Global Carbon Atlas

A web portal for the carbon cycle

Many contributors:
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Patrick Brockmann
Corinne Le Quéré
Pep Canadell
Vanessa Maigne
Pascal Evano
Anna Peregon
Robert J. Andres
Glen Peters
Roisin Moriarty
....
Why a Global Carbon Atlas?

- The increase in CO$_2$ is the primary cause of climate change
- CO$_2$ emissions are growing rapidly
- The need for reliable, public and published data
- The need of easily accessible information for different users

The Global Carbon Project mobilized research laboratories worldwide to upload the latest scientific data on the carbon cycle
Three applications of the Global Carbon Atlas

Scientists:
Interactive maps & time series of natural CO₂ fluxes (50 models)

General public:
Evolution of CO₂ and climate change scenarios for the IPCC

Policymakers:
Interactive visualization of fossil CO₂ emissions
Emissions, the state of the world in 2012

→ Need for Transparent and reliable data, for the CO₂ emissions, covering long period (1960 to 2013)

More information, data sources and data files at www.globalcarbonproject.org

Recent features: China, 5.9% growth in emissions in 2012
Evolution of the carbon intensity in the economy of China
China per capita emissions comparable to EU but well below USA
The overall balance of CO$_2$ emitted by humans

More than half of total human emissions absorbed by natural carbon sinks

How to best communicate these results (IPCC-like) to the general public?

Source: Le Quéré et al 2013; CDIAC Data; NOAA/ESRL Data; Global Carbon Project 2013
Emissions and Sinks in 2012

Visualizing human impact

WHERE DOES IT COME FROM?  WHO PRODUCED IT?  WHERE DOES IT GO?  WHEN WAS IT Emitted?

= 100 Mt of CO₂ (human emissions in 2012)

Both the ocean and land are continuing to remove emissions. Year-to-year variations are the largest on land, with some years being the most important cleaner of atmospheric carbon dioxide while others contributing little.

WHAT'S NEXT?
Take a look at the future

Designed by WEDODATA
Discovery tools of the carbon cycle
Applications to serve the scientific community

- Crucial to share “model” results and compare them to quantify & understand the uncertainties
- CATLAS currently supported by more than 25 research laboratories with C-cycle model outputs

Current products:

- Models of the ocean carbon (TRENDY, CMIP5,...)
- Data assimilation products (Atmospheric inversions, satellite based product,...)
- Vegetation carbon models (TRENDY, CMIP5,...)
Need for innovative technology

To view large volumes of data

With interactive viewing facilities

- Global maps of carbon fluxes and other related variables
- Time series of integrated fluxes/stocks for any regions
- Regional budgets
2010, heat wave in Russia seen by vegetation models
Mean Land ecosystem model net CO2 flux
Stippled areas: Stand-dev < threshold
Google earth export facilities...
Time series: N. Hemis net land carbon sink (Atm. inversions)

Interactive plotting facility with interactive capabilities:
- change X, Y axis
- filter the data
- add/remove product
Regional budget: interactive display of region/processes

**Regional Carbon Cycle Assessment and Processes**

- Fossil fuel emissions
- Wood products decay
- Crop products consumption
- Land use change
- Fires
- NPP
- Heterotrophic respiration
- Freshwater outgassing

- Crop products net trade
- Wood and crop products stocks
- Crop harvest
- Land ecosystem carbon stocks
- Soil C export
- Freshwater carbon stocks

**Click on a region to show all component CO2 fluxes**

- All components for a region
- All regions for selected components
Technical aspect of the research applications..

- latest server infrastructures & web technologies to bring interactivity and flexibility.

- HTTP apache web server
- Thredds Data server
- Java application server Tomcat
- Activated protocols and services
  - OPeNDAP protocols
  - WMS (Web Map Service) / ncWMS
  - NCSS (NetCDF Subset Service)
- PHP server
- Drupal CMS
Architecture of the system...

- Data access: various repositories, possibly remote,
- Data distribution: netcdf files; ascii file for time series
- Generic tool for any 2D time varying field
- Data Quality concern: following GEOVIQUA projet
Summary & Recommendations:

- Any C-portal should be an international effort with associated scientific teams (such as the Global Carbon Project); quality insurance!

