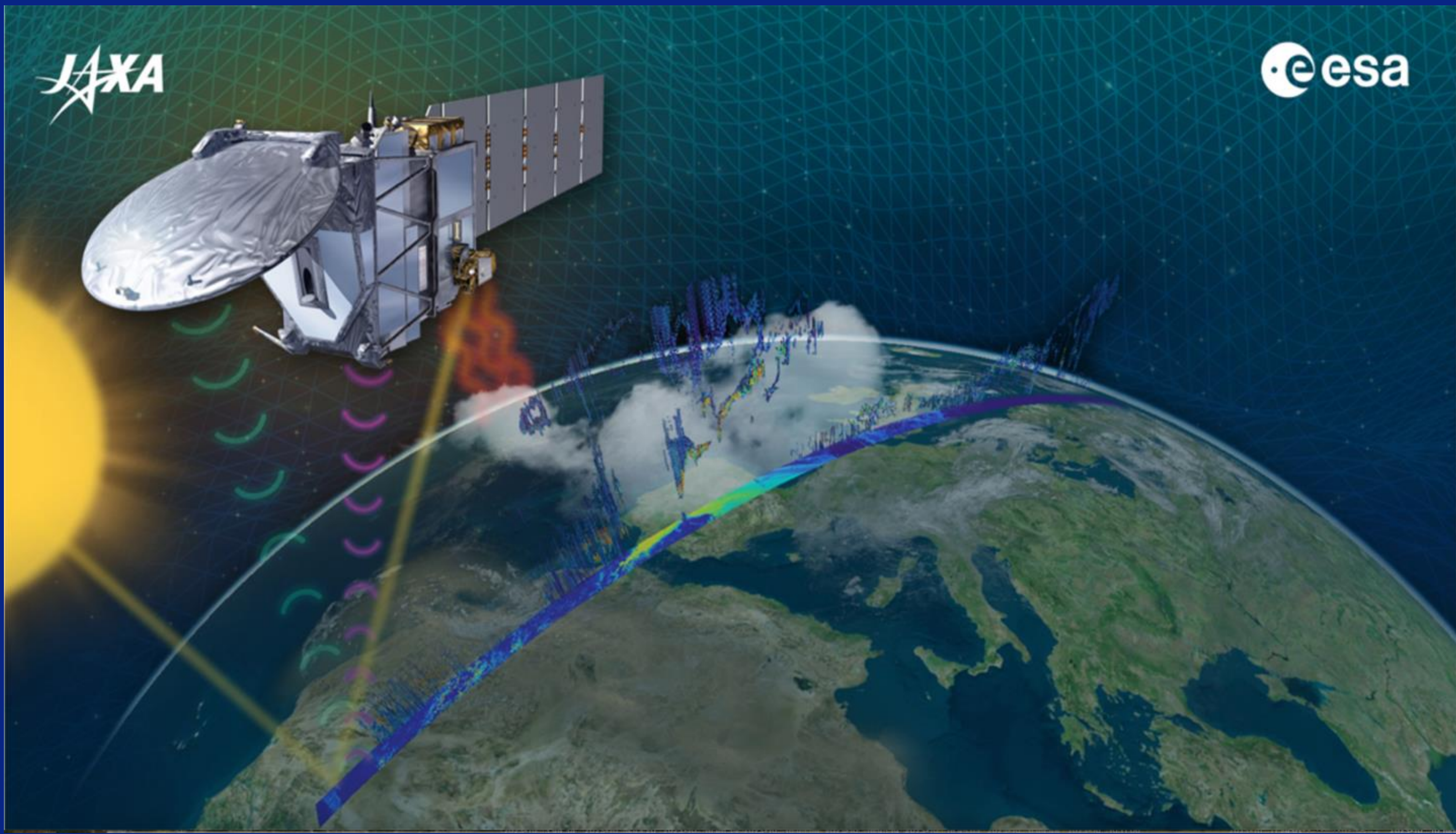

ESA-JAXA Pre-Launch EarthCARE Validation Workshop Report

EC-RP-ESA-SYS-1500

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1. Introduction

1.1 Introduction by Robin Hogan (ECMWF), and Hajime Okamoto (Kyushu University) – co-chairs of the Joint EarthCARE Mission Advisory Group

EarthCARE is ready for its launch in May 2024, and is eagerly awaited by the many communities in the various scientific disciplines that it will serve. Single-instrument and synergistic retrievals from its Dopplerised 94 GHz radar (CPR), its high-spectral-resolution 355 nm lidar (ATLID), its Multi-Spectral Imager (MSI) and its Broad Band Radiometer (BBR), are expected to enable advances in the understanding of clouds, precipitation, aerosols, radiation and their interactions in the atmosphere. Three hundred participants gathered on-site and online for the ESA-JAXA pre-launch EarthCARE science and validation workshop held from 13 to 17 November 2023 in Frascati. The workshop was organised around two focal areas, namely science and validation. Although both these aspects are strongly connected, the presentations were grouped so that those with a science focus were addressed in the first half of the workshop week, and those predominantly focusing on validation addressed in the second half of the workshop week. This present report summarises the validation-focused part of the workshop, and a separate report is in preparation for the science part. The validation workshop aimed to foster collaborations between the EarthCARE validation teams, including in particular collaboration between teams evaluating ESA and those evaluating JAXA products. It also sought to engage a wider community to join EarthCARE validation activities, and to review the status of validation projects that are underway including identification of gaps. A special focus of the workshop was the collaboration on the various post-launch campaigns, including synergy with those organised for other missions. A further aim was to discuss validation methods and lessons learned, and to identify best practices. Last but not least, the workshop presented the last opportunity to come together for preparations for the execution of the validation plan, including organization of the validation analyses. A total of 71 oral presentations were given, and 49 poster presentations and 6 validation support tools were exhibited.The workshop presentations can be downloaded from

https://www.earthcare-science-validation-2023.org/programme

and the posters from

https://www.earthcare-science-validation-2023.org/postersdemos.

1.2 Introduction presentation of validation workshop – Rob Koopman

Validation sessions were organized into oral, poster, and demo presentations. The topics covered in those presentations are reflected in the table of contents of this report. PI project oral presentations were accompanied by posters. The time allocation for talks followed a general guideline: PIs who had already presented their project at the 1st and 2nd validation workshops were allocated a 5-min talk and a poster presentation. New PIs were allocated a 10-min talk and a poster, whereas prospective PIs were allocated a 10-min oral presentation. Talks under the themes of networks and campaigns were allocated 12 min each. Presentations on tools were mainly demonstrated at demo booths and each was highlighted in a 5-min talk.

The commissioning timeline for each instrument on EarthCARE is still being refined. Correlative measurements to validate an EarthCARE instrument can take place as soon as "stable" nominal mode Level 0 products are generated for this instrument, well before L1 product release. Validation teams will be kept informed. Current planned sequence of stable nominal (NOM) mode operations: CPR, BBR, ATLID, MSI.

EarthCARE reference orbit has been specified as a system requirement but leaves one free parameter: the longitudinal shift of the entire orbit pattern. This is parameterised as the longitude of the Ascending Node Crossing of the first orbit of the repeat cycle (ANXLon). The reference orbit is theoretical; the actual orbit will vary East and West of this reference and it will be maintained within a deadband of 25

km at each side of the reference orbit. It is intended to select a value for the free orbit parameter (ANXLon) *a priori* to support validation sites coverage planning, this selection process is ongoing and validation teams will be informed of the outcome.
After the launch, validation teams will be continuously informed of EarthCARE news affecting their planning and analysis. ESA and JAXA are setting up technical information flow covering the four EarthCARE instruments. PIs are requested to submit progress reports on data acquisition and intercomparisons, to present at validation workshops (the initial results workshop is split into 3 parts matching the staggered public release schedule). Publications using pre-operational data (i.e. data that are not released to the public) need prior authorisation and a clarification statement.

1.3 ESA validation introduction – Rob Koopman

ESA validation-related activities can be grouped into three categories: 1) organisation for pre-launch and correlative measurements, 2) fostering of validation collaboration and coordination, and 3) initiating and supporting the development of methods and approaches.
ESA validation approaches include airborne campaigns, network intercomparison, satellite-satellite intercomparison, and data assimilation, all of which will continue during the entire mission lifetime, covering various geophysical and meteorological conditions. ESA pursues various airborne campaign opportunities, including home-based EarthCARE underflights.
ESA validation team consists of 40 PIs (currently) and is still growing in size. The proposed projects of ESA PIs cover validation of different geophysical parameters and is shown in the tabular/matrix form on dedicated posters. Various support tools and facilities are prepared for the validation teams and are presented in detail in ESA tools and logistics session.

1.4 JAXA validation introduction – Toshiyuki Tanaka

JAXA validation approach is composed of networks, campaigns and spaceborne measurements. JAXA validation team has collaboration and coordination activities including campaigns, networks, and best practice activities. Examples of networks include AD-Net (lidar network), WINDAS (wind profiler network), SAVERNET, SKYNET, AERONET, NIED Ka-band radars, All-sky cameras, BSRN, and GEBA.
Ground observation campaigns are located mainly in Koganei validation supersite, with instruments such as Doppler cloud radars, HSRL lidar, and wind profiler. The airborne campaign will be performed in collaboration with DLR.
Web pages and tools are being developed to monitor EarthCARE data, including quicklooks, orbit prediction, orbit search, etc. English version of these sites will be available.
EarthCARE product validation is highly challenging, so collaboration is indispensable.

2. Lessons Learned

Chaired by L. Baldini, K. Suzuki
Secretaries: S. Rusli, T. Tanaka

No	Title	Speaker
1	Looking Back on Lessons Learned from CALIPSO Validation	Dave Winker
2	Lessons learnt from Aeolus Cal/Val	Sebastian Bley
3	Lessons learned from the GCOM-C(Shikisai)/SGLI cloud observations	Takashi Y. Nakajima
4	Validation activities for dual-frequency precipitation radar (DPR) onboard GPM core observatory	Nobuhiro Takahashi
5	Introduction to EarthCARE DISC	Timon Hummel

1. Looking Back on Lessons Learned from CALIPSO Validation – Dave Winker

The concept of "Validation" adopted in CALIPSO is quite a broad one, including verification of instrument performance (calibration, signal-to-noise ratio, linearity of the response), geolocation (pointing, altitude), accuracy and precision of L2 data, and examination of assumptions in the retrieval algorithms; uncertainty of estimates also need validation. The CALIPSO Science Validation Plan (released in 2004) included different resources, such as ground-based networks, satellite comparisons, targeted aircraft campaigns, and large field campaigns.
Owing to such plans, several unexpected problems were discovered: orbit drift in 1064 channel calibration, ranging error in speed of light (rounding up to 3e8 m/s), excess PMT noise in the South Atlantic Anomaly. Early validation of L1 profiles were critical and deserved dedicated airborne campaigns after launch. With many underflights (mostly in the eastern US, with no global coverage), it was possible to aggregate statistics and get histogram of the distribution function of sensitivities, variability of lidar ratio for different aerosol types. A major issue with validation using ground networks was the time needed to acquire a sufficient collection of matched observations: for example, 5-6 years were needed to get enough sample from AERONET-CALIPSO spatial matching for statistically significant comparisons.
Validation of truth is not always available (actually "truth" is an elusive concept). In the very first stages, simple consistency checks using satellite data are useful, and visual inspection can identify non-physical results. Assimilation could help with the validation of uncertainties. A difficult validation problem encountered was related to latitudinal (intra-orbital) and seasonal (intra-annual) biases. It was mitigated in different evolution steps of the algorithms.

2. Lessons learnt from Aeolus Cal/Val – Sebastian Bley

Aeolus satellite carried just one large instrument- a Doppler lidar that measured for the first time profiles of the Earth's wind over a global scale. The mission exceeded expectations in terms of scientific impact and duration of the mission, and produced key observations to improve weather and climate models. The Cal/Val program played a fundamental role in Aeolus success. Several issues were fixed over the years and mitigated through reprocessing of data. In performing Cal/Val activities, communication/interaction among validation, science, NWP, industry, and mission experts is important. So are regular updates (e.g. information when new product versions become available) for validation teams (six months updates can be recommended). The importance of an effective communication platform to facilitate and trigger discussion among the validation teams was highlighted.
Early preliminary data provision to the validation teams (after 3 months into commissioning phase) took place although there were several issues with the product quality. Feedback from Cal/Val teams helped to decide about data to be released later to all users. Joint validation campaigns with instrumented aircrafts allowing analysis over larger areas were performed. Continuous validation is essential during

the lifetime of the mission and after the end of the mission. Validation is also required for the reprocessed datasets. Along with the mission, reports collected from the validation community with a regular schedule (every 6 months) were very helpful. Listening to recommendations from validation teams is important. On the other hand, validation teams should be properly informed when to measure as not everyone is familiar with orbit tools; overpass tables are a good alternative.

3. Lessons learned from the GCOM-C(Shikisai)/SGLI cloud observations – Takashi Y. Nakajima

The purpose of GCOM (Global Change Observation Mission) is the global, long-term, observation of Earth's environment and it is expected to play an important role in monitoring both global water circulation and climate change. The GCOM-C/SGLI instrument has 19 bands with 1400 km swath, which are similar bands to the EarthCARE MSI. Several methods were used for Cal/Val. The validation of the satellite-derived cloud flag using ground-based sky cameras was challenging. Clouds were detected using cameras even at nighttime in the city of Tokyo because of the background light and that was useful for validation. Water and ice cloud properties derived from SGLI were compared and evaluated with MODIS, demonstrating that satellite-satellite comparison is useful in the early phase of the mission. Lessons learned for EarthCARE are that more ground validation stations are needed due to narrower swath of MSI compared with SGLI and to validate cloud top heights using ATLID.

