ATLID summary and discussion

Holger Baars, Ulla Wandinger (TROPOS),
Tomoaki Nishizawa (NIES), David Donovan (KNMI)

1st ESA-JAXA EarthCARE In-Orbit Validation Workshop
14 – 17 January 2025 | VIRTUAL EVENT

Session summary

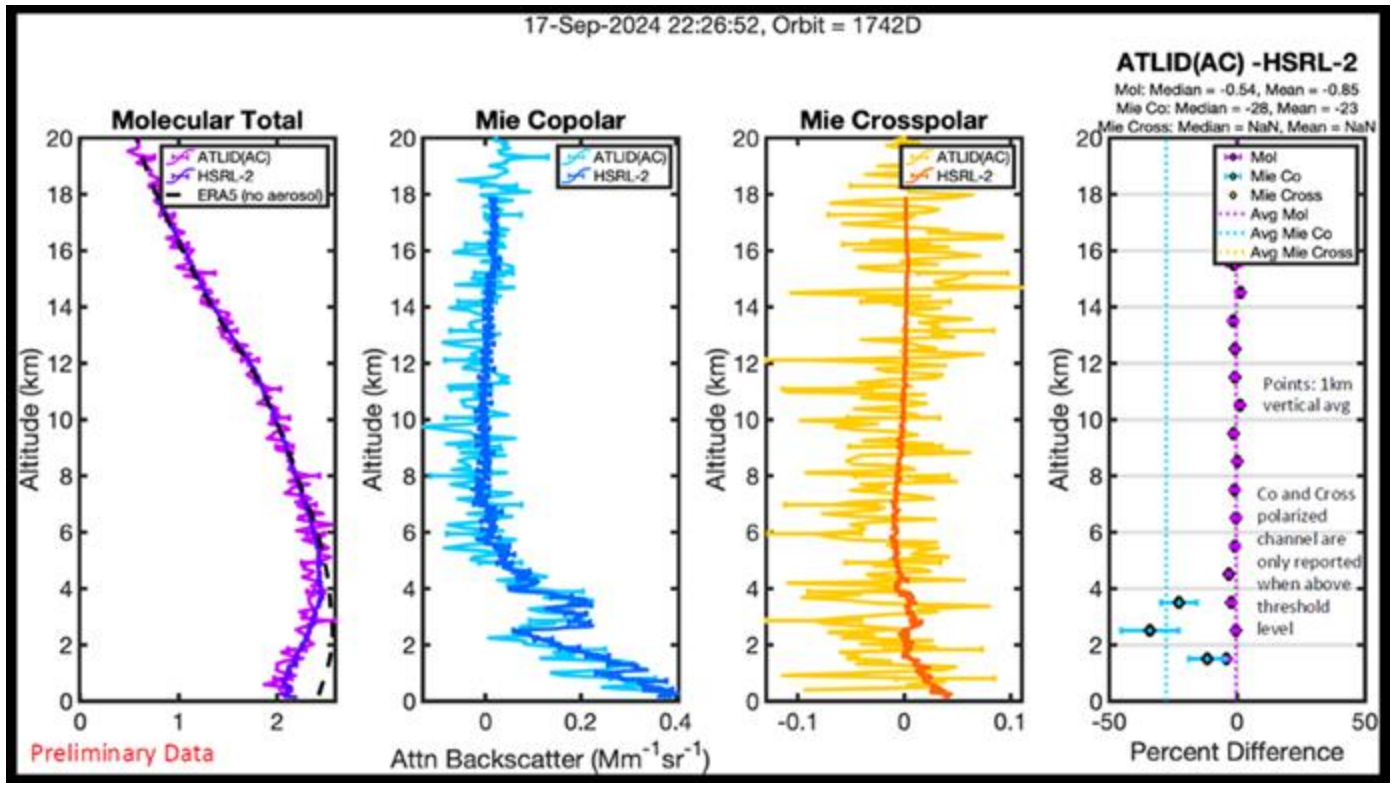
- **Two parts:**
  - **Tuesday afternoon (6 presentations)**
  - **Thursday afternoon (11 presentations)**
- **Excellent overview on validation efforts and impressive results for ATLID L1 and L2 products**

