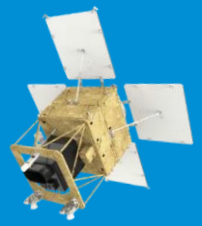
WORLD BANK GROUP | KOREA GREEN GROWTH TRUST FUND | Ministry of Finance and Economy | SEJONG CITY

Status and Perspectives of Utilizing Agricultural Satellite



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CAS(Compact Advanced Satellite)500-4,
Satellite for Agriculture and Forestry Monitoring
with 120km swath, 5m of spatial resolution

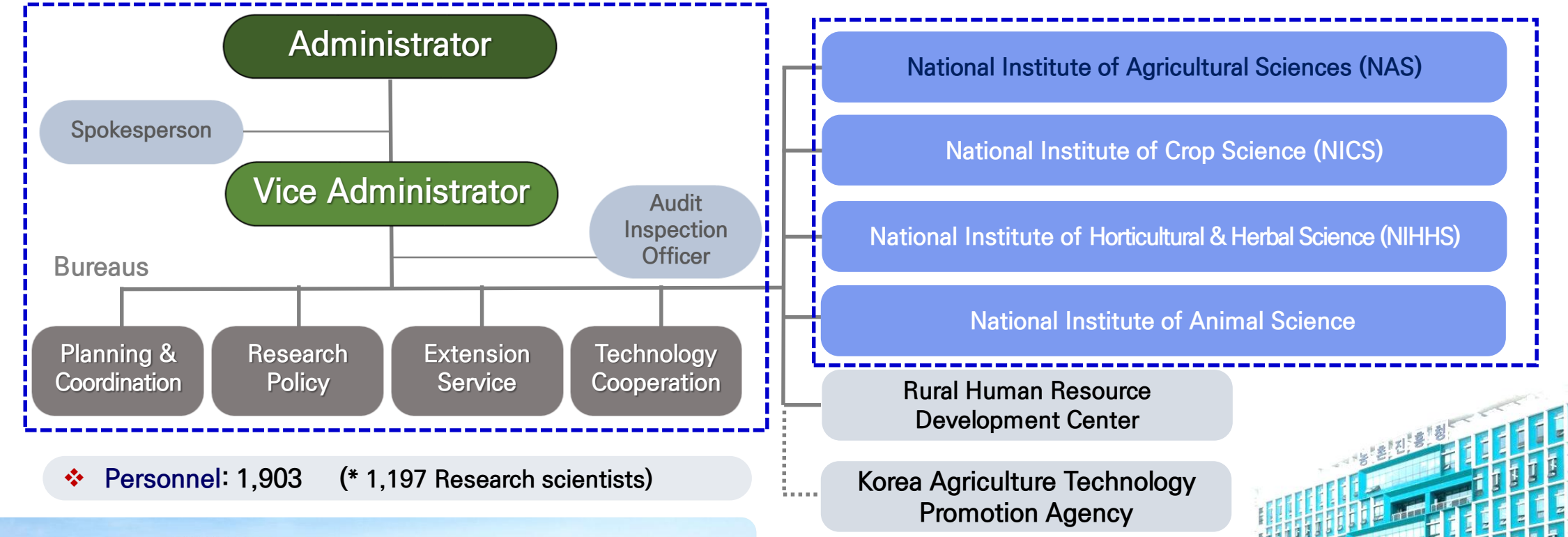
Suk Young Hong

Director, National Agricultural Satellite Center,
National Institute of Agricultural Sciences,
Rural Development Administration, Republic of Korea

Rural Development Administration
National Institute of Agricultural Sciences

Rural Development Administration (RDA)

RDA is **a Korean government agency** responsible for agricultural research, development, and extension services to improve rural livelihoods and advance the agricultural sector.

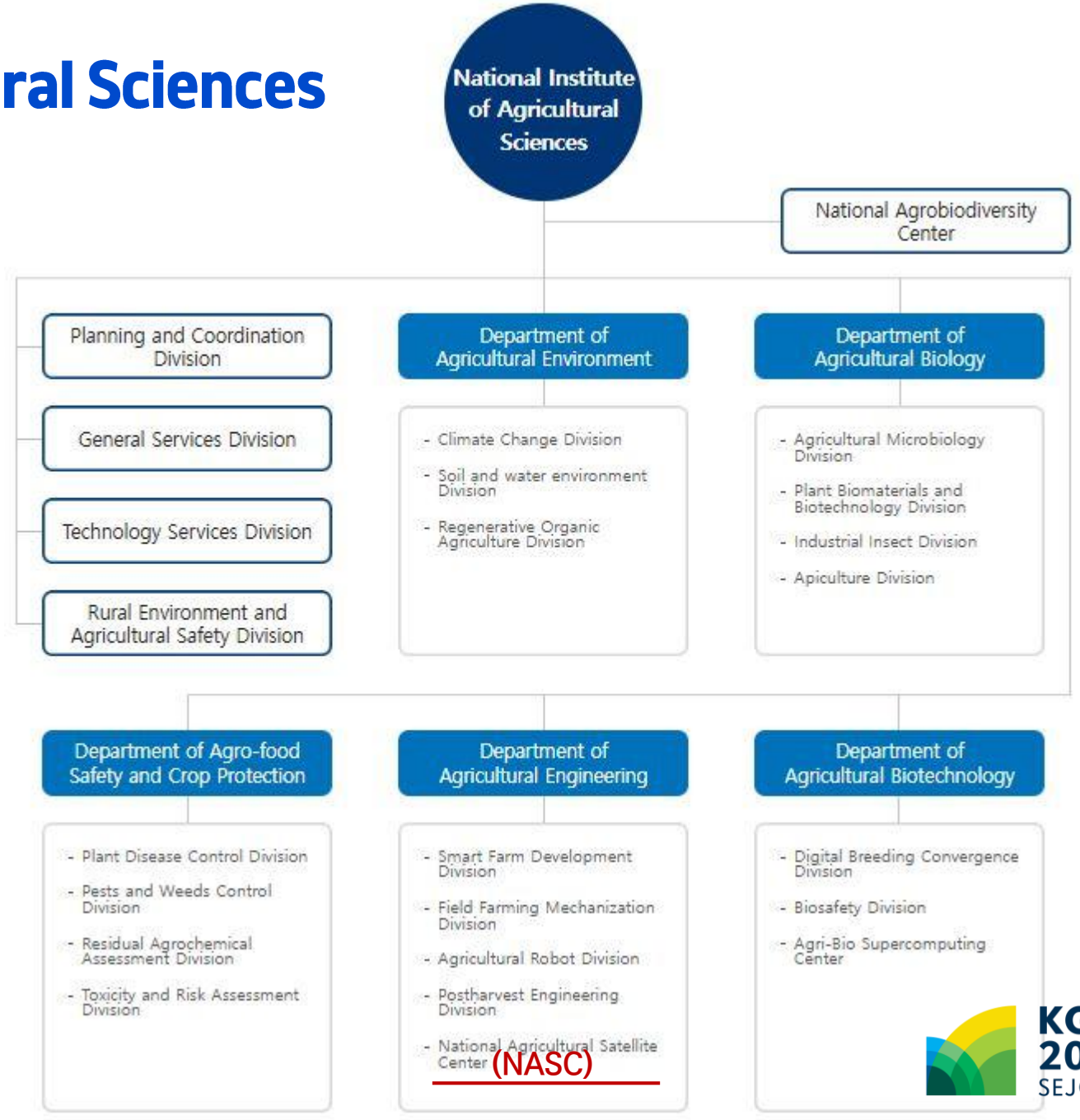


❖ Personnel: 1,903 (* 1,197 Research scientists)

National Institute of Agricultural Sciences

NIAS is a government research institute dedicated to advancing agricultural sciences and technology to improve agricultural productivity, sustainability, and food security.

❖ Personnel: 483



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Remote Sensing

A technique and the process that interprets bio-physical phenomena by sensing differently reflected or emissive energy signals of ground surface features(crop, soil, water, etc.)

RS Data collection

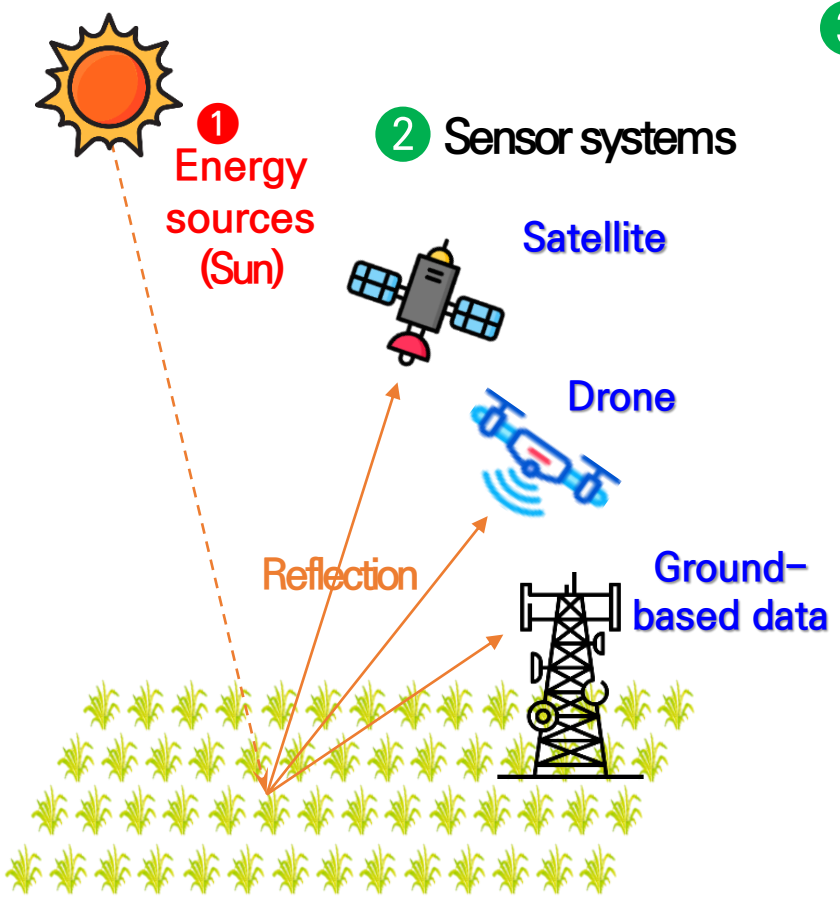
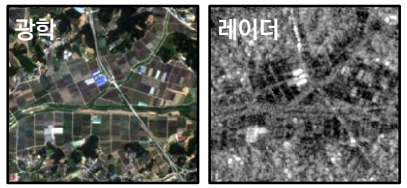


