THE ECCAD DATABASE: ACCESS TO A VARIETY OF INVENTORIES OF EMISSIONS FOR GREENHOUSE GASES AND AIR POLLUTANTS

Sabine DARRAS[1], Claire GRANIER[2,3], Cathy LIOUSSE[2], Thierno DOUMBIA[2], Sekou KEITA[2], Antonin SOULIÉ[2]

[1]*Observatoire Midi-Pyrénées, Toulouse, France*
[2]*Laboratoire d'Aérologie, Université de Toulouse, CNRS/UPS, Toulouse, France*
[2]*NOAA Chemical Sciences Laboratory–CIRES/University of Colorado, Boulder, CO, USA*

Abstract: ECCAD (Emissions of atmospheric Compounds and Compilation of Ancillary Data: eccad.aeris-data.fr) is the emissions database of the GEIA (Global Emission InitiAtive: geiacenter.org) international project. ECCAD provides a user-friendly access to many datasets of emissions, as well as detailed metadata for each of the datasets. ECCAD includes various tools for data visualization, computation of global and regional totals, and for interactive spatial and temporal analysis. The data are interoperable NetCDF CF-compliant files. The presentation will provide information on the datasets available in ECCAD, as well as examples of the analysis work that can be done online.

Keywords : Emissions ; Future scenario ; Data analysis; Database

Introduction

ECCAD (Emissions of atmospheric Compounds and Compilation of Ancillary Data: eccad.aeris-data.fr) is the emissions database of the GEIA (Global Emission InitiAtive: geiacenter.org) international project, which represents a community effort dedicated to emissions information exchange. The ECCAD database provides a user-friendly access to global and regional surface emissions for a large set of chemical compounds (greenhouse gases, atmospheric pollutants, aerosols and their precursors) and ancillary data (land use, active fires, burned areas, population, etc). The emissions inventories consist of different datasets at the global and regional scales, at various spatial resolutions from 0.05x0.1 to 1x1 degree in latitude and longitude. They are developed by groups in different world countries. The emissions are provided from the pre-industrial period to the end of the 21st century, on a daily, monthly or yearly basis, depending on the dataset and for different origins, anthropogenic, fires and natural (i.e vegetation, soils, oceans, volcanoes) and for a large set of sectors (i.e. energy, industries, transportation, agriculture, etc.).

1. ECCAD portal

ECCAD (http://eccad.aeris-data.fr) is developed as part of the French Atmospheric Data Center AERIS (http://www.aeris-data.fr). ECCAD has currently more than 2000 users originating from more than 80 countries. The project benefits from the large GEIA international community of users, who actively contribute to extend the number of available emission datasets.

The portal distributes more than 80 inventories, and half the inventories include emissions from anthropogenic or biomass burning sources, for CO, NO2, SO2 and particles/precursors emissions.

In the following paragraphs, we present the tools that can be used to evaluate the emissions from different inventories available in ECCAD, and provide some examples of the results.

2. Maps of the emissions

In ECCAD, after selecting the inventories, users can draw maps of the emissions for all the species, types of emissions and sectors. Figure 1 shows an example of maps that can be drawn by the users, for the emissions of PM2.5 by biomass burning from the GFAS inventory (https://atmosphere.copernicus.eu/global-fire-emissions), and for the PM2.5 anthropogenic emissions from the EDGARv5 inventory (Emission Database for Global Atmospheric Research: data.jrc.ec.europe.eu/ collection/edgar) inventory.
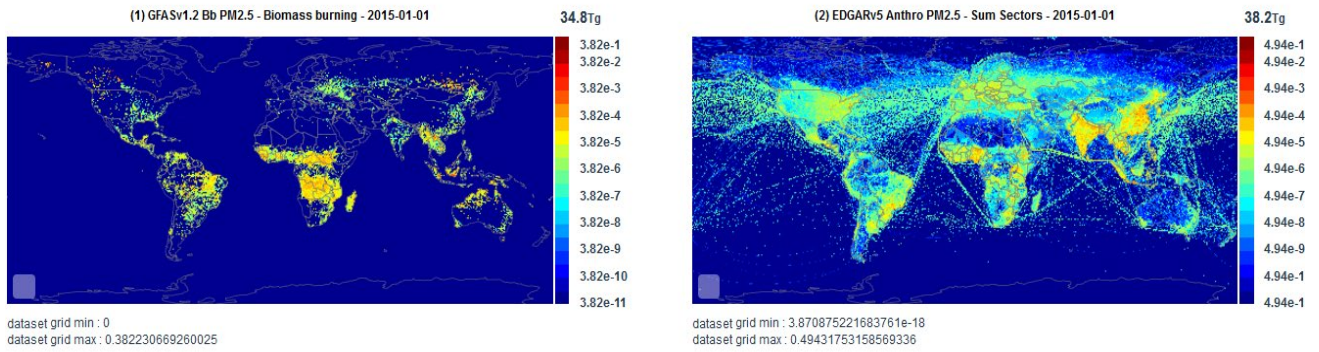
figure 1. PM2.5 emissions from biomass burning (left) and from anthropogenic sources (right) in 2015.

