Synspective

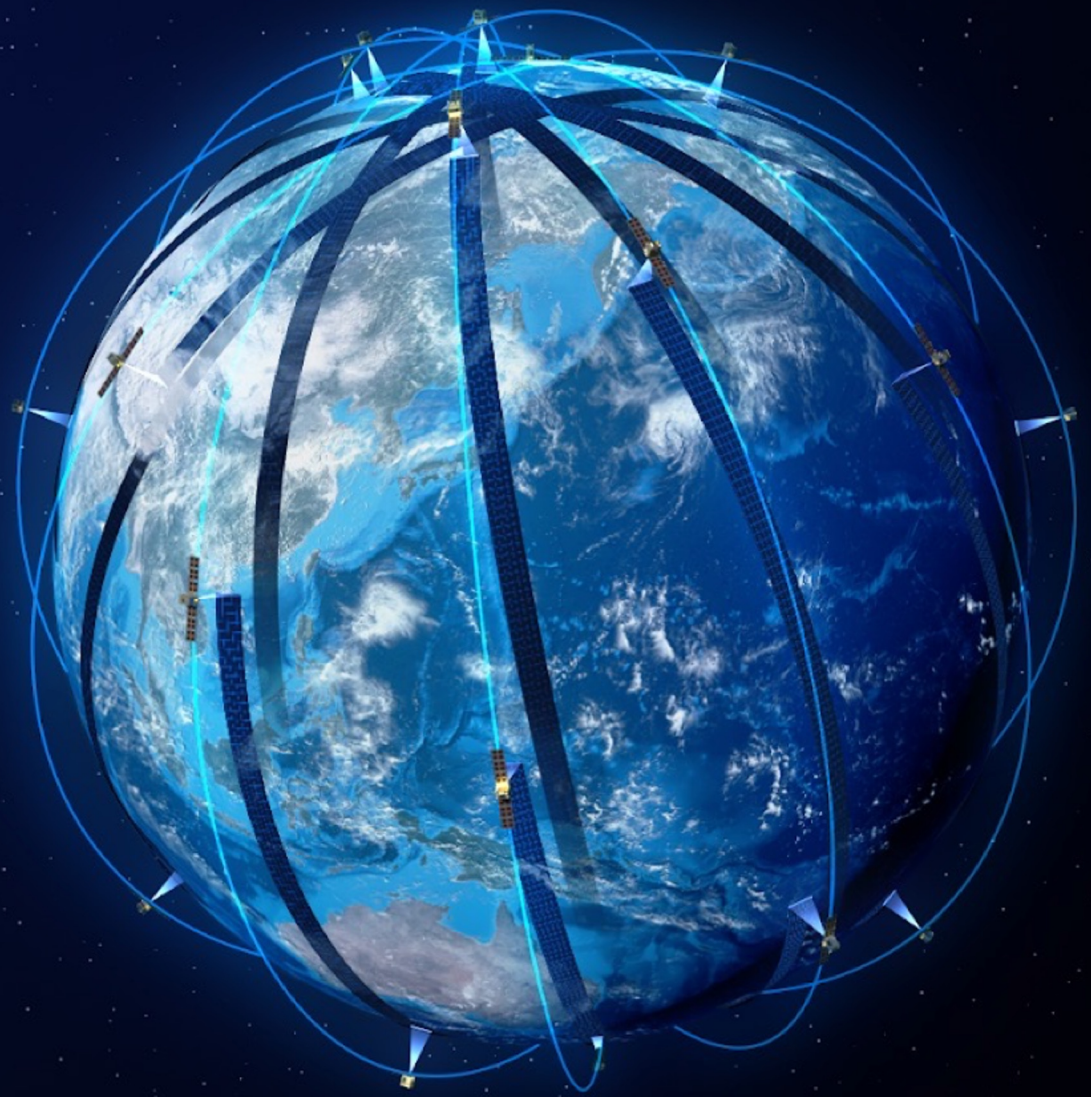
GeoSmart India, Hyderabad

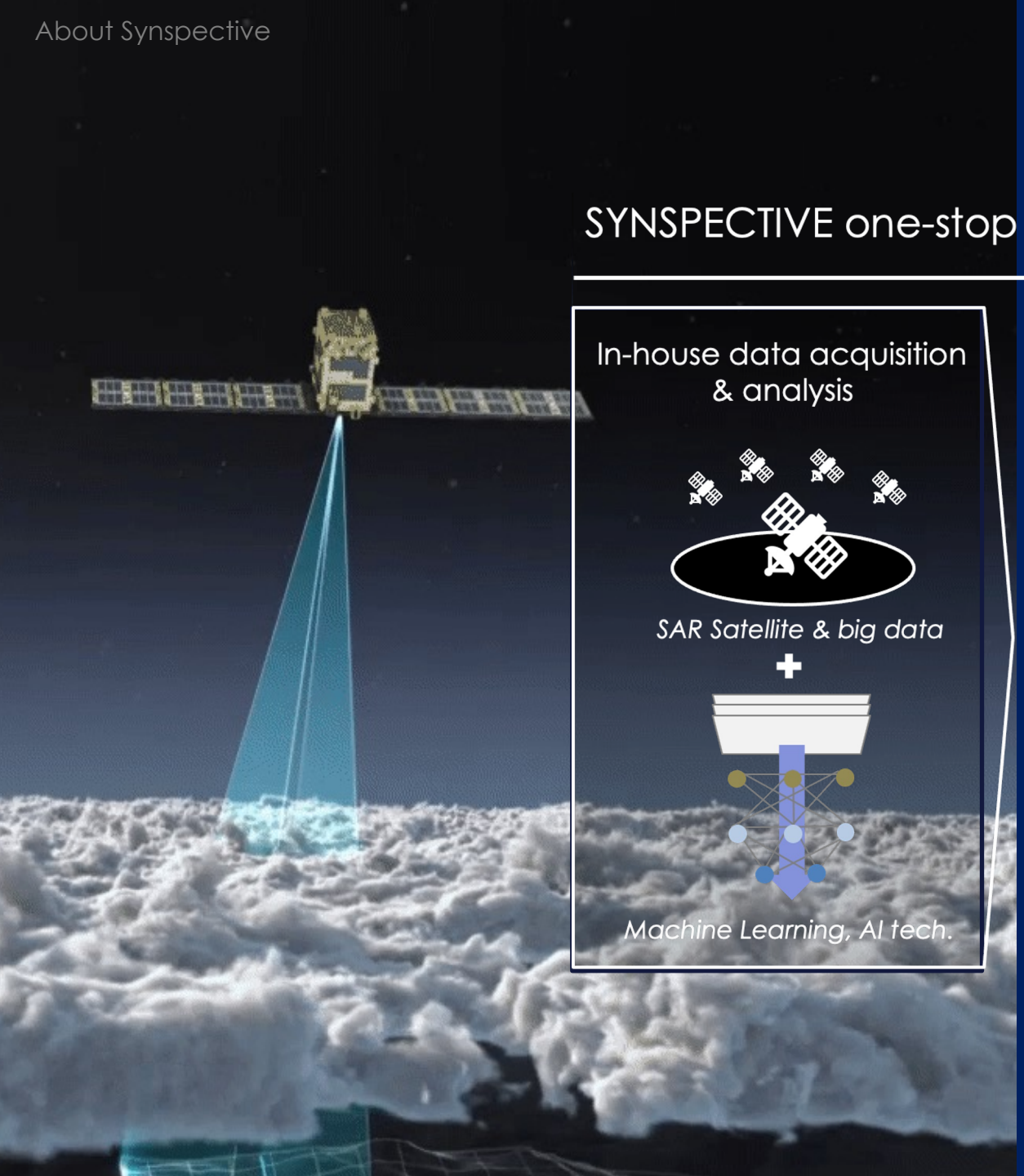
Technology Integration and Management

Spatio-temporal saliency of InSAR displacements and Synspective small satellite constellation

Abhinandan Arya

Vice President, Head of Technology - Solutions
Synspective Inc.





SYNSPECTIVE one-stop monitoring solution

In-house data acquisition & analysis

SAR Satellite & big data

+

Machine Learning, AI tech.

Advanced information delivery

Data Analytics Platform

Data anytime, no blind-spot	No-lead time, In-sightful, precise	Easy to use, API integration

