

# Corner Reflector Network Graz

URSI Austria Meeting 2026

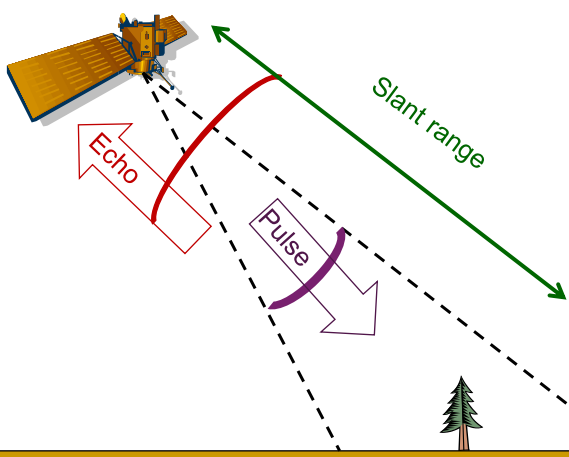
Karlheinz Gutjahr

SHAPING THE FUTURE, TOGETHER



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## RADAR: RAdio Detection And Ranging



SENTINEL 1 radar satellite © ESA

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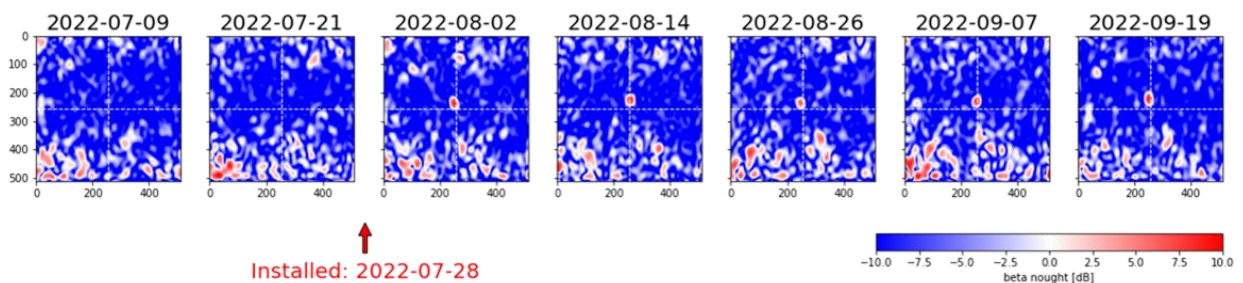
## Summary

- What is a corner reflector (CR)?
  - Objects that reflect signals from radar sensors in a focussed manner
  - Always designed for special (satellite) missions, e.g. Sentinel-1
- Why CRs?
  - Sharp increase in the intensity of the reflection => easily recognizable
  - Ground coordinates of reflection centre can be measured
- Purpose of CRs?
  - Calibration activities (sensor delays, ...)
  - Deformation measurements

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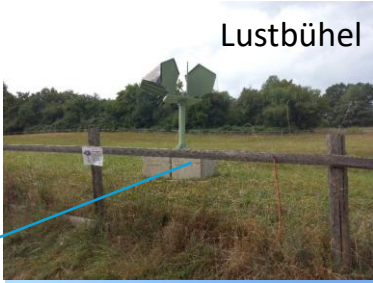
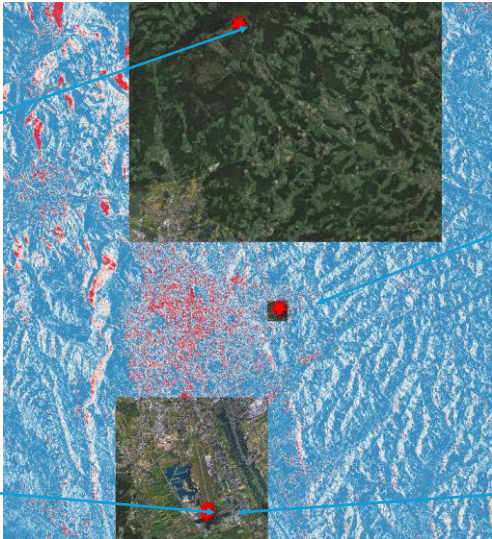
## CR Schöckel



