Antarctic Pseudo-Invariant Reference Sites for IRIDE Radiometric Calibration and Polar Earth-Observation Consistency

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IRIDE vs Sentinel-2: two radiance regimes

1. Mid-latitudes: Contrast

Within the mid-latitude range, Sentinel-2 increases 1.20–1.34 times faster than IRIDE, with a negative offset (Fig. A): the IRIDE response depends on the signal level. It is corrected with a linear fit (Huber, cell level).

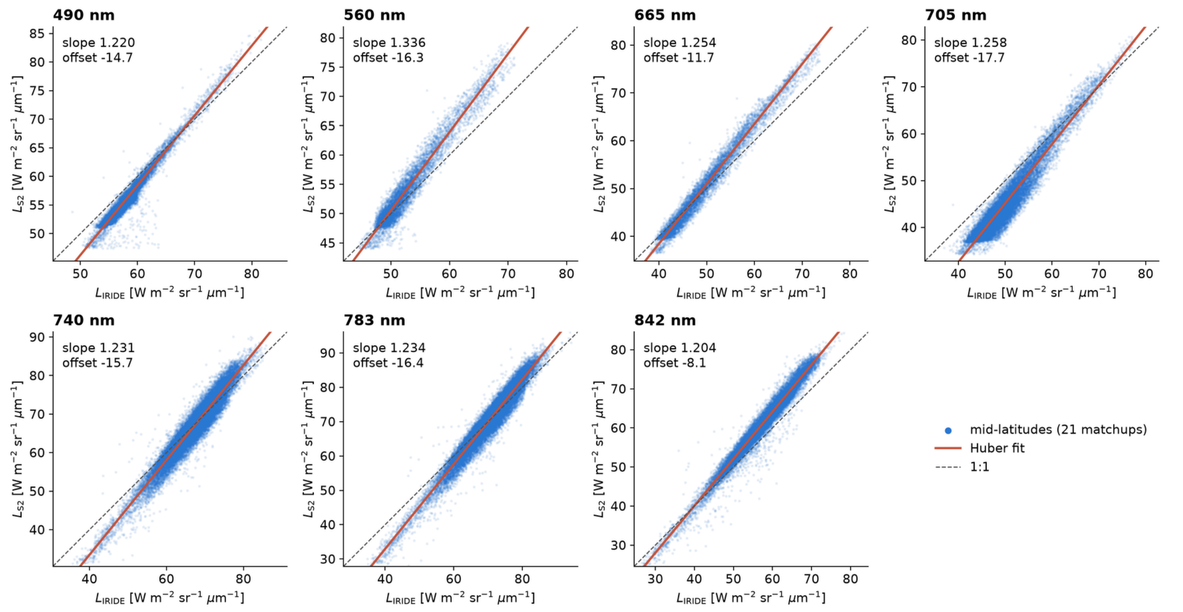


Fig. A: Mid-latitudes IRIDE vs Sentinel-2 TOA radiance per band, 200 m cells from 21 matchups (Aug–Sep 2026). Sentinel-2 brought to the IRIDE illumination geometry. Red: Huber fit; dashed: 1:1. The slope is well above 1: the IRIDE response depends on the signal level.

2. Snow: bias

Within the snow range, IRIDE and Sentinel-2 follow the 1:1 slope with a constant offset in ratio (Fig. B): no level dependence is visible, only a bias. It is corrected with one ratio per band, derived on 5 Dec 2025 and tested on two independent dates.

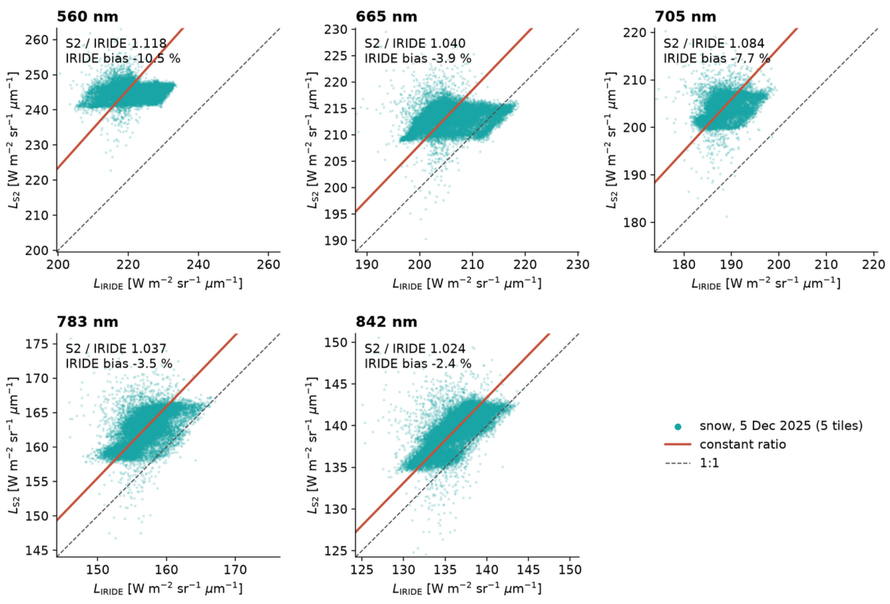


Fig. B: Snow, East Antarctic Plateau, 5 Dec 2025: IRIDE vs Sentinel-2 TOA radiance per band, 200 m cells from 5 tiles (11 min apart). Red: constant ratio r; dashed: 1:1. IRIDE is lower than Sentinel-2 by a constant fraction: a bias. 490 nm is saturated on snow.

