
GWF
GEOSPATIAL WORLD FORUM
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SAR and EO data fusion to realize a “Virtual Constellation” and its use cases.

Space Shift, Inc.

CEO: Naruo Kanemoto

Corporate profile

Company Name	Space Shift, Inc.
CEO	Naruo Kanemoto
Capital	274 million JPY
Year of establishment	December 2009
Number of Employees	25FTE + 50< interns
Location	Inspired.Lab, 6th floor, Otemachi Building 1-6-1 Otemachi, Chiyoda, Tokyo 100-0004 Japan
Other Locations	Tottori, Japan/ US / EU(Planning)
Web site	https://www.spcsft.com/
Business fields	Development of software for satellite data analysis, business related to the analysis of satellite data, consulting related to space business

Raised $5M as a series-A investment round（February 2021）

SPARX

Feburuary 16, 2021

For Immediate Release

SPARX Group Co., Ltd.
President and Group CEO Shuhei Abe
(TSE1: 8739)

SPARX's Space Frontier Fund Invests in Space Shift, a Developer of Satellite Data Analytics Systems
—Exploring the World through Space and AI—

TOKYO—February 16, 2021—SPARX Innovation for the Future Co., Ltd. (SIF)—a subsidiary of SPARX Group Co., Ltd. (SPARX; TSE1: 8739)—today announced that its Space Frontier Fund, established in June 2020, has invested in Space Shift, Inc., a developer of software that uses AI analytics to extract a wealth of information from Earth observation satellite data. Space Shift plans to use this capital to advance its AI development by dramatically improving its systems and specializing in data

Source: https://ssl4.eir-parts.net/doc/8739/tdnet/1936117/00.pdf

Mission & Vision

2,000~3,000 units of earth observation satellites will plan to be launched in 5 years over the world.
Big data and real-time data of earth will be available more easily and quickly in near future.

“Unraveling the World with Space and AI”

- Extraction of **more information** via AI’s surpassing cognitive ability
- Construction of global **digital twins**
- Visualization of **correlation** of various phenomena

Contribution of **realizing sustainable society**

through “the optimization of human activities and natural environment”

by utilizing satellite data analysis

Optical satellite vs SAR satellite

Space Shift is focusing on data analysis of SAR (Synthetic Aperture Rader) satellites.
Main features of optical satellite and SAR satellite are as follows.

Optical satellite

Passive sensors that receive reflection of sunlight

○
- Intuitively understandable imagery
- Many satellites available
- High resolution (0.3m~per pixel)

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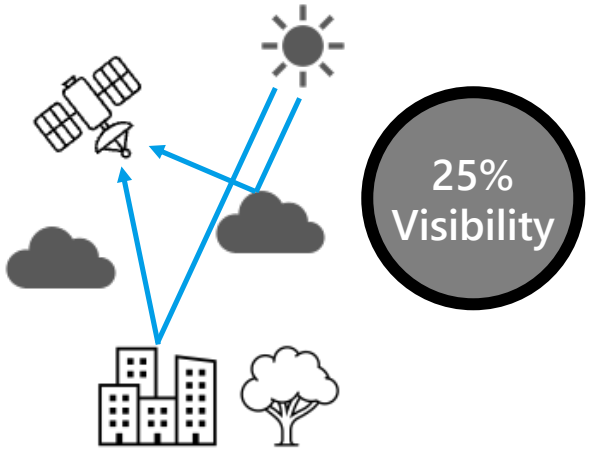
- Incapable of observations through clouds(50%) or at night(50%) = 25% visibility
- Greatly affected by sunlight



SAR satellite

Active sensors that receive the reflection of electromagnetic waves they emit

○
- Capable of observations through clouds or at night
- Identification of materials of objects
- High resolution (1.0m~per pixel)

×
- Unclear imagery and its difficulty to understand intuitively
- Few number of satellites available

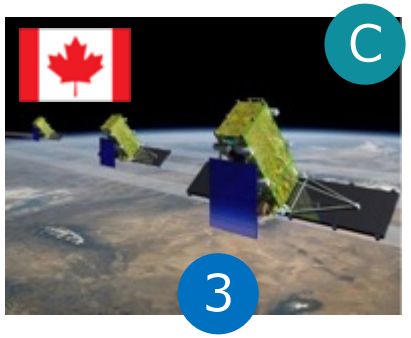
Developing technologies

LARGE Satellites

Cosmo Skymed

Sentinel 1A-1D

TerraSAR-X, TandemX, PAZ



Radarsat Constellation

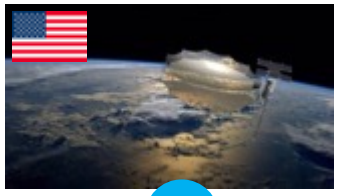
ALOS2,ALOS4

Develop Algorithms workable with all of SAR satellites

→ Middleware for "Virtual Constellation"

Micro Satellite constellations: **150-200** micro-SAR satellites will be launched by later 2020's total in the market.

Capella Space

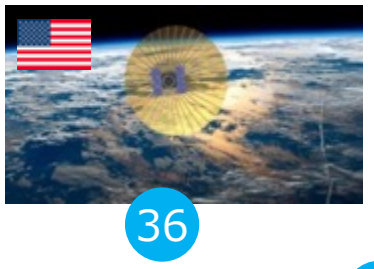


ICEYE

Metrea

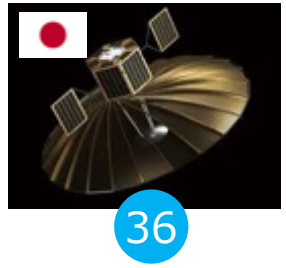
SPACEALPHA

UMBRA



Synspective

iQPS



n Planned number of satellites

SAR satellite constellation status

Name	Company	Com/Gov	Country	2023	2024	2025	2026	2027	2028	2029	2030
Cosmo-SkyMed	ASI	Gov	Italy	4	4	4	4	4	4	4	4
CSK Gen2	ASI	Gov	Italy	2	2	3	4	4	4	4	4
Terra SAR-X	DLR	Gov	Germany	1	1	1	1	1	1	1	1
TanDEM-X	DLR	Gov	Germany	1	1	1	1	1	1	1	1
Radarsat-2	CSA	Gov	Canada	1	1	1	1	1	1	1	1
RADARSATConstellation	CSA	Gov	Canada	3	3	3	3	3	3	3	3
Sentinel-1	ESA	Gov	Europe	1	2	3	3	3	3	3	3
NISAR	NASA/ISRO	Gov	US/India	-	-	1	1	1	1	1	1
ALOS-2	JAXA	Gov	Japan	1	1	1	1	1	1	1	1
ALOS-4	JAXA	Gov	Japan	-	1	1	1	1	1	1	1
SAOCOM-1 A,B	CONAE	Gov	Argentina	2	2	2	2	2	2	2	2
SAOCOM-2 A,B	CONAE	Gov	Argentina	-	-	1	2	2	2	2	2
PAZ	Hisdesat	Com	Spain	1	1	1	1	1	1	1	1
Large SAR Total				17	19	22	24	24	24	24	24
ICEYE	ICEYE	Com	Finland	27	32	37	42	48	48	48	48
Capella	Capella	Com	US	11	13	16	20	25	30	36	36
Metrea	Metrea	Com	US	0	0	1	3	5	8	8	8
SpaceAlpha	SpaceAlpha	Com	Canada	0	0	0	1	3	5	8	8
ASNARO-2	NEC	Com	Japan	1	1	1	1	1	1	1	1
Umbra	Umbra	Com	US	6	7	9	12	16	21	24	30
Synspective	Synspective	Com	Japan	3	6	15	30	30	30	30	30
iQPS	QPS研究所	Com	Japan	3	6	12	36	36	36	36	36
Small SAR total				51	65	91	145	164	179	191	197
World wide SAR total				68	84	113	169	188	203	215	221

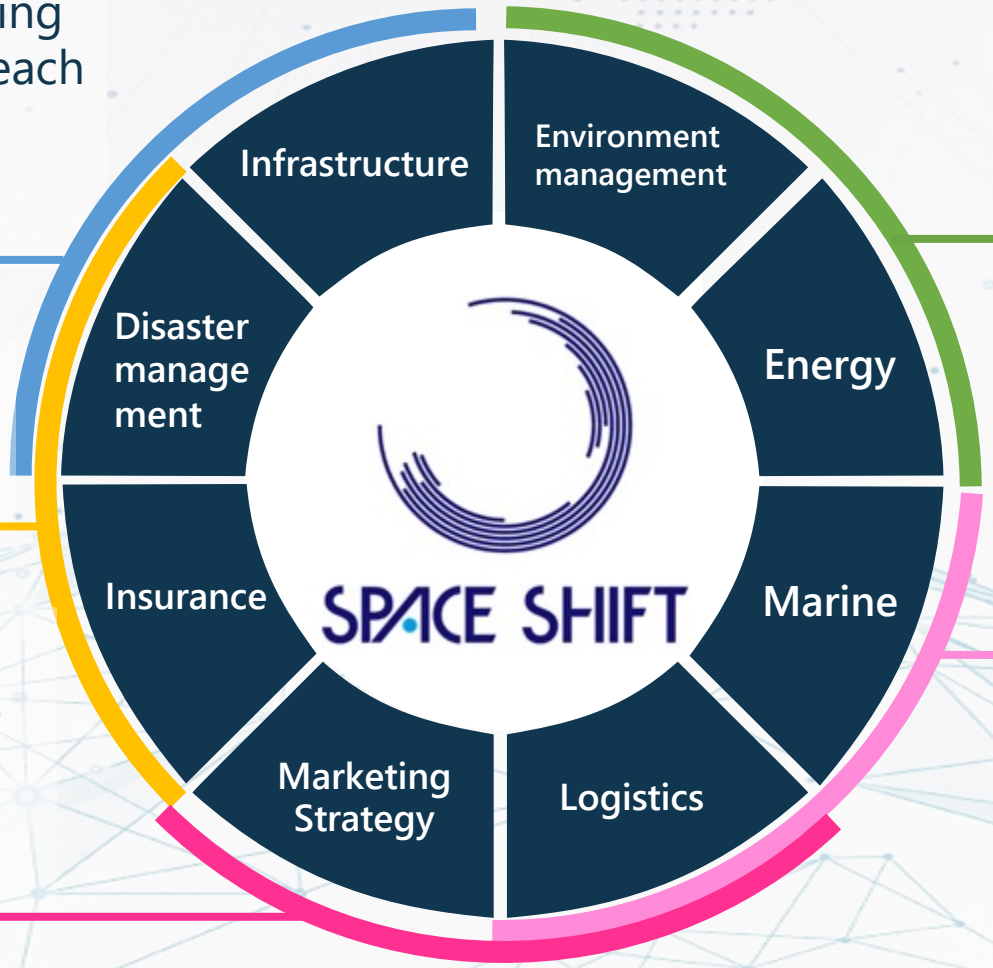
Our solution and Applications

Comparing SAR satellite data of two periods can observe minute changes on earth.
Space Shift supports various business fields by serving “InSAR Analysis” and “Change Detection”.

