Drought dynamics and variability over South-Asia:

A Preliminary Study Over India

Md Saquib Saharwardi & Pankaj Kumar

Indian Institute of Science Education and Research Bhopal, India

Fourth Workshop on Water Resources in Developing Countries: Hydroclimate Modeling and Analysis Tools, 12-23 June 2017, ICTP Trieste, Italy

Contact : saquib16@iiserb.ac.in

Outline

- **Introduction**
- **Data and Methods**
- **Results**
- **Conclusion**
- **Future Outlook**

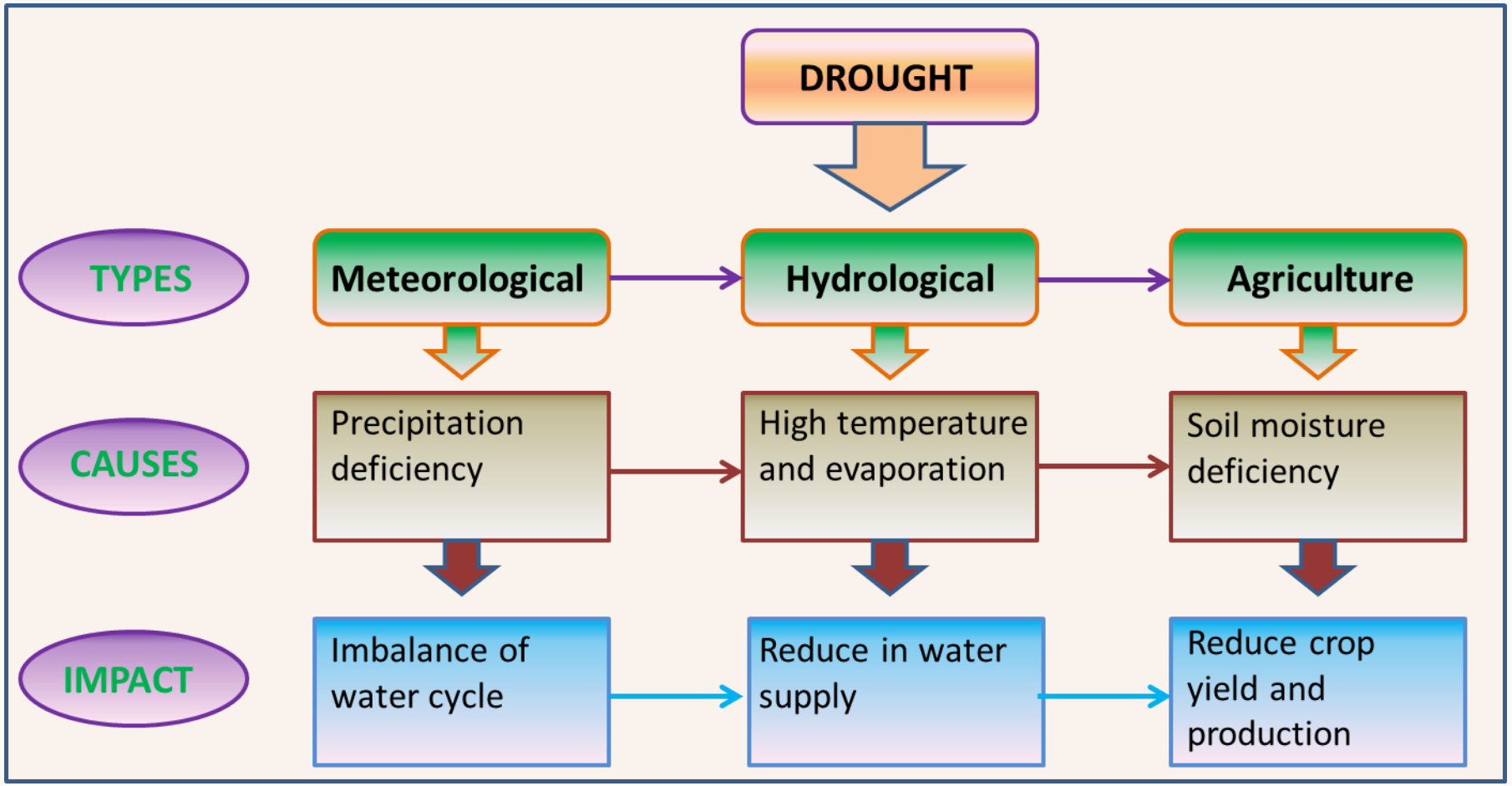
Contact : saquib16@iiserb.ac.in

Introduction

- **Drought is long term slowly occurring disaster initiated as deficit of precipitation and high evapotranspiration.**
- **Exponential population growth has led to increased agriculture water demands manifold, especially over developing countries.**
- **Several studies showed that drought reoccurrence intensity and frequency has increased over India in last decades or so (*Mallaya* et al., 2016).**
- **The increase in global warming has increased the frequency of drought over South-Asia by increasing temperature and evaporation more sunshine and low relative humidity (IPCC, AR5).**

