KC#27 Project Report

JAXA EORC plans for biomass mapping

Masato Hayashi, Osamu Ochiai, Takeo Tadono
Ko Hamamoto, Yuko Nakamura

Japan Aerospace Exploration Agency (JAXA)

K&C Science Team meeting #27
Tokyo, Japan, November 9-10, 2023

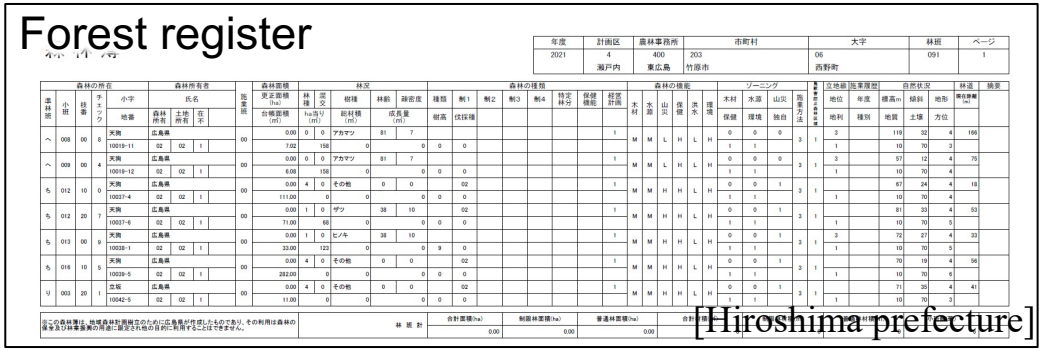
Contents

1. Current status of Japanese forest biomass assessment

- Prefectures manage forests using maps and forest registers by unit of *Shouhan*.
- The information is compiled in Forestry Agency's database and used for UNFCCC reporting.
- Stem volume is calculated based on tree species, age, etc., but accuracy is not sufficient.

Map

Forest register

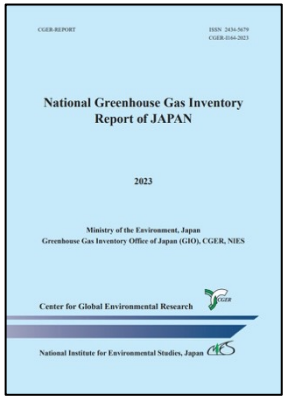


[Hiroshima prefecture]

Prefectural forest management information

[MOE]

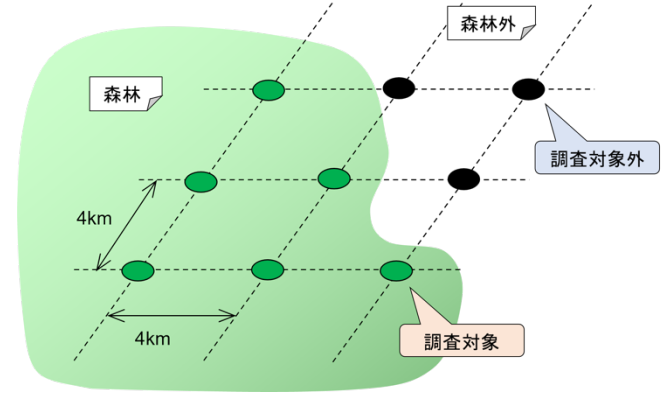
National Forest Resources Database

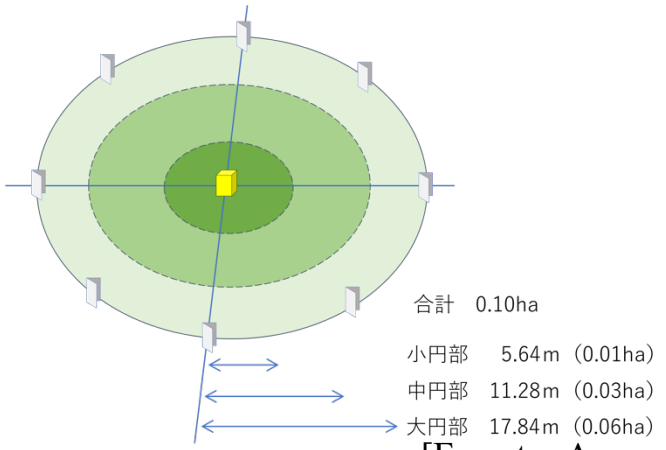


[MOE]

