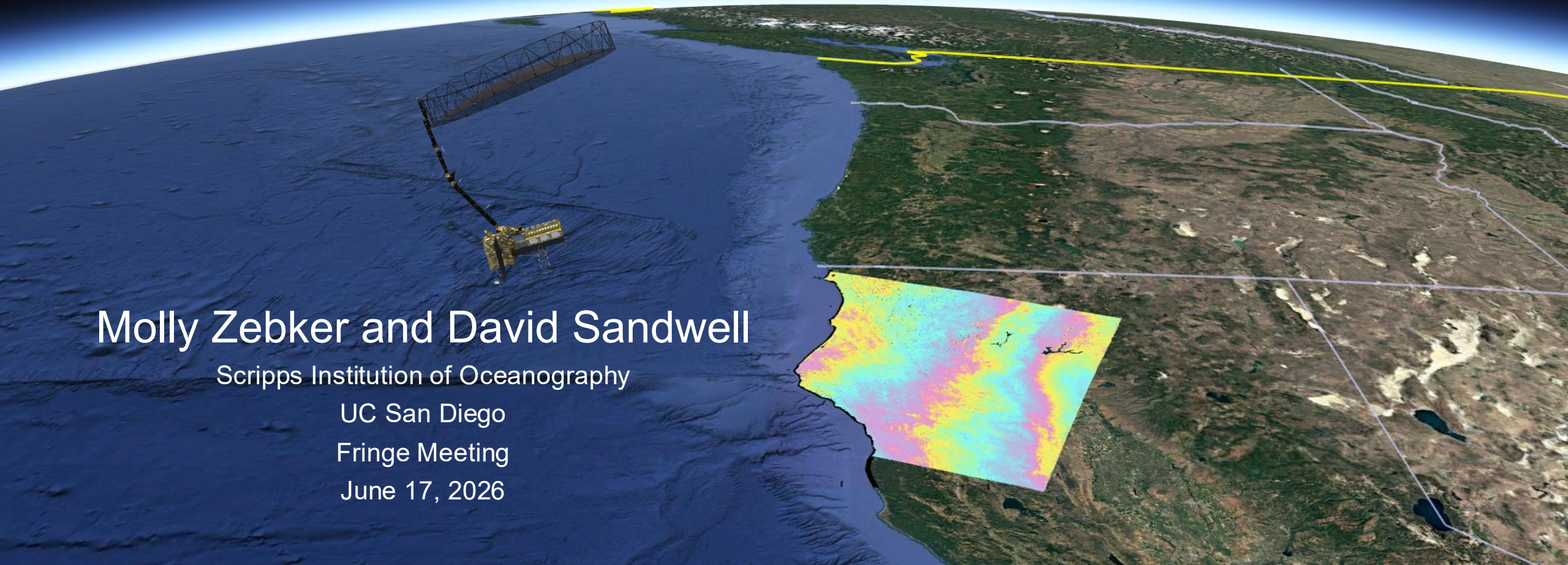
Coherence Analysis and Displacement Time Series in Cascadia Constrained by L-band NISAR



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Scripps Institution of Oceanography

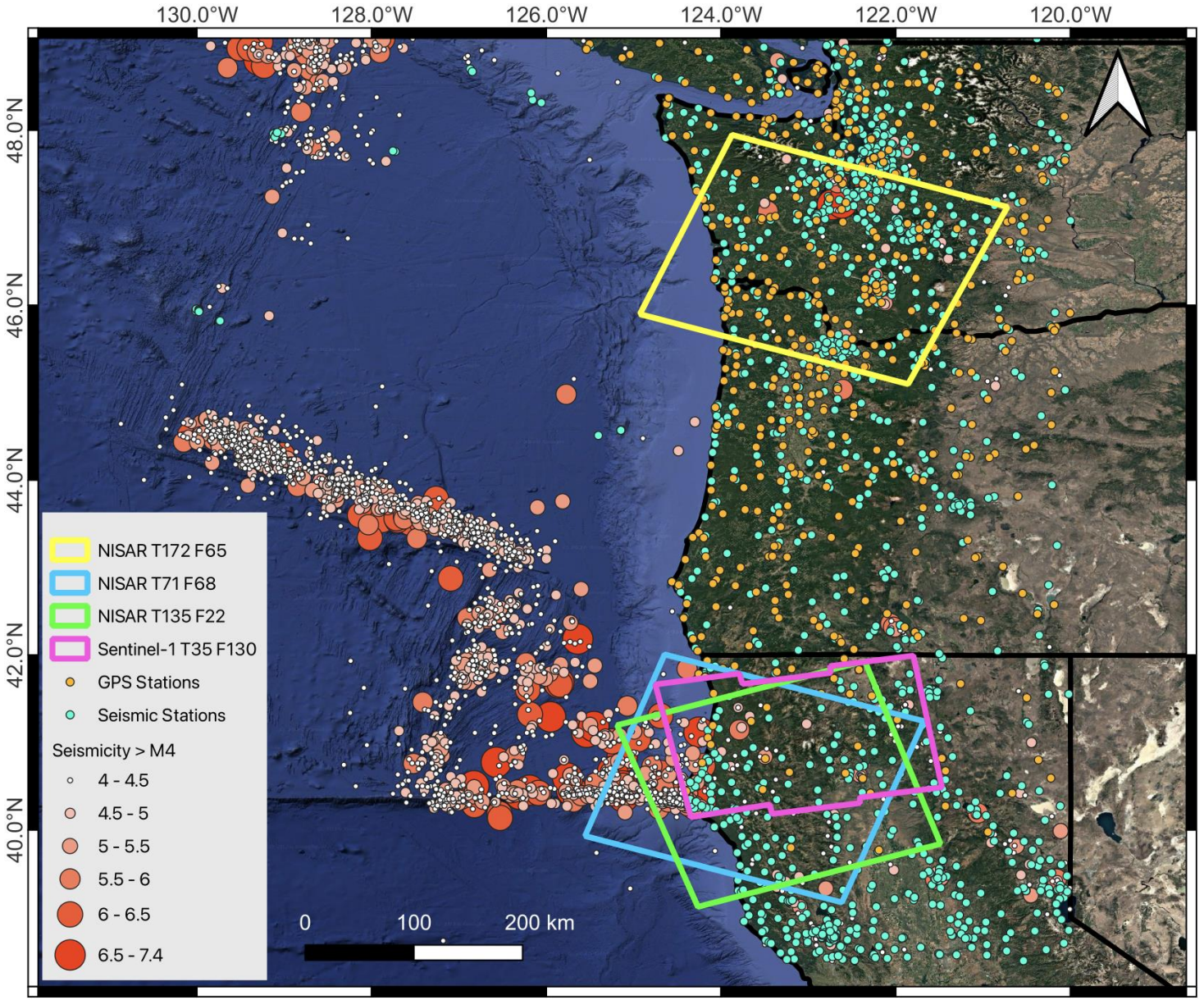
UC San Diego

Fringe Meeting

June 17, 2026

Cascadia Subduction Zone

GMTSAR
- Geometric alignment then cross correlation
- 60 m pixel spacing
- Gaussian filter with 160 m wavelength



