Synspective

Synspective's Small X-Band SAR Satellite (StriX) Constellation and its First InSAR Results

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Synspective

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About Synspective

Synspective

Founded in 2018
(Basic technology developed under ImPACT program in 2015-2018)

$200M in 4.5yrs

~180 Members From ~30 countries

Strategic Projects Award
WSBW 2019

MEXT Minister Prize
Nippon Startup Award 2022

Geospatial World Leadership
Award 2022

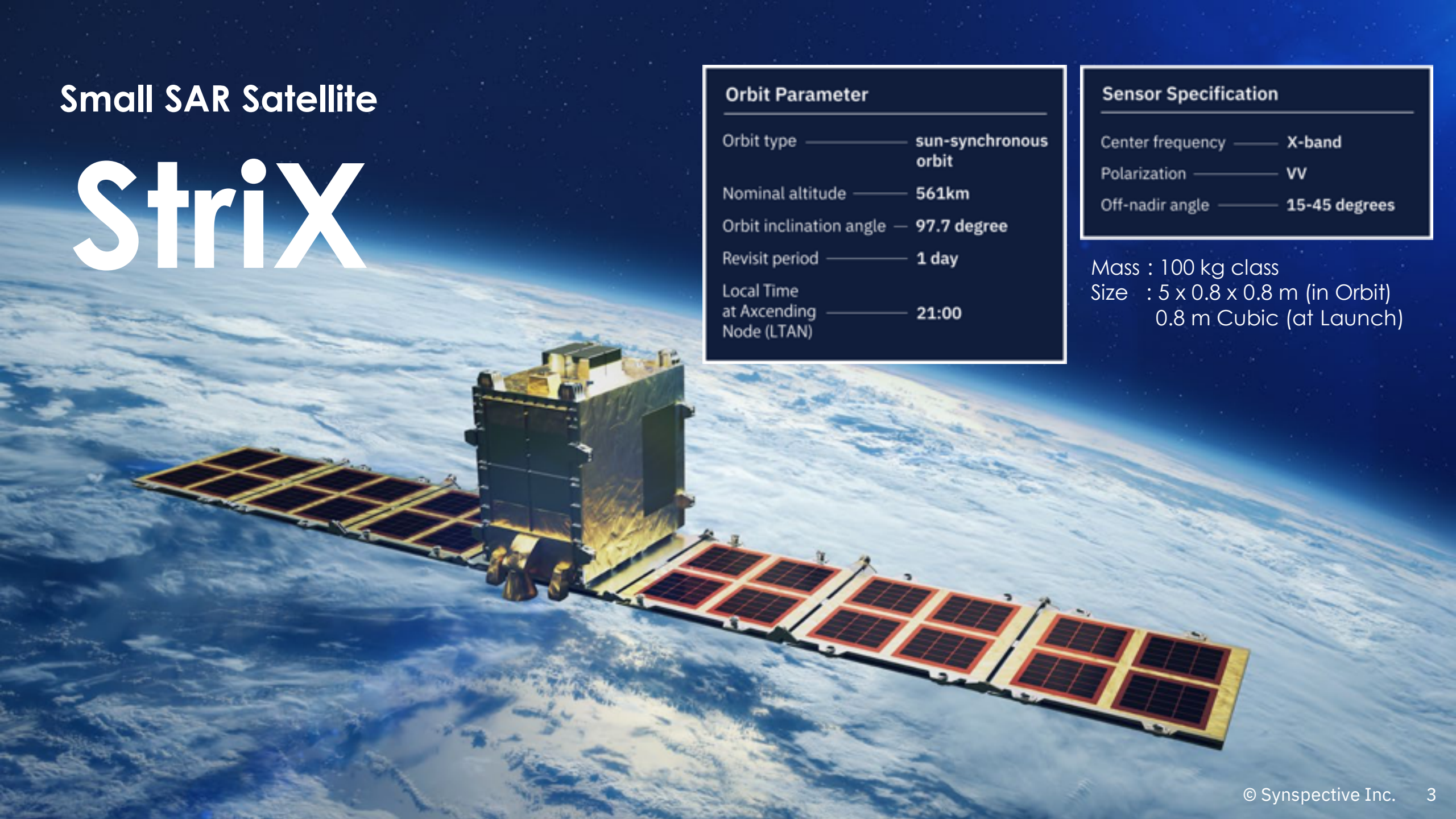
Small SAR Satellite

StriX

Orbit Parameter	
Orbit type	sun-synchronous orbit
Nominal altitude	561km
Orbit inclination angle	97.7 degree
Revisit period	1 day
Local Time at Axcending Node (LTAN)	21:00

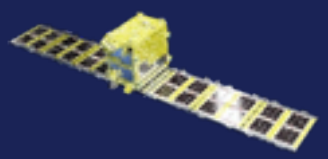
Sensor Specification	
Center frequency	X-band
Polarization	VV
Off-nadir angle	15-45 degrees

Mass : 100 kg class
Size : 5 x 0.8 x 0.8 m (in Orbit)
0.8 m Cubic (at Launch)



Roadmap

2020~ → **2024~** → **202X~**



▲ Dec 2020 StriX-α

▲ Mar 2022 StriX-β

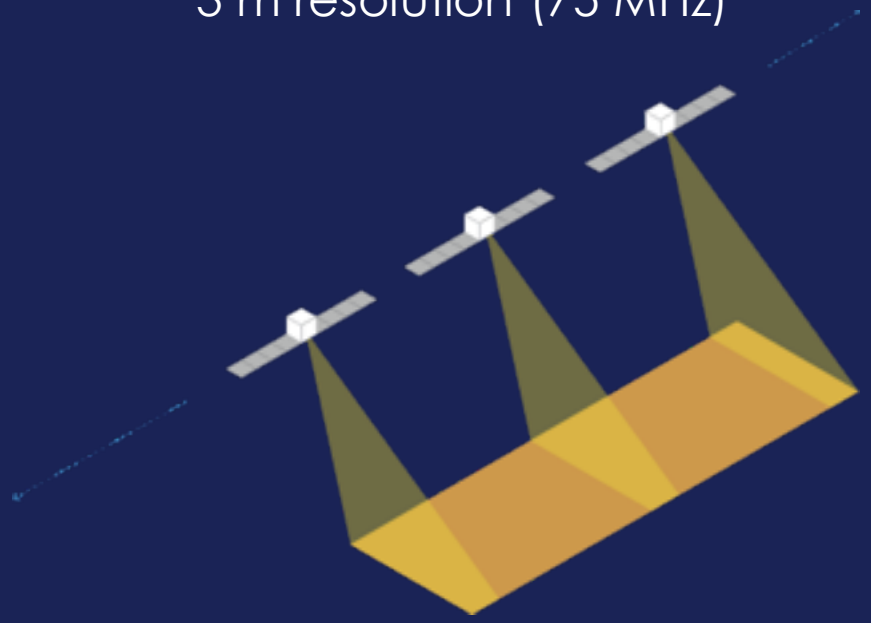
▲ Sep 2022 StriX-1

Daily

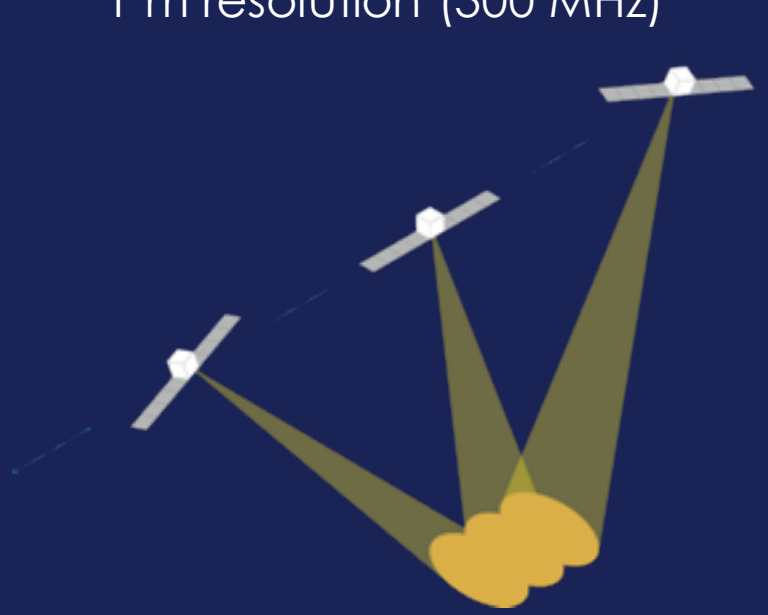
Near real-time (~hours)

