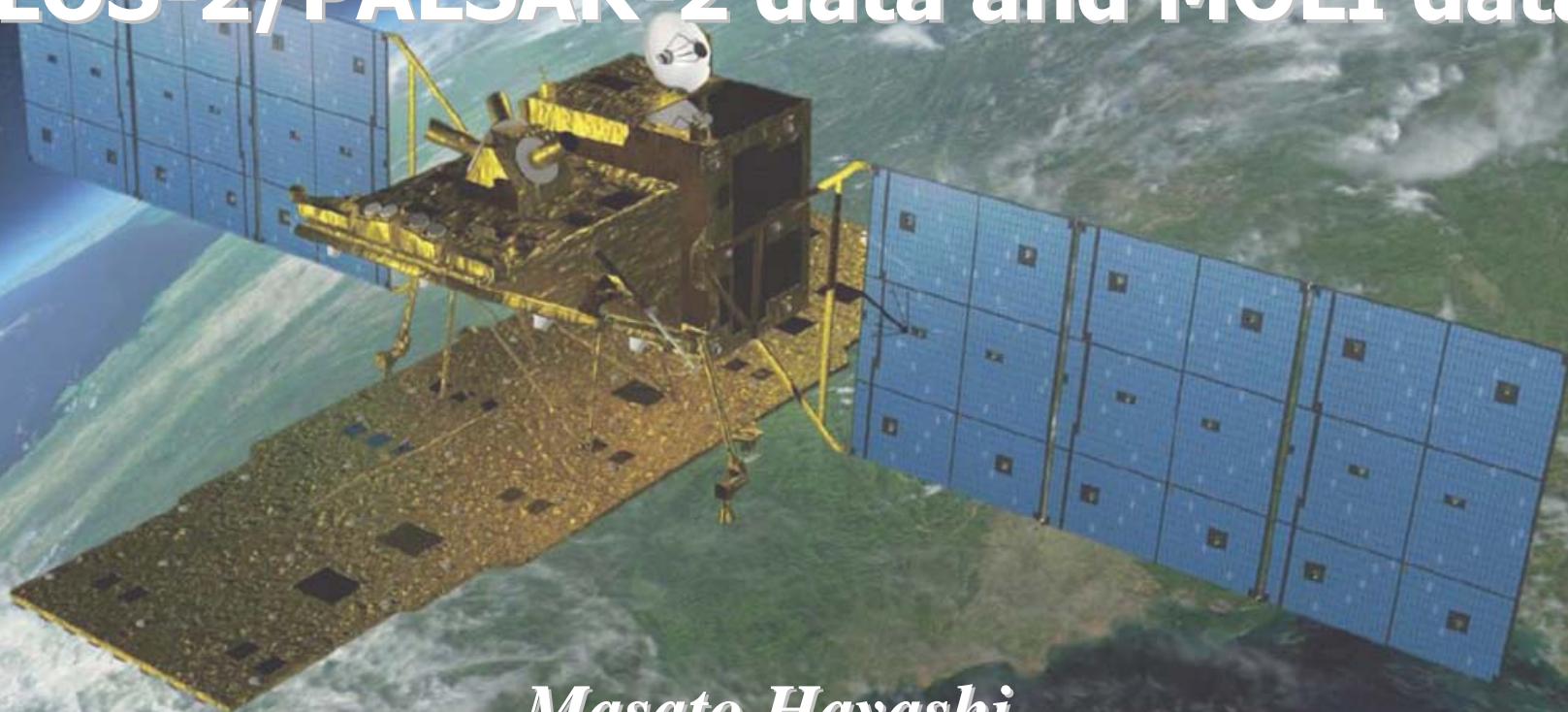


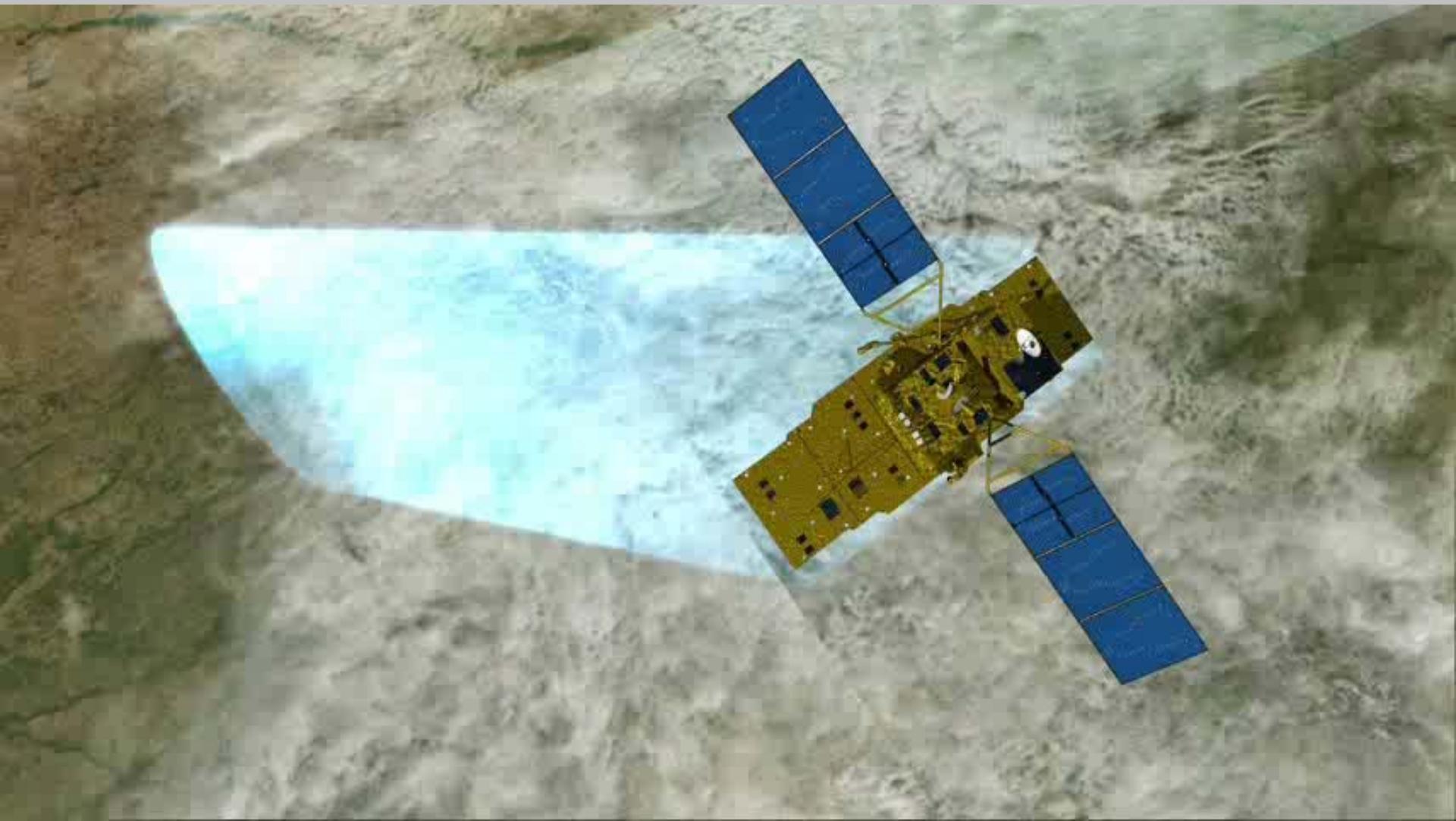
# Data fusion of ALOS-2/PALSAR-2 data and MOLI data



