Capella
an IonQ company

Operational High-Cadence, Mid-Inclination X-Band InSAR from Capella's Constellation

Two Years of Displacement Monitoring Results

Scott Staniewicz, Craig Stringham, Ron Muellerschoen,
Martin Kamme, Shaunak De, Gordon Farquharson

Special Thanks to Davide Castelletti, Nestor Yague-Martinez,
Victor Cazcarra-Bes and many others

Capella
an IonQ company

History of InSAR at Capella

2017
First InSAR constellation design

2020
First fortuitous InSAR collections

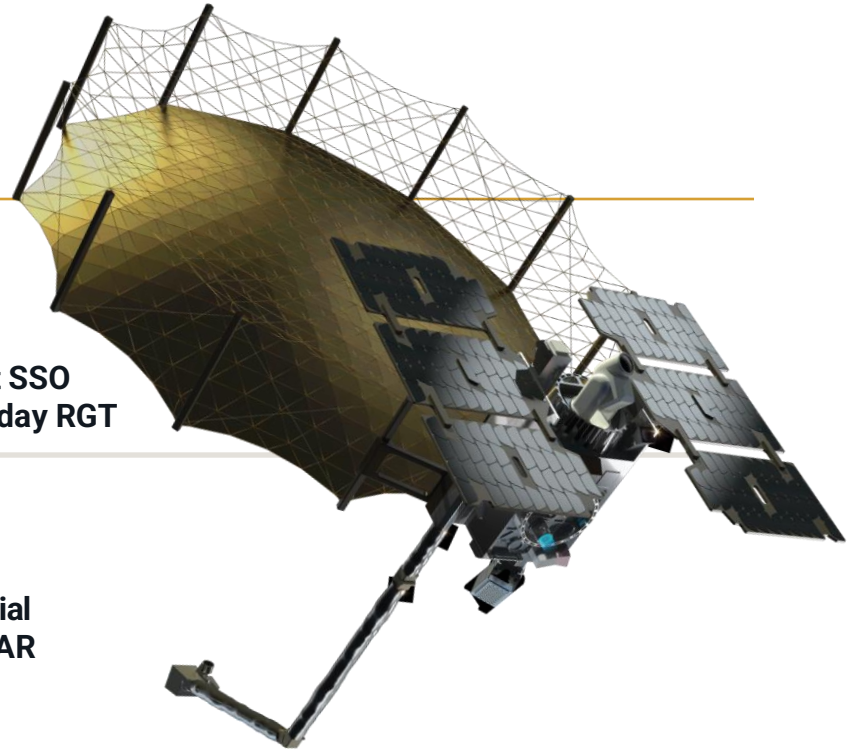
2022
Official InSAR project kick-off

2024
First mid-inclined satellite in 3-day InSAR tube

2024-25
Strategic partner InSAR tasking and collects

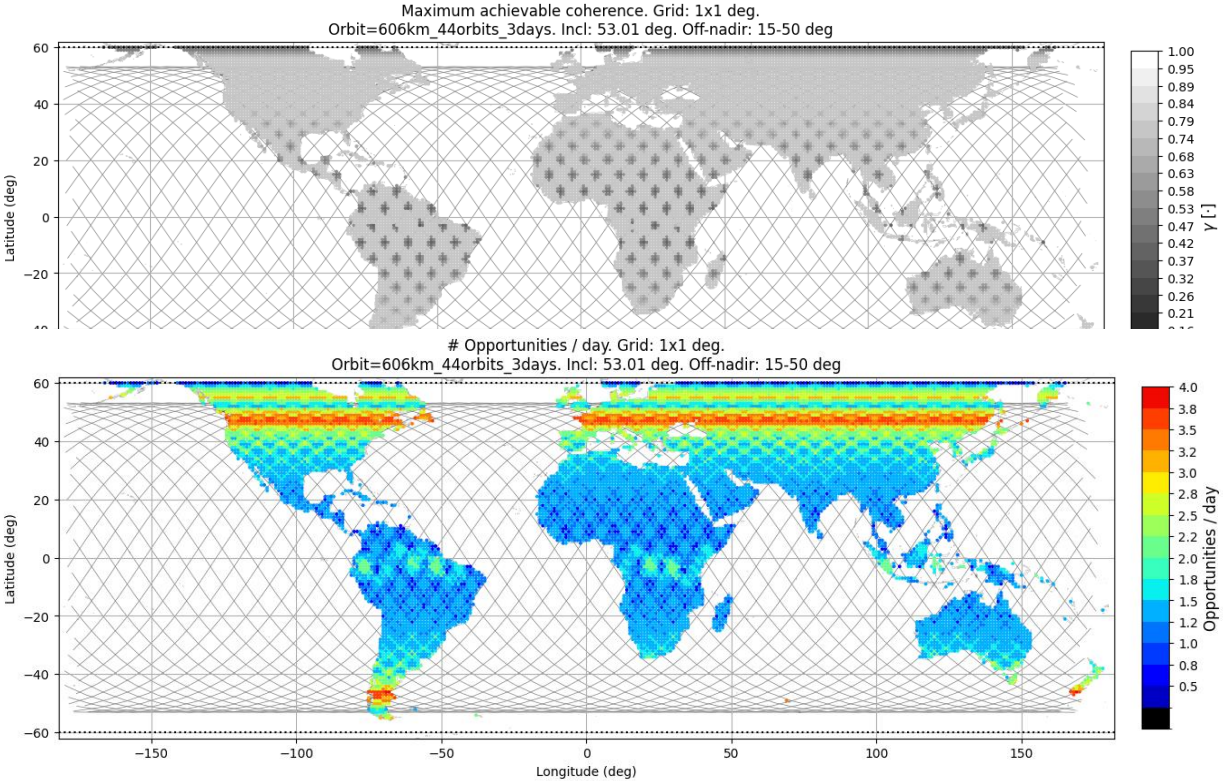
C-18: first SSO satellite in 7-day RGT

May 2026
Official commercial availability of InSAR tasking



Next chapter: operational InSAR tasking spans mid-inclination and SSO repeat-ground-track orbits.

C-13 mid-inclination InSAR

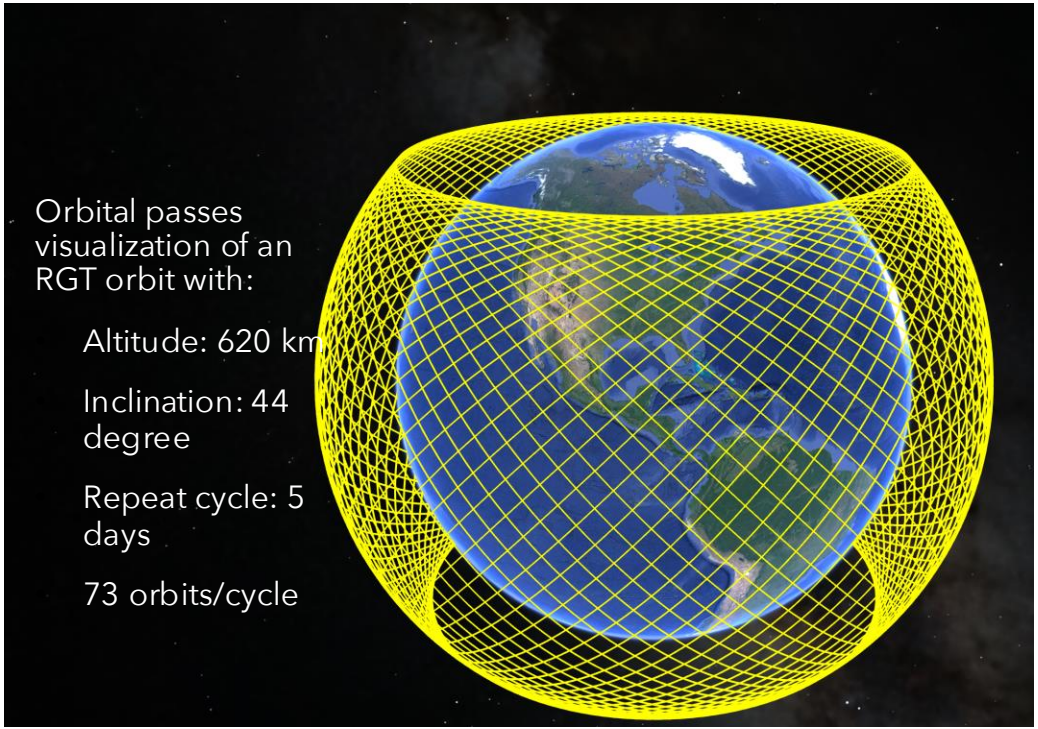


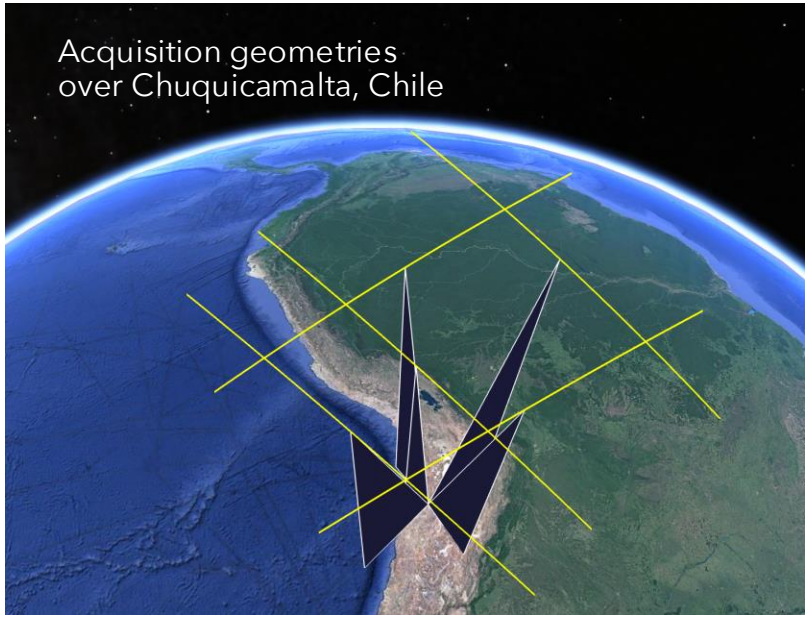
Capella-13	
Frequency	9.65 GHz
Bandwidth	600 MHz
Range res.	0.25 m
Azimuth res.	0.05 – 1.2m
Incidence	16-57 deg
Swath width	5-10 km
Orbit altitude	605 km
Repeat cycle	44 orbits / 2.95 days

Mid-inclination InSAR

Orbital passes visualization of an RGT orbit with:

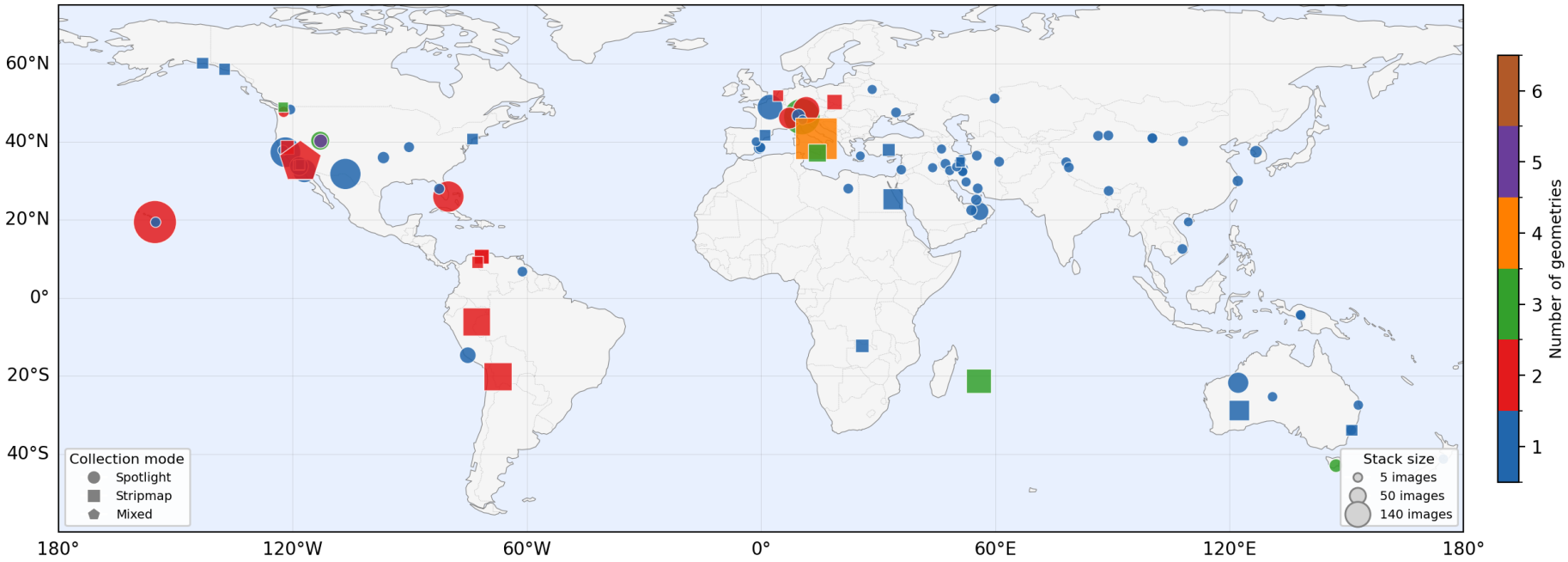
- Altitude: 620 km
- Inclination: 44 degree
- Repeat cycle: 5 days
- 73 orbits/cycle





