1st ESA EarthCARE Cal/Val Workshop Report

EC-RP-ESA-SYS-983

Bonn, Germany
13-15 June 2018

esa

European Space Agency

Table of Contents

Workshop introduction by A. Illingworth

(Emeritus Professor at University of Reading, EarthCARE European Mission Advisory Group Chair)

The EarthCARE mission due to be launched in 2021 has four advanced instruments on board: a Dopplerised 94 GHz radar (CPR), a high spectral resolution 355 nm lidar (HSRL, refered as EarthCARE ATmospheric LIDar, ATLID), a Multi-Spectral Imager (MSI) and a Broad Band Radiometer (BBR). By exploiting the synergy of these four instruments EarthCARE should provide new insights into the vertical structure of clouds, aerosols, and radiation in the atmosphere. The synergetic algorithms to retrieve these properties from the four instruments are complex, so now is the time to review the status of these retrievals and the activities needed before launch and during the commissioning phase to validate them. There have been 32 proposals in response to an ESA call for CAL/VAL activities, and 144 scientists and engineers from 22 countries gathered in Bonn to discuss how such CAL/VAL activities should be organised.

The objectives of this 1st ESA EarthCARE Cal/Val Workshop were as follows:
- Informing the participants on Mission status, algorithms and products, on the results of the Announcement of Opportunity, on tools, communications and data exchange.
- Familiarising Agencies, Principal Investigators, and the Mission Advisory Group with the contributions of the 32 proposals.
- Identifying collaboration opportunities, common methodologies, and overlaps
- Assessing the extent of completeness of proposed contributions with respect to the EarthCARE calibration/validation requirements.
- Stimulating exchanges within the nascent EarthCARE Cal/Val Team.

All presentations will be available at the workshop website:
https://atpi.eventsair.com/QuickEventWebsitePortal/earthcare/home

ESA Introduction Session

Chair: D. Maeusli, ESA EarthCARE System & Mission Manager
On behalf of ESA, D. Maeusli welcomed the participants and thanked the German Space Agency (DLR) and the Max Planck Institute for co-hosting this workshop, which was organized in concomitance with the 7th International EarthCARE Workshop. EarthCARE being developed in partnership with JAXA, D. Maeusli also welcomed the Japanese scientific community: while this workshop should offer them an excellent opportunity to become familiar with the EarthCARE Cal/Val program initiated in Europe; it also intended to promote coordination and synergies with Cal/Val activities in Japan.

R. Koopman opened the introduction session by stating the Cal/Val workshop objectives. The mission and system status presented on Monday was not repeated, but instead he referred the participants to the mission, system, product and algorithm posters. The evaluation of the Announcement of Opportunity (AO) for EarthCARE Calibration and Validation has been completed, including review of all the clarifications received. Since all clarifications were satisfactory, R. Koopman congratulated all Principal Investigators with

the acceptance of their proposals and welcomed them to the EarthCARE Cal/Val Team (ECVT). He continued with an overview of the independent measurement resources proposed by the ECVT as a whole, including for example at least 16 different airborne platforms, and the ample geographical coverage of ground-based lidars.
Subsequently he addressed ECVT practicalities, in particular the supporting documents, tools, services and communication channels, the validation data centre, and the validation rehearsal. Also he mentioned the target release dates for EarthCARE products towards the validation teams (3 months after launch for Level-1 products, 6 months for Level-2 products from single or two sensors, and 9 months for the remaining Level-2 products) and compared these to the target dates for public release (6, 9 and 18 months respectively).

D. Schüttemeyer presented the EarthCARE Campaign coordination process and background. He described the different roles of campaigns in different mission phases all along the mission lifetime and beyond. NARPEX, EPATAN and A-CARE are campaigns that have supported EarthCARE mission development and simulation. For campaigns in the context of EarthCARE Cal/Val, he highlighted the importance of detailed validation planning and data analysis.

A.M. Fjæraa from NILU presented the ESA Atmospheric Validation Data Centre (EVDC). This facility will host the independent datasets provided by the Principal Investigators of the ECVT. Only data that are collocated with EarthCARE should be uploaded. The data centre uses a standardized metadata format, that is used also by NASA (Aura mission) and networks like EARLINET, NDACC, and TCCON. She clarified that even if the general setup of the EVDC allows public access to datasets, this will not be the case for the EarthCARE Cal/Val where access to data is restricted to ECVT members ('campaign use'). Principal Investigators are invited to share also preliminary datasets, as soon as possible after observation. The EVDC is equipped with support functions, including an OPOT overpass tool already configured for EarthCARE (although it should be noted that the definitive phase of the orbit has not been selected yet).

M. Pinol Solé introduced the ESA overpass planning support service and tool suite. For fixed sites a set of tables has been produced and will be maintained. For campaigns and satellite-to-satellite collocations, dedicated requests can be placed but there are also several open source support tools available at http://eop-cfi.esa.int. Demonstrations of some of these tools were given during the poster sessions.

S. Niemeijer from S[&]T presented the ESA Atmospheric Toolbox. This open-source toolbox comprises a product access layer (CODA), a harmonisation and intercomparison layer (HARP) and a visualization layer (VISAN). Demonstrations of these tools were given during the poster sessions.

D. Lajas had introduced the EarthCARE End-to-End Simulator as part of the workshop opening session on Monday. Demonstrations of this simulator were given during the poster sessions.

The final presentation of this session was given by T. Kubota-san. He presented the plans and status of the JAXA validation activity. The first JAXA Research Announcement (RA) for

EarthCARE Validation covered the period from April 2013 to March 2015 and involved 14 Principal Investigators. The 2nd RA will cover April 2019 until March 2022 and will be released in September 2018 (TBC).

Session 1: General Approaches and Multi-Task Country Contributions

Chairs: J. Cole and D. Donovan
Secretary: R. Koopman

This session opened the sequence of sessions discussing the content of the proposals in response to the Cal/Val AO. This particular session was dedicated to proposals that grouped several diverse contributions from institutes in the same country.

AOID	Proposal Title	Speaker/PI
ID: 38188	German Initiative for the Validation of EarthCARE (GIVE)	U. Wandinger, S. Groß, A. Hünerbein
ID: 38839	Swedish contribution to ESA s EarthCARE Cal Val activities (SweVal)	A. Devasthale
ID: 39067	Validation of EarthCARE Product in China	X. Hu
ID: 39183	Validation of EarthCARE products towards their homogenization with CALIPSO for consolidating the 3D long-term ESA-LIVAS climatology of aerosols, clouds and radiation (ACROSS)	V. Amiridis
	NASA Assets (ground, sub-orbital and orbital) and field campaigns relevant for EarthCARE	F. Seidel
	CNES support to French research community activities in relation with EarthCARE Validation	T. Tremas
ID: 39211	Evaluation of vertical-profiles and column integrated aerosol properties from EarthCARE in Spain using EARLINET/ACTRIS facilities and airborne data from field-campaigns	D. Perez-Ramirez (talk cancelled but activity included in discussion session)

Each of the proposals provides a range of assets and methods to calibrate and validate EarthCARE instruments and products.

