

CAMS Profile Plotter Tool

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2024/08/20

Introduction :

CAMS Profile Plotter Tool is GUI application designed for visualizing vertical profiles and heat maps of atmospheric pollutants using data from the CAMS Atmospheric Data Store (ADS). The tool simplifies the process of working with NetCDF files, providing streamlined options for viewing, cropping, and analyzing atmospheric data.

Its primary focus is on facilitating vertical profile analysis, making it easier to interpret pollutant distribution across different atmospheric layers.

Instructions:

Features :-

1. Quick Check for NetCDF Dimensions
2. NetCDF Time Slicing
3. Crop NetCDF
4. Generate Vertical Plot
5. Generate Heat Map

>>Check your NC File Dimensions<<

NetCDF Time Slicer

Enter the parameters within the dimension of your nc file.
You can check your dimension by clicking the button above.

Keep the range of longitude within -180 to 180 degrees

Select NetCDF Files to Crop: Browse

Output Directory: Browse

Longitude Min:

Longitude Max:

Latitude Min:

Latitude Max:

Crop NetCDF

Select NetCDF Files: Browse

Start Date (2021-01-01T00:00:00):

End Date (2021-01-30T00:00:00):

Longitude:

Latitude:

Variable Name:

Generate Vertical Plot

Generate Heat Map

Written by: Dipson.B (2024)

Fig 1 : Main Graphical User Interface.

1.Quick Check For NetCDF Dimensions

Use the NetCDF file dimensions to quickly review the available variables, number of time steps, and the range of latitudes present after selecting a NetCDF (.nc) file.

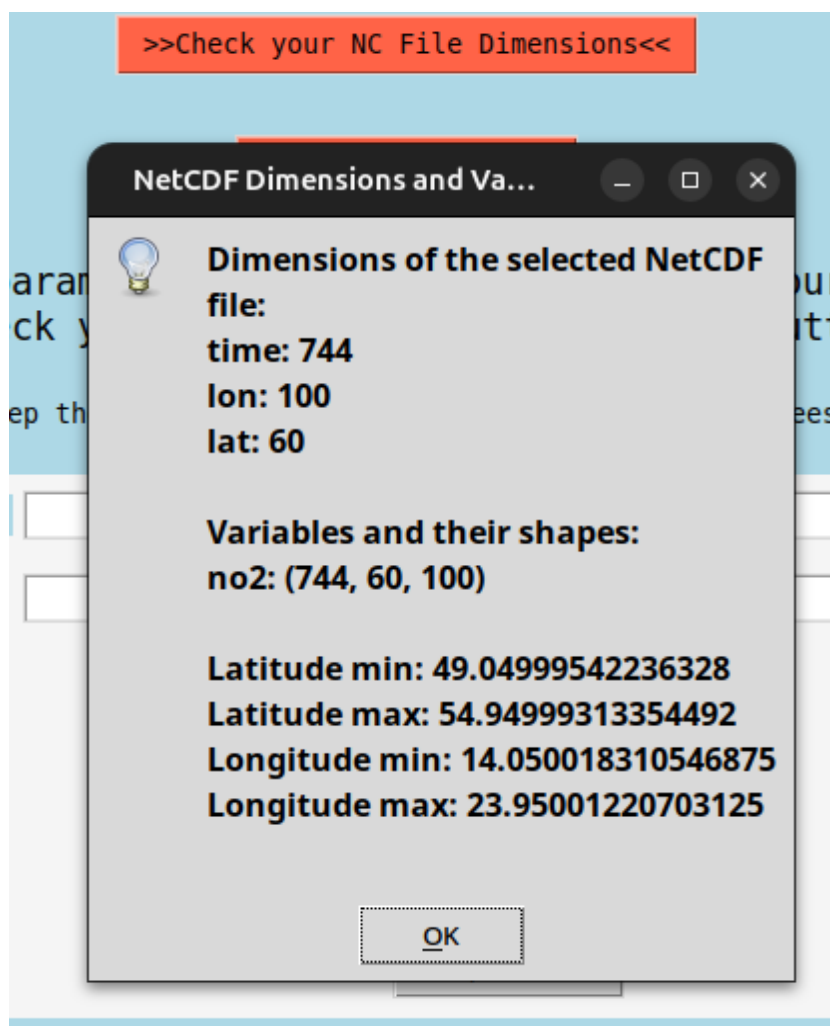


Fig 2 : Check Dimension feature for quick review of NetCDF file.

