



## **D8.15: Operational implementation of the AERO VRE services, and associated documentation and the associated user guide. [B19]**



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## 1. INTRODUCTION

Within the framework of ITINERIS WP8, a dedicated Virtual Research Environment (VRE) has been developed to support the exploitation and analysis of atmospheric aerosol data, with a particular focus on data related to Work Package 4 (WP4): Atmosphere.

The aim of the current deliverable is to describe AERO VRE focused on the study of desert dust particles and aerosol typing. The exploitation of desert dust and aerosol typing are highly relevant from a scientific and societal point of view.

Desert dust, mainly originating from Northern African deserts, is a key component of atmospheric aerosols, impacting climate, ecosystems, and socio-economic sectors like health and energy. Its long-range transport affects regions as far as the Caribbean and frequently impacts the Mediterranean, especially Italy during spring and summer. Climate change is expected to increase dust levels in the area. Satellite data show a doubling of dust events in the Mediterranean between 2005 and 2019, with more intense intrusions since 2020 (Cuevas-Agulló et al., 2024). Understanding dust dynamics through multi-platform observations is crucial for developing effective mitigation and adaptation strategies at local, regional, and global scales.

On the other hand, the aerosol type is one of the most highly sought-after parameters by aerosol data users. It is important for authorities to estimate the contribution of the different aerosol sources, but it is important even for researchers to investigate the impact on radiative budget of each of the aerosol types, and even the interaction of the aerosol type with water in the different phases (for cloud formation, raining events and so on). The lidar technique allows for the identification of the aerosol type in the vertical dimension. This means that the aerosol type is provided at different altitudes: lower troposphere (important for human health, air quality, and human activities as a whole), mid troposphere (important for the long range transport of particles and some human activities – e.g., aviation), and upper troposphere and lower stratosphere (important for the radiation budget – e.g., volcanic aerosols).

Both topics are addressed in Task 4.11 of WP4 for which some datasets have been produced. Along with these products, additional products are used for the purposes of the VRE, enriching the possibilities for researchers and users in general.

This document is structured in 3 main parts, one generically introducing the AERO VRE tool for desert dust and aerosol typing investigations; the second part describe the datasets used into the AERO VRE; finally the use of the AERO VRE is described in terms of modality of access to it and detailed instructions for the correct use of AERO VRE through some examples.

## 2. AERO VRE DESCRIPTION

### Description of the AERO VRE Desert Dust tool

The aim of this tool is to provide reliable information on the atmospheric dust distribution over Italy along with its temporal variation, on various spatiotemporal scales, for the last 20 years. In general, there are plenty of datasets of dust products obtained from simulations or observations or from the combination of observations with dust models (reanalysis). A review of the available observational datasets about mineral dust is reported in Mona et al. (2023). Some of them provide exclusively data of dust optical and microphysical parameters, whereas others need to be combined in order to retrieve dust products. Each dataset has its own characteristics and advantages but also its own limitations. Model data are characterized always by uncertainty, whereas observations provide a limited spatiotemporal coverage, and their availability and quality are affected by weather conditions. In this tool, a set of quality-assured and validated datasets will be used complementarily with the aim of identifying and quantifying the presence of dust in the atmosphere, overcoming possible gaps in observations, or uncertainty of the simulations.

The AERO VRE desert dust tool will give the users the option to visualize the information they want in two different ways: either with 2D maps or with profiles and time series for specific observational sites in Italy. The maps will be able to display dust products from models, and particularly the Dust Optical Depth (DOD). The user will be able to set the date they are interested in as well as the area they want to examine.

Regarding the visualizations at station level, the user will be able to pick one of available sites in Italy, participating in the AERONET or/and ACTRIS/EARLINET networks. After selecting a specific date, the tool shows available products for that date. These products include dust extinction profiles obtained from MONARCH reanalysis and ACTRIS/EARLINET (if the station is an ACTRIS/EARLINET member equipped with depolarization capability) and DOD data from models and AERONET (if the station is an AERONET member).

### Description of the AERO VRE Aerosol Typing tool

This tool enables the possibility of analyzing ACTRIS aerosol lidar observation with additional and external information. The concept behind this specific tool is the possibility to investigate specific cases using the ACTRIS aerosol profile, and one of the most relevant aerosols typing investigation tools currently available (i.e., Copernicus Atmosphere Monitoring Service model reanalysis of aerosol types). Here, similar to what has been developed for the desert dust investigation, the idea is to visualize the aerosol characterization output resulting from different approaches and datasets, providing an easy way for integrating non-uniform information, and finally, identify potential cases where the typing is not straightforward and mixtures could be relevant for further investigations. For such kind of application, the VRE visualizes together with ACTRIS aerosol profiles also CAMS model reanalysis for the examined case. CAMS provides forecast of the aerosol load as total on the vertical column, splitted over 4 main species (dust, sea salt, biomass burning and sulphate aerosols). These 4 components are retrieved from the forecast model considering the sources as modelled in the aerosol module of CAMS forecast (considering available source inventories and source mechanisms in the case of desert dust) and meteorological forecast for the transport mechanisms.

