Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

PEM07-01 Room:213 Time:April 30 14:15-14:30

Introdution to GLIMS mission

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The Global Lightning and sprIte MeasurementS (GLIMS) on the International Space Station (ISS) is a mission to detect and locate optical transient luminous events (TLEs) and its associated lightning simultaneously from the non-sun synchronous orbit, and was launched successfully in July, 2013 as part of the multi-mission consolidated equipment on Japanese Exposure Module (JEM). Our mission goals are to identify temporal and spatial evolutions of lightning and TLEs and to clarify the occurrence conditions of TLEs and global occurrence locations and rates of TLEs from the nadir observation. To achieve these goals, two CMOS cameras, six Photometers, VLF receiver, and VHF interferometer with two antennas, are installed at the bottom of the module to observe the TLEs as well as causative lighting discharges at nadir direction during day and night time. Though the luminous events so-called sprite, elves and jets have been investigated by numerous researchers all over the world based mainly on the ground observations, some important problems have not been fully understood yet such as generation mechanisms of columniform fine structure and horizontal offset of some sprites from the parent lightning discharges. In the JEM-GLIMS mission, observations from our synchronized sensors are going to shed light on above-mentioned unsolved problems regarding TLEs as well as causative lighting discharges.

The optical instruments are two CMOS cameras (LSI-1, LSI-2) and six-channel spectrophotometers (PH1 - PH6). The FOV of LSI is 28.3 deg. x 28.3 deg., and LSI-1 (LSI-2) equips a 766-832 nm wide band filter (a 762+/-7 nm narrow band filter). Each PH channel equips the optical band-pass filter, and these photometers measure the N2 1P, N2 2P, N2 LBH, and N2+ 1N emissions of lightning and TLEs. The radio receivers consist of one VLF receiver (VLFR) and two sets of VHF receivers (VITF). In order to detect TLE-associated whistler waves, VLFR employs a nadir-directing monopole antenna and an electronics unit recording waveform data with a sampling frequency of 100 kHz with 14-bit resolution. VITF consists of two patch-type antennas separated by 1.5 m and an electronics unit, and VITF mainly observes VHF pulses in the frequency range of 70-100 MHz excited by lightning discharges with a sampling frequency of 200 MHz with 8-bit resolution.

JEM-GIMS was successfully launched and transported to the ISS by the H-II Transfer Vehicle (HTV) No.3 cargo transporter at the end of July 2012, and started its operation from December 2013. So far, more than one thousand events were recorded. In this presentation, mission history and overview will be given as an introdution.

Keywords: Lightning, Sprite, ISS

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Estimating lightning characteristics by spaceborne spectrophotometric observation

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The present study analyzes satellite optical data to evaluate the effectiveness of spaceborne spectrophotometric measurement in characterizing properties of lightning flash. The main data analyzed here are those obtained by FORMOSAT-2/ISUAL limb observation and ISS/GLIMS nadir observation. While ISUAL spectrophotometer observes optical emissions of 150-280, 316, 337, 392, 762, 600-900 nm at a sampling rate of 10 kHz, GLIMS observes emissions of 150-280, 337, 762, 600-900, 316, 392 nm at a rate of 20 kHz. These data for the first time derive fine spectral and temporal properties of lightning emission observed from space. By analyzing the ISUAL optical data and ground-based radio data, we found that spectral intensity ratio is a new parameter to discriminate intra-cloud (IC) and cloud-to-ground (CG) lightning discharges: the blue/red intensity ratio of CG strokes tends to be lower than that of IC pulses. We also found similar tendency in GLIMS lightning events. A case study showed that the color of lightning turned to red when a very bright impulsive emission, which is consistent with a ground return stroke, occurred. These results consistently suggest that the color of CG component is redder than that of IC component, and we explain this as a result of the Rayleigh scattering which effectively attenuates blue light emissions in the case of light sources located at lower-altitudes such as CGs. Using this technique, we will further examine the lightning characteristics on a global level, focusing on latitudinal dependences and land/ocean contrast for example.

Keywords: lightning, CG, IC, satellite, remote sensing