



Global Carbon Project Annual Progress Report 2006-2007



ADDED VALUE OF PROJECT

The single biggest added value of the GCP is integration of multiple components of the carbon cycle into a coherent and consistent picture, including the natural (eg, carbon sources and sinks of the natural carbon cycle) and human components (eg, population, economic growth, carbon intensity of the economy, mitigation strategies). This integration is implemented at the global and regional scales (including urban regions) to understand i) the drivers of atmospheric CO₂ accumulation, ii) the magnitude of the carbon-climate feedback, and iii) points of intervention in managing future carbon trajectories which requires an integration of mitigation strategies and the dynamics of the natural environment.

END USERS OF PROJECT OUTPUTS

GCP's major end users are: i) the scientific community which requires the integration of some of their individual components and the new updates of carbon quantities; ii) international assessment processes largely the IPCC; iii) international policy development such as SBSTA and other calls from the UNFCCC, and more recently with UNESCO; iv) government agencies involved in designing carbon mitigation strategies, carbon markets, and positioning to participate in UNFCCC discussions; v) media largely press and television.

MAJOR ACTIVITIES AND ACHIEVEMENTS

MAJOR ACHIEVEMENTS

Theme 1: Patterns and Variability of Carbon Sources and Sinks

1. *State of the Carbon Cycle:* The GCP has released this year the first annual trend analyses of the perturbation of the global carbon budget. This release will be annual from now on around the August-September period. To establish the credibility of this effort, this first year we have published the analyses in two papers in PNAS (Canadell *et al.* 2007a; Raupach *et al.* 2007) and we expect to publish in the web and in media events the subsequent annual updates. A homepage has been established to make available the information [<http://www.globalcarbonproject.org/misc/carbontrends.htm>]. This effort integrates anthropogenic emission trends (fossil fuel and land use change), their global and regional drivers (population, GDP, carbon intensity of the economy, others), the dynamics of the natural carbon sources and sinks (oceans and land), and key measurements of the magnitude of the carbon-climate feedback (e.g, airborne fraction). This effort also contributed substantially to the IPCC Fourth Assessment, providing basic carbon-budget information cited in both the WG1 Summary for Policymakers (IPCC 2007) and in Chapter 7 of the WG1 report.
2. *Dynamic Regional Carbon Budgets:* Regional carbon budgets are currently developed by major national and regional consortia such as CarboEurope and the North American Carbon Program. The GCP has made contributions in two ways:
 - a. *Model-data fusion methods for regional carbon budgets:* Model-data fusion with multiple constraints had led to two intercomparison projects: OptIC (Trudinger *et al.* 2007b; Trudinger *et al.* 2007a) on optimisation methods, and REFLEX, a NERC-funded and GCP-inspired project to test model parameterisations and scaling methods against flux data.
 - b. *Coordination of regional carbon budget programs:* This past year the GCP stemming from a past workshop published a new dynamic framework that includes the full carbon budget with all natural and anthropogenic driving processes (Tschakert *et al.* 2007).
3. *Southeast Asia Carbon Study:* This program is in support of with a SARCS led effort to support

new research on the carbon cycle including terrestrial ecosystems and the South China Sea.

Theme 2: Processes and Interactions Driving Carbon Sources and Sinks

1. *Vulnerabilities of the Carbon Cycle:* Vulnerable carbon pools containing hundreds of gigatonnes of carbon could be destabilized through global warming and land use change, adding large biospheric emissions to the already large fossil fuel emissions. This activity defines and promotes a broad research agenda on carbon-cycle vulnerability (Canadell *et al.* 2007c; Raupach and Canadell 2007) and has made a contribution to the following components during the past 12 months:
 - a. Carbon in permafrost (response to warming). Second workshop of a series and submission of new framework to measure changes (Schuur *et al.* 2007)
 - b. Carbon in tropical peatlands (response to land use change and climate change). A new analyses of climate projections for the 21st century for peatland regions world-wide using a model intercomparison of 11 models (Li *et al.* 2007);
 - c. Carbon in high latitude peatlands (response to climate change): GCP co-sponsored the first symposium on the topic.
 - d. Ocean processes (responses to climate change and acidification): the GCP is working on a new analysis of vulnerabilities of ocean to carbon uptake including a regional basin level analyses.
2. *Source/Sink Processes in the Context of Climate Policy Development:* The GCP has contributed to assessments of scientific knowledge for international policy processes, particularly FCCC, to develop carbon accounting frameworks and incentives for reducing C emissions and increasing C sinks. These contributions have included assessments of (a) new accounting rules for LULUCF post 2012 (Schlamadinger *et al.* 2007, special issue); (b) factoring out direct and indirect anthropogenic effects on carbon sources and sinks (Canadell *et al.* 2007b); and (c) on the potential for deforestation avoidance as a mitigation option (Gullison *et al.* 2007).

