Extending TOPS burst overlap coverage using custom SAR focusing

Y. Larsen, A. Hooper, T. Grydeland, J. van Oostveen, M. Nergizci, M. Lazecky, T. Wright

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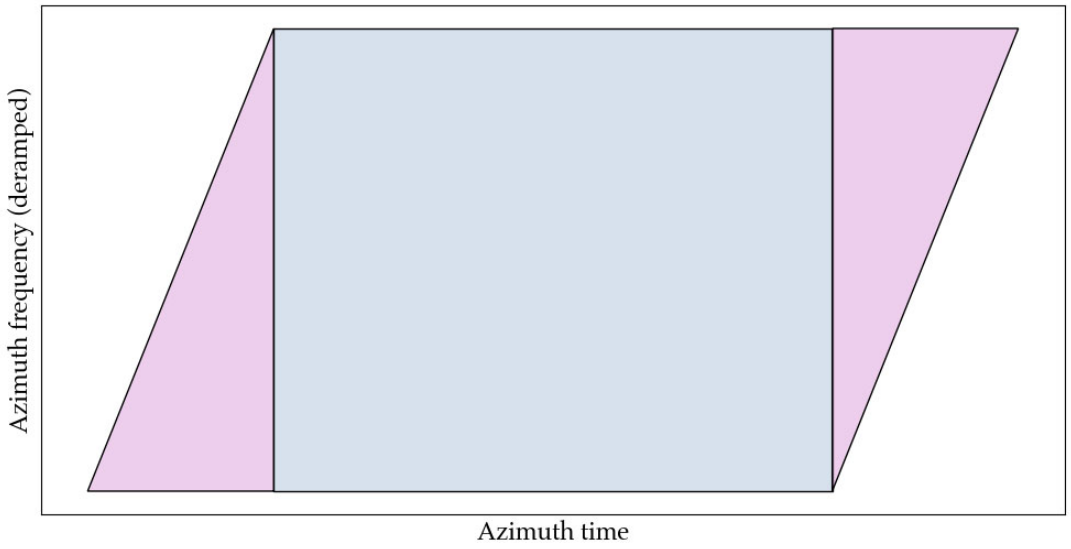
Motivation

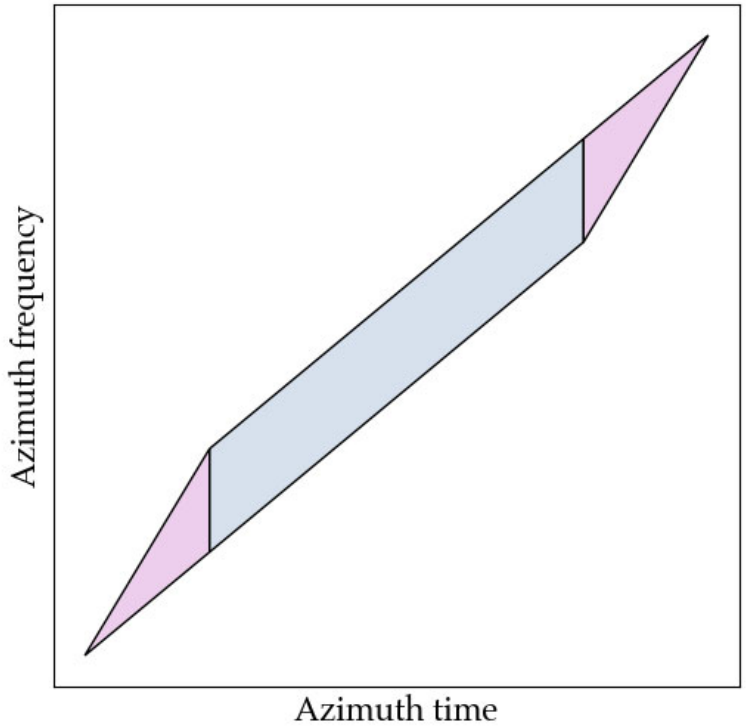
- Traditional InSAR is not sensitive to along-track motion
- The most common alternatives have relatively low sensitivity and/or resolution
  - Offset tracking
  - Along-track interferometry by azimuth split band
- Using Sentinel-1 TOPS burst overlap zones yields better sensitivity, but the coverage is sparse

New approach

Extension of TOPS burst overlap zones by exploiting **partially focused targets**