UNFCCC country report

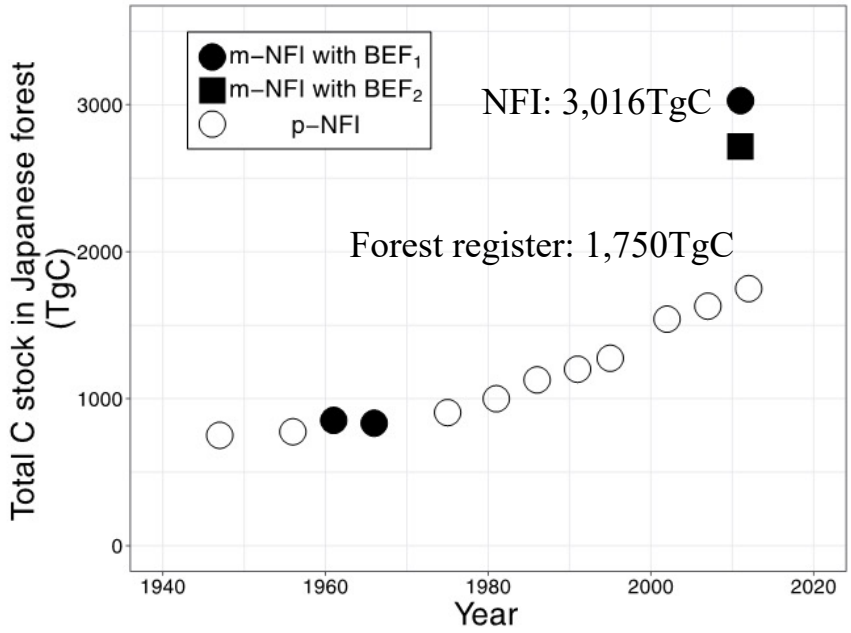
- Forestry Agency's National Forest Inventory has 15,0000 plots of 0.1 ha with 5-year intervals.
- The NFI data showed the forest register data underestimates the forest resources by 58-64%.
- This situation requires accurate forest biomass map of Japan, which is not a sampling survey.





[Forestry Agency]

Japanese National Forest Inventory



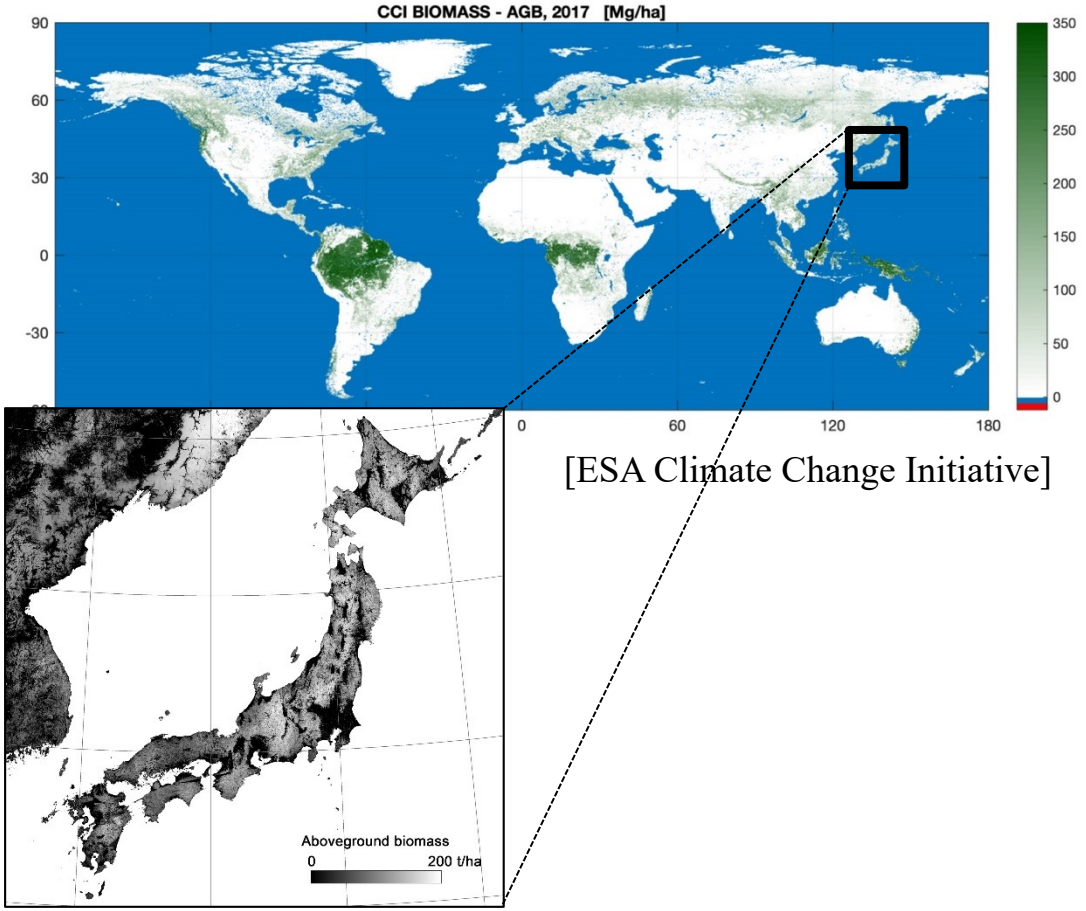
[Egusa et al., 2020]

Comparison of NFI and forest register

2. Issues of global forest biomass map

1. Current status of Japanese forest biomass assessment
2. Issues of global forest biomass map
3. JAXA activities to the present
4. Plans for the Stardust Program
5. Summary

