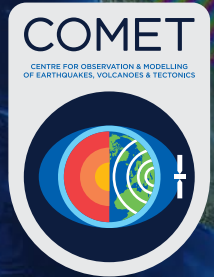


A comparative study of the phase bias in C-band and L-band InSAR



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COMET University of Leeds, SatSense



Bradford

Leeds



UNIVERSITY OF LEEDS



Centre for Satellite Data in Environmental Science

FRINGE 2023

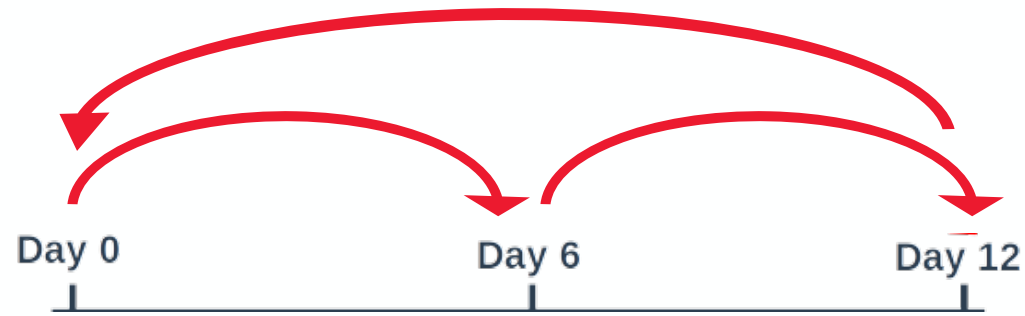
University of Leeds, UK | 11 - 15 September 2023

ESA UNCLASSIFIED - For ESA Official Use Only



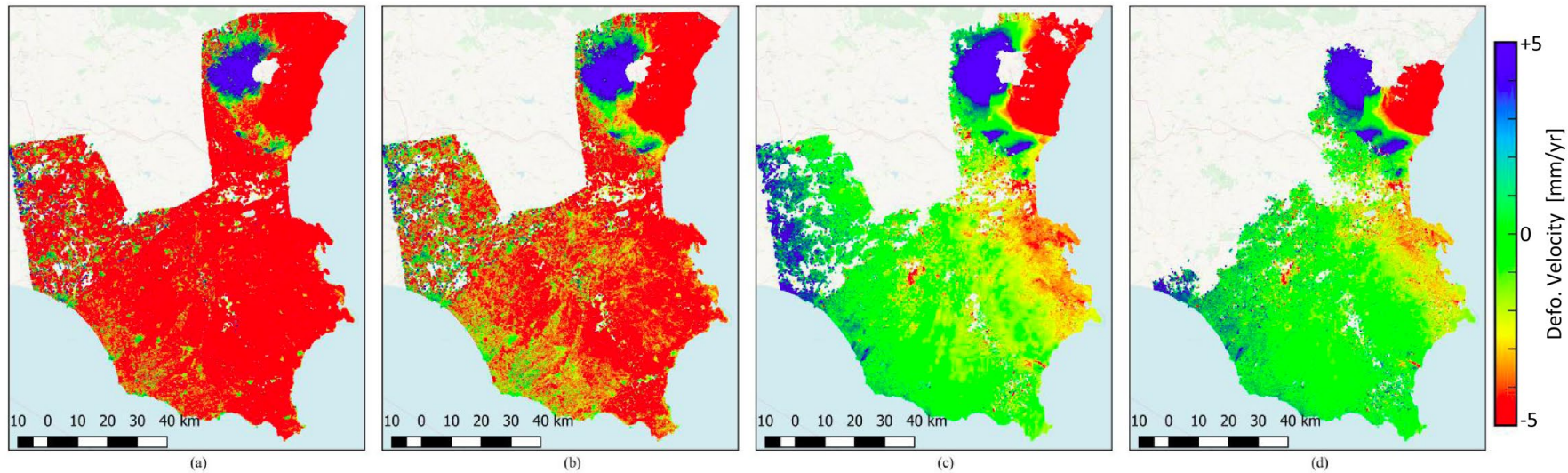
→ THE EUROPEAN SPACE AGENCY

Non-zero phase closure are a result of multilooking short-term interferograms



$$(\varphi_{0,6} + \varphi_{6,12}) - \varphi_{0,12} \neq 0$$

Small contributions accumulate to bias deformation



Displacement velocity maps of three different DS processing schemes (short temporal baselines) and PSI processing which is used as a benchmark.

Figure from H Ansari et al., IEEE TGRS 2021

- How and where does phase misclosure present itself for L-band InSAR?
- With the difference in wavelength, how is this different to C-band?
- What can we learn about the underlying physical mechanisms from this dataset?

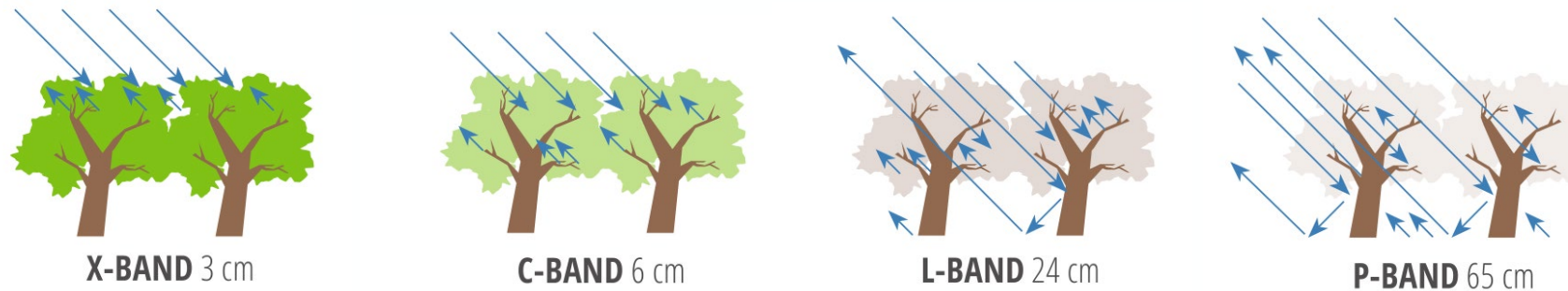


Figure from the NASA SAR Handbook, 2019

Motivation

- How and where does phase misclosure present itself for L-band InSAR?
- With the difference in wavelength, how is this different to C-band?
- What can we learn about the underlying physical mechanisms from this dataset?