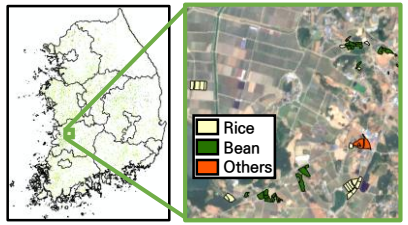
Image data analysis

3 Satellite image analysis(computing)

Data



Satellite



Field survey

SW

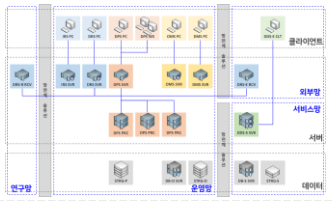
Deep learning

Crop/statistical models

OpenAPI (Plug-In)

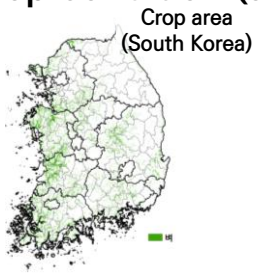
HW

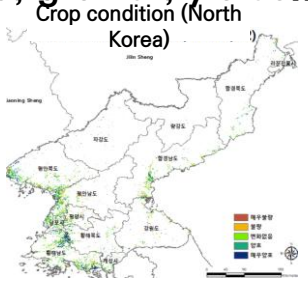
Ground station



4 Use of information(Applications)

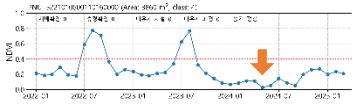
◦ Crop condition (area, growth, yields..)





◦ Disasters *Flood, drought, lodging, disease

◦ Land use changes



Background & Mission of NASC

✓ Operation of Agricultural Satellites
✓ Research on the Agricultural Use of Satellites

1995
<Soil Management Division>
Remote Sensing
Research Unit (lab.)
newly established
at the NIAS, RDA

2003
<Soil Management Division>
Soil information DB &
system management

2007
Top 100 National R&D Achievements

National Soil DB & Information System
https://soil.rda.go.kr

2012
Top 100 National R&D Achievements

Using optical and radar imagery
to observe and assess
agricultural production and environment

2012
CAS 500 planning
- demand submitted

12 satellites out of 106
were selected including
agricultural purposes

2014
<Climate and Ecology Division>
Remote sensing mission
strengthened

2018
Second phase CAS500 project was approved

CAS500-4 : Agriculture and Forestry
CAS500-5 : Water Resources
*2 satellites out of 12 in final

2019/2021
1) CAS500-4(Agriculture and Forestry Satellite) Development Project (multi-ministries)
2) Ground Station Project(RDA) : Image Preprocessing Algorithms, HW equipment, Building

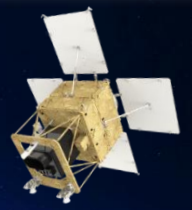
2020
Top 10 Representative Tech.
for coping with climate change

Estimating satellite imagery
to estimate major crop status

2024. 5. 14.
National Agricultural
Satellite Center (NASC)

NASC Road Map (2025~2030)

Vision



Implementation of smart agriculture and driving the creation of new markets in agricultural industry through “digital and AI transformation of agricultural observation”

Directions

- ◈ Seamless agricultural monitoring
- ◈ User-oriented satellite image product service
- ◈ Promoting the use of satellite images based on a cooperative system

Strategy(4) and Tasks(11)

① Satellite-based Crop growth and Cropland Monitoring	1.1 Satellite based Observation of Crop Condition 1.2 Satellite based Cropland Monitoring 1.3 Satellite based Risk Management of Ag. Disaster
② Analysis Ready Data (ARD) Service	2.1 Cal/Val of Basic Products of Agricultural Satellite 2.2 Analysis Ready Data (ARD) Service (L2~L3) 2.3 Agricultural Satellite Information Service (L4)
③ Stable Operation of Agricultural Satellite Ground Station	3.1 Stable Operation of Ag. Sat. Ground Station 3.2 Operation of Image Collection Planning Subsystem 3.3 Planning and Development of Follow-up Satellite
④ Promoting the Use of Agricultural Satellite Information	4.1 Cooperation or Agricultural Satellite Operation 4.2 Strengthening International Cooperation and Human Resources Training

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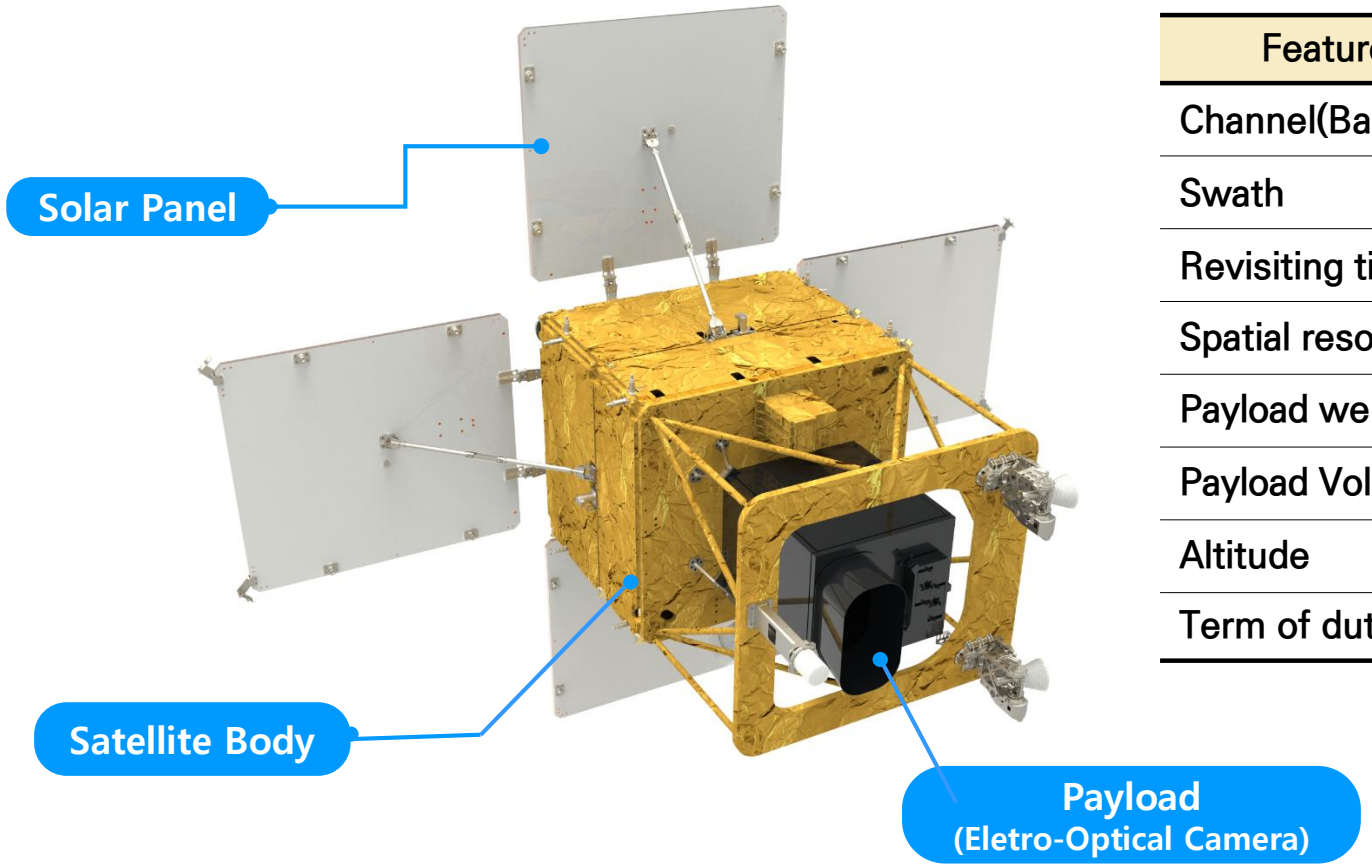
Agriculture and Forestry Satellite (CAS500-4)

- Observation and public service in the agricultural and forest sectors using 500kg standard satellite body developed in Korea
- To be launched aboard the SpaceX's Falcon9 projectile in 2026
- Multi-agency collaboration RDA, FSA, and KASA



Feature	Specification
Channel(Band)	Visible to Near-IR (≥5)(R, G, B, RE, NIR)
Swath	≥120Km
Revisiting time	1day
Spatial resolution	≥5m
Payload weight	≤150Kg
Payload Volume	X: 1,600mm, Y: 1,000mm, Z: 1,400mm
Altitude	≈900km
Term of duty	≥5yrs

Operation and Application of Agricultural Satellite

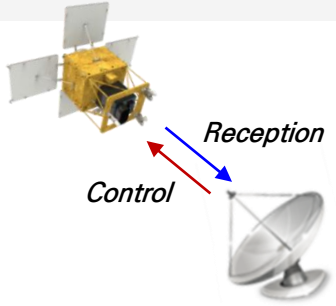
Image Acquisition

Level 1

- L0 (Raw image)
  → L1 (Basic Correction)

Before atmospheric correction

〈Level-1 RGB imagery〉



KASA

ICPS

KREONET

Base-level imagery (L1)

NASC (RDA)

Ag. Satellite Basic Products

Level 2 (Satellite Image)

- L1→L2(Geometric Correction)
  L2(Radiometric Correction)

After atmospheric correction

〈L2 surface reflectance RGB imagery〉

Level 3 (Vegetation Indices)

- L2 →L3(Vegetation indices)
  L3(Composite VI)

〈L3 – daily & composite NDVI imagery〉

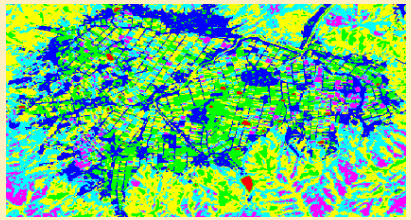
Higher-level application products

(CAS500-4+Other Satellites+Weather+Observations+GIS)

Level 4 (Agricultural Satellite Information)

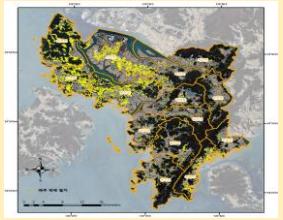
〈L4 Products〉

- (Crops) Cultivation area, growth, productivity
- (Farmland) Cultivation and cropland use change
- (Agricultural Disasters) Ag. pest & disease, soil moisture, agricultural drought(dry field), typhoons