Contact : saquib16@iiserb.ac.in

Drought and its types



Contact : saquib16@iiserb.ac.in

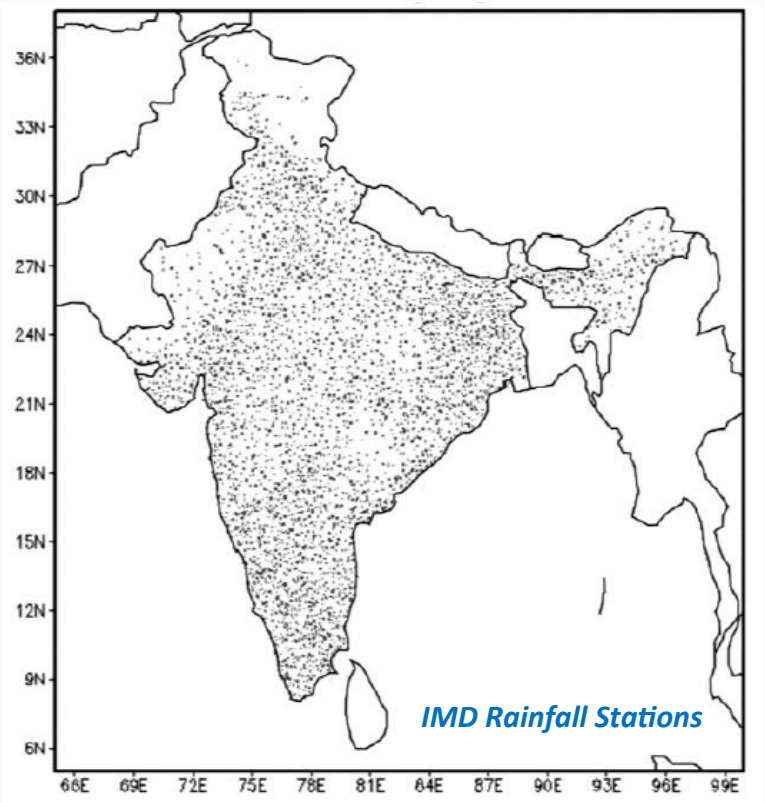
Objectives

- To analyze the extreme precipitation variability over India.
- To study the relationship between observation and model simulated precipitation variability focusing drought.
- In the present study SPI and SPEI indices has been used to determine drought variability over the region.

Contact : saquib16@iiserb.ac.in

Data

- We have taken the observational gridded monthly rain fall data at 0.25^0 x 0.25^0 and Temperature dataset at 1.0^0 x 1.0^0 from 1951 to 2005 from Indian Meteorological Department (IMD).
- CRU (Climate Research Unit)- University of East Angelia precipitation data, for the same period.
- High resolution regional coupled model (ROM, *Sein* et al., 2015) data for temperature and Precipitation at 0.44^0 x 0.44^0 (CORDEX South-Asia domain) for the same period.



