SAKURA SCIENCE
Exchange Program in Science
日本・アジア青少年サイエンス交流事業
さくらサイエンスプラン
Japan-Asia Youth Exchange Program in Science

Remote Sensing for Agriculture IV
Smart Agriculture

29th Oct. 2019 13:00 to 16:30
3-17-1, Toranomon, Minato-ku, Tokyo, Japan

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Remote Sensing Technology Center of Japan

What is Smart Agriculture ?

Social Issues

- Flexible farming that can adapt to rapid climate change.
- Increase profits by increasing the size of the field.
- Reducing labor costs through mechanization.

Agricultural Technique × **Advanced Technology**

↓

Smart Agriculture

New Technology

Key Technology: Remote Sensing

Satellite | **Drone** | **Hyperspectral**

Satellites for Earth Observation

Government | **Private Company**

Landsat(US)

Sentinel(EU)

WorldView(US)

ASNARO(JPN)

High Cost
High Resolution
High Frequency

Free
Low Resolution
Low Frequency

https://landsat.gsfc.nasa.gov/wp-content/uploads/2013/01/ldcm_2012_COL.png

https://upload.wikimedia.org/wikipedia/commons/3/3d/Sentinel_2-IMG_5873-white_%28crop%29.jpg

https://dg-cms-uploads-production.s3.amazonaws.com/uploads/page_field/image_value/311/worldview-3.png

https://www.restec.or.jp/ja/wp-content/uploads/2014/12/ASNARO.jpg

ALOS(JPN)

SPOT(Fr)

PlanetScope(US)

Hodoyoshi(JPN)

Low to Middle Cost
Middle to High Resolution
Low to Middle Frequency

Low Cost
High Resolution
Ultrahigh Frequency

http://www.satnavi.jaxa.jp/project/alos/images/top_image.png

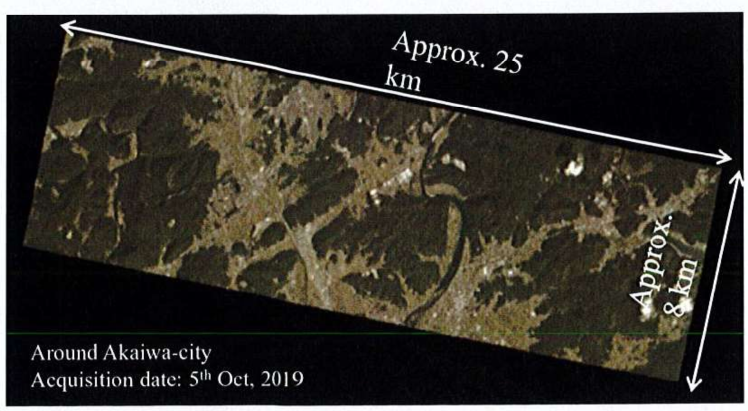
https://icon2.kisspng.com/20180403/jxe/kisspng-satish-dhawan-space-centre-polar-satellite-launch-spot-5ac42b22b5af72.2422111915228055387442.jpg

https://www.planet.com/assets/images/approach/dove.png

https://www.axelspace.com/wp-content/uploads/2015/11/hodoyoshi1_hover_small.png

Nano-satellite constellation

Nano-satellite: PlanetScope (DOVE)