In this way, lidar observations can be compared to forecast maps, investigating therefore the study case in terms of spatial and vertical distribution and understanding the degree of reliability of the aerosol type as determined by the aerosol observations. This synergistic visualization tool could offer insight into the aerosol typing investigation both for research and outreach.

## 3. DATASETS USED IN AERO VRE

### 3.1 DESERT DUST

#### *MONARCH dust regional reanalysis*

The MONARCH (Multiscale Online Nonhydrostatic Atmosphere Chemistry model) dust regional reanalysis (fully described in Di Tomaso et al., 2022) represents state-of-the-art desert dust information over a domain covering the most prominent dust source areas in northern Africa and the Middle East. This dataset was originally released for a 10-year period from 2007 to 2016; however, an extension of the time period is planned to improve the climatological representation of the dataset. Currently (August 2025), 12 years of data are available (2007-2018). Its spatial domain covers the regions of Northern Africa, the Middle East, and Europe, extending from 0° to 70° N latitude and from 30° W to 70° E longitude (Di Tomaso et al., 2021). MONARCH reanalysis novelty includes its unprecedented spatial and temporal resolution: Reanalysis fields are available at a 3-hourly time step, at a horizontal resolution of 0.1° latitude x 0.1° longitude (~ 10 km × 10 km at the Equator). The reanalysis has been obtained using the MONARCH model and by assimilating satellite coarse-mode DOD at 550 nm, derived from the MODerate resolution Imaging Spectroradiometer (MODIS) instrument operating aboard NASA's Aqua satellite. The MONARCH reanalysis dataset consists of upper-air profile variables such as dust mass concentration and an extinction coefficient at 550 nm, surface fields such as accumulated dust dry and wet deposition and mass surface concentration, and total column fields like instantaneous total column dust load, DOD, and coarse DOD (particle radius > 0.6 μm) at 550 nm. The quality of MONARCH reanalysis has been extensively evaluated in terms of DOD (Mytilinaios et al., 2023).

#### *WMO SDS-WAS Multi-Model dust product*

The World Meteorological Organization (WMO) Barcelona Dust Regional Center delivers timely and high-quality sand and dust storm daily forecasts for Northern Africa, the Middle East, and Europe. Every day 72h dust forecasts of DOD at 550 nm and dust surface concentration are available, provided by 15 individual dust models. The product that we will

use here is called Multi-Model (ensemble) forecast and it is the median of all the individual dust forecasts for a particular day, after bi-linear interpolation to a common grid mesh of  $0.5^\circ \times 0.5^\circ$  (Basart et al., 2019; Terradellas et al., 2022). This product has been available since 2012, and the output frequency is 3 hours. In general, the Multi-Model forecast has shown better verification scores than any of the contributing models in most regions and time periods and is therefore considered a valuable tool to issue trust-worthy predictions of mineral dust in the domain served by the WMO Barcelona Center.

### *AERONET dust-filtered products*

The AERONET (AErosol RObotic NETwork) ground-based photometer network provides a long-term and continuous database of high-quality aerosol optical properties globally since 1993 (NASA, 2026). In this study, we will use AERONET Version 3 quality-assured data (Level 2; Giles et al., 2019), and in particular the Aerosol Optical Depth (AOD) and coarse AOD at 500 nm, and the Ångström exponent (AE) at 440–870 nm. The AE is used as a filter because it is inversely related to the average aerosol size. Lower AE values ( $<1$ ) indicate the significant presence of coarse-mode particles (e.g., desert dust), whereas higher AE values ( $>1$ ) imply a large abundance of fine particles (e.g., biomass burning and urban aerosols). Here we will follow a discrimination method where  $DOD = AOD$  when  $AE < 0.75$ , and all data with  $AE > 1.2$  are considered free of dust, i.e.,  $DOD = 0$ . Finally, a mixed aerosol type is assumed when  $0.75 \leq AE \leq 1.2$ . On the other hand, the coarse AOD (particle radius  $> 0.6 \mu\text{m}$ ) can be assumed directly equivalent to DOD since coarse-mode AOD is mainly dominated by desert dust particles, and however sea-salt contribution and other coarse particle contributions are typically negligible during strong events. At this moment there are 32 AERONET sites across the country (18 of them active), well distributed from the south (Lampedusa) to the north (Bolzano) of Italy, providing a very sufficient geographical coverage. AERONET data are acquired at 15 min intervals on average, and this renders AERONET the dataset with the finest temporal resolution between the selected datasets, even if covering only daytime window.