Contact : saquib16@iiserb.ac.in

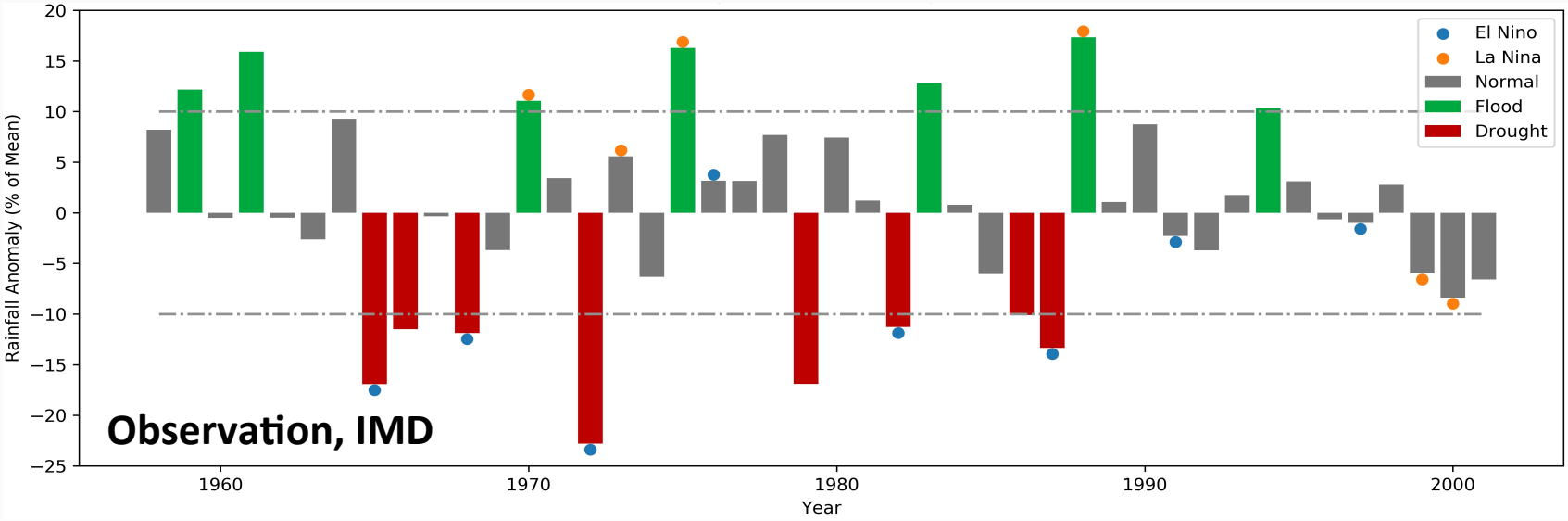
Methods

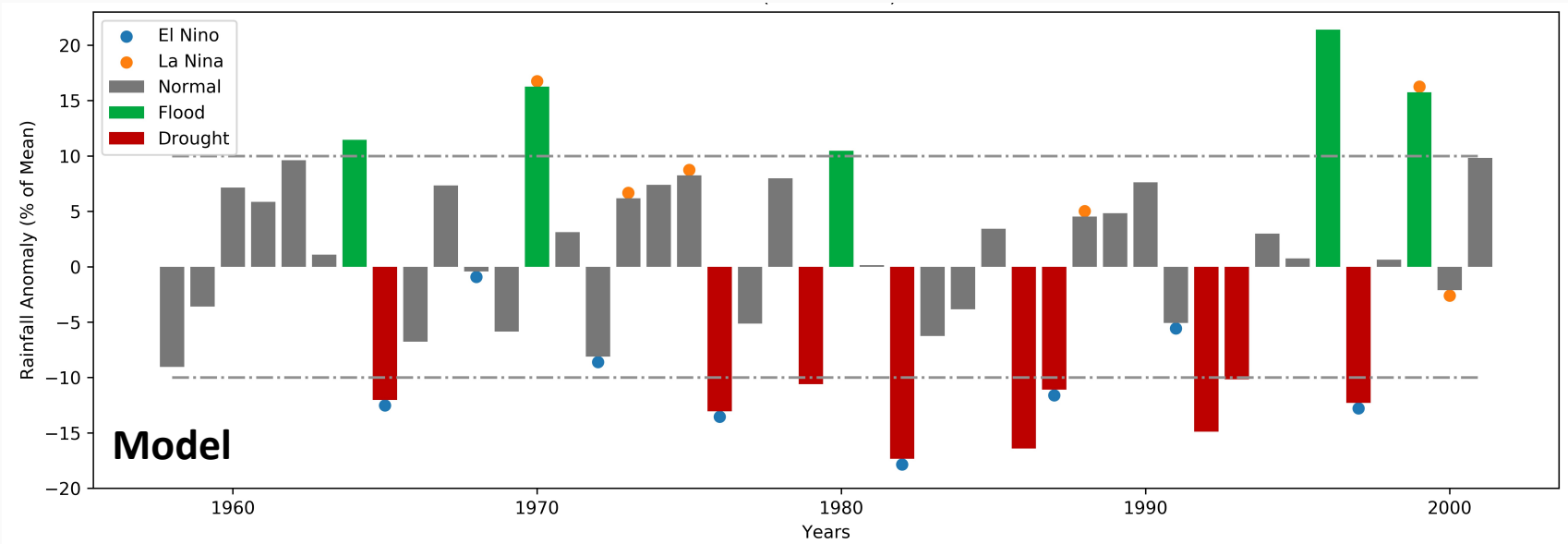
- **SPI (Standardized Precipitation Index) and SPEI (Standardized precipitation Evapotranspiration Index) indices has been used as the Indicator for drought studies.**
- **SPI is the Probability density function of cumulative precipitation climatology and calculated by method proposed by *Mckee* et al., 1993.**
- **SPEI is the monthly difference between precipitation and PET and is calculated by method proposed *Vicente-Serrano* et al., 2010.**
- **These both are multi-scale indices and better to represent the intra-seasonal and inter-annual variation of drought over the region.**

