

## Deliverable D2.9: First report on NA2 user support activities

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## 1. Introduction

This deliverable reports user support activities carried out in WP2 until month 30 of the project. User support in the context of this report is understood as any activity aimed to improving the amount of aerosol and cloud profiling data and their quality, as well as to the implementation of field campaigns and to the incorporation of new profiling stations meeting the required quality standards to the infrastructure. Outreach by providing support to users external to the project is also considered.

Although formally assigned to task 2.4 (Exchange of expertise, support to campaigns and new users), support to users exceeds the limits of this task and is interspersed through the development of other tasks in WP2 and other work packages. In particular, a crucial part of the support to users of lidar stations is implemented through WP6 (Lidar calibration centre) and task 2.1; for cloud profiling stations, support is also provided in tasks 2.2.1 and 2.2.2. Data quality-check interactive tools under development as part of WP10 (ACTRIS Data Centre) also provide useful feedback to lidar stations.

This report aims to summarize all these supporting activities. To avoid unnecessary repetition, whenever necessary the reader is directed to deliverables of task 2.4 or other tasks containing more detailed information.

## 2. Annual workshops and General Meetings

A part of support to users has been effected through the exchange of expertise achieved in the annual workshops of WP2, of which two have been held at the moment of writing this report.

The first WP2 workshop, attended by 96 people, took place in Leipzig, Germany, from 23 to 25 November 2015; the reader is referred to the minutes of the workshop (deliverable D2.4) for detailed information, including the presentation materials. The workshop was coupled with a Cloudnet technical meeting that took place on 26 November 2015 with a participation of 42 people, including members of new cloud radar stations; the minutes of this technical meeting can be found at <http://www.actris.eu/LinkClick.aspx?fileticket=hDMM9MRXJEs%3d&portalid=46>.

The second workshop was held in Barcelona from 7 to 11 November 2016, with an attendance of 92 people. A technical session focusing on lidar allowed in particular new stations to present their systems and needs, which were discussed with the audience. The session included a tutorial on the measurement and corrections of polarization effects in lidars, and reports of the related WP6 (Lidar calibration centre) activities providing quality assurance and training to lidar stations both inside and outside the ACTRIS community. Regarding cloud profiling, training and help for new stations was included in a Cloudnet technical session. Exchange of expertise in aerosol profiling, cloud profiling and synergetic use of lidar/radar and auxiliary equipment (e.g. sun and lunar photometer, sky cameras...) was achieved through science sessions. The reader is also referred to the minutes of the workshop (deliverable D2.6) for more details.

Exchange of expertise has also been facilitated through science sessions in the ACTRIS-2 General Meetings, of which two have been held in the reporting period: Frascati, 29 February – 4 March 2016, and Granada, 30 January – 3 February 2017. Detailed information is available in the ACTRIS website under meeting documents

([http://www.actris.eu/Documentation/ACTRIS2IAinH2020\(20152019\)/Meetingdocuments.aspx](http://www.actris.eu/Documentation/ACTRIS2IAinH2020(20152019)/Meetingdocuments.aspx), login required).

## 3. Lidar and radar field campaigns

Direct intercomparison between lidar reference systems and EARLINET lidar instruments was provided through task 2.1 in collaboration with WP6 in the following campaigns:

1. 13 - 22 September 2016: intercomparison of RALPH and DPL lidars of the Meteorological Observatory Hohenpeißenberg station of German National Meteorological Service (DWD) against the reference POLIS-6 system of Ludwig-Maximilians-Universität's Meteorological Institute.
2. ATHLI16 campaign (26 September – 7 October 2016). Athens lidar campaign comparing the EARLINET EOLE lidar system of the National Technical University of Athens against the reference MUSA mobile system of CNR-IMAA.
3. 25 March - 5 April 2017: intercomparison campaign in Limassol between Cyprus University of Technology's EARLINET lidar, Polly<sup>XT</sup> lidar of TROPOS Leipzig Aerosol and Cloud Remote Observations System (LACROS), and reference POLIS-6 lidar of Ludwig-Maximilians-Universität's Meteorological Institute.

The characteristics of the intercompared systems can be found in the Single Calculus Chain Handbook of Instruments (<https://scc.imaa.cnr.it/hoi/station/>, login required).

