Insights on solar wind–cosmic ray role-play in rainfall

Rissnalin Syiemlieh and Eeshankur Saikia*

Department of Applied Sciences, Gauhati University, Guwahati 781 014, India

Though the solar–galactic interaction in the terrestrial environment is a well-known phenomenon for the formation of rain-yielding clouds, the study of this event in a predominantly monsoon-dependent region such as India is ignored due to its relatively lesser influence on the total rainfall. However, since ocean currents and monsoons are consistently transforming from a periodic and predictable system to a stochastic and unpredictable one due to anomalies, the need to understand the impact of global parameters on local rainfalls is enormous today. It is not only confirmed that solar wind and cosmic rays play major roles in the formation of rain-yielding clouds even at geographical locations where more than 70% of the total rainfall is caused by monsoons (Vijay Kumar and Singh, *Hydrol. Sci. J.*, 2010, 55(4), 484–496), but also found that there is a dominant and consistent period of around 4.66 years, which is very significant as it happens to be the period of Quasi-Biennial Oscillation. Besides helping in strategic planning for rain-dependent events at the global level, the results obtained are expected to detect and predict local anomalies in the terrestrial environment due to variations in the Earth–Moon and solar–galactic system.

Keywords: Cosmic rays, Earth's atmosphere, ENSO, geomagnetic disturbances, QBO, solar wind.

between solar variability and weather: the variations in total solar irradiance provide variable heat input to the lower atmosphere, increasing the temperature; the variations in solar ultraviolet over a solar cycle change the ozone concentration and heat up the stratosphere where ultraviolet radiation is absorbed; and the effects of GCR on weather, which involve cloud processes[7,9,10]. A study on the relationship between ocean circulation, and local and global climate occurrences[11], provide information on how regional climatic are shaped by ocean circulation and emphasises the possible effects of climate change on tropical rainfall[12].

Several periodic variations are involved in the Sun–Earth–Moon system, the one-year period, which is the periodic motion of Earth about the Sun, and the 3- and 6-months, which are the quarter and half cycle of the Earth's revolution around the Sun and the 11-years is the solar cycle period[13]. Due to lunar tides, the 3.8, 8.85 and 9.3-year cycles are recognised as the spring tide cycle[14]. The 14 months (1.16-years), 28 months (2.33-years) and 4.66-years known as Quasi-Biennial Oscillation (QBO) are due to the zonal wind variation of the equatorial stratosphere which results from the downward propagation of the easterlies and westerlies wind[15]. Periods of ≤2, 2.9 and 3–6 years are the manifestation of the El Niño Southern Oscillation (ENSO), the temporal change in the central and eastern Pacific