

REgional Carbon Cycle Assessment and Processes (RECCAP)

Version 8

Mandate

1. Establish the mean carbon balance of large regions of the globe at the scale of continents and large ocean basins, including their component fluxes, using a combination of bottom up data and models from regional carbon cycle programs and global analyses.
2. Compare these bottom-up estimates with the results of regional top-down atmospheric inversions, and thereby test the compatibility of regional bottom-up estimates with global atmospheric constraints.
3. Evaluate the regional 'hot-spots' of interannual variability and possibly the trends and underlying processes over the past decades by combining available long-term observations.

Products

1. Synthesis book (or special issue), including chapters on regional land and ocean C budgets, chapters assessing overall state, trends and variability in carbon fluxes, and synthesis chapters testing compatibility of regional bottom-up estimates with global atmospheric constraints (pdfs should be available shortly after publication for wide distribution).
2. High-level synthesis paper reporting key results
3. Database (updatable in the future) of C fluxes from regional and global estimates

Synthesis individual chapters to be prepared before-hand

Principle

A group of scientists will take responsibility for assembling a synthesis of the C balance of their region, using an ensemble of methods and data. This synthesis should broadly follow the IPCC principles:

- draw mostly on existing research work and tools, although specific new data analysis or model simulations will be welcome,
- give a fair account of representative results obtained by different groups which can be reflected in the multiple authorship of the chapter,
- provide traceable and referenced information about the data and model sources,
- provide a clear assessment of uncertainties and methods, including remaining areas of discrepancy, or uncharted areas. We do not expect an even distribution of knowledge and uncertainties over each region of the globe, given the contrasting density of regional C observation networks.

Guidelines for chapter scope, content and lengths

No more than 15 pages of text double spaced + additional figures and references. The text should consist of synthesis work for a general scientific readership, summarizing the various

existing streams of data or model results, and focusing on analyzing the results and their uncertainties.

Global Chapters G1-G3

Each of these chapters will cover and analyze the globe subdivided into large regions (e.g. the TRANSCOM land and ocean regions) using a globally homogeneous approach global analysis of fossil fuel and cement emissions from harmonized energy-related statistics. Synthesis work in each of these 'global' chapters should begin with a summary description of the approach and data used, focus primarily on discussing regional differences in C balance and uncertainties, possibly in light of the underlying mechanisms. Each region will be analyzed both for its long term mean C budget over the target period 1990-2005, but also wherever possible for their rate of interannual variability and trends. Regions poorly constrained by data should be identified

Land Chapters L1-L8

Each regional land chapter should at least provide:

- Estimate of the long term mean C budget, over the past 15 years (1990-2005) excluding anthropogenic emissions that will be treated in a separate chapter.
- Provide estimate of the average (monthly) seasonal cycle of ecosystem fluxes and (if possible) of disturbance-related emissions.
- Provide a simple breakdown, e.g. in a summary table, of the long term mean C budget into component gross fluxes of GPP, NPP, RH, and Disturbance emissions for major land cover types including at least croplands, grassland and forests (themselves possibly separated if necessary into types such as deciduous vs. conifers).
- Provide estimation of the interannual flux anomalies over the past 16 years
- Give an overview of the dominant underlying processes causing sources and sinks and, if relevant, of sub-regional 'hot spots'.

Ocean Chapters O1-O7

Each regional ocean chapter should at least provide:

- Estimate of the long term mean C budget, over the past 15 years (1990-2005), including interior ocean.
- Provide an estimate of the natural and anthropogenic CO₂ fluxes
- Provide estimate of the average (monthly) seasonal cycle of CO₂ fluxes
- Provide a simple breakdown, e.g. in a summary table, of the long term mean C budget into component gross fluxes of primary production, export production, thermal component and physical transport.
- Provide estimation of the interannual flux anomalies over the past 15 years
- Give an overview of the dominant underlying processes causing sources and sinks and, if relevant, of sub-regional 'hot spots'.