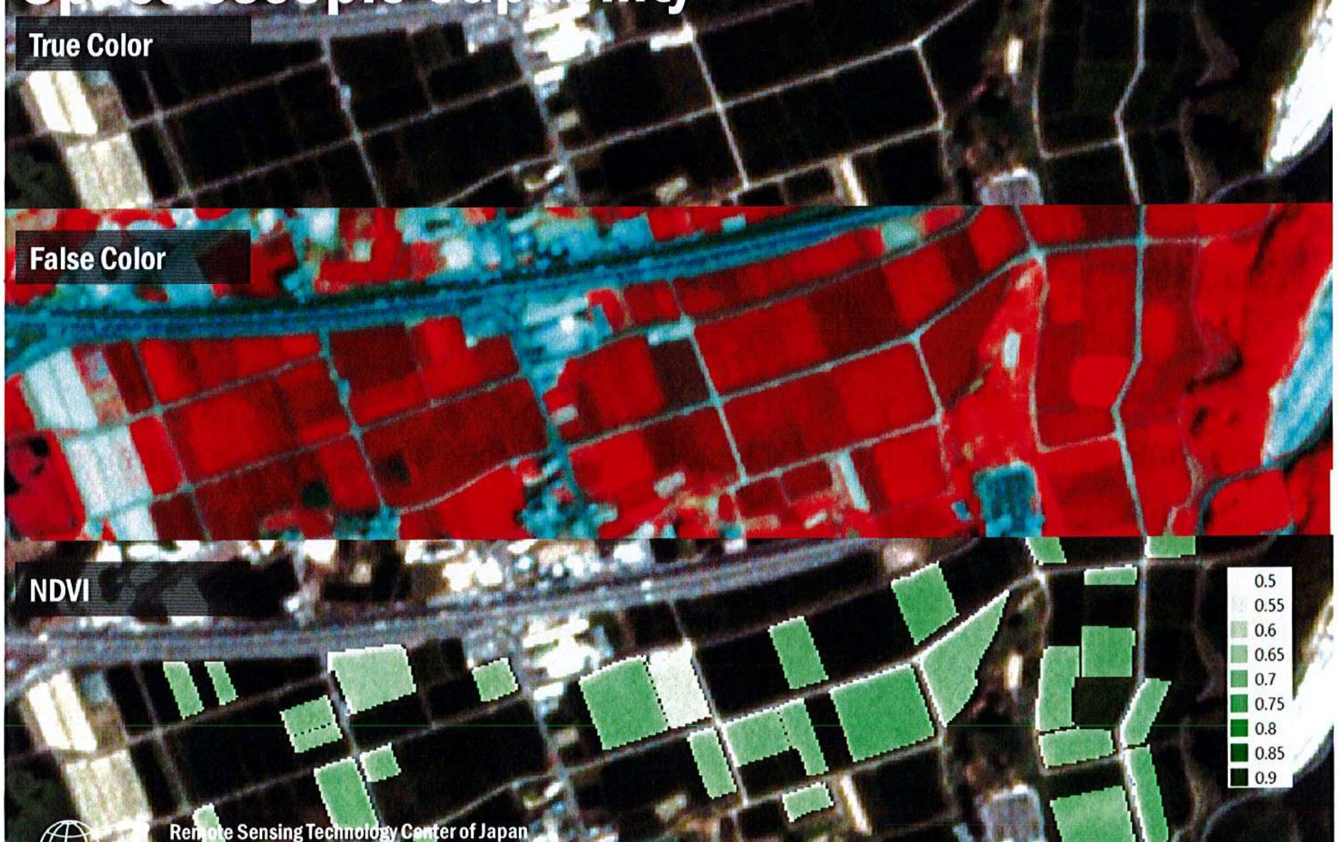
Shooting range of PlanetScope

Smart Agriculture using PlanetScope (2010)

- Satellite manufacturing cost reduced hundreds millions to hundreds thousands (US$).
- Satellite imagery cost reduced tens thousands to dozens of dollars.
- Number of satellite in orbit increase several to hundreds.
- Shooting frequency increase weeks to every day.
- High resolution despite of cheap.
- Free software available.

Spectroscopic Capability

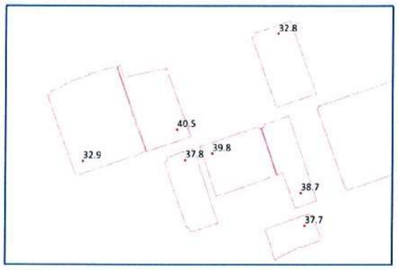
Spectroscopic Capability



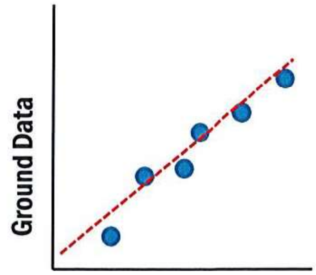
Outline of Analysis

Relationship between ground and satellite data

Ground Data

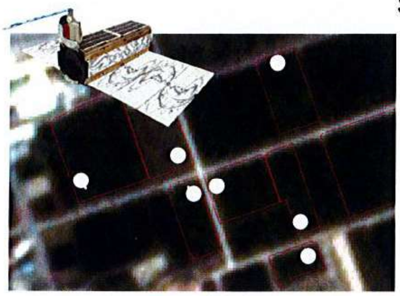


	Height
Point A	65
Point B	70
Point C	71
Point Z	66

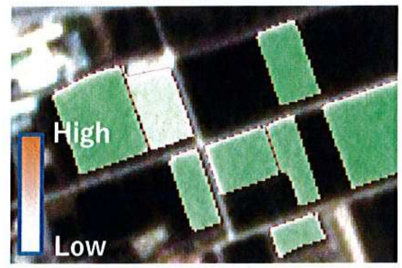


Adapt the relationship to whole satellite imagery

Satellite Data



	Band 1	Band 2	Band 3	Band 4
Point A	0.104	0.398	0.165	0.454
Point B	0.123	0.365	0.145	0.476
Point C	0.134	0.376	0.136	0.446
Point Z	0.111	0.353	0.132	0.498



Estimation Map

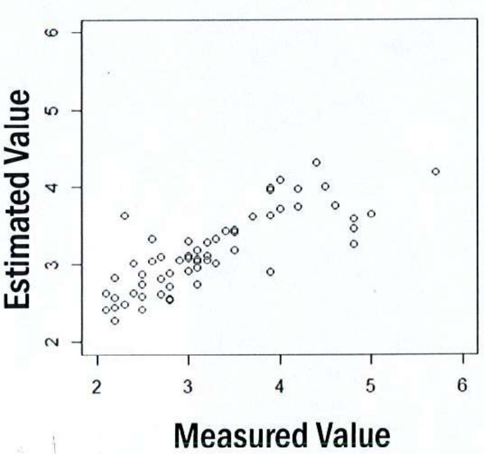
Ground Campaign (Paddy field)