11 RSLCs

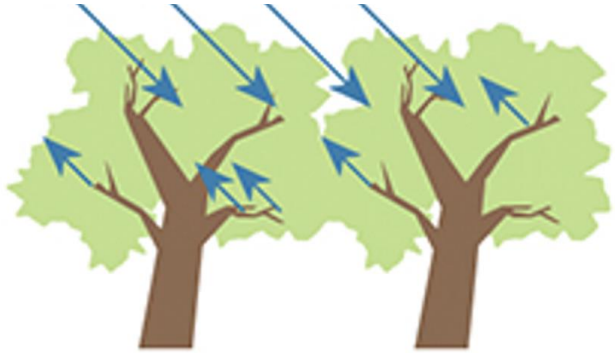
3 RSLCs

4 RSLCs

Sentinel-1

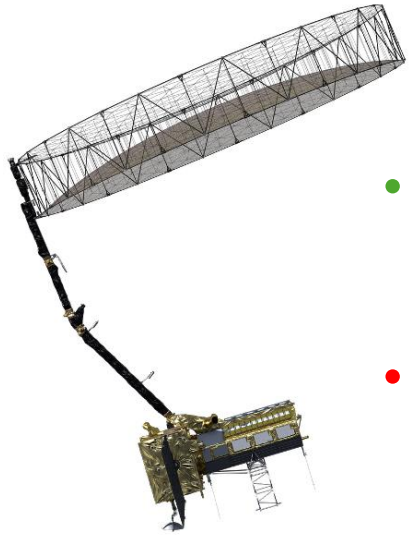
C-band 6 cm

- Decorrelates in vegetated areas
- Less susceptible to ionospheric phase delays

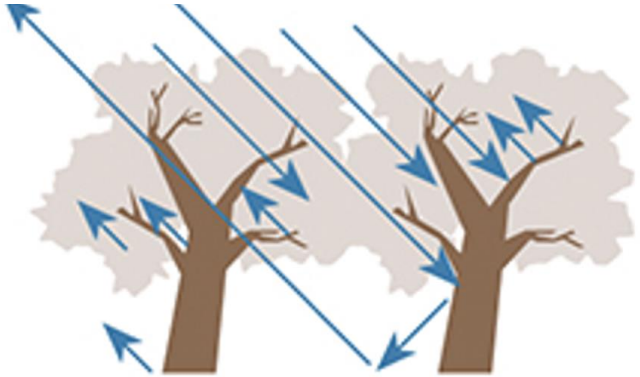


NISAR

L-band 24 cm



- Maintains coherence in vegetated areas
- More susceptible to ionospheric phase delays