- Portal Design / Graphics / Interpretations should be designed by Carbon cycle scientists...

- Portal should be interactive, well referenced, updated regularly, with different design for different audiences, with “help” facilities to navigate.

- Data policy is critical! Need to ensure proper PIs credit

- Current CATLAS portal technology can be used and extended for any surface Essential Climate Variables
Thank you for your attention!
(peylin@lsce.ipsl.fr)

Questions : contact@globalcarbonatlas.org
Facebook: https://www.facebook.com/globalcarbonproject
Twitter: https://twitter.com/gcarbonproject
**Scientific team**

**Philippe Ciais**
Dr. Philippe Ciais is the head of the Atmospheric Composition Department at the Laboratoire des Sciences du Climat et de l'Environnement. He is an expert in carbon cycle research and has authored more than 300 articles in A-ranking scientific journals, and was lead author of the IPCC 4th assessment report - for which he was one of the co-recipients of the Nobel Peace Prize in 2007 - and of the IPCC 5th assessment report. Philippe Ciais co-chaired the Global Carbon Project from 2007 to 2013; he helped to design and coordinate the implementation of the Global Carbon Atlas.

**Pep Canadell**
Dr. Pep Canadell is Executive Director of the Global Carbon Project and Research Group Leader at the Commonwealth Scientific and Industrial Research Organization (CSIRO) in Australia. His work involves internationally coordinated research on the human perturbation of the carbon cycle, global and regional carbon sources, sinks, and pools, and the mitigation requirements for climate stabilization. He has contributed to the 4th and 5th Assessment Reports of the IPCC, and holds a number of advisory roles in national and international research committees.

**Corinne Le Quéré**
Corinne Le Quéré is Professor of Climate Change Science and Policy at the University of East Anglia and Director of the Tyndall Centre for Climate Change Research. She conducts research on the interactions between climate change and the carbon cycle. Prof Le Quéré was author of the 3rd, 4th and 5th Assessments Reports of the IPCC, co-Chair of the Global Carbon Project (2007-2013), and is now a member of the science committee of Future Earth. She has overseen the design and implementation of the Emissions component of the Carbon Atlas, and is leading the GCP effort to update the Global Carbon Budget on an annual basis.

**Philippe Peylin**
Dr. Philippe Peylin is a research scientist working on the carbon cycle with a strong expertise in atmospheric CO₂ inversions and the use of ecosystem land surface models to diagnose the terrestrial carbon balance. He is responsible for the development of the ORCHIDEE land surface model and he coordinated or participated to several large international projects. He helped to design the Global Carbon Atlas and was specifically responsible for collecting the different carbon flux products displayed under the research application of the portal.

**Robert Andres**
Dr. Robert Andres works for the Carbon Dioxide Information Analysis Center (CDIAC) at Oak Ridge National Laboratory (ORNL) in the United States. He has worked on fossil fuel carbon dioxide emission inventories since 1992. Recent efforts have concentrated on improving temporal and spatial resolutions of the inventories as well as better quantifying their uncertainty. The Global Carbon Atlas combines this effort with that of others to describe the anthropogenic portion of the global carbon cycle.

**Glen Peters**
Dr. Glen Peters is a Senior Research Fellow at the Center for International Climate and Environmental Research - Oslo (CICERO) in Norway. He conducts research on the development and assessment of effective global climate policy. His most active areas of research are emissions accounting, the role of international trade in climate policy, carbon leakage, competitiveness concerns, and carbon footprints. Other areas of research include emission metrics and the annual updates of the global carbon budget.

**Robbie Andrew**
Robbie Andrew is a Senior Research Fellow at the Center for International Climate and Environment Research - Oslo (CICERO). His research focuses on the analysis of international climate policy, in particular the effects of and consequences for international trade of policy implementation. He also conducts research on future scenarios, carbon footprint methodologies, and ecosystem services, along with assisting in the Global Carbon Project's annual releases.