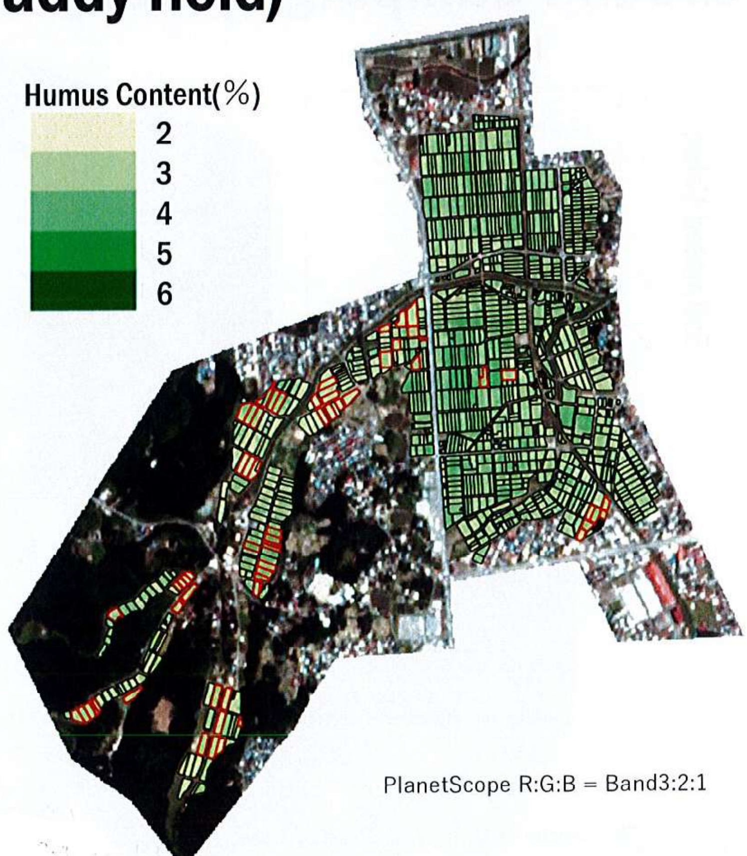
Soil	Soil Sampling & Analysis (Humus Content)
Fertilization	Height, Number of Stem, Leaf Color
Proper time of harvesting	Maturity Index, Ear Length, Culm Length, Leaf Color
Yield & Quality	Crude Protein, Refined Rice Weight

Ground Campaign (Paddy field)

Ground Campaign (Paddy field)

Soil Sampling: 16 to 17 Apl. 2018
Acquisition date: 24th Jun. 2018
Range: 2.1 to 5.7 %
MAE: 0.50 %

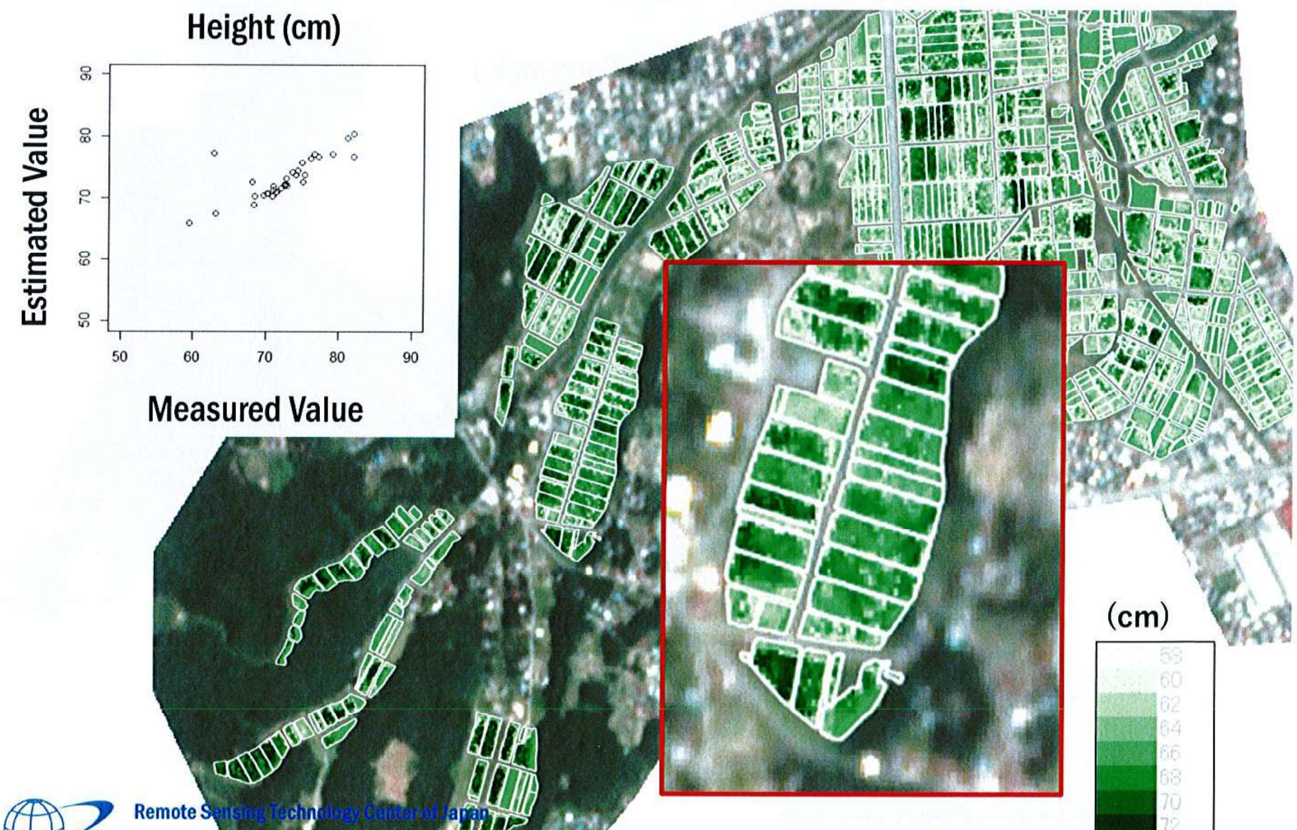




PlanetScope R:G:B = Band3:2:1

Ground Campaign (Paddy field)