4. **Validation activities for dual-frequency precipitation radar (DPR) onboard GPM core observatory – Nobuhiro Takahashi**

The Dual-frequency Precipitation Radar (DPR) is a scanning radar using two frequencies, at Ka and Ku band to obtain relevant 3-D information on rain and snow profiles. The aim of this instrument is also to serve as reference for calibration of a constellation of satellites equipped with microwave radiometers. To calibrate DPR, both internal and external calibrations are performed. External calibration uses ARC (Active Radar Calibrator) for overall performance of the radar (echo power, 10 times per year). Normalized sea surface backscattering cross section (s_0) is used for long-term monitoring. Statistics of s_0 will be available for EarthCARE CPR, although a careful treatment is needed to remove the effect of sea surface wind, because CPR is nadir-looking radar. Validation approaches include rainfall intensity using rain gauges, (accuracy of about 12%), weather radar products, or the Multi-Radar Multi-Sensor (MRMS) product, snowfall estimation (using radar and in-situ measurements) and precipitation microphysics using disdrometers and radar profilers like the 24-GHz micro rain radars. Specific campaigns were conducted targeting solid precipitation and snow.
As a result of recent development projects, two new devices namely Rainscope (a balloon-borne optical sensor able to reveal the shape and fall velocity of particles) and PAWR & MP-PAWR (Multi Parameter Phased Array Weather Radar) are also used for matching colocation in space and time. Similarly to GPM-CloudSat matchup data, a GPM-EarthCARE collocated dataset will be created in the future for use in the validation of EarthCARE. In summary, a statistical approach is needed for precise calibration and validation that is reflected in the Cal/Val plan for EarthCARE/CPR.

5. Introduction to EarthCARE DISC – Timon Hummel

DISC activities will start in the phase E2 (6 months after the launch onwards). Data Innovation and Science Cluster (DISC) activities are focused on sensor performance, products and algorithm (SPPA) at ESRIN. These include the improvements of the products and the development of new products (processor evolution and maintenance), internal Cal/Val, community interactions, development of tools, data assimilation coordination. The objective is to provide users with the best possible product quality. DISC is the central element in product evolution cycle. Organization of airborne validation campaigns does not fall under DISC tasks/responsibilities.

3. Best Practices

Chaired by D. Winker, N. Takahashi
Secretaries: R. Koopman, T. Hummel, V. Tzallas

No	Title	Speaker
1	Defining validation protocols for space-borne aerosol and cloud profile products	Vassilis Amiridis
2	Representativity of air- and spaceborne radar-lidar measurements	Florian Ewald
3	Near real-time validation of EarthCARE observations through monitoring within a data assimilation system	Mark Fielding

1. Defining validation protocols for space-borne aerosol and cloud profile products – Vassilis Amiridis

Validation of high-vertical-resolution aerosol and cloud profiling missions are unique because of the narrow footprint, the small correlation length of the features, the need for in-situ microphysical observations, and the large diversity of the data products. To avoid data gaps becoming knowledge gaps, a large community of (>80) scientists involved in the validation of the CALIPSO, Cloudsat, GPM, Aeolus, EarthCARE, and AOS missions, in collaboration with ESA, NASA, JAXA, and EUMETSAT, has begun the process of converging on a CEOS common practice protocol for the validation of aerosol, cloud, and precipitation profiles. The protocol, and several of the accompanying open-source tools that implement the common practices for simulation of orbital radiances from suborbital observations, are on target for release of a first draft by Q1 2024, with a final protocol by the end of 2024 with guidance for the (by then) in-orbit mission EarthCARE, the future missions AOS and Aeolus 2, and the candidate mission WIVERN. As part of the convergence process, three studies on open issues analysing historical data are underway, namely assessment of spatiotemporal representativity of ground stations, validation of lidar attenuated backscatter from the ground, and validation of Doppler products from dual-polarization weather radar observations.

2. Representativity of air- and spaceborne radar-lidar measurements – Florian Ewald

This study focused on three aspects of intercomparison of cloud-related parameters, namely the differences between orbital and airborne sampling, the differences between the A-train (DARDAR) and the EarthCARE (CAPTIVATE) retrieval algorithms, and finally the differences in statistical representativity between orbital and airborne retrievals. For the airborne samples, the WALES 532nm HSRL and the MIRA 35GHz radar on the German HALO research aircraft were used and compared with Cloudsat and CALIPSO. Collocated measurements during the NARVAL campaign showed similar sensitivities between orbital and airborne, yet lower resolution and higher noise for the orbital observations. The effect on retrievals is that those from orbital data miss the fine-scale structures that retrievals on airborne data can capture. In a statistical sense, the distribution of orbital retrievals is narrower for ice-water content and effective particle radii. The intercomparison between DARDAR and CAPTIVATE was performed on A-train datasets, hence without utilising the HSRL and Doppler, and Solar radiance handling capabilities of the latter. Both algorithms have similar results for thick clouds, with larger differences for effective radii in cirrus. Statistical intercomparison of IWC from collocated HALO retrievals with A-Train retrievals showed the A-Train to be missing sensitivity for thin clouds and having slightly higher IWCs at higher temperatures.

3. Near real-time validation of EarthCARE observations through monitoring within a data assimilation system – Mark Fielding

The presenter showed the potential of monitoring EarthCARE observations against NWP data. The ECMWF Integrated Forecast System model is now equipped with a suite of observation operators for

EarthCARE simulations. The importance of monitored observational data for data assimilation was highlighted since it allows for a thorough assessment of the quality of the observations. In addition, monitored observations against NWP data provide a swift detection of potential instrument issues by removing the day-to-day variability. Examples of such applications were discussed by contrasting CloudSat measurements to the ECMWF model. Small calibration changes or changes in the bias were easily and quickly identified. Regarding EarthCARE, it was mentioned that two downlink stations would be adequate to account for delays in the processing chain. Near real-time validation of CPR radar reflectivity and ATLID channels, which will be carried out by ECMWF during the commissioning phase, is at the final stages. Updates on RTTOV and CRTM will facilitate the simulation of EarthCARE data from more operational centres.

4. PI project talks

PI talks that are summarized in this section were presented in various sessions with different chairs and secretaries:

- Best Practice and PI Talks, Chairs: D. Winker, N. Takahashi (Secretaries: R. Koopman, T. Hummel, V. Tzallas)
- Accepted and prospective PI Talks, Chairs: N. Clerbaux, Y. Ohno (Secretaries: A. Velazquez, T. Tanaka)
- Tools, Logistics and prospective PI talks, Chairs: H. Baars, E. Marinou (Secretaries: M. Eisinger, A. Velazquez)
- Networks and PI Talks 1, Chairs: L. Baldini, T. Nishizawa (Secretaries: H. Baars, T. Tanaka)
- Networks and PI Talks 2, Chairs: U. Wandinger, T. Y. Nakajima (Secretaries: E. Marinou, T. Hummel, V. Tzallas)

The full list of PI names, IDs, talk titles and where the talk summaries can be found in this document, is provided in the Annex A.

The list of PI talks (including prospective PIs) covered in this section is shown in the following table. Note that the name of the speaker is indicated here, which in some cases is a Co-Investigator representing the PI.

No	Title	Speaker
1	Physical validation of EarthCARE Products	Chandra V Chandrasekar
2	Validation of EarthCARE doppler with Chinese cloud radar network, and retrievals with tropical triple-frequency radars	Haoran Li
3	Validate Cloud Profiling Radar on EarthCARE against Aircraft Observations of Cirriform Cloud	Vaughan Phillips
4	Statistically Based Calibration/Validation Control of ATLID L1 data	Artem Feofilov
5	Development and Validation of the Japanese EarthCARE 4-sensor standard algorithm for radiation fluxes	Akira Yamauchi
6	Aerosol optical properties and validation plan by using Sky radiometer	Kazuma Aoki
7	Validation Plan for CPR ECO Product	Hiroaki Horie
8	GIVE - the German Initiative for the Validation of EarthCARE	Ulla Wandinger
9	AVE-ECARE: validation and evaluation of EarthCARE aerosol products	Larisa Sogacheva
10	Norwegian initiative for EarthCARE Validation of Aerosol uncertainties and Radiation products in the Arctic (NEVAR)	Kerstin Stebel
11	Extinction validation from Umweltforschungsstation Schneefernerhaus (UFS) - a proposal for additional validation measurements	Thomas Popp
12	EMORAL lidar observations for EarthCARE Cal/Val Activities and beyond	Iwona S. Stachlewska
13	Validation for the EarthCARE observations with use of spaceborne lidar ACDL and ground-based lidar-net over China	Guangyao Dai
14	Validation studies of L2 cloud products by CPR, CPR-ATLID and CPR-ATLID-MSI	Hajime Okamoto
15	EarthCARE validation activities in Finland	Dmitri Moisseev

15	An Italian coordinated contribution to the Validation of EarthCARE products from three atmospheric observatories in the Central Mediterranean Sea	Gianluigi Liberti
17	CORAL - Cyprus Observations for EarthCare vALidation	Rodanthi Elisavet Mamouri
18	Validation plan for EarthCARE/CPR using scanning Ka-band cloud radar	Tadayasu Ohigashi
19	EarthCARE BBR L1 and L2 Products Assessment	Nicolas Clerbaux
20	Preparation for the validation of EarthCARE Product in China	Xuan Wang
21	Assessment of the environmental conditions for the generation of ice particle types from A-train observations	Hajime Okamoto
22	LITES: cal/val with lidar in Hatfield, UK	Rui Song
23	Validation of ATLID lidar data by means of ground-based lidar measurements in northern Sweden	Peter Völger
24	Cabauw Lidar observations for ATLID L1 and L2a product evaluation	David Donovan
25	Updates for the Cabauw activities for EarthCARE evaluation (CECARE)	Arnoud Apituley
26	Validation of the EarthCARE ATLID and MSI products using ground-based lidar and sunphotometry measurements	Tomoaki Nishizawa

1. Physical validation of EarthCARE Products – Chandra V Chandrasekar

The project aims at validation of CPR L2a products using ground-based dual polarization radars, from the Finnish network, the Nexrad network and CSU and NASA radars, with a particular focus on oriented ice crystals (strong depolarizing particles).

2. Validation of EarthCARE doppler with Chinese cloud radar network, and retrievals with tropical triple-frequency radars – Haoran Li

This prospective project would involve Chinese cloud/precipitation radar network with 200 stations, and a triple-frequency tropical radar. For doppler validation, the use of Ka band is proposed.

3. Validate Cloud Profiling Radar on EarthCARE against Aircraft Observations of Cirriform Cloud – Vaughan Phillips

The speaker discussed the method for validating CPR data against observations from aircrafts for cirriform clouds. The issue of the intense and lengthy planning of campaigns was highlighted, while the solution of applying for funding to the Swedish Space Agency (SNSA) and seeking suitable aircraft campaigns after launch was proposed.

4. Statistically Based Calibration/Validation Control of ATLID L1 data – Artem Feofilov

The presenter proposed 11 quality control parameters for ATLID L1 data and their feasibility was tested by applying them to CALIOP observations. The algorithm will be adapted for ATLID and it will allow for a quality control on a daily basis offering a set of daily scattering ratio histograms. In addition, a web interface offering a dynamic update of quality control results will be delivered. Lastly, the speaker hinted as future work the extension of the cloud merging technique, which was used for combined data from CALIPSO and Aeolus, to ATLID.

5. Development and Validation of the Japanese EarthCARE 4-sensor standard algorithm for radiation fluxes – Akira Yamauchi

The validation of the EarthCARE 4-sensor standard product is being developed using A-Train data as a test bed for EarthCARE. Cloud information is obtained from CLOUDSAT, CALIPSO and MODIS, aerosols from CALIPSO and meteorological data from ECMWF. Comparisons with CERES TOA fluxes will be done monthly at a 5º resolution by using radiative transfer calculations. Comparisons with surface fluxes will be performed using BSRN data.

6. Aerosol optical properties and validation plan by using Sky radiometer – Kazuma Aoki

This proposal focuses on ground validation of optical thickness of aerosol and cloud. Observations with a sky radiometer (http://skyrad.sci.u-toyama.ac.jp) are available with a high temporal resolution during daytime. Long-term record of aerosol optical properties is available since 2017 until now, showing the seasonal cycle at the Japan site.

7. Validation plan for CPR ECO Product – Hiroaki Horie

The validation of the CPR L1 and L2 products will be performed using a 94 Ghz ground-based radar. Several very-well instrumented sites are proposed, looking forward to adjoining satellite overpasses of the sites. Instrumentation includes W-band radar, several lidars (NICT, NIES, TMU and Kyushu-U), a microwave radiometer, wind profiler and sky-camera. External calibration (ARC) and sea surface calibration will be used for the CPR L1 calibration evaluation.

8. GIVE - the German Initiative for the Validation of EarthCARE – Ulla Wandinger

GIVE is a very comprehensive proposal for the validation of most of the EarthCARE products. Many scientists are involved in this holistic approach that includes cross-satellite validation, airborne campaigns, the use of mobile platforms, global networks and stationary observations, 4D-variable assimilation, etc. An update of the new stations and upgraded ones is presented: 1. Mindelo in Cape Verde, ACTRIS aerosol and cloud remote sensing, fully operational since October 2023, 2. Melpitz in Germany, instrumentation will be moved from Leipzig to Melpitz in spring 2024 and 3. Limassol in Cyprus to be upgraded in spring 2024 (in collaboration with Eratosthenes Center of Excellence). In addition, the new opportunities such as ATMO-ACCESS pilot project and the validation with ACTRIS network stations were introduced. New campaign opportunities, such as PERCUSION and BOWTIE, as well as the HALO South and GoSouth-II 2025 campaigns were also envisioned.