Methods

Across-track flat field

Non-uniformity across the sensor.

Over the flat, homogeneous snow of the East Antarctic Plateau, the uncorrected IRIDE images show across-track striping: the signal changes from one side of the swath to the other. Since the snow is uniform, this variation comes from the detector. The L1B column profiles confirm it: the same across-track shape, up to ±6 % at 560 and 665 nm, appears on every tile and on all three dates.

Correction. A flat field is derived from the L1B column profilesr. After correction the across-track variation is below 2 % (Fig. D).

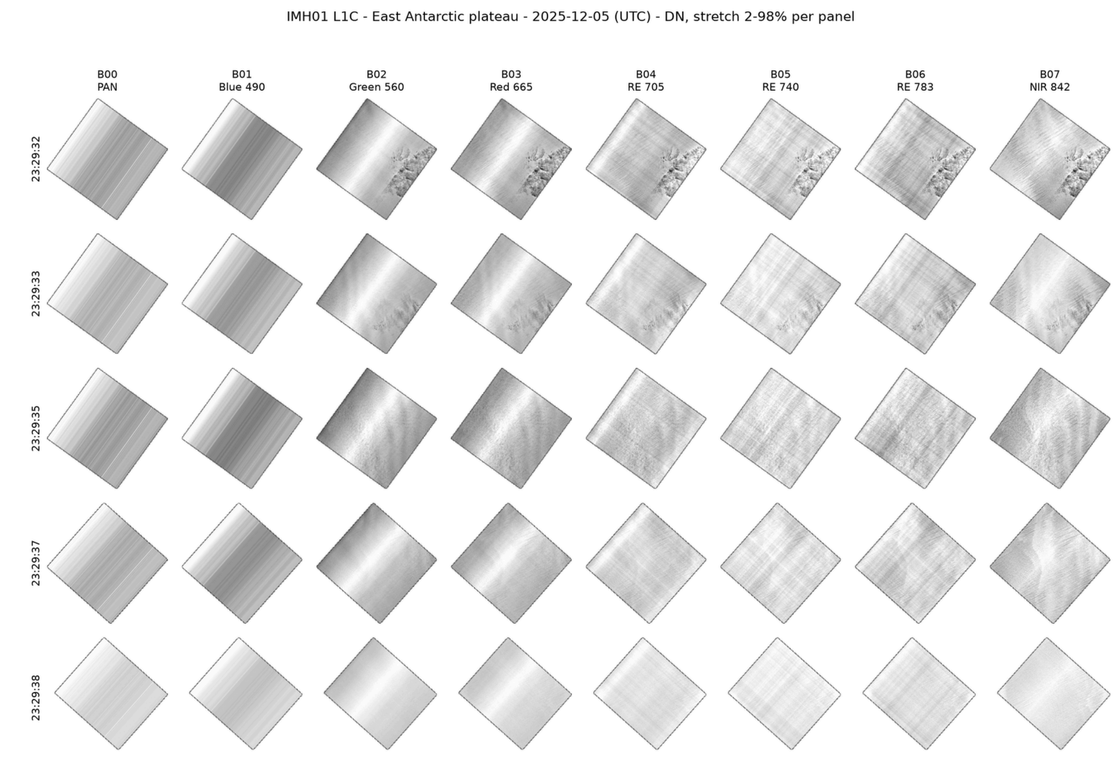


Fig. C: L1C images over Antarctica, stretch per panel

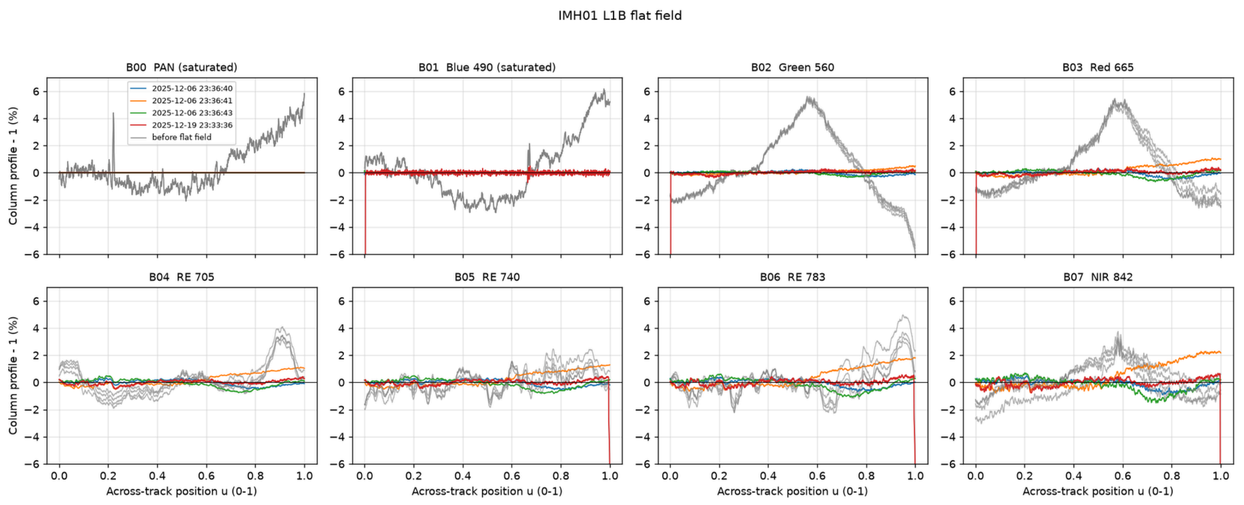


Fig. D. Across-track profile of IMH01 L1B radiance over the East Antarctic Plateau, per band (6 and 19 Dec 2025). Grey: before the flat field; colour: after the flat field, one line per tile. Profile: median of each detector column, shown as deviation from the mean (%).