2. Cropping NetCDF file

The 'Crop NetCDF' option allows users to extract a specific region from the NetCDF file by specifying the desired minimum and maximum latitude and longitude values. In this example, Germany has been cropped from (.nc) file.

Fig 3 : Interface to Crop NetCDF File.

```
dipson@dipson-Nitro-AN515-55:/mnt/sdrive/old_Documents/verticals/Verticals/processed$ cdo sinfo CAMS_analysis.nc
File format : NetCDF4
-1 : Institut Source T Steptype Levels Num Points Num Dtype : Parameter ID
1 : unknown unknown v instant 1 1 294000 1 F32 : -1
Grid coordinates :
1 : lonlat : points=294000 (700x420)
lon : 335.05 to 44.95001 degrees
lat : 30.05 to 71.95 by 0.1 degrees

dipson@dipson-Nitro-AN515-55:/mnt/sdrive/old_Documents/verticals/Verticals/processed/cropped$ cdo sinfo CAMS_analysis_cropped.nc
File format : NetCDF4
-1 : Institut Source T Steptype Levels Num Points Num Dtype : Parameter ID
1 : unknown unknown v instant 1 1 8100 1 F32 : -1
Grid coordinates :
1 : generic : points=8100 (100x81)
lon : 5.550018 to 15.45001 by 0.09999994
lat : 47.05 to 55.05 by 0.1 degrees
```

Fig 4 : Results of Cropping tool displayed using Climate Data Operators(CDO) in the terminal.

2. NetCDF Time Slicer

The NetCDF Time Slicer is used to trim NetCDF files based on specified time ranges. Additionally, users can select specific variables, as well as define minimum and maximum latitude and longitude values for more precise variable-level slicing.

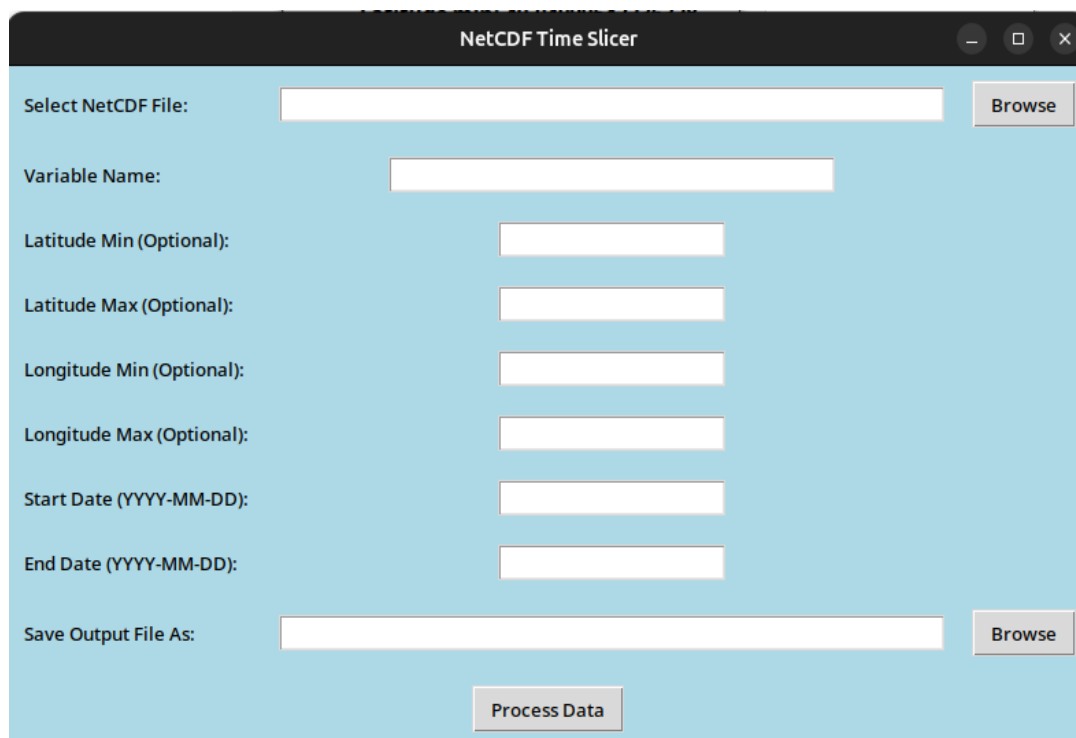
The image shows a software window titled "NetCDF Time Slicer". It has a light blue background and a dark grey title bar with standard window controls (minimize, maximize, close). The interface contains several input fields and buttons. At the top, there is a "Select NetCDF File:" label followed by a text input field and a "Browse" button. Below this is a "Variable Name:" label followed by a text input field. Next are four optional fields: "Latitude Min (Optional):", "Latitude Max (Optional):", "Longitude Min (Optional):", and "Longitude Max (Optional):", each with its own text input field. These are followed by "Start Date (YYYY-MM-DD):" and "End Date (YYYY-MM-DD):" labels, each with a text input field. At the bottom, there is a "Save Output File As:" label followed by a text input field and a "Browse" button. A "Process Data" button is located at the very bottom center of the window.

