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

PEM07-P01 会場:3 階ポスター会場 時間:4 月 30 日 18:15-19:30

国際宇宙ステーション搭載 GLIMS ミッションにより観測された雷関連電磁気現象に関する研究
VLF subionospheric disturbances and electrical properties of lightning discharges observed by JEM-GLIMS mission

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In this paper we report the preliminary results of ionospheric perturbation and causative lightning discharges observed by JEM-GLIMIS mission to study the electromagnetic coupling mechanism between the tropospheric lightning and overlaying ionosphere. Continuous nadir optical observations of lightning discharges are performed by ISS JEM-GLIMS mission and many lightning images have been observed globally. Ionospheric perturbations and electrical properties of causative lightning discharges such as polarity and vertical charge moment changes are derived by the data from UEC's ground-based observation networks of VLF/LF transmitter signal reception and of ELF waveforms respectively. We discuss the electrical coupling efficiencies from the tropospheric lightning to the ionosphere by comparing the area of the lightning flash and corresponding subionospheroic VLF disturbances and lightning properties.

キーワード: 中間圏発光現象, 雷放電, GLIMS, 電離層擾乱, 電荷モーメント
Keywords: Transient Luminous Events, lightning discharges, GLIMS, ionospheric perturbation, charge moment

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雷放電による静電場変化の多地点観測ネットワークの構築
The building of multipoint measurement network for observing electrostatic field changes caused by lightning discharge

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It’s not easy to understand the developing process of thunderstorm only with existing meteorological measurements because of its small spatial scale (less than an order of 1 km) and rapid change of the complicated structure. Electrostatic field under the thundercloud or its predecessor reflects the distribution of electrical charges, which is the result of frictions between ice crystal and hail due to strong vertical wind inside the thundercloud. If we measure the vertical electric field at multipoints on the ground, we could estimate the 3 dimensional distribution or the changes of the distribution of electrical charges, from which we may know the detailed development of thunderstorm. The traditional equipment for atmospheric electrostatic filed measurement is filed-mill sensor, which costs an order of 1 M JPY. In order to increase the number of observing stations, we should reduce the price of the instrument. Here we introduce a thunderstorm observation campaign, carried out in mountain area of Yamanashi prefecture, August 2013.We developed new plate-type electric filed sensor, which costs about 0.2 M JPY or less including recording device and battery for one site.This sensor was placed at seven locations in every 4 km with recording system and GPS clock.As a result, we succeeded to record the electrostatic field changes at the same time in multi points, which occured due to lightning strikes for three days.

キーワード: 雷放電, 静電場, 多地点観測
Keywords: lightning discharge, electrostatic field, multipoint measurement

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Preliminary results of global lightning study by the DEMETER satellite
Preliminary results of global lightning study by the DEMETER satellite

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We investigate statistical property of global lightning activity by means of the DEMETER satellite. The DEMETER satellite which was launch by CNES, France, was operated from 2004 to 2010. In the study, we use electric field data to measure Whistler waves generated by lightning. In this presentation, we show preliminary results of this study.

キーワード: 電離圏, 雷, ホイスラー
Keywords: Ionosphere, Lightning, Whistler waves

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JEM-GLIMS による雷放電から放射される VHF 帯電磁波観測
VHF lightning observations by digital interferometry on JEM-GLIMS

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Global Lightning and sprIte Measurements (GLIMS) mission is now ongoing on Exposed Facility of Japanese Experiment Module (JEM-EF) of the International Space Station (ISS). This paper focuses on an electromagnetic (EM) payload of JEM-GLIMS mission, very high frequency (VHF) broadband digital InTerFerometer (VITF). JEM-GLIMS mission is designed to conduct comprehensive observations with both the EM and the optical payloads for lightning activities and related transient luminous events (TLEs) expecting to give us many scientific impacts to the field.

VITF consists of two sets of antennas, band-pass filters, amplifiers, and 2-channel-AD-converter. Impulsive EM radiations received by the antennas are digitized by the AD converter synchronizing with another channel through the filters and the amplifiers. A patch type antenna is developed within the size of 200∗200 mm. It is mounted on the antenna base made of aluminum alloy and Teflon block with the total height of 100 mm to gain its bandwidth and to reduce the interference from other structural objects. The same two units of antennas are installed with the separation of 1.6 m. Their bandwidths with the higher return loss than -3 dB are from 70 to 100 MHz. The signals received by the antenna are transmitted along cables with the same lengths to the electronics. The AD converter records 130 waveforms as maximum of one dataset with the duration of 2.5 μs with 200 MS/s. The developments of VITF are based on the heritage of VHF sensor on Maido-1 satellite.

JEM-GIMS mission payload was successfully launched at the end of July 2012, and transported and installed to the ISS. After the initial checkout and maintenance, its nominal operation is continued from December 2012. Through the operation period, VITF corrects numerous VHF EM data synchronized with optical signals. About 650 VITF datasets were obtained in January and February 2013, for instance. The estimations of the EM direction-of-arrival (DOA) are attempted using the broadband digital interferometry. Some results agree with the optical observations, even though DOA estimation has difficulties caused by its very short baseline of the antennas and multiple pulses in short time, namely burst-type EM waveforms. VITF is designed expecting to estimate the DOA with about 10 km resolution that is equivalent to the scale of a thundercloud. The results on narrow bipolar pulses (NBPs) and/or transionospheric pulse pairs (TIPPs) are also expected as well as TLEs. The recorded VHF EM signals and the results of their DOA estimations, and the comparisons with optical observations will be introduced in the presentation.

Keywords: lightning, VHF radio observations, GLIMS, International Space Station