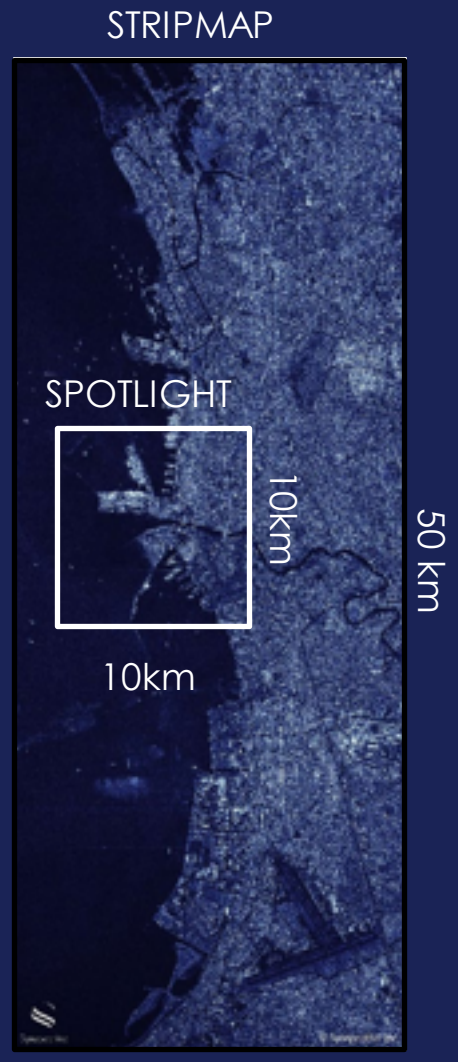
Observation Modes

Stripmap
20 x 50 km
3 m resolution (75 MHz)



Sliding Spotlight
10 x 10 km
1 m resolution (300 MHz)



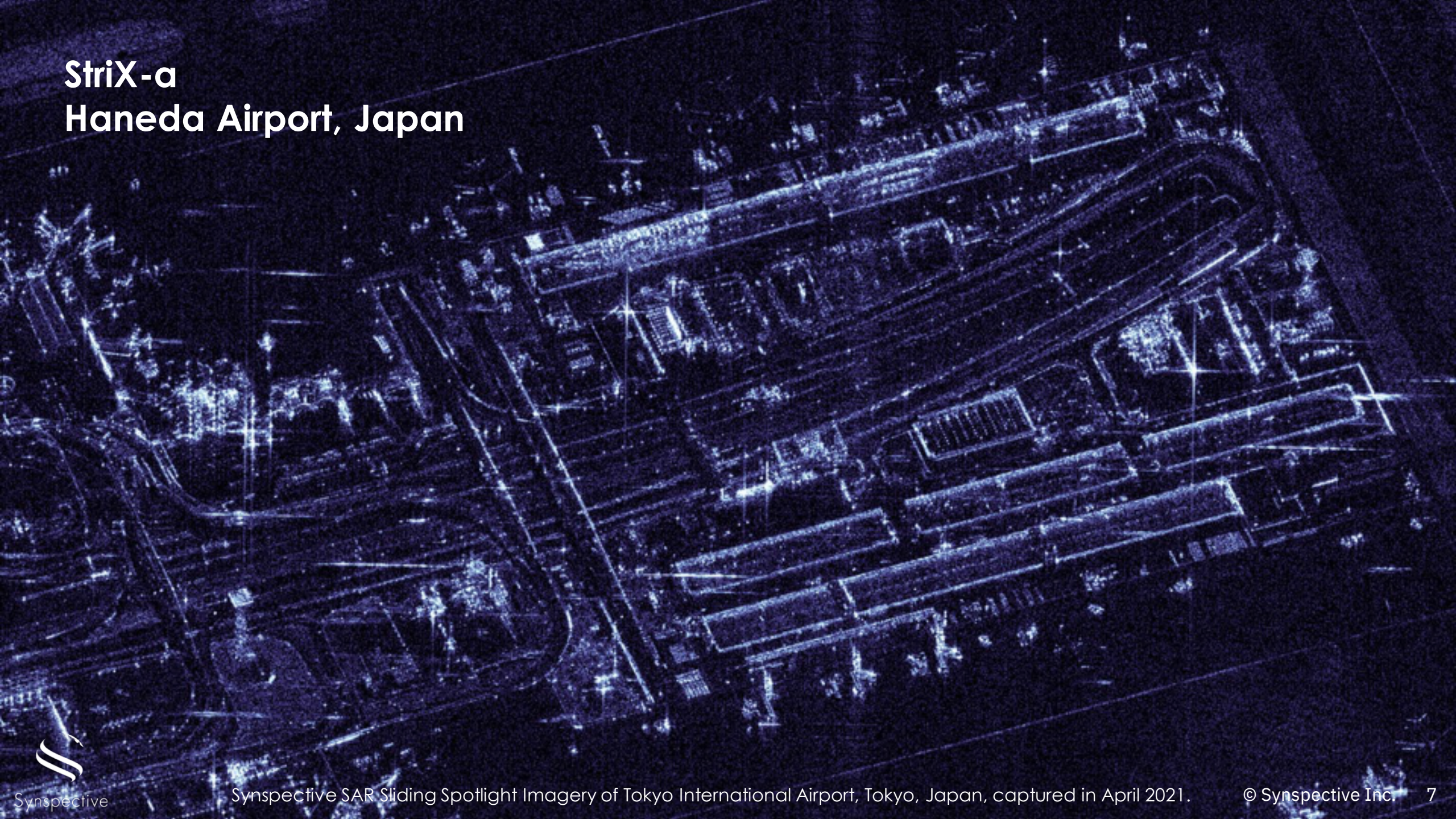


StriX-a
Tokyo, Japan

Synspective

Synspective SAR Sliding Spotlight Imagery of Tokyo, Japan, captured in April 2021.

StriX-a
Haneda Airport, Japan



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Synspective SAR Sliding Spotlight Imagery of Tokyo International Airport, Tokyo, Japan, captured in April 2021.

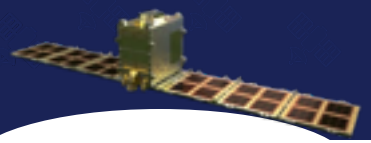
Business Model

Data creation → **Data understanding**

Key Target Market

Data Acquisition

SAR satellite constellation



Other big data

Analysis

Data science & Machine learning

Delivery

Service 1:
SAR data sales

Service 2:
Solutions

Key Target Market

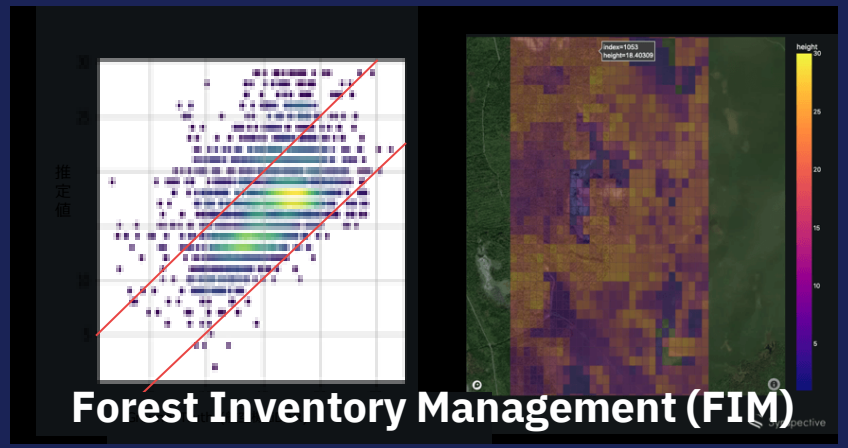
- Defense & Intelligence
- Data analyzer
- Infrastructure/AEC
- Energy/resources
- Finance & insurance

