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Solar terminator variation over low latitude ionosphere: results from VLF observations

Ajeet K Maurya[(1)], Suniti Saharan[(2)], Shreyam Jana[(3)], Sudipta Sasmal[(3)] and Abhirup Datta[(4)]
(1) Department of Physics, Babasaheb Bhimrao Ambedkar University, Lucknow, India, 226025, e-mail: ajeet.phys@email.bbau.ac.in
(2)Department of Physics, Doon University, Dehradun, Uttarakhand, 248001
(3) Institute of Astronomy Space and Earth Science, P177, CIT Road, Kolkata, 7000001
(4) Department of Astronomy, Astrophysics and Space Engineering, Indian Institute of Technology Indore, 452020

Abstract

The solar terminator is a moving line that divides any planetary body into day-side and night-side. When electromagnetic waves propagate long distances from transmitter to receiver, they pass through region of day to night and night to day. The waves pass through region of discontinuity and hence there appears two minima (in the wave amplitude & phase), known as morning terminator and evening terminator. The solar terminators are very sensitive to change in the ionosphere and are being use to study various geophysical events[1,2,3]. The current study investigates the effect of the solar terminator on the low and equatorial transmitter receiver's great circle path (TRGCP) during geomagnetically quiet days to established baseline for day-to-day variability in the terminator. We have used the Very Low Frequency (VLF) signals from VTX (18.6 kHz) and NWC (19.2 kHz) navigational transmitters recorded at the low-latitude Indian station, Dehradun. The TRGCP length suggest NWC-Dehradun as long path length (~7000km) while VTX-Dehradun as short path length (~2500km). The observation suggests that for short path, morning terminator forms due to mode transition at both receiver and transmitter. Monthly variation in Terminator Times (TT) shows transitions in Terminator Time Morning (TTM) and Terminator Time Evening (TTE), and they dominate during equinox season. The TTM for both NWC and VTX paths showed dependency on the transmitter during summer and on the receiver during winter. Further a correlation between local time and TTM and TTE is being estimated for both NWC and VTX transmitter paths. For the NWC path, the correlation with the receiver's local time during TTM and TTE is 0.6 and 0.76, respectively, while the correlation with the local time of the transmitter (NWC) and TTs is 0.46 and 0.61, respectively, in the morning and evening. Similarly, the correlation for TTM and TTE for the VTX path at the receiver location is 0.82, and 0.7, while at the transmitter location, it is 0.7 and 0.6 respectively for morning and evening. The higher correlation values for short path (VTX-Dehradun) is probably due to transmitter-receiver being in the same time zone. Further, higher correlation for TTM & TTE at receiver location for both path indicates receiver local time is dominating in the TT formation.

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