*Masato Hayashi*

*Japan Aerospace Exploration Agency (JAXA)*

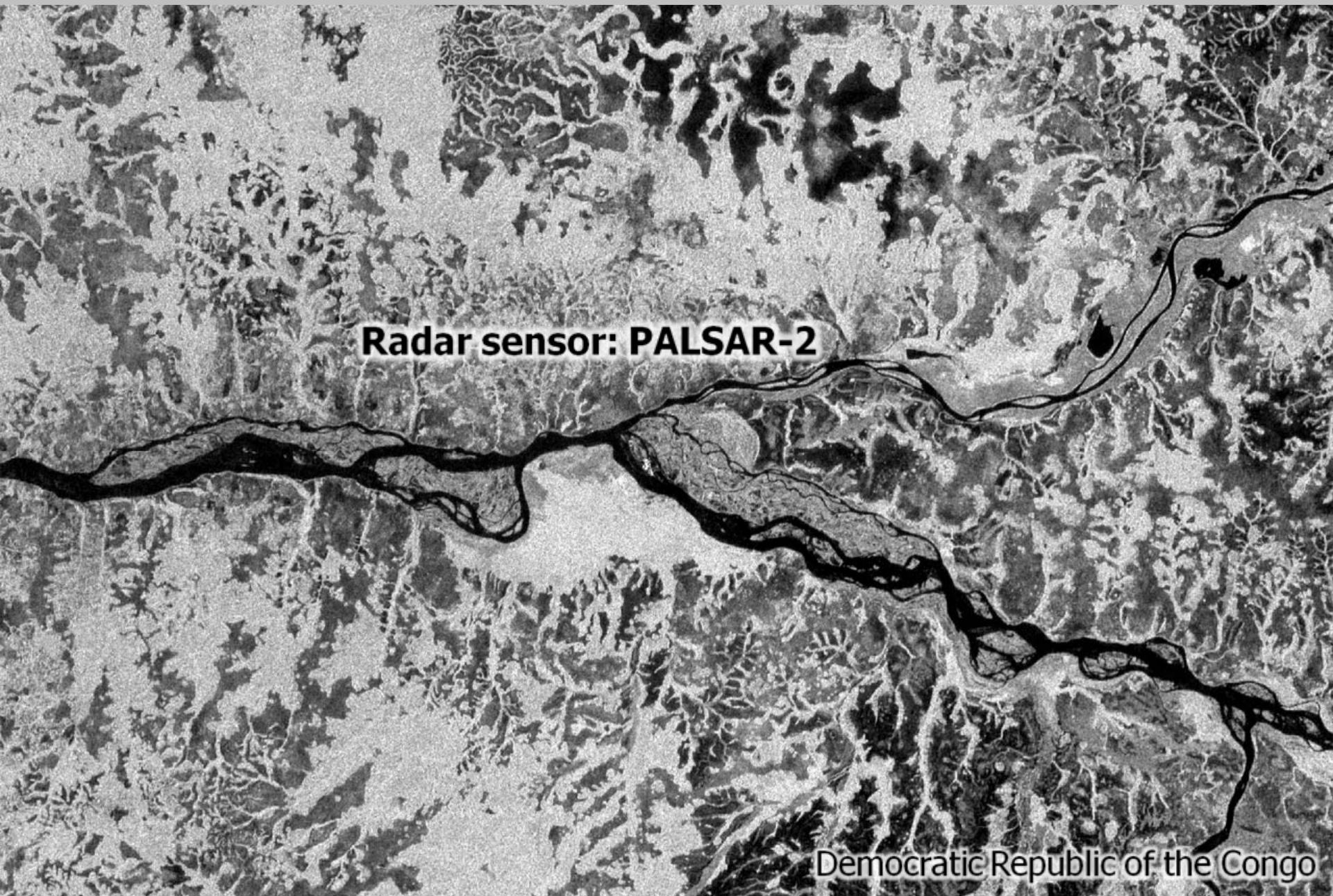
# 1. Advantage of PALSAR-2



**PALSAR-2 uses microwave, which penetrate cloud!**

PALSAR-2 can observe both day and night regardless of cloud cover.

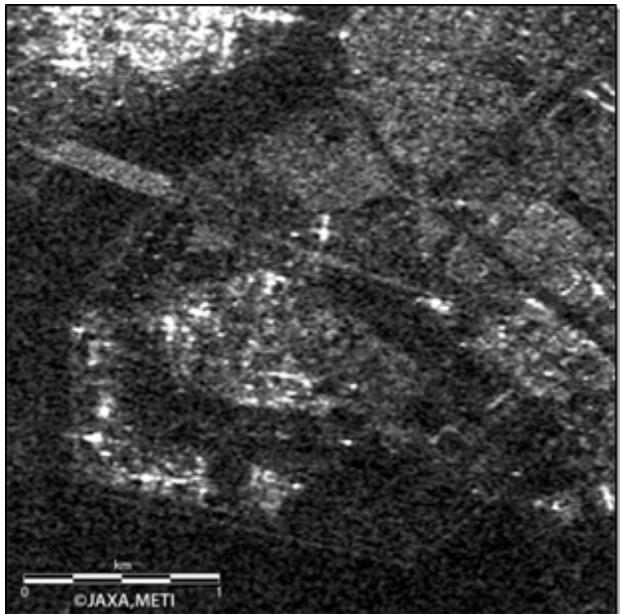
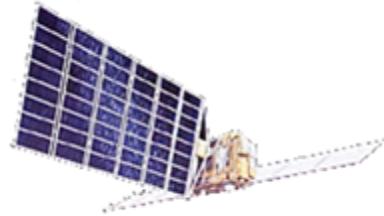
# 1. Advantage of PALSAR-2



