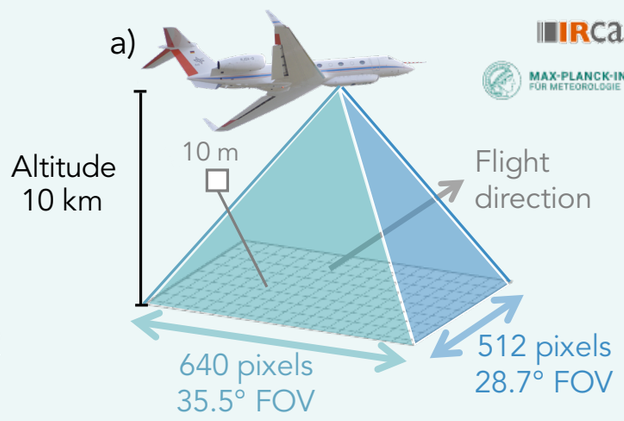
Validation of EarthCARE MSI thermal-infrared radiation measurements – First comparisons to airborne spectral imaging during PERCUSION (EVID03)

S. Rosenburg[1], A. Hünerbein[2], M. Schäfer[1], A. Ehrlich[1], A. Luebke[1], J. Müller[1], S. Groß[3], and M. Wendisch[1]

[1]Leipzig Institute for Meteorology (LIM), Leipzig University [2]Leibniz Institute for Tropospheric Research (TROPOS) [3]German Aerospace Center (DLR)

1. VELOX Video airborn**E** Longwave **O**bservations within si**X** channels

- Actively cooled thermal-infrared imager onboard HALO [1]
- 2D brightness temperature (BT) fields in channels similar to MSI TIR channels:



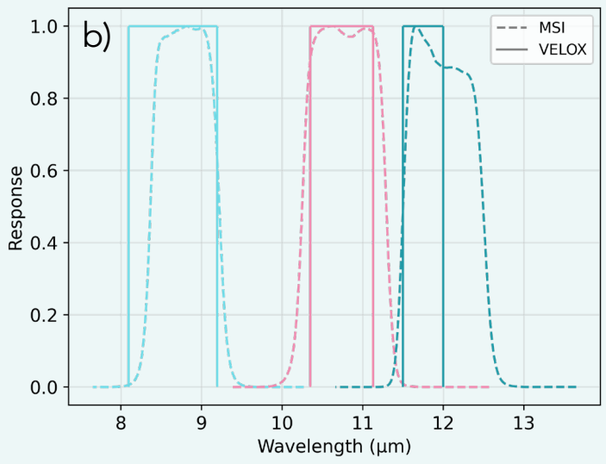


Fig. 1: a) VELOX measurement geometry. b) Comparison of spectral response functions for MSI [2] and VELOX.

