THE ECCAD DATABASE, VERSION 2: Emissions of Atmospheric Compounds & Compilation of Ancillary Data

AUTHORS

Sabine Darras, Observatoire Midi-Pyrénées, Toulouse, France

Claire Granier, Observatoire Midi-Pyrénées, Toulouse, France; Laboratoire d'Aérologie, Université de Toulouse, CNRS, UPS, Toulouse, France; NOAA/ESRL & CU/CIRES, Boulder, Colorado, USA

Catherine Liousse, Laboratoire d'Aérologie, Université de Toulouse, CNRS, UPS, Toulouse, France

Damien Boulanger, Observatoire Midi-Pyrénées, Toulouse, France

Nellie Elguindi, Laboratoire d'Aérologie, Université de Toulouse, CNRS, UPS, Toulouse, France

Hung Le Vu, Observatoire Midi-Pyrénées, Toulouse, France

BACKGROUND

For the past decade, ECCAD (Emissions of Atmospheric Compounds and Compilation on Ancillary Data) has been the emissions database for the IGAC/iLEAPS sponsored Global Emissions IniAtive (GEIA).

1. INTRODUCTION

THE ANALYSIS OF THE COMPOSITION OF the atmosphere, and its changes within space and time, requires an accurate quantification of surface emissions, as well as their spatial and temporal distribution. Since 1990, the GEIA (Global Emissions IniAtive) has brought together groups working on the development of emission datasets with the diverse users of these data, helping to create and distribute large amounts of information on emissions.

For the past decade, ECCAD (Emissions of Atmospheric Compounds and Compilation on Ancillary Data) has been the emissions database for the GEIA project (See **IGACnews issue 46, March 2012**). ECCAD was initially developed in order to provide easy access to a large number of emission data, together with analysis tools, to the scientific community and users. Recently, a new version of the database has been developed, which is detailed in this paper: the first version of the database will soon be disconnected, and all providers and users of ECCAD are invited to obtain an account on the new ECCAD version (see section 3 for details).

2. THE FIRST ECCAD DATABASE

The first version of the ECCAD database started in 2005 with the goal of providing easy access to emission data at both the global and regional scale, for anthropogenic, biomass burning and natural emissions. When available, the emission data were provided for different sectors related to fossil fuel and biofuel consumption, industry and agricultural sources, wildfires, deforestation and savannah fires. Natural emissions were also available, including emissions from the vegetation, soils and oceans. The compounds considered in the portal were ozone precursors, greenhouse gases, aerosols and their precursors, organo-halogens, and a few heavy metals. For each of the global and regional inventories, ECCAD provided an access to the emission data files in the NetCDF format, total annual emission data, pre-calculated emission maps for all the species, metadata and documentation on the inventory, and a visualization tool for comparing pre-calculated maps.

This first version of ECCAD had several issues: it could only accommodate datasets at a 0.5x0.5 or 1x1 degree spatial resolution. In addition, as the number of users has increased steadily over the past