Theme 3: Carbon Management

The GCP launched the Urban and Regional Carbon Management (URCM) Initiative in 2005. URCM is a place-based and policy-relevant scientific initiative aimed to support carbon management and sustainable urban development (Dhakal and Betsill 2007). URCM locates cities as centres of innovation, greenhouse gas emissions, and mitigation in the context of regions and the global carbon cycle. Major URCM activities to date include:

- a. First International Conference on Carbon Management at Urban and Regional Levels (4-8 September 2006, Mexico City)
- b. International Workshop on Institutional Dimensions of Carbon Management at the Urban and Regional Levels (5 December 2006, Bali, Indonesia)
- c. Side event at UNFCCC COP-12 in Nairobi on 15th December 2006 with ECN Policy Studies of Netherlands
- d. International Workshop on Urban and Regional Development Pathways and their Carbon Implications (March 28-30, 2007, Tsukuba, Japan)

WORKSHOPS ORGANIZED OR CO-ORGANIZED BY THE GCP TO SUPPORT THE ABOVE ACTIVITIES

URBAN AND REGIONAL CARBON MANAGEMENT AT LOCAL AND REGIONAL LEVELS

Connecting Development Decisions to Global Issues. Open Science Conference
4-8 September 2006, Mexico City, Mexico

This was the conference to launch the Urban and Regional Carbon Management (URCM) flagship of the GCP (Theme 3). The conference was co-sponsored by: Urbanization and Global Environmental Change, Industrial Transformations, Global Land Project, Analyses, Integrations and Modeling of the Earth System, START, Metropolitan Autonomous University, and the National Institute of Ecology (Mexico).

ADVANCED TRAINING WORKSHOP ON THE SE ASIA REGIONAL CARBON AND WATER ISSUES

14-25, November, Chung-Li and Kaohsiung, Taiwan

OPEN SCIENCE CONFERENCE ON THE GHG CYCLE IN THE NORTHERN HEMISPHERE

14-18 November 2006, Sissi-Lassithi, Crete (a CarboEurope contribution to the GCP)

The greenhouse gas cycle in the Northern Hemisphere is undergoing severe changes due to anthropogenic activities such as fossil fuel emissions and changes in land use and management. Regional estimates of terrestrial carbon and nitrogen balances as well as a detailed examination of the carbon cycling in oceans are essential for an improved assessment of continental scale carbon balances. In order to identify regional hotspots of vulnerability of the biospheric carbon and nitrogen cycles, the climate feedbacks on the carbon and the nitrogen cycle as well as the interactions between those two have to be considered. This includes a detailed analysis of the partitioning of ecosystem carbon fluxes as well as the turnover of carbon and nitrogen in soils. The present conference seeks to integrate the knowledge gathered on the greenhouse gas cycle within the big European research projects and the experience acquired outside those projects.

Conference Website: <http://www.carboeurope.org/conference/>

VULNERABILITY OF FROZEN CARBON

4-6 December 2006, Santa Barbara, California, USA

The second workshop of the permafrost working group met at the National Center of Analyses and Ecological Synthesis (NCEAS) in Santa Barbara, CA, USA. Progress on four different products will be assessed including a database and several peer review papers. This activity is conducted under a partnership between the GCP, the International Permafrost Association (IPA), and the WCRP-Climate and the Cryosphere project (CliC). The activity is supported by grants from NCEAS and ICSU. Contact: Chris Field, Pep Canadell