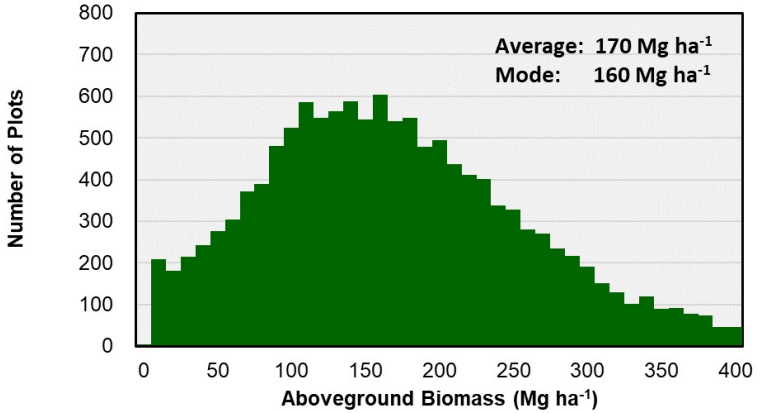
- There is still no forest biomass map covering the whole Japan, except global maps produced by several foreign agencies. The ESA's CCI map is a representative global map, but it underestimates Japan's forest biomass by 70% compared to the NFI data.



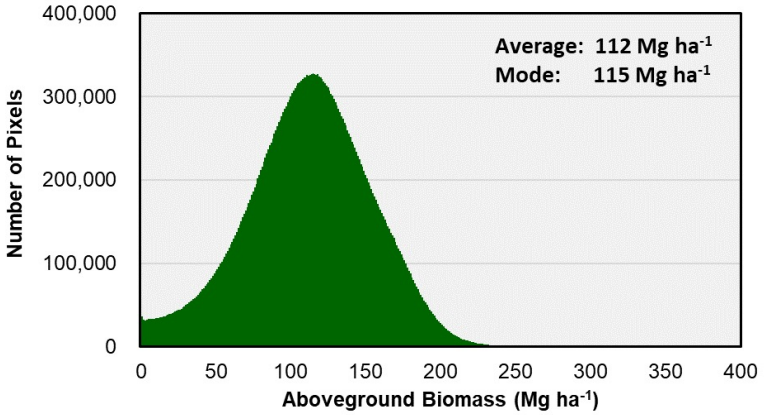
[ESA Climate Change Initiative]

CCI global above-ground biomass map

■ **NFI data (cycle 3)**



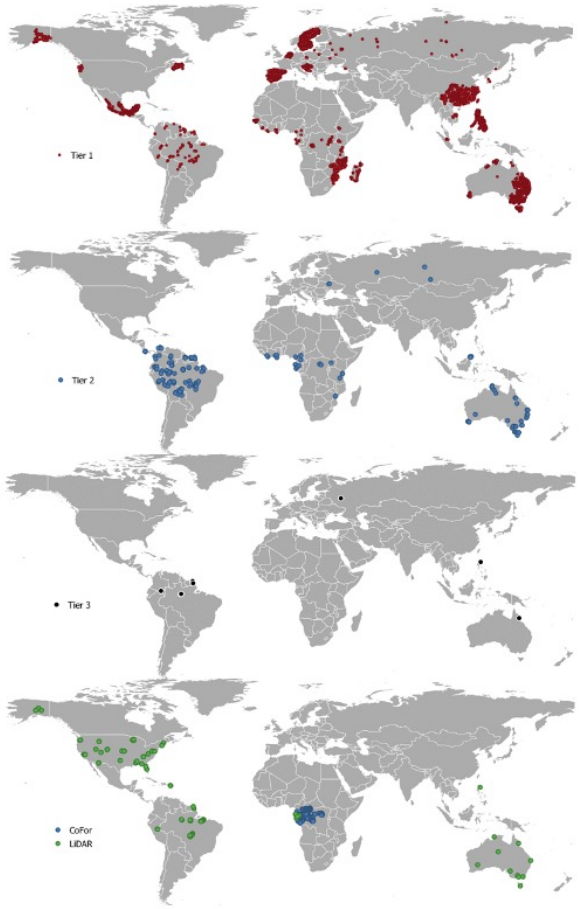
■ **CCI map (ver.3.0)**



Histograms of AGB in Japan

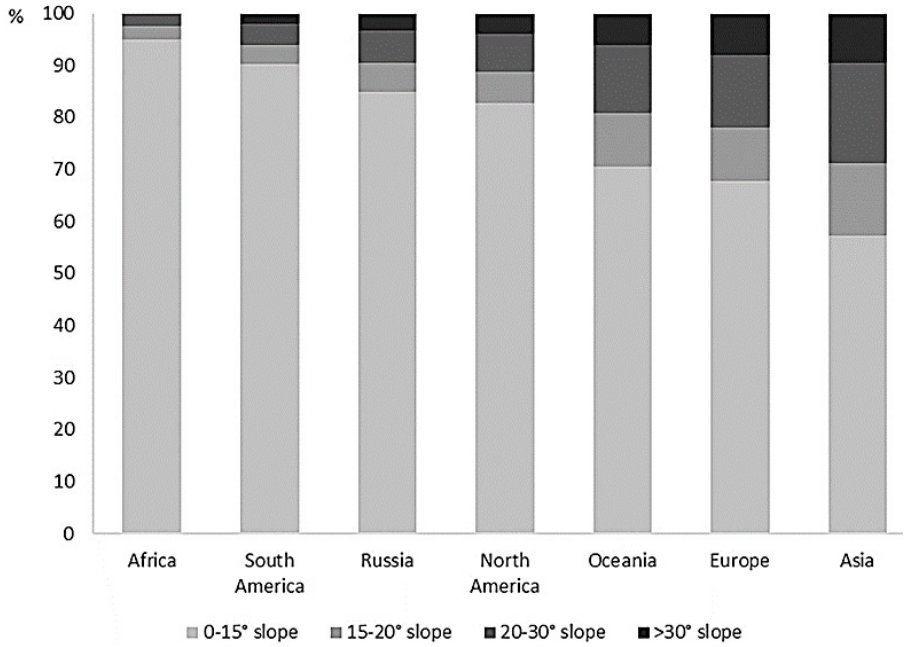
- Issue 1: Spatial deviation of reference data distribution
- Issue 2: Ground slope increases estimation error