9. AVE-ECARE: validation and evaluation of EarthCARE aerosol products – Larisa Sogacheva

The AVE-ECARE is a newly accepted Cal/Val activity in Finland. It aims to validate EarthCARE aerosol products, such as, the ATLID aerosol parameters and layer descriptors, MSI aerosol optical thickness, ATLID / MSI aerosol column descriptor, ATLID / CPR/ MSI composite product, etc. To this end, different measurements will be used, i.e, MODIS, MIRS, TROPOMI, PACE and aerosol layer height. AERONET and aerosol products from satellite will be used as reference. The validation protocol is being finalized. AOD analysis per station and stability is suggested. Latitudinal effects, instrument geometry and surface reflectance effects will also be investigated.

10. Norwegian initiative for EarthCARE Validation of Aerosol uncertainties and Radiation products in the Arctic (NEVAR) – Kerstin Stebel

NEVAR is another recently accepted Cal/Val activity that started in November 2022. This ground-based remote sensing project is divided in two phases: the first one comprises an inventory of the instrumentation and institutional capabilities in the Arctic and Antarctica; the second phase includes the aerosol uncertainties evaluation. The global evaluations / validations of L2 Aerosol Optical Thickness will be performed against AERONET/MAN. The evaluation of the radiation products, to be done after launch, will be carried out by comparing BBR data against simulated data for selected locations in the Arctic, using MYSTIC radiative transfer model for both1D and 3D geometries.

11. Extinction validation from Umweltforschungsstation Schneefernerhaus (UFS) - a proposal for additional validation measurements – Thomas Popp

Thomas Popp introduced a proposal to use regular UAV measurements/flights around the UFS (at 2650m) in the Zugspitze for the validation of aerosol optical depth (AOD) and aerosol properties and extinction profiles. Measuring with a wet aerosol spectrometer in the atmosphere will allow direct comparison to EarthCARE extinction profiles in the ambient atmosphere. Implementation is planned from 2024. Note that this is a prospective Cal/Val activity, not officially submitted to ESA.

12. EMORAL lidar observations for EarthCARE Cal/Val Activities and beyond – Iwona S. Stachlewska

The presentation included a detailed description of the ESA MObile RAman Lidar instrumentation and upgrades in the last 5 years. The new functionalities such as the broadband fluorescence and water vapor measurements together with wavelength-dependent polarization, backscattering and extinction coefficients can provide quality-assured high-level data products. The EMORAL lidar, fully autonomous and mobile, is foreseen to serve as one of the core ESA assets for the upcoming EarthCARE Cal/Val activities. An intercomparison with an ACTRIS reference lidar is scheduled in the frame of ATMO ACCESS.

13. Validation for the EarthCARE observations with use of spaceborne lidar ACDL and ground-based lidar-net over China – Guangyao Dai

The objective is to use the measurements from the first Chinese spaceborne lidar, ACDL/DQ-1, launched April 2022, ground-based Raman lidars and Doppler wind lidars to validate the observations from the ATLID instrument on EarthCARE. The ACDL/DQ-1, measuring at 532 nm and equipped with high spectral resolution and depolarization channels, is expected to precisely detect the three-dimensional distribution of aerosol and cloud globally with high spatial-temporal resolutions. The data products from ACDL/DQ-1 could be used for comparison with ATLID data after wavelength conversion. A high interest in the Chinese data was expressed! In addition, the onshore and offshore lidar network over China, with the use of multi-wavelength polarization Raman lidars, mass flux lidars, and Doppler wind lidars will provide the vertical profiles of the aerosols and thin clouds over their locations to be used for the validation of ATLID measurements.

14. Validation studies of L2 cloud products by CPR, CPR-ATLID and CPR-ATLID-MSI – Hajime Okamoto

An analysis of possible issues related to direct comparison under overpasses were highlighted, focusing on temporal and spatial matching. Satellite data from JAXA heritage used in past studies (e.g. TRMM, AMSR-E, MODIS) can be used for IWP, LWP and optical thickness statistical comparison. Validation can rely on ground-based instruments at the super site at NICT Tokyo that includes 355nm wind lidar, coherent 2um wind lidar, 94Ghz radars, etc. Example of 1-year statistics comparing Doppler velocity was shown with particular attention to the Doppler processing for aliasing. In order to check frequency distribution of the upward vertical velocity, vertical velocity of L-band wind profiler at Yonagunijima, Kumagaya, Mito and Minamidaitojima are examined.

15. EarthCARE validation activities in Finland – Dmitri Moisseev

A short overview of activities is provided regarding correlative validation, physical validation, and direct validation of Doppler measurements. Two Finnish ACTRIS cloud profiling stations and the FMI weather radar network are foreseen to be used for correlative validation. Different methods should be applied to different products. The Hyytiälä observatory can play an important role in validating L2 cloud and precipitation products and in physical validation of ice microphysics (observations of PSD, v(D), particle shape, precipitation rate, retrieved m(D)). There are plans to estimate attenuation and rain from disdrometers and cloud radar data. An important topic concerns the lack of IWC estimates above rain because of unknown attenuation at 94GHz. A further topic is the use of dual polarization observations and their link to raindrop sizes and fall velocities.

16. An Italian coordinated contribution to the Validation of EarthCARE products from three atmospheric observatories in the Central Mediterranean Sea – Gianluigi Liberti

The validation project involves three main sites (Rome, Rome suburbs and the Mediterranean island of Lampedusa). Addition of new instruments and upgrades from the latest presentation were provided and the funding from the Italian Space Agency (ASI) through the EC-VALMED.IT were secured for 2024-2026. The presentation highlights recent science advancements in characterizing sites and representativeness of measurements and matchup (www.eumetsat.int/characterisation-candidate-oc-svc-sites-lampedusa - Liberti et al 2000, Bracci et al 2023). The diversity in sites and instrumentation allows to exploit the expertise of the team in synergistic processing, statistical comparisons, and total radiation balance.

17. CORAL - Cyprus Observations for EarthCare vALidation – Rodanthi Elisavet Mamouri

Cyprus is a region known for its complex atmospheric environment as it is affected by haze and smoke, anthropogenic pollution, Saharan and Middle East dust. Validation consortium consists of Erastothenes Center of Excellence and CARE-C (Climate and Atmosphere Research Center) of the Cyprus Institute. They will focus on validation of EarthCARE aerosols and cloud products over Cyprus using Raman /polarization lidar and radar instruments in Limassol, ceilometer, sun photometers, and in-situ instruments (optical particle counters, impactors, backscattersonde) onboard UAVs. The validated aerosol and clouds products will then be utilized in RTM simulations and the outcome will be compared with high-quality solar irradiance measurements on the ground and at TOA (e.g. BBR data). Some activities are supported by funding from EXCELSIOR EU project, and by ATMO-ACCESS.

18. Validation plan for EarthCARE/CPR using scanning Ka-band cloud radar – Tadayasu Ohigashi

Validation of CPR is planned using statistical comparison (climatological comparison using CFAD) using ground-based Ka-band scanning radar, MWR, tower. Products usable for intercomparison: Doppler velocity, ZDR. Big dataset needs to be collected for meaningful comparisons. Examples of simultaneous and point-by-point comparison are shown, based on products obtainable from Ka scanning radar, such as CAPPI (Constant Altitude Plan Position Indicator) vertical cross sections. Direct comparison seems reliable only for reflectivity. Case studies and climatological histograms for statistical comparisons are implemented (more information on Poster no 15).

19. EarthCARE BBR L1 and L2 Products Assessment – Nicolas Clerbaux

The consortium formed by RMIB, IC, UV, and NASA Langley will validate L1 and L2 products from the BBR, specifically B-NOM, B-SNG, BM-RAD, and BMA-FLX. Intercomparisons will be done with other spaceborne measurements, such as CERES in across-track mode but also in the Programmable Plane Azimuth Scanning (PAPS) mode to maximize the angular collocation of the measurements and GERB at 0º and 45º East. SCARAB is no longer available, and CLARREO on ISS will likely not be available before 2026.

20. Preparation for the validation of EarthCARE Product in China – Xuan Wang

The national satellite center of CMA will include Cal/Val for meteorological data of Chinese missions. Two satellites were launched last year: Gou'mang and DQ1. Both are equipped with lidars at 532nm and 1064nm wavelength. The validation network includes 120 national radiosonde stations and 49 lidars operated in a network. Chinese reference lidar is compared to Potenza reference lidar. In Wuhan University they plan to build an enhanced lidar with WV and temperature capabilities. Intercomparisons with FengYun series satellites have been made and further development is foreseen.

21. Assessment of the environmental conditions for the generation of ice particle types from A-train observations – Hajime Okamoto

The speaker presented several aspects of the validation activities for precipitation and clouds. For the precipitation studies, the K2W methodology was described and sampling strategies and conditions for application of the method were explained. Regarding the validation activities for clouds, a newly developed dataset for assessing EarthCARE ice particle products was introduced and consistency studies between EarthCARE and A-train measurements were mentioned in the outlook after the launch of EarthCARE.

22. LITES: cal/val with lidar in Hatfield, UK – Rui Song

LITES (Lidar Innovations for Technologies and Environmental Sciences) facility in Hertfordshire (51.75 N, 0.24 W) will be used for the EarthCARE validation. LITES is a high-power multi-wavelength system, with HSRL, polarization, and spectroscopic Raman capabilities reaching altitudes higher than 13 km with high SNR. The system has been recently updated, and a processing chain is developed for automatic product outputs (in NetCDF). EarthCARE validation plan includes measurements in a time window of 3 hrs around overpass, collocation using trajectory analysis. ATLID aerosol profile products will be validated, and aerosol and cloud base/top heights will also be derived.

23. Validation of ATLID lidar data by means of ground-based lidar measurements in northern Sweden – Peter Völger

Ground-based lidar measurements in northern Sweden will be used for the EarthCARE validation (locations: IRF Kiruna (67.83 N, 20.41 E); Esrange Space Center, 30km ENE; 532nm measurements converted to 355nm). The arctic environment is often influenced by mountain lee waves. Validation plans are as follows. Validation targets: Cirrus clouds, PSCs, elevated aerosols; data products: A-EBD, A-CTH; measurements: during all validation period; methodology: comparison of individual cases (for Cirrus and PSCs) and statistical analysis (for Cirrus). The lidars are optimized for UTLS and stratospheric measurements (not capability in lower altitudes), occasionally balloon-borne in situ measurements of microphysical particle properties will be performed in cirrus clouds. Funding is secured for 2023-2025 (Swedish space agency). PI is interested to combine these measurements with airborne campaigns in the region (e.g. ALIVIO ARCTIC).
Rob Koopman’s suggestion: please consider collocated airborne and ground-based measurements, with collaboration between different Cal/Val teams.

24. Cabauw Lidar observations for ATLID L1 and L2a product evaluation – David Donovan

Means of validation include ground-based lidar measurements (CAELI ACTRIS multi-wavelength Raman depolarization water vapor system) at Cabauw (Central Netherlands) and supported instruments (e.g. BSRN, Doppler cloud radar). Validation plans: A-PRO and ACM-CAP direct L2 comparison; use of ATLID L1 forward model to compare with ATLID L1. No specific validation project is funded, but some work will be done in EU projects (e.g. CERTAINTY 2023-2025).

25. Updates for the Cabauw activities for EarthCARE evaluation (CECARE) – Arnoud Apituley

Measurements in CESAR (Cabauw Experimental Site for Atmospheric Research) in the Netherlands (supersite: wind/aerosol/water vapor lidars (daytime Raman extinction & backscatter at UV) include microwave radiometer, Ka/W radar, micro rain radar, MAXDOAS, BSRN, Aeronet, sky camera, 213 m tower (with in-situ instrumentations for meteorology, gasses, aerosol, fluxes, and drizzle X-band radar). CESAR is a part of ACTRIS aerosol and cloud remote sensing networks. A second site is located at Lutjewad Atmospheric Research Station with UV-lidar and Cloudnet station (W-band radar). Long-term validation of aerosol and cloud products and representativity of EarthCARE observations. CECARE is a national component of ACTRIS proposal (EVID05), is not yet funded but is a part of ATMO-ACCESS pilot project and EU-funded CERTAINTY project.

26. Validation of the EarthCARE ATLID and MSI products using ground-based lidar and sunphotometry measurements – Tomoaki Nishizawa

Validation effort will use measurements ifrom different observational sites in Japan (Toyama, Tsukuba, Koganei, Fukuoka, Hedo, Palau; lidar, sky radiometer, all-sky camera). NICT Koganei is a supersite located at 35.7 N, 139.5 E with instruments UV HSRL, DWL, W-band radars, MFMSPL multiple scattering lidar. Validation of aerosol and cloud ATLID and MSI products (columnar and profiles) will also be conducted using the AD-Net and SKYNET data. Ground measurement comparisons with CALIOP and Aeolus products were shown. Operational expenses will be covered by competitive funding. Palau site will close in 2024, currently considering where to relocate it.
Workshop recommendation: as we have very few marine-representative sites, it is recommended to try maintaining/support marine sites (as Palau) during the EarthCARE period.

