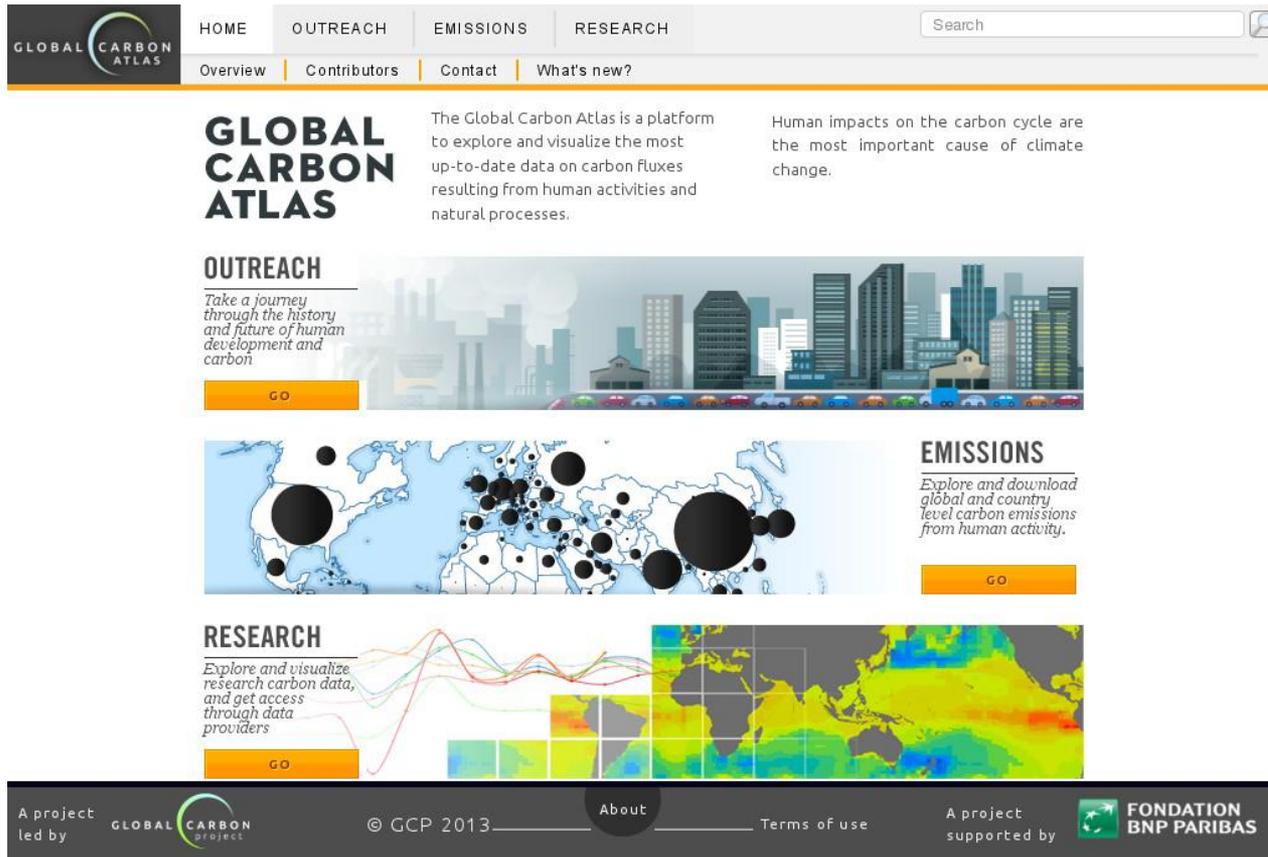


➔ A web portal for the carbon cycle



Many contributors:

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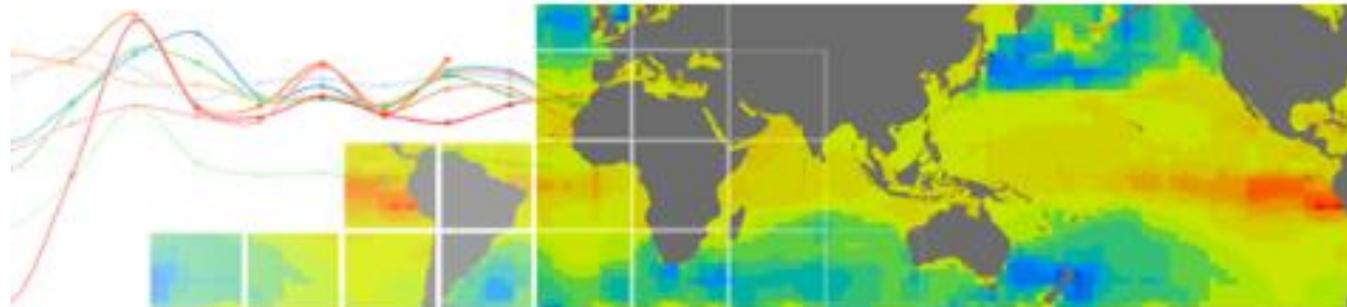
Roisin Moriarty

....

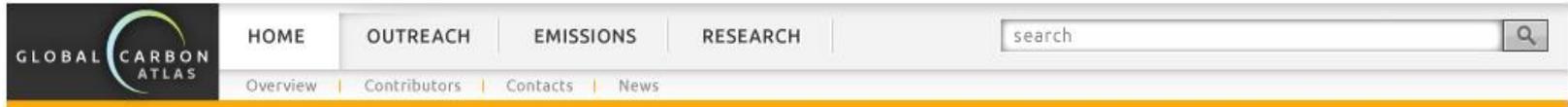
Why a Global Carbon Atlas ?

- The increase in CO₂ is the primary cause of climate change
- CO₂ 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



GLOBAL CARBON ATLAS

The Global Carbon Atlas is a platform to explore and visualize the most up-to-date data on carbon fluxes resulting from human activities and natural processes. Human impacts on the carbon cycle are the most important cause of climate change.