- Land displacement monitoring
- Displacement detection of each buildings
  (buildings, tunnels, bridges)
- **New building detection**

- Flood damage detection
- **Disaster info** providing service

- Crop growth monitoring
- Price prediction from crop’s growth status
- Traffic volume analysis
- People-Flow analysis

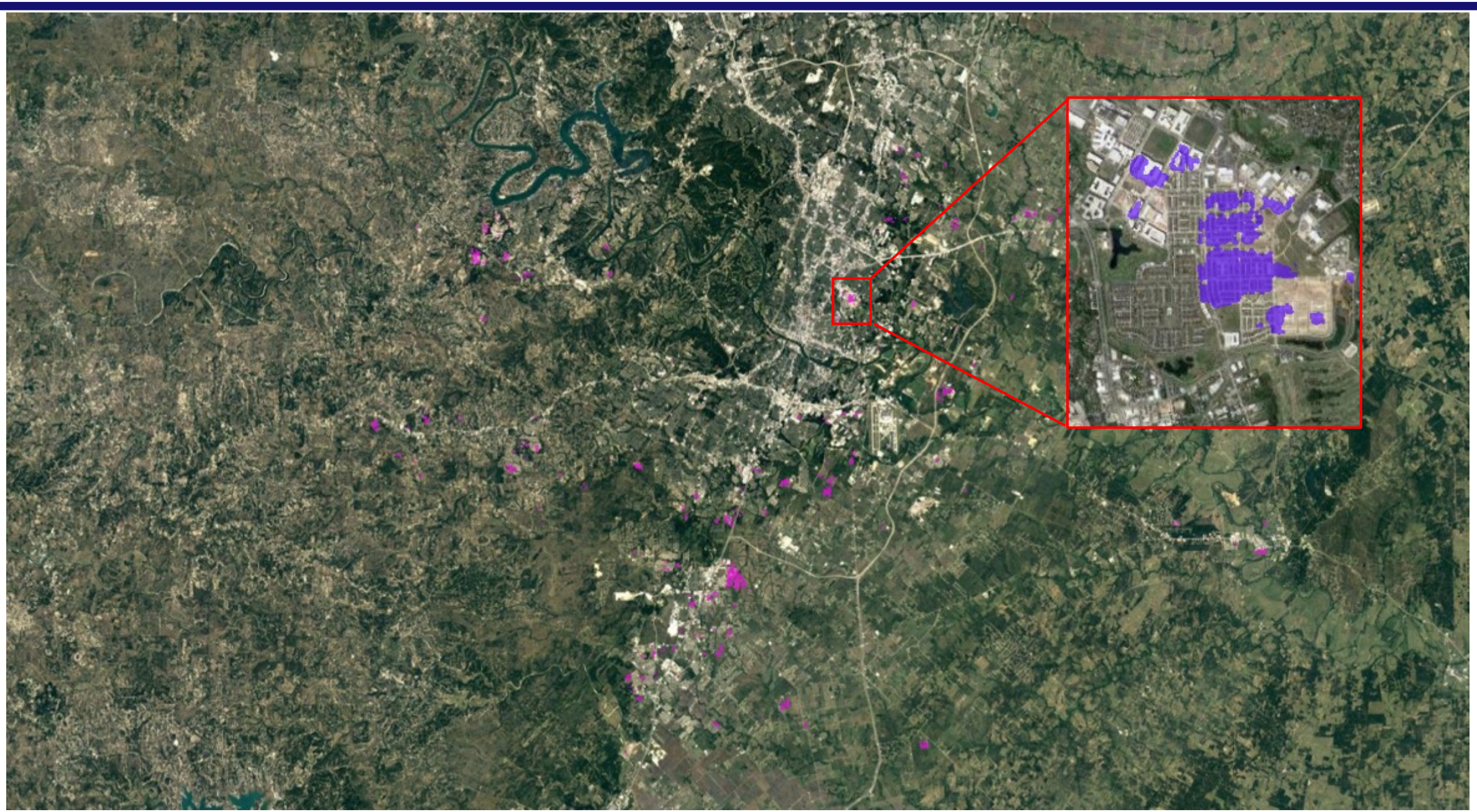


- Oil-spill detection
- Foresty monitoring

- **Ship detection**
- **Illegal ship estimation**

Central Austin Area prediction result

SPACE SHIFT



New Building detection

SPACE SHIFT

Central Austin area
Coordinates: W97°41'51.53", N30°17'45.34"