TOPSAR spectral properties



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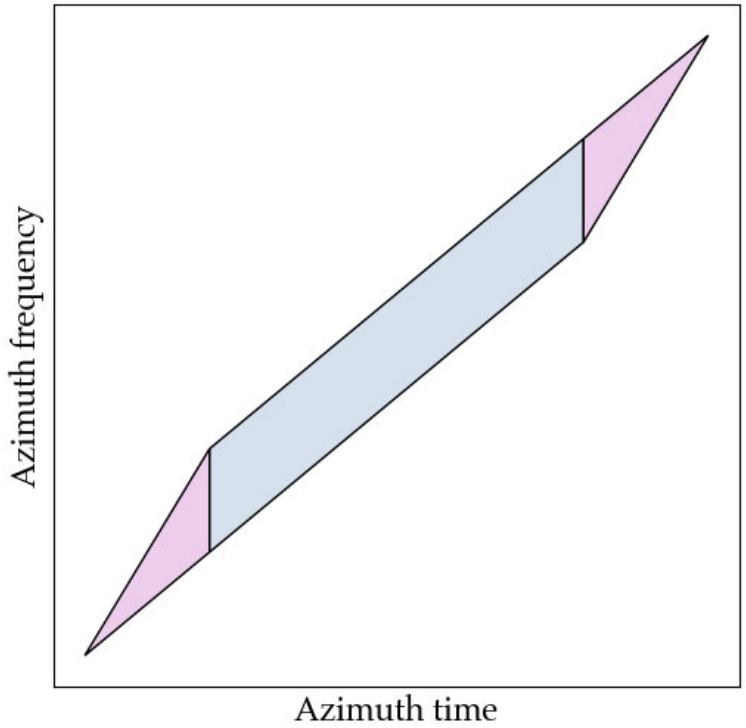
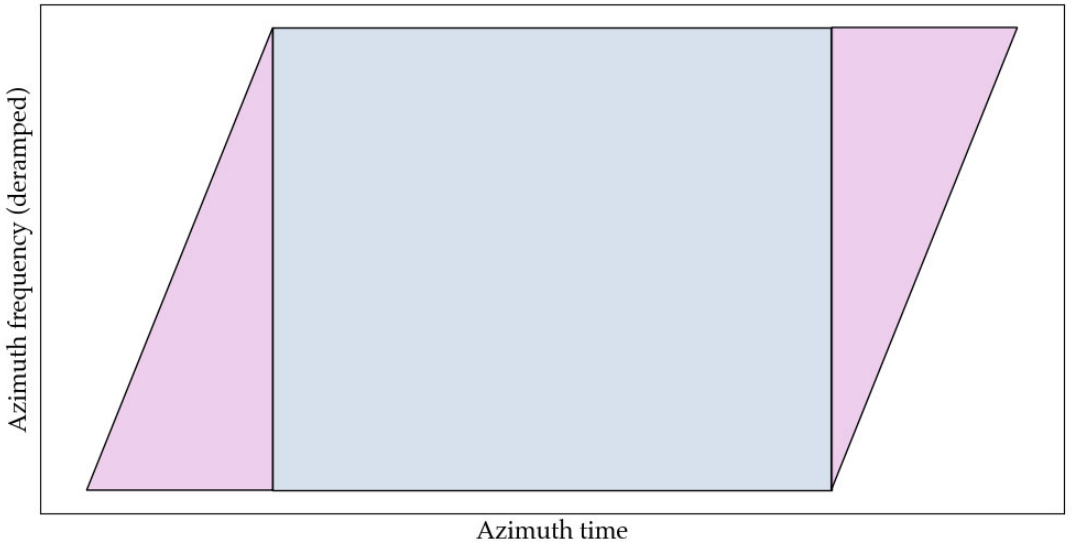
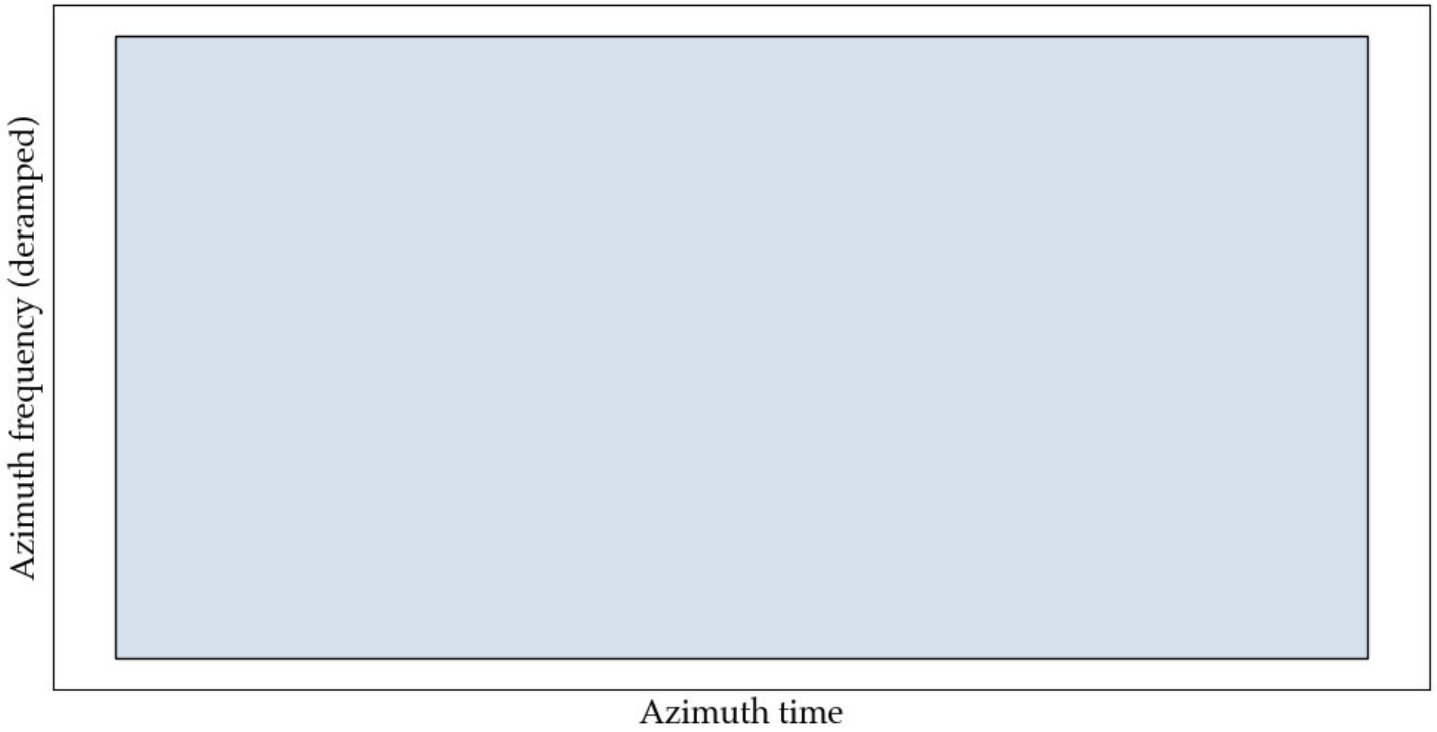




TOPSAR spectral properties

Standard SLC products



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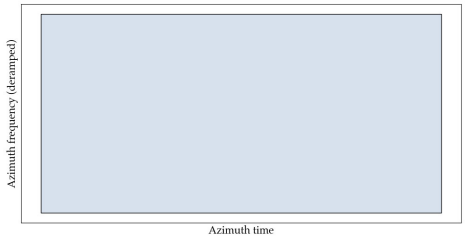

