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

Jan 7, 2016
JAXA
Jumpei Murooka

Contents

JAXA

1. Mission instruments: MOLI
2. Standard products of MOLI
3. Lidar product
4. Imager product
5. Integrated product with Lidar and imager
6. Wall-to-Wall map product
7. Product distribution

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.
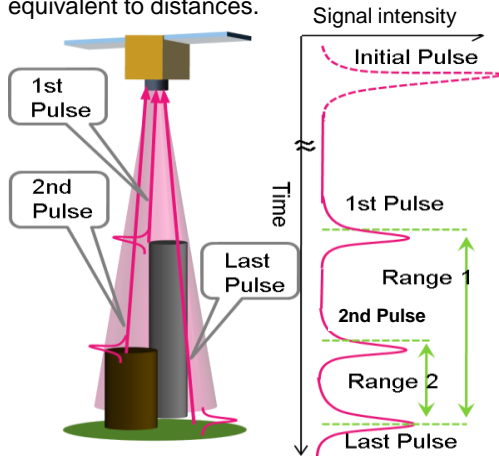
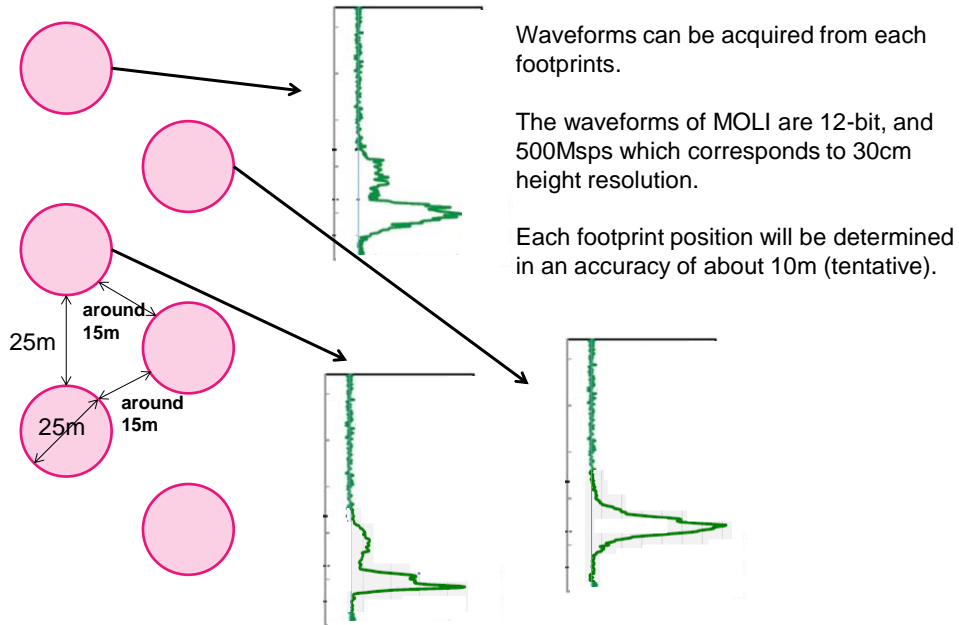Referential RGB image (5m resolution) (Mt. Tsukuba)

2. Standard products of MOLI

Product level	Product category	Products	Remark
L1	Lidar footprint products	Waveforms	including geolocation data
	Imager product (1km swath)	Image	geometrically corrected
L2	Lidar footprint products	Tree canopy heights	including geolocation data
		Forest biomass	including geolocation data
	Integrated products with Lidar and imager (1km swath)	Tree canopy heights	
		Forest biomass	
L3	Wall-to-Wall map products	Tree canopy height map	use for mainly global carbon cycle
		Forest biomass map	

Waveforms can be acquired from each footprints.
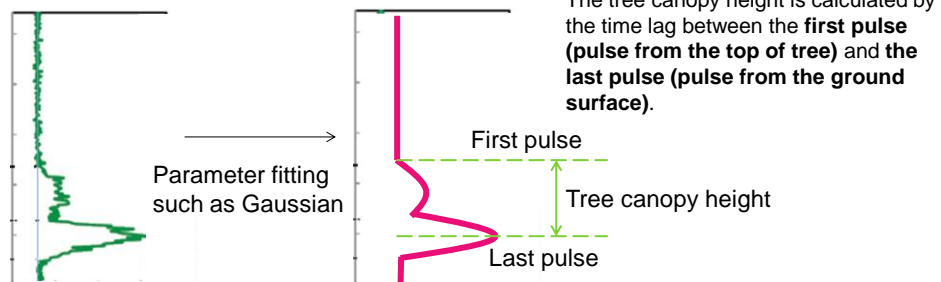
The waveforms of MOLI are 12-bit, and 500Msps which corresponds to 30cm height resolution.