〈Image Classification〉

〈Rice area〉



〈Kimchi Cabbage〉

Generation of level-2 and level-3 products

Generation of level-4 products with multi-convergence technology

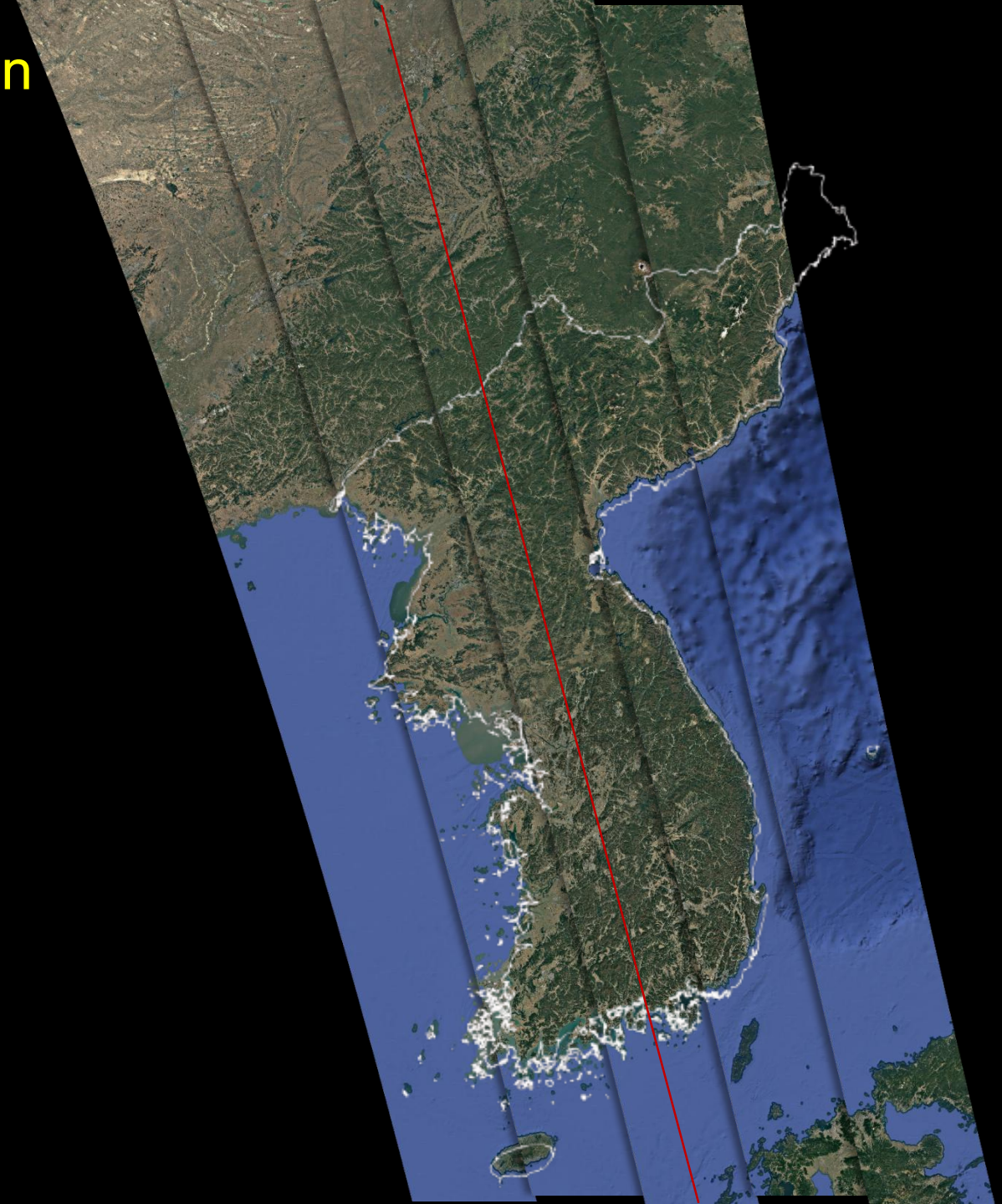
Data Service

Image Acquisition (Level 1)

*KASA→RDA

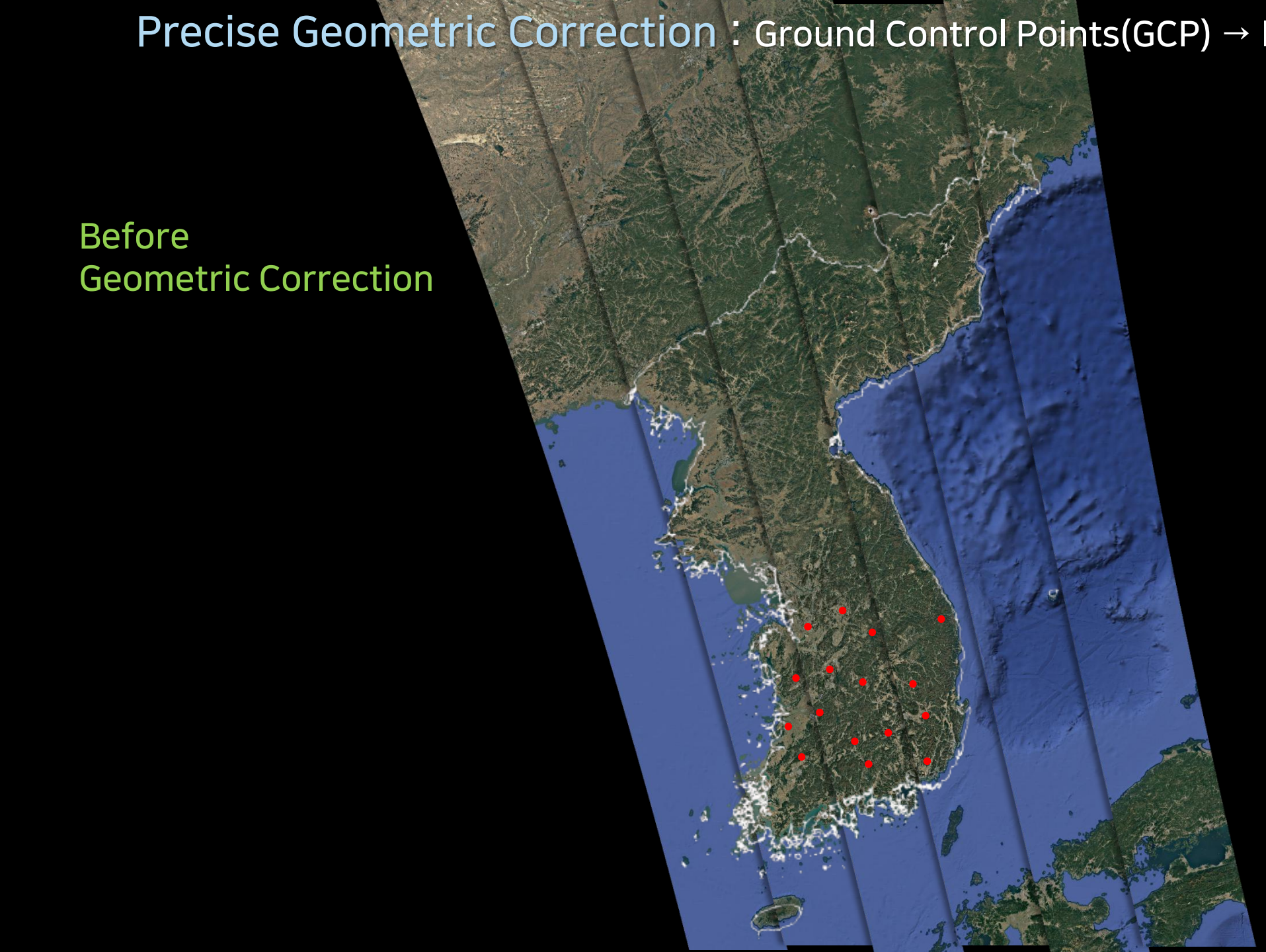
Image Acquisition (Level 1)

*KASA→RDA



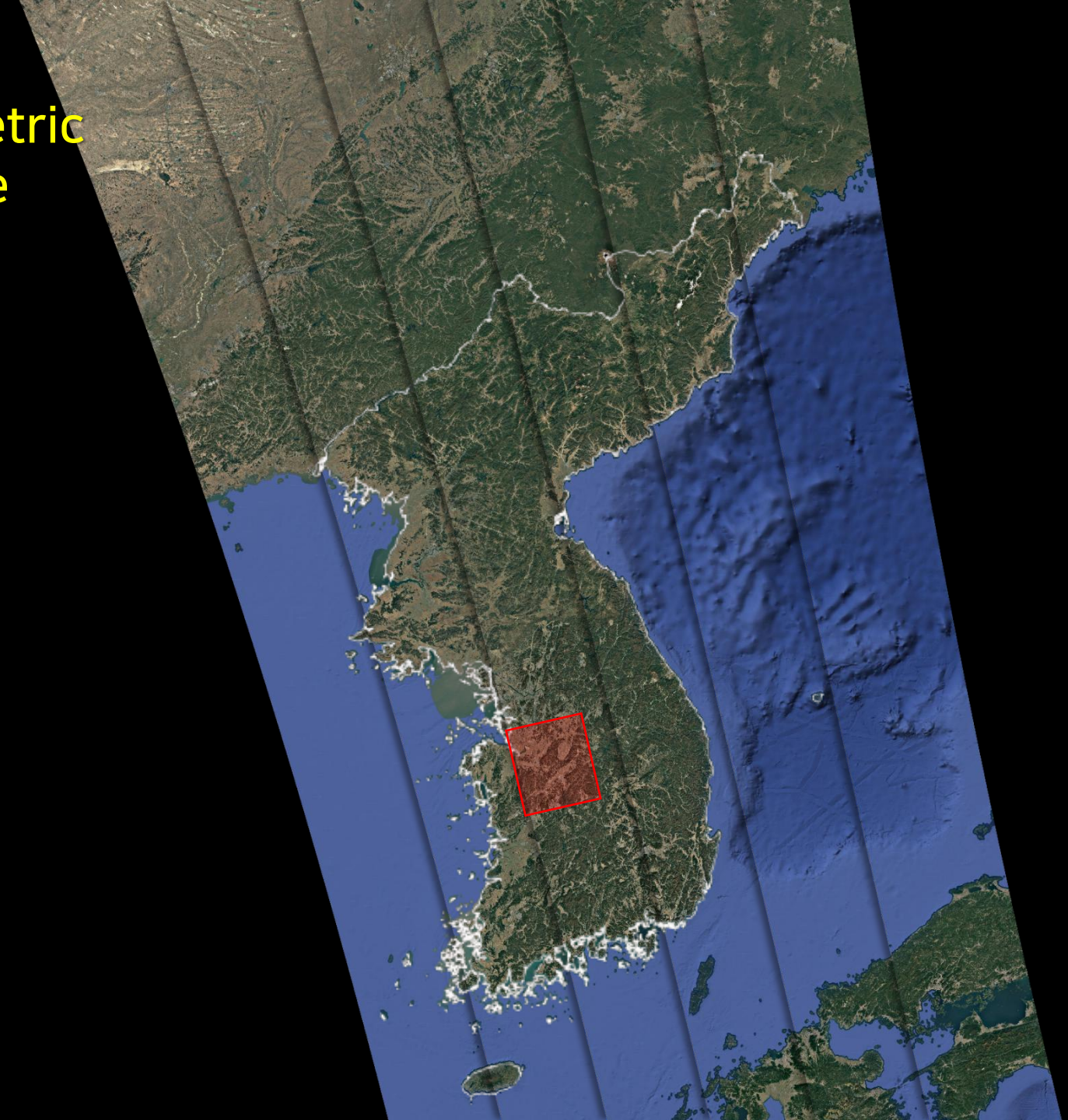
Precise Geometric Correction : Ground Control Points(GCP) → Image Registration