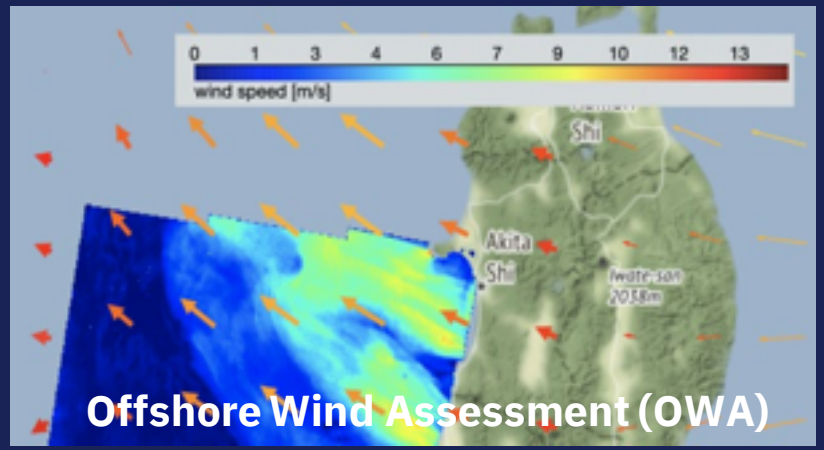
Solutions


Land Displacement Monitoring (LDM)


Flood Damage Assessment (FDA)


Disaster Damage Assessment (DDA)


Forest Inventory Management (FIM)

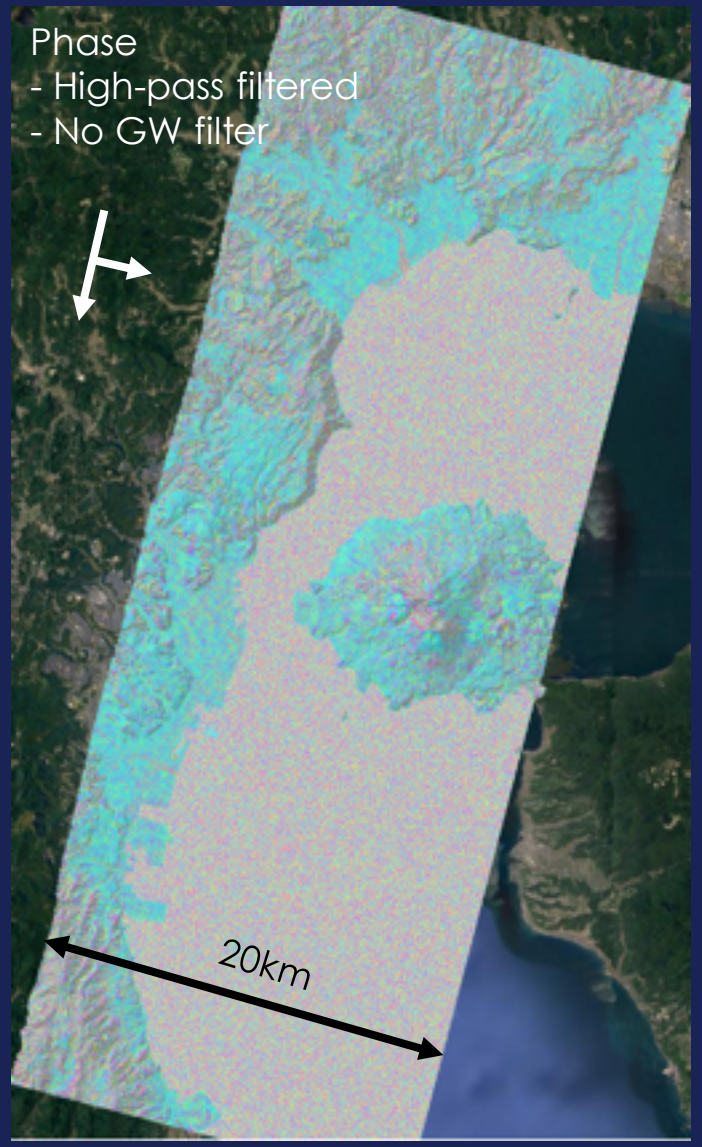


Offshore Wind Assessment (OWA)

InSAR Trial by StriX-1

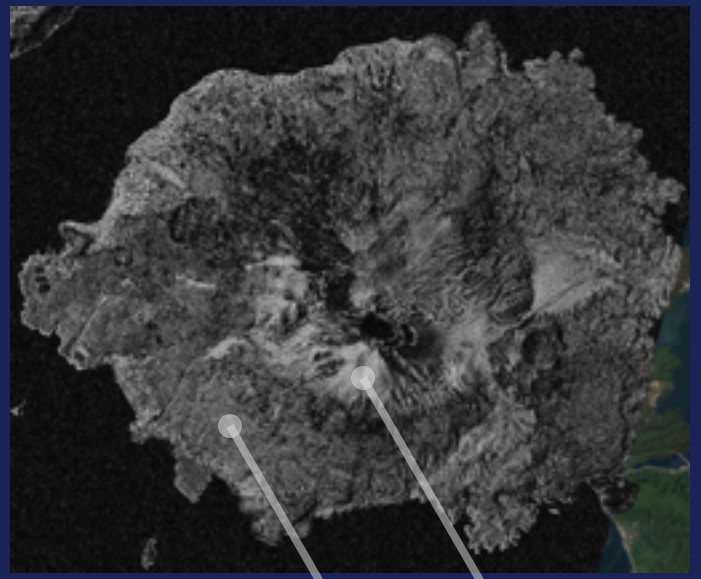
Mode	Stripmap	Sliding Spotlight
Area	Kagoshima, Japan	Koshigaya, Japan
Land Cover	Urban, Mountain, Sea	Urban, Cropland
Orbit Direction	Descending	Ascending
Look Direction	Left	Right
Off-nadir angle	~39 deg	~37 deg
Observation dates	2023-01-31 2023-02-01	2023-01-27 2023-01-28
Bperp (Bcrit)	~100 m (~5 km)	~-460 m (~20 km)
Height ambiguity	~80 m	~16 m
Multilook (Rg x Az)	4 x 4	4 x 8
Pixel Spacing	~6.0 m	~2.4 m