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

OUTREACH

Take a journey through the history and future of human development and carbon

GO



Policymakers:
Interactive visualization of fossil CO₂ emissions

EMISSIONS

Explore and download global and country level carbon emissions from human activity

GO

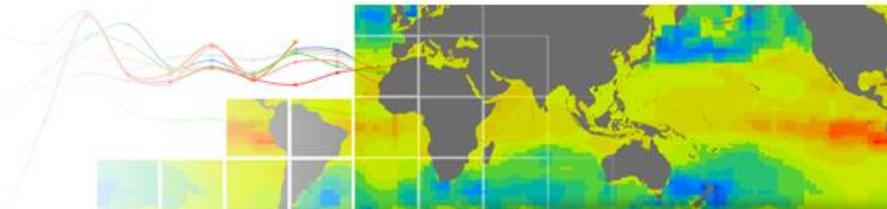


Scientists:
Interactive maps & time series of natural CO₂ fluxes (50 models)

RESEARCH

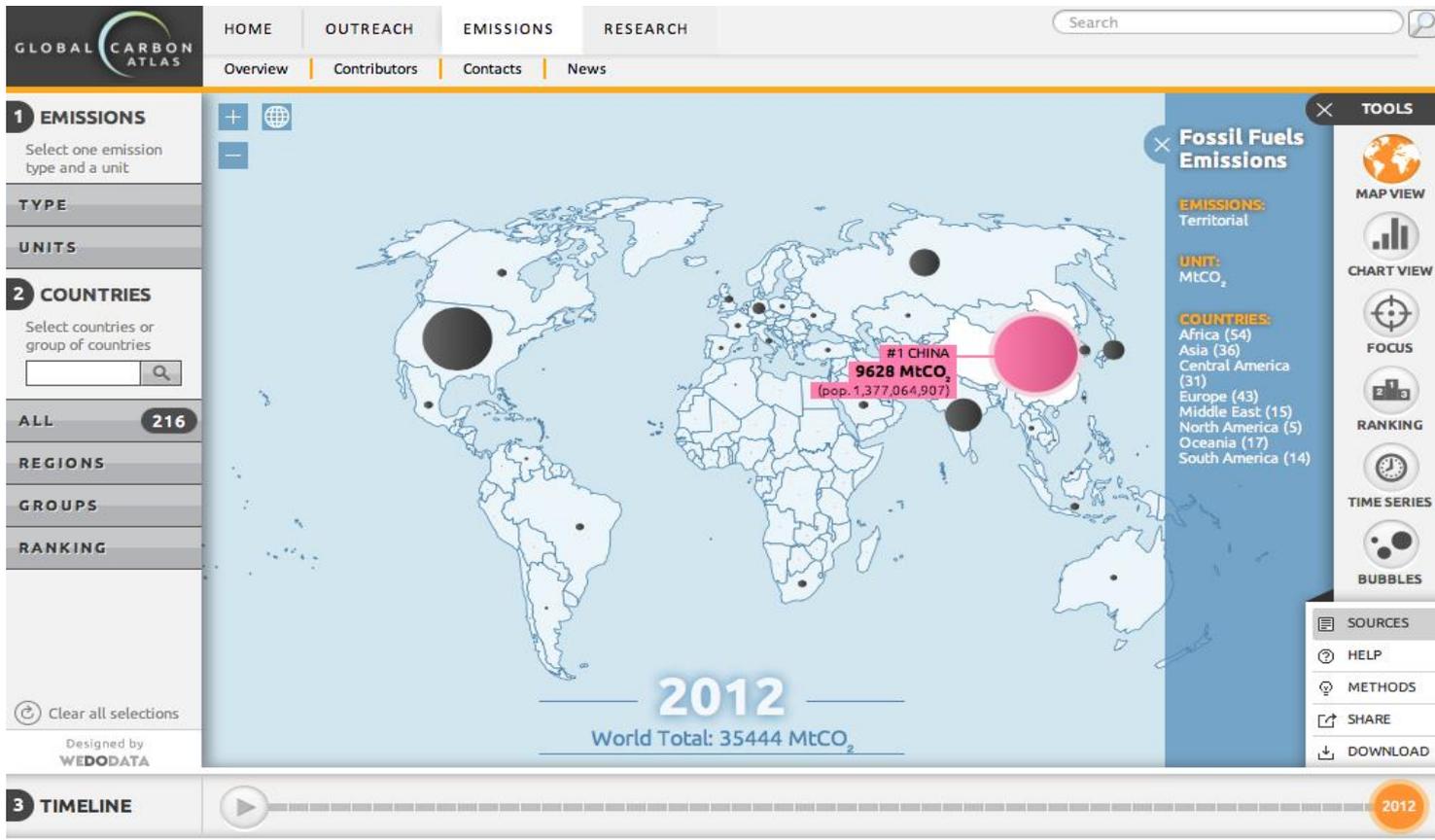
Explore and visualize research carbon data, and get access through data providers

GO



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

Boden, TA, G Marland, and RJ Andres. 2013. Global, Regional, and National Fossil-Fuel CO₂ Emissions. Carbon Dioxide Information Analysis Center (CDIAC), Oak Ridge National Laboratory, US Department of Energy, Oak Ridge, Tenn., USA doi:10.3334/CDIAC/00001_V2013