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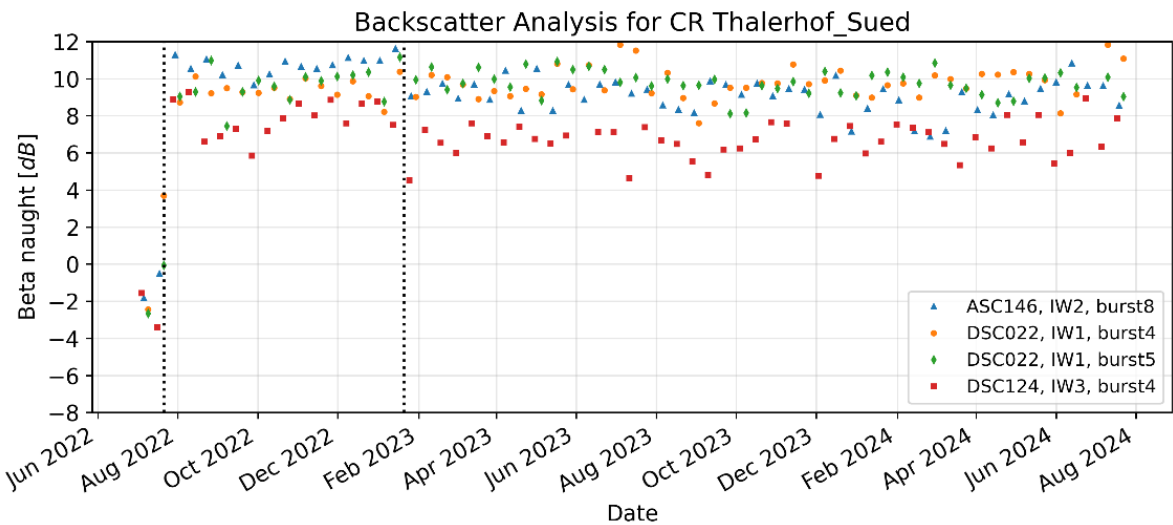
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CR Network Graz (since August 2022)



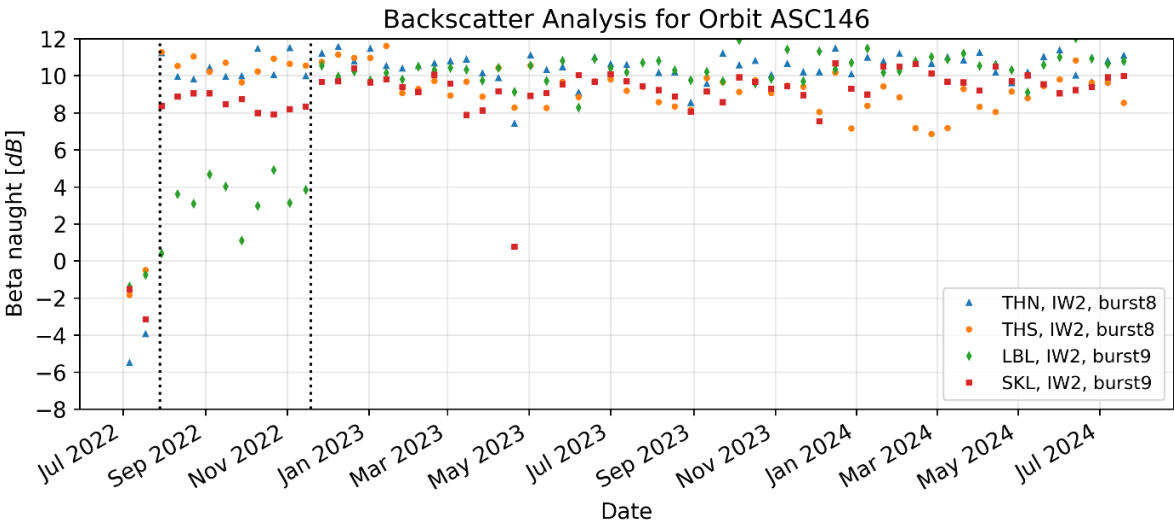
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Backscatter Analysis per CR