Another example of the maps than can be generated in ECCAD is given in Figure 2, which displays the distribution of ships emissions in 2022 from the CAMS-GLOB-ANT version 5.3 inventory (see companion paper from Soulié et al. in the conference).
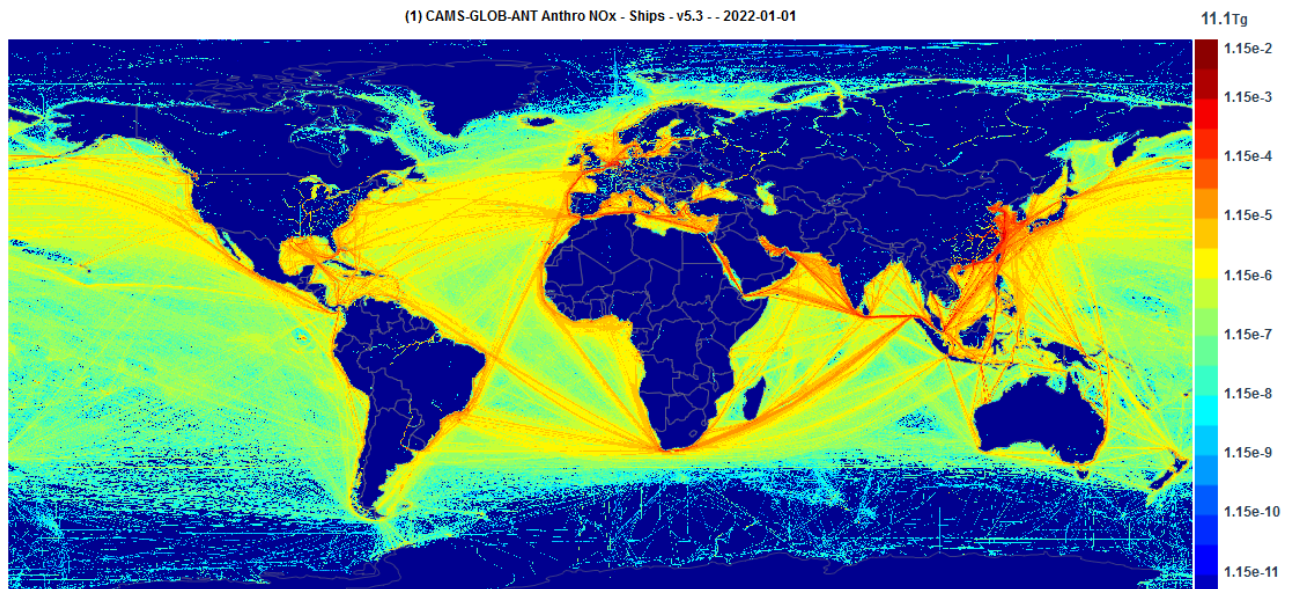