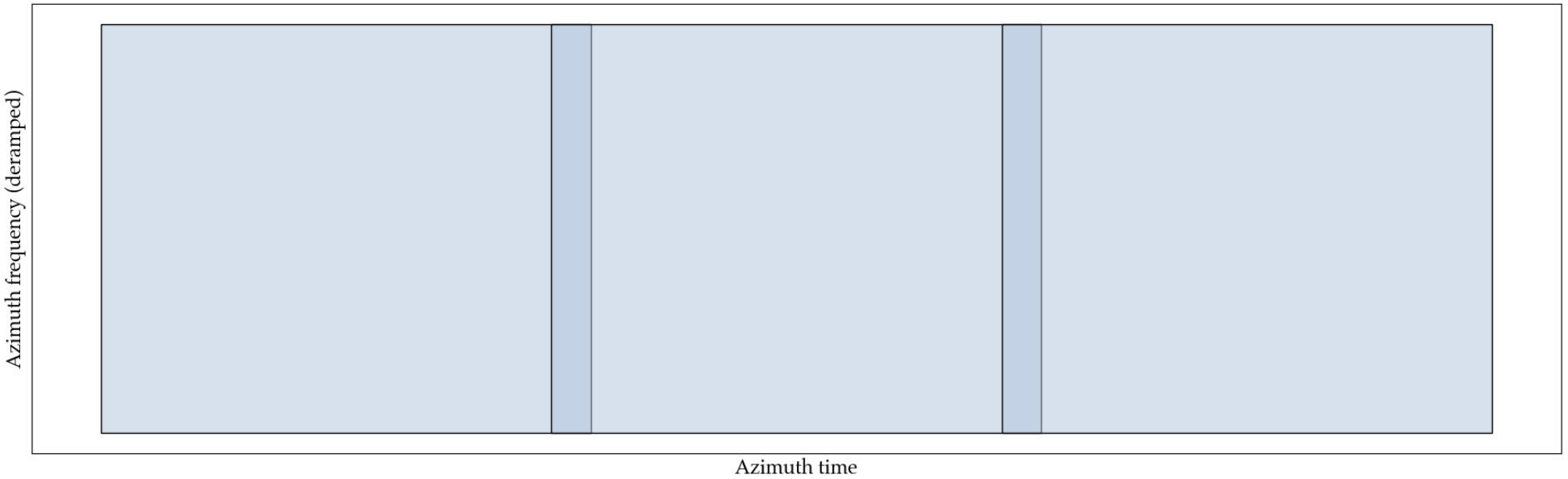

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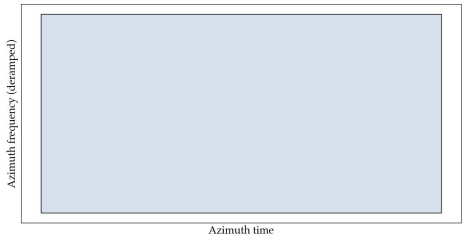

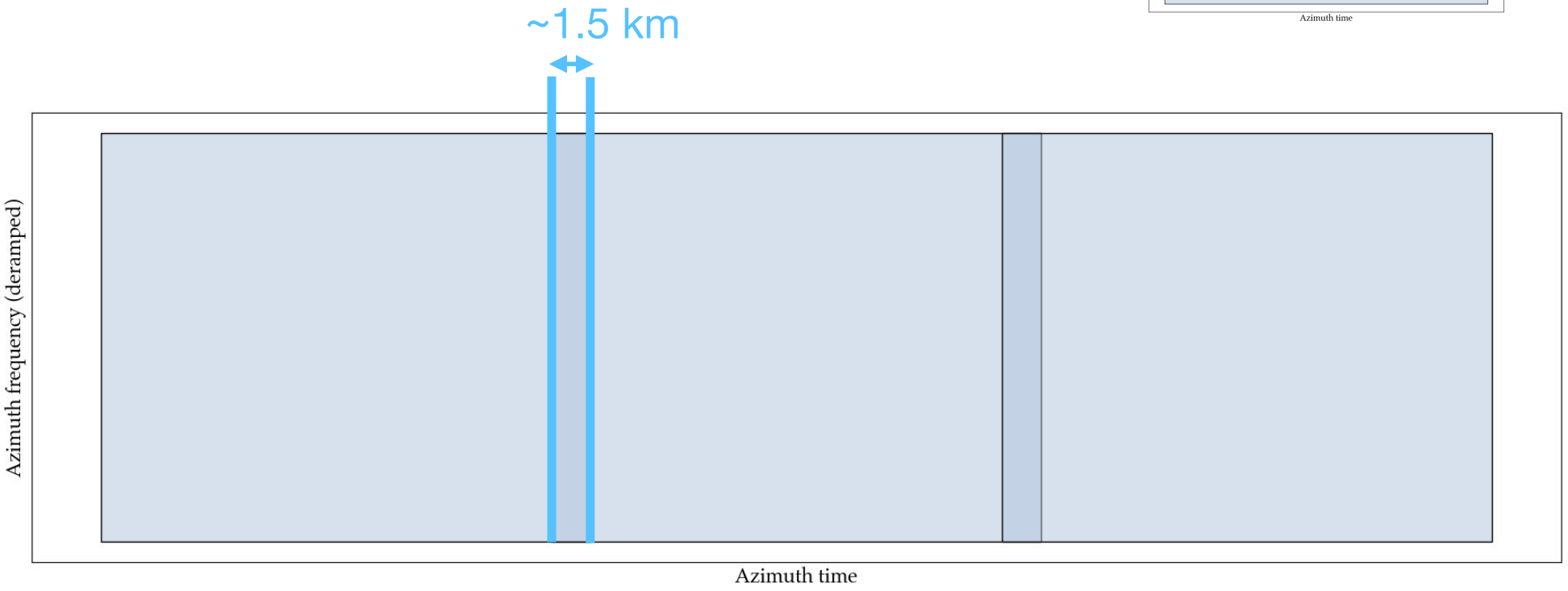

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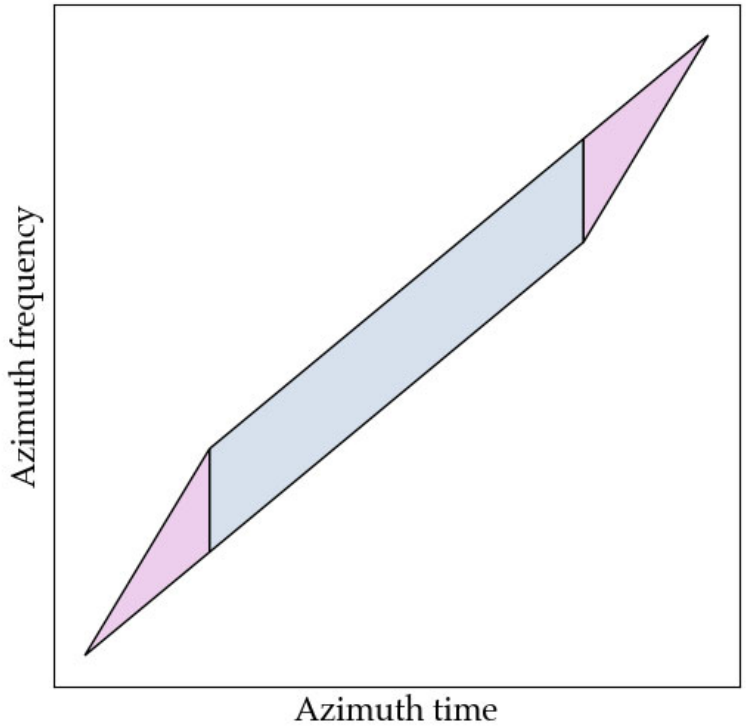

