1st ESA-JAXA EarthCARE In-Orbit Validation Workshop Report

14-17 January 2025 - online event

EC-RP-ESA-SYS-1554

Table of content

Introduction

Rob Koopman and Toshiyuki Tanaka

Introduction: EarthCARE mission

The Earth Cloud Aerosol and Radiation Explorer (EarthCARE) satellite mission, launched on 28 May 2024, is designed to advance our understanding of the role that clouds and aerosols play in reflecting incident solar radiation back out to space and trapping infrared radiation emitted from Earth's surface.

Developed within ESA's Earth Observation FutureEO programme, EarthCARE is the largest and most complex satellite in the series of Earth Explorer missions.

EarthCARE is a joint venture between ESA and JAXA, the Japan Aerospace Exploration Agency. JAXA provides the cloud profiling radar instrument. Both agencies have developed dedicated data products which have been subject to validation.

Introduction: workshop

The 1st ESA-JAXA EarthCARE In-Orbit Validaton Workhop addressed each of the four instruments on board:

- The ATmospheric LIDar ATLID,
- the Cloud Profiling Radar (CPR),
- the Multi-Spectral Imager (MSI), and
- the Broad Band Radiometer (BBR).

This in-orbit workshop follows several pre-launch validation workshops, and opens a series of in-orbit workshops. The first three of these are aligned with releases of products to the public.

- This 1st in-orbit validation workshop coincided with public release of the EarthCARE Level 1 products.
- The 2nd workshop, held from 17 to 20 March 2025 in Frascati, Italy, coincides with public release of the EarthCARE Level 2a and 2-sensor Level 2b products.
- The 3rd workshop, held from 1 to 5 December 2025 in Tokyo, Japan, addresses both Science and Validation, and is the first of a series of annual workshops that combine both these themes. This 2025 EarthCARE Science and Validation Workshop coincides with the public release of the 3- and 4-sensor products.

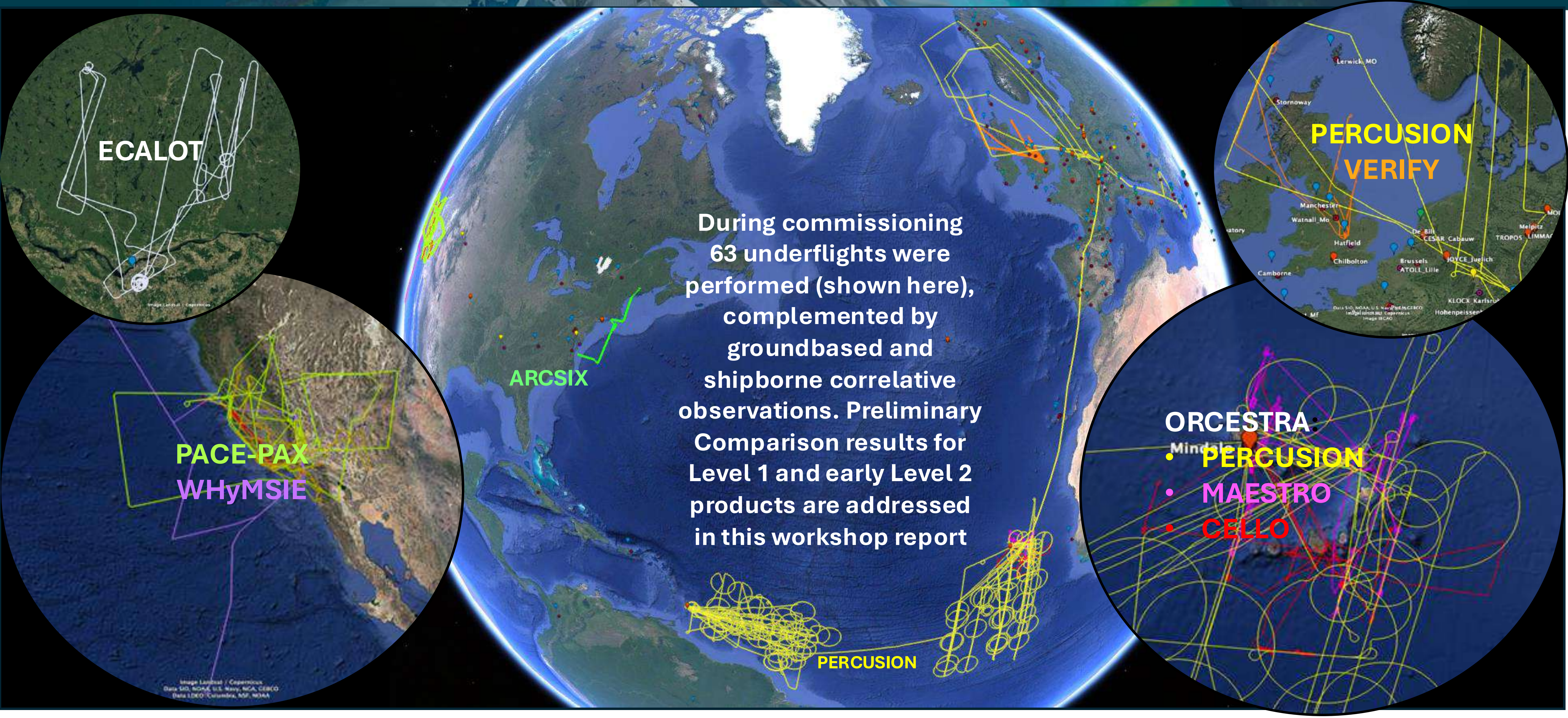
The objectives of the first in-orbit validation workshop were as follows:

- Discuss findings from initial validation activities addressing Level 1 and show early results from validation of Level 2 products.
- Formulate recommendations for product improvements
- Inform the broader scientific community of the quality of the publicly-released level 1 datasets

This online event was attended by 345 unique participants over the 4 days, with instantaneous peak attendance of 235 persons. The presentations will be uploaded to the workshop website:

https://www.earthcare-validation-2025-1.org

Introduction: Commissioning-Phase collaborative and dedicated Airborne Campaigns



During commissioning 63 underflights were performed (shown here), complemented by groundbased and shipborne correlative observations. Preliminary Comparison results for Level 1 and early Level 2 products are addressed in this workshop report

Report of BBR session

Nicolas Clerbaux, Jason Cole, Kentaroh Suzuki,
Almudena Velazquez

BBR session – Tue., 14 January 2025

BBR session (Co-chairs: Jason Cole, Nicolas Clerbaux, Kentaroh Suzuki)					
14:15	22:15	8:15	10	BBR Integrated Commissioning Team presentation	Emilio Alvarez
14:25	22:25	8:25	15	BBR Level 1 product verification	Nicolas Clerbaux
14:40	22:40	8:40	10	BBR Geolocation	Edward Baudrez
14:50	22:50	8:50	10	EarthCARE BBR Level 1 Products Assessment within BRAVO project	Christine Aebi
15:00	23:00	9:00	10	BBR Level 2 verification results	Almudena Velazquez
15:10	23:10	9:10	15	Early validation of JAXA four-sensor radiation product	Takashi M. Nagao
15:25	23:25	9:25	10	CERES and EarthCARE Intercomparison Opportunities	Alexander Jarnot
15:35	23:35	9:35	15	Discussion	(Co-chairs)

BBR session – Summary of the talks 1/2

Emilio Alvarez reported about the In-Orbit commissioning of the BBR. In general, everything ran smoothly, and the instrument is performing as expected. All commissioning requirements were fulfilled.

Nicolas Clerbaux reported on overall good quality of the B-SNG product. Some possible improvements in the L1 software and CCDB have been identified (the 'B' values). Preliminary comparison with CERES FLASHlux shows that the SW (LW) radiances might be biased high (low) with respect to CERES.

Edward Baudrez : reported about the overall good quality of the BBR geolocation (well within the 1km requirement) although some instabilities have been observed in (very limited) areas.

Christine Aebi : reported on the quality of the B-NOM product. She showed that the radiometric levels of the aft and fore views agree quite closely. The analysis also shows consistency between the different integration domains (except for the "full" domain due to the dead pixel).

BBR session – Summary of the talks 2/2

Almudena Velazquez Blazquez : showed preliminary assessment of the BBR L2 products (BM-RAD, BMA-FLX) with focus on the fluxes. She showed that the co-registration of the 3 views at the SW/LW reference level is in general working well. Flux comparison with CERES FLASHflux is in line with the radiance comparisons (i.e. brighter in SW, cooler in LW). In addition, the BMA-FLX product is compared with fluxes from ACM-RT, showing sometimes large discrepancies that are under investigation.

Takashi M. Nagao : reported on the development of the JAXA synergy radiation product (ALL-RAD) and on the early validation results using the BMA_FLX product. ALL_RAD and BMA_FLX exhibit low bias on a global average but strongly depends on land/water and day/night conditions, and the bias of SW flux is amplified when covered by clouds.

Alexander Jarnot : detailed how the CERES FM6 instrument could be operated in special scanning mode to optimize angular matching with the 3 BBR views. He also reported that the FLASHflux product quality should be close to the CERES edition products.

Stelios Kazadzis : summarized plans for participation in validation campaigns in Greece for radiative closure, which will validate aerosol and cloud optical thickness and perform radiative closure using solar irradiance measurements and radiative transfer calculations.

Questions and Discussion : There was little time for questions and discussion during the BBR session.

Seed questions for discussion 1/2

Question 1 : What has been identified by the validation teams as aspects to improve and are there clear/proposed ways to address that?

- Edward Baudrez : possibility to improve the B-SNG geolocation
- Biases : need to improve but way forward not yet clear

Question 2 : What are the positive aspects about the data, processors that can be highlighted from validation team results?

- Excellent data availability
- Very stable instrument, no anomalies
- Detector noise level better than requirements → BBR could be useful at finer spatial resolution than 10x10km.

Question 3 : What are the aspects that are yet to be validated?

- Nobody reported about the Solar Calibration (each 2 months) so far
- fore and aft view radiometric level (CERES?)

Seed questions for discussion 2/2

Question 4 : What should be noted to the public about the quality of the released L1 data?

- Provide more comprehensive information on how to interpret the BBR filtered radiances in B-SNG and B-NOM

Question 5 : What recommendations/suggestions are there for future L1 / L2 validation activities (e.g. needs/gaps) and for mission planning?

- Compare the aft and fore views with CERES. Need of specific acquisition campaigns to match these views.
- Compare the computed surface flux with ground-based measurements (e.g. BSRN)

Highlights

- Smooth commissioning for the BBR
- Overall instrument is stable and reliable, very few interruptions since launch
- Noise level better than expected in the B-SNG product → possibility of using the BBR measurements at finer resolution than those of B-NOM
- Fine tunning of the CCDB needed (B values, …)
- Evaluation of BBR L2 confirms that BBR is working well and consistency of the 3 views
- Not many fiducial reference measurements available. Best to compare with CERES
- Both L1 and L2 activities reported that the BBR is brighter in the SW than CERES and LW is cooler (calibration under investigation)
- So far solar calibration data not exploited
- In general good geolocation but some instabilities in very limited regions

Recommendations

- Investigate possibility of developing L2 radiances and fluxes at finer resolutions (from B-SNG data)
- Update the CCDB to remove detector to detector variability
- Include fore and aft view in radiance comparisons with CERES (liason with CERES Team to organise specific campaigns)
- Review L1 and L2 processings to be sure of consistency with the BBR calibration (i.e., Spectral Response normalisation and limits, LW calculation, …)
- Quality of the solar calibration data need to be evaluated in view of its use for ageing characterisation

Report of ATLID session

Holger Baars, David Donovan, Tomoaki Nishizawa, Ulla Wandinger

Session summary

- **Two parts:**
  - **Tuesday afternoon (6 presentations)**
  - **Thursday afternoon (11 presentations)**
- **Excellent overview on validation efforts and impressive results for ATLID L1 and L2 products**

ATLID session - part 1 (Co-chairs: David Donovan, Holger Baars, Tomoaki Nishizawa)					
16:00	00:00	10:00	10	ATLID Integrated Commissioning Team presentation	Georgios Tzeremes
16:10	00:10	10:10	15	ATLID Level 1 product verification and validation needs	David Donovan
16:25	00:25	10:25	15	NRT quality monitoring using NWP (ECMWF)	Mark Fielding
16:40	00:40	10:40	10	Statistically based calibration/validation control of ATLID Level 1 products	Artem Feofilov
16:50	00:50	10:50	35	Results from NASA airborne campaigns (ARCSIX, PACE-PAX, WHyMSIE)	Johnathan Hair, Amin Nehrir
17:25	01:25	11:25	20	First results from the HALO PERCUSION campaign	Silke Gross
17:45	01:45	11:45	15	Discussion	(Co-chairs)

ATLID session - part 2 (Co-chairs: David Donovan, Ulla Wandinger, Tomoaki Nishizawa)					
14:50	22:50	08:50	10	Evaluation of ATLID aerosol products with AD-Net	Yoshitaka Jin/Tomoaki Nishizawa
15:00	23:00	09:00	20	First validation results from AECARE including the ATMO ACCESS pilot activity	Holger Baars
15:20	23:20	09:20	10	EarthCARE ATLID Level 1 intercomparison with ACROSS lidars (PI Marinou)	Eleni Marinou
15:30	23:30	09:30	10	First intercomparison between CARO Lidar and ATLID Level 1 over Cyprus, Limassol.	Rodanthi Mamouri, Hossein Panahifar
15:40	23:40	09:40	10	EMORAL lidar ATLID Level 1 data validation effort for various conditions and locations.	Iwona Stachlewska, Afwan Hafiz
15:50	23:50	09:50	10	LITES lidar in UK: intercomparisons with ATLID Level 1 and Level 2 products	Avinash Yadav
16:00	00:00	10:00	20	Discussion	(Co-chairs)
16:20	00:20	10:20	10	BREAK 2	
16:30	00:30	10:30	10	First results from the ECALOT campaign	Keyvan Ranjbar
16:40	00:40	10:40	15	First comparisons between ATLID and ATR42 during MAESTRO campaign (including early Level 2 if available)	Emmeline Francois/Julien Delanoe
16:55	00:55	10:55	20	ATLID early Level 2 validation results	Ping Wang, Moritz Haarig
17:15	01:15	11:15	10	ATLID Level 2 aerosol product monitoring with CAMS (ECMWF)	Will McLean
17:25	01:25	11:25	10	Early Level 2 product validations in central mediterranean	Giandomenico Pace
17:35	01:35	11:35	25	Discussion	(Co-chairs)

Overview of presentations

Overview of presentations

Georgios Tzeremes: Overview of instrument commissioning

Beginning of August ready for measurements inline with validation needs. Only 5 instrument anomalies so far. Laser energy very stable. Currently no need to change anything wrt laser. Lidar constant above expectation. Cross channel calibration needs improvement (e.g. detector sensitivity parameter but also transmission parameters, and offset characterization). Spectral stability very good.

David Donovan: ATLID Level 1 product verification and validation needs

General, good performance and L1 data of good quality. Some issues, but all solvable. DD highlighted that his talk is on caveats rather than the good performance as it's about validation needs. Known issues: Background and offset removal issue (now fixed), Radiation noise, Hot/Cold Pixels (measures in place), 20 km feature (Charge Transfer Efficiency related - not fixed yet), Depol channel issue (Offset bug fix improved depolarization but did not solve everything), Spectral cross talk (current coefficients agree with theoretical values, but not yet fully validated). Needs from ECVT: Range of good Cal/Val cases covering different conditions (day/ight, different polarization targets).

Mark Fielding: NRT quality monitoring using NWP (ECMWF)

Near real-time monitoring at ECMWF in place and working. Can detect malfunctions in near real-time (e.g. hot pixel). NRT monitoring is precursor for data assimilation. Results: Data quality appears excellent when compared to ECMWF model data, AC baseline agrees with Calipso mean values, PSC yet missing in model, improved background noise correction (AC compared to AA) can be confirmed with model, Rayleigh backscattering bias in Southern Hemisphere high latitudes increasing.

Overview of presentations

Artem Feofilov: Statistically based calibration/validation control of ATLID Level 1 products

Monitor several quality/stability control parameters. Did detect hot/cold pixel and other issues. General findings: Mean stratospheric signals are quite stable, both daytime and night-time ones, seasonal behavior of daytime noise as expected, high sensitivity of Mie/Rayleigh indicators to laser frequency offset, cross-polar channel indicator did not show sensitivity to these cases as expected. Beside these issues, the instrument behaves quite well.

Johnathan Hair: Results from NASA airborne campaigns

Presents results from 4 different campaigns: PACE-PAX, ARCSIX, WH2YMSIE + APEX. NASA is very impressed by ATLID performance. Results: L1 data in excellent agreement with HSRL-2; Cirrus: trend below and above cirrus similar, in cirrus different as expected; Weak smoke layers: good agreement in most parts; The 355 nm attenuated molecular backscatter is within 1% (5%) of the HSRL-2 measurement in the free troposphere (close to the surface). ATLID's Level 1B molecular and Mie channels are impressively accurate, ATLID cross-polarized channel shows lower values than HSRL. Outlook: additional flights during NightBlue with 355 nm HSRL out of Bermuda in September 2025.

Silke Gross: First results from the HALO PERCUSION campaign

3 areas of operation with airborne HSRL (532 nm): Cabo Verde, Barbados, Europe. Findings: Rayleigh signals look fine but partly show cross-talk (e.g. in dust layers); Negative offset in Mie in low-aerosol regions; Optical thickness seems to be higher in ATLID compared to Wales for Cirrus (multiple scattering?); Depolarization too low in Cirrus. Generally, night-time observations show a better agreement. Prototype L1 data shows improved but not satisfying depolarization values while Mie-copolar data was not improved.

Overview of presentations

Yoshitaka Jin: Evaluation of ATLID aerosol products with AD-Net

AD-NET: Asian Lidar Network with partly HSRL capabilities, 355 nm HSRL at Koganei, + 2-wavelength HSRL at Tsukuba + Fukuoka + 2 Raman stations (Hedo + Toyama). These are the core stations: Good agreement for one Asian dust case in terms of scattering ratio, but no depol. Generally, good agreement in lowermost 3 km, but negative signals in free troposphere in Mie copolar signal. Report noisy daytime depolarization ratio.

Holger Baars: First validation results from AECARE including the ATMO ACCESS pilot activity

ACTRIS ground-based remote sensing supported by ATMO ACCESS pilot. Reports on challenges for L1 validation from ground and promotes use of CARDINAL simulator tool as well as signal ratios. Based on golden case analysis: Great signal quality with impressive results, e.g., stratospheric layers in the tropics observed by ATLID have been confirmed by ground-based lidar (Ruang volcano plume), layer boundaries do agree well. Caveats identified: Hot/cold pixels, daytime data challenging to validate due to background/offset correction issue (now fixed), night-time data shows also issues (especially Mie copolar) - maybe related to cross talk. Preliminary improvement of offset correction shows promising results but does not solve everything. Recommend database of golden validation cases for processor update validation. Promote use of discussion forum (information to be transferred to L2 user support) and remind to keep validation teams always up to date on which issues are already known and worked on.

Overview of presentations

Eleni Marinou: EarthCARE ATLID Level 1 intercomparison with ACROSS lidar

2 sites in Greece (Thessaloniki, Pangea), partly wavelength conversion is needed. Use of ATLID simulator for 5 cases. Excellent validation case for Thessaloniki, great agreement but noisy depol data reported. Cirrus case (nighttime) from Pangea, good agreement in cross-polar data. Conclusion on L1: Great SNR in stratosphere (thin layers detected), but noisy cross-polar data. First L2 validation looks good and shows interesting details (strato layer, target cat, thin aerosol layer).

Hossein Panahifar: First intercomparison between CARO Lidar and ATLID Level 1 over Cyprus, Limassol

Ground-based lidar at Cyprus + cloud remote sensing, tailor input for ATLID simulator and explain well the challenges on how to use the L1 simulator (denoising etc). Report too low depol for dust case and cirrus. Good results below cirrus in Rayleigh channel. Report negative signals in Mie cross-polar signals.

Afwan Hafiz: ESA Mobile Raman Lidar (EMORAL) Capabilities for EarthCARE Cal/Val

Operate ESA mobile reference system directly close to EarthCARE ground track (mainly in Poland currently). Report on challenges wrt differences between predicted and real orbit. Data provided to EVDC but need optimized SCC retrieval, 7 successful overpasses so far, distance less than 40 km. Also need to optimize input for L1 simulator tool. Report noisy cross-polar data for the night-time cases analyzed.