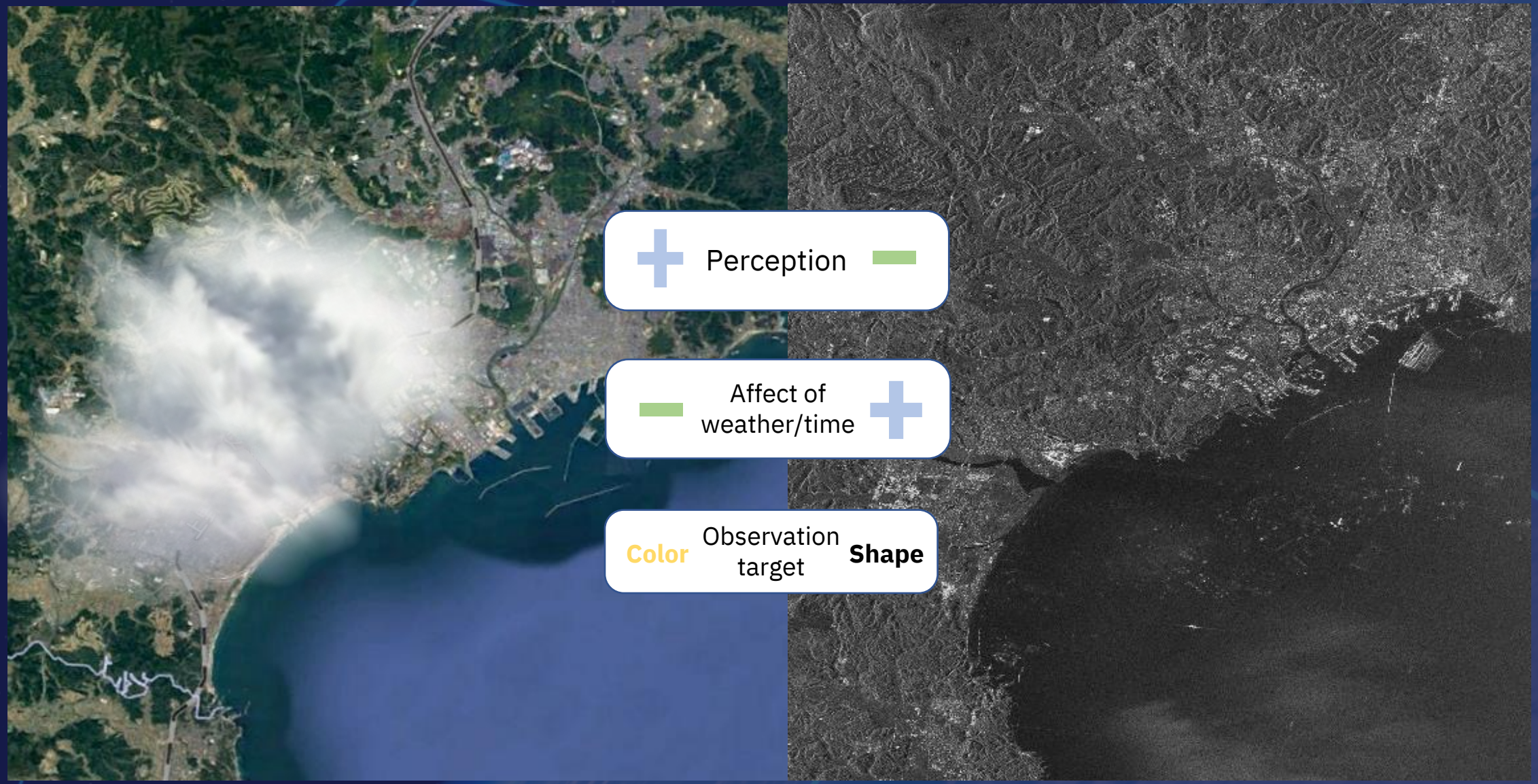
Sustainable business decision making

Observe

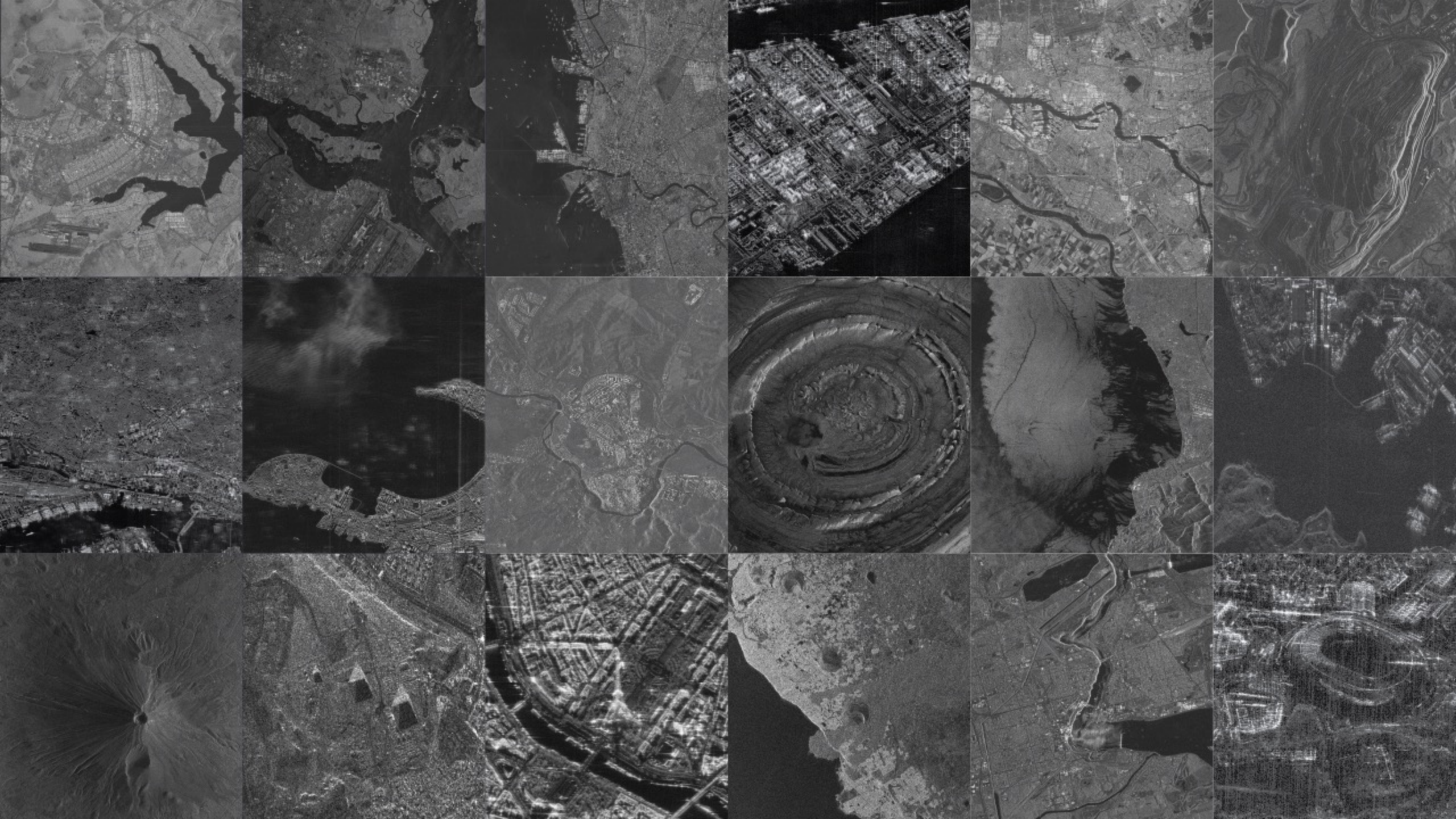
Analyse

Predict

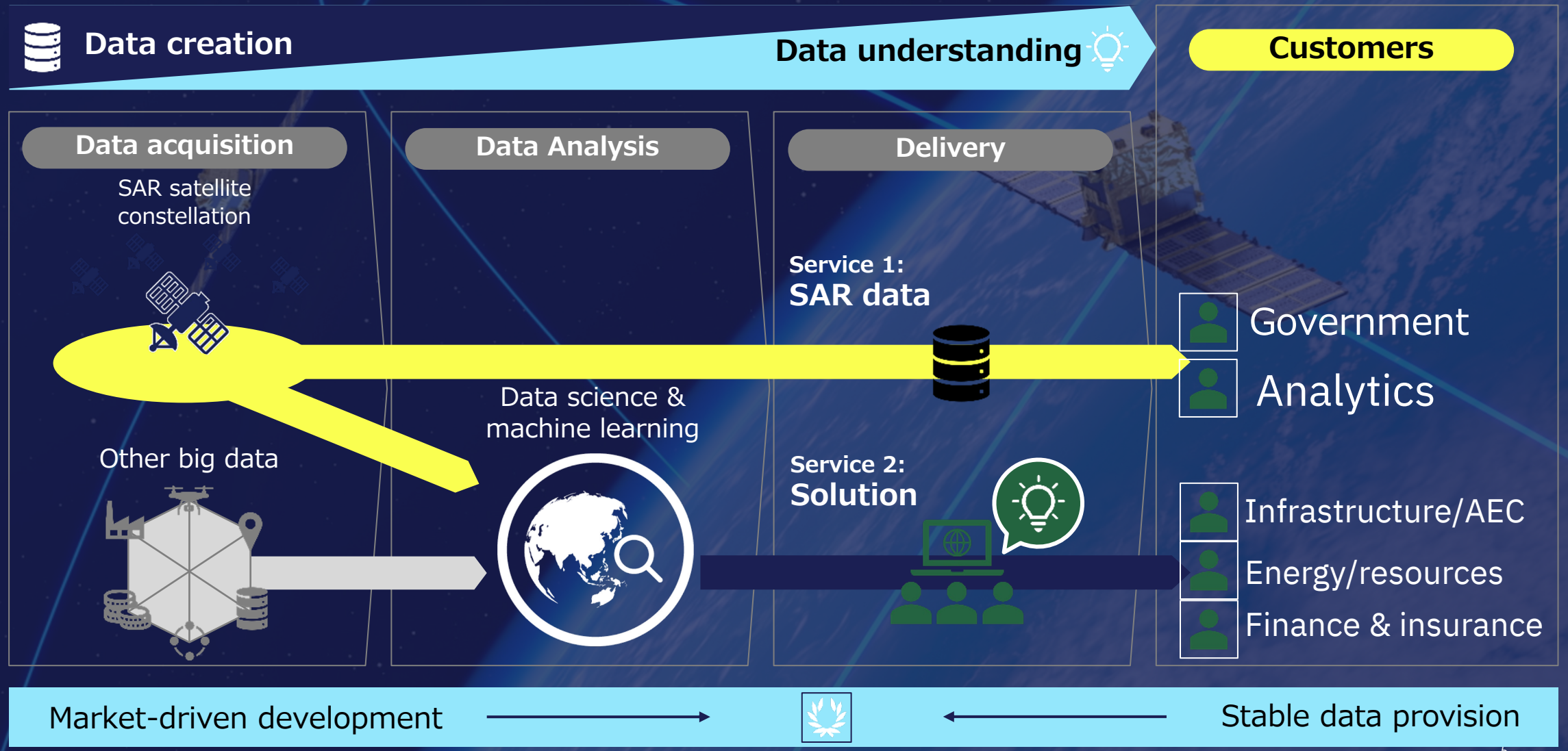
Optical vs. SAR



(1) *Information based on general industry average*
(2) *In the case of small SAR constellation*
(3) *Illustrative image whose clouds have been added to the original picture. Original source of picture is TerraMetrics*