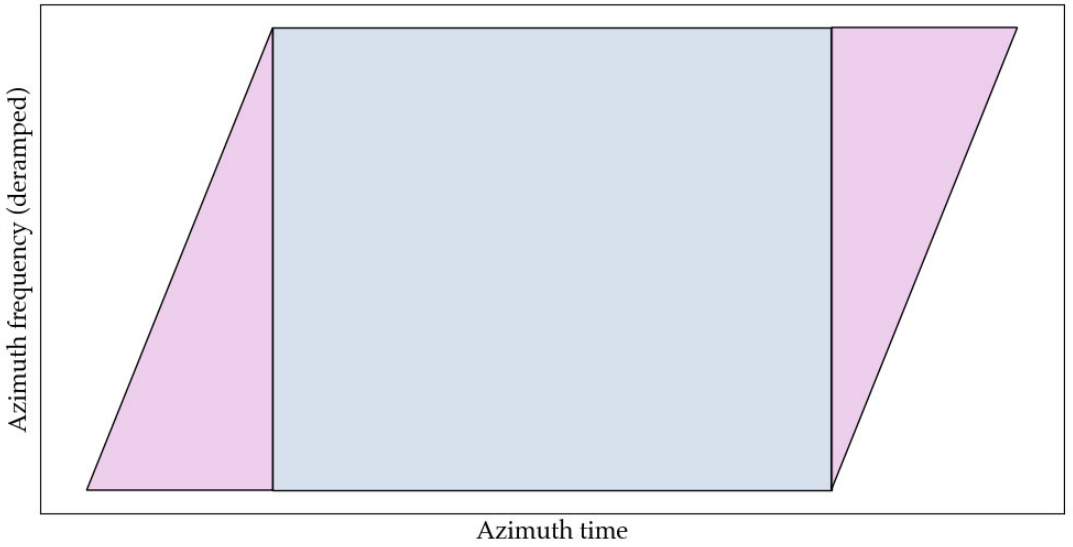

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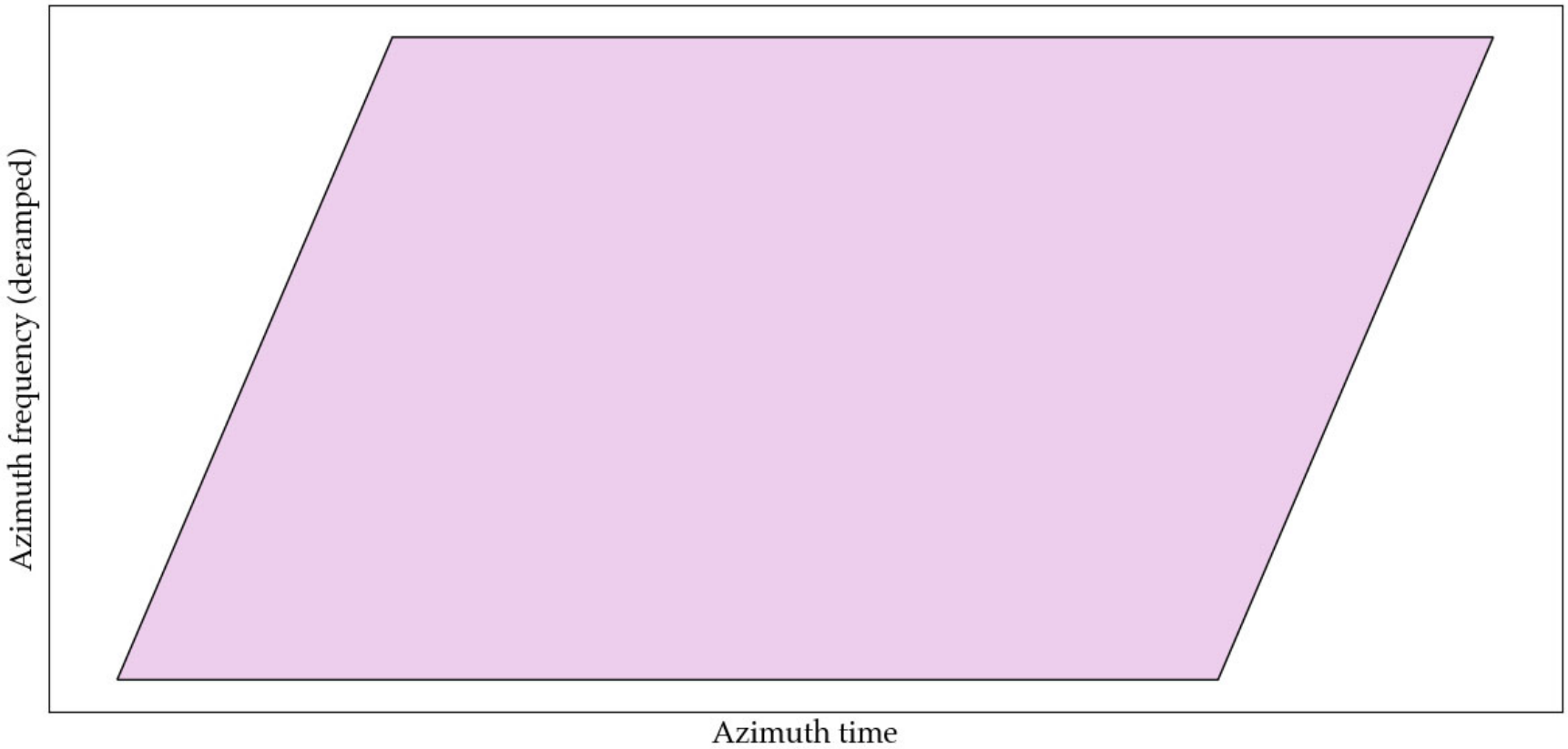
Custom SLC product



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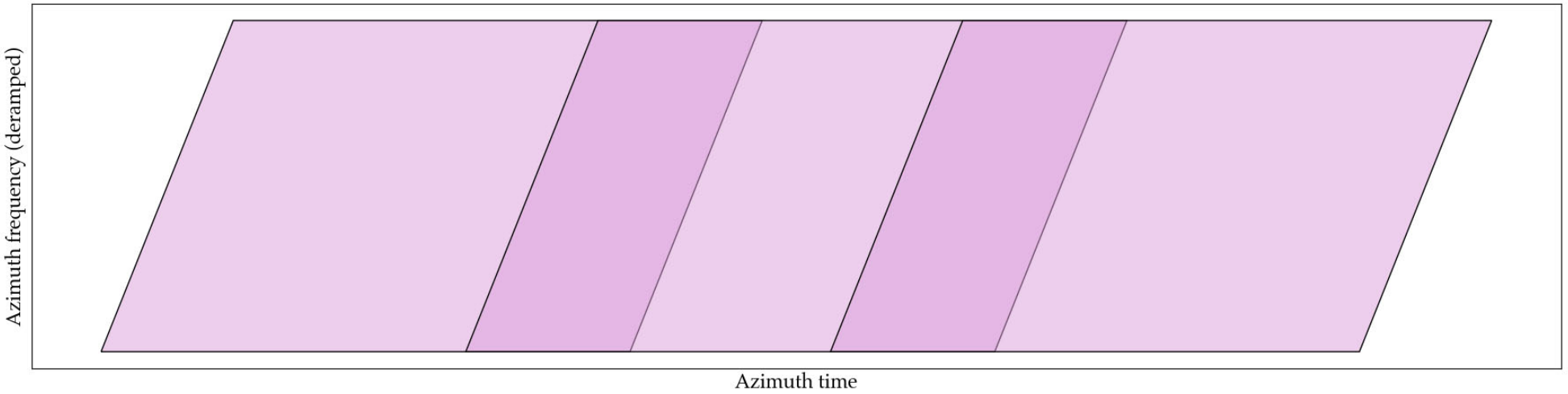