Many ground-based observations will be performed using a range of lidars, radars, radiometers and photometers using instruments sited at several location in Europe and other non-European sites including Barbados, China and North America. Fixed ground-based observation networks will be augmented by mobile surface observations. This includes land-based mobile sites from the German proposal (GIVE), the Greek proposal (ACROSS) and within the French proposals as well as ship-based observations within the German (GIVE) and Swedish (SWEVal). Mobile sites allow positioning of the instruments directly under EarthCARE overpasses and sampling of specific conditions. Additional surface based sites are available in China (Dunhunag) and North America (Railroad Valley, Ivanpah Playa, Rosamond dry lake and Frenchman Flat) for vicarious calibration of EarthCARE radiometers (MSI and BBR).

The German (GIVE), NASA and French presentations discussed a large number of previous, present and future aircraft missions and observing capabilities. The aircraft include a range

of remote sensing instruments, lidars, radars and radiometers that compliment the surface instruments and in the case of the French aircraft an instrument suite that is similar to EarthCARE instruments. The aircraft are also instrumented for in-situ observations of clouds and aerosols. The French and Swedish contributions will also use balloons and Zeppelins to perform short and long term airborne observations while the Greek (ACROSS) proposal will use UAVs for airborne observations.

All proposed using observations from a range of satellites to either calibrate and/or validate EarthCARE measurements and products. The satellites proposed to be used include those in the A-Train, SEVIRI, GERB, SCARAB, MGT as well as existing and future Chinese and NASA missions (for example TSIS-1 and MAIA). Some of the satellite-based calibration/validation will complement other projects, for example for SWEVal comparison of EarthCARE with other satellites will fall within the framework of EUMETSAT's Satellite Application Facility on Climate Monitoring (CMSAF) project.

The US National Aeronautics and Space Administration (NASA) presentation highlighted the availability of open-access surface-based, airborne and space-based observations they have made, and will make, that are relevant to EarthCARE. The French Space Agency (CNES) described their capabilities, including surface, airborne, balloon and space-based observations, and expressed their in-country support for French proposals.

Taken together the above proposals address calibration and validation of many EarthCARE instruments and products over a range of cloud and aerosol conditions. However, there were some concerns about some of the proposals having partial funding. Examples of concerns include:

- funding to locate a 94 Ghz radar at Norunda, Sweden (SWEVal)
- support for young researchers and acquisition of a cloud radar (ACROSS)

As some of the projects were not yet funded, or only partially funded, there was discussion about how to increase the awareness of funding agencies, especially in smaller countries. A. Lefebvre, EarthCARE project manager, noted that this awareness was achieved for ESA member states through the Data Operations Scientific and Technical Advisory Group (DOSTAG).

During the discussion, there were several points made about organization of and interaction with these projects. This included how national level coordination would be performed and how they would interact with algorithm developers. For the latter, it was noted that ESA would be developing a "portal" to facilitate the interaction between algorithm developers and Cal/Val projects.

.

Session 2: Specific Instrument, Product and Algorithm Validation

Chairs: L. Baldini and A. Battaglia
Secretary: M. Eisinger

In this session, validation plans for specific EarthCARE data products (and their algorithms) were presented. Validation methods encompass ground-based, airborne, and satellite platforms as well as statistical analysis of EarthCARE data without external references.

AOID	Proposal Title	Speaker/PI
ID: 37730	EarthCARE BBR L1 and L2 Products Assessment	N. Clerbaux
ID: 38623	SPACECARE (Study of Precipitation in the AntarctiC with EarthCARE)	J. Delanoe/ C. Genthon
ID: 38709	Evaluation of EarthCARE Radiances and Fluxes with CERES Data Products	S.Kato/ N. Loeb
ID: 38816	Validation of EarthCARE Aerosol products over key REgions with a focus on high latitudes (VECARE)	G. Ancellet
ID: 38935	Innovative retrieval methods of aerosol and cirrus cloud optical depth above water clouds and ocean surface, and its application in ATLID cal/val studies.	Y. Hu/D. Josset
ID: 39147	Calibration and Validation for EarthCARE Cloud Profiling Radar (CPR) using Ground Based and Satellite Weather Radar Observations	V. Chandrasekar
ID: 39184	Statistically based calibration/validation control of ATLID L1 data	A. Feofilov/ H. Chepfer
ID: 39186	Cabauw Lidar Observations for ATLID L1 and L2a product evaluation	D. Donovan
ID: 39205	Calibration and Validation of EarthCARE s Cloud Profiling Radar Data Products	O. Sy/S. Tanelli
ID: 39214	Cross-scale evaluation of ground precipitation derived from the ACM-CAP data product over Europe	Y. Markonis
	Discussion addressed also:	
ID: 39217	MMP : Monitoring MSI/EarthCARE L1 performances using concomitant intercalibration and stand-alone approaches	N. Scott (talk cancelled)
ID: 38188	German Initiative for the Validation of EarthCARE (GIVE)	U. Wandinger, S. Groß, A. Hünerbein

Session summary

N. Clerbaux outlined the validation of Level 1 and Level 2b BBR products: broad-band radiances and fluxes. Noise, gain and stability will be analysed for specific scenes identified by the MSI. The accuracy of the shortwave subtraction will be checked as well as the impact of the BBR chopper drum speed on the accuracy of the radiances and fluxes. Radiances can be compared adapting from GERB and similar satellite instruments, provided observation angles are the same. Finally the closure product provides an end-to-end verification of the production chain once the full chain is operational.

J. Delanoe (for C. Genthon) discussed the validation of Antarctic precipitation. Snowfall measurements over Antarctica are sparse. The snowfall rate for Antarctica has been derived from Cloudsat measurements, except the region around the pole, due to the orbit inclination. The Cloudsat data were compared to the snowfall rates obtained from the ground-based 24 GHz microwave rain radar of the Dumont d'Urville. The lowest 1 km which is particularly important is difficult to characterise because of ground clutter affecting satellite measurements. The wide variability of vertical profiles close to ground resulting from ground-based measurements make that extrapolation is not an option. Lidar measurements and a classification of PSCs 2007-2017 were also presented. A W band radar might be deployed at Dumont d'Urville in the future.