  *forest area over 30˚: 9.4% in Asia (Lundbäck et al., 2020), 36.9% in Japan (NFI data)



[ESA CCI]

Reference data of CCI map



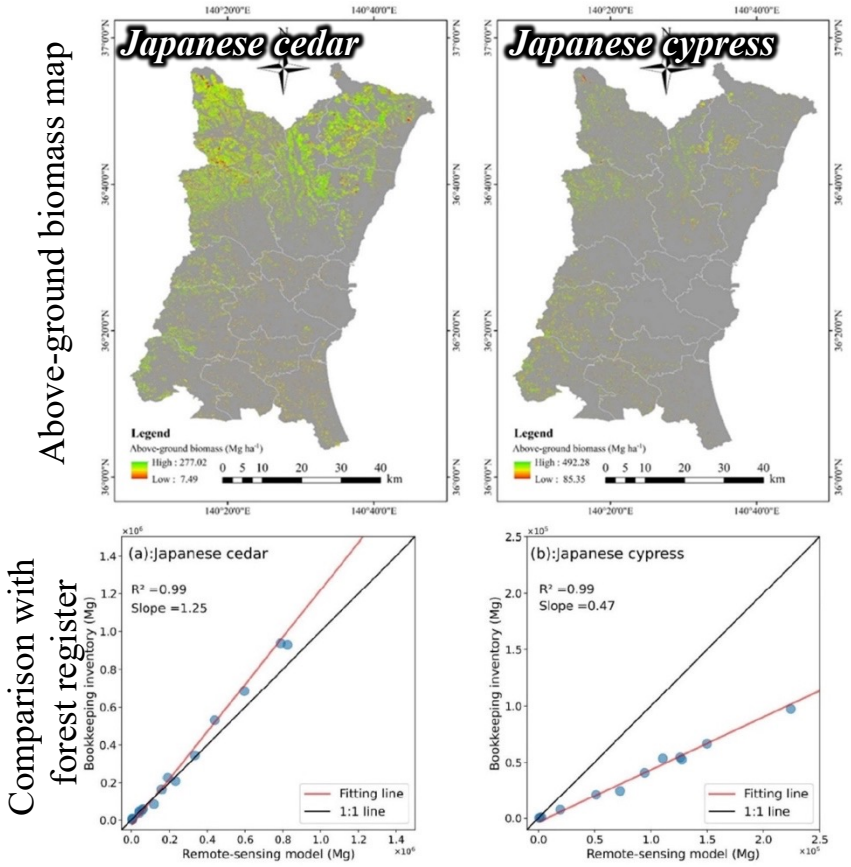
[Lundbäck et al., 2020]

Percentage of slope area

3. JAXA activities to the present

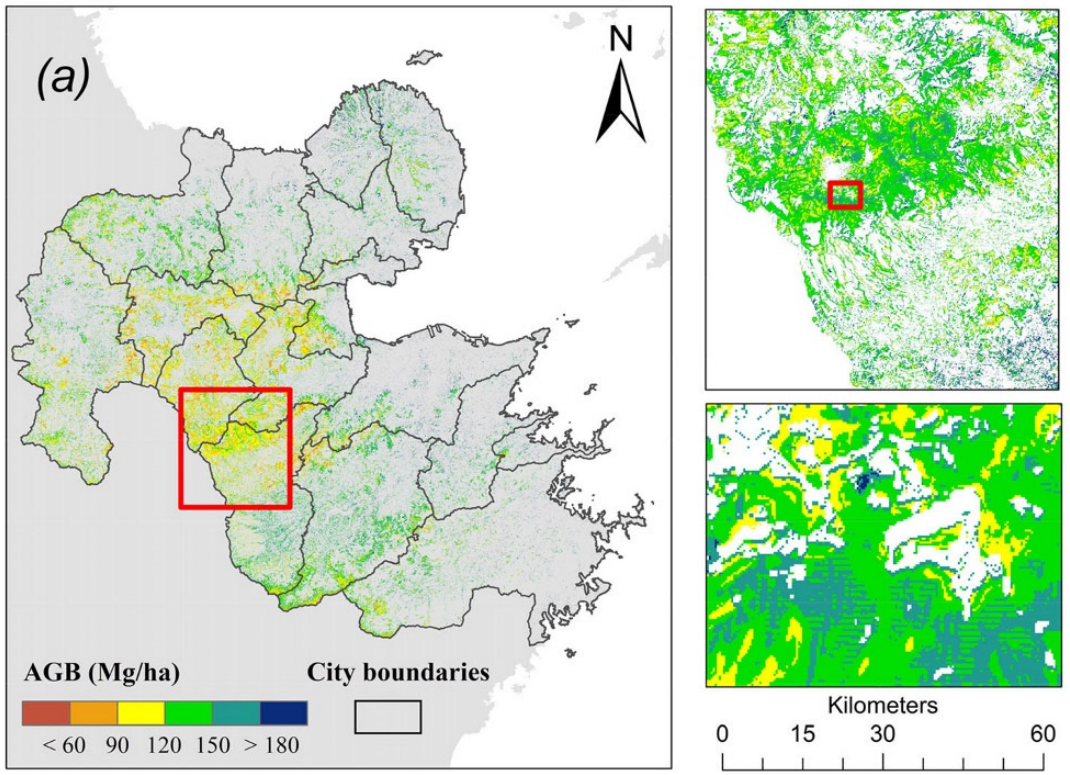
1. Current status of Japanese forest biomass assessment
2. Issues of global forest biomass map
3. JAXA activities to the present
4. Plans for the Stardust Program
5. Summary