Avinash Yadav: LITES lidar in UK: intercomparisons with ATLID Level 1 and Level 2 products

LITES lidar in UK, 2 overpasses. One with clear sky. No final results yet.

Overview of presentations

Keyvan Ranjbar: First intercomparison between ATLID and Airborne Elastic Cloud Lidar during ECALOT

Aircraft and surface campaign in Canada. Airborne backscatter lidar at 355 nm. Gridded airborne to ATLID: Fairly good agreement also for depol ratio during November flights. Analysis ongoing (lidar calibration) and two more flight campaigns planned. Covered interesting ice cloud cases.

Emmeline Francois: First comparisons between ATLID and ATR42 during MAESTRO campaign

6 dedicated EarthCARE flights around Cabo Verde, 5 processed. 3-wavelength and 355-nm HSRL. Results: Globally good agreement. Cirrus above aircraft introduce errors.

Ping Wang: Evaluation of ATLID L2 products using EARLINET data: first results

Level 2 data: A-AER + A-EBD all AA baseline. Targeted on aerosol (removed clouds). Used EARLINET/ACTRIS as reference. Compared and promoted the different horizontal resolution of EBD for a Cabauw case study (mean EBD high-resolution profiles agree better than the single high-resolution profile). Statistics based on 14 co-located profiles: The ATLID FM, AER, EBD products are in good shape especially the night-time orbits. The AER product seems having a small negative bias in extinction and backscatter. Lidar ratio from ground tends to be lower.

Moritz Haarig: Early ATLID L2 validation using PollyNET

3 locations from PollyNET, presented 2 night-time and 2 daytime cases (A-EBD+A-CTH): Dushanbe night-time backscatter and extinction look brilliant, depol too low, L2 even lower compared to L1. Night-time Cabo Verde: depol L1 and L2 the same, but too low extinction above liquid cloud (need to be checked), cloud top height validation inconclusive. Daytime Leipzig case: Too low depol, backscatter and extinction great. Lidar ratio from night looks good compared to ATLID.

Overview of presentations

Will McLean: Monitoring and assimilation of the ATLID Level 2 aerosol products in ECMWF's IFS-COMPO

Build on heritage from Aeolus wrt assimilation of backscatter and extinction. Do monitoring with first guess departures. O-B (model without assimilation) and O-A (model with assimilation). First assimilation experiments performed.
Pre-operational near-real-time monitoring of the products in the framework of the EarthCARE DISC beginning soon (need some model upgrades first).

Giandomenico Pace: Early Level 2 product validations in central mediterranean

Use of Roma and Lampedusa station (37 overpasses). Did validate A-ALD, A-CTH, and A-ICE. Illustrate the challenge on cloud top validation (e.g. during multi-layer cloud scenes). Ice water content comparison yield reasonable results for ATLID. A-ALD AOD compares well to AERONET. Generally, great first glimpse on EC-L2 data variety and quality. Authors highlight also the importance of the spatial-temporal representativeness and the usefulness to use MSI for this purpose.

Discussion:

Ulla Wandinger & Tomoaki Nishizawa highlight an upcoming comparison of ESA and JAXA products at the L2 workshop. Yoshitaka Jin highlighted the need for having the same L1 data as ESA to have a useful comparison. To be discussed wrt baseline AD.

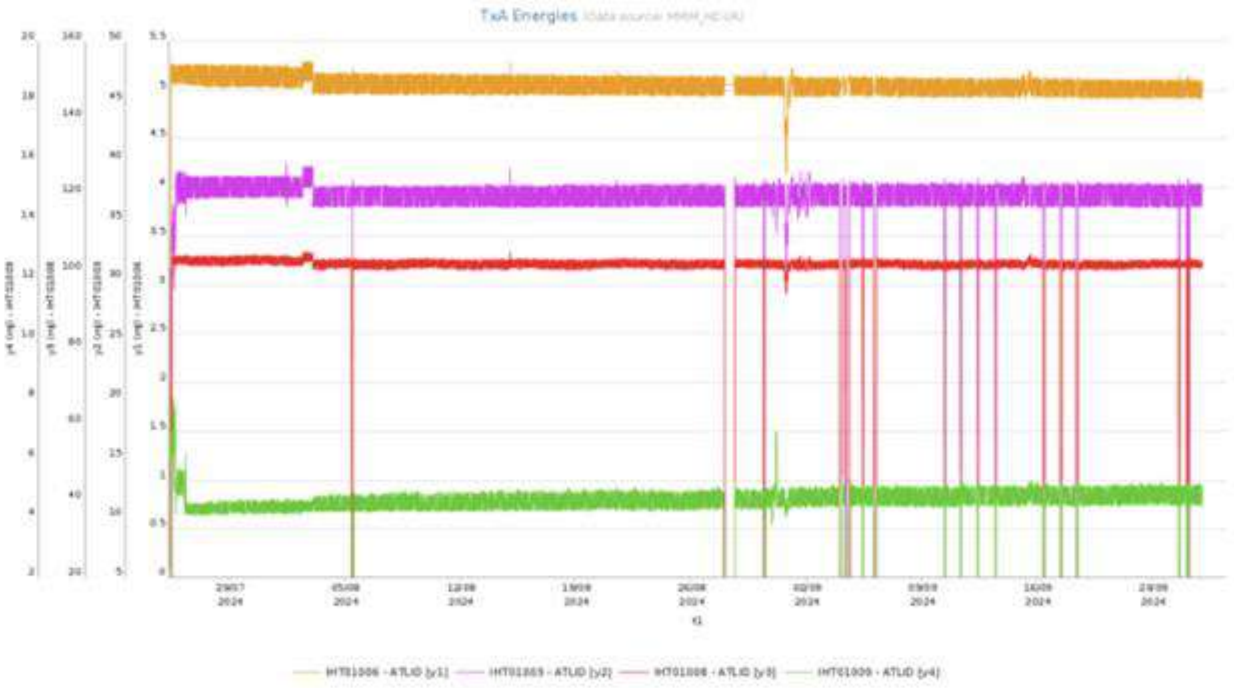
Highlights

Highlights

Instrument performance

Georgios Tzeremes: Overview of instrument

ATLID technical performance is very stable



- **Pressure of PLH**
  - 0.12mbar/ day in worst case for PLHA leads to over 14 years
  - Min PLH pressure operation is 227mbar, current pressure above 1100mbar.
- **Energy**
  - 0.005mJ per day trend in UV.=> maximum 5mJ degradation over 3 years.
  - Compensation possible: at MO level, at AMP level, at frequency selection. The usual level of compensation done on ground can easily compensate for the slight drift observed.
  - Lifetime prediction is difficult because it is not known if full range of correction available can be linearly extrapolated.
- **Other parameters difficult to assess**
  - High fluence Optics long term exposure vs LIDT
  - Laser Induced Contamination on long term
  - Other aging.

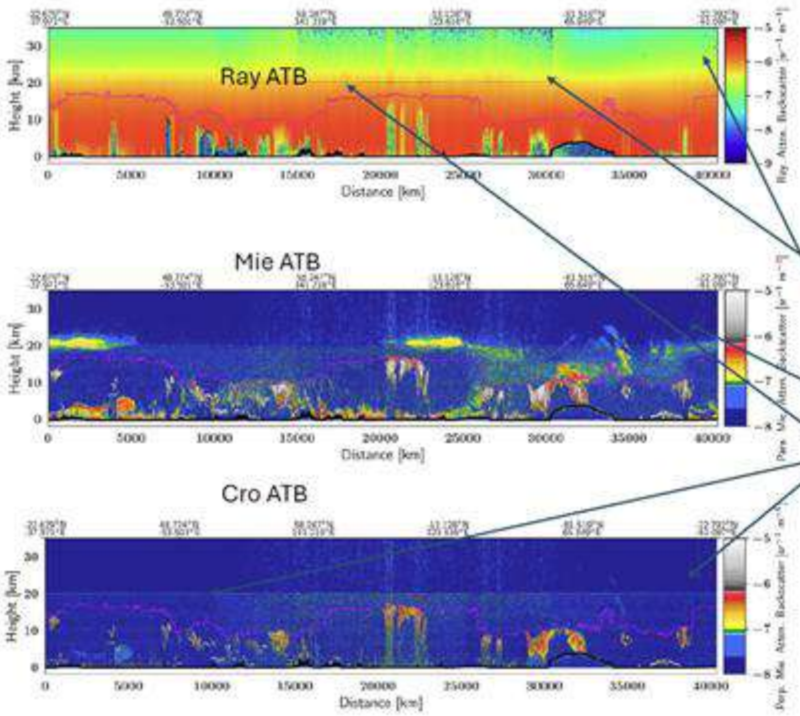
Lifetime estimation goes well beyond mission of 36 months with current ATLID configuration (B side)

Highlights

Instrument performance

Dave Donovan: ATLID Level 1 product verification and validation needs

Some issues, but all solvable. Not all fixed yet.

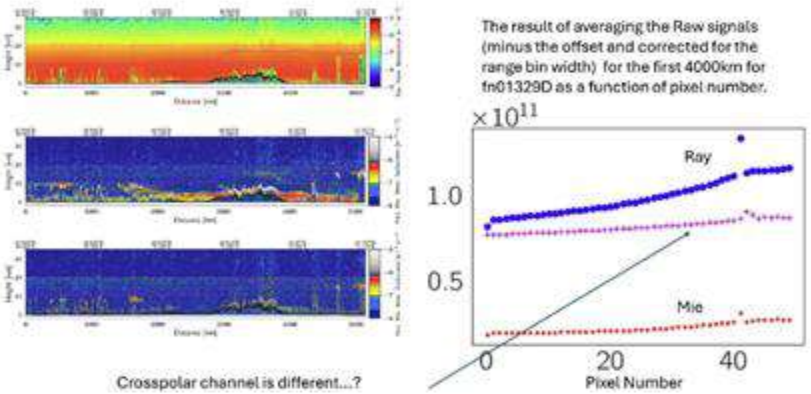


Sample output from the operational processor for one orbit.

Aug 14 Example.

1. Discontinuities due to bad calibrations, especially in daylight.
2. Radiation speckle noise
3. Hot Pixels
4. 20km feature in the Ray and Mie
5. Cold Pixel
6. Jumps between HR and LR
7. Offset Bug
8. Depolarization issues

20 Km features in the Ray and Mie Channels



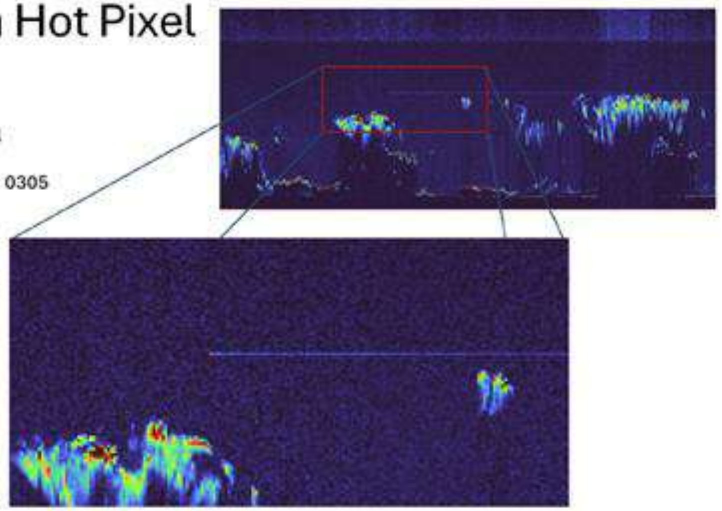
The result of averaging the Raw signals (minus the offset and corrected for the range bin width) for the first 4000km for fn01329D as a function of pixel number.

Crosspolar channel is different...?

Birth of a Hot Pixel

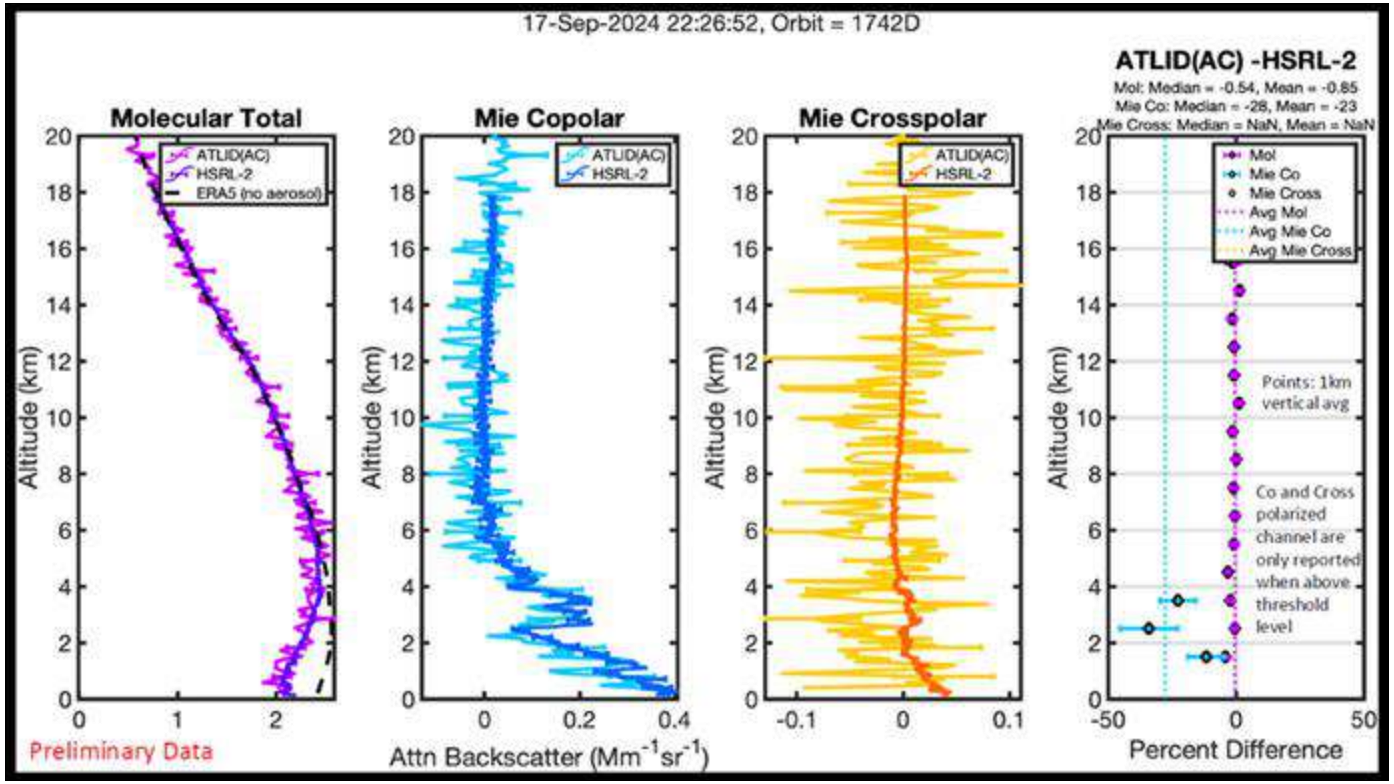
Cross-Polar Channel

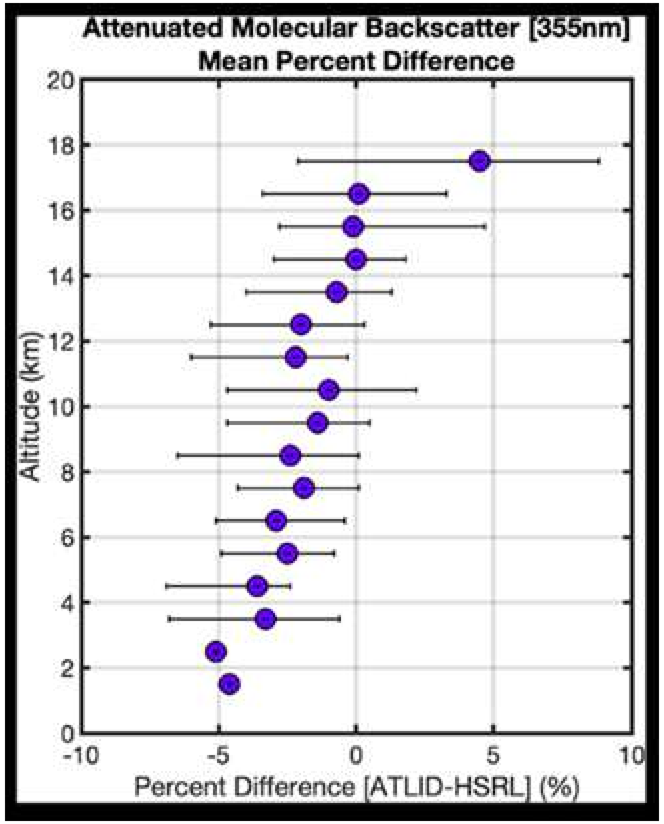
Frame 1355D 08/24 : 0305



Results from NASA airborne campaign (John Hair, Amin Nehrir)

Excellent intercomparison results for ATLID L1 data from airborne HSRL data, but also some biases obtained.





Highlights

First results from the HALO PERCUSION campaign (Silke Groß)

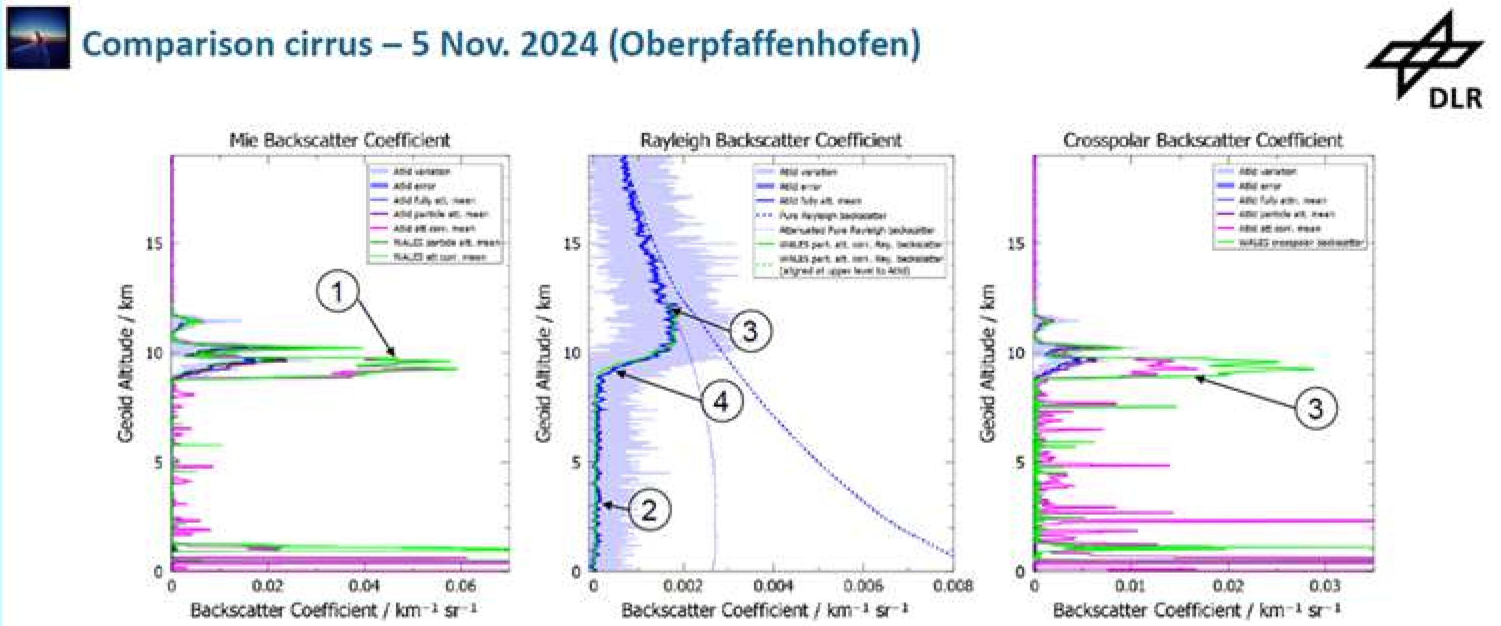
Good results in cirrus clouds

Some issues related to

Cross-polar signal

Cross-talk correction?

Multiple scattering?