Capella
an IonQ company

Capella C-13 InSAR: Delivered Stack Locations



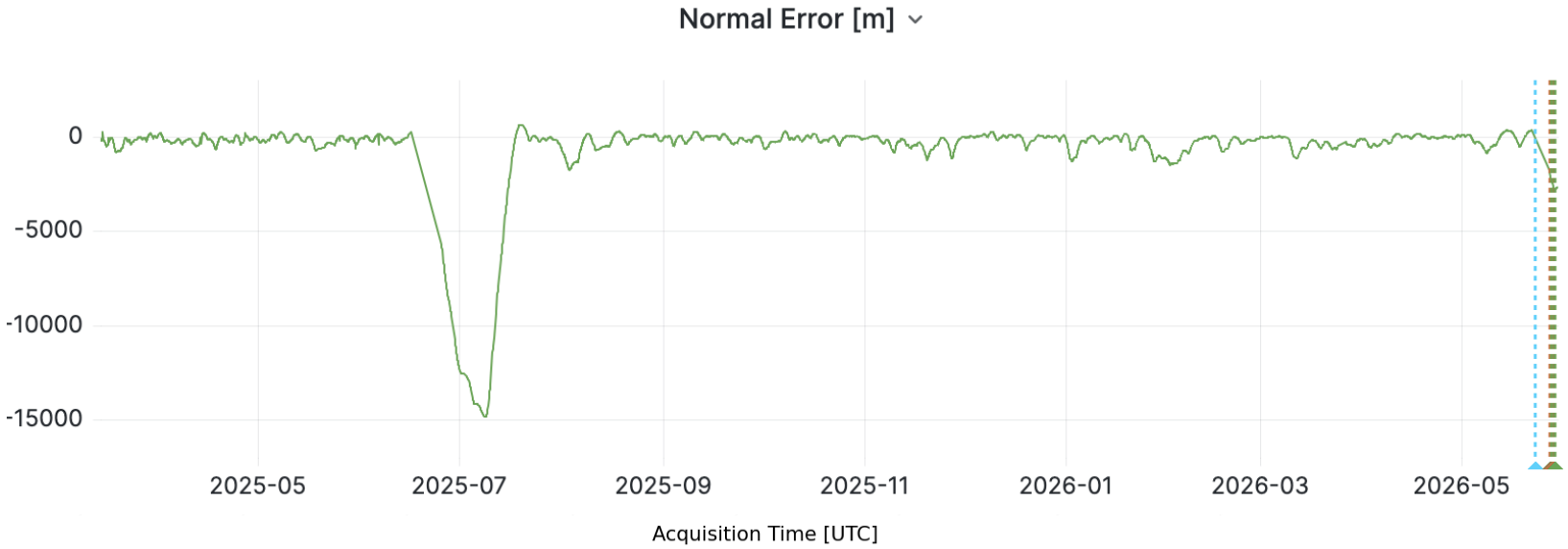
Mid-inclination SAR – 2.95 day repeat

Mid-inclination SAR – 2.95 day repeat

1:00 am (streets empty)

3:00 pm (traffic jam)

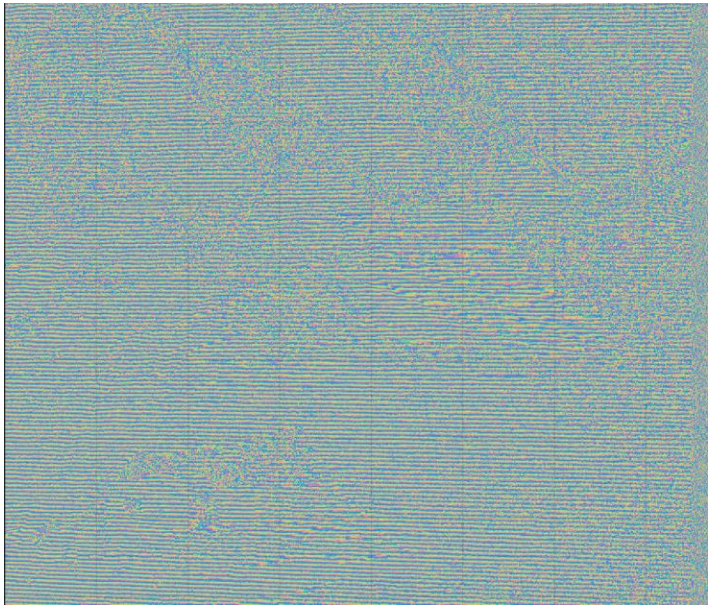
Orbital stability – Perpendicular baselines



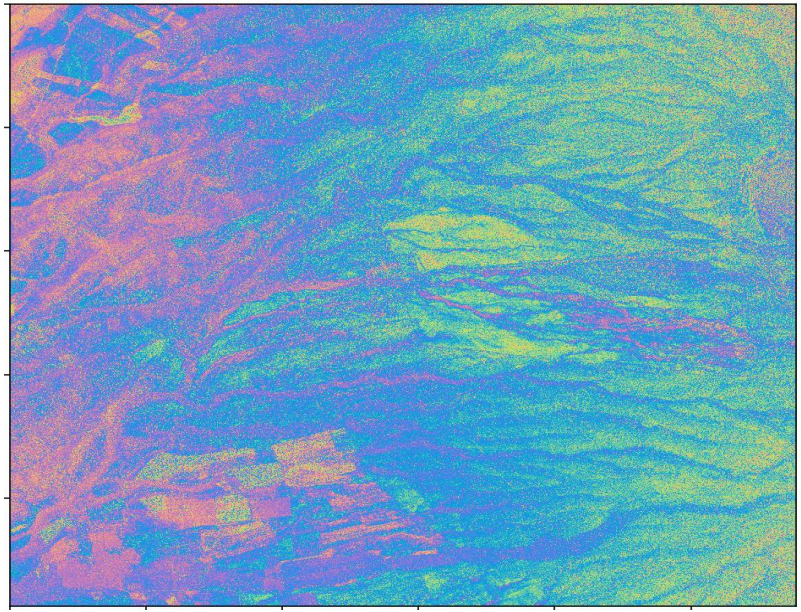
Example: Miami spotlight data with > 130 acquisitions