Democratic Republic of the Congo

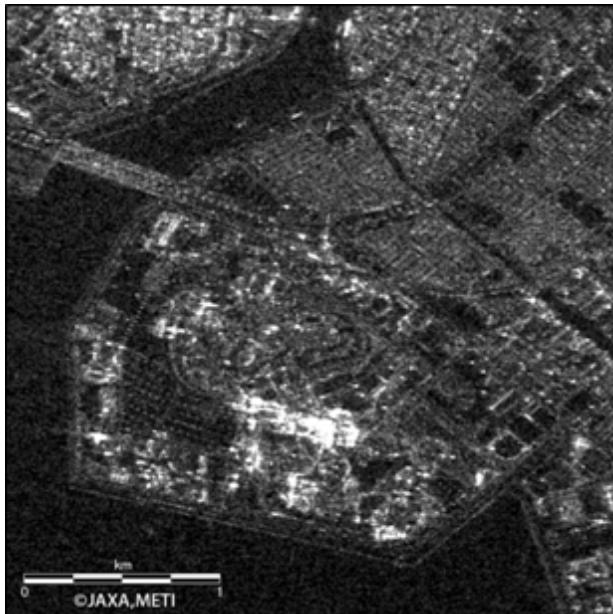
## 2. JAXA's SAR satellites

**JERS-1/SAR**



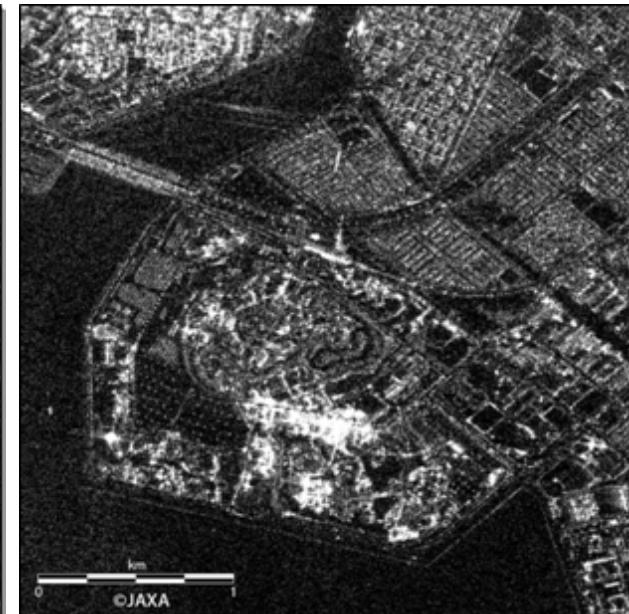
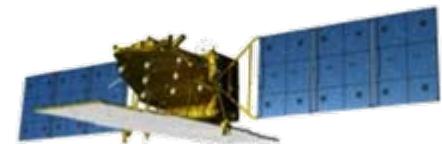
1992 - 1998  
Resolution = 18m

