MSI and BBR geolocation and coregistration performance assessment: an update

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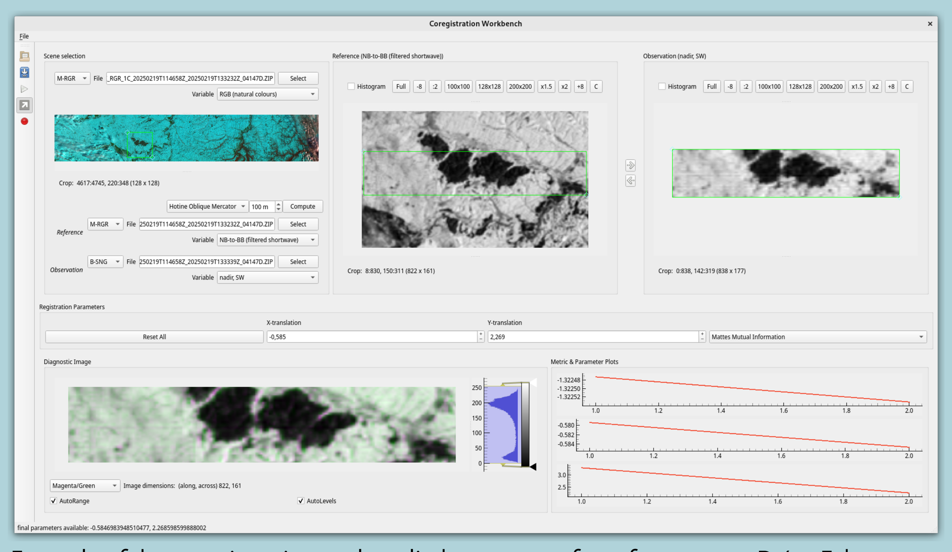
Introduction

The accuracy of the geolocation of the MSI and BBR L1b results is an integral part of the data quality. After all, of what use are the radiance values if their position can't be known accurately? A similar argument applies to the MSI L1c regridded results. Any misalignments in the L1c will cause problems in downstream applications (e.g., cloud masks). To evaluate the geolocation and coregistration performance, the EarthCARE DISC team (and before that, the CARDINAL team) has developed a set of specialized tools.

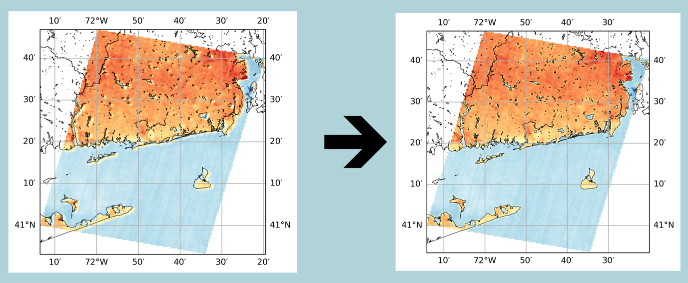


Example of the coregistration tool applied on a scene from frame 04147D (19 February 2025), co-registering MSI narrowband-to-broadband estimated filtered shortwave, to BBR nadir SW measurements. An across-track displacement of about +/-250m is estimated by the optimization.

Registration method

- Evaluate registration between two images = intensity-based image registration
- Input = reference + 'observation'
- Optimization algorithm that maximizes Mutual Information (MI) metric (≈ similarity between images that are not necessarily linearly correlated)
- The output of the optimization = translation of observation to match reference image