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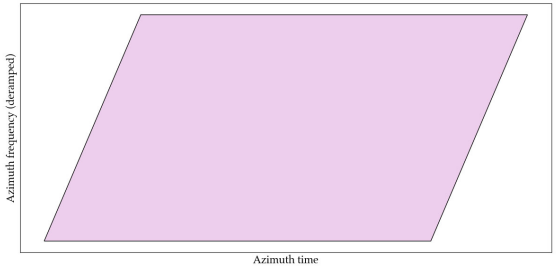

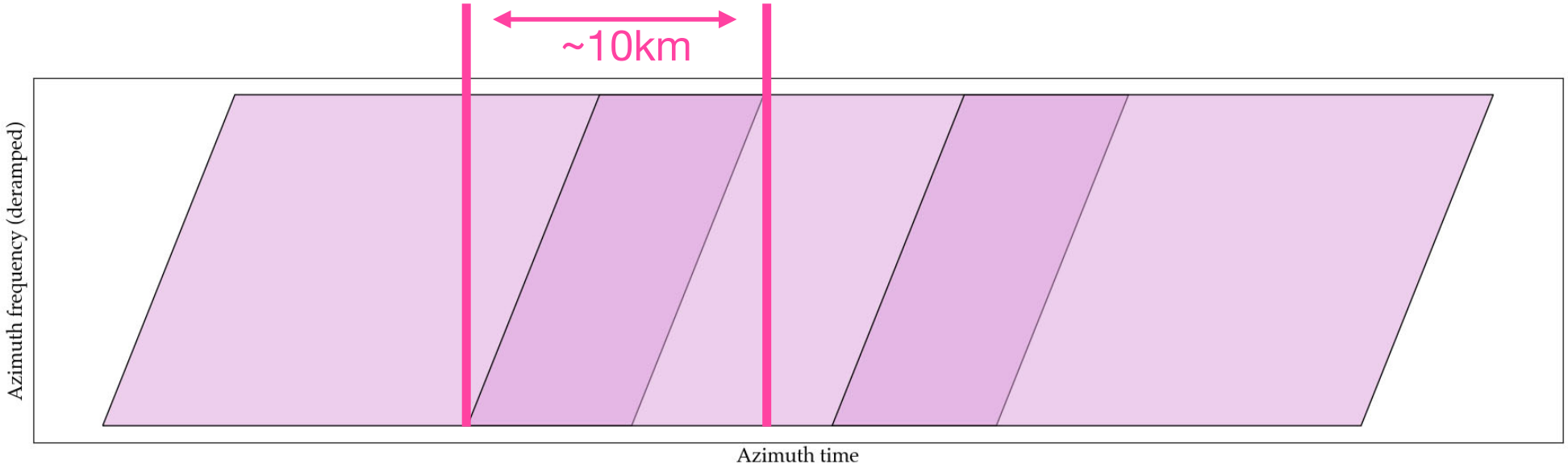

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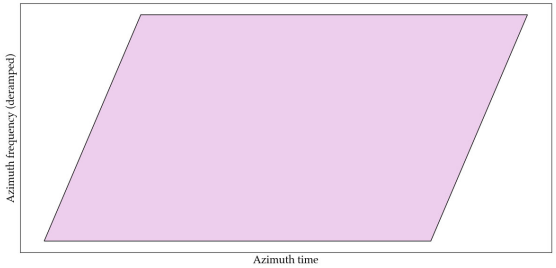