1 COUNTRIES
Select one country for detail
Select two countries for comparison

ALL 1

REGIONS

GROUPS

2 EMISSIONS
Click on emission type below to see the graphics

Territorial 1

Consumption 2

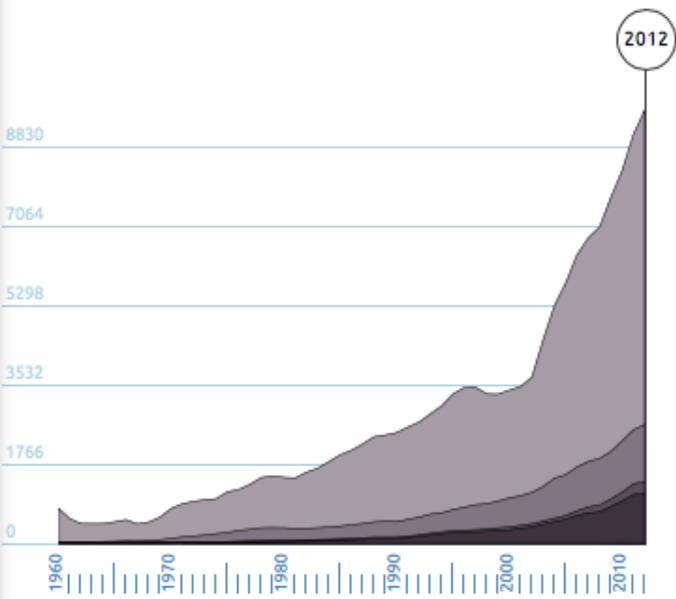
Per GDP 3

Per capita 4

CHINA
Territorial emissions

Territorial 1990 - 2012 2011 - 2012

Growth Index per year 6.2% 5.9%

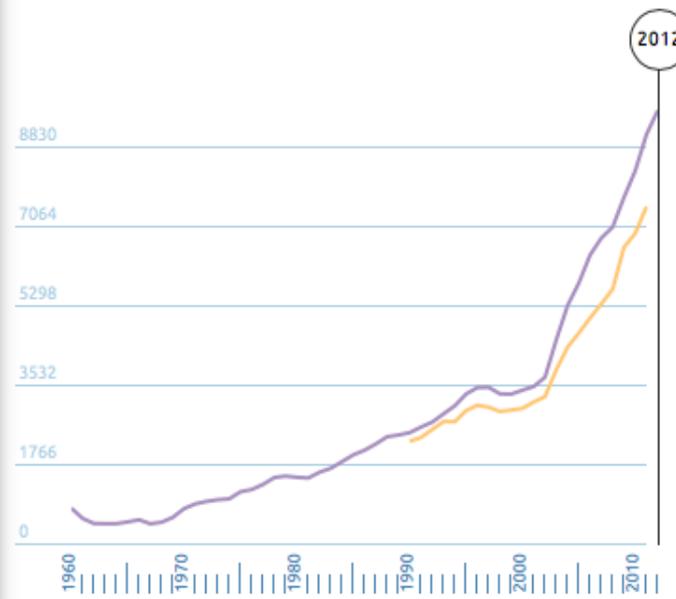


Emissions	MtCO ₂ (2012)
Coal	6990
Oil	1265
Gas	265
Flaring	No data for selected year
Cement	1108

CHINA
Consumption emissions

Territorial 1990 - 2012 2011 - 2012

Growth Index per year 6.2% 5.9%



Emissions	MtCO ₂ (2012)
Consumption	No data for selected year
Territorial	9628

TOOLS

Evolution of the carbon intensity in the economy of China

1 COUNTRIES
 Select one country for detail
 Select two countries for comparison

ALL **1**

REGIONS

GROUPS

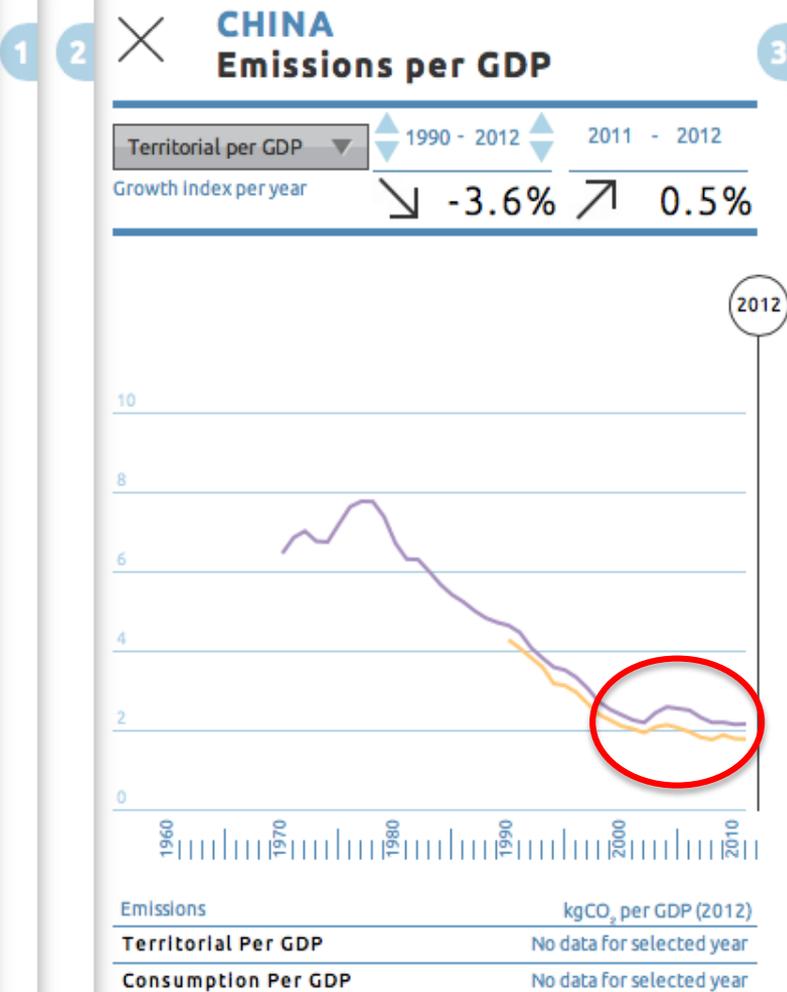
2 EMISSIONS
 Click on emission type below to see the graphics

