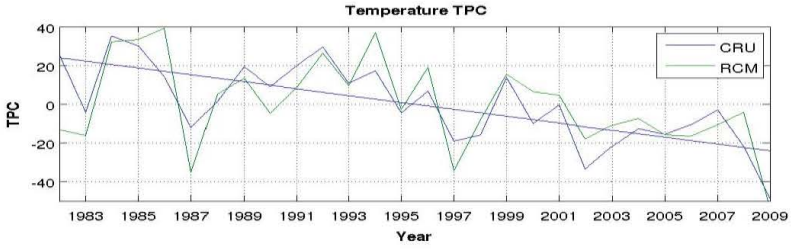
- During the 1st two heptads drought occurred more frequent and intense over the northern regions.
- For the last two heptads the southern regions ⇨ drought area whereas northern recover from drought

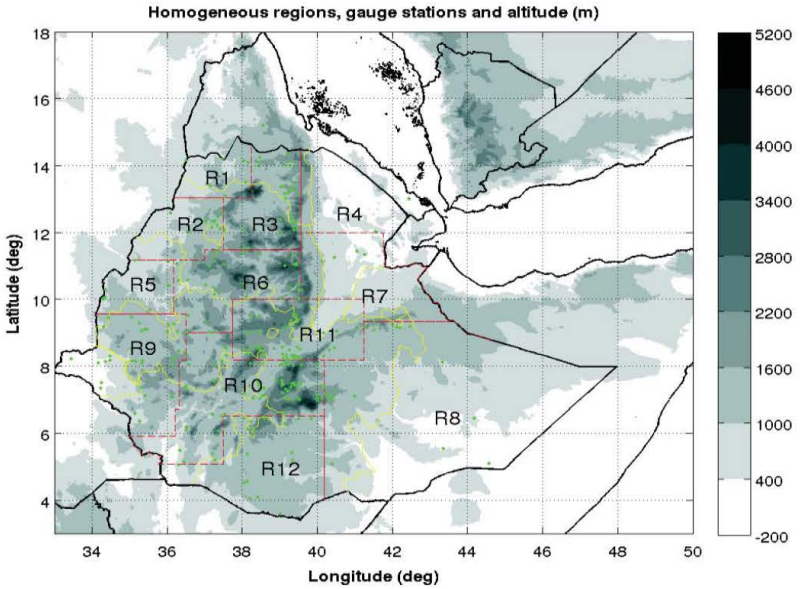
- Number of sever and extreme sever drought occurred years percentile and mean value of time series of drought indices indicate the same results

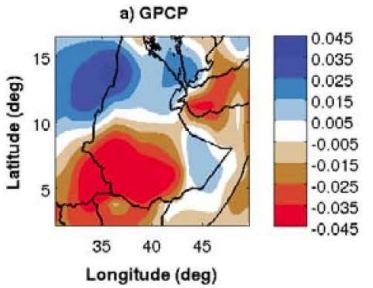
•Southern regions significant dry trend northern regions dominated by low frequency signals