2. Comparison strategy

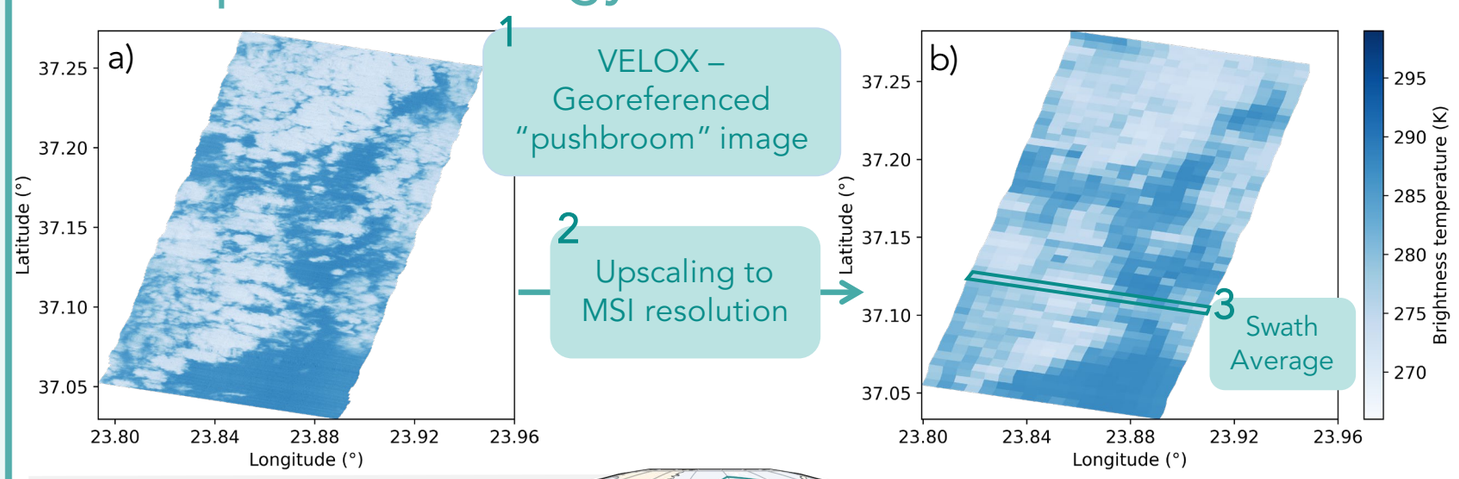


Fig. 2: a) Georeferenced VELOX pushbroom image, upscaled to MSI resolution (500 m) in b).

Selected 3 HALO-EarthCARE underpasses during PERCUSION ORCESTRA

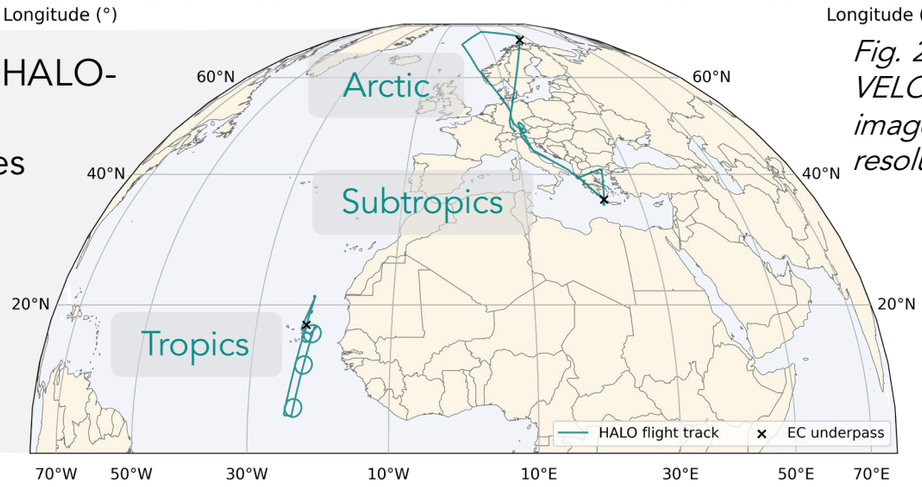
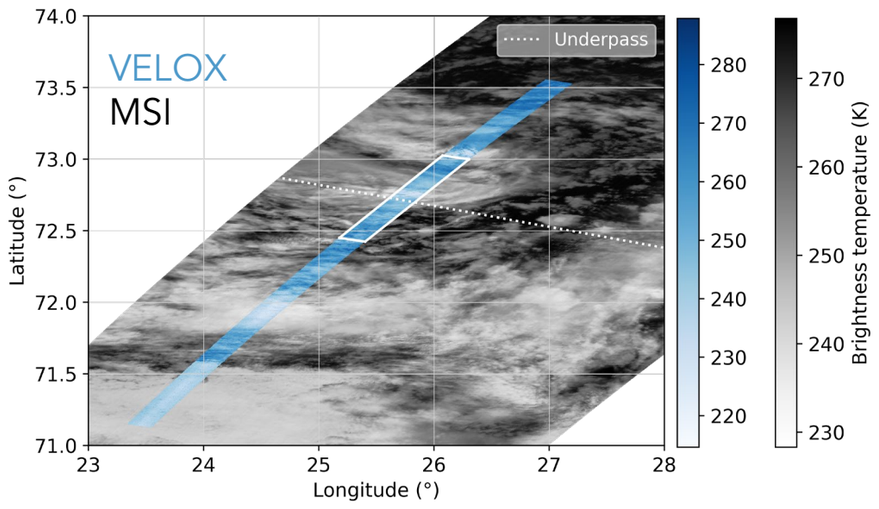