S. Kato (for N. Loeb) presented the validation using CERES data products. CERES (6 instruments are in orbit) should still be flying in 2021. Top-of-atmosphere (ir)radiances, surface irradiances, and cloud properties can be compared. Standard deviations are expected to be large for surface irradiance, and there is a possible sampling issue. The radiance comparison can help to identify calibration differences while the irradiance (flux) comparison can spot Angular Distribution Model (ADM) differences. Irradiances can also be derived from geostationary satellite measurements.

G. Ancellet looked at aerosol validation with a focus at high latitudes. This is a cooperation between LATMOS and Tomsk. ATLID aerosol products will be validated with lidars (including 355 nm lidars) at Tomsk, ALOMAR (Norway), and Dumont d'Urville station (Antarctica) and drifting Arctic buoys carrying backscatter lidars. Tomsk provides both ground-based and airborne lidars as well as in-situ measurements. Seasonal (or monthly) comparisons between ATLID and Calipso can be made. Currently, funding is ensured for ground stations, but not for airborne measurements and buoys.

Y. Hu (for D. Josset) discussed the validation of aerosol and cirrus above water clouds and ocean. The return from ocean and water clouds is well understood, so can be utilised to validate the column optical depth. Specifically, wind speed and aerosol optical depth (AOD) over ocean were derived from Calipso measurements using a neural network. The wind speed agrees quite well with AMSR-E, and the AOD agrees well with MODIS and POLDER. The AOD above water clouds from Calipso was found to agree well with a DIAL HSRL.

V. Chandrasekar reported on the CPR validation from ground based and satellite weather radars. This project will use 10 C-band Doppler radars in Finland (of which 9 with dual polarisation) and 158 Doppler radars in the US (NOAA-NWS). Observation volumes need to be matched carefully (noting that the ground radar is looking almost horizontally) but methods are available. The hydrometeor type classification is derived from Ku and Ka band measurements and can be compared to the CPR classification. ARM radars (W band) will be specifically used to validate CPR reflectivity. Some ground-based radars are calibration standards, others have a poorer level of calibration. In the discussion following this talk it was recommended to spend additional efforts on validation of Doppler and the snowfall rate.

A. Feofilov (for H. Chepfer) explained a statistically based validation of ATLID Level 1 products which is not using any external measurements. This method has been successfully

used for CALIOP validation and quality control. Histograms of reflected power and stratospheric noise and clustered histograms of scattering ratios were shown as examples, and a set of 11 quality control parameters was proposed. ESA noted that if successful this should become part of the operational ATLID quality monitoring, and will discuss further internally and with the ATLID instrument provider. A similar method could be applied to the CPR as well.

D. Donovan introduced the planned use of the lidars at Cabauw (NL) for ATLID L1 and L2 validation. These are a 355 nm non-HSRL depolarisation lidar and a multi-wavelength Raman lidar. Level 1 measurements can not be directly compared to ATLID as wavelengths and observation geometry are different. Instead, some forward modelling is required. D. Donovan noted that there are no funds for satellite validation in The Netherlands.

O. Sy (for S. Tanelli) presented a proposal for CPR validation in the US, employing the Airborne Third Generation Precipitation Radar (APR-3) which operates in the Ku, Ka and W bands (at 13, 35, and 94 GHz) and has Doppler and polarisation capabilities. In addition, RainCube (a 35 GHz radar in a CubeSat) might provide potential for validation. A RainCube has just been deployed on the International Space Station (ISS). In the future, a constellation of RainCubes could be used to study the temporal evolution of clouds and rain.

Y. Markonis showed how a statistical evaluation of ground-based precipitation data from radars and in-situ station measurements could be used to validate precipitation parameters in C-CLD and ACM-CAP.

Discussion

The discussion for session 2 focused on the question how to ensure state-of-the-art and consistent Level 2 retrieval algorithms. Important elements were:

- physical validation of pre-launch algorithms with existing data (not just simulated, but also satellite/airborne/ground-based),
- make algorithm descriptions to the public, also through publication of the algorithms in peer reviewed journals,
- identification of key assumptions (and limitations) of algorithms per cloud regime, and from that: identification of needs for additional measurements to improve/constrain assumptions made,
- algorithm intercomparisons (specifically with Japanese and US teams),
- continuous update of algorithms and re-processing campaigns.

ESA noted that for the feedback on algorithm shortcomings and improvements, the Cal/Val portal should be used. Inputs from the Cal/Val team will be prioritised by ESA. Algorithm developers could put forward specific questions to the team via this portal. A Level 2 testbed will be provided by ESA where the effect of code changes can be studied in dedicated experiments.

Session 3: Dedicated Campaigns and Regional Efforts

Chairs: J. Delanoë and S. Groß
Secretary: D. Schüttemeyer

AOID	Proposal Title	Speaker/PI
ID: 38018	Validation of EarthCARE products by comparison with airborne measurements and global NWP predictions	F. Marenco
ID: 38809	Balloon Aerosols Instruments for the Validation of EarthCare (BAIVEC)	J-B. Renard
ID: 38810	MORECALVAL : MObile Radar-Lidar-Radiometer EarthCare CAL/VAL project	J. Delanoe
ID: 38909	Airborne and Lidar Validation of EarthCARE (ALIVO EarthCARE)	M. Gausa
ID: 39821	An assessment of EarthCARE's Cloud Property Retrieval Algorithms for Persistent Ice-phase Clouds in the Canadian Arctic during Polar Night	H. Barker
ID: 39873	EarthCARE Calibration and Validation Using an Airborne HSRL	D.Winker (PI: C. Hostetler)
	Discussion addressed also:	
ID: 38188	German Initiative for the Validation of EarthCARE (GIVE)	U. Wandinger, S.Groß, A.Hünerbein
ID: 38811	An Italian coordinated contribution to the Validation of EarthCARE products from three atmospheric observatories in the Central Mediterranean Sea.	G L . Liberti
ID: 38816	Validation of EarthCARE Aerosol products over key REgions with a focus on high latitudes (VECARE)	G. Ancellet
ID: 39205	Calibration and Validation of EarthCARE s Cloud Profiling Radar Data Products	O. Sy (PI: S. Tanelli)
ID: 38935	Innovative retrieval methods of aerosol and cirrus cloud optical depth above water clouds and ocean surface, and its application in ATLID cal/val studies.	D. Josset
ID: 39211	Evaluation of vertical-profiles and column integrated aerosol properties from EarthCARE in Spain using EARLINET/ACTRIS facilities and airborne data from field-campaigns	D. Perez-Ramirez (talk cancelled but activity included in discussion session)

Session summary

38018 (Marenco): The team proposes to utilize airborne in-situ and remote sensing measurements on the FAAM aircraft for cloud, aerosol and precipitation measurements to validate scene classification, layer detection and aerosol-cloud separation.
Measurements can be performed in the UK, during already planned campaigns or during specific cal/val campaigns. Funding for the measurements is in review; an answer is expected End of 2018. Additionally Satellite or NWP data shall be used to compare cloud mask, aerosol products (dust, volcanic ash). Data shall be assimilated.