Fig 5 : Interface for Slicing NetCDF file based on Time or Latitude and Longitude.

To begin, select the desired NetCDF file by clicking the "Browse" button. Then, enter the variable name you wish to extract (e.g., `no2`, `temperature`, etc.). You can optionally define the minimum and maximum latitude and longitude values to crop a specific geographical region; if left blank, the entire spatial extent will be used. Next, specify the start and end dates in the format `YYYY-MM-DD` to filter the data by time. Finally, provide a name and location to save the output file, and click "Process Data" to generate the trimmed NetCDF file based on your selections. This tool is useful for focusing on specific time periods, regions, or variables from large NetCDF datasets.

Generating Vertical Plot

The 'Generate Vertical Plot' option allows user to visualize the vertical profile of a selected variable over a specified time range and location. In the examples mentioned below vertical plots of NO₂ have been generated for the periods 2021-01-01 to 2021-01-30 and 2021-01-01 to 2021-01-07.

The interface is divided into two main sections for data input. The top section, titled 'NetCDF Time Slicer', includes a red button '>>Check your NC File Dimensions<<' and instructions to enter parameters within the dimension of the NC file, with a note to keep longitude within -180 to 180 degrees. It features input fields for 'Select NetCDF Files to Crop' (with a 'Browse' button), 'Output Directory' (with a 'Browse' button), and ranges for 'Longitude Min', 'Longitude Max', 'Latitude Min', and 'Latitude Max'. A 'Crop NetCDF' button is at the bottom of this section. The bottom section contains input fields for 'Select NetCDF Files' (with a 'Browse' button), 'Start Date (2021-01-01T00:00:00):', 'End Date (2021-01-30T00:00:00):', 'Longitude:', 'Latitude:', and 'Variable Name:'. A 'Generate Vertical Plot' button is located below these fields. At the very bottom, there is a footer 'Written by: Dipson.B (2024)' and a 'Generate Heat Map' button.

>>Check your NC File Dimensions<<

NetCDF Time Slicer

Enter the parameters within the dimension of your nc file.
You can check your dimension by clicking the button above.

Keep the range of longitude within -180 to 180 degrees

Select NetCDF Files to Crop: /mnt/sdrive/old_Documents/verticals/Verticals/processed/level1_poland.nc Browse

Output Directory: Browse

Longitude Min:

Longitude Max:

Latitude Min:

Latitude Max:

Crop NetCDF

Select NetCDF Files: /mnt/sdrive/old_Documents/verticals/Verticals/processed/level1_poland.nc Browse

Start Date (2021-01-01T00:00:00): 2021-01-01T00:00:00

End Date (2021-01-30T00:00:00): 2021-01-30T00:00:00

Longitude: 21

Latitude: 52

Variable Name: no2

Generate Vertical Plot

Written by: Dipson.B (2024) Generate Heat Map

Fig 6 : Interface for generating Vertical Plots based on time limits , coordinates and Pollutant.