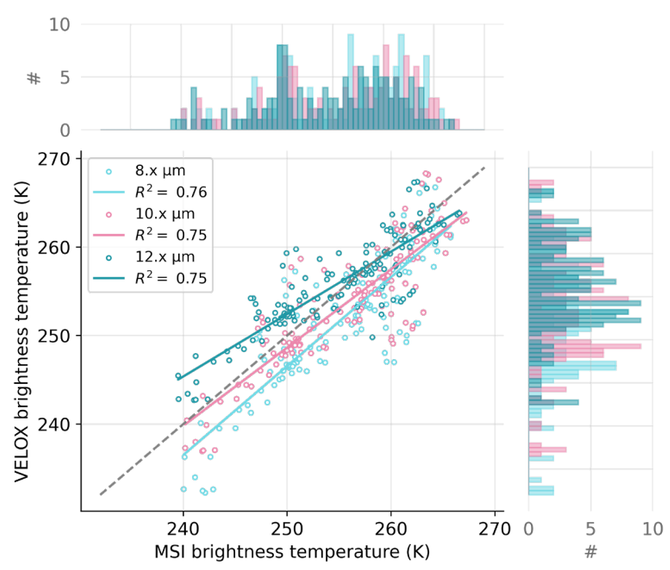
Fig. 3: Map showing flight tracks and EC underpasses of HALO flights during PERCUSION.

3. Results Comparing spatially matched swath averages

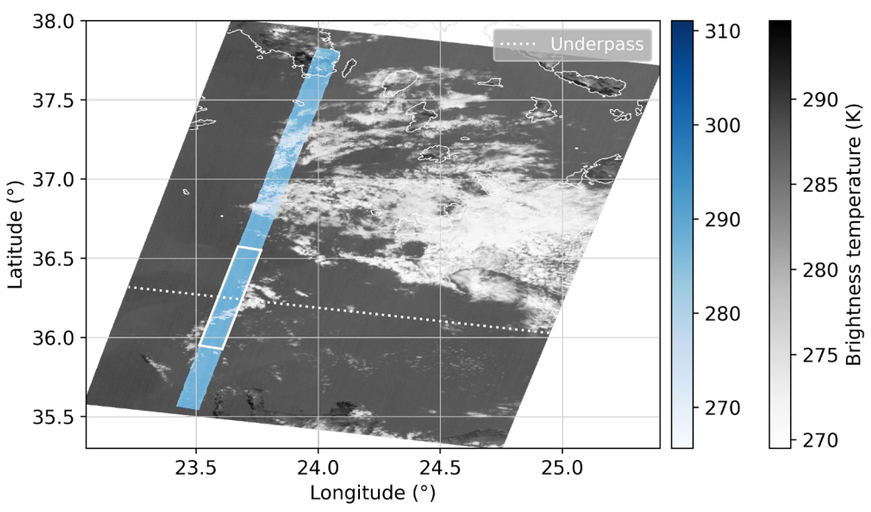
Uncalibrated (!) VELOX data
MSI RGR 1C Baseline AF