Contribution Model



Data creation
by SAR satellite

Data understanding

by Data science & Machine learning

Data Insight
by Data science & Machine learning

Jakarta

Max Upward 78 mm

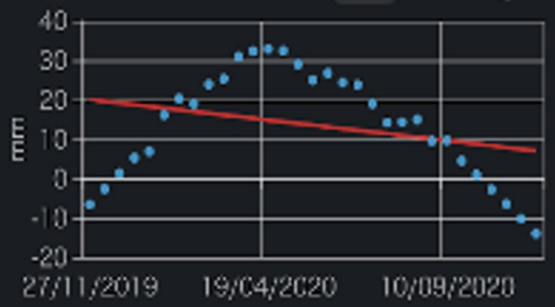
Max Downward -233 mm

Average Total Displacement -8 mm/year

1650877 points

15 Nov, 2019-21 Nov, 2020

1 Year -13 mm/year



3 Years

LOS

mm
78
50
22
0
-9
-37
-65
-93
-121
-149
-177
-205
-233

Search

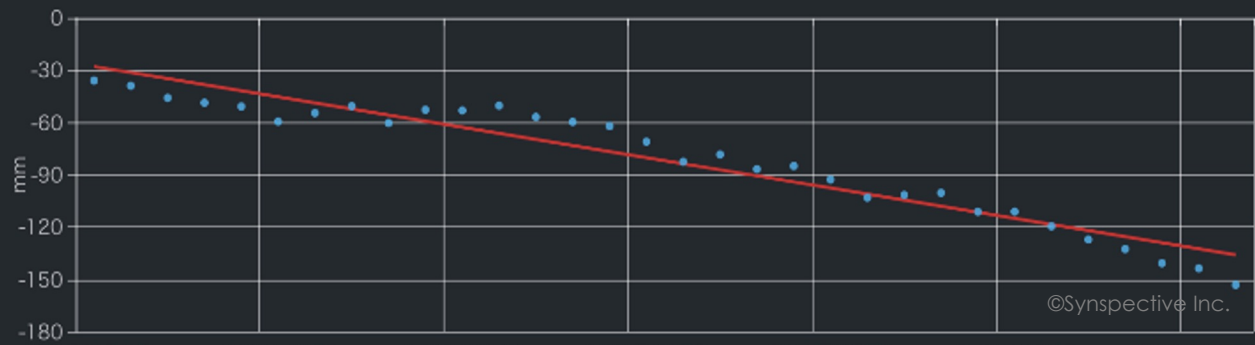
Displacement Data

1 Year 3 Years All

Lat -6.10266077
Lng 106.80478169

Disp Rate
-106 mm/year

Total Disp
-108 mm



Synspective

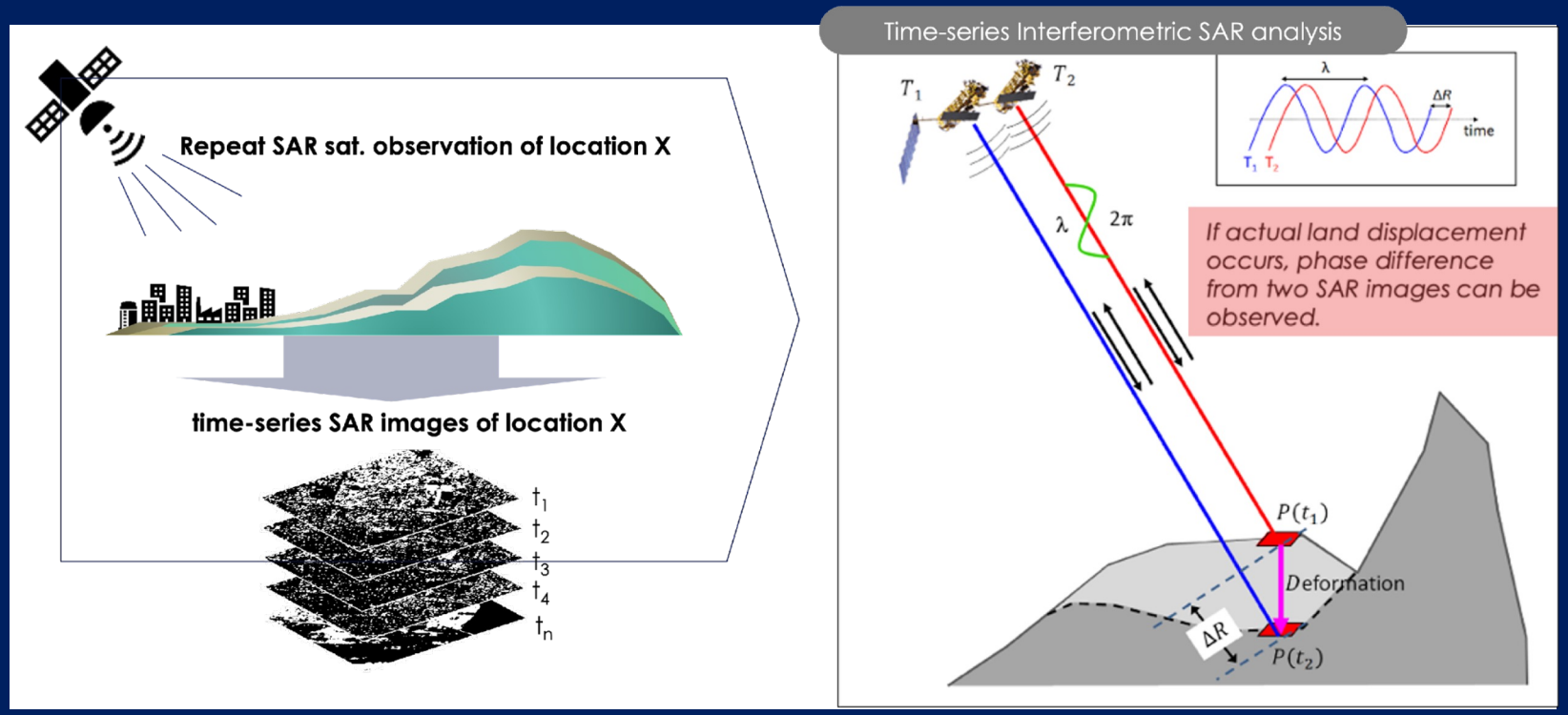
LAND DISPLACEMENT MONITORING

Advanced alerting mechanism for ground instability based on spatio-temporal saliency of InSAR displacements

We adopt principle of InSAR application in landslide-related research. Land displacement velocity from InSAR analysis is used to identify hotspots of susceptibility. Displacement time-series trend is used for identifying precursor.

Principle of Interferometric SAR

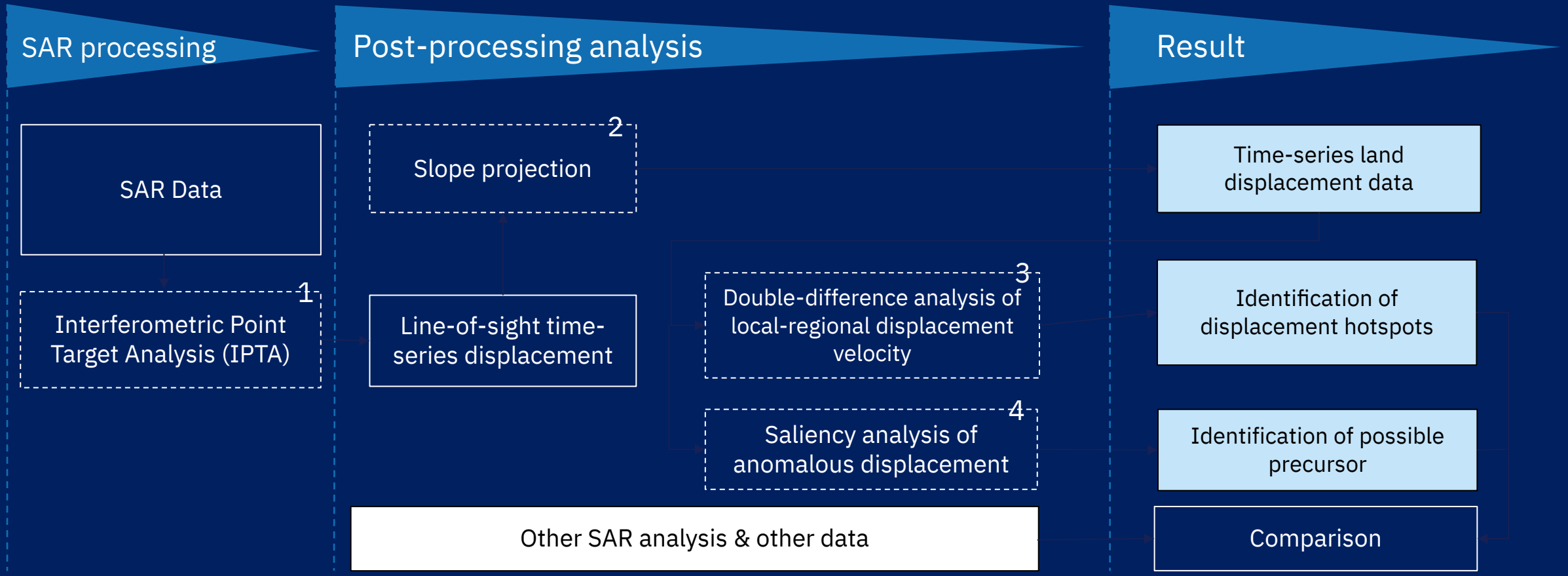
Time-series Interferometric SAR (InSAR) analyze stacks of SAR images. This analysis derives time-series trend of land displacement information from phase difference in radar wave recorded by each SAR image.



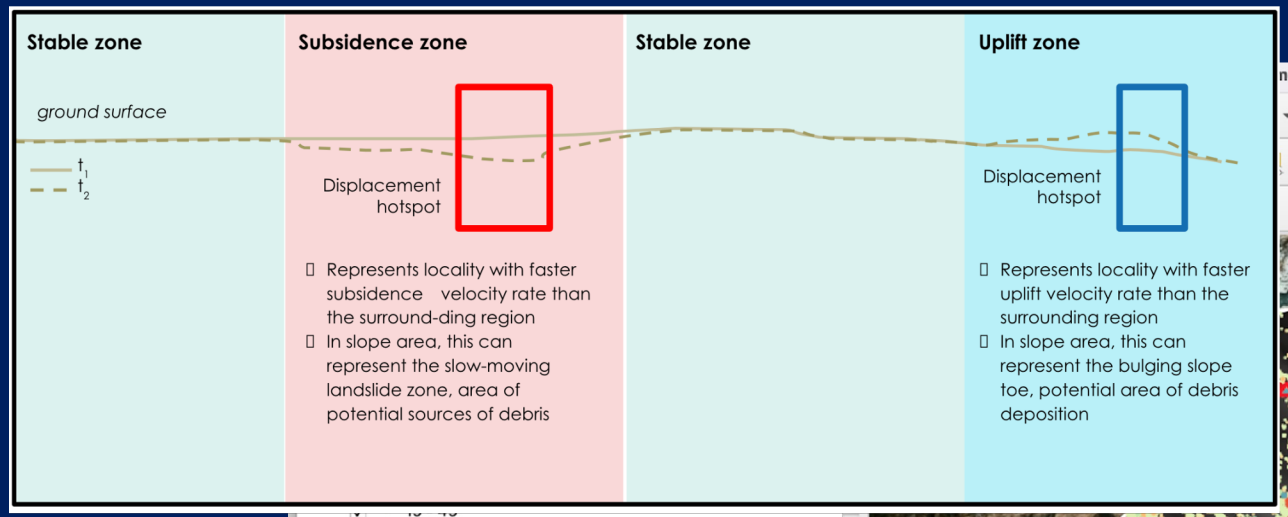
Time-series InSAR & post-processing analyses

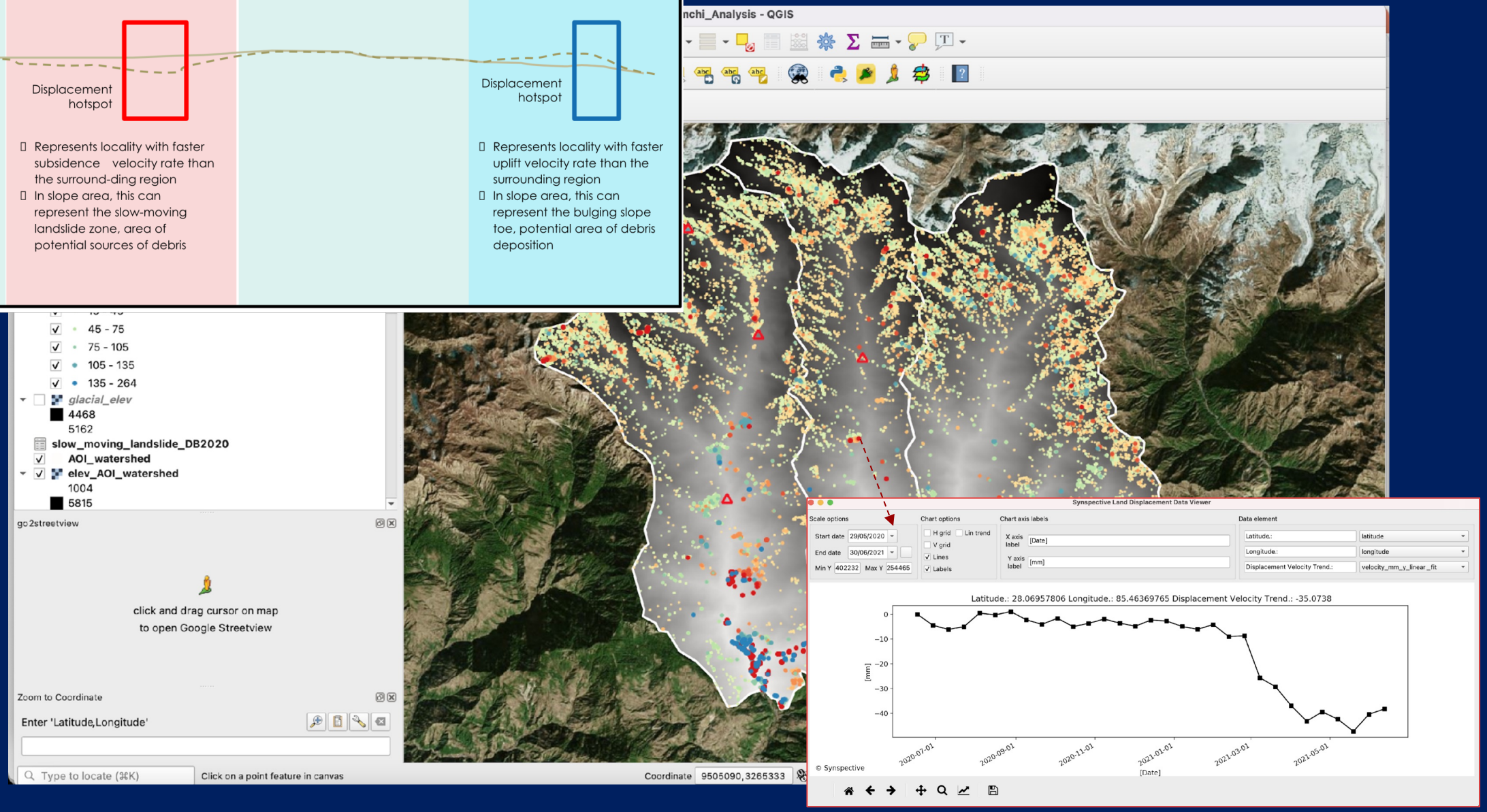
Displacement hotspot's locations having more intense land displacement velocity (= slow-moving landslide susceptible area, potential source of debris, deposition area of slow-moving debris, or actively bulging slope toe due to increasing strain)