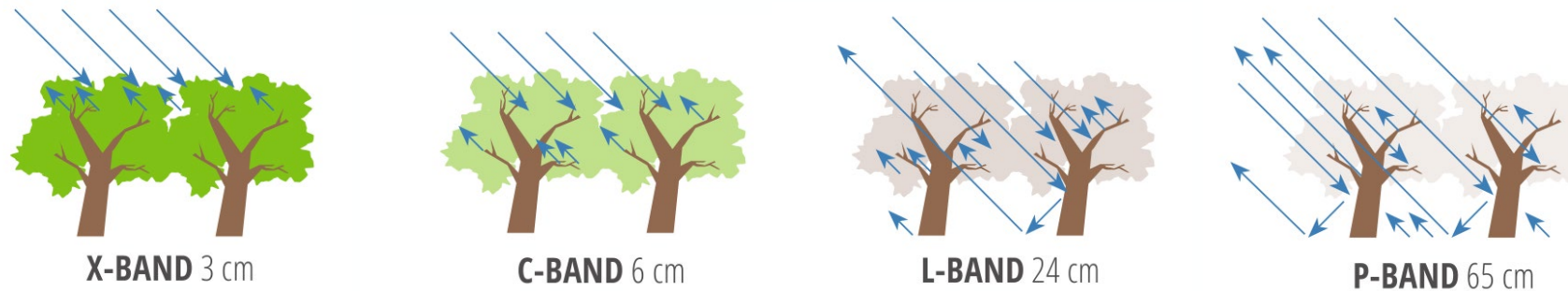


Figure from the NASA SAR Handbook, 2019

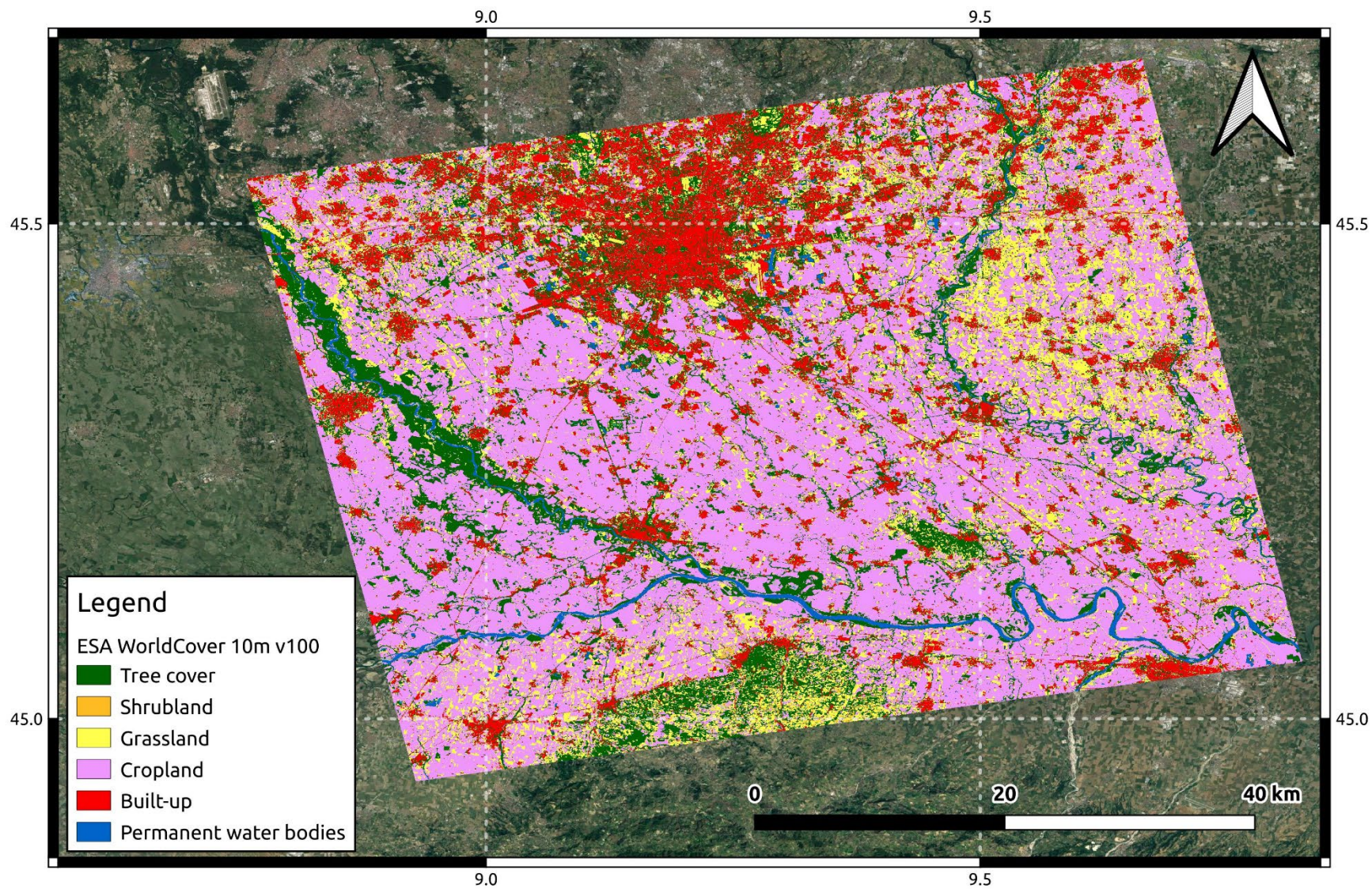
Study Region: Milan and surroundings, Italy

September 2020 to September 2021



Varied Landcover

March 2020



Loop closure: Sentinel-1 C-band

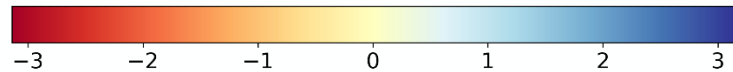
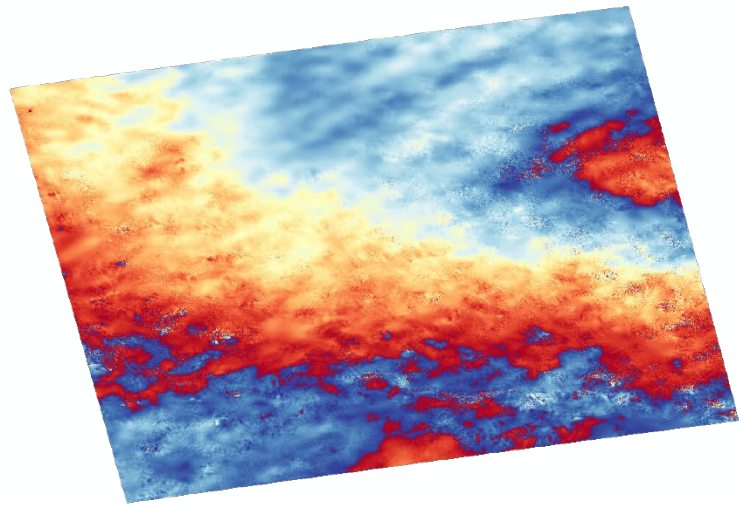
Interferograms processed by LiCSAR (COMET)



21st March 2021 to 14th April 2021, looks = 5 x 20

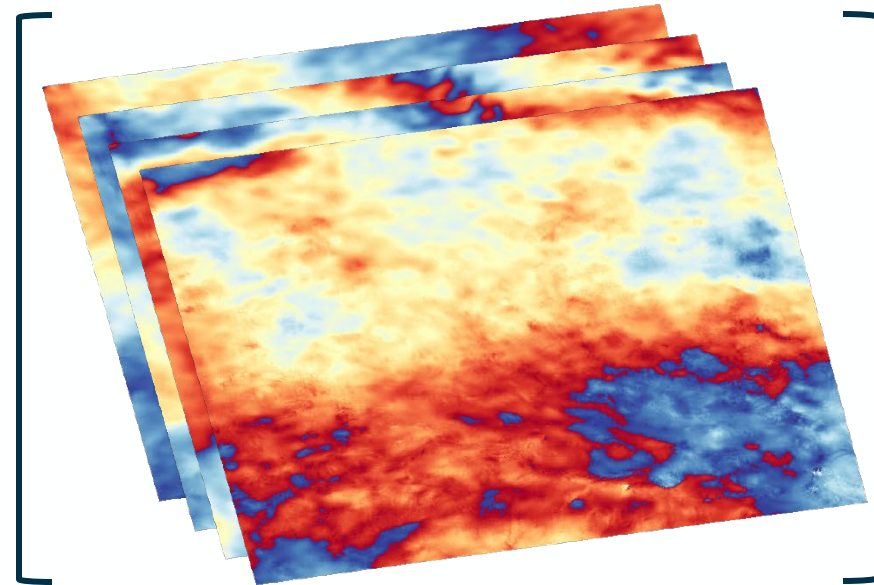
24-day

6-day



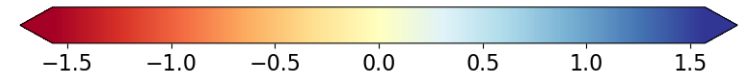
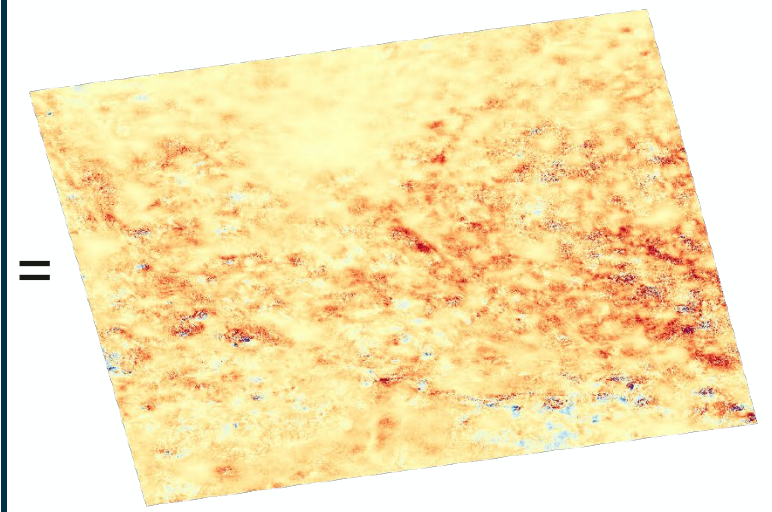
Interferometric phase, radians

