Nara Space Satellite Imagery Analytics Solution

# Financial Management Solution

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01

# Satellite Imagery Analytics Solution Overview

Satellite Imagery Analytics Introduction

Key Industry Applications

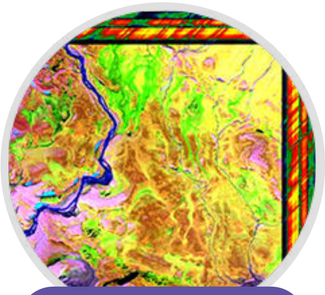
Service Delivery Options

Why the Financial Sector Uses Satellite Data

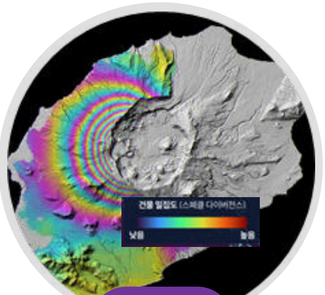
# Nara Space Satellite Imagery Analytics Solution

Nara Space collaborates with global data partners and leverages multi-sensor data fusion technologies to deliver highly accurate analytics results

Multispectral



Hyperspectral



SAR

**MULTI-SENSOR DATA FUSION**

# Key Industry Applications

## Natural Disaster

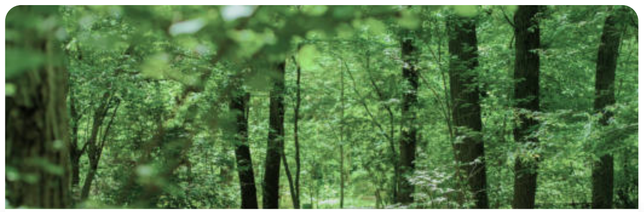
- Wild Fire Detection
- Flood Detection
- Landslide / Earthquake / Ground Subsidence

## Finance

- Construction Monitoring
- Economic Intelligence

## Agriculture

- Yield Prediction
- Corn
- Soybean
- Wheat

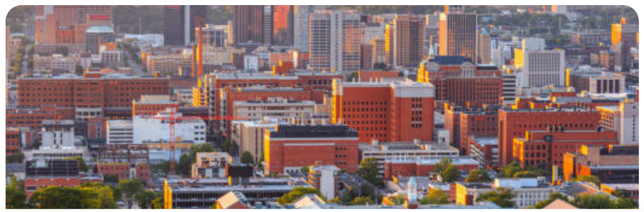


## Environment

- Tree Detection
- Land Classification
- Water Quality Assessment

## Defense

- Super-Resolution Imaging
- Object Detection
- Object Segmentation
- Change Detection



## Urban

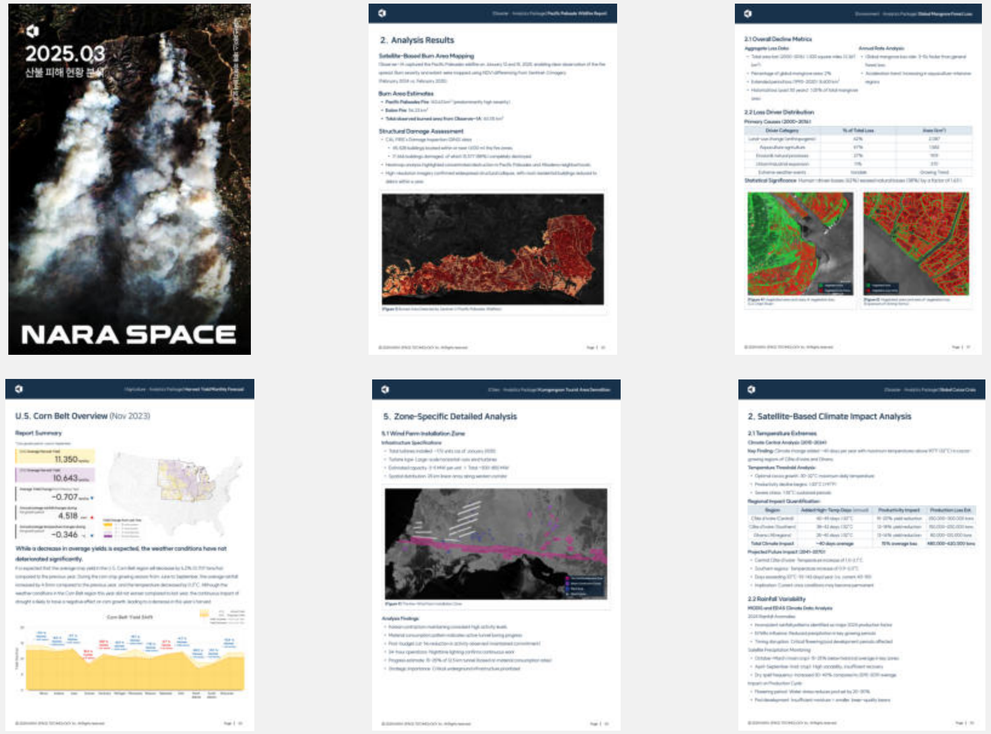
- Urban Management
- Smart City Strategy Development
- Land Use & Construction Monitoring

# Service Delivery Options

## On-Demand Insight Reports

Get concise, decision-ready summaries without handling satellite data

### Examples




## Custom Web Platform

A dedicated platform tailored for your organization

For APIs, additional analysis requests, or detailed customization, please contact us separately

# Why Satellite Data is Essential in the Financial Sector

| Limitations of Existing Financial Management | What Satellite Data Provides | |
|---|---|---|
| Limited verification of actual collateral assets when relying solely on corporate-submitted data | **Objective & Independent Due Diligence** | Cross-verification of submitted data and early detection of anomalies using real-world conditions captured directly by satellites |
| Difficult to verify ESG and sustainability compliance solely through local reports | **Independent Environmental Monitoring** | Independent monitoring and verification of environmental violations, such as deforestation and illegal development, without third-party intervention |
| Difficult to track asset status in overseas, remote, or restricted areas | **Remote & Wide-Area Due Diligence** | Regularly verifying asset status regardless of location and accessibility to proactively respond to project delays or asset distress |
| Difficult to capture investment opportunities as official statistical releases are already priced into the market | **Proactive Commodity Trend Tracking** | Tracking crude oil inventories and agricultural yields preemptively to secure a market edge and capture investment opportunities ahead of official announcements |

# Why Satellite Data is Essential in the Financial Sector

## Key Applications

### Credit & Collateral Appraisal
Verifying the actual status of collateral facilities, analyzing plant/warehouse utilization rates and inventory fluctuations, and automating anomaly alerts based on routine monitoring.

### ESG & Sustainable Finance
Detecting deforestation and green space degradation, tracking variations in carbon sinks, and monitoring illegal land development and environmental violations

### Overseas Project & Infrastructure Investment
Tracking construction progress milestones, conducting remote site inspections in restricted or remote regions, and scanning for natural disasters and external risk factors

### Commodity & Agricultural Market Prediction
Estimating crude oil inventories, forecasting agricultural crop yields, and simulating futures market prices