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

around 15m

25m

25m

around 15m

5

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**

6

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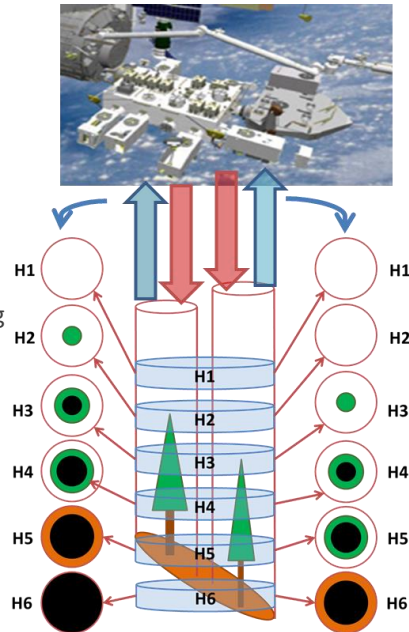
- Spatial resolution: 5m
- Swath: 1km
- Imager bandwidth:
  Band1: 550 - 630 nm (Green)
  Band2: 640 - 720 nm (Red)
  Band3: 740 - 880 nm (NIR)
- SNR: $\geqq$ 50 at each bands
- Geometrically corrected with GCP (Ground Control Point)
 (Characteristic topography,
   artificial structures, and so on)
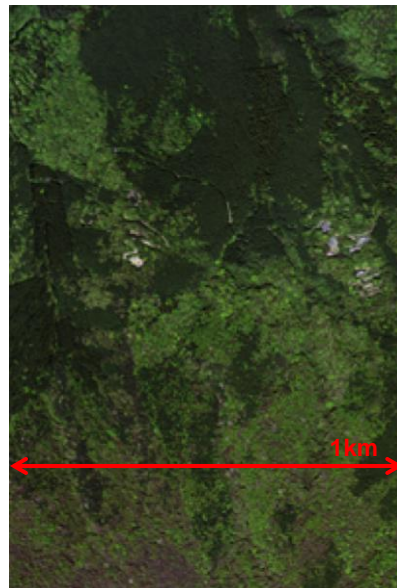
1km

Referential RGB image (5m resolution)
(Mt. Tsukuba)

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**
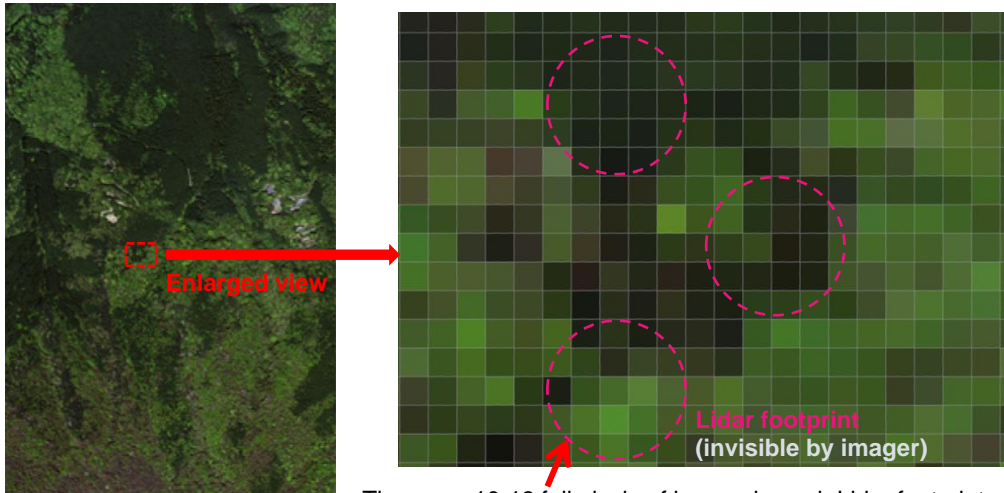
**Referential RGB image (5m resolution)
(Mt. Tsukuba)**

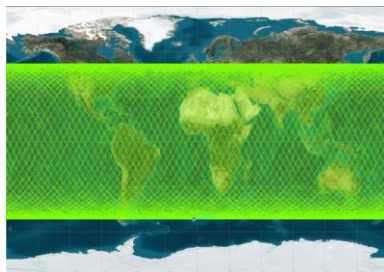There are 10-13 full pixels of imager in each Lidar footprints.

