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Research Article

LONG- TERM CHANGE IN PRE- MONSOON THERMAL INDEX OVER CENTRAL INDIAN REGION AND SOUTH WEST MONSOON VARIABILITY

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ABSTRACT

The pre-monsoon months (April- May), north- South surface air temperature gradient over the central Indian region is a crucial for forth-coming monsoon activity. In this paper, by using the Principal component Analysis (PCA) the monthly temperature gradient series have been prepared. For analysis, the grid (1°*1°) point surface air temperature data taken from the Climate Research Unit (CRU) at the University of East Anglia is used. The analysis is carried out for 106 years 1901-2006. For finding the thermal index gradients anomalies, we have consider the three blocks ;one block (74-80°E, 16-22° N), second block (74-80°E, 22-28° N) and third is (74-80°E, 28-34° N). The monthly time series are prepared from the PCA analysis over these blocks. From these monthly series the North-south temperature gradient anomalies are calculated and the statistical relationship between the Indian southwest monsoon rainfall over all India (AIR), northwest India (NWR) , north east India (NEIR), central north east India (CNEIR) and peninsular India (PIR) and surface temperature gradient (STG) anomaly over central Indian region has been examined for the period 1901-2006. The study is furthered by means of sliding 30 years correlation coefficients. The results indicate that the previous Mays STG anomaly has a strong and direct relationship with southwest monsoon rainfall, suggesting that positive STG over central India in May leads to good/bad southwest monsoon rainfall over India. The correlations are stronger for AIR and CNEI followed by NEI. The result also suggests that antecedent May STG anomaly may be useful in the long range prediction of the following southwest monsoon rainfall over India.

The trend analysis of pre- monsoon thermal index (April-May) over central Indian region and performance of monsoon over NE regions also carried out. The study suggested that pre- monsoon thermal index (April-May) over central Indian region is showing the decreasing trend and the period of stagnation of monsoon increases.

INTRODUCTIONS

Monsoon is basically a thermally-driven large-scale circulation. It is, therefore, logical to expect that any global and regional scale thermal anomaly may have its influence on the monsoon rainfall. Particularly the pre-monsoon months (April- May), north- South surface air temperature gradient over the central Indian region is a crucial for advancement of forth-coming monsoon activity. Therefore, temperature change in pre monsoon over central Indian region and the regional Aerosol concentration are important for study of long term change of rainfall during the monsoon (June-September). The number of scientists studied the relationship between surface and upper air temperature with the rainfall activity during the summer monsoon period (June-September). Viz. Parthasarathy et .al. (1990); Rajeevan, (1991) and Verma, R. K.et al (1985) and many others A number of studies addressed the relationship between Indian Summer Monsoon (ISM), and land and sea surface temperatures (e.g., Sikka (1980); Verma *et al* (1985) examined the global land surface air temperature anomaly patterns in association with inter-annual variability of ISMR. However, similar attempts related to North East Monsoon (NEM) were limited. Recently Pai (2003) discussed the prominent teleconnection patterns in the monthly global gridded surface air temperature anomalies associated with the inter-annual variability of ISMR.

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DATA AND METHODOLOGY

For the analysis, the grid (1°*1°) point surface air temperature data have been taken from the Climate Research Unit (CRU) at the University of East Anglia. The analysis is carried out for 106 years 1901-2006. For finding, the thermal index gradient anomalies, we have consider three blocks , first block

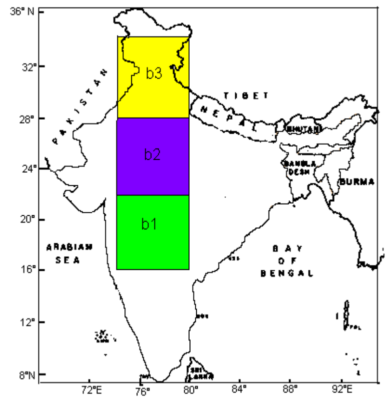

Figure1 : Different blocks used for the temperature gradients b1 block (74-80°E, 16-22° N), b2 block (74-80°E, 22-28° N) and b3 is (74-80°E, 28-34° N)