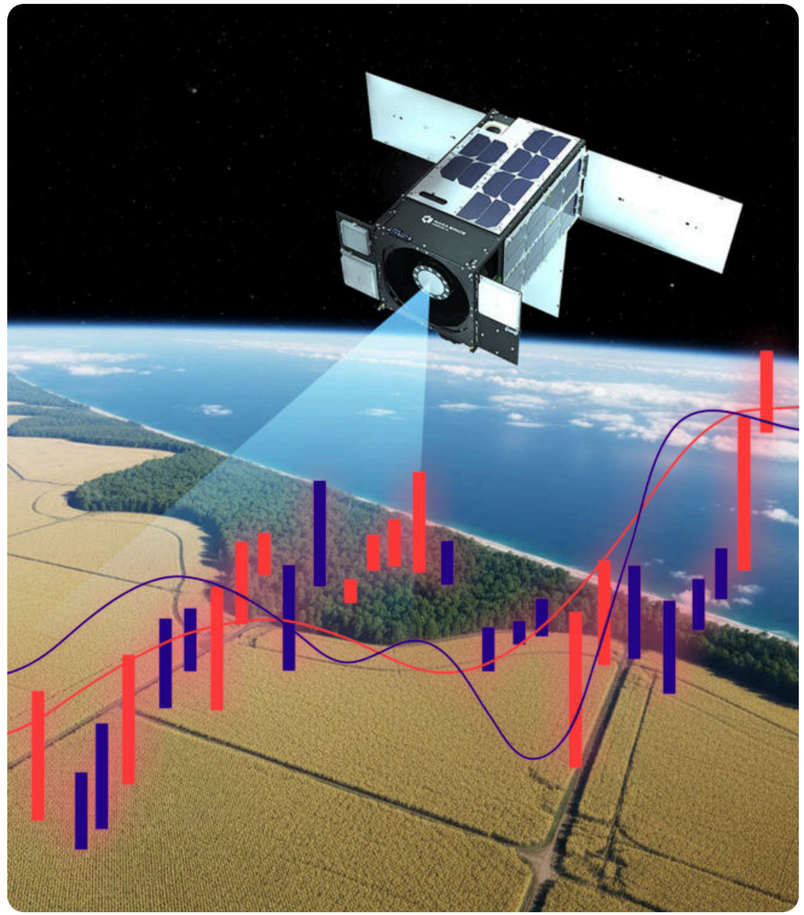
## Value for Financial Stakeholders

Addressing loopholes in document-based reviews, preventing collateral overvaluation, and enabling proactive credit risk management through the early detection of distress signs

Verifying compliance with ESG criteria, mitigating greenwashing risks, and minimizing environmental liabilities

Continuous validation of asset conditions without requiring physical site visits, ensuring a rapid response to project delays and asset impairment risks

Preemptively analyzing commodity conditions prior to official data releases to secure a strategic edge in futures positioning and hedge against price volatility risks



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02

# Global Supply Chain & Industrial Activity Monitoring

Tracking construction progress & site developments

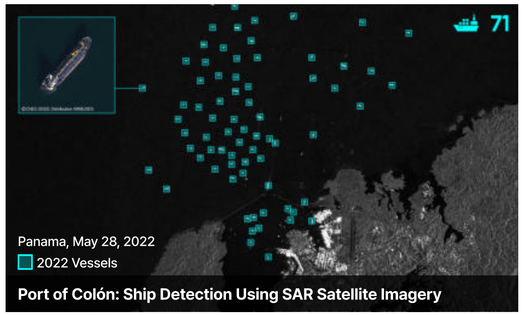
Monitoring port cargo traffic and logistics

Estimating crude oil inventory levels

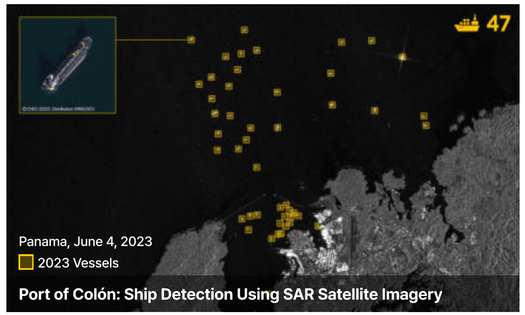
Analyzing climate risks for agricultural commodities

# Monitoring port cargo traffic and logistics

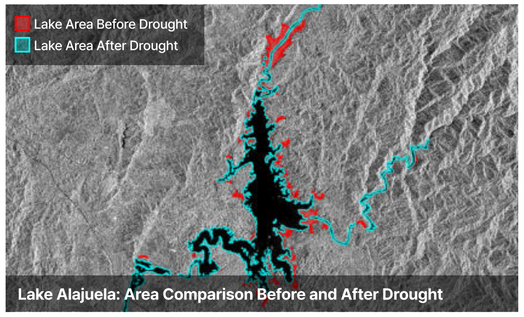
## Colón Port, Panama Canal



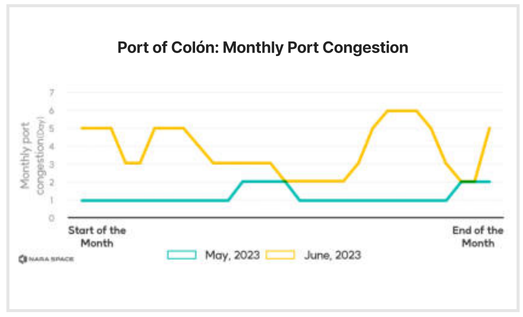
Port of Colón: Ship Detection Using SAR Satellite Imagery



Port of Colón: Ship Detection Using SAR Satellite Imagery



Lake Alajuela: Area Comparison Before and After Drought




## Technical Specifications

| | |
|---|---|
| **Available Resolution** | ~ 10m |
| **Input Data** | Optical : Sentinel-2, Kompsat-3/3a, Pleiades, Pleiades-Neo, Aerial Imagery<br>SAR : Sentinel-1, ICEYE |
| **Output Format** | Raster (GeoTIFF, PNG), Vector (GeoJSON), Statistical Data (CSV) |

## Key Advantages

### 1 Multi-Satellite & AI Fusion Vessel Detection

- Automatically detects the number of waiting vessels by combining SAR and optical satellite imagery with AI analysis, regardless of day/night or weather conditions.
- Tracks logistical status independently without relying on AIS signals or official statistics, enabling early identification of supply chain bottlenecks.

### 2 Port Operation Impact Analysis Due to Drought

- Quantitatively analyzes water level fluctuations and drought progression using multi-temporal satellite imagery.
- Estimates vessel transit restriction levels and forecasts navigability proactively using satellite indicators, even in the absence of local hydrological monitoring network data.

### 3 Composite Signal Fusion as a Leading Indicator of Cargo Volume

- Forecasts port congestion and changes in cargo volume early by comprehensively analyzing satellite-derived metrics, including waiting vessel counts, water level shifts, and transit restriction history.
- Overcomes the limitations of single data sources to provide highly reliable analytical indicators rooted in physical causality.

### 4 Securing Independent Supply Chain Data

- Preemptively assesses transit restriction status and timing based strictly on satellite observations, prior to official announcements by canal authorities.
- Delivers objective, independent data to evaluate global supply chain risks without depending on corporate disclosures or internal company insights.

# Estimating crude oil inventory levels

## KSA Aramco Crude Oil Inventory Monitoring


## Technical Specifications

| | |
|---|---|
| **Available Resolution** | ~ 1.5m |
| **Input Data** | Optical : Kompsat-3/3a, Pleiades, Pleiades-Neo, Aerial Imagery |
| **Output Format** | Raster (GeoTIFF, PNG), Statistical Data (CSV) |

## Key Advantages

### 1 Floating Roof Tank-Based Crude Oil Inventory Estimation

- Quantitatively estimate crude oil inventory volumes inside tanks by analyzing the shadow and tilt of floating roofs.
- Independently track inventory levels without relying on corporate disclosures or on-site access.

### 2 Simultaneous Global Supply Chain Monitoring

- Concurrently monitor inventory status across major global crude oil storage hubs, including the Middle East, the U.S., and Asia.
- Gain a comprehensive understanding of global supply chain flows without depending on single-country statistics.

### 3 Tracking Inventory Trends Ahead of Official Statistics

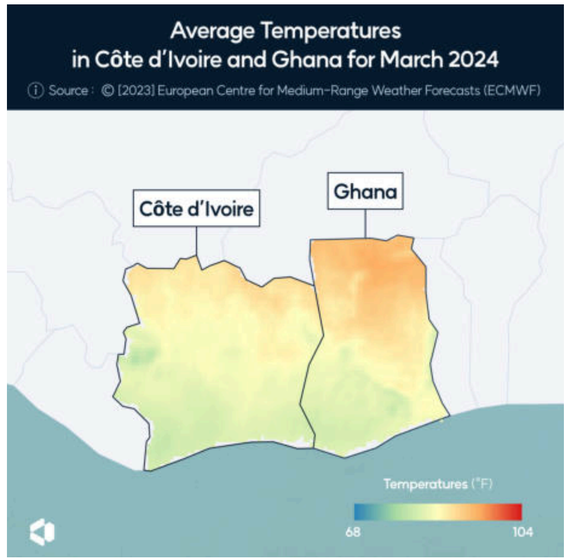
- Tracks inventory changes at major processing hubs using multi-satellite constellation data.
- Detects inventory trends ahead of official EIA and IEA releases, enabling faster trading and market response.