Support to external users (Vaisala, Campbell Scientific, Sigma Space, University of Leicester) was also provided by task 2.1 and WP6, in terms of instrument comparison with reference systems at CNR-IMAA CIAO Observatory, through the INTERACT-II campaign (1<sup>st</sup> of July 2016 – 10 January 2017) (see deliverables D2.6 and D6.1 for additional details).

With respect to radar cloud profiling, support has been provided in the framework of the following campaigns:

1. University of Cologne activities in the ongoing continuous CONCORD campaign in Ny-Ålesund in the framework of the “Arctic Amplification: Climate Relevant Atmospheric and Surface Processes and Feedback Mechanisms (AC)<sup>3</sup>” project .
2. October 2016 – August 2017: Cyprus Aerosol, Clouds and pRecipitation Experiment (CyCARE) employing TROPOS LACROS suite of remote sensing instruments with participation of Cyprus University of Technology.
3. 1 - 30 April 2017: NOAA PRE-TECT campaign in Finokalia (Crete) on characterization of desert dust by remote sensing (<http://pre-TECT.space.noa.gr/>), with participation of CNR-IMAA and the Finnish Meteorological Institute.
4. May-June 2017: TROPOS operated a Polly<sup>XT</sup> lidar and a stabilized cloud radar during the PASCAL (Physical feedback of Arctic PBL, Sea ice, Cloud And Aerosol) cruise onboard RV Polarstern in the framework of the “Arctic Amplification: Climate Relevant Atmospheric and Surface Processes and Feedback Mechanisms (AC)<sup>3</sup>” project.

For these campaigns modifications and updates to the Cloudnet radar processing chain were required, including provision for a new cloud radar instrument (RPG-94GHz).

#### 4. Schools and seminars

The following training activities, related to and with participation of instructors and trainees of WP2, have been held during the reporting period:

1. 1st LicalTrain workshop (23-27 May 2016). This training activity, organized by WP6, was focused on lidar internal quality assurance tests, and was attended by participants of 17 institutes, including 7 ACTRIS-2 associated partners (Institute of Physics Belgrade, University of Valencia, CIMEL, Saint Petersburg State University, S.U.Umarov Physical Technical Institute Academy of Sciences of the Republic of Tajikistan, Warsaw University of Technology, and Alfred Wegner Institute Potsdam), of which 2 are joining lidar stations (Belgrade and Burjassot (University of

Valencia), and one (CIMEL) is and industrial partner. See deliverable D6.1 for additional information.

2. 2<sup>nd</sup> LicalTrain workshop (27 February – 3 March 2017). Organized by WP6, the training workshop was centered on lidar data processing, with emphasis on depolarization measurements and calibration. It was attended by participants of 13 institutes, including two ACTRIS-2 associated partners (Institute of Physics Belgrade and UK Met Office), being Institute of Physics Belgrade a joining lidar station, and one external institution (ONERA).
3. Hyytiälä Winter School on the observation and modeling of high-latitude and Arctic clouds (19-25 March 2017). Organized by the University of Helsinki, it had lecturers from ACTRIS-2 participants University of Cologne, University of Leipzig, University of Helsinki, Finnish Meteorological Institute (FMI), and Technical University of Delft, as well as from Stony Brook University (USA) and NOAA (USA). Attendees included University of Cologne, University of Leipzig, University of Helsinki, University of Reading, KU Leuven, EPFL, ETH, University of Hertfordshire, and University of Stockholm.
4. Cloudnet Training School (27-31 March 2017). Organized by TROPOS and Cyprus University of Technology (CUT), and FMI, it brought together people from established and new Cloudnet stations to enable scientific introduction to the topic, exchange of ideas and hands-on training in one place. Participation was of 37 people of 22 ACTRIS-2 partner and associated partner institutions from 11 European countries, including one industrial partner (METEK).
5. 2<sup>nd</sup> ECARS Summer School on Satellite Cal/Val Activities employing ground-based remote sensors (3 - 12 April 2017). It was organized by INOE in Agios Nikolaos and Finokalia (Crete), in synergy with the PRE-TECT campaign (see Sec. 3), with lecturers from NOAA, Université de Lille-1, University of Hertfordshire, Physikalisch-Meteorologisches Observatorium Davos and UK Met Office and an attendance of ca. 20. The main objective was to provide theoretical and hands-on training on ground-based remote sensing networks for aerosol, clouds and trace gases measurements, airborne and satellite observations with focus on dust, and the use of remote sensing for data assimilation and validation of dust forecasts.

