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USER GUIDE

OCTOBER 2024
VERSION 3.3

Barcelona Dust Regional Center

WMO SDS-WAS Regional Center for Northern
Africa, Middle East and Europe, conducting
research and providing operational products

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ABOUT

The **WMO Barcelona Dust Regional Center** coordinates the research activities and operations of the World Meteorological Organization Sand and Dust Storms Warning Advisory and Assessment System (**WMO SDS-WAS**) in **Northern Africa, the Middle East, and Europe**.

The main objective of **the Center** is to enhance the ability of the countries to deliver timely and high-quality sand and dust storm forecasts, observations and knowledge to the users. Providing access to such information is fundamental to support the development of early warning systems and mitigation plans. Additionally, it responds to the growing interest of stakeholders from different sectors, enforcing the international partnership between research, operational services and user communities.

This **User Guide** explains how to access and explore the available dust products through **the Center's [website](#)** and describes the key features that allow users to customize their experience and the analysis of the provided information.

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DOCUMENT VERSIONS

| Version number | Date of publish | Version description |
|----------------|-----------------|--|
| 1.0 | 20/01/2022 | Includes descriptions for: daily dust products, dust catalogue, numerical data download service and citation. |
| 2.0 | 26/05/2022 | Includes updates on the following products: Models, Warning Advisory System, Observations. |
| 2.1 | 12/12/2022 | Minor editions and revision of the NASA/MODIS product used for the Evaluation of the daily dust forecasts. |
| 2.2 | 23/06/2023 | Includes updates to the dashboard including: URL Search Queries, Fullscreen Mode, Updated Map Controls and Date Picker, and Synchronised Zoom and Pan. |
| 3.1 | 15/02/2023 | Includes mobile visualisation interface, "select all" checkbox for multiple option checkbox, and improvements in RGB observations browsing. |
| 3.2 | 24/02/2024 | Includes technical requirements for models participating in the multimodel products. |
| 3.3 | 23/10/2024 | Includes new map layers (airports, country borders, ACTRIS stations), Vertical Profiles, and Visibility Active Stations |

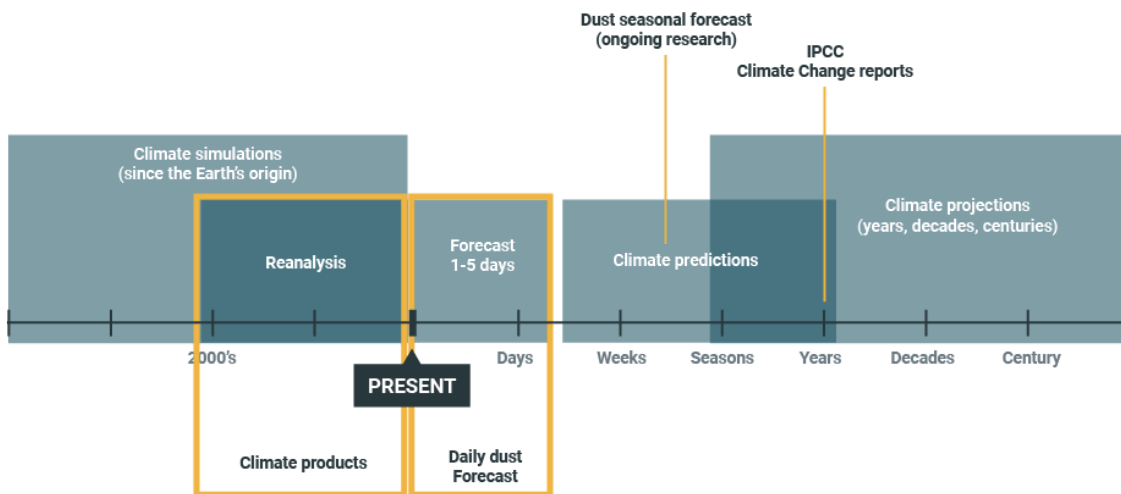
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1 From research to products

Numerical modelling is one of the most important sources of dust information. Models of dust emission, transport and deposition are used as a tool to complement dust observations and to deepen our understanding of the aspects that control the distribution of dust particles and the impacts they provoke. While global models of the dust cycle are used to investigate dust at large scales and its long-term changes, regional dust models are an ideal tool to study in detail the processes that influence dust distribution, as well as individual dust events.

The dust research can be associated with and conducted considering different time scales. Therefore, **dust model simulations can result in either short-term forecasts for up to 5 days ahead, seasonal forecasts for several weeks ahead or dust projections that consider future scenarios about the concentration of desert dust and are important for climate research.** Additionally, the historical record of information on desert dust can be completed with climate simulations and reanalysis datasets.



At the moment, the dust products available through the **WMO Barcelona Dust Regional Center** are mainly short-term dust forecasts which are useful to support the development of early warning systems.

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2 Dust products

The WMO Barcelona Dust Regional Center coordinates a network of collaborators (researchers, data providers and user communities) in Northern Africa, the Middle East and Europe and provides access to available dust products via the Center's official webpage (<https://dust.aemet.es/>). The products are available for visualisation and analysis on the fly through the interactive dashboard, as well as for download through the numerical data download service (THREDDS).

On the [Products page](#), users can select whether they want to explore the [Daily Dust Products](#) for short-term issued forecasts, the [Dust Products Catalogue](#) for a detailed inventory of dust observational products and models or the [Data download system](#) for numerical data.

Dust Products

The WMO Barcelona Dust Regional Center offers a wide range of dust products that serve the need for detailed dust information on a regional scale.

[EXPLORE ALL](#)

Daily Dust Products
Dust forecasts and dust-related observational products
[EXPLORE PRODUCT](#)

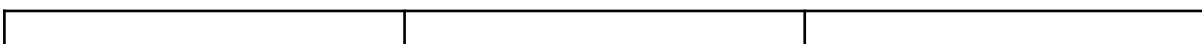
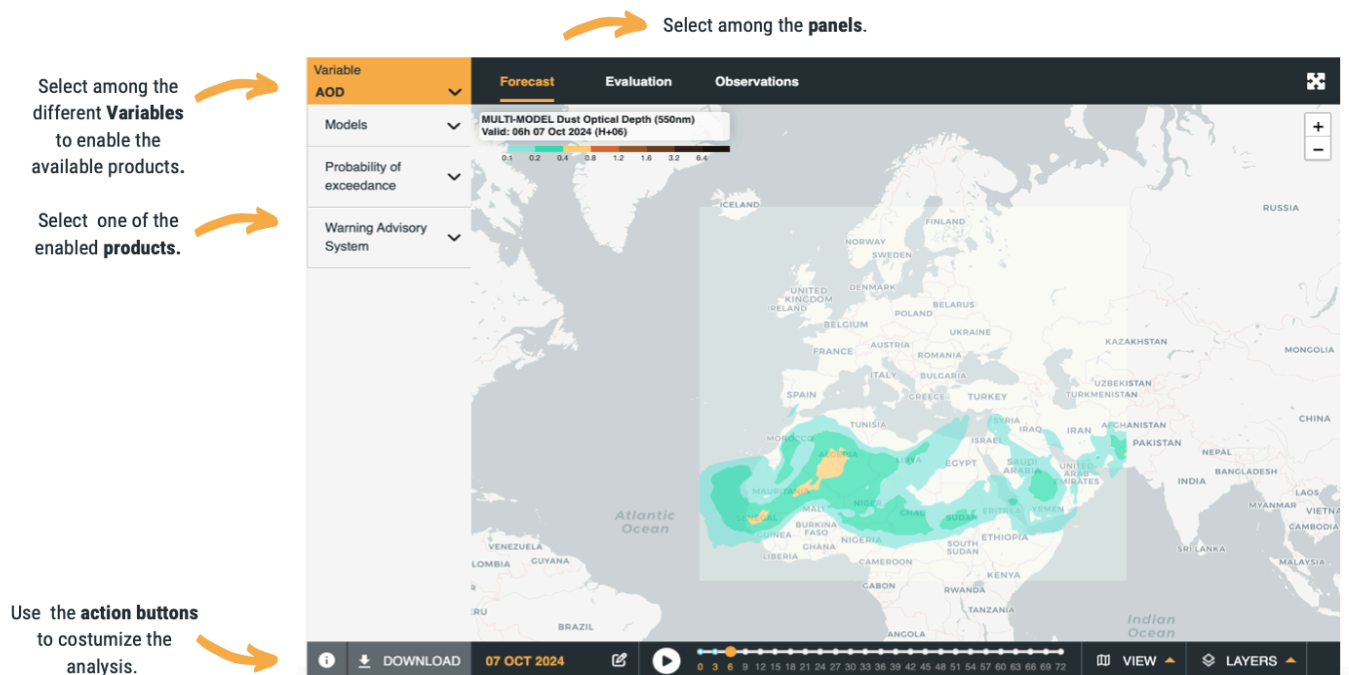
Dust Products Catalogue
Inventory of available dust observational and modelling products
[EXPLORE PRODUCT](#)

Data Download
Access and download the numerical data of dust forecasts
[EXPLORE PRODUCT](#)

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2.1 Daily Dust Products

This section includes daily dust forecasts, their comparison with observations, and dust-related observations. The products are displayed in an **interactive dashboard** that consists of three panels: i) **Forecast**, ii) **Evaluation** and iii) **Observations**. Users need to select one of the panels from the top menu and a variable from the side menu to see the products that are available for visualisation.



Dashboard action buttons

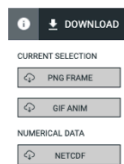
The dashboard includes several action buttons to customize and facilitate the analysis of the products. Users can change the base map (VIEW button), add extra layers of information (LAYERS button), change the spatial zoom of the displayed map, click on a specific location to obtain more detailed information about this point, access useful documents and download images, animations and numerical data (DOWNLOAD button).

 **Full screen mode**

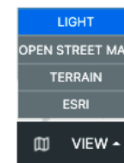
 **Zoom in**

 **Zoom out**

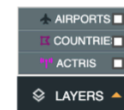
 **Access to **information** and documents (User Guide)**



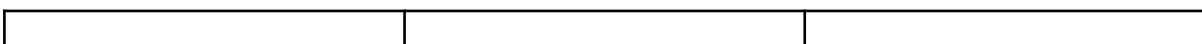
Download the currently displayed data in **image, animation or numerical** format



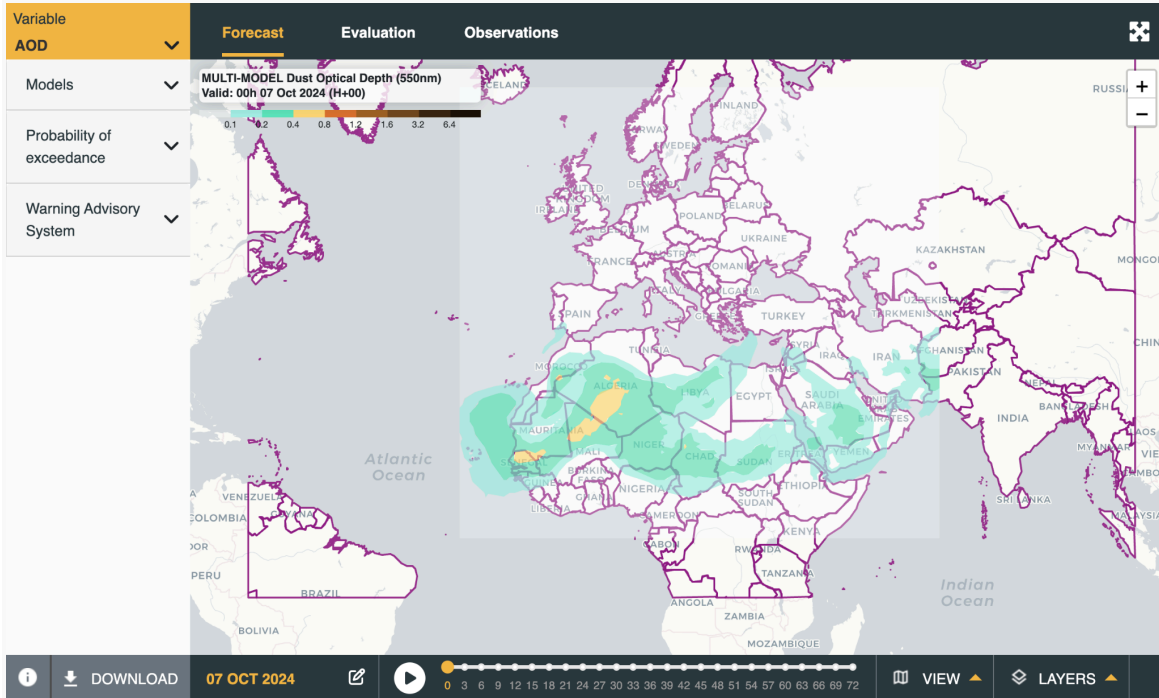
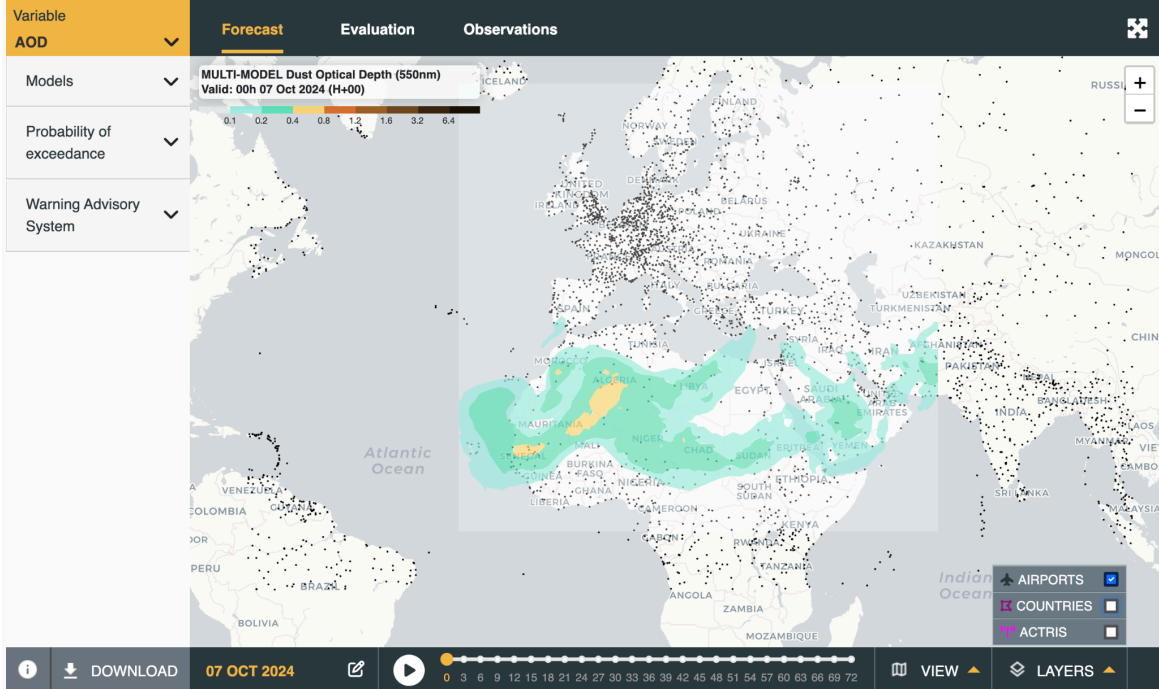
Change the base map displayed, selecting among **Light, Open Street, Terrain or ESRI** map