**ALOS/PALSAR**



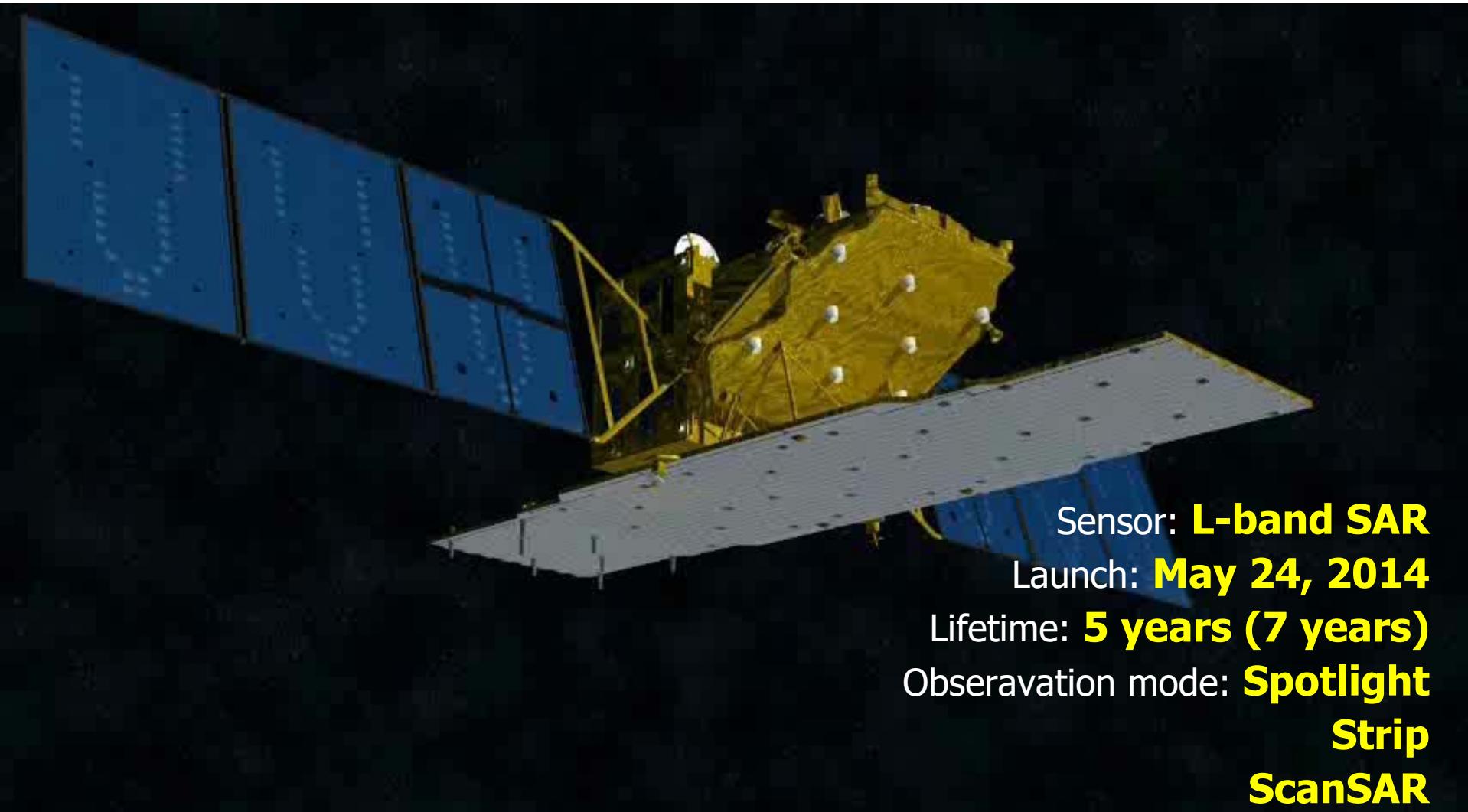
2006 - 2011  
Resolution = 10m

**ALOS-2/PALSAR-2**



2014 –  
Resolution = 3m

### 3. Specification of PALSAR-2



Sensor: **L-band SAR**

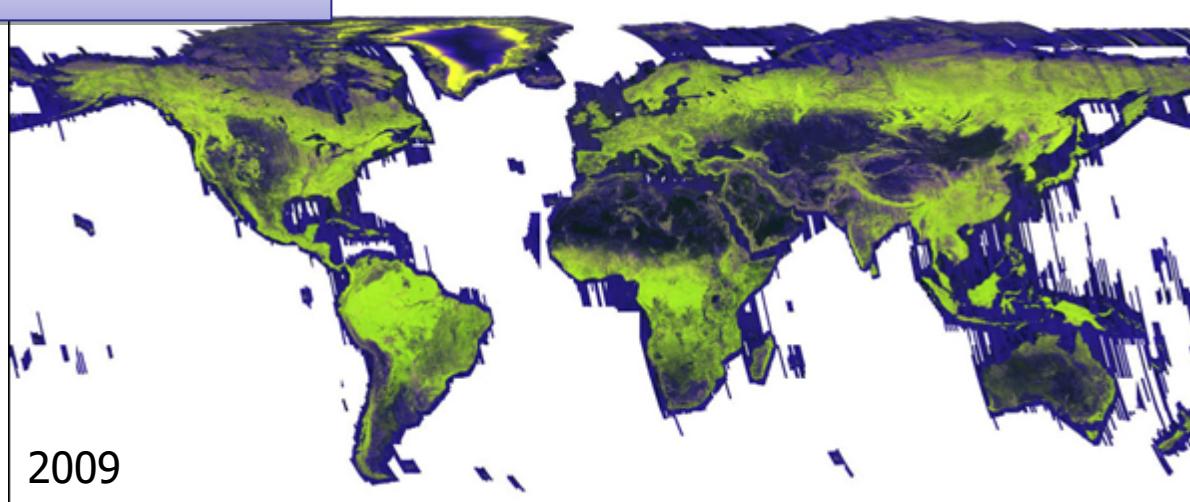
Launch: **May 24, 2014**

Lifetime: **5 years (7 years)**

Observation mode: **Spotlight  
Strip  
ScanSAR**

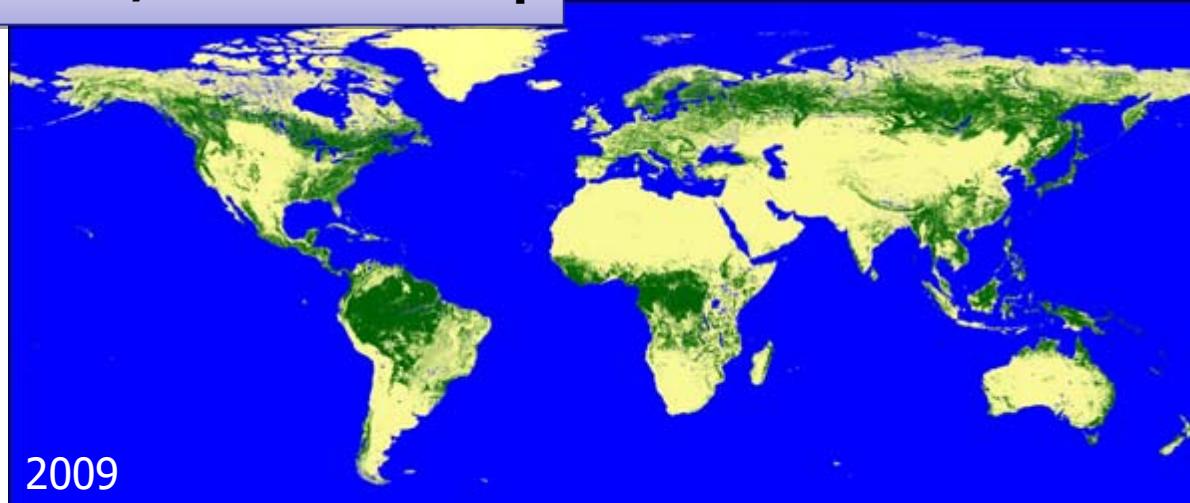
## 4. PALSAR-2 application: Global map

**Global Mosaic**



Resolution = 25m  
Year = 2007, 08, 09, 10, 15  
Polarimetry = HH, HV

**Forest/Non-Forest Map**



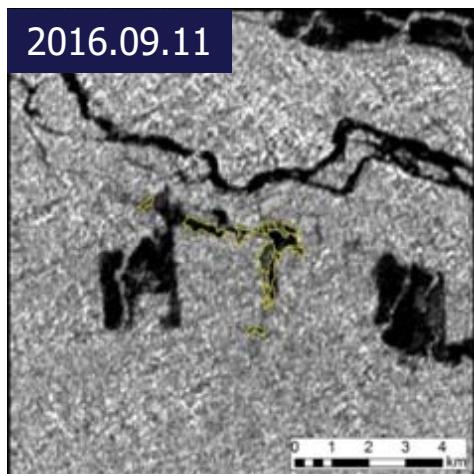
Resolution = 25m  
Year = 2007, 08, 09, 10, 15

# 5. PALSAR-2 application: JJ-FAST

## JICA-JAXA Forest Early Warning System in the Tropics (JJ-FAST)

The screenshot shows the JICA-JAXA Forest Early Warning System in the Tropics (JJ-FAST) web interface. The main feature is a map of Africa with various forest cover change detection results marked by yellow dots. A legend on the left indicates different colors for forest cover change. The interface includes a navigation bar with links for 'Forest cover change map', 'About JJ-FAST', 'Topics', 'Partnership', 'Forest Governance Improvement Initiative', and 'About JICA / JAXA'. On the right, there is a 'UPDATED INFORMATION' section with news items from November 2016, including the opening of the side event at COP21 and the launch of the Forest Governance Initiative. Below this is a 'Updates on data availability on Forest Cover Change Map' section with a history of updates from April 2017 to February 2018.