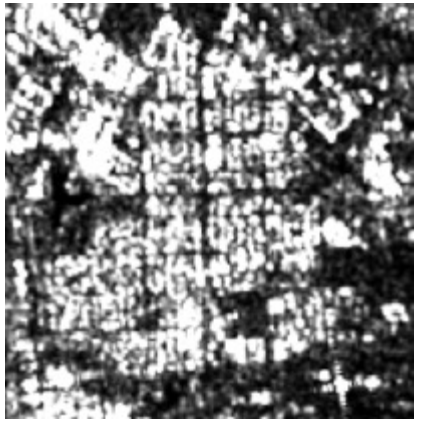
Prediction
Mar18 2015 – Oct12 2021

June 2015

July 2021

Mar 2015

Oct 2021



New Building detection

Central Austin area
Coordinates: W 97.710531, N 30.280259

Prediction
Mar18 2015 – Oct12 2021

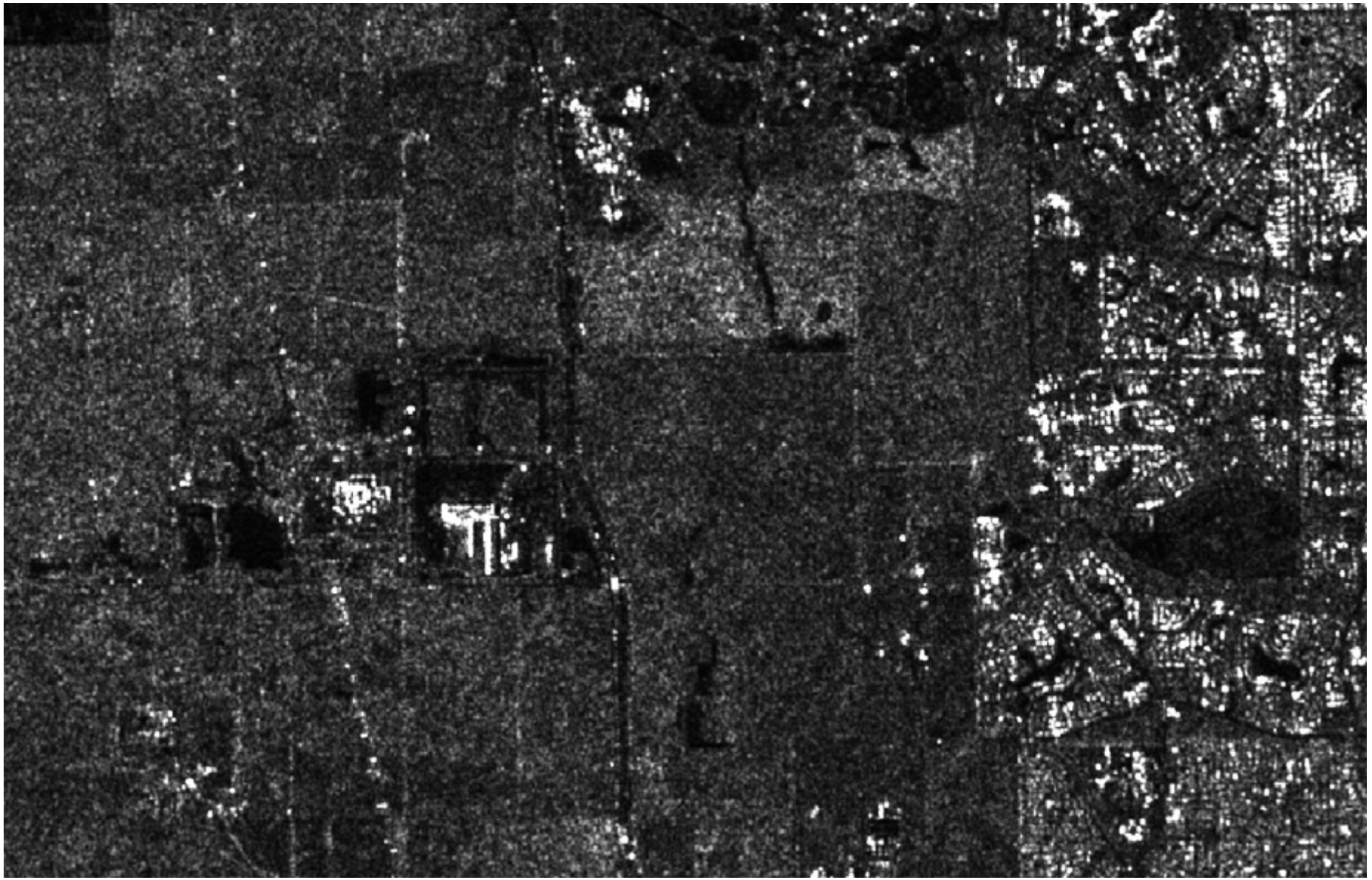
June 2015

Mar 2021

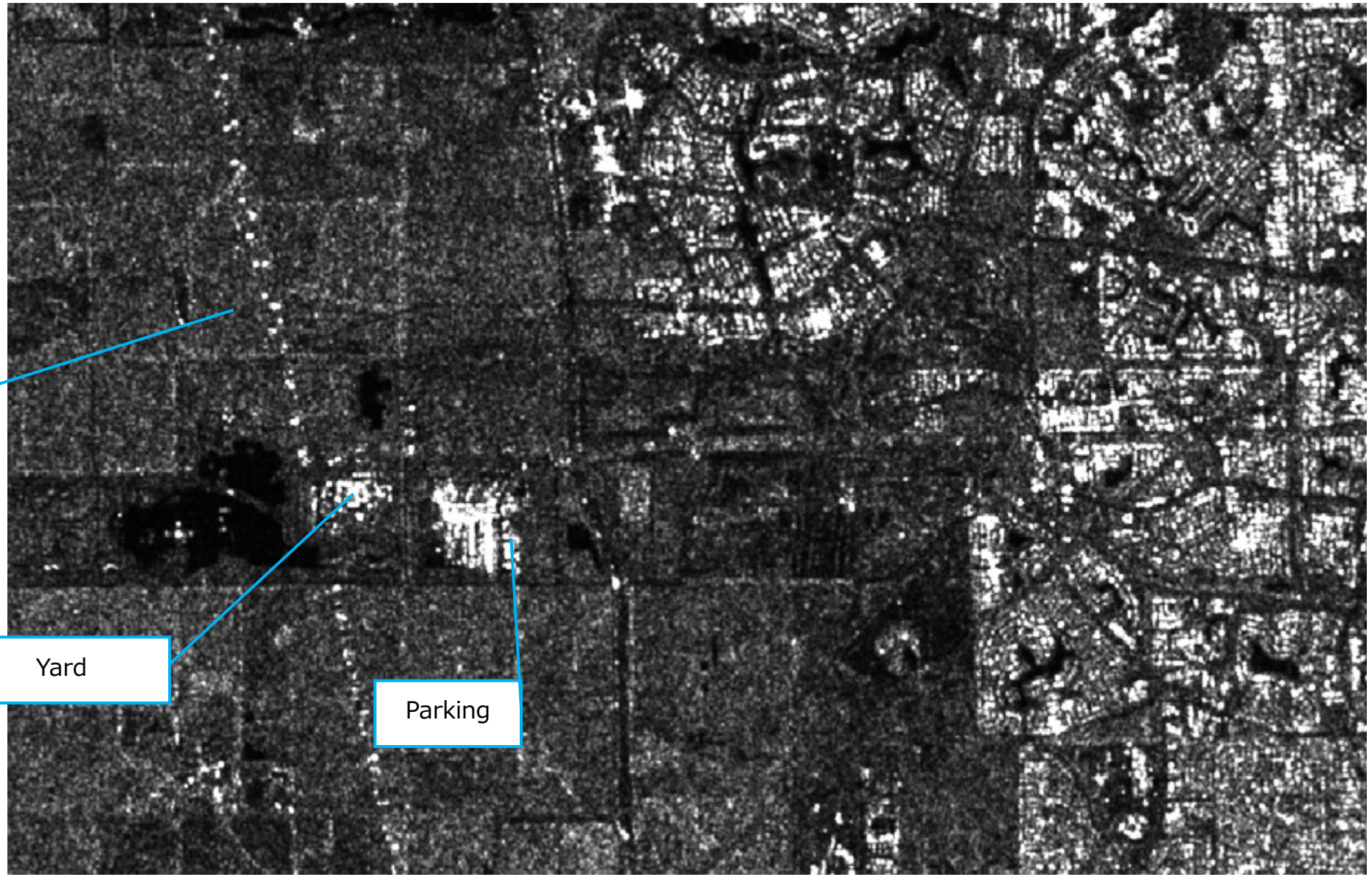
Mar 2015

Oct 2021

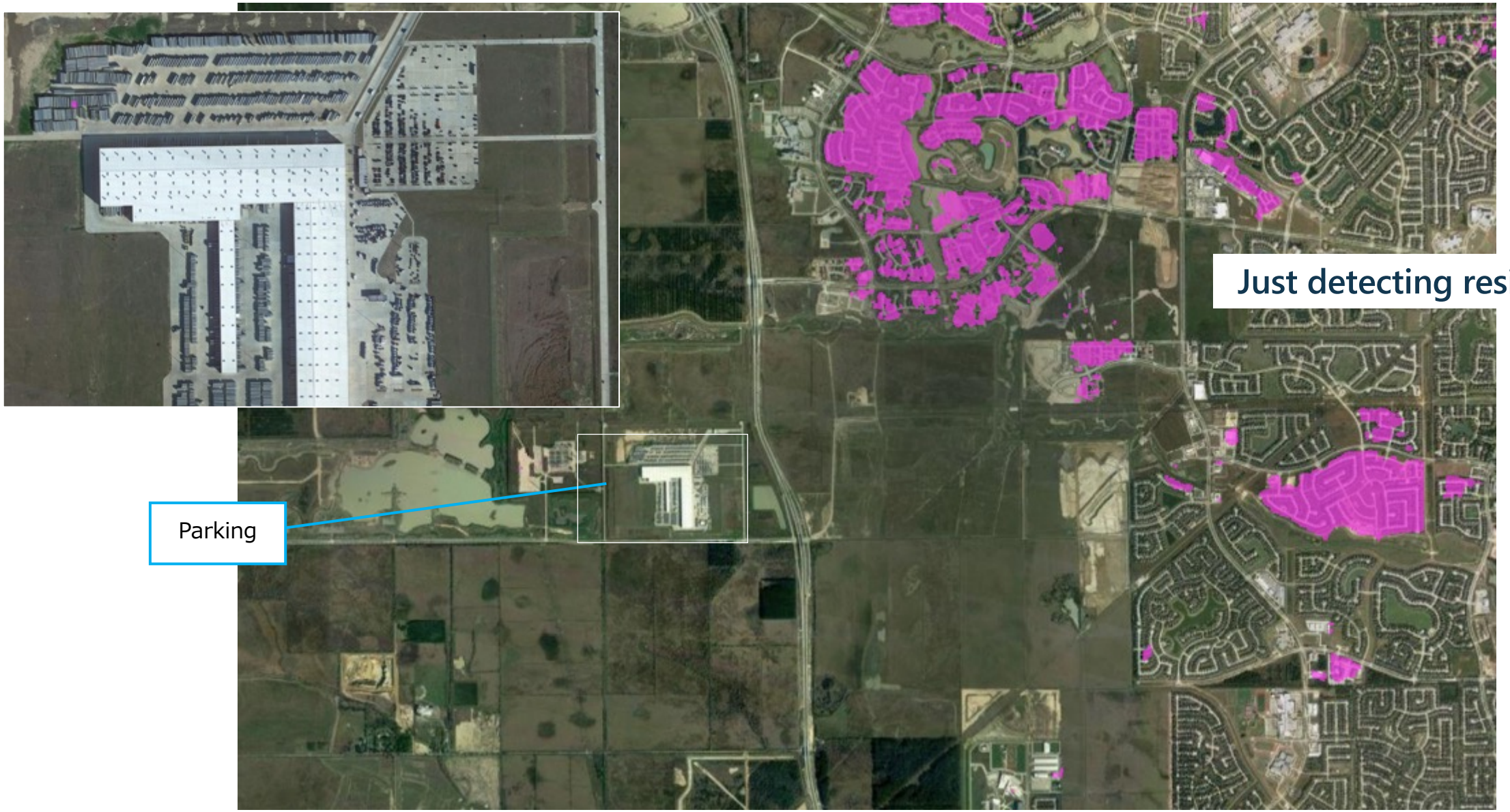
New Building detection



New Building detection



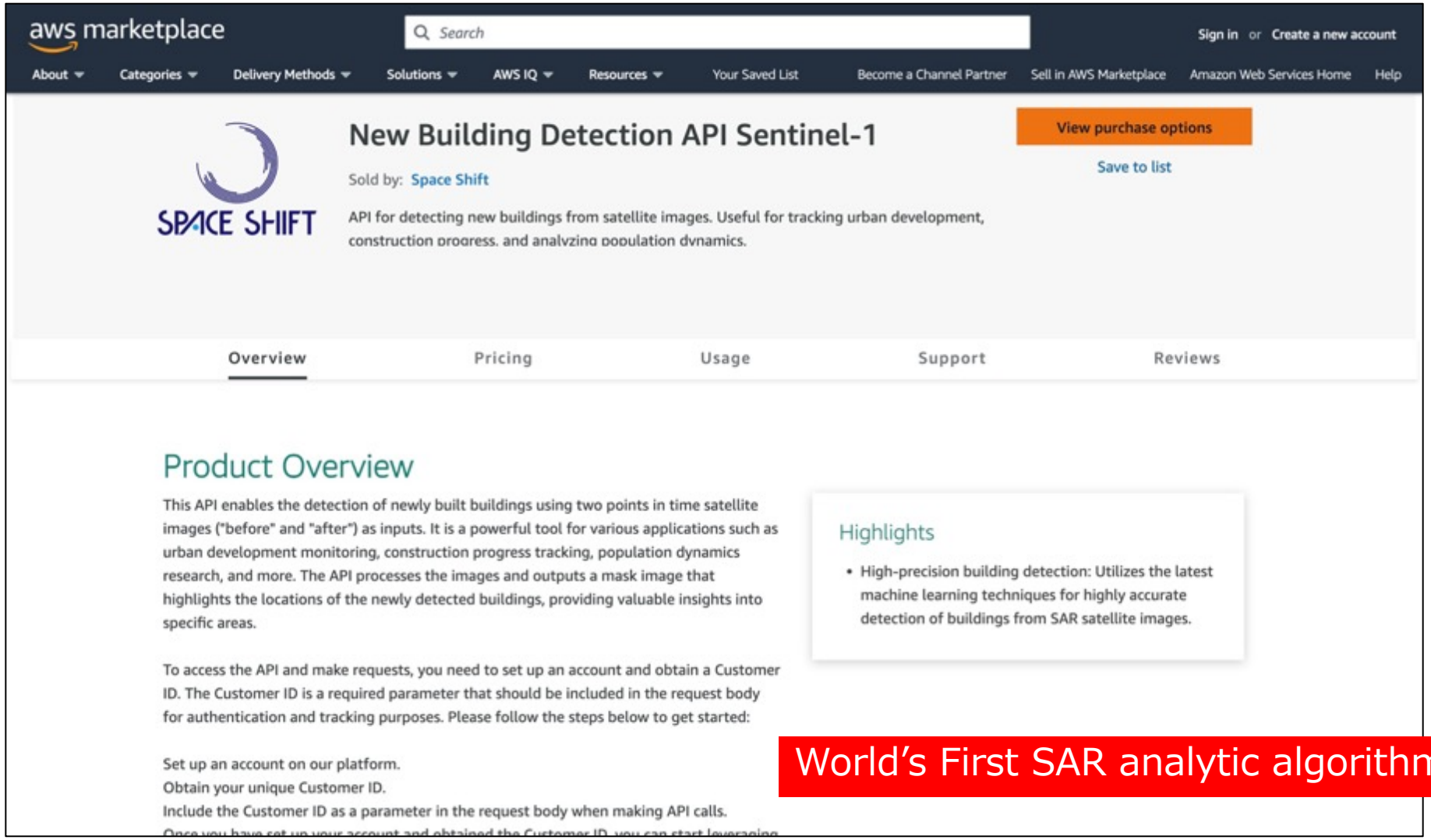
New Building detection



Just detecting residential area

New Building detection

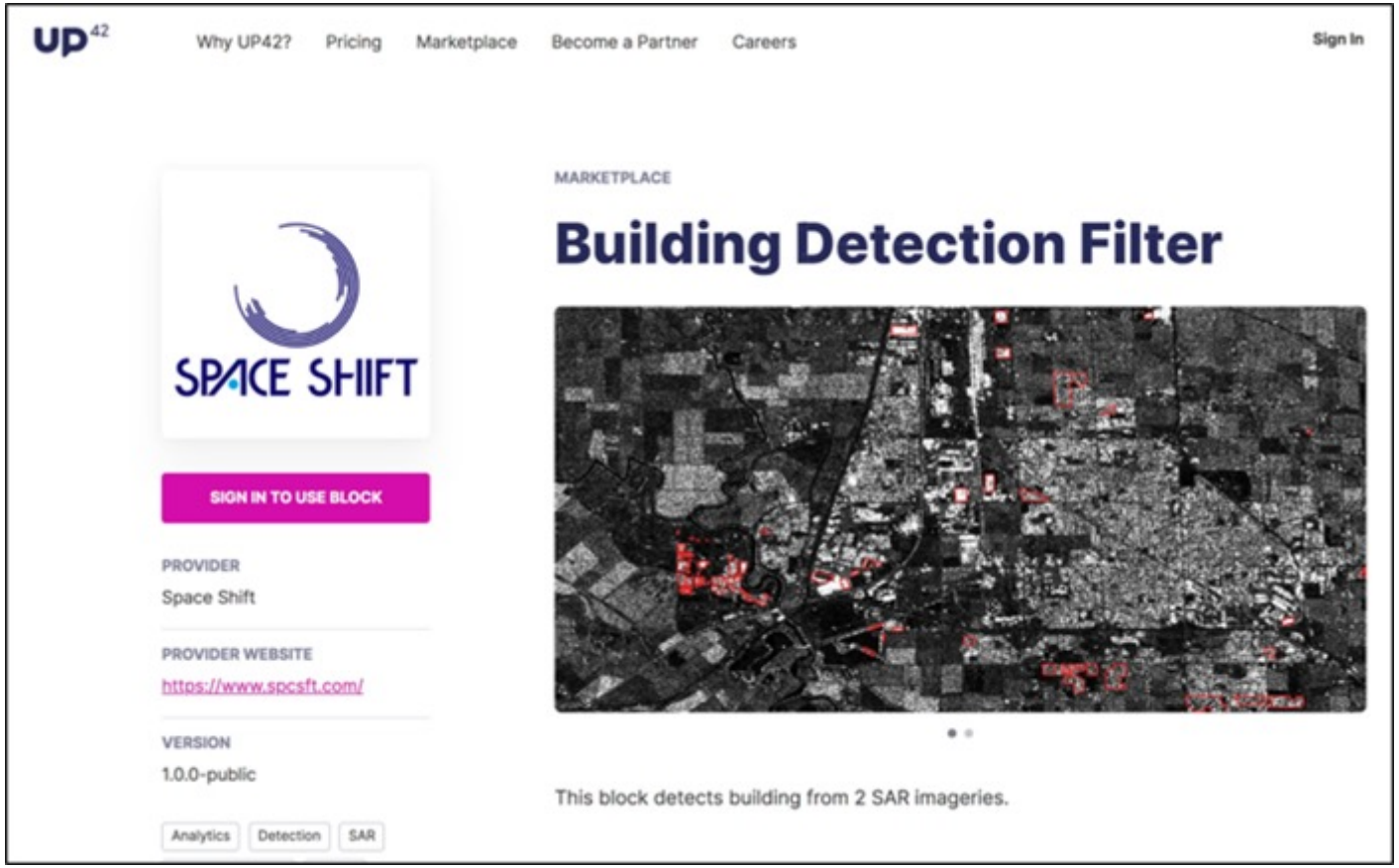
Available on AWS marketplace. Users can use our algorithm with Sentinel1 data hosted on AWS.



World's First SAR analytic algorithm on AWS!