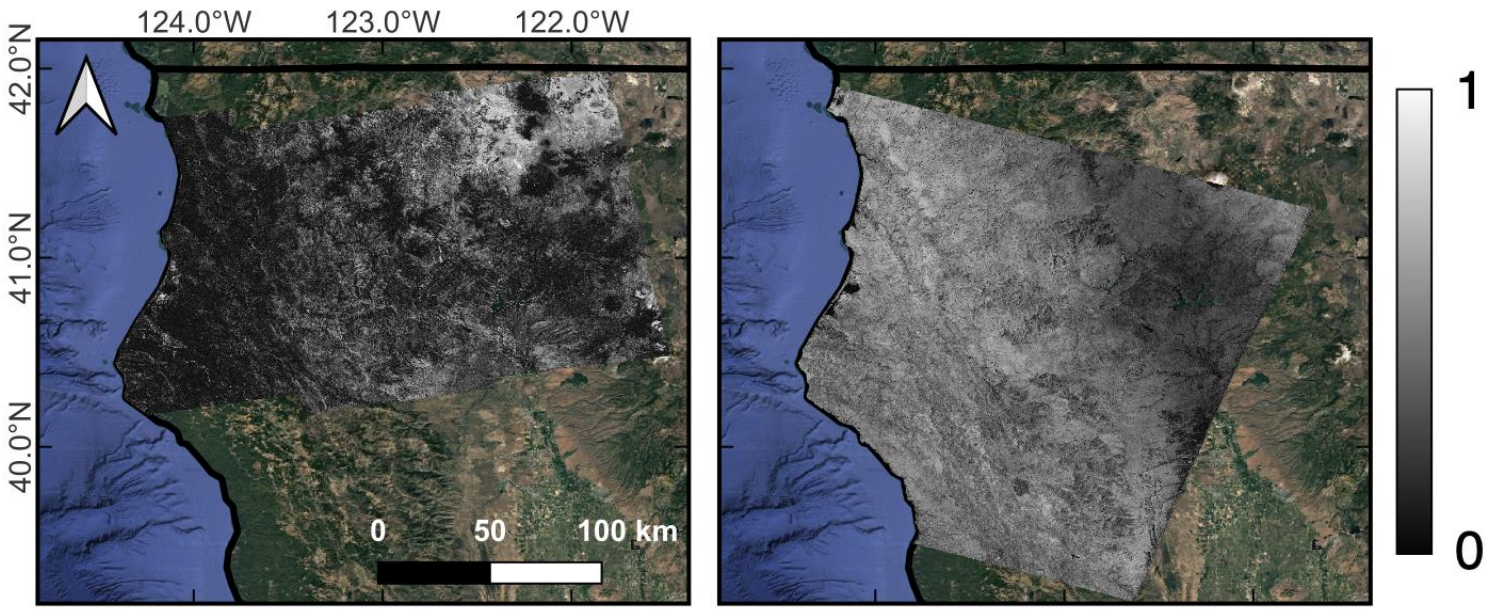
24 days
20251028 - 20251121

Sentinel-1

NISAR

24 days
20251022 - 20251115

Average: 0.22



Average: 0.41

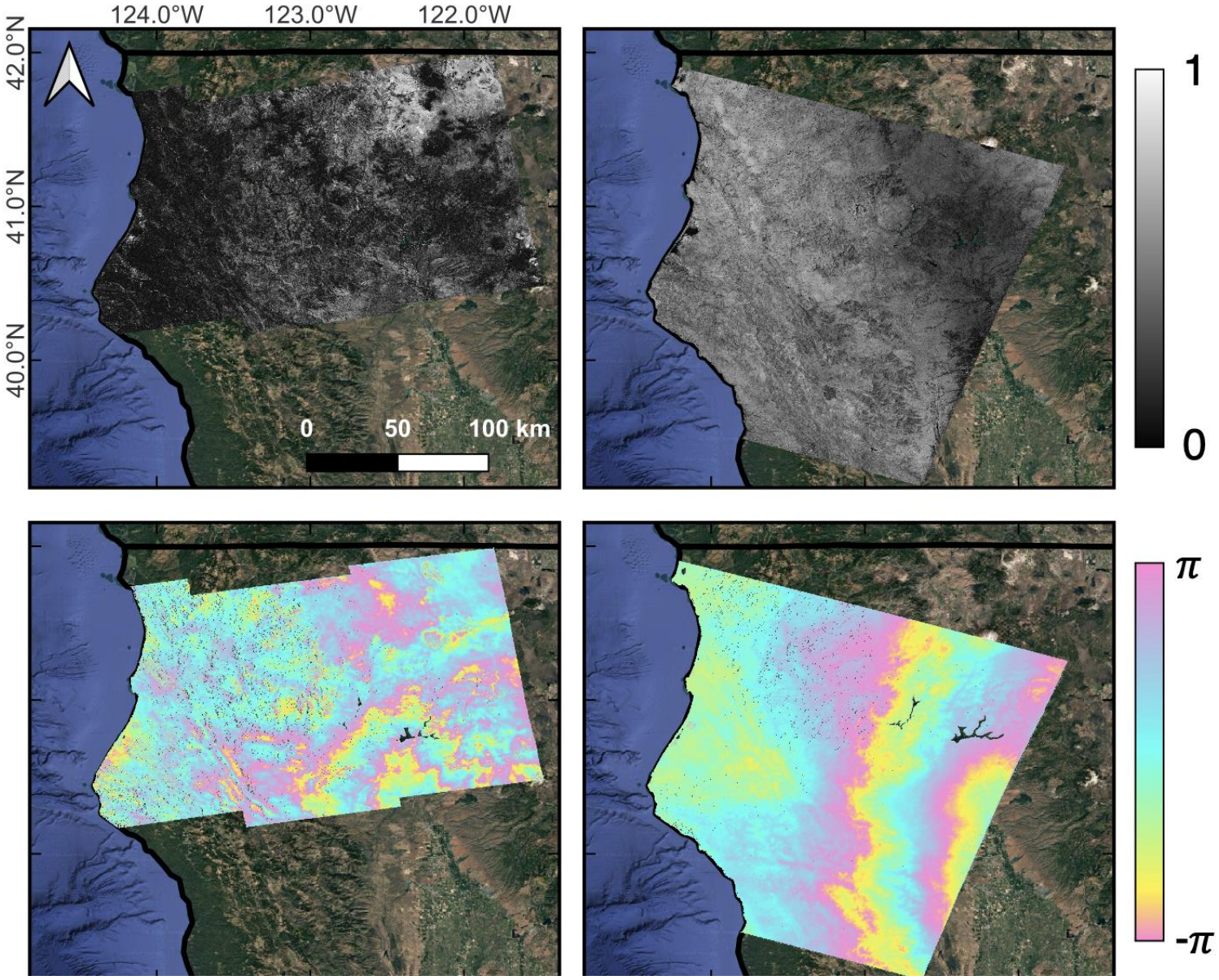
24 days
20251028 - 20251121

Sentinel-1

NISAR

24 days
20251022 - 20251115

Average: 0.22



Average: 0.41

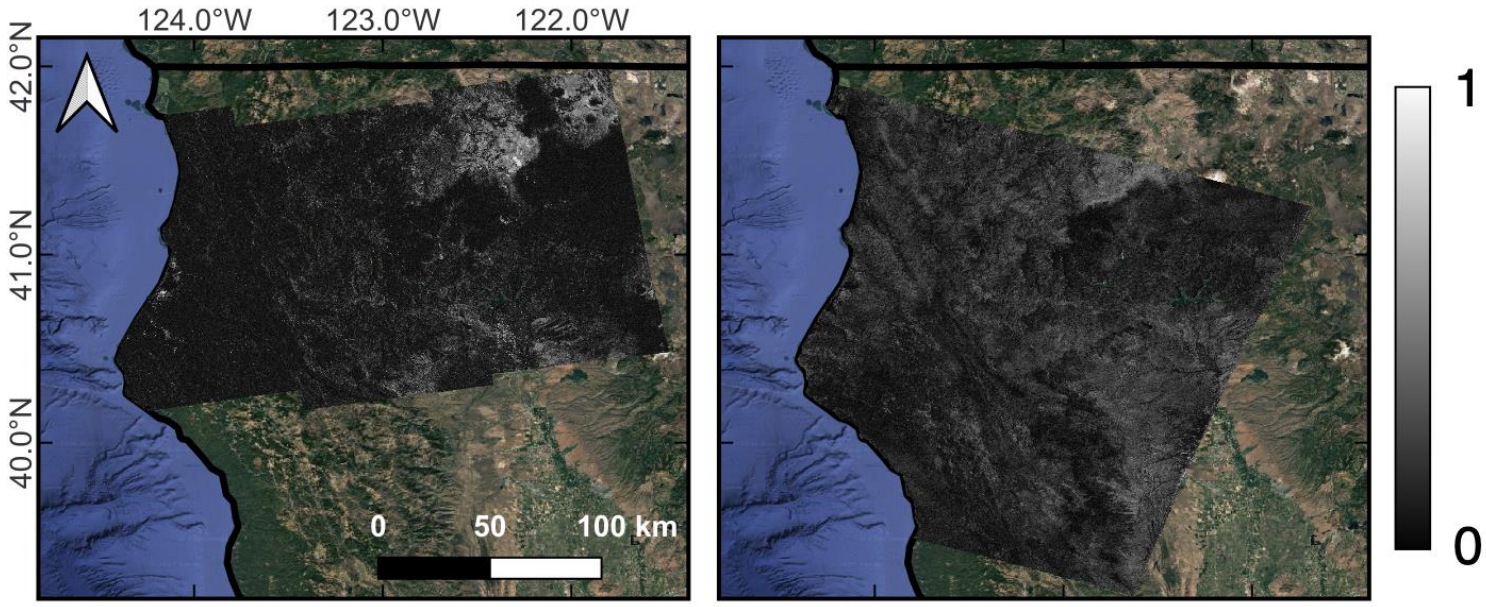
72 days
20251028 - 20260108

Sentinel-1

NISAR

72 days
20251022 - 20260102