This screenshot shows a detailed view of a specific deforestation area in Zambia. A callout box displays geographical information: Country (Zambia), State (Eastern), Town (Mambwe), Latitude (51°30'18"), Longitude (E32°8'11"), Change Area (6.1 ha), and Reliability (High). The background is a satellite map of the area, with a yellow rectangle highlighting the specific location. The interface includes a 'Google Map (baseline)' button, a date selector for 'Data Select (1 data)' (set to 2016/09/29-2016/09/30), and a 'Move Next Grid' button.



**Deforestation monitoring system.**  
Released in November 2016.

## 5. PALSAR-2 application: JJ-FAST

<b>Data source</b>	<b>ALOS-2/PALSAR-2</b> (ScanSAR mode)
<b>Target area</b>	About <b>80 countries</b>
<b>Update</b>	Every <b>1.5 months</b>
<b>Characteristics</b>	<ul style="list-style-type: none"><li>- <b>Global coverage</b>: almost all tropical forests.</li><li>- <b>Cloud-cover area observation</b>: even in rain season.</li><li>- <b>Small data traffic</b>: forester can use it in the field.</li></ul>

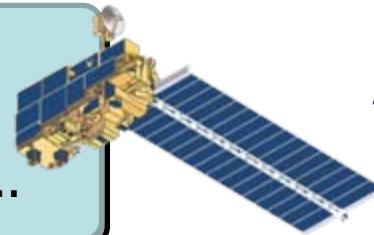
A world map showing the distribution of target countries for the JJ-FAST application. The map highlights several regions in red, including parts of South America (Brazil, Argentina, Bolivia), Africa (Nigeria, Congo, Kenya, Tanzania, Uganda, Rwanda, Burundi, Ethiopia, Somalia, Djibouti, Eritrea, Libya, Algeria, Morocco), and Asia (India, Indonesia, Thailand, Philippines, Vietnam, Laos, Cambodia, Myanmar, Bangladesh, Nepal, Bhutan, Sri Lanka, Maldives). The oceans are shown in light blue, and the outlines of continents and countries are in grey.

**Target countries**

# 6. Expectation for MOLI: Training data

## Image data

**Wide-area** forest observation data from  
Satellite **imager**: PALSAR-2, MODIS, SG...



## Training data

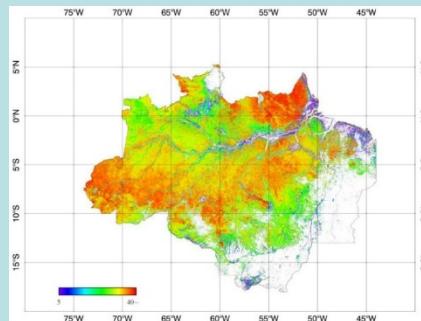
**Accurate** canopy height / biomass data from  
Spaceborne **LiDAR**: MOLI, ICESat, GEDI...



## Machine learning

## Large-scale map

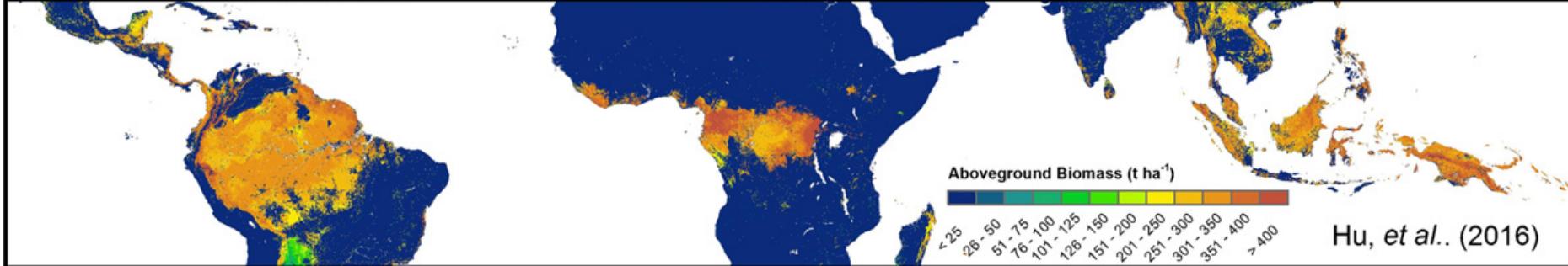
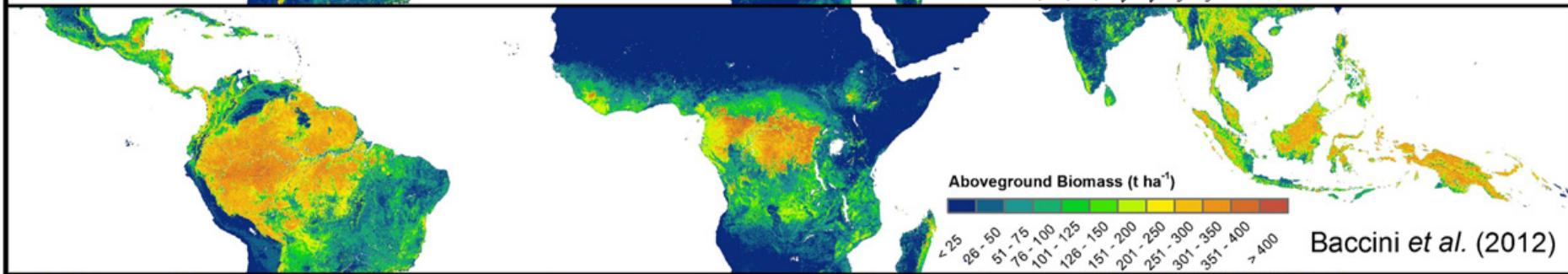
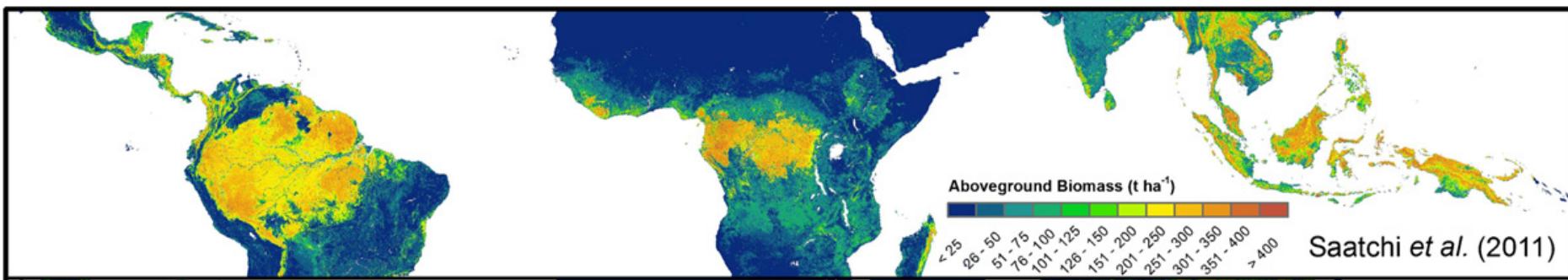
Canopy height / biomass map