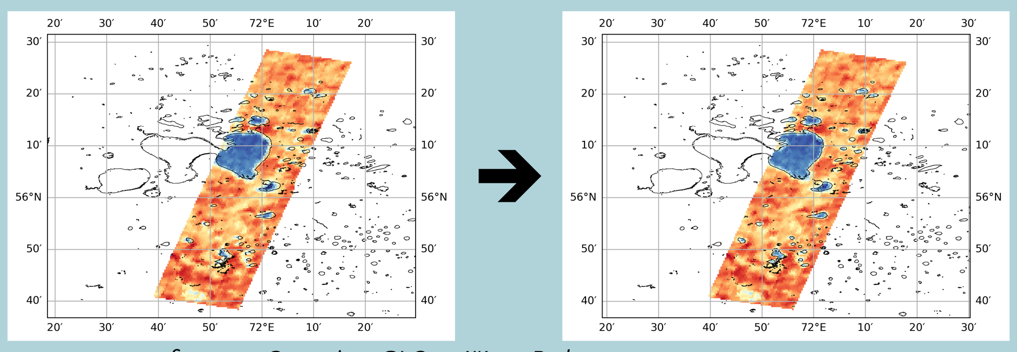
MSI



contours = reference = Copernicus GLO-30 Water Body Mask (~30m spatial resolution)

M-NOM frame 22269D (baseline AD), TIR3 (descending orbit)
rectified grid, 500 m, Hotine Oblique Mercator, grid azimuth 12.79°
along-track correction: 393 m (backwards w.r.t. direction of flight)
across-track correction: 913 m

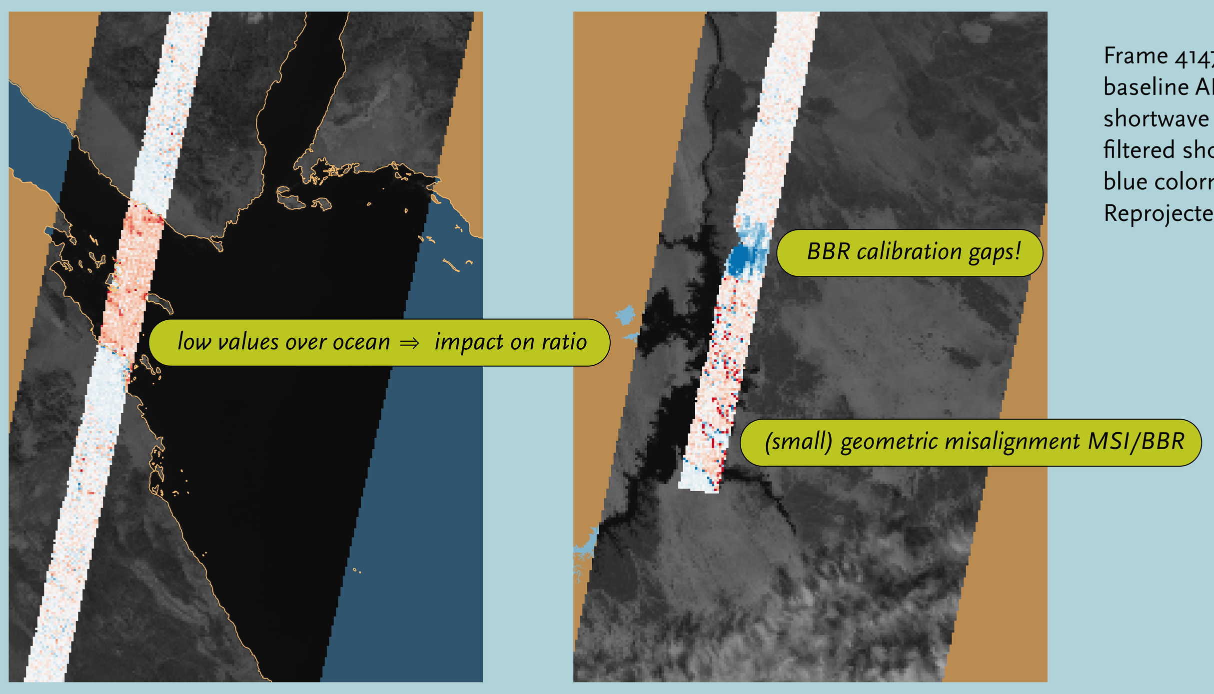
BBR



contours = reference = Copernicus GLO-30 Water Body Mask (~30m spatial resolution)

