

RELATIONSHIP BETWEEN ABSOLUTE LUMINOSITY OF TLEs AND CHARACTERISTICS OF VLF/ELF WAVES

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ABSTRACT

TLEs in the upper and middle atmosphere, such as sprites, elves and jets would cause significant heating and ionization of the atmosphere. In order to examine their chemical and electromagnetic effects on the atmosphere quantitatively, it is essential to measure the spectral characteristics of TLEs with absolute scales. However, on the ground observations atmospheric attenuation that is unstable and strongly dependent on the wavelength prevent us to obtain the true spectral information. Therefore, spacecraft is the ideal platform to install the well-calibrated optical equipments. ISUAL instruments onboard ROCSAT-2 satellite provided us the first opportunity to measure the absolute spectral characteristics of TLEs with sufficient high time resolution. The array photometer (AP), one of three ISUAL instruments, is an application of multi-anode photomultiplier tube to space use, which measures absolute luminosity with 16 FOVs at two wavelength ranges, namely, 360-470 nm covering N2 2nd Positive and N2 1st Negative and 520-750 nm covering N2 1st Positive and N2 Meinel. The intensity ratio of those two colors reflects the energy distribution of electrons produced in the TLEs by electric field. Also, the absolute luminosity would be a function of currents and/or electric field. ISUAL already observed about 100 and 700 events for sprites and elves, respectively. On the other hand, a ELF network consisting of three observation sites, that is, Syowa in Antarctica, Onagawa in Japan and ESRANGE in Sweden, is working 24 hour basis at a sampling rate of 400Hz. This facility enables us to collect charge moment information for most of the strong lightning, which could generate sprite events. Furthermore, we employed VLF receivers installed at two sites in Japan and at one site in ESRANGE to investigate characteristics of lightning discharge phenomena related to the TLEs as well as to locate these lightning. Combining the optical data in space and the VLF/ELF recordings on the ground, we examine the quantitative relationship between the absolute optical intensities and characteristics of electromagnetic pulse and/or charge

moment in detail for the first time. The generation mechanisms of sprites/elves inferred from the results are also discussed.