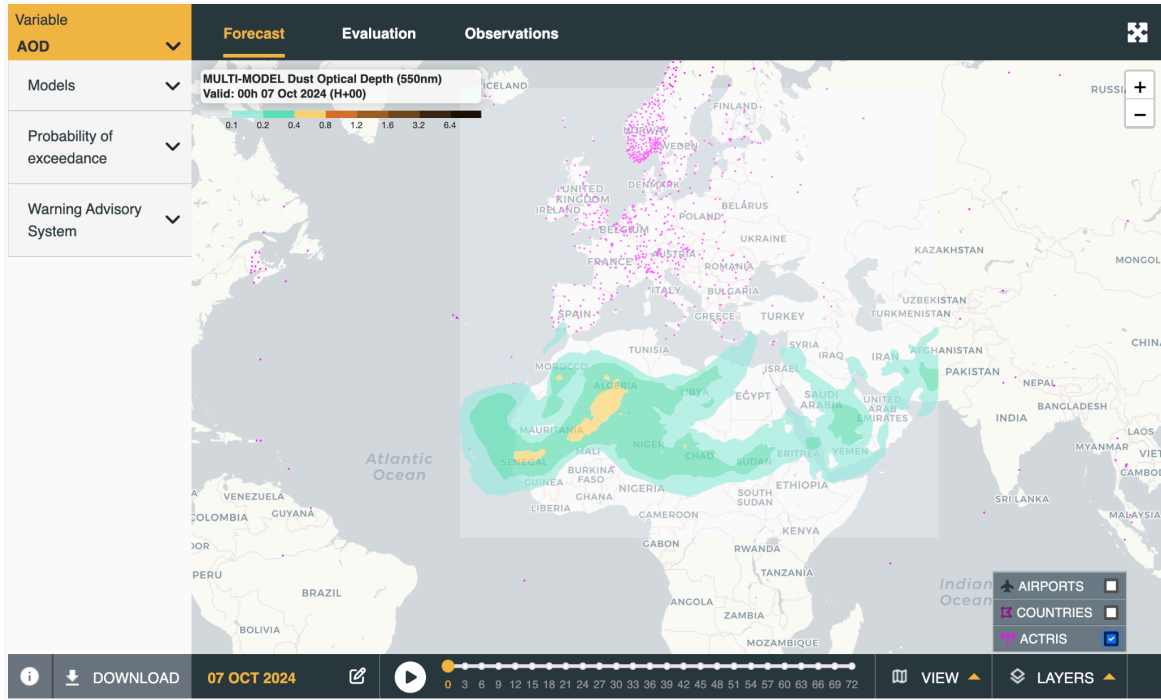
Add extra layers of information in the base map: **location of airports, country borders, ACTRIS stations**



New Map Layers. We have now added new layers to our Models and Probability of Exceedance maps. The Models section will have enhanced interactivity, with popups showing information about Airports and ACTRIS stations. We have added a total **3 new layers**:



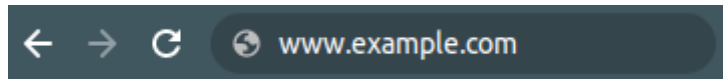
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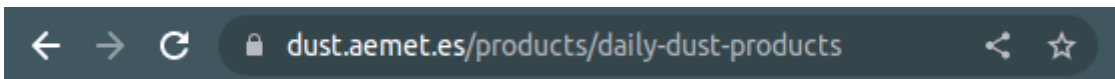
2.1.1 Navigating the Dashboard with your URL

Now, users can **navigate to various locations** on the dashboard with **URL queries**. The URL is the address that you type into your the address bar of your browser, which looks like this:

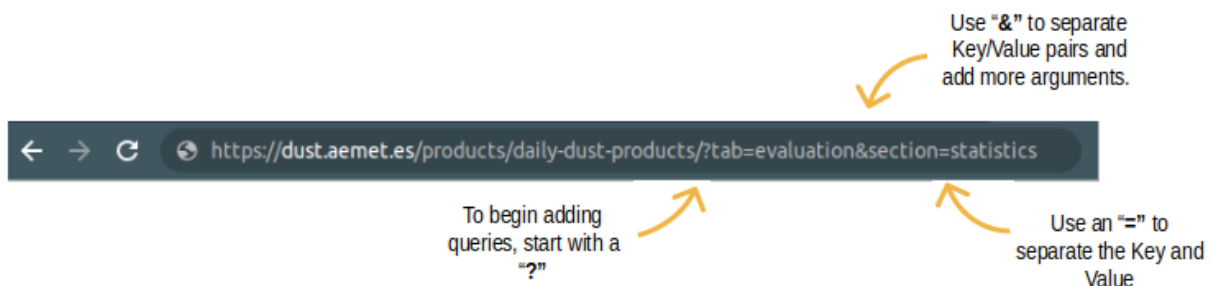


This new functionality will allow users to **quickly get to information** they are looking for on the dashboard, or share specific information with others through URL links. In practice, queries can be added to the base URL of the dashboard to get to the desired information.

For example, the dashboard is located at:



If you want to navigate directly to the Statistics section of the Evaluation tab, you can now modify the URL to include the desired tab and section, which would look like the following:



Queries are **not position dependent**, so they can be added in any order. The format for adding a query is to **add a "?" after the base URL**, and then the **queries separated by ampersands (i.e. &)**. After the question mark, the search **queries come in Key/Value pairs, separated by an "="**. So, in the above query, we have "tab=evaluation" and "section=statistics". Each Key/Value pair is separated by an "&".

So, to review, here are **some of the basics**:

- Queries are added by adding a "?" and then the Key/Value pairs after the base URL
- Key/Value pairs are separated by an "&"
- Queries do not need to be in a specific order
- All **queries should be** entered in **lower case**

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- **Spaces are accounted for with underscores** (“dry deposition” becomes “dry_deposition”)

As you navigate through the dashboard, you’ll notice that the **URL now updates when certain buttons or tabs are clicked**. Reviewing these changes is a great way to get hints at the proper formatting of the URL queries. Further, you might navigate to the area of the application that you will want to return to later, or send as a link, and then just copy the link out of the search bar.

There are **a total of 5 query keys** with each key having its own possible values.

The available keys are:

- tab
- var (abbreviated from variable)
- section
- model
- date

Values for “tab” are:

- forecast
- evaluation
- observations

Values for “var” are:

- aod
- concentration
- dry_deposition
- wet_deposition
- load
- extinction

Values for “section”:

- prob (abbreviated from “Probability of Exceedance”)
- was (abbreviated from “Warning Advisory System”)
- visual_comparison
- statistics
- eumetsat-rgb
- visibility
- Note: “models” is not needed as it is the default when landing on the “forecast” tab

Values for “model”:

- median (multi-model)
- monarch
- cams (CAM5-IFS)
- dream8-cams

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- nasa-geos
- metoffice (MetOffice-UM)
- ncep-gefs
- ema-regcm4
- silam
- lotos-euros
- icon-art
- noa (NOA-WRF-CHEM)
- wrf-nemo
- aladin
- zamg (ZAMG-WRF-CHEM)
- mocage

Values for “date”:

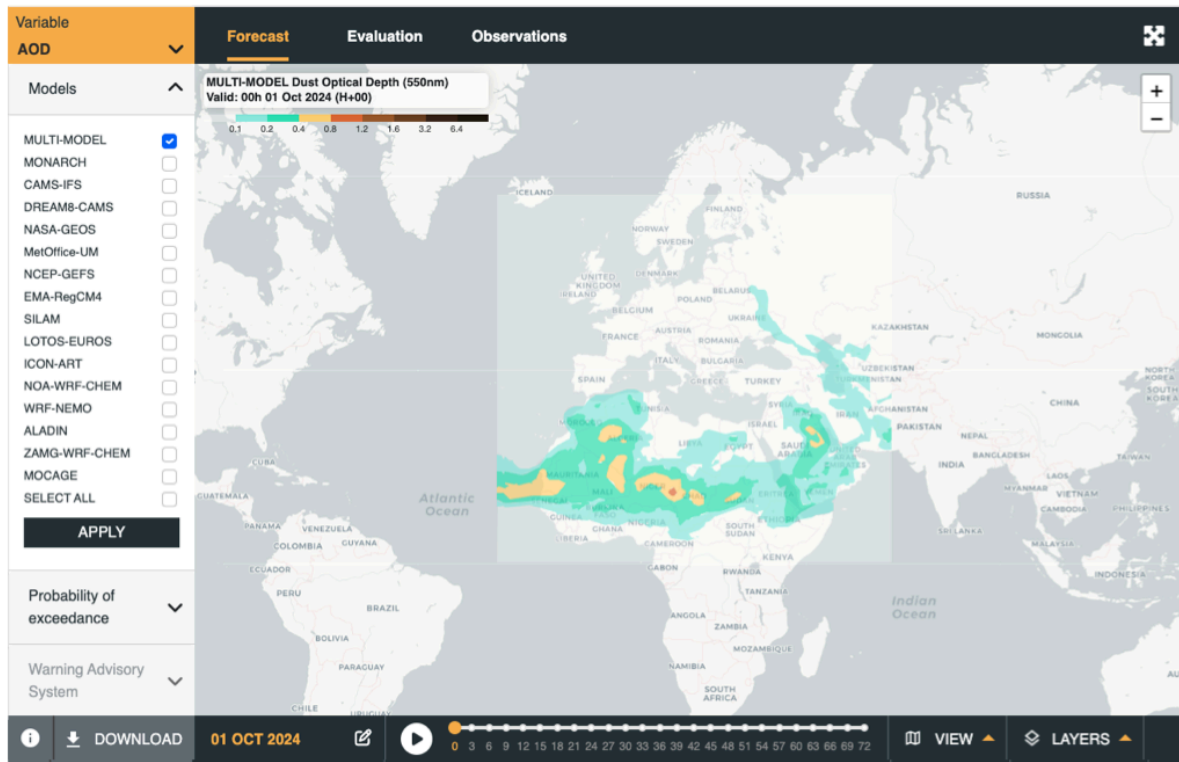
- Date is entered in YYYYMMDD format
- For example, September 25, 2022 is entered as 20220925

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2.1.2 Fullscreen Functionality

You can now take the dashboard into **fullscreen mode** in your browser. Look for the **square box in the top navbar on the right side**. Click this box and you will take the dashboard fullscreen. To put the dashboard back to its original size, click the button again or use your **Esc** button on the top left of your keyboard.