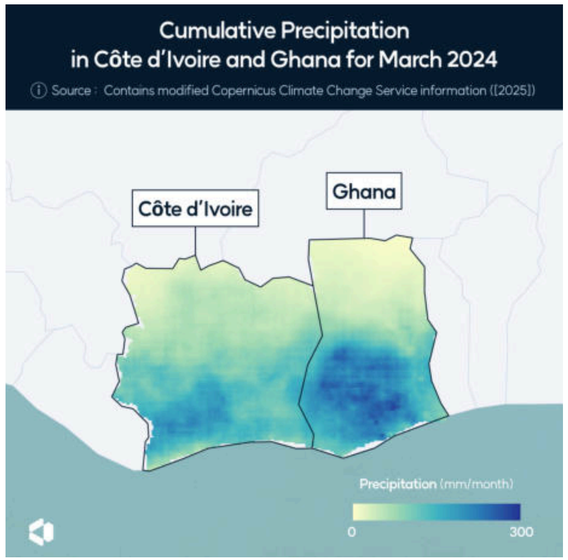
### 4 Quantifying Error Margins & Providing Confidence Intervals

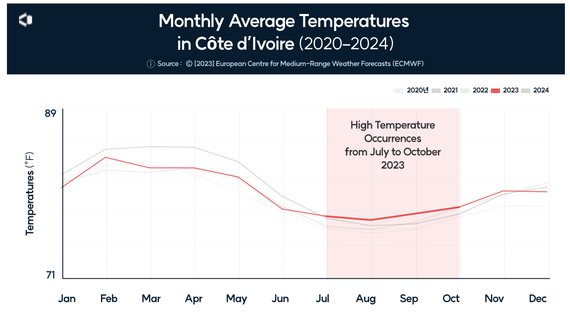
- Provides reliable error margins and confidence intervals through physical modeling of tank diameter and roof displacement.
- Goes beyond image interpretation to deliver quantitative reliability metrics for investment and risk decisions.

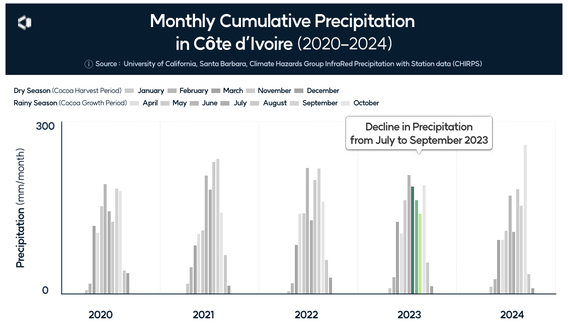
# Analyzing climate risks for agricultural commodities

## Cocoa from Côte d'Ivoire & Ghana - Climate Risk Analysis




## Technical Specifications

| | |
|---|---|
| **Available Resolution** | ~ 25km |
| **Input Data** | Reanalysis : CHIRPS Precipitation, ERA5 Temperature<br>Optical : MODIS, VIIRS, Sentinel-2, Kompsat-3/3a, Pleiades, Pleiades-Neo etc. |
| **Output Format** | Raster (GeoTIFF, PNG), Statistical Data (CSV) |

## Key Advantages

### 1 Early Detection of Agro-Meteorological Anomalies

- Combines satellite vegetation indices with meteorological data across commodity belts to detect El Niño/La Niña-driven droughts and excessive rainfall prior to crop yield degradation.
- Preemptively identifies production anomaly signals using satellite and climate data, even in growing regions lacking sufficient ground-based monitoring networks.

### 2 Quantifying Supply-Demand Imbalances Based on Physical Evidence

- Estimates potential declines in global inventory by analyzing changes in cropland acreage and crop health conditions.
- Secure leading market insights by analyzing the scale of supply shocks before they are priced into futures markets.

### 3 Commodity Price Volatility & Corporate Profitability Analysis

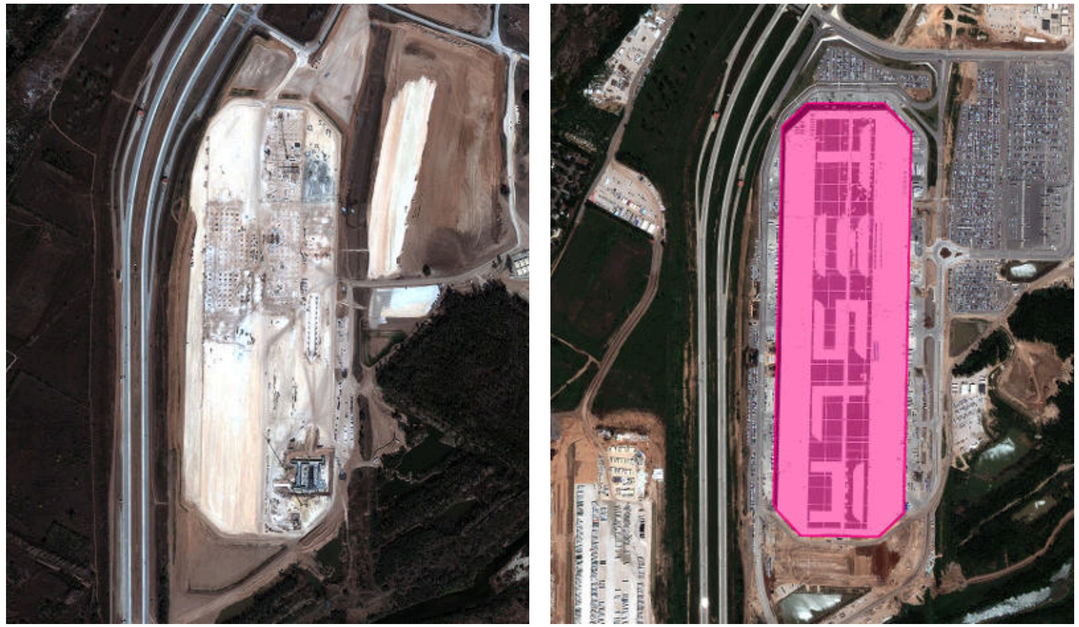
- Utilizes satellite data to analyze the impact and timing of how commodity price increases pass through to consumer goods prices.
- Forecasts potential margin compression early by estimating shifts in raw material costs, even in the absence of corporate cost disclosures.

### 4 Independent Agricultural Risk Analysis

- Monitors satellite-based climate risks across a broad spectrum of tropical and subtropical crops.
- Delivers independent data capable of analyzing supply risks without relying on producer country statistics or corporate disclosures.

# Tracking construction progress & site developments

### Tesla Factory Construction Site, US






## Technical Specifications

| | |
|---|---|
| **Available Resolution** | ~ 10m |
| **Input Data** | Optical : Sentinel-2, Observer-1A/B, Blacksky, Kompsat-3/3a, Pleiades, Pleiades-Neo, Aerial Imagery, etc.<br>SAR : Sentinel-1, ICEYE |
| **Output Format** | Raster (GeoTIFF, PNG) |

## Key Advantages

### 1 Comprehensive Monitoring of Large-Scale Construction Sites

- Simultaneously monitor hundreds to thousands of domestic and international construction sites via satellite imagery.
- Regularly observe remote or restricted international sites without requiring physical on-site visits.

### 2 Continuous Time-Series Progress Tracking

- Analyze construction progress, delays, or suspensions by cross-referencing historical and current imagery.
- Track structural changes through continuous data streams rather than isolated snapshots to establish concrete evidence for identifying anomalies.

### 3 AI-Driven Automatic Construction Phase Classification

- Automatically classify construction phases—such as excavation, structural framing, and finishing—and quantifying progress rates via deep learning-based object detection.
- Supports objective project management by evaluating site-specific schedules against standardized benchmarks.

### 4 Automated Early Warning System for Anomalies

- Dispatch automated alerts immediately upon detecting critical anomalies such as construction halts, unauthorized layout changes, or significant baseline schedule deviations.
- Streamline project and investment risk management by enabling proactive interventions before defaults or structural failures occur.