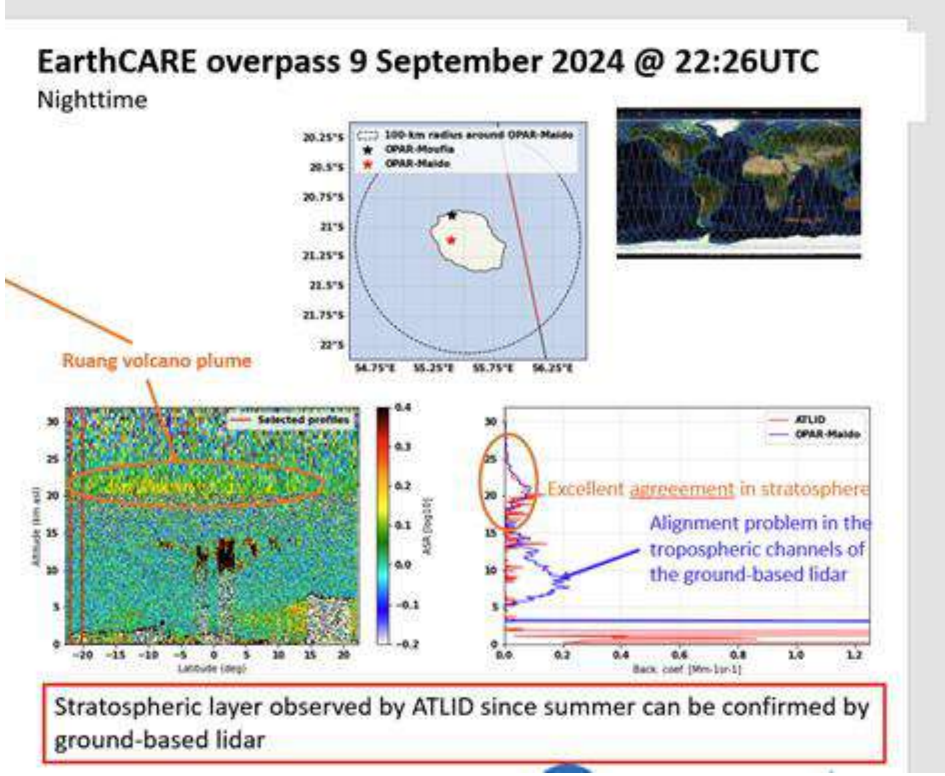
1. Comparable backscatter in cirrus cloud, as expected
2. Optical thickness lower than WALES below cloud (still positive below opaque cloud)
3. Slightly positive step in transmission, where negative one is expected
4. Extinction in cloud seems to be more stretched (multiple scattering effect?)
5. Depolarization in optically thick part of the cirrus significantly lower than for 532 nm (extinction correction?)

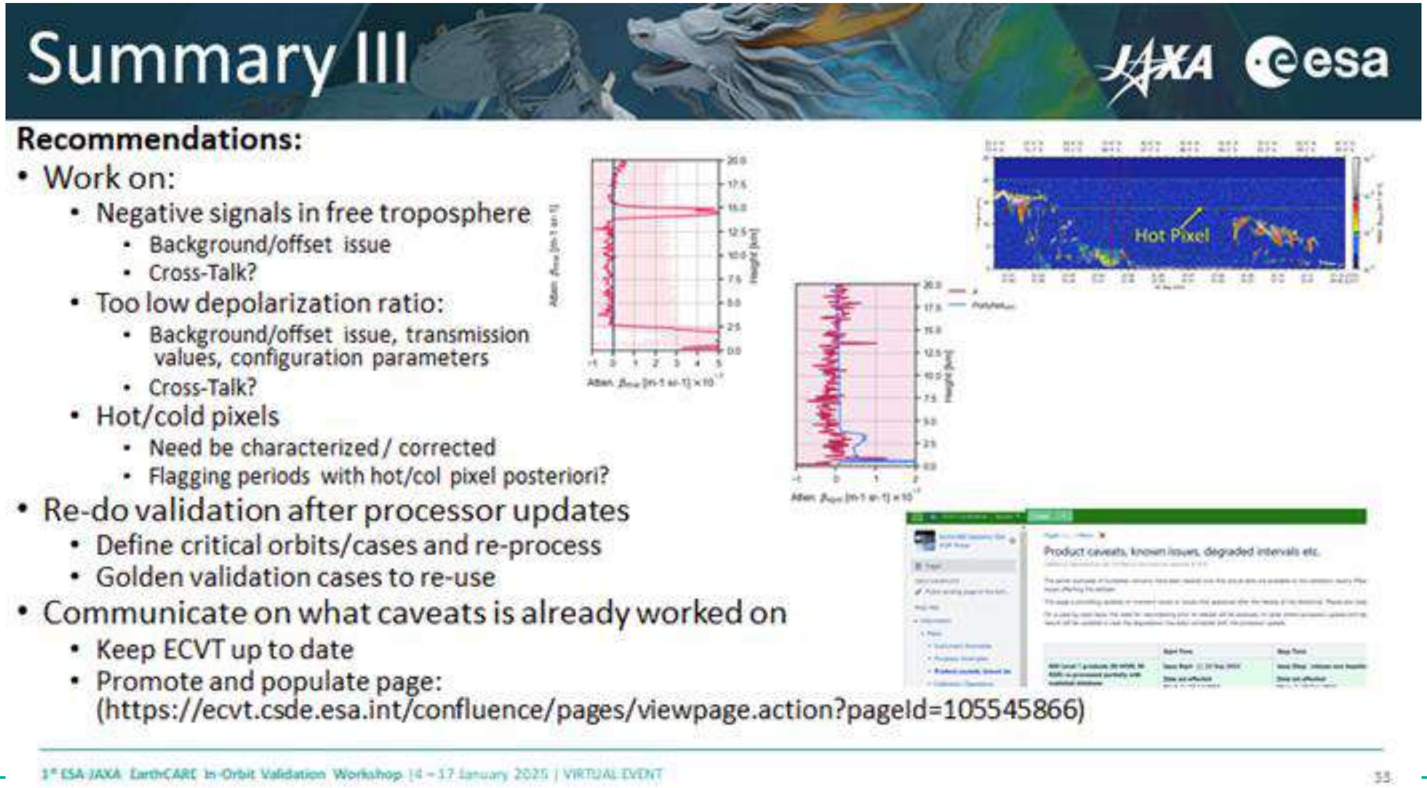
Highlights

Holger Baars: First validation results from AECARE including the ATMO ACCESS pilot activity

Great signal quality of ATLID with impressive results.

Quantitative comparisons reveal still some caveats as expected for an explorer mission:





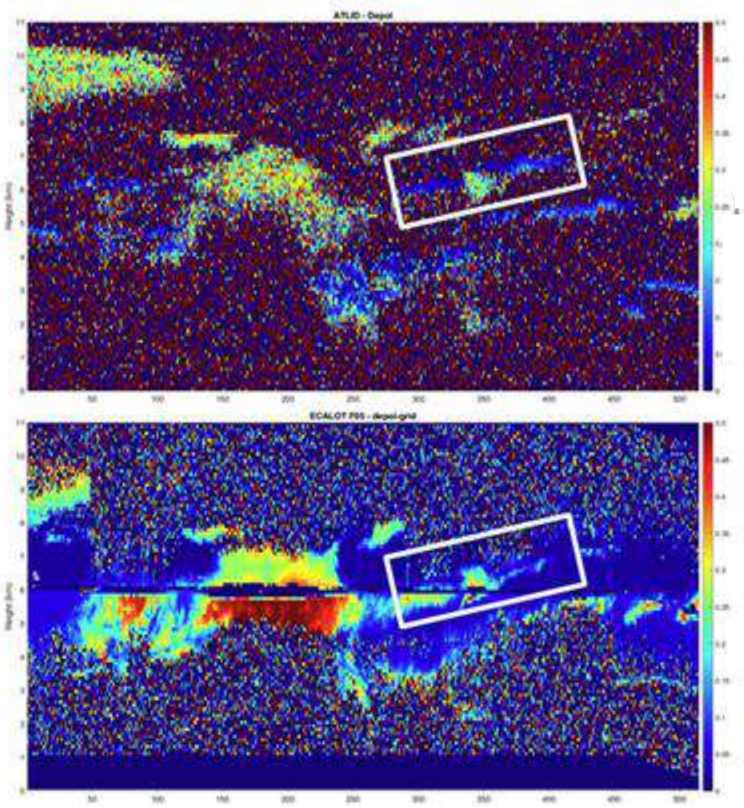
Highlights

Keyvan Ranjbar: First intercomparison between ATLID and Airborne Elastic Cloud Lidar during ECALOT

ECALOT Flight 5 – 2024-11-22

ATLID depolarization ratio
(cross_pol / co_pol)

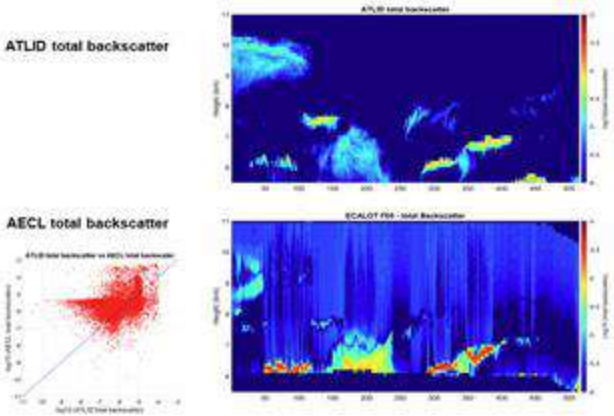
AECL depolarization ratio

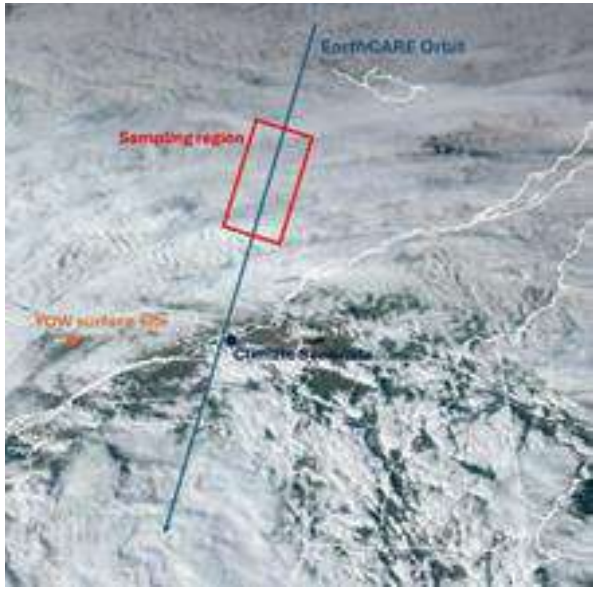


- Multi-layer cloud
- Thin ice clouds ≻ 6 km
- Mixed-phase clouds ≻ 4 & 1.8 km
- Supercool liquid layers

ATLID total backscatter

AECL total backscatter

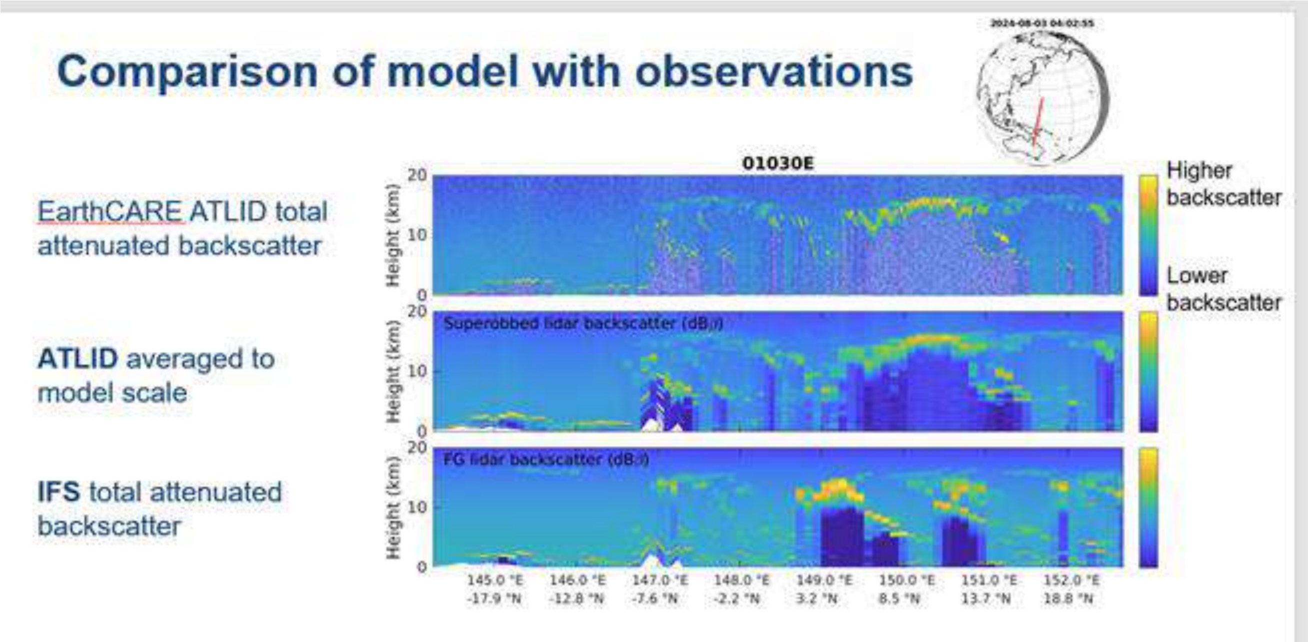


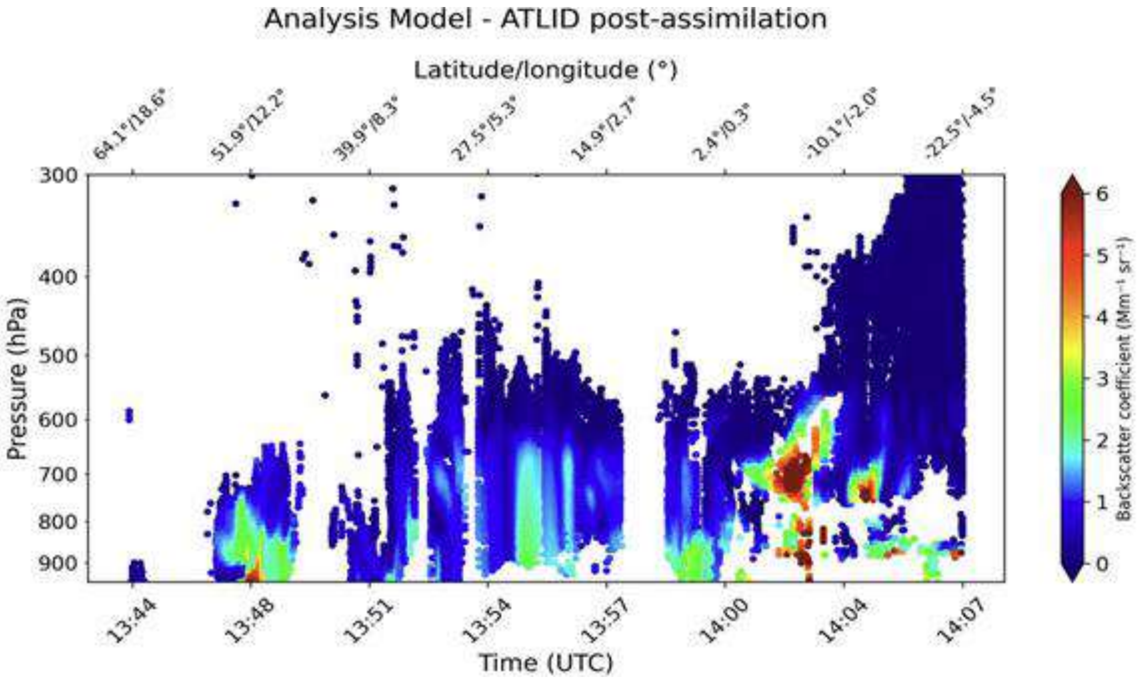


Highlights

ECMWF activities

Talks by Mark Fielding + Will McLean
ATLID L1B NRT quality monitoring is live:
https://charts.ecmwf.int/catalogue/packages/obstat/products/hist_ECare_LRBSC_v3
→ Data quality appears excellent
First test runs of assimilation of ATLID aerosol data



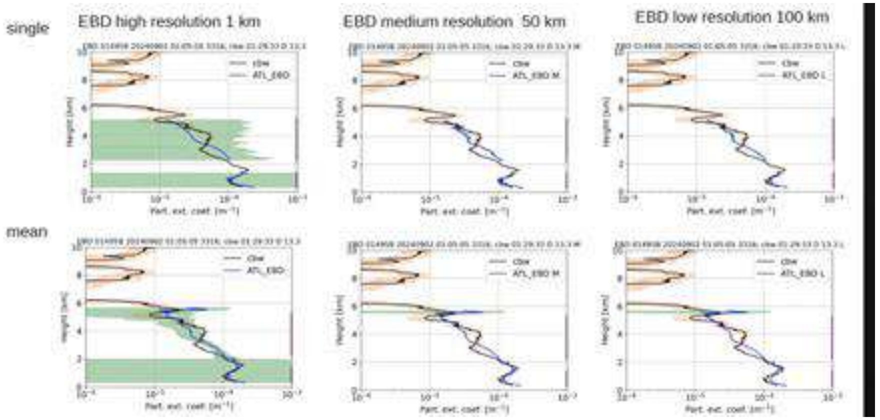


ECMWF model aerosol backscatter calculated from assimilation of ATLID

Highlights

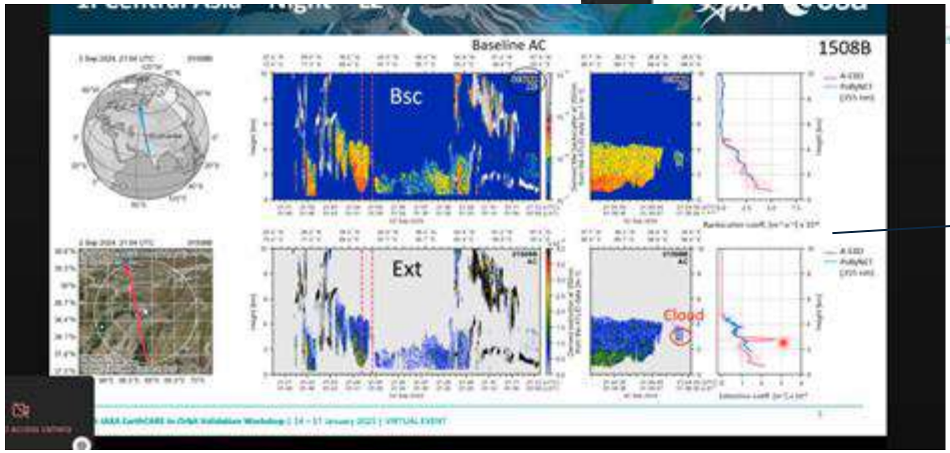
ATLID early Level 2 validation results (Ping Wang, Moritz Haarig)

Generally good results comparing L2 ground-based-vs-ATLID A-PRO
Illustrations of low-vs-med-vs-high res and EBD vs AER differences.

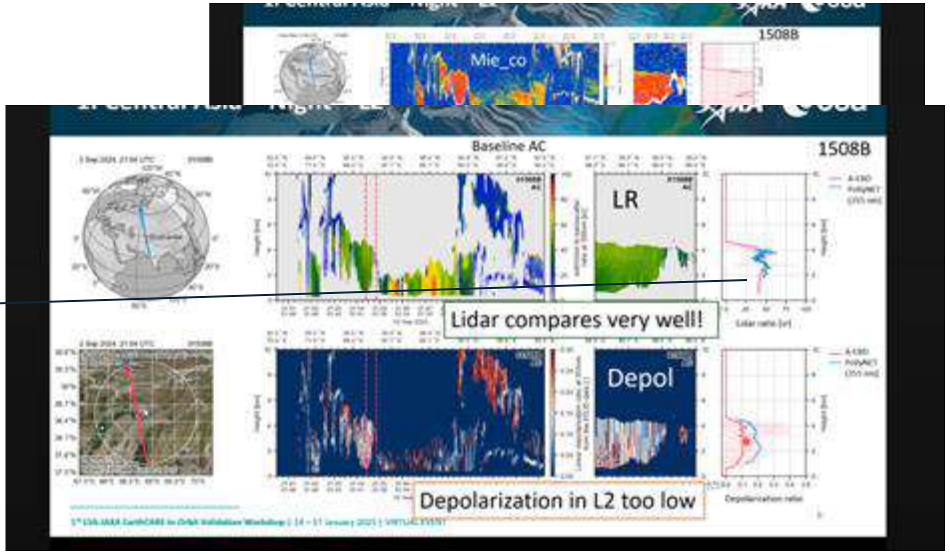


- We evaluate the ATLID AER, EBD products using EARLINET ECVT data every day.
- We showed the AER, EBD data at Cabauw from August to October 2024.
- The ATLID FM, AER, EBD products are in good shape, especially the night time orbits.
- The AER product seems having a small negative bias in extinction and backscatter.
- The mean EBD high resolution profiles usually have better agreement with the Cabauw measurements than the single high resolution profile.