Synthesis Chapters S1-4

These Synthesis Of Synthesis (= S chapters) will be drafted during the meeting, drawing upon the results of chapters 1-12 above. To facilitate this process, a spreadsheet with the main regional results from these chapters will be prepared and distributed short before the meeting. Four SOS chapters are foreseen that will integrate top-down inversions results with state of the art bottom-up long term mean fluxes, and their interannual variability, possibly also in key regions the long term trends. Areas where both approaches converge or differ will be identified, as well as uncertainties assessed into a coherent framework. A discussion of the different processes contributing regionally (eg CO₂ fertilization versus legacy from past land use change and climate change) will be provided in Ch-S3. Finally, Ch-S4 will make essential recommendations for reducing errors in the future (e.g. organizing data exchange protocols, tailored model intercomparisons or model-data comparison, identify regions where key information is missing and ways to reduce uncertainties in a 5-10 years time frame, including the forthcoming advent of remotely sensed CO₂ columns from new sensors)

List of chapters

Chapter authors are proposed only. Proposals have come to the GCP from an ongoing community consultation over the last 18 months. Authors will not be invited until the consultation process is closed after the ICDC8 in September 2009. Feedback on authorship and outline is sought.

Global Introductory Chapters

- Ch-G1 Fossil fuel emissions (global). Gregg Marland, Mike Raupach, Kevin Gurney et al. (including driver analyses)
- Ch-G2 Land use change emissions (global). Skee Houghton, Ruth DeFries, Hanson, Annette Freibauer, Guido van Werf (fire emissions) et al.
- Ch-G3 Global atmospheric budget (global scale analysis). Kevin Gurney, Andy Jacobson, Philippe Pelyn, Christian Rödenbeck, and TransCom [possibly two chapters, one on inversions and another on the global budget]

Terrestrial Regional Chapters

[Ensure all chapters have expertise on top-down and bottom-up approaches]

[Do people providing regional cuts from global modeling efforts need to be part of the regional chapters given their data will be used]

- Ch-L0 Global land chapter based on biogeochemical model outputs, MODIS NPP and other approaches to have global uptake and emissions. Colin Prentice, Stith, Steve Running, Guido van Werf et al.
- Ch-L1 Africa. Riccardo Valentini, Niall Hanaan, Christopher A. Williams, Dario Papale, Markus Reichstein et al.
- Ch-L2 Australia. Mike Raupach, Gary Richards, Yingping Wang et al.
- Ch-L3 China. Ming Xu, Shilong Piao, Shaoqiang Wang, Jingyun Fang, Yao Huang, Mei Huang, Guangsheng Zhou et al.
- Ch-L4 Europe. - Philippe Ciais, Sebastian, Markus Reichstein (MPI-Jena), Dario Papale (U. Tuscia who did the global fluxnet synthesis), S. Luysaert (U. Antwerp, created a new database of global forest C fluxes; two papers are submitted to Nature & Science); A. Cescatti (JRC ; modeller specialist of land surface models), N. Vuichard (LSCE ; modeller specialist of agricultural lands), Gert-Jan Nabuurs (inventories), Detlef Schulze, Riccardo Valentini et al.
- Ch-L5 North America. Mac Post (coordinator), David McGuire, Scott Denning, Andrew Jacobson, Ning Zeng, Steve Pacala, Chris Field et al.
- Ch-L6 Russia. Han Dolman (coordinates), Christian Wirth (forests), Usoltsev, David Archard or Mollicone (remote sensing, Lapshina (forest bogs), tundra: Kuhry (tundra), Hubberto, Belelli (Grassland), Shvidenko (forests), Luca Belelli et al.

- Ch-L7 South America. Jean Ometto (coordinator), Umberto Roach, Yadvinder Malhi (eddy fluxes, forest inventories), Emanuel Gloor, Scott Denning (atmospheric inverse modeling), Esteban Jobbagy et al.
- Ch-L8 South and Southeast Asia. Pep Canadell (coordinator), Shilong Piao, Ito, Yoshi Yamagata, Rizaldi Boer, Guido van Werf, et al.

Global Oceans

- Ch-O1 Global ocean climatologies. Chris Sabine, Taro Takahashi, Rik Wanninkhof. To compare multiple products providing mean and seasonal estimates of air-sea CO₂ fluxes. That includes Taro's new 2000 climatology, Sabine's seasonal flux maps (these can be used to convert the climatology to a real assessment of fluxes between the stated years), oceanic inversions of Niki's group, and other work as available (possibly the product from CASIX if ready on time).
- Ch-O2 Global ocean carbon storage. Toste Tanhua (CarboOcean) et al.