38809 (Renard): The team proposes to perform balloon-borne in-situ measurements below EarthCARE (15 planned launches from Southern France per year starting 2018 – additional balloons from La Reunion or Iceland for specific campaigns) and additional measurements (in-situ) on long-life (3 months) balloons (20 balloons planned in the period 202-2023). Data are available after the flight. Aerosol extinction and aerosol classification will be addressed in the cal/val activities. No information about funding is currently available.

38810 (Delanoe): aircraft tandem measurements with EarthCARE-like payload on SAFIRE Falcon and German HALO aircraft. Additional radar measurements on mobile systems can be performed.

38909 (Gausa): M. Gausa introduced the ideas of utilizing ground-based lidar and sunphotometer measurements together with UAV in-situ measurements for validating aerosol (AOD, microphysics, ext/bsc/adep profiles) and cloud products (ice/water). Manned aircraft measurements might be performed together with University of Tromsö (in-situ measurements). Ground-based lidar systems measurements will be performed during working hours. For specific campaigns a 24/7 mode can be applied. The group has contacted the Norwegian Space Center for funding.

39821 (Barker): H. Barker introduced the idea of airborne active, passive and in-situ measurements on Canadian aircraft with additional ground-based in-situ, Ceilometer and Radar measurements. No information about funding was provided.

39873 (Hostetler): C. Hostetler provided input for airborne HSRL measurements at 532 nm and 355 nm with additional 3-λ depolarization measurements. The activities will focus on aerosol properties. No information about specific campaigns or funding were provided.

38188 (Wandinger): U. Wandinger discussed envisaged airborne measurements with EarthCARE-like payload on HALO and additional airborne in-situ measurements for cal/val activities with respect to aerosol and cloud products.
A large number of EC-products are addressed. Ground-based measurements will provide further information to address aerosol and cloud products. Already planned campaigns will be too early for EC-cal/val. It is planned to perform measurements (airborne and ground-based) after launch. Location of the measurements can be chosen depending on the needs for EC-cal/val. Activities are not yet funded; funding will be applied.

38811 (Liberti): G. L. Liberti provided input for activities at different places in Italy.
Currently, ideas for additional airborne measurements are discussed. There is no funding available yet.

38816 (Ancellet): Ground-based lidar, airborne in-situ (size absorption) and Bouy measurements with focus on Aerosol products in the high-latitudes (Sebiria, Alomar, and Antarctica) were proposed. No funding is available so far; but it should be possible to retrieve funding for related activities.

39205 (Tanelli): S. Tanelli provides information for airborne radar measurements to perform multi-wavelengths retrievals. No information about planned campaigns after launch was provided.

38935 (Josset): D. Josset discussed airborne HSRL measurements (USA) focusing on aerosols and cirrus clouds taking also water clouds below aerosols into account.

Discussion

The discussion for session 3 focused on the question on the timing of actual campaign activities (Phase E1 and Phase E2) and also on which products (L1, L2).

The addressed elements are as follows:

- Many activities focus on high-latitudes; some will be performed in mid-latitudes. Is it important to also include the tropics and activities in the southern hemisphere?
- The locations for airborne measurements included in 38810 (Delanoe) and 38188 (Wandinger) after launch are not yet fixed. There is flexibility to address cal/val needs. Additionally, ground-based Lidar are performed in Leipzig, Cyprus (both lidar-radar-sunphotometer) and Israel (without radar). The mobile ground-based platform from TROPOS has some flexibility to choose a location depending on cal/val needs.
- Many activities are not yet funded. It shall be elaborated if funding within an EU framework is possible.
- Careful planning of the campaign activities appears to be crucial!
- The priorities for cal/val activities (especially during the commissioning phase) have to be defined!
- Aircraft measurements with EarthCARE-like payload are important during the commissioning phase, but it has to be defined when exactly these measurements are needed and what shall be addressed. HALO will be requested for this purpose.
- Overpasses of the ground-based stations are expected to be important.
- It has to be discussed where the airborne measurements and the mobile ground-based measurements should be performed. Airborne measurements over land and ocean are expected to be important.

Session 4: Global Coverage and long-term global mission support by observational networks and stations

Chairs: D. Donovan and U. Wandinger
Secretary: J. Von Bismarck

This session was dedicated to validation contributions from large-scale networks and persistent atmospheric observatories that can provide long-term mission support over a wide range of geographical areas. The observational sites usually perform continuous observations and provide standardized, quality-controlled products.

AOID	Proposal Title	Speaker/PI
ID: 38644	ACTRIS for EarthCARE L2 product evaluation (AECARE)	A. Apituley
ID: 38757	LALINET EarthCARE CAL/VAL	E. Landulfo
ID: 38768	Validation of EarthCARE level2 radar products in high-latitude and Arctic climates	D. Moisseev
ID: 38811	An Italian coordinated contribution to the Validation of EarthCARE products from three atmospheric observatories in the Central Mediterranean Sea.	G L . Liberti
ID: 38813	British and Korean lidars for ATLID validation (BAKLAVA)	M. Tesche
ID: 38834	CESAR for EarthCARE evaluation (CECARE)	A. Apituley
ID: 38836	ACTRIS-FR proposal for EarthCARE Cal/Val	B. Torres (PI: Ph. Goloub)
ID: 38841	EarthCARE Cal/Val Using the NASA Micro Pulse Lidar Network (MPLNET)	E. Welton
ID: 39173	Validation of the EarthCARE ATLID and MSI products using ground-based lidar and sunphotometry measurements in East Asia.	T. Nishizawa
	Discussion addressed also:	
ID: 38188	German Initiative for the Validation of EarthCARE (GIVE)	U. Wandinger, S. Groß, A. Hünerbein
ID: 38839	Swedish contribution to ESA s EarthCARE Cal Val activities (SweVal)	A. Devasthale
ID: 39067	Validation of EarthCARE Product in China	X. Hu
ID: 39183	Validation of EarthCARE products towards their homogenization with CALIPSO for consolidating the 3D long-term ESA-LIVAS climatology of aerosols, clouds and radiation (ACROSS)	V.Amiridis
ID: 38810	MORECALVAL : MObile Radar-Lidar-Radiometer EarthCARE CAL/VAL project	J. Delanoe
ID: 38816	Validation of EarthCARE Aerosol products over key REgions with a focus on high latitudes (VECARE)	G. Ancellet
ID: 38909	Airborne and Lidar Validation of EarthCARE (ALIVO EarthCARE)	M. Gausa
ID: 39147	Calibration and Validation for EarthCARE Cloud Profiling Radar (CPR) using Ground Based and Satellite Weather Radar Observations	V. Chandrasekar
ID: 39186	Cabauw Lidar Observations for ATLID L1 and L2a product evaluation	D. Donovan