### *ACTRIS/EARLINET dust product*

The European Aerosol Research Lidar Network (EARLINET; Pappalardo et al., 2014) is the longest-running and most extensive high-power lidar network in Europe dedicated to aerosol profile measurements. Established in 2000, EARLINET currently consists of 35 active lidar stations, 6 of which are located in Italy and provide daytime and nighttime measurements of aerosol optical properties twice per week on average. Several EARLINET stations now operate under the aerosol remote sensing component of the Aerosol, Clouds, and Trace Gases Research Infrastructure (ACTRIS; Laj et al., 2024), which coordinates and supports their activities. The main products of an ACTRIS/EARLINET lidar system are the aerosol backscatter and extinction coefficient profiles as well as the intensive properties that derive from them, namely the Ångström exponent (AE) and the lidar ratio (LR). In the frame of ITINERIS Task 4.11, a new desert dust data product was designed using ACTRIS/EARLINET standard products, i.e., aerosol extinction and backscatter coefficient. The desert dust product consists of dust extinction and dust backscatter coefficient profiles at 532 nm, obtained combining particle depolarization ratio profiles and backscatter/extinction profiles available at the same time over ACTRIS/EARLINET stations. Such datasets have been retrieved as part of the activities of Task 4.11 of WP4 and provided through the ITINERIS HUB (WP2). The dust product is currently available for the Potenza and Ispra stations from 2015 to 2021 (Mona et al., 2024).

## 3.2 AEROSOL TYPING

### *ACTRIS/EARLINET aerosol optical properties profiles*

ACTRIS/EARLINET data can be accessible at the ACTRIS data portal and at ACTRIS/EARLINET data portal (ACTRIS/EARLINET, 2026), where the user exploit the data choosing the station of interest and then selecting the period, the level (2.0) and the quality control version - under the “Advanced Search” tab. For each measurement, the backscatter coefficient profiles are available, as well as the extinction coefficient profiles if the measurement was taken at night. Accordingly, the database provides two types of files: (i) backscatter files (b-files), which also contain volume and particle depolarization ratio profiles if the selected station's lidar system can distinguish the cross-polarized component of the backscattered radiation; and (ii) extinction files (e-files), which also contain the LR profiles, defined as the extinction-to-backscatter ratio. Most ACTRIS/EARLINET lidar systems provide b- and e-files at various

wavelengths (typically the backscatter at 1064, 532, and 355 nm, and the extinction at 532 and 355 nm), which also allows the computation of the AE profiles. These optical properties, when considered together, make it possible to determine the type of particles present at different heights in the atmosphere.

### *CAMS global reanalysis (EAC4)*

The Copernicus Atmosphere Monitoring Service (CAMS) ECMWF Atmospheric Composition Reanalysis 4 (EAC4) is the fourth generation, freely available global reanalysis of atmospheric composition (CAMS, 2020). EAC4 combines high-quality observational data from around the world with model data to create a consistent, globally complete dataset using a physics- and chemistry-based atmospheric model (Inness et al., 2019). EAC4 consists of three-dimensional, time-consistent atmospheric composition fields, including aerosols and chemical species. The horizontal resolution of the dataset is  $0.75^\circ \times 0.75^\circ$  (~80 km x 80 km), and the atmosphere is divided vertically into 60 pressure levels ranging from 1000 hPa to 1 hPa. Total columns and surface-level data are also available. Currently, the dataset has temporal coverage from 2003 to 2024 with a 3-hour time step. The data are updated twice a year with a 4- to 6-month delay. The EAC4 provides a thorough list of different aerosol types emitted by anthropogenic and natural sources, including black carbon, dust, organic matter, sea salt, and sulfate.

## 4. AERO VRE – IMPLEMENTATION AND USAGE

The AERO VRE, as well as other ITINERIS VREs, is hosted by the D4SCIENCE digital infrastructure, that offers several services for developing open and reproducible science, mainly by means of open-source software solutions organized under the same technological platform. Tools developed within the AERO VRE are described in the following paragraphs.

### 4.1 ACCESSING THE VRE AERO

The common access point to any ITINERIS VRE is through the “ITINERIS VRE Gateway”, available at the URL <https://itineris.D4SCIENCE.org/>. User can then sign in with the federated D4SCIENCE functionality (Fig. 3).

Access the ITINERIS Virtual Research Environment (VRE):

- Go to the ITINERIS VRE Gateway homepage, as shown in the first image.
- Click the “Sign In” button to proceed to the login screen.

Log In to Your Account:

- On the login screen, enter your username or email and password, as shown in the second panel.
- Alternatively, you may sign in using one of the available single sign-on (SSO) options, including Google, GitHub, LinkedIn, Twitter, CNR-ISTI, or Academic/other.
- If you do not have an account, click “Register” at the bottom of the login window to create one.