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# 03

# Commodity Yield & Price Forecasting

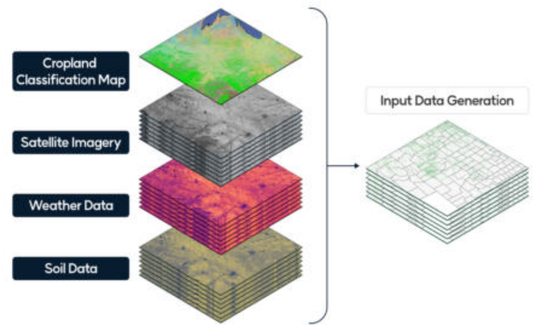
Corn Yield Forecasting

Potato Production Forecasting

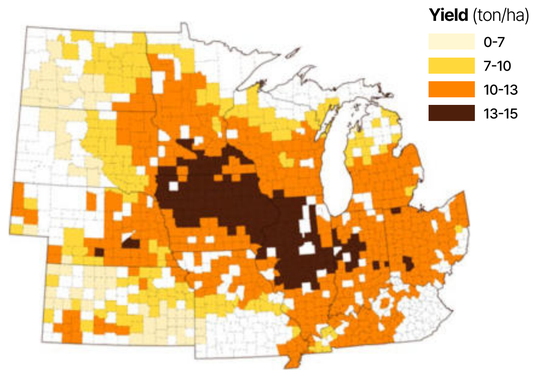
Commodity Price Forecasting

# Corn Yield Forecasting

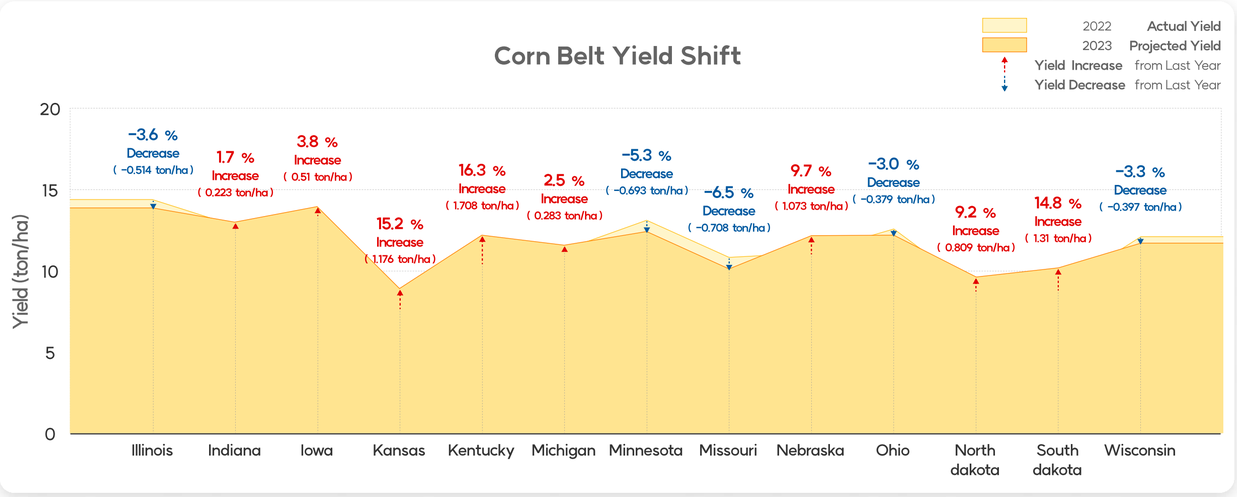
## Corn Belt's Corn Yield Forecasting




**Crop Yield Prediction Model Input Data**




**U.S. Corn Belt Corn Yield Forecast**




## Technical Specifications

| | |
|---|---|
| **Model Prediction Error Rate** | 4.7 % (RMSPE, Root mean square percentage error) |
| **Available Resolution** | ~ 500m |
| **Input Data** | Satellite Based Vegetation Index, Weather, Soil, Land Cover and Yield Data |
| **Output Format** | Vector(GeoJSON), Statistical Data (CSV), Report (PDF) |

## Key Advantages

### 1 Multi-Vegetation Index-Based Yield Model

- Analyze crop growth stages sequentially utilizing multiple vegetation indices.
- Overcome the limitations of single-index analyses to perform customized, crop-specific forecasting.

### 2 Integrated Climate & Environmental Variable Forecasting

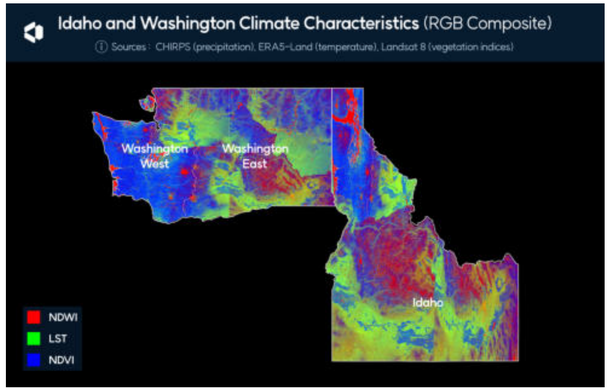
- Enhanced yield forecasting accuracy by combining satellite imagery with precipitation, temperature, and solar radiation data.
- Quantitatively reflects the impacts of sudden variables, such as climate anomalies, droughts, and floods, on final crop yields.

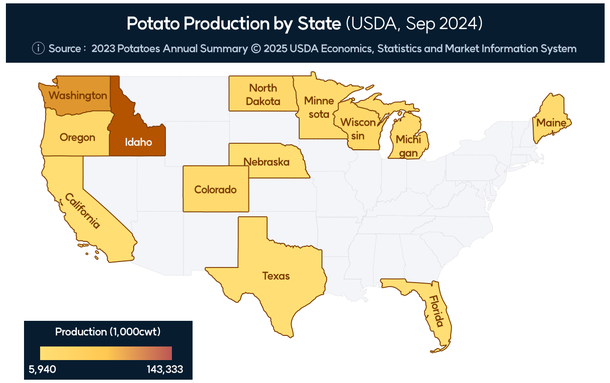
### 3 Pre-Harvest Yield Forecast

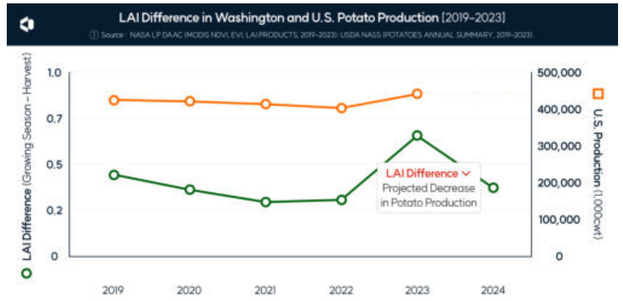
- Forecasts final yield volumes ahead of schedule by analyzing growth data months prior to harvest.
- Identify yield shifts weeks to months faster than official reports like, USDA & FAO, to support strategic market positioning.

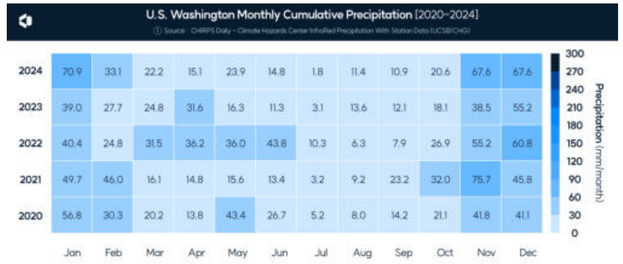
# Potato Production Forecasting

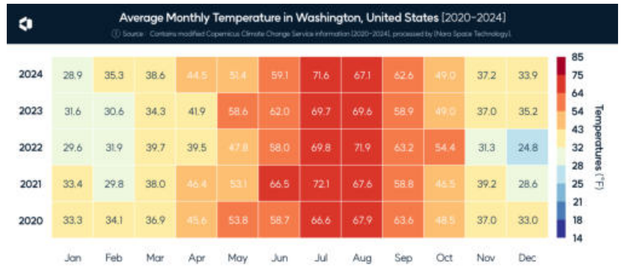
## Potato Production Forecasting by Major U.S. Producing States




## Technical Specifications

| | |
|---|---|
| **Available Resolution** | ~ 500m |
| **Input Data** | Satellite Based Vegetation Index, Weather, Soil, Land Cover and Yield Data |
| **Output Format** | Vector(GeoJSON), Statistical Data (CSV), Report(PDF) |

## Key Advantages

### 1 Crop-Specific Growth Characteristic-Based Production Forecasting

- Resolves discrepancies that root crops may exhibit between satellite-observed vegetation status and actual biological growth stages.
- Accounts for crop-specific growth time lags to leverage vegetation and meteorological data at optimal periods for precise production forecasting.