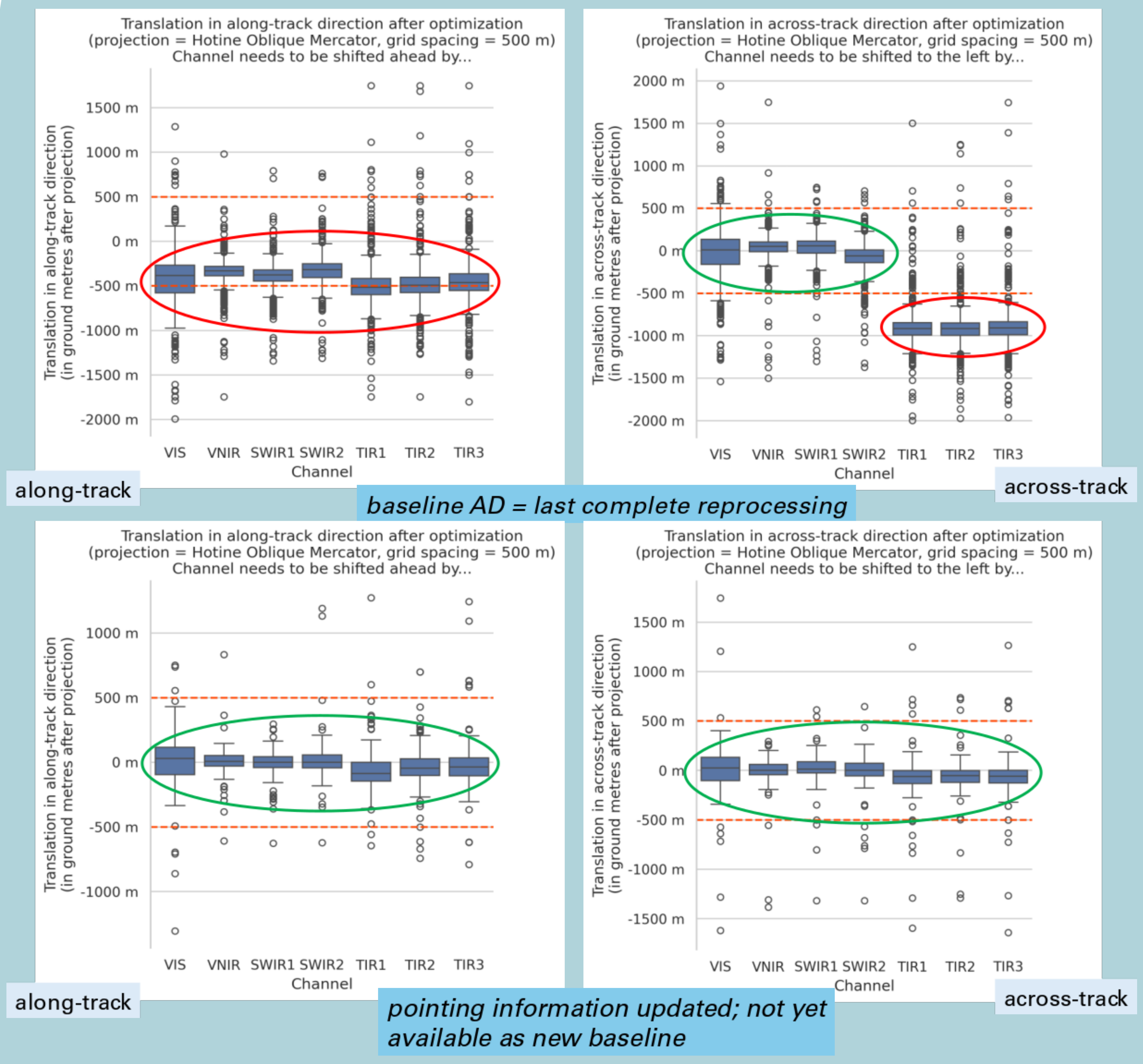
B-SNG frame 2014D (baseline AC), nadir, SW (= descending orbit)
rectified grid, 500 m, Hotine Oblique Mercator, grid azimuth 14.52°
along-track correction: 165 m to the North (= backwards w.r.t. direction of flight)
across-track correction: 558 m to the East