Before
Geometric Correction



GCP chips with
Known Locations

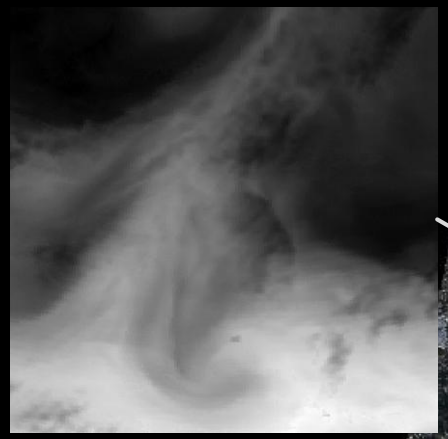
CAS500-4 Precisely Geometric Corrected Image (Level 2)



After
Geometric Correction

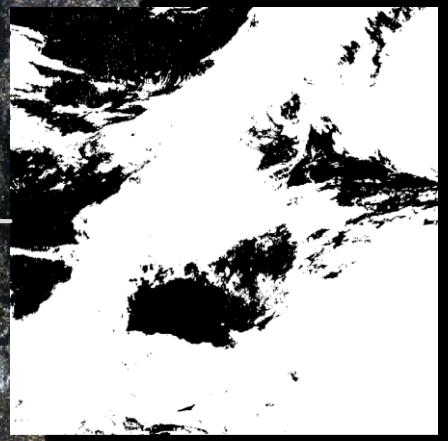
Atmospheric Correction Modeling

Before
Atmospheric Correction



Vapor

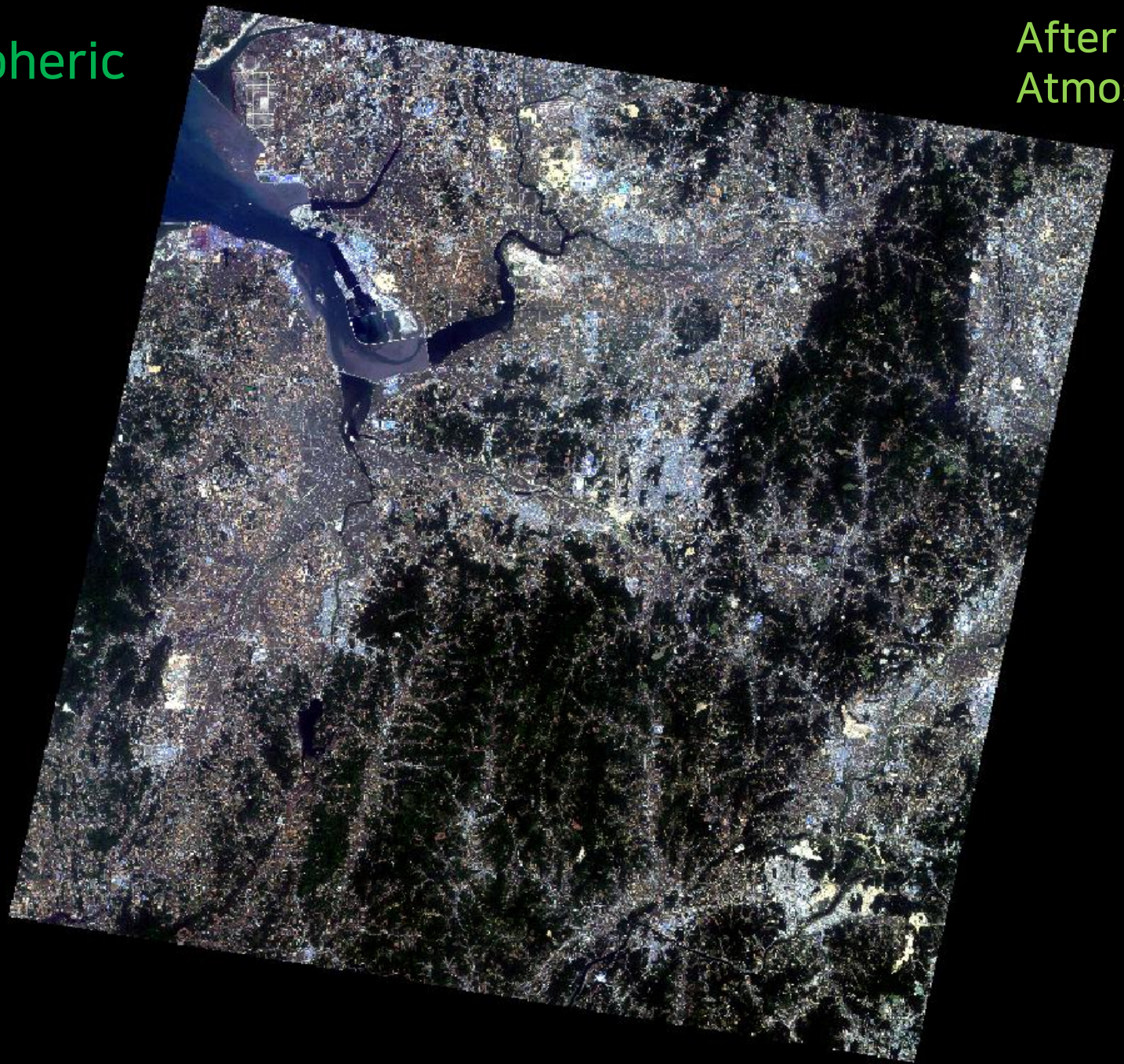
Ozone



Aerosol Depth(AOD)

CAS500-4 Precisely Atmospheric Corrected Image (Level 2)

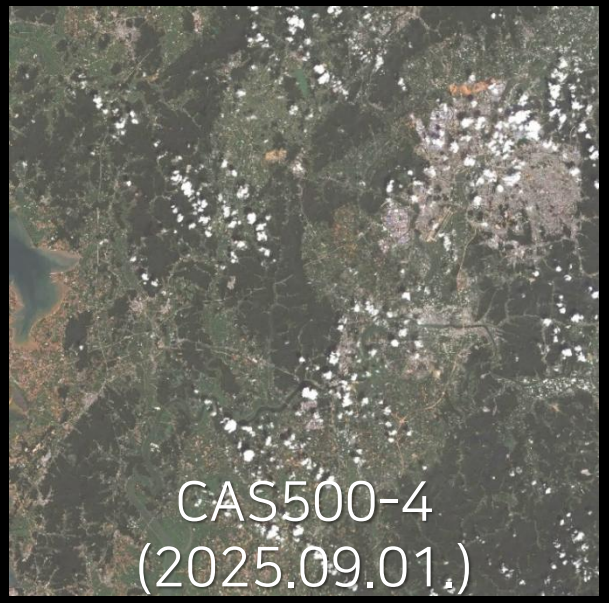
Image Service



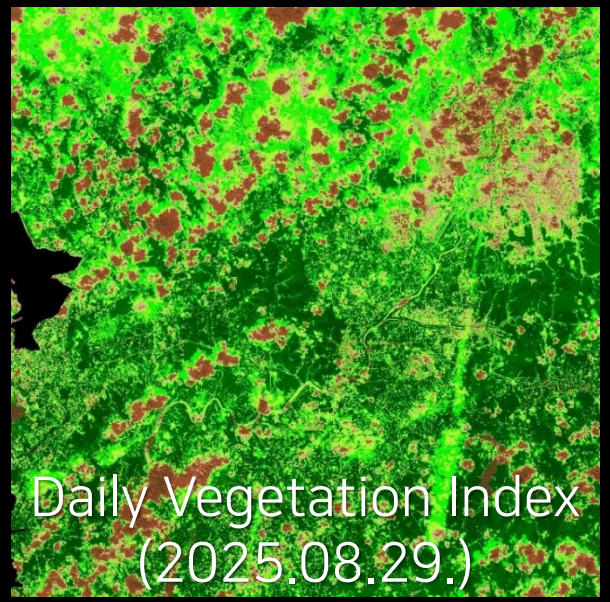
After Atmospheric Correction

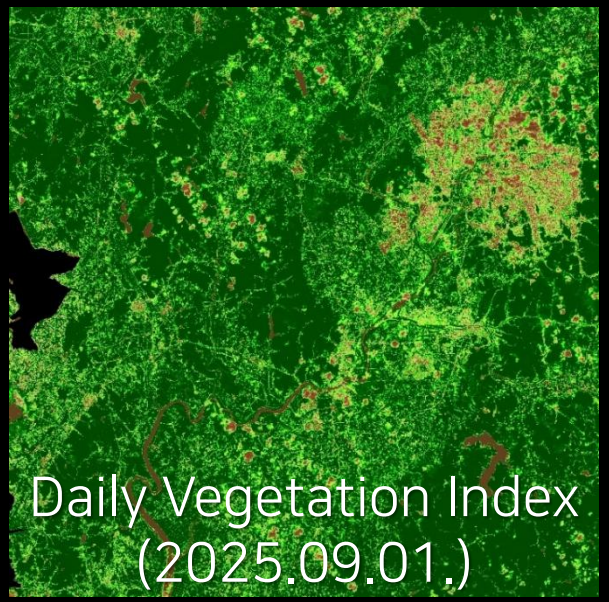
CAS500-4 NDVI image (Level 3)