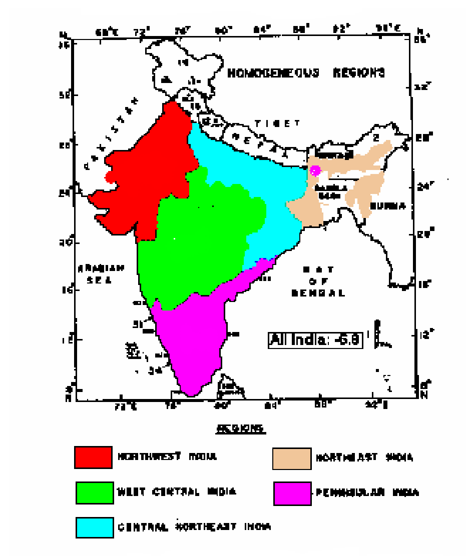

Figure2: Different homogenous regions of India

(74-80°E, 16-22° N), second (74-80°E, 22-28° N) and third one (74-80°E, 28-34° N) see figure1. The monthly time series are prepared from the PCA analysis over these blocks. The rainfall data is taken from I.I.T.M web site. By using the Principal Component Analysis (PCA) has been carried out over these blocks. The difference between the (PC1andPC2) of block one and block two are prepared. The variance explained by these is 98%. The monthly temperature series have been prepared and used for analysis. Similar analysis is carried out for block two and blocks three. The analysis is carried out for pre-monsoon months April and May

DISCUSSION

Pre- Monsoon temperature and monsoon variability relationship:

From these monthly series of the north-south temperature gradient anomalies are calculated and the statistical relationship between the Indian southwest monsoon rainfall over all India (AIR), northwest India (NWR), north east India (NEIR), central north east India (CNEIR) and peninsular India (PIR) see figure2 and surface temperature gradient (STG) anomaly over central Indian region has been examined for the period 1901-2006. The correlation analysis is carried out for month of April and

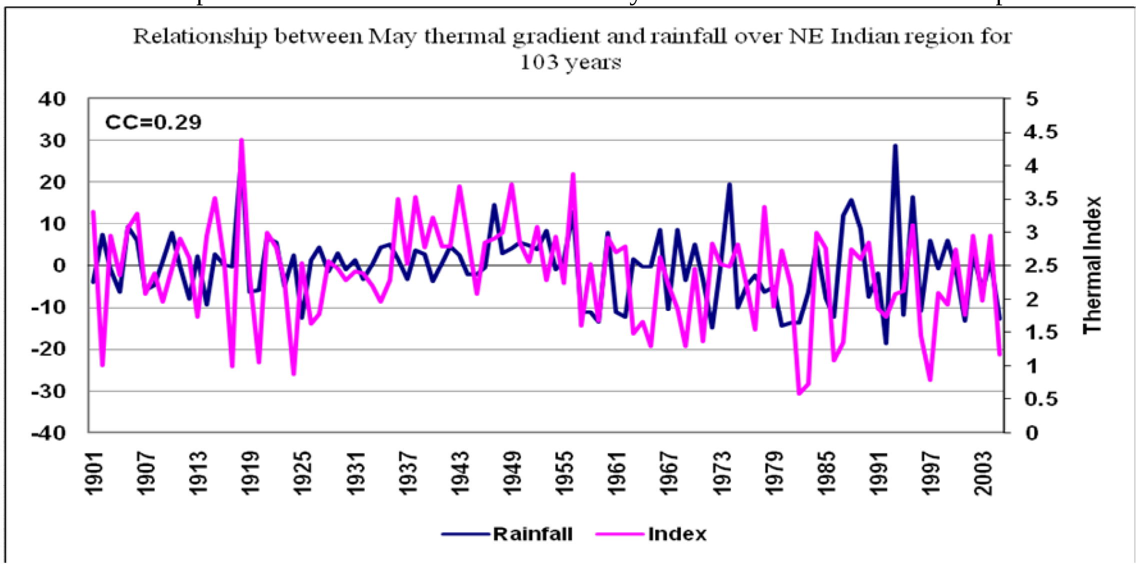

Figure3: Relationship between May thermal Gradient and rainfall over NE Indian region for103 years.

