

VHF Lightning Observations on JEM-GLIMS Mission

MORIMOTO, Takeshi¹, KIKUCHI, Hiroshi^{1*}, USHIO, Tomoo¹, SATO, Mitsuteru², SUZUKI, Makoto³, YAMAZAKI, Atsushi³

¹Osaka University, ²Hokkaido University, ³ISAS/JAXA

Global Lightning and sprItE MeaSurements (GLIMS) mission is scheduled on Exposed Facility of Japanese Experiment Module (JEM-EF) of the International Space Station (ISS). This paper introduced an electromagnetic (EM) payload of JEM-GLIMS mission, VHF broadband digital InTerFerometer (VITF) as well as our gradual approach to realize space-borne lightning monitoring by means of EM observations.

To realize a space-borne VHF broadband Digital InTerFerometer (DITF), Lightning Research Group of Osaka University (LRG-OU) intends to have gradual approach for the development. As the first step, LRG-OU has installed Broadband Measurement of Waveform for VHF Lightning Impulses (VHF sensor) on Maito-1 satellite to examine the feasibility of the space-borne DITF receiving VHF lightning impulses in space. VHF sensor comprises a system to record VHF broadband EM signals. Maito-1 satellite had been launched successfully and operated for 9 months in 2009. VHF sensor conducts 153 sets of lightning observations around the world, and provides its function in space. The results show the clear distinction between over land and ocean as well as the regional dependency in the feature of obtained VHF waveforms.

As the next step JEM-GLIMS mission is ongoing to observe global distributions of lightning and lightning-associated transient luminous events (TLEs) by combining radio and optical sensors. The simplest DITF, which consists of a pair of VHF broadband antennas and electronics to record EM waveforms from lightning discharges is installed. It is designed to estimate the direction-of-arrival with about 10 km resolution that is equivalent to the scale of a thundercloud. It means that VITF is able to monitor thunderclouds with lightning activities globally. Comprehensive observations with the optical payloads of JEM-GLIMS for lightning activities and related TLEs are expected to give us many scientific impacts. The developments of VITF are based on the heritage of VHF sensor on Maito-1 satellite.

After the designing and manufacturing, various environmental tests such as vibration, impact and thermal vacuum tests were conducted as well as electrical tests. It is developed on the heritage of VHF sensor on Maito-1 satellite and is scheduled to start observations in 2012. It is the first platform to realize the simplest DITF and synchronous observations with optical sensors.

Keywords: lightning observations, electromagnetic wave, transient luminous event, the International Space Station