Narrowband-to-broadband

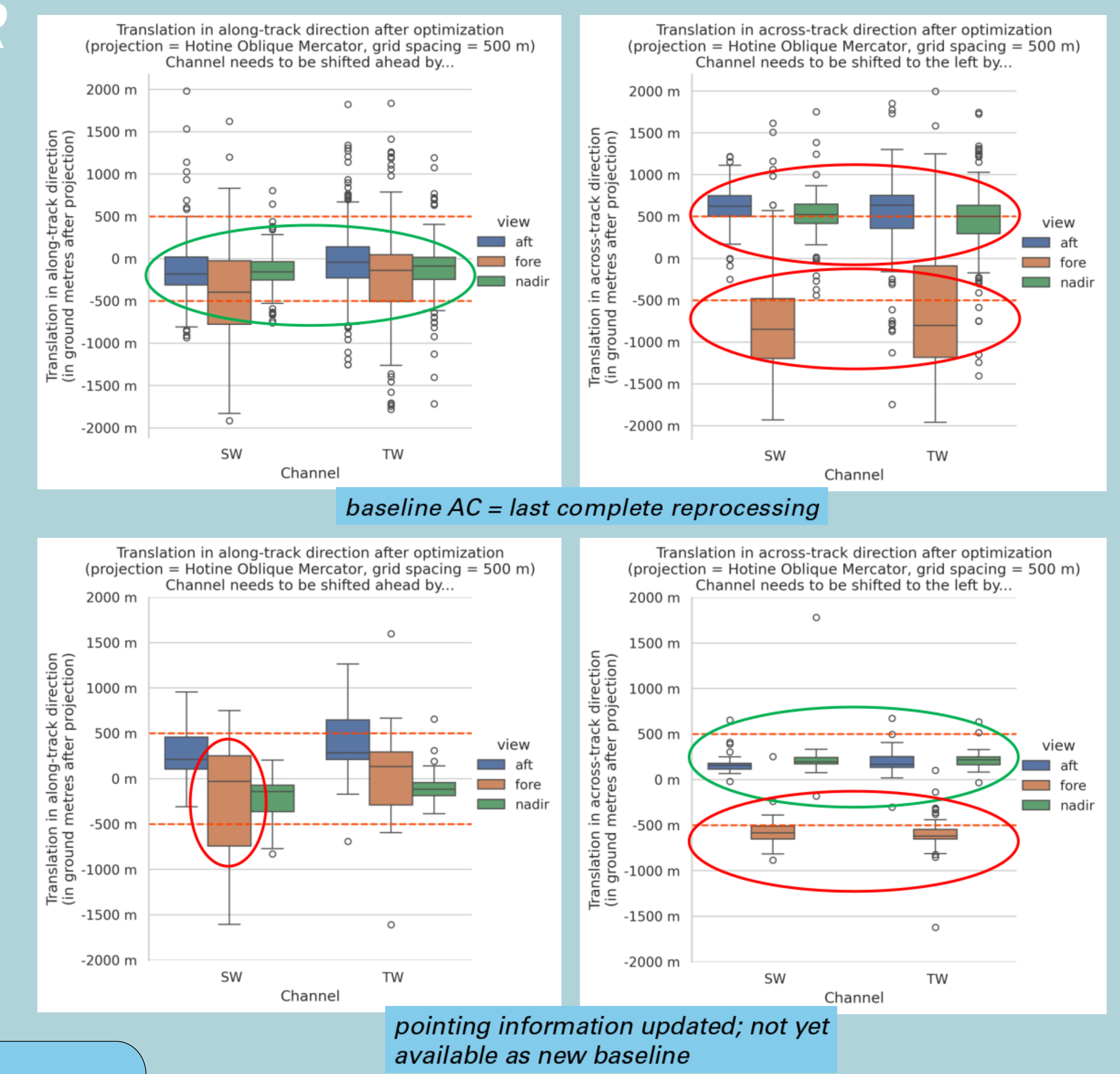


Frame 4147D (19 February 2025 11:46:58Z, baseline AF for M-RGR, baseline AD for B-SNG), MSI narrowband-to-broadband filtered shortwave radiance shown in greyscale, log ratio of MSI NB-to-BB filtered shortwave to B-SNG filtered shortwave radiance with a red/blue colormap, Copernicus GLO-30 Water Body Mask background. Reprojected to latitude/longitude grid with 0.01° box size.

