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Classification of climate zones over India based on satellite observations using a machine learning technique

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Pronounced changes in several climatological parameters has indicated a notable climate change around the globe over recent past. The present study aims to explore the pattern in changes that has occurred in Indian Monsoon precipitation in recent times. The ground based rain fall data are available in sufficiently long scale. However, that does not convey the different rain parameters except the rain intensity. Satellite observations such as TRMM observations can provide multiple rain parameters over a large spatial region simultaneously. The changes in rain features under climate change are not restricted to only changes in intensity, but also effected by other parameters such as rain cell size, spatial rain distribution, convective/stratiform proportion etc. It is therefore imperative to investigate the changes in all rain related parameters to get better understanding of climate change consequence.

The existing rain climatology is based on the long term rain gauge data which measures only the rain intensity. To study the climate change effect on the rain zones of India based on the existing climatology is thus not sufficient or adequate. Hence, redefinition of the homogeneous rain regions based on multiple parameters is attempted in this study. High resolution data set of multiple rain parameters of TRMM is used for present work. Data product (Version 7.0) 3A25 of TRMM satellite is used. The major challenge to utilize the satellite data for such purpose is due to lack of long term measurements. Unlike the ground based measurements, the time duration of this TRMM satellite covers only one and half decade. However, the satellite measurements are advantageous since large areal coverage can be obtained. Further TRMM PR has spatial resolution of ~4.3 km. Therefore, finer resolution data can be obtained. Even though the data period is not long enough but that certainly can give us the signature of variation in Indian monsoon and the impact of climate change on it. However, one can note that the rain is very non-homogeneous over Indian region. India was subdivided in Homogeneous Monsoon regions solely based on the rain intensity. This study redefine homogeneous monsoon zones over India, combining the recent trend in precipitation based on two major type of rains (convective and stratiform). The new classification is based on the changes in all five different precipitation parameters considered (Rain intensity, Convective rain intensity, stratiform rain intensity, Rain fraction, Convective/Stratiform fraction of rain in total rain) instead of only rain intensity. Statistical machine learning techniques are used to handle multiple number of rain features simultaneously. Further the trends in different rain parameters are examined over this newly defined rain zones. Results indicate the new classified zones can reveal some important trends in long term rain parameters for some of the regions which were earlier not detected.