InSAR Trial – Kagoshima, Stripmap

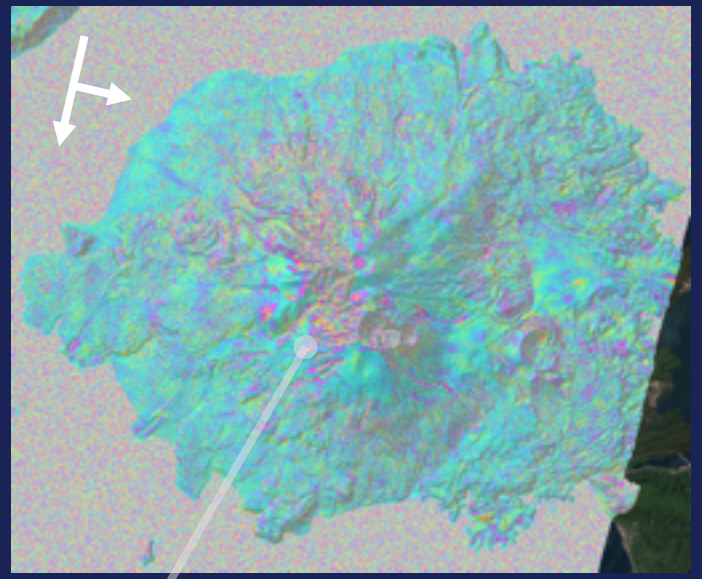


InSAR Trial – Sakurajima, Stripmap

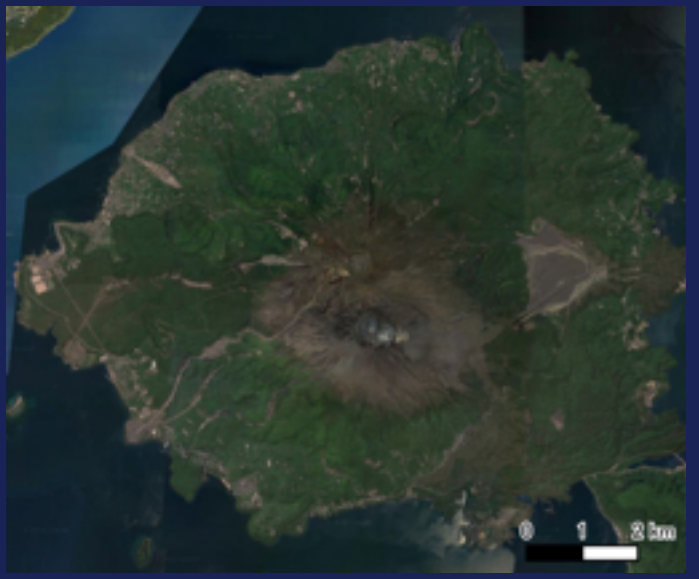
Coherence



Phase



Optical image from GSI Tiles



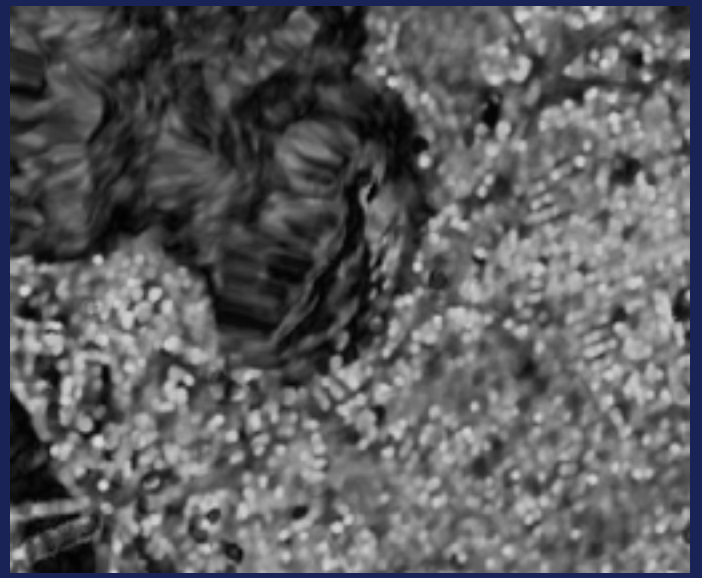
Phase changes around craters
due to DEM error (topographic change)

High coherence (>0.6) in bare soils

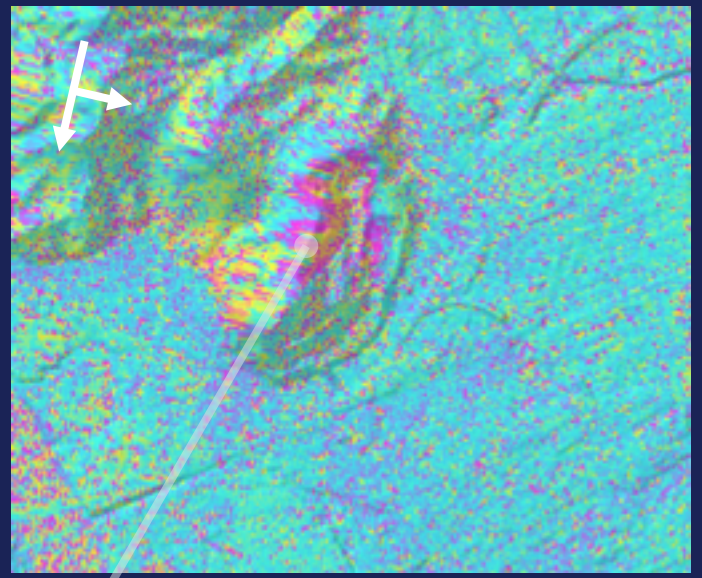
Moderate coherence (>0.4) even in forests (owing to 1-day interval)!

InSAR Trial – Aira, Stripmap

Coherence



Phase

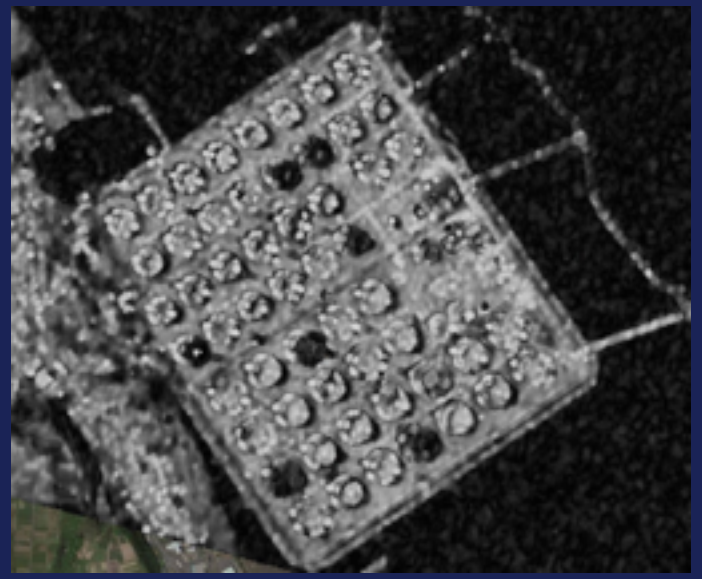


Optical image from GSI Tiles

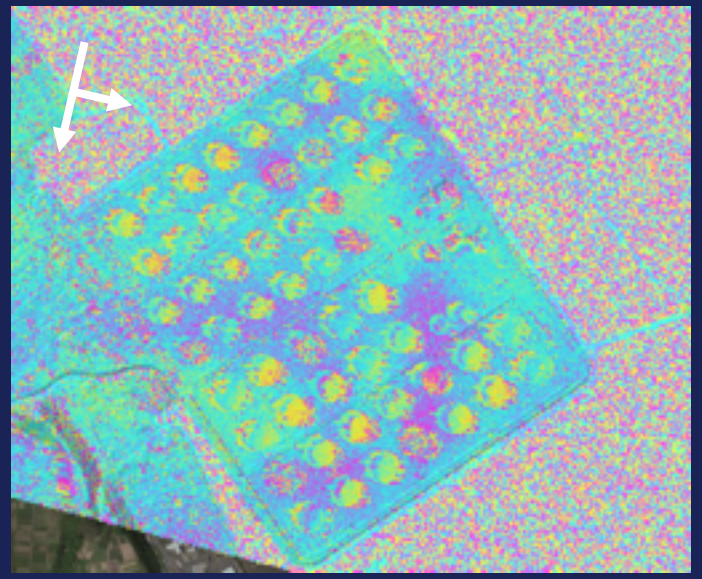
Phase changes around the quarry
due to DEM error (topographic change)

InSAR Trial – Oil Tank, Stripmap

Coherence



Phase



Optical image from GSI Tiles

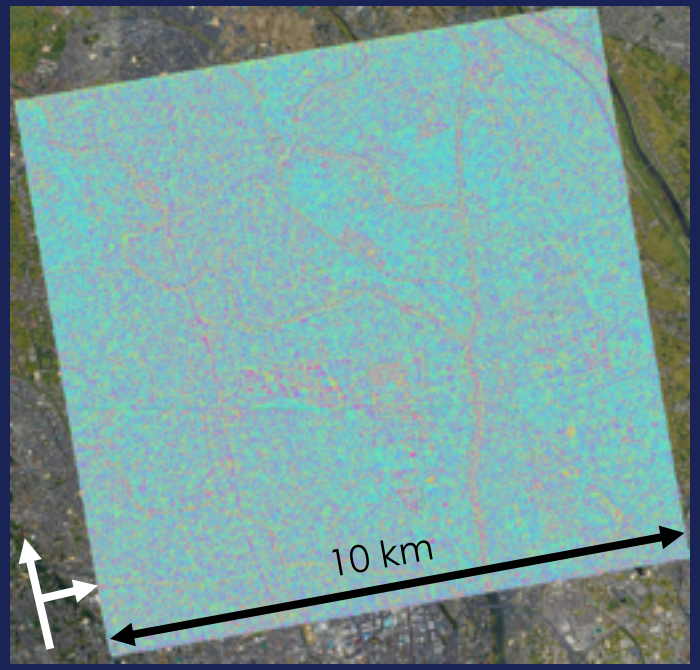
Phase changes on oil tanks
due to fluctuations of the floating roof + DEM error