Improved orbit estimates and reliability

Before: real-time orbits



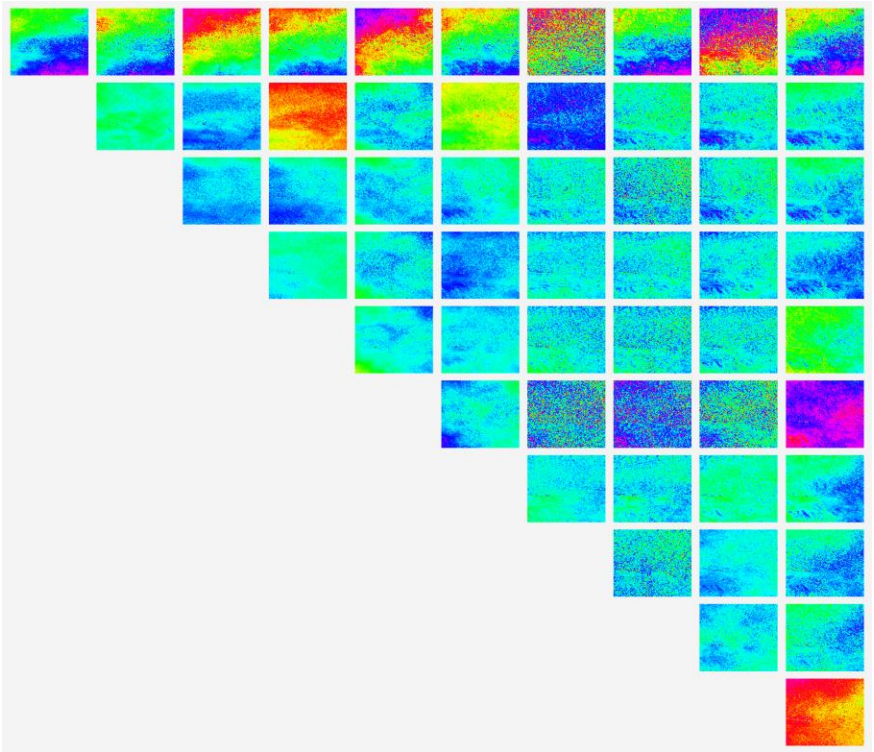
After: ~10-50 cm RMS orbital precision



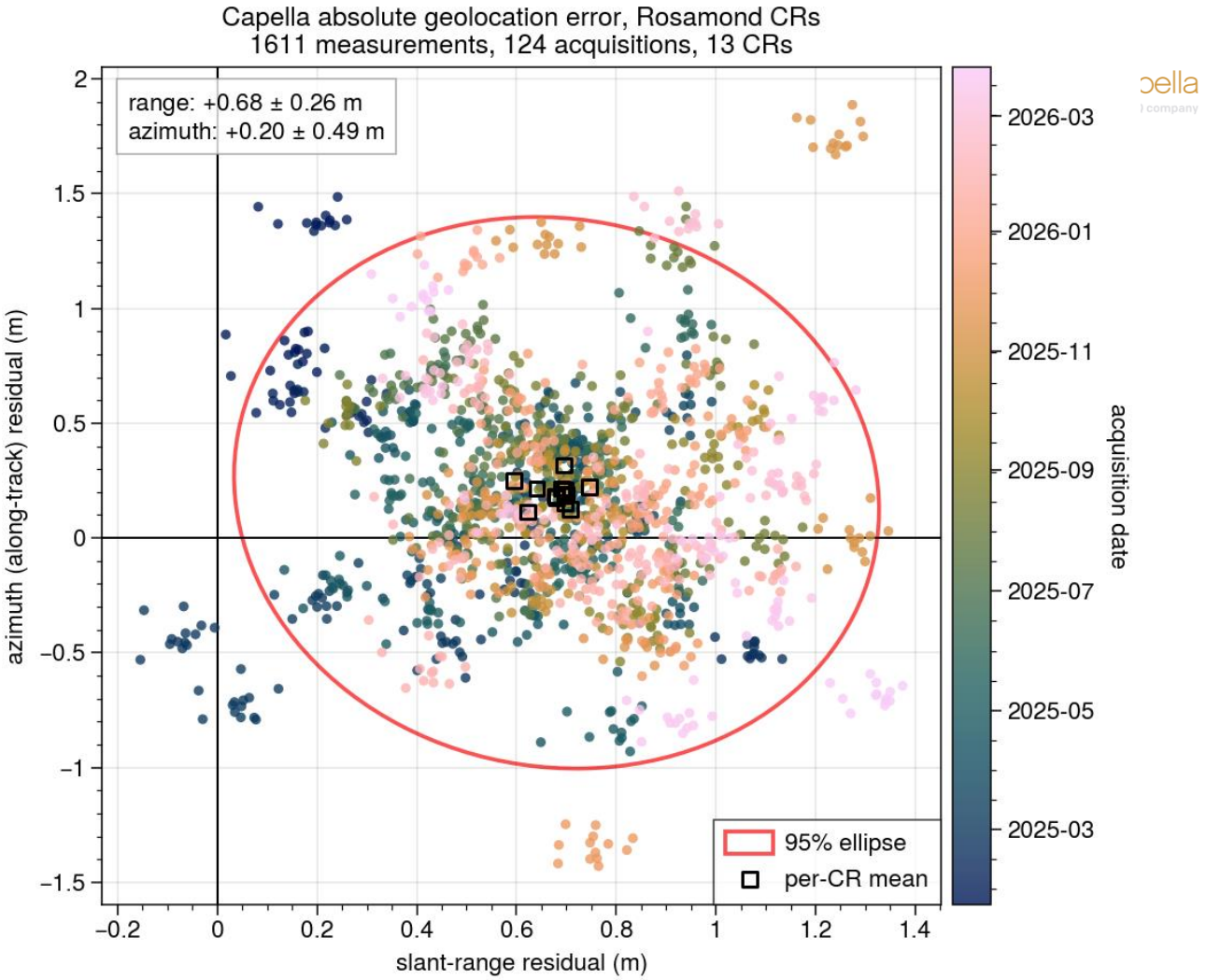
Improved orbit estimation

Geocoded SLCs – coregistered using orbits + DEM

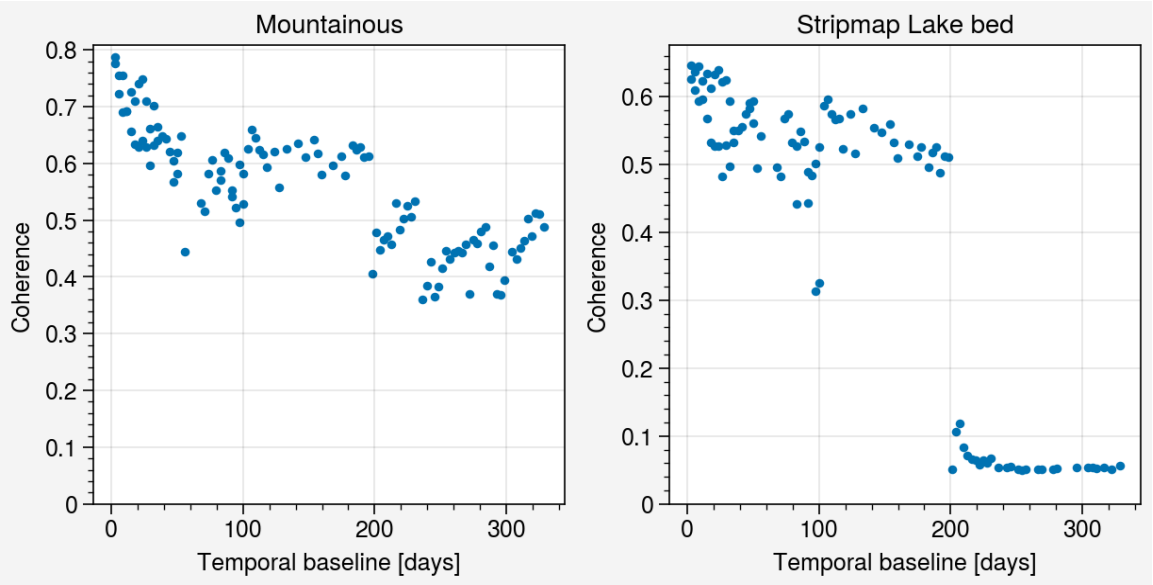
High coherence possible with no cross-correlation refinement!