Regional Oceans

[Ensure all chapters require expertise on top-down and bottom up approaches]

Regional chapters below discuss the contribution of anthropogenic CO₂ and DIC, an estimate of the contributing processes, and interannual variability or trend as appropriate.

- Ch-O3 Pacific. Feely, McKinley et al.
- Ch-O4 Atlantic and Arctic. Schuster, Stefanie Dutkiewicz (MIT), Mick Follows (MIT) et al.
- Ch-O5 Southern Ocean. Tilbrook, Nikki Lovenduski (US) et al.
- Ch-O6 Indian. Nicolas Metzl, Sharma, Claire Lo Monaco
- Ch-O7 Coastal Ocean. Arthur Chen, Alberto Borges (Belgium), Casper Plattner (modeller), Helmuth Thomas, Wei-Jun Cai et al.

Global Lateral Fluxes

- Ch-G3 Rivers and lateral fluxes (globe). Peter Raymond (US- CCSSG suggested), Abril, Sundquist

Global Syntheses

- Ch-S1 Comparison of atmospheric & bottom up fluxes (mean decadal). Wolfgang Knorr, Ning Zeng, Markus Schulz, et al. (include atmospheric inversions, flux studies, book-keeping methods (inventories), and combined methods (data assimilation))
- Ch-S2 Inter-annual variability at regional scale. Rachel Law (proposed?), Kevin Gurney, Corinne Le Quere, Guido van Werf,
- Ch-S3 Attribution to regional processes over the globe (Niki Gruber and Pep Canadell contribute here)
- Ch-S4 Future trends. Pierre Friedlingstein, Mike Raupach, Stephen Stitch, ocean forward modeler, et al.
- Ch-S5 Final recommendations (lead group, Rik Leemans interest in contributing)

Time line

Aug 2007

Draft of mandate and scope (= this document)

April 2008

“Sign-in” on chapter scope ; regional programs are contacted and will provide a quick feedback to Pep on the initiative + help to identify a list of key persons (= regional representatives, on the order of up to 3 persons per region responsible for representing their science communities).

May 2008

Chapter framework (list of questions to be addressed) and time window (spatial & temporal resolution)

September 2009

Invitations to lead authors and request for chapter outline (submitted by September in Jena)
Detailed soft protocol for the production of regional chapters.

September 2009 (ICDC8)

Information and consultation session at the ICDC8 in Jena, Germany

October 2009

Deadline for submission of chapter outlines

Global datasets and model runs available to the regional groups.

- Ocean inversions: Niki Grubber
- Ocean biogeochemical models: Corinne Lequere
- Atmospheric inversions: Kevin Gurney (most of the data)
- Terrestrial biogeochemical models: Colin Prentice/Stephen Stith + US contribution (available **towards the end of 2009**).

June 2010

Regional groups deliver chapters drafts

July-August 2010

Internal review of the chapters & model results output is collected.

October 2010

Hold the meeting over 4 full days; get revised MS from internal review; draft of the SOS chapters

2011

Estimated 12 months processing; reviewing and finishing the SOS chapters, checking the consistency between chapters (units, definitions ...); provide summary tables with fluxes in Annex

Committees and Engagement

Steering Scientific Committee

Philippe Ciais, *Chair* (France), Pep Canadell (Australia), Chris Field (USA), Kevin Gurney (USA), Niki Gruber (Switzerland), Corinne Le Quere (UK), Mike Raupach (Australia), Chris Sabine (USA), Ming Xu (China)

Sponsors/Endorsement

The following organizations and projects have informally endorsed RECCAP with the commitment to contribute:

- COordination action Carbon Observation System (COCOS), Europe
- Carbon Cycle Interagency Working Group (CCIWG), USA

- Chinese Science Academy (CAS), China
- CSIRO Marine and Atmospheric Research, Australia
- National Institute for Environmental Studies (NIES), Japan
- Quantifying and Understanding the Earth System (QUEST), UK
- IOCCP
- CarboAfrica

Contact

For further information and interest in getting involved please contact: Pep Canadell
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