- We would like to thank the EVDC team, all EARLINET sites, all PollyNET sites for providing data.



WOW !

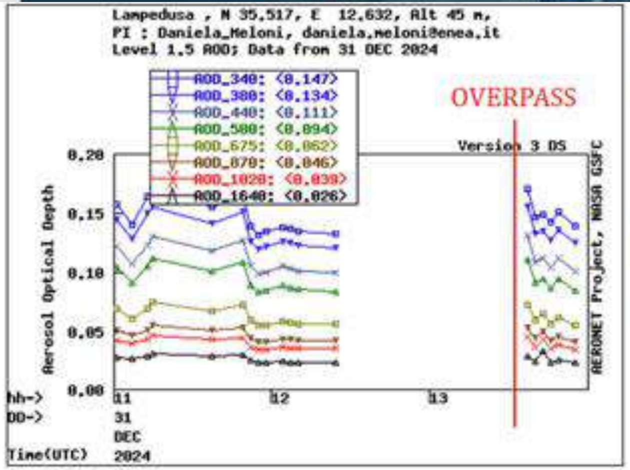


Highlights

Giandomenico Pace: Early Level 2 product validations in the Central Mediterranean

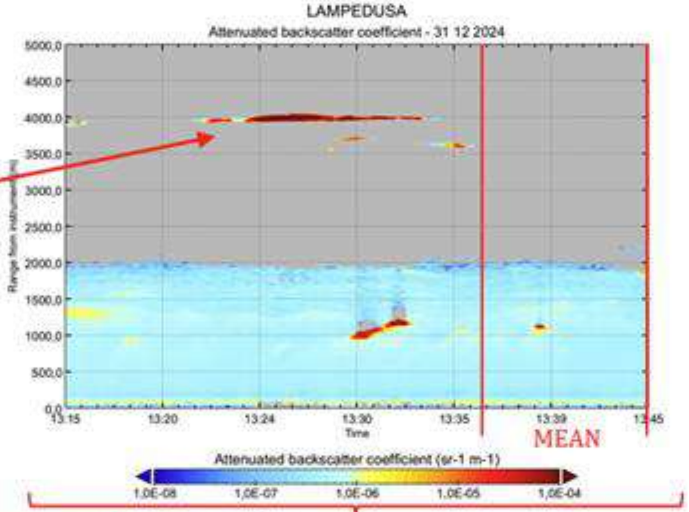
AOD comparison yields excellent agreement

A-ALD AOD at 355 nm — 31 December 13:29:07 – dist. 10.9 km



AERONET AOD at 340 and 380 nm.

No AERONET data available before 13:37 UT, due to thin cloud presence



	LAMPE. 13:37-13:45	ATLID 4 s (±7 km)	ATLID 10 s (±28 km)
Mean	**0.147**	**0.148**	0.606
Standard deviation	0.013	0.029	1.084
Number of data	4	8	43

31 Dec. overpass

Highlights

Highlight summary

- ATLID instrument performance is excellent; very stable laser power, laser frequency, co-alignment ...
- Airbore HSRL comparisons (PACE-PAX, PERCUSION, MAESTRO) demonstrate the high data quality of ATLID
- Network validation activities (AD-Net, ACTRIS, ...) provide high coverage and allow for statistical comparisons (regional, seasonal, long-term)
- Stratospheric aerosol layer in the Tropics around 20 km height (Ruang volcano plume) validated with lidar at La Reunion
- NRT monitoring with ECMWF models is a very valuable support and underlines the excellent data quality of ATLID, first assimilation exercises done

Advertisement

- There are two L2 product chains - one in Europe, one in Japan
  - Validation is needed for both
  - We intend to show product comparisons in Frascati

Seed questions and recommendations

Seed questions

Seed questions (1/2)

- **What has been identified by the validation teams as aspects to improve and are there clear/proposed way to address that?**
  - Deviation in Rayleigh attenuated backscatter towards the surface (up to 5%) identified by NASA aircraft campaigns and confirmed by GJZ
  - Depol channel calibration: The depol ratios are likely still too low by about a factor of 1.3
  - Partly negative or positive Mie signals in regions where it should be zero → background subtraction, signal calibration, cross-talk correction still need to be carefully evaluated
  - Hot and cold pixels, radiation spikes, high-res/low-res discontinuity → flag pixels for which corrections have been applied (to check for remaining biases)
  - Nighttime measurements seem to have better performance
  - Possibly problem with A-PRO just above water clouds

- **What are the positive aspects about the data, processors that can be highlighted from the validation team results?**
  - Validation teams highlight the impressive signal quality
  - In general very good ATLID L1 data quality
  - Stratospheric performance to be highlighted
  - Good validation results even for signals/aerosol layers below cirrus clouds
  - First L2 validation results also show very good agreement of ATLID and reference products
  - Good L2 retrievals down to the ground even in mountain conditions (no contamination from surface return)

Seed questions

Seed questions (2/2)

- **What are the aspects that are yet to be validated?**
  - Depolarization in cirrus, day vs. night
  - Influence of multiple scattering (in and below cirrus clouds)
  - Sensitivity limits e.g. what are detection limits for thin aerosol layers (in day and night conditions)
  - Stratospheric features
  - Long-term behavior (statistical evaluations)
- **What should be noted to the public about the quality of the released L1 data?**
  - The 20 km issue (charge transfer) will still be there
    - Planned to be fixed in next release
  - Weekly Dark Current Maps are planned for Hot-Pixel management
    - HP will be expected to appear and may take a few days before the DCM are updated
    - A software fix to handle periods between DCM updates is being worked on
  - Not all issues with the depol channel are fixed yet
    - The depol ratios are likely still too low by about a factor of 1.3.
- **What recommendations/suggestions are there for future L1 / L2 validation activities (e.g. needs/gaps) and for mission planning?**
  - Look at cirrus clouds and other highly depolarizing targets, check also for multiple-scattering effects
  - Validate stratospheric features (PSCs, volcanic layers) using lidars designed for stratospheric observations, e.g. NDACC

Lessons learnt

Lessons learnt / Tips

- ATLID L1 simulator tool is useful for L1 validation, but care should be taken when using it:
  - Don’t use noisy signals as input
  - Consider upper-level attenuation (stratospheric layers, cirrus) when comparing lower-atmosphere signals
- Using signal ratios instead of attenuated backscatter signals for comparison allows L1 validation without using the simulator tool
  - Cross-polar Mie/co-polar Mie as proxy for particle depolarization ratio
  - Total Mie/Rayleigh or total/Rayleigh as measure of the backscatter ratio / scattering ratio (be careful with the definitions)
- Select the averaging period and ATLID cross-section length carefully:
  - Check homogeneity of the scene
  - Remove clouds carefully or put specific focus on clouds
  - Make use of MSI or other tools to assess the representativeness

Recommendations

Recommendations

- Recent offset-bug fixed data has only been available with AD release. This issue should improve both the depol and the spectral cross-talk corrections. Thus, we should expect fewer cases of statistically significant negative Mie ATBs in clear-sky conditions. Relevant Cal/Val cases should be revisited when appropriate re-processing of commissioning phase data has occurred
- It is known that the depolarization ratio is currently too low in release AD. This should be improved in the next release. Again, relevant Cal/Val cases should be revisited when appropriate re-processing has occurred
- In general, a database with Golden Validation Cases (frames or orbits) should be maintained to check improved algorithms and processor updates for the same conditions in the future
- Be careful with the terminology regarding the signals (co-polar Mie, cross-polar Mie, Rayleigh) and don’t compare ‘apples and oranges’

Recommendations

Recommendations II

- Stratospheric measurements yet rare, contact additional stations
  → e.g., NDACC, stratospheric contributions welcome!
- Combining lidar, radar, sun photometer etc. for validating a larger set of L2 products (e.g. AOD, cloud top height) is a useful approach. → Help validating the entire suite of ATLID (and synergy) products/variables! Consider that certain variables might be calculated in different ways
- Scene selection and averaging should be done carefully. Trajectory analysis may help in searching for the correct periods/locations to be compared. MSI can help in checking the homogeneity
- Keep the validation teams up to date: Which issues are already known and which are going to be fixed soon
- Advertisement for forum - level 2 format as good example. Share your validation results!
- Forum content to be taken up by DISC L2 user support team

Report of CPR session

Hajime Okamoto, Nobuhiro Takahashi, Alessandro Battaglia,
Eleni Marinou, Vasileios Tzallas

CPR Session presentations

Min	Title	Speaker
5	Welcome and session opening	Toshiyuki Tanaka
10	CPR Integrated Commissioning Team presentation	Hirotaka Nakatsuka, Nobuhiro Tomiyama, Matthias Gollor
10	CPR calibration	Hiroaki Horie
10	CPR Level 1 product evaluation	Kaya Kanemaru
10	ATLID and CPR geolocation and co-registration	Gerd-Jan van Zadelhoff
15	CPR mirror image analysis	Shunsuke Aoki
15	Comparison between CPR observation modes	Yuki Imura
15	Findings on Level 1 product from ESA Level 2A algorithm verification	Pavlos Kollias
10	NRT quality monitoring using NWP (ECMWF)	Mark Fielding

Min	Title	Speaker
15	Doppler validation with WINDAS	Yuichi Ohno
15	EarthCARE CPR validation using ACTRIS' ground-based radar network	Lukas Pfitzenmaier
20	First results from the HALO PERCUSION campaign	Florian Ewald
10	First comparisons between CPR and ATR42 during MAESTRO campaign (including early Level 2 products if available)	Julien Delanoe
15	First intercomparison between CPR and NAW cloud radar during ECALOT campaign	Paloma Borque
15	CPR early Level 2 product validation results	Pavlos Kollias
10	Discussion	(Co-chairs)

Excellent overview of CPR products validation efforts and outstanding results

- CPR summary

Min	Title	Speaker
5	Welcome	Toshiyuki Tanaka
50	CPR summary and discussion	Hajime Okamoto, Nobuhiro Takahashi, Alessandro Battaglia
5	Closing statements ESA and JAXA	Timon Hummel, Takuji Kubota

CPR summary of the talks:
CPR performance and Level 1 algorithm

- Generally, CPR performs as expected:
  - Better sensitivity than CloudSat/CPR (Ze < -35dBZe) [H. Nakatsuka] [H. Horie]
  - Doppler velocity observation and its accuracy are satisfactory [Y. Imura] [L. Pfitzenmaier]
  - Different performance for different PRF (pulse repetition frequency) settings (e.g. 16, 18 and 20 km modes) as expected --- **proposal of 18km operation-mode, instead of 20km-mode, for 60S – 60N** [Y. Imura]
  - Geolocation is within the required range [B. Treserras and P. Kollias] [H. Horie] [H. Nakatsuka]
  - There were several issues recognized during the commissioning phase (see below).
- Issues solved (causes are confirmed): [H. Nakatsuka]
  - HPT switch-off by body current (decreasing trend and JAXA will improve the system to reduce the unobservable period) [H. Nakatsuka]
  - I, Q offset (rainbow color Doppler velocity field). Now good with SPU-B (primary side). [H. Nakatsuka]

CPR summary of the talks:
CPR performance and Level 1 algorithm

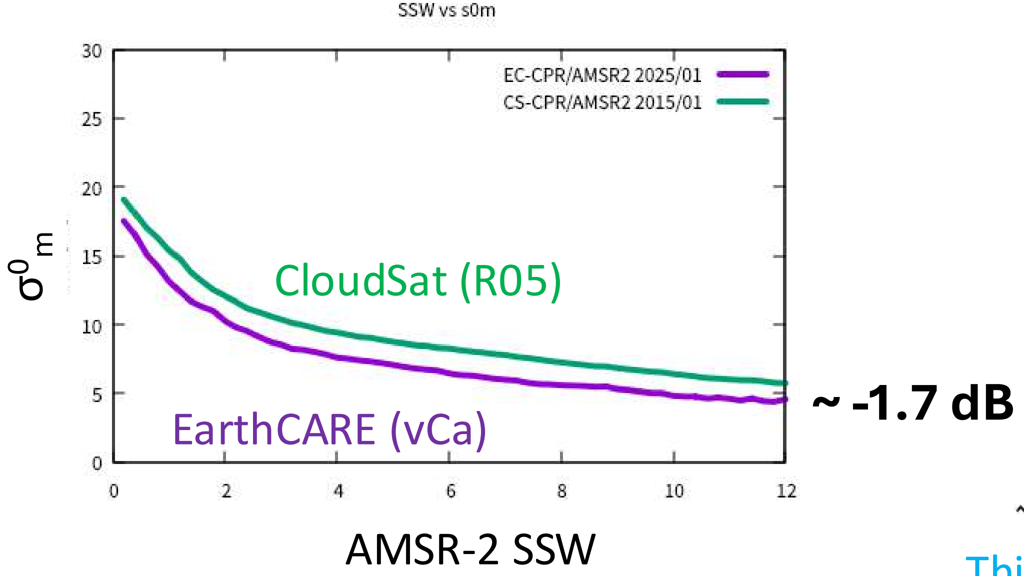
- Issues solved (continued)
  - Calibration was improved by ARC — H. Horie
  - Bug fixed in Doppler spectrum calculation in Level 1 — H. Nakatsuka
  - Mirror images appear as 2nd trip echo ---Methods are established. (The algorithm is currently applied in Level 2, Will these be applied to Level 1?). ESA-JAXA also need to discuss (if overlapping, the mirror Z should be subtracted). — S. Aoki, P. Kollias
- Issues unsolved
  - The differences in calibration of Ze still exist against CloudSat (~2dB) — L. Pfitzenmaier
  - Beam pointing correction (critical for capturing zonal climatology of Doppler signal) — K. Kanemaru, M. Feilding
  - Surface detection were sometimes incorrect for heavily attenuated profile (NICT will investigate) — P. Kollias, P. Borque, F. Ewald
  - Artificial echo at 2.5 km altitude (JAXA will investigate) — P. Kollias
  - PRF dependency of Doppler spectrum width (JAXA-NICT will investigate) — H. Nakatsuka, P. Kollias
  - Noise floor underestimation (JAXA-NICT will investigate) — P. Kollias

Radar reflectivity factor (Z) validation

Current CPR's reflectivity factor (Z) bias is about ~ -1.7 dB (after reflecting the external cal. result) or -4 dB (without external cal. result)

Comparison of σ_m^0 with CloudSat data

σ_m^0 measured by EC-CPR (vCa) is slightly (~1.7 dB) lower than to that by CS-CPR

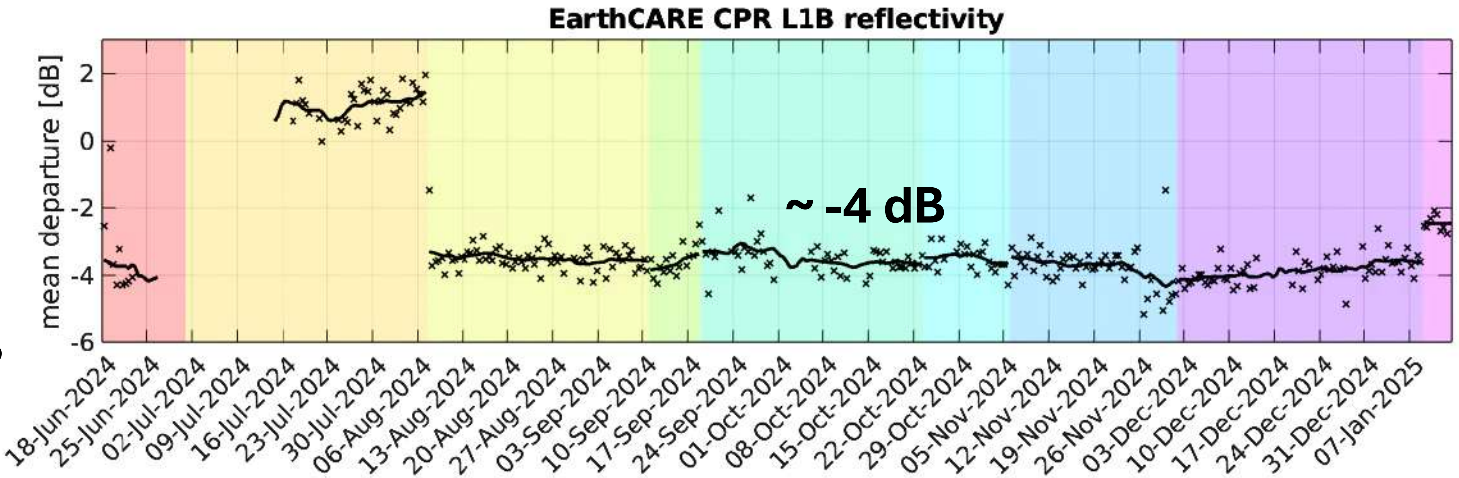


EarthCARE(EC)-CPR: 2025/01/01-2025/01/14 (vCa)
CloudSat(CS)-CPR: 2015/01/01-2015/01/31 (R05)

K. Kanemaru

Comparison with ECMWF radar reflectivity

(without external cal. result)



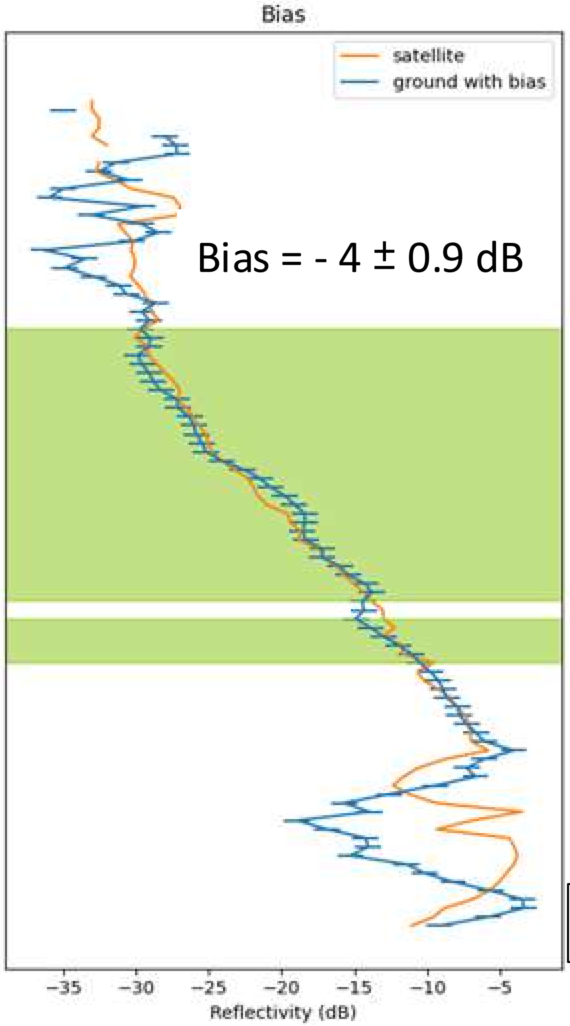
This method has the advantage of being applicable on very short time scales!

M. Feilding

Radar reflectivity factor (Z) validation
comparison with ground-based and aircraft obs.