CO-BENEFITS OF GREENHOUSE GAS AND AIR POLLUTION MANAGEMENT

November 15, 2006 in Nairobi, Kenya

UNFCCC COP-12 Side Event

This side event is co-hosted by the Energy Research Center (ECN) Policy Studies (the Netherlands) and the Global Carbon Project (GCP) and it deals with co-benefits of urban air quality management and the greenhouse gas mitigation. The aim is to stimulate discussion on the potential for using the co-benefits approach and why we are seeing so few initiatives happening in this field under the current climate regime. In this one and half hour session, discussions will be made on various dimensions of this issue. Speakers include representatives from ECN Policy Studies, GCP, US EPA's Integrated Environmental Strategies Program, Global Environment Facility (GEF) Sustainable Transport Portfolio and the Bus Rapid Transit Program of Bogotá (which is the first to have its methodology approved for Clean Development Mechanism).

Contact: Emiel van Sambeek (vansambeek[AT]ecn.nl) and [Shobhakar Dhakal](#)

GCP-IHDP/IDGEC INTERNATIONAL WORKSHOP ON INSTITUTIONAL DIMENSIONS OF CARBON MANAGEMENT AT THE URBAN AND REGIONAL LEVELS

5 December 2006

Grand Hyatt Bali, Nusa Dua, Bali, Indonesia

This one day workshop explored theoretical framework of fit, scale and interplay applied in the contexts of urban and regional carbon management as well as clarified the practical dimensions of carbon management related institutional challenges. The workshop discussed city case studies from Europe, USA, China, and Latin America and explored urban carbon management opportunities from a development perspective. The workshop identified research gaps, new research directions and ideas in institutional dimension of carbon management to pursue it further.

Contact: Shobhakar Dhakal

INTERNATIONAL WORKSHOP ON URBANIZATION, DEVELOPMENT PATHWAYS AND CARBON IMPLICATIONS

28-30 March 2007

Tsukuba, Japan

This workshop helped to clarify the status quo of urbanization phenomena and their drivers in relation to carbon management. The workshop gathered people from key institutions working on global scale analyses of the urbanization phenomenon involving both the integrated assessment community and the urban energy and urban dynamics analyses. The workshop assessed how urbanization is treated in integrated assessment models and discussed the insights that can be gained from different approaches. The workshop was successful in developing a preliminary network of scholars interested in the analysis and modeling of urban and regional development pathways & scenarios and their carbon consequences.

Contact: Shobhakar Dhakal

OCEAN SURFACE: PCO₂ AND VULNERABILITIES

11-14 April 2007, Paris

Simple steady-state models show that the ocean CO₂ sink will continue to increase as long as atmospheric CO₂ increases. However, this result assumes that the oceanic temperature, circulation, and biology, do not change. Numerous oceanographic surveys are now showing that (1) the ocean has in fact warmed significantly in the past 50, (2) the surface salinity has changed roughly showing an enhancement of the water cycle, and (3) ocean circulation has changed. Large-scale changes in ocean circulation have also been highlighted by a worldwide decrease in sub-surface oxygen observed since the early 1980s.

The workshop explored the potential vulnerability of the ocean carbon sink and organize a working group to undertake an activity with the goal to gain better insights on the future trajectories of the ocean carbon sink.

Contact: Corinne Lequere

CARBON IN PEATLANDS: STATE OF THE ART AND FUTURE RESEARCH

15-18 April 2007, Wageningen, The Netherlands

The symposium aims to bring together leading scientists of different disciplinary fields to summarize the state-of-the-art in recent research related to carbon cycling in peatlands, to define directions of future research and to facilitate transfer of knowledge between disciplines.

Contact: [Juul Limpens](#)

Meeting website: <http://www.peatnet.siu.edu/CC07MainPage.html>

ASIA ENERGY ENVIRONMENT MODELING FORUM (AEEMF) WORKSHOP ON HOW TO MODEL LOW CARBON SOCIETY:

30-31 May 2007, Beijing, China

Organized by [Asia Energy Environment Modeling Forum](#) (AEEMF) and the [Global Carbon Project](#) (GCP)

This two day workshop gathered energy and emission modeller from Asia to share research results and different modelling approaches. This year's focus was on how to model low carbons society which was participated by researchers from Japan, India, China, Indonesia, Thailand, Australia and others. GCP contributed to strengthen the forum as well as capacity building by involving younger modellers.