- Anomaly in time-series displacement pattern is used to identify possible precursor



Time-series land displacement data from InSAR | Synspective Land Displacement Data Viewer





Presence of large amount of debris flow in Melamchi Bazaar Flood Disaster (June 15th, 2021) motivated the necessity of investigating risk related to slope instability in Melamchi upstream area

© Phurpa Rohit Ghale, Rabin Raj Niraula, Twitter @dhahalsivaji

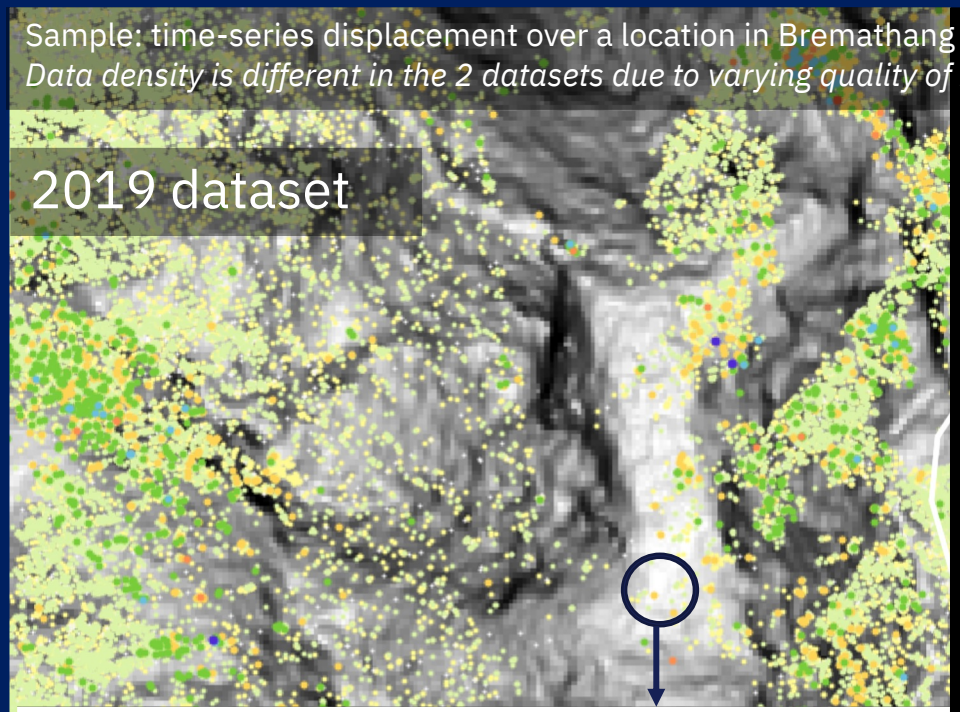
© Nepal Flying Labs, Maxar

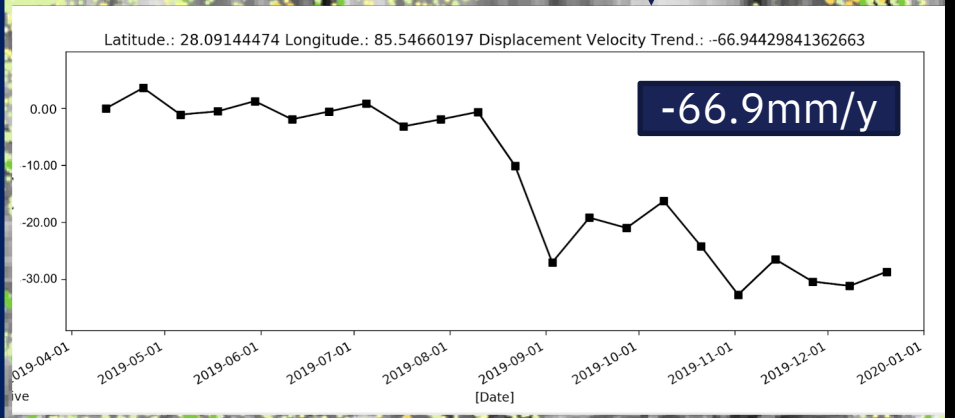
Refer also: Profile of Melachi Disaster (report by ICIMOD, 2021)

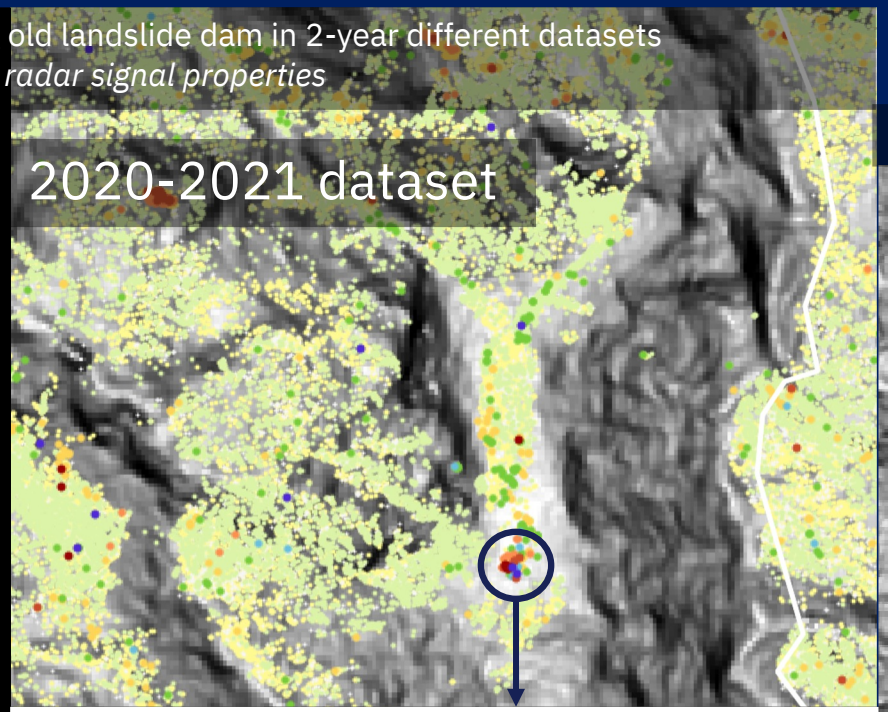
A 12-day interval time-series displacement data is provided in GIS-operable format (with viewer plugin provided). Clicking each data point shows time-series displacement & annual velocity (mm & mm/yr)

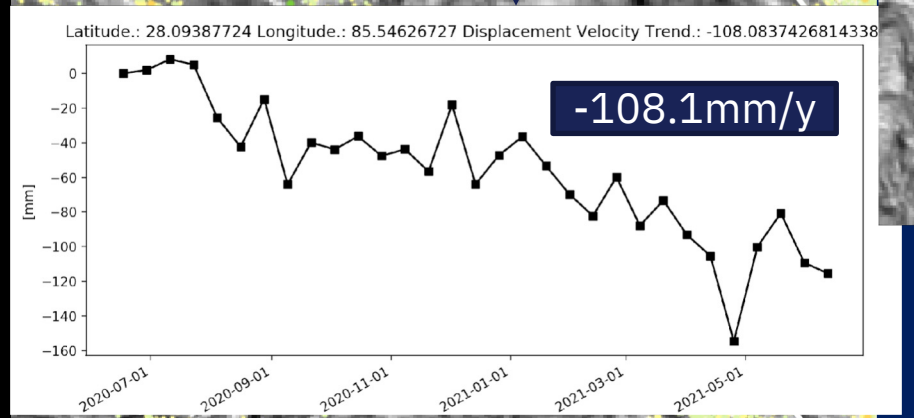
Sample: time-series displacement over a location in Brematthang old landslide dam in 2-year different datasets

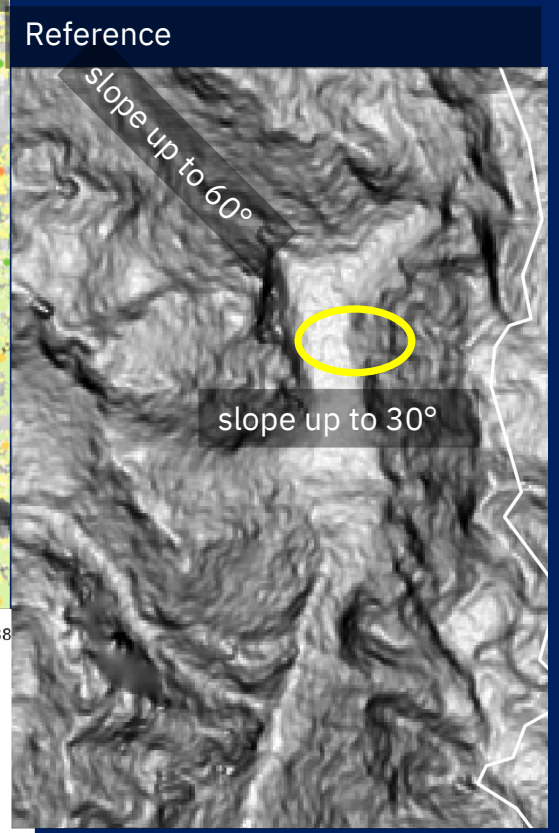
Data density is different in the 2 datasets due to varying quality of radar signal properties