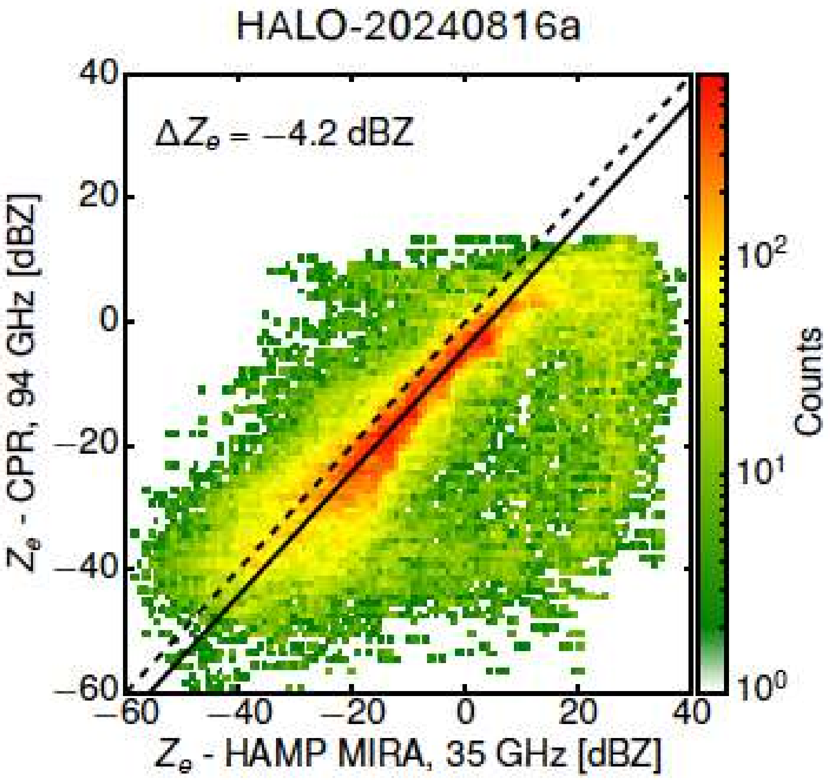
Comparison with ground-based/airborne observation shows about -4 dB bias (w/o external cal. result)

ACTRIS' ground-based radar network



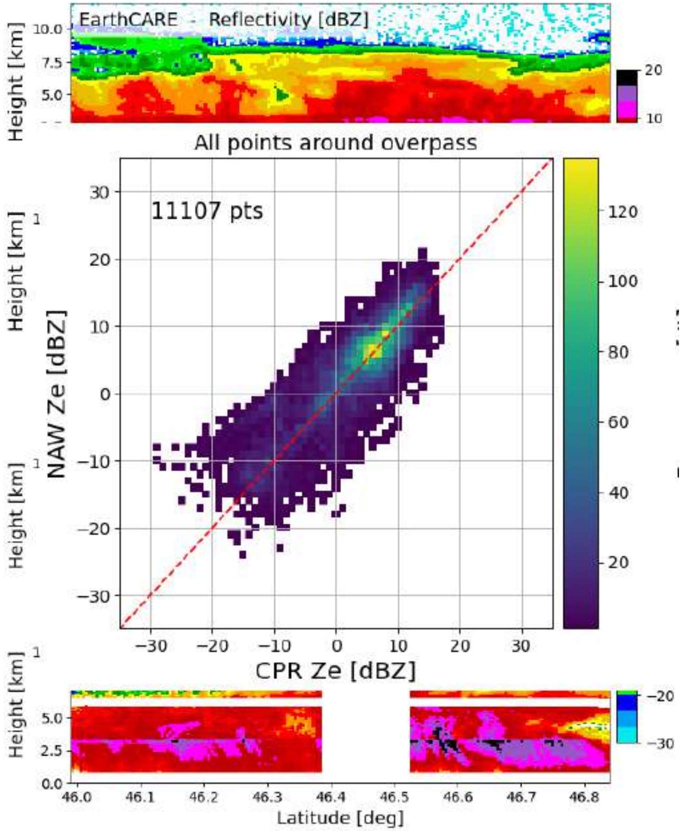
L. Pfitzenmaier

Comparison with MIRA onboard HALO



F. Ewald

Comparison with NAW
(after +5 dB offset for CPR)



P. Borque

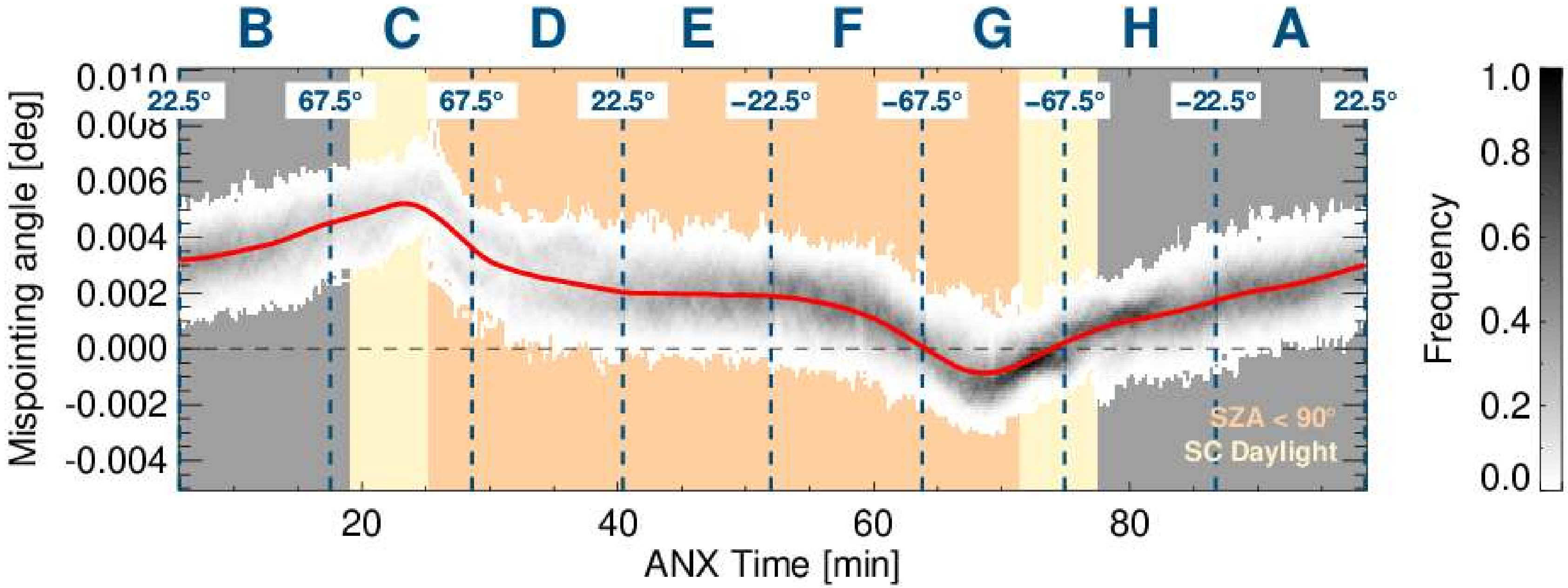
CPR antenna mispointing

- **Mispointing trends influenced by solar illumination cycles and thermoelastic distortions on the antenna.**
- **JAXA is almost ready to update the antenna distortion model.**

P. Kollias

H. Nakatsuka

This error can introduce biases in zonal climatology of Doppler signal. Note that it will be very challenging to use any ground based or airborne system to calibrate the Doppler to this level of accuracy in a short period (signal will appear only when building climatologies, long wait is necessary).



Satellite line-of-sight velocity contamination

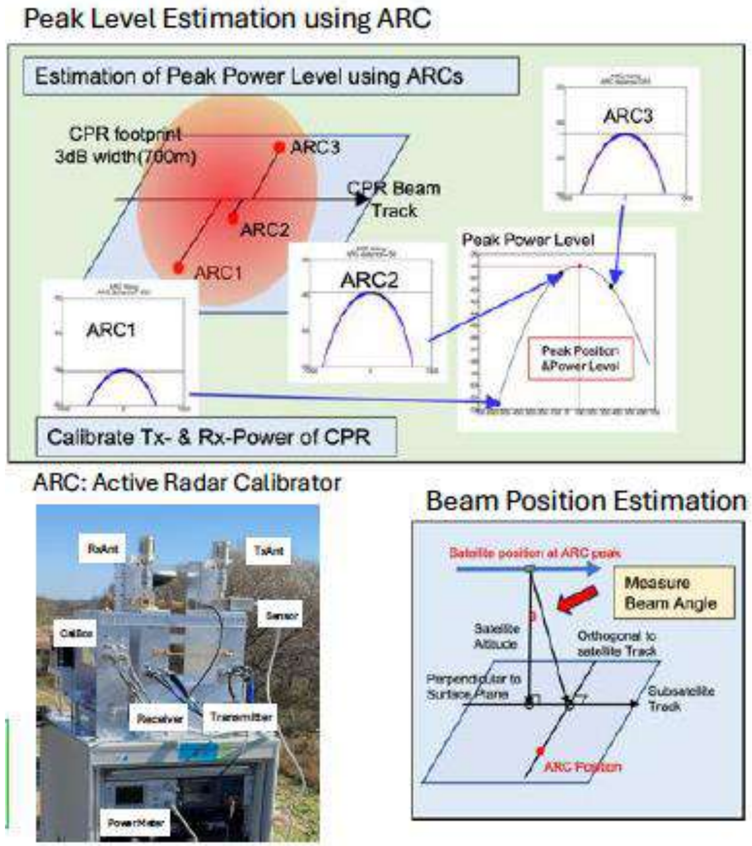
0.01º(7.6km/s) → 1.32m/s

Geolocation evaluation

Both external calibration with ARCs and coastline/geographical gradient detection methods confirmed that the **CPR geolocation is within the required range**.

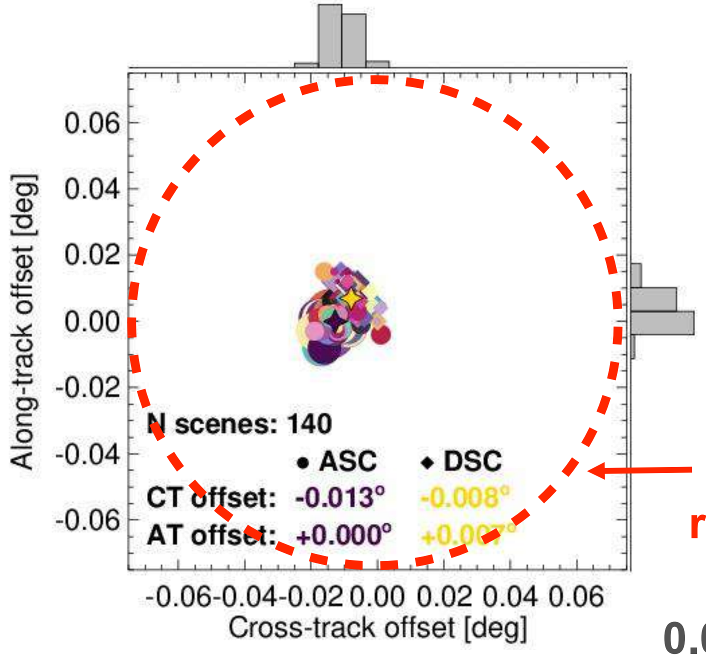
H. Horie

B. Treserras and P. Kollias (talk by van Zazelhoff)



H. Horie

Combined statistics
Dec 2024



* mission requirements

$0.01°_{400km} \sim 70m$

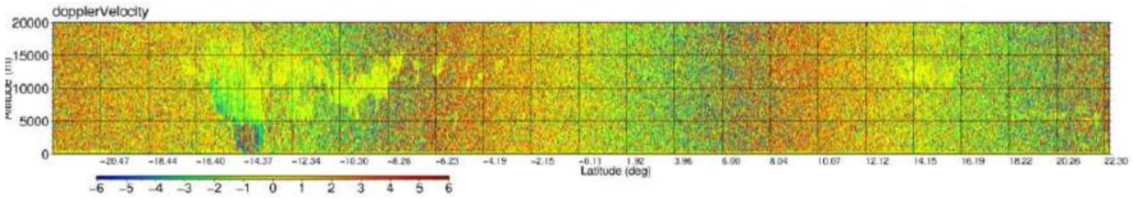
B. Treserras and P. Kollias (talk by van Zazelhoff)

I, Q bias correction (Top)
Artificial echo at 2.5 km altitude (Bottom)

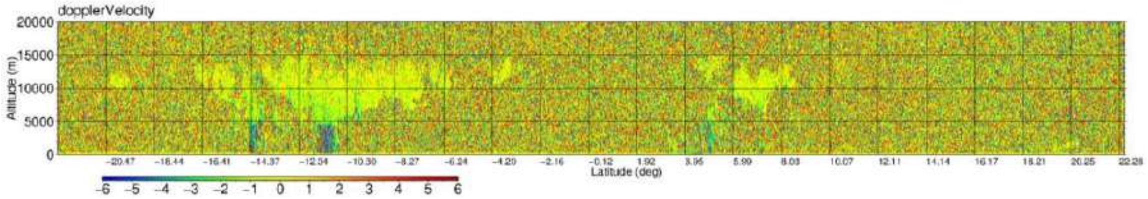
I, Q bias correction for SPU-B clearly reduces the Doppler bias of weak echo. (solved)

H. Nakatsuka

(Before IQ offset correction)



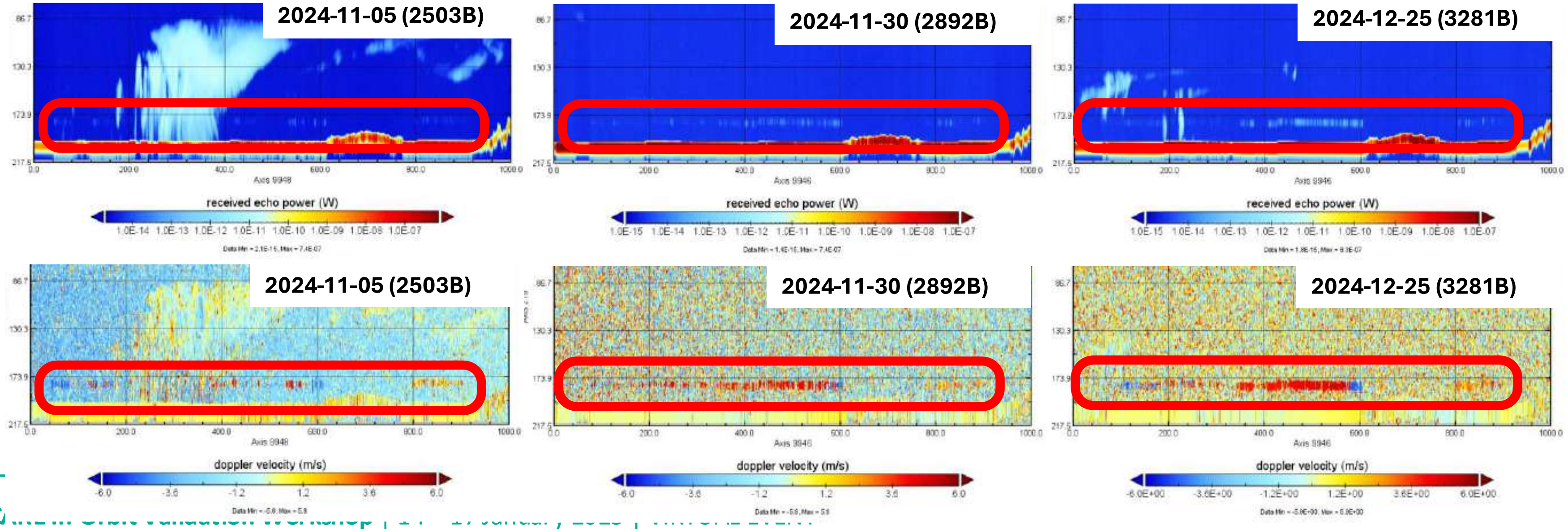
(After IQ offset correction)



Unexpected weak echo (Z and Doppler) appears when the surface return is very strong. JAXA continues to investigate the cause. Needs to be solved.

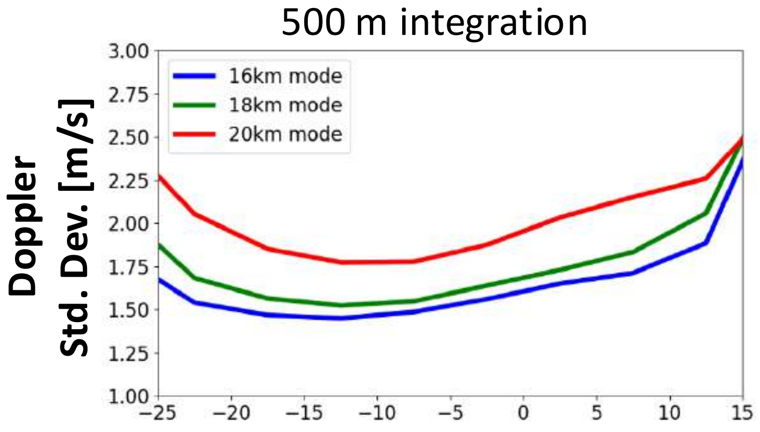
H. Nakatsuka

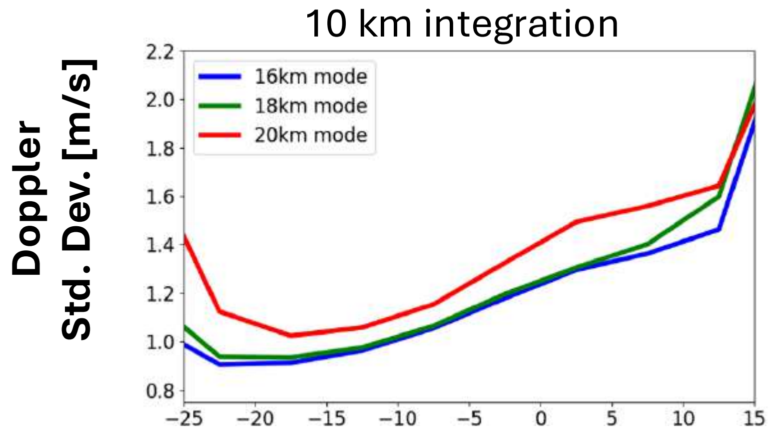
P. Kollias



Doppler accuracy evaluation

post-launch evaluation

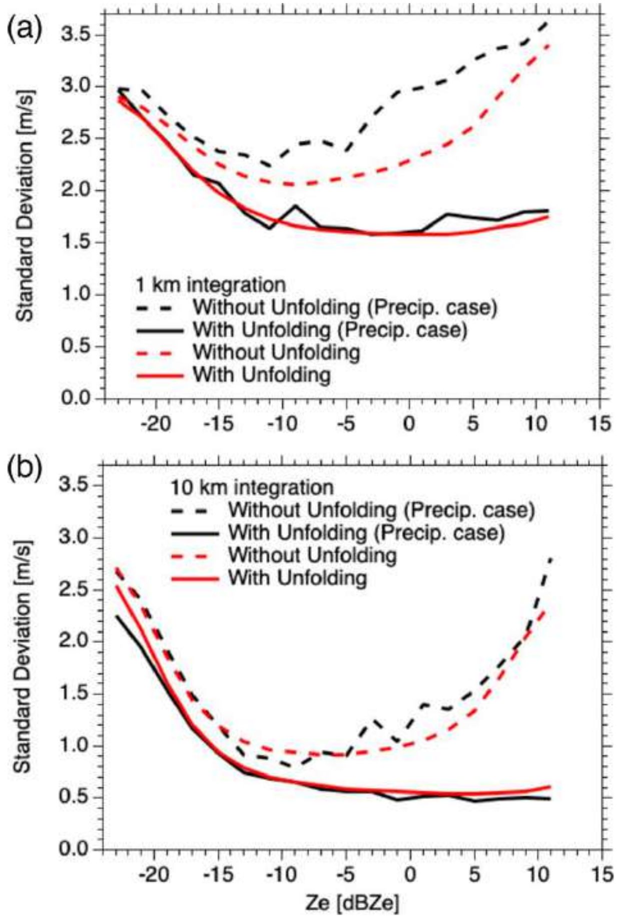




Y. Imura

- Variability of Doppler velocity significantly reduced from 20 km mode (low PRF) to 18 km mode (high PRF almost comparable to that of 16km-mode)
- Very few cloud fraction appear above altitude of 18km.
- Comparing with pre-launch estimation, post-launch estimation shows larger variation for higher reflectivity regions caused by the natural variabilities
- Provided that the natural variability components would be similar among three modes, the **18km-mode operation is proposed instead of 20km-mode in 60S-60N**

pre-launch estimation (20 km mode)