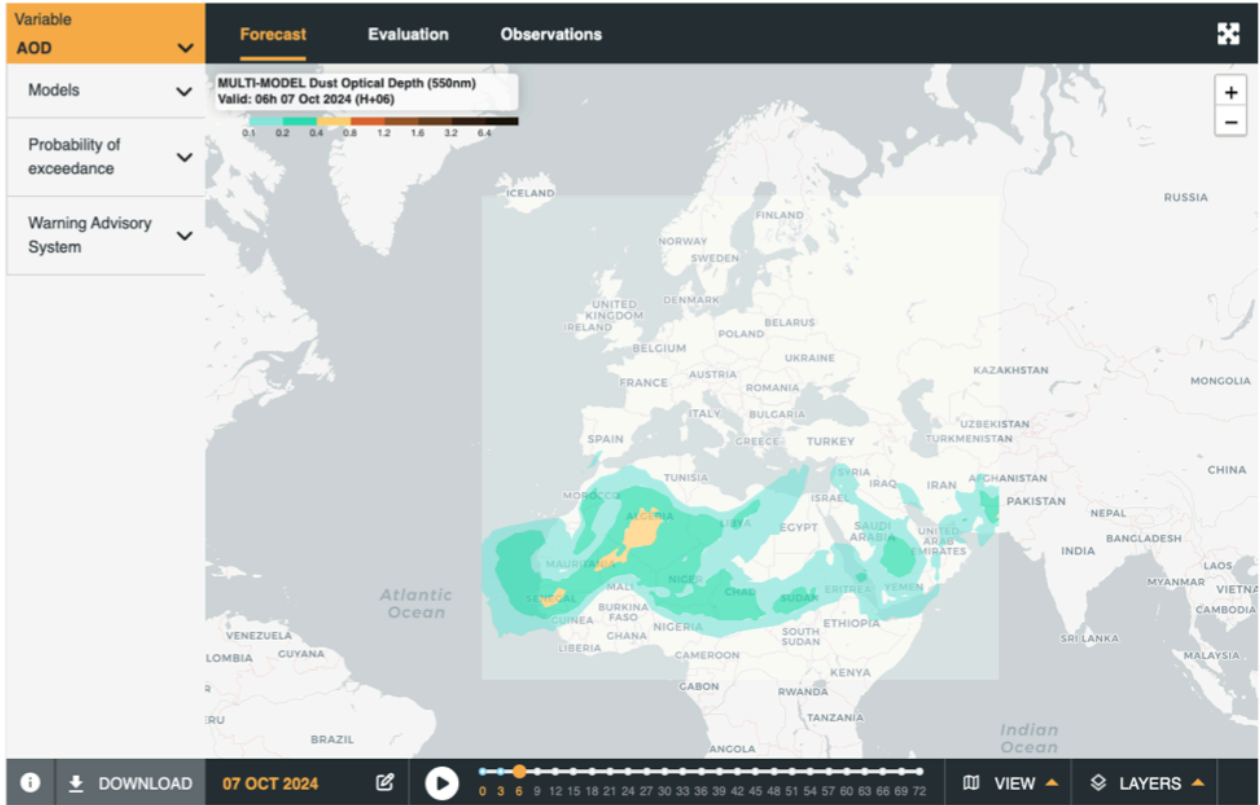
Click here to toggle Fullscreen mode



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2.1.3 Map Controls

We have updated the controls(**date picker, timeseries, and views menu**) for better functionality, and moved them out of the map space to afford a better field of vision. You will notice that **the pause button** from the time series bar **has been removed**.

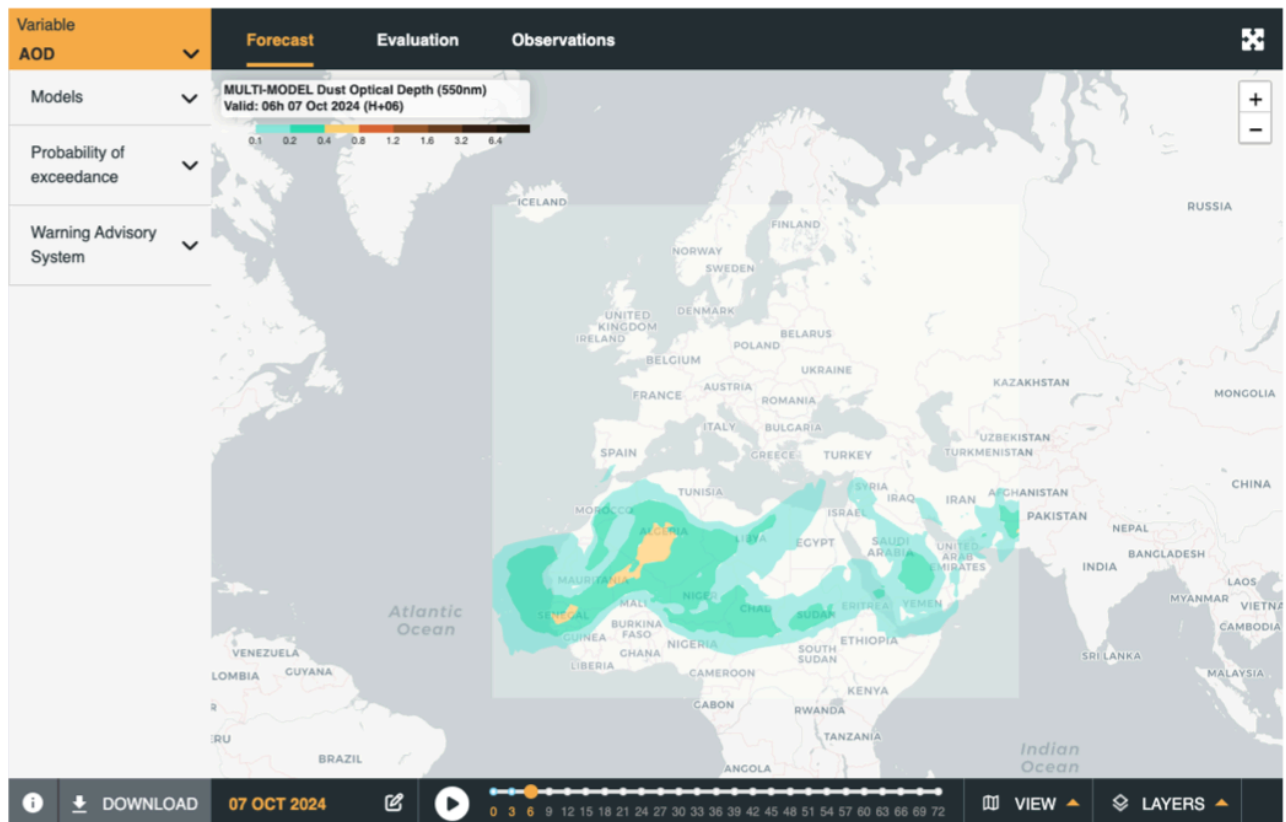


The map controls have now been moved below the map space and updated for better functionality

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2.1.4 Using the Date Picker

When choosing a date to interact with the various map products that we offer, you can use the date pickers in various ways to **choose which date to view**. You can **click on the date picker or the clear button** which appears as an icon of a pencil on a small piece of paper to get started.

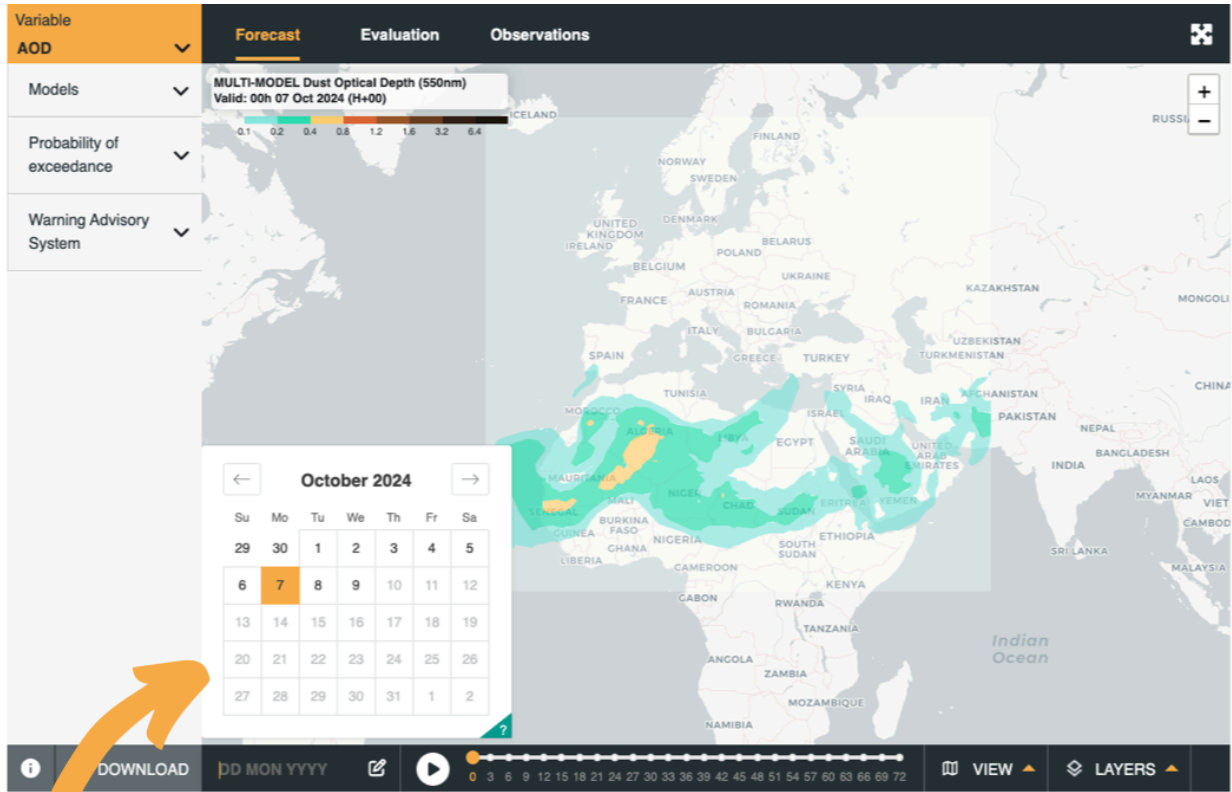


To **clear** the date or **pull up the calendar**, click this icon



If you click the **clear button**, you will be able to **access the calendar popup, or the manual entry box**. To enter a date manually, **use the format noted shown in grey** in the box. To use the calendar, **simply click the day** which you want to see. You can also **flip through the months with the left and right arrows** at the top of the calendar popup.

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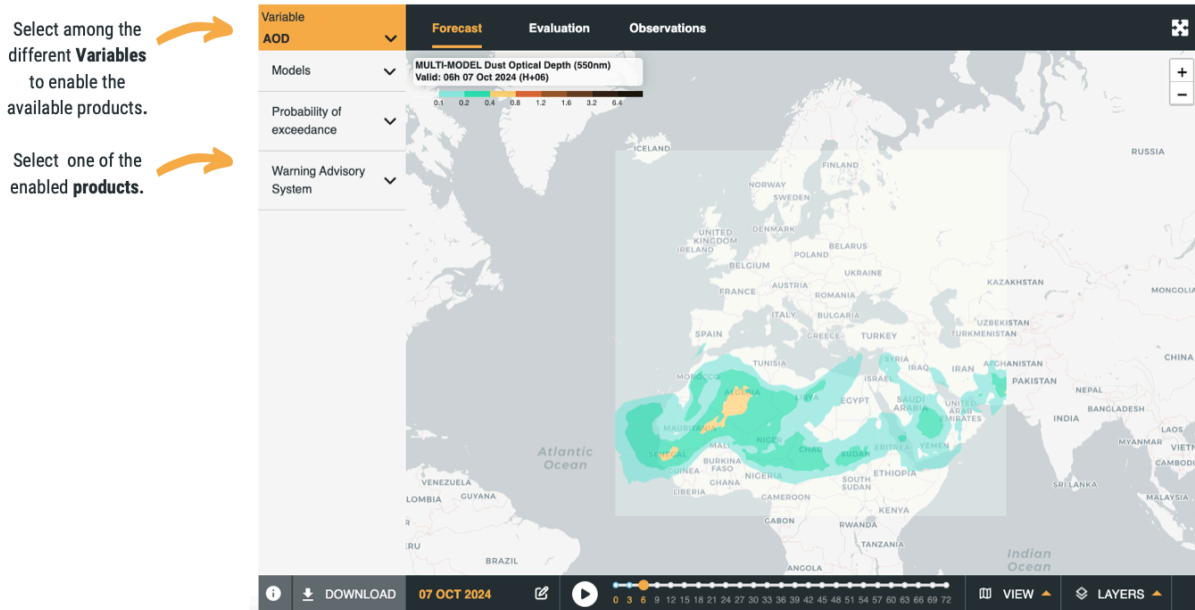
You can also **select a date** by using the **calendar** popup

Dates can be **manually entered** following the format in gray

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2.1.5 Exploring the forecast

The “Forecast” panel contains a map displaying the daily dust forecast, according to the **variable** and **product** parameters selected by the users on the left sidebar.



Forecast variables

The full definition of the variables, as well as the enabled products for each one, can be found in the following table:

| Variable name | Description | Units | Full name | Enabled products |
|---------------|---|--------------------------|--------------------------------------|--|
| AOD | Effective depth of the dust-aerosol column from the viewpoint of radiation propagation. It corresponds to the integrated extinction coefficient over a vertical column. | Dimensionless | Dust aerosol optical depth at 550 nm | Models, Probability of exceedance |
| Concentration | Mass concentration of dust particles in the atmosphere. By default, the dust concentration at surface level is shown. | $\mu\text{g}/\text{m}^3$ | Dust surface concentration | Models, Probability of exceedance, Warning |

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| | | | | Advisory System |
|-----------------------|---|-------------------|-----------------------------------|-------------------------------------|
| Dry deposition | Accumulated dry dust deposition over the previous 3 hours. Dry deposition processes consider the removal of dust (and sand) by sedimentation and turbulent diffusion. | mg/m ² | Dust dry deposition | Models (only available for MONARCH) |
| Wet deposition | Accumulated wet dust deposition over the previous 3 hours. Wet deposition processes consider the removal of dust (and sand) by in-cloud and below-cloud scavenging. | mg/m ² | Dust wet deposition | Models (only available for MONARCH) |
| Load | Accumulated mass concentration of dust (and sand) in the vertical column of the atmosphere. | g/m ² | Dust load | Models (only available for MONARCH) |
| Extinction | The sum of scattering and absorption of solar and infrared radiation by dust (and sand) at surface level. It is associated with visibility. | Mm ⁻¹ | Dust surface extinction at 550 nm | Models (only available for MONARCH) |

Based on the “**Variable**” selection (in the upper-left corner), the available dust products for the selected variable are enabled. These may include:

- *Models (intercomparison)*: Access to 72h dust forecasts of individual models and the MULTI-MODEL result (median of all individual models). This product (MULTI-MODEL and all individual models) is available for the variables: AOD, and Concentration. In the case of the MONARCH model, the product is available for the following variables: AOD, Concentration, Dry deposition, Wet deposition, Load, and Extinction.

