植生ライダMOLIの概要
Overview of Vegetation Lidar MOLI

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Under the PARIS AGREEMENT (Adopted at COP 21 in 2015), each country, including developing countries, is obliged to declare its emissions, but an objective verification method was considered necessary from the perspective of credibility and accuracy. It is said that one of the largest errors today is in the evaluation of CO_2 absorption by forests. Regarding the assessment of forests as a CO_2 absorption source, biomass and the change of biomass observed. We propose the use of airborne and satellite-mounted LIDAR as an effective method of directly measuring tree height. JAXA has begun studying the space vegetation LIDAR mission using the Multi-footprint Observation Lidar and Imager (MOLI) in collaboration with scientists. The main objective of this mission is to globally and precisely measure canopy height from space for improving biomass estimation. MOLI is designed to be mounted on the Exposed Facility (EF) of the Japanese Experiment Module on the International Space Station (ISS). The mission requirements for MOLI were set through discussions with scientists, and are listed as follows:

1. MOLI measures canopy height globally with accuracy of ±2 m (for canopy height less than 20 m) or ± 10% (for canopy height above 20 m) so as to generate map data of canopy heights and biomass, combined with imagery data from other satellites. The measurement data are also used as inputs or for validation in carbon cycle models.

2. Simultaneously, MOLI also measures the vegetation index and vegetation phenology for generating more accurate map data of canopy height and biomass.

3. MOLI measures the average amount of carbon per sub-national-scale area (80 km grid) to an uncertainty level of 20% or less (95% confidence interval).

The system requirements for MOLI are set based on the mission requirements. Regarding the waveform generated by the Geoscience Laser Altimeter System (GLAS) installed in the ICESat. However, waveforms with a lower S/N (less than 10) were excluded from analysis, as it greatly reduced the accuracy of canopy height measurement. Based on this result, the S/N requirement of MOLI was set to 10 or more, and the measurement precision of canopy height reached ±2 m or 10 %.

The tilted ground causes significant errors in measuring the canopy height due to the difference in height of the ground in the footprint. MOLI must be able to detect the inclination of the ground in order to estimate the difference in height of the footprint ground. Thus, MOLI must have a multi-footprint to estimate the tilt of the ground surface by detecting the time lag of each footprint.

Since MOLI needs to acquire data on vegetation phenology and vegetation index at the same time as the LIDAR observation to generate map data, it also has an optical imager with multiple bands. Using the imager, MOLI also measures the canopy height to identify the trees observed by MOLI for ground

verification. The imager GSD is 5m. The imager also has green, red and NIR bands for measuring vegetation phenology and vegetation index.

To realize the sampling design, it is necessary to irradiate two laser beams and receive two reflection signals with the array detector. We considered dividing the laser beam into two laser beams by using an optical system. Based on this method, one laser transmitter is attached and the pulse energy is 40 mJ

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