5. Airborne and shipborne campaigns

Chaired by S. Gross, J. Delanoë (part 1) and P. Kollias, D. Donovan (part 2)
Secretaries: H. Baars, T. Fehr (part 1) and E. Marinou, J.von Bismarck (part 2)

No	Title	Speaker
1	NASA Goddard Space Flight Center (GSFC) Elastic Backscatter Lidar Efforts Relevant to EarthCare Calibration/Validation and Synergistic Data Products	Ed Nowottnick
2	EarthCARE Calibration and Validation Using the NASA LaRC Airborne HSRL-2	Chris Hostetler
3	The Arctic POlar Night EXperiment (PONEX) Aircraft Campaign to Assess EarthCARE's cloud property retrieval algorithm	Zhipeng Qu
4	Calibration and Validation of EarthCARE's Cloud Profiling Radar Data Products	Ousmane Sy
5	ALIVIO Norwegian EarthCARE Cal/Val Effort	Robert Oscar David
6	Calibration and Validation of EarthCARE Retrieved Products Using Measurements from the UK Facility for Airborne Atmospheric Measurements (FAAM)	Kamil Mroz
7	The Mediterranean EarthCARE Cal/Val experiment ACROSS	Eleni Marinou
8	Discussion campaign session part 1	
9	Strategy of measurements with the light balloon aerosols counter LOAC for the validation of EarthCare (BAIVEC project)	Jean-Baptiste Renard
10	Unmanned Aerial Vehicles and other observations for the cal/val of EarthCARE	Franco Marenco
11	In-situ airborne measurements during Aeolus Cal/Val JATAC campaigns – relevance for EarthCARE aerosol products	Griša Močnik
12	EC-TOOC – Airborne EarthCARE-like payload for preparation and validation studies	Silke Gross
13	BOWTIE – The shipborne Trans-ITCZ Experiment	Julia Windmiller
14	MORECALVAL: MObile Radar-Lidar-Radiometer EarthCare CAL/VAL project	Julien Delanoë
15	PACE-PAX	Kirk Knobelspiesse
16	Discussion campaign session part 2	

Airborne and shipborne campaigns part 1

1. NASA Goddard Space Flight Center (GSFC) Elastic Backscatter Lidar Efforts Relevant to EarthCare Calibration/Validation and Synergistic Data Products – Ed Nowottnick

NASA's CPL (Cloud physics lidar: elastic lidar at 355, 532, 1064nm with 1064 depolarization) is implemented in several different airborne platforms with the capability to perform flexible flights (including P3 and ER2 aircraft, and aircrafts with high-altitude capability). Real-time data products have been described for the example of CATS (Cloud aerosol feature mask). Roscoe (355, 1064nm up and downlooking lidar) is well suited for ULTS studies; 532 nm is not available due to eye safety. For the AOS mission, the ALICAT lidar (elastic polarization lidar at 532 & 1064nm) will perform Cal/Val in AOS-Storm NASA mission (planned for the 2028 launch). EarthCARE lidar ratio will be useful for ALICAT retrievals. For the EarthCARE Cal/Val, the NASA ER2 mission with CPL will take place in the fall 2024 around Palmdale California and it is possible to underpass EarthCARE. Other joint field campaigns /future opportunities (NASA EVS-4) might be used. In 2025, the home base will change from Palmdale to Edwards.

2. EarthCARE Calibration and Validation Using the NASA LaRC Airborne HSRL-2 – Chris Hostetler

This is a funded effort by NASA for EarthCARE validation with HSRL-2 (3b,2a+3dp). HSRL-2 has HSRL capabilities at 355 and 532nm, ocean profiling and O3 DIAL capabilities. HSRL-1 has been deployed in several aircrafts so far, together with polarimeters and once with the JPL radar. Measurements are capable to bridge CALIPSO with EarthCARE datasets (wavelength differences) and to help to extract more value from European 532nm lidars (WALES) for ATLID validation. HSRL-2 was used to validate CALIPSO lidar ratio and typing. It was emphasized that especially the large number of flights conducted allowed for statistical analyses. HSRL-2 can be used to validate EarthCARE level 1 (at 355 nm), aerosol typing, and level 2 products. The team is participating/contributing in the ECVT and ACPV activities. HSRL-2 products are available from L0 to L2 but for EarthCARE validation a L1b intermediate product will be developed, i.e. ATLID level 1b data validation needs some effort. Long-term dataset of 355, 532, and 1064 nm measurements are available to the community for any group that wants to use it towards the homogenization of the different missions or algorithm development. Translation of data base (wavelengths) was skipped on NASA side due to missing funding. Upcoming flights include PACE-PAX (Sep 2024), during which more EarthCARE underflights are in discussion.

Discussion: widen the view to the global aerosol population, HSRL-2 is useful but should not be used for global assessment. It is task for collaboration to bring all different results together. Recommendation: to widen HSRL2 measurements in more areas around the Earth, e.g. for Saharan dust more measurements in Saharan outflows and Arabian dust is needed. Same for smoke.
Response: there is plan to fly in the Asia2 campaign, so some improvement on this aspect is in progress.

Q: Lidar ratio for ice clouds?
A: It is related to cloud microphysics, and current research topic. Work will be done for water cloud microphysics and optical properties also.

3. The Arctic POlar Night EXperiment (PONEX) Aircraft Campaign to Assess EarthCARE's cloud property retrieval algorithm – Zhipeng Qu

The objective is to improve weather and climate forecasts in polar regions, to improve representations of processes in NWP models, and to collect new observations of surface emissivity and thermal profiles, cloud microphysics, and aerosols. Expertise is available through many airborne campaigns in the last 20 years to improve weather and climate forecast. Experimental design: two 3-week windows Jan 2025 and Feb 2025 departing from Inuvik. Weather flights and clear sky flights will be performed, along with suborbital flights for EarthCARE and AOD-HAWC with a special focus on optically thin ice clouds. Instruments: X, W, Ka-band radars (up, side, and downward looking), elastic cloud lidar 355nm (upward looking), MW sounder, in-situ probes, and more. Benefits for ESA EarthCARE mission is the closure assessment of the active instrument retrievals by comparison with BBR radiation retrieval. To this end, surface and atmospheric properties will be used, 3d scene construction algorithms using X and W-band radars and cloud in-situ probes for scene reconstruction. Aerosol in-situ probes and ALI lidar for Aerosol validation, 355nm lidar for cloud validation, FIRR-2 and broadband radiometers for Radiation Cal/Val. Surface sites consist of Inuvik, Iqaluit, Eureka, and Alert.

4. Calibration and Validation of EarthCARE's Cloud Profiling Radar Data Products – Ousmane Sy

Calibration of CPR measurements is planned with APR-3 measurements. APR-3 is a triple frequency radar with scanning, depolarization, and Doppler capabilities (W-band Doppler & Ka/Ku-band) used in several field campaigns. Differences between the measurements from different wavelengths were shown and investigated. CloudCube airborne radar is a Ka/W/G-band radar with Doppler capabilities. RainCube is a spaceborne radar deployed from ISS, used for SAT-SAT validation: measurements were compared with GPM (satellite to satellite intercomparison) and with airborne measurements. A point was raised that one should be careful to compare not nadir to nadir data. It is possible to construct a profiling radar in a Cubesat, a constellation could be used in the future. INCUS constellation consists of 3 DAR radars Ka-band and 1 DMR radiometer in a train, is targeting vertical transport of air and water by convective storms, and is anticipated to be launched in 2026. Work on GPM vs APR 3 comparison has been publishd (S.L. Durden, et al., IEEE GRSL, 2020). Comparison between APR3 and in-situ collocated cases were performed and showed good performance in some specific cloud types (O.O. Sy, et al., J. Atmos. Oceanic Tech., 2020). For EarthCARE Cal/Val, special focus lies on EarthCARE Doppler products. Doppler measurements on aircraft are stabilized and cross-track scanning will be performed. Key mention: Raincube are freely available data, invitation to use it to the community (https://tcis.jpl.nasa.gov/data/raincube).

5. ALIVIO Norwegian EarthCARE Cal/Val Effort – Robert Oscar David

The ALIVIO project complements other Norwegian projects presented by others: validation using airborne measurements (in-situ) and ground measurements at ALOMAR observatory (remote sensing, 355, 532, 1064nm depolarization at 532nm (upgrade for 355nm depolarization channel is planed)). The validation focus is on aerosol (ground-based) and clouds (ground-based, airborne). Validation is planned together with DLR-HALO during the ORCESTRA campaign (tropical Atlantic). Other flight plans include STEP-CHANGE (2025, Palau) and in Norwegian Arctic (2026). The team has experience with cloud phase validation based on ALOMAR and CALIPSO measurements. Collaboration with Kiruna lidar is not yet planned but the team would be happy to collaborate. For EarthCARE, the validation scope includes L2 liquid and ice cloud properties and cloud base and height, L2 aerosol products (backscatter and depolarization profiles), cloud L2 products (ice cloud properties).

6. Calibration and Validation of EarthCARE Retrieved Products Using Measurements from the UK Facility for Airborne Atmospheric Measurements (FAAM) – Kamil Mroz

FAAM Airborne Lab will be out of action from July 2024 until early 2025 (will be missing most of the EarthCARE commissioning phase). Development of a new UK FAAM airborne lab, with many sensors on board including remote sensing instruments (e.g. broadband radiometers, imaging IR radiometers, mini-lidar), and in-situ instruments for aerosol and cloud properties, meteorological probes for T, q, P air motion, CO_2, CH_4 concentration). Mid-life upgrade is planned which will improve instruments capabilities, e.g. new spectrometers, lidar up and downward pointing, new aerosol inlets, new optical array probes, radiation UNIRAS Far mid-IR spectrometer). EarthCARE validation objectives are to collect measurements within clouds by performing 10 overpasses within 20 min of the EarthCARE track, at least 120 km long and by sampling a wide range of meteorological conditions. Conditions of particular interest are continental and marine aerosols, clouds, now and large-scale rain. Potential FAAM flights include 1-2 flights in June 2024 from UK and in spring 2025 from UK and Ireland. Interest to collaborate in existing campaigns was expressed.

7. The Mediterranean EarthCARE Cal/Val experiment ACROSS – Eleni Marinou

The speaker highlights a planned field campaign in the Mediterranean based on lessons learned from Aeolus and pre-EarthCARE campaigns (ASKOS campaign, part of JATAC), and on an unprecedented amount of quality-assured datasets. The Mediterranean basin provides a complex aerosol-cloud environment needed to exploit EarthCARE capabilities. Three major objectives of this campaign are the validation of EarthCare aerosol and cloud products using ground-based and in situ measurements, science studies, and bridging spaceborne lidar data records. Three intense operational periods (IOP) are planned for 3 months at 3 supersites (Potenza, Pangea, Cyprus) consisting of a full ACTRIS ARS and CRS, and in-situ onboard UAV's in Cyprus. The team will use EarthCARE products along with radiation measurements for closure studies. The spring and the month of September are foreseen as target periods. Potential ARM deployment is also targeted as well as the support of airborne measurements. The airborne support includes HALO with EarthCARE-like payload in September 2024, and additional aircrafts such as airborne in-situ (Slovenia) and FAAM, SAFIRE, NASA (all still under discussion). The eVe lidar is to be upgraded by the end of summer 2024. Several collaborations are still to be completed, i.e. with Slovenian small aircraft (2025), FAAM (Kamil Mroz, Thorwald Stein), French SAFIRE (Julien Delanoë), and HSRL-2 (Chris Hostetler) and P3 (Simone) including possibly extra sensors (through Jens Redemann) are all candidates for 2026/2027.

Q: Is fall 2024 campaign confirmed?

A: Ground-based stations will operate and discussions with Silke Gross (DLR) are ongoing to get a few flights over the site (she has funding for 5 flights from Munich in the broader area).

8. Discussion campaign session part 1

Q: Which cloud properties are measured?

A: All aircrafts have radars, except a couple of them that focus on aerosol and radiation.

Q: It is important to 'correct' in-situ measurements (dried a posteriori) for their original ambient (wet) state.

A: Relevant for non-dust only. Otherwise is difficult. General answer cannot be given for all aircraft, due to the complexity of different instruments.

Julien Delanoë: We need a strategy for many aircrafts to fly together, to document the area before and after the overpass, and be well prepared to fly together.

Q: ECMWF output for the campaigns? ESA refers to X-MET, but it is only for EarthCARE swath. Are there plans for ECMWF to provide data in advance to the Cal/Val teams?

A: ESA needs to investigate this possibility with ECMWF! Eleni reported on the JATAC model support by ECWMF (through a formal request to ECMWF) and suggested a similar approach could be followed.

Dave Donovan: EVDC data formats for the lidar products: the background meteorological conditions are needed in the correlative products, they should ideally be delivered with the products, if this is not possible the meteorological condition is needed from a reliable source (ECMWF): campaign and modelling support from ECMWF would be great!

Airborne and shipborne campaigns part 2

9. Strategy of measurements with the light balloon aerosols counter LOAC for the validation of EarthCare (BAIVEC project) – Jean-Baptiste Renard

This validation project will utilise balloon-borne measurements with the LOAC aerosols counter (concentrations for 19 size classes from 200 nm to 50 µm; measurements at 4 scattering angles for aerosol typology). The concentration measurements are converted to extinction coefficients considering their aerosol type (hence their refractive index). Measurements are collected up to 30-35 km altitude with up to 100 m resolution. Past intercomparisons with CALIPSO measurements have been performed. Developed coincidence criteria for validation studies with EarthCARE are [>1hr & > 50 km] and for unperturbed conditions [>3hr & > 100 km]. Four locations in France (3 North, 1 South: Aire sur l'Adour, Orléans, Ury, Reims) are ready to launch on overpass "under alert" (flexible launch from the group, no specific instrumentation is needed). Funding is available for a 1-year campaign of ~45 flights: background monitoring (2/month for 10 months) and 2 monthly intense phases (12-13/month; best period: May – September 2024, months will be decided based on meteorological forecast). In 2025 LOAC will measure in the tropics at ~20 km altitude for several months (around the world, onboard 4 Strateole2 gondolas). LOAC can operate in drones (size with battery 1 kg), but drone operations are not in the plans for now.

10. Unmanned Aerial Vehicles and other observations for the Cal/Val of EarthCARE – Franco Marenco

Observations will be performed at three Cyprus stations with sun-photometers, ceilometers, 1 lidar, and 1 flux station. UAV-based measurements (tailored platforms) focus on coarse-mode mass concentrations (UCASS OPC; 0.4-20 and 3-40μm), collected samples (GPAC impactors; >1μm), backscatter ratio (COBALD), aerosol size distribution (POPS; 0.14-3.3μm). Measured particle sizes up to 40 μm from Cabo Verde (ASKOS campaign) and performed chemical composition analysis were shown. Measurements are limited up to 6 km due to permission reasons. The height can be increased using ballons, but it is still difficult to fly regularly mainly due to weather. Intercomparison of aerosol concentrations from in-situ and lidar are performed. Funding was available (ATMO ACCESS Cal/Val project) for some flights on 25 Oct. – 3 Nov. 2023, which were performed already) and for June - September 2024, next to lidar measurements and fast data submission to the EVDC). Additional planned campaigns: AEROMOST e-prolife campaign; ACROSS campaign (2025-2026).