To begin, click "Browse" to select a NetCDF file. Next, specify the start and end dates in the format YYYY-MM-DDTHH:MM:SS to define the time range of interest. Enter the longitude and latitude coordinates where the vertical profile should be extracted. Then, provide the variable name (e.g., no2) that you want to analyze. Once all fields are filled, click "Generate Vertical Plot" to create a plot showing how the variable behaves at different vertical levels over time at the selected location.

The examples below show vertical profiles of NO₂ at the coordinates 21.0° longitude and 52.0° latitude, generated for two different time periods: from January 1 to January 30, 2021, and from January 1 to January 7, 2021.

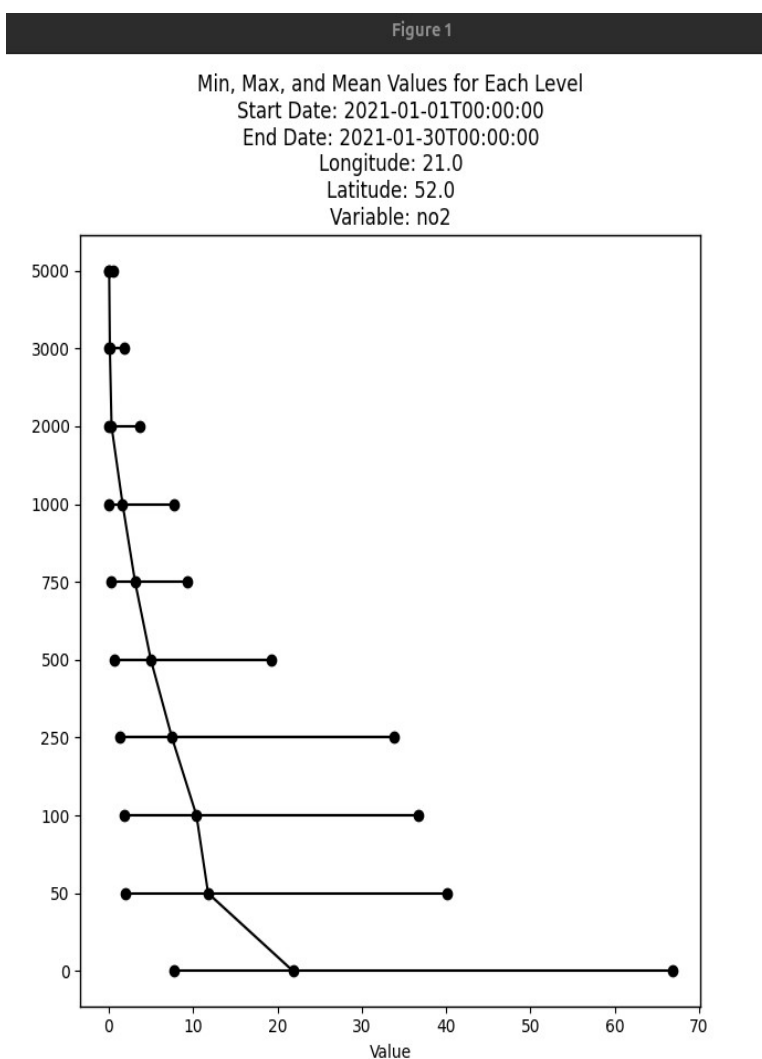


Fig 7: Vertical Plot for NO₂ at different levels over a month at Specific coordinate