ID: 39211	Evaluation of vertical-profiles and column integrated aerosol properties from EarthCARE in Spain using EARLINET/ACTRIS facilities and airborne data from field-campaigns	D. Perez-Ramirez
ID: 39214	Cross-scale evaluation of ground precipitation derived from the ACM-CAP data product over Europe	Y. Markonis

Session summary

38644 (Apituley): ACTRIS, the European Aerosols, Clouds and Trace gases Research Infrastructure, with its EARLINET lidar network and Cloudnet radar network will contribute to the validation of ATLID, CPR and synergy products. The general funding of ACTRIS is based on national contributions of the participating countries. Alerting tools for clusters of stations to be activated in case of satellite overpasses are in place. Funding for EarthCARE-specific tool developments and manpower for analysis is still to be defined. During the discussions, existing and planned ground-based instrument synergies were highlighted (for example existing synergies between radars and additional passive instruments and ceilometers, but also a combined Earlinet/Cloudnet target classification). Summarizing, ACTRIS will be able to provide long-term ground-based reference data and covers a wide area. Essential experience in a comparable venture has been gathered for example during the CALIPSO validation activities.

38757 (Landulfo): The Latin American Lidar Network LALINET will contribute to correlative Raman lidar measurements from several station distributed across Latin America to validate ATLID (and synergy) products.

38768 (Moisseev): The “Validation of EarthCARE level2 radar products in high-latitude and Arctic climates” will contribute to ATLID, CPR and synergy product validation with C-, Ka- and W-band radars as well as several lidars distributed over three Finnish Arctic sites, partially on campaign basis and partially operational. The addition of input from a weather radar (multi-frequency approach) is expected to allow better ice-cloud retrievals under precipitation conditions. The activities add a unique coverage in the Arctic region.

38811 (Liberti): “An Italian coordinated contribution to the Validation of EarthCare products from three atmospheric observatories in the Central Mediterranean Sea” will provide correlative measurements with multiple passive and active ground-based instruments at two sites in different area of Rome (CIRAS in the outskirts, BAQUNIN in the city centre for which some activities currently receive ESA support), as well as on the island of Lampedusa in the Mediterranean (including 1 buoy). The funding of all the proposed activities is not yet secured. A vicarious calibration infrastructure proposal has been submitted to a funding agency (other than ESA).

38813 (Tesche): The BAKLAVA activity will contribute with two powerful stationary Raman lidars with capability of multi-wavelength spectrometric profiling of Raman scattering and depolarisation of atmospheric constituents in UK and Korea. High-power lidars allow for investigating the ATLID Rayleigh calibration range of 30-40 km height. UK Space Agency has been contacted for funding.

38834 (Apituley): CESAR for EarthCARE evaluation (CECARE) will contribute to the validation of mainly EarthCARE aerosol and cloud products via intercomparisons to products generated from the wide range of instrumentation at the CESAR supersite. The site could host additional campaigns (trans-national access site).

38836 (Torres for Goloub): The ACTRIS-FR activity contributes with a subset of instruments from the AECARE proposal operated by French institutions. The GARRLiC algorithm will be featured for combined AERONET (night & day) and lidar measurements to derive advanced profiles of aerosol optical properties. Some new stations in Equatorial Africa have entered the network recently. Stations in the Tropics will be of importance for stratospheric aerosol investigations.

38841 (Welton): The NASA Micro Pulse Lidar Network (MPLNET, co-located with AERONET Sun and sky photometers) will support the validation mainly of EarthCARE cloud and aerosol products, via data access and support to the interpretation of the validation data. MPLNET features a standardized processing. Relevant products for ATLID L2a validation include PBL height, CTH, CBH, furthermore drizzle droplet size and wind speed is derived. Most, but not all products are operationally produced.

39173 (Nishizawa): The "Validation of the EarthCARE ATLID and MSI products using ground-based lidar and sunphotometry measurements in East Asia" project contributes to ATLID L1b and L2a and MSI L2a validation by means of:
1) AD-NET lidar systems, partly comprising multi-wavelength Raman lidars,
2) SKYNET (PREDE) radiometer network covering areas in Europe, East Asia and India,
3) Validation analysis addressing ATLID L1b, A-AER, A-EBD, A-ALD, M-AOT and AM-ACD products. According to the discussions the products are consistent with EARLINET/AERONET products, and the metrological calibration facility for SKYNET exists in Hawaii.

Discussion
The following general questions, raised by the audience and the chairs, have been discussed at the end of the session:

- How good is the global coverage of the activities (map displayed)? Is (further) global coverage needed and if yes, why? How is the global distribution of combined lidar/radar sites? It is noted that coverage with lidars is better than with radars. Southern Ocean sites are missing in general. Efforts towards better collocation of lidar, radar and radiation measurements are needed.
- New CPR-like ground-based W-band radars - how is global coverage evolving? How is the synergy with lidars? Will mobile systems be of interest for direct comparisons in addition to statistical approaches? What is the latest evolution of the ground-based systems calibration procedures?
- How should/can datasets/network stations and associated efforts and contributions to EarthCARE Cal/Val, which are not part of an EarthCARE Cal/Val proposal (AERONET was specifically mentioned), be supported (for example via support letters)?
- Should specific Cal/Val products be developed by the ground-based networks?
- Is a multi-wavelength radar complement needed to address Cal/Val needs w.r.t. precipitation products?