figure 2. SO2 global ship emissions for year 2022

3. Map Comparison tool

ECCAD includes a tool allows to compare maps, in order to understand the location of the differences between two datasets, and to display the differences in the emissions provided by an inventory at different periods. An illustration is given in Figure 3 (top), which compares the CO2 distribution 2000 and 2021 from the CAMS-GLOB-ANT inventory. This comparison shows the large increase in CO2 emissions in most regions of the world, except for Europe. Figure 3 (bottom) shows another comparison, for the BC anthropogenic emissions between 1950 and 2019 from the CEDS inventory (McDuffie et al., 2020). This comparison shows the impact of the regulations in pollutant emissions in Europe and North America, as well as the large increase in emissions in most areas of Asia, Latin America and Africa.
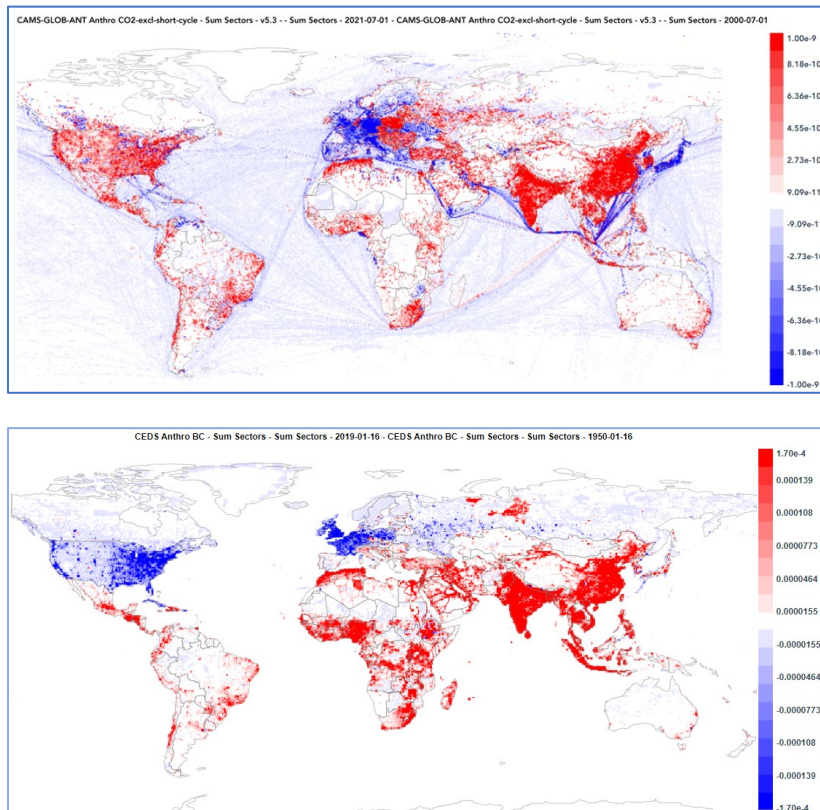
figure 3. Change in CO2 emissions from 2000 to 2021 from the CAMS-GLOB-ANT version 5.3 inventory (top) and change in BC emissions between 1950 and 2019 from the CEDS inventory (bottom)

4. Time series tool

ECCAD includes tools that can be used to plot time series and compare time series. This tool includes a comparison of different types of emissions, together with comparisons that can be done by countries, regions and the global scale. Figure 4 shows an example, where anthropogenic emissions from the EDGARv5 inventory are compared with the fires emissions provided by the GFAS dataset, for Asia (left) and Africa (right). Figure 4 shows that, for Africa, emissions from fires were dominant in the 2000s, but, with the growth of anthropogenic emissions in this region, anthropogenic emissions might become soon of the same magnitude as the emissions from fires.
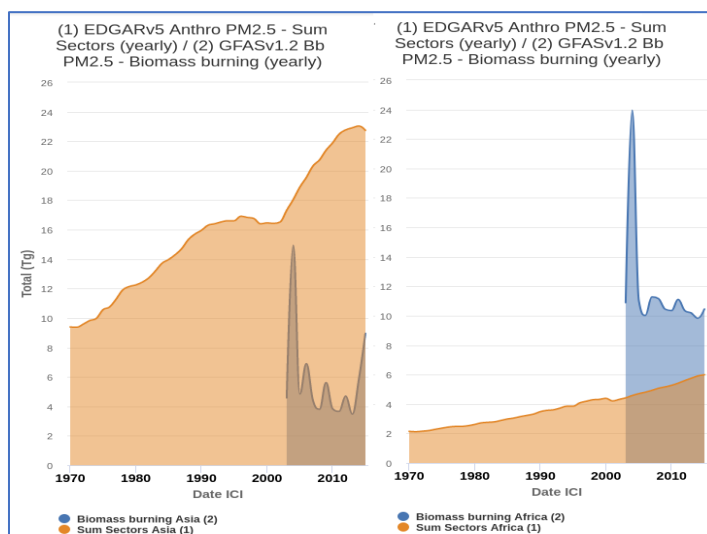

figure 4. Biomass burning and anthropogenic black carbon emissions for year 2015 for Asia (left) and Africa (right)