New Building detection

New Building Detection



AIRBUS GROUP

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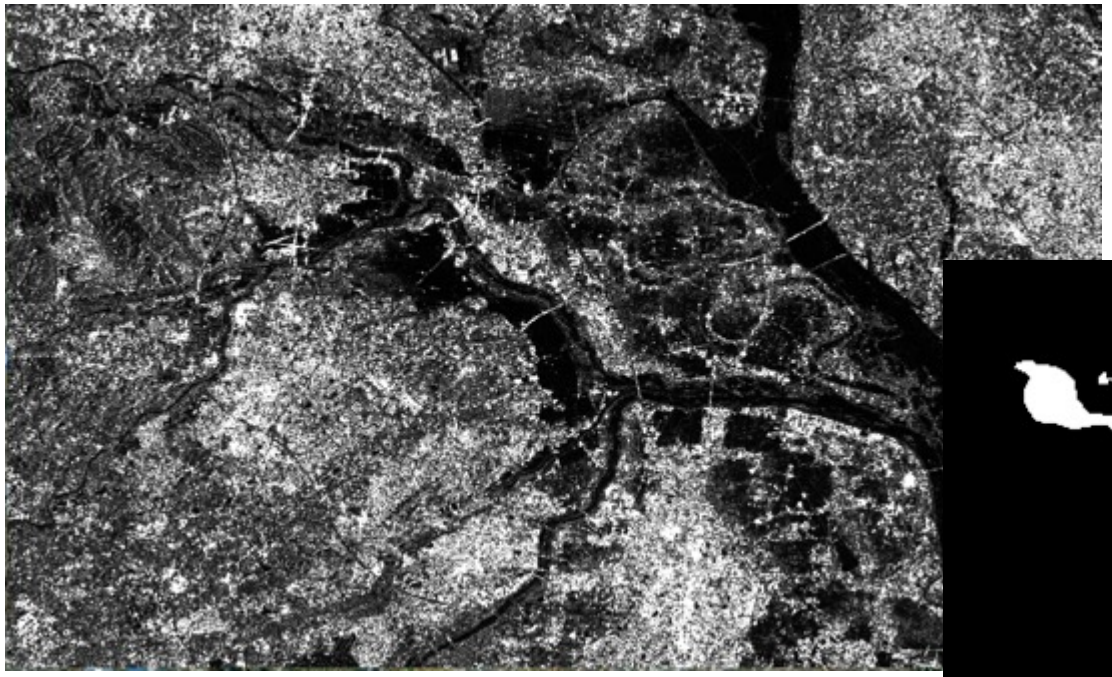
SPACE SHIFT

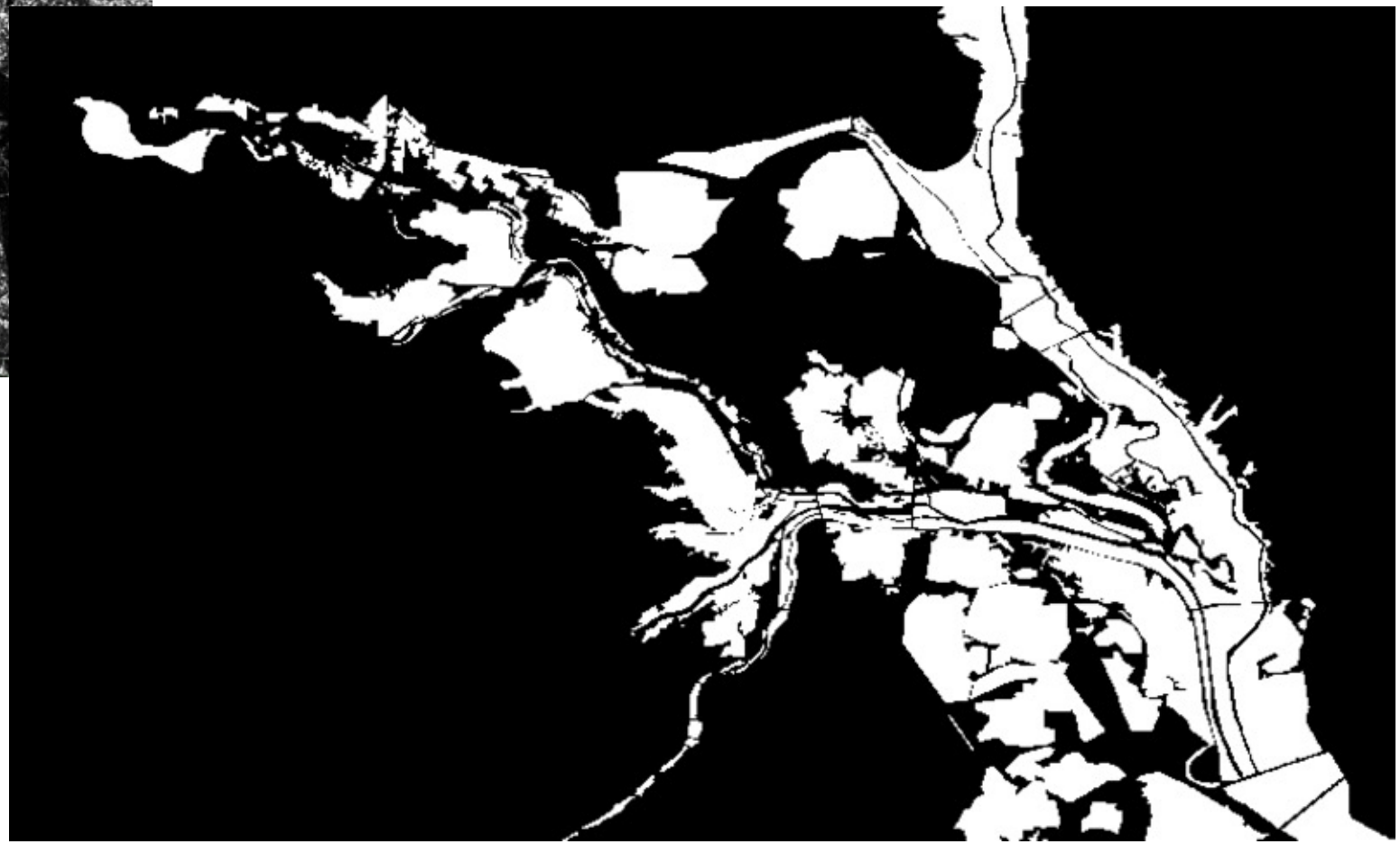
Our Algorithm has been offered as a service on the satellite data platform operated by UP42 (an AIRBUS company).

This technology can be used for highly accurate situation monitoring in areas lacking ground data, such as emerging countries and depopulated areas, as well as for forecasting economic indicators by observing urbanization trends.