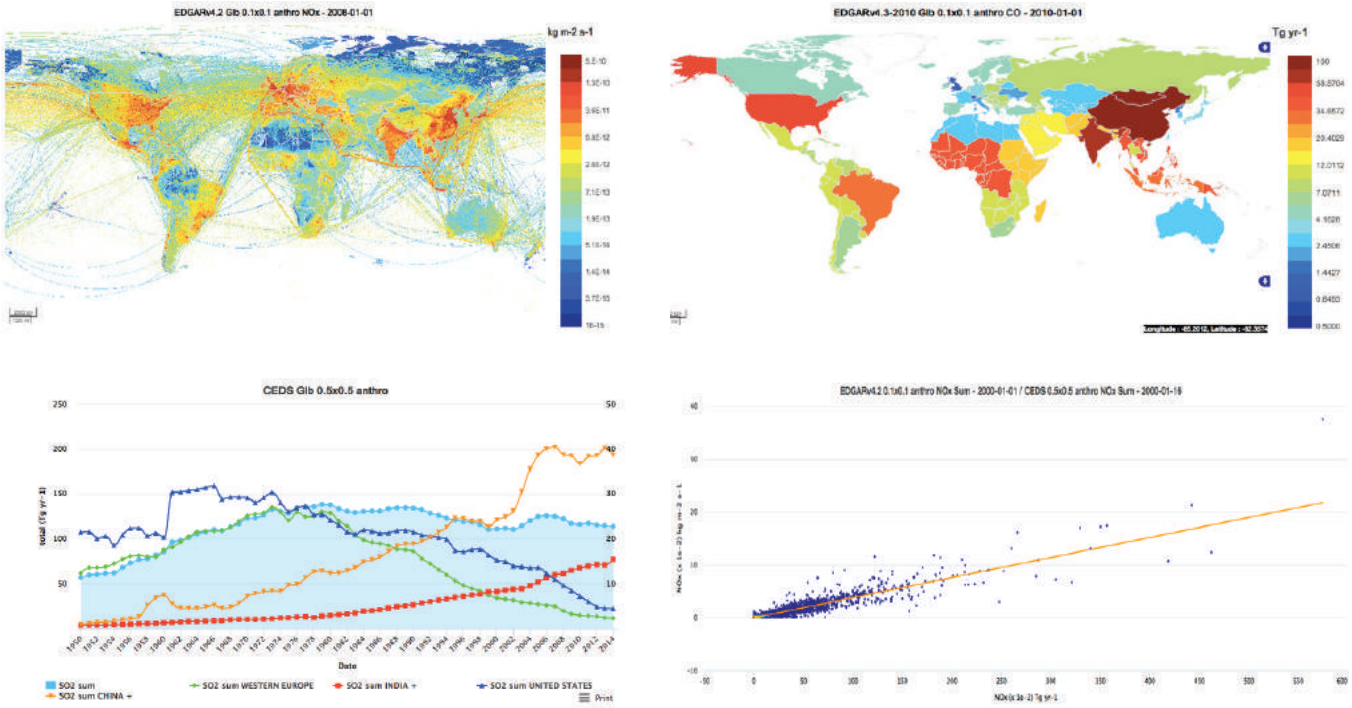

FIGURE 1. Examples of the ECCAD visualization tools, spatial distribution of the emissions (top left), totals emitted for different regions (top right), time series of total emitted (global and for several regions, bottom left), and scatter plot (correlation between NOx emissions from EDGAR4.3 and CEDS for 2010).

few years, reaching more than 2,800 users to date, the technical and computational demands has also increased considerably. In order to make the database more adapted to current gridded emissions data, and to make ECCAD more efficient while many users are connected at the same time, it was decided to start the development of a new version of the database. This database is now fully operational and is described in the following sections.

This first version of ECCAD, located at **http://eccad.sedoo.fr**, will be disconnected in the Spring of 2018. All users are therefore invited to obtain an account to the new version of ECCAD, as indicated in the next section.

3. THE NEW VERSION OF THE ECCAD DATABASE

ECCAD is developed as part of the French AERIS portal (Data and Service for the Atmosphere: **http://www.aeris-data.fr**), which offers access to various products related to atmospheric sciences, such as surface, in-situ and satellite observations, laboratory and spectroscopic information, modeling tools and surface emissions.

Within AERIS, and with the support of the French National Institute for Earth Sciences and Astronomy (CNRS-INSU), the French National Center for Space Studies (CNES), the Copernicus Atmosphere Monitoring Service (CAMS), the French Environment and Energy Management Agency (ADEME) and the United States Environment Protection Agency (US EPA), the new version of the ECCAD database has been developed.

The application can now handle datasets of any resolution, and includes several new data analysis tools, a new download system and a detailed documentation on the features of the database. The ECCAD website has a new graphical chart, with a responsive web design, improved ergonomics and navigation. The URL of the ECCAD database is **http://eccad.aeris-data.fr**.

The ECCAD portal relies on a postgreSql database where all the metadata and the parameters for the application are stored. ECCAD uses Thredds map server, which offers friendly visualization options: zoom, color tables, scale ranges (logarithm or linear). Totals and regional statistics are pre-calculated allowing data quality assessment and on-line quick interactive data analysis.

4. DATA AVAILABLE IN ECCAD

The current list of surface emissions data available in ECCAD is shown in Table 1. It includes emissions from different regions and time periods, as well as emissions optimized using inverse modeling techniques. In ECCAD,

