



Modeling of lower ionospheric response during solar X-ray events using propagating radio wave signal

Tamal Basak^{*(1)}, Sudipta Sasmal⁽²⁾, Suman Chakraborty⁽³⁾ and Sandip Kumar Chakrabarti⁽²⁾⁽³⁾

(1) Amity University, Action Area II, Major Arterial Road, Rajarhat, Kolkata 700135, India

(2) Indian Centre for Space Physics, 43 Chalantika, Garia Station Road, Kolkata 700084, India

(3) S.N. Bose National Centre for Basic Sciences, Salt Lake, Sector 3, Kolkata 700098, India

1 Extended Abstract

The excess solar X-ray radiation during solar flares causes an enhancement of ionization in the lower ionospheric D-region and hence affects sub-ionospherically propagating Very Low Frequency (VLF) radio wave signal amplitude and phase. VLF signal amplitude and dynamic phase perturbation (ΔA) and amplitude time delay (Δt) (also the corresponding solar X-ray as measured by GOES-15) of several VLF transmitters such as NWC/19.8 kHz, VTX/18.2 kHz etc. signals have been computed for solar flares. In the first part of the work, using the well-known Long Wave Propagation Capability technique, we simulated the flare induced excess amount of lower ionospheric electron density profile by amplitude perturbation method [1]. Unperturbed D-region electron density is also obtained from simulation with the help of the 2-component D-region model and compared with International Reference Ionosphere-model results. Further, in the second part, we compute the corresponding 'sluggishness' through ionospheric time delay and effective electron recombination coefficient (α_{eff}) analysis [1]. We find that while the time delay is anti-correlated with the flare peak energy flux (ϕ_{max}) which is independent of solar zenith angle values [2, 3].

References

- [1] Basak, T., Chakrabarti, S. K., Effective recombination coefficient and solar zenith angle effects on low-latitude D-region ionosphere evaluated from VLF signal amplitude and its time delay during X-ray solar flares, *Astrophysics and Space Science*, **348**, 315–326, 2013.
- [2] Basak, T., Chakrabarti, S. K., Pal, S., Global effects on Ionospheric weather over the Indian subcontinent at sunrise and sunset, *AIP Conf. Proc.*, **1286**, 137-149, 2010.
- [3] Basak, T., Sasmal, S., Chakraborty, S., Chakrabarti, S. K., Quantitative modeling of lower ionospheric response during solar X-ray events: a propagating radio wave simulation approach, (to be submitted), 2018.