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Deliverable 1.4

Advanced analysis of available data

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EXECUTIVE SUMMARY

This document is the deliverable “D1.4 Advanced analysis of available data” for the European Union project “FOCI: Non-CO2 Forcers and their Climate, Weather, Air Quality and Health Impacts” (hereinafter also referred to as FOCI, project reference: 101056783). The D1.4 could be very relevant report based outcome of Task 1.2, however, this content was covered already in D1.2, originally considered to be just “DATA”,in accompanying explanation of the methods and outputs of the advanced analysis. This is explained in short notes, in addition to that there are some new references on products based on the advanced data analysis available now.

CONTRIBUTION TO THE FOCI OBJECTIVES

The aerosol particles optical properties coming from advanced analysis of data provided by D1.2 Database of advanced aerosol particles optical properties contribute to the FOCI integrated observational and modelling analysis which focuses on the radiative forcing properties of different atmospheric non-CO2 species in the wider context of the warming potential of all key GHGs. It is concluding the Task 1.2 of the WP1 and thus contributing to the Objective 1.2 of this WP "To provide field data about mass concentration, chemical composition and extensive and intensive optical properties of PM and anthropogenic PM species", which overal aims to contribute to the objective O1 To examine and evaluate the climate relevant **processes and feedbacks of anthropogenic** primary and secondary radiative forcing species, based on new and available observations datasets, which include aerosol components like BC, POA, SOA, sulphate particles and precursors (e.g. SO2 and NH3), tropospheric O3 and precursors (NOx, VOCs, CO) and CH4 (WP1).

1. INTRODUCTION – ABOUT THIS DOCUMENT

WP1 is organized in three major tasks:

Task 1.1: Data compilation and harmonization (Lead beneficiary: CSIC)

Task 1.2: Advanced analysis of available data (Lead beneficiary: CSIC)

Task 1.3: Advanced model representation of physiochemical properties of anthropogenic aerosols and their feedbacks (Lead beneficiary: FMI)

Consequently, there are three Deliverables associated with these three Tasks, namely:

Deliverable D1.1: Harmonized dataset of in-situ and column integrated aerosols and gas-phase species (CSIC; database ready and final document describing the data ready and uploaded by M12)

Deliverable D1.2: Database of advanced aerosol particles optical properties (CSIC; database ready and final document describing the data ready and uploaded by M24)

Deliverable D1.3: Model representation of properties and feedbacks of anthropogenic non-CO2 forcers (FMI; final document to be uploaded by M30, actual delivered M36)

Following the Grant Agreement (GA), an additional Deliverable D1.4 (CSIC; final document to be uploaded by M30) was included. The name of the Deliverable D1.4 is "Advanced analysis of available data" and it is consequently directly related to Task 1.2.

As indicated in the Grant Agreement (GA), D1.1 and D1.2 are datasets/databases (that were gathered in WP1 and made accessible for the FOCI project), whereas D1.3 and D1.4 are Documents/Reports.

However, the huge amount of data produced in Task 1.2 did not allow to direct upload them to the European portal. The same happened for Task 1.1. Therefore, CSIC uploaded two Documents (D1.1 and D1.2) to the portal. These Documents in PDF describe in detail the data collected and analysed in Tasks 1.1 and 1.2 and provide all the information/links needed to access the data.

Consequently, the Deliverable D1.4 (Advanced analysis of available data) should be the Document/Report associated to Task 1.2 (Advanced analysis of available data). However, the advanced products obtained in Task 1.2 were already described in details in the Deliverable D1.2.

For example, the majority of the data gathered in Task 1.1 (and described in D1.1) were included in the GHOST database v1.5 developed and maintained by BSC (Globally Harmonised Observations in Space and Time). In total, the GHOST dataset v1.5 comprises of more than 6 billion processed measurements, for 220 components, across 32 networks, from January 1970 through to January 2022. Thus, GHOST represents one of the biggest collection of harmonised atmospheric surface measurements ever undertaken. The publication describing GHOST v1.5 can be found in Bowdalo et al., 2024a (*https://doi.org/10.5194/essd-16-4417-2024*) and the data included in GHOST v1.5 can be found in Bowdalo et al., 2024b (https://zenodo.org/records/10637450).

Similarly, the products obtained in Task 1.2 from the advanced analysis of the available data were described in D1.2 and the data were included in the GHOST database v1.5.1. The publication describing GHOST v1.5.1 is in preparation and the data included in GHOST v1.5.1 can be found in Bowdalo et al., 2024c (*https://zenodo.org/records/15075961*).

Therefore, WP1 provided the data (data sets, microdata, etc) associated to Tasks 1.1 and 1.2 together with the corresponding documents describing such data (uploaded to the EU portal as Deliverables D1.1 and D1.2).

Therefore, D1.4 was originally intended as the document associated to Task 1.2 describing the products obtained from the advanced analysis of the available data. However, this description has been transferred to D1.2.

2. LIST OF PRODUCTS OBTAINED FROM THE ADVANCED ANALYSIS OF AVAILABLE DATA

The list of products obtained from the advanced analysis of available data (Task 1.2) and described in the Deliverable D1.2 is reported below:

- Scattering and Absorption Angstrom Exponents (SAE and AAE) of atmospheric aerosol particles. Available in GHOST v.1.5.1 (https://zenodo.org/records/15075961).
- Black Carbon (BC) and Brown Carbon (BrC) contribution to absorption in the UV-VIS range from in-situ surface absorption measurements. Data are available at https://zenodo.org/records/13365276. The corresponding publication describing this specific dataset is Rovira et al., 2025.
- OA, Chl, NO_3^-, NH_4^+, SO_4^{2-} and BC mass concentrations in PM1 and OA source contributions (available from Chen et al., 2022). The time series of resolved OA source apportionment results and corresponding external data as well as detailed description of rolling PMF settings are publicly available from Zenodo (Chen et al., 2022; DOI: 10.5281/zenodo.6522811).
- Total absorption (370-950 nm), BC absorption (370-660 nm), BrC absorption (370-660 nm), Absorption Angström Exponent (AAE), OA Mass Absorption Cross-Section (MAC; 370-660 nm), OA imaginary refractive index (k; 370-660 nm), k Angström Exponent (□) of OA particles, density of OA particles, and organic carbon (OC) mass concentrations at 18 European sites. The corresponding publication is ongoing and the dataset is available at https://zenodo.org/records/13365276.
- BC and BrC contribution to AAOD at 440 nm from AERONET data. The corresponding publication is ongoing. The data are available in GHOST v.1.5.1 (https://zenodo.org/records/15075961).
- Equivalent black carbon (eBC) mass concentrations Europe. Part of the data are available in GHOST v1.5 (https://doi.org/10.5281/zenodo.10637449). Additional eBC mass concentration data were collected within the RI-URBANS project (Savadkoohi et al., 2023; https://doi.org/10.5281/zenodo.7982201).
- Mass absorption cross section (MAC) of eBC in Europe are available from (Savadkoohi et al., 2024; https://doi.org/10.5281/zenodo.13739655) and are also available in GHOST v.1.5.1.
- Aerosol particles backscatter fraction (BF) and Asymmetry parameter (g). Available in GHOST v.1.5.1.
- Aerosol particles single scattering albedo (SSA). Available in GHOST v.1.5.1.

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