Contact: Tae Yong Jung and Shobhakar Dhakal

GCP-CARBONAFRICA AFRICA SYMPOSIUM

23-25 August 2007, Kruger NP, South Africa

The meeting will bring together regional and international experts working on carbon cycle sciences in the African continent which deal with the interactions of climate change and human activity. The goal of the symposium is to present the latest research results, foster partnerships, and contribute in setting research priorities.

Symposium website: <http://www.globalcarbonproject.org/meetings/africa.htm>

MAJOR OUTCOMES OF SSC MEETING (2007)

1. To write a short paper that provides feedback on the development of the new generation of IPCC scenarios. The paper to be finished by Friday August 24 as an input to an IPCC meeting that Le Quere and Friedlingstein will attend next week.
Responsibility: Le Quere, Friedlingstein, Canadell
2. To organize a workshop on diagnostic FF emissions modeling relating to production and consumption views. This will integrate with the atmospheric CO₂ constraint (Hestia-Kevin Gurney, FFDAS-Rayner/Raupach).
Responsibility: Shobhakar, Raupach
3. To develop a global vulnerability synthesis that will include the multiple efforts to date and measure the possible extent of the carbon-climate feedback during this century. An SSC effort lead by Philippe. First outline/call for involvement by the end of 2007.
Responsibility: Ciais, Friedlingstein
4. To move full steam with a new bioenergy activity. First, to write a 2-3-page paper presenting the framework and scope of the ESSP bioenergy activity. Team: Patwardhan, Klepper, Field, Freibauer, Qi, Guy, Field, Qe, Shobhakar, Canadell. A bioenergy meeting to be organized as

soon as possible.

Responsibility: Patwardhan writes the first draft

5. To write a research agenda on Biodiversity and Carbon. Team: Midgley, Raupach, Le Quere, Freibauer, Ometto.

Responsibility: Midgley

6. To organize a "Synthesis of synthesis" of regional carbon budgets in 2008 (first Wk of a comprehensive activity). Team involved: Ciais, Hanson, many others

Responsibility: Ciais, Le Quere, Raupach, Canadell

PUBLICATIONS(*) AND OTHER PRODUCTS

PUBLICATIONS

(*) All publications cited in this section are the result of directly organized GCP workshops and activities. Publications from the broader community contributing to GCP activities are not included here.

Canadell JG, Kirschbaum MUE, Kurz WA, Schlamadinger B, Yamagata Y (2007a) Factoring out natural, indirect and direct human effects on terrestrial greenhouse gas sources and sinks. *Environmental Science and Policy* 10: 370-384

Canadell JG, Le Quere C, Raupach MR, Field CB, Buitenhuis ET, Ciais P, Conway TJ, Houghton RA, Marland G (2007b) Contributions to accelerating atmospheric CO₂ growth from economic activity, carbon intensity, and efficiency of natural sinks. *Proc. Natl. Acad. Sci. U.S.A.* **In press**

Canadell JG, Pataki D, Gifford RM, Houghton R, Luo YQ, Raupach MR, Smith P, Steffen W (2007c) Saturation of the terrestrial carbon sink. In: Canadell JG, Pataki D, Pitelka L (eds) *Terrestrial Ecosystems in a Changing World*. The IGBP Series, Springer-Verlag, Berlin, pp 59-78

Canadell JG, Pataki D, Pitelka L (2007d) *Terrestrial Ecosystems in a Changing World*. Springer-Verlag, Berlin

Dhakal S, Betsill MM (2007) Challenges of urban and regional carbon management and the scientific response. *Local Environment* 12,

Gullison RE, Frumhoff P, Canadell JG, Field CB, Nepstad DC, Hayhoe K, Avissar R, Curran LM, Friedlingstein, Jones CD, Nobre C (2007) Tropical forests, climate change and climate policy. *Science* 316: 985-986

IPCC (2007) Climate change 2007: the physical science basis. Summary for policymakers. IPCC Secretariat, Geneva