9

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.
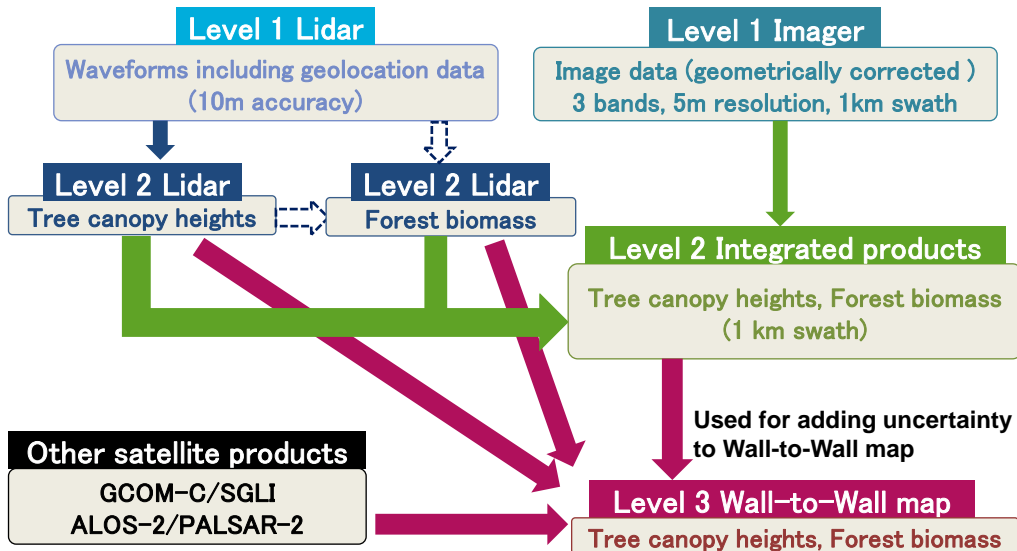(Blank region occurs between ISS orbits.)

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.

10

Products flow overview

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)

**Used for adding uncertainty
to Wall-to-Wall map**

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

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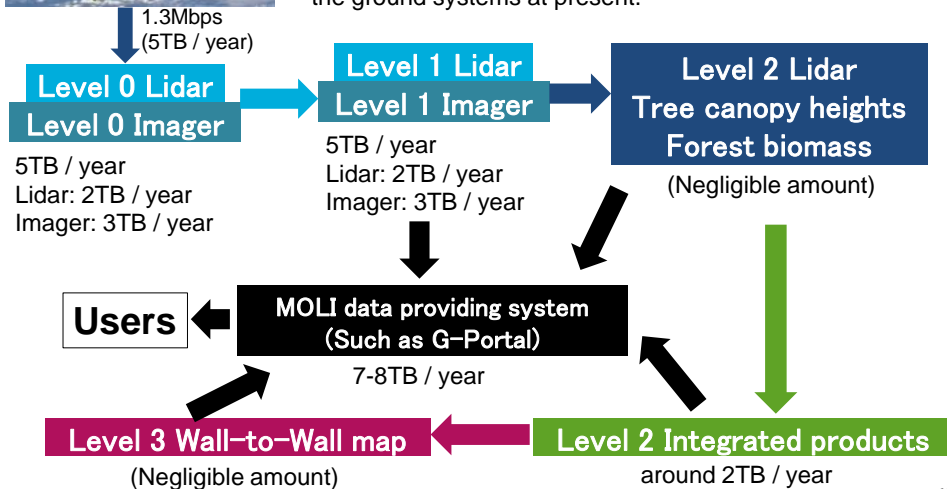Tree canopy heights, Forest biomass

11

---

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.

1.3Mbps
(5TB / year)

**Level 0 Lidar
Level 0 Imager**

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

**Level 1 Lidar
Level 1 Imager**

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

**Level 2 Lidar
Tree canopy heights
Forest biomass**

(Negligible amount)

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

12

- 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.

13

MOLI

森

14