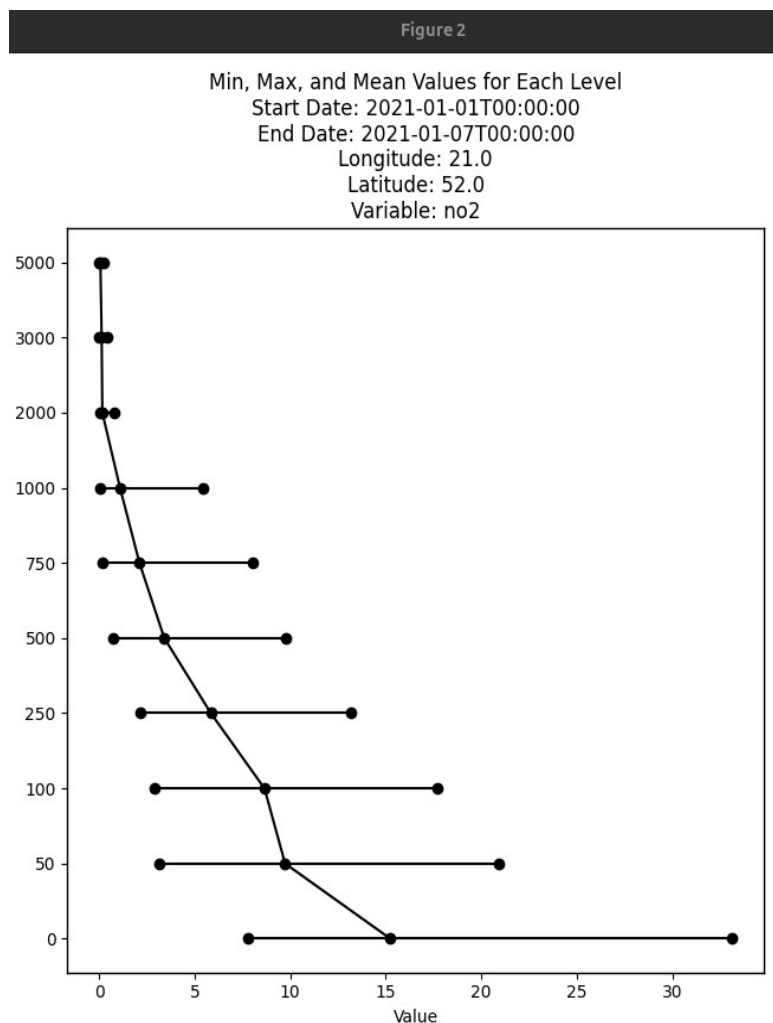


Fig 8: Vertical Plot for NO2 at different levels over a week at Specific coordinate

5. Generating Heat Maps .

The process of generating a heat map consists of two primary steps: initially transforming into a DataFrame, followed by creating the heat maps based on the refined data.

Steps:

- Select Generate HeatMap
- Click on Generate DataFrame
- Choose either Hourly Heat Map or Daily Heat Map

In the example below, both the Hourly and Daily Heat Maps were generated for the period from January 1, 2021, to January 30, 2021.

The image shows two parts of the CAMS Profile Plotter Tool interface. On the left is a small, partially visible window with a 'Generate Heat Map' button. On the right is the main application window, which has a light blue background and a black border. It contains several input fields and buttons for configuring the heat map generation process.

NetCDF Files:

Browse

Variable Name (Designated for heatplot):

Output Directory for generated CSV File:

Browse

Generate Dataframe

#####

Make sure to generate dataframe before plotting Heatmap

Hourly Heat Map

Daily Heat Map

Fig 9 : Interface for generating Heat Maps for Pollutants

HOURLY HEAT MAP FOR POLLUTANT

Hourly Pollution Heatmap

CSV File Path:

/mnt/sdrive/old_Documents/verticals/Verticals/processed/com

Browse

Start Time (YYYY-MM-DD HH:MM:SS):

2021-01-01 00:00:00

End Time (YYYY-MM-DD HH:MM:SS):

2021-01-30 00:00:00

Latitude:

52.22

Longitude:

21.01

Generate Heatmaps

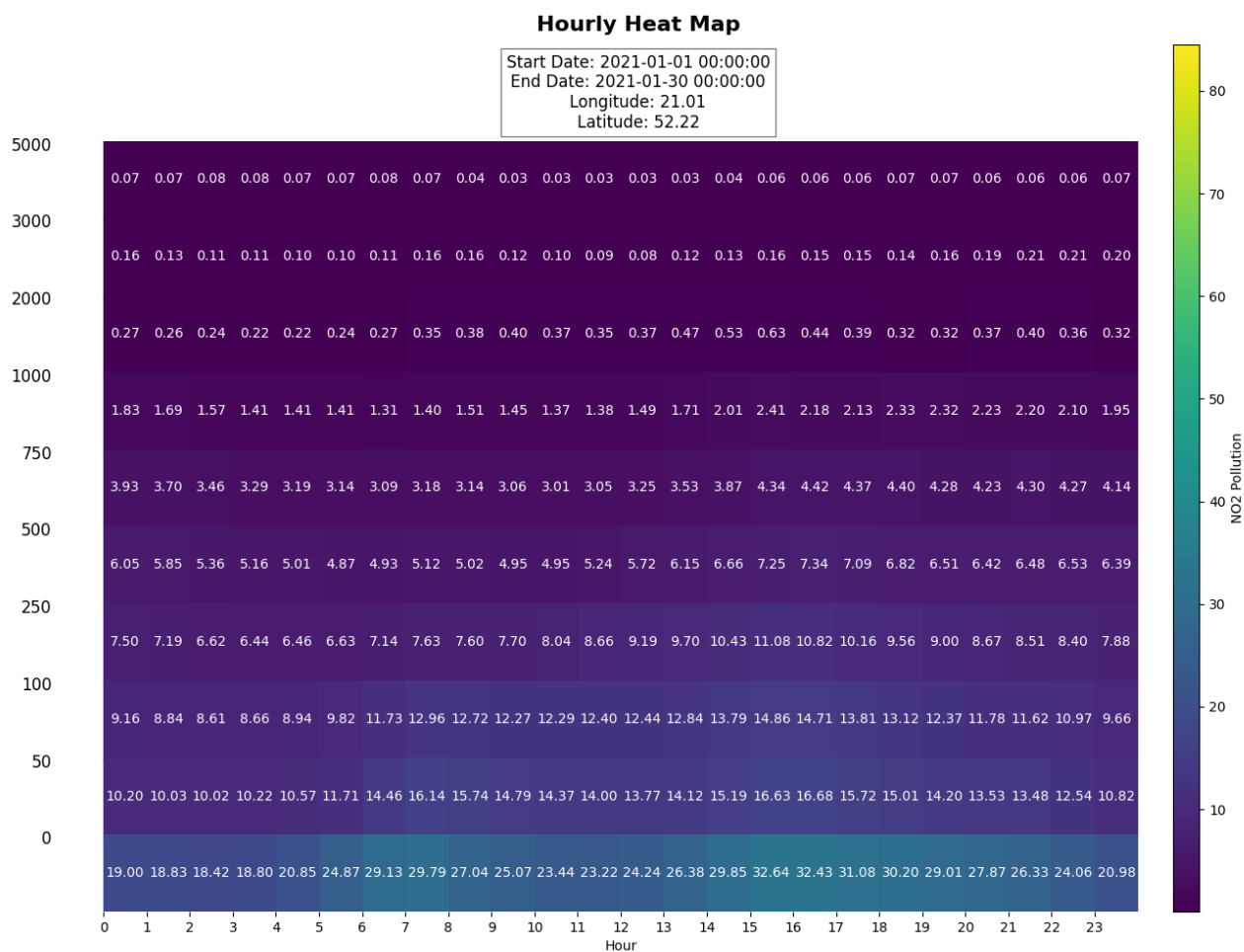


Fig 10 : Hourly Heat Map for the given setting.

DAILY HEAT MAP

The Daily Heat Map displays the average concentration for each day within the selected timeframe at various levels.

In the given example, a Daily Heat Map for NO₂ has been generated for the month of January 2021.

The screenshot shows a web-based interface for generating heatmaps. It features a light blue background with a white border. At the top, there is a label "Data File:" followed by a text input field containing the path "/mnt/sdrive/old_Documents/verticals/Verticals/processed/cor". Below this is a "Browse" button. Further down, there are two time selection fields: "Start Time (YYYY-MM-DD HH:MM:SS):" with the value "2021-01-01 00:00:00" and "End Time (YYYY-MM-DD HH:MM:SS):" with the value "2021-01-30 00:00:00". Below the time fields are two location fields: "Latitude:" with the value "52.22" and "Longitude:" with the value "21.01". At the bottom, there is a "Generate Heatmaps" button. The interface is designed for data visualization and analysis.