Average: 0.14



Average: 0.17

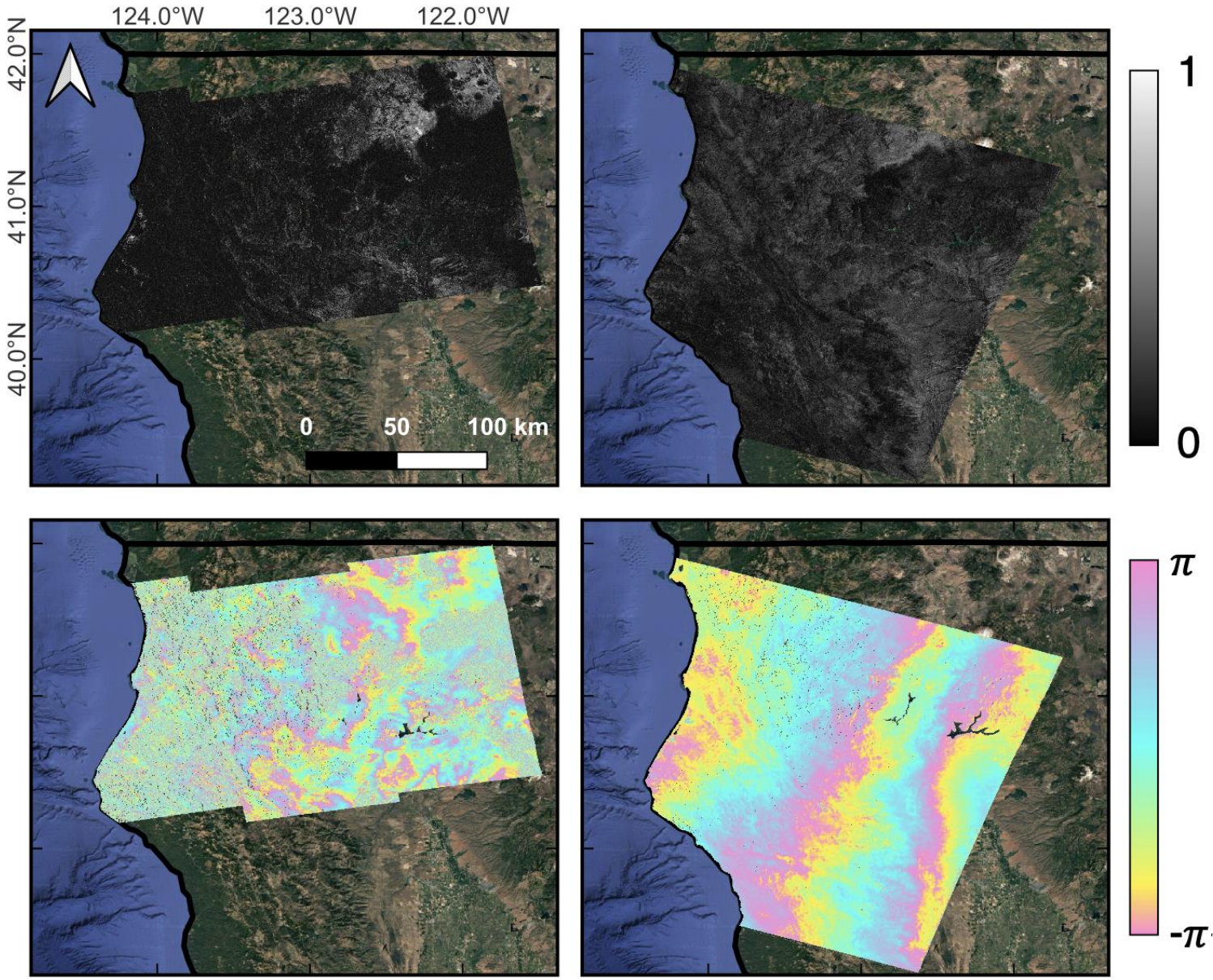
72 days
20251028 - 20260108

Sentinel-1

NISAR

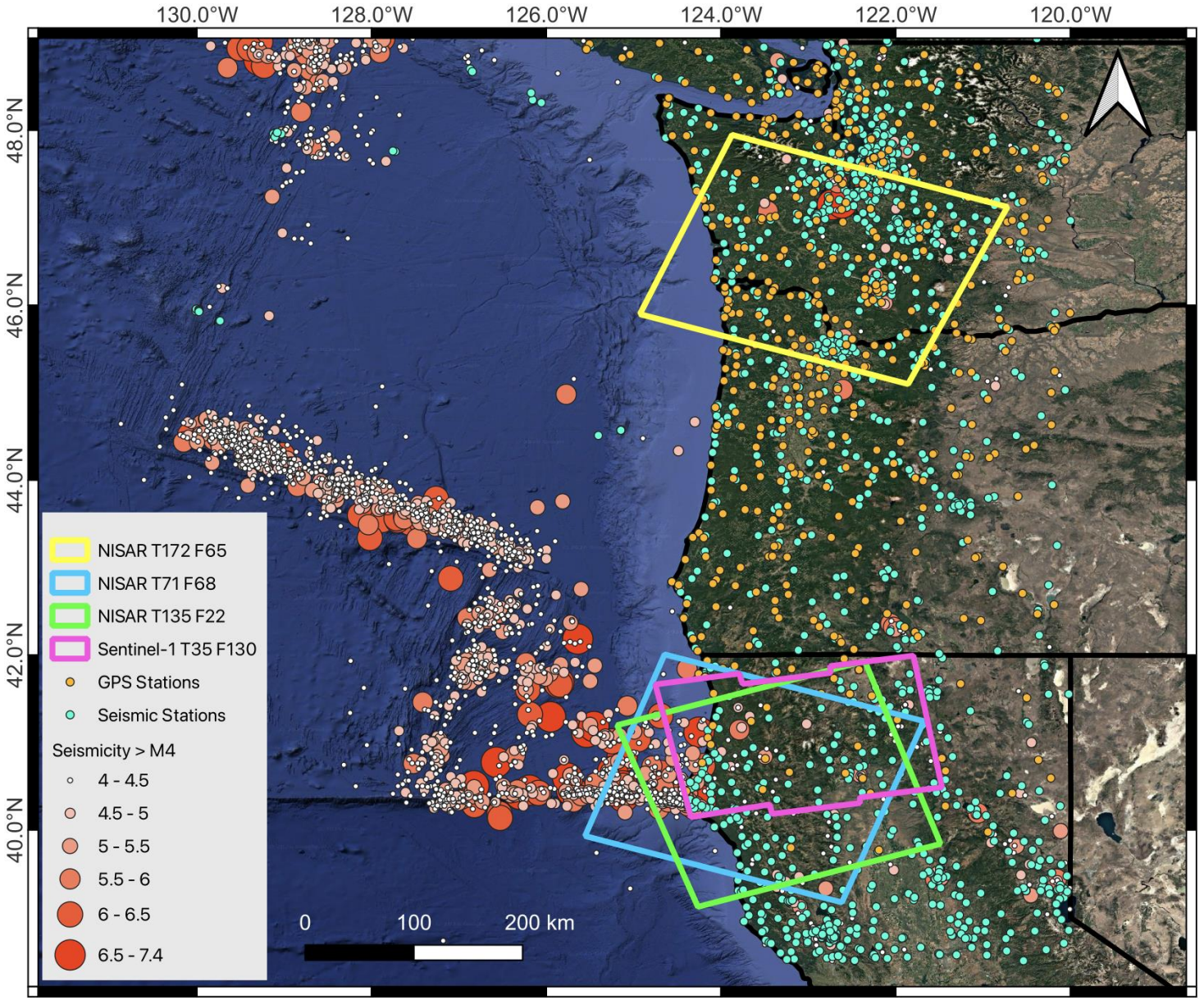
72 days
20251022 - 20260102

Average: 0.14



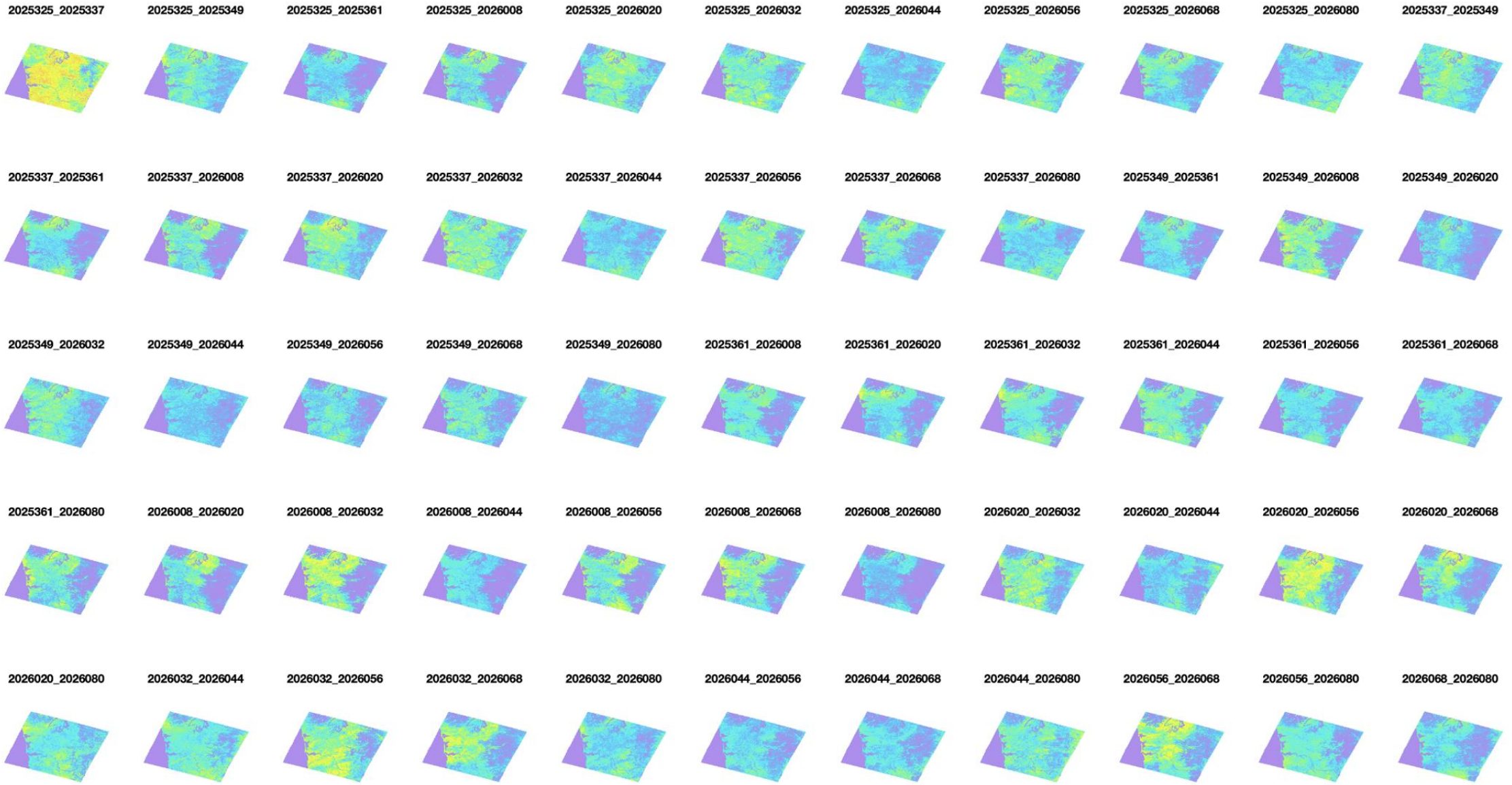
Average: 0.17

Cascadia Subduction Zone

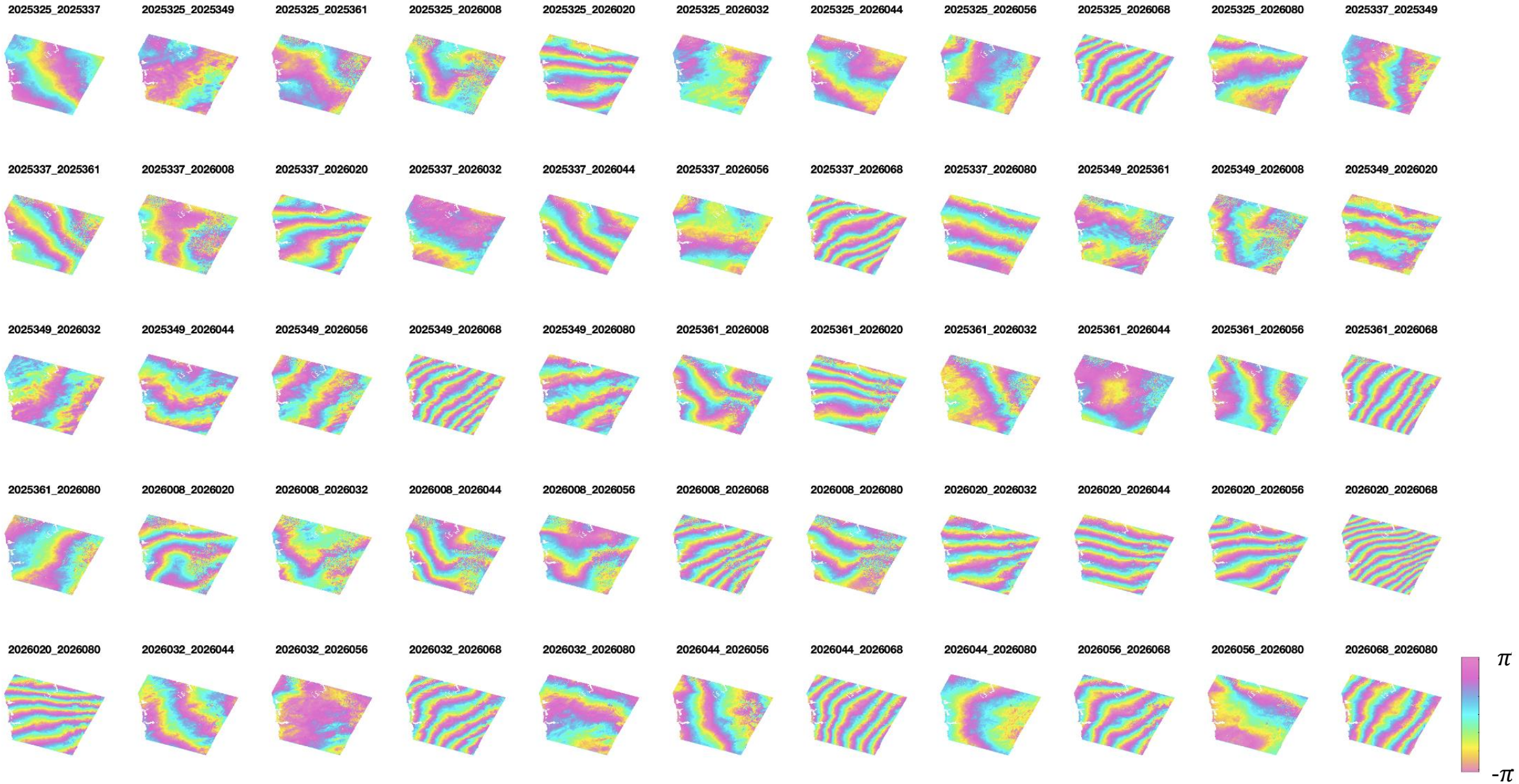


11 RSLCs

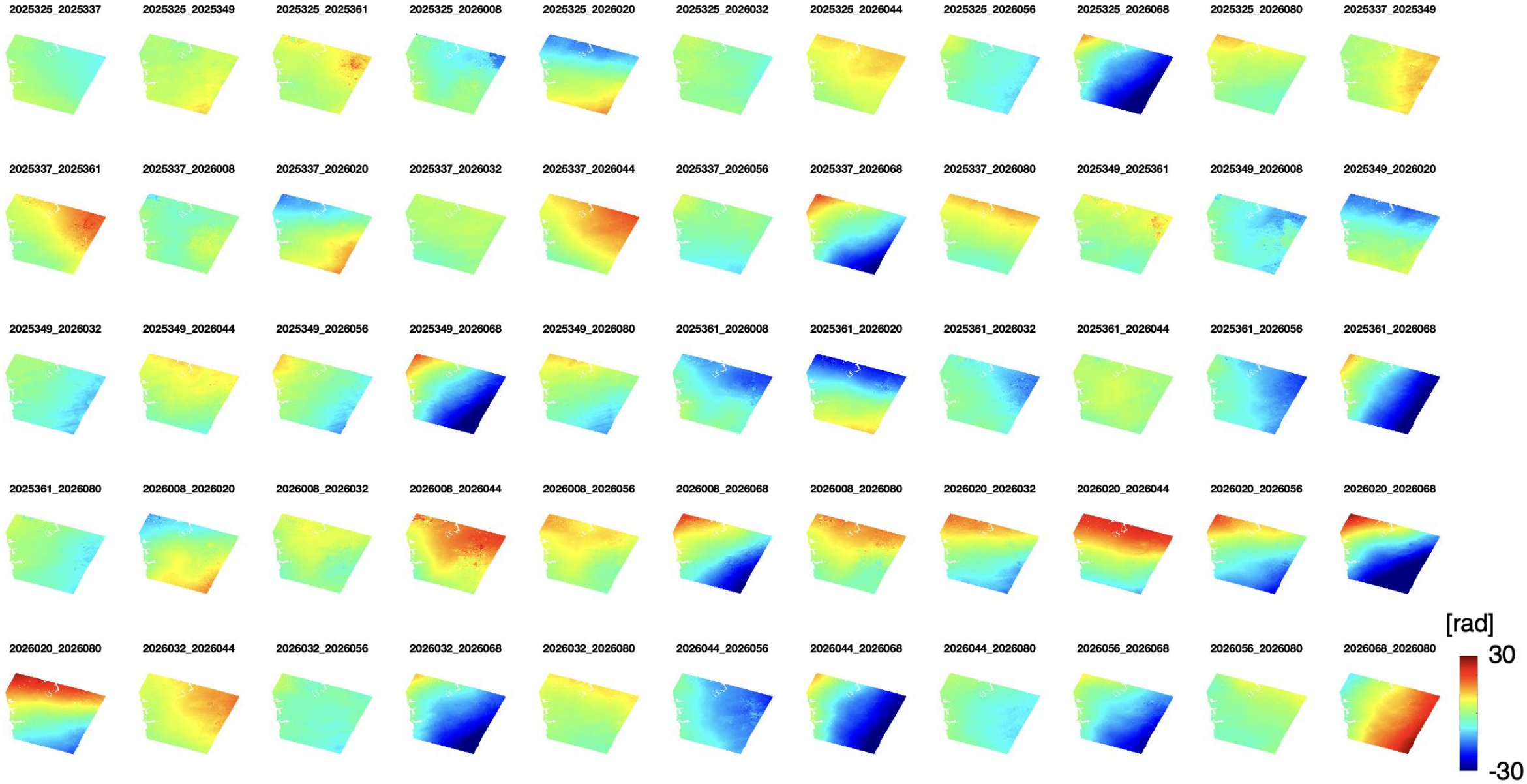
Correlations