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- **Probability of exceedance:** Percentage of models that predict the exceedance of a given threshold for a particular variable. This product is available only for the variables: AOD, and Concentration.
- **Warning Advisory System:** Information about the warning levels of dust and sand concentration (from Normal to Extremely High) for the next 2 days (before April 1st, 2023) at province level for particular countries. This product is available only for the variable: Concentration. (3 days available after April 1st, 2023)

Product: Models

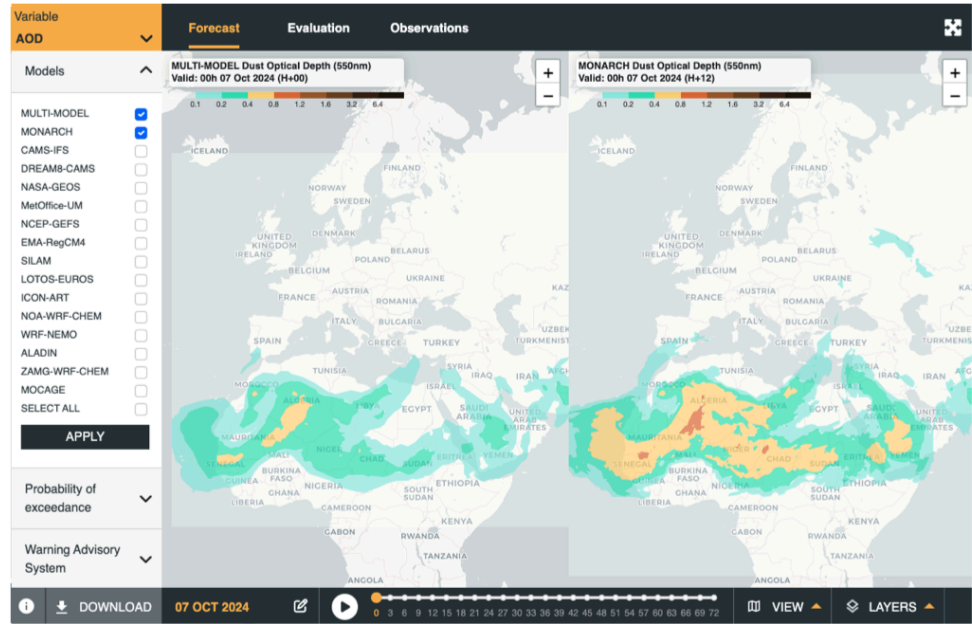
This menu includes all the individual models that currently contribute to the daily dust forecasts provided by the Center. The individual models are used to produce the MULTI-MODEL forecast, which is the median of all the available dust forecasts for a particular day, after bi-linear interpolation to a common grid mesh of $0.5^\circ \times 0.5^\circ$. At present, the MULTI-MODEL forecast is calculated only for Concentration and AOD. In general, the MULTI-MODEL forecast shows 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 Center.

Based on their selection of models, users can analyse and compare forecasts from various models simultaneously. Lead times range from 0 to 72 h, and predictions are available for every 3 hours.

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Select among the different **Variables**.

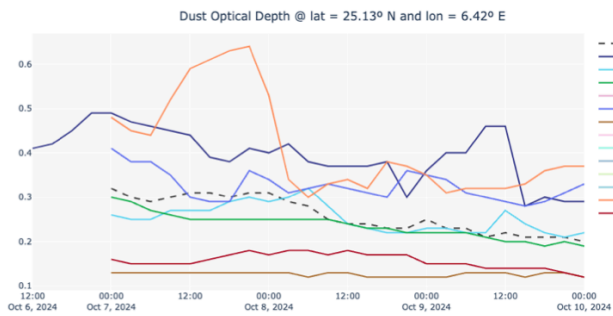
Select among the different **Models** or the **Multi-model** and click on **APPLY**.



Select **Day, Month, Year**

Select a specific **Time frame** or the **Animation** for the next 72 hours.

After clicking on a specific location on the map, the time series of the selected variable is plotted.



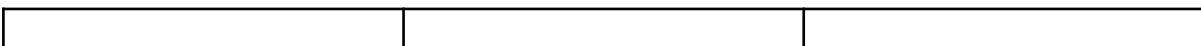
Download plot as png file.

Zoom in

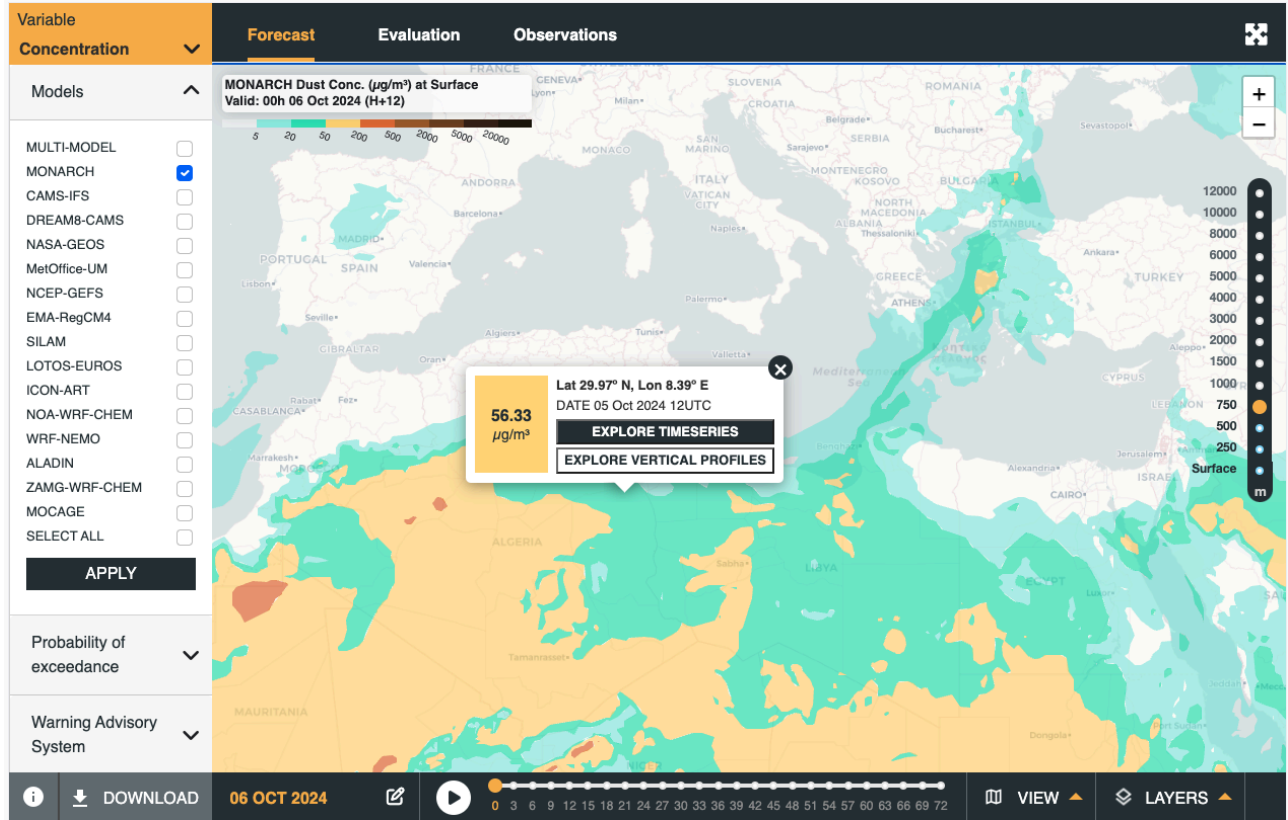
Zoom out

Reset axes and return to the initial plot.

Click on the **Models** to add/remove them from the plot.



Vertical Profiles have been added to the Models section for the Concentration variable. These will now be accessible from the popups that appear after clicking the Models maps (only available for the MONARCH model).

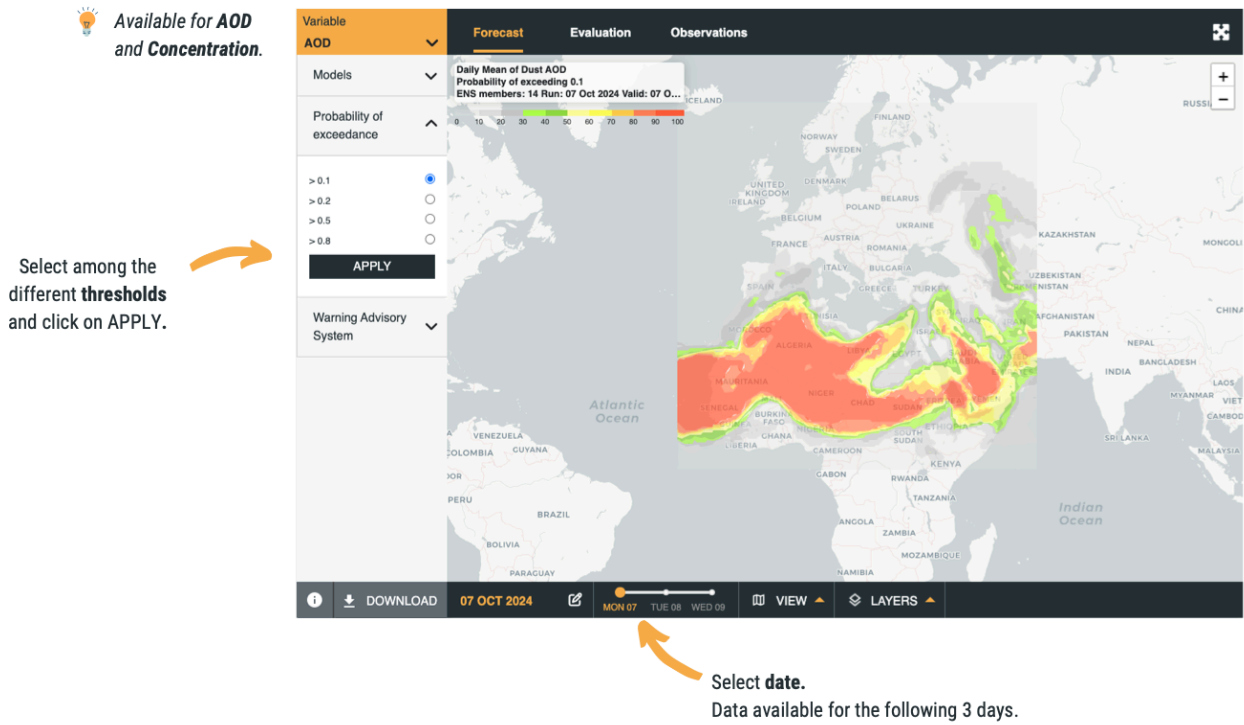


More information on the participating models and the generation of the MULTI-MODEL forecast can be found in [Terradellas et al. \(2020\)](#), while more details about MONARCH, the reference model of the Center, is available in [Basart et al. \(2020\)](#). Moreover, detailed information about the individual models that contribute to the Center, their technical features and the contact details of the modelling groups can also be found in the [Dust Products Catalogue](#) and [here](#).

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Product: Probability of exceedance

Users can refer to this product to check the **“Probability of exceedance”**, a given threshold of the daily mean value of both dust surface Concentration and AOD. It is calculated taking into account all the individual models that contribute to the Center and is generated for the 3 days with spatial resolution of 0.5°x0.5°.




These probability maps are particularly useful for air quality stakeholders and for planning and managing any activity that can be affected due to the presence of airborne dust. More information about this product can be found in [Werner et al. \(2020\)](#).


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Product: Warning Advisory System


Users can consult the color-coded maps of the “Warning Advisory System” product for categorical (qualitative) information about the warning levels of sand and dust concentration (from Normal to Extremely High) for 3 days for some of the most vulnerable countries in the Sahel region.