Territorial **1**

Consumption **2**

Per GDP **3**

Per capita **4**



TOOLS

MAP VIEW

CHART VIEW

FOCUS

RANKING

TIME SERIES

BUBBLES

SOURCES

HELP

METHODS

SHARE

DOWNLOAD

China per capita emissions comparable to EU but well below USA

1 COUNTRIES

Select up to 10 countries

ALL **7**

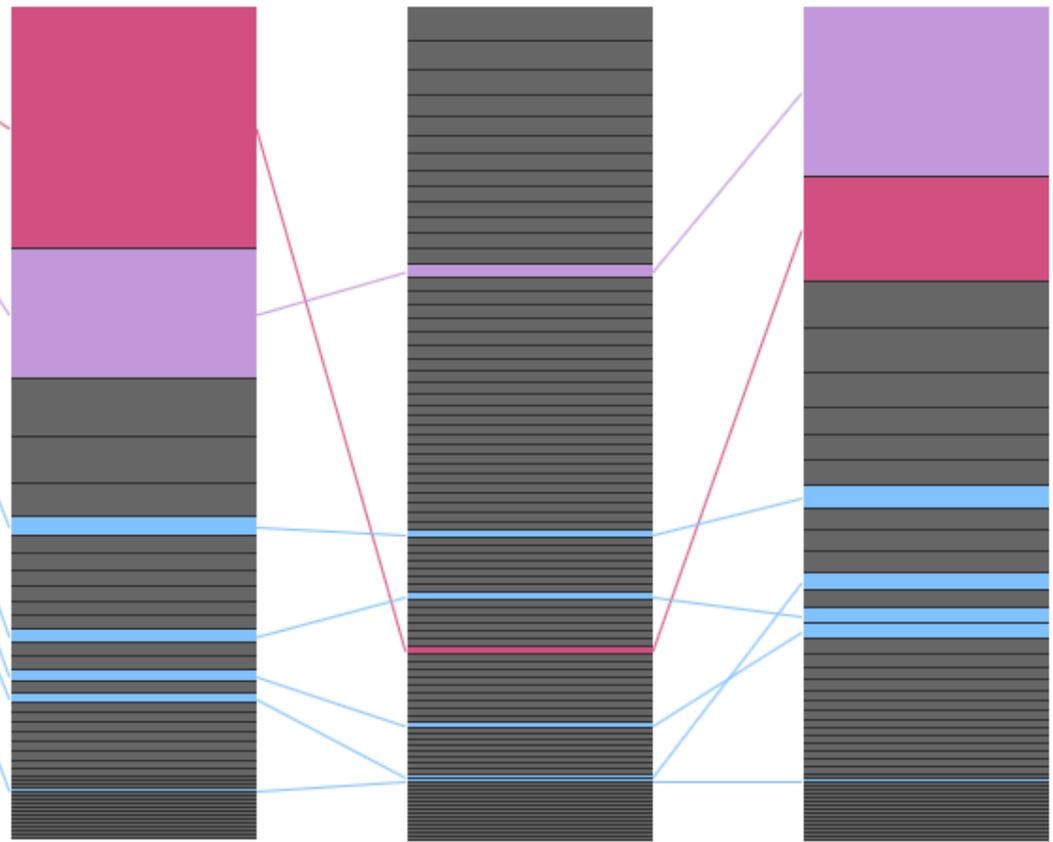
REGIONS

GROUPS

HIGHLIGHT

- China X
- USA X
- Germany X
- United Kingdom X
- Italy X
- France X
- Sweden X

Territorial MtCO₂ | Territorial tCO₂ / person | Oil MtCO₂



TOOLS

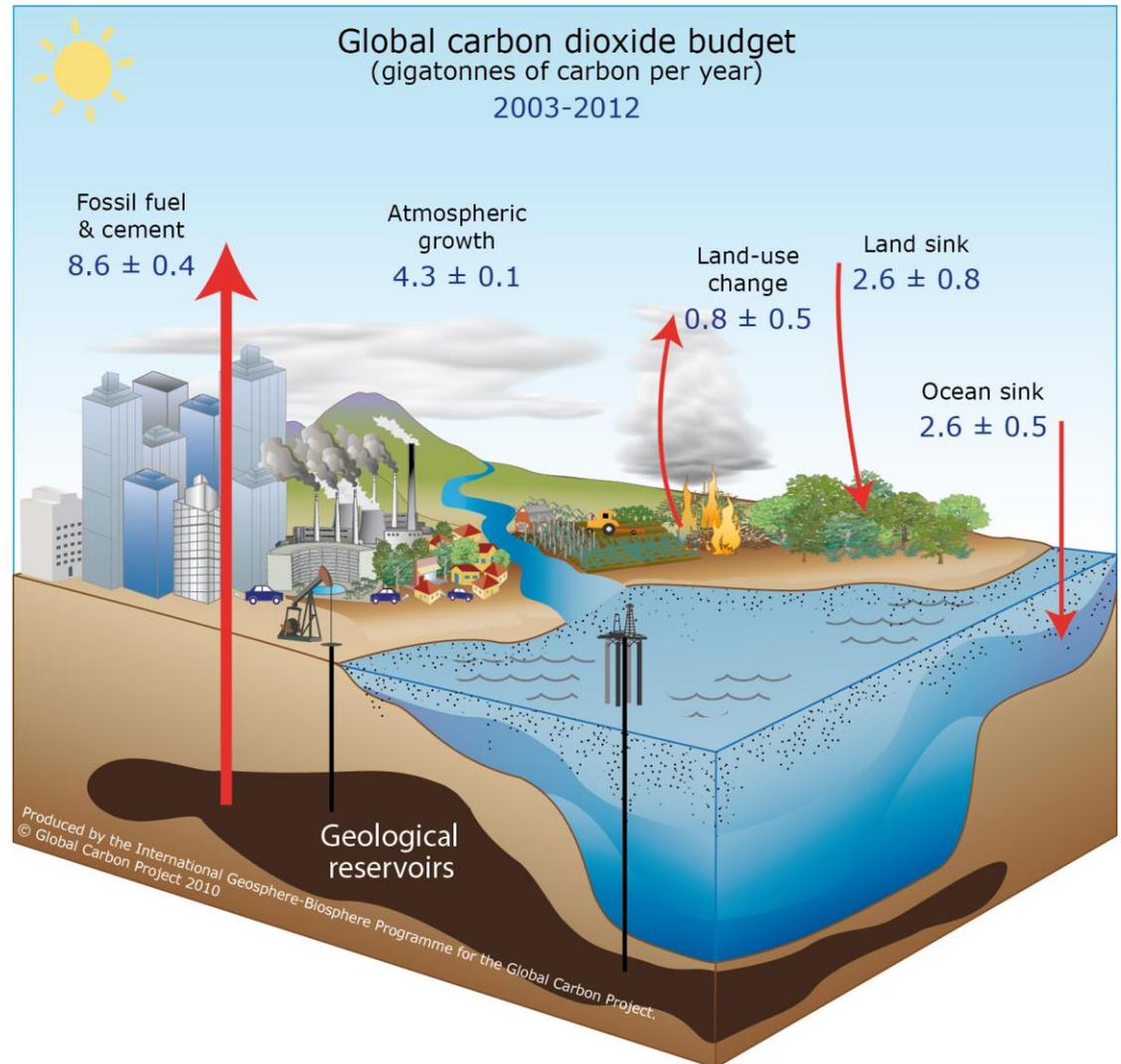
- MAP VIEW
- CHART VIEW
- FOCUS
- RANKING
- TIME SERIES
- BUBBLES

- SOURCES
- HELP
- METHODS
- SHARE
- DOWNLOAD

The overall balance of CO₂ 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 ?



CARBON STORY

Visualizing human impact

SO FAR IN 2012

- WHERE DOES IT COME FROM?
- WHO PRODUCED IT?
- WHERE DOES IT GO?
- WHEN WAS IT EMITTED?

● = 100 Mt of CO₂ (human emissions in 2012)

PAST

PRESENT >

FUTURE

SOURCES

SHARE



IN THE ATMOSPHERE



ON LAND



IN THE OCEAN

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

CARBON STORY

2000s

Urbanization and energy
 Over half of the global population lives in urban areas with an associated consumption of about 70% of the world primary energy. An additional 2.8 billion people, largely from developing countries, are to join the urban world with its higher energy consumption, by 2050. >Fifth assessment of IPCC says: 'It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century'.

HUMAN IMPACT SO FAR
 1,465 GtCO₂

WHAT NOW? Analyse the present

Concentration of CO₂ in the atmosphere (ppm)

800,000 BC | 400,000 BC | 100,000 BC | 1800 | 1860 | 1900 | 1920 | 1955 | 1965 | 1995 | 2013

Pre-industrial Era

YOU ARE HERE

Designed by WEDODATA

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,...)



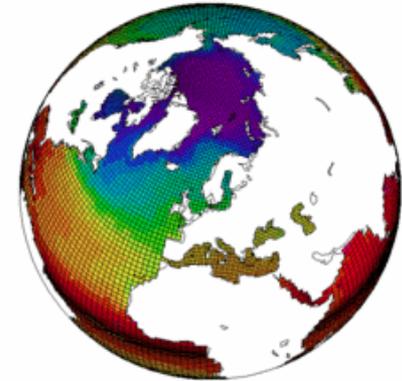
Data assimilation products (Atmospheric inversions, satellite based product,...)