- Σ



Interferometric phase, radians

=

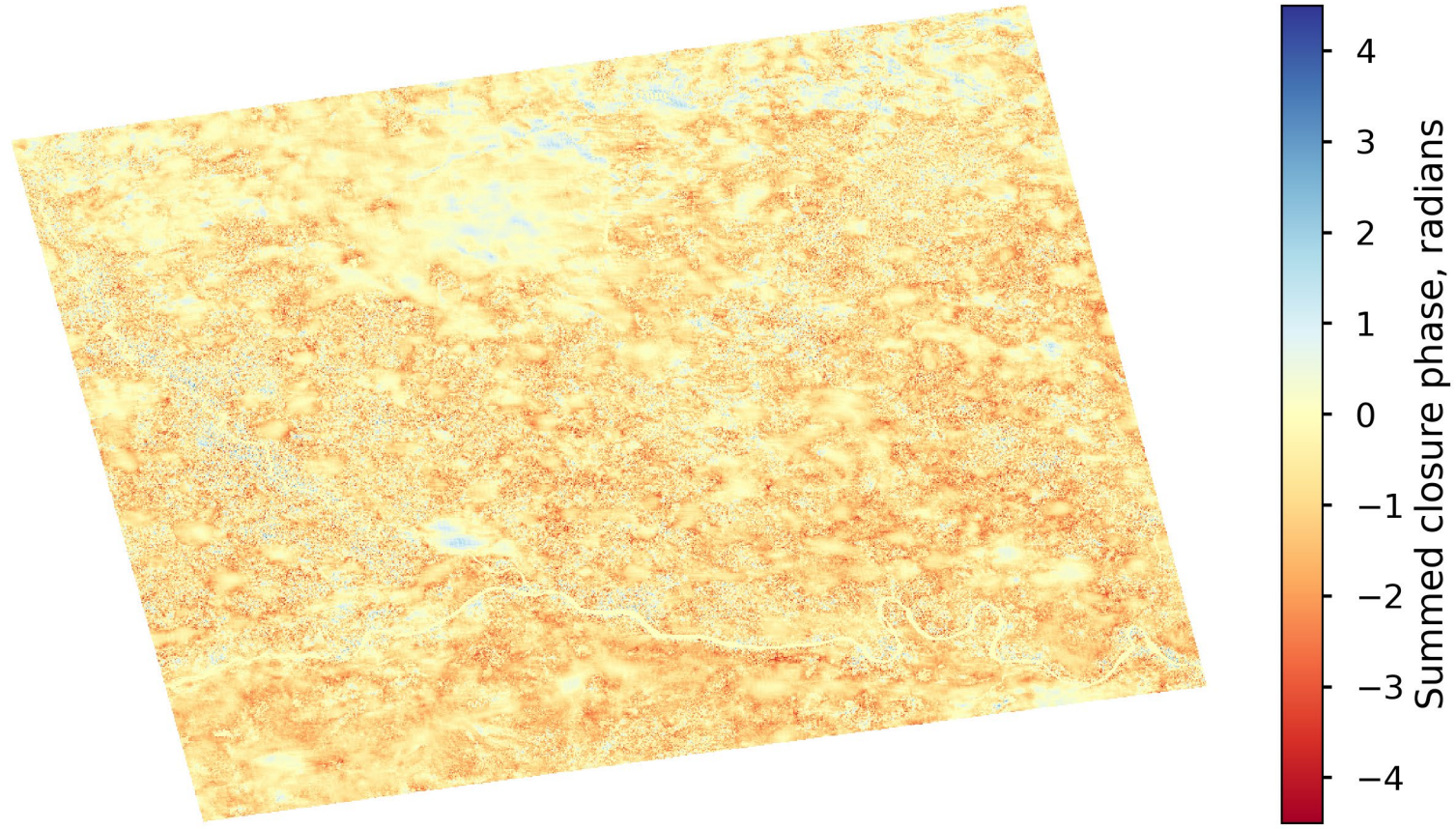


Closure phase, radians

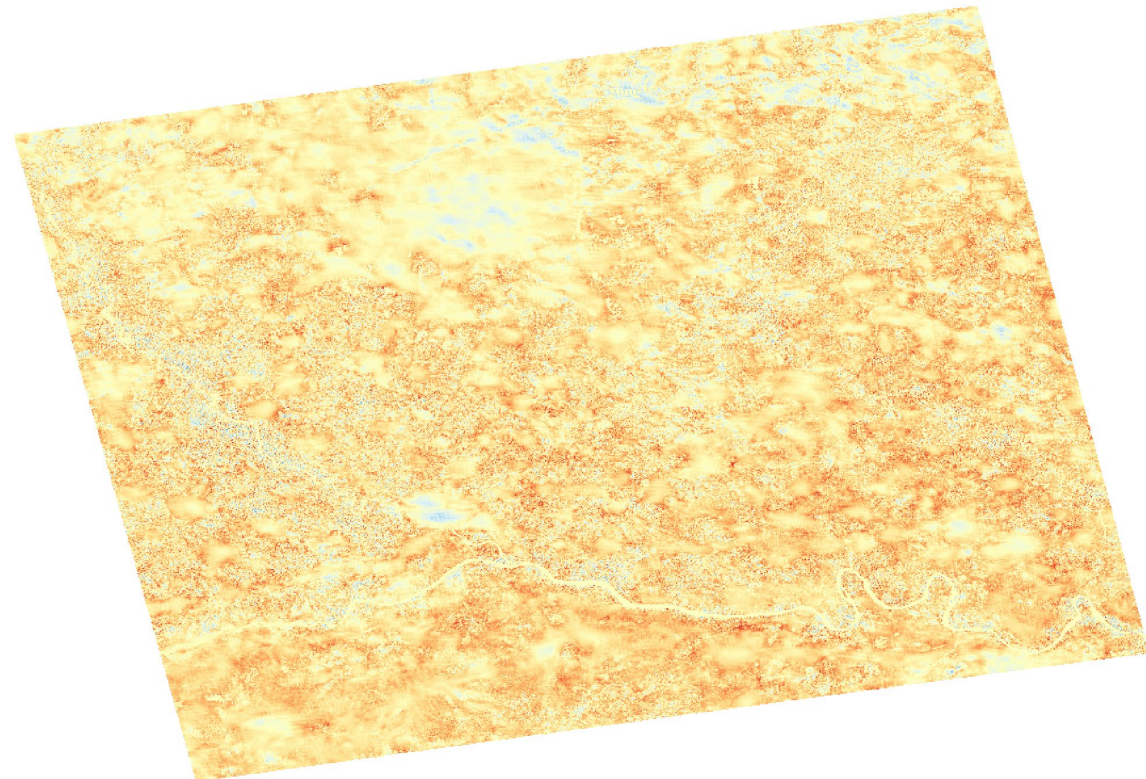
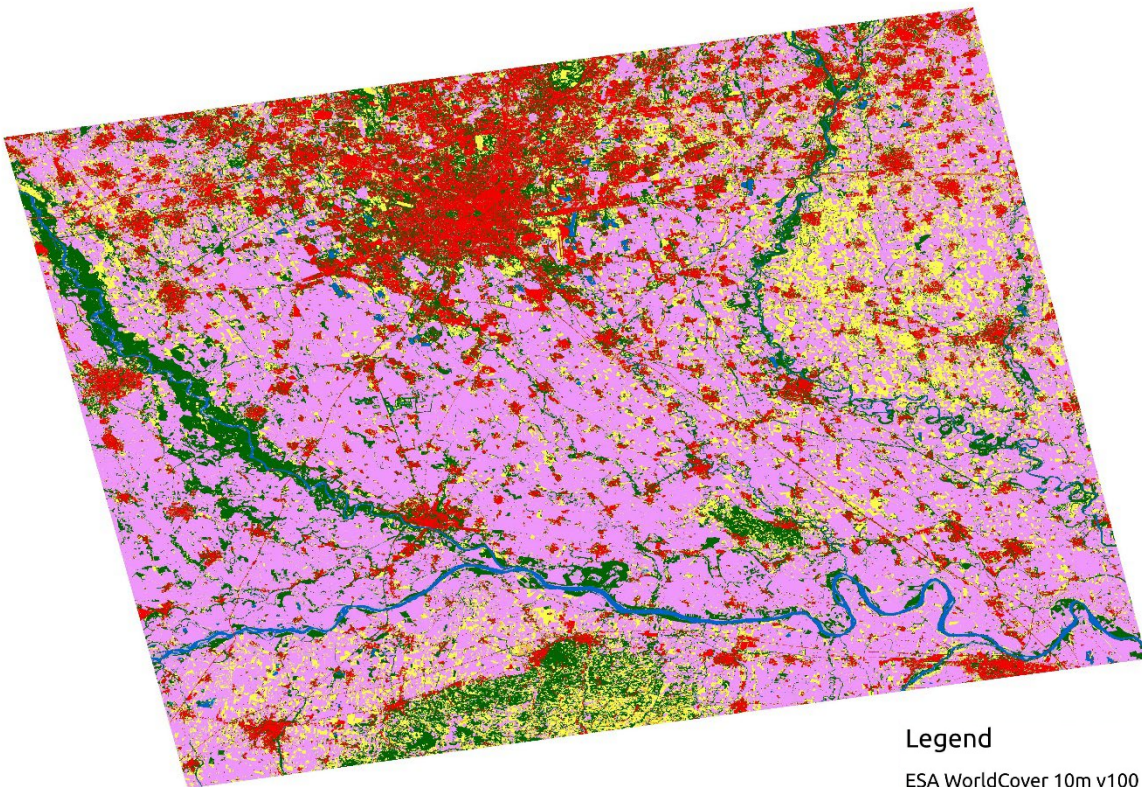