ECCAD can also be used to compare different time series, in order to have a general look at the inventories. Figures 5 show an example of the time series for global CO anthropogenic emissions from the beginning of the 20th century to 2060, and Figure 6 show the time series for global BC from the start of the preindustrial period to 2020. These graphs show the large differences between the inventories: to understand better these differences, analyses by sectors can then be done by the users as shown in section 5.
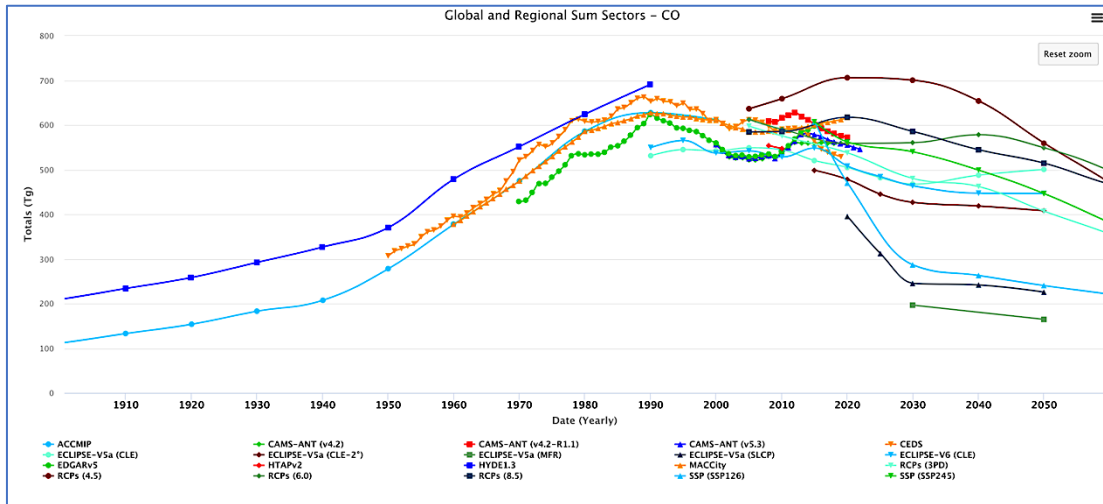

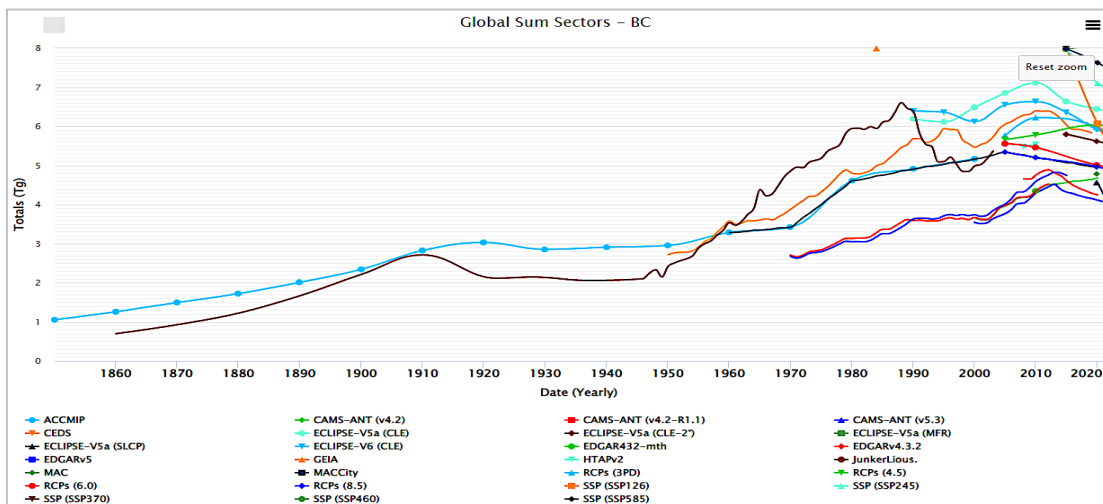**figure 5**. Yearly CO emissions for various inventories.

figure 6. Black carbon time series from historical period 1860 to 2020.