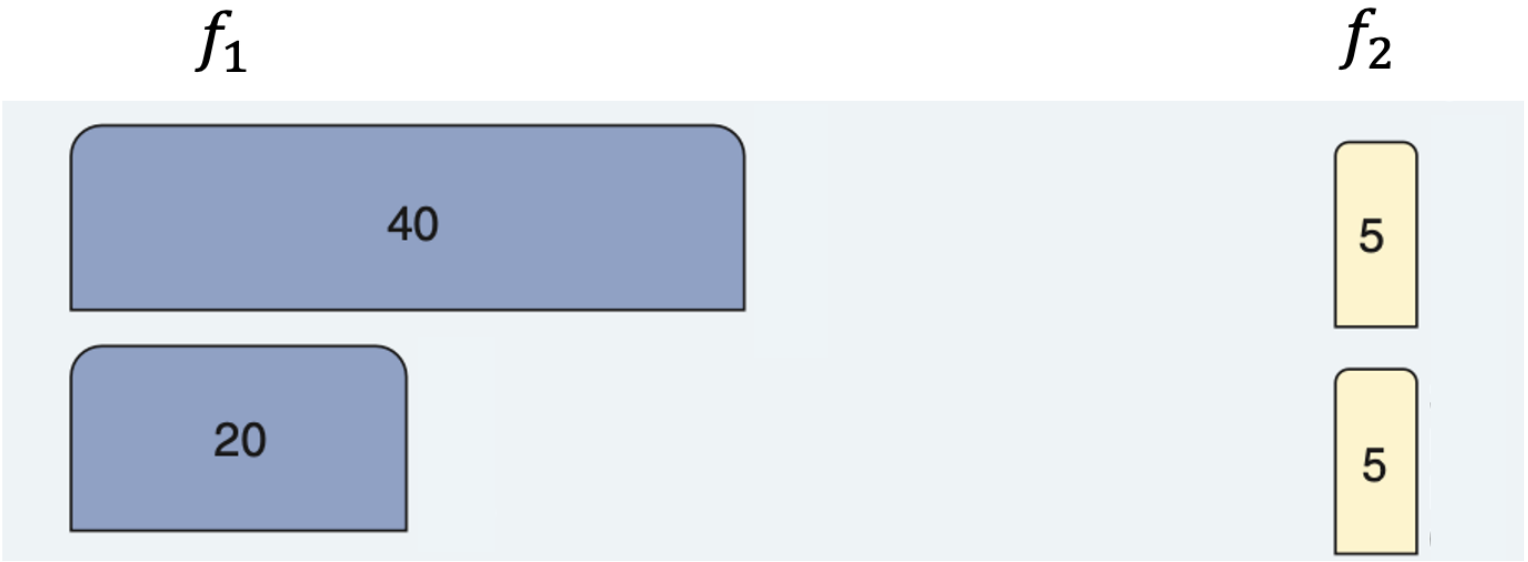
Interferograms



Unwrapped Interferograms



Ionosphere Corrected Interferograms



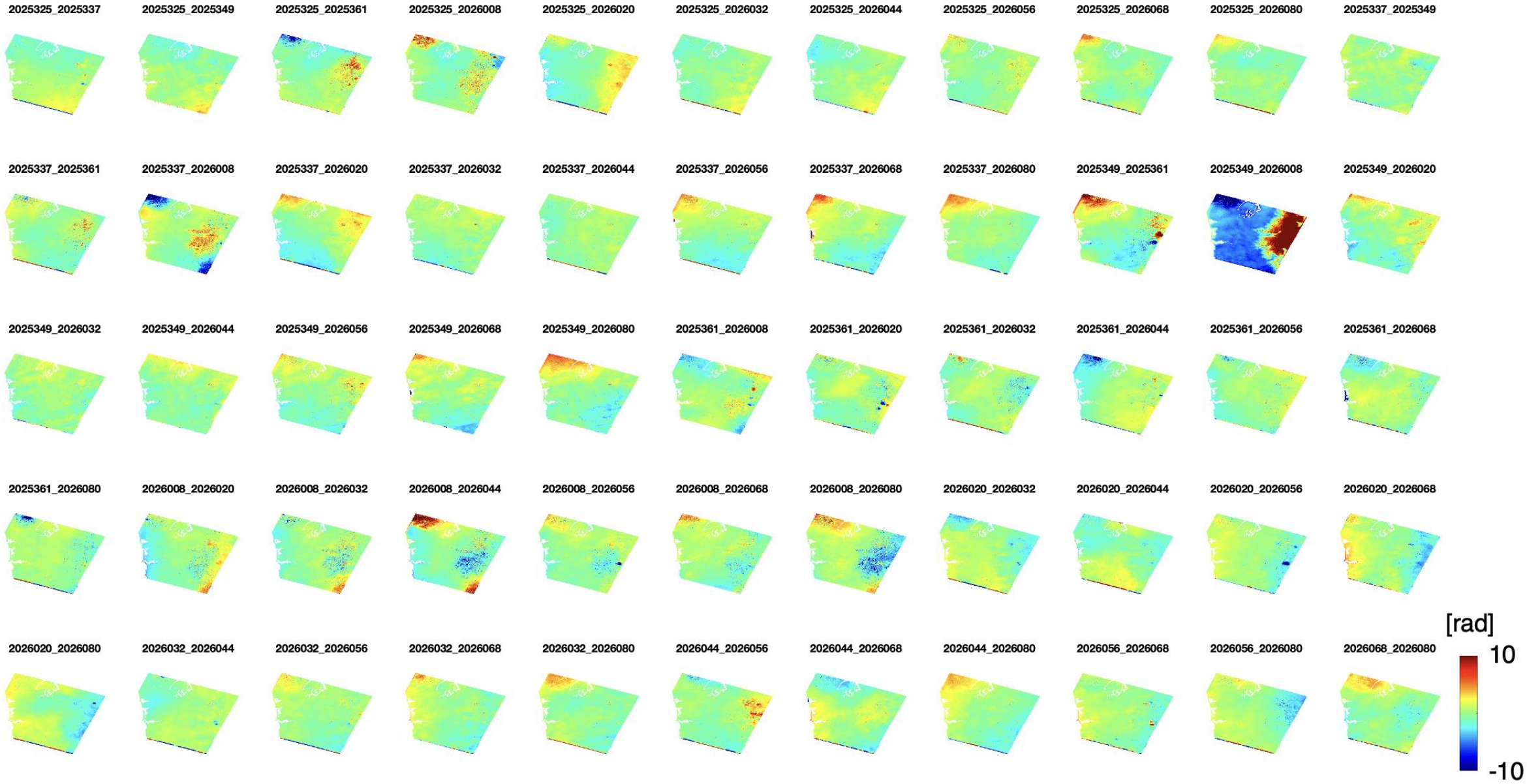
From NISAR Handbook

$$\phi_{iono} = \frac{f_1 f_2}{f_0(f_2^2 - f_1^2)}(\phi_2 f_1 - \phi_1 f_2)$$

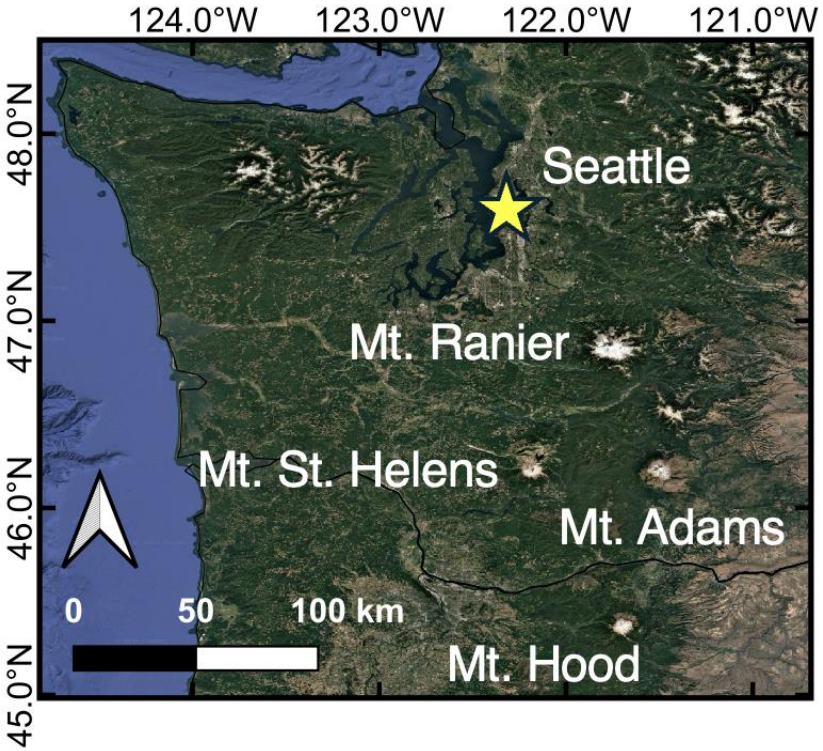
Gomba et al. 2015

Mask areas coherence < 0.1
Gaussian filter with 10 km wavelength

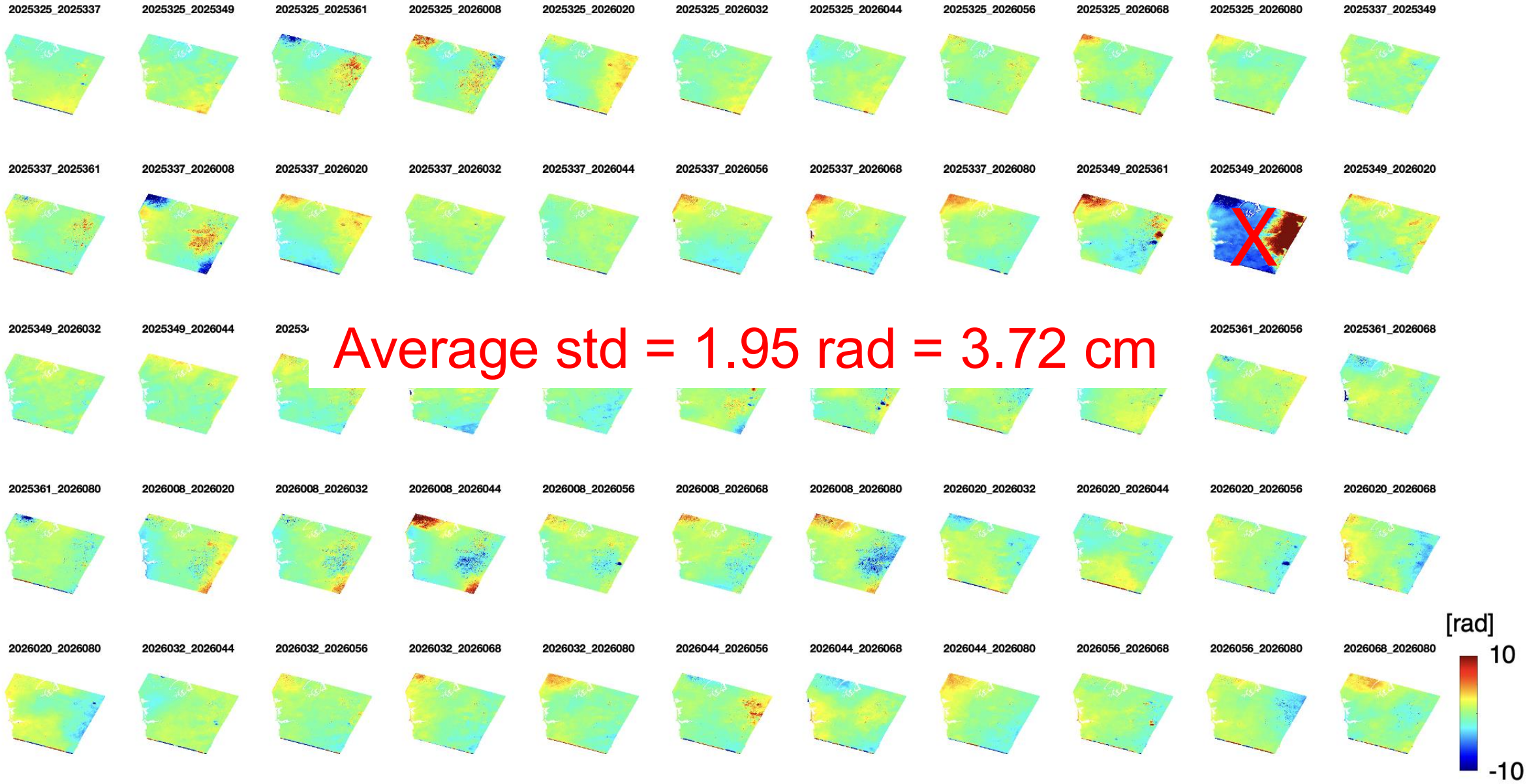
