



VHF scintillation associated with equatorial plasma bubbles over low latitude Indian region: a case study

Ashok Kumar Sharma^(1,2) and Omkar B Gurav³

¹School of Physics, Shri Mata Vaisno Devi University, Kakryal, Katra-182320, (J&K), India.

ashok.kumar@smvdu.ac.in

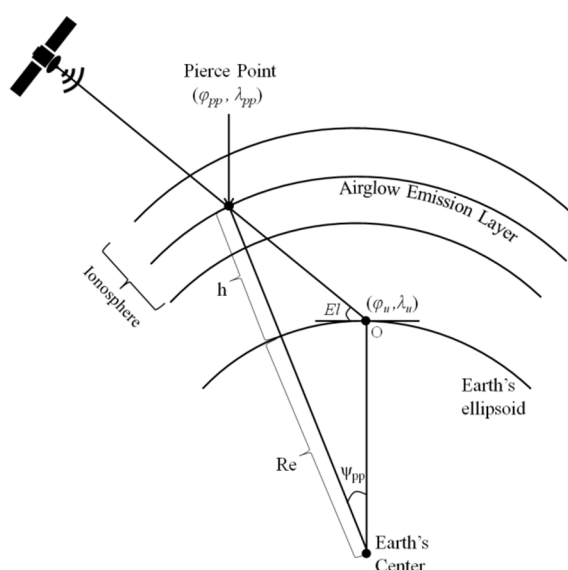
²Formerly at Space and Earth Science Laboratory, Department of Physics, Shivaji University, Kolhapur, India

aks_phy@unishivaji.ac.in

³Space and Earth Science Laboratory, Department of Physics, Shivaji University, Kolhapur, India

omgurav91@gmail.com

The nightglow observations of OI 630.0 nm emission carried out from low latitude station Kolhapur using All Sky Imager (ASI) with 140° field of view (FOV) for the month of April 2011 are used. The images were processed to study the field aligned irregularities often called as equatorial plasma bubbles (EPBs). The present study focuses on the occurrence of scintillation during the traversal of EPBs over ionospheric pierce point (IPP). Here we dealt with the depletion level (depth) of the EPB structures and its effect on VHF signals. We compared VHF scintillation data with airglow intensities at Ionospheric pierce point (IPP) from the same location. The determination of IPP can be done by drawing its geometry as shown in Figure 1.



The signal transmitted from the satellite to the receiver penetrates the ionospheric shell (F-layer peak), the intersection between line of sight and this shell is called the ionospheric pierce point (IPP). Rao et al., (2006), studied the F-layer peak height variation using GPS data over Indian low latitude region and found that the peak electron density height (hpF2) varies from about 275 to 575 km at the equatorial region, and varies slightly from 300 to 350 km at and beyond the anomaly crest regions. Here we have assumed that the OI 630.0 nm emission peak height for Kolhapur location is around 250 km (Ghodpage et al., 2014). In present analysis we have calculated the geodetic coordinates of IPP at this altitude. Figure 1 represents the geometry for determination of IPP coordinates. The VHF scintillation receiver is located at point 'O' having coordinates (φ_u, λ_u) which represents the latitude and longitude of the location (16.8° N, 74.2° E, 10.6° dip. Lat.), El is the elevation angle

to the satellite, R_e is the radius of the earth (~6371 km), h is the height of airglow emission layer (~250 km), ψ_{pp} is the earth's centered angle between the receiver and IPP and $(\phi_{pp}, \lambda_{pp})$ are the coordinates of the IPP.

We found that largely depleted EPBs traversing over IPP make stronger scintillation. From previous literature, it is believed that the small scale structures are present near the steeper walls of EPBs which often degrades the communication, the analysis presented in this paper confirms this belief. The steeper walls has the density gradient as compared to center of EPBs, hence causes severe scintillations (>0.6). Also, we have calculated the zonal drift from both the techniques and found that the drifts are larger/smaller estimated from VHF scintillation data/ASI data. This confirms the presence of vertical shear in the ionospheric-thermospheric altitudes. The present study is based on few quiet night observations and needs further rigorous analysis on large data set to get the climatological picture of plasma bubble induced scintillation activity over Indian low latitude region.

Reference:

1. P.V.S., Rama Rao, K., Niranjana, D.S.V.V.D., Prasad, S., Gopi Krishna, G.Uma, "On the validity of the ionospheric pierce point (IPP) altitude of 350 km in the Indian equatorial and low-latitude sector", *Ann. Geophys.*, **24**, 2006, 2159–2168.

R.N., Ghodpage, A., Taori, P.T., Patil, S., Gurubaran, S., Sripathi, S., Banola, A. K.Sharma, "Simultaneous optical measurements of equatorial plasma bubble (EPB) from Kolhapur (16.81N, 74.21E) and Gadanki (13.51N, 79.21E)", *J. Atmos. Sol.-Terr. Phys.* **121**, 2014, 196-208.