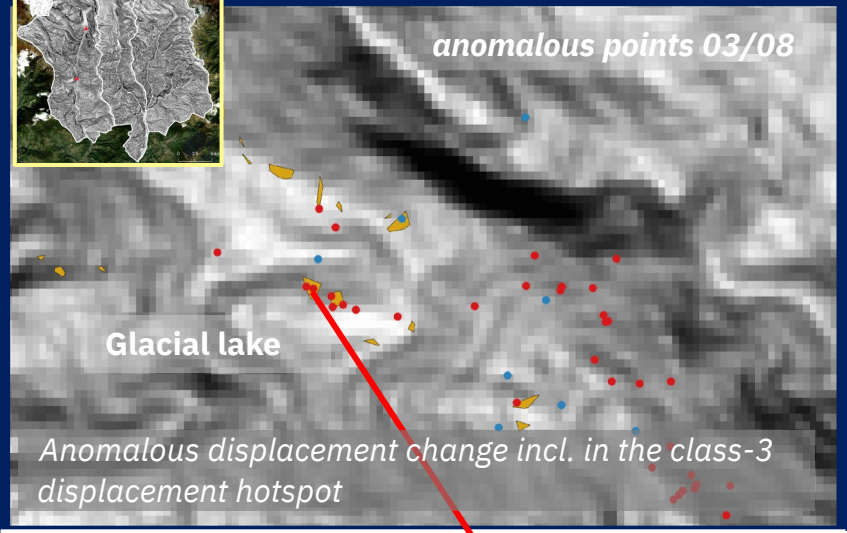


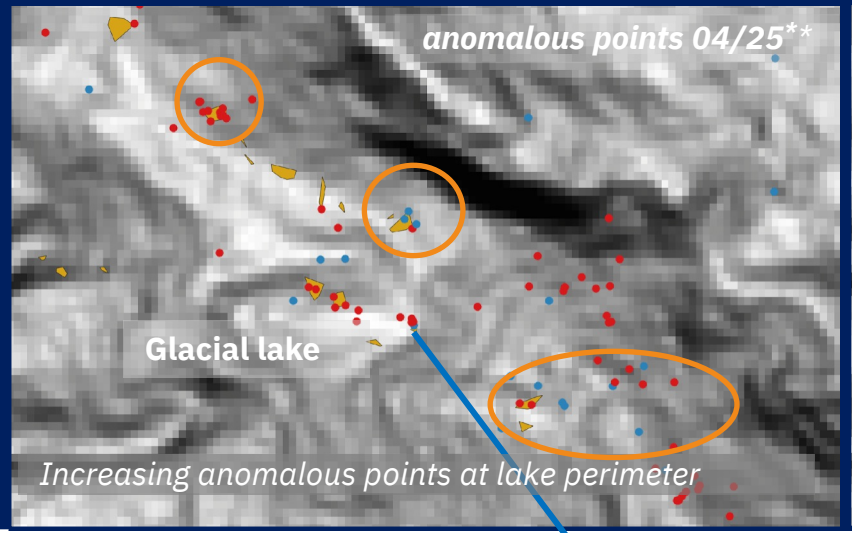


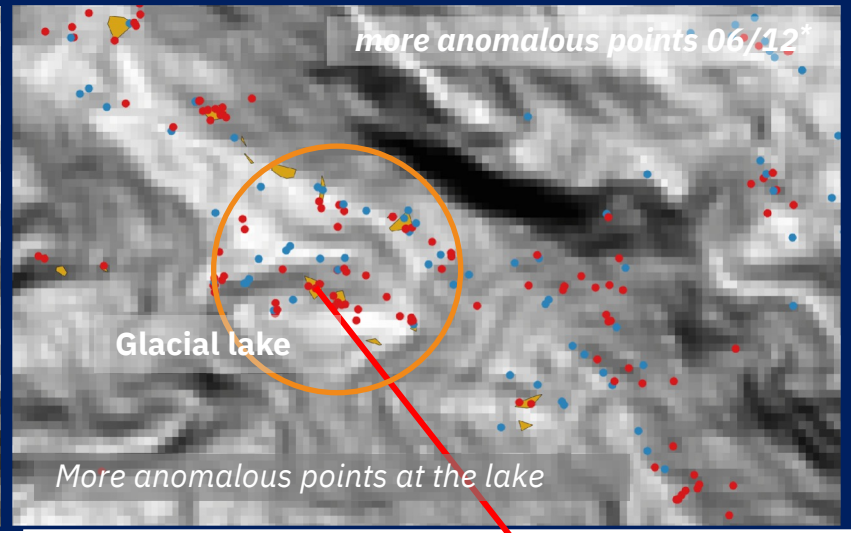


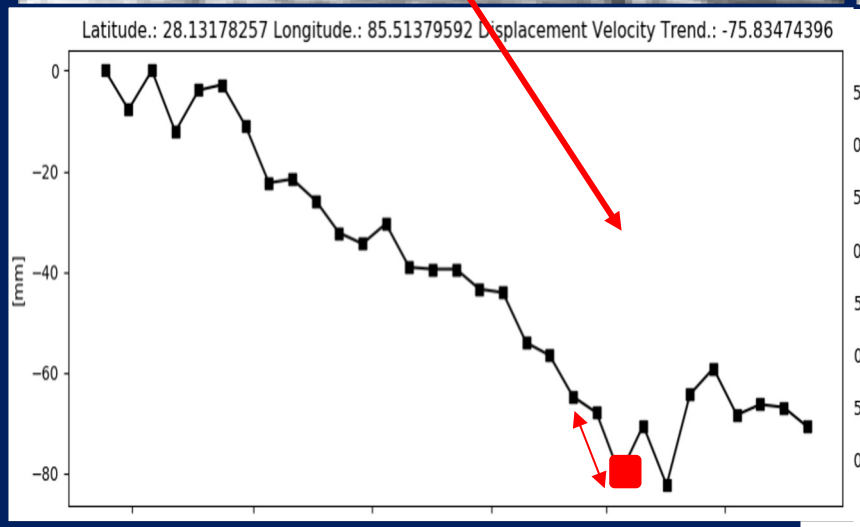
Although anomaly could be detected as early as 03/08, significant increase of anomalous displacement trend on 06/12 observation could have necessitated higher alertness

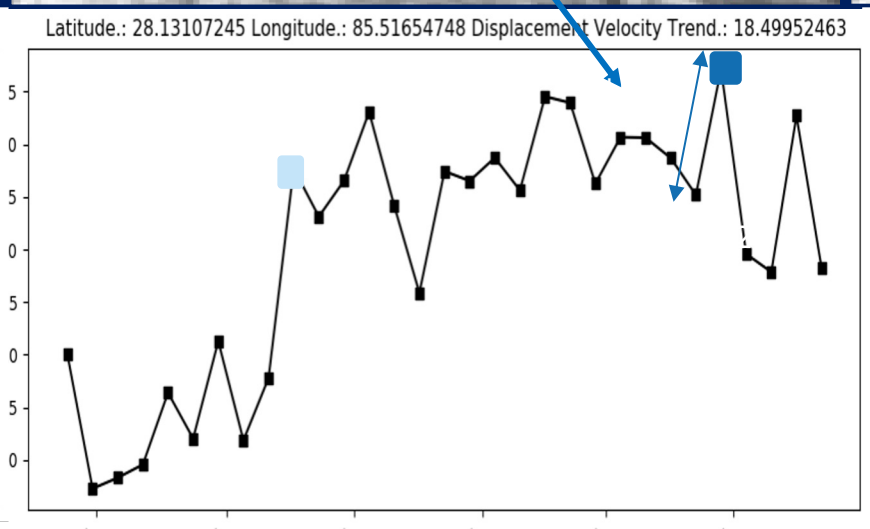
anomalous down trend on specified date anomalous up trend on specified date displacement hotspot zones

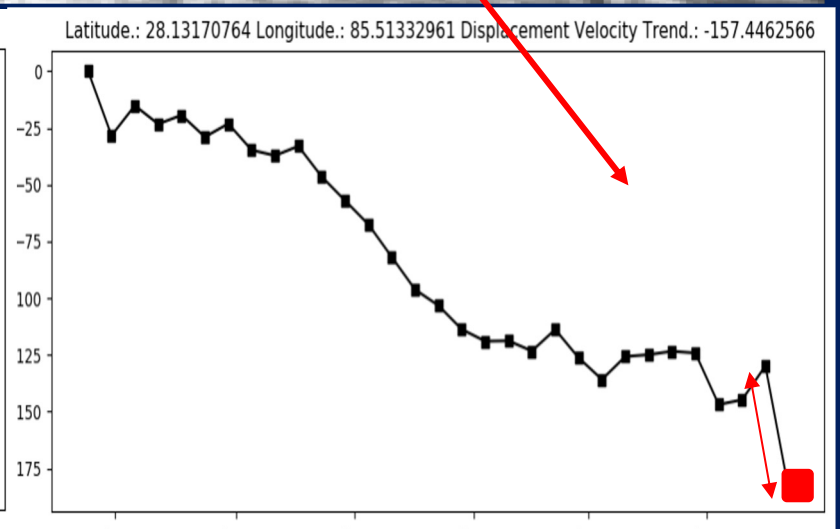








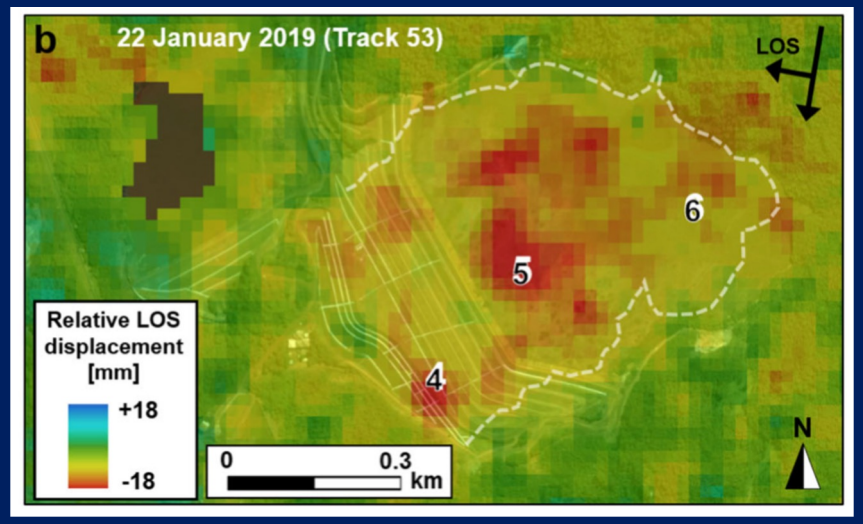




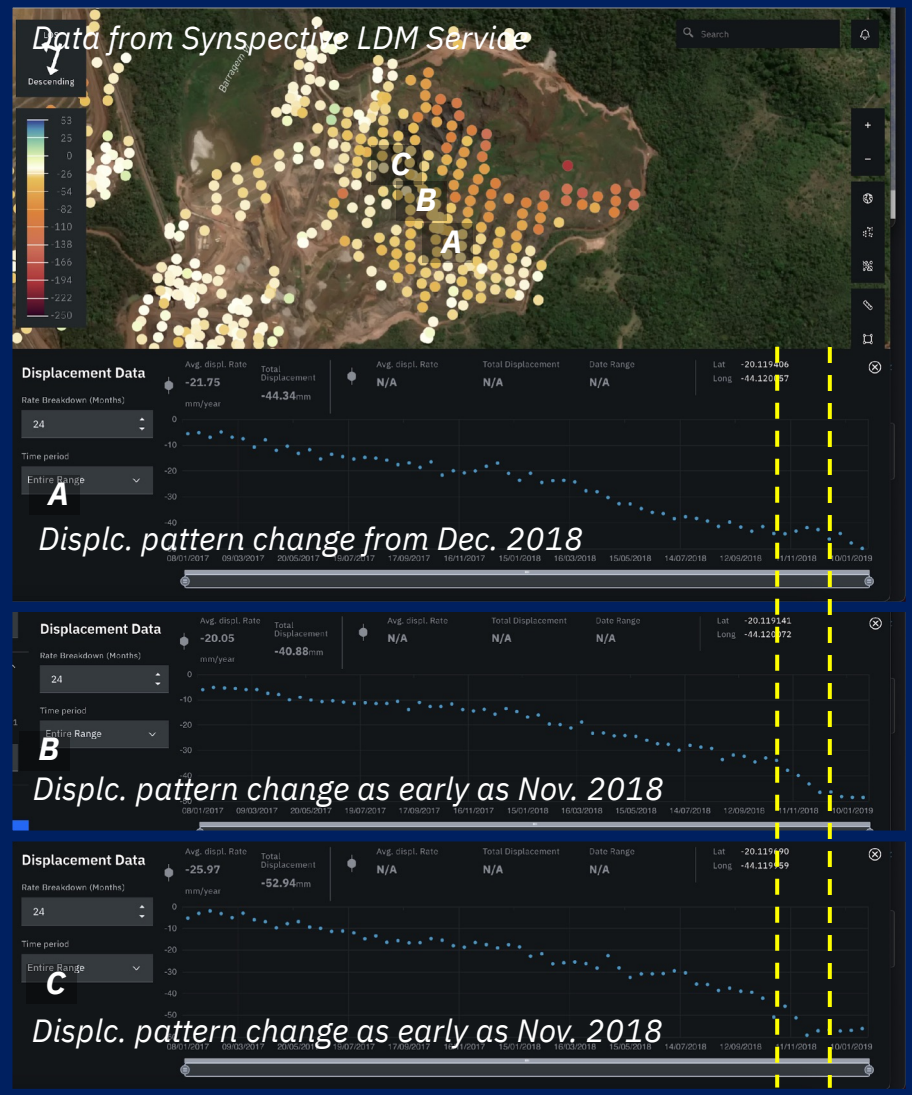
** Anomalous point from earlier period are co-displayed in later period*

Tailings Dam Monitoring | Mining

Detailed observation of displacement velocity over specific location offers possibility of detecting a precursor



the most conclusive evidence of precursory deformation indicative of the occurrence of a collapse, with correct failure date predictions that could have been reliable made as early as 51 days prior (from 5 Dec 2018).