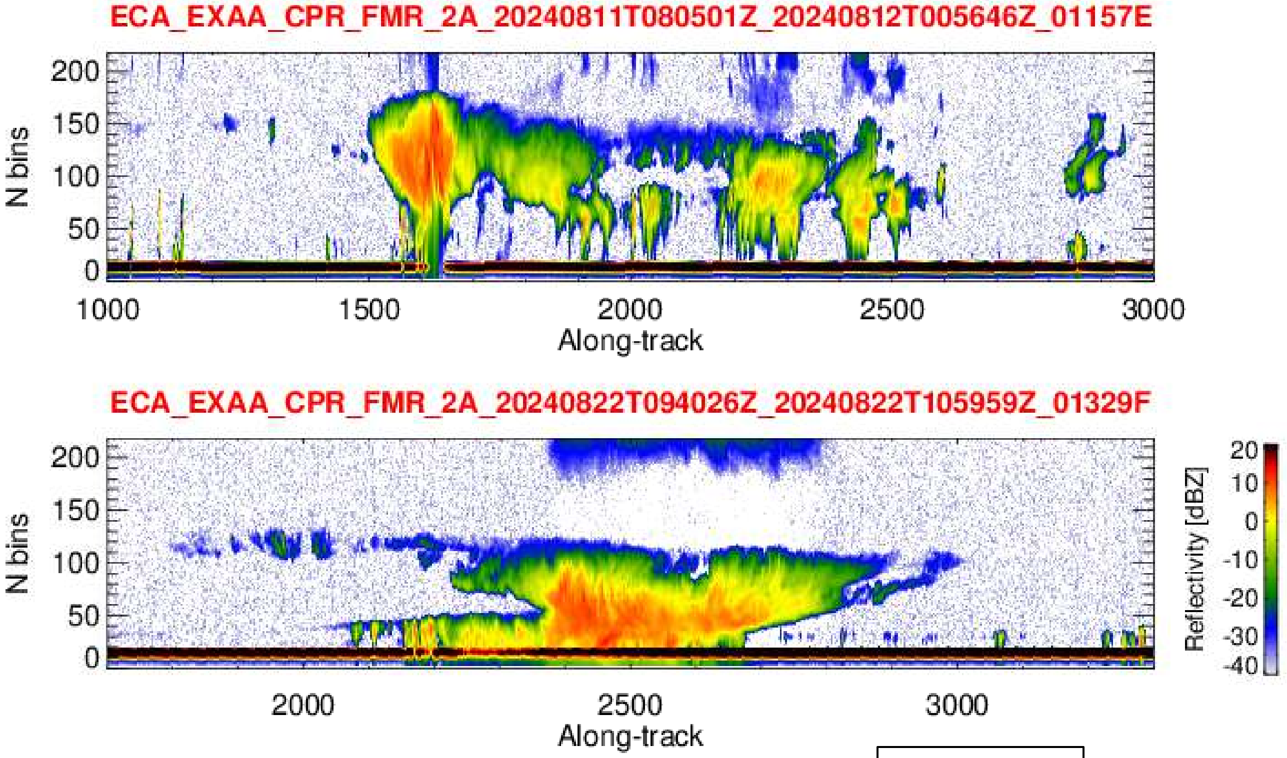


Hagihara et al. (2023)

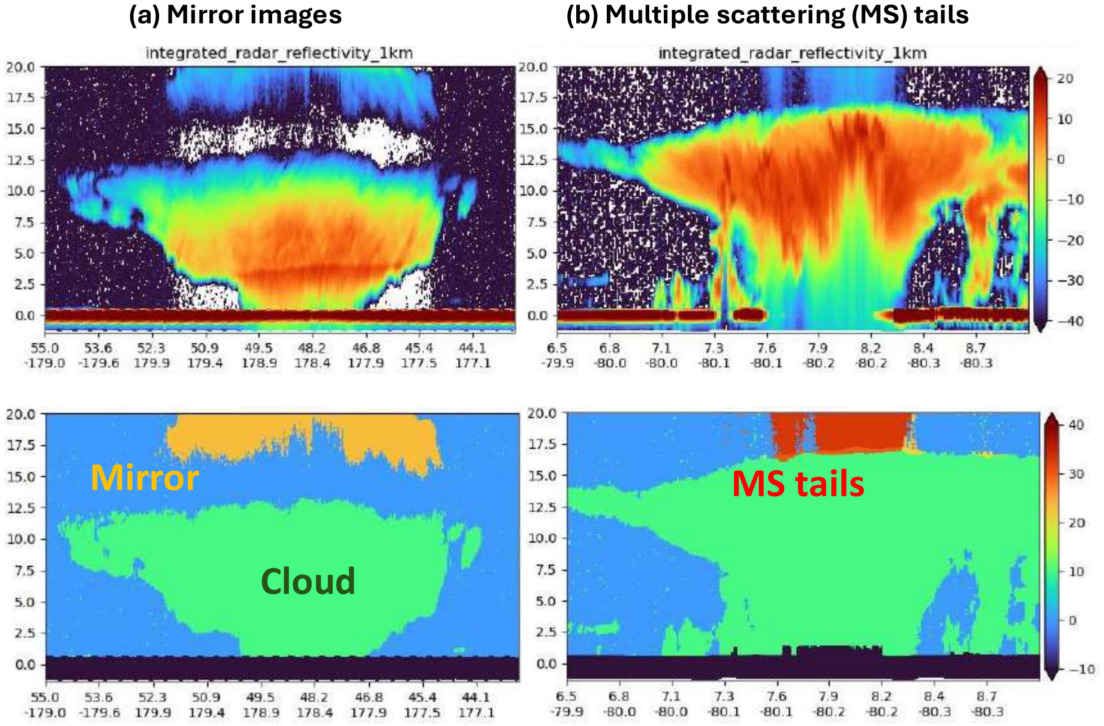
Mirror image & MS tail detection/masking

- Methods to mask mirror image and multiple scattering tails are established.

P. Kollias   S. Aoki



P. Kollias



Height-distance diagrams of radar reflectivity and cloud mask of mirror images and MS tails in EarthCARE CPR observation.

S. Aoki

Underestimation of noise floor affects the Level-2 Cloud Mask and Tb estimation

P. Kollias

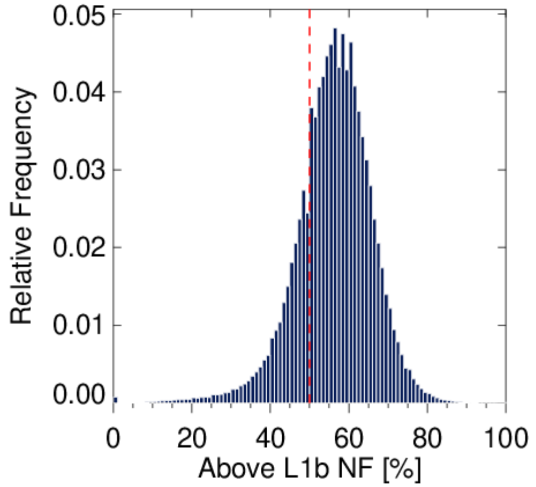
Noise Floor

- Underestimated
- Affected by second-trip echoes
- Reported only every 14 profiles

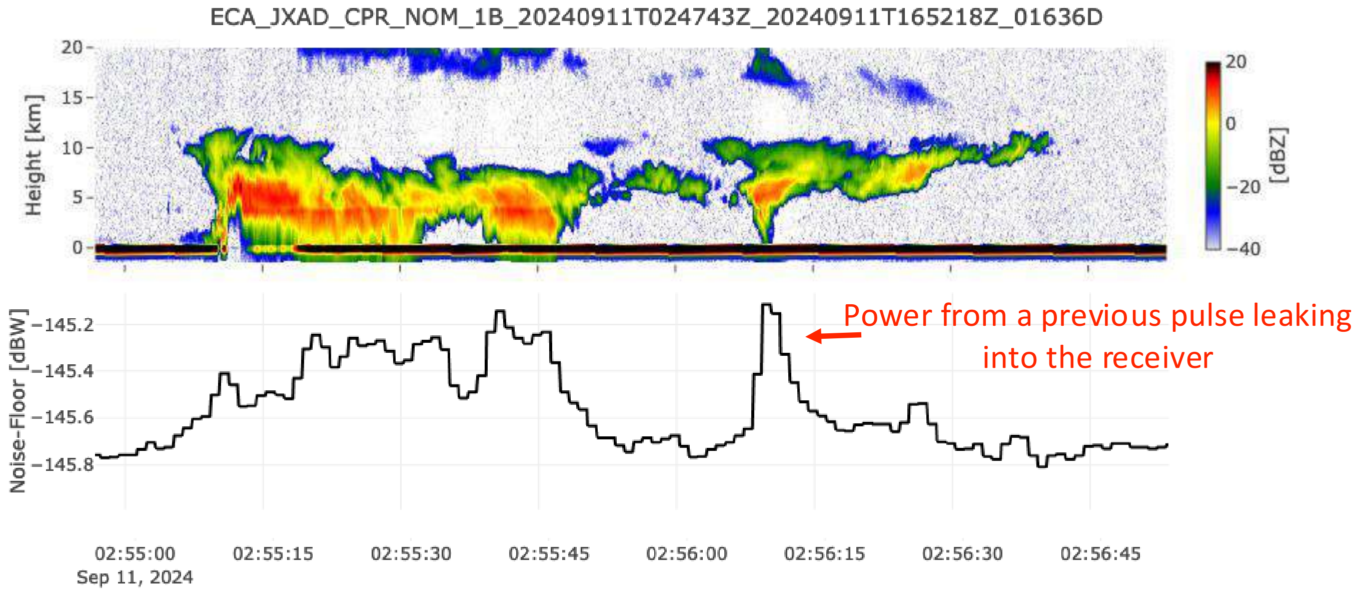
Impacts →

L2a Cloud Mask

L2a Brightness temperatures



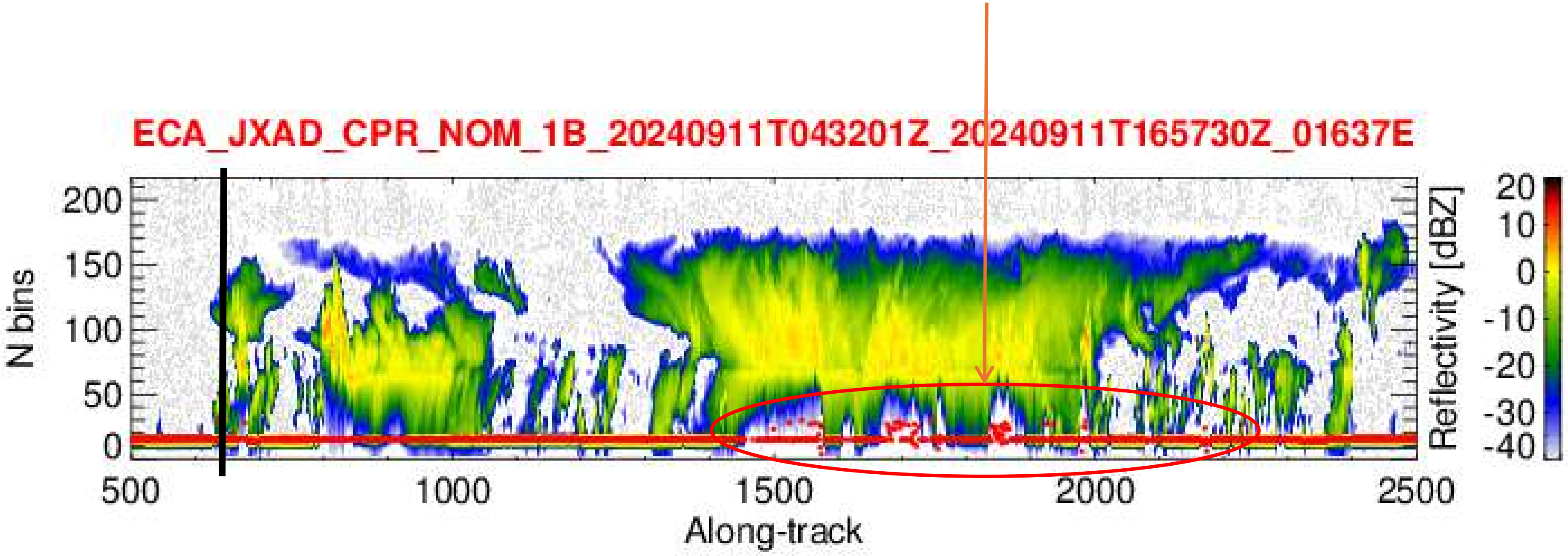
Percentage of values above the L1b NF in clear-sky conditions

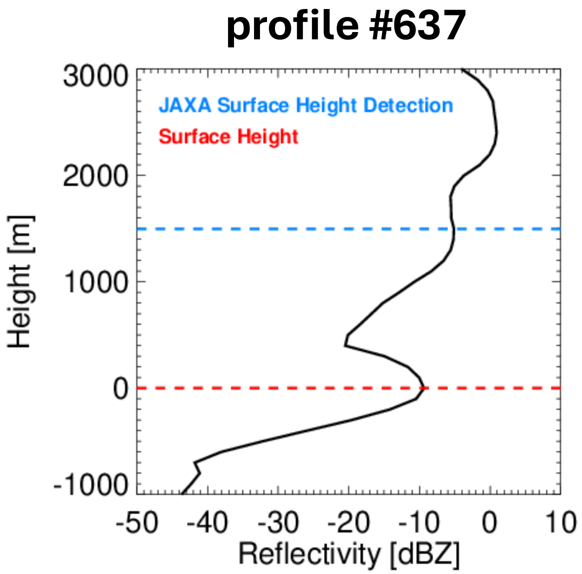


Surface Height Detection

P. Kollias

The L1b surface height detection, defined by the C-NOM variable *surfaceBinNumber*, is sometimes incorrect in profiles **with strong attenuation**.





Other considerations

- Calibration activity
  - sea surface calibration (expecting the final calibration result)
  - Proper space and time averaging strategy in ground-based radar comparisons
- Attenuation estimation (comparison of profile)
  - comparison of downward looking radar vs. upward looking radar
  - comparison with longer wavelength radar (e.g. MIRA)
- Doppler velocity unfolding method has already established?
- Expectation of future validation activities
  - validation of geophysical products from Level 2
  - comparison with other satellites (e.g. GPM, CloudSat)

H. Horie

L. Pftzenmaier

F. Ewald

J. Delanoe

P. Borque

Seed questions for discussion

Question 1: What has been identified by the validation teams as aspects to improve and are there clear/proposed way to address that?

- There is general consensus on the Z calibration (with some procedure being capable to provide feedbacks at almost the daily scale) with all Cal/Val methods converging (still 2dB discrepancy between instrument and cal/val apprroaches)
- Doppler cal/val is more challenging (seasonal and zonal variations!!), make sure correlation of I and Qs and range weighting is properly accounted for)

Validation team suggestion for 16-18 km mode operations (*16km-mode in polar as current and 18km in other regions (<60deg) and no more 20km mode*) ➔ Imura-san's work. Is there consensus of the validation team on this recommendation?

Question 2: What are the positive aspects about the data, processors that can be highlighted from the validation team results?

- Outstanding results. Sugestion for public communications with highlights & Press release

Question 3: What are the aspects that for the validation team are yet to be validated?

- Non-uniform beam filling, aliasing corrections, multiple scattering flags, cloud boundary stretching
- Anything else we have missed?

Question 4: What should be noted to the public about the quality of the released L1 data?

- Need to be crystal clear from the users point of view which calibrations have been applied to Z and Doppler signal
- Also flags for artifacts needed (mirror, anomalous 2.5 km height feature)

5. What recommendations/suggestions are there for future L1 / L2 validation activities (e.g. needs/gaps) and for mission planning?

- L2 is generally more challenging (both JAXA and ESA products to be intercompared), and intercomparisons to be presented to the March workshop
- Remember that in addition to products it is important to validate assumptions underpinning algorithms

Highlights

- Outstanding results. Sugestion for public communications with highlights & press release & highlight validation results to a more (semi) scientific audience
- CPR better sensitivity than CloudSat (Ze < -35dBZe)
- Doppler velocity observation and its accuracy are satisfactory
- Good geolocation within the required range
- Several issues were recognized and solved or improved during the commissioning phase: (i) HPT switch-off by body current; (ii) I, Q offset, (iii) calibration; (iv) L1 Doppler spectrum bug; (v) mirror images and multiple scattering tails
- Several issues were recognized but remain and JAXA will investigate how to improve them: (i) Calibration; (ii) CPR antenna mispointing, (iii) Elevated surface detection in heavily attenuated profile; (iii) Artificial echo at 2.5 km altitude; (iv) aliasing, PRF dependency of Doppler spectrum width; (v) Noise floor underestimation
- Validation team suggestion for 16-18 km mode operations (16km-mode in polar as current and 18km in other regions (<60deg) and no more 20km mode). An action item for JMAG to decide on the new operational modes

Recomendations for product improvements

- To improve the CPR's reflectivity factor bias. To revisit relevant Cal/Val cases when appropriate re-processing has occurred
- On the effect of mirror images which appear as 2nd trip echo, methods are currently established to mask them in the Level 2 products. To investigate if these can be applied to Level 1 products
- CPR beam pointing correction is needed, to consider the possibility to apply the model Alessandro Battaglia proposed to reduce the biases between ground and satellite
- To correct C-NOM surface detection in strongly attenuated profiles (occasionally observed elevated)
- To correct artificial echo at 2.5 km altitude
- To investigate the effect of the PRF dependency on Doppler spectrum width
- To investigate the noise floor underestimation
- To perform sea surface calibration, and provide the final calibration results
- Uppon public release is important to: (i) clearly state which calibrations have been applied to Z and Doppler signal; (ii) assign flags to artifacts (e.g. mirror, anomalous 2.5 km height feature, multiple scattering)

Recomendations for validation

- **Aspects for the validation team that are yet to be validated:** (i) Non-uniform beam filling; (ii) aliasing corrections; (iii) Multiple scattering flags; (iv) Cloud boundary stretching
- **Recommendations for future validation activities:** (i) validation of geophysical products from Level 2 (both JAXA and ESA products to be intercompared); (ii) validation of assumptions underpinning algorithms; (iii) comparison with other satellites (e.g. GPM, CloudSat); (iv) investigate attenuation estimation and comparisons with other instruments (e.g. MIRA) (iv) **Present validation results in March workshop!**
- **On Doppler calibration validation from the ground**: the Cal/Val teams need support on what would be a correct direction to go (e.g. what variable to use, what range uncertainty to expect and to compare to). Feedback: on the L2 ESA data, the pointing correction is applied and the data are flagged on what is wrong, so 0 bias is expected in statistics comparisons (i.e. statistics with big datasets of similar cloud; e.g. 20 cases). This apply for randomly oriented cases (e.g. rain will deviate from 0). Also, the Doppler reported in the upper part of shallow clouds is not the one at top but at the middle of the cloud, intercomparison is needed with ground stations towards an improvement
- **On folding effects** in L1 Data Doppler data: corrections apply from L1 to L2, validation of the correction is need in L2 products
- **On L1b spectral width validation:** an indirect check can be the use of the L2 products and the EC simulator with the measurements and try to find indirectly what were the parameters in the measurements.
- **Keep the validation teams up to date: Which issues are already known and which are going to be fixed soon**

Report of MSI session

Sebastian Bley, Rene Preusker, Minrui Wang,
Stephanie Rusli, Vasileios Tzallas

Overview

MSI session on Thursday 16 Jan 2025

CET	JST	EST	Min	Title	Speaker
MSI session (Co-chairs: Rene Preusker, Sebastian Bley, Minrui Wang)					
13:00	21:00	07:00	5	Welcome and session opening	Rob Koopman
13:05	21:05	07:05	10	MSI – L1 products in-orbit validation ~~MSI Integrated Commissioning Team presentation~~	Olivier Defauchy
13:15	21:15	07:15	15	MSI Level 1 product verification	René Preusker
13:30	21:30	07:30	10	MSI – L1 geolocation accuracy ~~MSI Geolocation and Co-registration~~	Edward Baudrez
13:40	21:40	07:40	15	MSI – L1 cross-satellite validation using data from MSG SEVIRI ~~MSI Level 1 product validation using data from MSG SEVIRI and from Cloudnet stations~~	Sebastian Bley
13:55	21:55	07:55	15	First comparison of MSI and specMACS observations during PERCUSION	Bernhard Mayer
14:10	22:10	08:10	10	MSI early Level 2 product validation results	Anja Hünerbein
14:20	22:20	08:20	25	Discussion	(Co-chairs)

MSI summary on Friday 17 Jan 2025

08:30	16:30	02:30	30	MSI summary and discussion	Rene Preusker, Sebastian Bley, Minrui Wang

Overview

<u>Olivier Defauchy: MSI – L1 products in-orbit validation</u>
MSI L1 data are compliant to most requirements (accuracy, precision, stability, VNS diffuser aging). The requirements for VNS absolute radiometric accuracy and consequently VNS inter-channel radiometric accuracy are not yet entirely met. A full year in orbit characterization and further diffuser BSDF update will allow full compliance.

<u>René Preusker: MSI Level 1 product verification</u>
Radiometry between L1b and L1c products is found to be consistent. The geometry of VNS bands between L1b and L1c products is not consistent because L1c geometry is based on the L1b TIR component. L1 monitoring shows expected seasonal features (e.g. sunglint increase during Southern Hemisphere summer), SWIR-2 striping greatly reduced in baseline AE. VNS radiometric calibration suffers from severe deficits in ground characterisation → vicarious calibration needed.