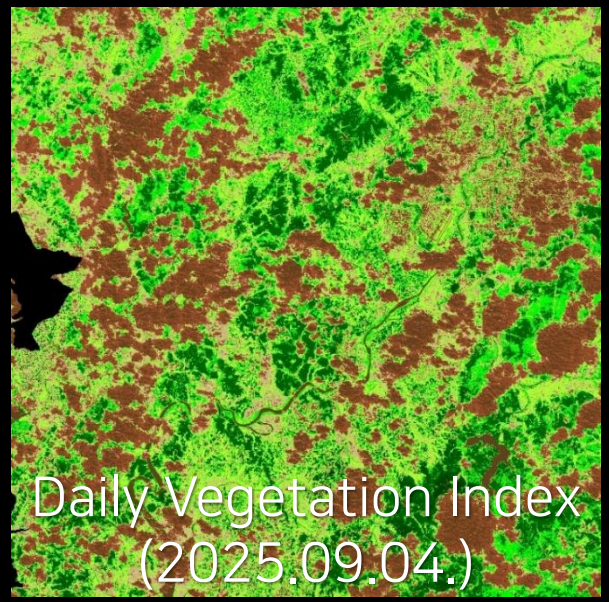
NDVI Image Service



	~ 0.0
	0.0 ~ 0.1
	0.1 ~ 0.2
	0.2 ~ 0.4
	0.4 ~ 0.6
	0.6 ~ 0.8
	0.8 ~ 1.0
	1.0 ~

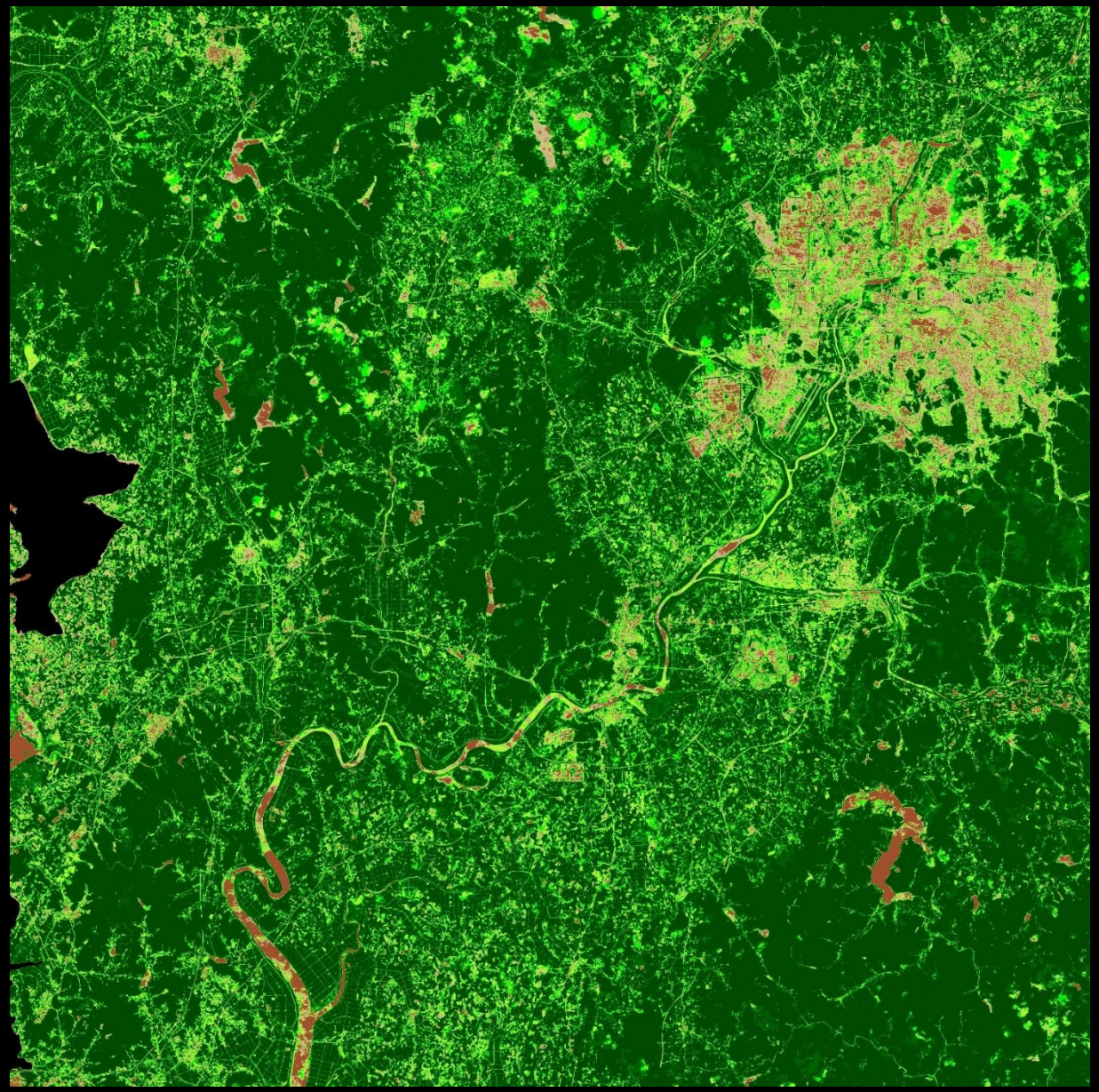






CAS500-4
10-days & 30-days NDVI image (Level 3)

NDVI Image Service



색상	구간
	~ 0.0
	0.0 ~ 0.1
	0.1 ~ 0.2
	0.2 ~ 0.4
	0.4 ~ 0.6
	0.6 ~ 0.8
	0.8 ~ 1.0
	1.0 ~

Cloud Noise Reduction
By Maximum Value
Composite of multi-layers
of NDVI

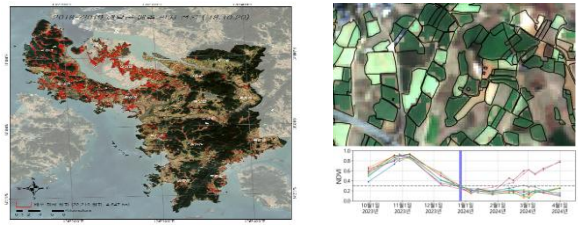
Agricultural Satellite Information (Level 4)

* 2026~2030

1 Supply & Demand of Ag. Products

- Cultivation areas of major crops including kimchi cabbage onion, garlic, etc.

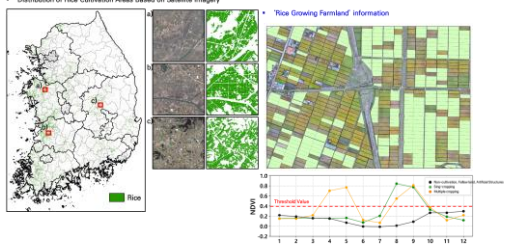
〈Cultivation and harvested area of Kimchi cabbage〉



2 Agricultural Policy – Check Compliance –

- Adequate production of cereal crops
- Check compliance with direct payments and subsidies

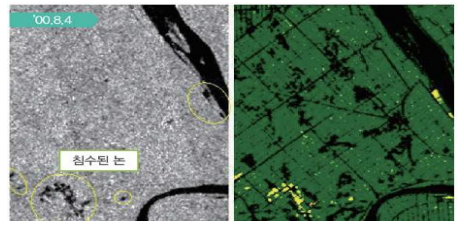
〈Rice cultivation monitoring and check compliance〉



3 Ag. Disaster Rick Management

- Data service for crop disaster insurance risk management & compliance

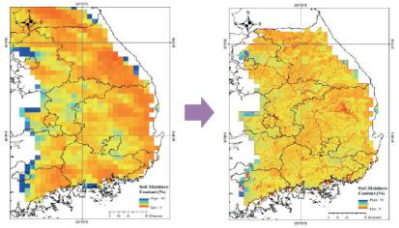
〈Damage by flooding〉



4 Soil & Environment Monitoring

- Soil moisture, evapotranspiration
- Agricultural drought monitoring

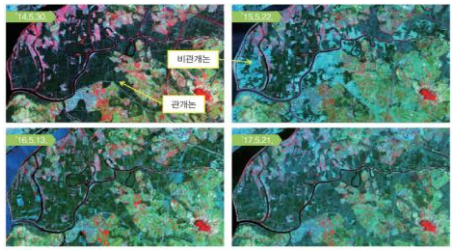
〈Soil moisture monitoring〉



5 Agricultural Statistics

- Cultivation areas and crop condition monitoring of Korean peninsular

〈Rice transplanting status of North Korea〉



6 International Cooperation

- International cooperation including Asia, Africa, and Latin American countries

〈International cooperation network〉

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Agricultural Satellite Information (Level 4)

* 2026~2030

Crop Condition Observation

Crop	Cultivated Area	Harvested Area	Crop Growth	Crop Yield
Rice	○		○	○
Wheat	○		○	○
Paddy soybean	○		○	○
Kimchi Cabbage (Autumn/Winter)	○	○	○	○
Kimchi Cabbage (Summer)	○	○	○	
Garlic	○		○	○
Onion	○	*Early-maturing onion ○	○	○
Barley	○		○	
IRG	○		○	
Potato(Gwanghwal)	○	*Greenhouse removal ○		
Corn	○		○	○
Green Onion	○		○	
Radish	○		○	
Carrot	○		○	
Cabbage	○		○	
Apple	○			
Pear	○			
Total (42)	17	4	14	7