### 2 Mid-to-Long Term Crop Condition Forecasting

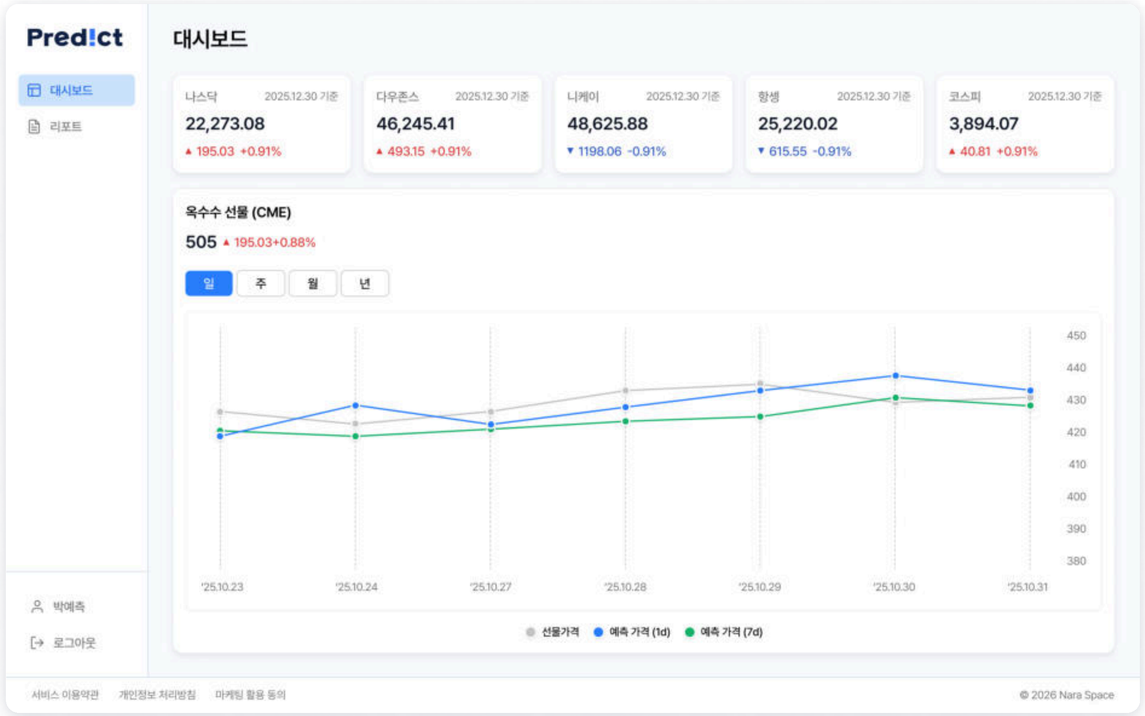
- Identifies long-term crop development trends by analyzing meteorological distribution and historical shift patterns.
- Forecasts production fluctuations for climate-sensitive crops through year-over-year comparative analysis to support mid- to long-term supply-demand outlooks.

### 3 Customized Forecasting Models by Commodity

- Build and operate specialized forecasting models tailored to the unique biological characteristics of commodities such as corn, potatoes, and cocoa.
- Highly scalable to new crops and regions, offering comprehensive coverage across the global agricultural market.

# Commodity Price Forecasting

## Predict: Futures Price Movement Forecasting Platform




## Technical Specifications

| | |
|---|---|
| **Input Data** | Satellite, Predicted Production, Economic, Environmental, and Meteorological Data |
| **Output Format** | Predicted Price Data(CSV) |

## Key Advantages

### 1 Integrated Satellite & Financial Data Analytics

- Synthesizes satellite-derived crude oil inventories and agricultural yield forecasts with financial market datasets, including futures prices, foreign exchange rates, and trading volumes.
- Overcomes the constraints of isolated data streams to execute price forecasting that simultaneously accounts for supply, demand, and market sentiment.

### 2 Leveraging Proprietary Leading Indicators

- Directly input  independently acquired inventory and crop condition data into forecasting models prior to official statistical announcements.
- Utilize supply-side intelligence that precedes public statistics to facilitate early market shifts capture.

### 3 Deep Learning-Based Short to Mid Term Price Forecasting

- Predict the direction and magnitude of short, mid, and long-term price fluctuations across distinct time intervals using deep learning architectures.
- Move beyond rudimentary trend analysis to incorporate complex market patterns, enabling resilience against abrupt price volatility.

### 4 Continuous Performance Enhancement via Data Refinement

- Consistently upgrades predictive accuracy through the accumulation of fresh datasets and continuous model optimization.
- Features a versatile framework expandable from crude oil and grains into diverse commodity sectors, including metals and energy.

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# 04

# Core Analytics Technologies

Object Detection

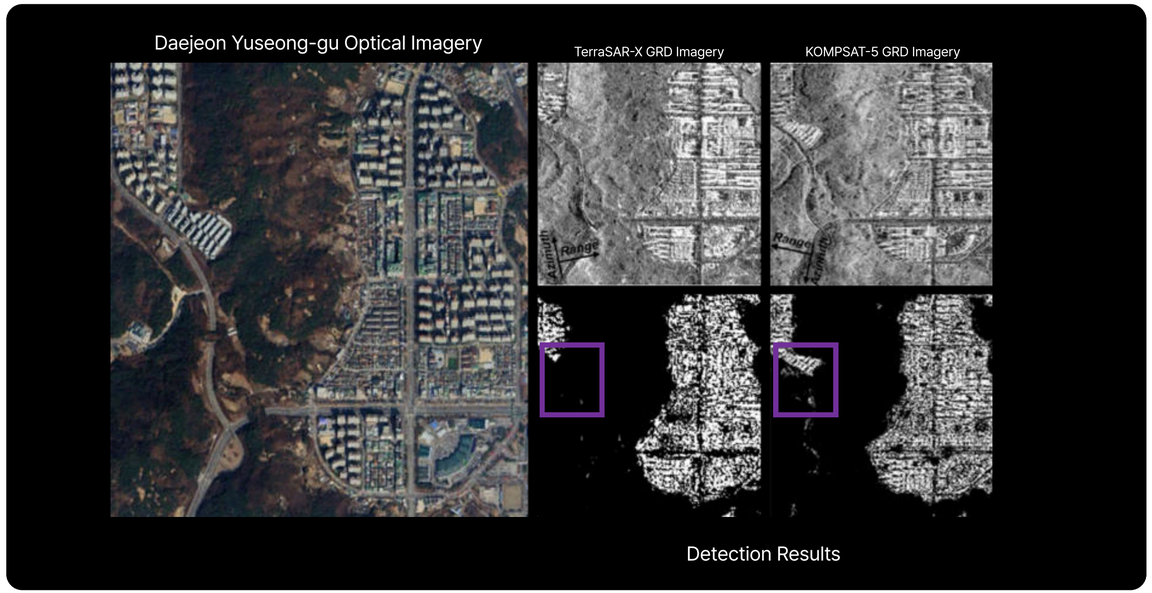
Super Resolution

Gap-Filling

GenAI (Generative AI)

# **Object Detection :** Urban Area Detection Based on SAR Imagery

## Daejeon Yuseong-gu Optical Imagery




## Technical Specifications

| | |
|---|---|
| **Available Resolution** | 3 m (TerraSAR-X), 5 m (KOMPSAT-5) |
| **Input Data** | SAR GRD Image Before and After the Event |
| **Output Format** | Raster (GeoTIFF, PNG) |

## Key Advantages

### 1 Extraction of building-specific SAR scattering mechanisms

Achieve high-precision detection by analyzing building-specific SAR scattering behaviors—such as shadowing and double-bounce effects—far surpassing the limitations of traditional backscatter-only analysis.

