Overview of MOLI data product
(MOLI: Multi-footprint Observation Lidar and Imager)

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1. Mission instruments: MOLI

MOLI consists of two aligned nadir-viewing Lidar and Imager.

Lidar can measure time-series intensity of reflected light from the ground within laser footprint. Time lag between pulses is equivalent to distances. Imager data consists of 3 bands image. These bands are Green (550-630nm), Red (640-720nm) and NIR (740-880nm), respectively.

2. Standard products of MOLI

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3. Lidar product (Waveforms)

Waveforms can be acquired from each footprints.

The waveforms of MOLI are 12-bit, and 500Mmps which corresponds to 30cm height resolution.

Each footprint position will be determined in an accuracy of about 10m (tentative).

3. Lidar product (Tree canopy heights / Forest biomass)

**Tree canopy heights**

The tree canopy height is calculated by the time lag between the first pulse (pulse from the top of tree) and the last pulse (pulse from the ground surface).

**Parameter fitting such as Gaussian**

**First pulse**

**Tree canopy height**

**Last pulse**

**Forest biomass**

Forest biomass will be estimated via tree canopy heights because forest biomass has a good correlation with tree canopy heights. Forest biomass will be also estimated by waveforms directly, and this method is also being studied.

⇒ We will adopt either method which is more accurate, or we will switch the two methods depending on a situation.

The details will be presented by Dr. Hayashi, NIES
3. Lidar product (Multi-footprints)

- A slope ground causes a significant error in canopy height measurement because of the ground height difference in a footprint.
- MOLI has multi-footprints to estimate the slope angle of the ground surface by detecting the time lag of each footprints.

4. Imager product

- Spatial resolution: 5m
- Swath: 1km
- Imager bandwidth:
  - Band1: 550 - 630 nm (Green)
  - Band2: 640 - 720 nm (Red)
  - Band3: 740 - 880 nm (NIR)
- SNR: ≥50 at each bands
- Geometrically corrected with GCP (Ground Control Point) (Characteristic topography, artificial structures, and so on)
5. Integrated product with Lidar and imager

Imager data within a Lidar footprint are able to be associated with Lidar data. MOLI can make integrated products, which is tree canopy heights / forest biomass map with 1km width. The details are presented by Mr. Sawada, NIES

There are 10-13 full pixels of imager in each Lidar footprints.

6. Wall-to-Wall map product

- It is impossible to observe all land surface by MOLI because MOLI measures only nadir angle.
- Fusion analysis with other satellite data is necessary for making Wall-to-Wall map products.

The details will be presented by Prof. Kajiwara.

MOLI can make products with only 1km width by itself. (Blank region occurs between ISS orbits.)

Fusion analysis with other satellite data will make it possible to make Wall-to-Wall map product. Candidate satellites are GCOM-C/SGLI, ALOS-2/PALSAR-2, and so on.
7. Product distribution

Data amount of waveforms is not so large compared to that of general imager, and the imager of MOLI has only 200 pixels. Therefore, data amount of MOLI is not so large, and MOLI requires no specific system for data storage and distribution in the ground systems at present.

Users

MOLI data providing system (Such as G-Portal)
7-8TB / year

Level 3 Wall-to-Wall map
(Negligible amount)

Level 2 Integrated products
around 2TB / year

Level 2 Lidar
Tree canopy heights, Forest biomass
(Negligible amount)

Level 2 Integrated products
Tree canopy heights, Forest biomass (1 km swath)

Used for adding uncertainty to Wall-to-Wall map

Level 3 Wall-to-Wall map
Tree canopy heights, Forest biomass

Level 0 Lidar
Level 0 Imager
5TB / year
Lidar: 2TB / year
Imager: 3TB / year

Level 1 Lidar
Waveforms including geolocation data (10m accuracy)

Level 1 Imager
Image data (geometrically corrected)
3 bands, 5m resolution, 1km swath

Level 2 Lidar
Tree canopy heights

Level 2 Lidar
Forest biomass

Level 2 Integrated products
Tree canopy heights, Forest biomass (1 km swath)

Other satellite products
GCOM-C/SGLI
ALOS-2/PALSAR-2

Level 1 Lidar

Level 1 Imager

Level 2 Lidar

Level 2 Lidar

Level 2 Integrated products

Level 3 Wall-to-Wall map
Summary

• We introduced the overview of MOLI products.
  – L1 Lidar footprint product: Waveforms
    Imager product: Image
  – L2 Lidar footprint products: Tree canopy heights / Forest biomass
    Integrated products with Lidar and imager: Tree canopy heights / Forest biomass
  – L3 Wall-to-Wall map products: Tree canopy heights / Forest biomass

• Details of each products are presented by following session.
  – Dr. Masato Hayashi: Algorithm for MOLI footprint data product
  – Mr. Yoshito Sawada: Modeling of LIDAR and Imager data on MOLI instruments
    – Algorithms for MOLI along-track 1 km-width products –
  – Prof. Koji Kajiwara: Data fusion of MOLI and GCOM-C/SGLI

• We think MOLI requires no specific system for data storage and distribution in the ground systems at present, because data amount of MOLI is not so large.