Geophysical Research Abstracts
Vol. 18, EGU2016-13222, 2016
EGU General Assembly 2016

Factors Affecting the Inter-annual to Centennial Time Scale Variability of All Indian Summer Monsoon Rainfall

Abdul Malik and Stefan Brönnimann

Oeschger Center for Climate Change Research and Institute of Geography, University of Bern,Switzerland
(abdul.malik@giub.unibe.ch)

The All Indian Summer Monsoon Rainfall (AISMR) is highly important for the livelihood of more than 1 billion people living in the Indian sub-continent. The agriculture of this region is heavily dependent on seasonal (JJAS) monsoon rainfall. An early start or a slight delay of monsoon, or an early withdrawal or prolonged monsoon season may upset the farmer's agricultural plans, can cause significant reduction in crop yield, and hence economic loss. Understanding of AISMR is also vital because it is a part of global atmospheric circulation system. Several studies show that AISMR is influenced by internal climate forcings (ICFs) viz. ENSO, AMO, PDO etc. as well as external climate forcings (ECFs) viz. Greenhouse Gases, volcanic eruptions, and Total Solar Irradiance (TSI).

We investigate the influence of ICFs and ECFs on AISMR using recently developed statistical technique called De-trended Partial-Cross-Correlation Analysis (DPCCA). DPCCA can analyse a complex system of several interlinked variables. Often, climatic variables, being cross correlated, are simultaneously tele-connected with several other variables and it is not easy to isolate their intrinsic relationship. In the presence of non-stationarities and background signals the calculated correlation coefficients can be overestimated and erroneous. DPCCA method removes the non-stationarities and partials out the influence of background signals from the variables being cross correlated and thus give a robust estimate of correlation. We have performed the analysis using NOAA Reconstructed SSTs and homogenised instrumental AISMR data set from 1854-1999.

By employing the DPCCA method we find that there is a statistically insignificant negative intrinsic relation (by excluding the influence of ICFs, and ECFs except TSI) between AISMR and TSI on decadal to centennial time scale. The ICFs considerably modulate the relation between AISMR and solar activity between 50-80 year time scales and transform this relationship to statistically significant positive. We conclude that the positive relation between AISMR and solar activity, as found by other authors, is due to the combined effect of AMO, PDO and multi-decadal ENSO variability on AISMR. The solar activity influences the ICFs and this influence is then transmitted to AISMR.

Further, we find that there is statistically positive intrinsic relation between AISMR and AMO from 26 to 100 year time scales which is modulated by ICFs (PDO, ENSO) and ECFs. PDO, ENSO, and solar activity weaken this intrinsic relationship whereas the combined effect of ECFc (solar activity, volcanic eruptions, CO_2, & tropospheric aerosol optical depth) results in strengthening of this relationship from 70 to 100 year time scales.

There is a negative intrinsic relation between AISMR and PDO which is not statistically significant at any time scale. However this relationship becomes statistically significant only in the presence of combined effect of North Atlantic SSTs and ENSO (4-39 year time scale) and individual effect of TSI (3-26 year time scale) on AISMR.

We also find that there is statistical significant negative relationship between AISMR and ENSO on inter-annual to centennial time scale and the strength of this relationship is modulated by solar activity from 3 to 40 year time scale.