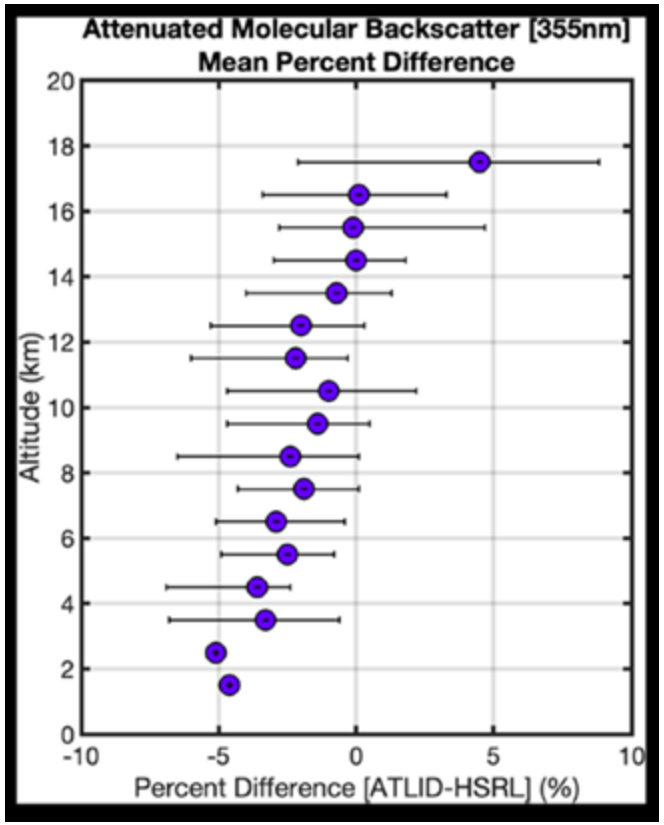
ATLID session - part 1 (Co-chairs: David Donovan, Holger Baars, Tomoaki Nishizawa)					
16:00	00:00	10:00	10	ATLID Integrated Commissioning Team presentation	Georgios Tzeremes
16:10	00:10	10:10	15	ATLID Level 1 product verification and validation needs	David Donovan
16:25	00:25	10:25	15	NRT quality monitoring 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)

