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Exploring the variability of evapotranspiration as a response to vegetation dynamics over North-East India using remote sensing

A. Borah* [(1)], B. Pathak [(1), (2)], U. Bhattacharjee [(2)], A. M [(3)], P. K. Bhuyan [(2)]

(1) Department of Physics, Dibrugarh University, Dibrugarh, Assam-786004,
email: borahanindita97@gmail.com, binita@dibru.ac.in
(2) Centre for Atmospheric Studies, Dibrugarh University, Assam-786004, email: pkbhuyan@gmail.com, bhattacharjeeuday17@gmail.com
(3) Indian Institutes of Science Education and Research, Bhopal- 462 066, email: anu110402@gmail.com

Variability in evapotranspiration (ET) plays a crucial role in influencing terrestrial hydrology, vegetation dynamics and energy partitioning of the land surface. North-East India (NEI) region is rich in water resources including mighty river Brahmaputra and Barak and their tributaries and is highly vegetated with 66% vegetation cover. This region is a vulnerable zone to climate change as the people in this region are dependent on the natural resources – water bodies, forest ecosystem for livelihood, development, and sustainability. The present study analysed the interrelation between the hydrometeorology and vegetation dynamics through investigating the variation of water budget-derived evapotranspiration (ET), vegetation dynamics [Normalized Difference Vegetation Index (NDVI), Leaf Area Index (LAI)]. The Moderate Resolution Imaging Spectroradiometer (MODIS) satellite retrieved ET dynamics exhibited an increasing trend at a rate of 3.28 mm yr^{-1} (standard deviation= 34.9 mm yr^{-1}) over North-East India (NEI) during 2000-2021. The analysis revealed that the highest ET occurs in monsoon season with monthly maximum in September (95.04 mm yr^{-1}- 127.99 mm yr^{-1}) and lowest in winter month of January (51.08 mm yr^{-1}- 68.64 mm yr^{-1}). This high ET coincided with peak growth of most of deciduous vegetation and sufficient soil moisture. Low magnitude in winter season is mainly due to leaf fall in deciduous forests, relatively less agricultural crop growth and dry weather with little or no rain during winter. The occurrence of maximum ET in the main growing season of monsoon with highest amount of rainfall reveals dominance of transpiration in ET over this region Annually, the highest ET was observed in 2019 (990.95 mm yr^{-1}), associated with highest NDVI value (0.64) that year and the lowest ET (855.73 mm) was detected in 2000. ET strongly correlated with NDVI (0.72) and LAI (0.83), suggesting the controlling role of transpiration in ET due to large vegetation cover. Our findings suggest that MODIS LAI is more sensitive indicator of hydroclimatic variability than MODIS NDVI at regional scales. The main conclusions are drawn as follows: ET has a significant change in the temporal and spatial distribution due to the complex in the topography condition and fluctuation of vegetation dynamics change which contribute differently to ET.