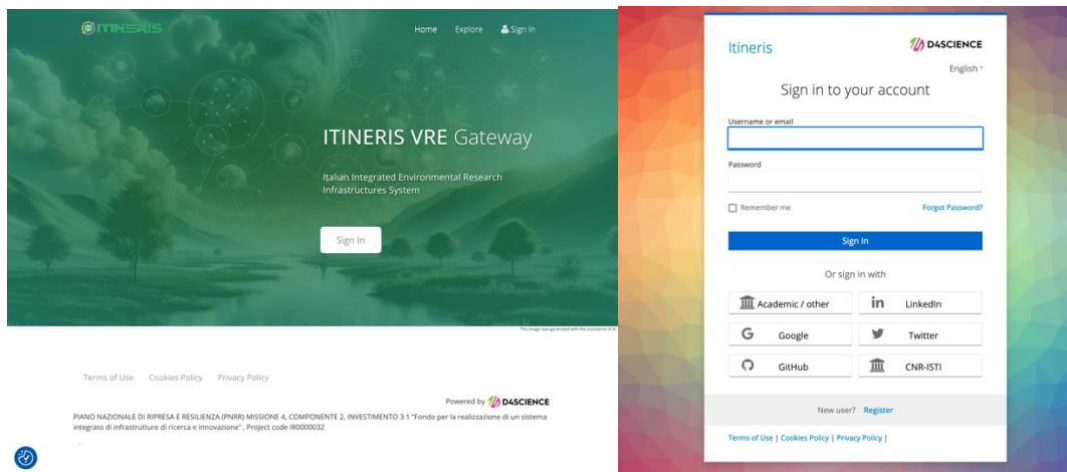


Figure 1 - ITINERIS VRE Gateway access page (left) and sign in functionality (right)

Once logged in, the user is presented with the ITINERIS Gateway (Fig. 2), with a dashboard that summarizes account details, the user's files, important news and, on the right side, all the ITINERIS Virtual Research Environments the user has access to. To request access to additional VREs, the user can start the procedure by clicking the "Add more" button. After completing the request, the user should wait for D4SCIENCE staff to authorize access to the AERO VRE. By clicking the "ITINERIS AERO" button, the user enters the AERO VRE.

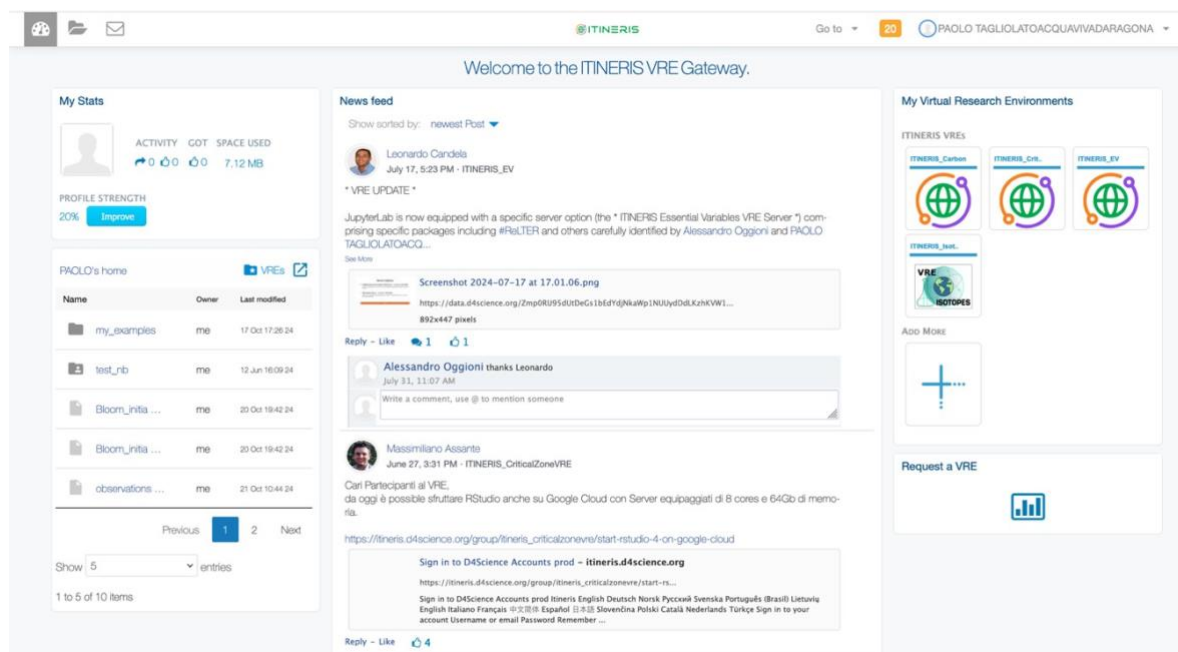


Figure 2 - ITINERIS VRE Gateway

After logging in, you will be directed to the main dashboard of the ITINERIS AERO VRE (Fig. 3).