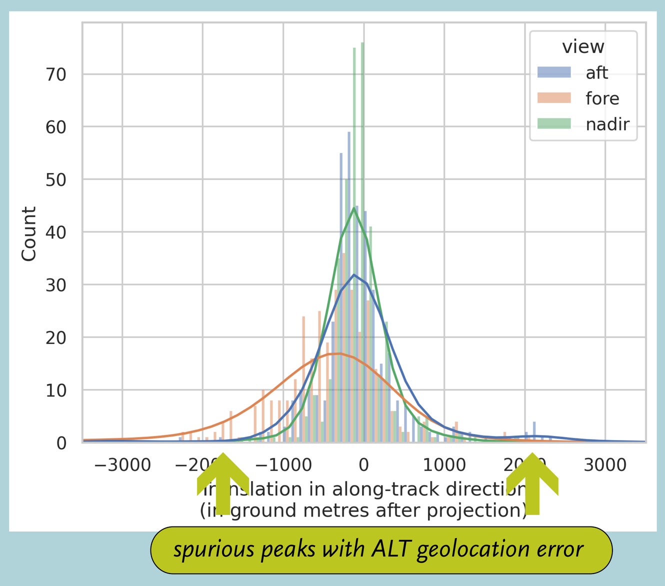
MSI



BBR



The geolocation of the B-SNG product is generally good, but there are still areas with significant geolocation error. The geolocation errors seems to be limited to the off-nadir views, but it is not understood why they are happening. Investigation is ongoing.