$$D_n^k = \sum_{i=0}^{k-1} (P_{n-i} - PET_{n-i}), n \geq k$$

Contact : saquib16@iiserb.ac.in

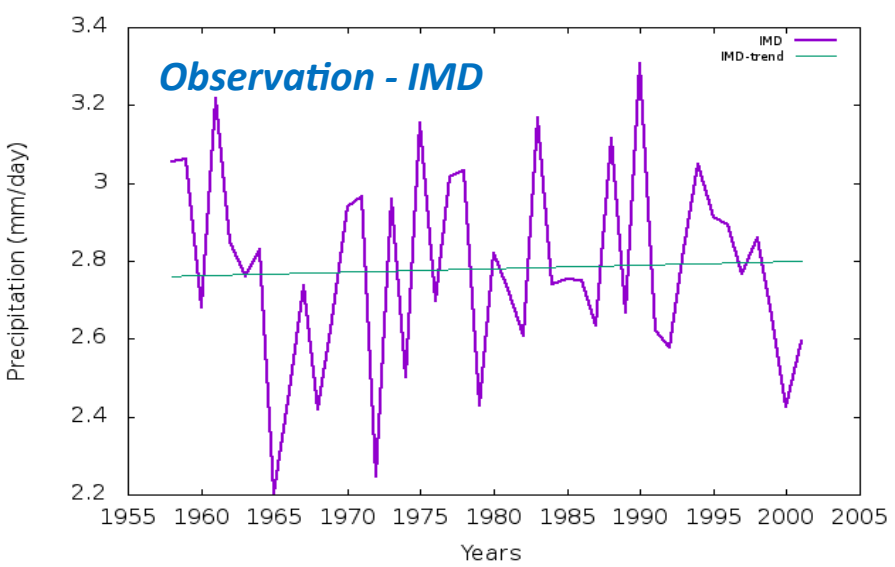
All India Summer Monsoon Rainfall, 1958-2001