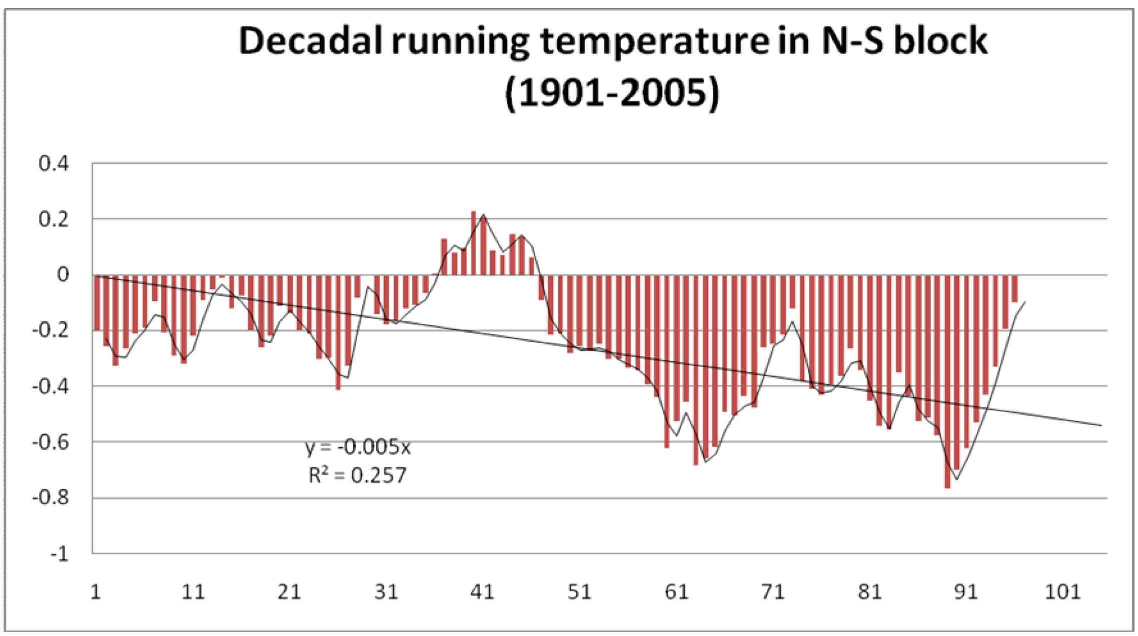

Figure 4: Decadal running temperature Gradient trend from1901-2005

May (Table 1and2). The results indicate that the previous Mays STG anomaly has a strong and direct relationship with southwest monsoon rainfall, suggesting that positive STG over central India in May leads to good/bad southwest monsoon rainfall over India. The correlations are stronger for AIR and CNEI followed by NEI (Figur3). The result also suggests that antecedent May STG anomaly may be useful in the long range prediction of the following southwest monsoon rainfall over India. The April STG doesn't show significant relationship with monsoon rainfall with different homogeneous regions.
The trend analysis is carried out for May temperature gradient figure 4 it is seen that there is significant decreasing temperature gradient on decadal scale.