[Sawada et al., 2015]

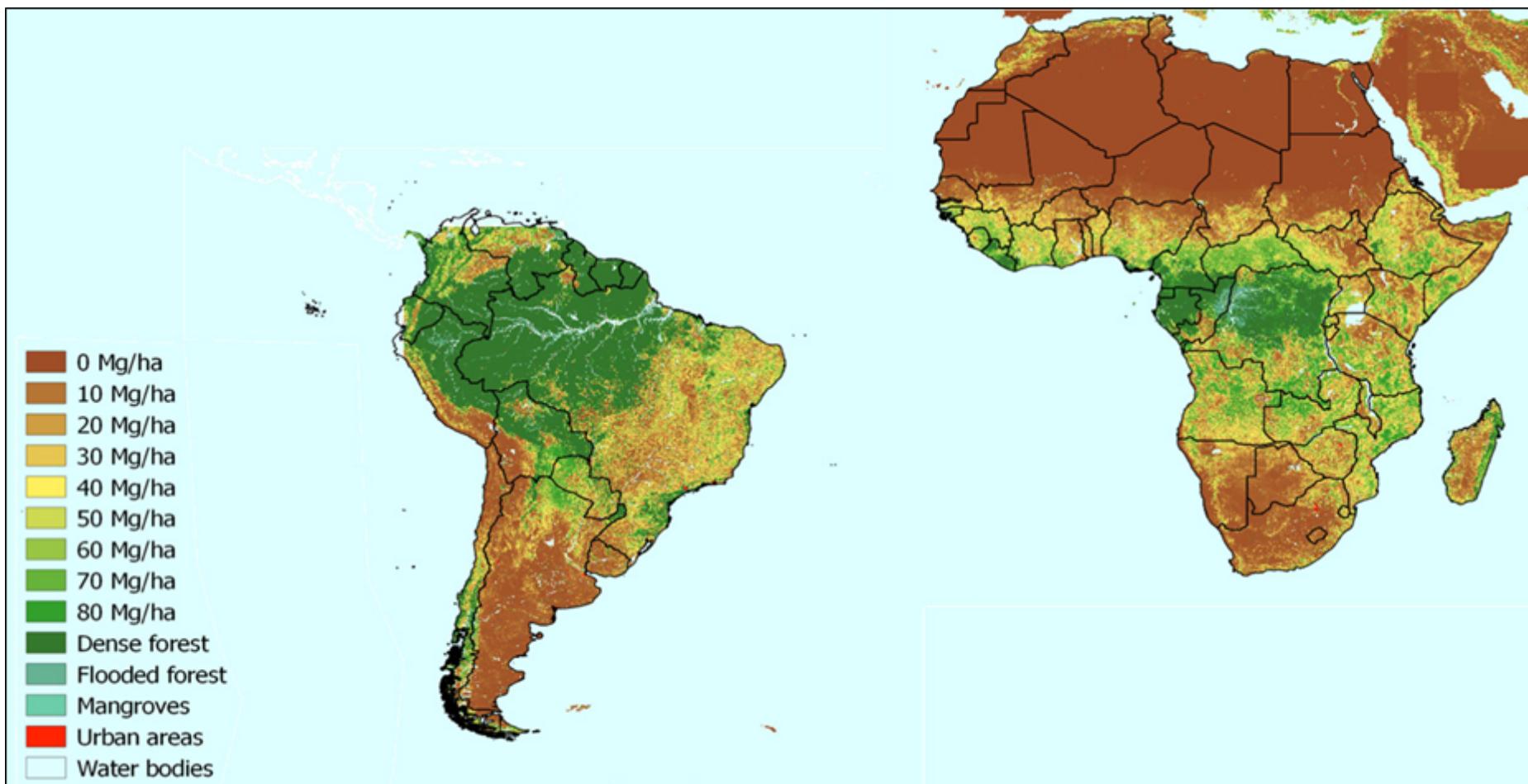
# 6. Expectation for MOLI: Training data

**Global forest maps using ICESat and MODIS data.**



# 6. Expectation for MOLI: Training data

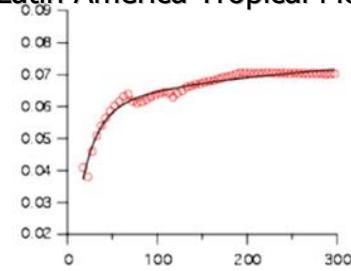
**Global forest map using in-situ and PALSAR data.**



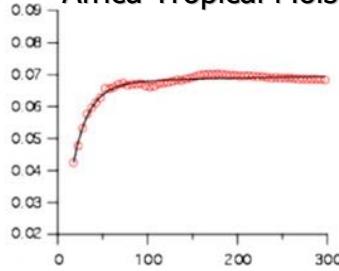
[Le Toan et al., 2017; @K&C meeting]

