



HARMONIA

International network for harmonization of
atmospheric aerosol retrievals from ground
based photometers

HARMONIA CA21119

Deliverable 5.3a

Annual review of progress/achievements towards deliverables during MC meetings

Authors Kyriakoula Papachristopoulou, Ioannis-Panagiotis
Raptis, Anca Nemuc, Stelios Kazadzis,
Lionel Doppler, Akriti Masoom,
Monica Campanelli, Victor Estelles,
Stavros Solomos, Ilias Fountoulakis and Sophie
Vandenbussche

Date 30 October 2023

1. Introduction

It is the overall objective of the WG5 to establish mechanisms to disseminate the outcomes of the HARMONIA COST Action (CA21119) WG1-4 activities towards measurement improvement, new techniques and measurement approaches to aerosol scientists and instrument users (inside and outside the HARMONIA consortium). The main targets are:

- Present HARMONIA results to various structures dealing with aerosol measurements, including aspects of the entire processing chain; from measurement to end-user products.
- Disseminate and communicate scientific results and end user aerosol related activities towards different audiences (scientists, public, industry, government bodies).
- Exchange and combine software and hardware user tools among partners towards retrieval improvements.
- Publish scientific results of HARMONIA collaboration to peer reviewed journals, conferences, and reports.

This deliverable describes the progress, the achievements and all the networking activities towards the three deliverables of the first year of the action, based on the discussions during the MC and the corresponding WG meetings. The three deliverables of the first year of the Harmonia action came from WG1, WG2 and WG3 and are respectively:

D1.1: Create a list of existing and foreseen campaigns or experiments needed for night and day aerosol measurements and report on the data collection and analysis of the data/measurements.

D2.1: Report on synergistic approaches towards better quality products

D3.1a: Share the recordings and the presentations of the first Workshop that was organized, with potential users from different interested communities, dealing with climate effects of aerosols, aerosol forecasting, air quality, renewable energy availability, and urban environments, from academia and operational agencies. The

deliverable D3.1a concerns the report for the first of the two workshops and has to be submitted at the end of the first year of the COST action.

2. Annual review for 1st years deliverables

2.1 Deliverable D1.1

The main objective of the WG1 is the homogenization and harmonization of global aerosol measurements and retrievals. To achieve this goal networking is a key aspect since different instruments/networks and related algorithms have to be unified. The cooperation and the knowledge exchange inside the HARMONIA and specifically inside the WG1 aims to create a scientific roadmap on worldwide homogenization of aerosol properties' measurements including calibration, standard operation, quality assurance and control procedures and post processing.

Field campaigns and experiences of aerosol measurements are a unique source of information from different instruments, including different data collection methods and analysis. Hence, the first deliverable of WG1 (D1.1) was:

Deliverable D1.1: "Create a list of existing and foreseen campaigns or experiments needed for night and day aerosol measurements and report on the data collection and analysis of the data/measurements."

In the first WG1 meeting (online, Mar. 2023) a set of six main past campaigns were presented and discussed, and it was decided (also in the first WG2 meeting, online Mar. 2023) that campaigns are both WG1 and WG2 topic (many WG members are in both WG1 and WG2). After the second WG1 and WG2 meetings and the second MC meeting in Davos (May 2023) the decision was made to have a WG1 & WG2 common task "campaigns", which fills the exigences of MoU D1.1 (WG1 /Deliverable 1) as well as of task T2.1 (WG2, Task 1):

Task: T2.1: "Create a list of existing field campaigns or experiments including daytime, night-time aerosol retrievals and low-cost sensors and a database with data from existing networks (GAW, Aeronet, Skynet and Pandonia) and other independent instruments more suitable for performing intercomparison."

So, under the common task “campaigns” of WG1 and WG2, two different subtasks have been distinguished, which finally formulated the deliverable D1.1. The first one (D11A) was the creation of an open list of the campaigns/ experiments using different instrumentation. This was a spreadsheet that all WG1 and WG2 members were asked to fill out with campaigns or experiments in case they have organized or hosted such at their station. Those have to fulfill the criteria that have been defined at MC2 meeting in Davos (May 2023):

- Campaigns where WG members attended or have contact for data access.
- The Campaigns must have at least one photometer (sun, lunar, star or Sky camera) co-located (ground-based aerosol retrievals from sunphotometers).
- Not only Campaigns, but also long-term measurements
- Ancillary measurements (laboratory and model user) can be listed.

Additionally, if WG1&2 Members do not have done such campaigns/experience but have some suggestions for future campaigns, they should report them “future suggestion” of the spreadsheet.

The second subtask (D11B) was the overview of the six campaigns selected as “main campaigns”. Five campaigns of the recent years: Izaña 2017, ANNAC 2020, SCILLA 2020, QUATRAM I/II/III 2018-2021, and WMO FRC-V 2021 were selected. This is an overview of the main results of these campaigns, differences-similarities in the results, with interpretation (campaign’s place environment, season, etc.). The results of this subtask were also presented at EMS 2023 (Sept. 4-8) in Bratislava by the WG1 leader (Lionel Doppler et al.). The first author (Lionel Doppler) contacted co-authors / PIs / Main actors of these campaigns to ask for results, graphics, etc. and many WG1 and WG2 members also contributed. A first work basis were the presentations during the first WG1 and WG2 meetings (online, March 2023).