Vegetation carbon models
 (TRENDY, CMIP5,...)

Need for innovative technology

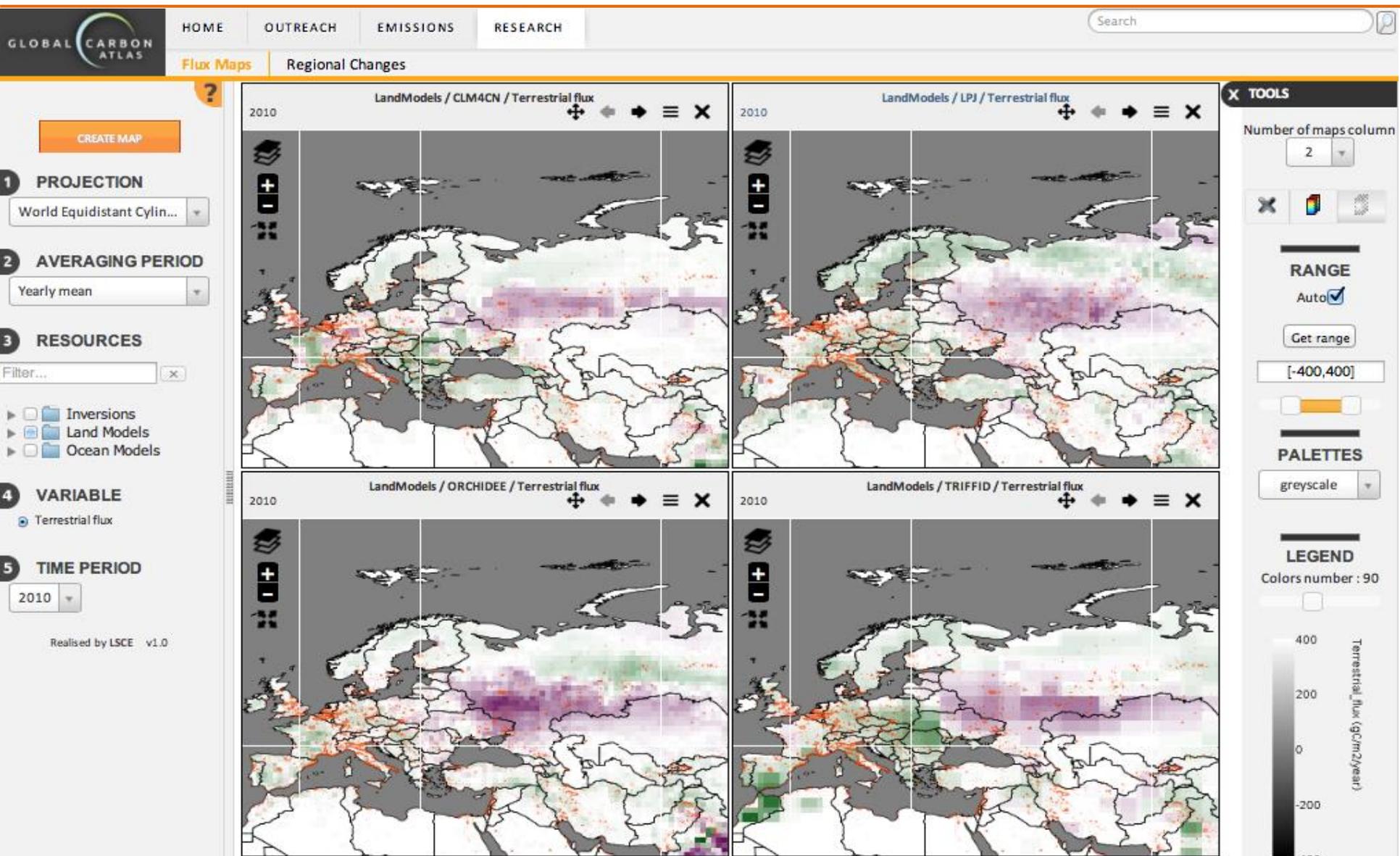
To view large volumes of data

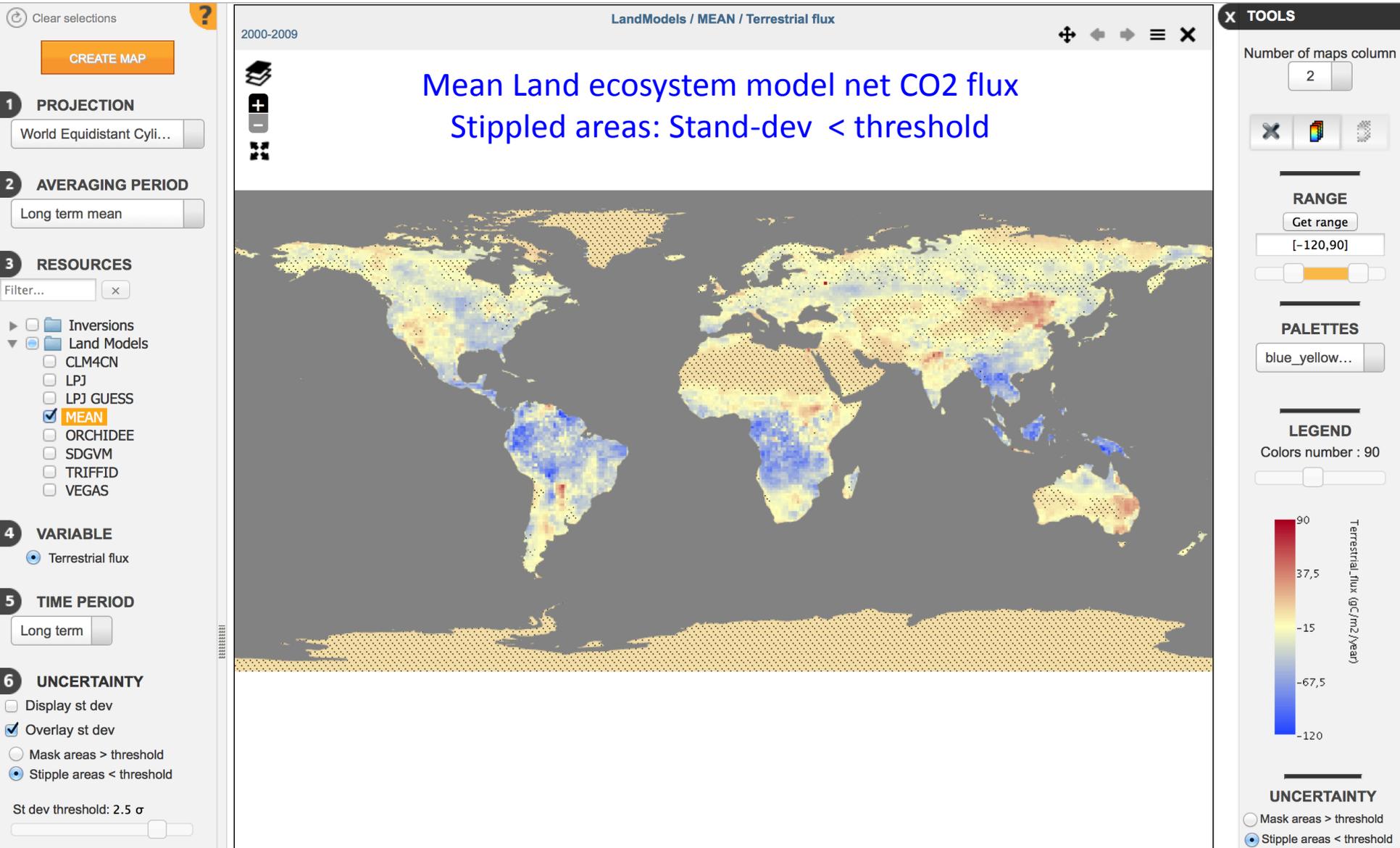


With interactive viewing facilities

- 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





Google earth export facilities...

The image shows a Google Earth interface displaying a global map of Terrestrial Flux. The map uses a color scale from blue (-500) to red (500) to represent carbon flux in gC/m²/Year. Key geographical features are labeled: Cercle arctique, N70°, N50°, N30°, Tropicque du Cancer, Méridien d'origine, E 10°, E 30°, Équateur, N10°, S10°, Tropicque du Capricorne, and S30°. The interface includes a search bar with the text 'Rechercher' and 'exemple: Restaurant', a 'Lieux' panel with 