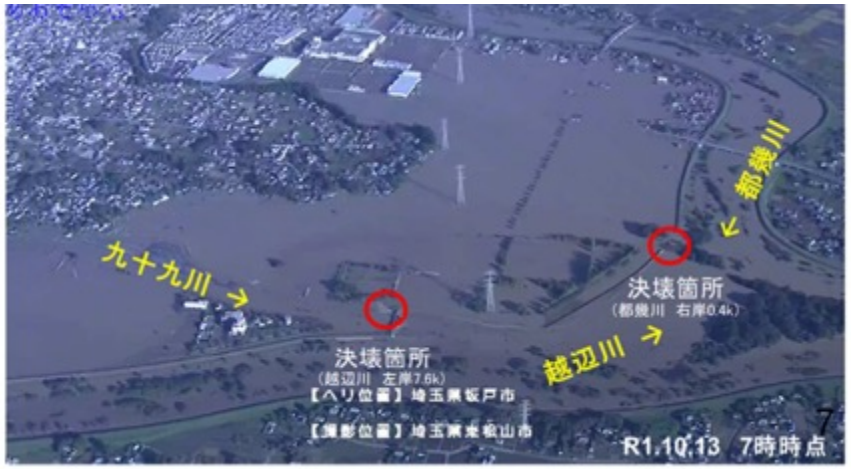
SPACE SHIFT



Flood area analysis with TOYOTA



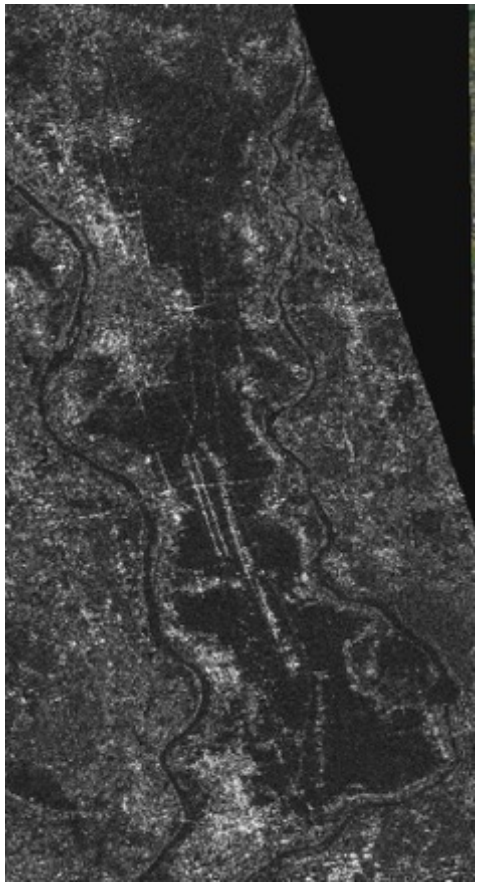
Aerial Photo



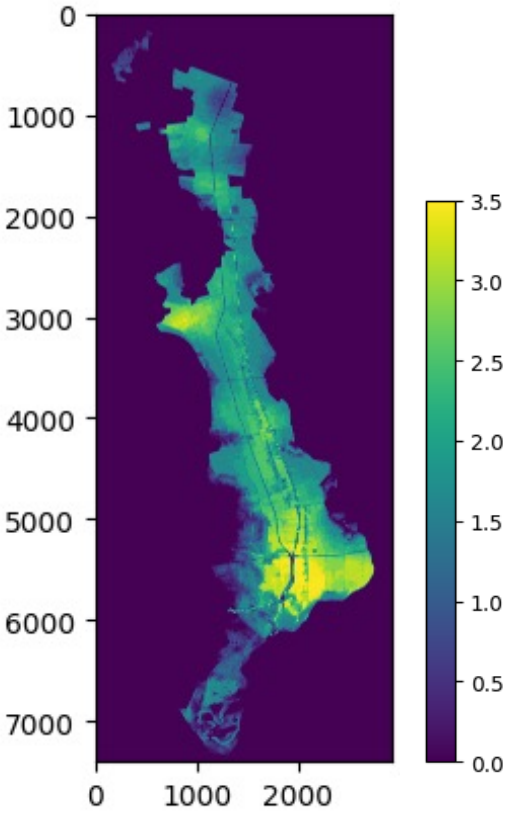
Disaster Monitoring

Aerial Photo

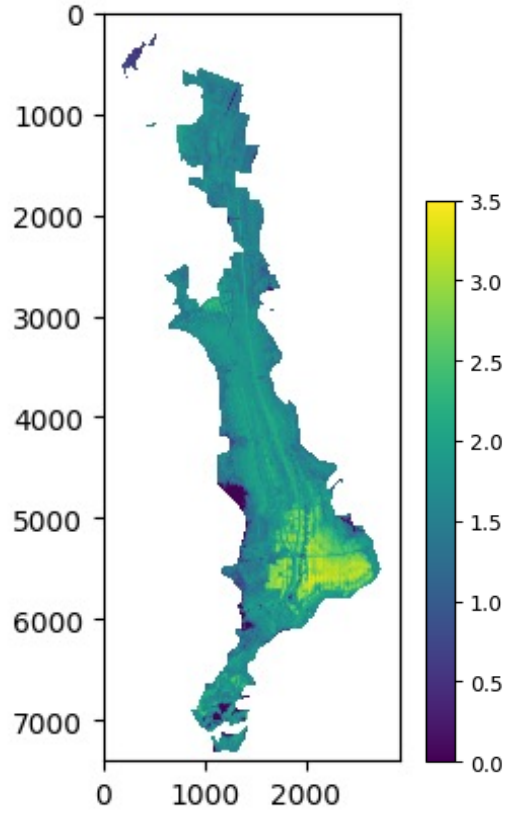
SAR satellite



Actual Depth

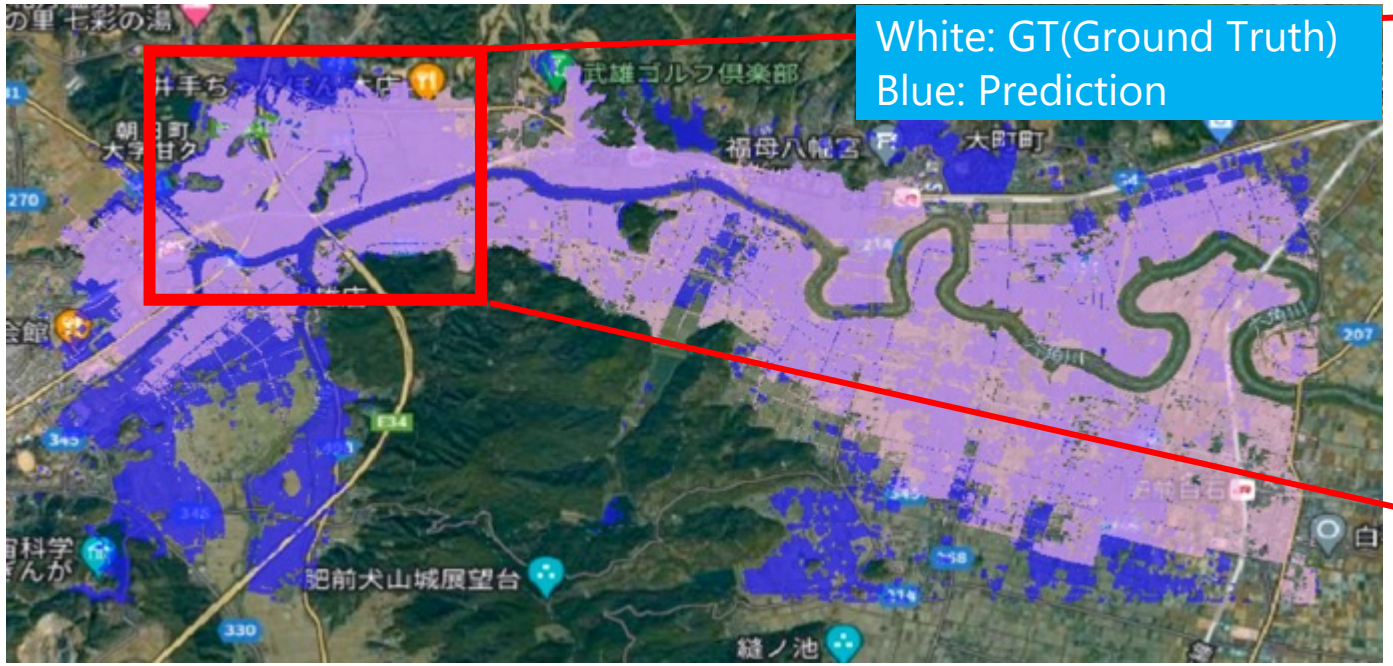


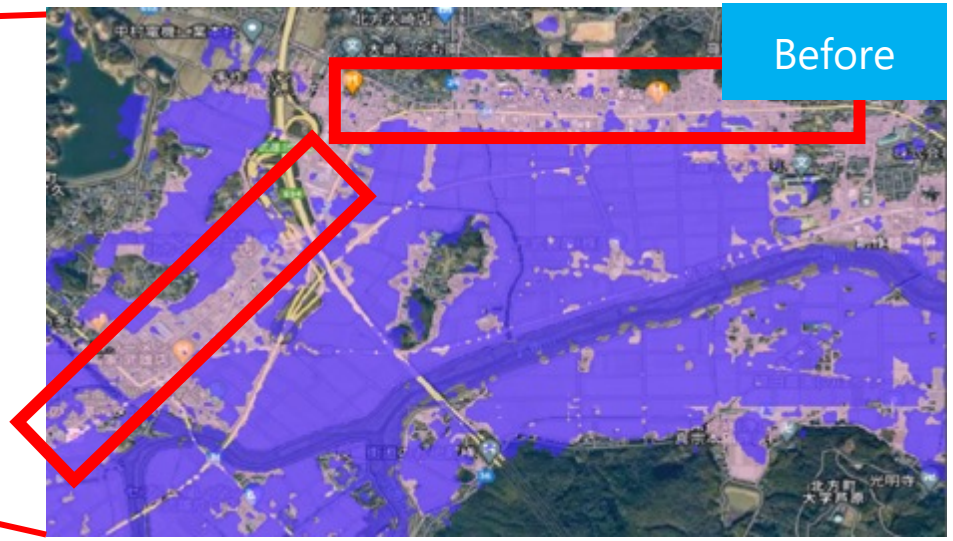
Predicted Depth



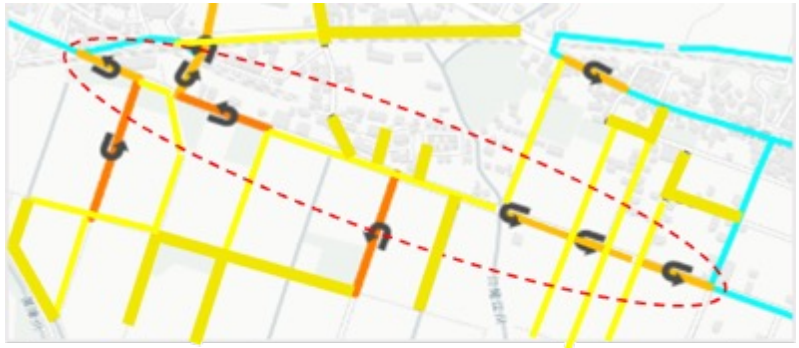
By combining data from the inundation area with existing elevation information, we will detect the degree of inundation (inundation depth), which has been done in field surveys so far. It is expected to be used as highly real-time disaster prevention information, such as confirming the situation in the event of flood damage, which could not be realized by on-site surveys after the water recedes. This technology is being considered for introduction by local governments and insurance companies.

Disaster Monitoring

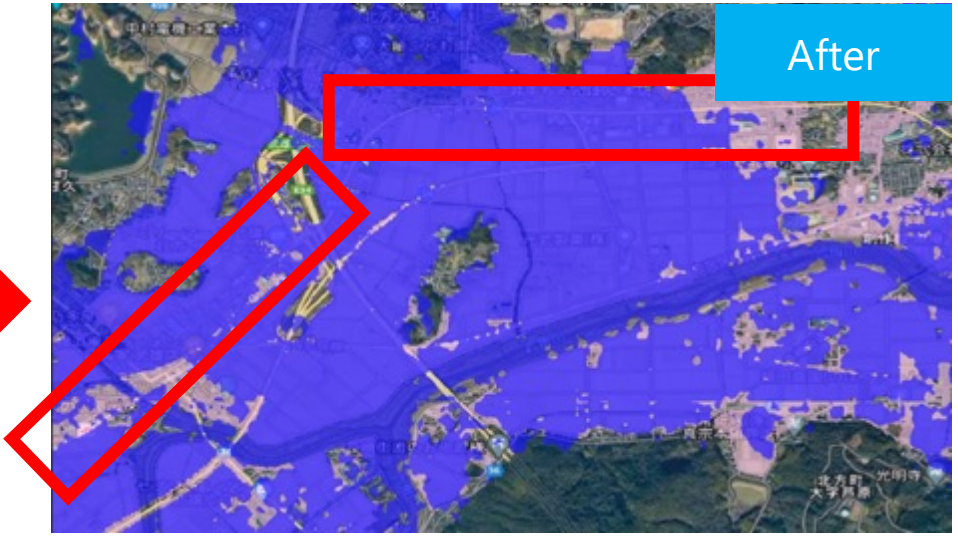




SAR satellites were able to complement residential areas where changes were difficult to capture.



Car movement data from TOYOTA



Vegetable distribution forecasting

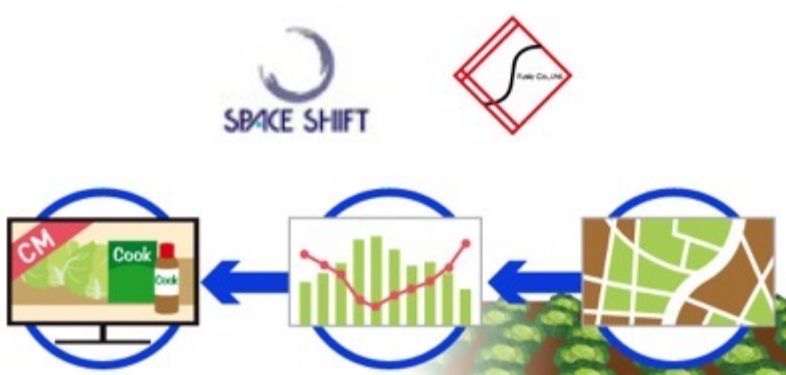
World's Fifth Advertisement Agency

dentsu group

- Satellite data analysis is used to predict the quantity, timing, and price of vegetable shipments.
- Optimize timing of TV commercial for seasonings for vegetables to maximize its sales for their clients

JAXA

JAXA will use AI to develop technology to supplement satellite data loss due to cloud effects, etc.



Developing a system for predicting supply and demand of agricultural products to reduce food waste and realize a sustainable society

Optimization of TV commercial planning

Vegetable distribution forecasting

Broadcasting cooking source commercials at a time when cabbage prices are falling correlates with higher product sales. Based on the amount of cabbage shipments predicted by satellite data analysis, we assisted an advertising company in developing a plan for broadcasting TV commercials.

Supply chain

Production

Harvesting

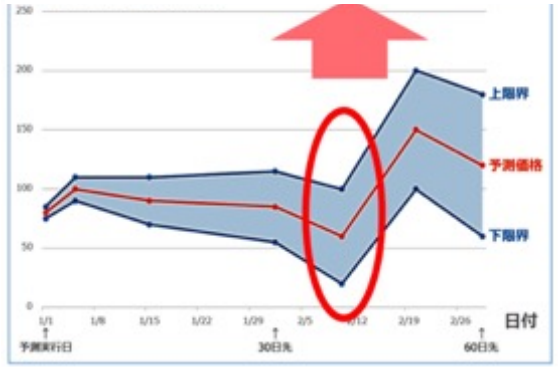
Logistics

Product marketing

Satellite data analysis

- Monitoring cabbage growth status and predicts production volume through AI analysis with satellite data
- Predicts cabbage prices two months from now based on the results of the production forecast

Predicting when cabbage prices are low and planning the timing of commercial broadcasting



Provides useful information to supply chain stakeholders in addition to advertising companies

Agricultural distributor

Are there any areas that are likely to be overproduced?
How much area is planted?
How much area is being planted?

What is the production status of agricultural products related to your products?
I want to increase sales through efficient commercial placement.

In addition to determining when to place commercials, the ability to understand production conditions in other regions can be used to make decisions such as shifting the timing of your harvesting, planting, or shifting to other crops that are in high demand. And the optimization of the distribution of agricultural products contributes to the reduction of food loss.