## 6. Expectation for MOLI: Training data

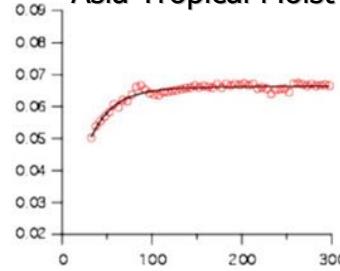
Latin America Tropical Moist



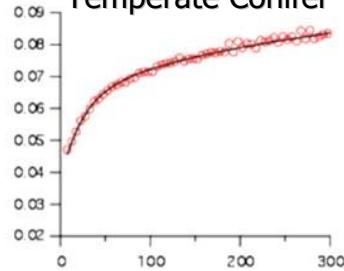
Africa Tropical Moist



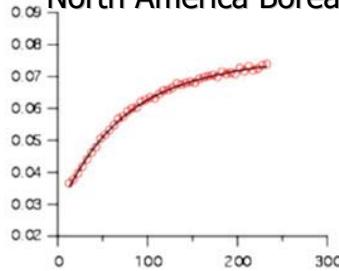
Asia Tropical Moist



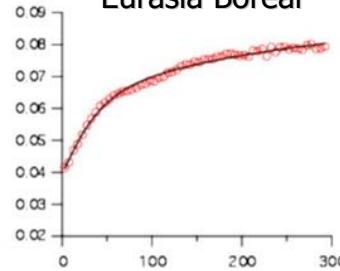
Temperate Conifer



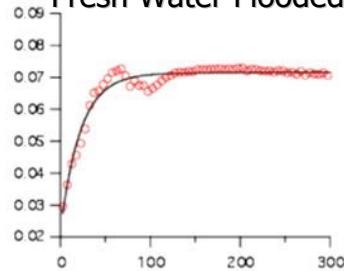
North America Boreal



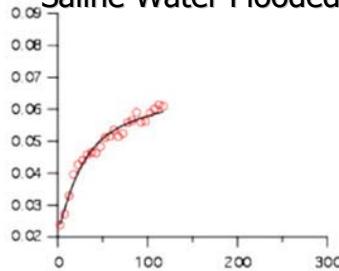
Eurasia Boreal



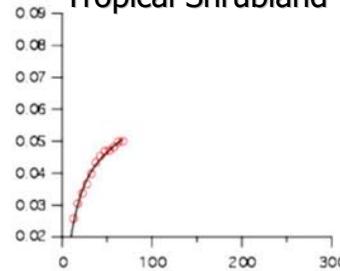
Fresh Water Flooded



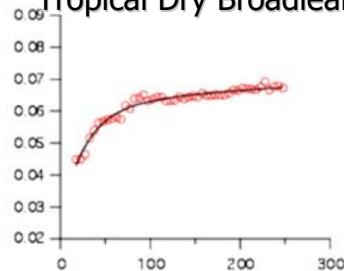
Saline Water Flooded



Tropical Shrubland



Tropical Dry Broadleaf



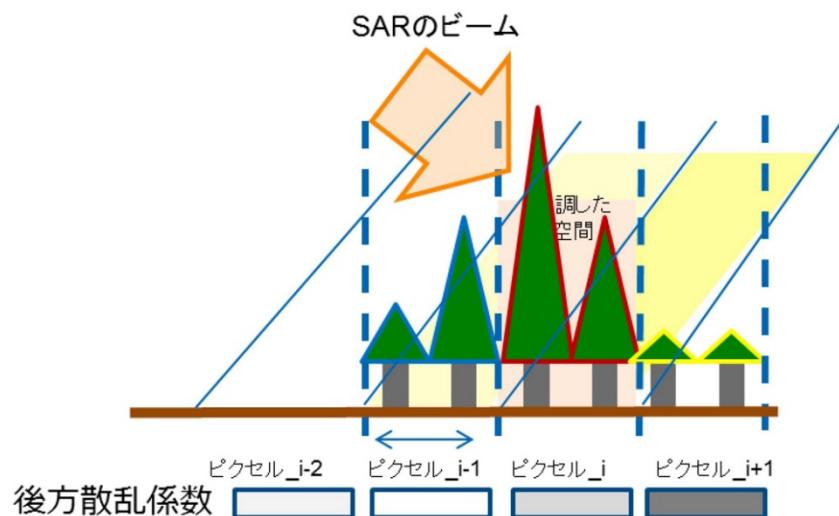
[Yu & Saatchi, 2016]

AGB (Mg/ha)

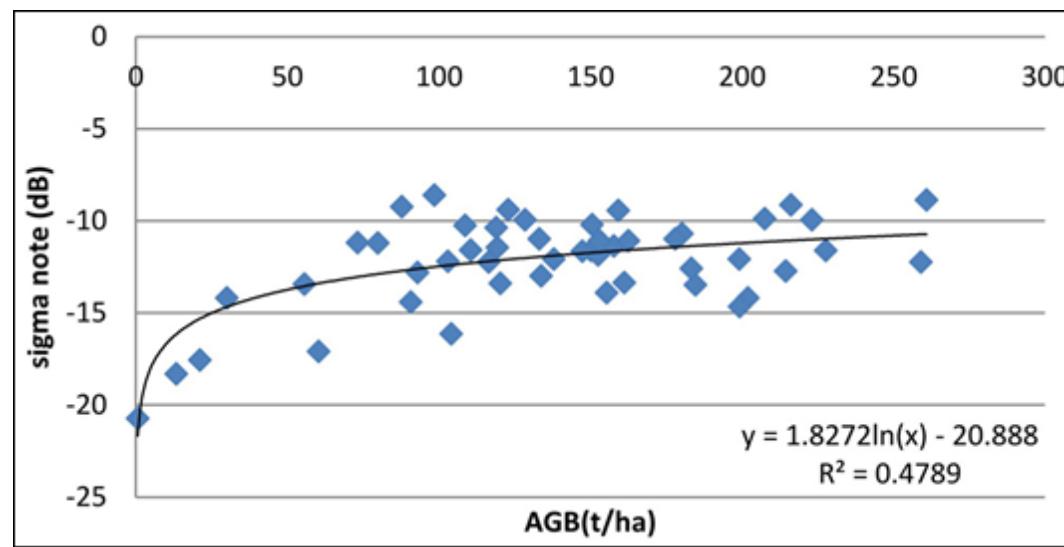
ALOS HV sigma-0 (m^2/m^2)