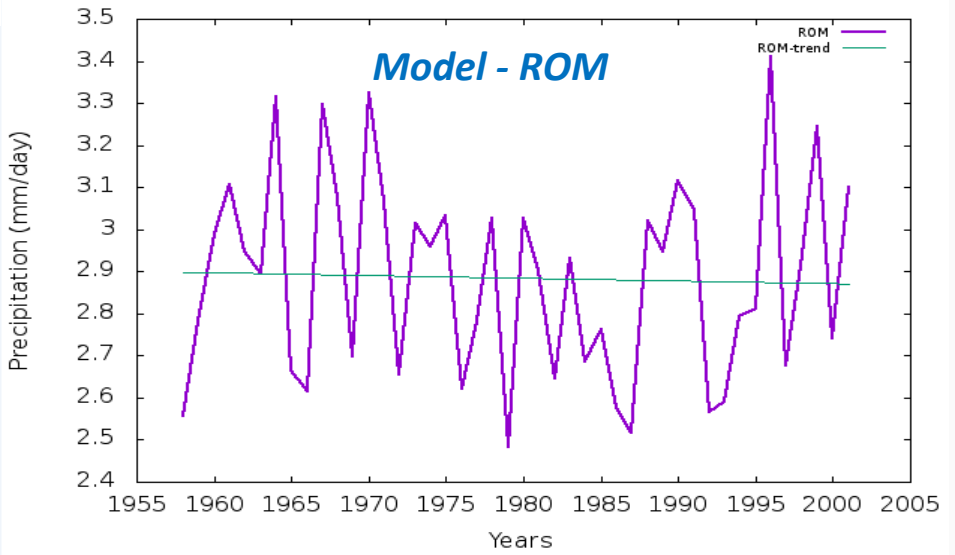




Contact : saquib16@iiserb.ac.in

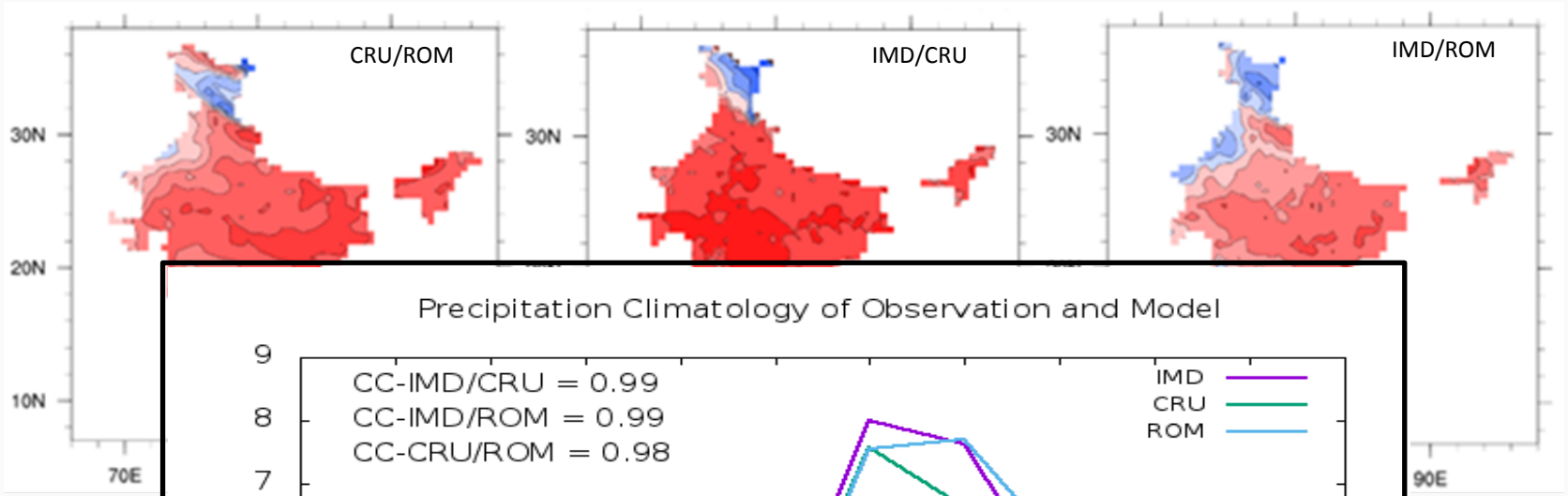
Trend of Precipitation over India

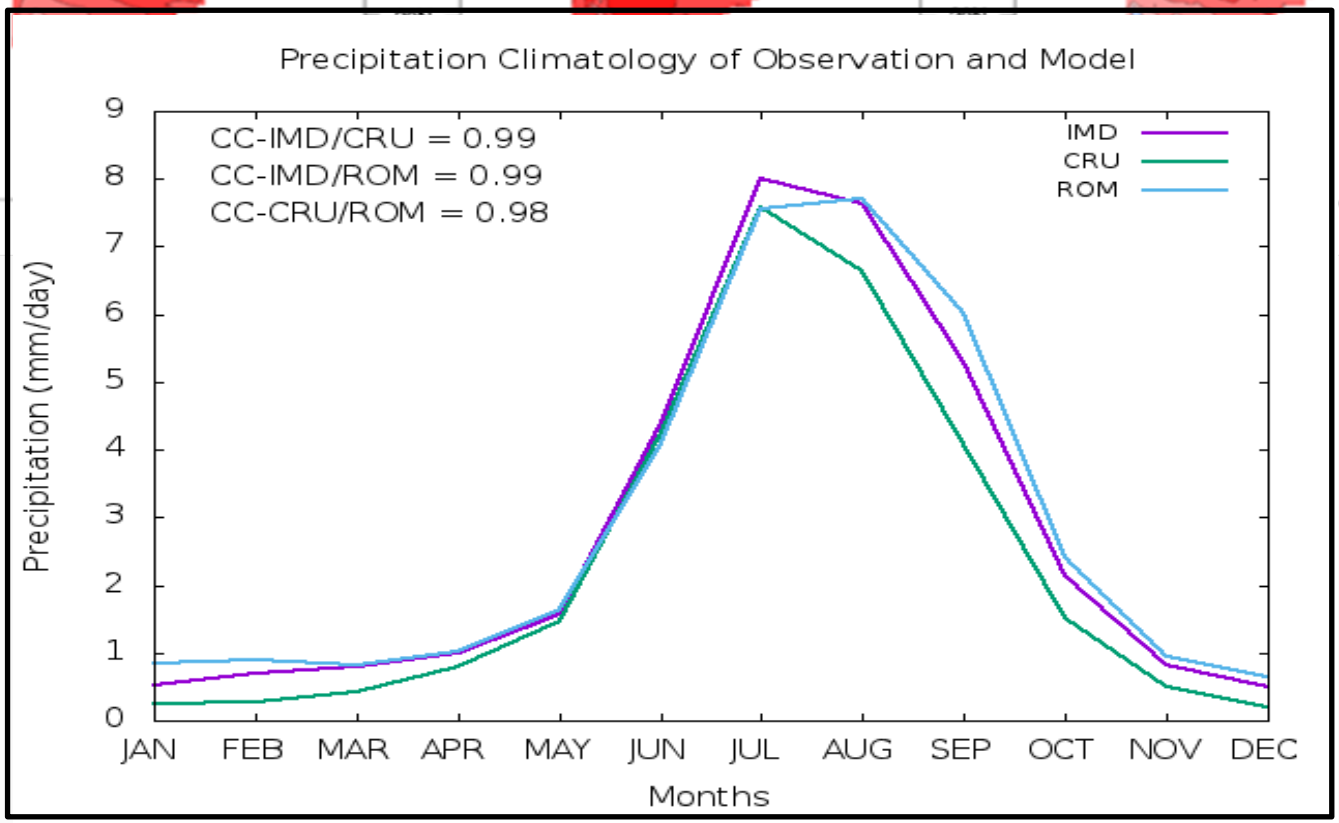