Ground Campaign (Paddy field)




Ground Campaign (Paddy field)
Sampling
Drying
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Ground Campaign (Paddy field)
Thrashing
Moistu ontent of Grain
Quality
Measurement
Yield Measurem nt
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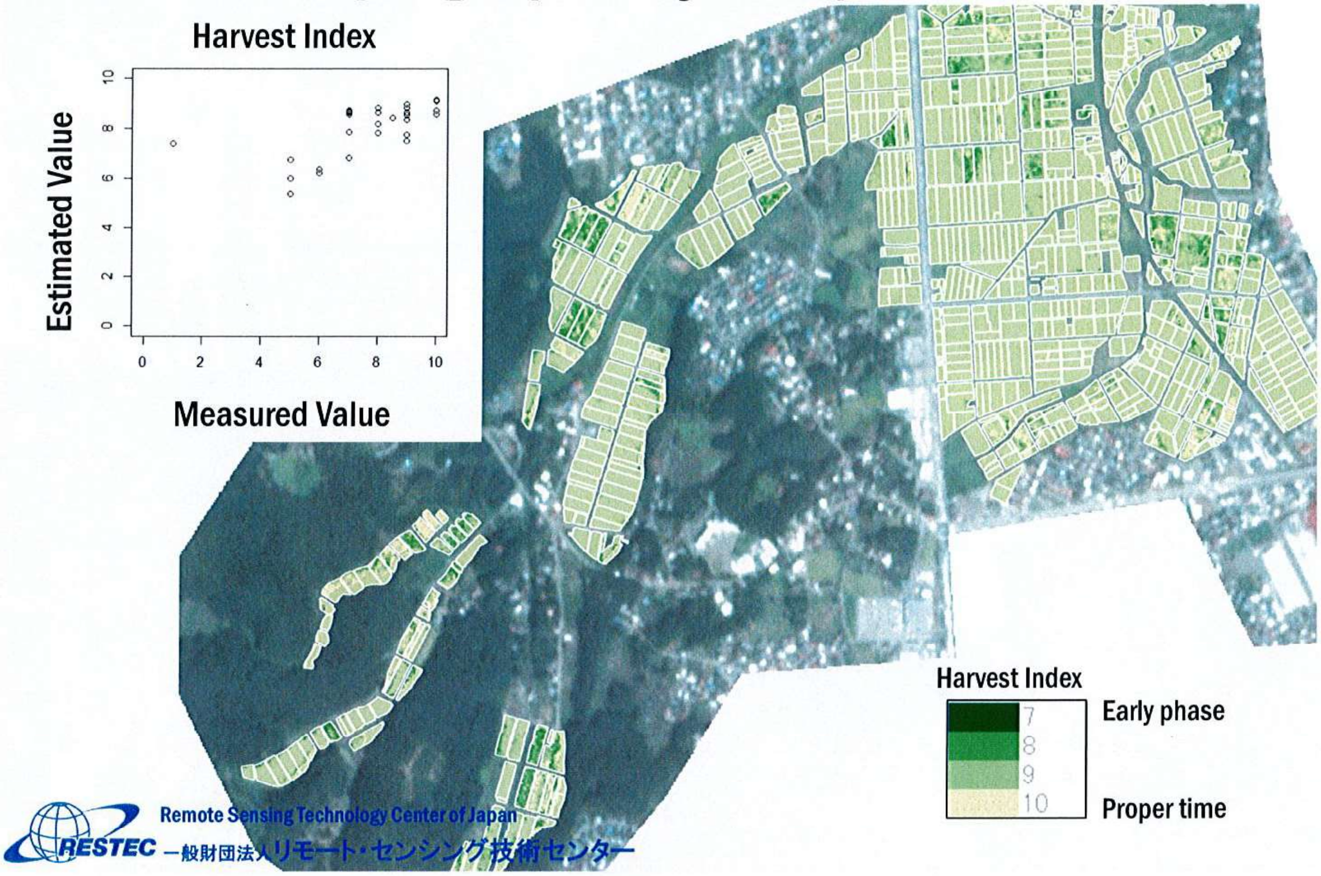
Ground Campaign (Paddy field)