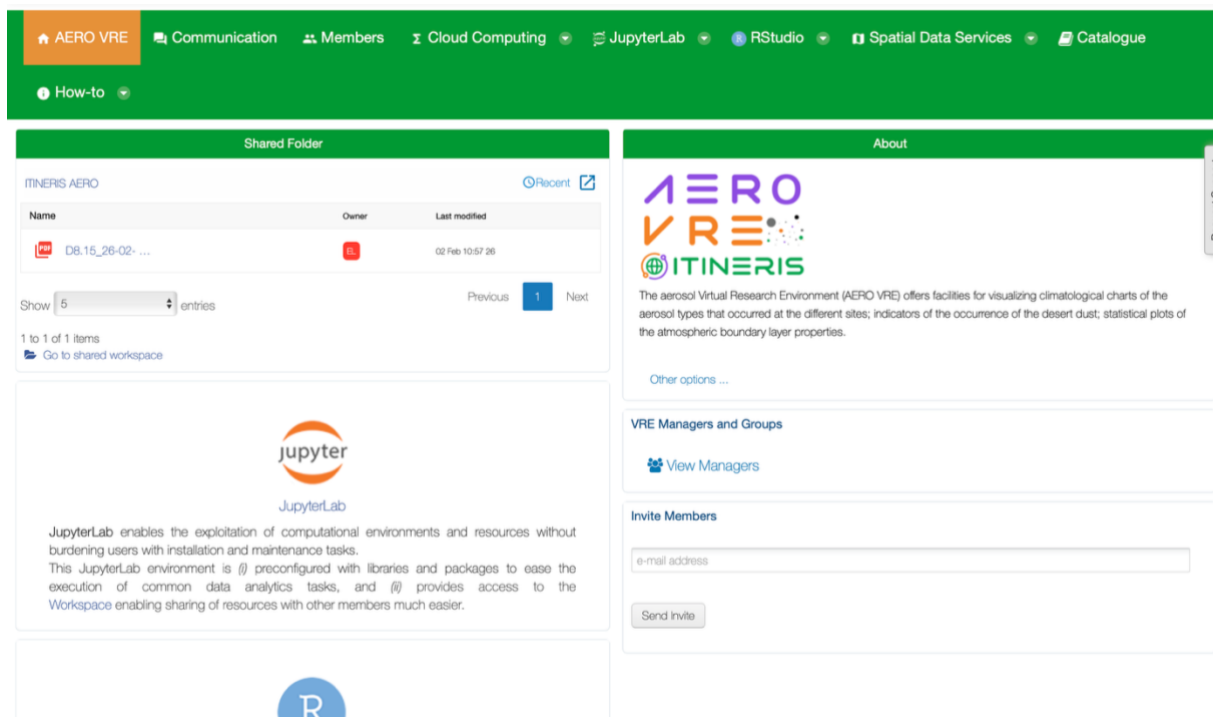


Figure 3 - ITINERIS AERO VRE main dashboard

This dashboard includes a brief overview of the VRE’s objectives, a synthesis of the VRE shared folders, as well as direct links to the primary tools available for research and analysis: **Cloud Computing**, **JupyterHub** and **RStudio**. The codes described in the following sections make use of CCP (Cloud Computing Platform). Each code has been imported from a dedicated GitHub repository and is available as Method (under VRE each code is considered as “Method”). Original codes have been developed in Python and make use of specific code design in order to exploit the ShinyApp integrated in the VRE for the (automatic) generation of User Interface (UI) within CPP.

In order to run Method, follow these steps:

- From the top Menu select Cloud Computing > Cloud Computing Platform (CCP);
- On the left side Methods are listed. Toggle the Aerosol Remote Sensing category to visualize available Methods;
- Click on green button (Play symbol) to load the chosen method in the CCP;
- In the central part of the screen “Method execution form” will appear, here the user must set input parameters and finally click “Execute” button at the bottom of the page. The “Execute” button becomes visible only when all mandatory input fields are filled with user inputs.

Please refer to following Method schemas in order to properly set and run the codes.