https://www.nost.co.jp/

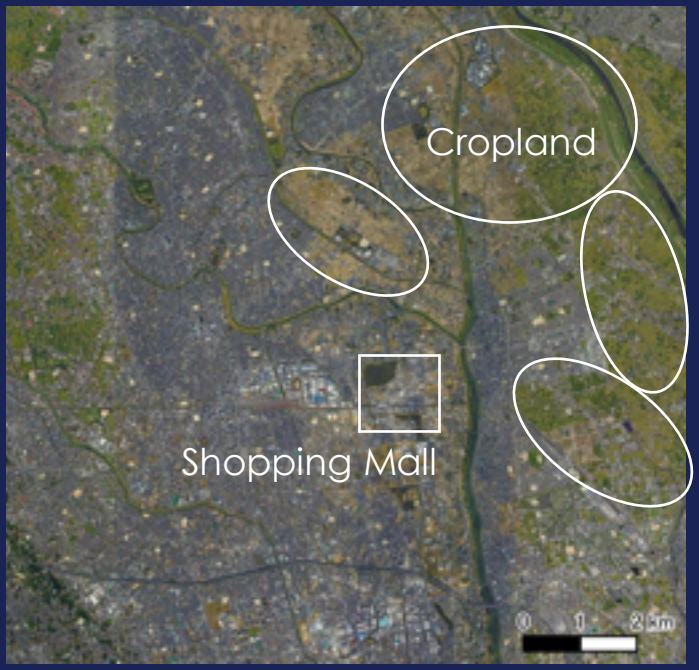
InSAR Trial – Koshigaya, Sliding Spotlight

Coherence

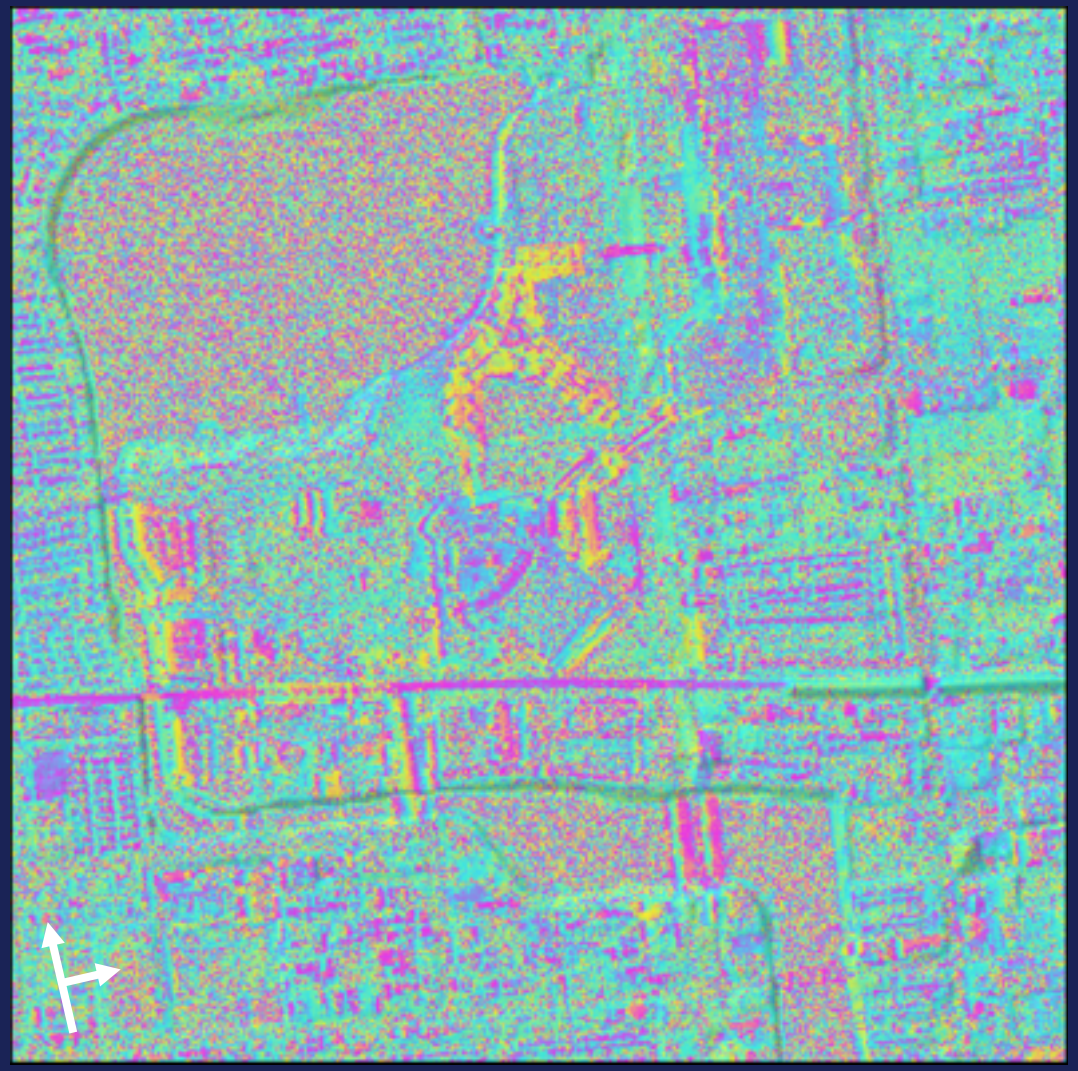
Phase
- High-pass filtered
- No GW filter