'Atlas/Flux/LandModels/montfco2_CLM4CN_Sep2013-ext3_1980-2010_monthlymex', and a 'Calques' panel with 'Galerie Google Earth'. The bottom of the screen displays 'Data SIO, NOAA, U.S. Navy, NGA, GEBCO © 2015 Google Image Landsat US Dept of State Geographer' and 'Google earth' logo. The bottom right corner shows coordinates '13°47'21.34"N 16°27'59.40"E' and altitude 'altitude 13550.23 km'.

Time series: N. Hemis net land carbon sink (Atm. inversions)

Clear selections

CREATE PLOT

1 REGIONS

Filter...

- Global
- Land
 - 05 Global Land
 - 06 Northern Land**
 - 07 Tropical Land
 - 08 Southern Land
 - 09 Tundra
 - 10 North America
 - 11 Europe
 - 12 North Asia

2 AVERAGING PERIOD

Yearly mean anomaly

3 RESOURCES

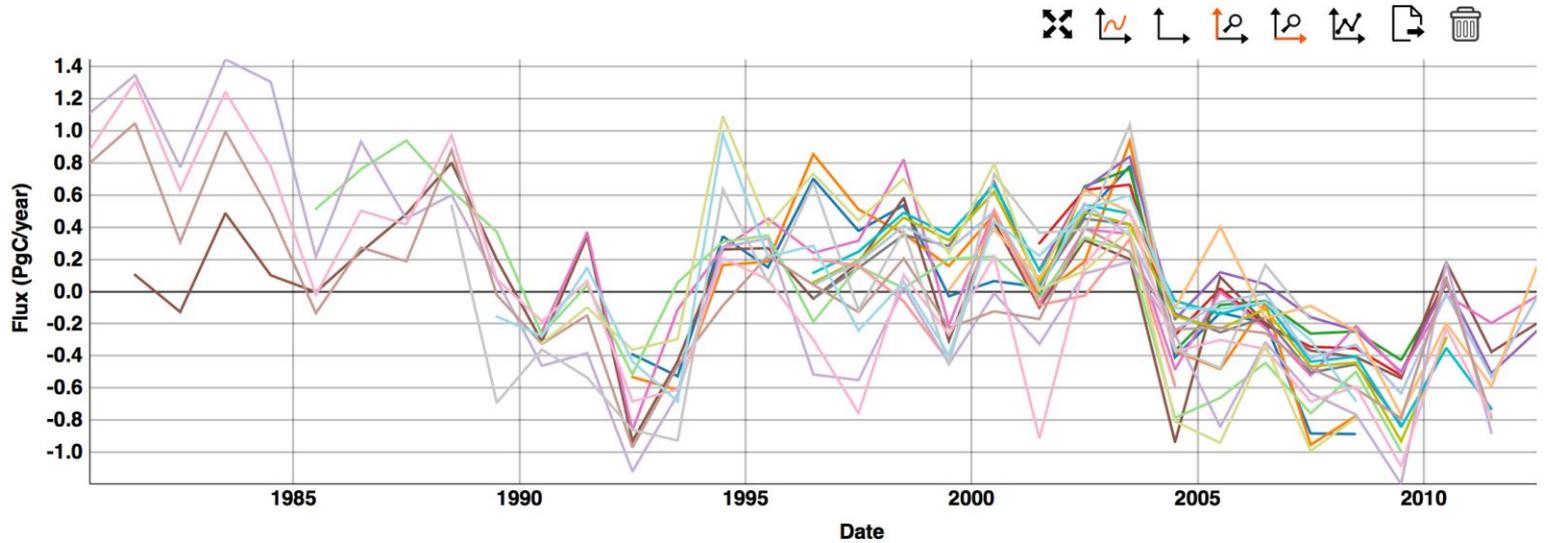
Filter...

- Inversions**
- Land Models
- Ocean Models
- CMIP5
- CCDAS
- FOSSIL
- DATA-DRIVEN