Q: Are there any plans for large sizes measurements for clouds?

A: UCASS is capable, but the cloud wet environment may affect the UAVs, the possibility will be investigated.

11. In-situ airborne measurements during Aeolus Cal/Val JATAC campaigns – relevance for EarthCARE aerosol products – Griša Močnik

The speaker proposed light aircraft measurements of absorption coefficient (fine, coarse), scattering coefficient, size distribution (total, coarse), solar irradiance, RH, CO2. The team has experience in flight coordination with other aircrafts (e.g. DLR-Falcon, LATMOS-Saphire, NASA-DC8). Measurements from Cabo Verde campaign were performed, where size diameters up to 13 μm were collected and 3D resolved measurements are available. Backscatter intercomparison between the in-situ measurements (converted) and lidar measurements (ground-based and Aeolus) showed very good agreement. The comparison results were good after extrapolation from 520nm (in-situ optical sensor frequency) to 532nm (ground-based lidar), but extrapolation from 520nm to 335nm (Aeolus) sometimes led to less accurate results. A study of the dust & black carbon heating rates was performed. For EarthCARE Cal/Val, operations are planned during ACROSS campaign (upon available funding) with possibly additional payloads.

12. PERCUSION (former EC-TOOC) – Airborne EarthCARE-like payload for preparation and validation studies – Silke Gross

PERCUSION is an airborne campaign with HALO aircraft including the cloud observatory package (WALES HSRL lidar, MIRA Ka-band radar, SpecMACS hyper-spectral imager, HAMP MW radiometer) to retrieve vertical and horizontal distributions of aerosol, clouds, turbulence, and humidity. Products of target classification mask, aerosol typing, cloud microphysics synergistic retrievals, radiative transfer calculations, and closure studies are also developed and used. EarthCARE validation strategy in the months of August - September 2024 consists of 9 weeks of active measurements, 10 flights out of Cabo Verde, 10 out of Barbados, 5-6 from Germany/Oberpfaffenhofen, the majority with

EarthCARE overpasses. Over Cabo Verde, coordinated flights with ATR42 (RASTA W-band radar, HSRL lidar, in-situ) and any additional aircraft are planned, in order to use multiwavelength lidar, radar data, and in situ microphysical properties (also measurements in clouds) for the evaluation of EarthCARE products. After EarthCARE underflights, a circular flight pattern will be performed for a better characterization of the conditions around the track and the evolution of the clouds measured. The measurements will be supported by shipborne measurements (BOWTIE) and ground-based stations (Mindelo, Barbados). As for the flights over Germany, overpasses over lidar/radar ground stations will be considered (e.g. ACTRIS sites).

13. BOWTIE - The shipborne Trans-ITCZ Experiment – Julia Windmiller

BOWTIE is a shipborne campaign in the Tropical Atlantic in the period 10 August – 24 September 2024 with a chance to cross under 3 – 5 EarthCARE tracks. It is based at the METEOR vessel and is a part of the ORCESTRA campaign. The focus is on Atlantic Inter-Tropical Convergence Zone (ITCZ) (e.g. structure, dynamics, precipitation). Measurements cover precipitation (funded), surface fluxes, aerosols and upper ocean measurements (disdrometer, sea snakes, open-path gas analyser, aerosol spectrometer, and more), cloud base height, cloud water and water content (ceilometer, microwave radiometer, GPS Met.), atmospheric profiles of humidity, wind, temperature, clouds, and aerosol (Raman multi-wavelength lidar, radiosondes, wind lidar, W-band radar, drones), 3D precipitation field (PICCOLO: CSU Sea-Pol C-band scanning Rain Radar). Drone measurements (T, WV, wind speed/direction, aerosols; up to 4km) may be added if the funding request is successful. The W-band radar is ship-stabilized (with collocated MWR & ceilometer). Cloudnet products will be available. The point of contact for this campaign is Heike Kalesse.

14. MORECALVAL: MObile Radar-Lidar-Radiometer EarthCare CAL/VAL project – Julien Delanoë

The project's main activities is to have airborne campaigns with multiple platforms (DLR-HALO, LATMOS-ATR42; multi-wavelength HSRLs, W- and Ka-band Doppler radars, specMACS, in-situ). The plan is to have direct under-flights of the EarthCARE track, and airborne flights in tandem. This would facilitate the calibration of EarthCARE's instruments (CPR, ATLID, MSI) as well as the validation of cloud, precipitation, and aerosol synergistic products (L1 & L2). The field campaign plan includes 1. PREMAESTRO - Toulouse (July 2024; ATR42; funded), 2. ORCHESTRA - Cabo Verde (August-September 2024; ATR42+HALO; funded), 3. BACCOPA - Central equatorial Africa (Sept 2025; ATR42; funded), 4. NAWDIC - Ireland/Brittany (Feb 2026; ATR42; not funded yet), 5. STACCATO - Africa (fall 2027; HALO; not funded yet), 6. AC3-PND - Arctic (2028; HALO; not funded yet). Additional activities include balloon-borne flights (LATMOS&CNES) at 20-22 km, starting on June 2024 from Kiruna (CNES STRALI project; W-band Doppler radar and 808 nm lidar). Furthermore, the following ground-based platforms (from DLR and LATMOS), including a BASTA radar (W-band) network and a portable system, a BALI system (scanning BASTA and ulidar 532/808 nm), and synergistic observations from Poldirad and BASTA (C-band+W-band, which can be moved) are available.

Notes from questions: regarding the time of balloon flights, at first they will last a few hours and then attempt to increase the duration of the flights. The weight of the stratospheric radar is ~45 kg, but it can be improved.

15. The Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) mission and the PACE Postlaunch Airborne eXperiment – Kirk Knobelspiesse

PACE will be launched in January 2024 with 3 passive instruments onboard: 1. OCI spectrometer, 2. HARP2 multiangle polarimeter, and 3. SPEXone multiangle polarimeter. Official data distribution will follow on-orbitt commissioning (60 days), with heritage and required products first, followed by advanced and polarimetric products. The full list of products is available on https://pace.oceansciences.org/data_table.htm. The "Pace science data product validation plan" document is available at pace.oceansciences.org/documents.htm. The PACE-PAX (PACE Postlaunch Airborne eXperiment) validation campaign is scheduled to take place in California, 3-27 September 2024. It will include remote sensing proxy observations from NASA ER-2 (polarimetry, spectrometers, HSRL-2, RSP), in situ sampling with CIRPAS Twin Otter (aerosol/cloud in-situ, aerosol phase function, in situ data synergy), ocean instruments, ocean floats, and surface sites (Aeronet). Coordinated observations under PACE will take place over surface sites and onboard marine vessels. There is a potential synergy between PACE and EarthCARE since the two mission will have 1-hour difference in overpass (PACE 13:00 LT, EarthCARE 14:00 LT) at campaign site. Daytime collocations within 5 minutes will be possible once per base period, around 42° latitude, and within 90 minutes over the tropical Atlantic. PACE and EarthCARE validation campaigns (e.g. PACE-PAX, PERCUSSION, MAESTRO) and relevant for both missions, and coordination of activities will be mutually beneficial.

16. Discussion campaign session part 2

Q: Are we missing something in particular regimes, e.g.cloud or locations? Coverage of clouds and aerosol conditions in all areas? Are there campaigns covering Africa?

A: There are very few measurements from platforms in the ocean, and no measurements in Russia. There is a lack of observations in the southern hemisphere, these are important gaps. Amazon basin is also not well covered. Plans from French teams for 4 stations with 3 frequency bands radar to be placed in Antarctica to be used in Cal / Val in mid 2024 - 2025. There are various lidar networks like MPLNET that has a global coverage, and LALINET in south America. GALION is a lidar network of networks, it has tool that shows where all the stations are, where the gaps and what the coverages are. There are country reports on the Arctic area that explore gaps and give recommendations to national bodies and stakeholders where to put measurements. Regarding flying in Africa, 2 years in advance is a good time-period to start asking for permission for flights in the continent for some places. Help from the agency would be very helpful and maybe we get access for some campaigns if we plan in advance!

Q: One cloud property of interest is the vertical air velocity. How will the sensing of the vertical air velocity will be validated by the airborne or ground-based campaigns?

A: Airborne observations are more complicated than ground-based due to the moving platform. The sum of the terminal fall velocity can be measured, and at the altitude of the measurements they can measure the vertical air motion and derive some terminal fall velocity and maybe extrapolate it and link it to reflectivity. In many field campaigns there are lots of dropsondes that measure the vertical air velocity, but not sure how accurate they are and they also sometimes fail.

Q: What validation effort can help to eliminate the cross-talk contamination of ATLID's Rayleigh and Mie channels?

A: Using only L2 retrievals is not enough. A direct comparison of attenuated backscatter is needed. For this comparison, there is a tool that has been developed to take ground-based measurements and simulate what ATLID should see (see talk 'L1 ATLID simulator'). This allows users to adjust things to see the effect of not having the cross-talk right. This tool will be publicly available before EarthCARE launch.

Q: US NASA campaigns have a centralized data repository and common data format. It would be useful to have the same approach for the European campaigns.

A: In terms of centralization, the European and American approaches have been synchronized in the past. There are efforts to do the same now for EarthCARE. EVDC is organizing the collection of Cal/Val data from EarthCARE campaigns and metadata standardization.

Q: Cal/Val tasks are not trivial and require a lot of resources. Tasks involve collocation, co-registering the dataset, providing the data in the correct format, QA, etc. How to maximize the level of this activities, funding, etc?

A: ESA supports this activity but the broader aspect that goes deeper into the science should be tackled by the scientific campaign leads. Scientists usually take the lead and ESA helps to obtain funding from national agencies.

Q: Is there a device that measures directly the density of particles (size spectrum)? Now we assume they follow power-law and run our models.

A: Not only do we need validation of the products but also validation of the assumptions used in the algorithms is needed. Not known what the state of the art is to get better size distribution information but good quality, collocated data of size distribution is desired.

6. Networks

Chaired by L. Baldini, T. Nishizawa (part 1) and U. Wandinger, T. Y. Nakajima (part 2)
Secretaries: H. Baars, T. Tanaka (part 1) and E. Marinou, T. Hummel, V. Tzallas (part 2)

No	Title	Speaker
1	WEGN4CARE: The WegenerNet 3D Open-Air Laboratory for Climate Change Research and its Potential for the Validation of EarthCARE Cloud and Precipitation Products	Andreas Kvas
2	A 94-GHz Radar Network in Europe for the Calibration and Validation of Spaceborne Cloud Profiling Data Products	Lukas Pfitzenmaier
3	Combining EarthCare and ARM facility measurements for validation and research applications	James Mather
4	EarthCARE Cal/Val preparation activity in the framework of the European Project ATMO-ACCESS	Holger Baars
5	EVID05: The new structure of the ACTRIS-related contribution to EarthCARE Cal/Val – AECARE	Holger Baars
6	LALINET EarthCARE Cal/Val Activities	Eduardo Landulfo
7	EarthCARE Cal/Val Using the NASA Micro Pulse Lidar Network (MPLNET)	Jasper Lewis
8	Performance Evaluation of the Rain Mask Algorithm for Global Precipitation Monitoring Using NASA MPLNET Lidar Network	Simone Lolli
9	AD-Net and SAVER-Net lidar networks for validation of ATLID products	Yoshitaka Jin
10	Assessment of EarthCare Aerosol and Cloud Products through Ground-Based Measurements from the E-PROFILE and AERONET Networks. (AEROCLOUD)	Francisco Navas-Guzmán
11	CPR Doppler validation using WINDAS	Yuichi Ohno
12	The WMO GAW Aerosol Lidar Observation Network (GALION): status and coordination plans relevant to EarthCARE	Judd Welton
13	Discussions	

1. WEGN4CARE: The WegenerNet 3D Open-Air Laboratory for Climate Change Research and its Potential for the Validation of EarthCARE Cloud and Precipitation Products – Andreas Kvas

The WegenerNet 3D Open Air Lab is a dense network composed of 150 climate stations covering 22kmx16km in South Austria. Some stations have extended atmospheric sounding capabilities after a "3D expansion" since May '21. Instrumentation includes X-band radar, GNSS Water Vapor Sounding IR cloud structure radiometer, MW tropospheric Profiling radiometer. The X-Band weather radar (dual-polarization, focusing on precipitation, and operated according to 2.5 min data sampling) is placed to the South of the 156 stations and covers these by sweeping North. Measured geophysical parameters including precipitation rate and type, T, WV profiles (up to 10 km), LWP, IWV, tropospheric path delay, all-sky map of inf. brightness temperature, derivations of 3D cloud structures. The contribution to EarthCARE will mostly target the development of cloud and precipitation products for validation.

Q: How to correlate a point measurement with profiling for rainfall phenomena?

A: The correlation is about 50% but drops steeply at more than 3km away.

2. A 94-GHz Radar Network in Europe for the Calibration and Validation of Spaceborne Cloud Profiling Data Products – Lukas Pfitzenmaier

FRM4Radar (where FRM stands for Fiducial Reference Measurements) is a project funded by ESA focusing on pointing out and quantifying CPR uncertainties from ground-based instruments. To ensure data quality and trusted measurements, activities performed concern the calibration of Cloudnet instruments in cooperation with ACTRIS, corrections on antenna pointing errors (critical for correct Doppler estimates), estimation of confidence of some products, and development of new products. Radar data processing algorithms written in Matlab are available on GitHub. New developments will be implemented soon in ACTRIS. Data from ASKOS campaign have been already uploaded to EVDC. Recent activities concern a simulation tool to create synthetic EarthCARE CPR data from ground observation that will be released soon. Progress in radar calibration using disdrometer-based methods and exploitation of the synergy of MW radiometer and ceilometer measurements has been also targeted.