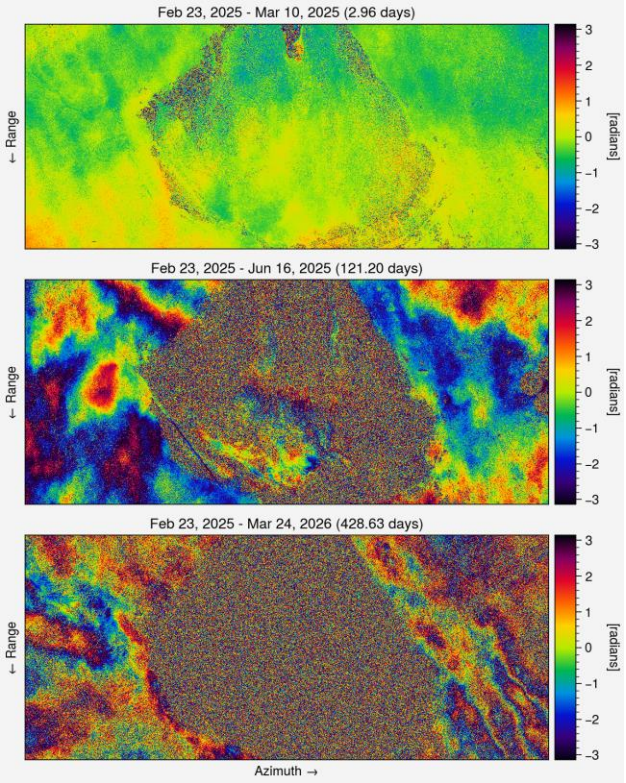


Improved orbit estimates and reliability



Longer term coherence: Rosamond, CA

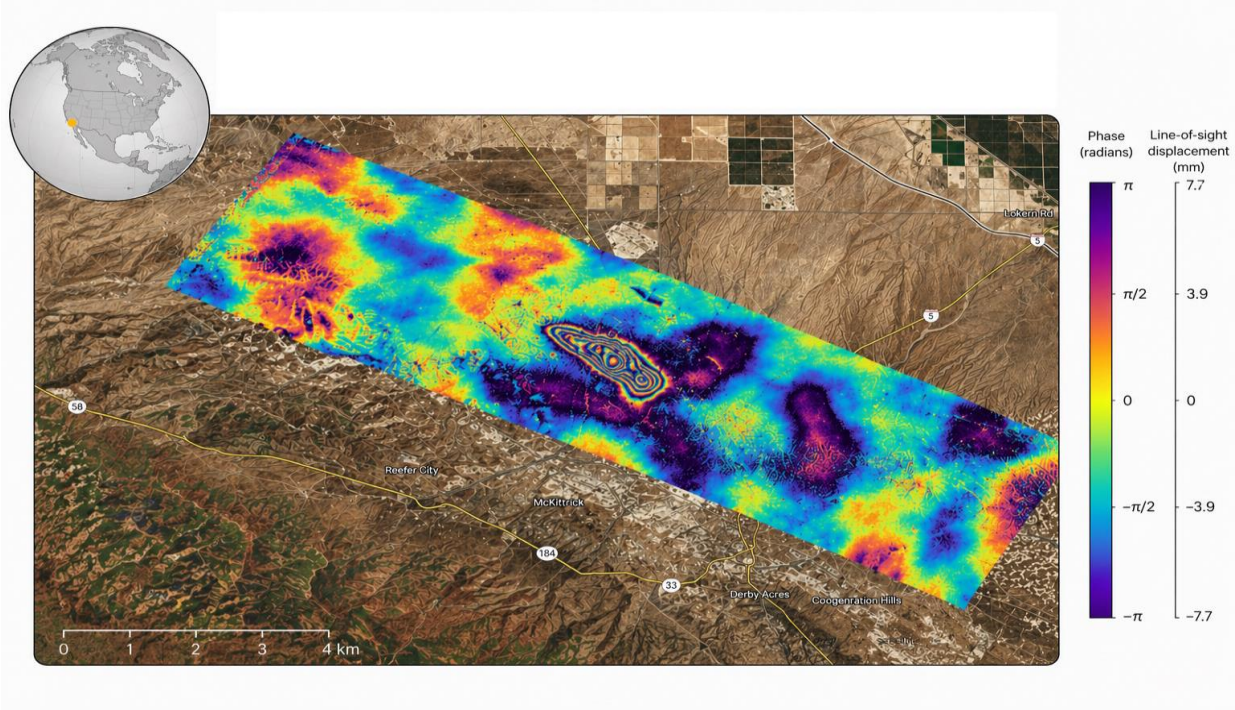


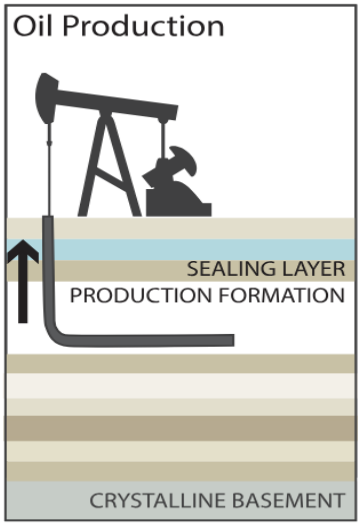


Capella
an IonQ company

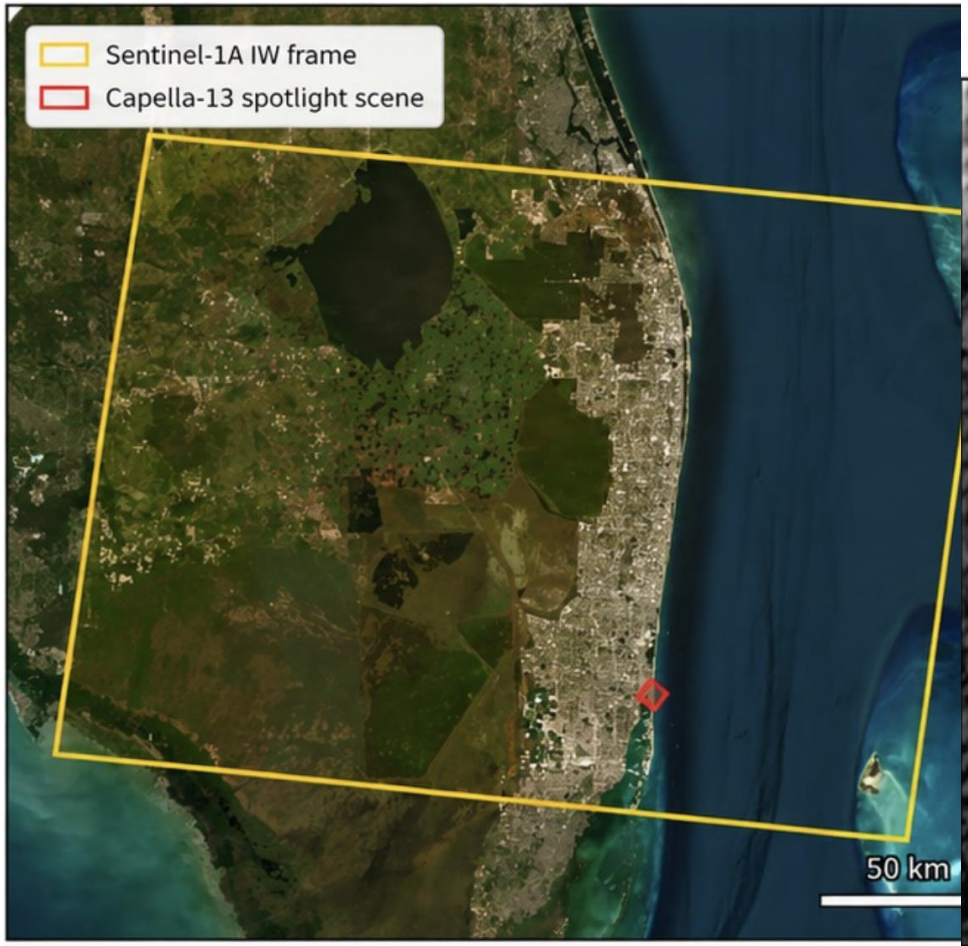
Example campaigns

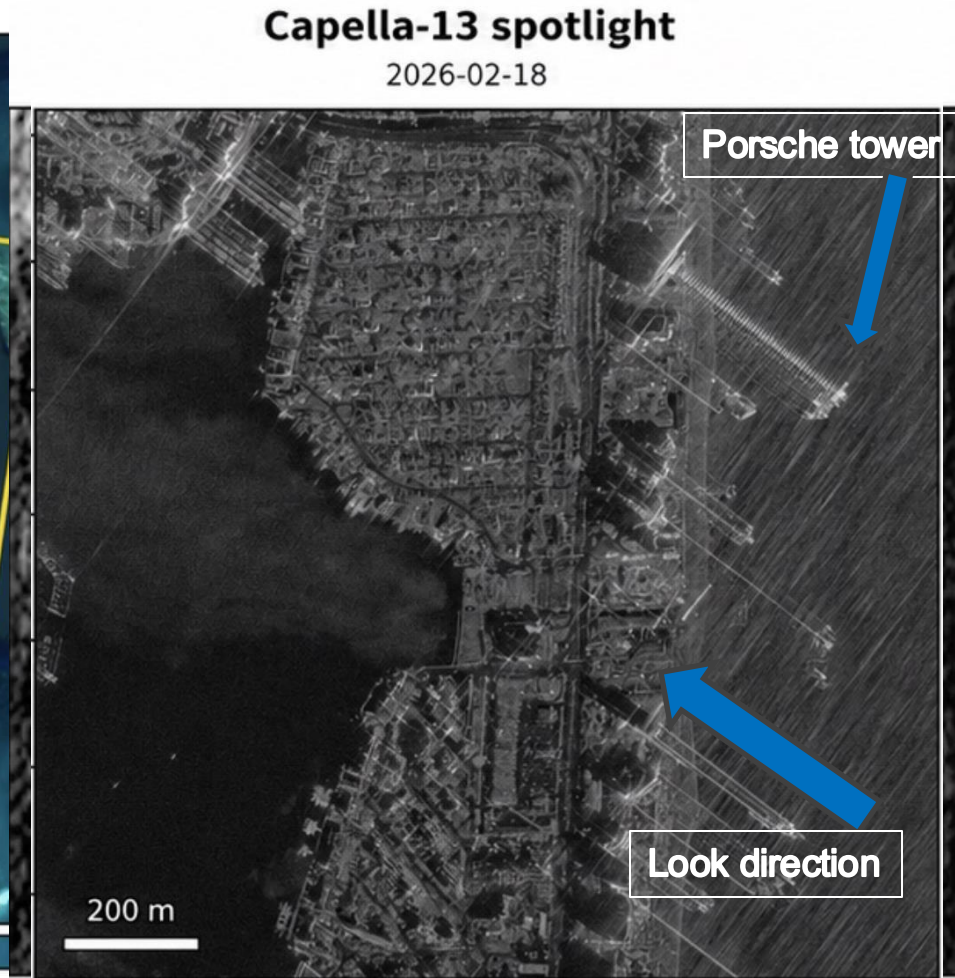
Cymric Oil field



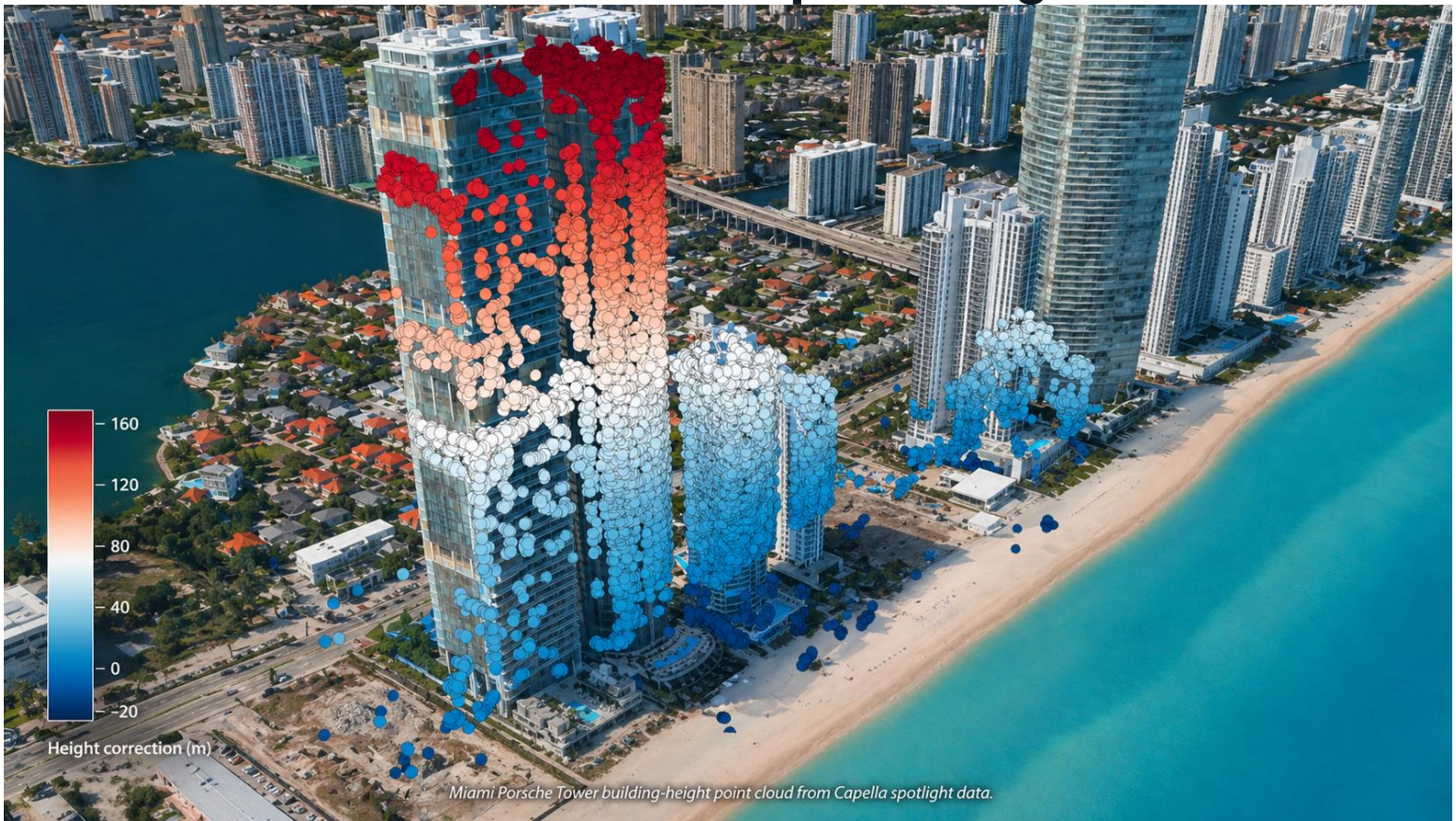


Coverage and resolution vs Sentinel-1

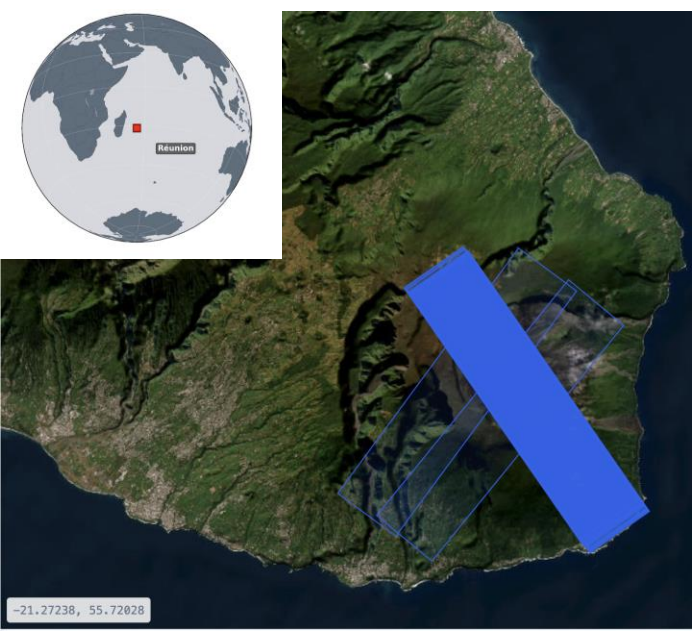


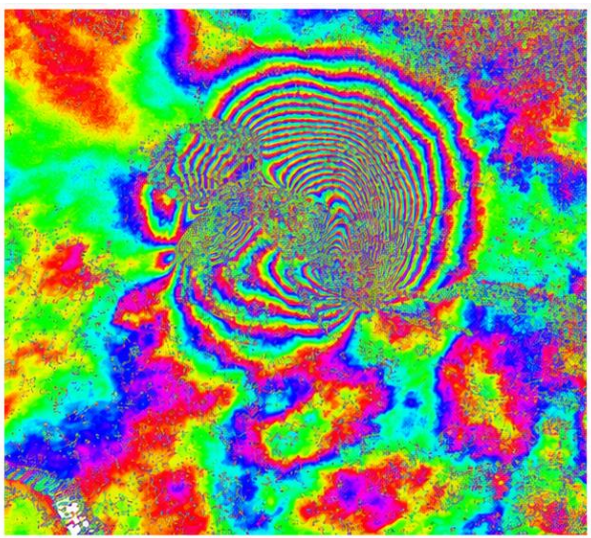


Porsche Tower – Miami – PSI point height correction



Piton de la Fournaise, Réunion



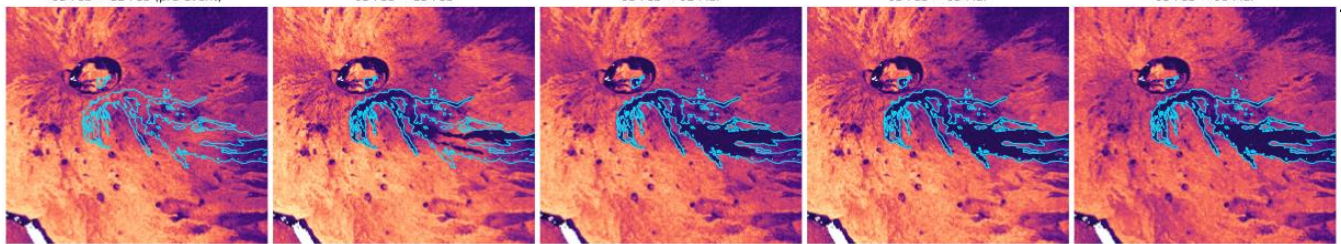


Wrapped phase

−π / −7.7 mm 0 π / +7.7 mm

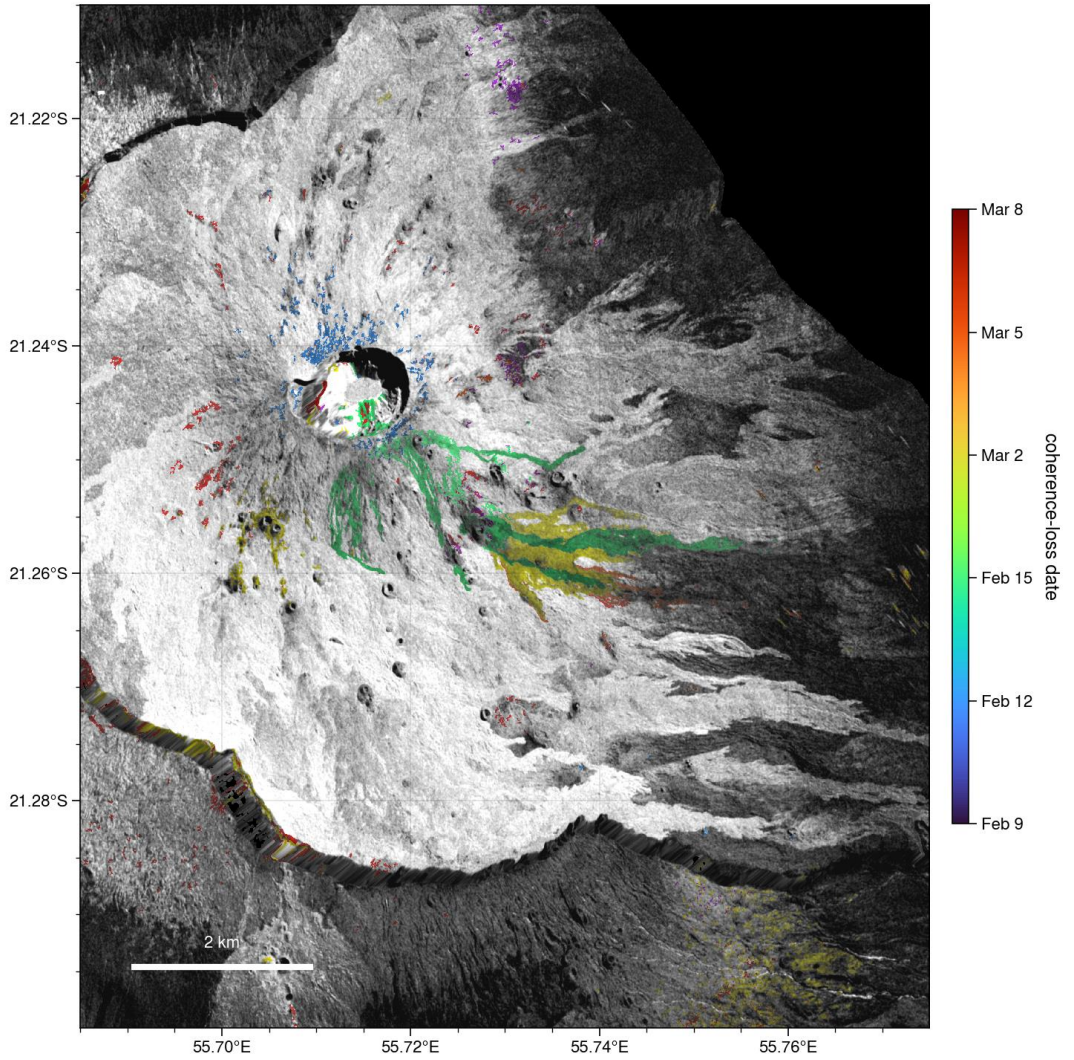