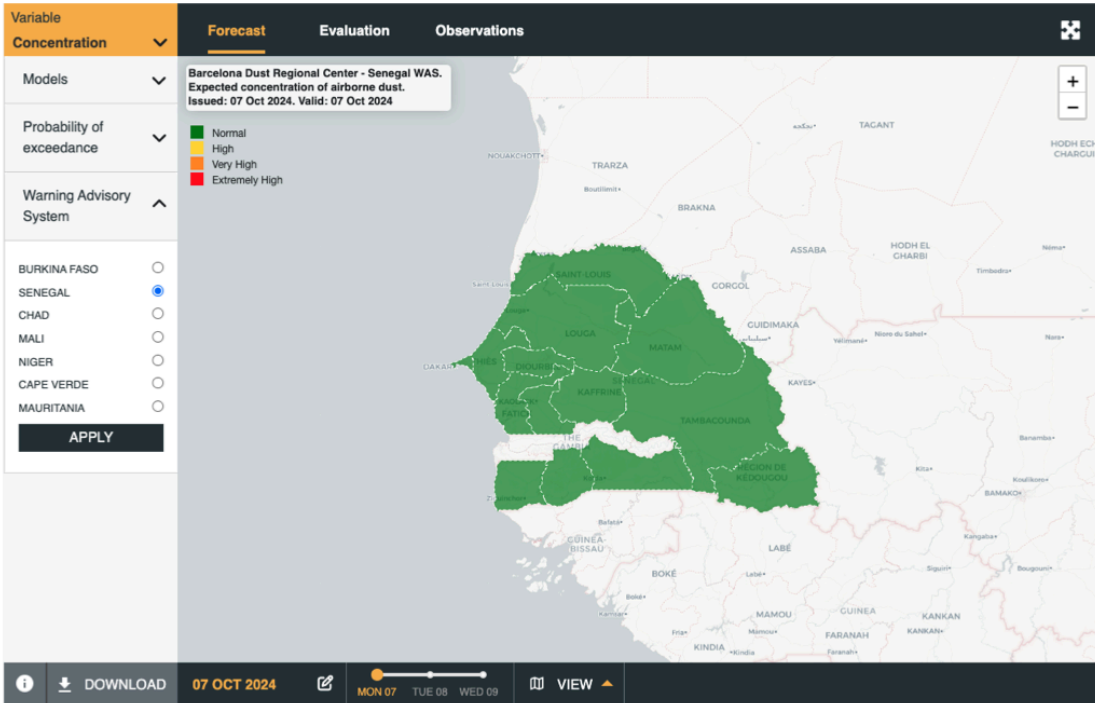
The warning levels are based on the MULTI-MODEL Concentration forecast and are established for each region according to the highest concentration value expected for the day, at any model grid-point within the province. The warning advisory thresholds have been set based on a percentile-based approach using the daily maximum concentration of the historical MULTI-MODEL time series.

 This product has been developed under the Climate Risk and Early Warning Systems (CREWS) initiative.

 Available only for **Concentration**.

Select a country and click on APPLY. 

 Currently available for 7 countries.



Select the day to view.
Data available for the following 3 days.
2-day forecasts available before Apr 01, 2023.

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procedures aimed at the mitigation of damages caused in vulnerable sectors. More information about this product can be found in [Terradellas et al. \(2018\)](#).

2.1.6 Exploring the evaluation

The “Evaluation” panel presents the comparison of the dust forecasts against dust-filtered observations. Here, the forecasts are compared to:

- [AERONET AOD photometric measurements](#); The global-international AERONET network provides AOD at different wavelengths. In this comparison the direct-sun cloud-screened (Level 1.5) AOD is used. A dust filter that corresponds to Ångström Exponent at 440-870 nm lower than 0.6, is applied to the AOD observations prior to the comparison ([Basart et al., 2017](#)).
- [NASA/MODIS Aqua and Terra NRT AOD combined product](#); MODIS AOD retrieval (in particular the Deep Blue product) is available over areas not easily covered by other observational data sets, e.g. very bright reflective surfaces such as deserts, and is therefore particularly relevant for dust applications.

The time period of the comparison, as well as the forecasts to be compared can be defined by the users. The evaluation results are presented in the form of visual comparison and statistics (skill scores).

The visual comparison of dust AOD (MULTI-MODEL and individual models) against dust-filtered AOD observations is available for AERONET stations located in Northern Africa, the Middle East and Southern Europe for the selected date range selected. The comparison is made on a 3-hourly basis.

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Available only for AOD.

Select among the Visual Comparison or the Statistics.

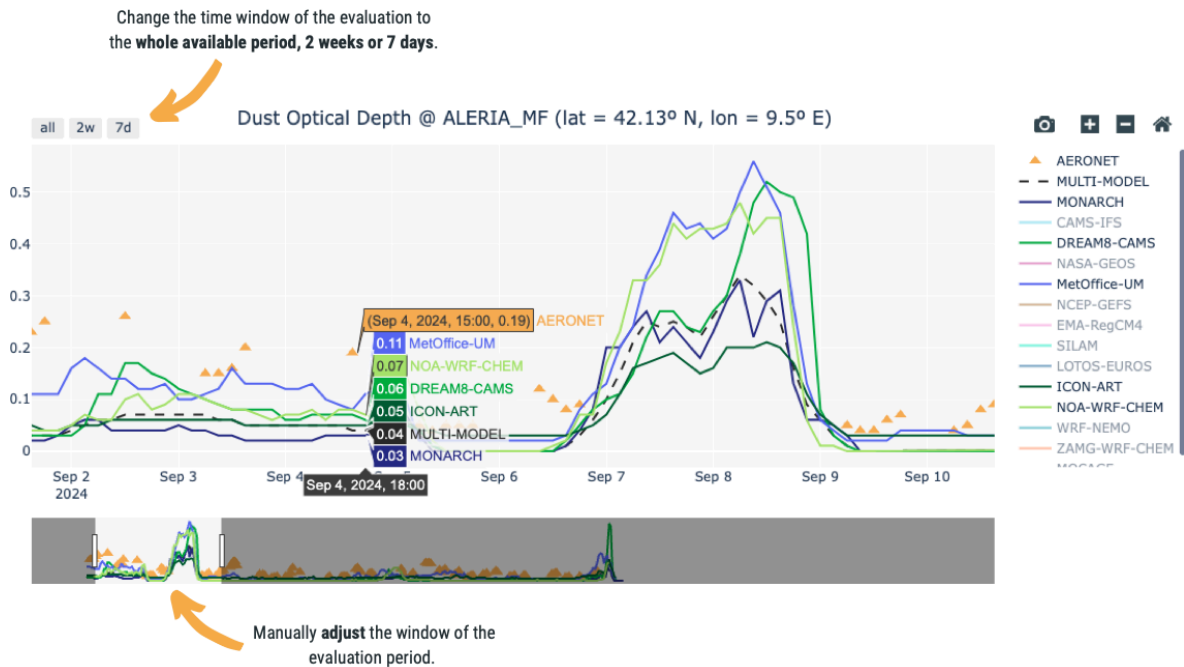
Select Observations' Network.

Select Station.

Select the date range for the evaluation.

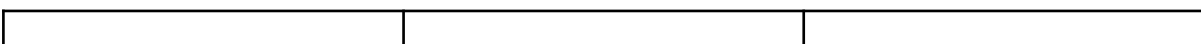
Visual comparison: AERONET

After selecting a specific AERONET station on the map, the comparison between the dust AOD forecasts and observations is plotted as time-series.

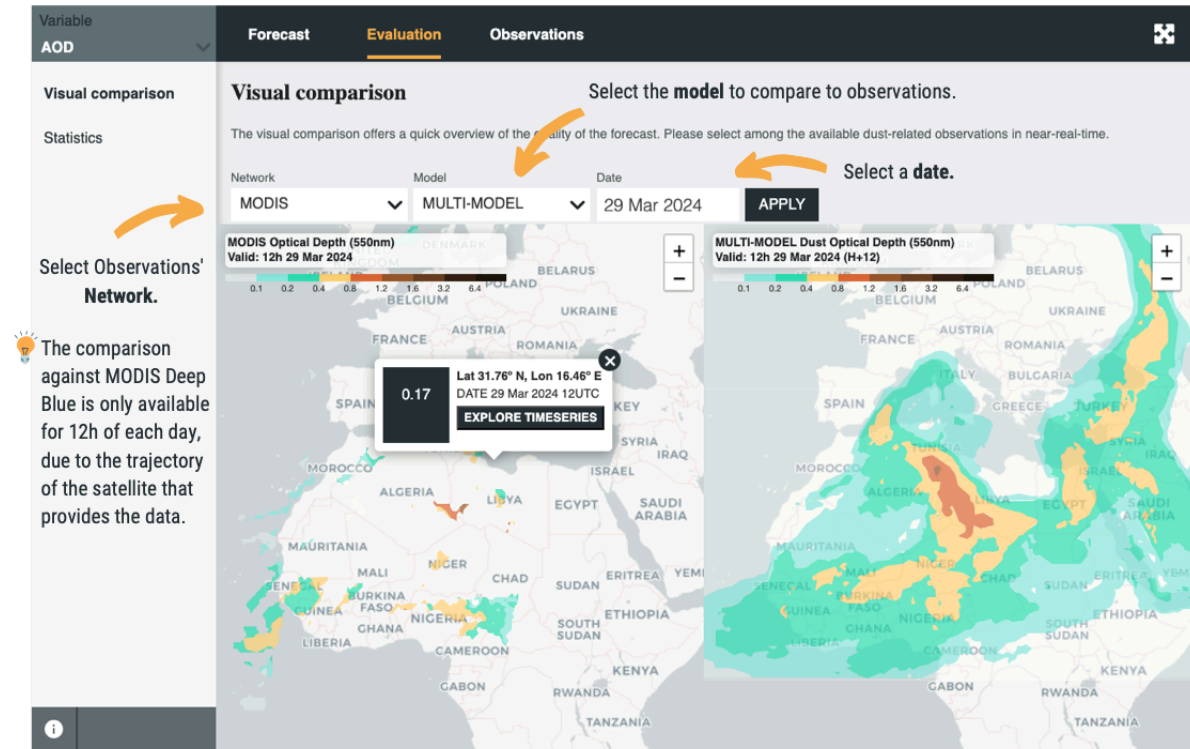


Visual comparison: MODIS

The visual comparison of the dust AOD forecast (MULTI-MODEL and individual models) against MODIS/Aqua NRT AOD product is available in the form of maps



plotted side-by-side for a particular day (at 12UTC), and also in the form of time series upon click to a specific location on the map.



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Statistics

The corresponding skill scores of the evaluation against AERONET and MODIS observations are available for the whole domain. In the case of the AERONET network, they are also available per region (Northern Africa, the Middle East and the Mediterranean) and stations. They can be displayed in a list or map format, according to the user's selection. The metrics used to quantify the mean departure between modelled and observed quantities are the mean bias error (BIAS), the root mean square error (RMSE), the correlation coefficient (r), the fractional gross error (FGE) and the number of total cases (TOTAL CASES). Their definition is given in [Terradellas et al. \(2020\)](#).

Visual comparison

Statistics

The accuracy of the forecast can be quantified by comparing it to observations and is presented by a set of statistics (skill scores). Here, you can use the selection menu to explore the skill results, based on the selected observation dataset.

Then, select the **time period of the evaluation** and click on **APPLY**.

Network: Aeronet v3 lev1.5 | Models: 10 models | Statistics: 1 statistics | Timescale: Monthly | Selection: September 2024

APPLY **VIEW MAP**

Click here to see the statistics plotted on a map.

| MBE | | | | | | | | | | |
|---------------|-------------|---------|-------|-------------|-----------|-----------|------------|-------|-------------|-------|
| Station | MULTI-MODEL | Monarch | Cams | Dream8-Macc | Metoffice | Ncep-Gefs | Ema-Regcm4 | Silam | Lotos-Euros | Noa |
| Europe | -0.13 | -0.13 | -0.13 | -0.13 | -0.06 | -0.14 | -0.14 | -0.14 | -0.12 | -0.12 |
| Mediterranean | -0.11 | -0.11 | -0.11 | -0.11 | -0.05 | -0.12 | -0.13 | -0.13 | -0.10 | -0.10 |
| MiddleEast | -0.14 | -0.11 | -0.14 | -0.12 | 0.09 | -0.20 | -0.25 | -0.21 | -0.04 | -0.08 |
| NAfrica | -0.09 | -0.07 | -0.10 | -0.09 | -0.03 | -0.11 | -0.17 | -0.12 | -0.08 | -0.07 |
| Total | -0.12 | -0.11 | -0.12 | -0.12 | -0.03 | -0.14 | -0.15 | -0.14 | -0.10 | -0.10 |

Statistics in regions and specific stations are available only for AERONET.