Examples of Our solution

Growth of cabbage filed observed by optical satellite

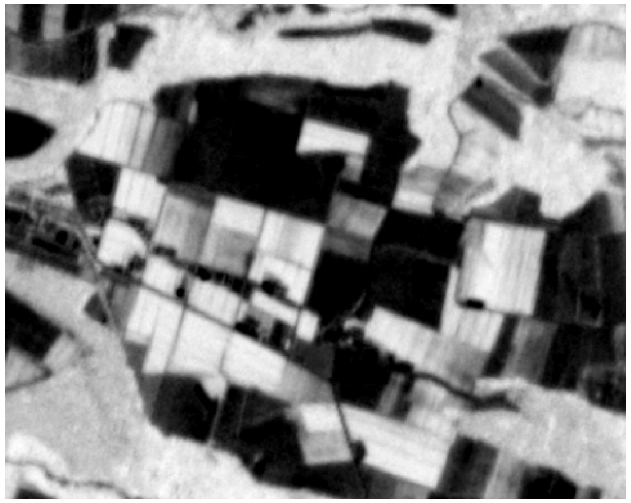
Jun 20, 2017

July 20, 2017

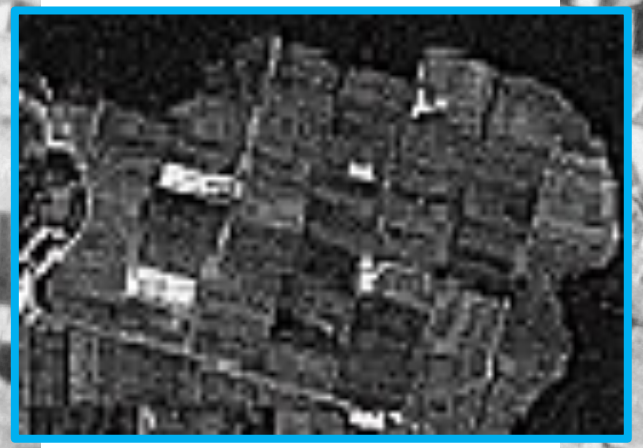
Just one data between these 2 periods

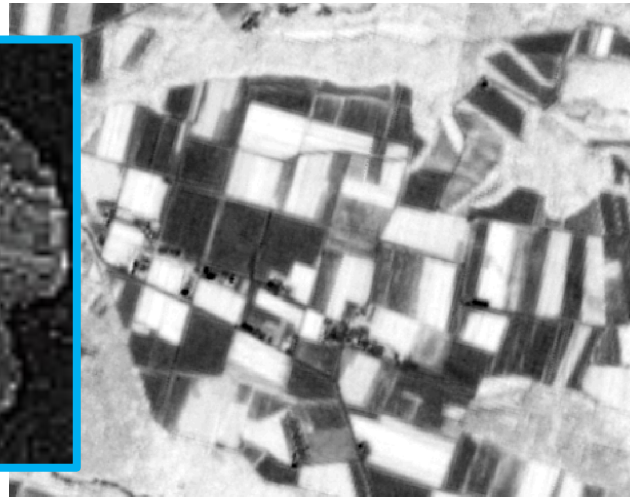
Sep 10, 2017

NDVI processed images



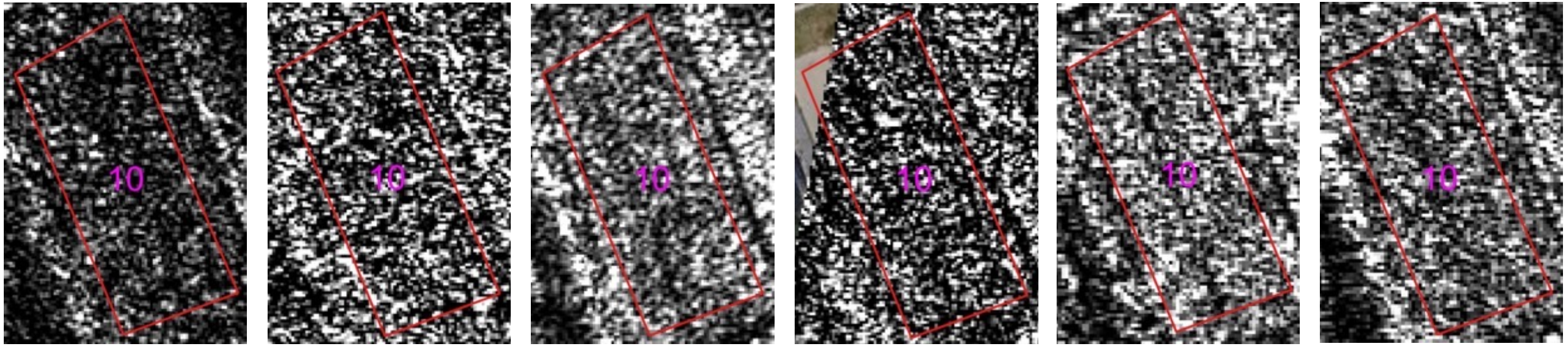
Interpolating with SAR data





SAR analysis of green onion growth using actual farm

Micro SAR Data



6/23 7/4 7/20 7/28 8/25 8/29

Real photo on the ground

SAR analysis of green onion growth using actual farm

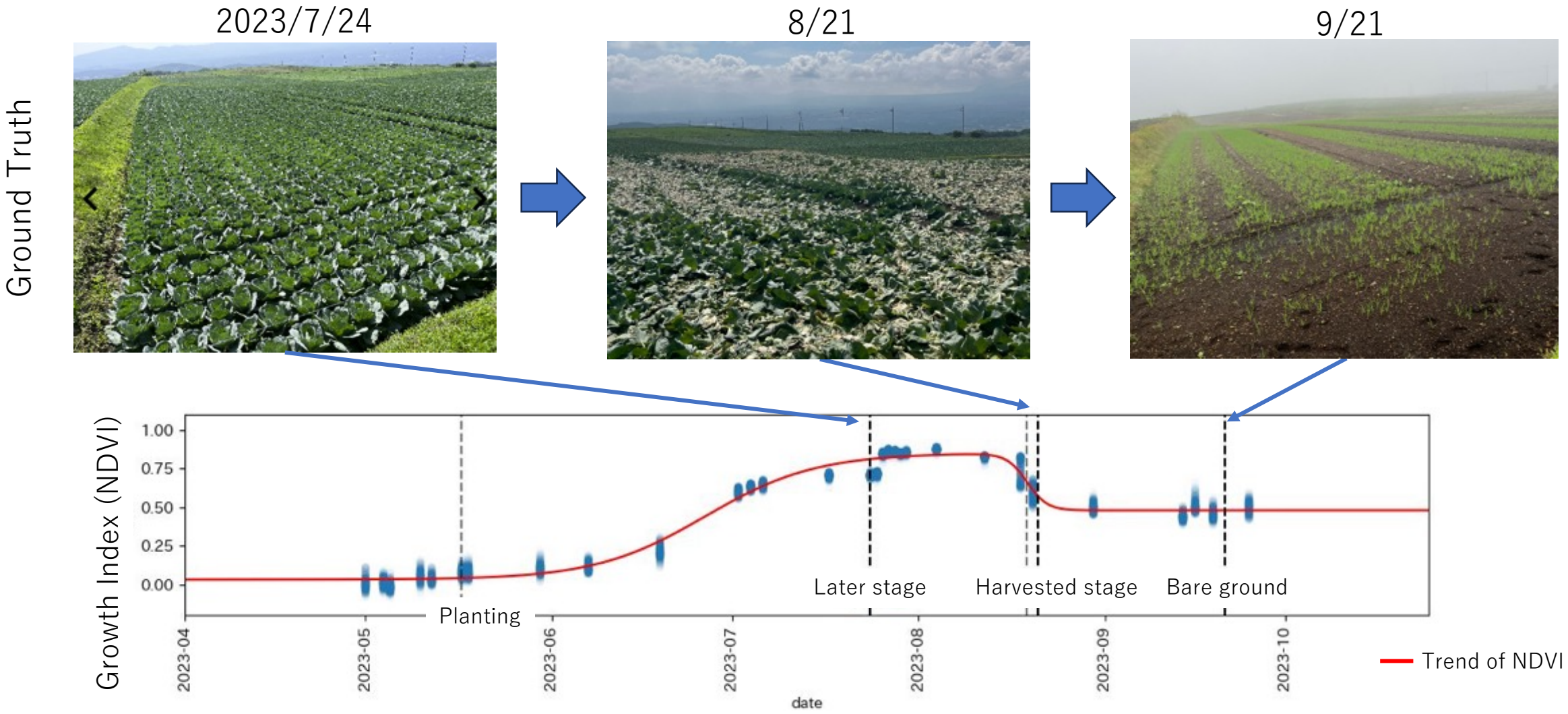
Measure and record the length and width

Measuring spectrum with a spectrometer to measure growth with leaf color

Taken photo

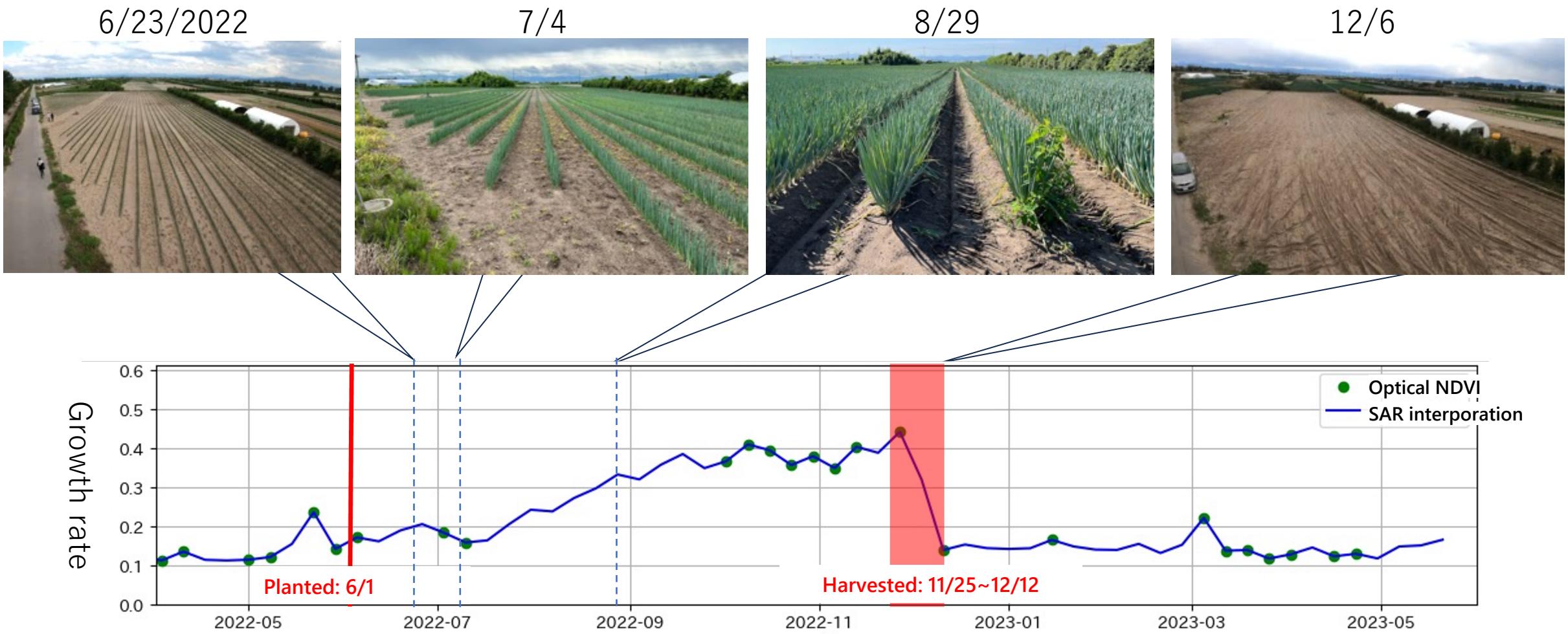
Take photo of the entire area from the tall pole near the field

SAR and Optical synthesis for vegetable growth (Cabbage)