Contact : saquib16@iiserb.ac.in

Correlation between Observation and Model



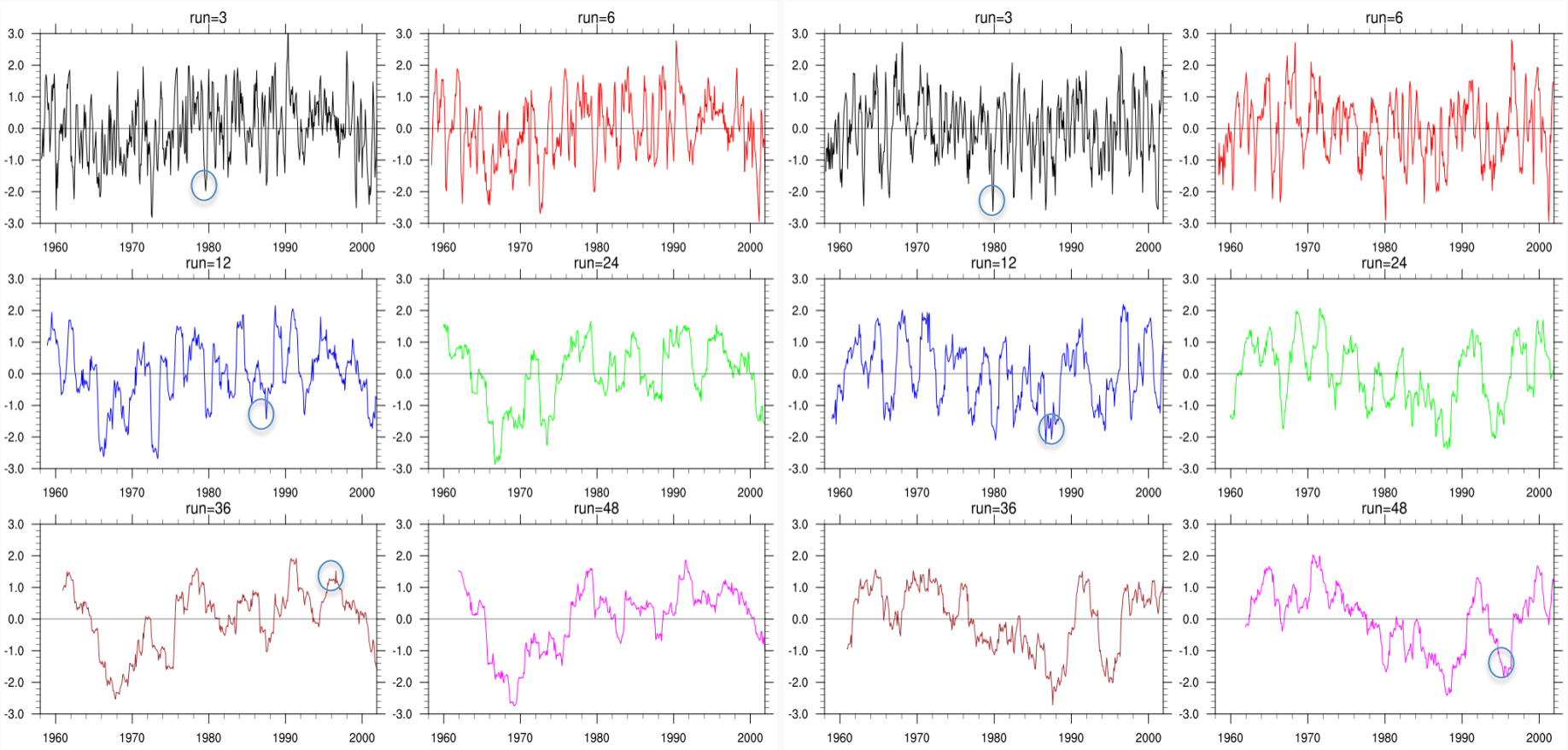


Contact : saquib16@iiserb.ac.in

Standardized Precipitation Index (SPI)