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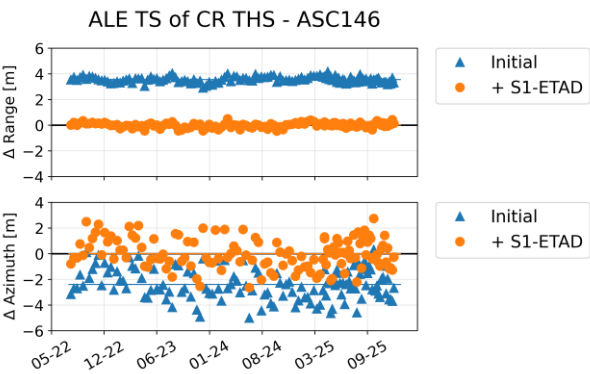
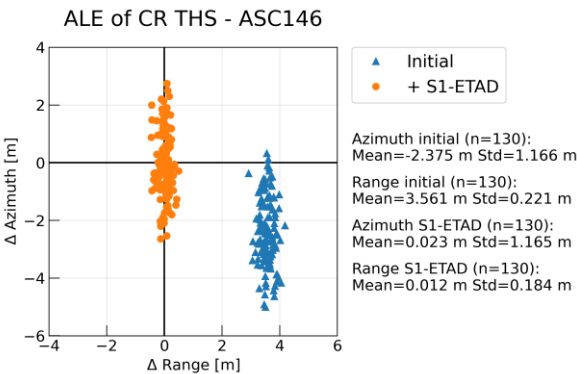
## Backscatter Analysis per Orbit



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## CR Thalerhof – Sentinel-1

Calibration: ALE ... *absolute localization error*



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## ALE Results (SLC Products)

### Thalerhof North

| Orbit   | Swath, Burst, Samples, ETAD | Azimut Initial [m] | Range initial [m] | Azimut S1-ETAD [m] | Range S1-ETAD [m] |
|---------|-----------------------------|--------------------|-------------------|--------------------|-------------------|
| ASC 146 | 2, B8, 130, 130             | -2.437 +/- 0.836   | 3.933 +/- 0.224   | -0.027 +/- 0.840   | 0.390 +/- 0.151   |
| DSC 022 | 1, B4, 134, 134             | -3.154 +/- 0.774   | 2.865 +/- 0.181   | 0.197 +/- 0.804    | -0.096 +/- 0.107  |
| DSC 022 | 1, B5, 131, 109             | -3.260 +/- 0.734   | 3.548 +/- 0.178   | 0.024 +/- 0.729    | -0.062 +/- 0.112  |
| DSC 124 | 3, B4, 124, 123             | -1.131 +/- 0.986   | 3.839 +/- 0.230   | -0.070 +/- 0.987   | -0.011 +/- 0.181  |

### Thalerhof South

| Orbit   | Swath, Burst, Samples, ETAD | Azimut Initial [m] | Range initial [m] | Azimut S1-ETAD [m] | Range S1-ETAD [m] |
|---------|-----------------------------|--------------------|-------------------|--------------------|-------------------|
| ASC 146 | 2, B8, 130, 130             | -2.375 +/- 1.166   | 3.561 +/- 0.221   | 0.023 +/- 1.165    | 0.012 +/- 0.184   |
| DSC 022 | 1, B4, 134, 134             | -2.996 +/- 1.216   | 2.882 +/- 0.204   | 0.351 +/- 1.221    | -0.072 +/- 0.151  |
| DSC 022 | 1, B5, 131, 108             | -3.347 +/- 1.117   | 3.600 +/- 0.207   | -0.040 +/- 1.187   | 0.003 +/- 0.152   |
| DSC 124 | 3, B4, 123, 123             | -1.105 +/- 1.285   | 3.760 +/- 0.264   | -0.048 +/- 1.291   | -0.087 +/- 0.211  |

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## ALE Results (SLC Products)