Li W, Dickinson RE, Fu R, Niu G, Yang Z, Canadell JG (2007) Future precipitation changes and their implications for tropical peatlands. *Geophysical Research Letters* 34, L01403, doi:10.1029/2006GL028364

Raupach MR, Canadell JG (2007) Observing a vulnerable carbon cycle. In: Dolman AJ, Valentini R, Freibauer A (eds) *Observing the Continental Scale Greenhouse Gas Balance of Europe*. Springer, Berlin

Raupach MR, Marland G, Ciais P, Le Quere C, Canadell JG, Klepper G, Field CB (2007) Global and regional drivers of accelerating CO₂ emissions. *Proc. Natl. Acad. Sci. U.S.A.* doi_10.1073_pnas.0700609104

Schlamadinger B, Bird N (2007) Options for including agriculture and forestry activities in a post-2012 international climate agreement. *Environment and Science Policy* 10: 269-394

Schlamadinger B, N. Bird, S. Brown, J. Canadell, L. Ciccarese, B. Clabbers, M. Dutschke, J. Fiedler, A. Fischlin, C. Forner, A. Freibauer, N. Hoehne, T. Johns, M. Kirschbaum, A. Labat, G. Marland, A. Michaelowa, L. Montanarella, P. Moutinho, D. Murdiyarso, W. Ohyantcabal, N. Pena, J. Penman, K. Pingoud, Z. Rakonczay, E. Rametsteiner, J. Rock, M. J. Sanz, U. Schneider, A. Shvidenko, M. Skutsch, P. Smith, Z. Somogyi, E. Trines, M. Ward, Y. Yamagata (2007) Options for including LULUCF activities in a post-2012 international climate agreement. Part I – Synopsis of LULUCF under the Kyoto Protocol and Marrakech Accords and criteria for assessing a future agreement. *Environment and Science Policy* 10: 271-282

Trudinger CM, Raupach MR, Rayner PJ, Enting IG (2007a) Using the Kalman filter for parameter estimation in biogeochemical models. *Environmetrics* **Submitted**

Trudinger CM, Raupach MR, Rayner PJ, Kattge J, Liu Q, Pak BC, Reichstein M, Renzullo L, Richardson AE, Roxburgh SH, Styles JM, Wang YP, Briggs PR, Barrett DJ, Nikolova S (2007b) The OptIC project: an intercomparison of optimisation techniques for parameter

estimation in terrestrial biogeochemical models. *JGR Biogeosciences* 112, G02027, doi:10.1029/2006JG000367

Tschakert P, Huber-Sannwald E, Ojima DS, Raupach MR, Schienke E (2007) Holistic, adaptive management of the terrestrial carbon cycle at local and regional scales. *Global Environmental Change: Human and Policy Dimensions* **In press**

Schuur, E.A.G, J. Bockheim, J. Canadell, E. Euschkirchen, C. Field, S. Goryachkin, S. Hagemann, P. Kuhry, P. Lafleur, H. Lee, G. Mazhitova, F. Nelson, A. Rinke, V. Romanovsky, N. Shiklomanov, C. Tarnocai, S. Venevsky, J. G. Vogel, S.A. Zimov (2007) The vulnerability of permafrost carbon to climate change: implications for the global carbon cycle. *BioScience* **Submitted**

OTHER PRODUCTS

Carbon Policy Brief (2006). Sponsored by UNESCO-SCOPE and developed by the GCP. The 6-page leaflet targets policy forums including FCCC meetings, Man and Biosphere, and Sustainability Fora.

Coulter L, Canadell L, Dhakal S (2007) Carbon offsets and reductions. GCP series no. 6, Canberra.

OUTREACH AND CAPACITY BUILDING ACTIVITIES

The main means by which the GCP reaches its various stakeholders is through peer review publications, publications targeted to broad audiences of non-climate scientists and policy makers (eg, Policy Brief for UNESCO and the Carbon Offset report), the GCP website, the annual/biannual e-NEWS email to the GCP database of 3,500 entries, and press releases to reach printed and Internet media.

Over the last 12 months, the GCP has had its highest presence in the media following the release of various analyses in conferences and publications on i) drivers of CO₂ emissions, ii) saturation of the southern ocean sink, and iii) the potential of tropical deforestation avoidance. The GCP and host institutions of participant members released 15 press releases in this period with hundreds of media hits in papers and web-based groups.