OBSERVATIO

MODEL

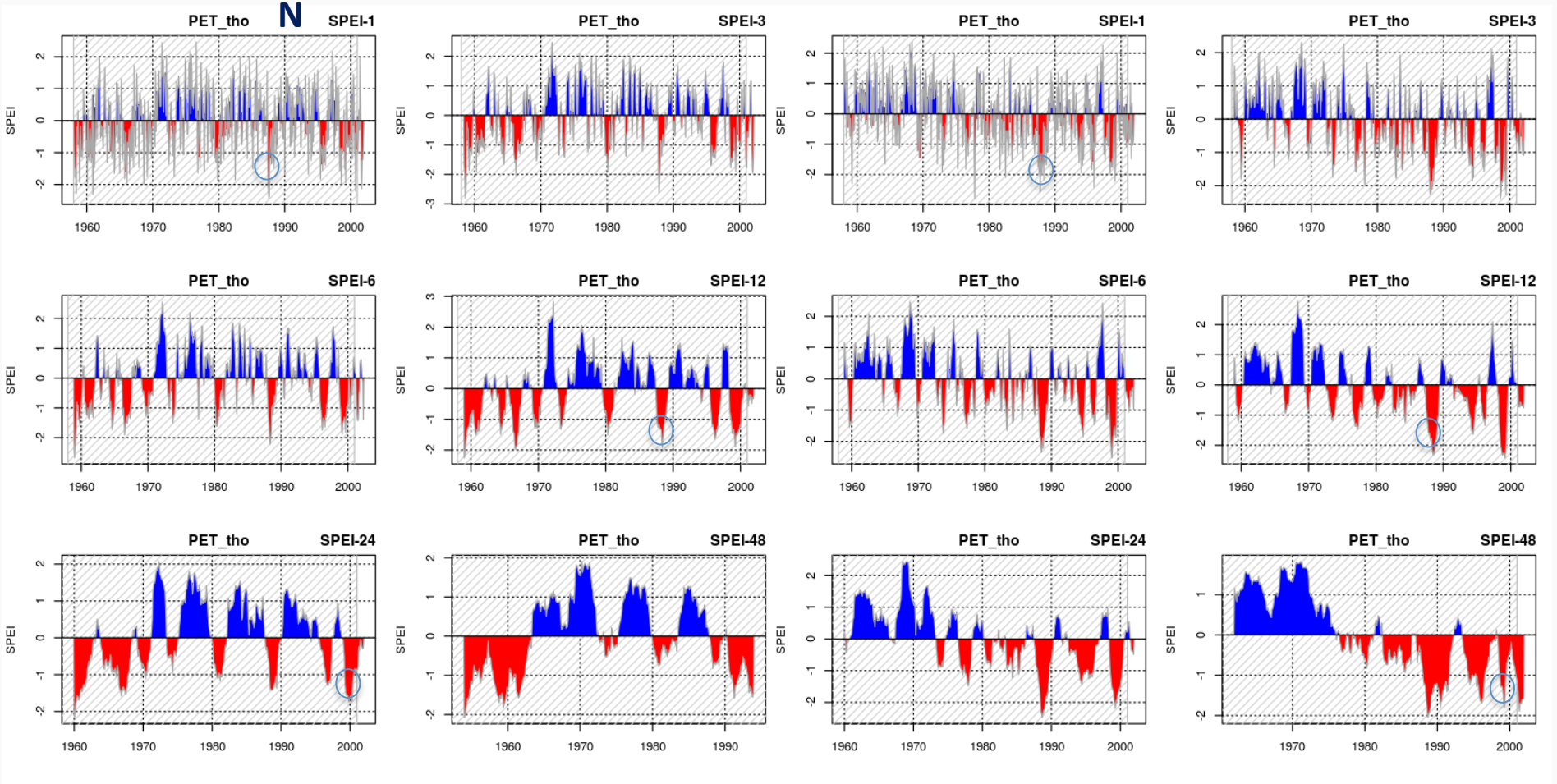


Contact : saquib16@iiserb.ac.in

Standardized Precipitation Evapotranspiration Index (SPEI)

OBSERVATION

MODEL



Contact : saquib16@iiserb.ac.in

Conclusion

- There is no significance increase in precipitation since more than 50 years.
- It is noticed that during monsoon season the dry spells are prolonged though the amount of rainfall is more or less close to long period average.
- Model is able to represent the annual cycle interestingly very well. The spatial correlation is also reasonably well represented.
- At longer time scale SPEI is showing a better drought inter-annual variability than SPI.
- The short-term drought, SPEI (3, 6) is characterized by strong periodicity at quasi-biennial and decadal timescales.