## 4.2 VRE AERO USAGE GUIDE

### DESERT DUST TOOLS – Usage Guide

Code Acronym: <b>DOD time series</b>
Code Name (extended): Dust Optical Depth Time Series Plotting Utility
Description: This utility uses AERONET, WMO and MONARCH data to visualize dust optical depths measurements for a specific date time (computed from -36h to +36h from user inputs) at measurement sites
Release version: 0.1 (09/09/2025)
Data Source: AERONET, WMO Multi-Model & MONARCH data.
Input parameters: <ul style="list-style-type: none"> <li>1. Observation site (only AERONET Italian stations available, e.g. IMAA_Potenza, reported as AERONET acronym)</li> <li>2. Observation date (format DD/MM/YYYY)</li> <li>3. Observation hour (format HH:MM)</li> </ul>
Products: None
Image output (if any): Yes
Image example: <div style="text-align: center;"> </div>
Common user mistakes: <ul style="list-style-type: none"> <li>1. Incorrect date format for the observation (format DD/MM/YYYY)</li> <li>2. Incorrect hour format for the observation (format HH:MM)</li> <li>3. Date range outside limits (available date range from 2007-01-01 to 2024-12-31)</li> </ul>
Notes: Italian sites available only.

Code Acronym: <b>DOD 2D map</b>
Code Name (extended): Dust Optical Depth 2D map Plotting Utility
Description: This utility uses WMO Multi-Model and MONARCH data to produce territorial maps of dust optical depth (550nm).
Release version: 0.1 (09/09/2025)
Data Source: WMO Multi-Model and MONARCH data
Input parameters: <ul style="list-style-type: none"> <li>1. Observation date (format DD/MM/YYYY)</li> <li>2. Map region corresponding to the center of the map (Italy, Europe, EuAfAm stands for Europe-Africa-America region)</li> </ul>
Products: WMO Multi-Model and MONARCH data files (NetCDF format) data
Image output (if any): Yes
Image example: <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p>WMO SDS-WAS MultiModel 2014-05-30 00:00:00 12:00 UTC</p> </div> <div style="text-align: center;"> <p>MONARCH Reanalysis 2014-05-30 00:00:00 12:00 UTC</p> </div> </div>
Common user mistakes: <ul style="list-style-type: none"> <li>1. Incorrect date format for the observation (format DD/MM/YYYY)</li> <li>2. Map region different by available options (Italy, Europe, EuAfAm)</li> </ul>
Notes: Data download from WMO Multi-model and MONARCH data could be slow; plot production could be delayed.
<b>ATTENTION:</b> The tool depends on the functionality of WMO Multi-model API service for accessing the respective data. DOD 2D map crashes in case such API does not work properly.

Code Acronym: <b>Dust Profiles</b>
Code Name (extended): Dust Profiles Plotting Utility
Description: This utility plot Desert dust profiling dataset at 532nm obtained at Potenza and Ispra stations between the years 2015 and 2021.
Release version: 0.1 (09/09/2025)
Data Source: Desert dust profiling product data collection, Italy 2015-2021 by ITINERIS, dataset available at: <a href="https://doi.org/10.71763/CNR-IMAA/ITINERIS/DESERT_DUST_PROFILING_PRODUCT/2015-2021/ALL">https://doi.org/10.71763/CNR-IMAA/ITINERIS/DESERT_DUST_PROFILING_PRODUCT/2015-2021/ALL</a> and MONARCH available at: <a href="https://earth.bsc.es/thredds_dustclim/homepage/">https://earth.bsc.es/thredds_dustclim/homepage/</a>
Input parameters: <ul style="list-style-type: none"> <li>1. Observation site (ACTRIS/EARLINET 3-digit codes, e.g. POT)</li> <li>2. Observation date (format DD/MM/YYYY)</li> <li>3. Observation hour (format HH:MM)</li> </ul>
Products: None
Image output (if any): Yes
Image example: <div style="text-align: center;"> </div>
Common user mistakes: <ul style="list-style-type: none"> <li>1. Incorrect observation site (ACTRIS/EARLINET 3-digit codes, e.g. POT)</li> <li>2. Incorrect observation date format (format DD/MM/YYYY)</li> </ul>

3. Incorrect observation hour format (HH:MM)

Notes: Potenza and Ispra observation sites available only.