The publication of the Carbon Policy also targeted to reach communities other than scientific was welcomed by UNESCO with over 8,000 copies distributed. Likewise, the publication of the Carbon Offset and Reductions report was also very much awaited by both scientific and non scientific communities with an interest to neutralize carbon emissions from a diverse portfolio of activities.

In terms of capacity building, the GCP organizes annually a regional carbon meeting associated with the annual SSC meeting with the goal to foster carbon cycle sciences in the region with an emphasis on establishing long term links between institutions and supporting younger scientists. This year we organized a 3-day symposium in South Africa covering carbon research from Africa wide. The GCP also supports and contributes to the annual 2-week southeast Asia training course on carbon and water issues lead by SARCS.

INTERACTIONS

Through the involvement in activities, the GCP interacts with members of the four sponsor programs: IGBP: particularly with AIMES (high latitude initiative), SOLAS-IMBER Carbon Group (vulnerabilities of ocean sinks), GLP (particularly the office in Japan) on vulnerabilities on land.

WCRP: Coupled Modeling Working Group for carbon-climate feedbacks and testing observed trends with C4MIP runs, and CLiC on the permafrost activity.

IHDP: particularly with the new Urban initiative (through the URCM activity in the GCP), IDGEC, and GLP (see above).

Diversitas: in pursuing the development of a carbon-biodiversity agenda with appointed representative Andy Hector.

The GCP also contributes and interacts regularly with the European Space Agency and the multiple observation programs on land and oceans (IOCCP, IGCO, GTOS).

Regular contributions to IPCC and SBSTA including a site event every year.

As part of the effort on vulnerability of carbon in tropical peatlands, the GCP has jointly developed a partnership with the Global Environment Center in Thailand and CIFOR in Indonesia, with an increasing involvement of and products targeted to the forestry and palm oil industries.

CHALLENGES AND CONSTRAINTS

Resources at the office level to support an appropriate level of activity and services to the community continue being limited and impeding a larger impact and fulfillment of the multiple demands on the project. That includes appropriate support for translating key research results into products appropriate for communities other than scientific and attending the multiple demands to participate in discussion fora.

GOALS AND PLANS FOR MAJOR ACTIVITIES IN 2007- 2008

1. To establish a new Bioenergy activity and support the ESSP wide Bioenergy cross cutting activity.
2. To prepare a major regional synthesis of carbon budgets which will require 2-3 years for final completion.
3. To run a new global analyses on the vulnerability of the natural carbon cycle over this century.
4. To develop new diagnostic tools for modeling fossil fuel emissions relating to production and consumption views.
5. To run a preliminary analysis of the threats to climate change of destabilizing methane hydrates and the energy opportunities which could bring in the future.
6. To further push the activity on urban energy, emission modeling, and policy analyses with a major workshop in 2008.

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IPO, PROGRAM ADMINISTRATION AND MANAGEMENT

The GCP has established a network of global and regional centres to support particular research themes and scientific communities to engage on carbon activity. There are two International Project Offices (Canberra, Australia and Tsukuba, Japan); one Affiliated Office (Beijing, China); three Liaison Offices (Paris, France; Jena, Germany; and Washington DC, US); and a GCP Carbon Committee (Moscow, Russia). All are co-located with and hosted by national institutions.

IPO-Canberra (director: Pep Canadell). Currently supported by the Australian Greenhouse Office (AGO) and CSIRO with good perspectives for continue funding. Current funding: US\$120,000 from AGO and matching funds to cover overheads from CSIRO. The office is critically under funded.

IPO-Tsukuba (director: Shobhakar Dhakal). Currently supported by the Ministry of the Environment (ME) and the National Institute for Environmental Sciences (NIES). Current contract ends in March 2008 and there are positive signs for continue funding. Current funding: US\$220,000 from ME and NIES and in-kind support from NIES for hosting office; US\$65,000 from NIES for activities.

ADDITIONAL COMMENTS

9 October 2007

Compiled by: Pep Canadell and Shobhakar Dhakal