### 2 High-precision detection of urban environments

Using extracted morphological features, our solution can accurately identify densely built-up zones and urban structures, enabling valuable applications in urban planning, infrastructure monitoring, and post-disaster damage assessment.

### 3 Comparative analytics across multiple imagery types

Enable robust cross-verification by comparing not only identical SAR images but also data from different SAR sensors, providing a more comprehensive and multi-layered analytical perspective.

# **Object Detection :** Optical Image-Based Building / Road Detection

## Mandalay, Myanmar

## Technical Specifications

| | |
|---|---|
| **Recommended Resolution** | ~ 1 m |
| **Input Data** | RGB band |
| **Output Format** | Raster (GeoTIFF, PNG), Vector (GeoJSON) |
| **Model performance (mIoU)** | 0.84 (on test data with resolution under 1 meter) |

(*mIoU : Mean Intersection over Union)

## Key Advantages

### 1 Robust Object Detection Model Built on Global Datasets

By jointly training on diverse domestic and international datasets,
the model ensures consistent and stable performance regardless of regional characteristics or environmental variations.

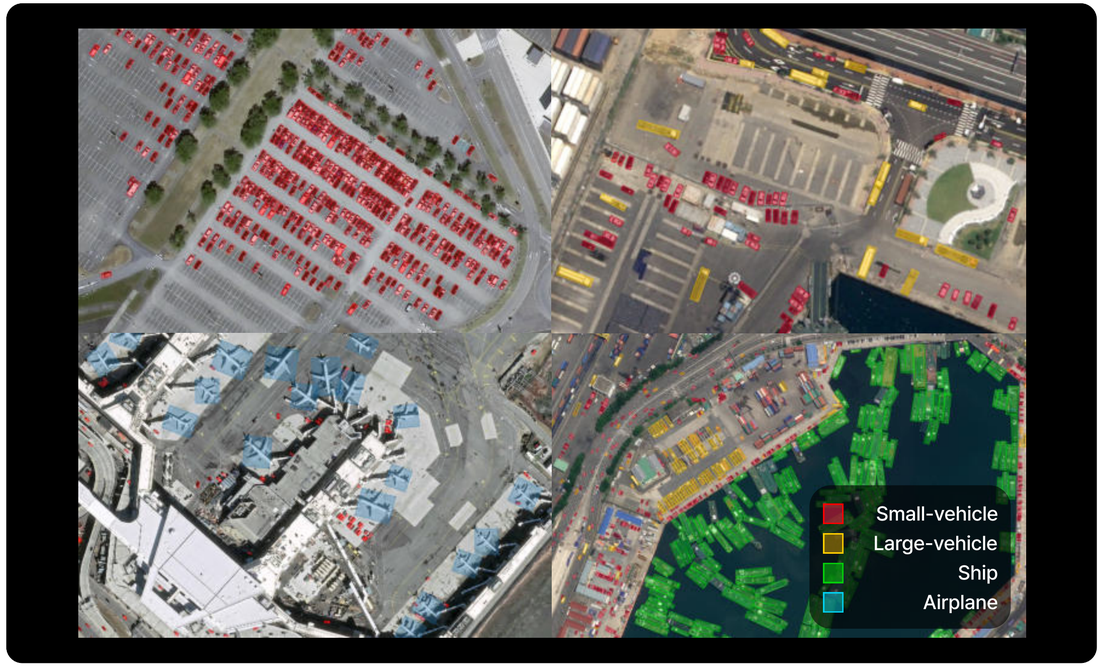
### 2 High-Precision Urban Area Detection through Ultra-High-Resolution Training

Achieves mIoU of 0.84 on imagery with spatial resolution finer than 1 meter.

### 3 High-Speed Analysis Enabled by an Efficient Inference Model

Achieves fast inference of approximately 13 seconds per 1000 × 1000 pixel input, enabling rapid and accurate detection across large-scale spatial areas.

# **Object Detection :** Transportation Means




## Technical Specifications

| | |
|---|---|
| **Recommended Resolution** | ~ 0.5 m |
| **Training Data** | Self-Constructed Data (Pleiades, Pleiades Neo), DOTA Dataset (Satellite and Aerial Imagery), AI Hub (Kompsat-3, Kompsat-3A) |
| **Input Data** | RGB band |
| **Output Format** | Vector (GeoJSON, SHP) |

## Key Advantages

### 1 Training on multi-resolution satellite and aerial imagery

Leveraging datasets such as Pleiades, Pleiades Neo, and DOTA, we combine imagery at various resolutions with Super-Resolution (SR) outputs to deliver robust detection performance at 0.5 m–class high resolution.

### 2 Enhanced accuracy through Super-Resolution integration

By sharpening object boundaries with advanced Super-Resolution technology, we simultaneously improve detection accuracy and the visual quality of the results.

### 3 High-precision detection across five transportation classes

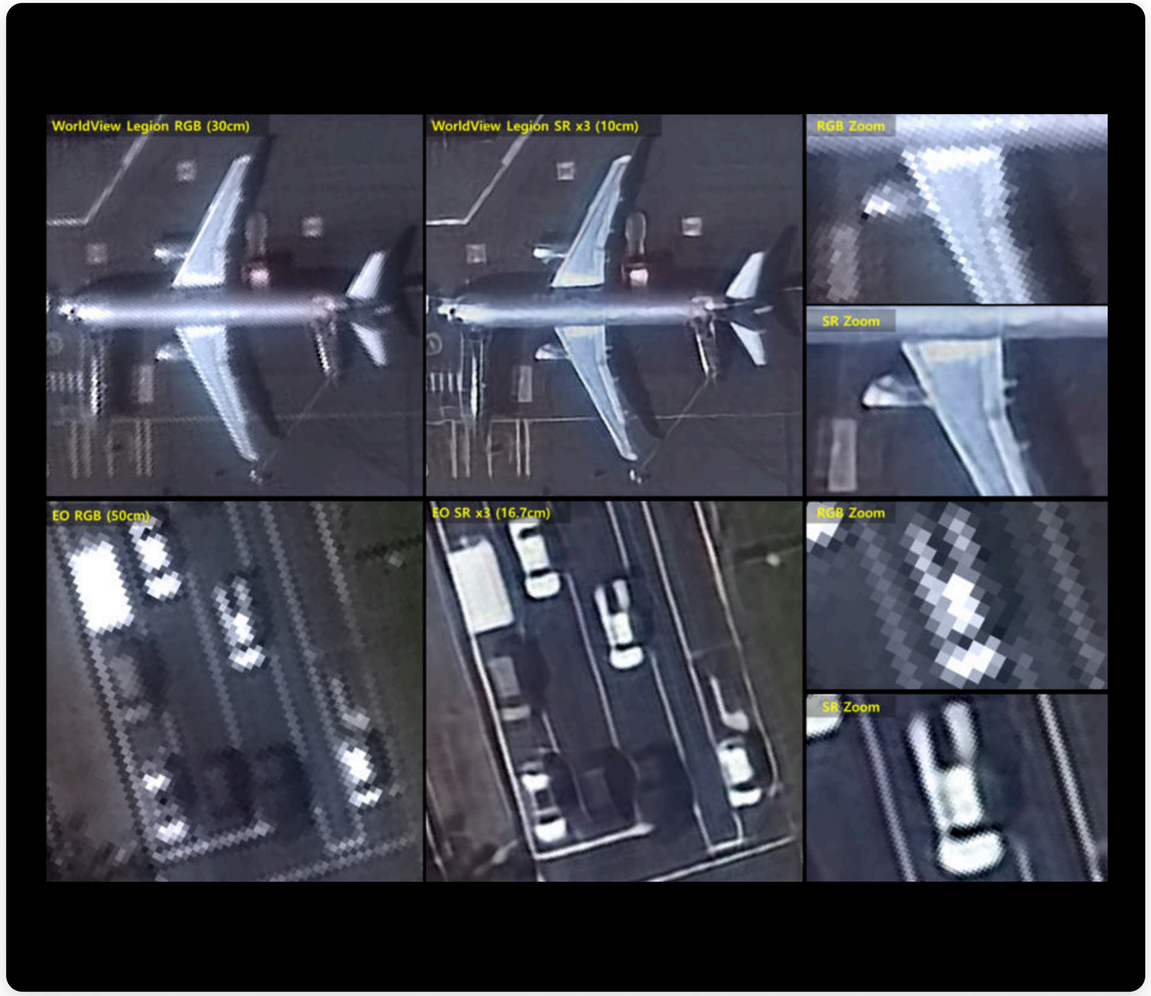
The model distinguishes multiple transportation asset types—such as fire trucks, heavy vehicles, ships, and aircraft—achieving an average recall above 0.98 accuracy across five transportation classes.