4 VARIABLE

- Ocean flux
- Terrestrial flux**
- fossil

Realised by LSCE v1.2



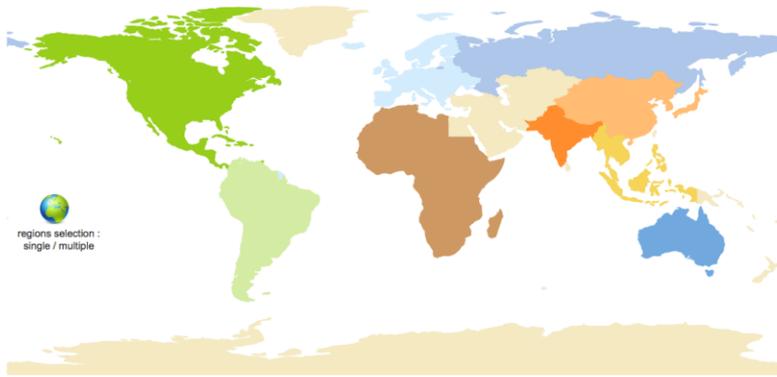
- C13 CCAM law / Terrestrial flux / 06 Northern Land / Yearly mean ano...
- C13 MATCH rayner / Terrestrial flux / 06 Northern Land / Yearly mean ...
- CTRACKER EU / Terrestrial flux / 06 Northern Land / Yearly mean ano...
- CTRACKER US 2011 / Terrestrial flux / 06 Northern Land / Yearly mea...
- CTRACKER US 2013 / Terrestrial flux / 06 Northern Land / Yearly mea...
- JENA s81 V3 6 / Terrestrial flux / 06 Northern Land / Yearly mean ano...
- JENA s90 V3 6 / Terrestrial flux / 06 Northern Land / Yearly mean ano...
- JENA s96 V3 3 / Terrestrial flux / 06 Northern Land / Yearly mean ano...
- JENA s96 V3 4 / Terrestrial flux / 06 Northern Land / Yearly mean ano...
- JENA s96 V3 5 / Terrestrial flux / 06 Northern Land / Yearly mean ano...
- JENA s96 V3 6 / Terrestrial flux / 06 Northern Land / Yearly mean ano...
- JENA s99 V3 6 / Terrestrial flux / 06 Northern Land / Yearly mean ano...
- JMA 2010 / Terrestrial flux / 06 Northern Land / Yearly mean anomaly
- LSCE an v2 1 / Terrestrial flux / 06 Northern Land / Yearly mean anom...
- LSCE var MACC V11 1 / Terrestrial flux / 06 Northern Land / Yearly me...
- LSCE var MACC V11 2 / Terrestrial flux / 06 Northern Land / Yearly me...
- LSCE var MACC V12 3 / Terrestrial flux / 06 Northern Land / Yearly m...
- NICAM niwa ver3 / Terrestrial flux / 06 Northern Land / Yearly mean a...
- TRCOM mean 9008 / Terrestrial flux / 06 Northern Land / Yearly mean ...
- rigc patra / Terrestrial flux / 06 Northern Land / Yearly mean anomaly

➔ Interactive plotting facility with interactive capabilities:

- change X, Y axis
- filter the data
- add/remove product

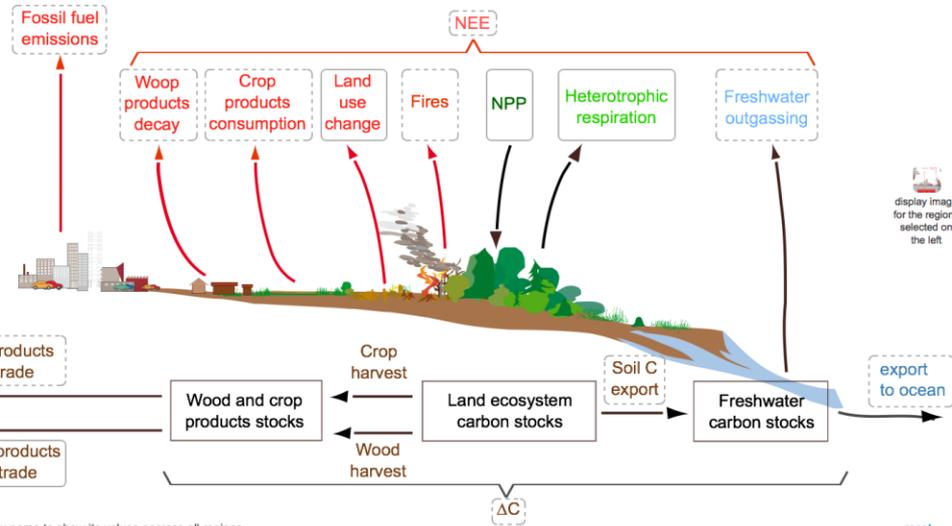
[reset all](#)
[export images](#)
[help](#)
[get data](#)
[plot uncertainty](#)

Regional Carbon Cycle Assessment and Processes



Click on a region to show all component CO2 fluxes

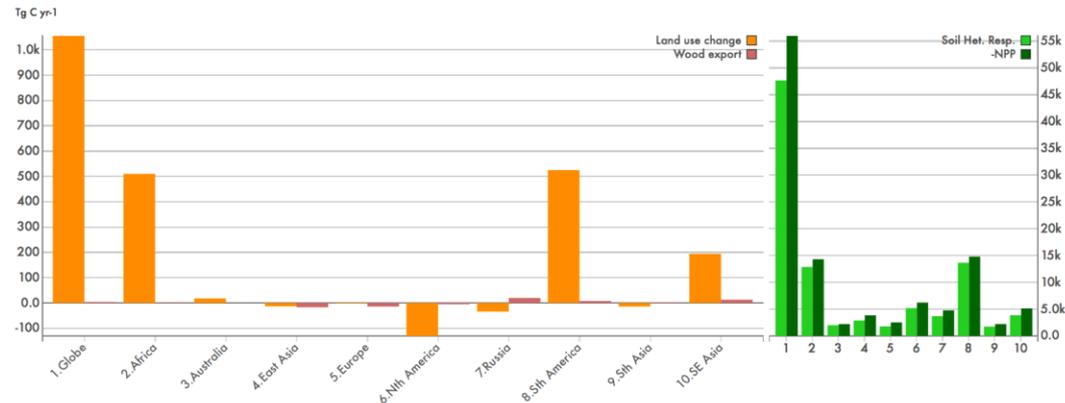
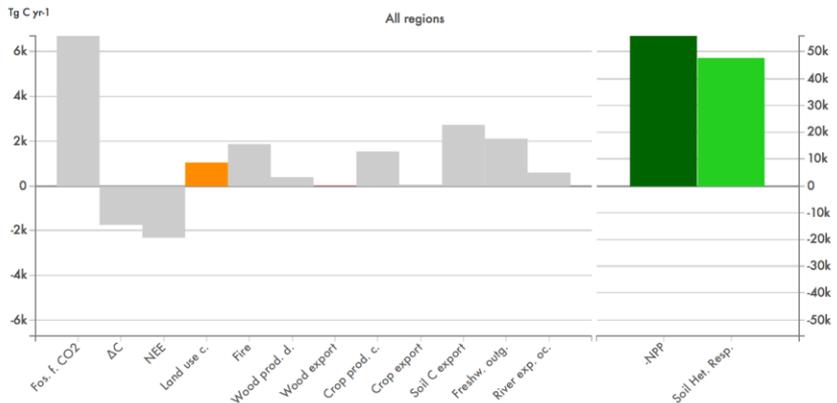
reset