- Many prefectures conducted airborne LiDAR measurements to create stem volume maps.
- Using them as training data, JAXA and the Kato Lab. of Hokkaido University are collaborating to create regional-scale above-ground biomass maps.



[Li Hantao et al., 2022]

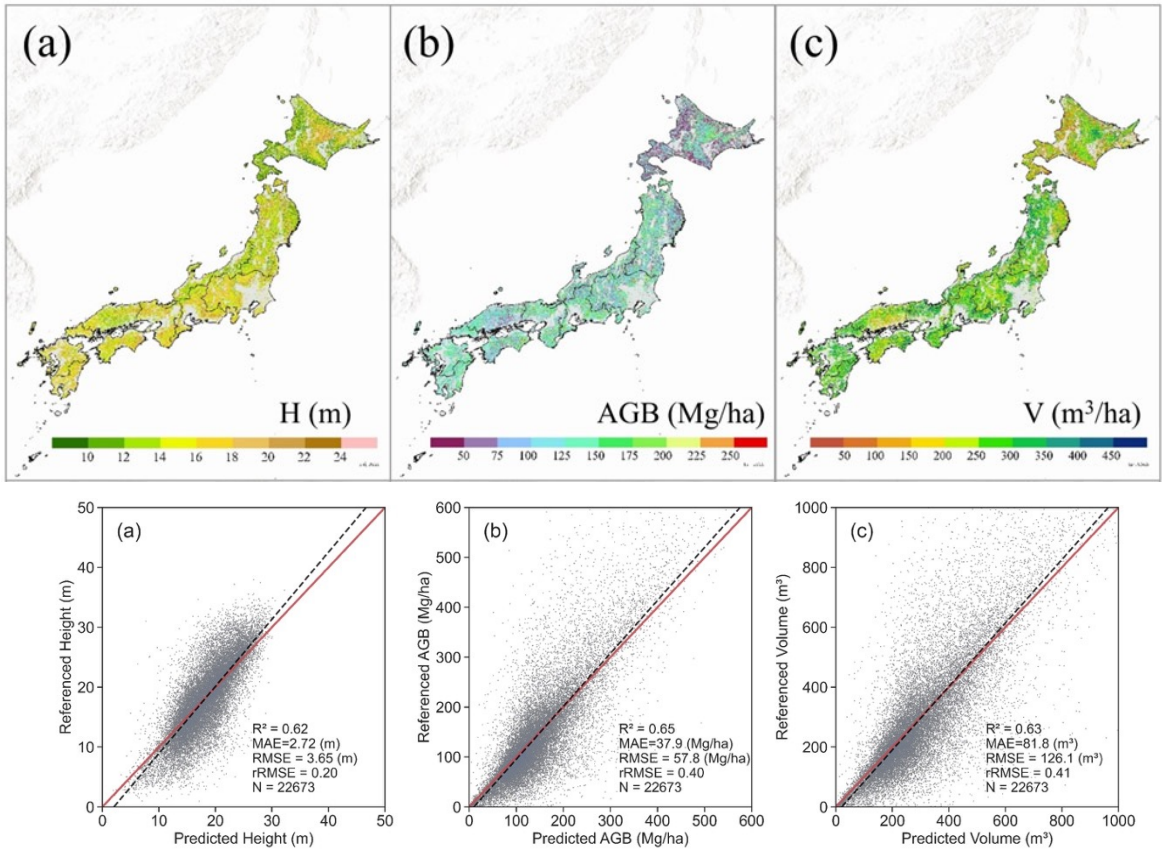
AGB map of Ibaraki Pref.



[Li Hantao et al., 2022]

AGB map of Oita Pref.