**Transportation Means Object Detection Accuracy**

| Class | Small Vehicles | Large Vehicles | Ships | Airplanes | Average |
|---|---|---|---|---|---|
| Recall | 0.98 | 0.93 | 1.00 | 1.00 | 0.98 |
| AP | 0.90 | 0.73 | 0.94 | 0.90 | 0.87 |

# Super Resolution

## 3X Super Resolution to a WorldView Legion (30 cm) image




## Key Advantages

### 1 High-quality super-resolution tailored to your satellite imagery

Incorporates satellite-specific characteristics—such as brightness, noise patterns, and atmospheric effects—to preserve original features while enhancing spatial resolution, enabling more precise object detection and analysis.

### 2 Fast processing of large-scale imagery through model lightweighting and optimization

By lightweighting the model and optimizing inference, high-volume, large-area satellite imagery can be processed at high speed, ensuring both high throughput and consistent image quality.

### 3 Maximizing value from existing low-resolution imagery and reducing costs

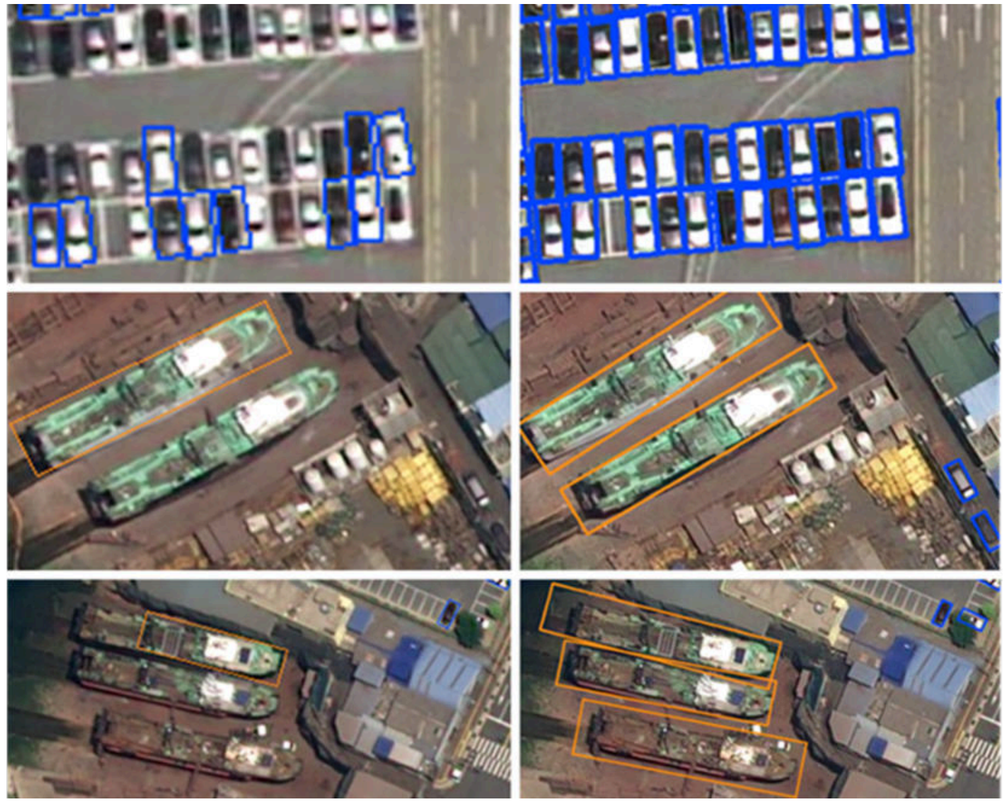
By upscaling existing low-resolution archives—such as Landsat and Sentinel—into high-resolution products, you can reduce reliance on costly high-resolution acquisitions while significantly increasing data utilization.

### 4 Boosting accuracy across multiple analysis workflows

Applying super-resolution enhances performance in change detection, object detection, and disaster monitoring, improving both detection accuracy and overall analysis quality.

# Super Resolution

## Accuracy Improvement After SR Application



## Performance Improvement Cases Before / After SR Application

| Performance Improvement Cases Before / After SR Application | | | | | |
|---|---|---|---|---|---|
| Class | Small Vehicles | Large Vehicles | Ships | Airplanes | Average |
| Recall | 0.61 → **0.98** | 0.84 → **0.93** | 0.97 → **1.00** | 1.00 → **1.00** | 0.85 → **0.98** |
| AP | 0.59 → **0.90** | 0.55 → **0.73** | 0.89 → **0.94** | 0.98 → **0.90** | 0.75 → **0.87** |

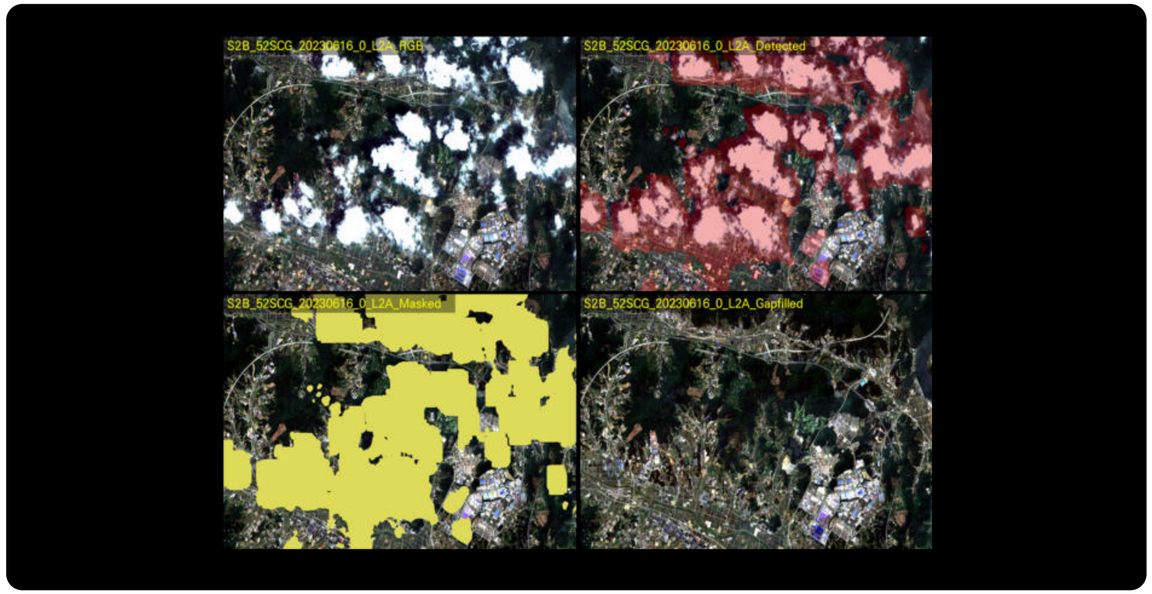
## Technical Specifications

| | |
|---|---|
| **Recommended Resolution** | 0.3 m - 10 m |
| **Applicable Satellites** | Applicable to more than 20 high- to low-resolution satellite types |
| **Input Data** | RGB / RGBN |
| **Output Format** | Raster (GeoTIFF, PNG / 8bit) |

# Gap-Filling

The images illustrate the cloud and cloud-shadow masking and gap-filling process applied to Sentinel-2 (10 m) imagery for the Korean peninsula

## Gap-filling




## Technical Specifications

| | |
|---|---|
| **Recommended Resolution** | ~ 30 m |
| **Training Data** | Landsat 8-9 (30 m) , Sentinel-2 (10 m) |
| **Input Data** | RGB + a |
| **Output Format** | Raster (GeoTIFF, PNG / 8bit , 16bit) |

## Key Advantages

### 1 Deep learning–based precise cloud detection

Leveraging advanced deep learning models, cloud-covered areas are detected far more accurately than with conventional threshold-based methods.

