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Author: Mr. Yusei Honjo  
Nihon University, Japan

Dr. Masahiko Yamazaki  
Nihon University, Japan  
Prof. Masashi Kamogawa  
University of Shizuoka, Japan  
Mr. Ryoma Miura  
Nihon University, Japan

## DEVELOPMENT OF E-FIELD/PLASMA HYBRID MEASUREMENT PAYLOADS FOR CUBESAT

**Abstract**

In recent years, the extensive damage caused by earthquakes has highlighted the need for enhanced disaster prevention and mitigation measures. Although conventional long-term forecasts estimate seismic activity over a span of several years, these predictions are not always sufficient to substantially reduce human and economic losses. Consequently, short-term forecasts—based on precursor phenomena thought to arise weeks to hours before an earthquake—have garnered growing interest. Since the 1980s, there have been numerous reports of ionospheric fluctuations observed prior to earthquakes. DEMETER, a 100 kg-class small satellite operated by CNES in France from 2004 to 2010, confirmed a phenomenon in which the intensity of 1.7 kHz electromagnetic waves decreased near the epicenter within four hours before earthquakes of magnitude 4.8 or greater. However, the physical mechanisms remain insufficiently understood, necessitating high sampling-rate and multi-point observations. Against this backdrop, Nihon University and the University of Shizuoka are developing "PRELUDE", a W6U-sized (226 mm x 100 mm x 366 mm) CubeSat intended to capture fluctuations in VLF-band electromagnetic waves. Central to this mission is a 3U-sized (113 mm x 100 mm x 366 mm) hybrid sensor unit integrating an electric field sensor (double-probe method) and a plasma sensor (Langmuir probe method). This approach enables the incorporation of instruments equivalent to the DEMETER ICE and ISL probes into a CubeSat platform. By leveraging a common principle—measuring the satellite-referenced local electric potential—the sensor unit employs an extendable boom that spans 1.5 m on each side, achieving a total length of 3.4 m including the satellite chassis. This compact, foldable design allows the payload to fit within the limited space of a CubeSat. In this presentation, we outline the design of what may be the world's first integrated electric field and plasma measurement sensor for a CubeSat, along with ground-test evaluation results. PRELUDE, carrying this proposed payload, has been selected for JAXA's (Japan Aerospace Exploration Agency) Innovative Satellite Technology Demonstration-4 program and is scheduled for launch in FY2025. By focusing on measurement accuracy and boom deployment characteristics, we will demonstrate its potential to advance short-term earthquake forecasting capabilities.