Corrected Unwrapped Interferograms



Average LOS Velocity over 4 months



Corrected Unwrapped Interferograms

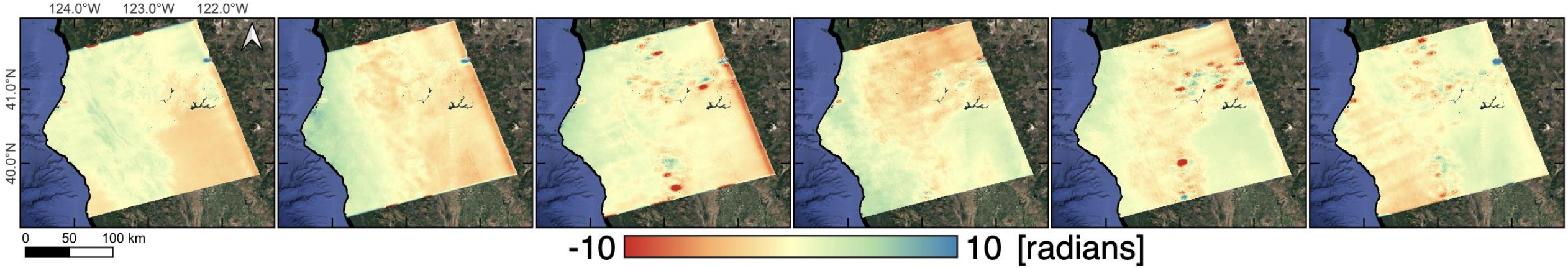


Average std = 1.95 rad = 3.72 cm

More Atmospheric Noise Residuals

Ascending

1.58 **2.03** **1.73** **2.08** **1.94** **1.43**

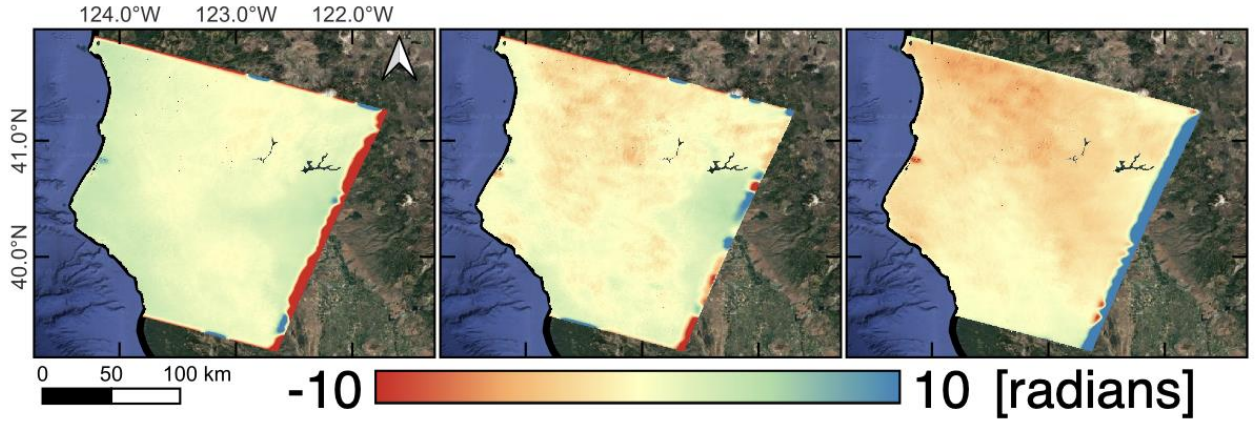


ASC = 1.8 rad; 3.43 cm

DSC = 1.3 rad; 2.48 cm

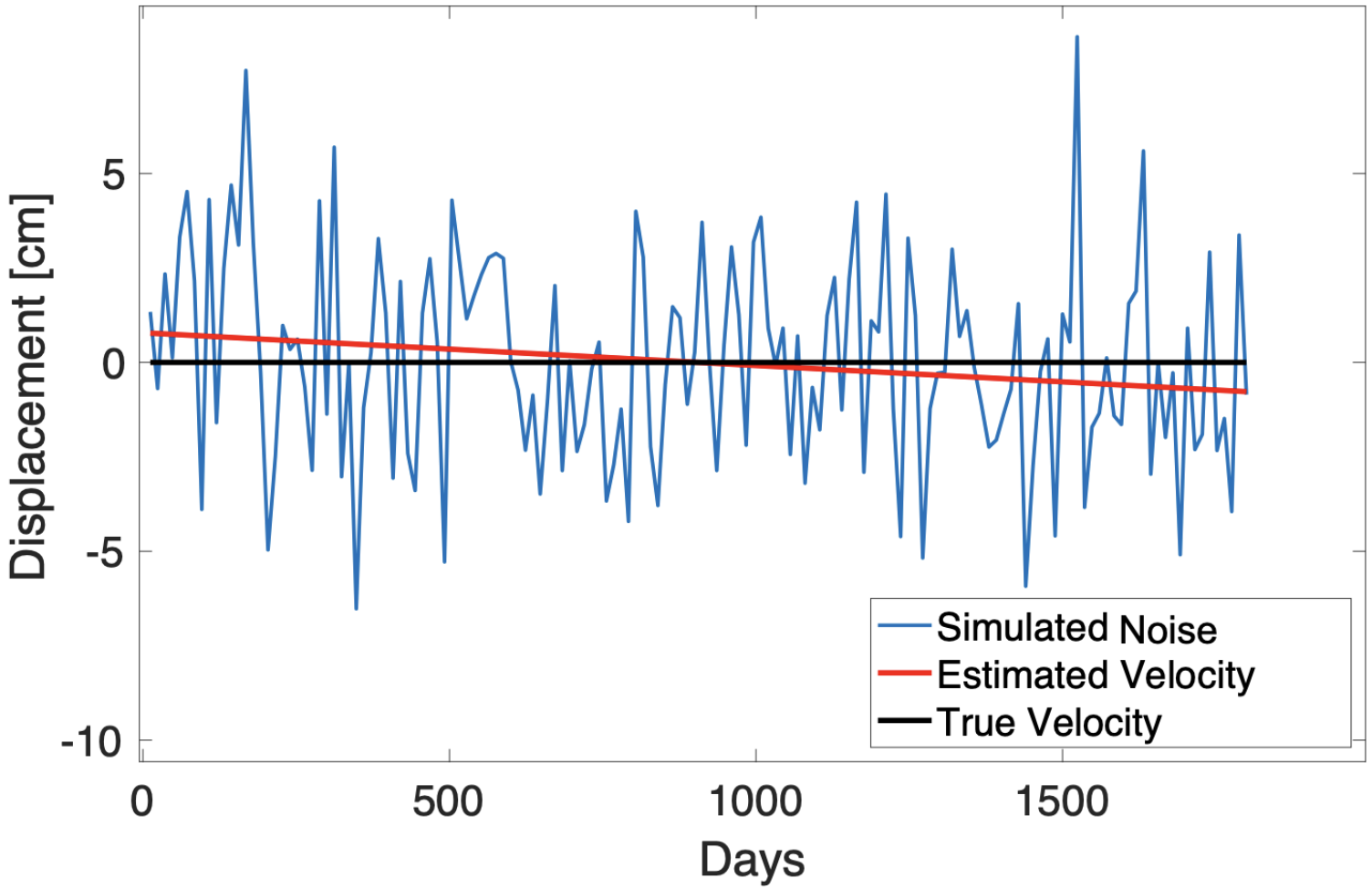
