

## Remote sensing and in-situ observations of ionizing effects of energetic electrons in the ionosphere

*Suvorova A. V.\*<sup>1</sup>*

<sup>1</sup> *Moscow State University*

Continuous observations by LEO satellites such as NOAA/POES, DMSP and ESA/MetOp showed that sudden enhancements of fluxes of the >30 keV electrons often occur outside the SAA region. Since the electrons were observed below the ERB in the forbidden zone the phenomenon was called as an enhancement of forbidden energetic electrons (FEE). In our previous studies, it was shown that the occasional penetrations of electrons with energy of tens of keV from the Earth's radiation belt (ERB) to altitudes below 800 km are one of the important sources of direct ionization of the ionosphere at low latitude. The conclusion was obtained from analysis of simultaneous local observations of the FEE enhancements and increases of total electron content from few TEC to tens of TEC using remote sensing techniques of global ionospheric maps (GIM) and GNSS radio occultation (RO). In the present study we combine in-situ and remote sensing measurements of ionospheric ionization using, respectively, the CINDY instrument onboard the C/NOFS satellite and RO vertical profiles of electron density acquired from the COSMIC/FORMOSAT-3 satellites to demonstrate the ionizing effect of the energetic electrons in the ionosphere.

**Keywords:** ionospheric ionization, radio occultation, GNSS, energetic electrons