Grebby, S., et.al. 2021. Advanced analysis of satellite data reveals ground deformation precursors to the Brumadinho Tailings Dam collapse. Communications Earth & Environment. https://doi.org/10.1038/s43247-020-00079-2

Sinkhole Detection Method

Sinkhole Mechanism and Display

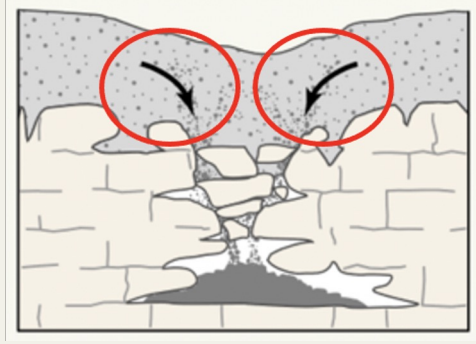
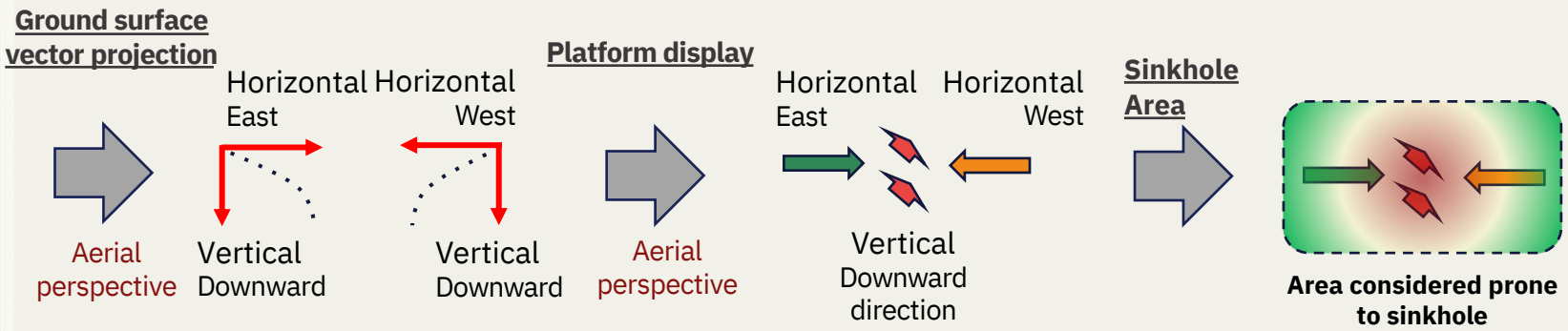
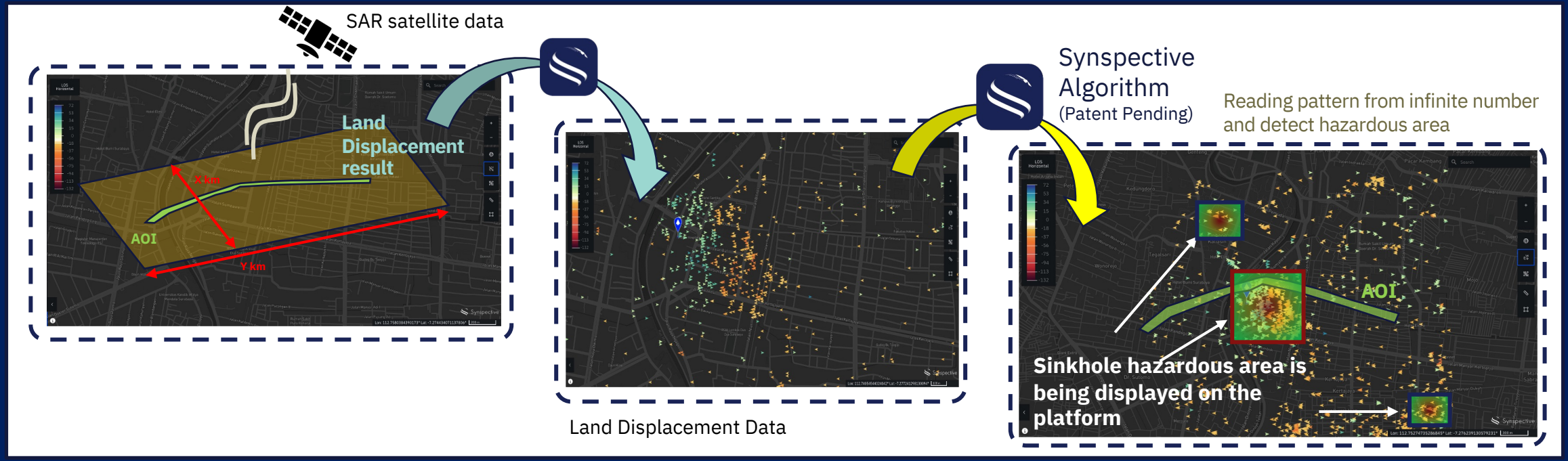
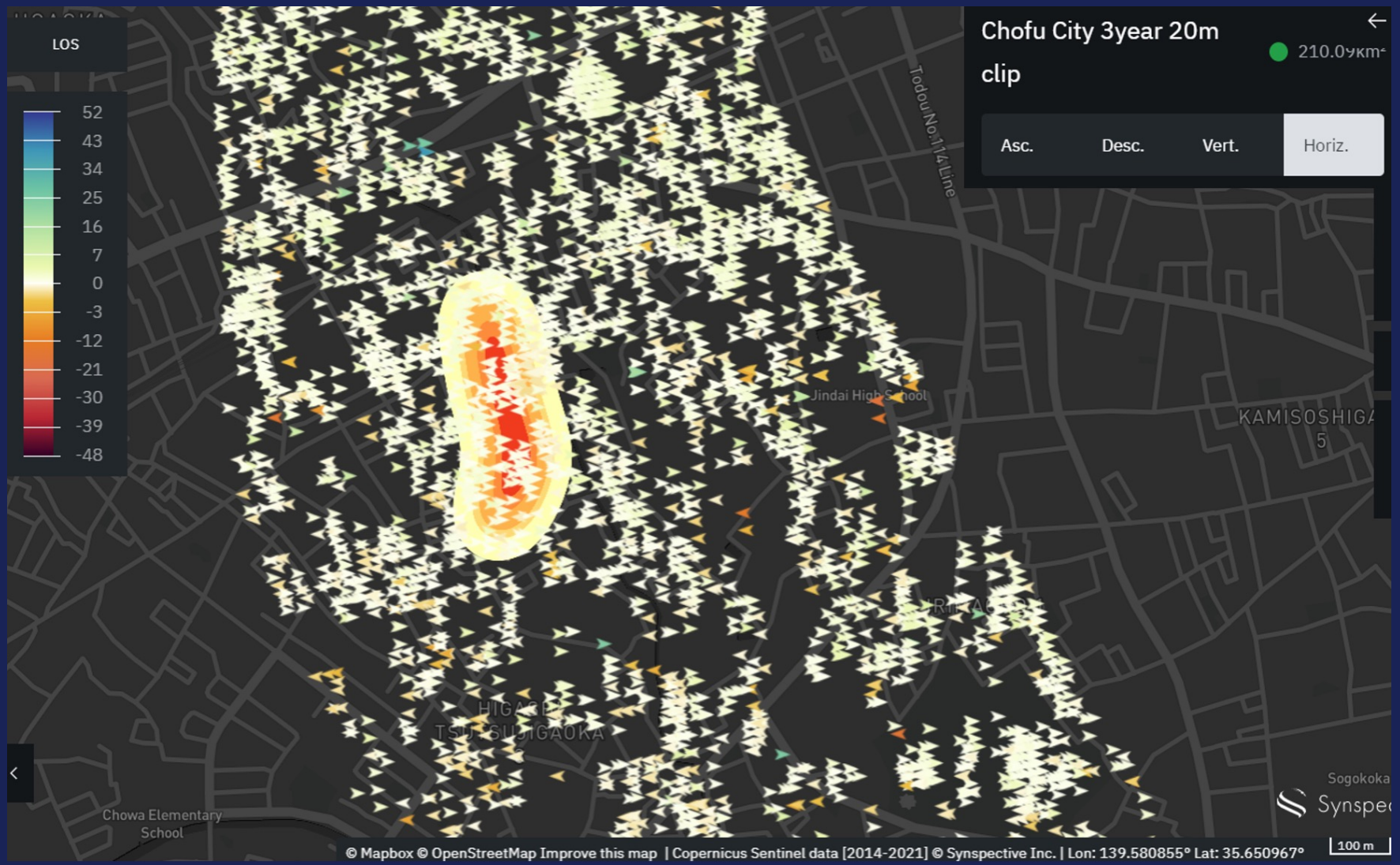


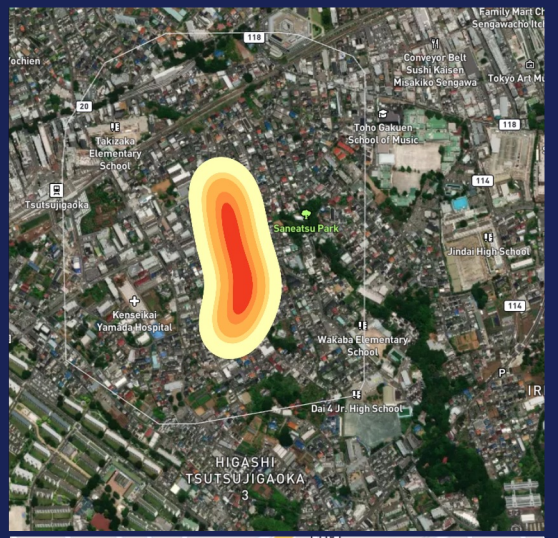
Fig 1 : Ground cavity and subsidence[1]