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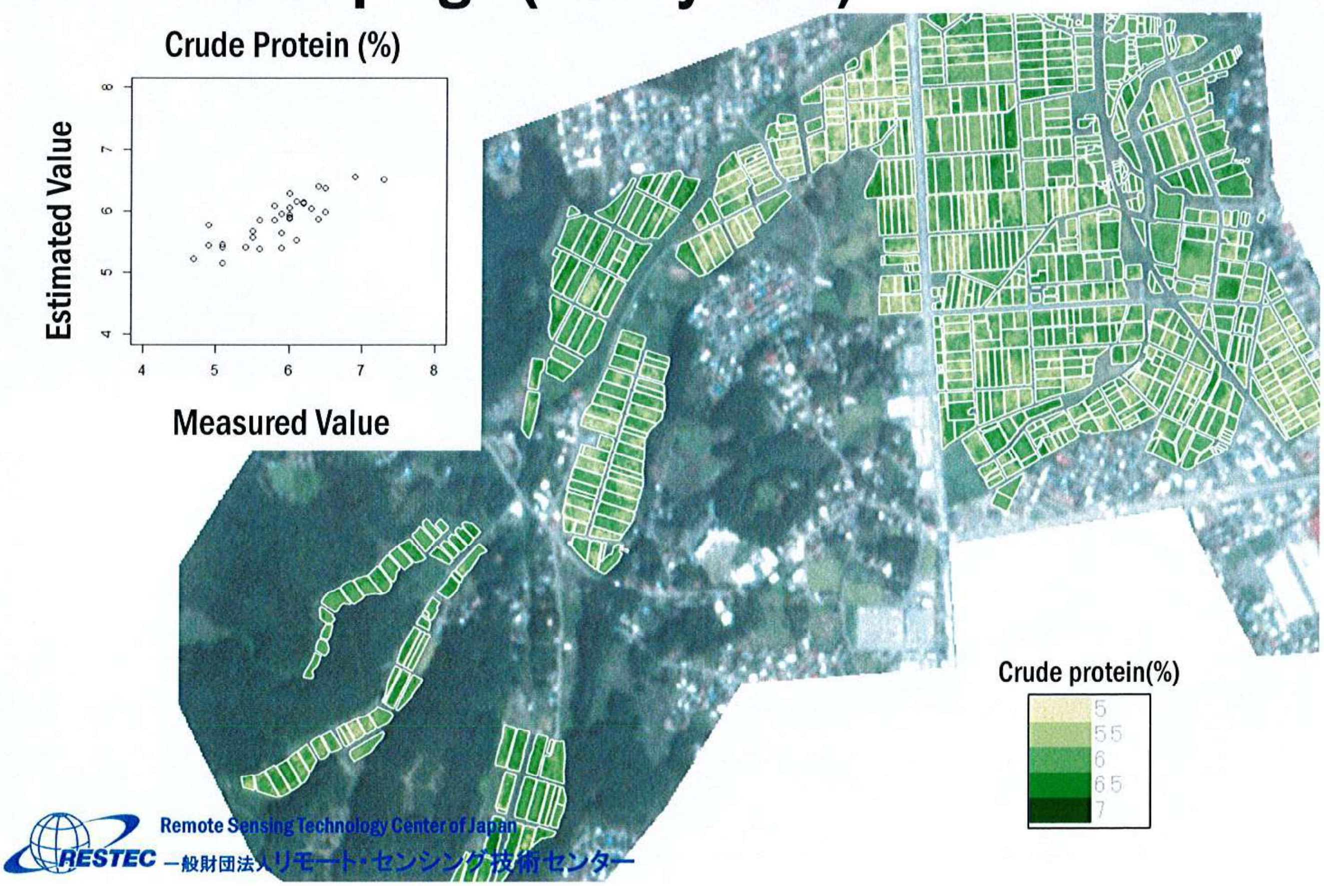
Ground Campaign (Paddy field)



Drone

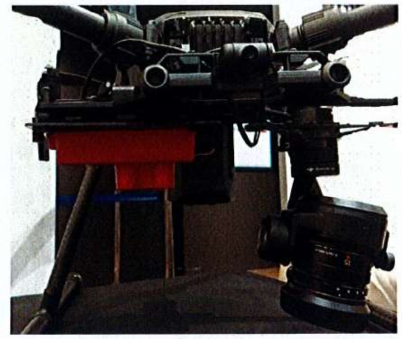
Drone: MATRICE 200

Manufacturer: DJI (China)
Weight: 4,530 g
Max ascent velocity: 5 m/s
Max drop rate: 3 m/s
Max speed: 23 m/s (83 km/h)
Max flight time: 24 minute
Location accuracy of hovering: ±0.1 m(vertical)
±0.3 m(horizontal)
Max takeoff weight: 6,140 g