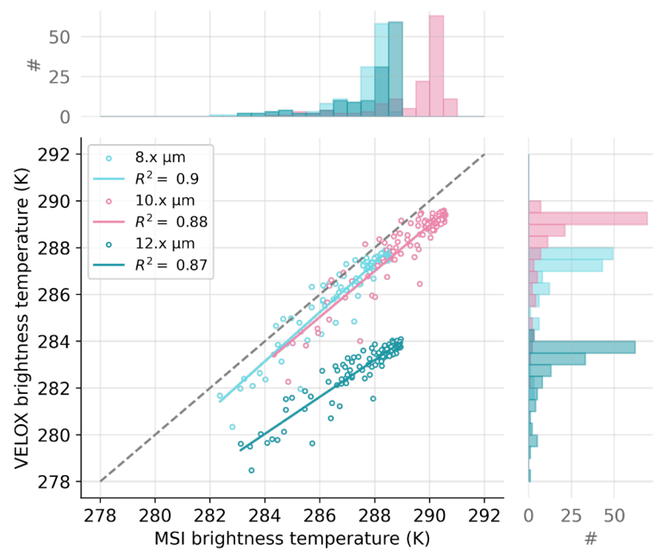
Arctic (2024-11-14)



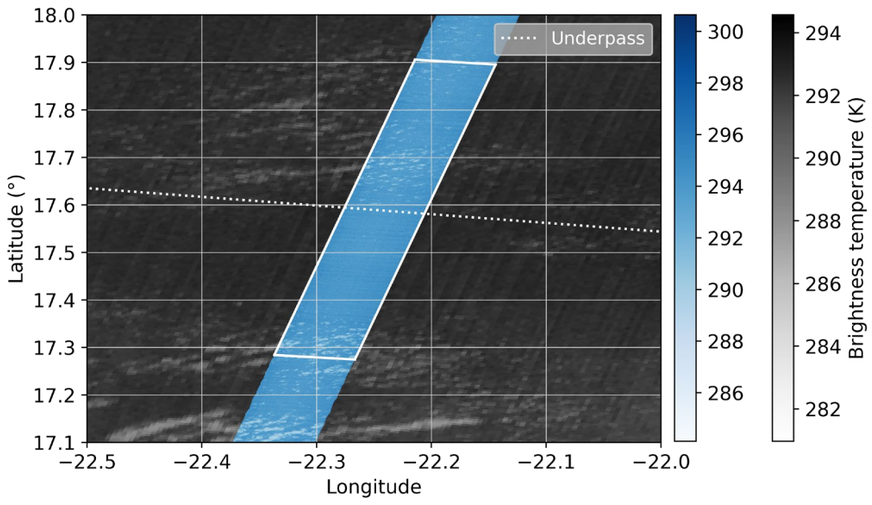


Subtropics (2024-11-19)





Tropics (2024-08-13)



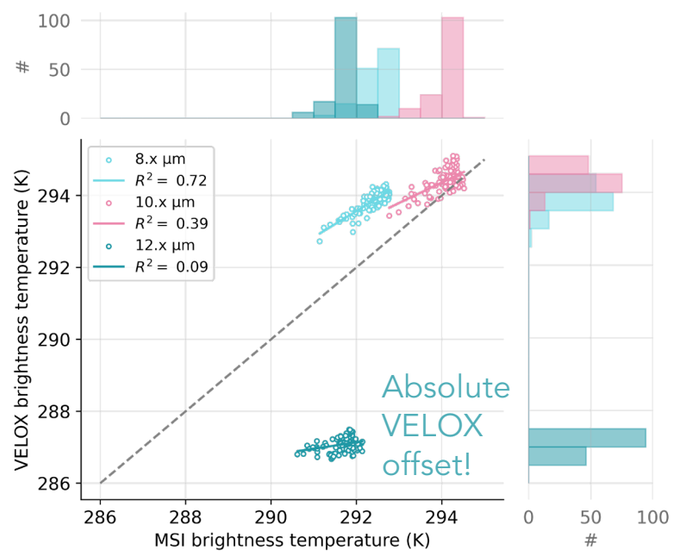


Fig. 4: Left: VELOX BT pushbroom image mapped onto MSI BT image for respective 8.x µm channel and for all three cases shown in Fig 3. Right: Comparison of spatially matched MSI and VELOX BTs and their distribution.