C-band: Cumulative loop closure

Sum of all 24 - (6 + 6 + 6 + 6) day loops



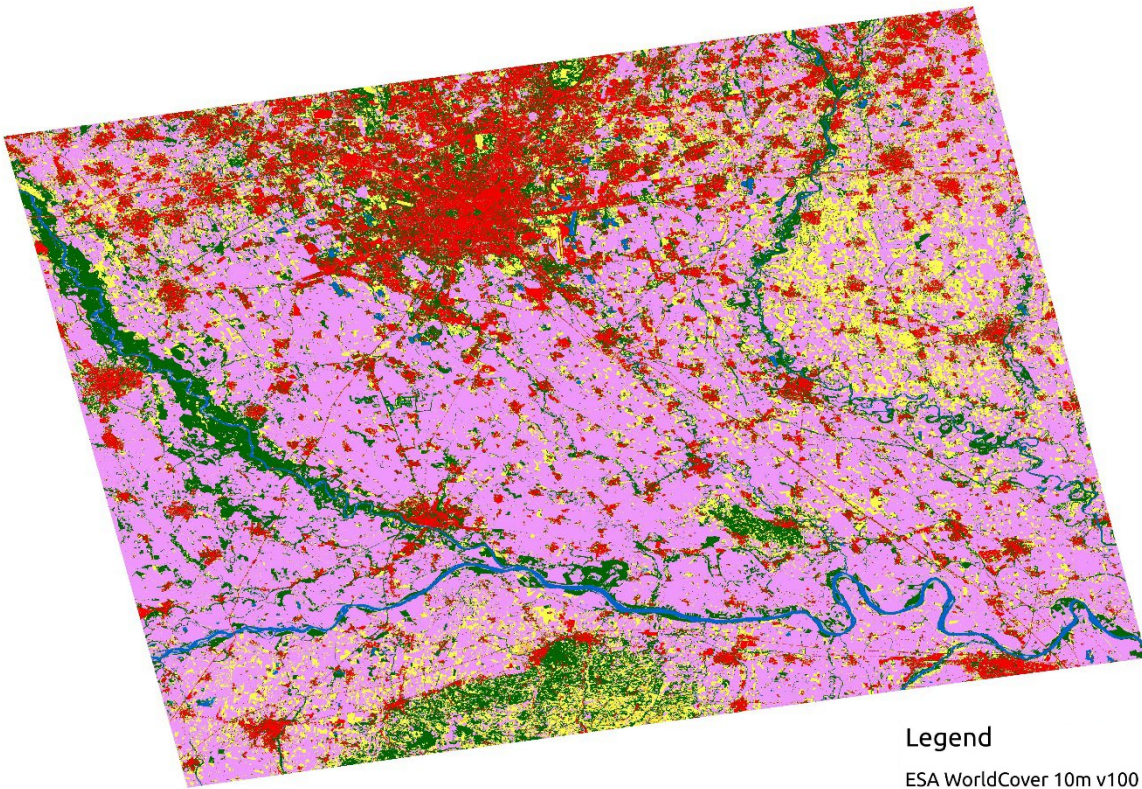
C-band: Cumulative loop closure



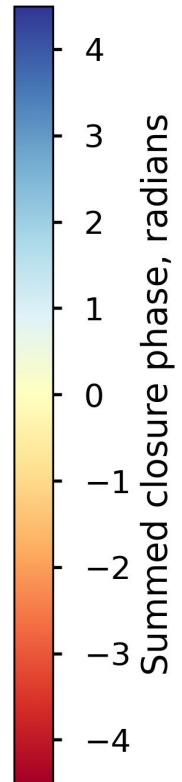
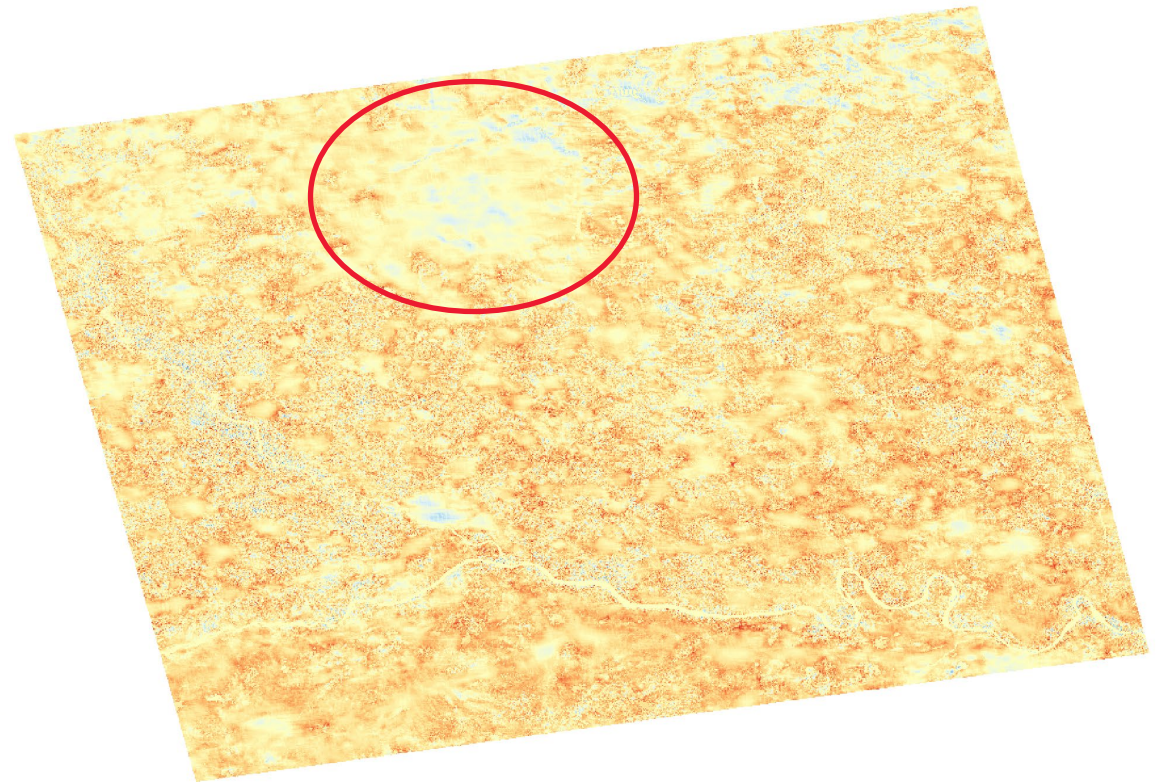
Legend

- ESA WorldCover 10m v100
- Tree cover
- Shrubland
- Grassland
- Cropland
- Built-up
- Permanent water bodies