Farmland Cultivation & Use

· Farmland Cultivation Monitoring

· Farmland Use & Change Monitoring

2

Agricultural Disaster Risk Management · Soil & Environment Monitoring

Inundation · Waterlogging

Lodging

Diseases

Pest Damage

4

Soil Moisture

Evapotranspiration

Agricultural Drought

3

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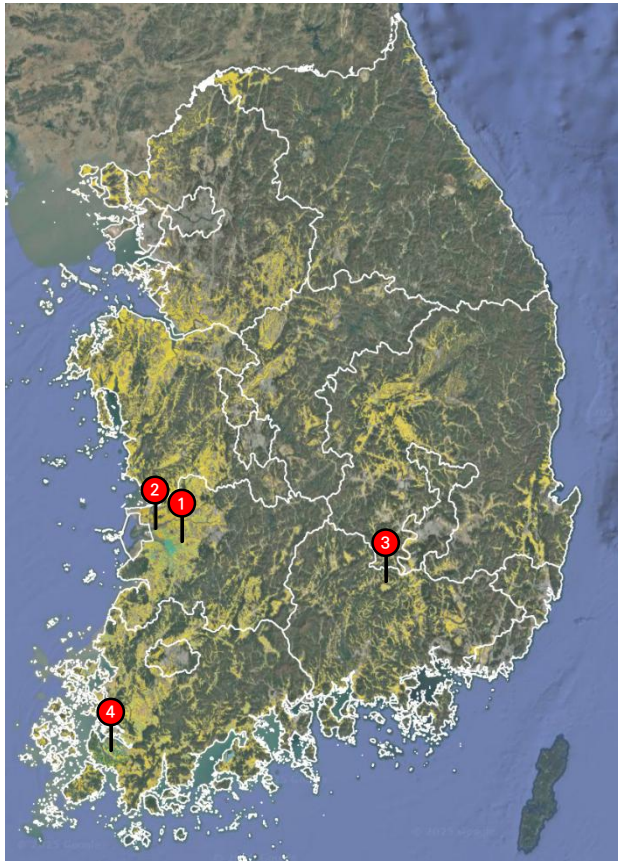
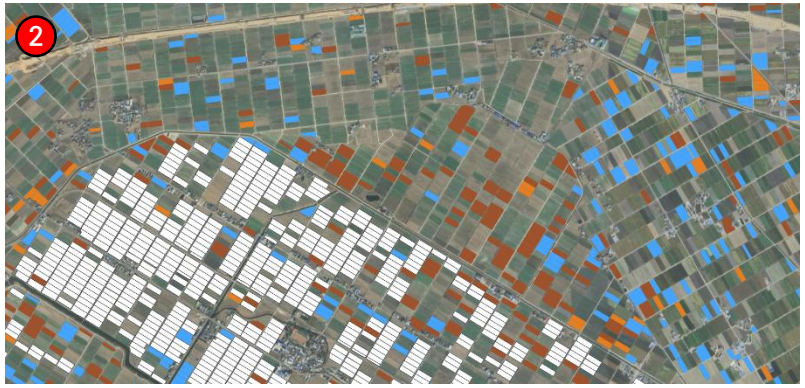
Crop Cultivation Area (Level4)

* 2026~2030

◉ Crop Cultivation Area(17 types)

- Satellite images (CAS500-4, Sentinel, etc.) and AI-based Crop Classification
- Crop data layer for 15 major crops





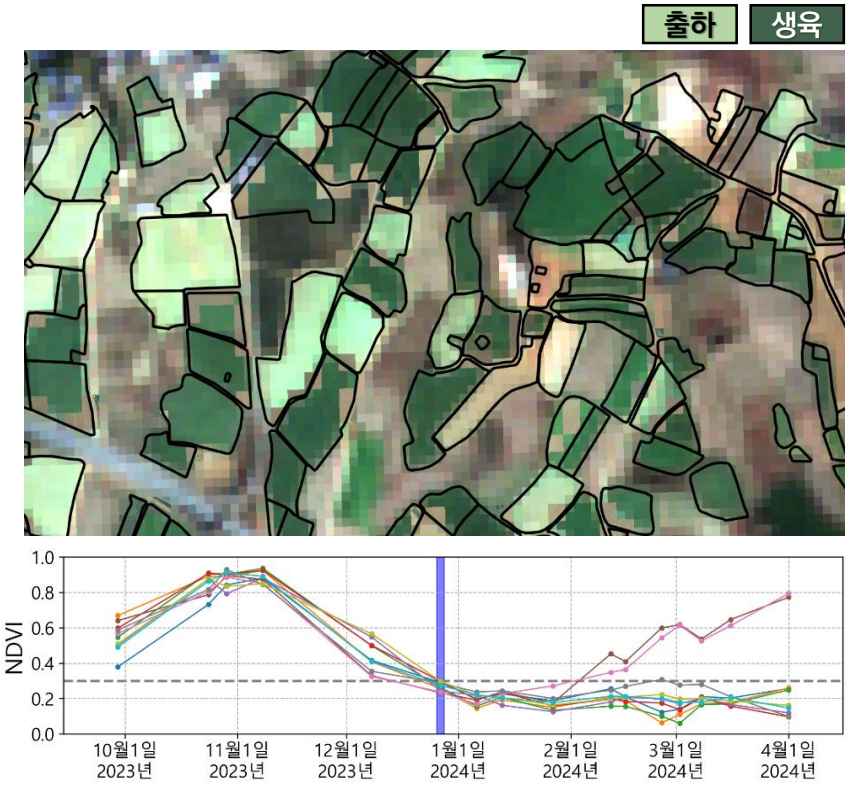
Rice Sopybean Wheat Barley Potato (House) Kimchi cabbage Garlic Onion Forage

Crop Harvested Area (Level4)

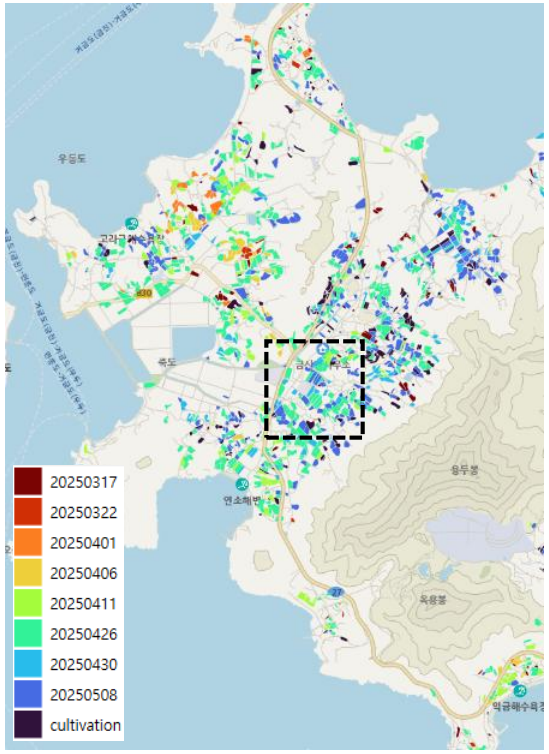
* 2026~2030

◉ Crop Harvested Area(4 types)

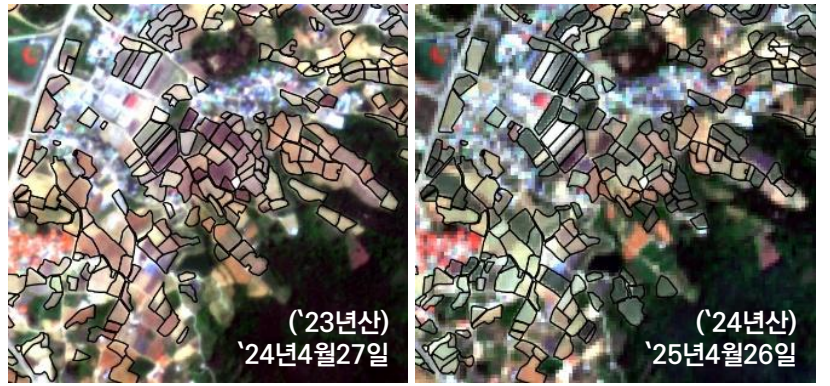
- Time-series satellite images (CAS500-4, Sentinel, Planetscope etc.) – based crop harvested area characterization

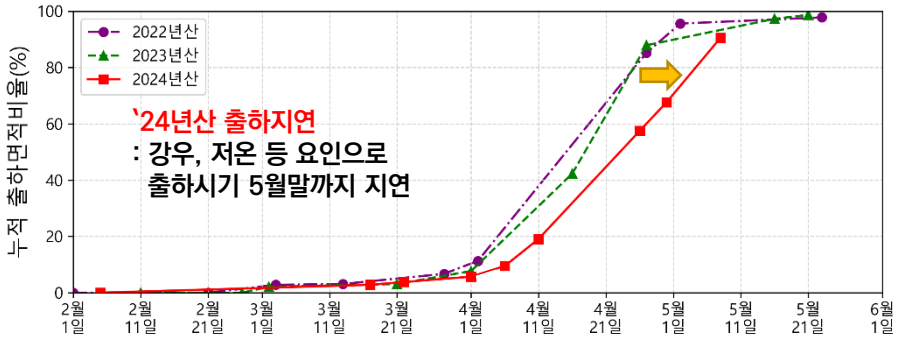


〈Harvesting detection of winter Kimchi cabbage 〉



〈Harvesting detection of early-spring onion〉





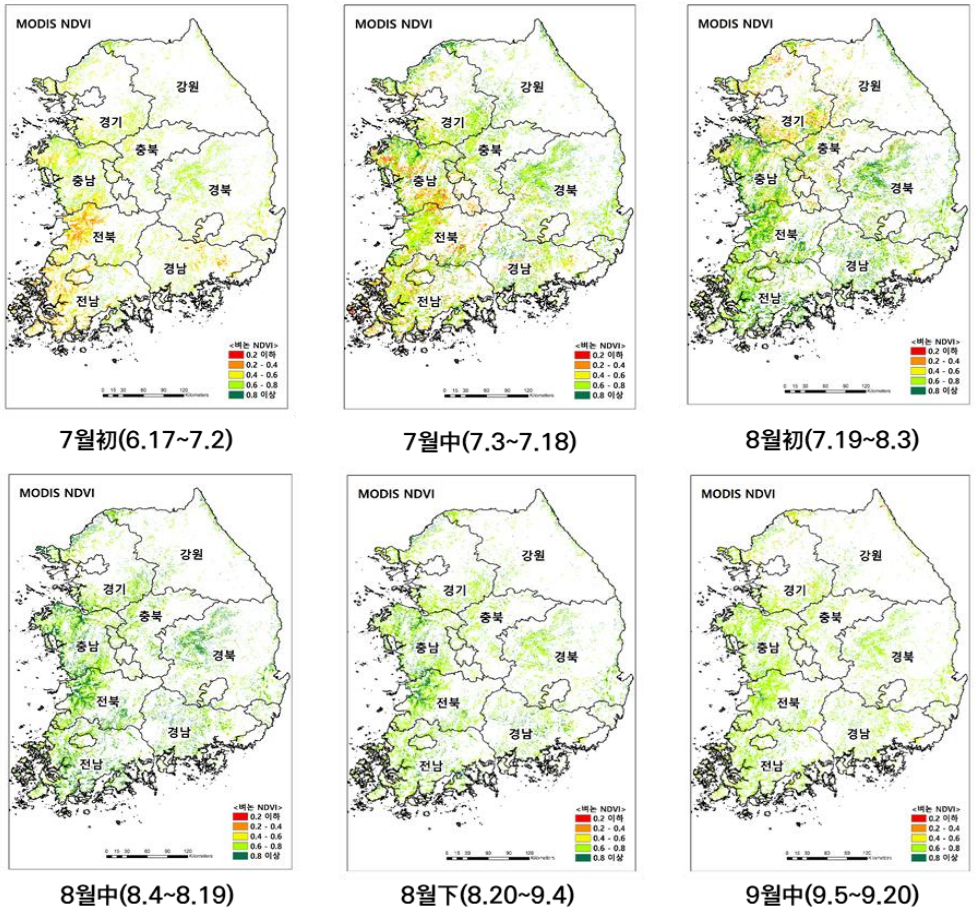
〈Accumulated harvested area ration of early-spring onion 〉