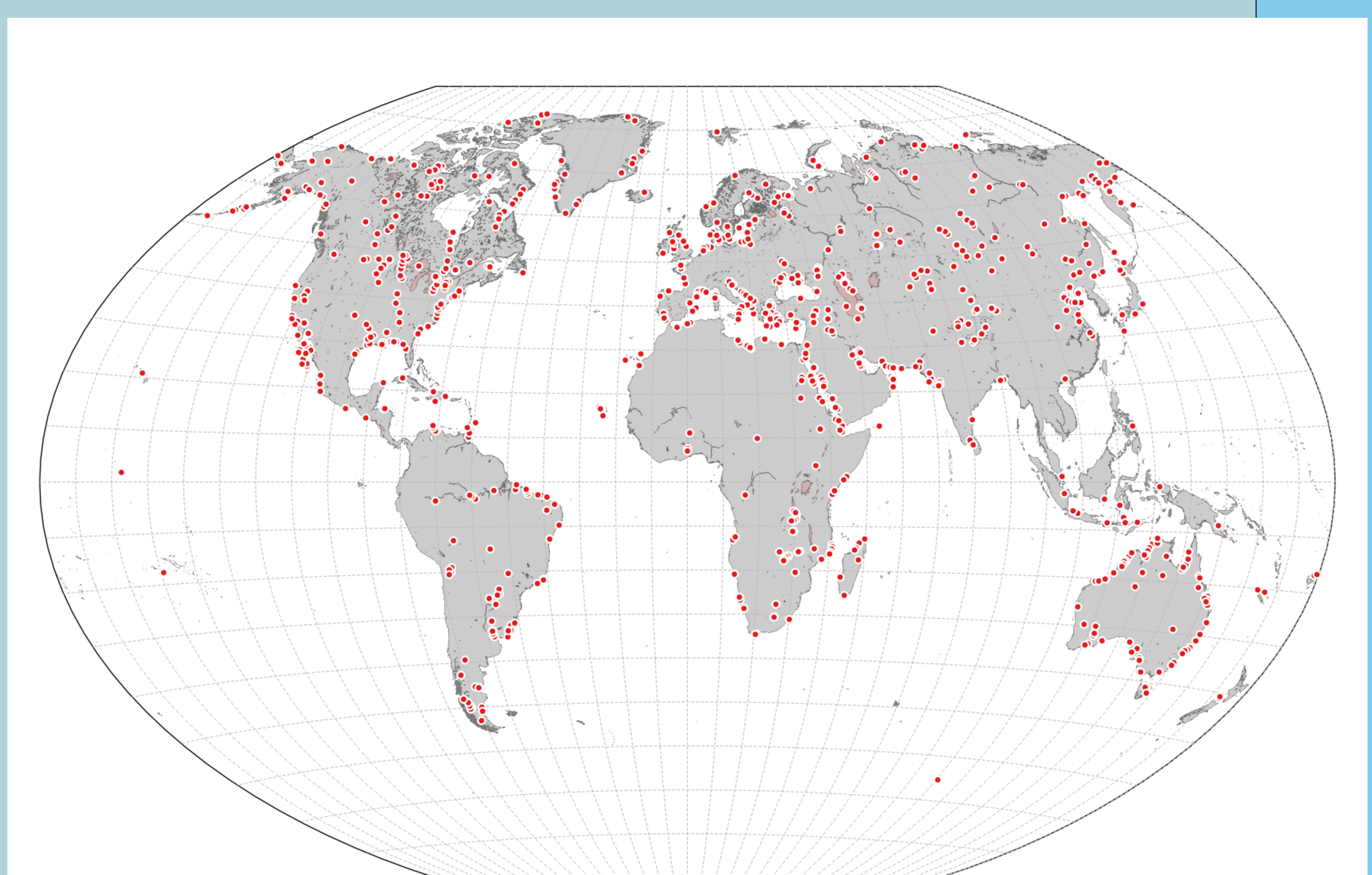
Automation

Automatic extraction of clear-sky scenes that could be useful for geolocation & coregistration assessment:

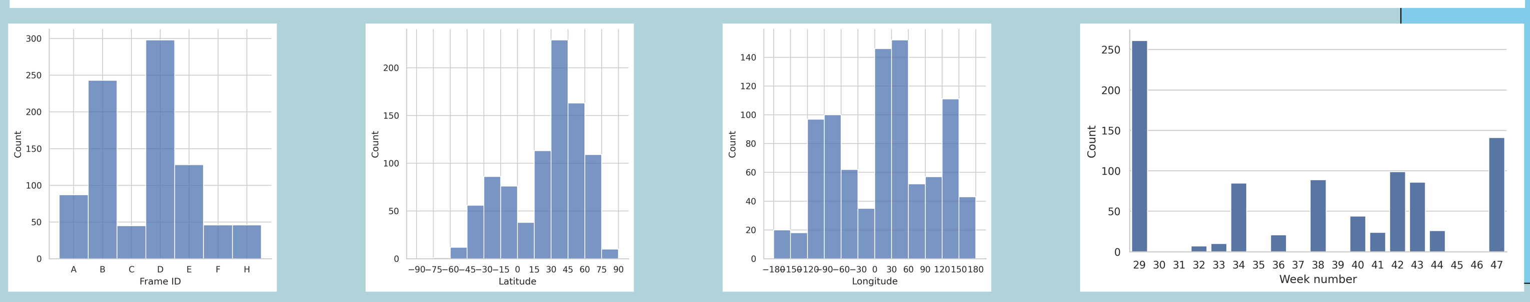
- *Use a global (static) map of high-curvature areas*
- *Combine with M-CM information (improvements in cloud detection since M-RGR baseline AF)*
- *Optimization algorithm selects 'best' locations*

Excerpt of the 'curviness' map over Europe, highlighting the areas of interest for the automatic scene detection

Scenes



893 scenes, 336 frames, 144 orbits, 18 July – 24 November 2024



ecaio

A Python library for convenient ingestion of EarthCARE data

- Open .zip-files directly
- Convenient syntax for dataset access, e.g., "radiance = msi_rgr.pixel_values"
- Data are cached
- Recipes for derived quantities (e.g., VNS reflectance, TIR radiance, RGB composites, narrowband-to-broadband conversion, frame margins
- Automatically mask values from bad BBR detectors
- Easy conversion of EarthCARE time stamps
- Generic file opening with EcaioOpen()
- Fast spatial subsetting

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