<u>Edward Baudrez: MSI – L1 geolocation accuracy</u>
900 scenes were used to assess the L1b geolocation and L1c co-registration accuracy. M-NOM geolocation accuracy excellent for VNS, but out-of-spec for TIR bands. TIR geolocation accuracy and known issues with SWIR-1 L1c products have been solved for the upcoming baseline (AF) release.

<u>Sebastian Bley: MSI – L1 cross-satellite validation using data from MSG SEVIRI</u>
Comparison to SEVIRI shows that TIR calibration has been improved with baseline AE which has been publicly released this week. VIS and NIR reflectances seem too high (12-20 %) in comparison to SEVIRI for cloudy scenes. Both bands reach many values above 1 even above 1.2, which is unrealistic and causes gaps in the cloud products. For vicarious calibration, the focus should be on FCI onboard MTG with much better spatial resolution than SEVIRI.

Overview

<u>Bernhard Mayer: First comparison of MSI and specMACS observations during PERCUSION</u>

SpecMACS (hyperspectral imager SpecMACS onboard of the German HALO aircraft during PERCUSION campaign) VNS radiances have been compared to collocated MSI radiances (only nadir pixels) during the PERCUSION campaign – approximately 20 available under flights. First comparison of two underflights looks very promising (one case study excellent agreement, one flight with 5% deviation). Interested in comparison of cloud products (e.g. cloud top height, droplet size).

<u>Anja Hünerbein: MSI early Level 2 product validation results</u>

In comparison to MODIS and SEVIRI cloud products, MSI M-CM and M-COP products and their features look very promising. M-AOT comparison to MODIS also looks promising. MODIS data are suitable for surface or aerosol validation despite 30-min difference with collocated MSI data. Statistical Level 2 validation requires that issues at Level 1 to be resolved first.

<u>Discussion :</u>

- Differences between baseline AE and the upcoming baseline AF: further improvements to across-track correction and co-registration. Importance of consulting the disclaimer.
- PACE-PAX campaign data are available and can be used for MSI validation. On one of the aircraft involved in PACE-PAX there are also polarimeters for studying clouds. For example, polarimetry effective radius from PACE-PAX could be compared with the EarthCARE data. There are crossings between the PACE and EarthCARE satellites. The OCI imager on PACE has a large swath which allows good comparison cases with MSI.

Highlights

1. MSI L1 data are in general compliant to the requirements
   - TIR and VNS Radiometric Precision : Compliant
   - TIR Absolute Radiometric Accuracy : Compliant
   - TIR Inter-channel Radiometric Accuracy : Compliant
   - TIR and VNS Long Term Radiometric Stability : Compliant within the limited time period observed
   - VNS Diffuser Ageing : Compliant within the limited time period observed
   - TIR-VNS co-registration: Compliant

Defauchy

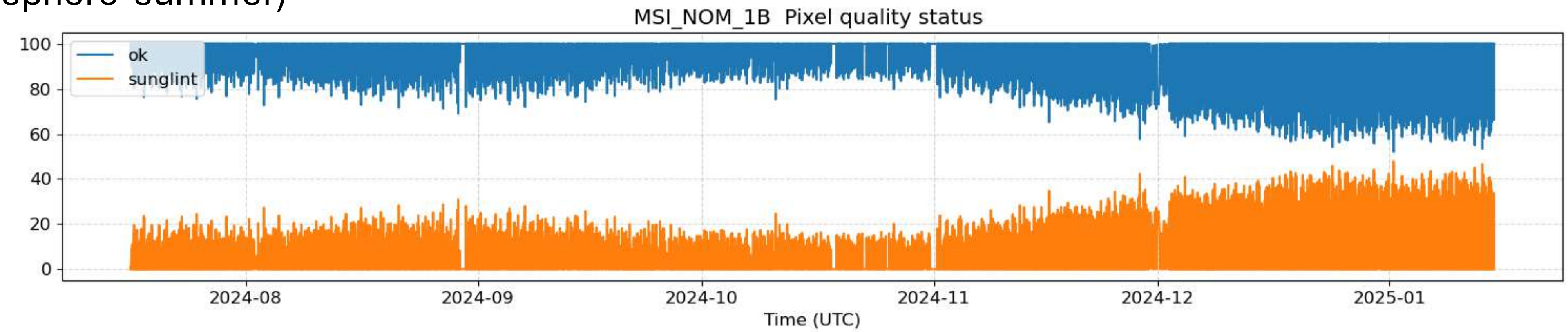
2. Consistent radiometry between NOM (L1b) and RGR (L1c) products, with L1b/L1c regridding for the VNS bands shown to work very well

Preusker

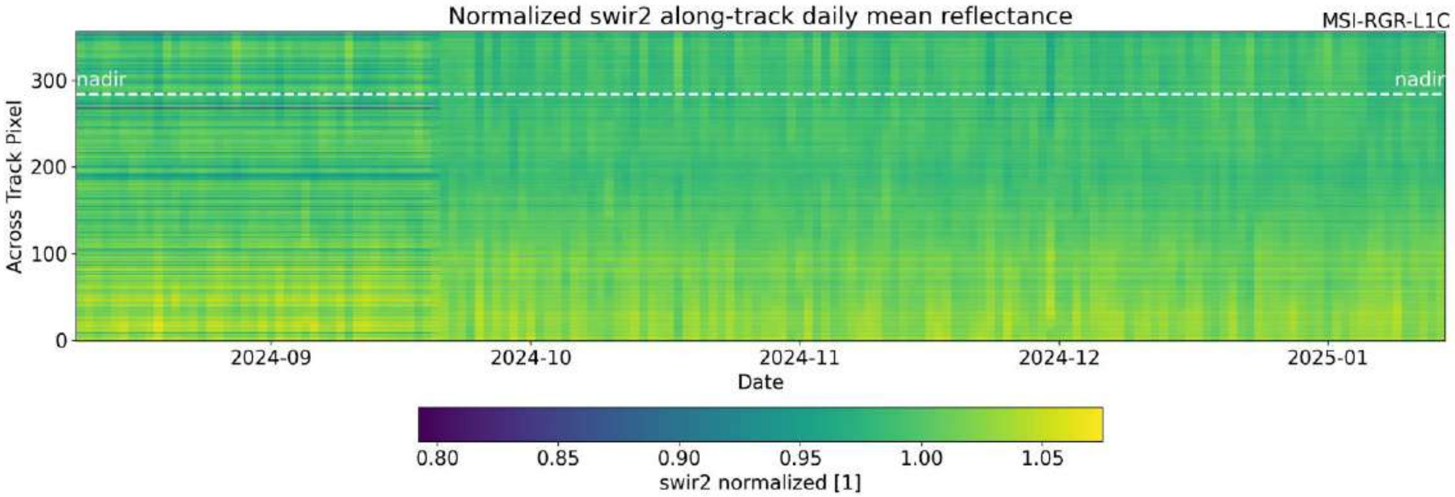
Highlights

Preusker

3. L1 monitoring shows expected seasonal features (e.g. sunglint increase during Southern Hemisphere summer)



4. SWIR-2 striping (artefact) is greatly reduced in AE almost no striping effect is seen in TIR bands.



Highlights

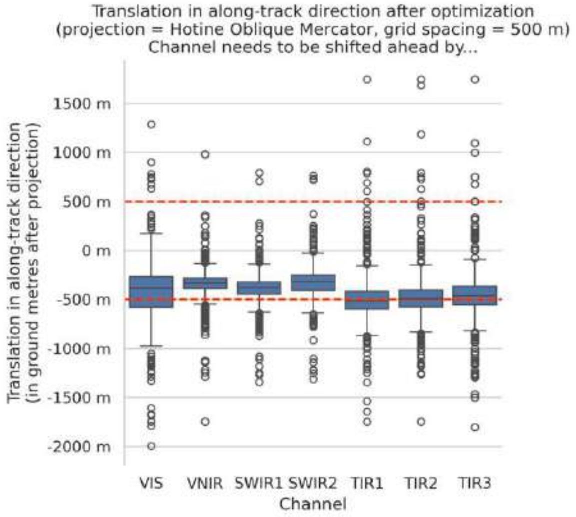
5. Geolocation accuracy deficiencies have been improved for the upcoming baseline (AF)

Baudrez

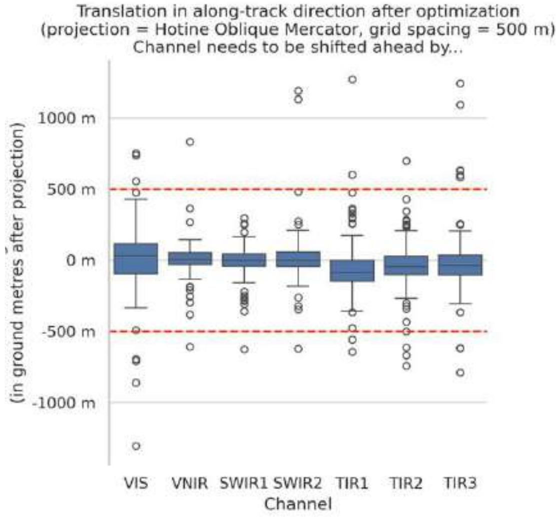
along-track

across-track

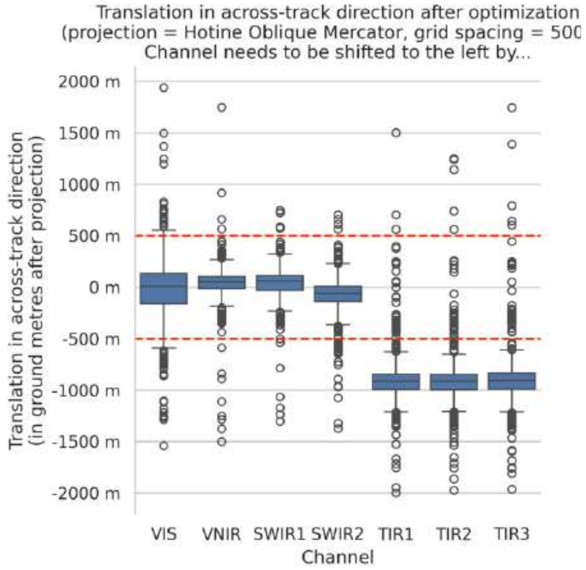
baseline AE



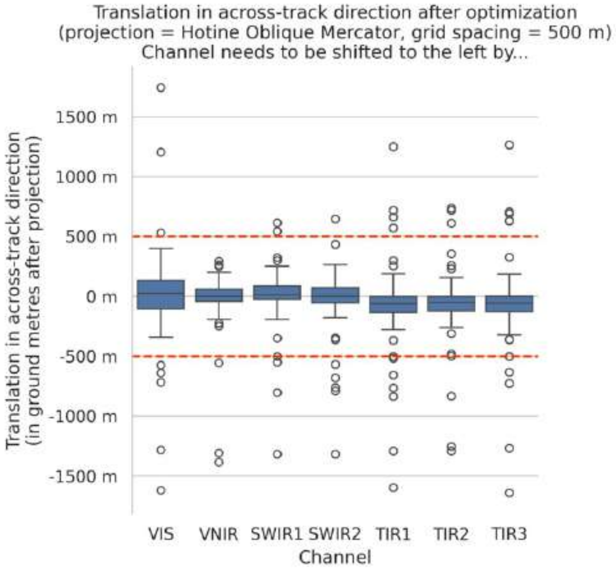
Upcoming baseline (AF)



baseline AE



Upcoming baseline (AF)

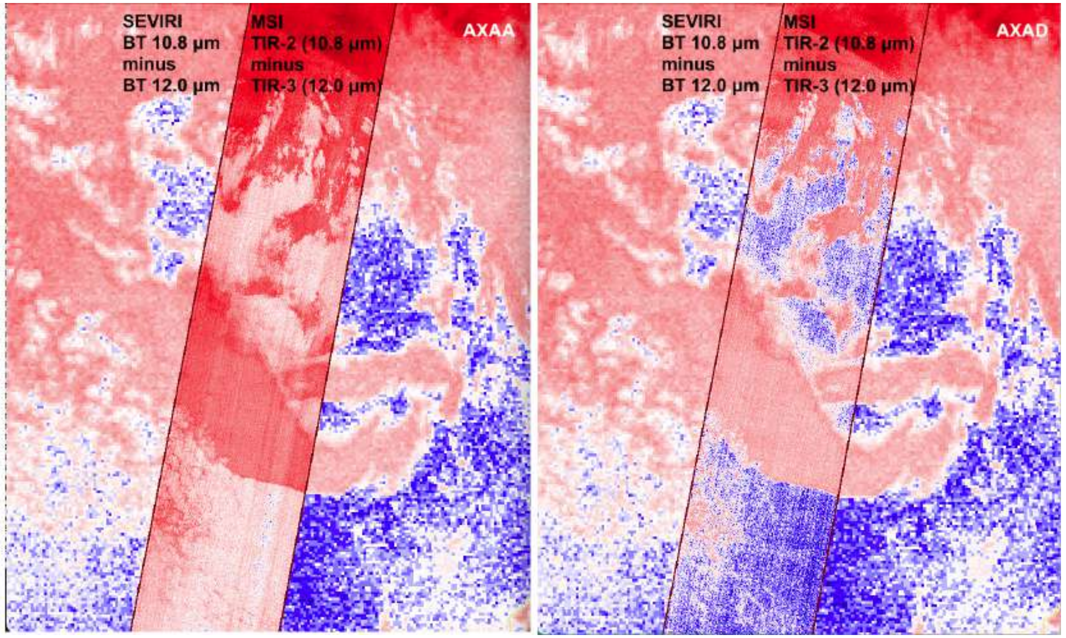


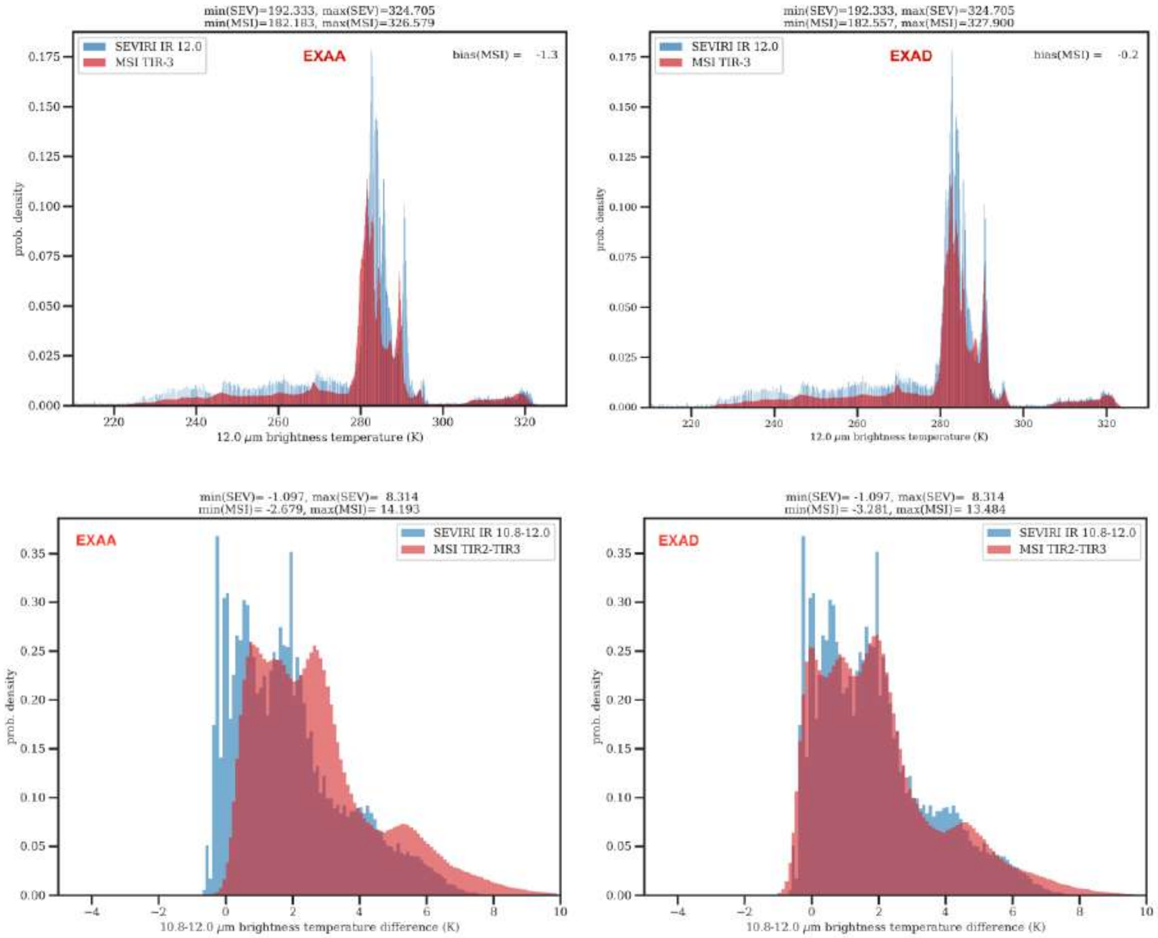
6. Coregistration accuracy: known issues in SWIR-1 M-RGR is fixed for next baseline (AF)

Highlights

7. Comparison to SEVIRI shows that TIR calibration has been improved in baseline AE

Bley



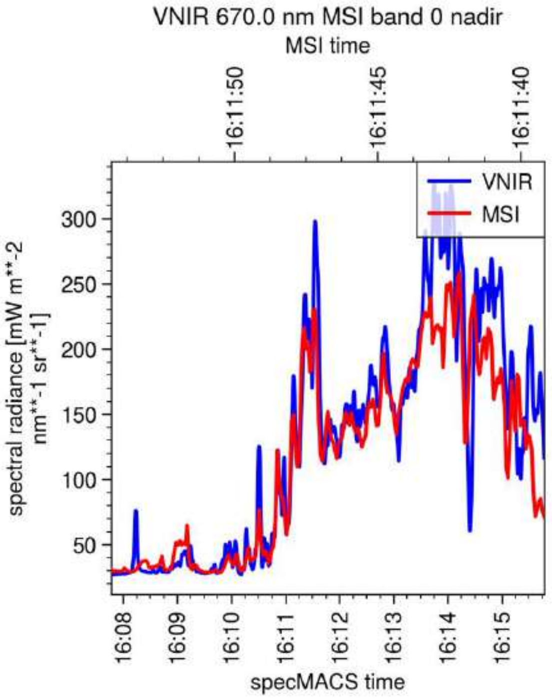


Highlights

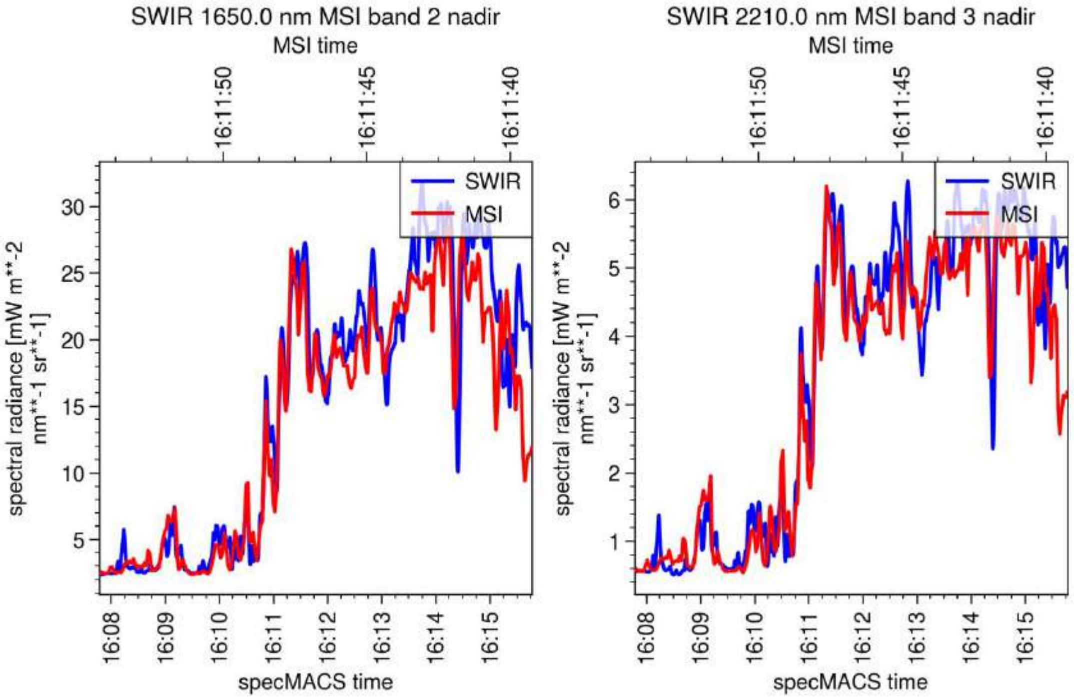
➕ 8.First L1 comparisons between MSI and the hyperspectral imager SpecMACS onboard of the German HALO aircraft (PERCUSION campaign) look very promising (one case study shows excellent agreement, another flight with 5% deviation)