### Lustbühel

| Orbit   | Swath, Burst, Samples, ETAD | Azimut Initial [m] | Range initial [m] | Azimut S1-ETAD [m] | Range S1-ETAD [m] |
|---------|-----------------------------|--------------------|-------------------|--------------------|-------------------|
| ASC 146 | 2, B9, 119, 115             | -1.876 +/- 0.646   | 3.931 +/- 0.218   | 0.085 +/- 0.647    | 0.048 +/- 0.119   |
| DSC 022 | 1, B4, 124, 124             | -3.141 +/- 1.012   | 3.216 +/- 0.214   | 0.255 +/- 1.012    | -0.074 +/- 0.120  |
| DSC 124 | 3, B3, 115, 115             | -0.728 +/- 1.275   | 3.342 +/- 0.263   | 0.033 +/- 1.282    | -0.126 +/- 0.172  |

### Schöckel

| Orbit   | Swath, Burst, Samples, ETAD | Azimut Initial [m] | Range initial [m] | Azimut S1-ETAD [m] | Range S1-ETAD [m] |
|---------|-----------------------------|--------------------|-------------------|--------------------|-------------------|
| ASC 146 | 2, B9, 129, 129             | -2.243 +/- 0.736   | 3.100 +/- 0.215   | 0.161 +/- 0.740    | 0.193 +/- 0.135   |
| DSC 022 | 1, B3, 134, 134             | -2.837 +/- 0.927   | 2.675 +/- 0.186   | 0.343 +/- 0.923    | -0.124 +/- 0.105  |
| DSC 124 | 3, B2, 124, 124             | 0.142 +/- 1.039    | 2.752 +/- 0.228   | -0.043 +/- 1.025   | -0.157 +/- 0.151  |
| DSC 124 | 3, B3, 123, 123             | -2.118 +/- 0.923   | 3.577 +/- 0.213   | 0.047 +/- 0.924    | -0.107 +/- 0.161  |

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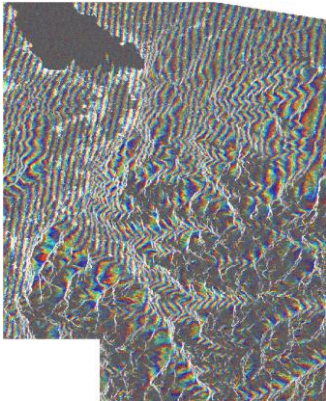
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# Differential SAR Interferometry

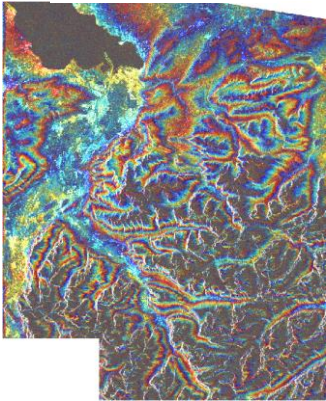


$$\varphi = \varphi_{\text{ellipsoid}} + \varphi_{\text{topography}} + \varphi_{\text{displacement}} + \varphi_{\text{atmosphere}} + \varphi_{\text{processing}} + \varphi_{\text{noise}}$$