### 2 Continuous monitoring without cloud constraints

By reconstructing areas obscured by clouds and cloud shadows, continuous observation becomes possible without interruption, while preserving both spatial and temporal resolution.

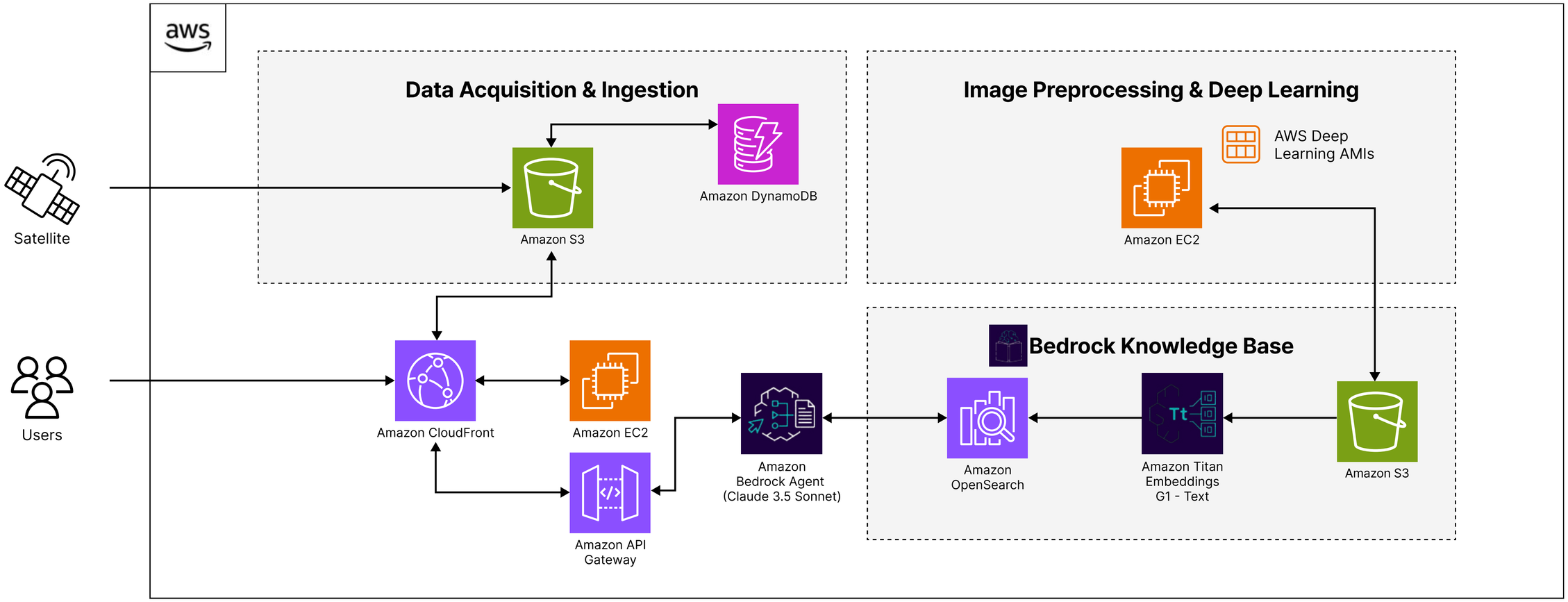
### 3 Seamless restoration of cloud-obscured areas

Advanced machine learning algorithms naturally reconstruct missing regions, preserving land-cover patterns even in complex terrain.

### 4 Purpose-built for time-series intelligence

Delivers gap-free time-series imagery for use cases that demand continuous monitoring, including land-cover change detection, agricultural monitoring, and water resource management.

# Automatic Reporting Using GenAI




**Key Advantages**

**1 Save time**

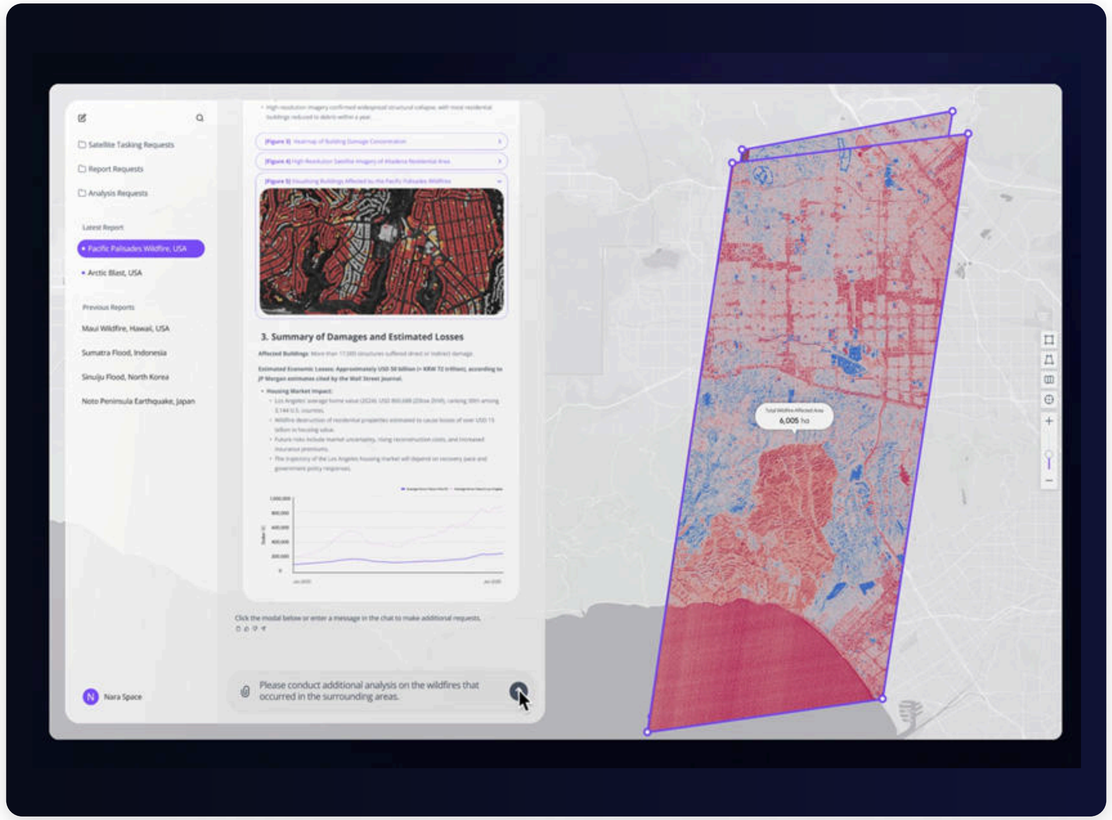
By leveraging Gen AI, report generation is dramatically reduced, enabling actionable insights in record time.

**2 Minimized Hallucinations**

By leveraging a rich, domain-specific knowledge base, the system significantly reduces hallucinations and delivers reliable analytical results.

# GenAI-Based Customer-Specific Copilot System

## Copilot System Example




## Key Advantages

### 1 User-friendly chatbot interface

An intuitive, conversational system that lets users easily request satellite image analysis and receive their results in no time.

### 2 Proactive, automated reporting

When a disaster occurs, the system automatically runs the analysis and delivers a report to the user, without requiring any manual request.

### 3 On-demand, deeper analysis

Once an initial report has been generated, users can immediately request additional or more detailed analyses to support in-depth decision-making.

### 4 24/7 Availability

The Gen AI system delivers essential information instantly, without time constraints or waiting periods, enabling timely decision-making during critical moments.

NARA SPACE

# Thank you

Contact us: sales@naraspace.com