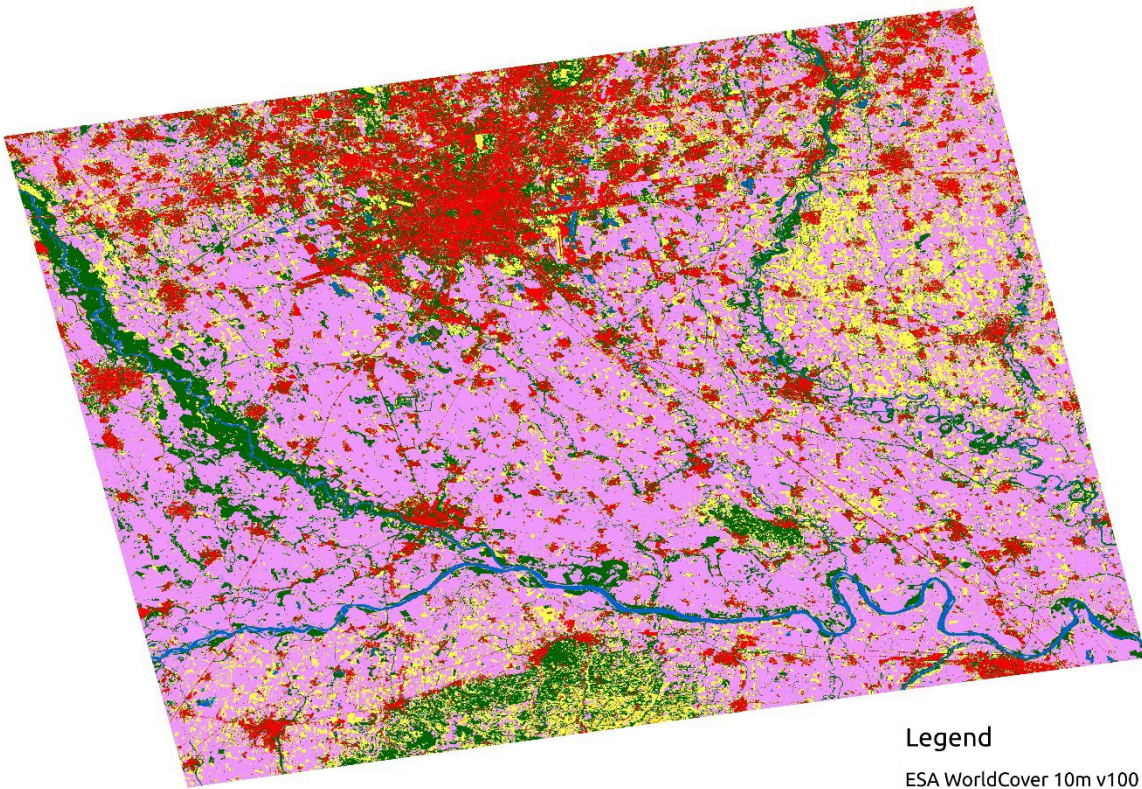
C-band: Cumulative loop closure



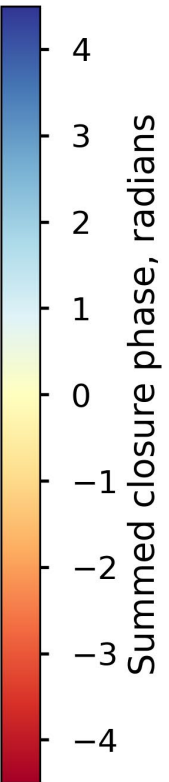
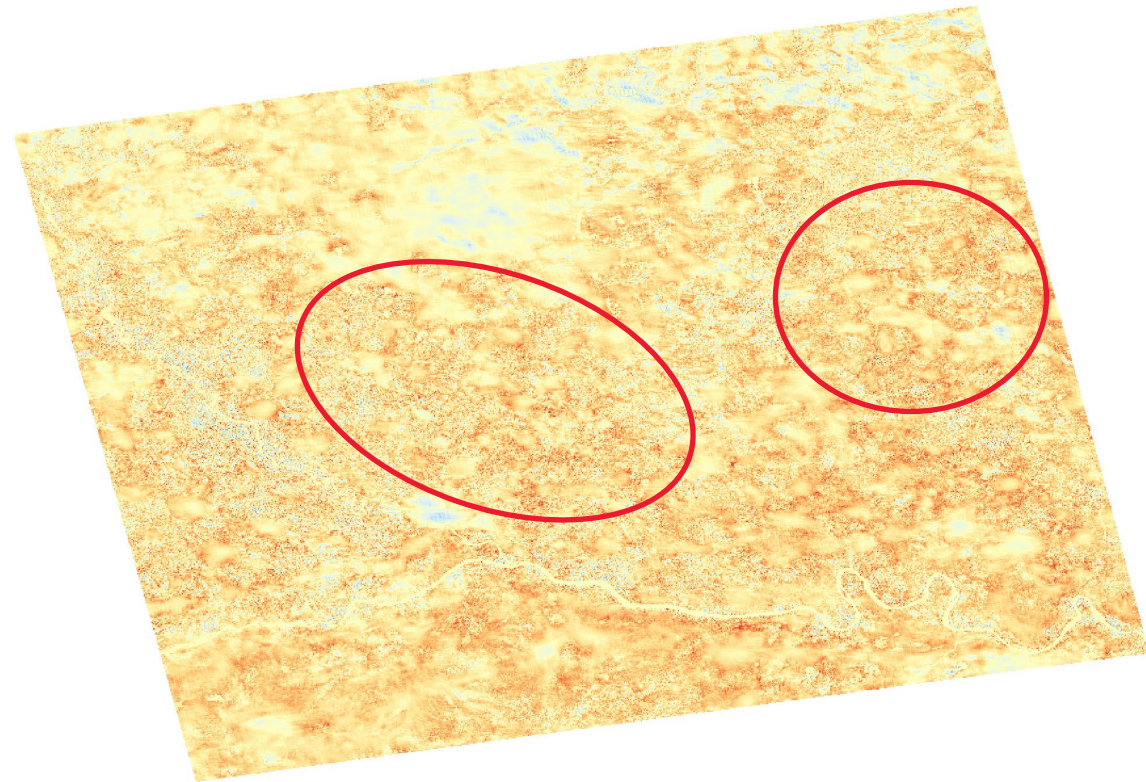
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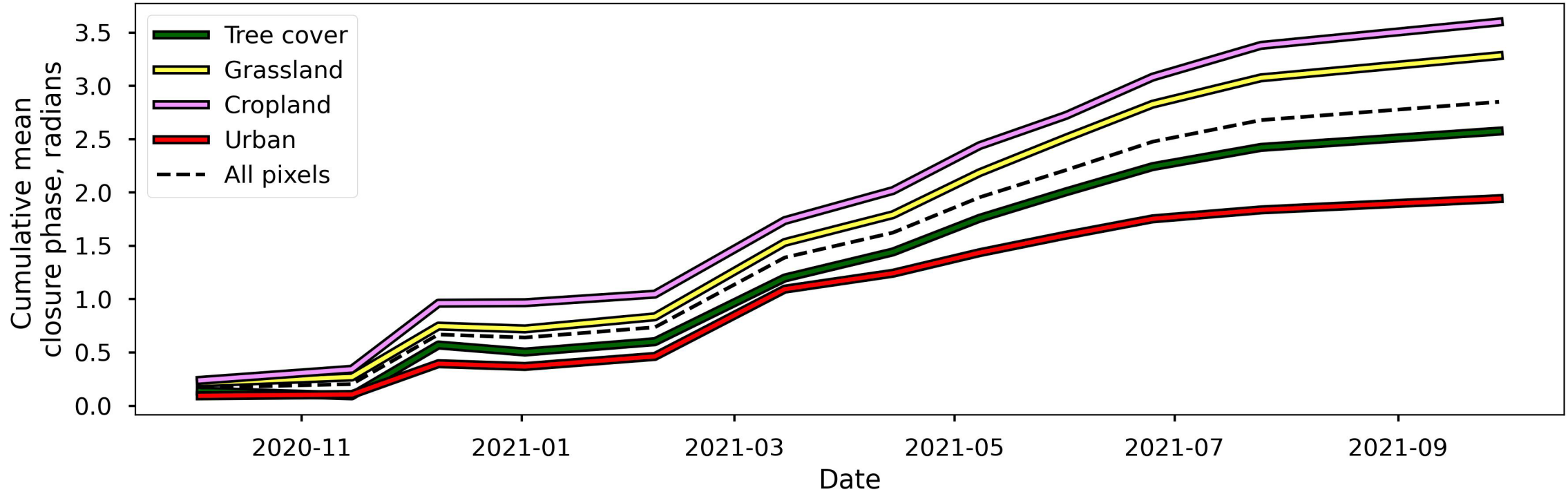
C-band: Cumulative loop closure



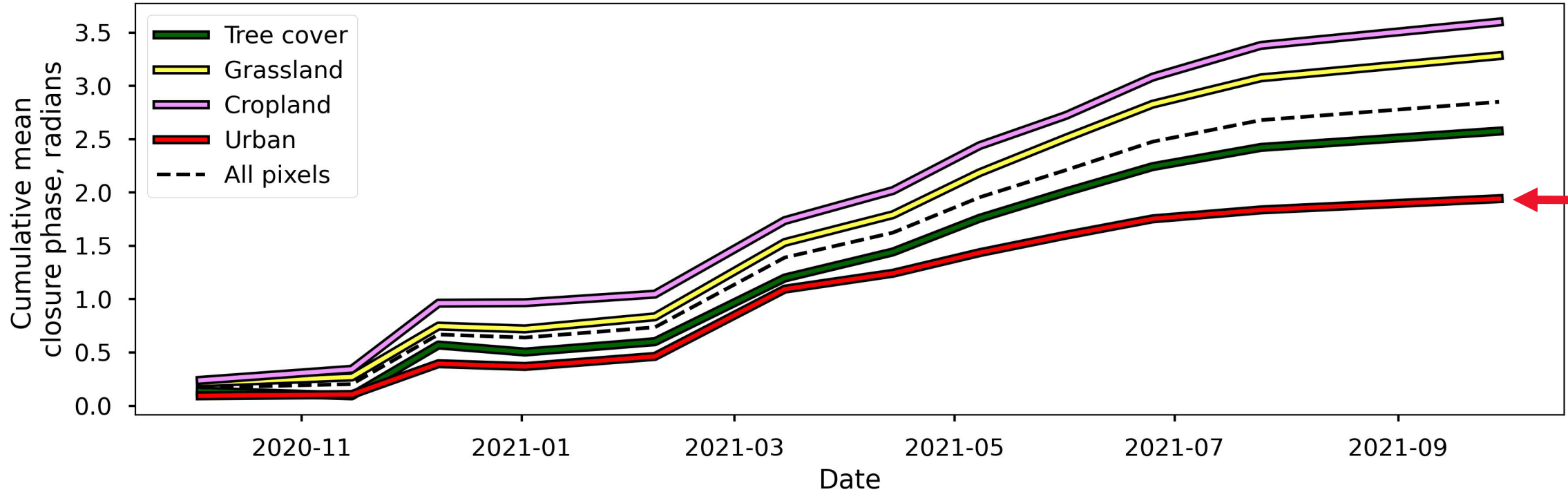
- Legend
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Loop closure time series by landcover: C-band

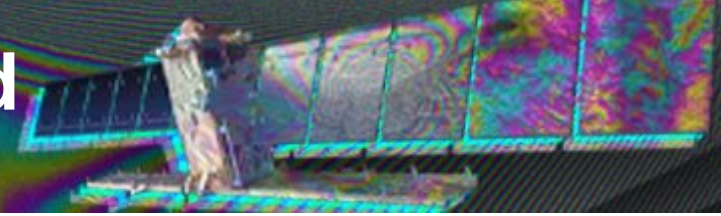


Loop closure time series by landcover: C-band



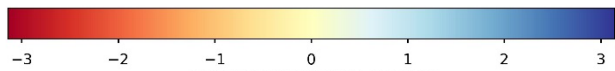
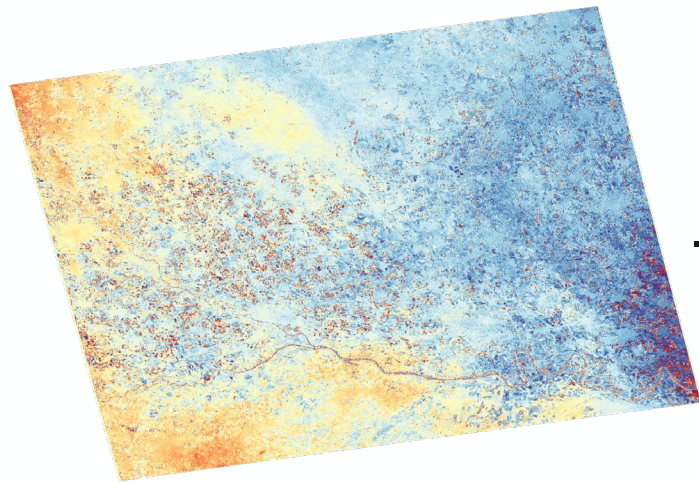
Loop closure: ALOS-2 L-band

28 - (14 + 14) day loop: 26th June to 12th July 2021



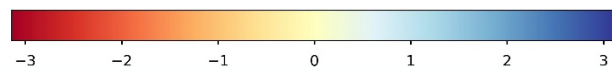
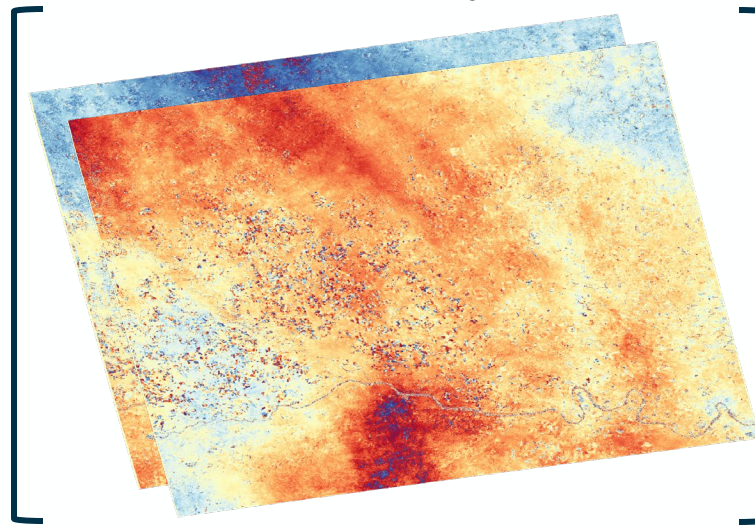
26th June to 12th July 2021, looks = 4, 14