Crop Growth & Yield (Level4)

* 2026~2030

◉ Crop Growth (14 types)

- Time-series satellite-derived vegetation indices
- Crop growth status and anomaly

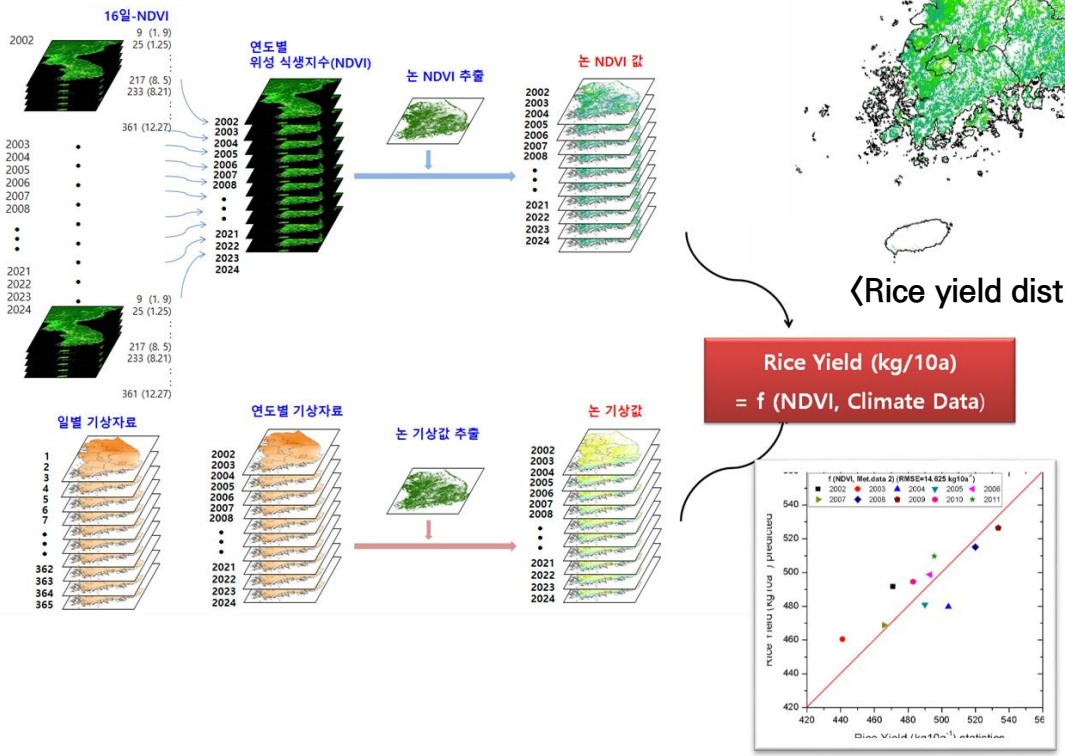


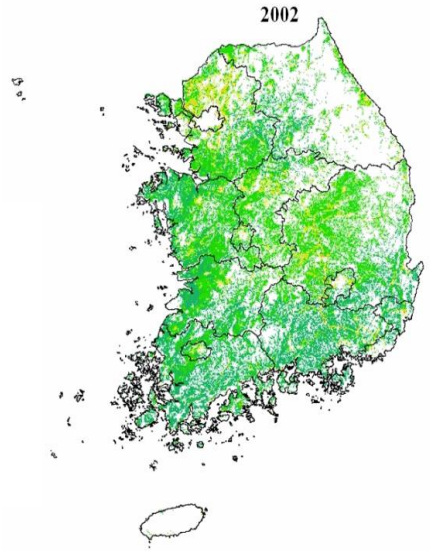
〈Rice growth status based on time-series NDVI〉

◉ Crop Yield (7 types)

- Satellite imagery and AI based crop yield models

▪ 모형 구축 개념도





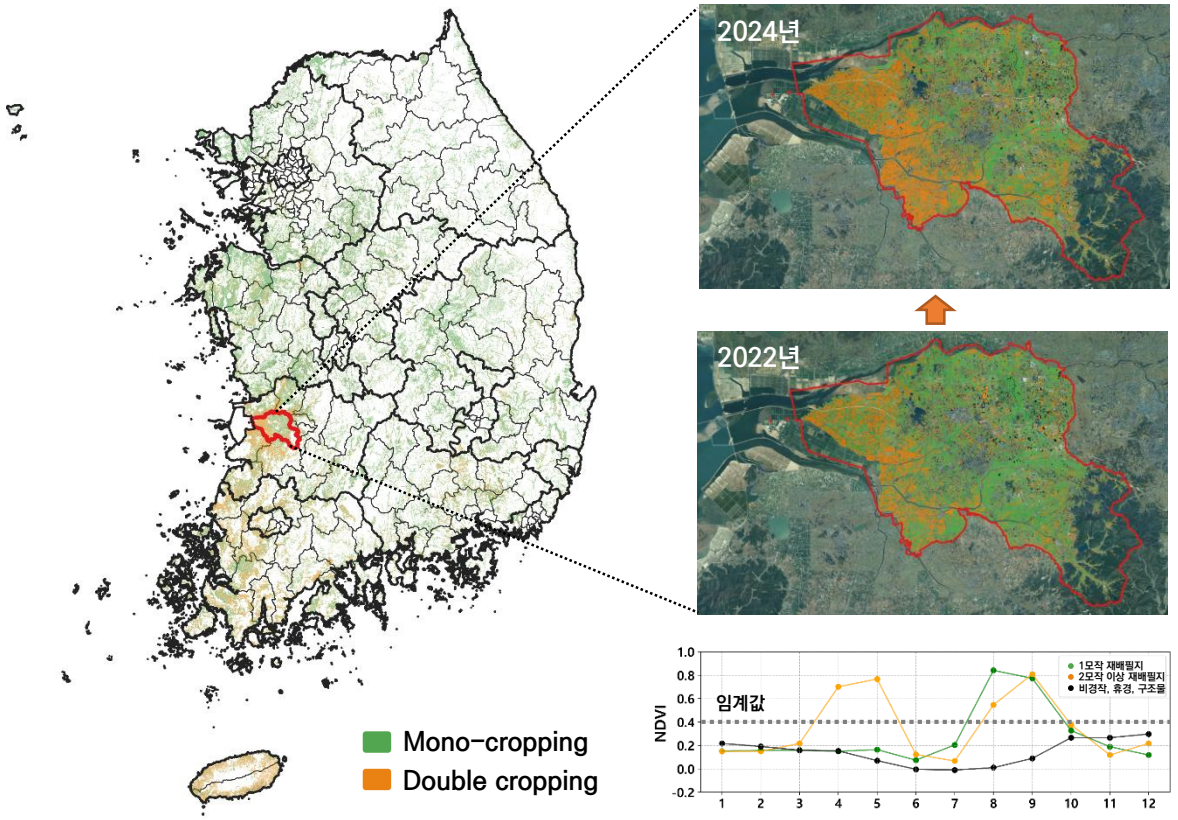
〈Rice yield distribution〉

Farmland Cultivation & Use (Level4)

* 2026~2030

Farmland Cultivation Monitoring

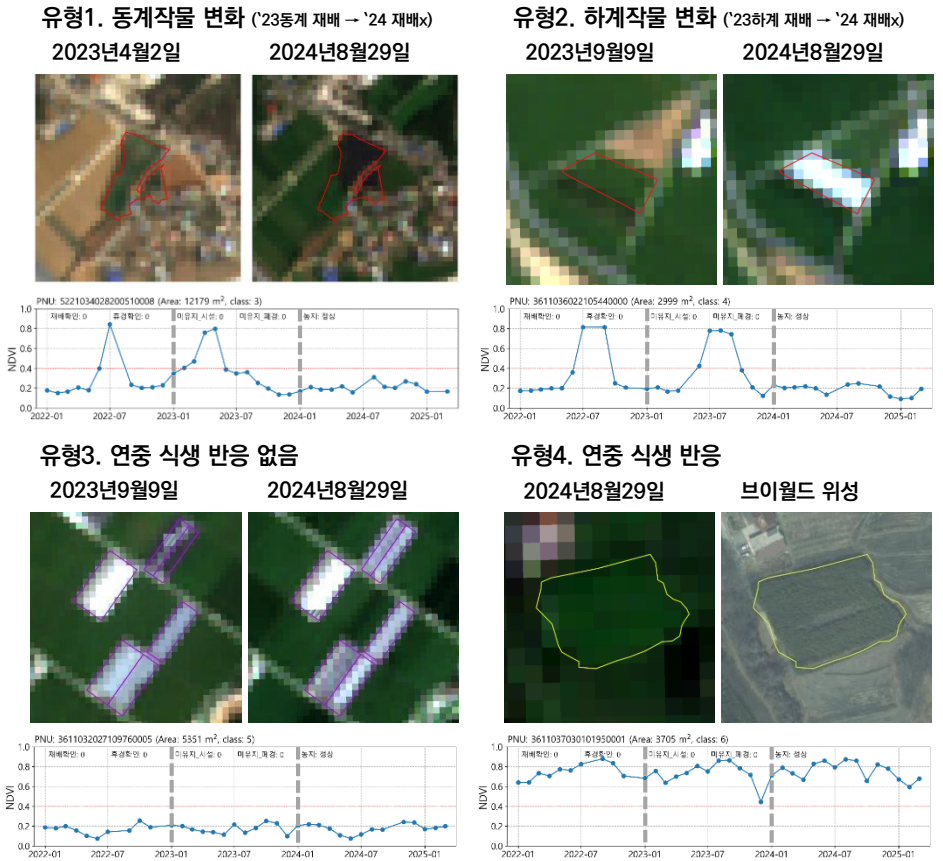
- Farmland cultivation monitoring to support agricultural policy such as direct payment and subsidy



〈Year-round farmland cultivation monitoring〉

Farmland Use & Change Monitoring

- Monitoring and detection of agricultural facilities & structures to check compliance