RedEdge on MATRICE 200

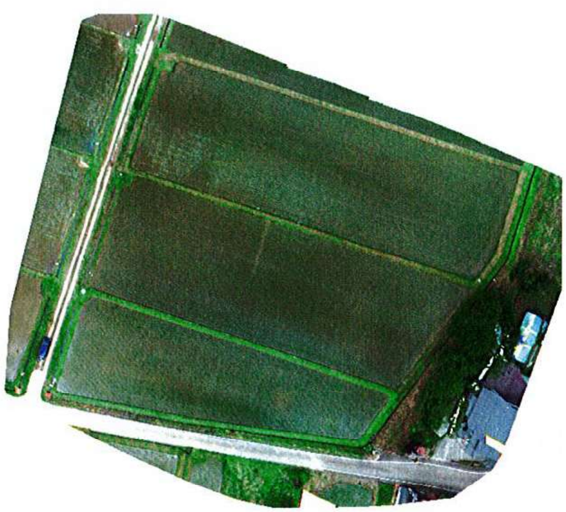
Multispectral sensor RedEdge

MATRICE200

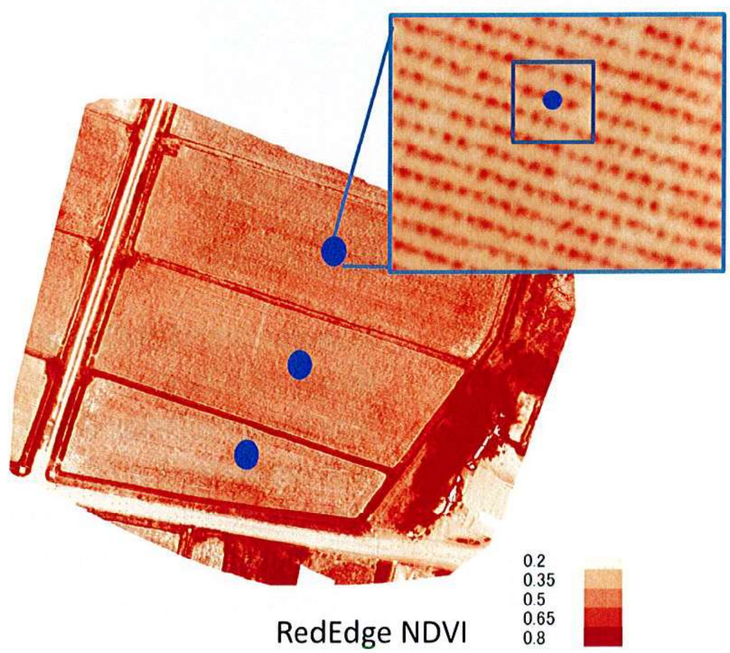


Product: MicaSense (US)
5 Bands
Blue: 465 to 485 nm
Green: 550 to 570 nm
Red: 663 to 673 nm
Rededge: 712 to 722 nm
NIR: 820 to 860 nm

RedEdge imagery and NDVI



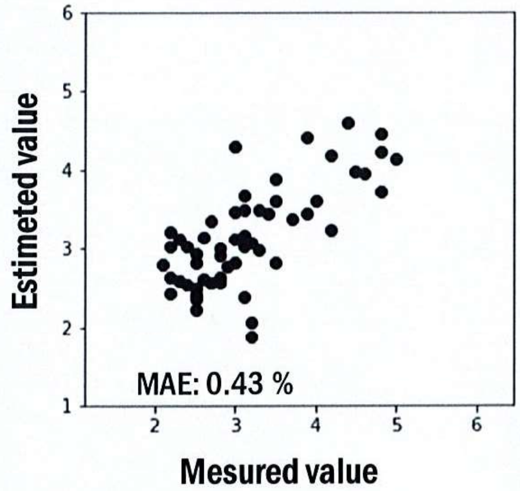
RedEdge true color image

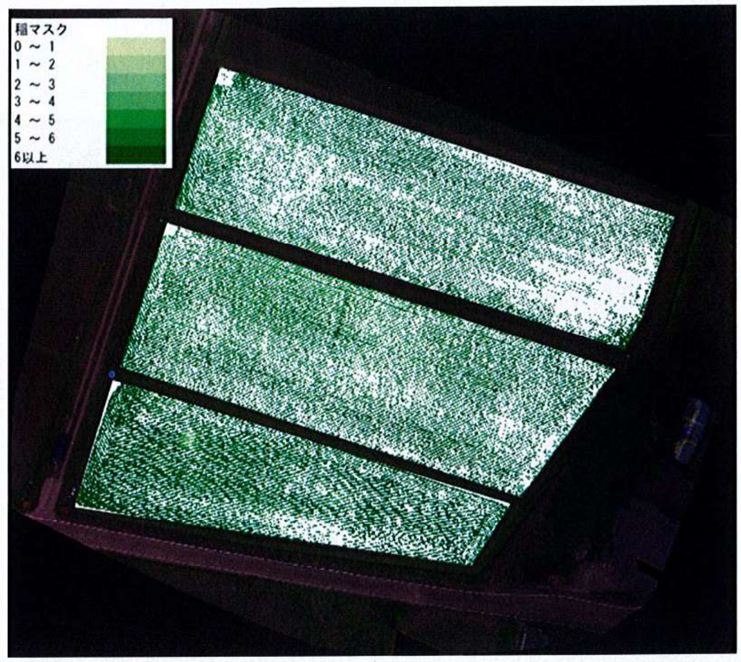


RedEdge NDVI

Humus content estimated by RedEdge

Estimated within 10 % error





Sampling date: 16 to 17 Apl. 2018
Range: 2.1 to 5.7 %

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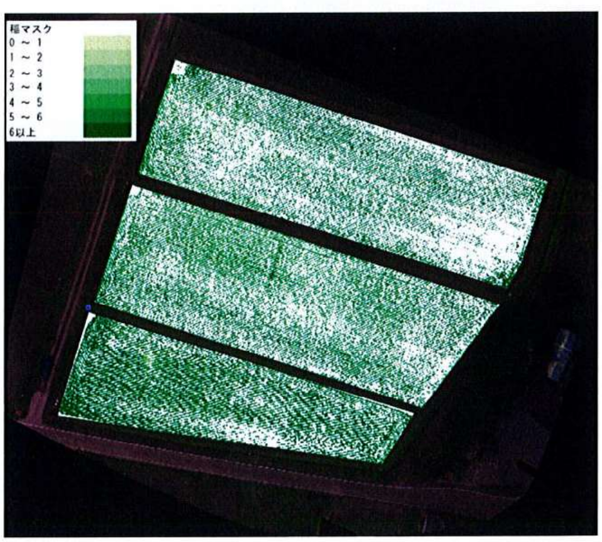
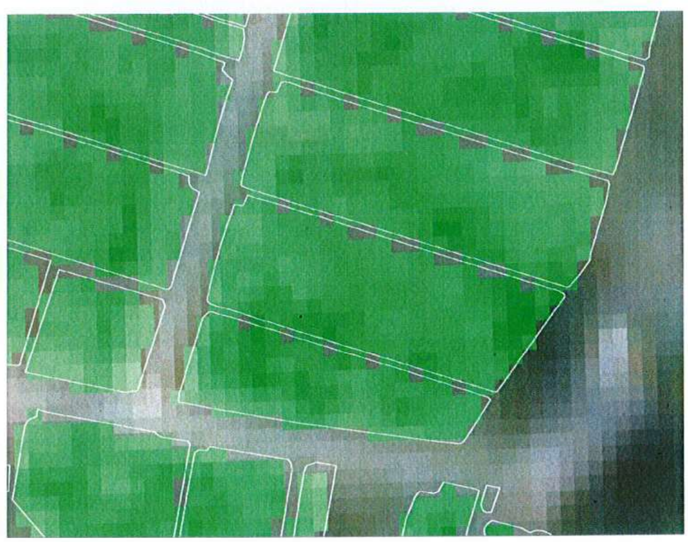
Comparison Drone with Sat