Coherence

0 0.5 1

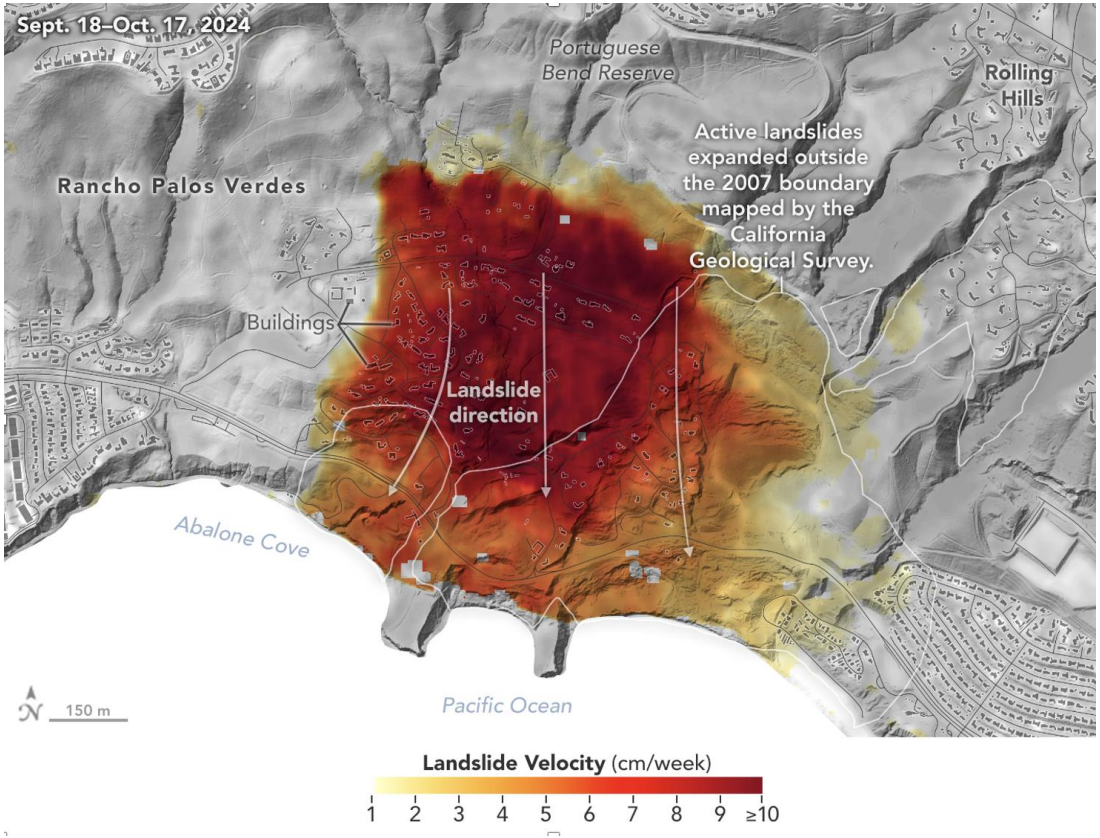


Piton de la Fournaise
Lava flow evolution

Brightness: mean coherence
Hue: date of largest coherence drop
Saturation: coherence just before the drop



Landslide on Palos Verdes Peninsula

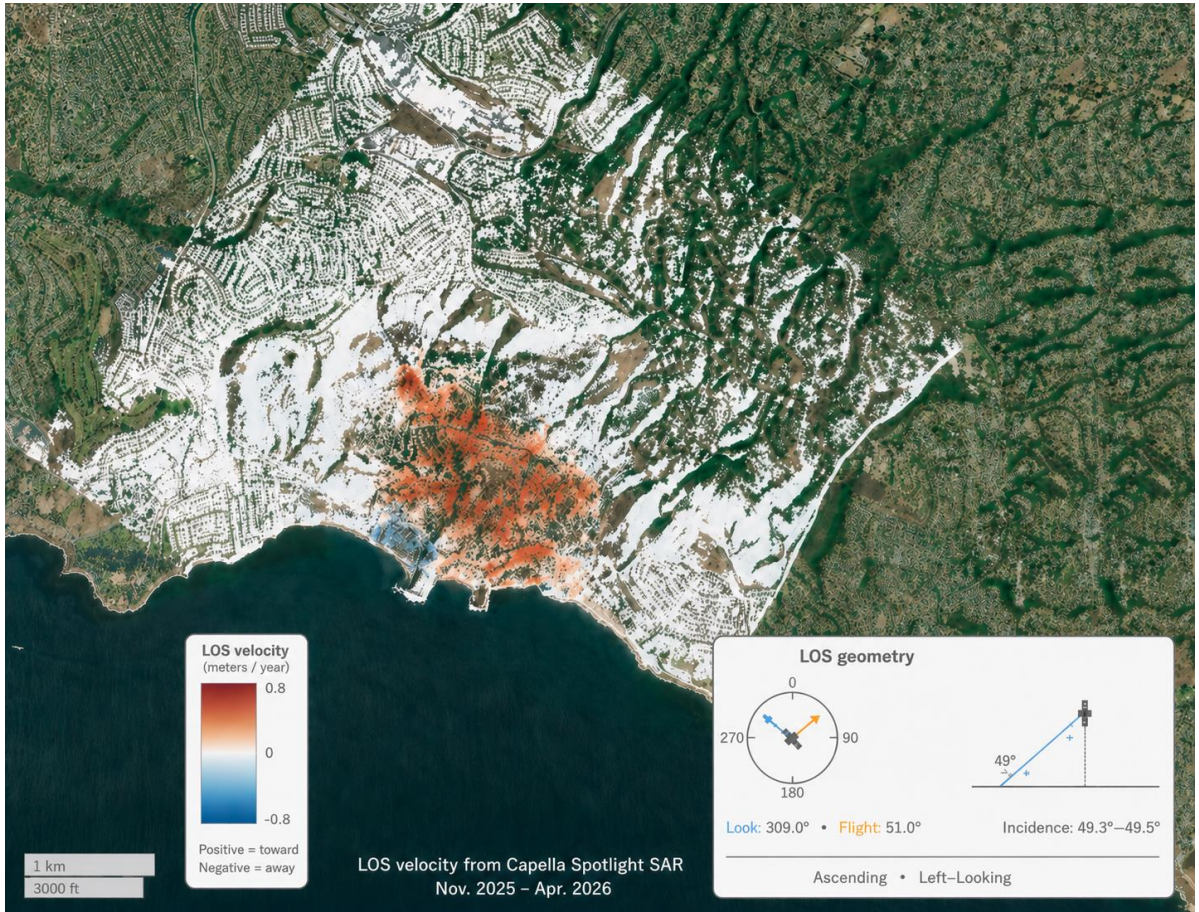


Peak motion in 2024:
3-5 meters / year

UAVSAR flights Sept. 18 and Oct. 17, 2024

Source: Al Handwerger, NASA Earth Observatory

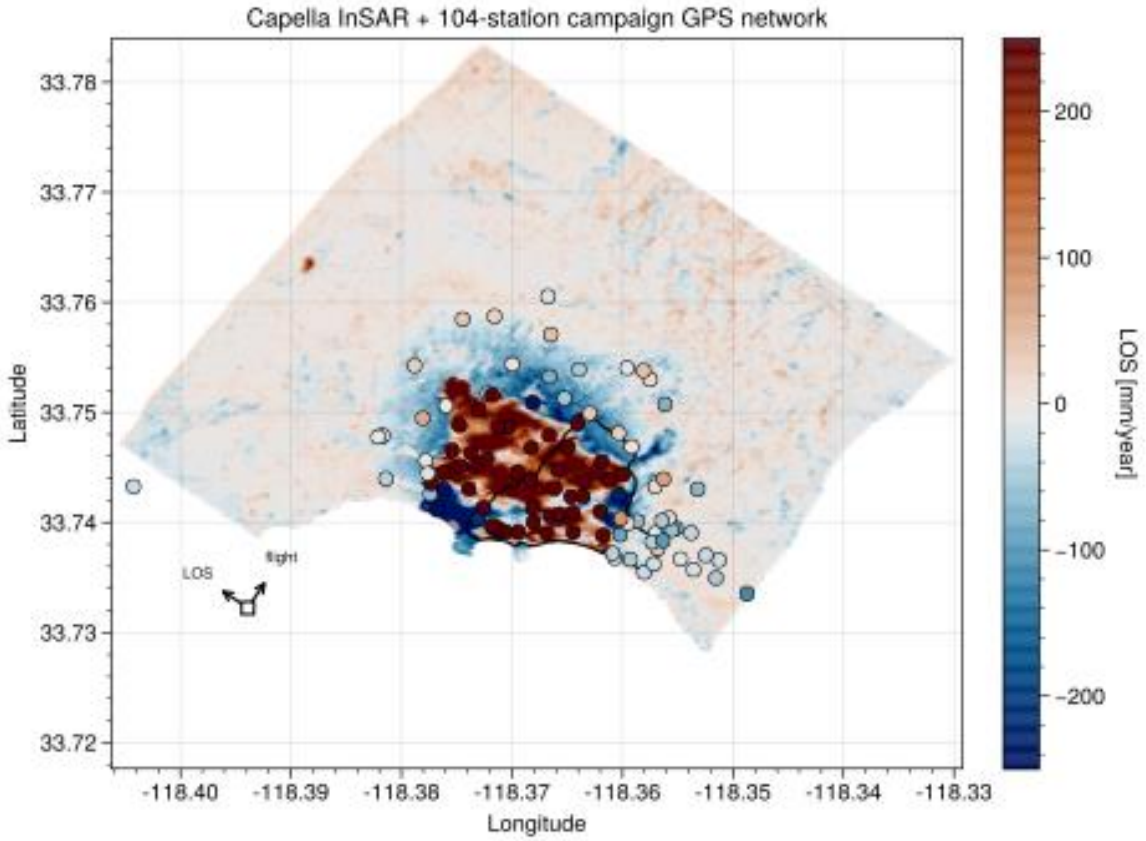
Palos Verdes – Capella-13 Spotlight InSAR



50 Spotlight images
Nov, 2025 – May, 2026

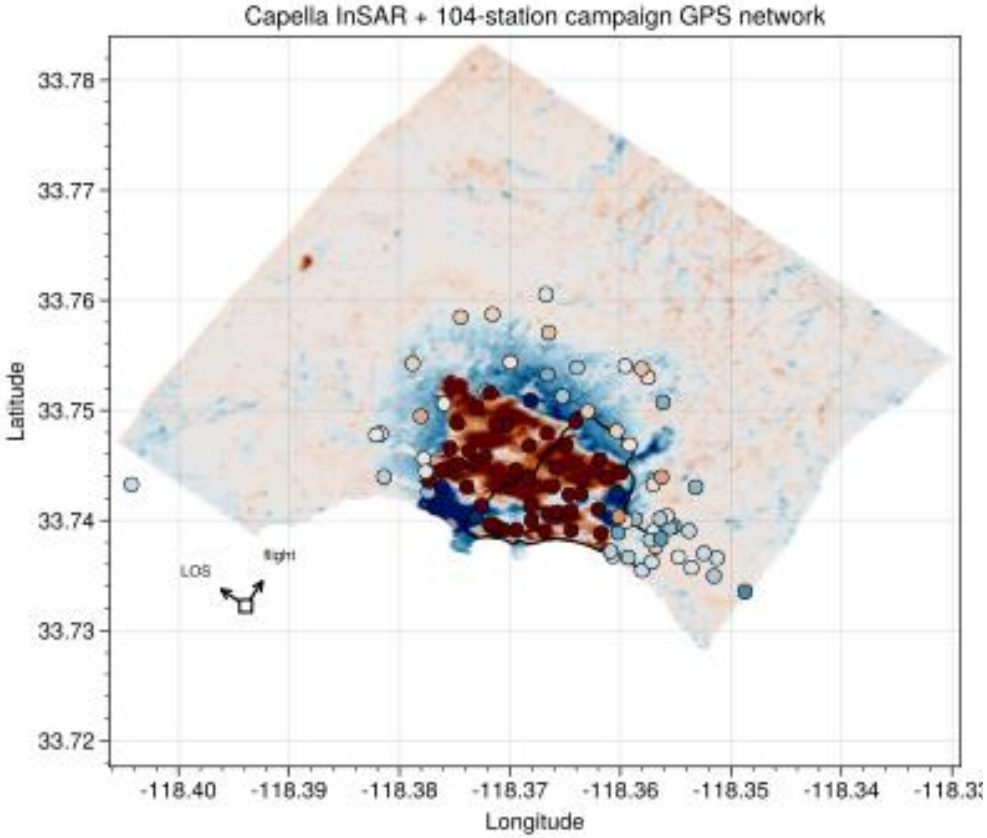
25-50 cm resolution
49° incidence

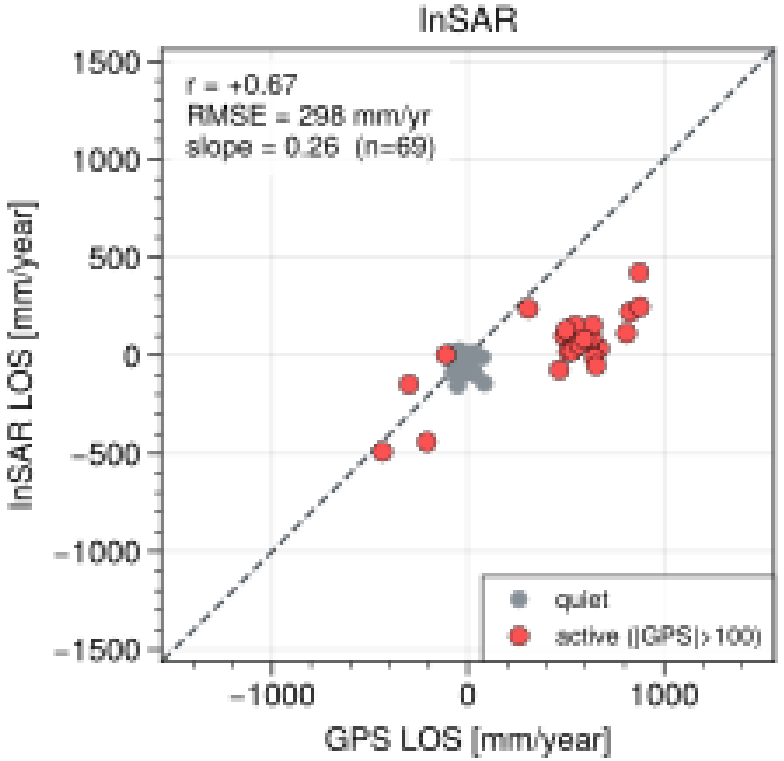
Palos Verdes – Capella-13 Spotlight InSAR