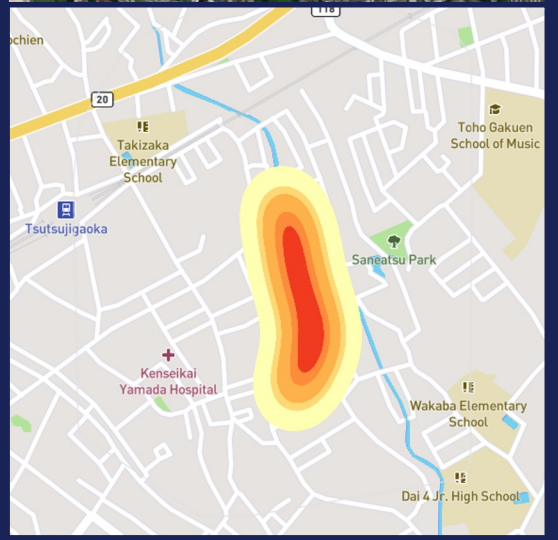




Sinkhole Detection Use Case



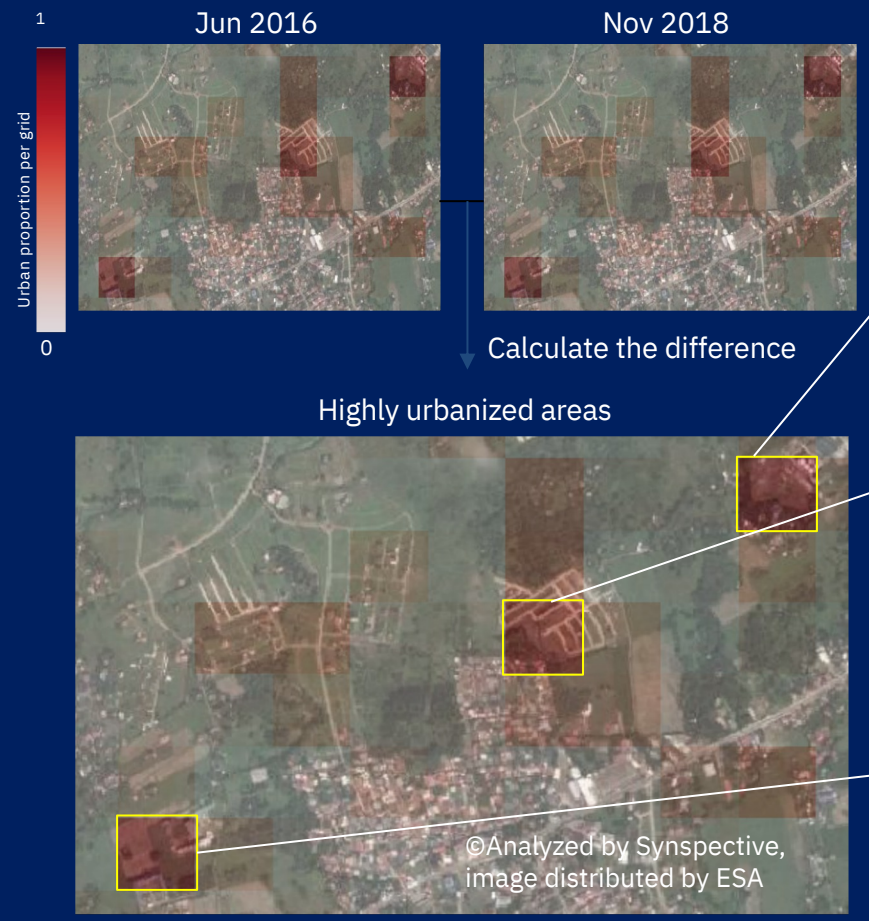




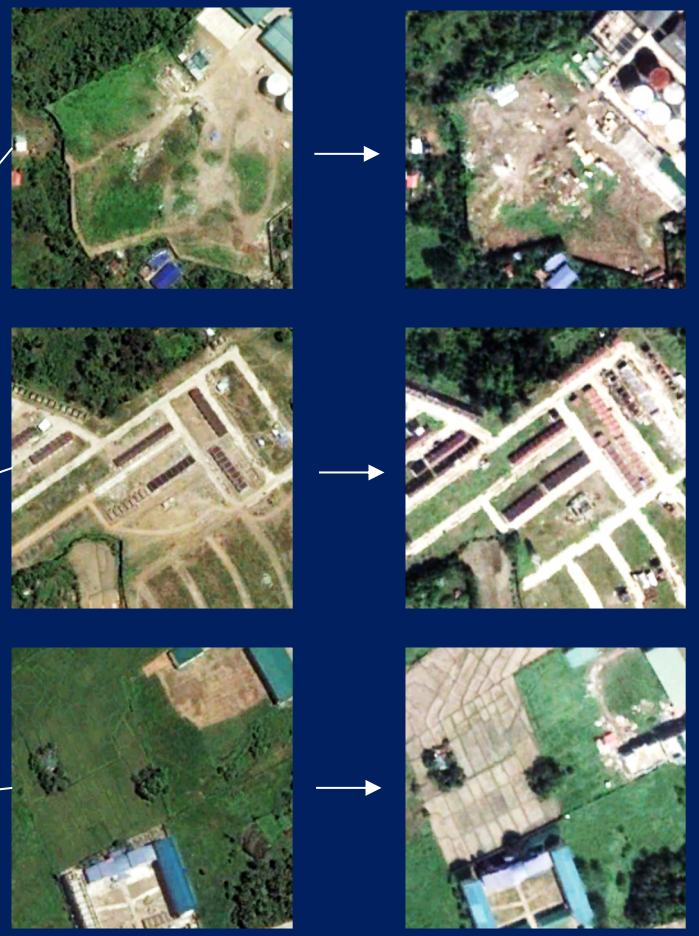
Assessment of urban development

Developing areas can be detected with time-series SAR images and urbanization speed will be estimated in a scale of city, state or country.

Distribution map of urbanization (200 m square)



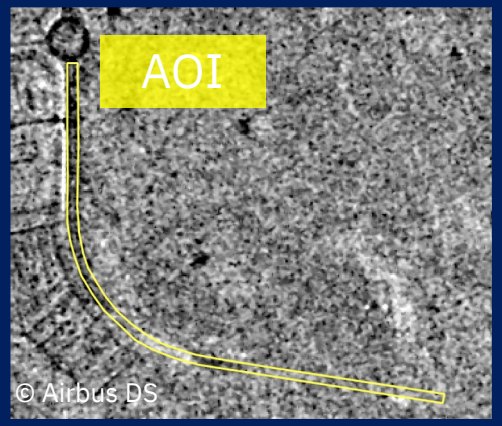
Google Earth imagery



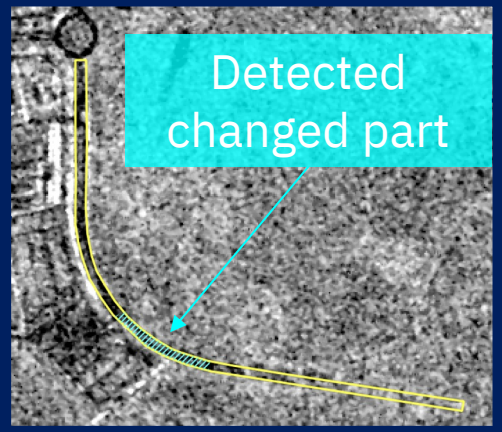
Monitoring of civil constructions (roads)

The status of building/road construction projects can be monitored on SAR images.

Period A



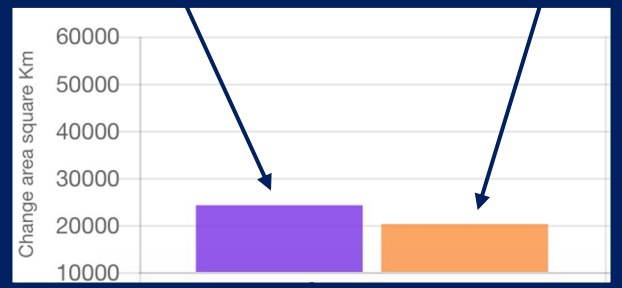
Difference between 2 periods



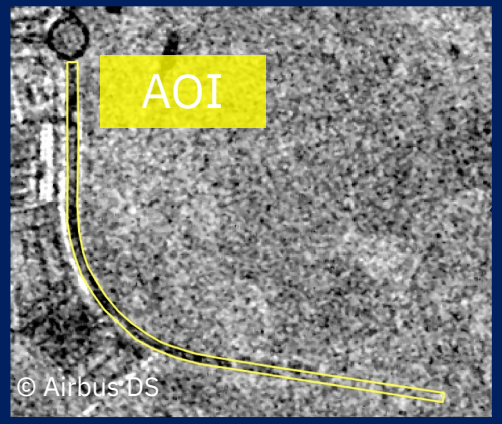
© Airbus DS

Calculated change area

Construction plan

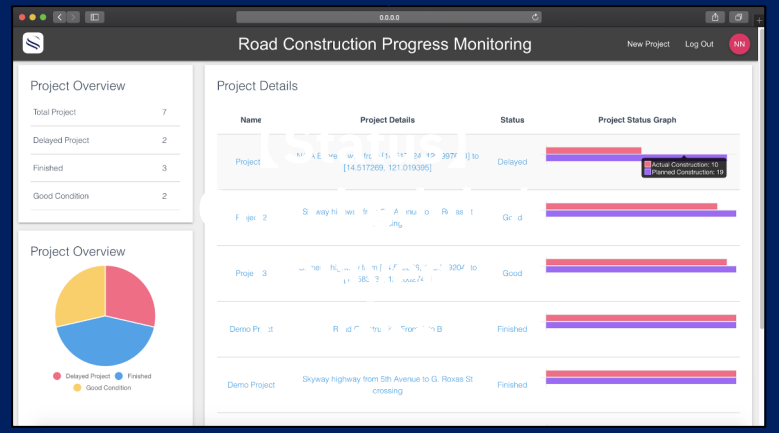


Period B



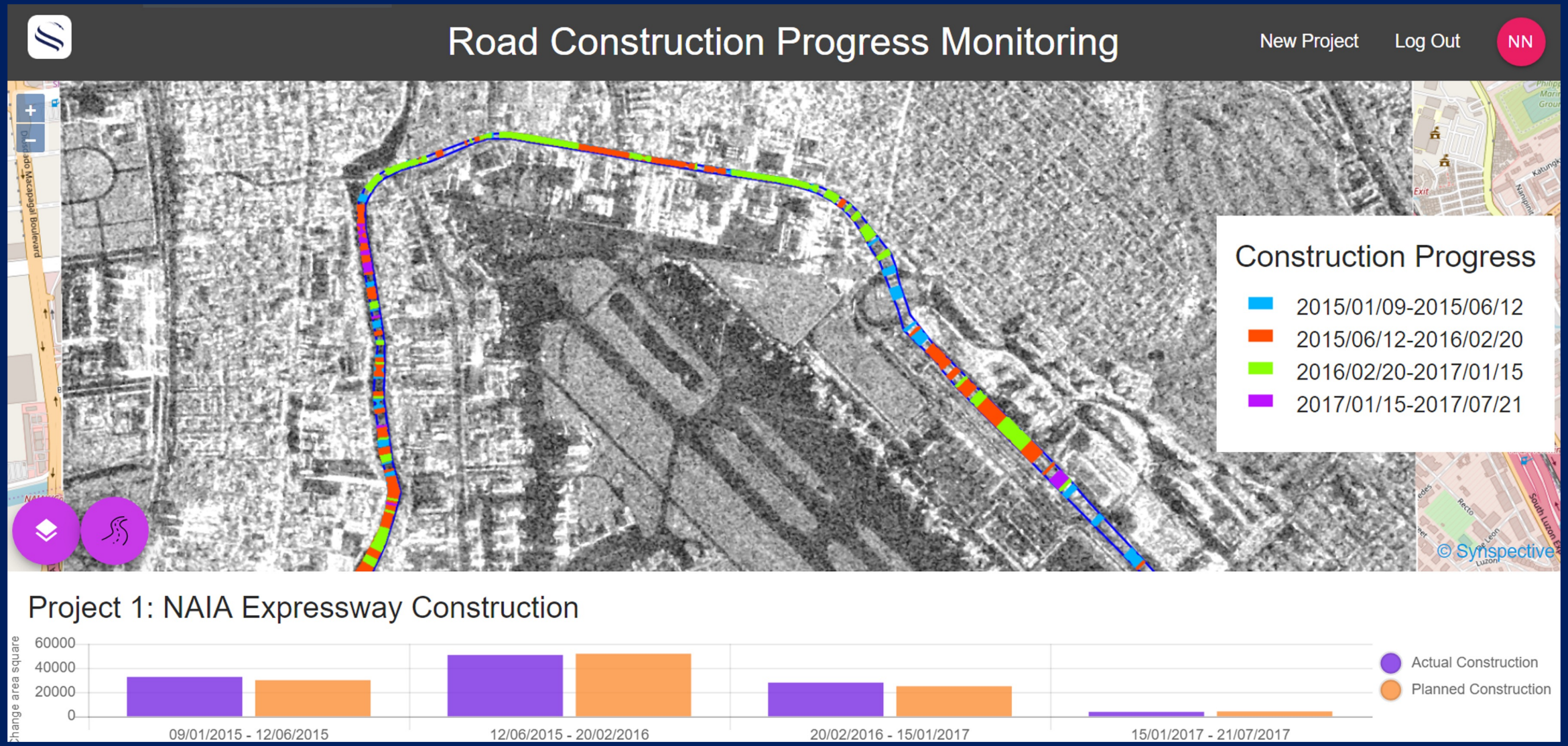
*AOI: Area of Interest

Construction progress is displayed on the user-friendly interface to easily monitor and compare multi projects.