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



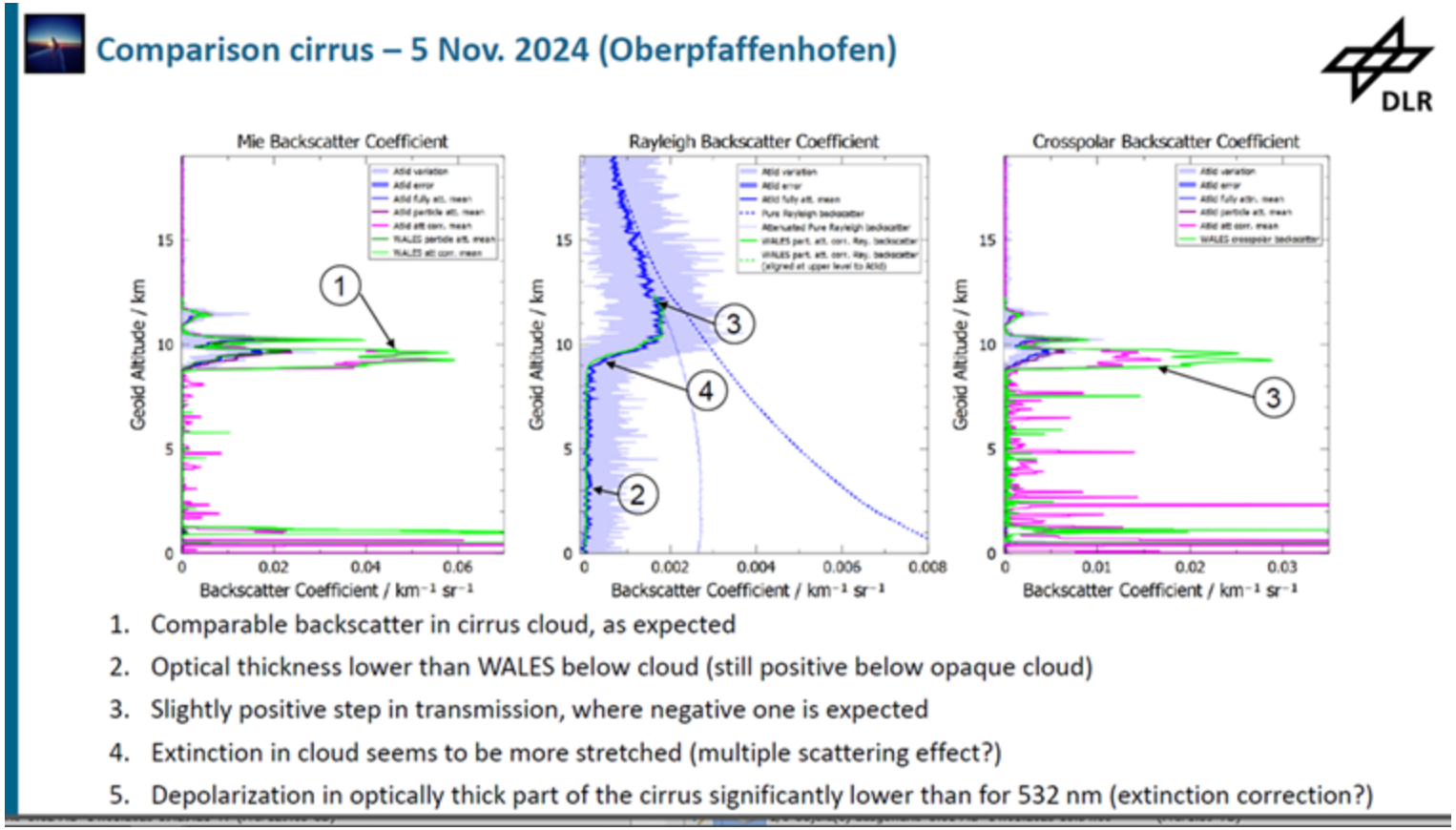


First results from the HALO PERCUSION campaign (Silke Groß)

Good results in cirrus clouds

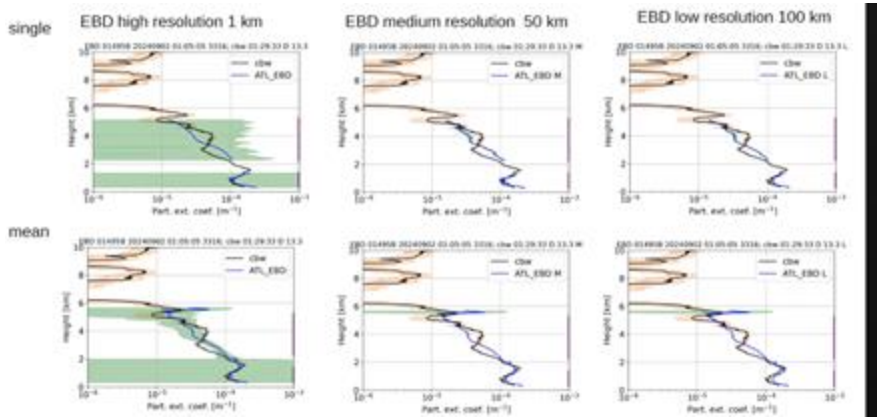
Some issues related to

- Cross-polar signal
- Cross-talk correction?
- Multiple scattering?