*AEROSOL TYPING TOOLS – Usage Guide*

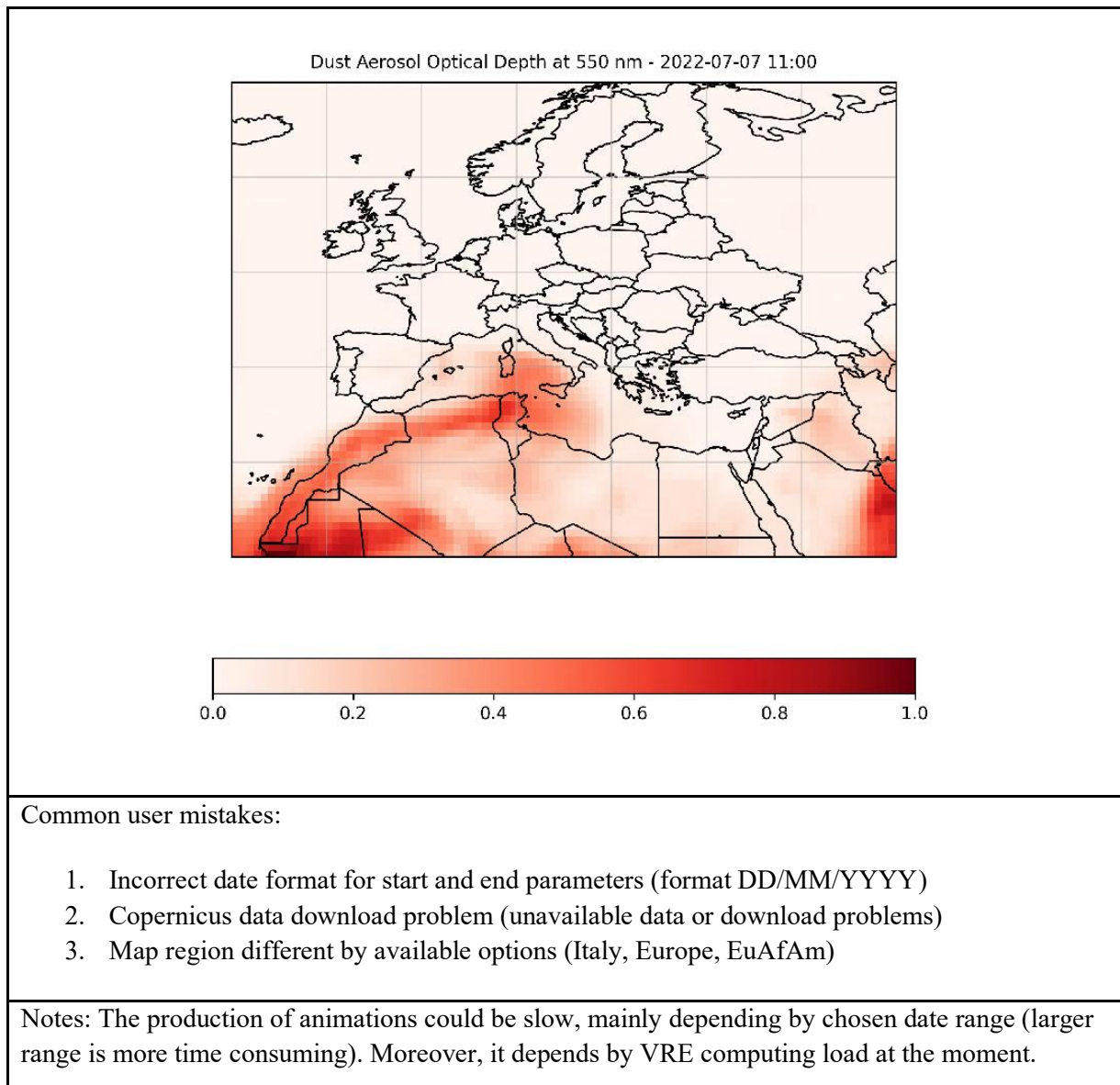
<b>Code Acronym: Optical Property Profiles</b>
Code Name (extended): Optical property profiles lidar data plots
Description: This utility plots Aerosol Backscatter, Extinction, and Depolarization Ratio, plus Lidar ratio and Angstrom Exponent profiles for a specific site, date and time range as provided in ACTRIS/EARLINET database
Release version: 0.1 (09/09/2025)
Data Source: ACTRIS/EARLINET database
Input parameters: <ul style="list-style-type: none"> <li>1. Observation site (ACTRIS/EARLINET 3-digit code only, e.g. POT)</li> <li>2. Observation date min (format DD/MM/YYYY)</li> <li>3. Observation date max (format DD/MM/YYYY)</li> <li>4. Observation hour min (format HH:MM)</li> <li>5. Observation hour max (format HH:MM)</li> <li>6. Number of panels, 3p or 5p (for daytime obs choose 3p, for nighttime obs choose 5p)</li> </ul>
Products: ACTRIS/EARLINET (NetCDF files)
Image output (if any): Yes
Image example: <div style="text-align: center;"> <p>POT_2025-06-13_2100_2025-06-13_2300_5p</p> </div>

Common user mistakes:

1. Incorrect observation site (ACTRIS/EARLINET 3-digit code, e.g. POT)
2. Incorrect min date format for the observation (format DD/MM/YYYY)
3. Incorrect max date format for the observation (format DD/MM/YYYY)
4. Incorrect min hour format for the observation (format HH:MM)
5. Incorrect max hour format for the observation (format HH:MM)
6. Panel mode (3p and 5p allowed only)

Notes: It is strongly advised to check data availability on ACTRIS/EARLINET database before running the script. Data download and elaboration from ACTRIS/EARLINET database could result in a delayed plot production.