Session 5: Validation using Models

Chairs: A. Illingworth and J. Cole
Secretary: R. Koopman

This session discussed proposals using models as a method to quantity control EarthCARE products

AOID	Proposal Title	Speaker/PI
	Discussion addressed:	
ID: 38018	Validation of EarthCARE products by comparison with airborne measurements and global NWP predictions	F. Marenco
ID: 38188	German Initiative for the Validation of EarthCARE (GIVE)	U. Wandinger, S.Groß, A.Hünerbein
ID: 39217	MMP : Monitoring MSI/EarthCARE L1 performances using concomitant intercalibration and stand-alone approaches	N. Scott (talk cancelled)

Session summary

Assimilation of EarthCARE data was highlighted as a potential method to identify systematic changes in EarthCARE products which is a form of quality control. Three groups presented plans for assimilation of EarthCARE data and associated monitoring. The UK MetOffice was mainly focused on the assimilation of dust related products, with a potential expansion to cloud fields. In the scientific workshop, ECMWF showed:

- the positive impact on weather forecasts from assimilating cloud data and
- how continuous monitoring of the NWP model and the observations should rapidly identify any systematic changes in the observation data products (talks by Jankisková and Fielding, respectively).

The GIVE project also plans to assimilate EarthCARE data into their models. For all assimilation approaches, the need for near real time data was highlighted as this is important for operational use of EarthCARE data.

Discussion

In addition to using assimilation techniques, it was suggested that models could be used to screen EarthCARE data and to address the representativity of independent ground-based data for intercomparing pairs of profiles that are not on the exact same sampling path. In particular, models could support network validation approaches by interlinking observation stations with the EarthCARE track under consideration of atmospheric flows (trajectories).

Although the session goal was to use models to validate EarthCARE products it was pointed out that the converse is also important, using EarthCARE products for model evaluation, and we should improve interaction with modellers. One way to achieve this is engagement with appropriate international projects such as the Cloud Feedback Model Intercomparison Project (CFMIP), Aerosol Comparisons between Observations and Models (AEROCOM), the International Cooperative for Aerosol Prediction (ICAP) and the WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS).

Session 6: Validation against other Satellites

Chairs: N. Clerbaux and P. Kollias
Secretary: R. Koopman

AOID	Proposal Title	Speaker/PI
ID: 39266	Plan for EarthCARE/ATLID Calibration and Science Product Validation Using CALIPSO	D. Winker
	Discussion addressed also:	
ID: 37730	EarthCARE BBR L1 and L2 Products Assessment	N. Clerbaux
ID: 38188	German Initiative for the Validation of EarthCARE (GIVE)	U. Wandinger, S.Groß, A.Hünerbein
ID: 38709	Evaluation of EarthCARE Radiances and Fluxes with CERES Data Products	N. Loeb
ID: 38816	Validation of EarthCARE Aerosol products over key REgions with a focus on high latitudes (VECARE)	G. Ancellet
ID: 38839	Swedish contribution to ESA s EarthCARE Cal Val activities (SweVal)	A. Devasthale
ID: 39067	Validation of EarthCARE Product in China	X. Hu
ID: 39147	Calibration and Validation for EarthCARE Cloud Profiling Radar (CPR) using Ground Based and Satellite Weather Radar Observations	V. Chandrasekar
ID: 39183	Validation of EarthCARE products towards their homogenization with CALIPSO for consolidating the 3D long-term ESA-LIVAS climatology of aerosols, clouds and radiation (ACROSS)	V.Amiridis
ID: 39205	Calibration and Validation of EarthCARE s Cloud Profiling Radar Data Products	O. Sy (PI: S. Tanelli)
ID: 39217	MMP : Monitoring MSI/EarthCARE L1 performances using concomitant intercalibration and stand-alone approaches	N. Scott (talk cancelled)
ID: 39821	An assessment of EarthCARE s Cloud Property Retrieval Algorithms for Persistent Ice-phase Clouds in the Canadian Arctic during Polar Night	H. Barker

The possibilities to validate against other satellite data is quite different between the passive (BBR, MSI) and active (ATLID, CPR) instruments. While for the first group a large panel of satellite's instruments can be expected to be useful for validation, few (or no) instruments are expected to be available to compare with the active instruments once EarthCARE will be on orbit. The CloudSat is already out of the A-train. During the workshop, Dr Winker (CALIPSO PI) confirmed that it must be assumed that the CALIPSO mission is likely to end before the launch of EarthCARE. The CALIPSO PI presented his plans for intercomparison between CALIOP and ATLID, even after the end of the CALIPSO mission, using statistical methods. He highlighted that the Version 4 algorithms had achieved a calibration accuracy better than 1.5%. Several proposals will perform similar statistical comparisons of the active instruments products with CloudSat and CALIPSO. Making the EarthCARE data homogeneous with those previous missions is a necessary step to extend the 3-dimensional climatology of cloud and aerosol profiles (focus of the ACROSS proposal

by V. Amiridis). VECARE also considers the use of CALIPSO/SODA data for validation of the EarthCARE aerosol products, either using simultaneous data or using a climatology.

Two cal/val proposals put the focus on the BBR level 1 and 2 products. Being defined at the Top Of the Atmosphere, the BBR products can only be compared with other satellite observations. Seiji Kato, representing Norman Loeb (CERES PI) during the workshop, confirmed the likelihood to have (at least) one CERES instrument in an afternoon orbit during the EarthCARE mission (on Aqua, S-NPP or NOAA-20). One CERES instrument should be operated in cross-track mode to continue the CERES global coverage mission, likely the FM-6 from NOAA-20. If previous CERES instruments are still in good state (FM-3,-4 or -5), they could be operated in particular acquisition mode to optimize the matching of the radiances and fluxes. When restricted to (quasi-)simultaneous observations, the spatial representativity of those LEO-LEO intercomparison is however not guaranteed, given the specific observation geometry of the 3 EarthCARE BBR views. Comparison with the GERB geo-stationary observations (from Meteosat-11) will provide a perfect temporal matching (GERB repeat cycle of acquisition is about 5') but will suffer of the reduced BBR swath that cannot cover a full GERB PSF. Comparison with fine-scale BB estimates from the narrowband MSG/SEVIRI is foreseen in the German GIVE initiative. Intercomparison with the broadband ScaRaB instrument on MeghaTropique can be interesting as the optics of this instrument is quite close to the one of the BBR but this is subject to an extension of the MT mission until the EarthCARE launch.

Several proposals will perform inter-comparison of the MSI visible and infrared bands radiances with well-established reference observations from research or operational sensors (e.g. MSG/SEVIRI, MODIS, ...). In the past, the use of non-standardized intercomparison methodologies for the radiance led to somewhat incoherent results. Now, methodologies are being consolidated in the GSICS initiative. At this level, the EarthCARE Cal/Val team will benefit from the involvement of Dr. Hu, vice-chair of the GSICS Research working group. The MSI cloud and aerosol products (as well as the products combining MSI and ATLID) will be compared with a large set of well-established reference products, including the operational products of the EUMETSAT SAFs, as for instance with the nowcasting and climate monitoring SAF (SweVal).

