



GSLV effect on Earth's lower ionosphere

Kumarjit Saha*(1), Barin Kumar De(1) and Anirban Guha(1)

(1)Department of Physics, Tripura University, Suryamaninagar, 799022, Tripura (West), India
email: sahakumarjit2@gmail.com; email: barin_de@yahoo.com; email: anirban1001@yahoo.com

The effect of the rocket exhaust products on the D-region of the ionosphere is investigated with the help of Very Low Frequency (VLF) electromagnetic wave along the Earth-ionosphere waveguide. VLF is a very useful tool to study the Earth's lower ionospheric disturbances. The changes in the electron density profile are computed from the observed VLF signal perturbations after the rocket launch. We report the effect of the rocket exhaust on the lower ionosphere at an altitude around 58 km. The effect is primarily caused by localized free-electron depletion by water molecules by the process of attachment, decreasing the electrical conductivity of the ionosphere. The electron depletion is supposed to be formed by the rocket exhaust products of the 1st stage burn of Geosynchronous Launch Vehicle (GSLV) rocket launched from Sriharikota, India, on 27th August 2015 at 11:22 UT (16:52 IST). A Long Wave Propagation Capability (LWPC) model study also supports our findings.

At the very beginning a limited number of in-situ experiment has done (Bernhardt et al 1998) and after that satellite-based observation, continuous global positioning system (GPS) (Maeda and Heki 2014), study the reaction of rocket exhaust product in the upper ionosphere has been done to understand the occurrences of chemical reaction of rocket exhausts product with ionosphere and its effect. Now adays, VLF/LF method has become a powerful tool to perform quantitative studies the change in electron density in the ionospheric D-region.

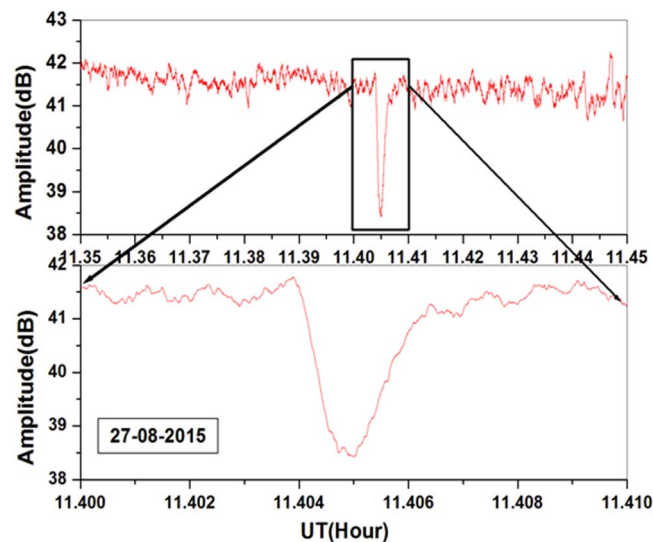


Figure 1. Time series plot of the VLF signal during the GSLV launch time. A square box of the upper panel represents the perturbed time and zoomed plot of that region are shown in lower panel of this figure.

1. Bernhardt, P.A., J.D. Huba, W.E. Swartz, and M.C. Kelley, Incoherent scatter from space shuttle and rocket engine plumes in the ionosphere, *J. Geophys. Res.*, 1998, 103, 2239-2251.
2. Maeda, J., and K. Heki, Two-dimensional observations of midlatitude sporadic E irregularities with a dense GPS array in Japan, *Radio Sci.*, 2014, 49, 28–35, doi:10.1002/2013RS005295.