Data File:

/mnt/sdrive/old_Documents/verticals/Verticals/processed/cor

Browse

Start Time (YYYY-MM-DD HH:MM:SS):

2021-01-01 00:00:00

End Time (YYYY-MM-DD HH:MM:SS):

2021-01-30 00:00:00

Latitude:

52.22

Longitude:

21.01

Generate Heatmaps

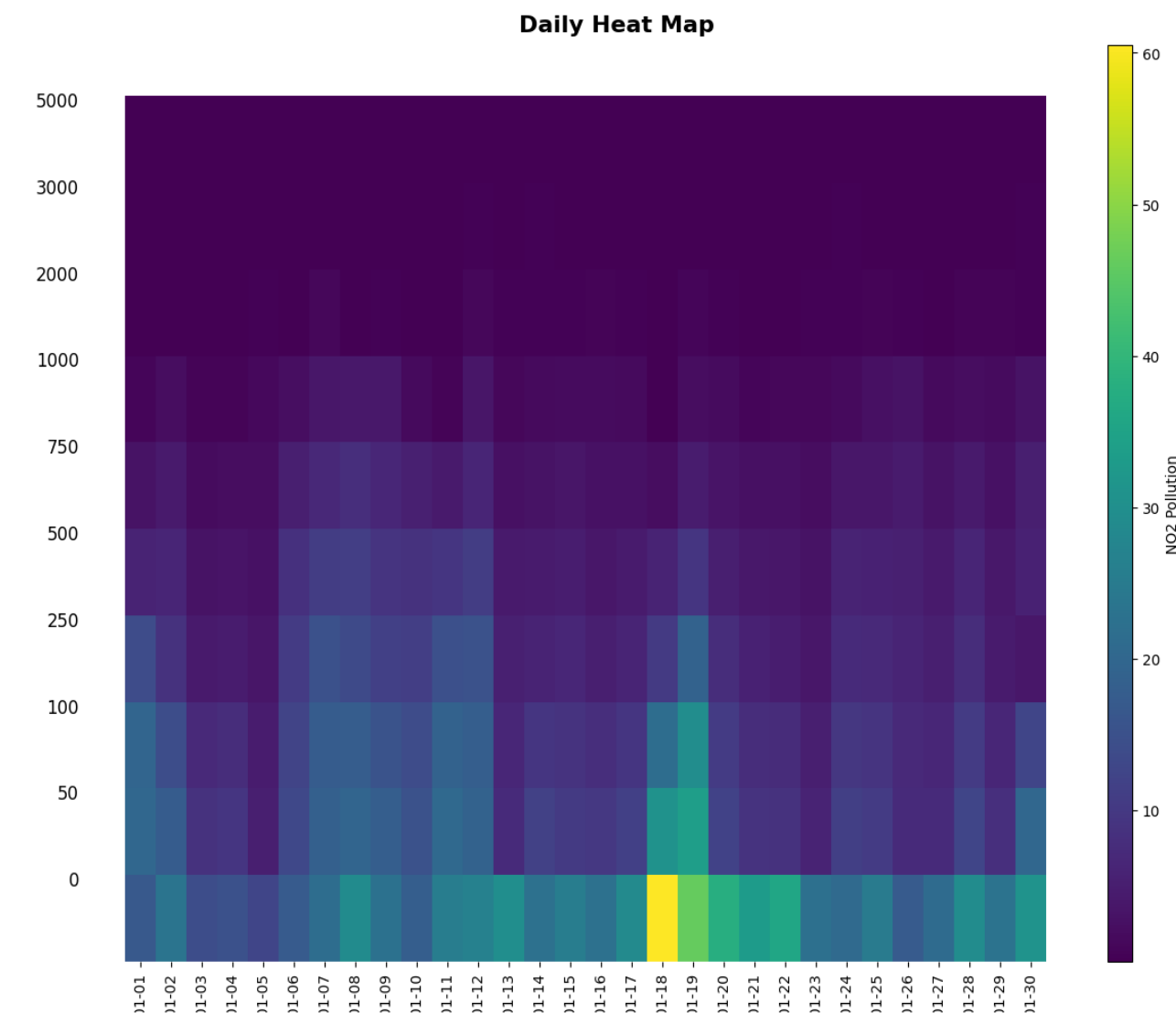


Fig 11 : Daily Heat Map of Pollutant for given setting

References :

1. Copernicus Atmosphere Monitoring Service (CAMS). Atmosphere Data Store. (<https://ads.atmosphere.copernicus.eu/>)