3. Combining EarthCARE and ARM facility measurements for validation and research applications – James Mather

The project is a new addition to EarthCARE validation (EVID40). ARM support ranges from field campaigns deployment, hosting guest instruments, to facility developments (LES simulations are also developed). An overview of potentials of ARM facilities that includes a network of 3 fixed locations and 3 mobile observatories and datasets were illustrated to highlight possible impacts on EarthCARE validation. Datasets include measurements of clouds, aerosols, precipitation, radiation, and surface properties since 1992. Data is freely available. ARM facilities are equipped with radiosondes, microwave radiometer, IR interferometer, 35 Ghz cloud radar, micropulse lidar, Doppler lidar, Hemispheric sky imager, in situ sensors for aerosol number, size, cloud condensation nuclei, and instruments to measure surface meteorology, radiation and heat fluxes. Additional instrumentation at selected locations includes Raman lidar, high spectral resolution lidar, and scanning radars. A new site is established at Maryland (2025). A mobile deployment in April 2024 in Tasmania (possibly overlap with GoSouth) for 12 months, Southeast US (BNF) is planned. Potential activities for EarthCARE validation: Alignment of ARM radars or lidars with EarthCARE, harmonization of ARM data streams with ACTRIS, NASA, and NOAA, and development of special data streams (merged products). Further, use of the novel developed open-source L1 simulator tools. Availability of piloted and uncrewed aerial platforms: Tethered Balloon System, Uncrewed Aerial System ArcticShark, Regional Jet Challenger 850 CRJ200 (delivery in 2025 ready for science flight by 2026). More information can be found on www.arm.gov/capabilities; ww.arm.gov/data/; www.arm.gov/capabilities/observatories/aaf. Important note: call for mobile facility deployment out "now", contact: Jim Mather

Q: Does the harmonization with ACTRIS include target classification retrievals?

A: Reach out to stakeholders and check how to do this, details of what to harmonize will come when such a framework is established.

4. EarthCARE Cal/Val preparation activity in the framework of the European Project ATMO-ACCESS – Holger Baars

ATMO-ACCESS project = Sustainable Access to Atmospheric Research Facilities. ATMO-ACCESS pilot activity to prepare ACTRIS for EarthCARE validation: Preparation activities at ACTRIS topical and data centers and ACTRIS national facilities (observatories) and selected additional ATMO-ACCESS non-ACTRIS sites were illustrated. First preparation activity was finalized with a 2-month rehearsal campaign performed in Oct/Nov 2023. Most of the goals of the preparation activities have been already achieved. A rehearsal campaign has been conducted with simulated orbits, 46 participating stations and ACTRIS topical and data centers. A reasonable measurement coverage was achieved within the rehearsal campaign. The complex QA/QC procedures were not yet fully completed but are targeted to be ready for EarthCARE launch. Additional instrument intercomparison (MPL, ESA reference lidars) is scheduled for 2024. Real validation is planned with additional mobile facility deployment and some limited data analysis, but Pilot activity ends already in September 2024.

5. EVID05: The new structure of the ACTRIS-related contribution to EarthCARE Cal/Val – AECARE – Holger Baars

AECARE now covers ACTRIS remote sensing, EARLINET and Cloudnet. Due to the new infrastructure some changes in the project have taken place, e.g. several new stations are now involved, and new instruments have been obtained. Furthermore, ACTRIS central facilities (data centers and topical centers) are now involved ensuring a centralized QA/QC and standardized data flows. The coordination was taken over by Holger Baars. Funding is secured for performing measurements but is very limited for data analysis. The ATMO-ACCESS pilot activity was used to start preparation for the EC Cal/Val already.

6. EVID07: LALINET EarthCARE Cal/Val Activities – Eduardo Landulfo

LALINET covers 15 sites in Latin America: 2 radar, 9 lidar/ceilometer, 4 other sites. It's an umbrella project. In 2025, a harmonization campaign with EU partners is planned. LALINET is especially interested in biomass burning aerosol, aerosol cloud interaction (ACI), Southern Atlantic Anomaly (SAA), and in the troposphere and stratosphere. A LALINET workshop will take place in April 2024 in Sao Paulo with a dedicated EarthCARE session: https://xiiwlmla.umag.cl/. LALINET data is currently only available via direct contact (e.g., Eduardo Landulfo).

Comment: EVDC is in contact with LALINET to include the data in EVDC with appropriate compliance.

7. EarthCARE Cal/Val using the NASA Micro Pulse Lidar Network (MPLNET) – Jasper Lewis

The use of MPLNET (https://mplnet.gsfc.nasa.gov including new sites) for EarthCARE validation (EVID17) was presented. The activity is funded by NASA (2021-2026). Validation plans include (a) Validate aerosol, cloud, and planetary boundary layer heights using L3 MPLNET products; (b) Compare drizzle occurrence and properties (C-TC, C-CLD); (c) Evaluate EarthCARE-based cirrus datasets for TOA CRE (top-of-atmosphere cirrus cloud radiative effect) with MPLNET collocated cases and CALIPSO historical dataset. Preliminary codes have been developed using simulated ATLID datasets. First tests were performed using CALIPSO observations. Data conversion to GEOMS format for EVDC is in progress. Coordination with other GALION networks is in the planning.

8. Performance Evaluation of the Rain Mask Algorithm for Global Precipitation Monitoring Using NASA MPLNET Lidar Network – Simone Lolli

A new Rain Mask Algorithm (RMA; based on lidar depolarization ratio measurements; outputs: rain, no-rain; 60 sec temporal resolution) has been developed for application in MPLNET lidar products. The mask will be used in the validation of EarthCARE CPR products. Evaluation of the mask is performed at ground level against disdrometer data (2 sites; 60 min sampling averaging). Intercomparison shows >78% correct detection of rain events, while some cases are not detected correctly (possibility for further improvement of the mask there).

9. AD-Net and SAVER-Net lidar networks for validation of ATLID products – Yoshitaka Jin

During the EarthCARE mission, validation of JAXA ATLID L2a products will be performed using ground-based lidar and photometer data, collocated in space and time, from AD-Net (3 HSRL, 4 Mie/Raman lidars, and 12 Mie lidars), SAVER-Net (7 Mie lidars in Argentina and Chile), SKYNET (photometers able to retrieve also size distributions), MRI lidar, and a shipborne lidar (JAMSTEC's MIRAI vessel). Three sites with HSRL data will be used (Koganei site: HSRL at 355nm and MFMSPL at 355 nm; Tsukuba site: HSRL 355/532 nm; Fukuoka site: HSRL 532 nm) for statistical analysis of aerosol and cloud optical properties. The MFMSPL lidar will be used for the evaluation of the ATLID multiple scattering effect. The MRI lidar (range from 0.1 to 35 km, backscatter and depolarization ratio uncertainties <10%) at Tsukuba site will be used for the validation of stratospheric aerosol properties. In case of insufficient data, CALIPSO & Aeolus data will be used for statistical comparisons.

10. Assessment of EarthCare Aerosol and Cloud Products through Ground-Based Measurements from the E-PROFILE and AERONET Networks. (AEROCLOUD) – Francisco Navas-Guzmán

This project will use E-PROFILE (more than 400 Ceilometers in Europe) and AERONET data for EarthCARE validation (ATLID, MSI, ATLID+CPR, ATLID+CPR+MSI) as new ECVT member (EVID 41). The GRASP (Generalized Retrieval of Aerosol and Surface Properties) code will be applied (at 44 stations with co-located sun photometer and ceilometer) to derive automatic optical and microphysical aerosol properties (vertical and column-integrated). Additionally, new aerosol optical and microphysical products will be derived from the synergy of AERONET and ATLID observations (properties from GRASP algorithm). The validation of the EarthCARE and EarthCARE/AERONET products will be performed with ground-based data (coincidence criteria: 3 hrs and 120 km distance from the overpass). The L2 product assessment will be carried out using longer-term observations. Field campaigns in winter and summer 2025 (Payerne station in Switzerland; AGORA observatory in Granada-Spain; ACTRIS aerosol and cloud remote sensing facilities, drone measurements, COBALD sondes, weather stations) will be performed for the validation of the EarthCARE products and the new retrievals. Funding secured (2023 - 2026).

11. CPR Doppler validation using WINDAS – Yuichi Ohno

This project will use WINDAS network (33 sites of L-band wind profilers in Japan) for CPR Doppler measurements validation on ice clouds. WINDAS can estimate vertical velocities in ice clouds and/or rain cases. Ice and snow targets at high altitudes are the cases where WINDAS measurements are most comparable to W-band Doppler measurements. Due to the wavelength difference, frequency conversion should be considered and applied (similarly, wavelength conversion for rain targets will be needed if rain targets are used). More than 14 WINDAS sites will measure in less than 10 km distance from the EarthCARE paths and one in less than 1 km distance. Ice/snow echo monthly mean appearance in WINDAS sites is around 20% in the Southern sites, and more frequent in the Northern sites.

12. The WMO GAW Aerosol Lidar Observation Network (GALION): status and coordination plans relevant to EarthCARE – Ellsworth J. Welton

GALION is a network of lidar networks organized through the WMO Global Atmospheric Watch (GAW) program providing observations and easy access to lidar data (new data center and website: http://galion.world). GALION Networks are AD-Net, LALINET, MPLNET, EARLINET/ACTRIS, and NDAAC Lidar. GALION has established standards: Each network has a traceable history of peer-reviewed calibration and processing methods. Data harmonization (including metadata and vocabularies) is currently the focus of the network. Centralized coordination with WMO OSCAR for information/search/discovery/format of data. Harmonization of vocabularies and definitions of GALION variables to EVDC standards are in process. Intercomparisons and coordination between GALION members is ongoing (MPLNET-EARLINET, EARLINET-LALINET) as well as collaboration with Ceilometer networks. Partial funding through CARGO-ACT Horizon EU project (ACTRIS-US collaboration).

13. Discussions

Q: Validation is the main discussion topic here, but calibration is also important. Space agencies should mind the calibration too. Japan is investing heavily in active radar calibration for CPR but that's the only one place on Earth. What is the strategy when it comes to looking into the in-orbit variation of Doppler velocity of reflectivity? Any plans to monitor natural targets like cirrus?

A: ECMWF will monitor regional variations using a global model to compare against simulated observations of cirrus. During the commissioning phase, there will be dedicated instrument teams which include the agencies, industry, and scientists. First meetings of CPR and ATLID commissioning teams have already taken place. Plans for the commissioning of BBR and MSI are being drafted. ESA plans to include activities beyond immediate instrument calibrations by industry. Algorithm developers will also contribute to the commissioning phase for Cal/Val of the instruments.

7. ESA validation tools and logistics

Chaired by H. Baars, E. Marinou
Secretaries: M. Eisinger, A. Velazquez

No	Title	Speaker
1	ESA-ECVT logistics	Stephanie Rusli
2	ESA orbit and swath tools	Montserrat Pinol Solé
3	Atmosphere Virtual Lab (AVL)	Sander Niemeijer
4	Level-1 ATLID simulator	David Donovan
5	MSI-simulator tool	Nils Madenach
6	A L1 transformational operator for the objective evaluation of the EarthCARE Cloud Profiling Radar data products using suborbital observations	Lukas Pfitzenmaier
7	EVDC-Cal/Val database	Ann-Mari Fjæräa
8	EVDC-Cal/Val tools	Jarek Dobrzanski

1. ESA-ECVT logistics – Stephanie Rusli

The speaker provided important logistical information to the ESA-ECVT, including the upcoming activities timeline: the EarthCARE validation implementation plan (Jan 2024), the ESA validation rehearsal (12-23 Feb 2024) and review (21 Mar 2024), the target release of L1 data to ECVT (Aug 2024), and the preliminary validation results workshop (Nov 2024). It was mentioned that the launch is scheduled for May 2024 and that CPR check out is soon afterward, BBR after, then ATLID, and finally MSI. The importance of getting access to three different systems was highlighted: 1. Correlative databases on EVDC (ESA Validation Data Center), 2. ECVT portal which is the Confluence platform to exchange information (not data) among the validation teams, and with ESA, 3. EarthCARE data dissemination system on https://earth.esa.int. For the validation rehearsal, 25 days (1 repeat cycle) of simulated EarthCARE. data (all ESA L1 and L2 data products) will be made available. EarthCARE data dissemination system that will be operational after launch will be made accessible during the rehearsal. Goal for PIs is familiarization with ESA data products and format, tools, and validation infrastructure. Validation rehearsal is the last chance to test the systems before launch and to provide constructive feedback to ESA so tools and infrastructure can be improved. For the EarthCARE validation implementation plan it was highlighted that there is missing information (dedicated posters). It is important to provide ground station location, so ESA can produce overpass tables. Validation support tools are presented in the next talks and demos (ESA orbit tools, Atmosphere Virtual Lab, EVDC, AVL, CIS, L1 tools.). Validation best practices is summarized in a CEOS document.

2. ESA orbit and swath tools – Montserrat Pinol Solé

Two graphical (ESOV and SAMI) and 3 command line tools (ZoneOverPass, TrajectoryOverPass and Instrument collocation tool) for EarthCARE were introduced and examples and animations were presented. Tools are available to be used either on Windows, Mac or Linux platforms. Recommendation to validation teams to get familiar with the ESOV tool for the overpasses of regions of interest.

3. Atmosphere Virtual Lab (AVL) – Sander Niemeijer

Focus is on Jupyter notebook environment to simplify the use of EarthCARE data products. Installation is straightforward in Python using "import harp". This tool supports interactive visualisation of several parameters. Intercomparisons are also possible with ground data using "harpcollocate". More details about AVL can be found on https://atmospherevirtuallab.org/earthcare. Discussion forum is available at: https://forum.atmospherictoolbox.org. Note: support for more EarthCARE products are still being added on request.