1.05 **1.40** **1.38**

STD in radians



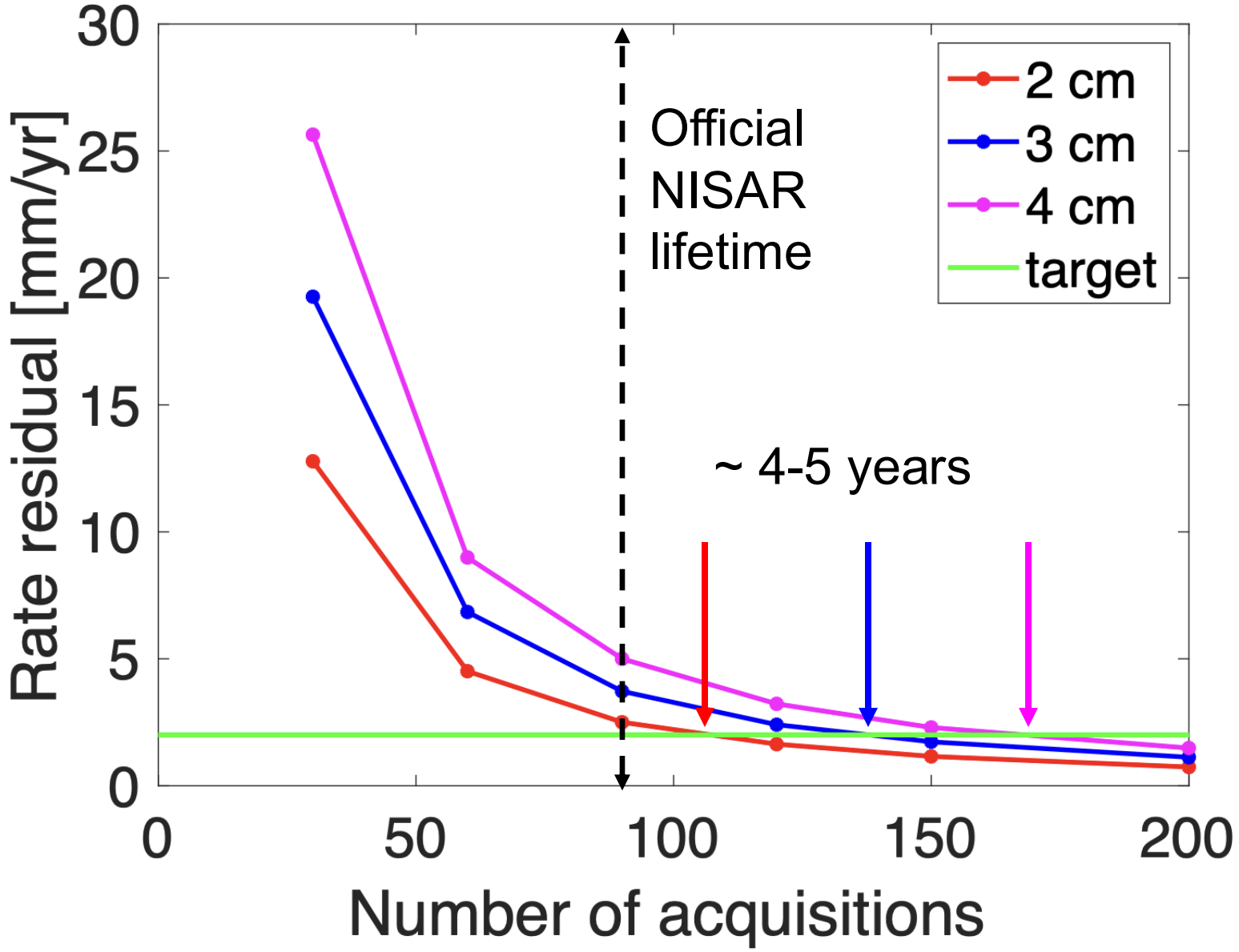
Descending

Noise Projections for Future Time Series

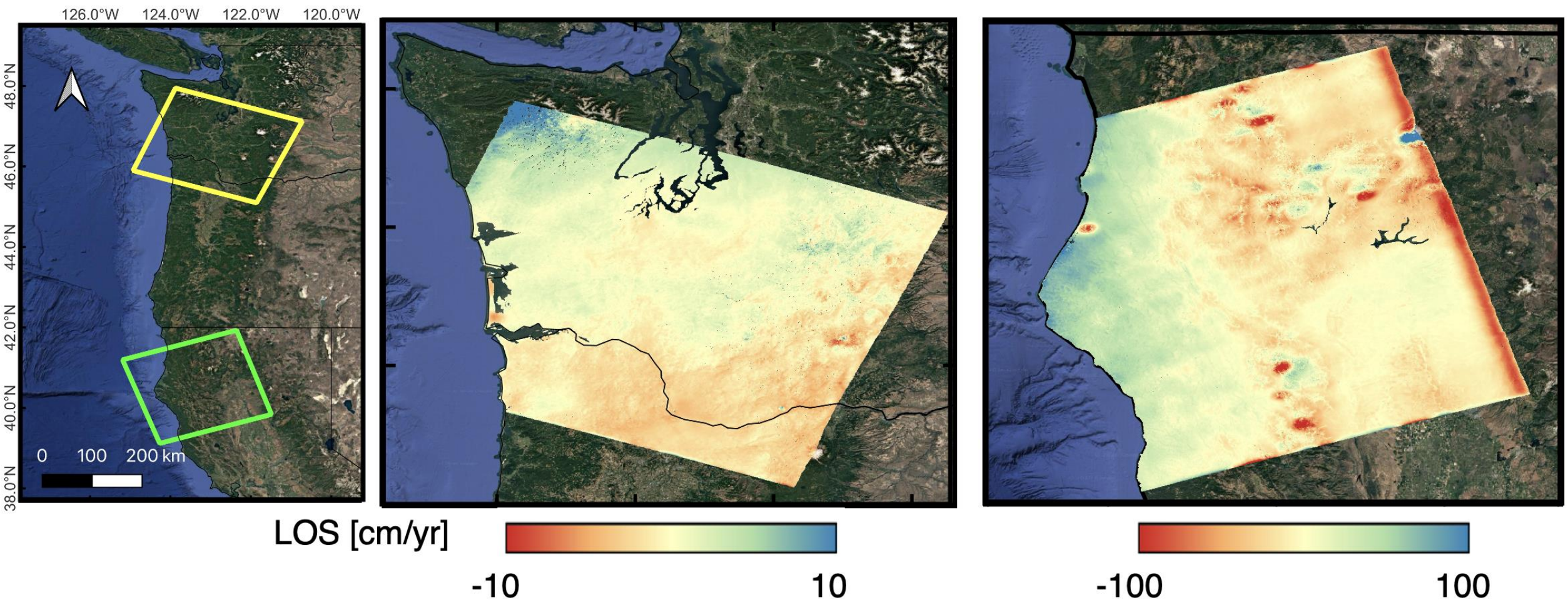


- Compute velocity 10,000 times (or until convergence)
- Compute mean and STD of velocities
- Repeat for different time series lengths (1 – 6 years) and noise levels (2 – 4 cm)

Noise Projections for Future Time Series



Average LOS Velocity



Early Takeaways

- NISAR maintains coherence longer than Sentinel-1
- Higher quality phase data over vegetated regions
- Time series of 4-5 years is needed to reduce current atmospheric noise residuals to 2 mm/yr goal

Ongoing Work

Refine a secondary alignment to correct for ionospheric effects and improve coherence

More accurate ionosphere corrections e.g., outlier removal, masking, filtering