Monitoring of civil constructions (roads)

Construction projects are checked if the progress is delayed or on schedule.



Monitoring of civil constructions (buildings)

The status of building construction projects can be monitored on SAR images.

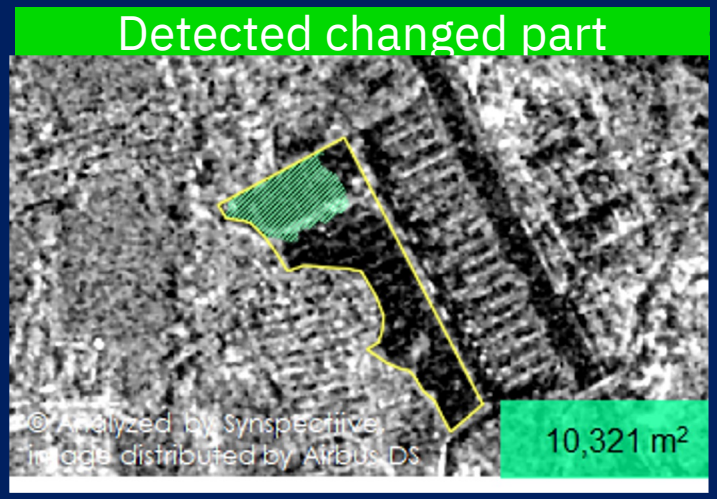
Period A

Period B

*AOI: Area of Interest

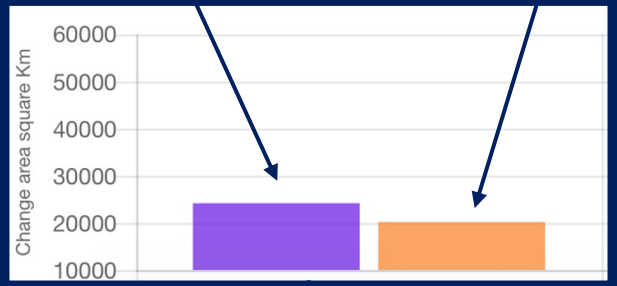
Difference between 2 periods

Detected changed part



Calculated change area

Construction plan



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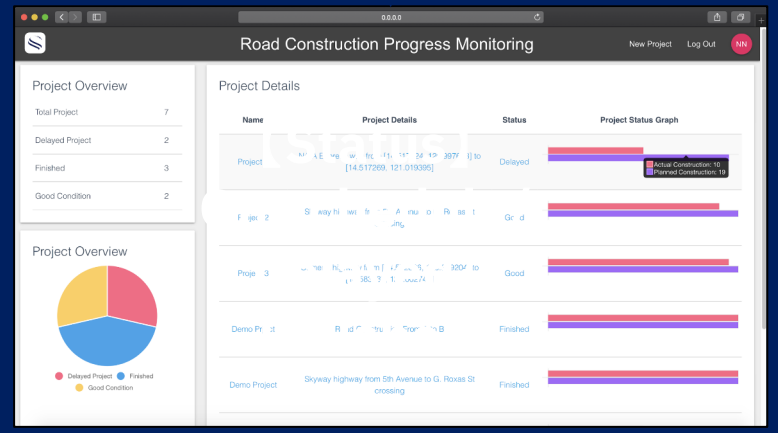
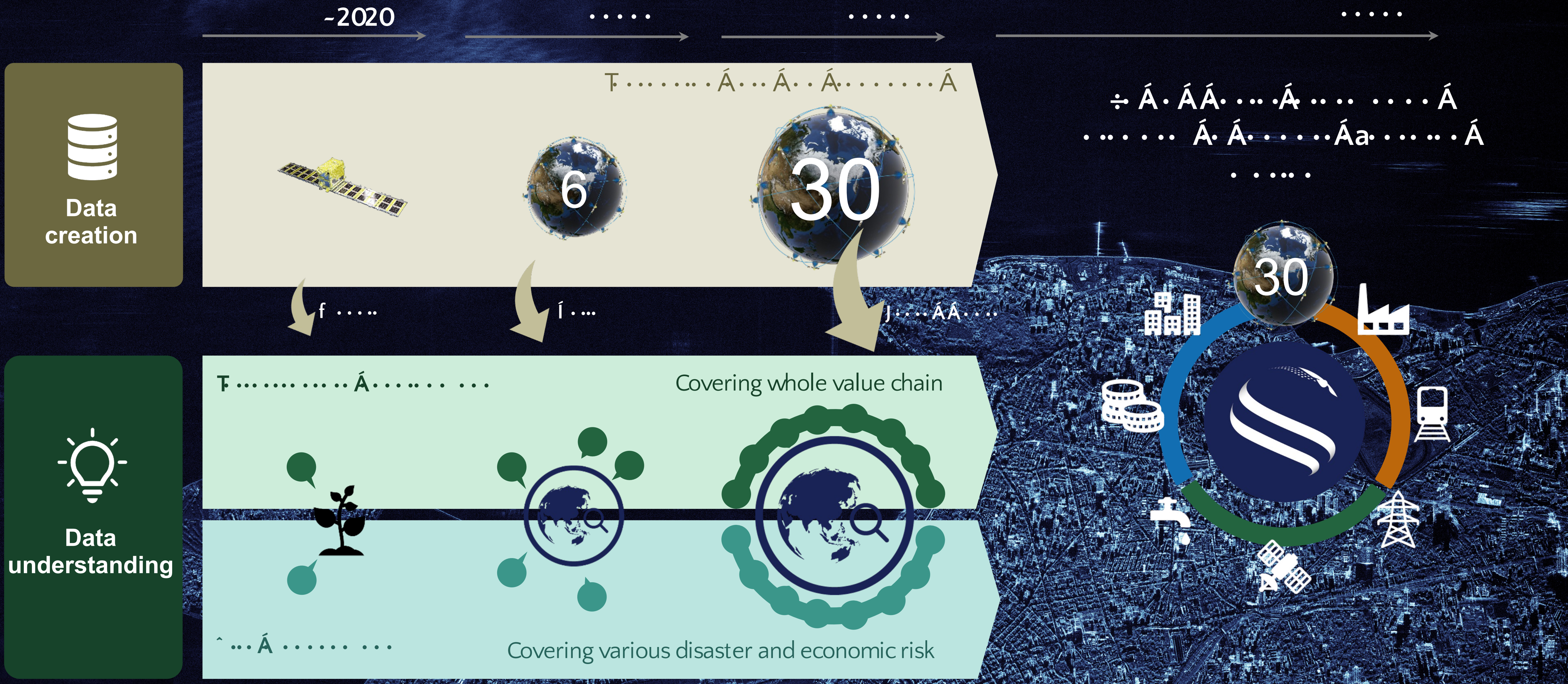
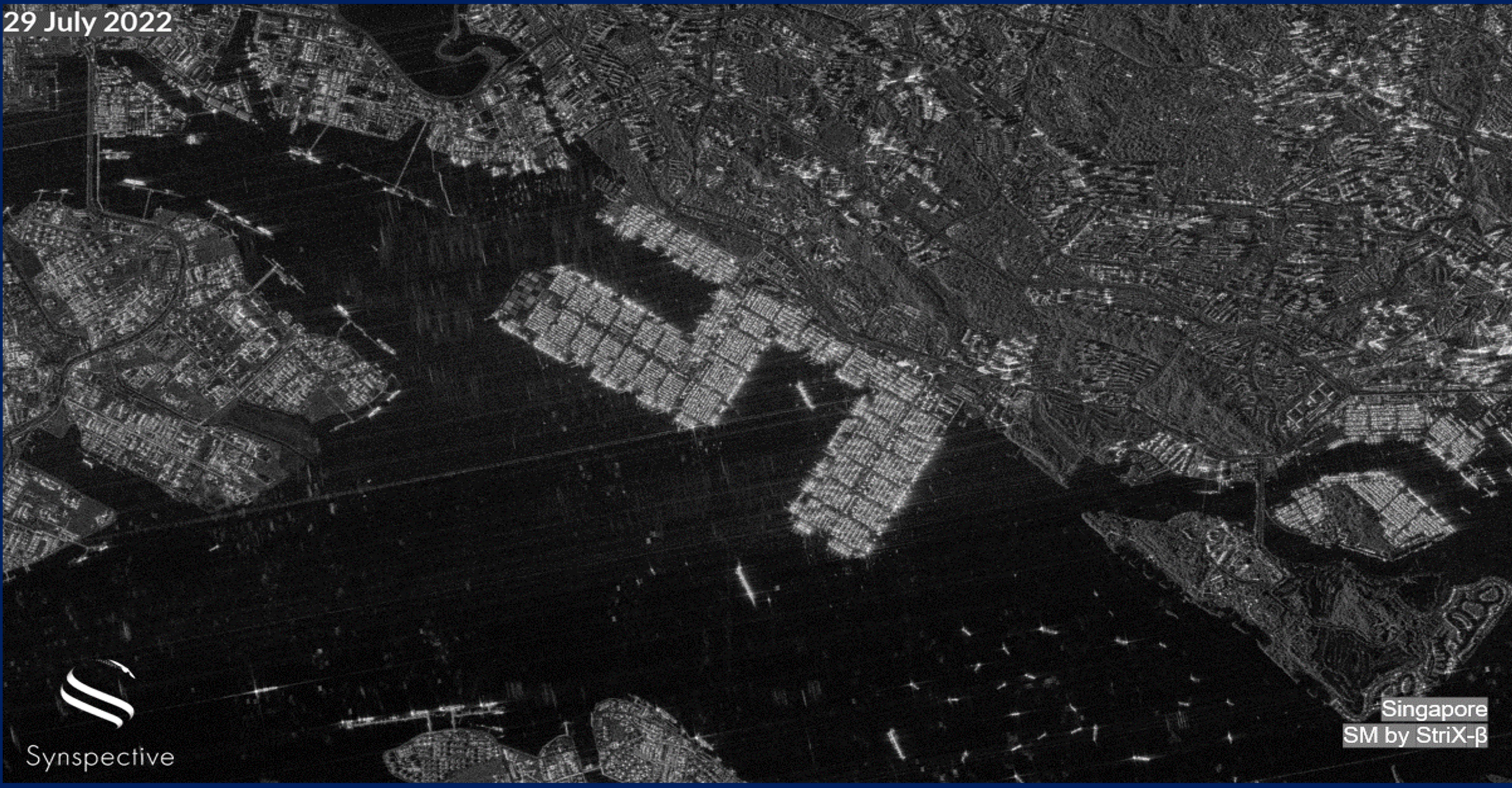


Synspective Satellite



Sun Synchronous Orbit
6 Planes x 5 satellites
Altitude 561 Km

Port of Singapore



Synspective

Thank You

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