4. Level-1 ATLID simulator – David Donovan

A light and flexible simulator to generate realistic ATLID L1 data from ground-based lidar observations (or model data) has been developed. Its main components are lidar radiative transfer and (simple) instrument model. The simulator should be useful for both ATLID Cal/Val activities and general studies. The simulator is available via Gitlab: https://gitlab.com/KNMI-OSS/satellite-data-research-tools/cardinal-campaign-tools. Outputs from the simulator, in official ATLID L1 format, can directly be used by ATLID processors. A variety of examples illustrating its functionality are presented and discussed. Status: The instrument model is largely in place, and beta testing is underway. The next release will be in Jan 2024.

5. MSI-simulator tool – Nils Madenach

A light and flexible, python-based forward simulator for the validation of L1 EarthCARE MSI spectral radiances and brightness temperatures has been developed. It accounts for the smile effect, uses JSON input file for the VNS and TIR modules, and the output is provided in official M-RGR format. The simulator is freely available, integrated in the EVDC site, successfully tested using Cloudnet and PollyXT lidars, and first validations done using SEVIRI. Input data could also be models.

6. A L1 transformational operator for the objective evaluation of the EarthCARE Cloud Profiling Radar data products using suborbital observations – Lukas Pfitzenmaier

A simple, python based, L1 CPR forward simulator tool to convert L1 suborbital (surface-based or airborne) measurements to the EarthCARE CPR L1 observations has been presented. It accounts for differences in the sampling geometry, measurement uncertainty, and instrument sensitivity. The tool simulates instrument characteristics (e.g. noise, PRF, along-track integration, vertical resolution). And allows for a conversion from 35 GHz to 94 GHz. The simulator can be applied to EarthCARE or CloudSat data evaluation. Examples were presented presented, documentation and publication are being finalized as well as extension to ARM and RASTA input data.

7. EVDC-Cal/Val database – Ann-Mari Fjæräa

The EVDC ESA Cal/Val database is a central, long-term repository in Europe for archiving and exchange of correlative data for the validation of atmospheric composition products from satellite platforms such as EarthCARE. It is linked with international archives like AVDC and NDACC. The EVDC offers various tools and services for Cal/Val PIs and users, such as data search and download, data submission and formatting, data processing and analysis, orbit prediction and visualization, and satellite data access. Harmonised (meta) data format is GEOMS HDF/NetCDF. A code for conversion to GEOMS is available. DOI service (already used by EVID05 (ATMO-ACCESS)) is also offered. Data agreement needs to be signed prior to accessing the data https://evdc.esa.int. The EVDC will contribute to the "Best practices" document. Team's email address: nadirteam@nilu.no / amf@nilu.no.

8. EVDC-Cal/Val tools – Jarek Dobrzanski

Description of the different tools available at EVDC for the support of the EarthCARE mission. Work is performed by 3 partners of the EVDC: ICHEC, Skytek, and NILU. In particular, the web tool for both satellite and correlative products, the cloud processing on supercomputer nodes, the collocation database and the orbit prediction tools were presented. Access is available via https://evdc.esa.int and registration is required. Standardised workflows starting from search outputs (collocating, processing, visualisation) can be accommodated. ATLID/CPR/MSI tools described in the previous talk can be integrated in the workflows. Two examples of visualisation using the workflow were shown.

8. Panel discussion

Panel composition: Robin Hogan (chair), Ulla Wandinger, Jason Cole, Dmitri Moisseev, Hajime Okamoto, Masaki Satoh, Nobuhiro Takahashi, Tomoaki Nishizawa

The discussion was structured around several questions posed by the chair, although with limited time not all were covered equally.

What L2 algorithms are currently not well covered by Cal/Val activities?

Aerosols would appear to be well covered, but not true terminal velocity of hydrometeors, upward air motion, 3D reconstruction or radiative closure to 10 W/m^2. Are any other L2 retrievals poorly covered, and what can we do about it?

- The surface downwelling longwave and shortwave fluxes are very important variables output from EarthCARE's radiative products, but are difficult to evaluate because of the rarity of direct overpasses (see next section). It would be extremely valuable to analyse not only the limited number of BSRN sites, but also the more extensive database used by Martin Wild, such as GEBA (global energy balance archive) and ocean buoys.
- Tethered Balloons measurements (e.g. TROPOS) could be useful for vertical profiles of radiation and winds, including in clouds.
- It was asked whether Level-1 BBR measurements are covered, but was confirmed that there will be a programme of comparison with both CERES and GERB.

How do we overcome the point-site rare-overpass problem?

Much of our Cal/Val effort is focussed around ground-based observations that will experience few (or zero) direct overpasses. Can we overcome this with statistical analysis, scanning cloud & weather radars, a dense networks of surface stations, or other imaging satellites?

- For clouds that decorrelate rapidly, the problem is especially difficult.
- Using 3D-constructed data across track to match the point-site observation can help (the 3D-construction algorithm uses the MSI radiances to fill out the swath by selecting the nadir radar-lidar profile that best matches the off-nadir MSI pixel in terms of radiances). Geostationary and other satellite data could be helpful to match them.
- Most cloud radars are only capable of vertical profile observations (for these observations statistical analysis can be applied). Some cloud radars are capable of scanning, and the applicability of such observations for Cal/Val should be studied, but what are their limitations, e.g. scan speed, maximum range etc? Can we obtain data from more scanning radars? Recommendations have been provided on scanning strategies to the ACTRIS cloud profiling stations by ACTRIS Centre for Cloud Remote Sensing (CCRES), using input from FRM4radar.
- Can we use weather radar for context? Weather radars are used especially for precipitation nowcasting and validation, but the data are not always open (apart from US NEXRAD and OPERA). But then it would probably be more interesting to compare rainfall estimates from EarthCARE directly with those from weather radar, which use a much more suitable wavelength for rainfall.
- For some cloud products an option may be to combine wind information with non-collocated measurements using advection/trajectories.
- Can we use models in some way to help co-location? The assimilated model data might conceivably be useful for matching. It is important to point out in response to this comment and the previous one that there are already large uncertainties in comparing one remotely sensed quantity to another, so if we need to use winds and models to try to match them up then the additional errors are likely to render one observation incapable of "validating" the other.

- It was pointed out that many of the discussion points here had been covered in the ACPV activity, and the panellists were invited to contribute to that by reviewing the "best practices" document.

Some observations/retrievals we trust more than others, but which?

Generally speaking, there is a hierarchy of trust in various types of observations that will be compared to EarthCARE, but do we agree on this hierarchy? For example, we tend to most trust in-situ sampling from aircraft (recognising that even this has uncertainties). Also trusted are "direct" lidar products such as ceilometer cloud base, 355nm HSRL/Raman extinction profiles. On the other hand, observations that are not going to "validate" EarthCARE are things like remote cloud microphysical retrievals, since their errors tend to be dominated by the same assumptions as EarthCARE retrievals (but the comparisons are still extremely interesting). Cal/Val participants should also be aware that the CPR and ATLID backscatter measurements will not be calibrated by ground-based radar and lidar; experience with previous missions suggest the calibration is more likely to be the other way around.

- How can we get more underflights with in-situ sampling?
- V Chandrasekar said that calibration of ground-based radars needs to be addressed before they are used for calibration/validation. Kotska Wallace summarized the calibration plans for the CPR and ATLID, but more ARC calibration stations around the world would be beneficial.

Mechanism to improve algorithms or release experimental versions?

The L2 teams will struggle to account for all the information coming from the Cal/Val activities as they improve the algorithms in the early part of the mission – how could we release experimental versions of the products, and should we aim for an open-source release of the retrieval code so that others can run them and propose changes?

- It was agreed that it is unclear how best to communicate findings from the Cal/Val team to the L2 team, and to receive feedback, without overwhelming the L2 team.
- Open-source software release would be helpful because it would allow the validation activities to be extended to include validation of physical assumptions used in the retrievals.
- One approach would be a computational sandbox for EarthCARE, for example as being proposed in the 'MAAP' concept (Multi-mission Algorithm and Analysis Platform, involving multiple space agencies). This would facilitate experimentation with different algorithm versions. The operational processor evolution could then be based on evolution based on consolidated and prioritised feedback. However, there will potentially be conflicting information from different field campaigns, and algorithm changes may have significant downstream consequences (e.g. on radiative closure) so members of the Cal/Val team should be realistic in their expectations of how quickly the L2 team can incorporate their proposed changes into official algorithm versions.

Data provision vs. data use

Submission of data to the EVDC is important, even if there is no funding for work on analysing the data for validation purposes. We should identify capacity and funding for looking at many datasets (from the EVDC). Are any important networks/sites at risk of being discontinued (e.g. the ATMO-ACCESS pilot)?

Publications

Should we initiate a separate journal special issue on EarthCARE Cal/Val, or instead a combined special issue covering general EarthCARE science including Cal/Val? Benefit for data providers could be co-authorship in publications.

- There was general support for the suggestion to go for a combined Science & Cal/Val special issue (SI), probably as a multi-journal Copernicus SI involving ACP and AMT. This will be initiated by members of the JMAG shortly after launch.
- Questions: what are the mechanisms for motivating data submission to the EVDC? How can we best work together as a community? The EVDC authorship policy should be stated clearly so that Cal/Val data providers get adequate recognition for their work.

Communication tools and access to communication channels

We need good communication channels and easy access to them for all who work on validation, but there are currently many issues regarding access to ESA's Confluence (such as the need to whitelist IP addresses). Should we also set up smaller working groups to tackle specific problems, specific cloud types etc.?

- Regarding working groups, satellite groups (for example) below these groups can be 'organically' managed (self-organised, keeping others informed via subpages of confluence). It would be good to create an initial list of 'seed topics', or perhaps organise a (sub)group per geophysical parameter?
- We need to enhance collaboration with modelling communities. They include those in climate modelling who engage in CMIP activities, those in global km-scale modelling who participate in the DYAMOND-like intercomparison experiments, and those in operational weather modelling who assimilate satellite observations in numerical models to produce better 3D cloud and aerosol analysis fields.

Annex A: Mapping of Projects to PI Talks

ESA/ JAXA ID	PI, Speaker	Talk title	Remark
J-1	Hajime Okamoto	Validation studies of L2 cloud products by CPR, CPR-ATLID and CPR-ATLID-MSI	Covered under PI talks
J-2 E-22	Tomoaki Nishizawa	Validation of the EarthCARE ATLID and MSI products using ground-based lidar and sunphotometry measurements	Covered under PI talks
J-3	Hiroaki Horie	Validation Plan for CPR ECO Product	Covered under PI talks
J-4	Takashi Nakajima	Lessons learned from the GCOM-C(Shikisai)/SGLI cloud observations	Covered under Lessons Learned
J-5	Kentaroh Suzuki, Akira Yamauchi	Development and Validation of the Japanese EarthCARE 4-sensor standard algorithm for radiation fluxes	Covered under PI talks
J-6	Kaori Sato, Hajime Okamoto	Assessment of the environmental conditions for the generation of ice particle types from A-train observations	Covered under PI talks
J-7	Ohigashi Tadayasu	Validation plan for EarthCARE/CPR using scanning Ka-band cloud radar	Covered under PI talks
J-8	Kazuma Aoki	Aerosol optical properties and validation plan by using Sky radiometer	Covered under PI talks
E-01	Nicolas Clerbaux	EarthCARE BBR L1 and L2 Products Assessment	Covered under PI talks
E-03	Ulla Wandinger	GIVE - the German Initiative for the Validation of EarthCARE	Covered under PI talks
E-04	Christophe Genthon	SPACECARE: Study of Precipitation in the AntarctiC with EarthCARE	Not presented
E-05	Holger Baars	EVID05: The new structure of the ACTRIS-related contribution to EarthCARE Cal/Val - AECARE	Covered under networks
E-06	Norman Loeb	-	Not presented
E-07	Eduardo Landulfo	LALINET EarthCARE Cal/Val Activities	Covered under networks
E-08	Dmitri Moisseev	EarthCARE validation activities in Finland	Covered under PI talks
E-09	Jean-Baptiste Renard	Strategy of measurements with the light balloon aerosols counter LOAC for the validation of EarthCare (BAIVEC project)	Covered under campaigns
E-10	Julien Delanoë	MORECALVAL: MObile Radar-Lidar-Radiometer EarthCare CAL/VAL project	Covered under campaigns
E-11	Gianluigi Liberti	An Italian coordinated contribution to the Validation of EarthCARE products from three atmospheric observatories in the Central Mediterranean Sea	Covered under PI talks
E-12	Detlef Müller, Rui Song	LITES: cal/val with lidar in Hatfield, UK	Covered under PI talks
E-14	Arnoud Apituley	Updates for the Cabauw activities for EarthCARE evaluation (CECARE)	Covered under PI talks
E-15	Philippe Goloub	-	Poster only