Contact : saquib16@iiserb.ac.in

Future Outlook

- **ROM simulations results will be used to further understand the overall drought dynamics over South-Asia.**
- **High-resolution (ROM) regional coupled model (CORDEX domain) simulations, using several RCP's for the period 1950-2100 will be performed, to understand the future drought dynamics over South-Asia.**
- **To develop drought factsheets with uncertainty assessment.**

Contact : saquib16@iiserb.ac.in

Acknowledgement

- ICTP for funding my visit and opportunity
- Dept. of Science and Technology, Govt. of India for providing me Ph.D. fellowship
- Climate and Glacier modeling group, IISER Bhopal, India

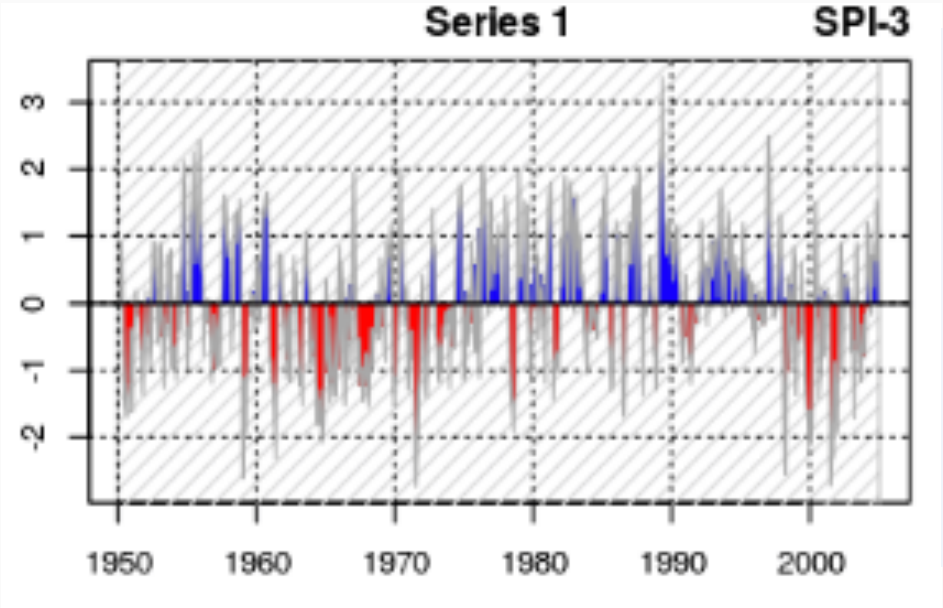
http://home.iiserb.ac.in/~kumarp/index.html

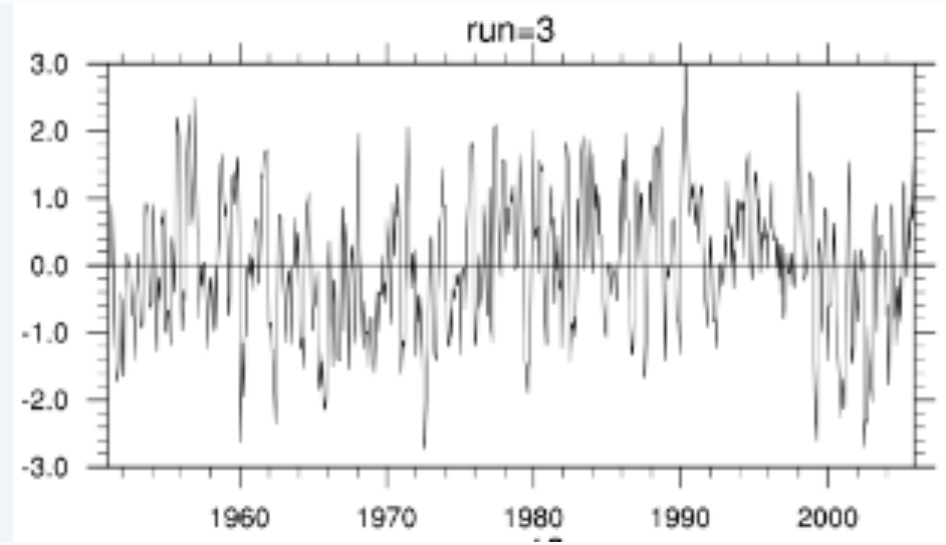
THANK YOU

FOR YOUR KIND ATTENTION !

Contact : saquib16@iiserb.ac.in

Contact : saquib16@iiserb.ac.in





Contact : saquib16@iiserb.ac.in