28-day



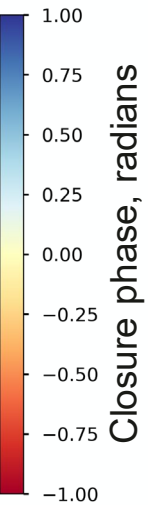
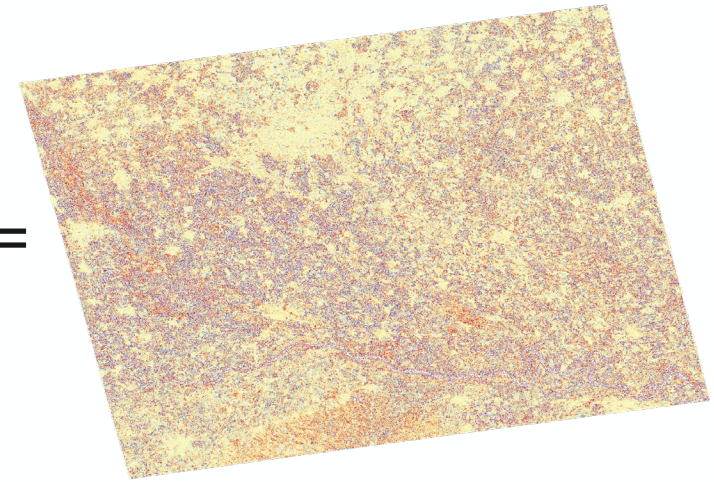
Interferometric phase, radians

14-day



Interferometric phase, radians

=

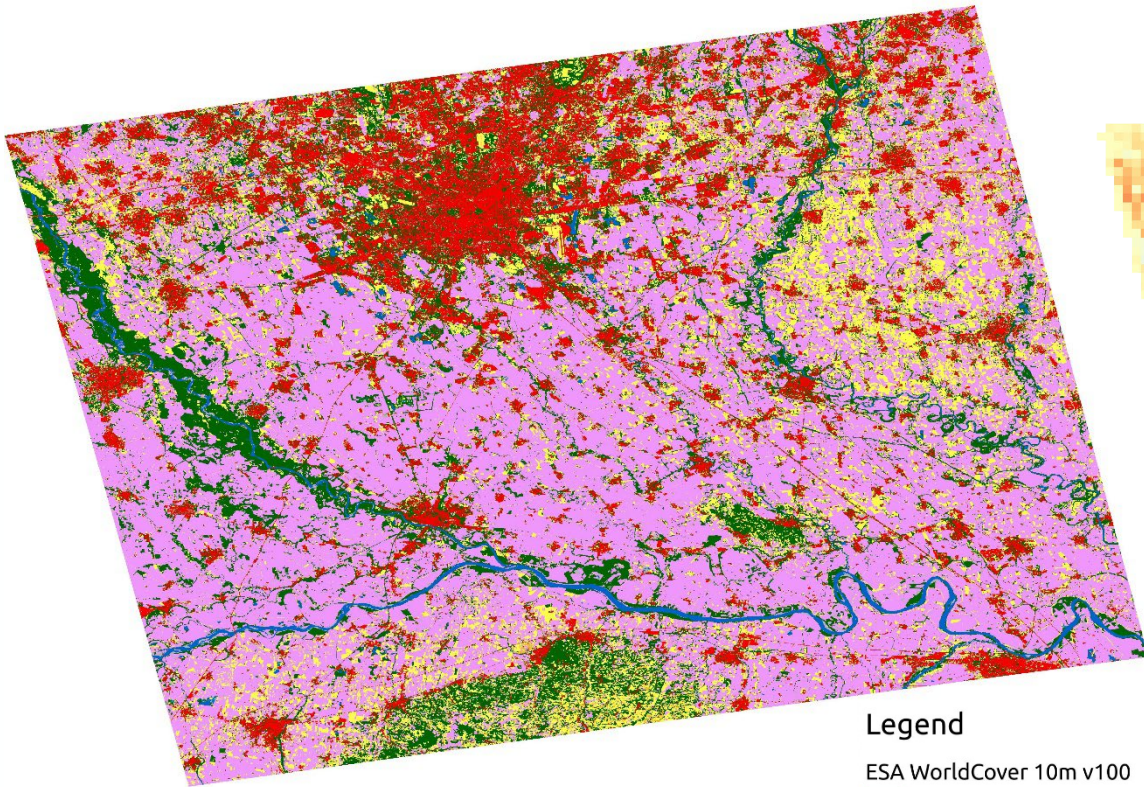


Closure phase, radians



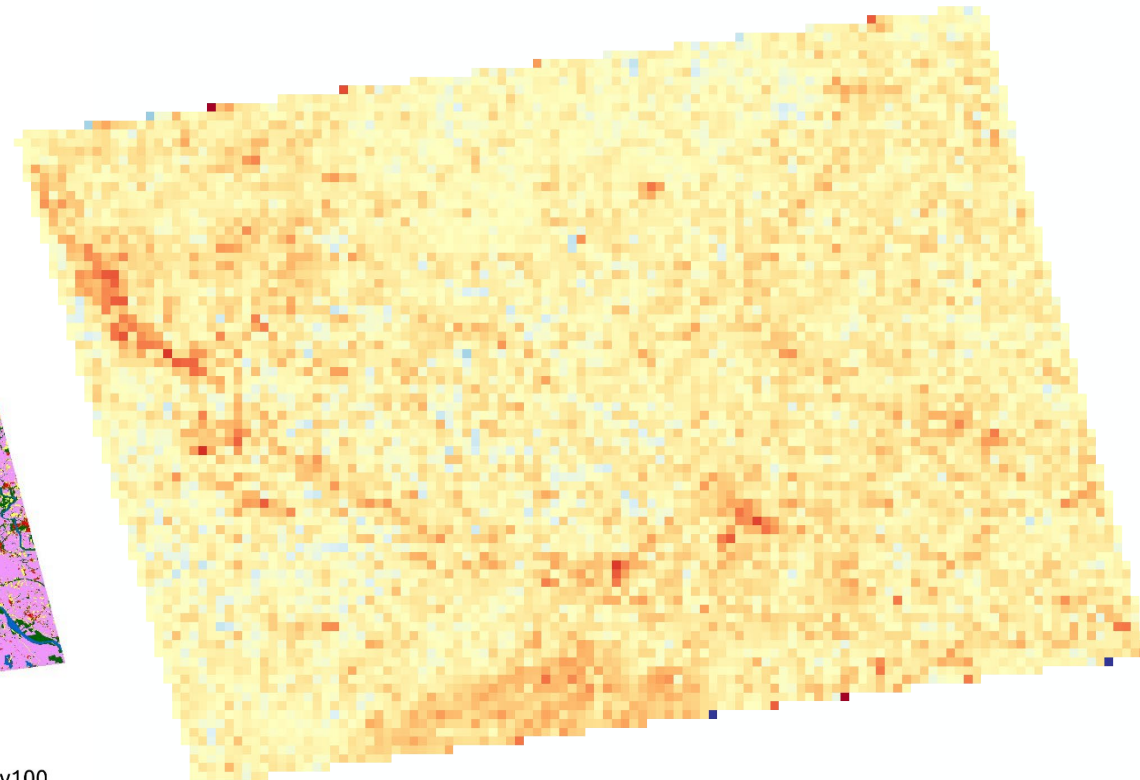
L-band: Greater loop misclosure for forested areas

Closure phase multilooked further 30 by 30 px



Legend

- ESA WorldCover 10m v100
- Tree cover
- Shrubland
- Grassland
- Cropland
- Built-up
- Permanent water bodies