5. Tool for sectors analysis

Most of the inventories available in ECCAD are provided for different sectors. Information on the different sectors are provided in the ECCAD catalog. A tool for the analysis of the emissions provided by different sectors is also available in ECCAD. Figure 7 shows two examples of the analysis that can be done, for the NOx (left) and SO2 (right) anthropogenic sources from the CAMS-GLOB-ANT version 5.3 inventory. This figure highlights that the NOx major emission sources are transportation, power generation and industry sectors. Shipping accounts for nearly the same amount than road transportation. For SO2, power generation and industry processes account for the major part of the emissions with less than 1% contribution from road transport and up to 10% from ships.
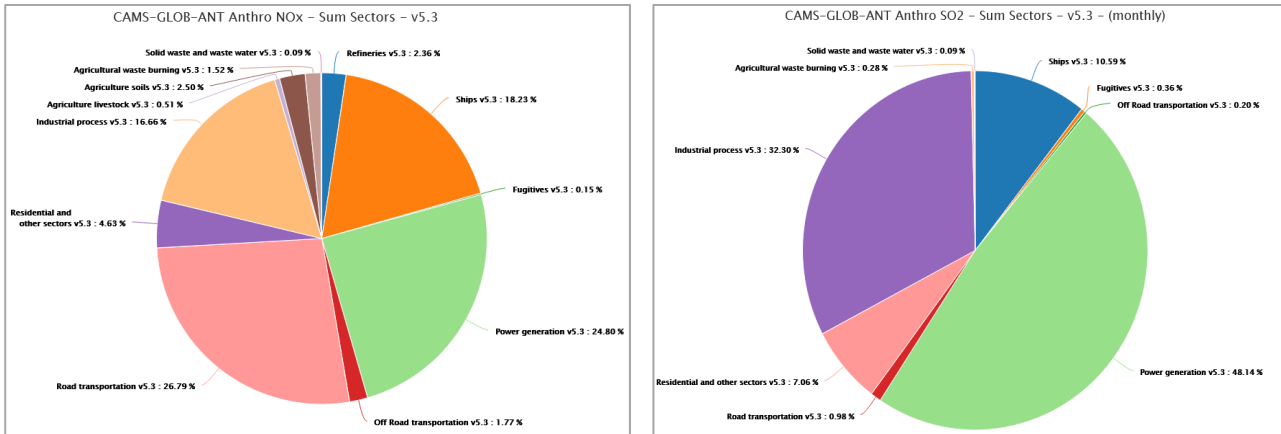
figure 7. Contribution of different sectors to the global emissions of NOx (left) and SO2 (right)
(percentage over the 2000-2020 period)

6. Tools for point source emissions

ECCAD also includes point sources emissions. An example of such sources is the emissions of SO2 from continuously degassing volcanoes. Figure 8 shows an example of these emissions, from the CAMS-GLOB-VOLC dataset, based on the observations from the NOVAC network (Arellano et al., 2021). The emissions are very variable in time, and ECCAD allows a detailed analysis of these emissions, for each volcano included in the dataset.
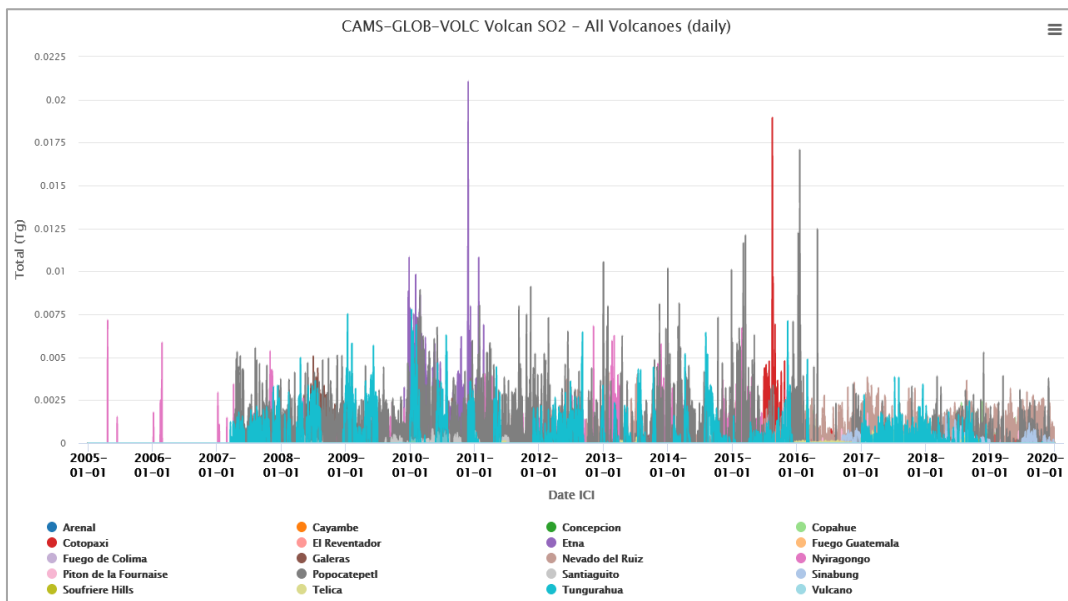

figure 8. SO2 daily emissions from NOVAC volcanoes.

Conclusion

ECCAD is the database of the GEIA network, which provides an access to a large number of emissions datasets. In the presentation, we will provide an online demonstration of the ECCAD system, and show how users can analyze in a user-friendly way the emission datasets included in ECCAD. Details on the download of the datasets will also be provided during the demonstration.

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