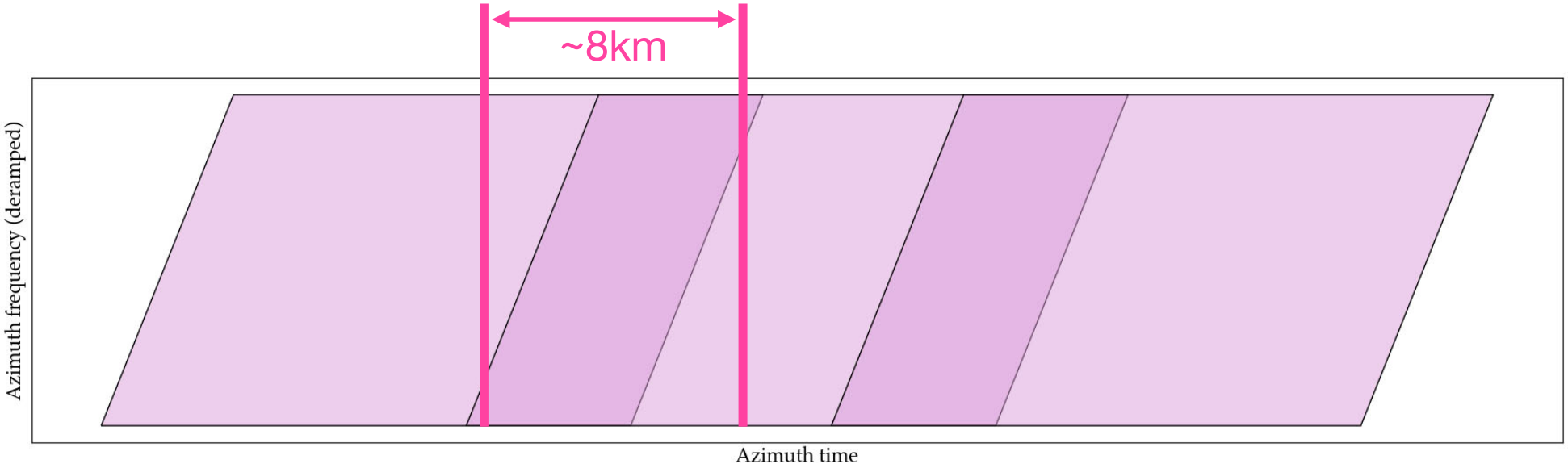

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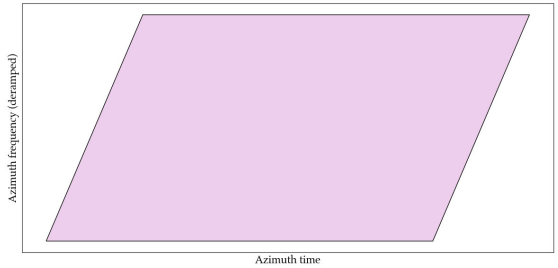
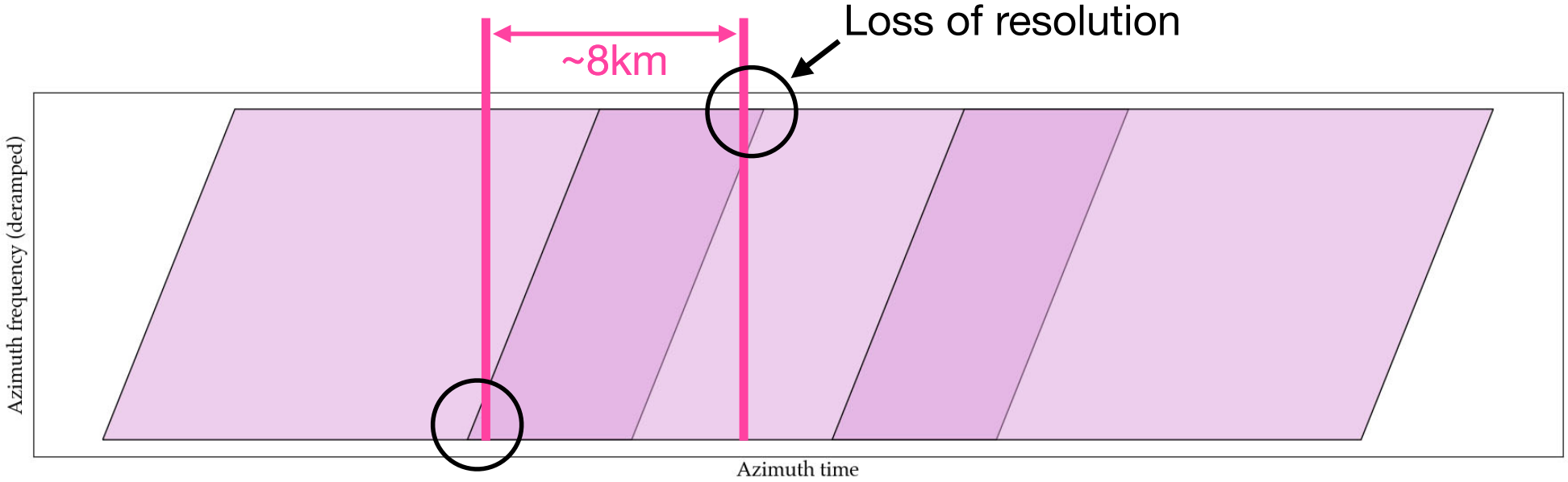
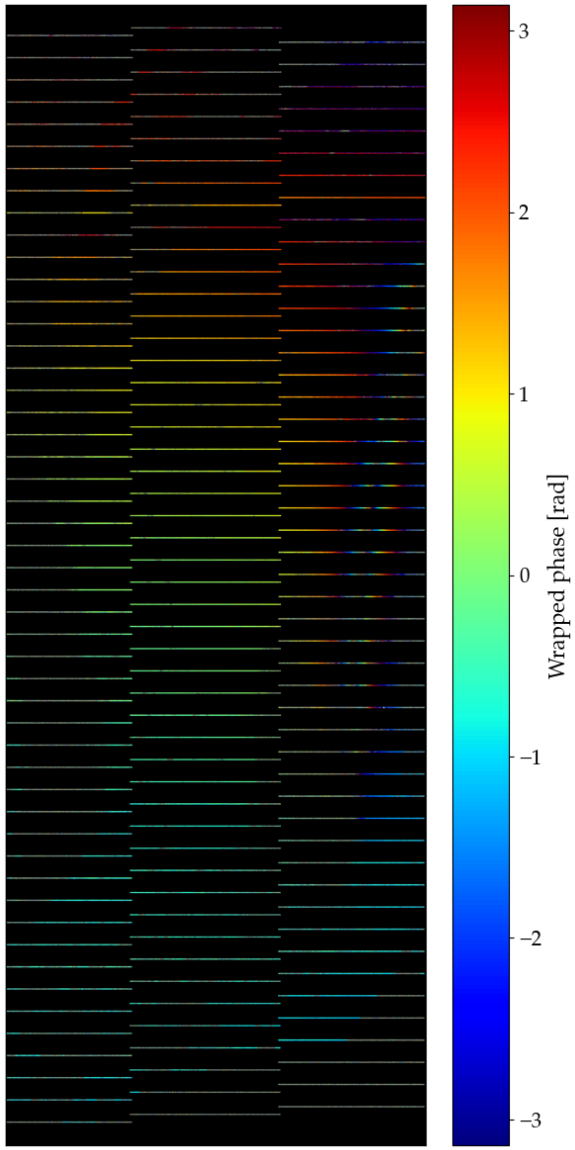




Custom focusing

- Extending the overlap zones requires custom SAR focusing
- Extra zeropadding to leave space for partially focused targets
- Optionally: optimise the processing bandwidth for this particular use case
- Optionally: also keep partially focused targets in slant range direction