Drone

Satellite

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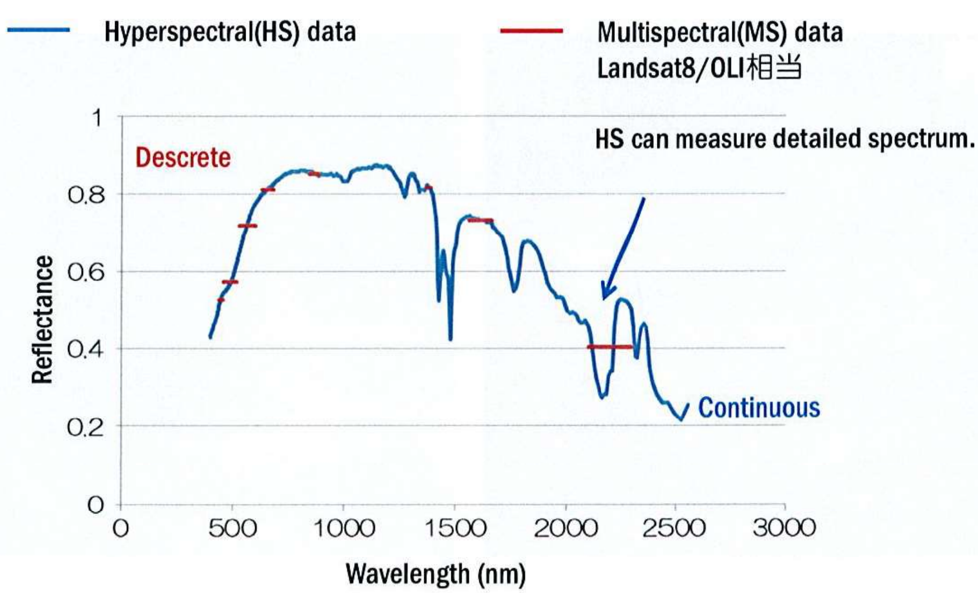
Hyperspectral sensor