E-16	Abhay Devasthale	-	Not presented
E-17	Ellsworth Welton, Jasper Lewis	EarthCARE Cal/Val Using the NASA Micro Pulse Lidar Network (MPLNET)	Covered under networks
E-18	Robert Oscar David	ALIVIO: Norwegian Cal/Val Efforts	Covered under campaigns
E-19	Damien Josset	-	Not presented
E-20	Xiuqing Hu, Xuan Wang	Preparation for the validation of EarthCARE Product in China	Covered under PI talks
E-21	V. Chandrashekar	Physical validation of EarthCARE products	Covered under PI Talks
E-23	Vassilis Amiridis, Eleni Marinou	The Mediterranean EarthCARE Cal/Val experiment ACROSS	Covered under campaigns
E-24	Helene Chepfer, Artem Feofilov	Statistically Based Calibration/Validation Control of ATLID L1 data	Covered under PI talks
E-25	David Donovan	Cabauw Lidar observations for ATLID L1 and L2a product evaluation	Covered under PI talks
E-26	Simone Tanelli, Ousmane Sy	Calibration and Validation of EarthCARE's Cloud Profiling Radar Products	Covered under campaigns
E-27	Perez-Ramirez	-	Poster only
E-28	Yannis Markonis	-	Not presented
E-29	Noelle Scott	-	Not presented
E-30	David Winker	Looking Back on Lessons Learned from CALIPSO Validation	Covered under Lessons Learned
E-31	Zhipeng Qu	The Arctic POlar Night EXperiment (PONEX) Aircraft Campaign to Assess EarthCARE's cloud property retrieval algorithms	Covered under campaigns
E-32	Chris Hostetler	EarthCARE Calibration and Validation Using the NASA LaRC Airborne HSRL-2	Covered under campaigns
E-33	Peter Völger	Validation of ATLID lidar data by means of ground-based lidar measurements in northern Sweden	Covered under PI talks
E-34	Gottfried Kirchengast, Andreas Kvas	WEGN4CARE: The WegenerNet 3D Open-Air Laboratory for Climate Change Research and its Potential for the Validation of EarthCARE Cloud and Precipitation Products	Covered under networks
E-35	Vaughan Phillips	Validate Cloud Profiling Radar on EarthCARE against Aircraft Observations of Cirriform Cloud	Covered under PI talks
E-36	Larisa Sogacheva	AVE-ECARE: validation and evaluation of EarthCARE aerosol products.	Covered under PI talks
E-37	Thorwald Stein, Kamil Mroz	Calibration and Validation of EarthCARE Retrieved Products Using Measurements from the UK Facility for Airborne Atmospheric Measurements (FAAM)	Covered under campaigns
E-38	Kerstin Stebel	Norwegian initiative for EarthCARE Validation of Aerosol uncertainties and Radiation products in the Arctic (NEVAR)	Covered under PI talks

E-39	Rodanthi-Elisavet Mamouri	CORAL - Cyprus Observations for EarthCare vALidation	Covered under PI talks
E-40	James Mather	Combining EarthCare and ARM facility measurements for validation and research applications	Covered under networks
E-41	Francisco Navas-Guzmán	Assessment of EarthCare Aerosol and Cloud Products through Ground-Based Measurements from the E-PROFILE and AERONET Networks. (AEROCLOUD)	Covered under networks
E-42	Daniel Cecil	NASA Atmosphere Observing System (AOS)	Presented in the science part
Prospective	Haoran Li	Validation of EarthCARE doppler with Chinese cloud radar network, and retrievals with tropical triple-frequency radars	Covered under PI talks
Prospective	Grisa Mocnik	In-situ airborne measurements during Aeolus Cal/Val JATAC campaigns – relevance for EarthCARE aerosol products	Covered under campaigns
Prospective	Thomas Popp	Extinction validation from Umweltforschungsstation Schneefernerhaus (UFS) - a proposal for additional validation measurements	Covered under PI talks
Prospective	Iwona Stachlewska	EMORAL lidar observations for EarthCARE Cal/Val Activities and beyond	Covered under PI talks
Prospective	Guangyao Dai	Validation for the EarthCARE observations with use of spaceborne lidar ACDL and ground-based lidar-net over China	Covered under PI talks

Annex B: Validation Workshop Programme

Day 3: Wed 15 November 2023			
Time	**Min**	**Title**	**Speaker**
Session: Lessons Learned, Chairs: L. Baldini, K. Suzuki (Secretaries: S. Rusli, T. Tanaka)			
14:45	15	Introduction by JAXA+ESA	Robert Koopman, Toshiyuki Tanaka
15:00	12	Looking Back on Lessons Learned from CALIPSO Validation	David Winker
15:12	12	Lessons learnt from Aeolus Cal/Val	Sebastian Bley
15:24	12	Lessons learned from the GCOM-C(Shikisai)/SGLI cloud observations	Takashi Nakajima
15:36	12	Validation activities for dual-frequency precipitation radar (DPR) onboard GPM core observatory	Nobuhiro Takahashi
15:48	12	Introduction to EarthCARE DISC	Timon Hummel
16:00	30	Coffee break	
Session: Best Practice and PI Talks, Chairs: D. Winker, N. Takahashi (Secretaries: R. Koopman, T. Hummel, V. Tzallas)			
16:30	3	Session intro	(Chairs)
16:33	5	Physical validation of EarthCARE Products	Chandra V. Chandrasekar
16:38	5	Validation of EarthCARE doppler with Chinese cloud radar network, and retrievals with tropical triple-frequency radars	Haoran Li
16:43	5	Validate Cloud Profiling Radar on EarthCARE against Aircraft Observations of Cirriform Cloud	Vaughan Phillips
16:48	5	Statistically Based Calibration/Validation Control of ATLID L1 data	Artem Feofilov
16:53	12	Defining validation protocols for space-borne aerosol and cloud profile products	Vassilis Amiridis
17:05	12	Representativity of air- and spaceborne radar-lidar measurements	Florian Ewald
17:17	12	Near real-time validation of EarthCARE observations through monitoring within a data assimilation system	Mark Fielding
17:29	61	Demos/Poster session	
18:30	30	End of Day	

Day 4: Thu 16 November 2023			
Time	**Min**	**Title**	**Speaker**
Session: Airborne Campaigns 1, Chairs: S. Gross, J. Delanoë (Secretaries: H. Baars, T. Fehr)			
9:15	3	Session intro	(Chairs)
9:18	12	NASA Goddard Space Flight Center (GSFC) Elastic Backscatter Lidar Efforts Relevant to EarthCare Calibration/Validation and Synergistic Data Products	Ed Nowottnick
9:30	12	EarthCARE Calibration and Validation Using the NASA LaRC Airborne HSRL-2	Chris Hostetler
9:42	12	The Arctic POlar Night EXperiment (PONEX) Aircraft Campaign to Assess EarthCARE's cloud property retrieval algorithm	Zhipeng Qu
9:54	10	Calibration and Validation of EarthCARE’s Cloud Profiling Radar Data Products	Ousmane Sy
10:04	10	Norwegian EarthCARE Cal/Val Efforts	Robert Oscar David

10:14	10	Calibration and Validation of EarthCARE Retrieved Products Using Measurements from the UK Facility for Airborne Atmospheric Measurements (FAAM)	Kamil Mroz
10:24	10	The Mediterranean EarthCARE Cal/Val experiment ACROSS	Eleni Marinou
10:34	40	Discussion	
11:14	31	Coffee break	
Session: Airborne Campaigns 2, Chairs: P. Kollias, D. Donovan (Secretaries: E. Marinou, J.von Bismarck)			
11:45	3	Session intro	(Chairs)
11:48	10	Strategy of measurements with the light balloon aerosols counter LOAC for the validation of EarthCare (BAIVEC project)	Jean-Baptiste Renard
11:58	10	Unmanned Aerial Vehicles and other observations for the cal/val of EarthCARE	Franco Marenco
12:08	10	In-situ airborne measurements during Aeolus Cal/Val JATAC campaigns – relevance for EarthCARE aerosol products	Griša Močnik
12:18	12	In-situ airborne measurements during Aeolus Cal/Val JATAC campaigns – relevance for EarthCARE aerosol products	Silke Gross
12:30	12	BOWTIE – The shipborne Trans-ITCZ Experiment	Julia Windmiller
12:42	12	MORECALVAL: MObile Radar-Lidar-Radiometer EarthCare CAL/VAL project	Julien Delanoë
12:54	12	PACE-PAX	Kirk Knobelspiesse
13:06	35	Discussion	
13:41	64	Lunch break	
Session: Accepted and prospective PI Talks, Chairs: N. Clerbaux, Y. Ohno (Secretaries: A. Velazquez, T. Tanaka)			
14:45	3	Session intro	(Chairs)
14:48	5	Development and Validation of the Japanese EarthCARE 4-sensor standard algorithm for radiation fluxes	Akira Yamauchi
14:53	5	Aerosol optical properties and validation plan by using Sky radiometer	Kazuma Aoki
14:58	5	Validation Plan for CPR ECO Product	Hiroaki Horie
15:03	8	GIVE - the German Initiative for the Validation of EarthCARE	Ulla Wandinger
15:11	10	AVE-ECARE: validation and evaluation of EarthCARE aerosol products.	Larisa Sogacheva
15:21	10	Norwegian initiative for EarthCARE Validation of Aerosol uncertainties and Radiation products in the Arctic (NEVAR)	Kerstin Stebel
15:31	10	Extinction validation from Umweltforschungsstation Schneefernerhaus (UFS) - a proposal for additional validation measurements	Thomas Popp
15:41	34	Coffee Break	
Session: Tools, Logistics and prospective PI talks, Chairs: H. Baars, E. Marinou (Secretaries: M. Eisinger, A. Velazquez)			
16:15	3	Session intro	(Chairs)
16:18	10	EMORAL lidar observations for EarthCARE Cal/Val Activities and beyond	Iwona S. Stachlewska

16:28	10	Validation for the EarthCARE observations with use of spaceborne lidar ACDL and ground-based lidar-net over China	Guangyao Dai
16:38	15	ESA-ECVT logistics	Stephanie Rusli
16:53	5	ESA orbit tools	Montserrat Pinol Sole
16:58	5	Atmosphere Virtual Lab	Sander Niemeijer
17:03	5	Level-1 ATLID simulator	David Donovan
17:08	5	MSI-simulator tool	Nils Madenach
17:13	5	A L1 transformational operator for the objective evaluation of the EarthCARE Cloud Profiling Radar data products using suborbital observations	Lukas Pfitzenmaier
17:18	5	EVDC-Cal/Val database	Ann Mari Fjaeraa
17:23	5	EVDC-Cal/Val tools	Jarek Dobrzanski
17:28	62	Demos.and poster session	
18:30		End of Day	

Day 5: Fri 17 November 2023			
Time	**Min**	**Title**	**Speaker**
Session: Networks and PI Talks 1, Chairs: L. Baldini, T. Nishizawa (Secretaries: H. Baars, T. Tanaka)			
9:15	3	Session intro	(Chairs)
9:18	5	Validation studies of L2 cloud products by CPR, CPR-ATLID and CPR-ATLID-MSI	Hajime Okamoto
9:23	5	EarthCARE validation activities in Finland	Dmitri Moisseev
9:28	5	WEGN4CARE: The WegenerNet 3D Open-Air Laboratory for Climate Change Research and its Potential for the Validation of EarthCARE Cloud and Precipitation Products	Andreas Kvas
9:33	5	An Italian coordinated contribution to the Validation of EarthCARE products from three atmospheric observatories in the Central Mediterranean Sea	Gianluigi Liberti
9:38	10	A 94-GHz Radar Network in Europe for the Calibration and Validation of Spaceborne Cloud Profiling Data Products	Lukas Pfitzenmaier
9:48	10	CORAL - Cyprus Observations for EarthCare vALidation	Rodanthi Elisavet Mamouri
9:58	10	Combining EarthCare and ARM facility measurements for validation and research applications	James Mather
10:08	10	EarthCARE Cal/Val preparation activity in the framework of the European Project ATMO-ACCESS	Holger Baars
10:18	5	EVID05: The new structure of the ACTRIS-related contribution to EarthCARE Cal/Val - AECARE	Holger Baars
10:23	5	LALINET EarthCARE Cal/Val Activities	Eduardo Landulfo
10:28	5	Validation plan for EarthCARE/CPR using scanning Ka-band cloud radar	Tadayahu Ohigashi
10:33	5	EarthCARE BBR L1 and L2 Products Assessment	Nicolas Clerbaux
10:38	5	Preparation for the validation of EarthCARE Product in China	Xuan Wang
10:43	20	Discussion	
11:03	22	Coffee break	
Session: Networks and PI Talks 2, Chairs: U. Wandinger, T. Y. Nakajima (Secretaries: E. Marinou, T. Hummel, V.Tzallas)			
11:25	3	Session intro	(Chairs)

11:28	5	Assessment of the environmental conditions for the generation of ice particle types from A-train observations	Hajime Okamoto
11:33	5	SPACECARE: Study of Precipitation in the AntarctiC with EarthCARE – not presented	Christophe Genthon – not present
11:38	5	LITES: cal/val with lidar in Hatfield, UK	Detlef Müller
11:43	5	Validation of ATLID lidar data by means of ground-based lidar measurements in northern Sweden	Peter Völger
11:48	5	Cabauw Lidar observations for ATLID L1 and L2a product evaluation	David Donovan
11:53	5	Updates for the Cabauw activities for EarthCARE evaluation (CECARE)	Arnoud Apituley
11:58	5	EarthCARE Cal/Val Using the NASA Micro Pulse Lidar Network (MPLNET)	Jasper Lewis
12:03	5	Validation of the EarthCARE ATLID and MSI products using ground-based lidar and sunphotometry measurements	Tomoaki Nishizawa
12:08	10	Performance Evaluation of the Rain Mask Algorithm for Global Precipitation Monitoring Using NASA MPLNET Lidar Network	Simone Lolli
12:18	10	AD-Net and SAVER-Net lidar networks for validation of ATLID products	Yoshitaka Jin
12:28	10	Assessment of EarthCare Aerosol and Cloud Products through Ground-Based Measurements from the E-PROFILE and AERONET Networks. (AEROCLOUD)	Francisco Navas-Guzmán
12:38	10	CPR Doppler validation using WINDAS	Yuichi Ohno
12:48	12	The WMO GAW Aerosol Lidar Observation Network (GALION): status and coordination plans relevant to EarthCARE	Judd Welton
13:00	20	Discussion	
13:20	20	Sandwich break	
13:40	60	Panel discussion	Ulla Wandinger, Robin Hogan, Jason Cole, Dmitri Moisseev, Hajime Okamoto, Masaki Satoh, Nobuhiro Takahashi, Tomoaki Nishizawa
14:40	5	Closing	
14:45		End of Conference	