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2.1.7 Exploring the observations

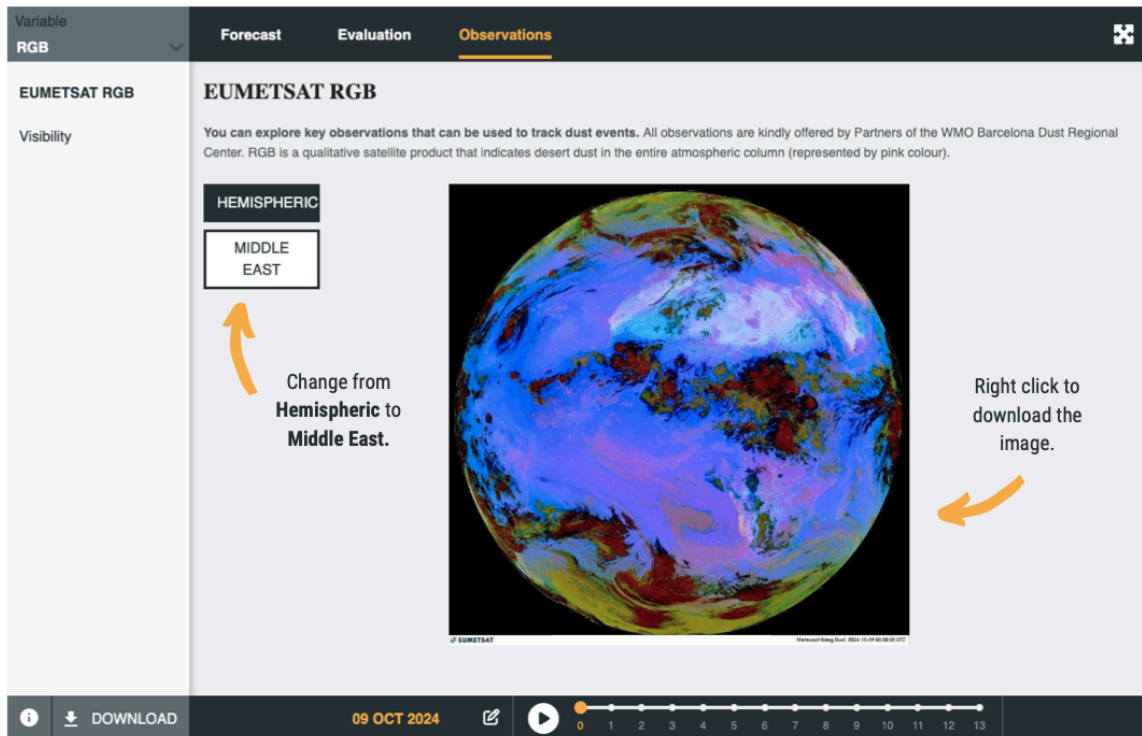
Product: EUMETSAT RGB

The “**Observations**” panel offers a visualisation of key observations that can be used to track sand and dust storms. **The datasets presented here** are different from those used for model evaluation (see [2.1.2 Exploring the evaluation](#)). All observations are kindly offered by [Partners](#) of the WMO Barcelona Dust Regional Center.

This product is an **RGB** (Red, Green, Blue) composite based on three infrared channels of the EUMETSAT SEVIRI, which provides images every 15-minutes. This RGB combination is designed to monitor the evolution of dust storms during both day and night (the presence of dust is associated with pink/magenta colour).

***RGB Image Availability:** RGB timeseries loop will now only show timesteps for available images (Previously 24 timesteps were shown, even when not all the images were available.)

 This product is kindly offered by the European Organisation for the Exploitation of Meteorological Satellites ([EUMETSAT](#)).



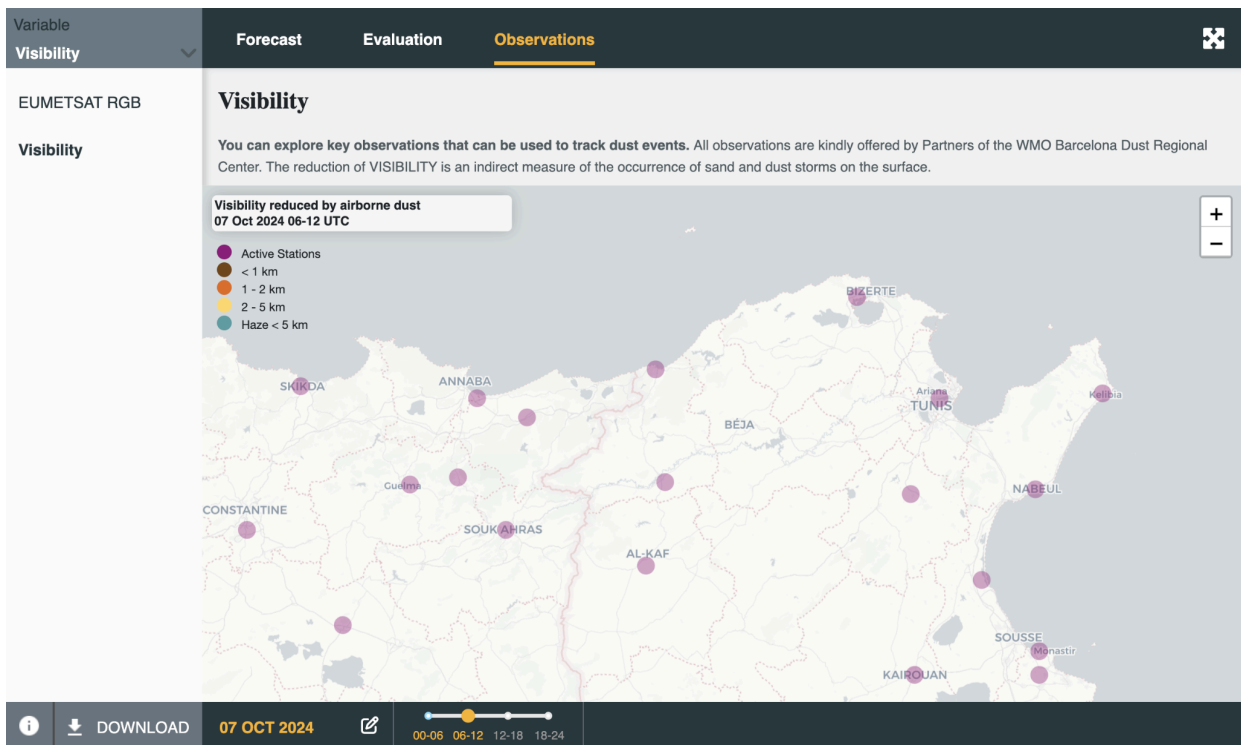
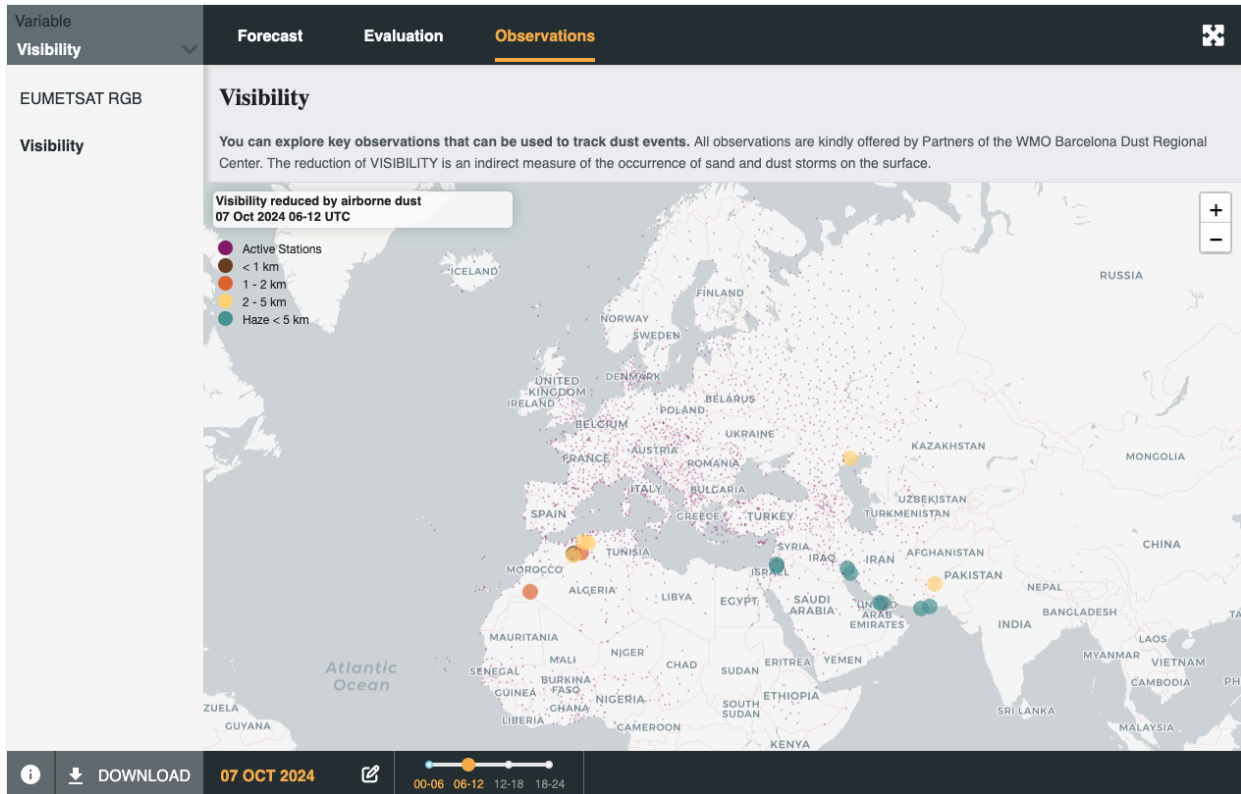
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Product: Visibility

Visibility can be used as an indirect measure of the presence of airborne sand and dust at surface level. This product shows cases of 6-hourly visibility reduction less than 5 km associated with airborne sand or dust reported in METAR (METeorological Aerodrome Reports), SPECI (a special METAR when conditions change significantly at a staffed location) and SYNOP (surface synoptic observations) bulletins. Another category has been added for those stations reporting haze (HZ) with visibility reduction less than 5 km. In these cases, haze could be caused by an aerosol different from dust such as fume, volcanic ash, etc. In addition, this product shows only visibility reduction data with a relative humidity less than 80%. Relative humidity and visibility reduction values are provided along with latitude, longitude, station name via a pop-up window when the cursor points to a station

This product is kindly offered by the AEMET meteorological database.

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Visibility Active Stations. In our Observations section, we will now show all Active Stations on the map that provide data.

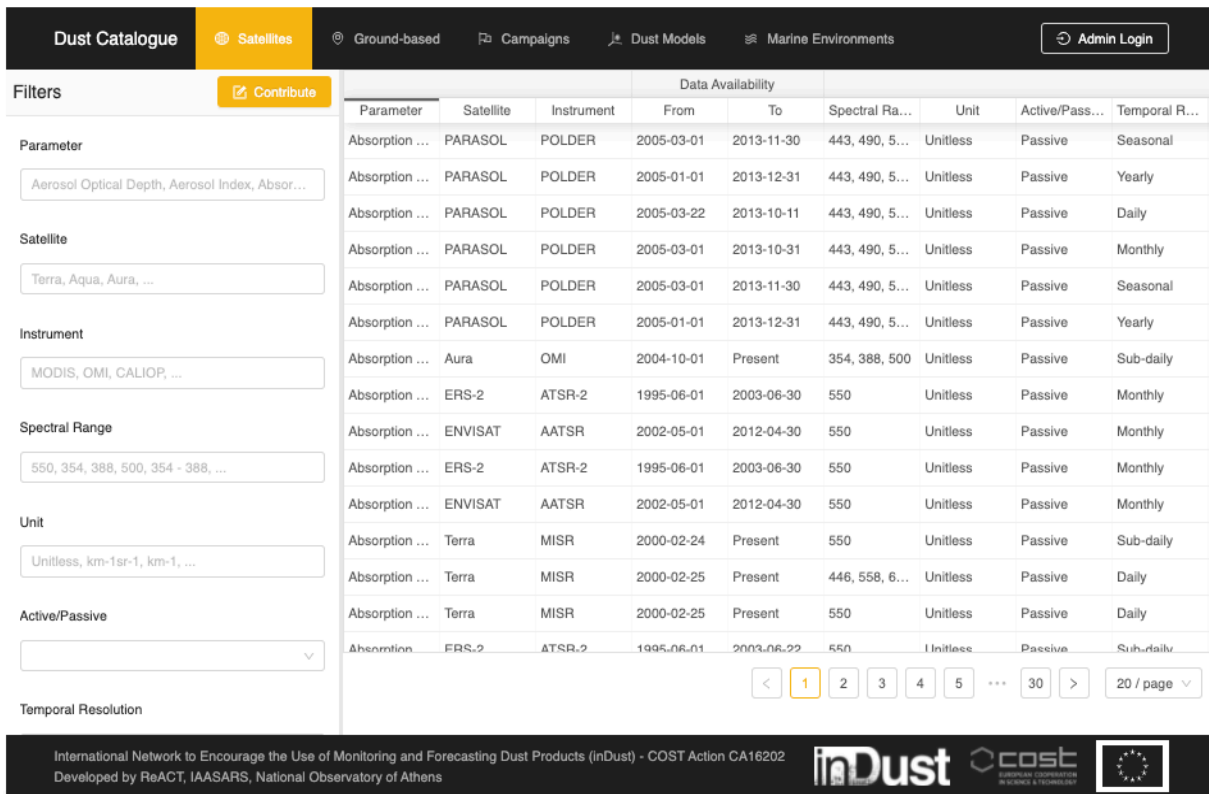
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2.2 Dust Products Catalogue-

A detailed inventory of the available dust observational and modelling products is compiled in the “Dust Products Catalogue”, developed in the framework of the [COST Action inDust](#).

Users can find centralised dust information from different sources (satellites, ground-based networks, experimental campaigns, marine ecosystems and models), as well as the contact details of the person/group in charge of each source. A wide range of filtering options based on parameters, type of measurement/instruments, and region among others, is available to facilitate the search.

 The database was developed by the [National Observatory of Athens \(NOA\)](#) and it is hosted by the [WMO Barcelona Dust Regional Center](#).