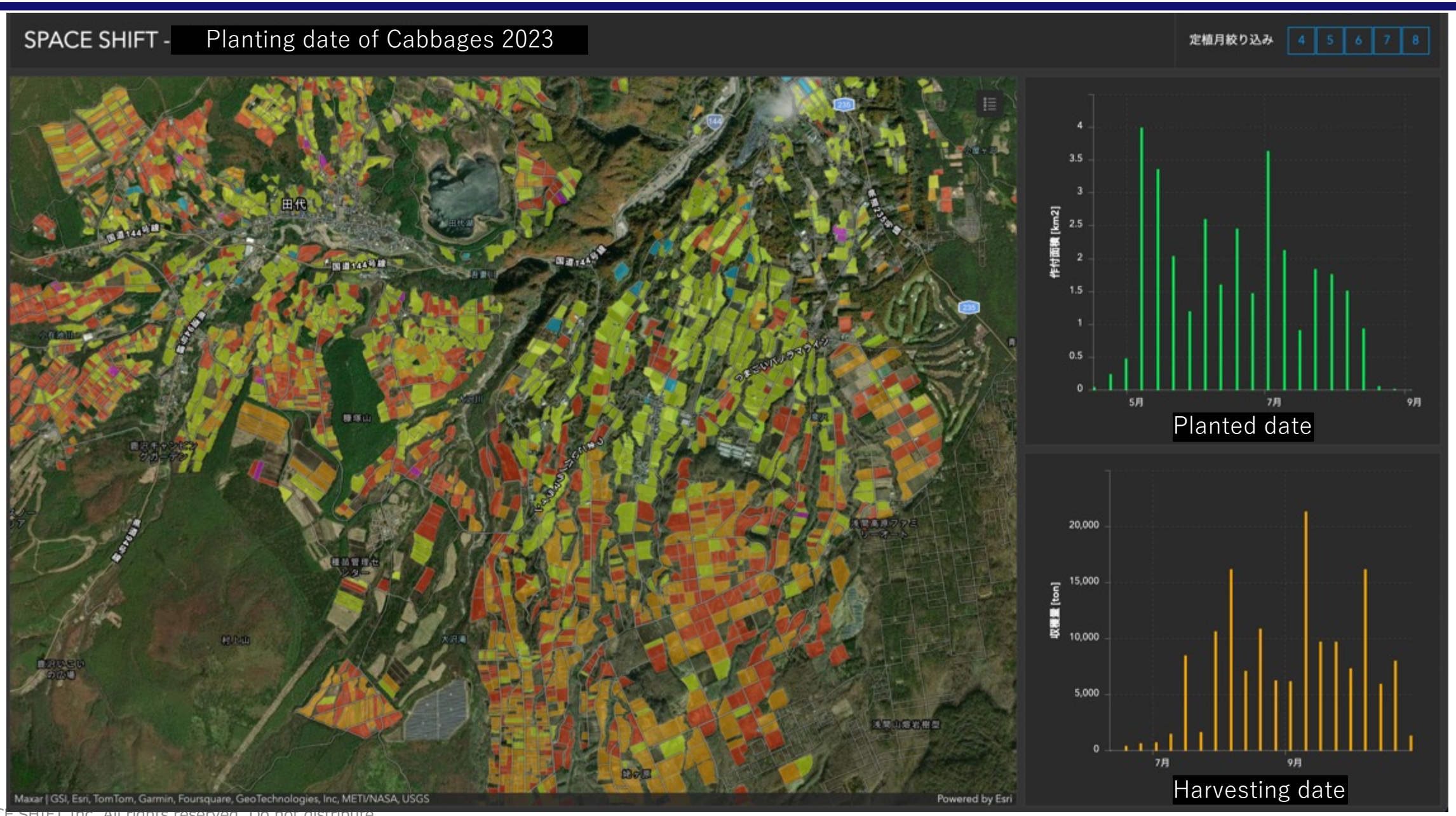
- Precise detection of planting period and harvesting
- **This analysis has been done with Sentinel1(SAR) and 2(Optical) to interpolate cloudy optical scenes.**

SAR and Optical synthesis for vegetable growth (Green Onion)



- Vegitable growth monitoring for each single paddy with open free data
- Observation on green dots are made by Optical. Others are by SAR interporation.

Planting and Harvesting date projection



Vegetable distribution forecasting

- **Total Production Forecasting for Primary Industries**
- **Production Volume Optimization/Distribution Control/Consumption control**

Hyper Spectral | Optical | SAR

Total Production Volume

Optical | SAR

Harvesting status

Ground data

Market price

Ground data

Marketing products related to the crops

Feed back

Farmer

What is the situation in other areas?

When should we ship to maximize profit?

Distributor

Are there any areas of potential overproduction?

How many acres will be planted this year?

I want to monitor production status in real time.

Ad Agency

I need to predict the circulating price two months from now.

I want to make harvest forecasts that weather models cannot predict.

I'd like to plan and market an ad for a related product at a time when prices are going down.

Food Company

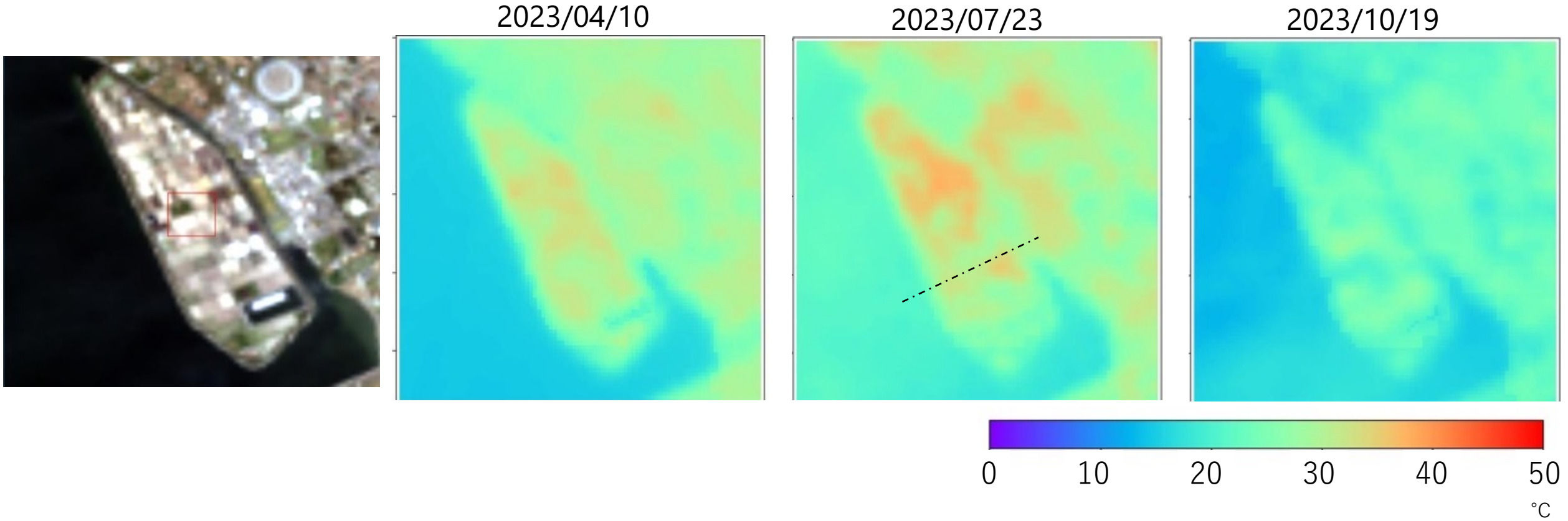
I want to increase sales through efficient commercial placement.

Utilizing Satellite Data Analysis Improving the Efficiency of Crop Distribution

Different use values for different stakeholders

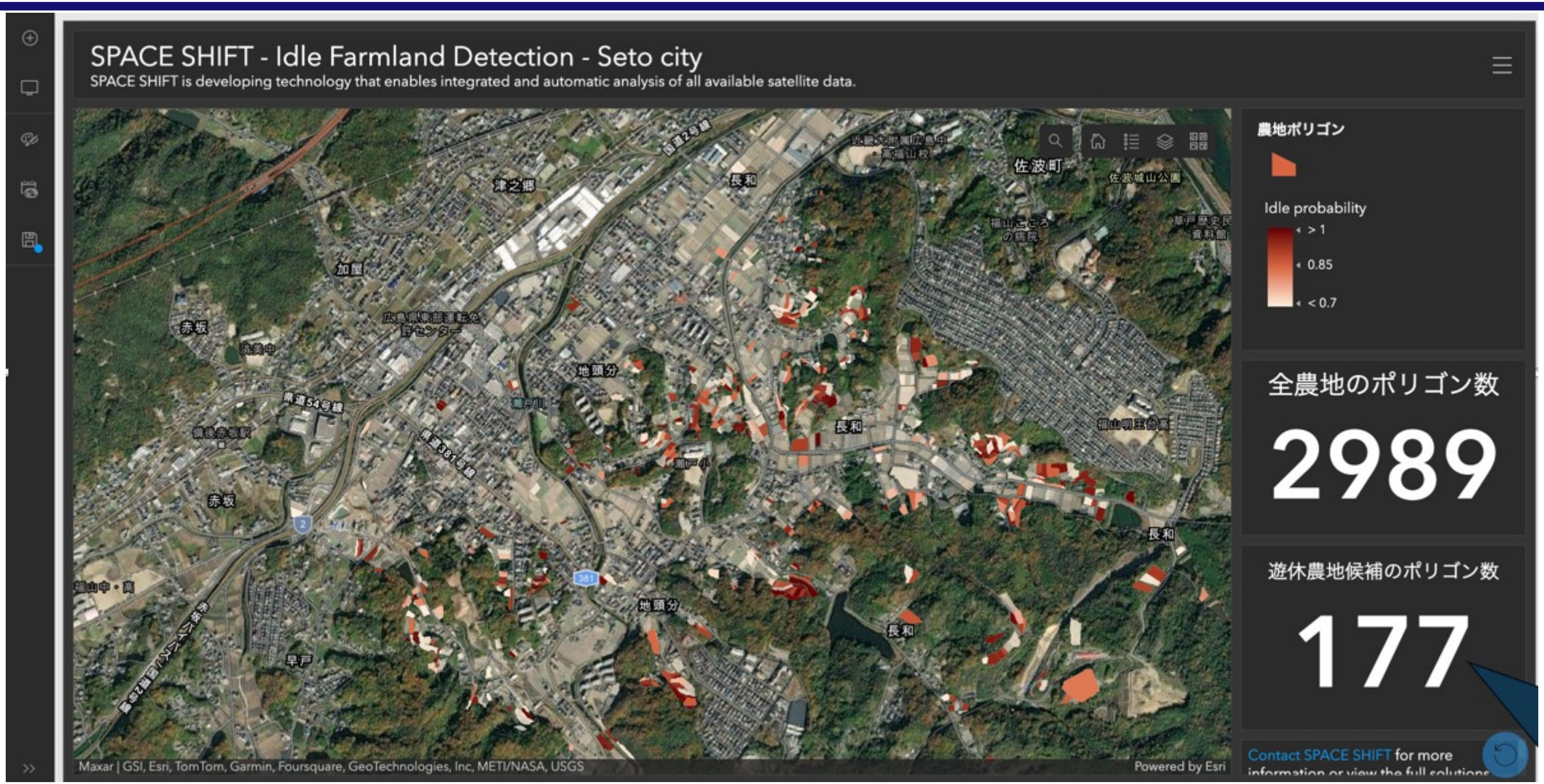
Measurement of ground temperature

Measurement of ground temperature by Landsat



- Confirmed damaged plants are tending to be in higher temp area
- Can be used for searching better area or finding better conditions for the plant

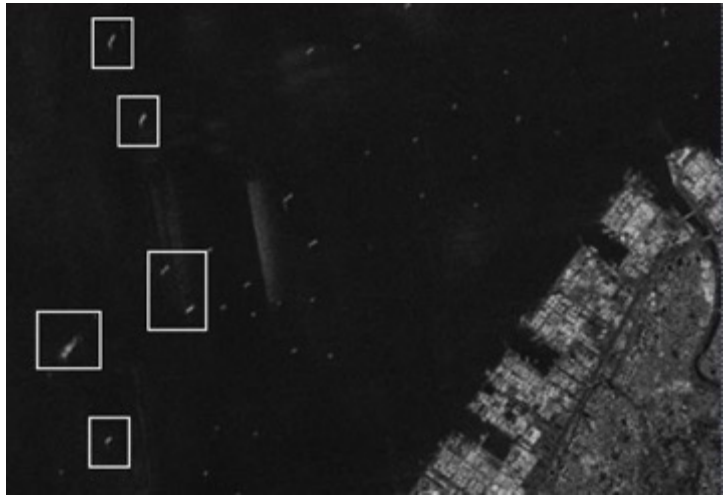
Idle Farm Detection



Maritime

SAR is very capable to capture maritime situations. Lots of algorithms and usecases are already developed and expand its applications.