Generally speaking, given the number and quality of the proposals addressing the passive instruments, it can be expected that a clear picture of the BBR and MSI calibration and radiances/products accuracies will emerge rapidly after or even during commissioning of the instruments.

Closing session: Analysis of coverage with respect to Validation Requirements / Gap Analysis Session

Chairs: A. Illingworth, D. Donovan, L. Baldini, S. Groß, U. Wandinger, N. Clerbaux
Secretaries: T. Wehr, D. Schüttemeyer, M. Eisinger, J. Von Bismarck, R. Koopman

The closing discussion session highlighted the following aspects:

a) An impressive number of valuable Cal/Val activities have been proposed.
b) How are these activities to be interfaced with the algorithm developers?
c) There is a need to keep track of which activities are being funded.
d) Need of a mechanism for storing and exchanging the data from the Cal/Val activities.
e) There is an urgent need to define the activities during the commissioning phase.

Gap Analysis:

f) The CloudSat radar is (rather unexpectedly) providing the best global estimates of snowfall and light precipitation. EarthCARE should be able to continue this activity. Ground validation of these precipitation estimates with ground-based mm wave radars is very difficult – (e.g. due to attenuation by wet radomes). .
g) The suggestion of using ground-based radars to validate L2 CPR or synergistic products depends on the ability of the ground-based facilities to perform improved retrievals. This requires cm-wavelength radars at these sites in addition to mm-wavelength radars (94- or 35-GHz). This is true not only for liquid precipitation but also snow. Examples of well instrumented sites for L2 CPR data product validations are Julich (U. of Cologne, Germany) and Hyytiala (Univ. of Helsinki, Finland). Thus, there is a need to add cm-wavelength radars at more sites, especially in lower latitudes to detect tropical and subtropical cloud systems.
h) Two new level 2 lidar products should be implemented, namely the integrated backscatter of i) the ocean surface and ii) layered (supercooled) water clouds. Implementation would be relatively simple. Such information would be an invaluable advantage to constrain and improve the retrievals of optical depth from ATLID.

Considering the specific aspects of each session:

1 Multi-task Country Contributions;
   a) Activities are proposed in Germany and France that include airborne observations with in-situ validations. Such studies are crucial in providing direct evidence of the performance of the retrieval algorithms. The USA has many aircraft data sets; post launch activities would be very welcome. The organization and funding of all these activities is of utmost importance to the success of EarthCARE.
   b) Co-ordinated ground-based activities in Sweden, China, and Greece will provide useful statistical validation.

2 Specific instrument, products and algorithm validation
   a) Pre-launch strategy should focus on algorithm development and geophysical validation. This is more reliable than relying on simulations. A means of

comparing the performance of various algorithms needs to be implemented; this should also involve the Japanese and American teams.

b) Post launch strategy - mostly ground based 'statistical validation' with (but not exclusively) ground-based instruments that establishes the performance of the algorithms in various situations.

c) It was recommended to spend additional efforts on validation of Doppler and the snowfall rate.

3 Dedicated campaigns

a) Most in the mid or high latitudes. Do we need tropical campaigns?

b) The priorities for Cal/Val in the commissioning phase need to be defined.

c) Aircraft campaign with an EarthCARE like payload are need, but where and when need to be defined. The HALO aircraft should be requested (this is urgent).

4 Global coverage by observational networks

a) Is the global coverage of activities (map displayed) adequate?

b) How is the global distribution of combined lidar/radar sites?

c) New CPR like 94GHz radars are now available – how is global coverage evolving. How accurate are the latest ground-based calibration procedures?

d) Should special Cal/Val products be developed by the ground-based networks?

e) How accurate are the ground-based precipitation products?

5 Validation using (NWP and climate) models.

a) Monitoring the level 1 and level 2 products by comparing with their representation is operational NWP and climate models enables: i) instrument malfunctions to be rapidly identified ii) long term biases to be characterized. This Cal/Val workshop did not specifically address such monitoring activities as it was outside the scope of the call.

b) ECMWF has been funded by ESA for the past 8 years to develop such activities. The funding is about to end – a means of continuing it needs to be found. The deliverable would be real time monitoring of the satellite instrument performance.

6 Validation against other satellites.

a) For active instruments it is unlikely that other radar or lidars will be flying in space when EarthCARE is launched.

d) Calibration of the CALIOP lidar using molecular returns at high altitudes is accurate to 1.5%; a similar performance is to be expected from ATLID.

e) Calibration of CloudSat radar reflectivity using ocean surface return is accurate to better than 1dB; a similar performance is to be expected for CPR.

f) Proposals for calibration of the BBR and MSI are of high quality and a clear picture of the BBR and MSI calibration and radiance products will emerge rapidly after or even during commissioning of the instruments.

After the final discussion, R. Koopman presented a roadmap for the near term and the long term:

- In July the workshop report will be drafted and the PIs will receive a formal notification of acceptance and support
- By the end of 2018, a first version of the validation plan will be produced
- The target for PIs to obtain funding conformation by the PIs is mid 2019.
- A joint ESA-JAXA EarthCARE Cal/Val workshop will be held in October 2020
- The Validation Rehearsal will take place in the first quarter of 2021 and the EarthCARE Launch is scheduled for June 2021

He also summarised the additional take-home messages with respect to those flagged in the session summaries, namely the focused subgroups for ECVT, support for data upload, the WebEx sessions for training on tools, and the importance of showing explicitly the dependence on an external (network) provider, and promoting the use of data from past campaigns.

A. Lefebvre, ESA EarthCARE Project Manager, thanked all the participants, the organisers, the chairs and secretaries and in particular DLR and MPI for co-hosting this workshop together with ESA.