**PALSAR-2 sensitivity saturates**  
at high biomass forest (> 100 t/ha).

## 6. Expectation for MOLI: Training data

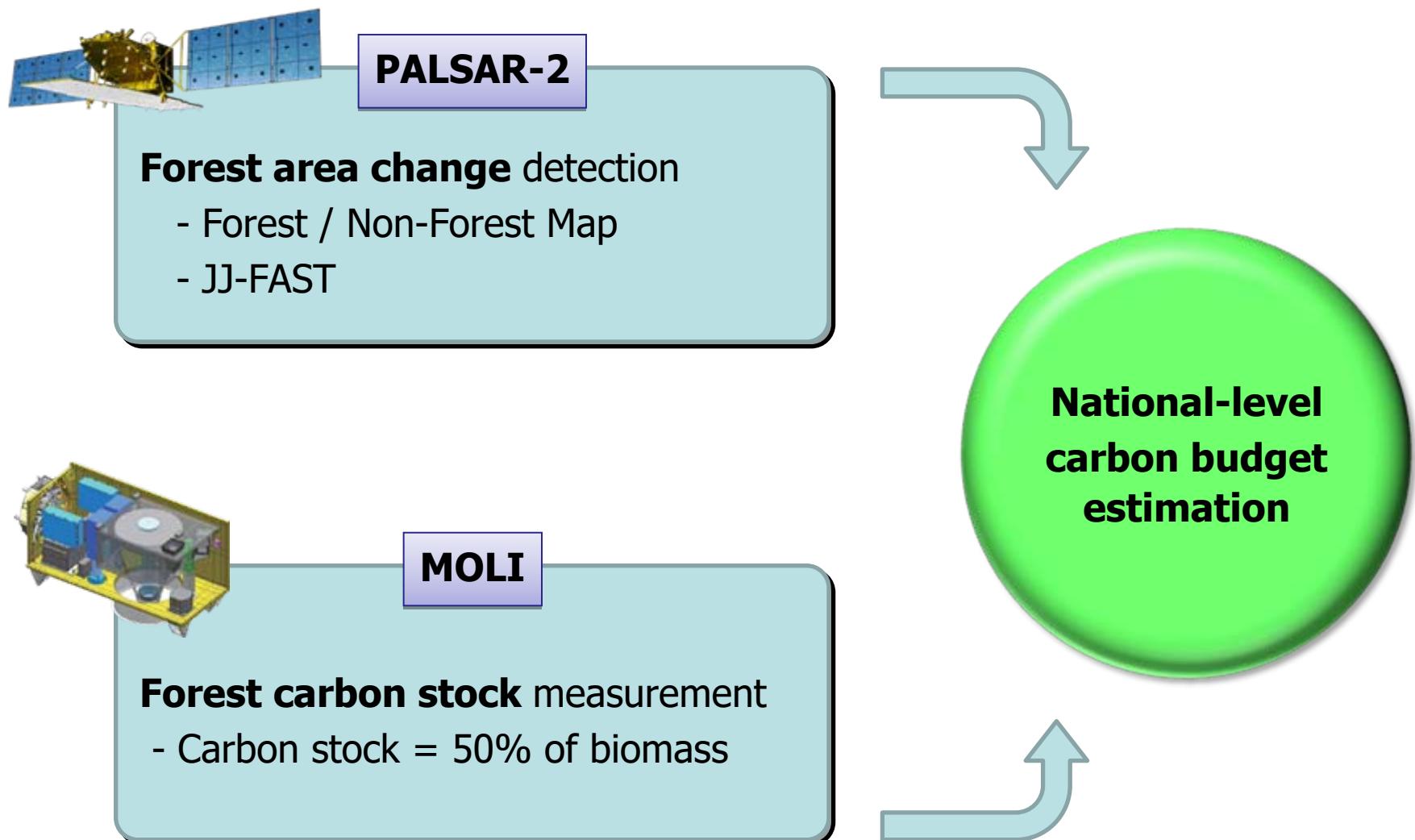


**Improving relationship**  
between PALSAR-2 image and biomass  
using canopy height data.



[RESTEC, 2016]

## 7. Expectation for MOLI: Carbon estimation



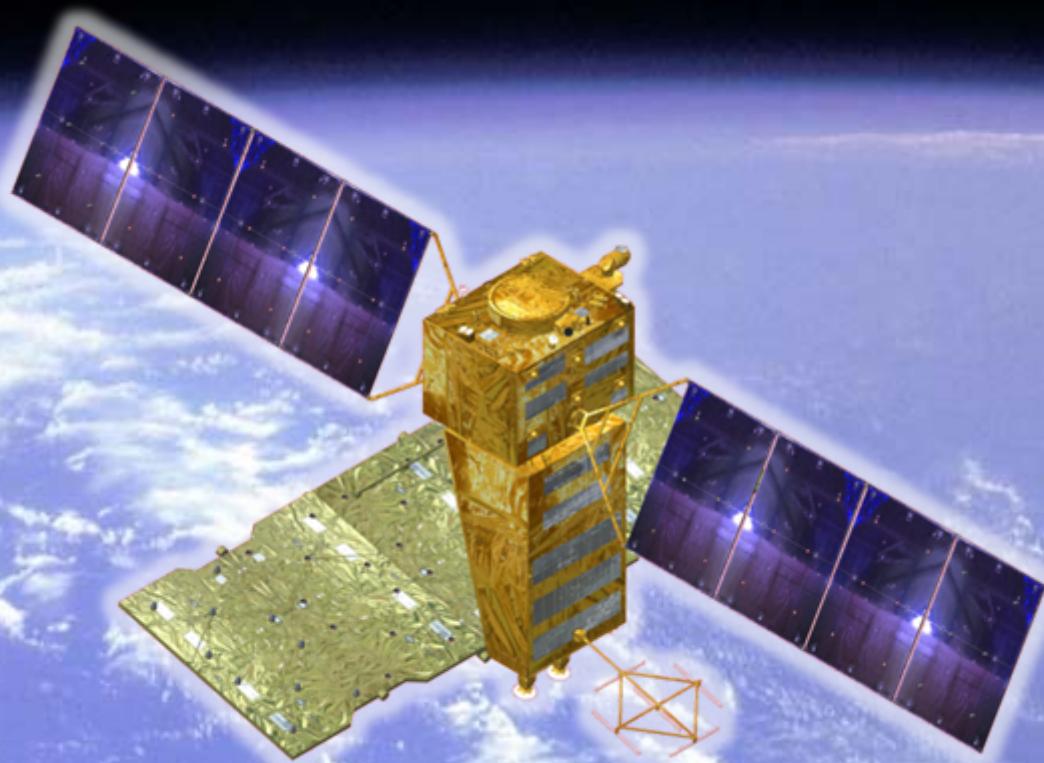
## 9. Conclusion

- 1. ALOS-2/PALSAR-2 acquire cloud-free image, so quite suitable for global-scale forest monitoring.**
- 2. MOLI is expected to provide an accurate training data for a forest biomass map development using PALSAR-2 data.**
- 3. Fusion of PALSAR-2 and MOLI data can provide strong forest monitoring tool.**

**ALOS-2**



## 10. ALOS-2 follow-on mission



**Advanced Radar Satellite: ALOS-4**

Launched in JFY 2020