Comparison HS with MS

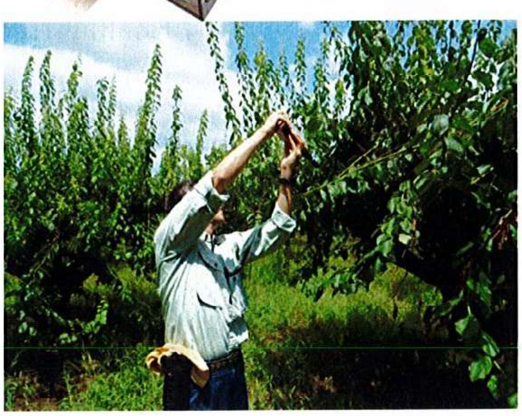


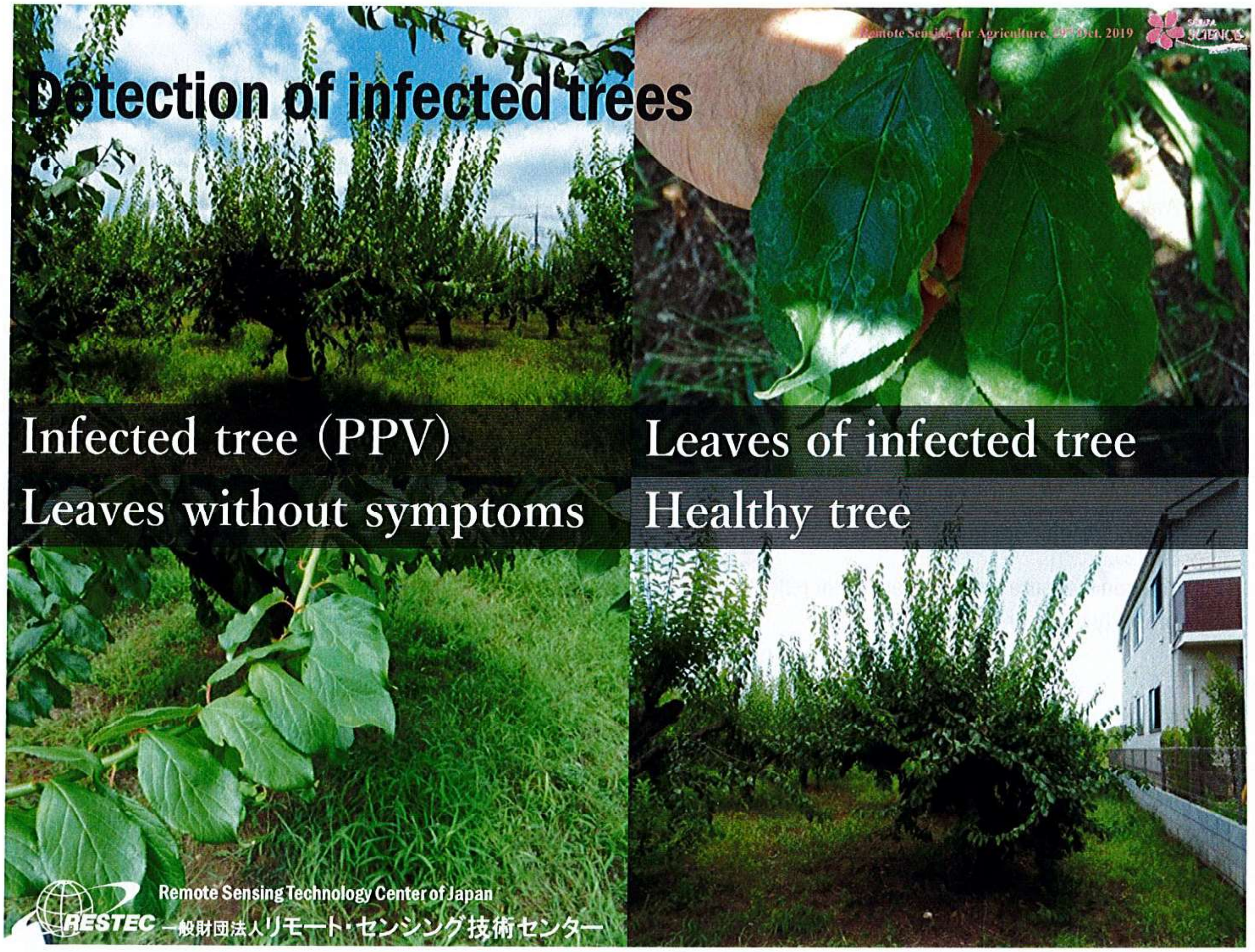
Comparison HS with MS

Wavelength: Vis to SWIR	Wavelength: Vis to SWIR
Number of Bands: 2 to dozens	Number of Bands: dozens to hundreds
Spectral resolution: dozens nm	Spectral resolution: 1 to 5 nm
Descrete	Continuous
Cost: Cheap	Cost: High
SN ratio: High	SN ratio: Low
Spatial resolution: High	Spatial resolution: Low
You can measure only an overview of reflectance property using broad band.	You can measure detailed reflectance property using narrow bands.

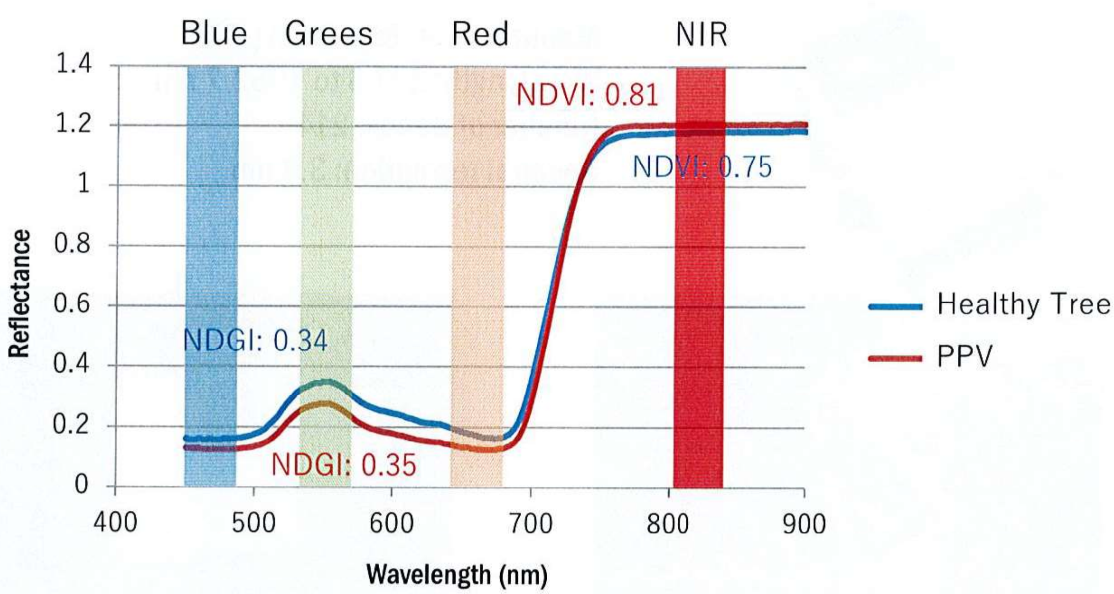
Carrying HS sensor: MS-720

Manufecturer: Eiko Seiki (JPN)
Wavelength: 347.6 to 1052.7 nm
Number of Bands: 214
Spectral resolution: 3.3 nm





Comparison infected leaves with healthy leaves



Thank you for your attention !