Acronym	Dates	Resolution	Acronym	Dates	Resolution
GLOBAL INVENTORIES					
MACCity (ANT)	1960 - 2020	0.5x0.5	PKU (ANT)	2002-2013	0.1x0.1
ACCMIP (ANT,BB)	1850 - 2000	0.5x0.5	HYDE1.3 (ANT)	1890-1990	1x1
RCPs (ANT)	2005 – 2100	0.5x0.5	POET (ANT,BB,NAT)	1990-2000	1x1
HTAPv2 (ANT)	2008, 2010	0.1x0.1	GFAS1.3 (BB)	2003-2016	0.1x0.1
CAMS (ANT)	*2000-2018*	*0.1x0.1*	GFAS1.2 (BB)	2003-2015	0.1x0.1
EDGARv4.3 (ANT)	1970-2010	0.1x0.1	GFED4 (BB)	1997-2015	0.25x0.25
EDGARv4.2 (ANT,BB)	1970-2008	0.1x0.1	GFED3 (BB)	1997-2010	0.5x0.5
EDGARv4tox1 (ANT)	1970-2008	0.1x0.1	IS4FIRES (BB)	2000-2011	0.5x0.5
CEDS (ANT)	1950-2014	0.5x0.5	GICC (BB)	1900-2005	1x1
ECLIPSEv5 (ANT)	1990-2050	0.5x0.5	GUESS-ES (BB,NAT)	1970-2009	1x1
ECLIPSEv4 (ANT)	2005-2050	0.5x0.5	*CAMS (NAT)*	*2000-2018*	*0.5x0.5*
RETRO (ANT, BB)	1960-2000	0.5x0.5	MEGAN-MACC (NAT)	1980-2010	0.5x0.5
J&Liousse (ANT)	1860-2003	1x1	MEGANv2 (NAT)	2000	0.5x0.5
Andres-CO2 (ANT)	1950-2011	1x1	IASB-TD-OMI (BB,NAT)	2005-2014	0.5x0.5
REGIONAL INVENTORIES - EUROPE					
TNO-MACC (ANT)	2003-2007	7x7 km	EMEP (ANT)	1980-2020	0.5x0.5
TNO-MACCII (ANT)	2003-2009	7x7 km	APIFLAME (BB)	2012-2014	0.25x0.25
CAMS-Europe (ANT)	*2000-2015*	*7x7km*			
REGIONAL INVENTORIES - ASIA					
REASv2 (ANT)	2000-2008	0.25x0.25	*MarcoPoloKNMI (ANT)*	*2007-2013*	*0.25x0.25*
REASV1 (ANT)	1980-2020	0.5x0.5	SAFAR-India (ANT)	2005	1x1
IASB-TD-OMI (ANT)	*2007-2012*	*0.25x0.25*			
AFRICA					
L14 -Africa (ANT)	2005-2030	0.25x0.25	*DACCIWA (ANT)*	*1990-2015*	*0.125x0.125*

TABLE 1. List of emission inventories currently available in ECCAD, for anthropogenic (ANT), biomass burning (BB) and natural (NAT) emissions. Datasets in italics currently have restricted access.

In order to avoid errors when using the emissions data and to allow meaningful comparisons between the datasets, all emissions are provided with the same unit, i.e. kg/m2/s. The values of the mass of each species has been harmonized, and are indicated in the item "species" of the ECCAD catalogue. In order to avoid errors in the conversion from the standard unit to molecules/cm2/s, as commonly used in models, the molar masses of the compounds are given in the files downloaded from the system.

In order to make the database more adapted to current gridded emissions data, and to make ECCAD more efficient while many users are connected at the same time, it was decided to start the development of a new version of the database. This database is now fully operational.

the access to the emission data can be made either public, or restricted to a subset of users. The latter can be useful, for example, during on-going projects when users can ask the ECCAD team to include their data and restrict the access, so that they can use all the ECCAD tools for evaluating and analyzing their data. It is expected that all data with restricted access will eventually become public, after the publications on the datasets are completed.

5. EMISSION ANALYSIS TOOLS

Several analysis tools are available within ECCAD, including visualization tools, and calculations of totals emitted at the global scale, per continent, region or country. Totals can be calculated for a specific period of time, for a specific sector and for different regions. Tools to compare datasets, such as scatter plots, are also available. Examples are given in Figure 1.

6. DOWNLOAD AND FORMAT OF THE DATA

Most data are downloadable and different options are given to the users: emissions for a single species or a group of species can be downloaded, and download restricted to a specific region will be available soon.

The format of the data is Netcdf-CF compliant format, version 4, which provides a native compressed format. Emissions statistics for each species and sector (when available) are now provided as csv files, which can be downloaded together with the Netcdf files.

7. HOW TO CITE AND CONTRIBUTE

All the datasets are provided with metadata, providing information on the dataset (spatial and temporal coverage and resolution, the methodology used to generate the data), as well as information on the acknowledgements that all users are required to use in publication, i.e. the citation of the dataset used in the work reported in the publication, as well as an acknowledgment of the ECCAD database.

The current users of ECCAD are very diverse, which allows ECCAD to continuously expand the number of datasets available to the community. All colleagues interested in increasing the visibility of their data are invited to contact the ECCAD team: the ECCAD team will work on the formatting of the data for their inclusion in ECCAD, so providers are encouraged to submit their data, even if they are in a non-classic format. The ECCAD team will work with the providers for the development of the metadata.

Further improvements will be made to the ECCAD database in the forthcoming months, such as the inclusion of non-gridded data and the development of tools to compare gridded and non-gridded data, the development of more efficient download tools including a regridding system to different grids defined by the users, and continuous improvements to the visualization and analysis tools. IGAC