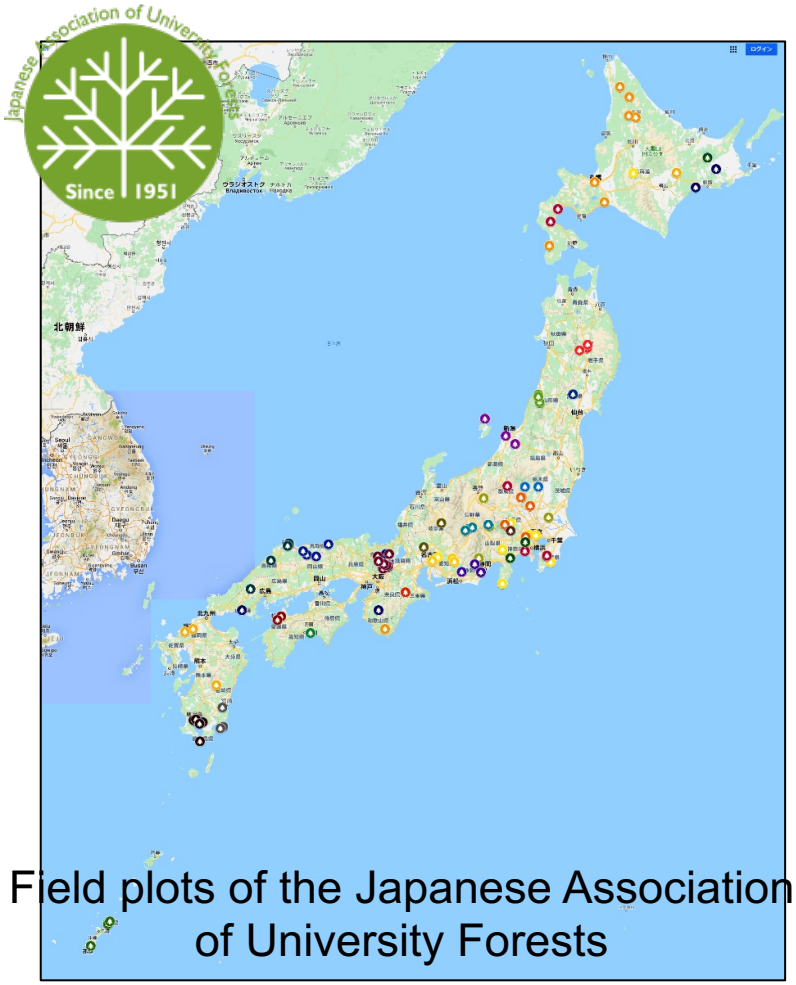
- In collaboration with Kato's lab, we used 17 areas of airborne LiDAR data to create 10-meter-resolution canopy height, above-ground biomass, and stem volume maps for the whole Japan.



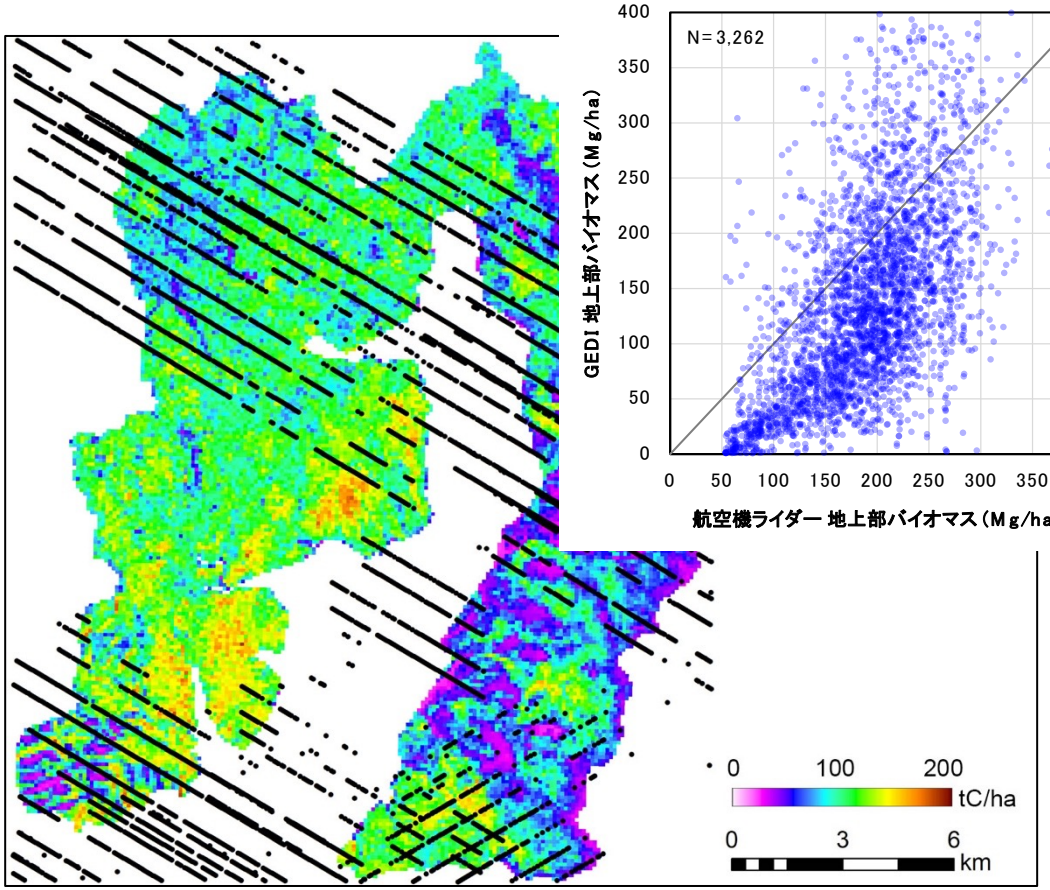
[Li Hantao et al., preparing to submission]

Poster presentation:
P003, Li Hantao, Mapping the Forest Carbon Stock Over Japan in High Resolution Using Multisource Remote Sensing Data with Machine Learning.