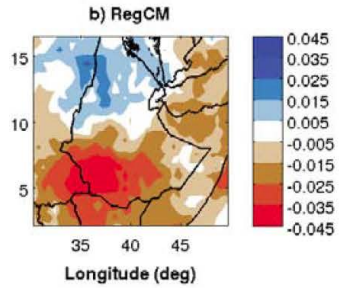


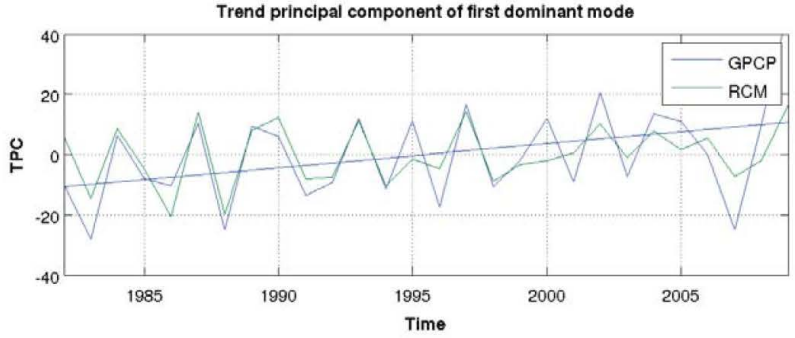


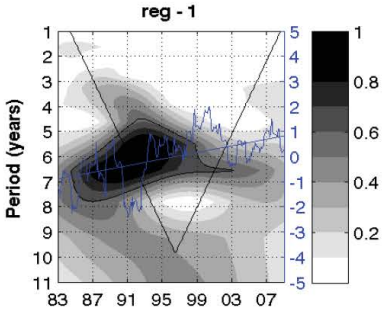


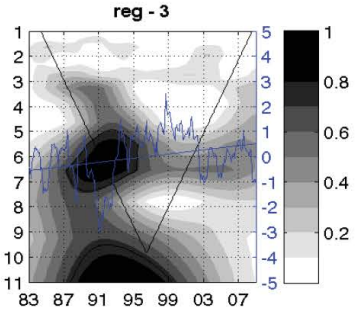


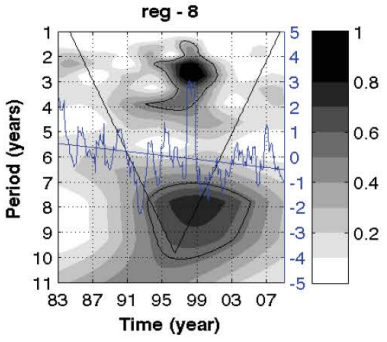


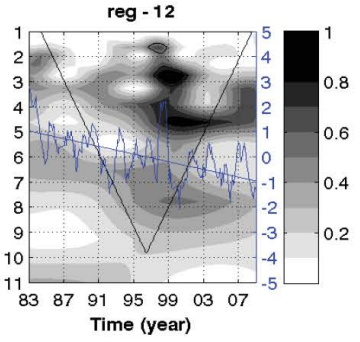






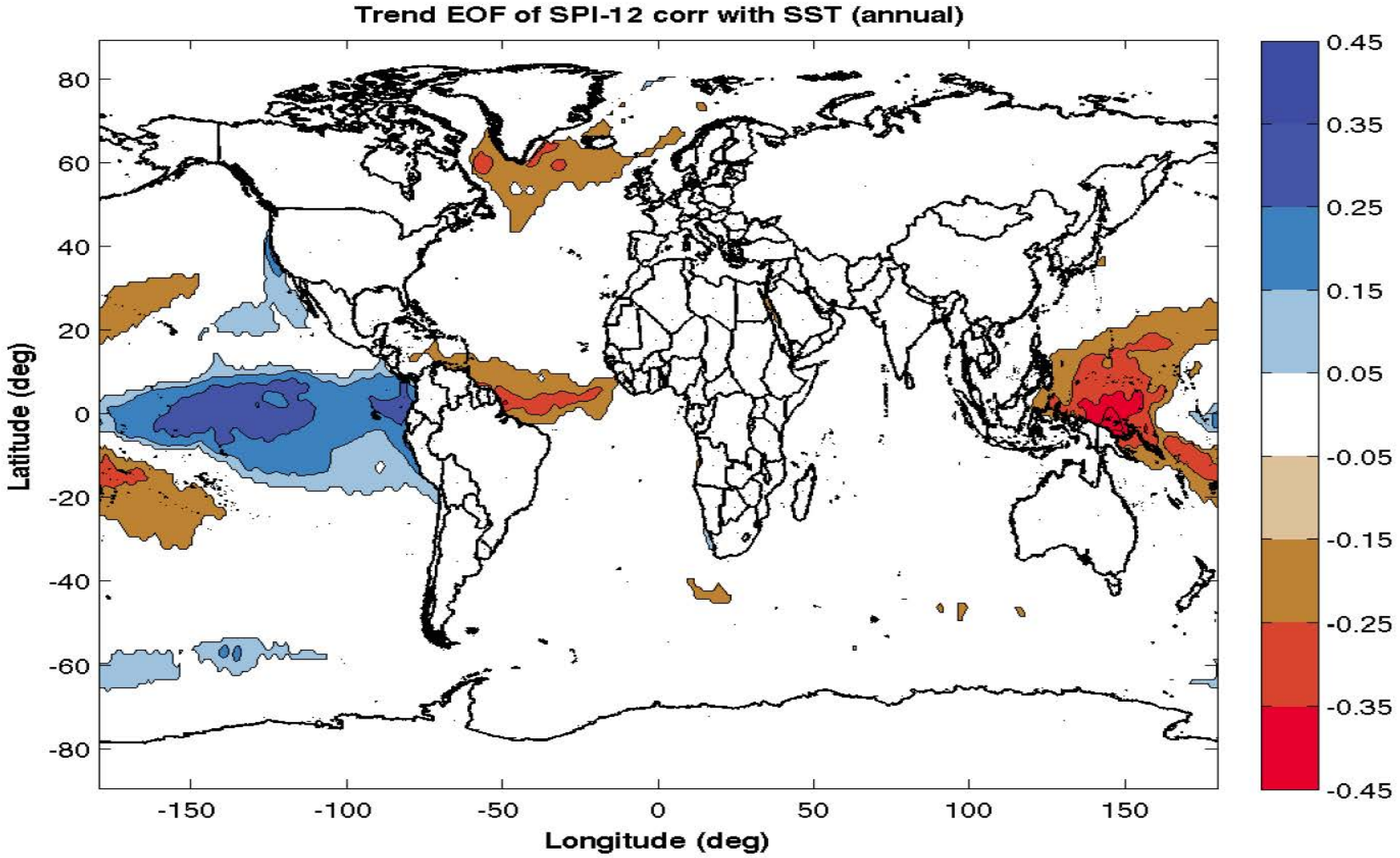






Is there any association with global SST ??

- The 1st TPC and global SST
- The equatorial, northern Atlantic and ENSO events are correlated to the drought over the southern Ethiopia
- Same result also found corr of homg-regions with SST.