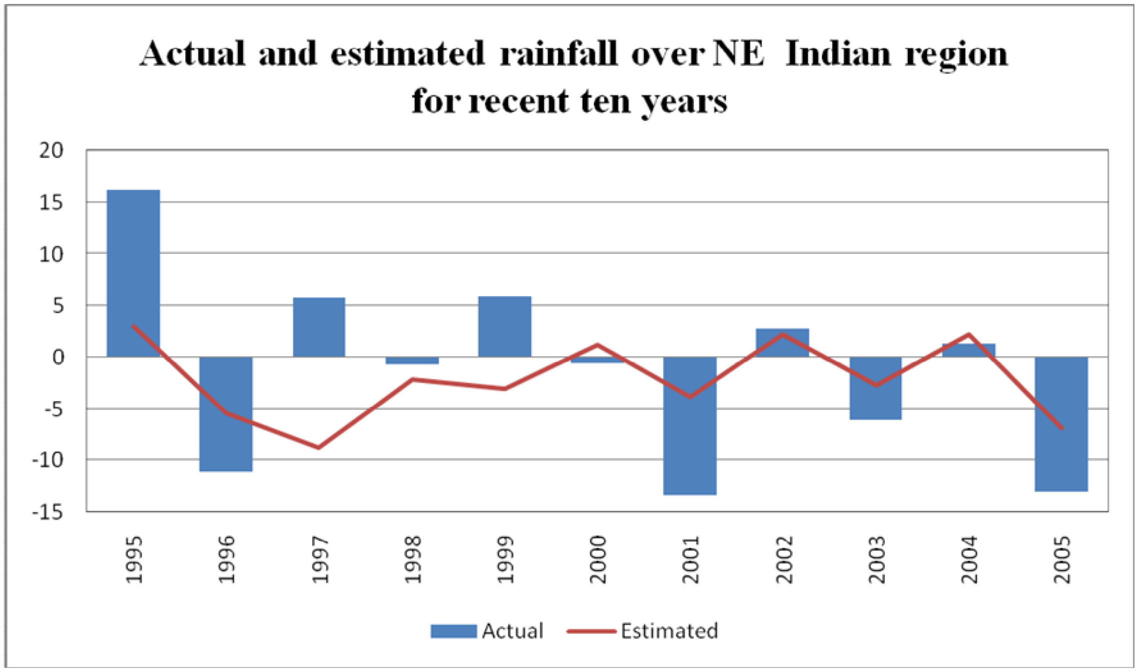

Figure 5: Forecasting verification for recent ten years 1995-2005 over NE Indian region

Table1: Relationship between April thermal gradient (b2-b1) and rainfall for period 1901-2005

	JJAS	June	July	Aug	Sep
All India	0.03	0.09	0.10	-0.07	-0.07
Hom India	0.00	0.07	0.06	-0.08	-0.05
Cor India	0.02	0.11	0.12	-0.09	-0.08
NW India	-0.03	0.01	0.02	-0.06	-0.02
WC India	0.02	0.09	0.09	-0.08	-0.06

CNE India	0.09	0.14	0.14	-0.02	-0.12
NE India	0.05	0.00	0.04	0.00	0.05
Pen India	-0.02	-0.03	0.00	0.00	-0.02

Table2: Relationship between May thermal gradient (b2-b1) and rainfall for period 1901-2005

Regions	JJAS	June	July	Aug	Sep
All India	0.02	0.14	-0.05	0.01	-0.03
Hom India	-0.04	0.05	0.00	-0.08	-0.05
Cor India	-0.07	0.09	-0.03	-0.10	-0.06
NW India	-0.18	-0.19	-0.03	-0.12	-0.09
WC India	0.06	.0.16	0.02	-0.04	-0.01
CNE India	0.14	0.18	-0.18	0.25	0.06
NE India	0.29	0.24	0.05	0.20	0.07
Pen India	-0.12	-0.03	-0.03	-0.07	-0.14

Since there is less rainfall activity in summer monsoon rainfall over NE Indian region in recent decade, the linear regression equation is developed for seasonal prediction of monsoon rainfall (June to September) , The verification of actual and estimated rainfall anomalies is depicted in figure5. It is seen that there is considerable good correspondences between actual and estimated rainfall in recent decade.

Conclusions

It is observed that, generally the April temperature gradient is not associated with monsoon rainfall activity, which means whatever the warming in April is higher or lower it is not linked with performance of monsoon rainfall. The North South surface air temperature gradient in month of May over the central India can be useful for seasonal prediction of monsoon rainfall over the North East India. There is decreasing trend in temperature gradient in month of May. The North South surface air temperature gradient in month of May over the central India can be useful for seasonal prediction of monsoon rainfall in June over all India

Physical explanation could given on the bases of study effects of Black Carbon Aerosols on the Indian Monsoon (Journal of Climate, Jun 15, 2008 by Meehl, Gerald A, Arblaster, Julie M, Collins, William D) The radiative effects of BC aerosols are most dramatic during the dry season over South Asia, in particular for the pre-monsoon months of March-April-May. Surface temperatures cool over most of India, the Bay of Bengal, and the Arabian Sea because of the decreased solar radiation at the surface caused by the absorption and reflection of solar radiation by the BC aerosols. The warmer air from the effects of the shortwave heating in the lower troposphere is advected northward and manifested by warming over the elevated heat source of the Tibetan Plateau, thus producing an anomalously strengthened meridional temperature gradient through most of the depth of the troposphere during MAM. Consequently, there is anomalous inflow from the Indian Ocean to the south, and enhanced rainfall over most of India during the pre-monsoon season of MAM. However, as the BC aerosol concentrations decrease during the monsoon season, the anomalous elevated heat source and meridional temperature gradient decreases. This, in combination with the anomalously cool SSTs in the Arabian Sea and Bay of Bengal left from the effects of the BC aerosol effects in MAM, produce reduced rainfall over much of India, the Arabian Sea, and the Bay of Bengal during the monsoon season of JJA.

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