Code Acronym: <b>CAMS reanalysis aerosol type animation</b>
Code Name (extended): CAMS reanalysis aerosol type animation
Description: This utility uses Copernicus Climate data to generate animations of aerosol evolution of a physical variable on a specific area. It is possible to plot a map for Italy, Europe, EuAfAm (Europe-Africa-America) regions. The code produces an animation (WebP format) of the evolution of chosen variable in date range set by user.
Release version: 0.1 (09/09/2025)
Data Source: Copernicus Climate Data Store (need personal API key)
Input parameters: <ul style="list-style-type: none"> <li>1. Target Variable from Copernicus (choose one of 'black_carbon_aerosol_optical_depth_550nm', 'dust_aerosol_optical_depth_550nm', 'organic_matter_aerosol_optical_depth_550nm', 'sea_salt_aerosol_optical_depth_550nm', 'sulphate_aerosol_optical_depth_550nm', 'total_aerosol_optical_depth_469nm', 'total_aerosol_optical_depth_550nm', 'total_aerosol_optical_depth_670nm', 'total_aerosol_optical_depth_865nm', 'total_aerosol_optical_depth_1240nm')</li> <li>2. Start date (format DD/MM/YYYY)</li> <li>3. End date (format DD/MM/YYYY)</li> <li>4. Geo area corresponding to the center of the map (Italy, Europe, EuAfAm stands for Europe-Africa-America region)</li> <li>5. Personal CDS API key (see specific instruction to Copernicus CDS website in order to create a personal API key)</li> </ul>
Products: Copernicus data (zip files)
Image output (if any): Yes
Image example:



Code Acronym: <b>Daily AOD</b>
Code Name (extended): Aerosol Optical Depth Plotting Utility - Daily
Description: This utility plots AERONET daily AOD measurements at wavelengths 340, 380, 440, 500, 675, 870, 1012, 1064 nm.
Release version: 0.2 (09/09/2025)
Data Source: AERONET site
Input parameters: <ul style="list-style-type: none"> <li>1. Observation site (only AERONET Italian stations available, es. IMAA_Potenza)</li> <li>2. Observation date min (format DD/MM/YYYY)</li> <li>3. Observation date max (format DD/MM/YYYY)</li> </ul>
Products: AERONET daily data (txt files)
Image output (if any): Yes
Image example: <div style="text-align: center;"> </div>
Common user mistakes: <ul style="list-style-type: none"> <li>1. Incorrect date format for start and end parameters (format DD/MM/YYYY)</li> <li>2. Date range higher than 30 days (set as max value)</li> <li>3. AERONET data download problem (unavailable data or download problems)</li> </ul>
Notes: Data download from AERONET site could be slow, plot production can be delayed.

Code Acronym: <b>Monthly AOD</b>
Code Name (extended): Aerosol Optical Depth Plotting Utility - Monthly
Description: This utility plots AERONET data of the average daily AOD value at wavelengths 340, 380, 440, 500, 675, 870, 1012, 1064 nm.
Release version: 0.2 (09/09/2025)
Data Source: AERONET site
Input parameters: <ul style="list-style-type: none"> <li>1. Observation site (only AERONET Italian stations available, es. IMAA_Potenza)</li> <li>2. Observation date min (format DD/MM/YYYY)</li> <li>3. Observation date max (format DD/MM/YYYY)</li> </ul>
Products: AERONET data (txt files)
Image output (if any): Yes
Image example: <div style="text-align: center;"> </div>
Common user mistakes: <ul style="list-style-type: none"> <li>1. Incorrect date format for start and end parameters (format DD/MM/YYYY)</li> <li>2. Chosen date range lower than 30 days (must be higher than 1 month)</li> <li>3. AERONET data download problem (unavailable data or download problems)</li> </ul>
Notes: Data download from AERONET site could be slow, plot production can be delayed.

Code Acronym: <b>Angstrom Exponent</b>
Code Name (extended): Aerosol Optical Depth Plotting Utility – Angstrom Exponent
Description: This utility plots AERONET Angstrom Exponent (440-870 nm) daily values over a time range greater than 30 days.
Release version: 0.2 (09/09/2025)
Data Source: AERONET site
Input parameters: <ul style="list-style-type: none"> <li>1. Observation site (only AERONET Italian stations available, es. IMAA_Potenza)</li> <li>2. Observation date min (format DD/MM/YYYY)</li> <li>3. Observation date max (format DD/MM/YYYY)</li> </ul>
Products: AERONET data (txt files)
Image output (if any): Yes
Image example: <div style="text-align: center;"> </div>
Common user mistakes: <ul style="list-style-type: none"> <li>1. Incorrect date format for start and end parameters (format DD/MM/YYYY)</li> <li>2. Chosen date range lower than 30 days (must be higher than 1 month)</li> <li>3. AERONET data download problem (unavailable data or download problems)</li> </ul>
Notes: Data download from AERONET site could be slow, plot production can be delayed.

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