- We collaborate with Forestry and Forest Products Research Institute (FFPRI) and university experiment forests to collect reference data.
- They has more than 1,000 field survey plot data, airborne LiDAR data, and GIS data.

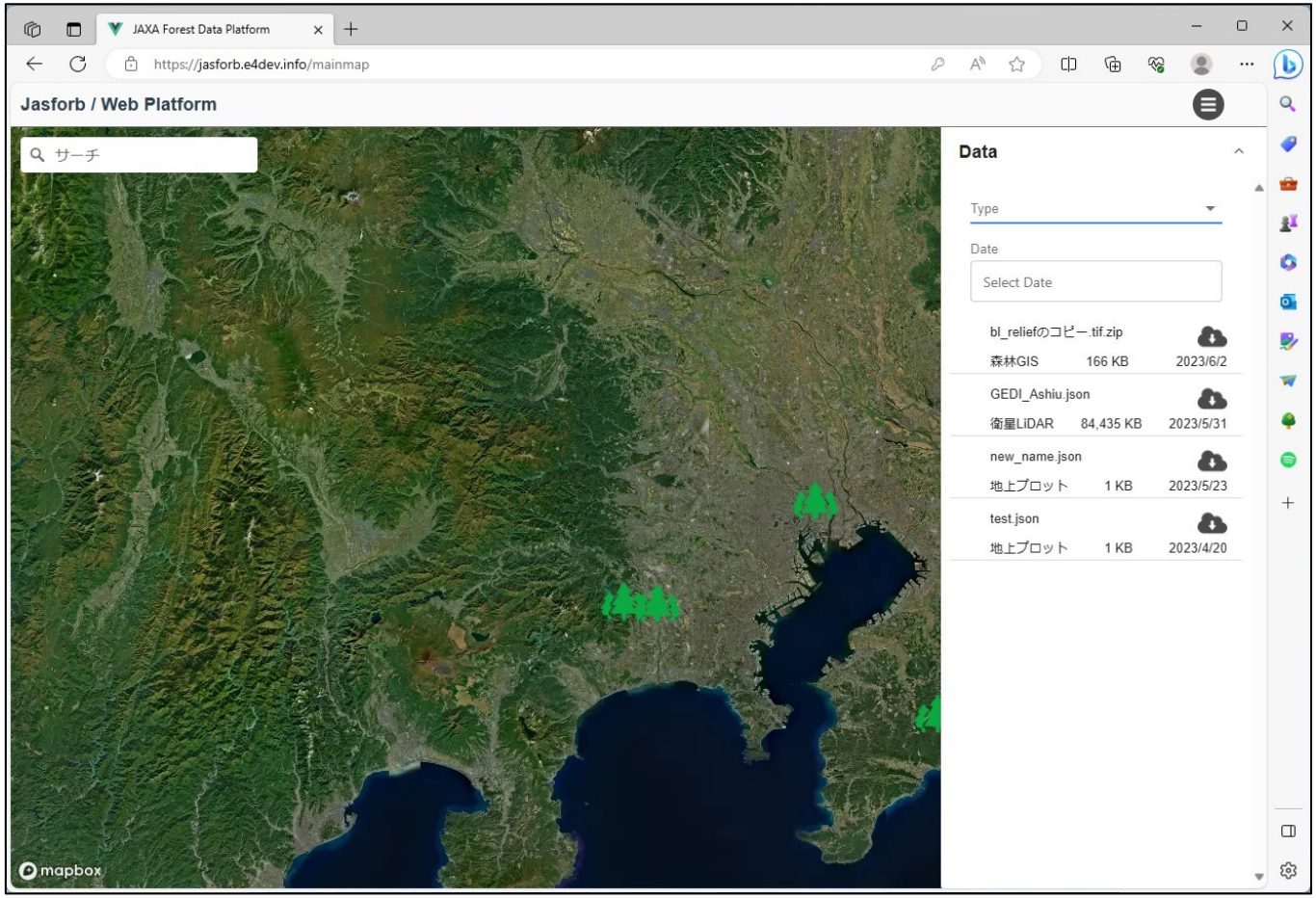


Field plots of the Japanese Association of University Forests



AGB comparison of airborne LiDAR and GEDI

- We are developing with FFPRI and the universities the platform Jasforb (Japan satellite and forest biomass research platform) to organize and share the reference data in the cloud.