Results

$$L_{S2} = a\, L_{IRIDE} + b$$

λ (nm)	490	560	665	705	740	783	842
Slope a	1.220	1.336	1.254	1.258	1.231	1.234	1.204
Intercept b [W m^{-2} sr^{-1} µm^{-1}]	−14.7	−16.3	−11.7	−17.7	−15.7	−16.4	−8.1
Residual, median	0.0 %	−0.1 %	−0.1 %	−0.2 %	−0.1 %	+0.7 %	+0.4 %
Residual, rms	2.1 %	2.2 %	1.8 %	3.8 %	2.9 %	2.5 %	1.3 %

$$L_{S2} = r\, L_{IRIDE}$$

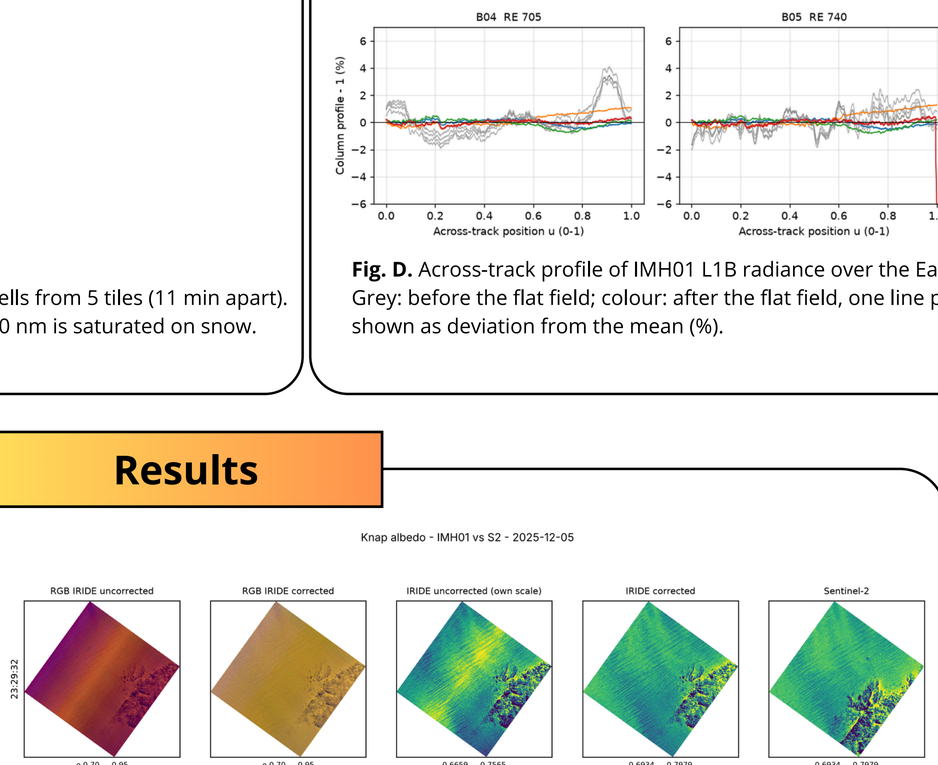
λ (nm)	560	665	705	740	783	842
Ratio r	1.118	1.040	1.084	1.046	1.037	1.024
IRIDE bias	−10.5 %	−3.9 %	−7.7 %	−4.4 %	−3.5 %	−2.4 %
Residual, 6 Dec	+0.6 %	+0.7 %	+0.3 %	+0.3 %	+0.3 %	+0.4 %
Residual, 19 Dec	+1.0 %	+0.9 %	+0.3 %	0.0 %	−0.1 %	+0.9 %

≤ 1%
bias vs S2, independent dates

1.3-3.8%
rms residual, mid-latitudes

r ≈ 0.92-0.93
snow indices vs S2

~6% — < 2%
across-track non-uniformity



Limitations & Next Steps

- One satellite only (**IMH01**); flat field from one date

Next:

- same chain on IMH02 and the other IRIDE MS satellites
- add the signals of more scenes to the flat field estimate.