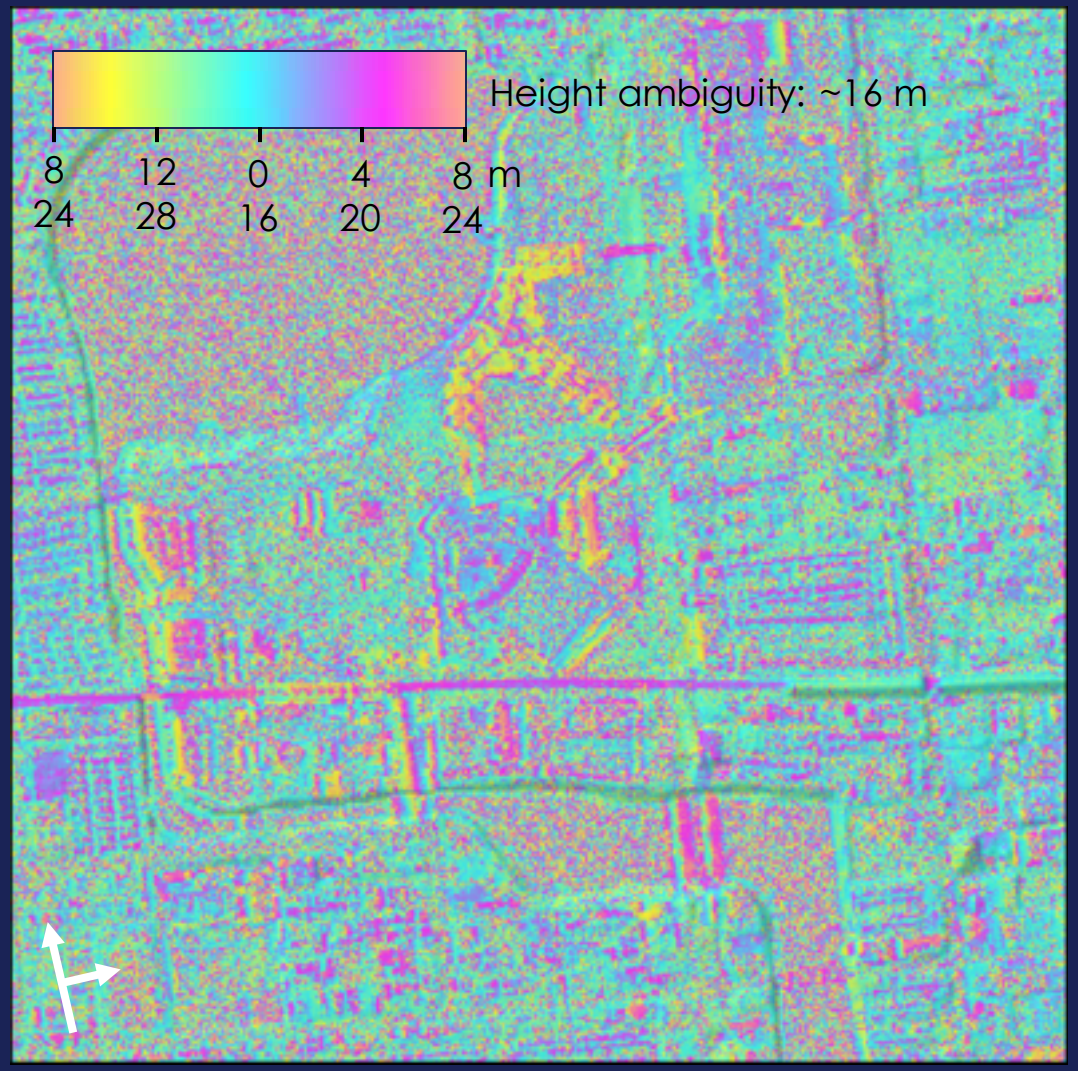
Optical image from GSI Tiles

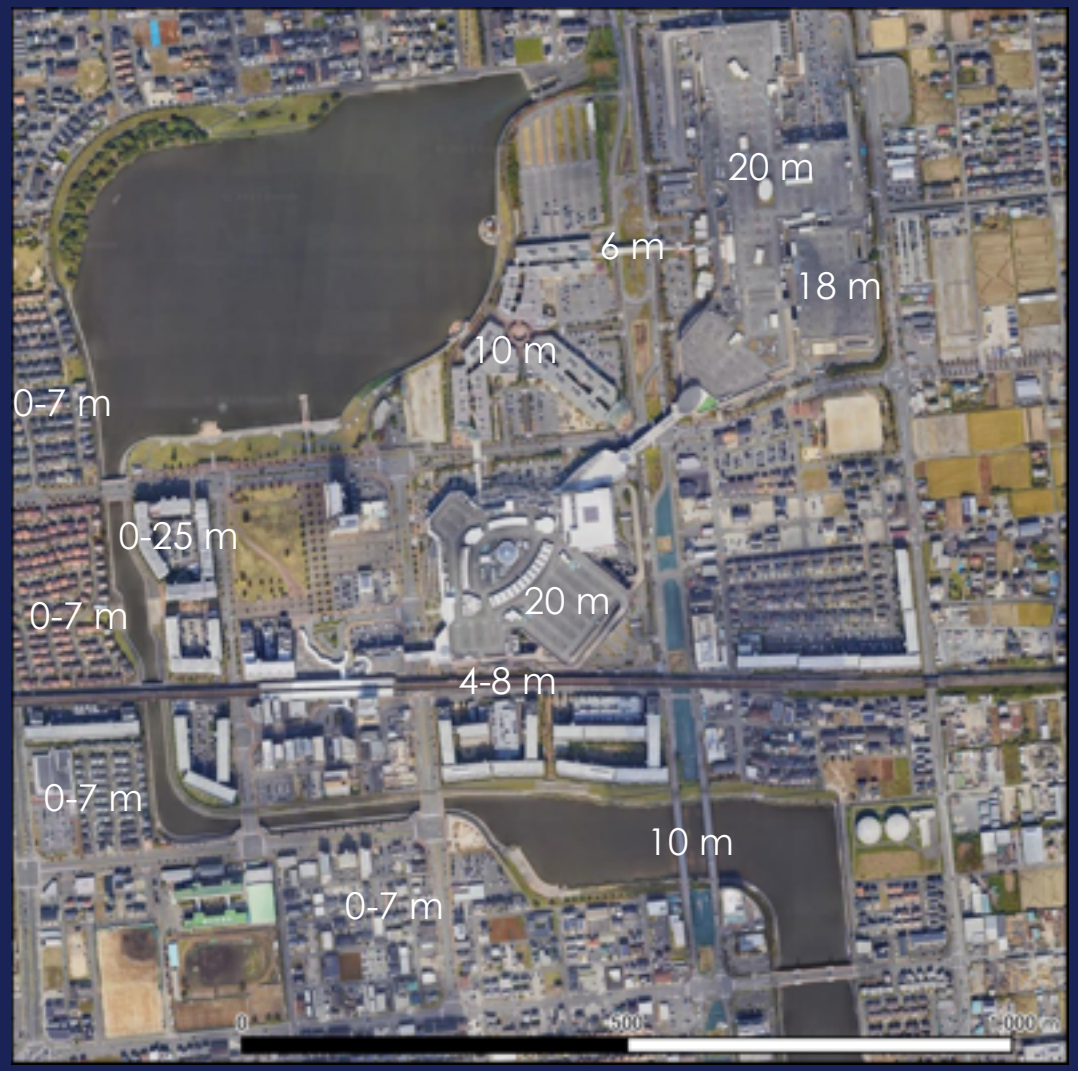


InSAR Trial – Shopping Mall, Sliding Spotlight

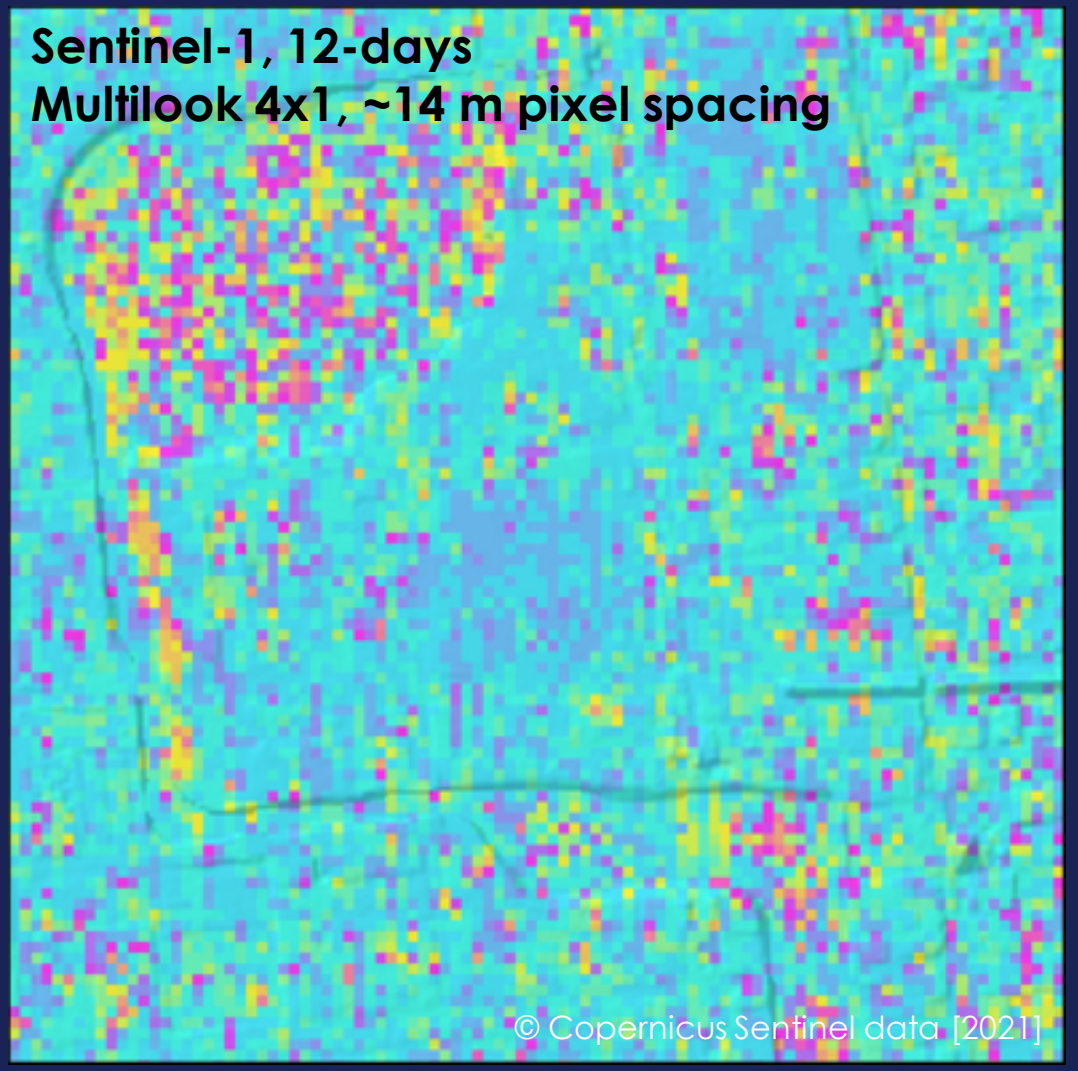


InSAR Trial – Shopping Mall, Sliding Spotlight





InSAR Trial – Shopping Mall, Sliding Spotlight



Summary

- **Synspective** has developed and operated small X-band SAR satellites **StriX** since 2018
- **Three satellites** have been launched so far, and **30 satellites** will be launched by **202X**
- StriX's **InSAR** capability was demonstrated
  - 1-day interferograms showed sufficient coherence even in forest
  - Fine differential phases with high resolution (much higher than Sentinel-1) were successfully obtained