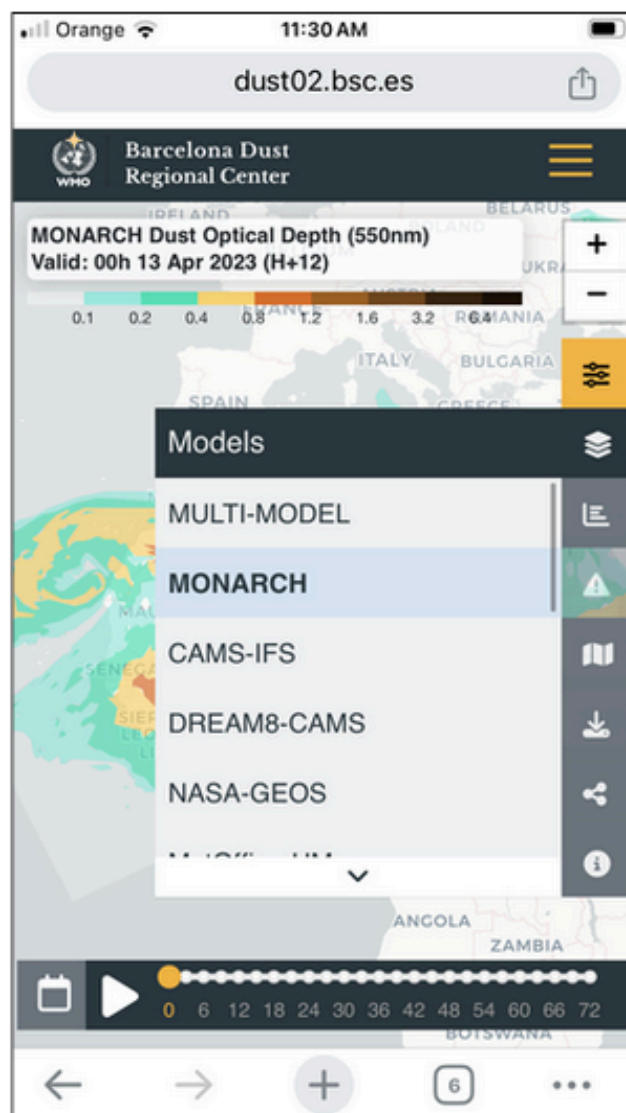
The screenshot shows the 'Dust Catalogue' web application. The top navigation bar includes 'Dust Catalogue', 'Satellites', 'Ground-based', 'Campaigns', 'Dust Models', 'Marine Environments', and an 'Admin Login' button. On the left, there are several filter sections: 'Parameter' (with a search box containing 'Aerosol Optical Depth, Aerosol Index, Absor...'), 'Satellite' (with a search box containing 'Terra, Aqua, Aura, ...'), 'Instrument' (with a search box containing 'MODIS, OMI, CALIOP, ...'), 'Spectral Range' (with a search box containing '550, 354, 388, 500, 354 - 388, ...'), 'Unit' (with a search box containing 'Unitless, km-1sr-1, km-1, ...'), 'Active/Passive' (with a dropdown menu), and 'Temporal Resolution'. The main area displays a table with columns: Parameter, Satellite, Instrument, Data Availability (From, To), Spectral Ra..., Unit, Active/Pass..., and Temporal R... The table lists various dust products, such as 'Absorption ...' from 'PARASOL' and 'Aura' satellites, and 'Absorption ...' from 'ERS-2' and 'ENVISAT' satellites. At the bottom of the table, there are pagination controls showing page 1 of 20.

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2.3 Dashboard for Mobile Phones

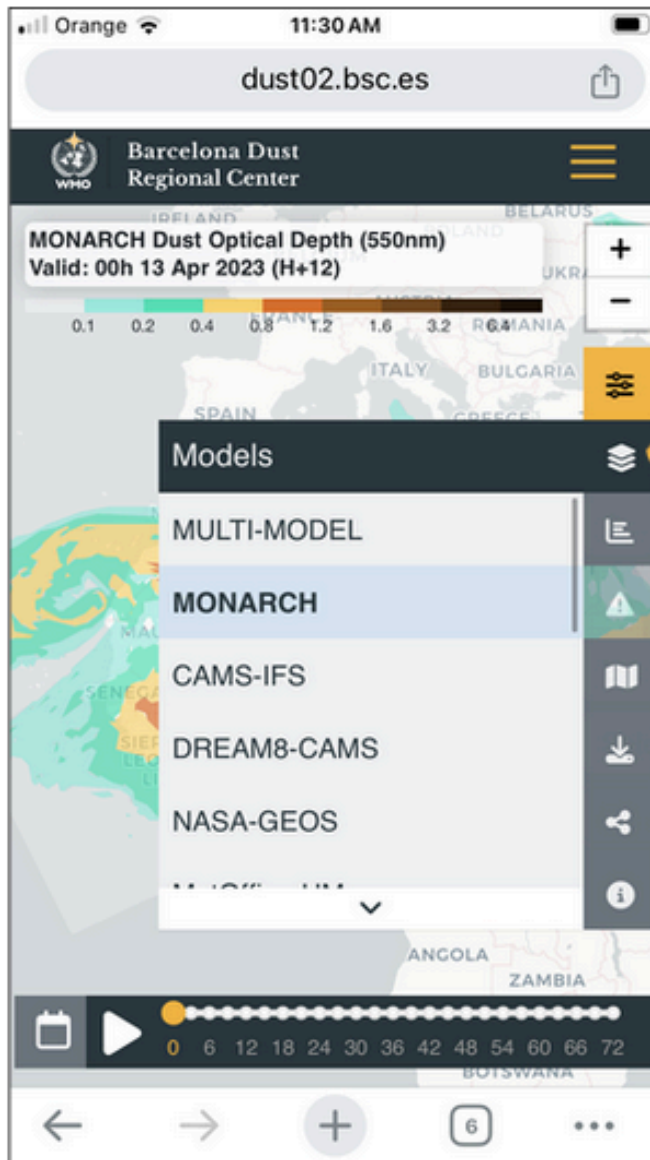
The **Dashboard is accessible through mobile browsers** (optimised for Chrome and Safari) and works in portrait mode (landscape mode not yet supported). The Mobile Dashboard provides **access to the Forecast products** (Models, Probability of Exceedance, and Warning Advisory System). Currently the time series graphs are not yet supported.

Functionalities for the Dashboard are moved to the **right sidebar** to allow for easy access.



All of the main options and menus have been moved into the sidebar.

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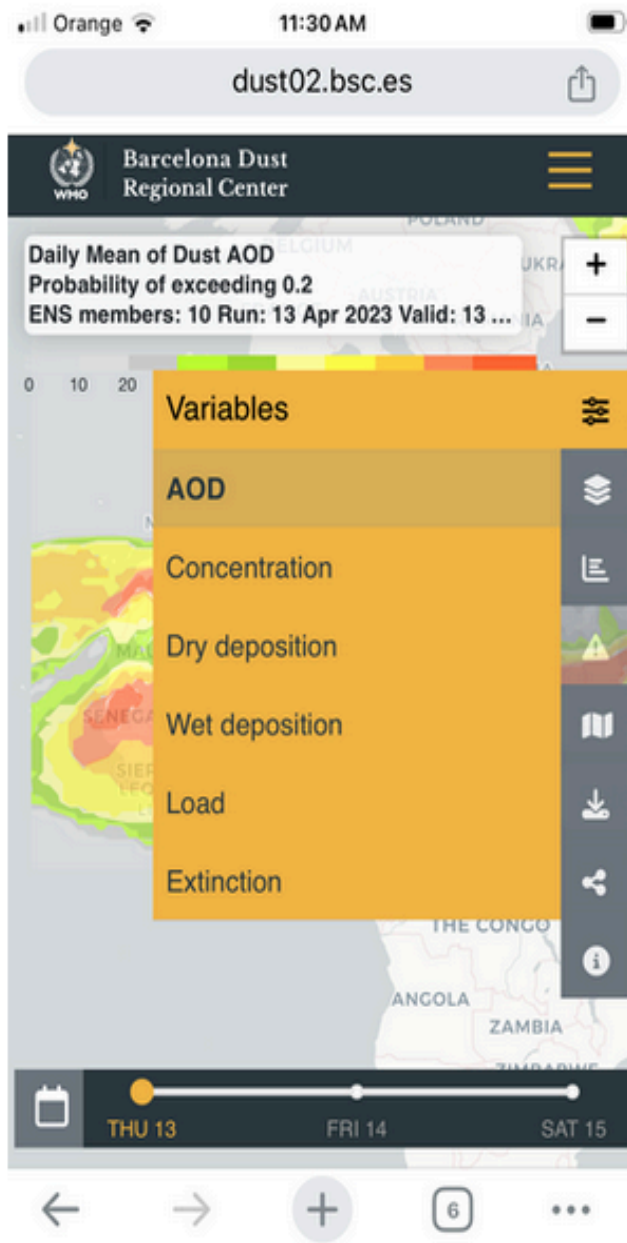


Scroll through and choose models here.

You'll see that all of the sections have titles to allow you to understand which menu you are currently viewing. The **Probability of Exceedance and Warning Advisory System buttons will become transparent and inaccessible** if you change to a Variable that is

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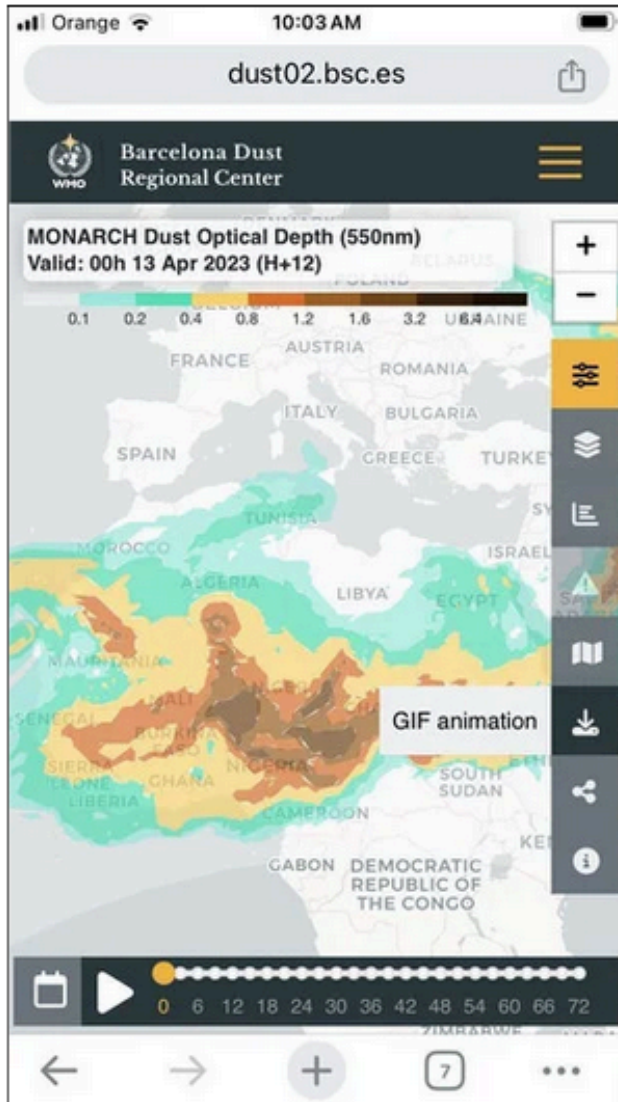
not compatible. An alert will also show to let you know that these products have become inaccessible. **If you click the close button on these alerts, they will not appear again.** If you do not close these alerts, they will automatically disappear after a few seconds, but they will reappear when you change variables again.



Warning Advisory Service menu will become transparent to alert you that it is not available for the selected variable. This will also happen with the Probability menu.

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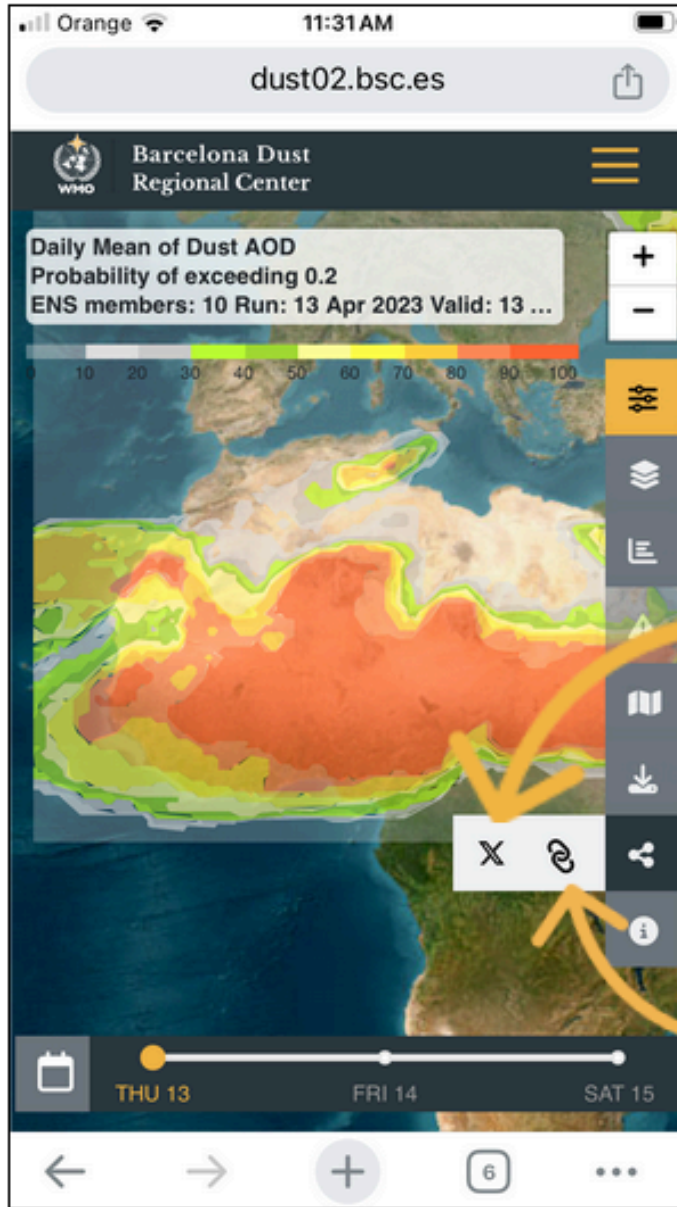
You can **download the animated gifs** of the model loops by tapping the download icon on the sidebar, and then selecting “Gif animation”.