## 5. Quality assurance and data quality checks

Lidar stations are required to send annually through the Lidar Remote Quality Assurance (LiReQA) virtual facility of WP6 the results of a series of internal quality checks (see Sec. 6), after which they receive feedback on possible hardware problems reflected by the tests; details can be found in deliverables D2.5, D2.7 and D6.1. Support on lidar components and subsystems can be requested by both internal and external users by responding to the periodic calls of WP6 Lidar Component Test Laboratory (LiCoTest); so far 6 institutions have benefitted of this service (see deliverable D6.1 for further details).

Cloudnet stations receive support on the utilization of the Cloudnet processing chain, which has to be tailored for the station configuration (see deliverable D2.2). The design of calibration procedures for Cloudnet radars is underway, as reported in deliverable D2.3. See also deliverables D2.5 and D2.7 for more information on quality assurance for Cloudnet stations

Support to lidar and radar users is also provided by feedback on data quality checks that help in detecting issues at both hardware and processing levels. Quality checks have been done essentially in a manual way until recently, but the implementation of automated tools for lidar data has begun in the framework of WP10 (VA1: ACTRIS Data Centre); see milestone document M10.5 for detailed information.

## 6. Documentation and online support

Helpful documentation for users, especially joining and new, is available online through the following links:

- Lidar Calibration Center (LiCal):  
<http://www.actris.eu/DataServices/InstrumentCalibration/LIDAR.aspx>  
Contains information on the services provided by LiCal and on the service access procedures,
- Measurements of Profile of Aerosol Backscattering and Extinction
  - o WMO/GAW report No. 153 “Aerosol Measurement Procedures Guidelines and Recommendations”:  
<http://www.actris.eu/DataServices/MeasurementGuidelines/AerosolColumnandProfile.aspx>  
Contains a chapter on the measurement of backscatter- and extinction-coefficient profiles
  - o Lidar quality-assurance internal checkups:  
<http://www.actris.eu/Portals/46/Data%20and%20Services/Measurement%20guidelines/Column-profile/Internal%20lidar%20checkup%20procedures.pdf?ver=2017-03-13-181155-077>  
Describes the internal lidar checkup procedures whose results the EARLINET stations have to submit to LiReQA annually (see Sec. 5).
  - o Depolarization measurements and calibration and supplement: <https://www.atmos-meas-tech.net/9/4181/2016/amt-9-4181-2016.pdf> and <https://www.atmos-meas-tech.net/9/4181/2016/amt-9-4181-2016-supplement.pdf>  
Paper by Vollker Freudenthaler in Atmospheric Measurement Techniques (2016) and its supplement providing a complete description of lidar depolarization measurements and their calibration by the  $\Delta 90$  method, including error assessment.
  - o Assessment of lidar calculus subsystems  
[http://www.actris.eu/Portals/46/Data%20and%20Services/Measurement%20guidelines/Column-profile/Assessment\\_of\\_lidar\\_calculus\\_subsystems.pdf?ver=2017-03-13-180928-290](http://www.actris.eu/Portals/46/Data%20and%20Services/Measurement%20guidelines/Column-profile/Assessment_of_lidar_calculus_subsystems.pdf?ver=2017-03-13-180928-290)  
Analysis of different algorithms for the retrieval of aerosol optical coefficients, including the computation of error bars.
- EARLINET information
  - o General information: [https://www.earlinet.org/index.php?id=earlinet\\_homepage](https://www.earlinet.org/index.php?id=earlinet_homepage)
  - o Complete list of EARLINET stations, including non-permanent and joining, with coordinates, altitude, research performing organization, PIs and key personnel: <https://www.earlinet.org/index.php?id=105>
  - o Requirements and procedures to join EARLINET: <https://www.earlinet.org/index.php?id=268>

Moreover EARLINET provides an online forum (<https://earlinetforum.ima.cnr.it/>, login required), where users can pose questions and receive support quickly in a collaborative manner.