- Future StriX satellites will have higher InSAR capability (e.g., better orbit control)
- Next step is InSAR time series analysis using 1-day interval consecutive images

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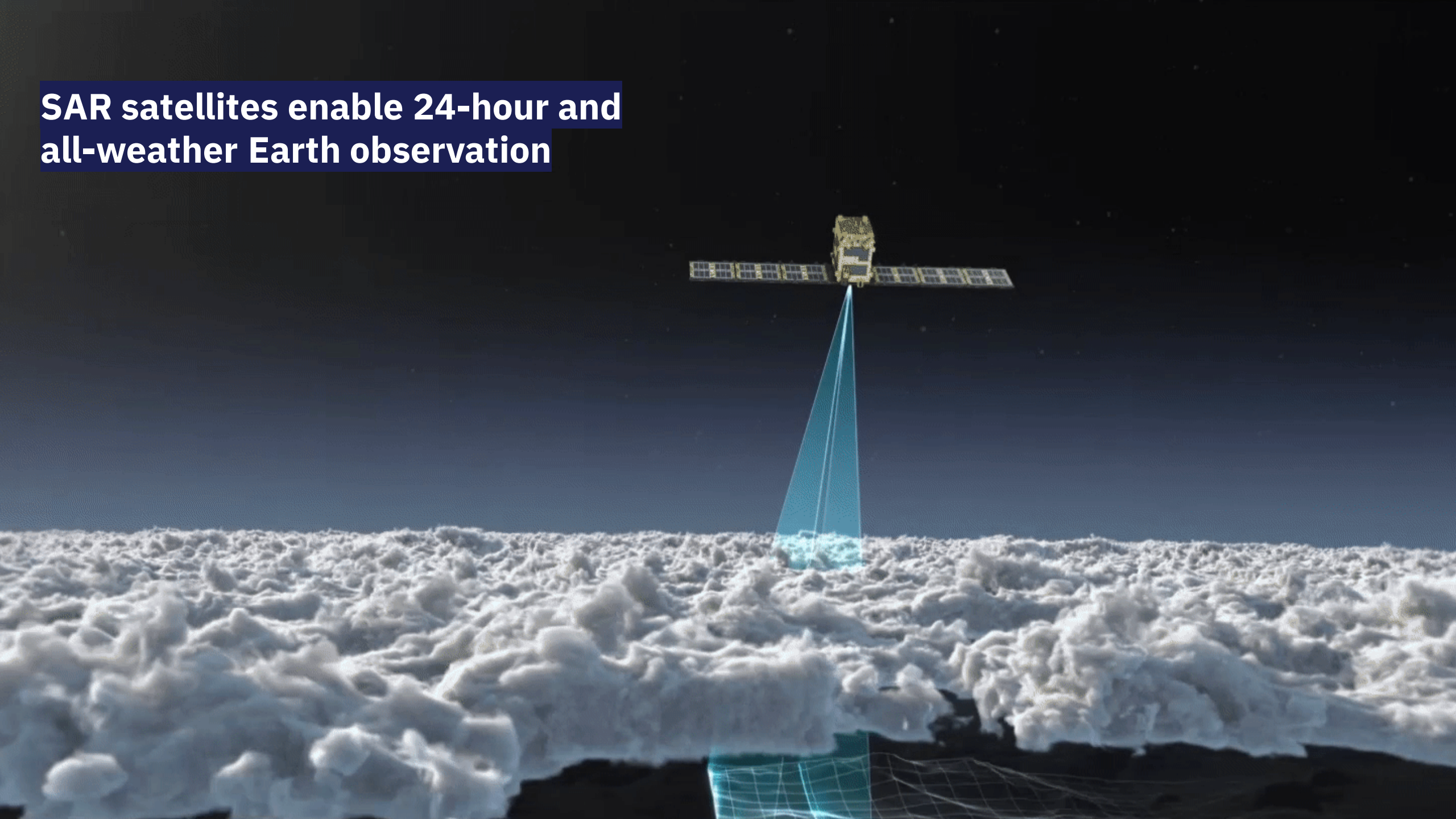
Synthetic Data for Perspective on Sustainable Development

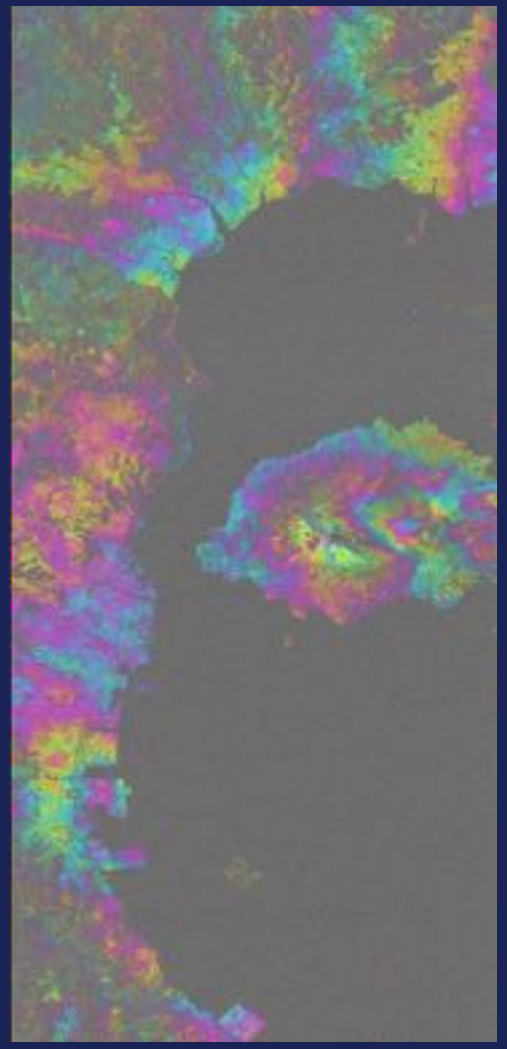
SAR satellites enable 24-hour and all-weather Earth observation



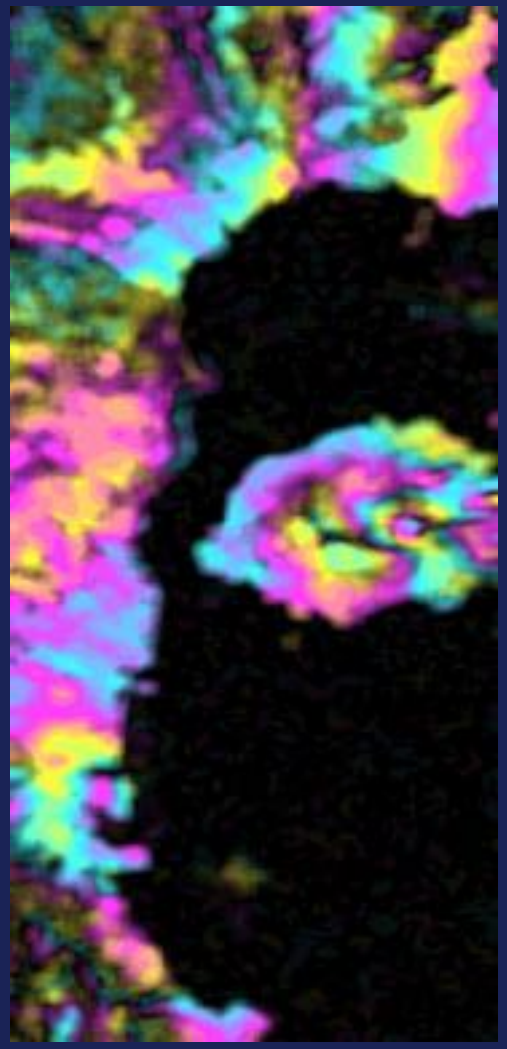
Synspective aims to build the Learning World ecosystem with our analytics platform and SAR data provided near real-time to understand changes and disaster damage anywhere in the world.