Download Gifs of Model loops

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You can now **copy the URL** directly to your system clipboard to paste or share by selecting the share icon in the sidebar menu. **Sharing to X (Twitter)** is also available in this menu.

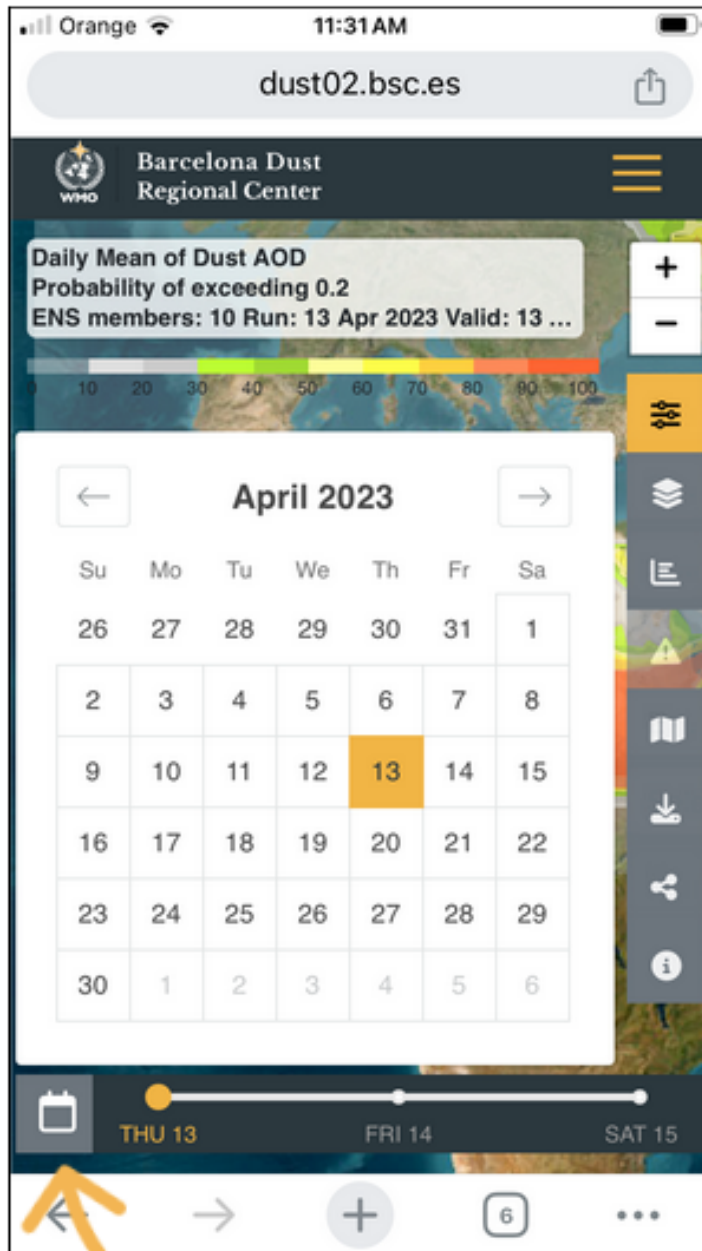


Click the X button to share to Twitter (X)

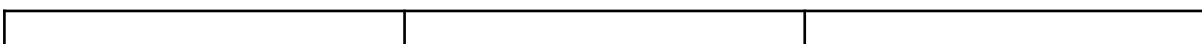
Click the link button to copy the current URL

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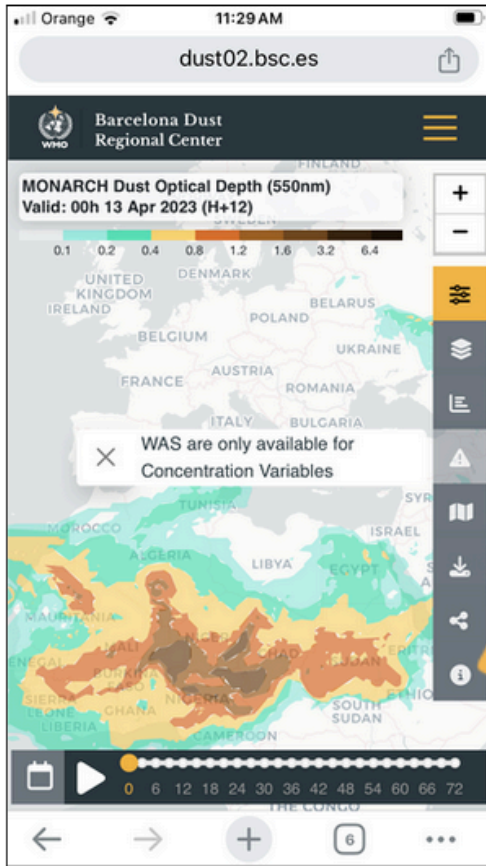
The **calendar** can be brought up by selecting the calendar icon on the bottom floating navbar. You can also switch through the available timesteps or days by tapping a step on the navbar.



Click the Calendar
to choose the date

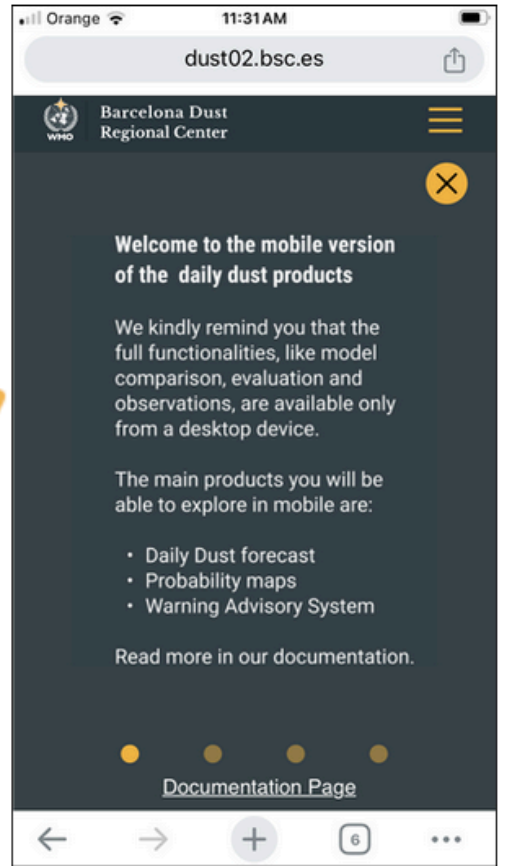


A quick **tour of the mobile Dashboard** is available by tapping the information icon located at the bottom of the sidebar. This will allow you to swipe through cards that detail some of the important aspects and functionalities of the mobile Dashboard.



1. Click the Info icon to bring up the Info Guide and tour

2. Swipe through the pages to get an overview of the app



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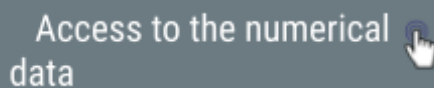
3 Numerical Data Download Service

The WMO Barcelona Dust Regional Center provides easy access to the numerical data of the products available in the website through a THREDDS Data Server (TDS). TDS is a web server that provides metadata and data access for scientific datasets, using remote data access protocols. THREDDS is developed and supported by [Unidata](#), a division of the University Corporation for Atmospheric Research ([UCAR](#)), and is sponsored by the National Science Foundation. The download can be completed using a variety of services (OPeNDAP, HTTPServer, NetcdfSubset).

In order to access and download the numerical data of the daily dust forecasts, registration is needed. User access can be requested via [email](#). Two types of access to the daily dust forecasts are implemented:

- Public, providing access to numerical predictions issued more than 2 days ago.
- Restricted, providing access to all the numerical predictions available for re-distribution, including those issued less than 2 days ago. Access is normally limited to National Meteorological and Hydrological Services and other institutions contributing actively to the WMO Barcelona Dust Regional Center and the SDS-WAS programme. Public administrations, research and educational institutions are eligible to access these services in support of specific activities. Applications will be evaluated and answered within 30 days of the date of the petition.

Once registration is completed, users can access the archive of the numerical data of the daily dust forecasts, according to the type of access that has been granted to them (Public or Restricted).



Access to the numerical data

The repository is divided into two folders (BDRC THREDDS Public Data and BDRC THREDDS Restricted Data). These are divided into various subfolders; one for every model that provides data to the Center.

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| Dataset | Size | Last Modified |
|--------------------------|------|---------------|
| EDRC_THREDDS_Public_Data | | -- |
| WRF-WMO/ | | -- |
| SILAM/ | | -- |
| NOA/ | | -- |
| NCEP-GEFS/ | | -- |
| NASA-GEOS/ | | -- |
| MetOffice-UM/ | | -- |
| MULTI-MODEL/ | | -- |
| MONARCH/ | | -- |
| LOTOS-EUROB/ | | -- |
| ICON-ART/ | | -- |
| EMA-ResCM4/ | | -- |
| DREAMS-CAMS/ | | -- |
| CAMS-IFS/ | | -- |

Each of the models' folders contain the published dust daily forecasts ordered per year and month (including those models decommissioned, e.g. BSC-DREAM8b). After selecting a specific month, users can access the list of files that can be downloaded. When users select a specific file, the available download links appear.

Initial TDS Installation

THREDDS Data Server

Catalog <https://dust.aemet.es/thredds/catalog/dataRoot/MULTI-MODEL/2021/12/catalog.html>

Dataset: 12/20211231_3H_MEDIAN.nc

- Data size: 3.772 Mbytes
- Data type: GRID
- ID: publicDatasetScan/MULTI-MODEL/2021/12/20211231_3H_MEDIAN.nc

Access:

1. **OPENDAP:** /thredds/dodsC/dataRoot/MULTI-MODEL/2021/12/20211231_3H_MEDIAN.nc
2. **HTTPServer:** /thredds/fileServer/dataRoot/MULTI-MODEL/2021/12/20211231_3H_MEDIAN.nc
3. **NetcdfSubset:** /thredds/ncs/dataRoot/MULTI-MODEL/2021/12/20211231_3H_MEDIAN.nc

Dates:

- 2022-01-01T01:35:12.054Z (modified)

Viewers:

- [NetCDF-Java ToolsUI \(webstart\)](#)
- [Integrated Data Viewer \(IDV\) \(webstart\)](#)

Alternatively, the download of files can be done through the command line, by using the following commands:

Download a file

```
wget --user="USER" --password="PASSWORD"
"https://dust.aemet.es/thredds/fileServer/dataRoot/MODEL/YEAR/MONTH/FILE"
```

example:

```
wget --user="USER" --password="PASSWORD"
"https://dust.aemet.es/thredds/fileServer/dataRoot/MONARCH/2020/12/2020123112_3H_SDSWA
S_NMMB-BSC-v2_OPER.nc"
```

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Subsetting time, latitude, longitude and variable

```
wget --user="USER" --password="PASSWORD"
"https://dust.aemet.es/thredds/ncss/dataRoot/MODEL/YEAR/MONTH/FILE.nc?var=OD550_DUST&
var=SCONC_DUST&north=NORTH&west=WEST&east=EAST&south=SOUTH&horizStride=1&time_start=TIME_START&time_end=TIME_END&timeStride=1&addLatLon=true&accept=netcdf4"
```

example:

```
wget --user="USER" --password="PASSWORD" -O 20201231_3H_MEDIAN_test.nc
"https://dust.aemet.es/thredds/ncss/dataRoot/MULTI-MODEL/2020/12/20201231_3H_MEDIAN.nc
?var=OD550_DUST&var=SCONC_DUST&north=50.0000&west=-20.0000&east=50.0000&south=0.00
00&horizStride=1&time_start=2020-12-31T12%3A00%3A00Z&time_end=2021-01-01T12%3A00%3A
00Z&timeStride=1&addLatLon=true&accept=netcdf4"
```

4 How to cite

The WMO Barcelona Dust Regional Center must be acknowledged as the source of information in any materials (graphs, articles, papers, written scientific works, etc.) derived from the numerical data, visualisations or products available in the [Center's official webpage](#).

A citation example is shown below, which should be adapted accordingly:

"Dust data and/or images were provided by the WMO Barcelona Dust Regional Center and the partners of the Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS) for Northern Africa, the Middle East and Europe."

In addition, it is strongly recommended to include the [reference](#) article per model(s) in the Bibliography. A more detailed explanation of how to appropriately acknowledge the Center can be found in the [Data Policy](#).

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User support (contact)

Users can get in touch with the WMO Barcelona Dust Regional Center for additional information through the [Contact](#) page.

Additionally, for issues concerning the models that contribute to the Center, users can consult the [contact details](#) of the modelling groups.

To stay informed about the latest activity of the Center, users can subscribe to the [newsletter](#).



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