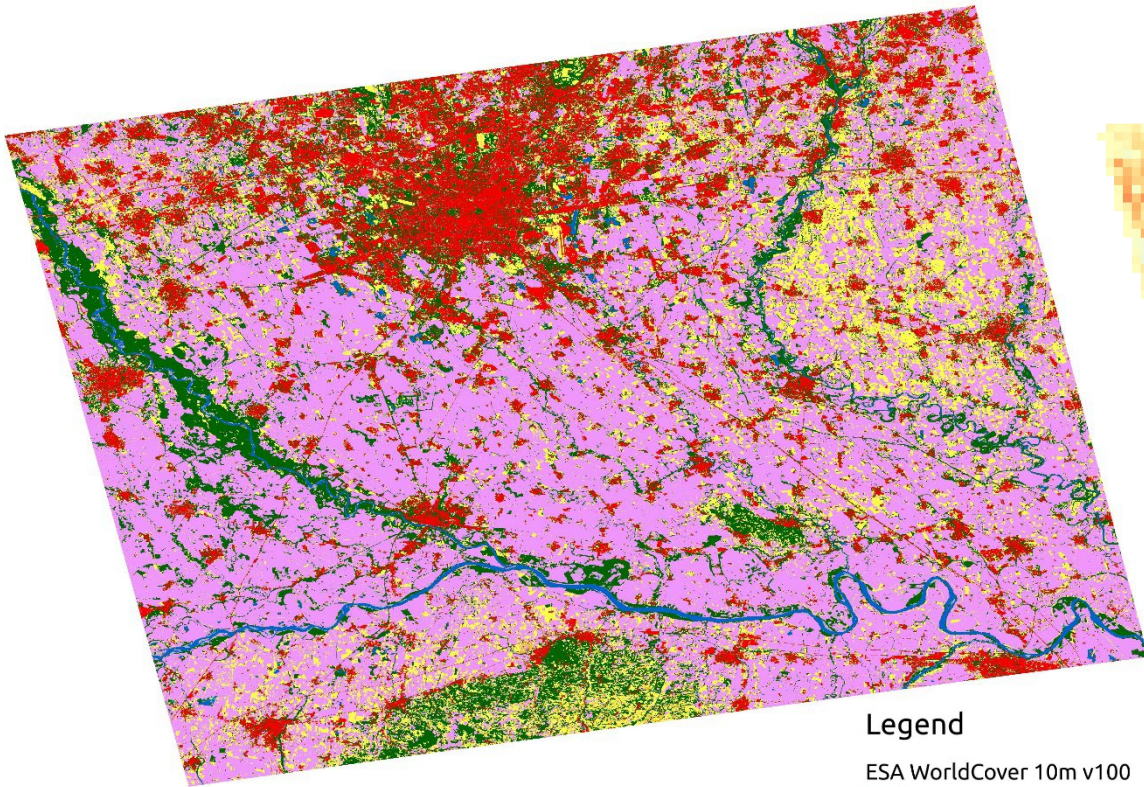


Closure phase, radians

0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6

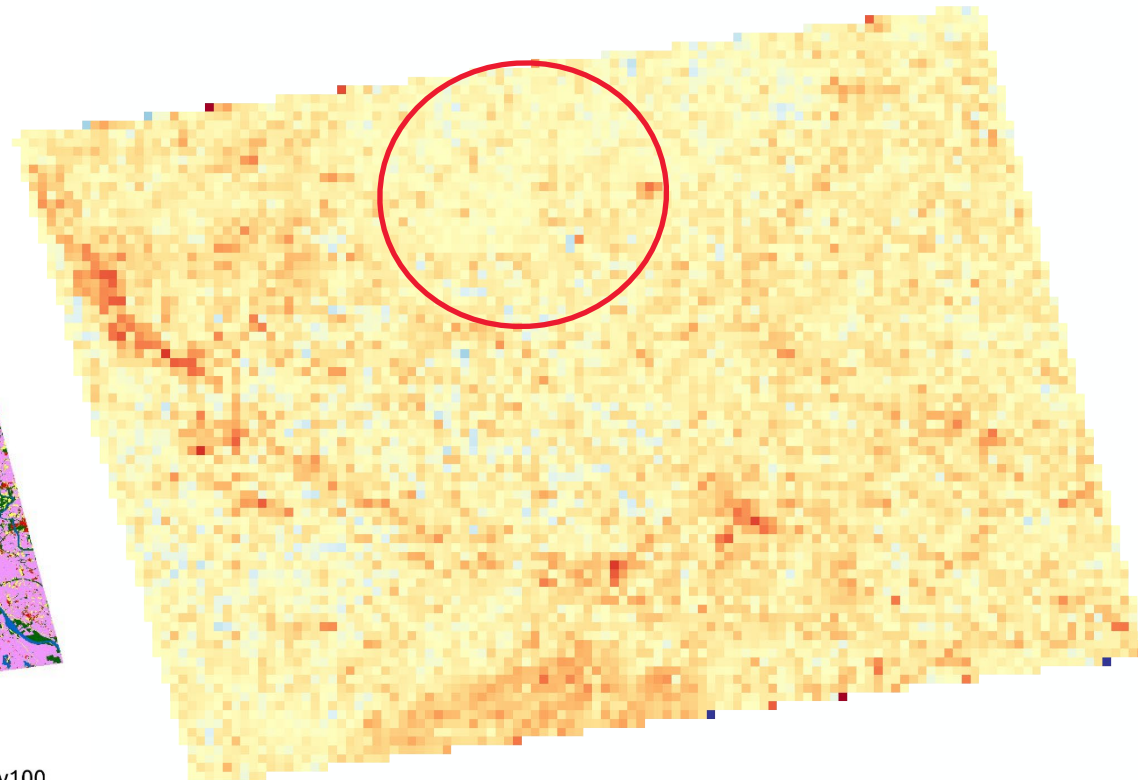
L-band: Greater loop misclosure for forested areas

Closure phase multilooked further 30 by 30 px

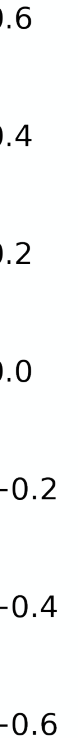


Legend

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- Tree cover
- Shrubland
- Grassland
- Cropland
- Built-up
- Permanent water bodies