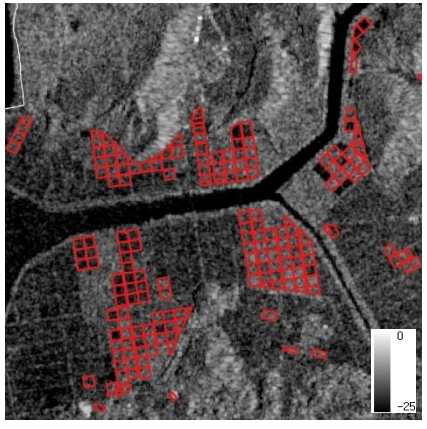
〈Farmland use & change monitoring〉

Agricultural Disasters, Soil & Env. Monitoring (Level 4)

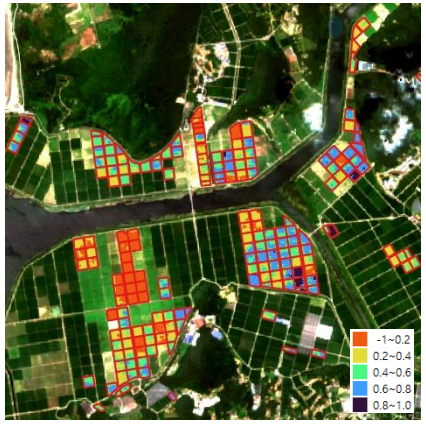
* 2027~2030

Risk Management of Agricultural Disasters

- Widespread agricultural disasters such as flooding, lodging, crop diseases and pest damage due to climate change

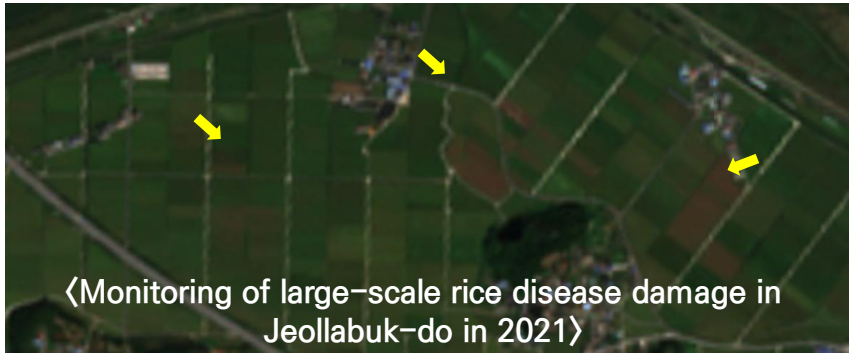


Detection of inundated farmland with radar satellite data



Detection of abnormal crop growth using optical satellite image

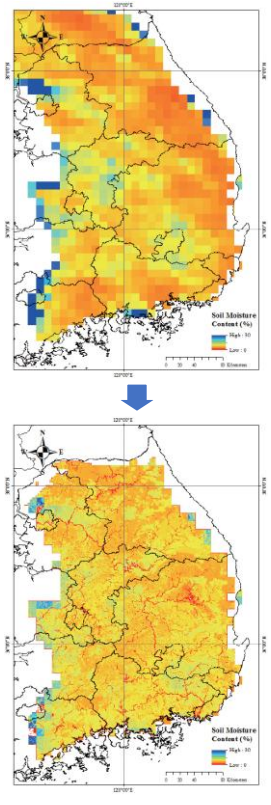
〈Analysis of damage areas affected by heavy rainfall in 2025〉



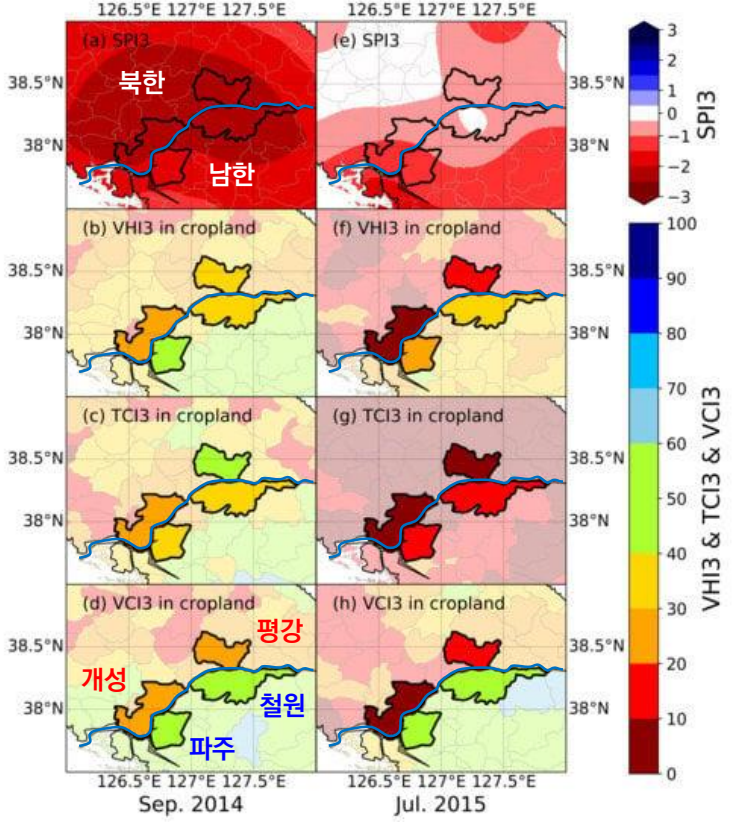
〈Monitoring of large-scale rice disease damage in Jeollabuk-do in 2021〉

Soil & Environment Monitoring

- Monitoring soil moisture, evapotranspiration, and agricultural drought in upland fields associated with ground truth data



〈Satellite image-based downscaling of soil moisture〉



〈Case study on agricultural drought monitoring in Korean peninsular〉

Collaboration Framework

Governance System and Policy Framework for CAS500-4 Operations

CAS500 Operations Committee

(Participants: NAS, NIFoS, NGII, KWRI, KASA, KARI)

- ✓ Identification of satellite and imagery demand
- ✓ Joint utilization of data from CAS500-4

NASC Operations Committee

(Participants: RDA, farmers, private companies, etc)

- ✓ Stable operation of satellite and production of high-quality, user-customized data products

Policy Council for the Use of Agro-forestry Satellite

(Participants: MAFRA, RDA, KFS, NAS, NIFoS)

- ✓ Discussion on effective policy applications using satellite data
- ✓ Joint efforts to promote the use of satellite-derived information

Operational , Research Cooperation Council for Agro-forestry Satellite

(Participants: RDA, KFS, NAS, NIFoS)

- ✓ Joint operation of satellite and implementation of efficient R&D
- ✓ Collaborative use of satellite data from satellite

Promotion of Private Sector Participation, Strengthening of International Cooperation, and Capacity Building

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Summary

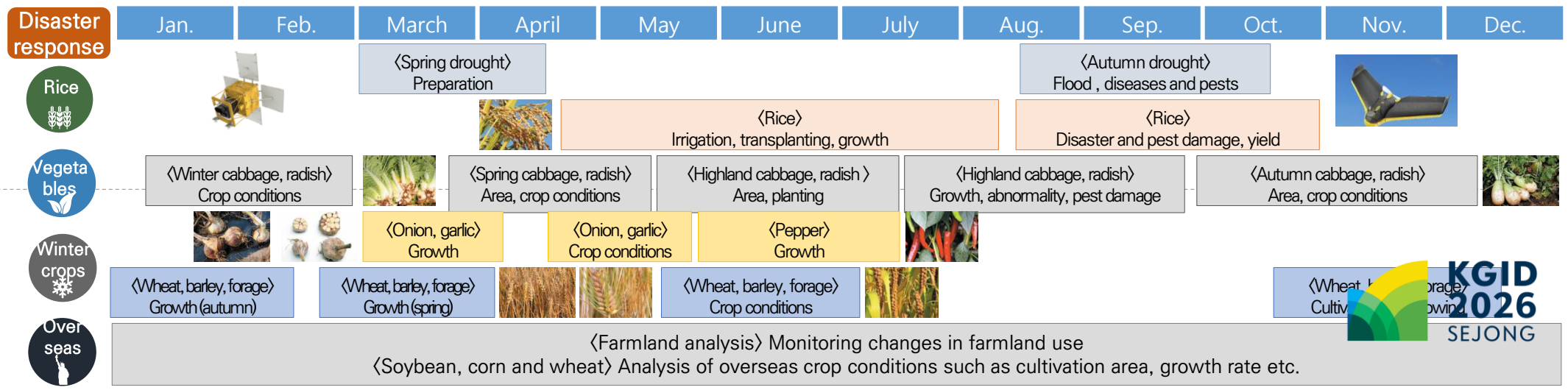
Launching & operating
Agriculture and Forestry Satellite

Satellite imagery and AI integrated products (Application)

~2024	2025	2026	2027	2028
• (Nationwide) rice area and yield estimation (July) (1 crop)	• (Key-regions) crop area and condition monitoring (6 crops) – wheat (April) – garlic/onion (April) – soybean (August) – kimchi cabbage (October)	Establishment of • CAS500-4 integrated observation and analysis system • system for delivering basic and high-quality products	• (Nationwide) crop area and condition monitoring expansion to 10 crops, including fruits (apple, pear, etc.)	• Integration of satellite-weather-soil database systems and further expansion to 15 crops

(Training data) location and crop info collection, spatial DB construction, (Agricultural disaster) floods, droughts, pest outbreaks monitoring **(Direct payment compliance)** cultivation detection and analysis, **(Grain-importing countries, Korea, International partners)** crop areas, conditions, and production environments monitoring

Year-Round Agricultural Monitoring Schedule



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“Future Agriculture, Connected by Satellite”

KGID 2026

CAS 500 Series Project

Compact Advanced Satellite(CAS) 500 is a 500kg class medium-sized satellite providing valuable information for earth and environment

* **Chief Organization : Korea AeroSpace Administration**, Ministry of Science and ICT (MSIT)

- **CAS500-1**('21.3.) **and -2**('25) **(Urban & Land)** : 0.5/2m, 12km x 12km, VIS-NIR
  - ·National Geographic Information Institute, Ministry of Land, Infrastructure and Transport (MLIT)
- **CAS500-4**('25) **(Agriculture & Forestry)** : 5m, 120km x 120km, VIS-NIR
  - ·National Institute of Agricultural Sciences, Rural Development Administration (RDA)
  - ·National Institute of Forest Science, Korea Forest Service (KFS)
- **CAS500-5**(after '25) **(Water)** : 10m, 120km x 120km, C-band SAR
  - ·K-water, Ministry of Environment