display image for the regions selected on the left

Select a flux name to show its values across all regions

reset



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

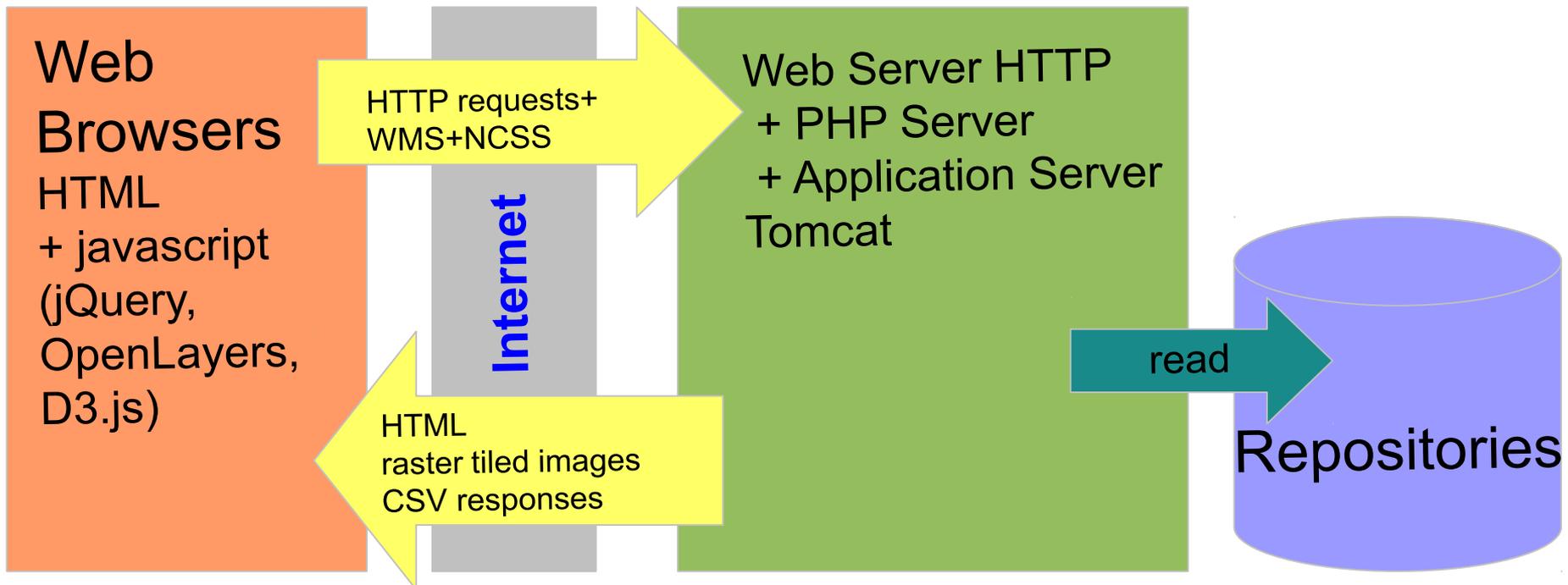
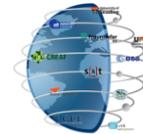


→ Drupal CMS



Architecture of the system...

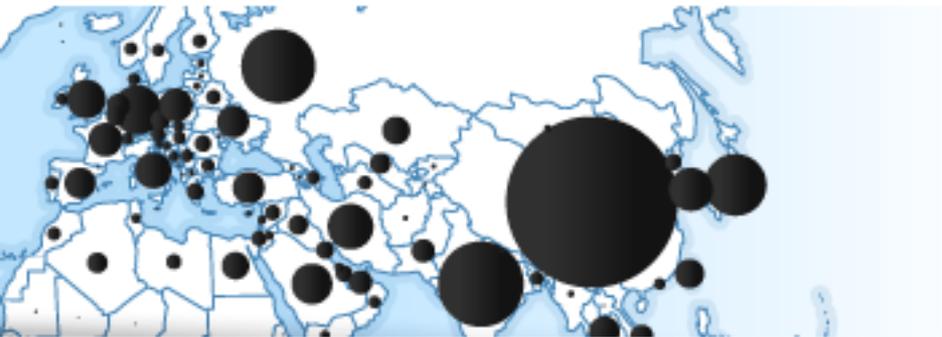
- Data access : various repositories, possibly remote,
- Data distribution: netcdf files; ascii file for time series
- Generic tool for any 2D time varying field
- Data Quality concern: following GEOVIQUA projet



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

globalcarbonatlas.org

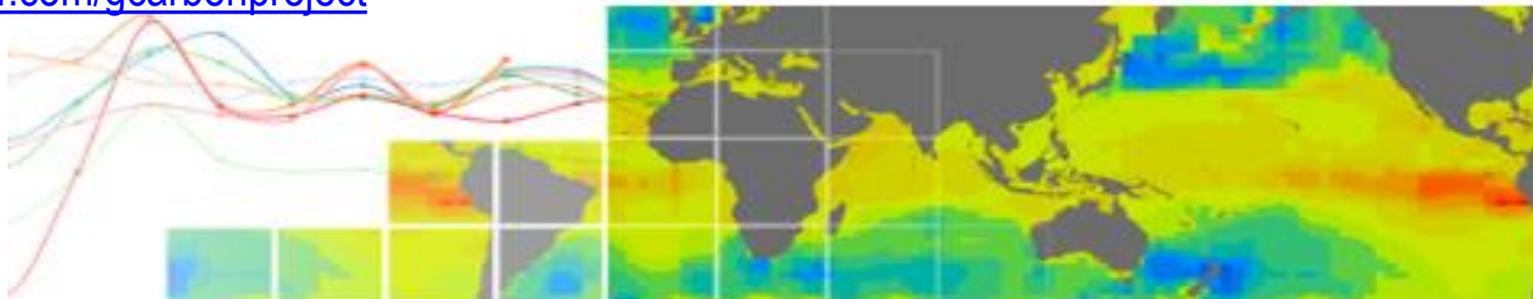


Thank you for your attention!
(peylin@lsce.ipsl.fr)

Questions : contact@globalcarbonatlas.org

Facebook: <https://www.facebook.com/globalcarbonproject>

Twitter: <https://twitter.com/gcarbonproject>





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-recipient 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 focusses 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.



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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Brice Terdjman : Responsible of Outreach application

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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Laboratoire CEA – CNRS – UVSQ



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Norwegian Research Council
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US National Science Foundation
Australian Climate Change Science Program
European Union Seventh Framework Programme

The Leverhulme Trust, UK
Ministry of Environment of Japan
European Research Council
Swiss National Science Foundation
Mistra-SWECIA, Sweden



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Emissions and Sinks – an average for 2003-2012

8.6 ± 0.4 GtC/yr 92%



0.8 ± 0.5 GtC/yr 8%



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%



+