Example: Tectonic events

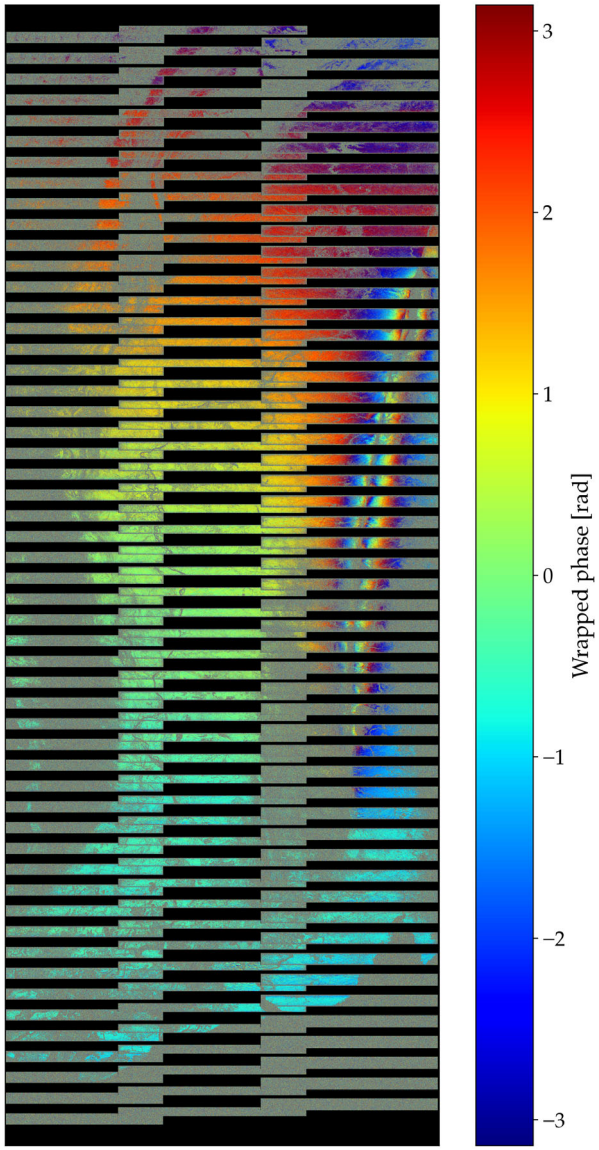
Myanmar Mar 28, 2025, M7.8 Earthquake

Large North-South component along 500km rupture

S1A/S1C coseismic interferogram

Mar 27 - Apr 2, 2025

Overlap zones from **standard SLCs**



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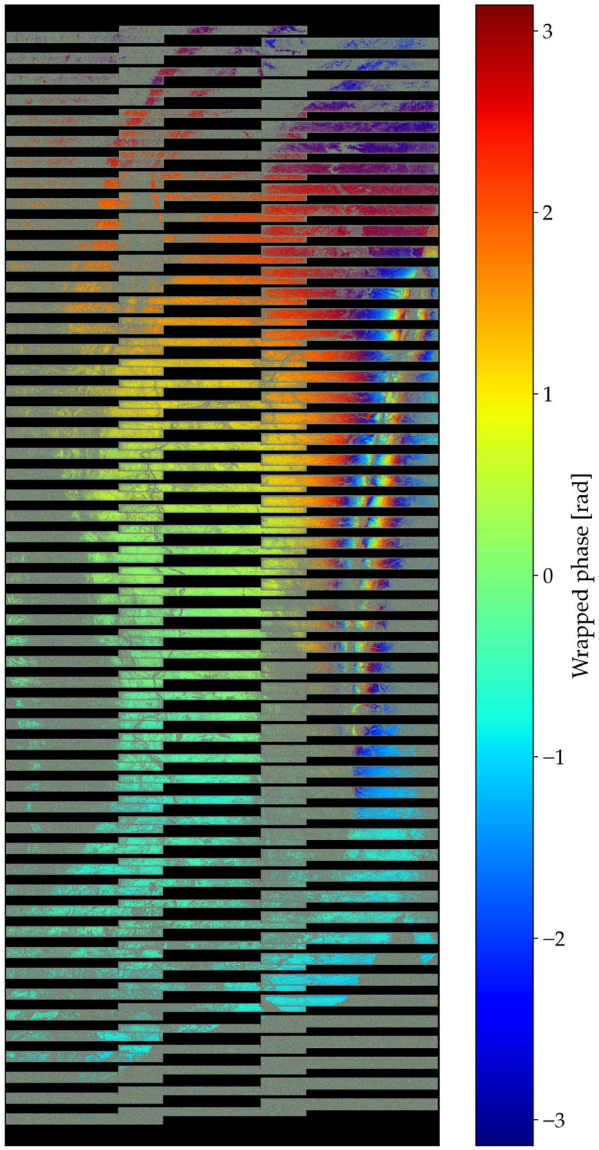

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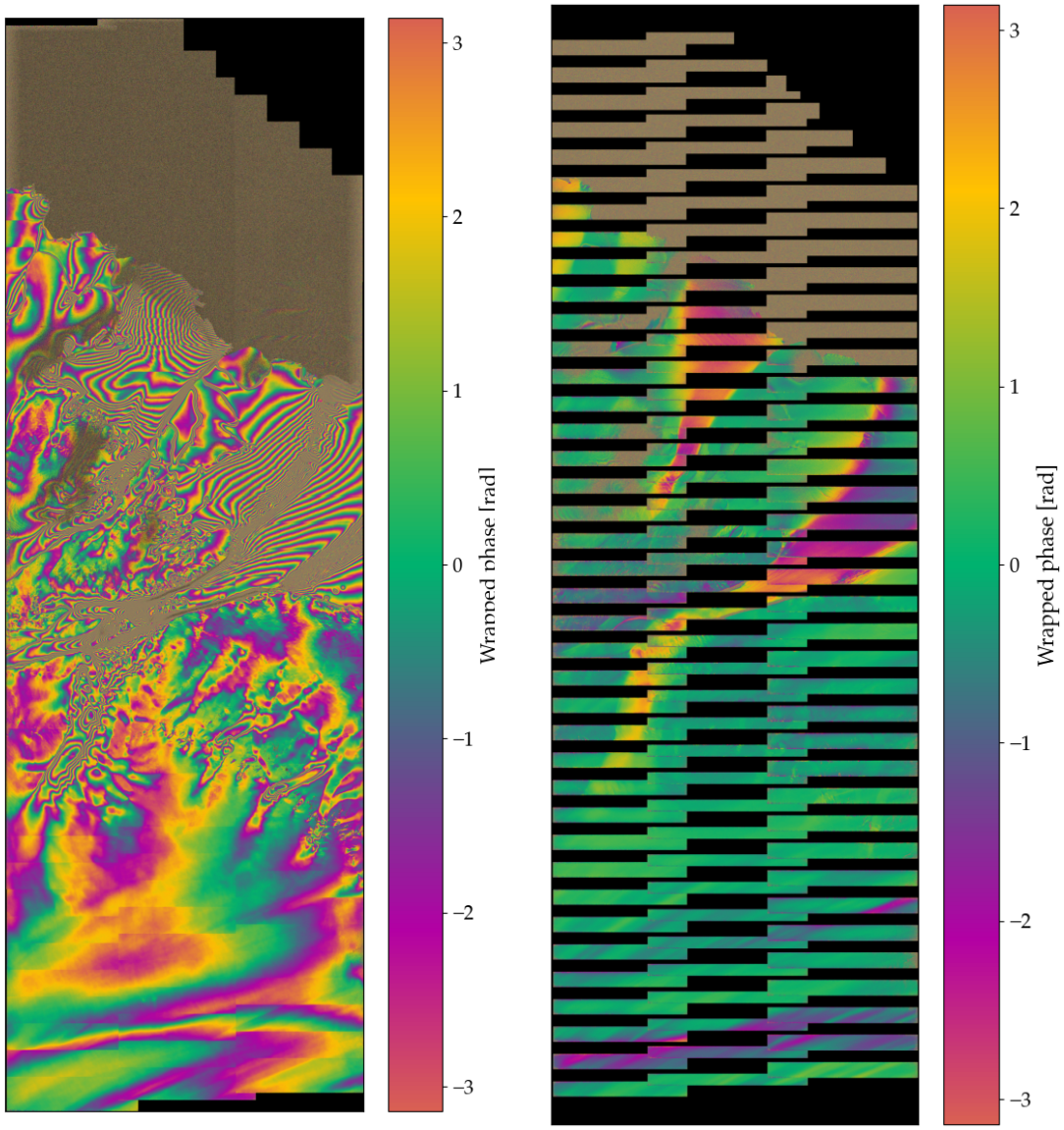
More on this application:

Thu Jun 18: Earthquakes & Tectonics 2
12:30pm - 12:50pm
Improved 3-D Co-seismic Deformation From Increased Burst Overlap Interferometry Coverage
Andy Hooper et al