List of Participants

First Name	Family Name	Affiliation
Claudia	Acquistapace	University Of Cologne
Gerard	Ancellet	LATMOS
Calcan	Andreea	Incas
Kazuma	Aoki	University Of Toyama
Arnoud	Apituley	KNMI
Magdalena	Ardelean	National Institute for Aerospace Research "Elie Carafoli" - INCAS
Anum	Ashraf	NASA
Stephen	Atkins	Otago Polytechnic Of New Zealand
Holger	Baars	Leibniz Institute for Tropospheric Research (TROPOS)
Luca	Baldini	Consiglio Nazionale Delle Ricerche, Istituto Di Scienze Dell'atmosfera E Del Clima
Howard	Barker	Environment and Climate Change Canada
Alessandro	Battaglia	University Of Leicester
Edward	Baudrez	Royal Meteorological Institute Of Belgium
Maurice	Borgeaud	ESA
Alessio	Bozzo	ECMWF
Stefan	Buehler	University Of Hamburg
Luca	Bugliaro	DLR
Johannes	Bühl	TROPOS
Ulrike	Burkhardt	DLR Institute for Atmospheric Physics
Giampietro	Casasanta	ESA/ESRIN
Quitterie	Cazenave	DLR / Latmos
Chandra V	Chandrasekar	FMI
Helene	Chepfer	Sorbonne Université
Nicolas	Clerbaux	Royal Meteorological Institute of Belgium
Jason	Cole	Environment And Climate Change Canada
Julien	Delanoë	LATMOS/UVSQ/IPSL
Hartwig	Deneke	TROPOS
Abhay	Devasthale	Swedish Meteorological And Hydrological Institute (smhi)
Steven	Dewitte	RMIB
Yohannes	Dhuguma	ASTU
Jose	Dias Neto	University Of Cologne
Nicole	Docter	Institute for Space Sciences, Freie Universität Berlin
Carlos	Domenech	GMV
David	Donovan	KNMI
David	Duncan	Chalmers University
Michael	Eisinger	ESA
Florian	Ewald	German Aerospace Center
Artem	Feofilov	Sorbonne University / UPMC / LMD / Ecole Polytechnique
Mark	Fielding	ECMWF
Jurgen	Fischer	
Ann Mari	Fjaeraa	NILU - Norwegian Institute For Air Research

Athina Avgousta	Floutsi	Delft University Of Technology
Michael	Gausa	Andøya Space Center
Yahya	GOUR	LaMP/OPGC
Silke	Groß	DLR
Martin	Hagen	Deutsches Zentrum für Luft- und Raumfahrt (DLR)
Yuichiro	Hagihara	JAXA
Muhannad	Hammad	University Of Szeged
Ingrid	Hanssen	Andøya Space Center
Arnaud	HELIERE	ESA
Robin	Hogan	ECMWF
Hiroaki	Horie	NICT
Yongxiang	Hu	NASA Langley Research Center
Xiuqing	Hu	National Satellite Meteorological Center,China Meteorological Administration
Anja	Hünerbein	Leibniz Institute For Tropospheric Research
Anthony	Illingworth	University Of Reading
Marta	Janiskova	ECMWF
Rachel	Jenkins	GMV
Heike	Kalesse	Leipzig Institute for Meteorology (LIM) University of Leipzig
Seiji	Kato	NASA Langley Research Center
Maryam	Khal	Cadi Ayyad University
Maki	Kikuchi	JAXA
Stefan	Kneifel	University Of Cologne
Pavlos	Kollias	University Of Cologne
Rob	Koopman	ESA
Klaus	Kruse	Airbus Defence & Space
Takuji	Kubota	Japan Aerospace Exploration Agency
Takuji	Kubota	
Rei	Kudo	Meteorological Research Institute, Japan Meteorological Agency
Kaori	Kuroiwa	JAXA
Dulce	Lajas	ESA
Eduardo	Landulfo	Ipen/lalinet
Anne Caroline	Lange	Forschungszentrum Jülich
Matthew	Lebsock	Jet Propulsion Laboratory
Alain	Lefebvre	ESA
Wolfgang	Leibrandt	ESA
Jasper	Lewis	UMBC JCET
Gian Luigi	Liberti	Isac-cnr
Chung-chi	Lin	Herr
Jakob	Livschitz	ESA
Anna	Luebke	Max Planck Institute For Meteorology
Damien	Maeusli	ESA
Franco	Marenco	Met Office
Eleni	Marinou	DLR
Yannis	Markonis	Czech University of Life Sciences, Prague
Shannon	Mason	University Of Reading

Dmitri	Moisseev	University Of Helsinki
Danilo	Muzi	ESA
Takashi	Nakajima	Tokai University
Teruyuki	Nakajima	Japan Aerospace Exploration Agency
Christine	Nam	Universitaet Leipzig
Sander	Niemeijer	S&T
Tomoaki	Nishizawa	National Institute for Environmental Studies
Yuichi	Ohno	National Institute of Information and Communications Technology
Eiji	Oikawa	Research Institute for Applied Mechanics, Kyushu University
Kazuyuki	Okada	JAXA
Hajime	Okamoto	Kyushu University
Riko	Oki	JAXA
Davide	Ori	University Of Cologne
Ling	Ou Yang	Oyoung Consulting
Zouhair	Ourhzif	Faclty Of Sciences Semlalia Marrakech
Tommaso	Parrinello	ESA
Joao	Pereira Do Carmo	ESA
Lukas	Pfitzenmaier	University Of Cologne
Montserrat	Pinol Sole	ESA
Kory	Priestley	NASA
Emmanouil	Proestakis	National Observatory Of Athens
Jean-baptiste	Renard	Lpc2e-cnrs
Christian	Retscher	ESA/ESRIN
Woosub	Roh	Atmosphere And Ocean Research Institute, The University Of Tokyo
Manuel Angel	Ruiz-Saldana	GMV-UK
Kaori	Sato	Research Institute For Applied Mechanics, Kyushu University
Masaki	Satoh	
Florian	Schneider	Leibniz Institute For Tropospheric Research
Dirk	Schuettemeyer	ESA
Felix	Seidel Caprez	NASA
Patric	Seifert	Leibniz Institute for Tropospheric Research (TROPOS)
Odran	Sourdeval	University Of Leipzig
Johan	Strandgren	DLR Institute of Atmospheric Physics
Filip	Strnad	Faculty of Environmental Sciences
Kentaroh	Suzuki	University Of Tokyo
Ousmane	Sy	Jet Propulsion Laboratory
Frédéric	Szczap	Laboratoire De Météorologie Physique (laMP)
Nobuhiro	Takahashi	
Matthias	Tesche	University Of Hertfordshire
Tyler	Thorsen	NASA
Eiichi	Tomita	JAXA
Nobuhiro	Tomiyama	JAXA
Florian	Tornow	Freie Universität Berlin
Benjamin	Torres	LOA-CNRS Univ. Lille
Thierry	Trémas	CNES
Christoforos	Tsamalis	Met Office Hadley Centre

Gerd-jan	Van Zadelhoff	KNMI
Almudena	Velazquez Blazquez	Royal Meteorological Institute of Belgium
Nicolas	Viltard	Latmos-ipsl
Albrecht	Von Bargen	DLR Raumfahrtmanagement
Jonas	von Bismarck	ESA
Kotska	Wallace	ESA
Ulla	Wandinger	TROPOS
Tobias	Wehr	ESA
Ellsworth	Welton	NASA
Jason	Williams	KNMI
Dave	Winker	NASA
Akira	Yamauchi	The University of Tokyo