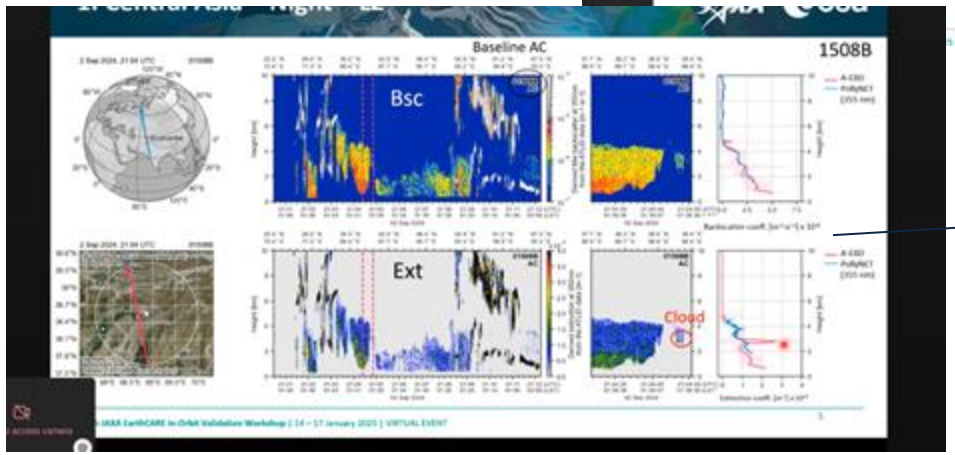
ATLID early Level 2 validation results (Ping Wang, Moritz Haarig)

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

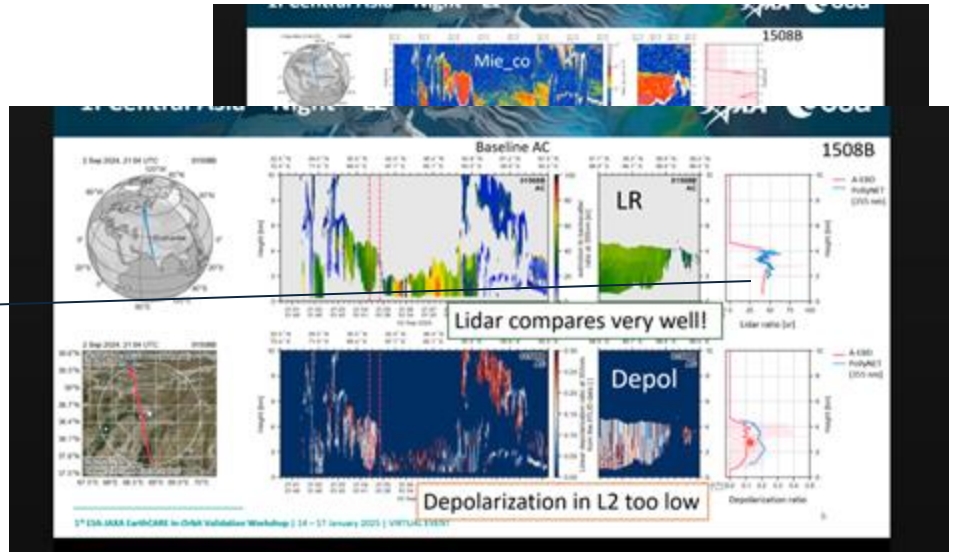


- We evaluate the ATLID AER, EBD products using EARLINET ECVT data every day.
- We showed the AER, EBD data at Cabauw from August to October 2024.
- The ATLID FM, AER, EBD products are in good shape, especially the night time orbits.
- The AER product seems having a small negative bias in extinction 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

- 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

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 (1/2)

- **What has been identified by validation team 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 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 (2/2)

- **What are 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)
  - Long-term behavior (statistical evaluations)#
  - Stratospheric features
- **What should be noted to 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 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 high-power lidars (designed for stratospheric observations), e.g. NDACC

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

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.
- 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.
- Be careful with the terminology regarding the signals (co-polar Mie, cross-polar Mie, Rayleigh) and don't compare 'apples and oranges'.
- 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!

Use the forum

→ Fast response and interesting for all

In short, the L1 ATLID times will be different than the JSG times by about 3 seconds. This is expected and due to the re-binning of the products to the Joint-standard-Grid shared with the radar and the other instruments.

End of presentation