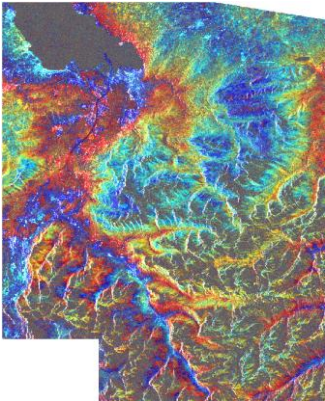
$\varphi$



$\varphi - \varphi_{\text{ellipsoid}}$



$\varphi - \varphi_{\text{ellipsoid}} - \varphi_{\text{topography}}$

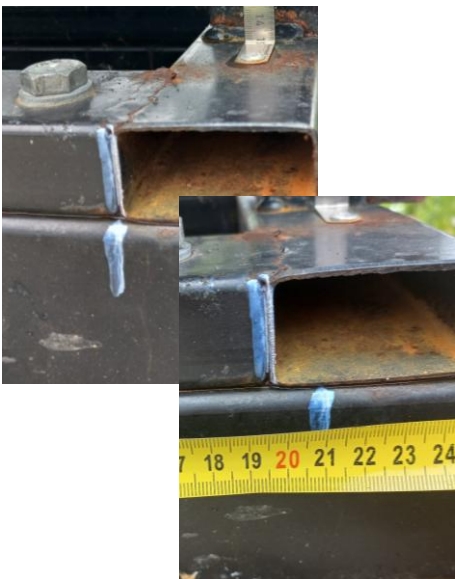


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## Thalerhof South

### Adjustable mounting



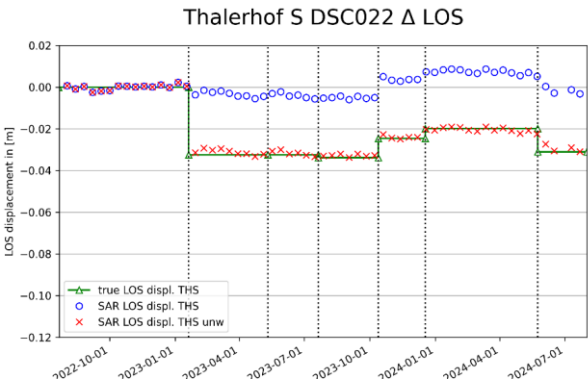
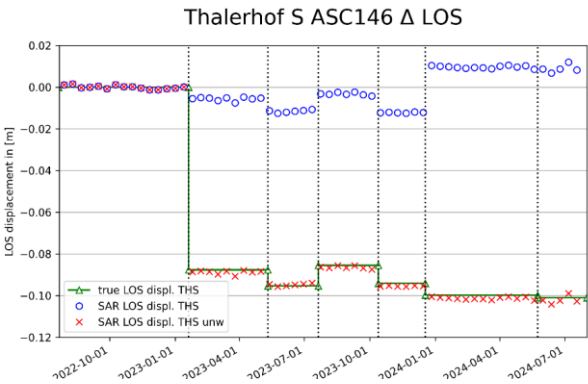
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## LOS Displacement Thalerhof South

Ascending orbit 146

Descending orbit 022



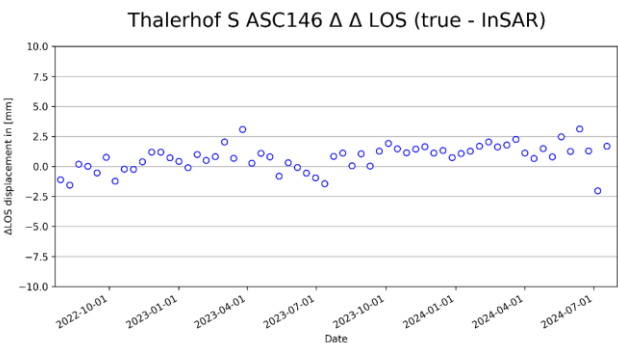
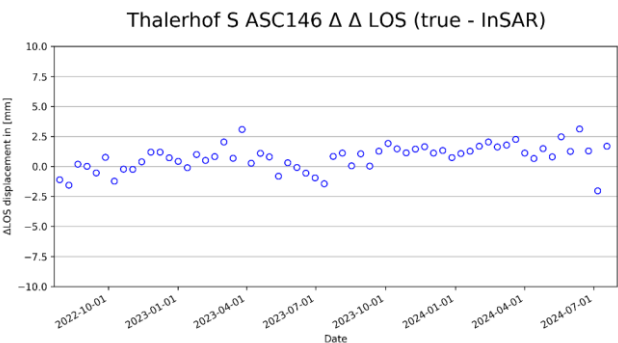
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## LOS Displacement Thalerhof South

Ascending orbit 146

Descending orbit 022



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CEOS SARCalNet

https://www.sarcalnet.org/dynamic-calibration-site/?site\_id=332



Home - Calibration Sites - Library - Glossary Resources - Contact CEOS-WGCV - SAR Subgroup

### Calibration Site GRAZ-AT

Geolocation



Back to sites overview

Only operational

All directions

Side length

All purposes

Site description

|                                |                         |
|--------------------------------|-------------------------|
| Unique site identifier         | GRAZ-AT                 |
| Site name                      | Graz                    |
| Country                        | Austria                 |
| Province / State / Region      | Styria                  |
| Primary target type identifier | AT - Artificial Targets |
| Target types                   | CR                      |
| Primary sensor                 | Sentinel-1              |

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THANK YOU!

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FUTURE, TOGETHER

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