InSAR Trial – Kagoshima, Stripmap

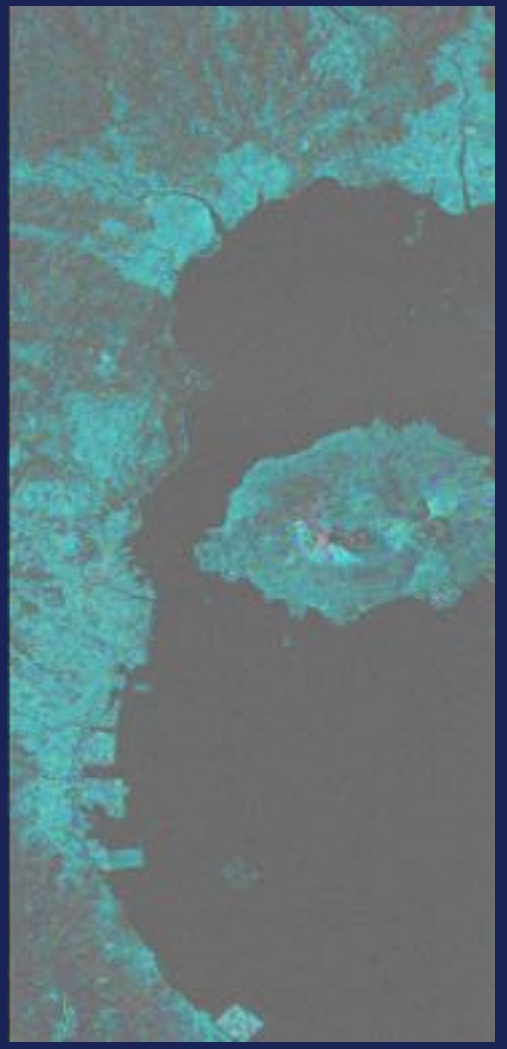
After baseline refinement



LP filtered (r=64pixel)

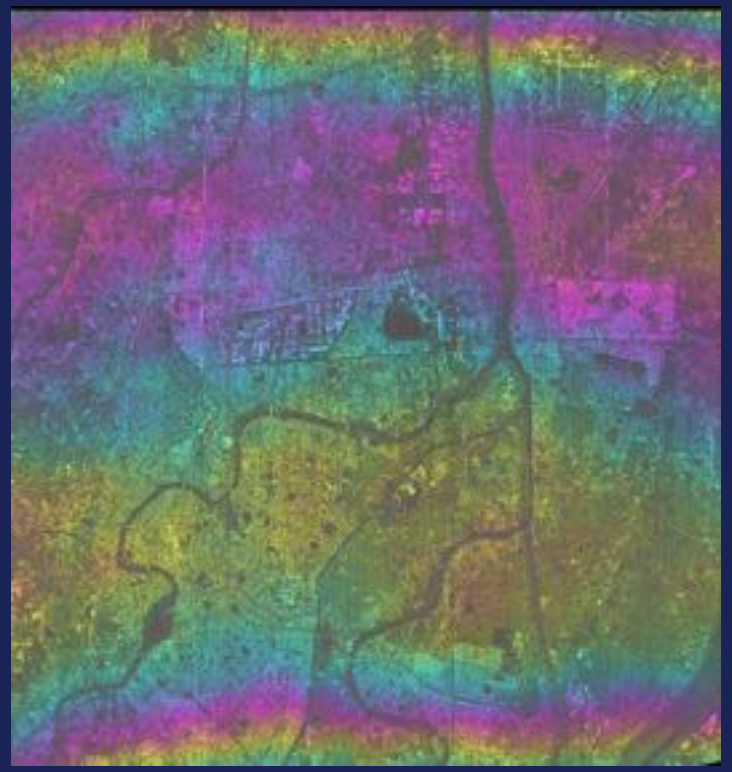


HP filtered

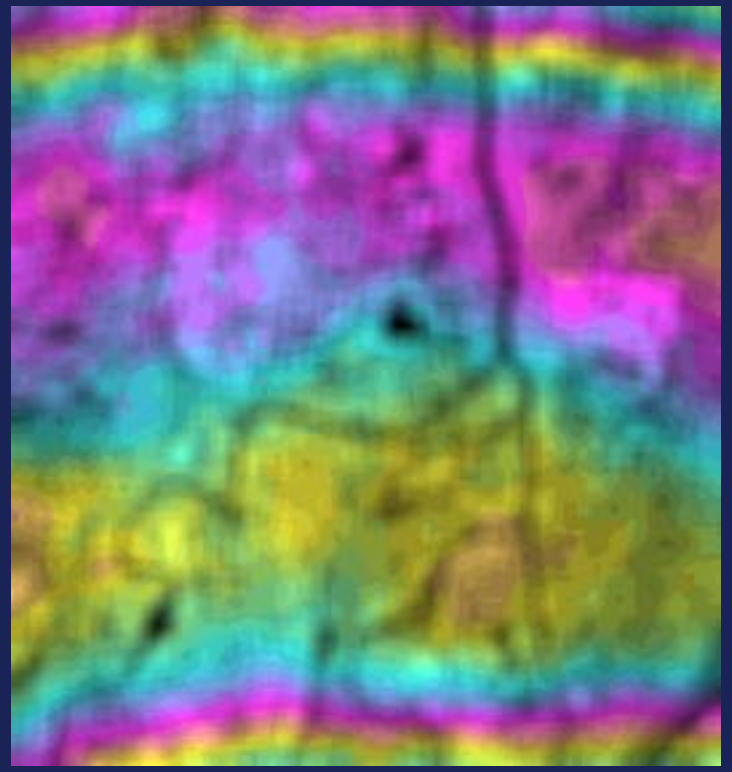


InSAR Trial – Koshigaya, Sliding Spotlight

After baseline refinement



LP filtered (r=64pixel)



HP filtered

https://commons.wikimedia.org/wiki/File:越谷レイクタウン.jpg
シンプルですけど機能的なベッド, CC BY-SA 4.0, via Wikimedia Commons

Q & A

About StriX
Q. What is the designed lifetime of StriX?
A. 5 years (SrtiX-β and -1) and 3 years (StriX-a)

Q. Why LTAN is 21:00, not dawn dusk?
A. Considering the placement of the constellations, other satellites, and actual needs

Q. How much observation resource is available?
Q. How many scenes can StriX acquire per day?
A. Details are confidential. We have been delivering the images to customers including the Japanese government.

Q. What is the price of the data?
A. Please contact us.

Q. Do you already use StriX data in the solutions?
A. We mainly use Sentine-1 data currently, but we started using StriX data in some solutions.

Q. How do you deploy the 30 satellites (i.e., orbit configuration)?
A. We have not fixed it yet, but the title slide one is one of the candidates (i.e., 6 plains x 5 satellites) to cover the global surface with a 1-day repeat orbit.

About InSAR
Q. How stable is the orbit?
Q. How often is InSAR achievable?
Q. Is it possible to achieve a stable orbit like Sentinle-1? If possible, when?
A. Details are confidential, but we are gradually improving the orbit conditions. We aim to achieve the InSAR time series analysis by StriX in the future constellation.

Q. How many InSAR-capable data do you have so far?
A. Several, but not many.

Q. How accurate is the orbit information?
A. It is not very accurate now but will be improved.

Q. Were there any difficulties in StriX InSAR?
A. Because the orbit accuracy was not good enough unlike Sentinel-1, an extra step to remove dense fringes was required. The other steps are normal.

Q. Can we quantitatively estimate the DEM error from multi-temporal data?
Yes, it is one of the next steps. We have some consecutive images which can be used for it. However, I did not do that here because, from a 2-pass interferogram, it is difficult to quantitatively estimate the DEM error larger than height ambiguity. Also, I was not sure if the orbit accuracy was good enough to do it. The accuracy of the DEM estimation relies on the accuracy of Bp.