Ship detection



Detection of Ships by AI

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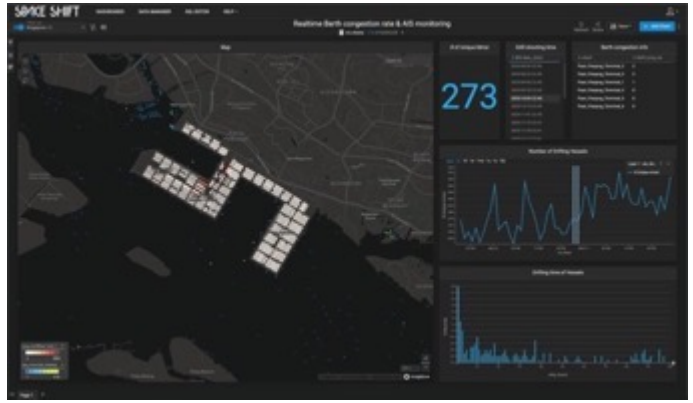
Maritime domain awareness
Route Optimization

Port monitoring



Monitoring of containers at the port by SAR satellite data

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AIS signal information

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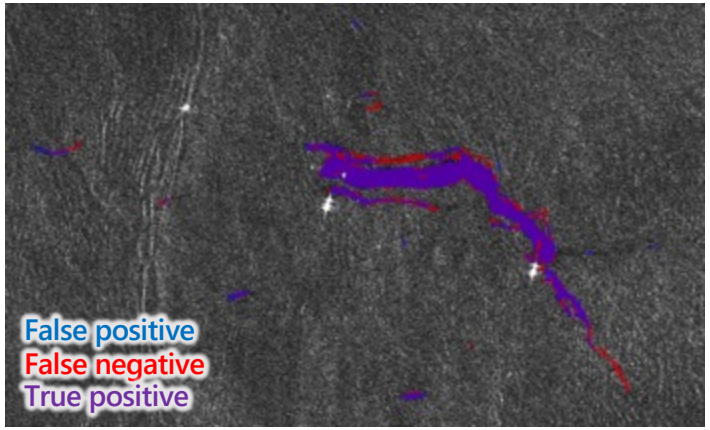
Port congestion prediction

Oil-Spill detection



Detection of oil-spills caused by accident or offshore oil

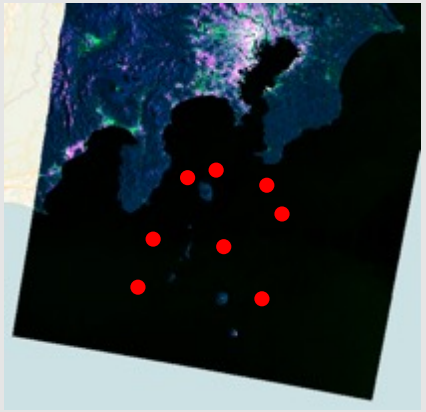
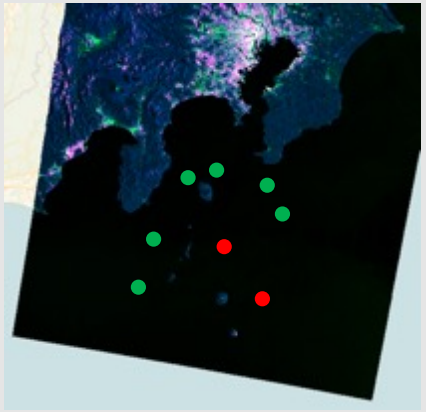
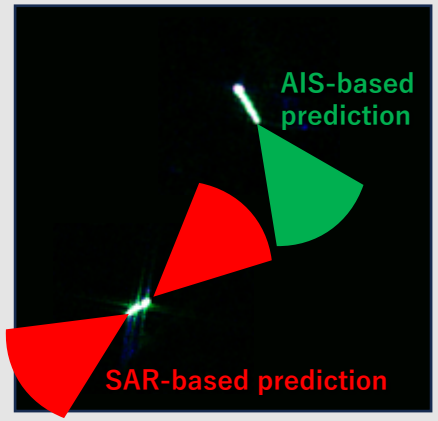
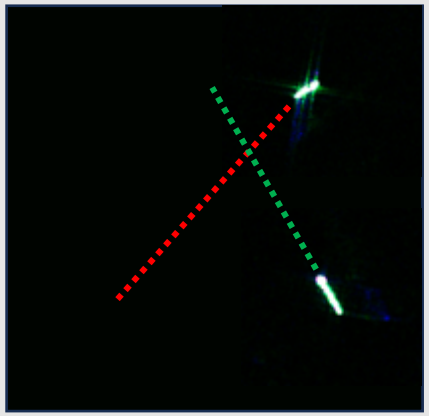
Others

- Fishery monitoring
  Fish Farming
- Offshore Wind power
- MDA

Maritime

Utilizing Multiple Satellite with data fusion

- Tracking ships requires integration of various resources, especially AIS and SAR satellite data.
- Space Shift are working with various satellite data providers to track Dark ships (no AIS signal).

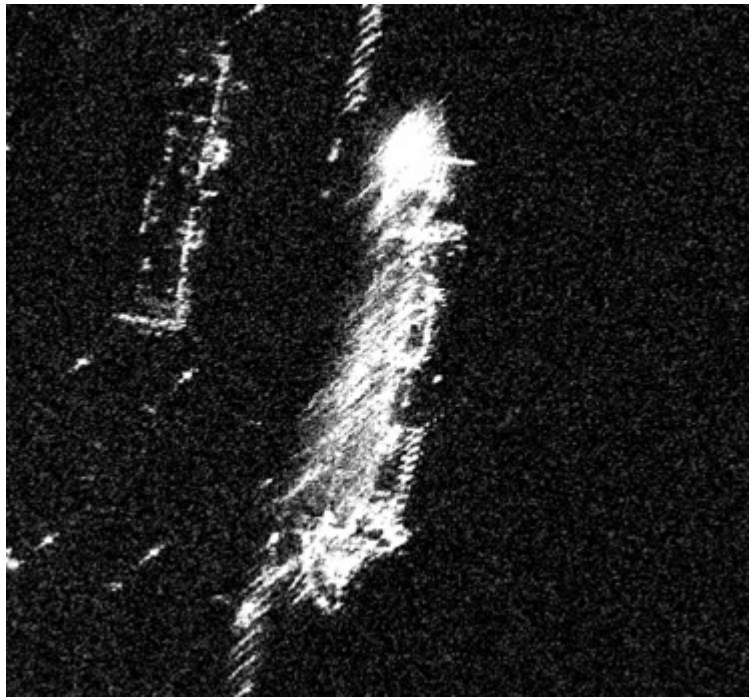
Detection	Identification	Prediction	Tracking	Activity
		Satellite AIS		
Wide-area SAR satellite		Tip& Cue	High-resolution SAR satellite	In-Situ operation
Detecting ships in large area	AIS matchup To detect Dark ships	Ship track prediction	Tracking specific vessels	Control activities, etc.
				

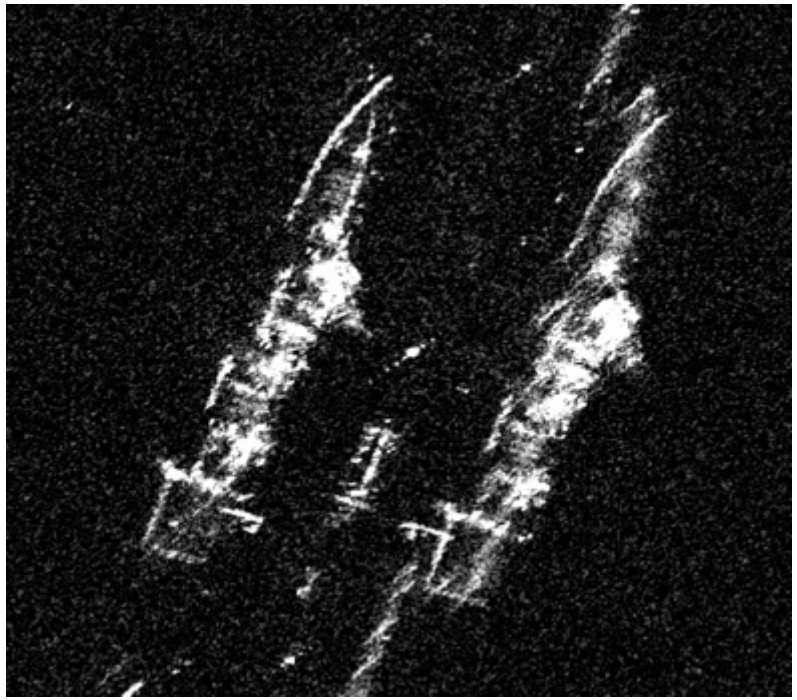
Role of Space Shift

- **Algorithm developer** to fuse information from various data sources
- **Cooperative relationships with all of SAR satellite data providers**

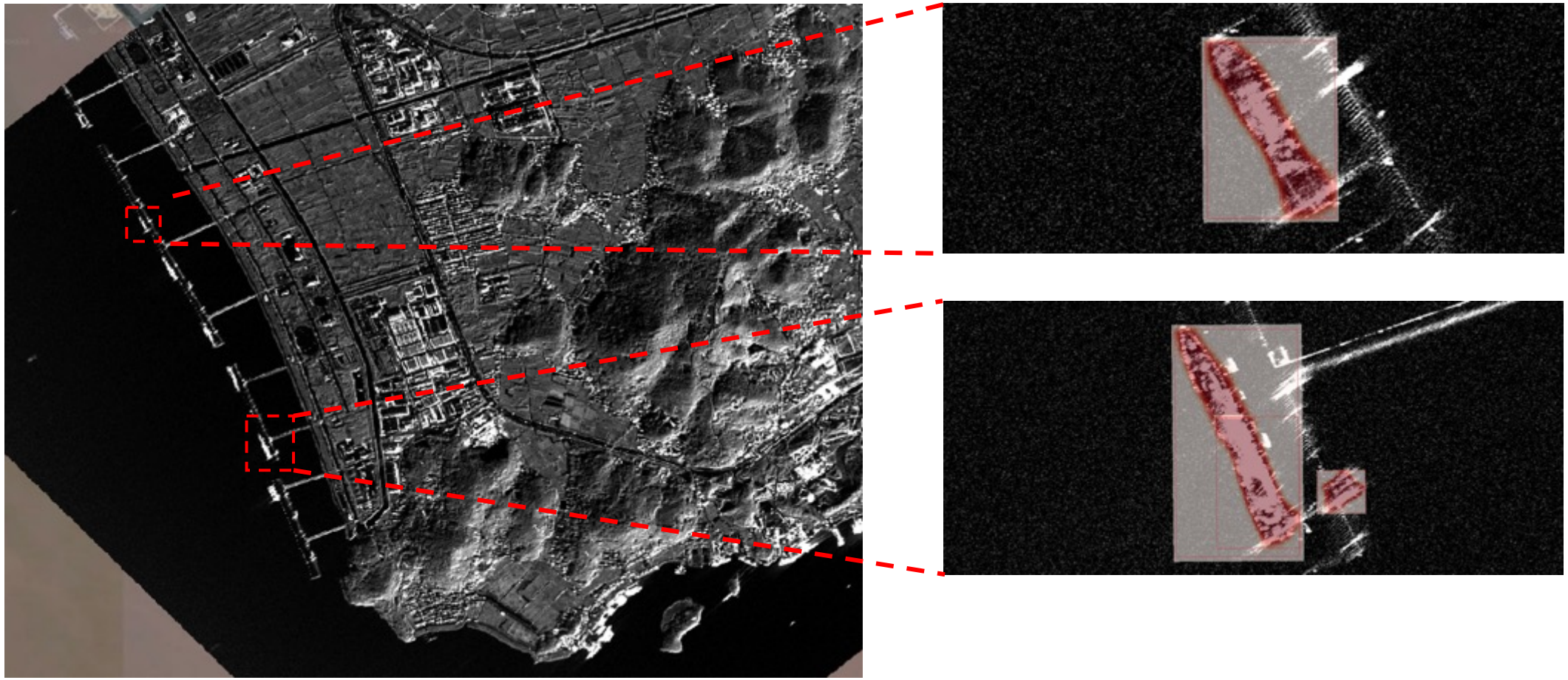
Examples of Target

- Although the exact ship type cannot be determined this time, we have developed the model to detect Chinese military ships as shown in the right.
- This time we targeted military ships, but we would like to target other type of ships in the future.





Summary of Result



Our algorithm successfully detects anchored ships and has good performance with mAP >= 0.5