4. Potential differences

- Absolute offset in VELOX data
- Spectral response functions (Fig. 1b)
- Flight altitude – TOA BT differences

Radiative transfer simulations (libRadtran) with tropical ERA5 atmospheric profile for TOA and flight altitude, and response functions

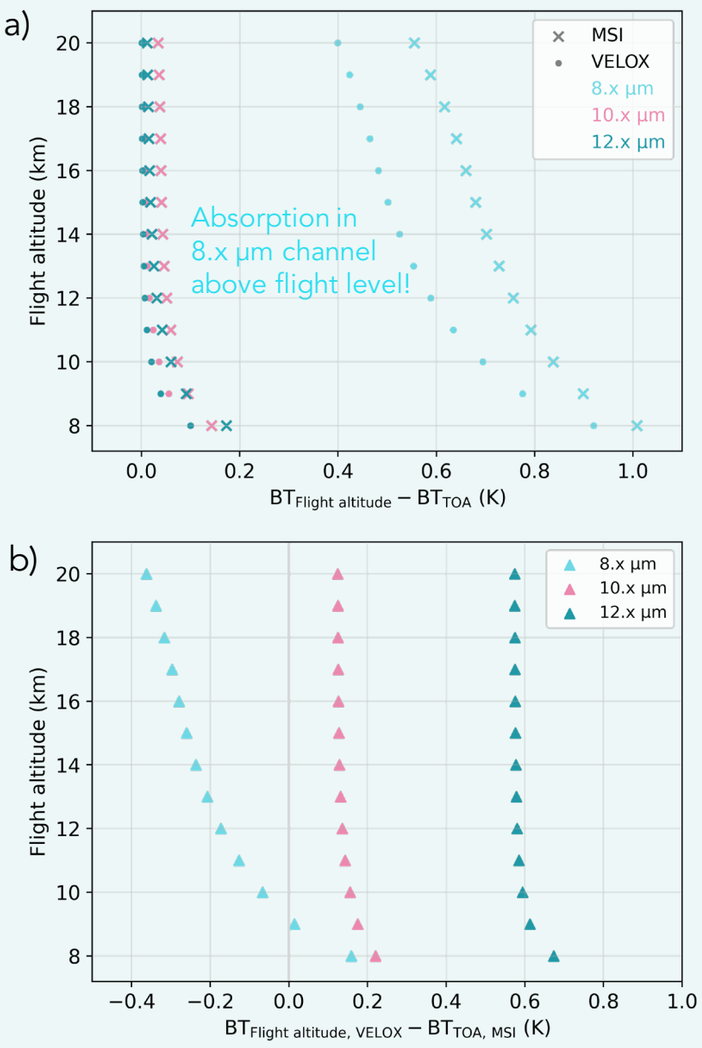


Fig. 5: a) Comparison of simulated BTs for different altitudes and spectral channels. b) Same as a), but adapted to validation comparison.

5. Next steps

- General quantification of TOA – flight altitude brightness temperature difference
- Analyzing importance of resolution for different cloud products (500 m vs. ~10 m) in context of radiative impacts

2nd ESA-JAXA EarthCARE In-Orbit Validation Workshop
17–20 March 2025 | ESA–ESRIN | Frascati (Rome), Italy

REFERENCES

[1] M. Schäfer, K. Wolf, A. Ehrlich, et al., *Atmos. Meas. Tech.*, **15**, 1491-1509 (2022).
[2] RTTOV (https://nwp-saf.eumetsat.int/site/software/rttov/download/coefficients/, 11.03.2025)