- The 2nd dominant TPC (explain northern regions), more correlated with northern and central Atlantic and the north west Indian ocean.
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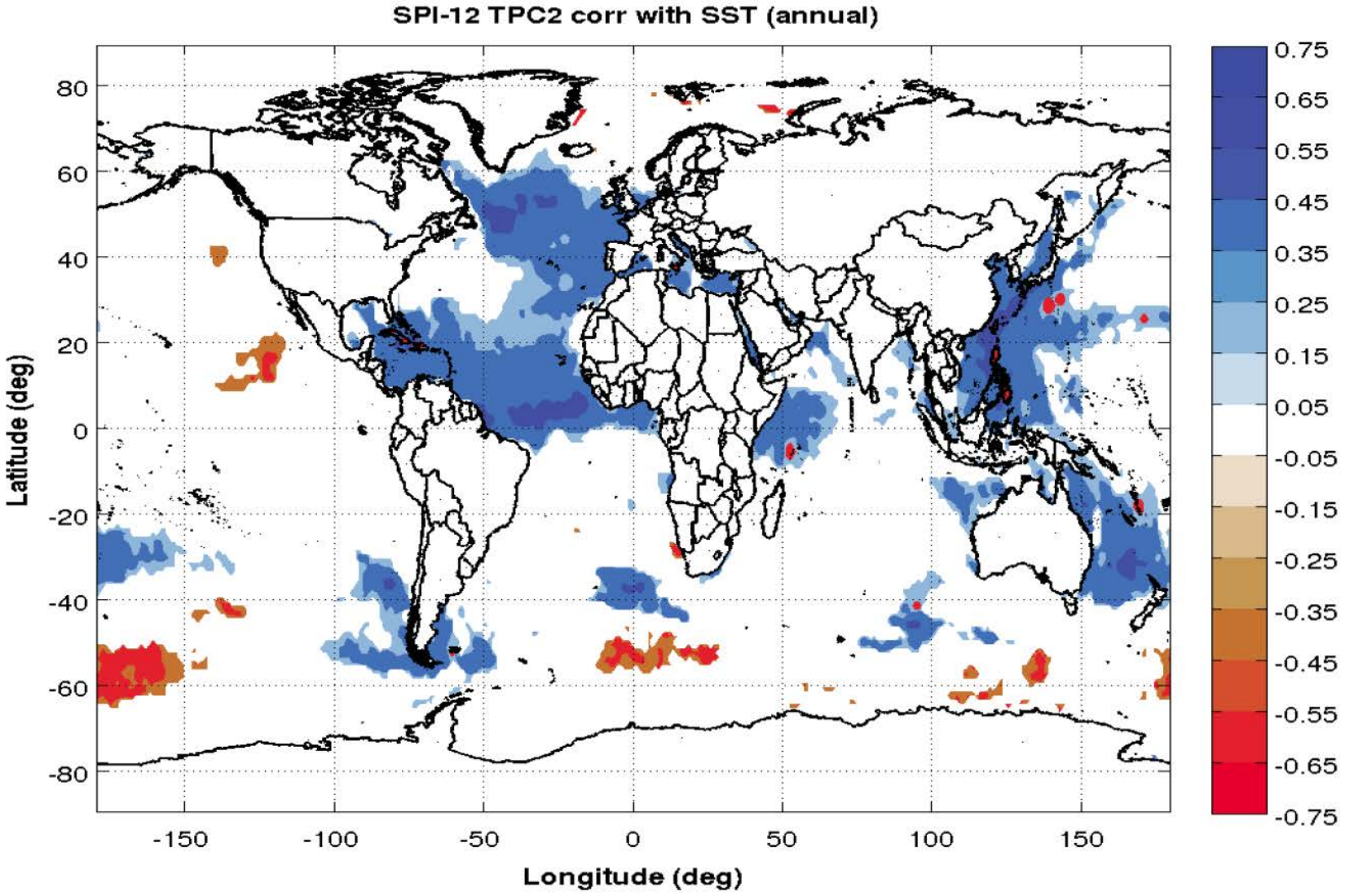
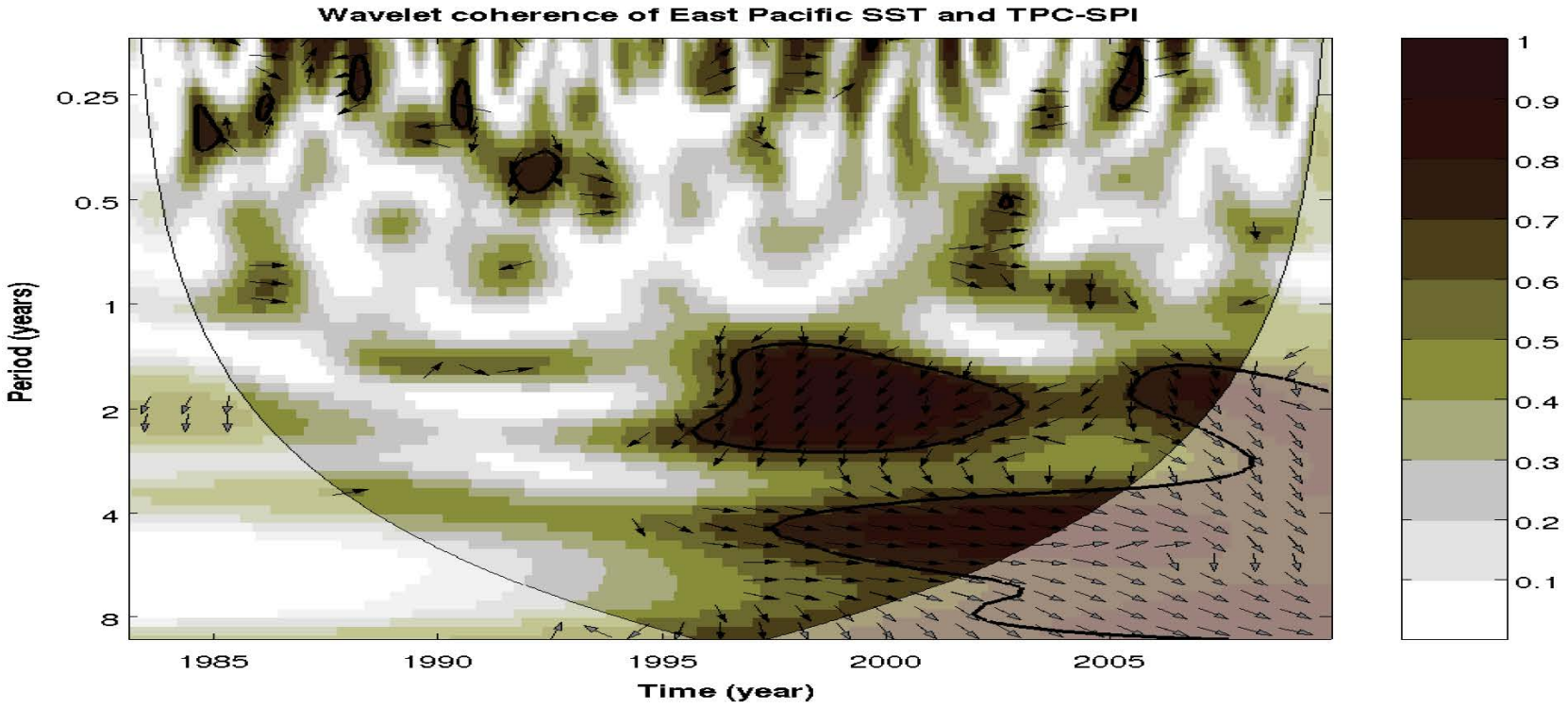
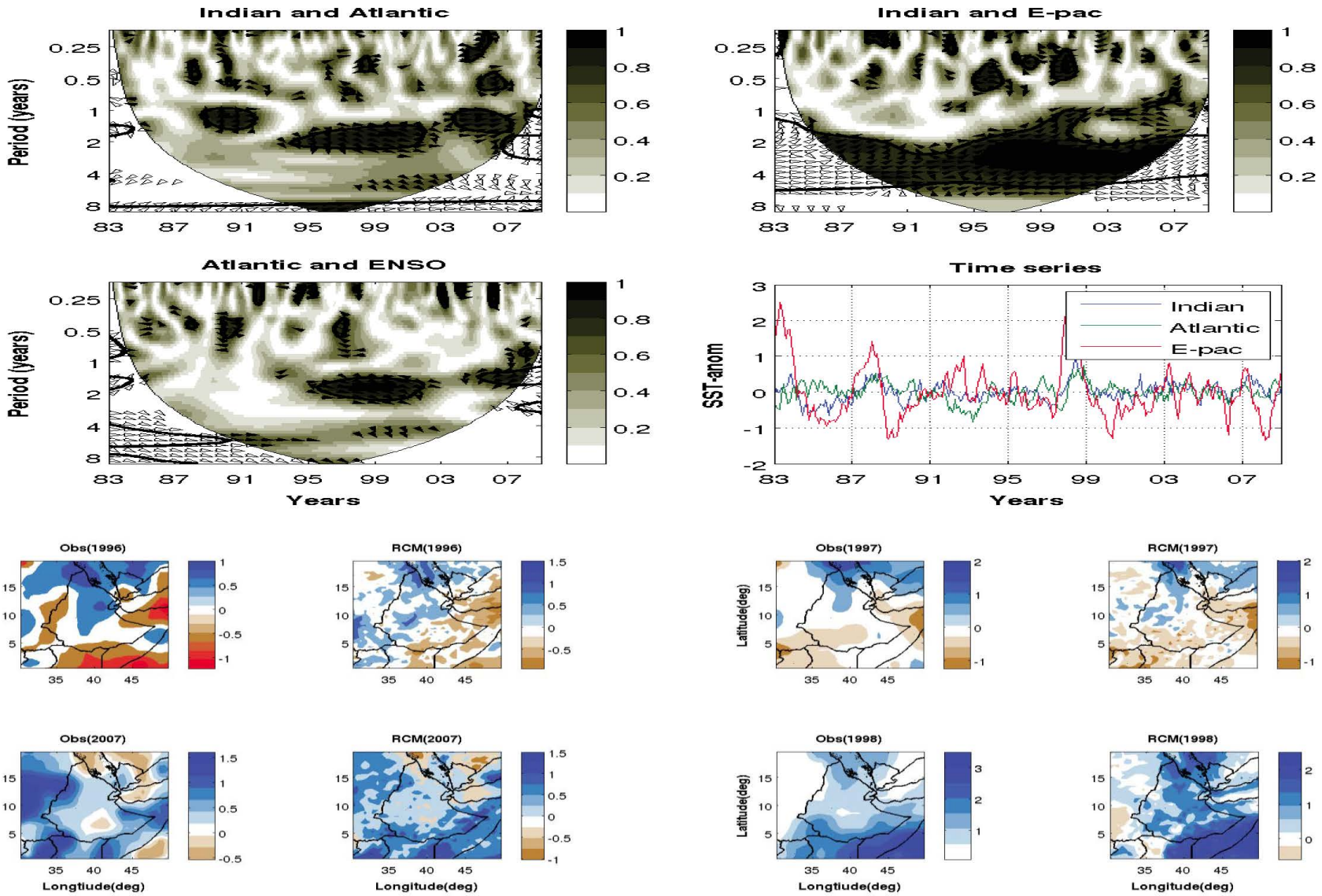


• Have common high power, which is ~2 and ~4-6 years band and coherent in the period from ~1997-2001.
• Similar results are found using Palmer drought severity index (PDSI).
•Drought in/out phase with the east/west for 4 years period signals.





•Not only selected ocean basin like SIOD, Atlantic, Indian etc may have significant relation with drought So, association with drought require further work.

Summery

❖During the recent decade, there has been an increase in frequency and intensity of drought over the southern regions of Ethiopia

❖This drought can be due to both local and remote forcing.

❖ENSO and Equatorial Atlantic SST anomalies seem to be the candidates for the remote forcing

❖El Niño and +IOD mostly(1982, 1994, 1997, 2006) occurred at the same year but 2007 La Niño occurred with +IOD (wet over Ethiopia)

Future work

We will examine the projection of drought using different RegCMx output Scenarios.

Thank you!

Thank very much again all ESP group
Specially Filippo and Gulilat