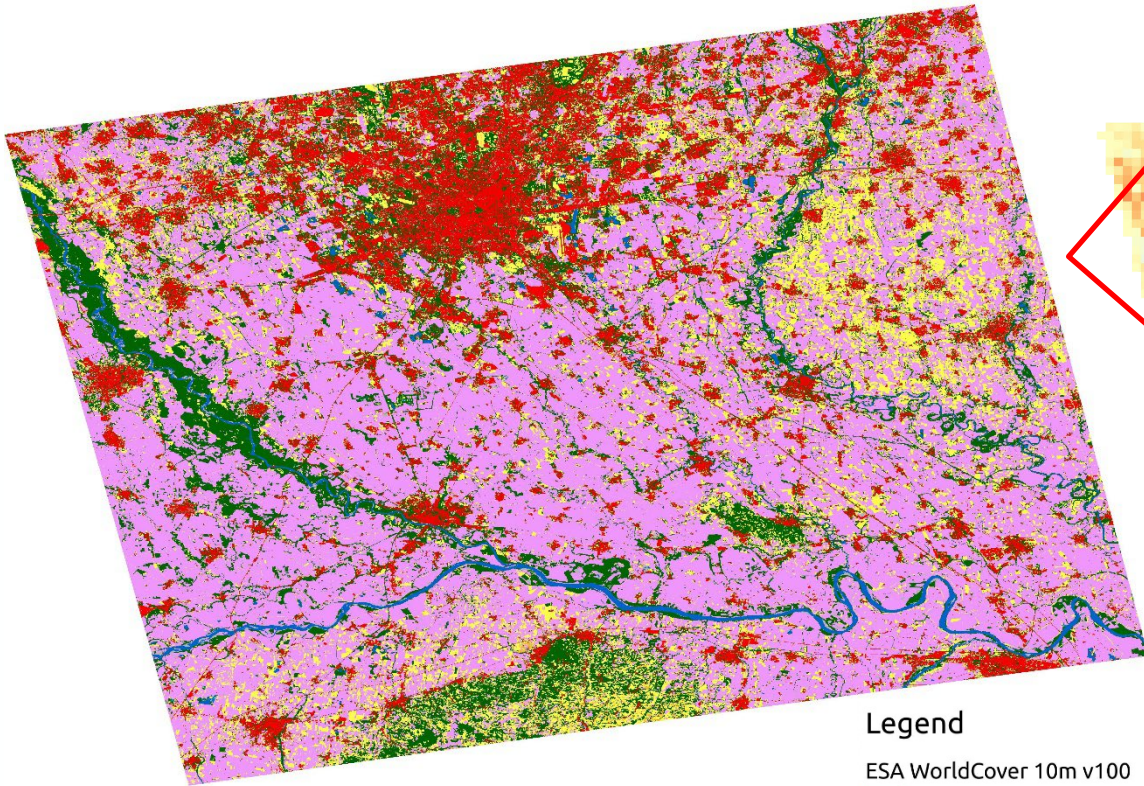


Closure phase, radians

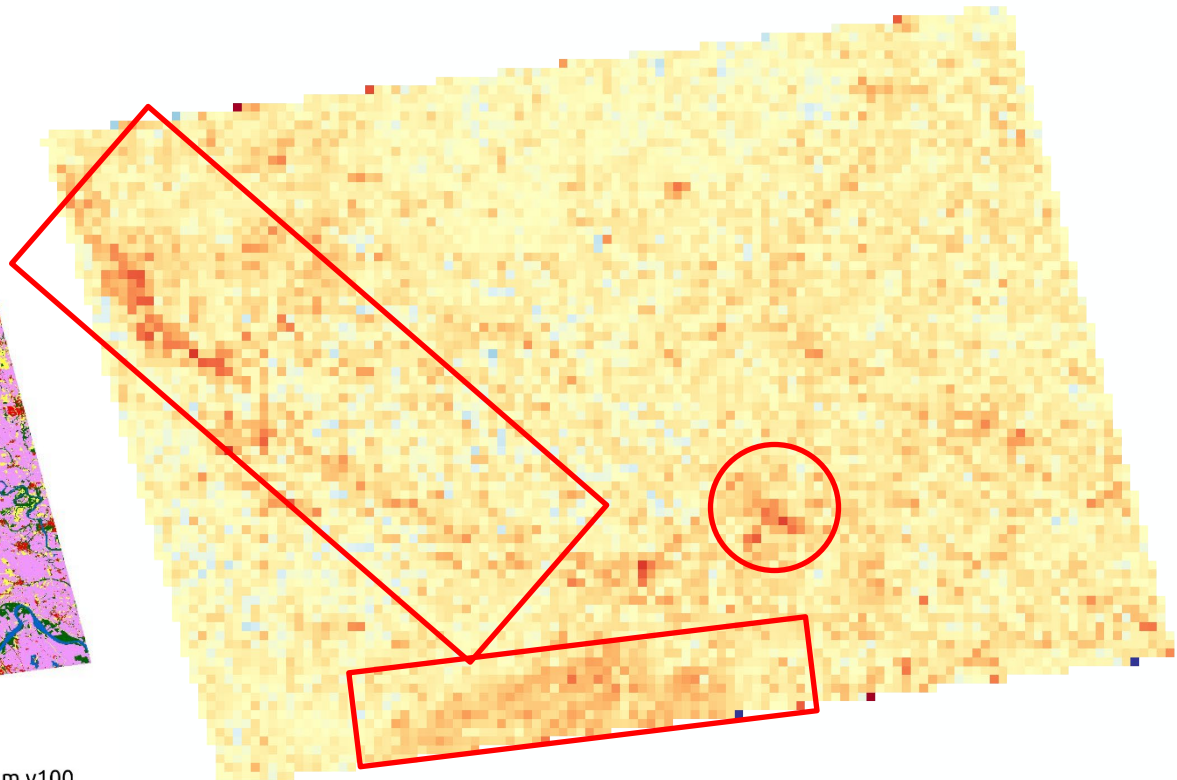


L-band: Greater loop misclosure for forested areas

Closure phase multilooked further 30 by 30 px



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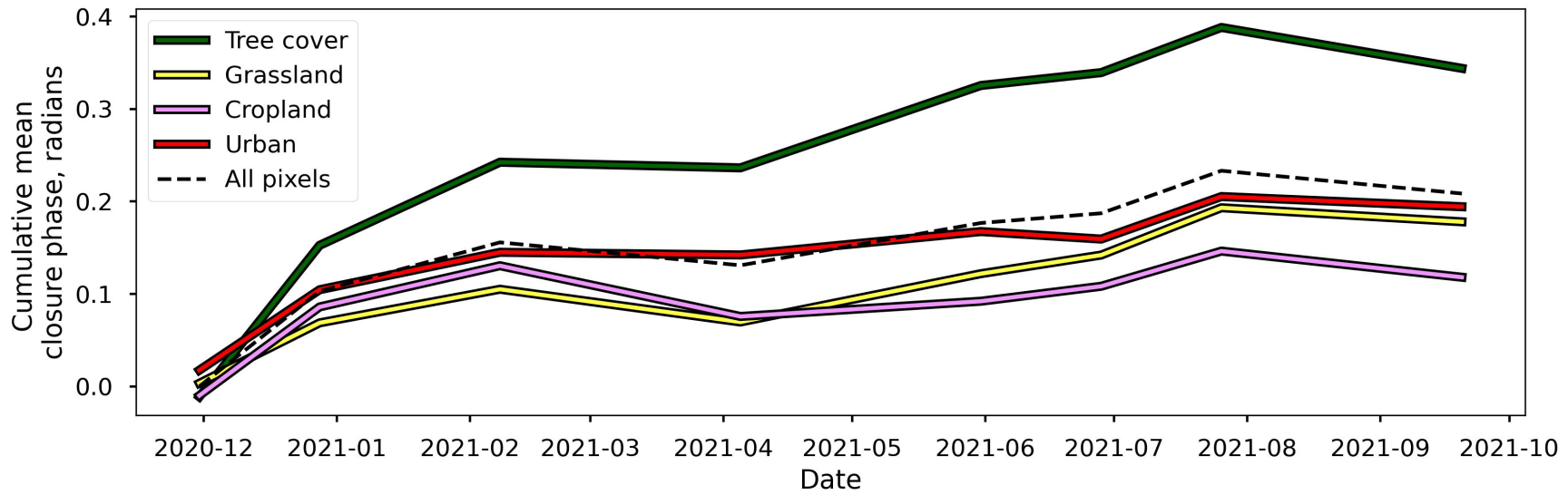
Closure phase, radians



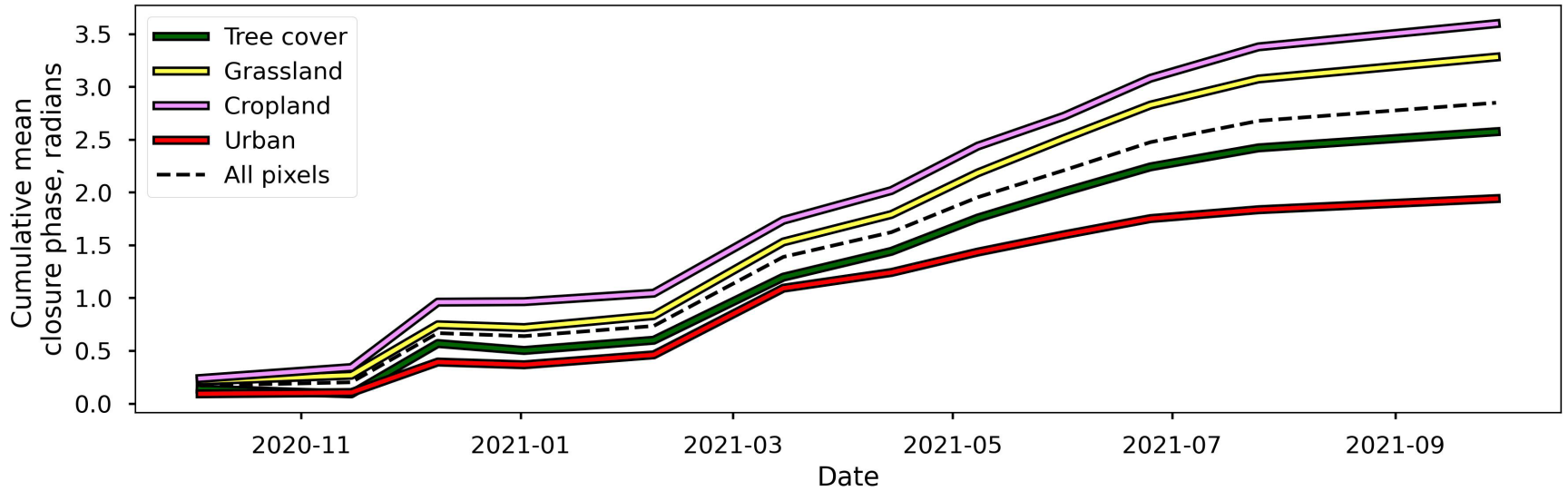
Loop closure time series by landcover: L-band



L-band



C-band

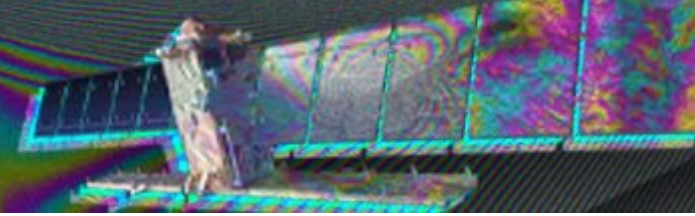


Conclusions and Outlook

- As expected, cropland and grassland exhibit the highest cumulative phase closure for C-band.
- Phase misclosure seems to be more prominent for forested areas over cropland for L-band.
- Points towards dependence on volume scattering in vegetation rather than soil moisture changes.
- More research is needed for different vegetation levels (drier/wetter climates).

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Acknowledgements



- ALOS-2 data was obtained through JAXA Earth Observation Research Agreement 3 (EO-RA3).
- Milan Lazecky for LiCSAR processing.
- Yasser Magsoudi for discussion on phase bias and tips with processing.

Poster 50

High-resolution Change Detection for Sibling-based Time Series InSAR using Random Forests
Jacob Connolly¹, Andy Hooper¹, Stuart King¹, Tom Ingleby¹, Tim Wright¹, David Baker¹
¹COMET, University of Leeds, ²University of Edinburgh, ³ESA/ESRIS, ⁴NASA/ASD

Abstract: Accurate and reliable detection of change is essential for the monitoring of natural and anthropogenic hazards such as land subsidence, forest loss, and urban expansion. This paper presents a novel approach to high-resolution change detection using Synthetic Aperture Radar (SAR) data. The proposed method combines a novel change detection algorithm with a Random Forest (RF) classifier to detect and classify change in SAR data. The method is applied to a time series of SAR data from the ALOS-2 satellite to detect and classify change in a residential area. The results show that the proposed method is able to detect and classify change at a resolution of 10m, which is significantly higher than other methods. The method is also able to detect and classify change in a wide range of SAR data, including both amplitude and phase data. The method is also able to detect and classify change in a wide range of SAR data, including both amplitude and phase data.

Introduction: Accurate and reliable detection of change is essential for the monitoring of natural and anthropogenic hazards such as land subsidence, forest loss, and urban expansion. This paper presents a novel approach to high-resolution change detection using Synthetic Aperture Radar (SAR) data. The proposed method combines a novel change detection algorithm with a Random Forest (RF) classifier to detect and classify change in SAR data. The method is applied to a time series of SAR data from the ALOS-2 satellite to detect and classify change in a residential area. The results show that the proposed method is able to detect and classify change at a resolution of 10m, which is significantly higher than other methods. The method is also able to detect and classify change in a wide range of SAR data, including both amplitude and phase data. The method is also able to detect and classify change in a wide range of SAR data, including both amplitude and phase data.

Methods: The proposed method consists of two main steps: change detection and classification. The change detection step uses a novel change detection algorithm to detect change in SAR data. The classification step uses a Random Forest (RF) classifier to classify the detected change. The method is applied to a time series of SAR data from the ALOS-2 satellite to detect and classify change in a residential area. The results show that the proposed method is able to detect and classify change at a resolution of 10m, which is significantly higher than other methods. The method is also able to detect and classify change in a wide range of SAR data, including both amplitude and phase data. The method is also able to detect and classify change in a wide range of SAR data, including both amplitude and phase data.

Results: The results show that the proposed method is able to detect and classify change at a resolution of 10m, which is significantly higher than other methods. The method is also able to detect and classify change in a wide range of SAR data, including both amplitude and phase data. The method is also able to detect and classify change in a wide range of SAR data, including both amplitude and phase data.

Conclusions and Outlook: The proposed method is a novel approach to high-resolution change detection using SAR data. The method is able to detect and classify change at a resolution of 10m, which is significantly higher than other methods. The method is also able to detect and classify change in a wide range of SAR data, including both amplitude and phase data. The method is also able to detect and classify change in a wide range of SAR data, including both amplitude and phase data.

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