Tidal Influence on the Generation of Post-Midnight F region Irregularities

Meenakshi S*[1,2] and S Sridharan[1]

(1) National Atmospheric Research Laboratory, India, meenakshi@narl.gov.in, susridharan@narl.gov.in
(2) Indian Institute of Space Science and Technology, India

Understanding F region irregularities have always been a topic of interest for space scientists since it can help in forecasting ionospheric conditions for better radio communication and geopositioning. They usually occur during post-sunset hours with higher occurrence during the equinox months of solar maximum years. But recent observations have shown that these irregularities can also occur at delayed hours (Post-midnight hours)). In contrast to the post-sunset F region irregularities (PSF), these post-midnight F region irregularities (PMF) have different morphology and occurrence characteristics with higher occurrence during the solstice months of solar minimum years. The Rayleigh Taylor Instability (RTI) is widely accepted mechanism behind the generation of the PSF, whereas the generation mechanisms for the PMF are still under debate. Observations from the Equatorial Atmosphere Radar (EAR), Kototabang (0.2°S, 100.3°E, 10.36°S dip latitude) echoes due to F-region irregularities show an anomalously high percentage of occurrence (PO) of the PMF during the equinox month of September 2019, when a major Austral Sudden Stratospheric event (SSW) has occurred. While this anomalous high occurrence is also observed over Ascension Island (7.9°S, 14.4°W geographic; dip latitude: 16°S), it is not observed over Jicamarca (11.95°S, 76.87°W, dip latitude: 1.10°N). The possible influence of tides on the generation of these irregularities is investigated using TIMED-SABER temperature observations. It is found that the migrating diurnal tidal (DW1) amplitude has reduced drastically during September 2019 due to its interaction with planetary waves prior to the SSW leading to the generation of stationary diurnal tide DS0 resulting in the relative enhancement of migrating semi-diurnal tide (SW2) over DW1 at 10^{o}N, but not at ~10^{o}S (Jicamarca latitude). It is suggested that though the semi-diurnal tidal variation in the electric field imposed by the SW2 suppresses the generation of irregularities during post sunset hours, when it is westward. However, when the electric field turns eastward at later hours, it can lift the F layer to higher heights thereby favoring the RTI to act.