2.2 Deliverable D2.1

The objective of the WG2 is to improve aerosol measurements using solar-, lunar- and star photometry, breaking new grounds for aerosol retrieval techniques including calibration improvement (via S.I. traceable related standardization results), hardware and software improvement actions. The exchange of knowledge

and experience among manufacturers, calibration and data processing related scientists and users by establishing a network through HARMONIA, are the foundations for those improvements. The exploitation of existing measurement experimental data for different aerosol environments is one of the main sources of information for investigating and suggesting improvements of aerosol photometry measurement.

The exploitation of synergistic approaches with solar-, lunar- and star photometry is one way to improve aerosol measurements. This is the first deliverable of the WG2:

Deliverable D2.1: “Report on synergistic approaches towards better quality products.”

After the WG1 and 2 meetings and the second MC meeting in Davos (May 2023) it was decided that the improvements of aerosol measurements by using synergistic approaches (D21) could be achieved by using synergy of measurements (as subtask D21A) and synergy of algorithms (as subtask D21B).

Concerning D21A, a census of campaigns, long term measurements and permanent observatories was done. All WG1 and WG2 members involved in the management of stations or campaigns (or in the processing of the dataset) were asked to fill in a spreadsheet. This information can be shared for both WG2 and WG1. For every permanent station the requested information to be filled was the availability of specific instruments. The geographical location of those instruments will be part of the deliverable, along with a table presenting an overview of the stations and the available equipment.

Concerning D21B the synergy of algorithms was explored. In fact, different platforms measuring aerosol properties simultaneously require the development of synergistic approaches among the various algorithms that typically manage a multi-instrument database. The approaches to improve the quality and synergy of the algorithms include: 1) development of algorithms; 2) inter-comparison and validation of inversion algorithm products; 3) combined use of algorithms.

2.3 Deliverable D3.1a

The objective of the WG3 is to increase the applicability for aerosol optical properties for different scientific fields. HARMONIA network and specifically WG3 aims to link the accuracy and uncertainty of aerosol optical properties to the objectives and needs of the climate and atmospheric related scientific community and relevant structures (e.g. WMO, GCOS, satellite related missions) and to create interacting mechanisms with users (Climate scientists, air quality, solar energy, aviation and others). The expertise of diverse groups in HARMONIA (ground-based aerosol monitoring, satellite monitoring, atmospheric modelling, etc.) and the networking activities are essential in fulfilling those objectives.

The organization of dedicated workshops to bring together users from all communities (e.g., Academia, industry, operational agencies, research structures, EU and WMO research services) is the best way to maximize the use of ground-based aerosol measurements and with this is related the first Deliverable of WG3:

Deliverable D3.1a: “Share the recordings and the presentations of the first Workshop that was organized, with potential users from different interested communities, dealing with climate effects of aerosols, aerosol forecasting, air quality, renewable energy availability, and urban environments, from academia and operational agencies.”

During the first WG3 meeting (online Mar. 2023), it was decided to start organizing the first workshop and to contact people from satellite, modelling, solar energy etc. community to join. WG3 Teams were organized, with Team 1 having a task related to workshop organizing: Identification/invitation of communities of potential users: Climate, satellite measurements, modelling, solar energy resource and forecasting, health, and aviation.

At the second MC meeting in Davos (May 2023), it was decided to organize the first workshop in September 2023 in Athens, Greece (Academy of Athens).

A successful Workshop was organized by HARMONIA COST Action for aerosol end user engagement, on September 19, 2023, in Academy of Athens, Athens, Greece (<https://harmonia-cost.eu/wp3-workshop-for-aerosol-end-user-engagement-at-athensgr/>). More than 40 people participated from different scientific fields. The agenda included talks about aerosol optical properties use and effects on climate,

in numerical weather prediction, satellite community, the aviation and solar energy sector. There were also presentations of aerosol observations from different networks (ACTRIS and Brewer Network). Lessons learnt and experience of aerosol users from InDust COST Actions were also presented and discussed. The workshop closed with a fruitful discussion about aerosol products and their harmonization, and the paths for the exploitation of HARMONIA COST Action's outcomes have been set. Main outcomes of the discussion and recommendations were:

- To try to pick some of the subjects and work more on some of the issues that seem more promising.
- To get involved with communities like AeroCom-Aerosat and participate in their upcoming meeting.
- To try to keep both high-level objectives but also lower level adequate of all countries' scientific expertise.

A summary of the main suggestions and recommendations of the users of ground-based measurements, as emerged from the discussion is provided in Table 1.

Table 1. Main needs of the users of ground-based aerosol observations

Modelers	<ul style="list-style-type: none"> • Need for harmonized ground-based measurements. • The measurements should be linked to satellite data and modelling. • Pick regional representative sites, not mountains or ships to set up new observational sites. • Provide data at satellite overpass times. • Try to connect with satellite and modelling communities. • Need for AOD and AAOD for fine and coarse mode particles from ground-based measurements. • Expand the measurements of the aerosol properties in the IR. • More observations for SSA.
Assimilation of CAMS products	<ul style="list-style-type: none"> • AERONET and in situ are very important for verification of the model output but not for assimilation. Satellite information is used for assimilation. • Information for the vertical aerosol profile and type is needed (can be provided from active sensors).

Energy	<ul style="list-style-type: none"> • There is a need for higher spatial density in zones where it is needed (i.e., Qatar, Morocco), notably in cities (photovoltaic development). • Need for high resolution measurements. • Involve more passive sensors, e.g., fish-eye cameras from the ground, to assess aerosols.
Aviation	<ul style="list-style-type: none"> • Accurate ground-based measurements near the airports, especially relative to dust. • More information for the aerosol vertical profile. • Main challenge is to translate measurement information to thresholds & constraints.