Example: ice motion

Jutulstraumen Glacier
Queen Maud's Land
East Antarctica

IW mode, 1-day S1C/S1D

Feb 22-23, 2026

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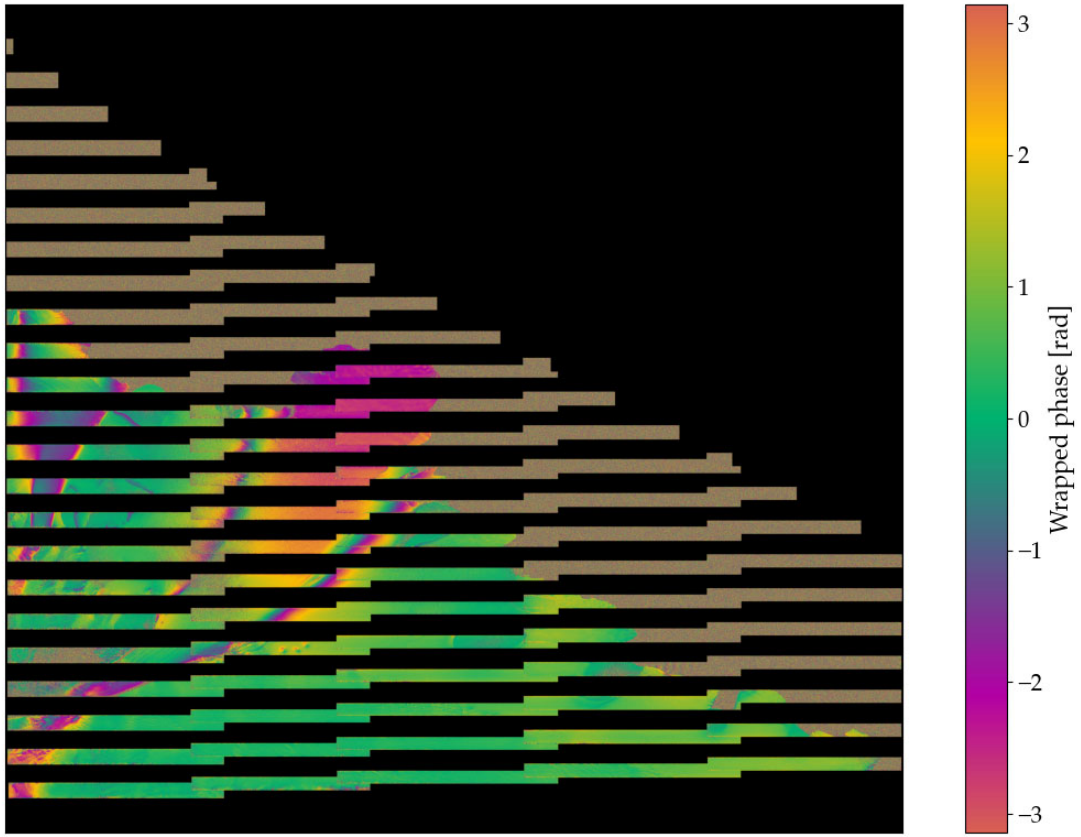

Jutulstraumen Glacier
Queen Maud's Land
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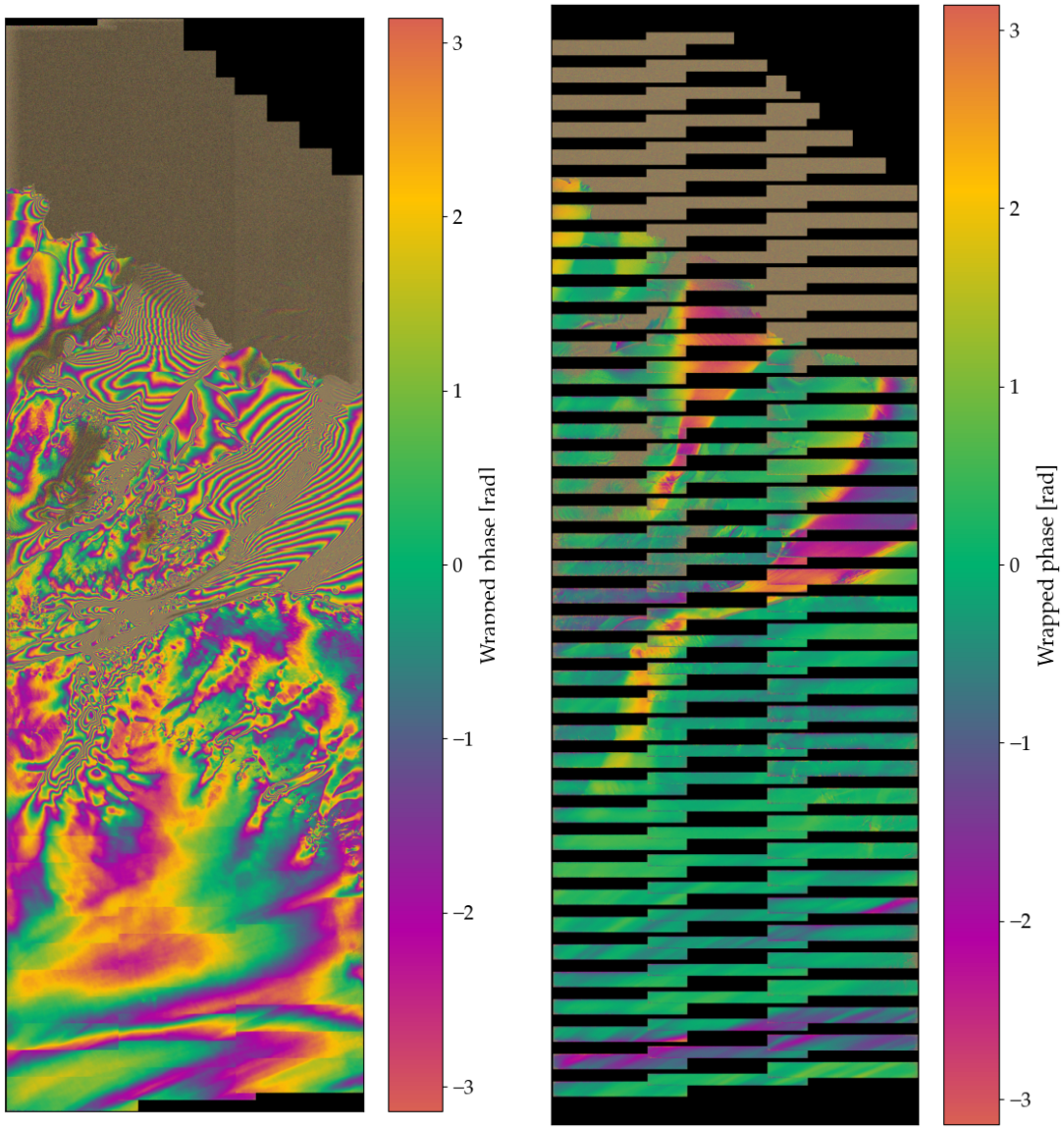
EW mode, 1-day S1C/S1D

Apr 15-16, 2026



Summary

Extending TOPS overlap zones is possible by custom focusing, preserving **partially focused targets**.

Particularly useful for cases with large-scale along-track motion

- Ice motion
- Tectonic motion