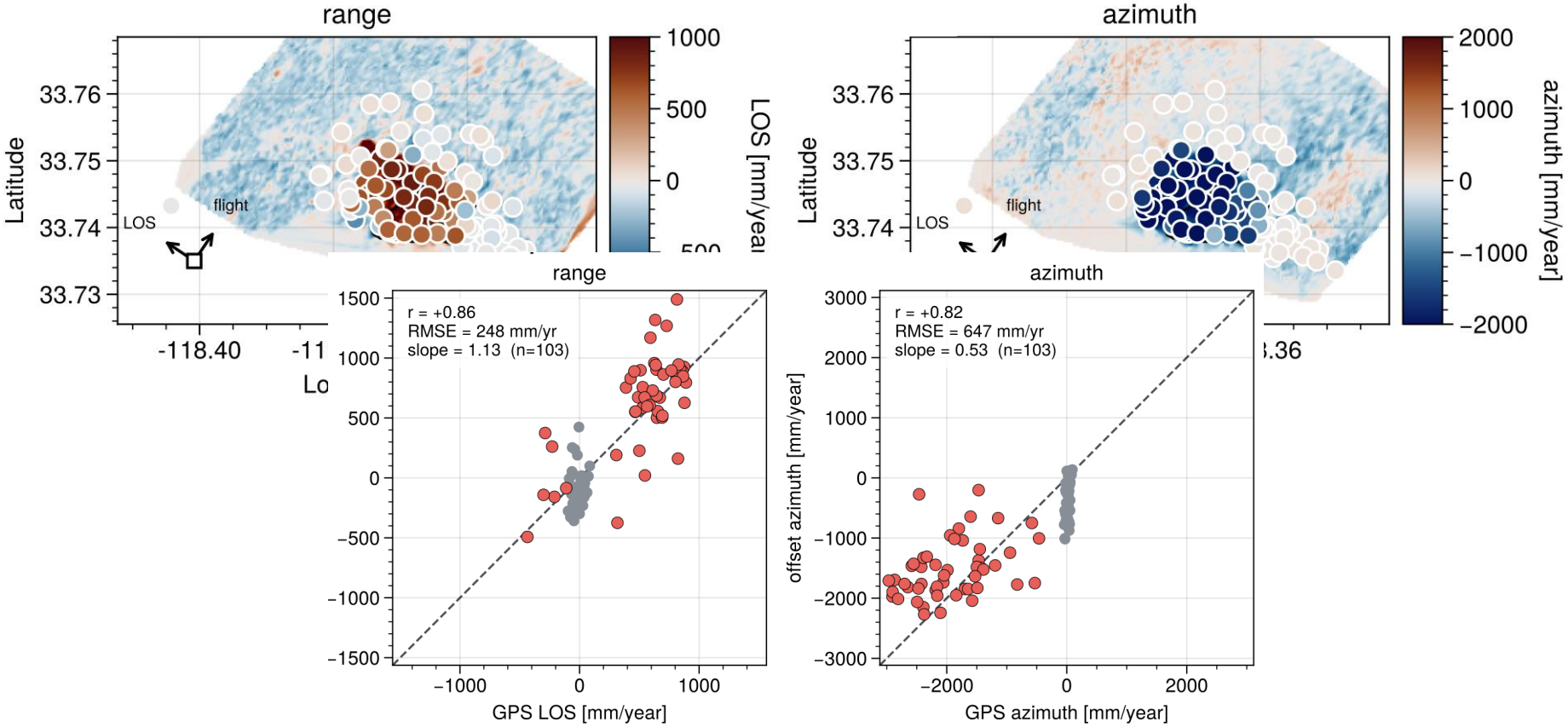
GPS data provided by Al Handwerger

Palos Verdes – Capella-13 Spotlight InSAR

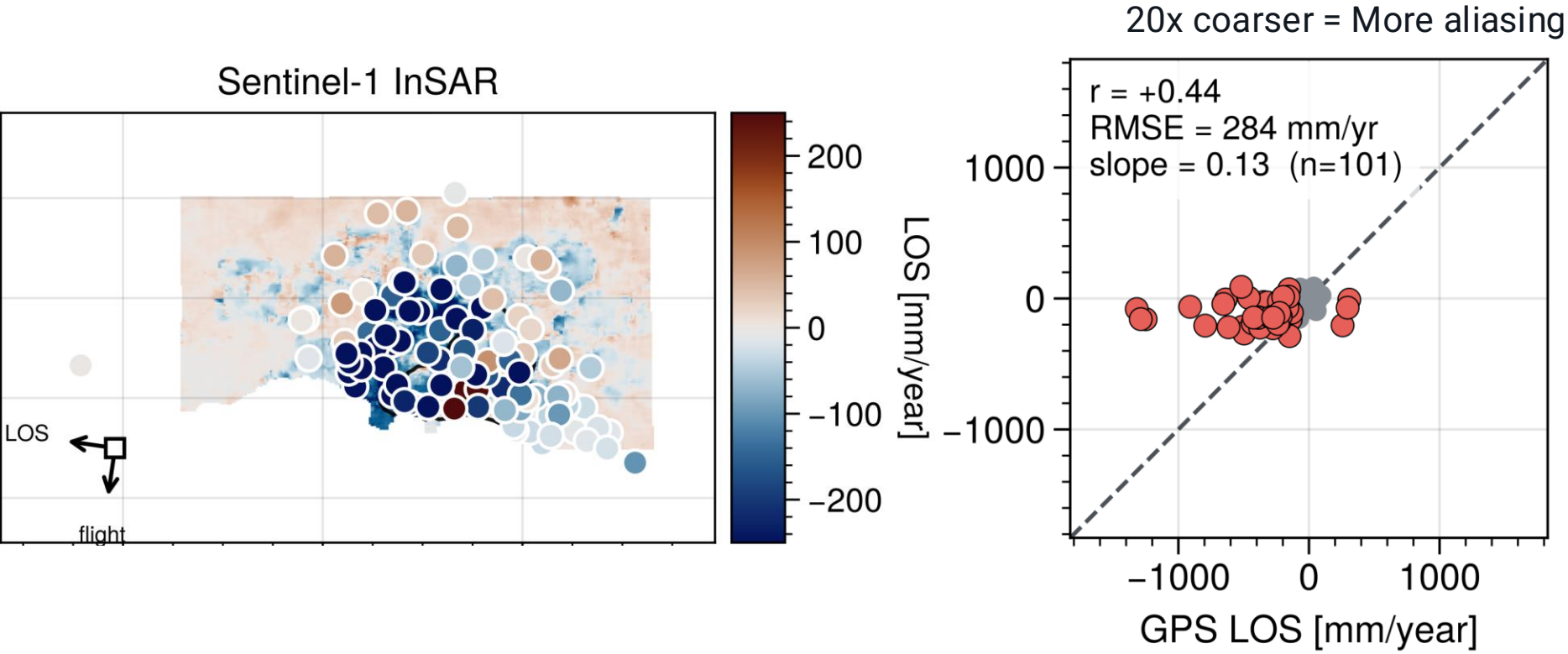




Palos Verdes Landslide – Pixel offset tracking



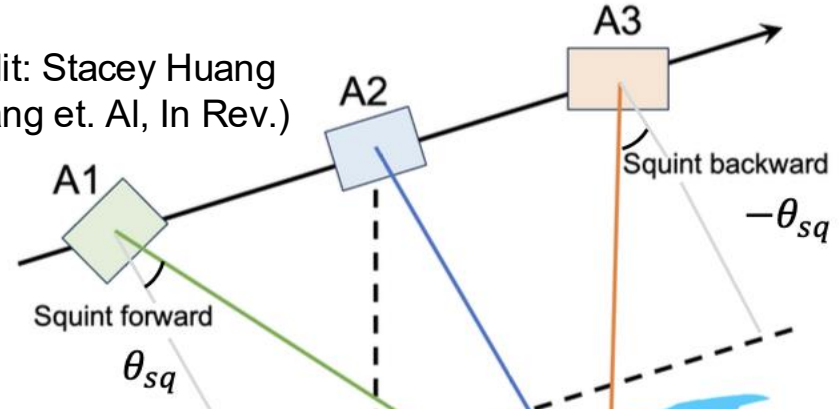
Palos Verdes Landslide – Sentinel-1 comparison

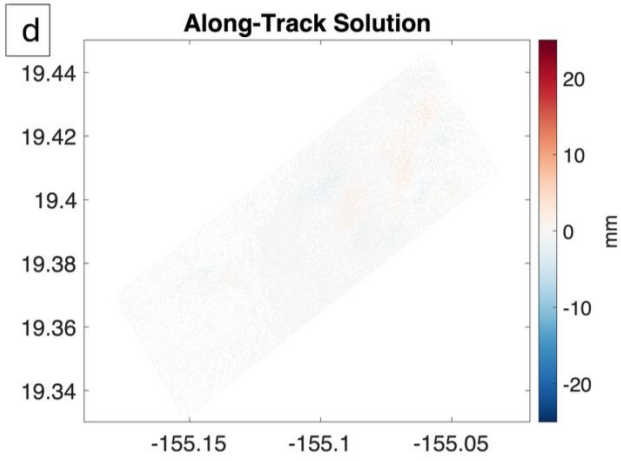


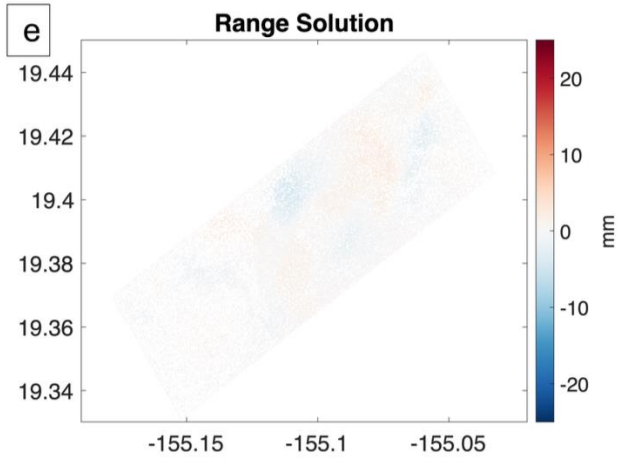
NASA SDC: troposphere + deformation

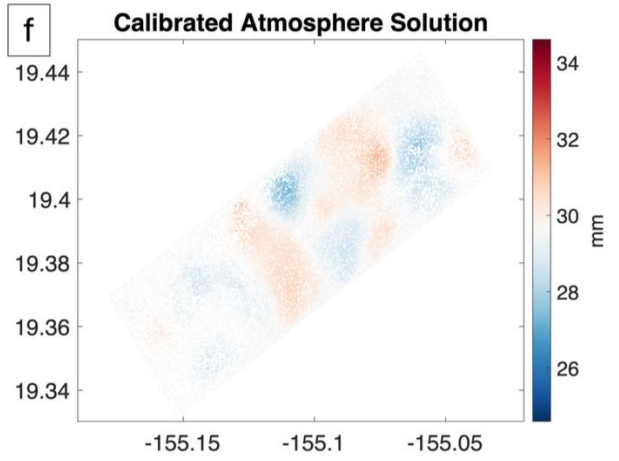
Long-dwell spotlight application: simultaneous atmospheric and deformation

Credit: Stacey Huang
(Huang et. Al, In Rev.)



