

Predictability of Kiremt Rainfall Variability over the Northern Highlands of Ethiopia on Dekadal and Monthly Time Scales Using Global Sea Surface Temperature

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Abstract : Countries like Ethiopia, whose economy is mainly rain-fed dependent agriculture, are highly vulnerable to climate variability and weather extremes. Sub-seasonal (monthly) and dekadal forecasts are hence critical for crop production and water resource management. Therefore, this paper was conducted to study the predictability and variability of Kiremt rainfall over the northern half of Ethiopia on monthly and dekadal time scales in association with global Sea Surface Temperature (SST) at different lag time. Trends in rainfall have been analyzed on annual, seasonal (Kiremt), monthly, and dekadal (June–September) time scales based on rainfall records of 36 meteorological stations distributed across four homogenous zones of the northern half of Ethiopia for the period 1992–2017. The results from the progressive Mann–Kendall trend test and the Sen’s slope method shows that there is no significant trend in the annual, Kiremt, monthly and dekadal rainfall total at most of the station's studies. Moreover, the rainfall in the study area varies spatially and temporally, and the distribution of the rainfall pattern increases from the northeast rift valley to northwest highlands. Methods of analysis include graphical correlation and multiple linear regression model are employed to investigate the association between the global SSTs and Kiremt rainfall over the homogeneous rainfall zones and to predict monthly and dekadal (June–September) rainfall using SST predictors. The results of this study show that in general, SST in the equatorial Pacific Ocean is the main source of the predictive skill of the Kiremt rainfall variability over the northern half of Ethiopia. The regional SSTs in the Atlantic and the Indian Ocean as well contribute to the Kiremt rainfall variability over the study area. Moreover, the result of the correlation analysis showed that the decline of monthly and dekadal Kiremt rainfall over most of the homogeneous zones of the study area are caused by the corresponding persistent warming of the SST in the eastern and central equatorial Pacific Ocean during the period 1992 - 2017. It is also found that the monthly and dekadal Kiremt rainfall over the northern, northwestern highlands and northeastern lowlands of Ethiopia are positively correlated with the SST in the western equatorial Pacific, eastern and tropical northern the Atlantic Ocean. Furthermore, the SSTs in the western equatorial Pacific and Indian Oceans are positively correlated to the Kiremt season rainfall in the northeastern highlands. Overall, the results showed that the prediction models using combined SSTs at various ocean regions (equatorial and tropical) performed reasonably well in the prediction (With R² ranging from 30% to 65%) of monthly and dekadal rainfall and recommends it can be used for efficient prediction of Kiremt rainfall over the study area to aid with systematic and informed decision making within the agricultural sector.

Keywords : dekadal, Kiremt rainfall, monthly, Northern Ethiopia, sea surface temperature

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