Mayer

25 Aug 2024; specMACS VNIR vs MSI



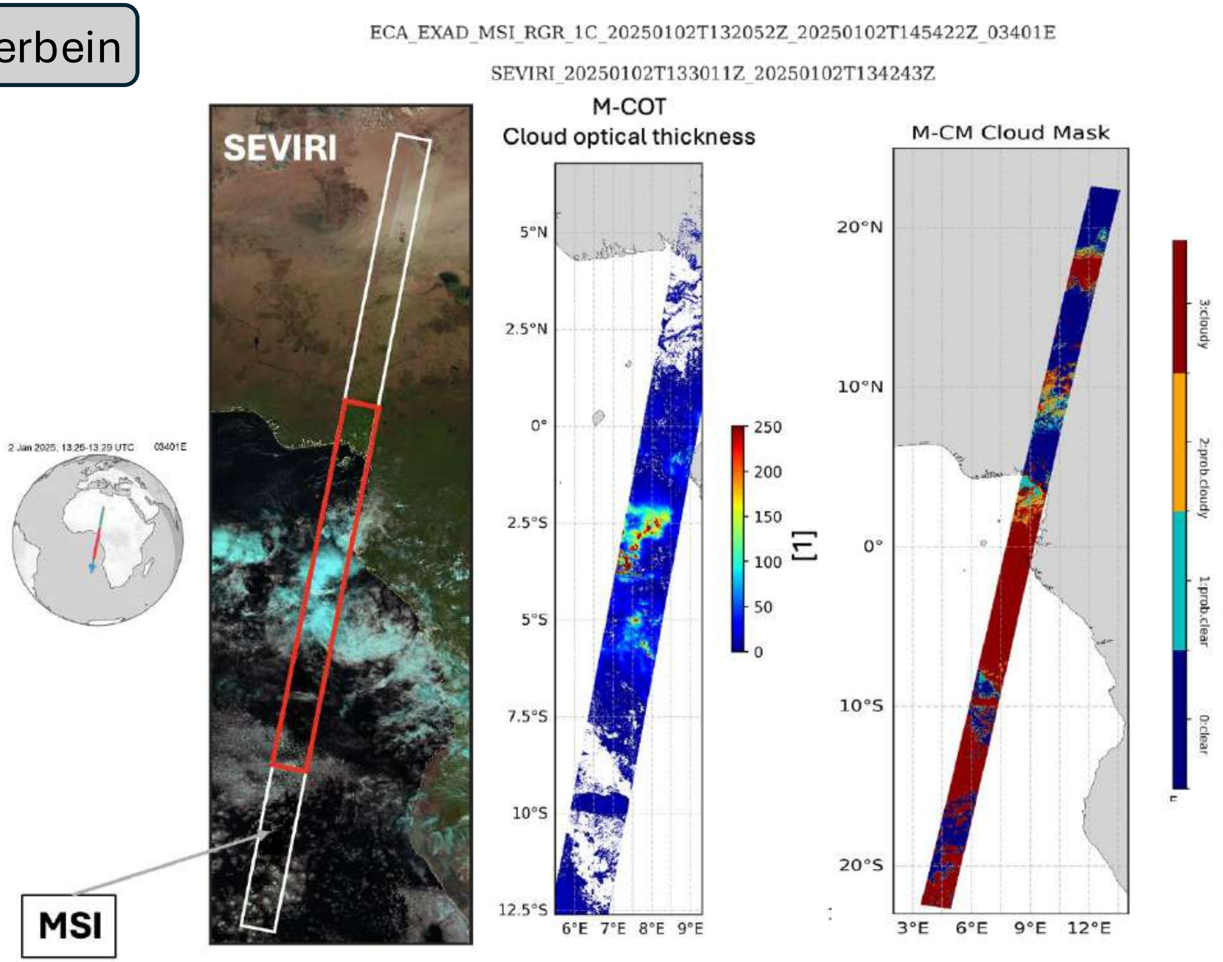
25 Aug 2024; specMACS SWIR vs MSI

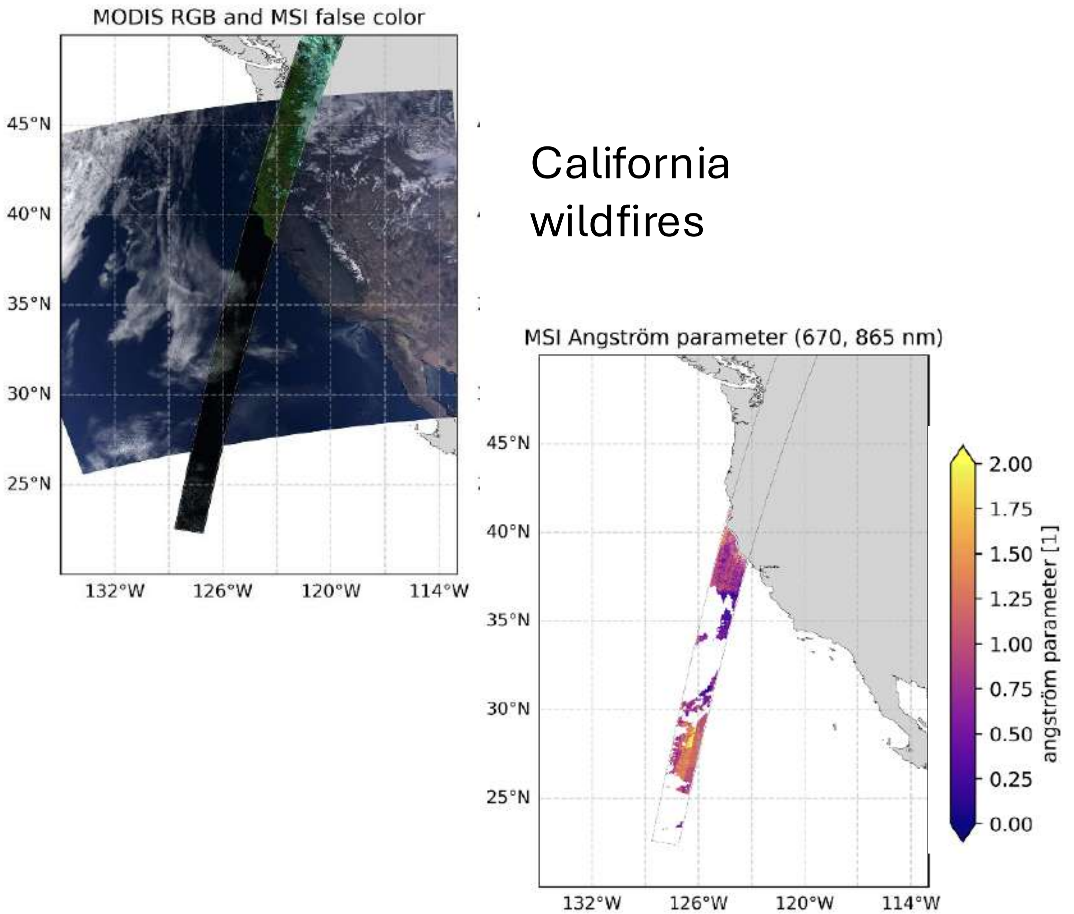


Highlights

9. Level-2 comparison between MSI (M-CM and M-COP) products comparison with MODIS and SEVIRI cloud products look very promising, as does the comparison between M-AOT and MODIS products.

Hünerbein





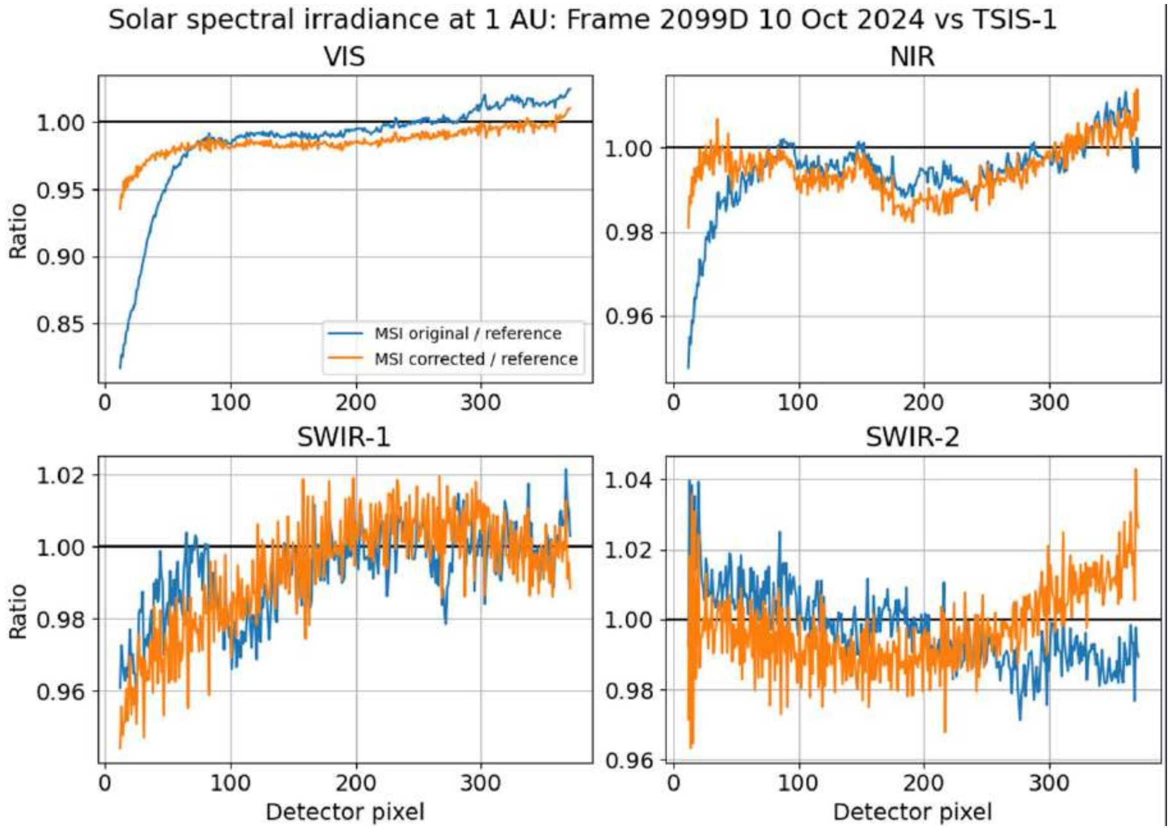
California wildfires

Highlights

1. VNS Absolute Radiometric Accuracy : Compliant **with the caveat on the start of the VIS band**

   VNS Inter-channel Radiometric Accuracy: **Not Yet Compliant for the VIS band**

→ Preliminary correction is implemented through update of diffuser BSDF using normalized daily across-track statistics.

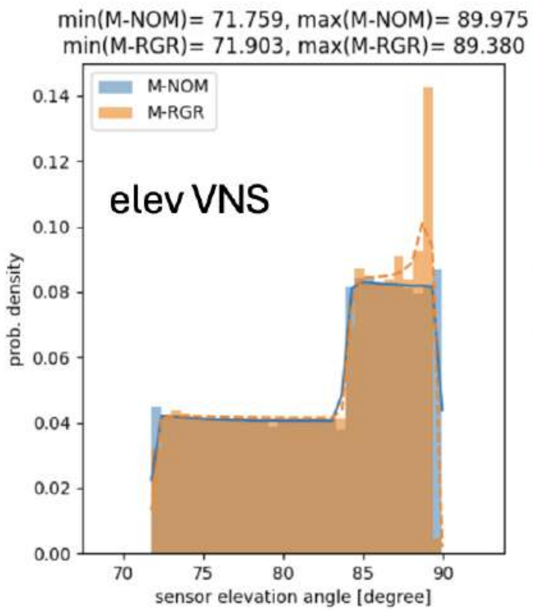


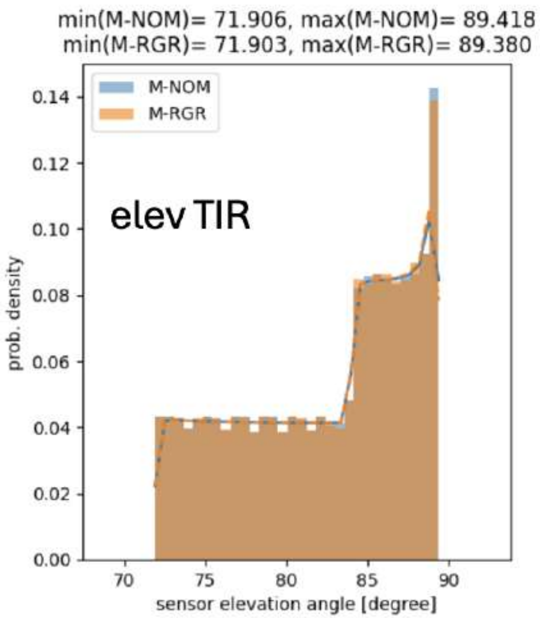
Defauchy

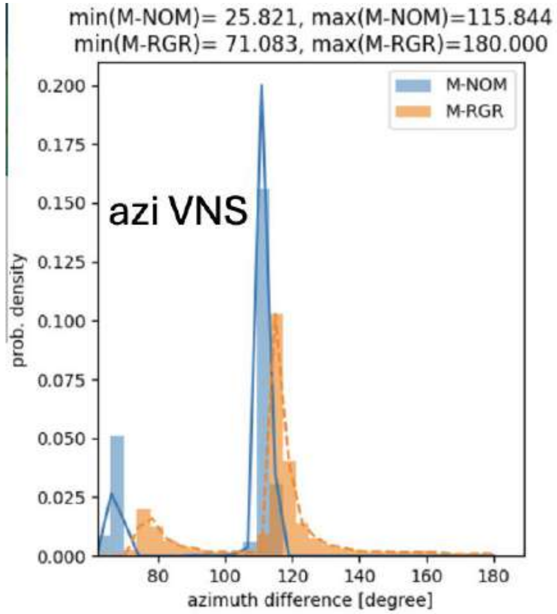
Highlights

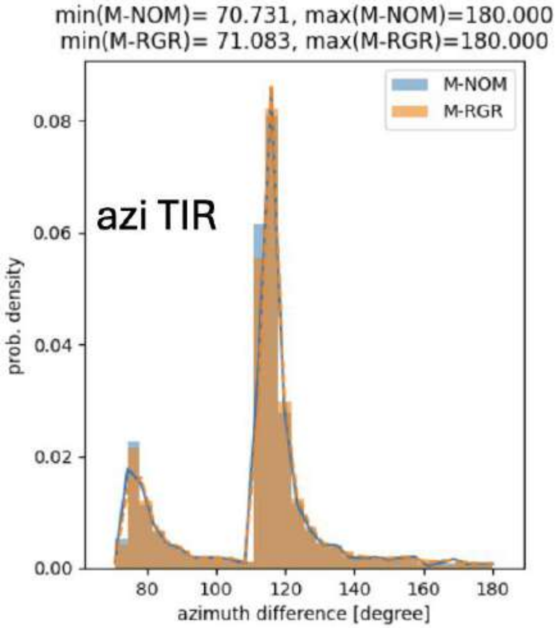
2. Geometry (sensor and solar angles) of VNS bands is not consistent between L1B and L1C products . Lessons learned: reference band should be VNS, instead of TIR, because TIR does not depend on scattering (there is no ‘azimuth’ in TIR RTM). Alternatively, include both TIR and VNS geometries in L1C.

Preusker





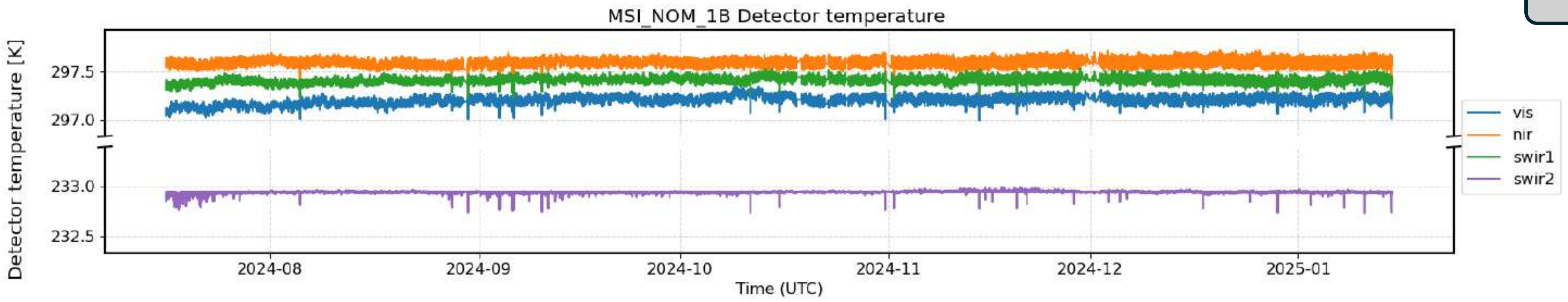




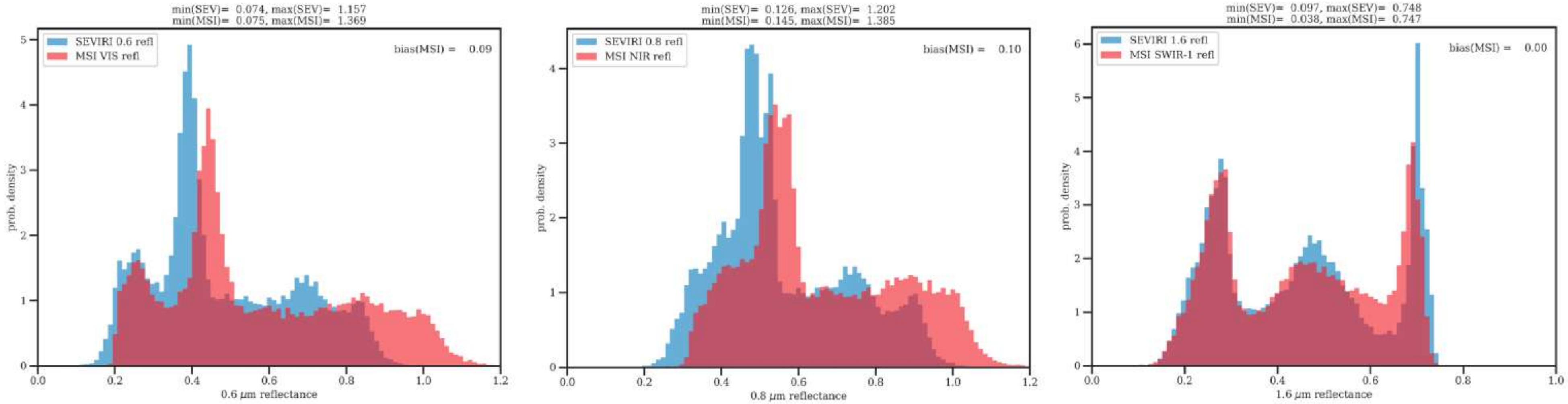
Highlights

3. Detector temperature drops are identified: small (~0.1K) but correlated.

Preusker



4. VIS and NIR reflectances seem too high (by 12-20 %) in comparison to SEVIRI for cloudy scenes.



Bley

Recommendations

- The VNS radiometric calibration is not compliant over the entire across track range. To reach VNS compliance, a full year in-orbit characterization including further BSDF updates will be required and additional intense vicarious calibration using reference instruments on other satellite platforms (e.g. FCI onboard MTG) and Pseudo Invariant Calibration Sites
- Analyse impact of latitude of frame ID on co-registration accuracy
- Detector temperature drops hould be further monitored and assessed to understand the nature of the correlation. The origin, and the impact
- Exploit collocations with NASA hyperspectral imagers during campaigns, by collaboration between EarthCARE (DISC) and airborne experts from NASA and SRON, and also with PACE OCI satellite instrument team
- Pursue further comparisons of L2 products with MODIS and SEVIRI products as initial comparisons look promising, but further L2 verification or validation requires remaining L1 issues to be fixed first