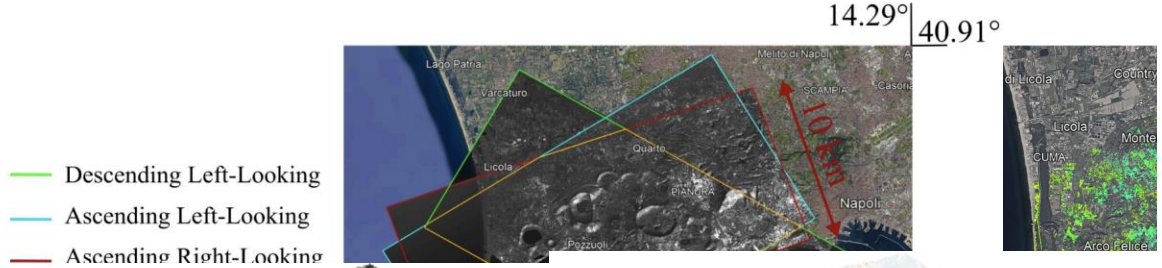


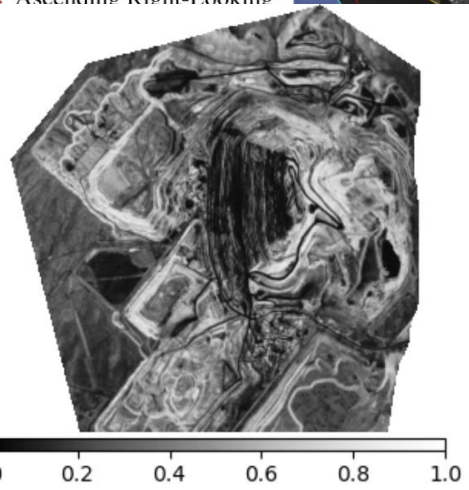


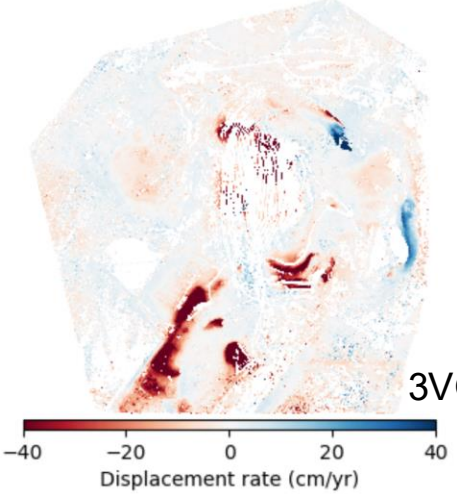


Analytics partners!

IREA-CNR

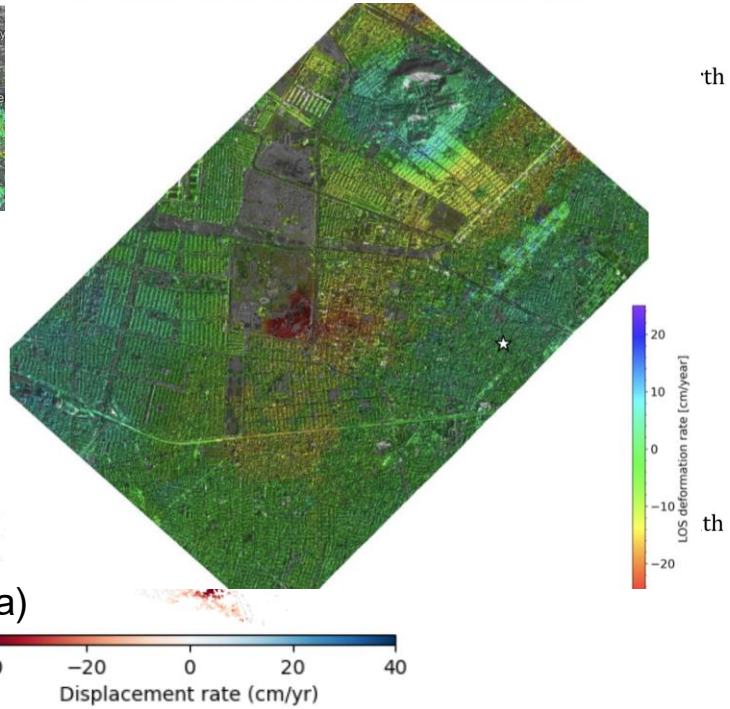






3VG (Orica)

GAMMA!



Try out our open data!

Capella Space
open-data STAC catalog

stacindex.org/catalogs/capella-space-open-da

`pip install capella-reader`

https://github.com/capellaspace/capella-reader

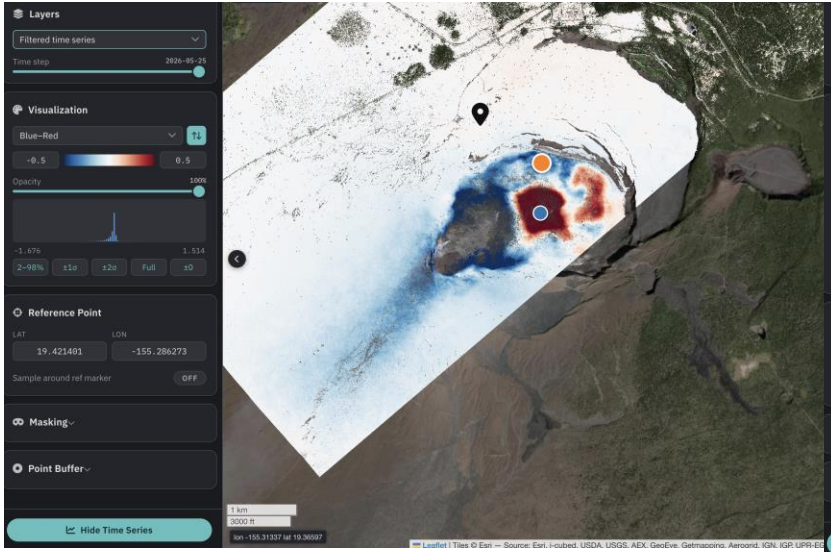
```python
from capella_reader import CapellaSLC
from capella_reader import adapters

slc = CapellaSLC.from_file("path/to/slc.tif")

# Convert to ISCE3 data structures
radar_grid = adapters.isce3.get_radar_grid(slc)
orbit = adapters.isce3.get_orbit(slc)
doppler_poly = adapters.isce3.get_doppler_poly(slc)
doppler_lut = adapters.isce3.get_doppler_lut2d(slc)

# Access metadata
print(slc.shape)                                    # (rows, cols)
print(slc.meta.collect.platform)                    # 'capella-14'
print(slc.meta.collect.image.center_pixel.incidence_angle)
```

Capella
an IonQ company

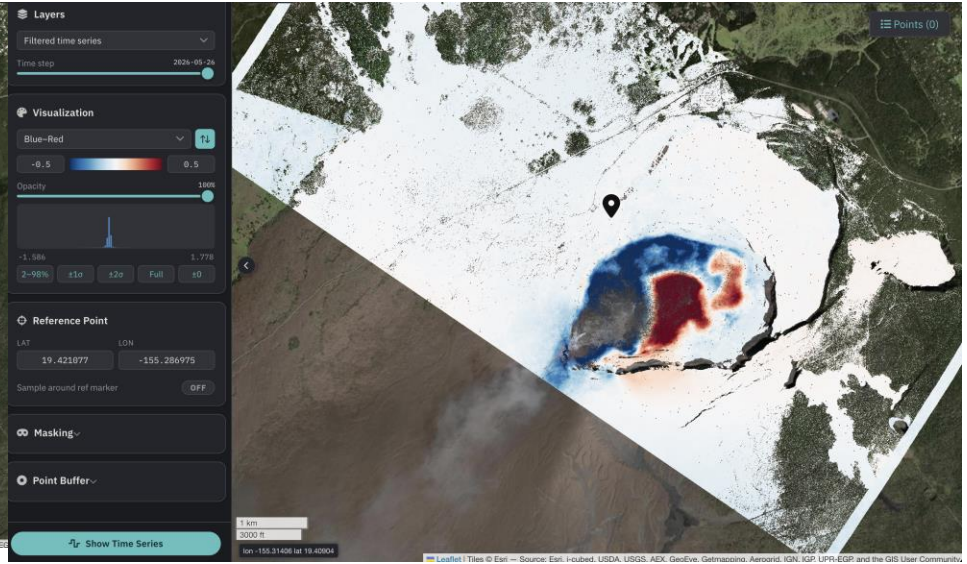
Thank you!

Kilauea, Hawaii: Spotlight

Descending (right-looking)

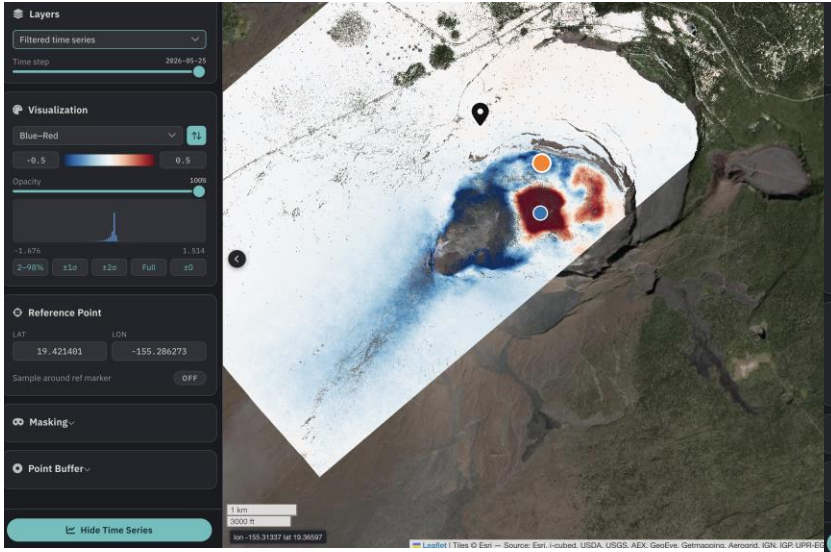


Ascending (left-looking)