**Shilong Piao**
Dr. Shilong Piao is Cheung Kong Professor of Peking University. His current research focuses on the data-model integration to improve our ability for predicting terrestrial carbon cycle responses to global change. He has contributed to the 5th Assessment Reports of the IPCC. He is now on the Editorial Advisory board of Global Change Biology and also serves on editorial board of Agricultural and Forest Meteorology.

**Anna Peregon**
Dr. Anna Peregon is researcher at the Laboratoire des Sciences du Climat et de l’Environnement (LSCE), France. She conducted research on various aspects of the carbon cycle in the Northern Eurasia, and was served as Scientific Assistant in the 5th Assessment Report of the IPCC. Dr. Peregon is now assist coordination and provides liaison to potential contributors to the Global Carbon Atlas.

**Róisín Moriarty**
Dr. Róisín Moriarty is a Senior Research Associate at the Tyndall Centre for Climate Change Research and the University of East Anglia. She participates in the publication of the GCP’s annual Global Carbon Budget update and the Emissions component of the Global Carbon Atlas. She has a background in ocean biogeochemical and ecosystem research with a primary focus on the ocean carbon cycle.
Team of computer engineers and contractors

Patrick Brockmann
Patrick Brockmann is a scientific software engineer who has worked at LSCE (Laboratory of Sciences of the Climate and Environment) since 1998. He has master degrees in both computer science and remote sensing. He has worked extensively on model intercomparison projects and on earth system model infrastructure in climate modelling research. His research interests include data visualization, geo-spatial web applications, geo-services architectures and data processing in high performance computing environments. He coordinates the project and the technical architecture of the research applications developed for the Global Carbon Atlas.

Vanessa Maigné
Vanessa Maigné is a development engineer who has worked at LSCE (Laboratory of Sciences of the Climate and Environment) since 2013 after 5 years at the IPSL (Pierre Simon Laplace Institute). She has a master degrees in computer science and physics and is an expert in Java/J2EE development and front-end new technologies. She is a developer of the research applications for the Global Carbon Atlas.

Pascal Evano
Pascal Evano is an assistant researcher at CEA-LSCE (Laboratory of Sciences of the Climate and Environment) since 2012. He has a degree in Geography and a MSc in Remote Sensing and GIS. He's working in relation with the GeoViQua (GEOSS Quality Visualization) project which is a European project which intends to introduce in GEOSS quality visualization tools. Pascal Evano assisted in development of scientific applications of the Global Carbon Atlas (Web Map Service protocol to compare carbon data models).

Franck Corsini and Philippe Weill (ISIS, Informatique fédérative IPSL - Services et Infrastructures) for network and servers infrastructure.

WeDoData
WEDODATA is a data visualization agency based in Paris specialized in print infographics, web and mobile applications with a strong data input. At WEDODATA, journalists, graphic designers and web developers work as a team to deliver the most creative and accurate visualizations to their clients such as OECD, FranceTV, Radio France or French WIPO branch. WEDODATA assisted the Carbon Atlas team in the design (conception and development) of the Outreach and Emissions applications.
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Vincent Le Jeune : Development of Emission application
Anthony Vessière : Development of Emission application
Website : http://wedodata.fr/

ClimMod Engineering
CLIMMOD is a scientific engineering company involved in the field of numerical modeling and simulation for climate and environment. The team consists of engineers with extensive research experience in the development and validation of scientific software. CLIMMOD was responsible for development and integration of the web platform for the Global Carbon Atlas.
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The Editorial Board is made up of experts in the subject area that the Global Carbon Atlas including data providers, research user community, broader user community (NGOs, civil society, industry, higher education), and science communicators. The provide advice on content and appropriateness, review content and links to user community, and advice on communication content and strategies for the multiple audiences.

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Emissions and Sinks – an average for 2003-2012

8.6 ± 0.4 GtC/yr  92%

4.3 ± 0.1 GtC/yr  45%

2.6 ± 0.8 GtC/yr  27%

Calculated as the residual of all other flux components

2.6 ± 0.5 GtC/yr  27%

Source: Le Quéré et al 2013; CDIAC Data; Global Carbon Project 2013
Eastern Equatorial Pacific, the largest emitter of CO$_2$ in the ocean.