Jasforb platform beta version

4. Plans for the Stardust Program

1. Current status of Japanese forest biomass assessment
2. Issues of global forest biomass map
3. JAXA activities to the present
4. Plans for the Stardust Program
5. Summary

- The Stardust Program is a research budget, and "Establishment and strategic implementation of forest biomass estimation methodology for achieving carbon neutrality" was adopted.

Lead Ministry: Ministry of Education, Culture, Sports, Science and Technology
Collaborating ministries: Ministry of the Environment, Forestry Agency
Implementing agency: JAXA
Project period: FY2023 - FY2025
Budget: 1 billion yen
Project Contents:

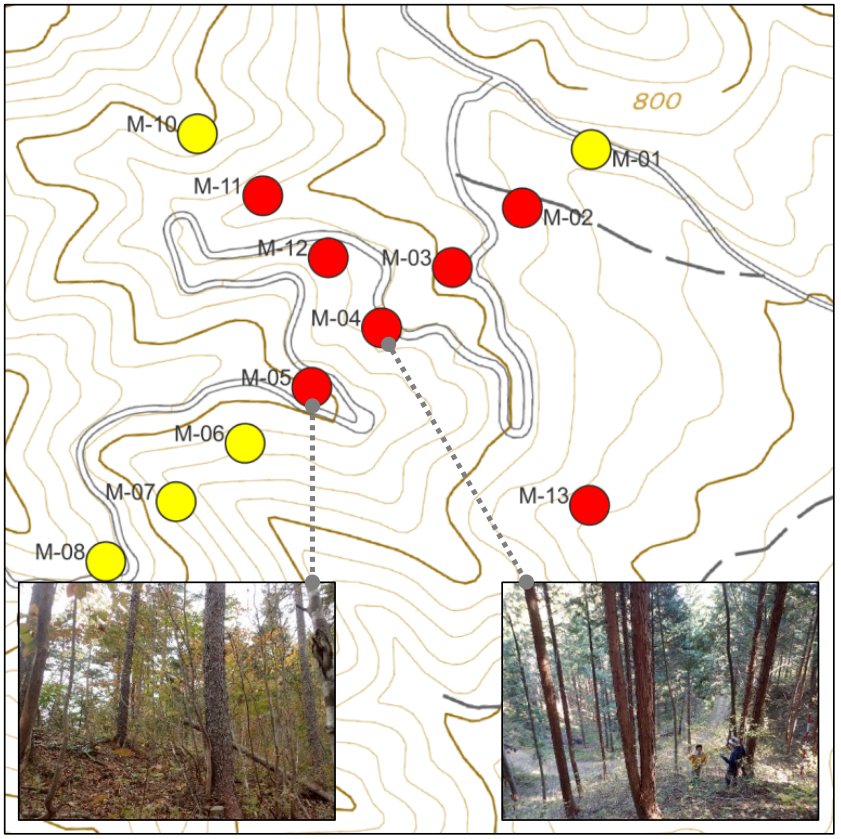
(1) Development of method for calculating terrestrial carbon budget
(2) Development of carbon budget calculation at watershed scale
(3) Development and validation of forest biomass maps at country level
(4) Experimental use of forest carbon credit accounting

Image of airborne SAR

Items regarding forest biomass estimation research (1)

- Airborne LiDAR data collection throughout Japan
  - Collection of airborne LiDAR data and stem volume maps owned by prefectures.
  - Complementary mapping for some forest types (e.g., broadleaf forests).
- Field plot database development for validation
  - Plot database development (> 1,000 plots) owned by university experiment forests.
  - Digitization of plot data, additional measurement of location and height information, etc.
- Research platform development
  - Enhancement of the Jasforb platform, and collection of various data on the cloud.
  - Data sharing among stakeholders (and some data will be open to the public).
- Study on forest biomass estimation using GEDI
  - Error factors Analysis in GEDI L4A products based on ground surveys.
  - Estimation model development suitable for Japanese forests using GEDI waveform.

Airborne LiDAR data for publicly available



Field surveys at GEDI footprint

Items regarding forest biomass estimation research (2)

- **Study on forest biomass estimation using PALSAR-2**
  - Investigation of capability by coherence, multi-polarization, time series information, etc.
  - Consideration of supplementation method for distorted areas in PALSAR-2 imagery.
- **Creation of forest biomass map of Japan**
  - Country-scale map development using airborne LiDAR, GEDI, PALSAR-2, etc.
  - Investigation of use for climate change action and carbon credits.
- **Study on Solar-Induced chlorophyll Fluorescence (SIF)**
  - SIF ground observations at about 5 sites in Japan.
  - Study of relationship of SIF and forest production, and comparison with satellite data.
- **Creation of forest biomass maps in Southeast Asia**
  - Country-scale maps development for about 3 countries by applying Japanese methodology.
  - Investigation of administrative use for climate change action.

5. Summary

- For creating accurate forest biomass map of Japan, we need to develop reference dataset and estimation method considering topography.
- JAXA has been working on forest biomass mapping in collaboration with the Forestry and Forest Products Research Institute (FFPRI) and several universities.
- With new funding available this fiscal year, we plan to expand the efforts to create country-scale forest biomass maps of Japan and Southeast Asia over a three-year period.