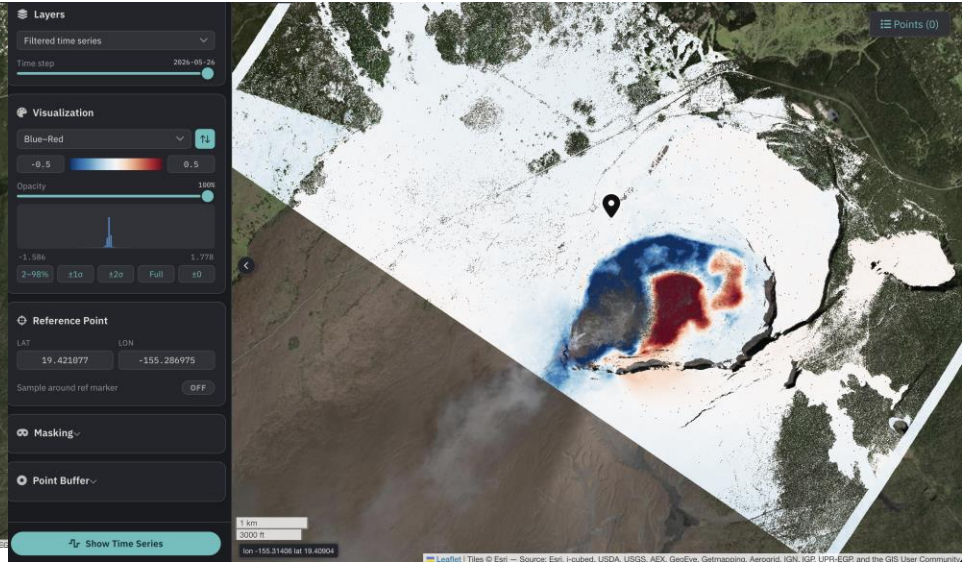


Kilauea, Hawaii: Spotlight

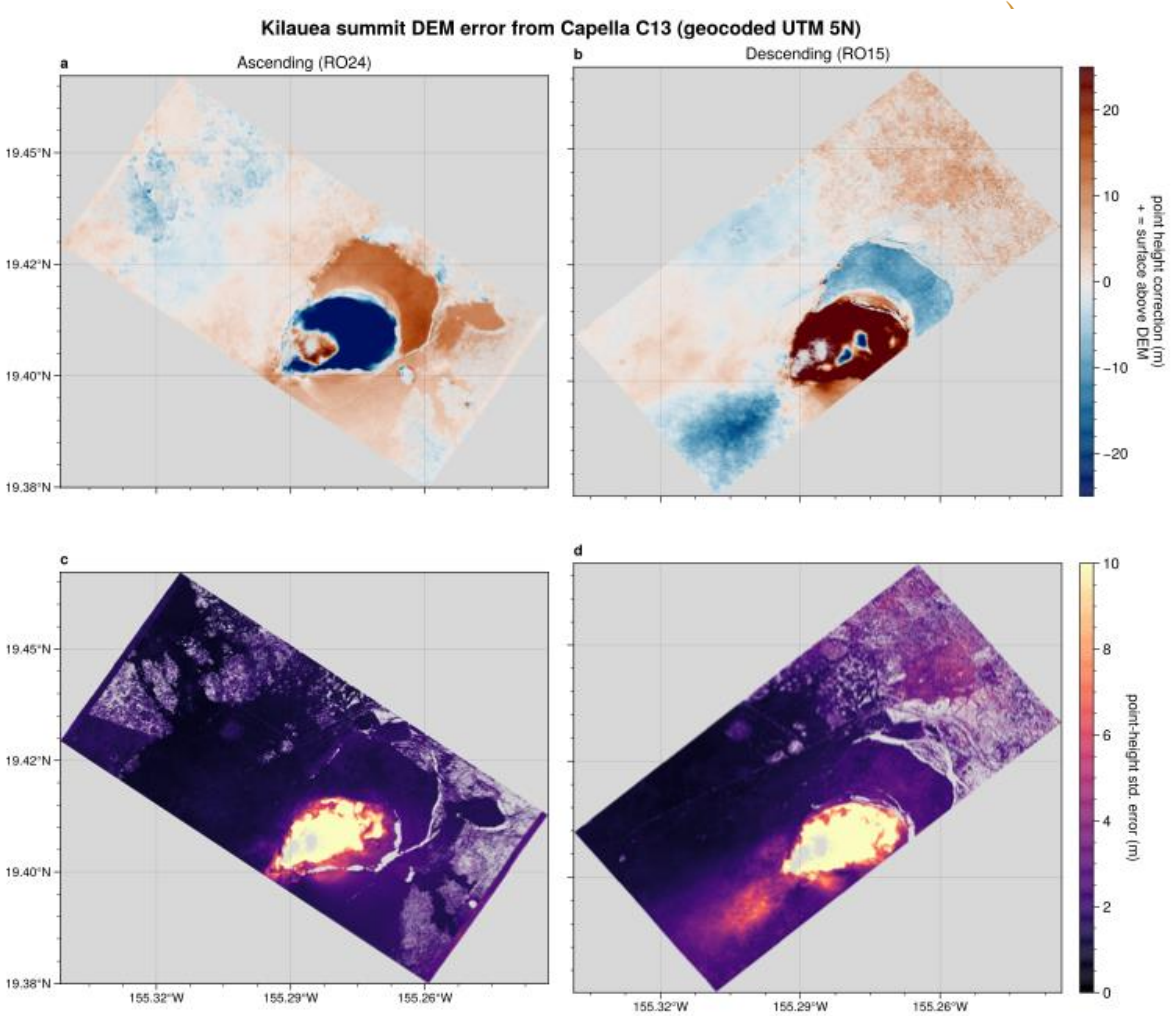
Descending (right-looking)



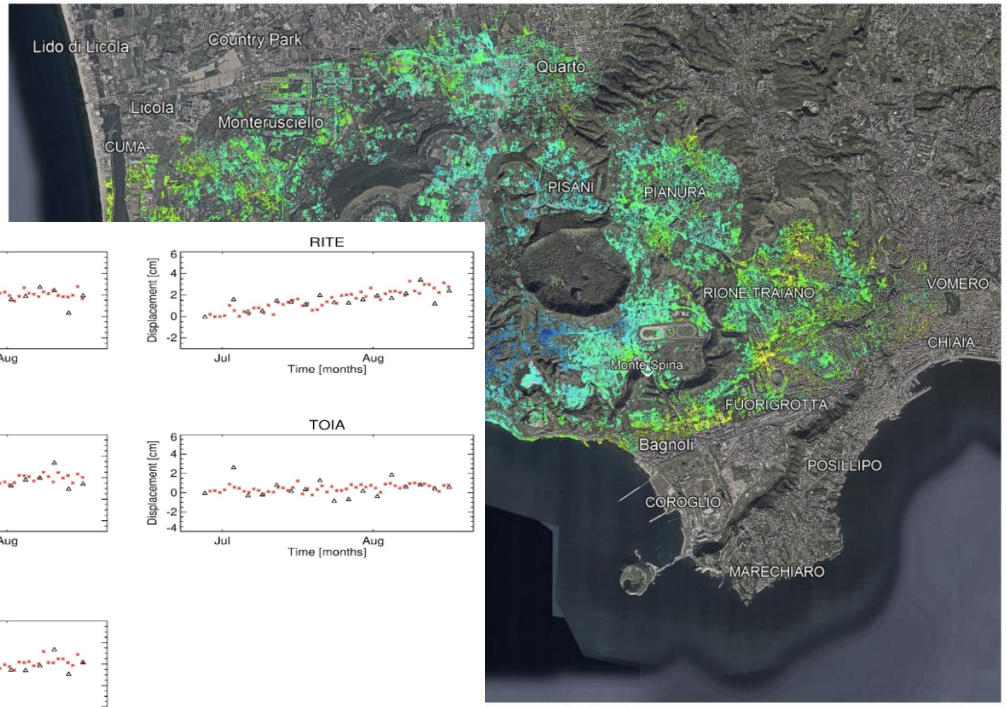
Ascending (left-looking)

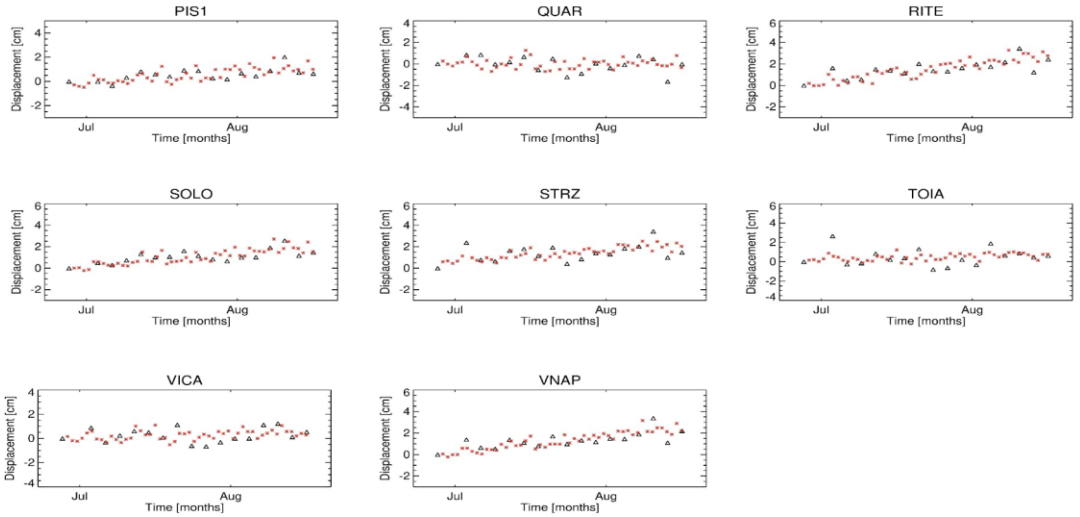


Kilauea, Hawaii: DEM Errors in Caldera



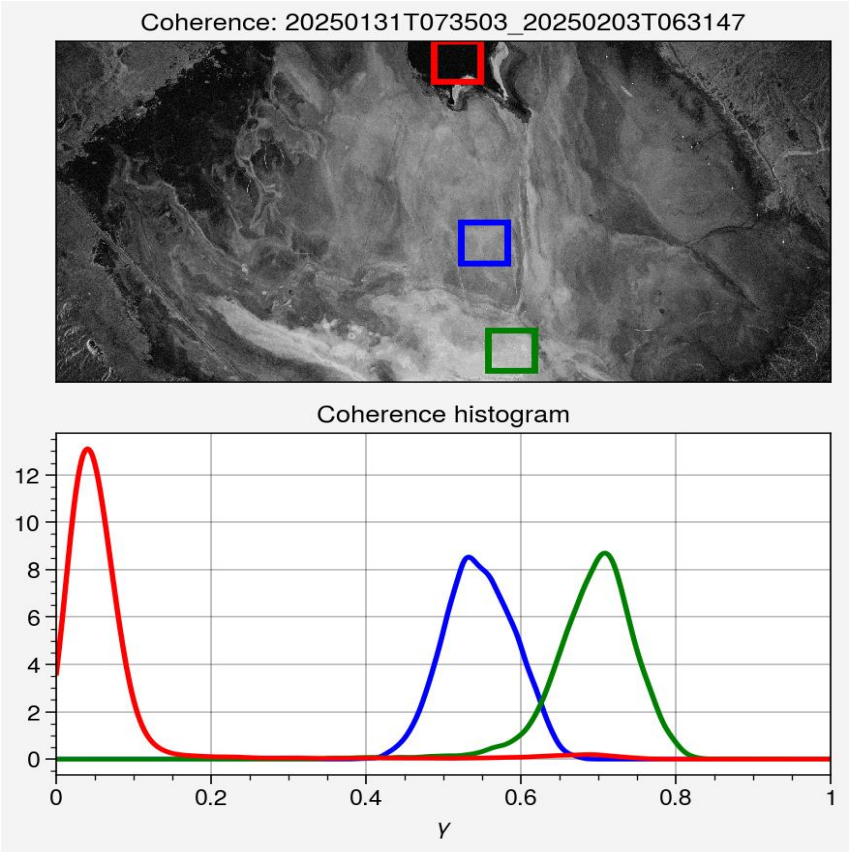
Campi Flegrei -



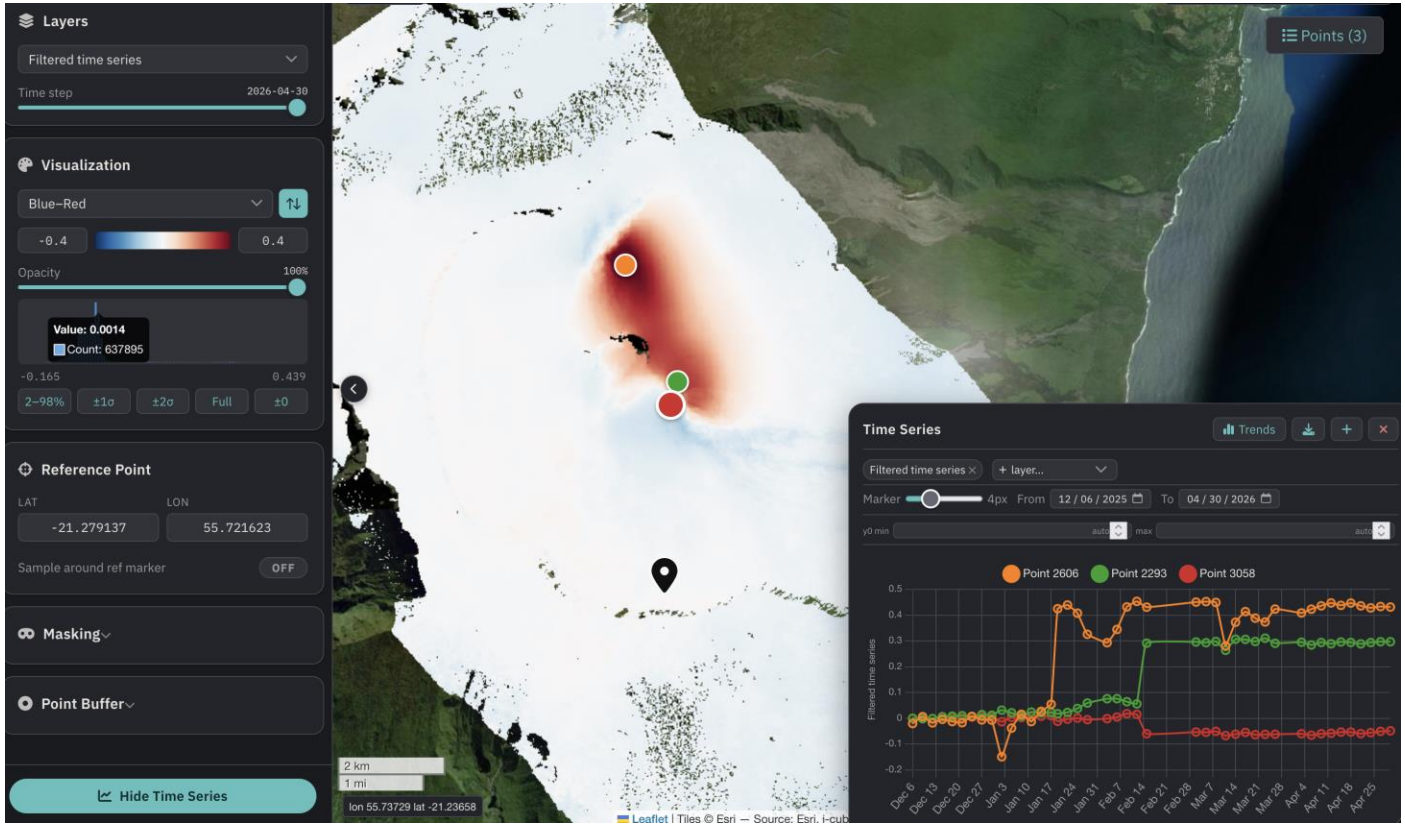


Δ SAR ✱ GNSS

Rosamond coherence analysis



Piton de la Fournaise: multiple eruptions captured



Kilauea, Hawaii: Extended spotlight

Descending (right-looking)

Ascending (left-looking)