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Terrestrial Ecosystems in a Changing World

With 104 Figures

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Preface

The GCTE project was born on the day the Berlin wall fell (November 10, 1989). It was the final day of the Planning Committee meeting for the IGBP, at Berlin's Wissenschaftskolleg. Co-ordinating Panel 4 had presented its recommendations to the IGBP Planning Committee during the preceding week, and on that day they were accepted as the basis for GCTE, ratified later at the general IGBP inaugural meeting in Paris, in 1990.

The first full meeting of GCTE was its Open Science meeting in Brighton, England, in February 1991. Much good science was defined and put into effect at that meeting. But one point remained unresolved – an appropriate name and acronym. Everyone was agreed that GCTE was dreadful and could never work. The topic was debated at (the end of) each subsequent meeting of the Steering Committee, and no agreement on a better (publishable) name and acronym was ever reached. Its clumsiness eventually made it distinctive and so, 15 years later, it is finally put to rest, with the project.

From its inception GCTE was marked by, and most fortunate in having, a group of outstanding scientists to lead its defined Activities. They constituted the GCTE Steering Committee and their performance and stature attracted the best researchers joining what has been an exemplary (yet essentially voluntary) scientific effort.

The evolution of GCTE is an interesting reflection of scientific progress and increasing awareness of what is needed to understand the functioning of the Earth System. It began with three “Foci”, ecophysiology (at various scales), vegetation dynamics (again at scales from patches to the globe) and agro-ecosystems. A fourth Focus, on biodiversity, but also involving linkages across the other three, was added as results from initial studies and models began to emerge. The evolution to a more integrated approach continued and the results presented in this volume show the level of awareness that has now been achieved.

Perhaps the most important achievement of GCTE has been to demonstrate the critical role that terrestrial ecosystems play in the functioning of the Earth System. When GCTE began, it was widely assumed that Earth System dynamics were dominated by the ocean-atmosphere system, and that terrestrial systems were just the recipients of changes in the dynamics of these two great fluids. Now the picture is much different, as the following examples demonstrate.

Terrestrial processes in the carbon cycle. Until very recently, projections of future atmospheric CO₂ concentration were determined only by estimated emissions from fossil fuel combustion and land-use change. Research within GCTE and elsewhere has elucidated the important role that feedback processes in terrestrial ecosystems – heterotrophic respiration, wildfires, permafrost melting – will play in determining the trajectory of atmospheric CO₂ concentration over the next few decades and centuries. This work has contributed to the issue of ‘sink saturation’ and the possibility that the terrestrial will switch later this century from being a net sink to a net source of carbon.

Nonlinearities in the Earth System. Within the IGBP framework, GCTE took the lead in analyzing the nature of nonlinear change in Earth System functioning. This work played a central role in the emergence of abrupt change, surprises and extreme events as unifying themes in the second phase of IGBP research.

Dynamic Global Vegetation Models (DGVMs). When GCTE began its implementation in 1991, the terrestrial surface was treated as a 'big leaf' or a 'green slime' in global climate models. One of the project's highest priorities was to change this situation. Several research groups associated with GCTE produced prototype DGVMs by the mid-1990s, a model intercomparison was implemented later in the decade, and now DGVMs are recognized as an essential component – as important as the oceans and the atmosphere – in Earth System models.

Complementing this Earth System perspective, the last phase of GCTE also placed emphasis on the consequences of global change for the things that matter to people – captured in this book in the section on "Ecosystem Services". These consequences are mostly reflected at regional scales and the regions under most stress are discussed in the final section of the book.

We are delighted and honored to have been asked to write this Preface. Brian was GCTE's first Chair and Will the first full time Scientific Officer, before he took over as IGBP Director. We both greatly enjoyed our involvement, benefiting from it enormously, and this was in large measure thanks to all the fine people who were involved. We cannot mention them all but we want to acknowledge one person in particular, Rowena Foster, for the prodigious effort she has put in, throughout the 15 years of its existence, to making GCTE work. We know that every scientist who was involved in one of the many workshops organized by Rowena will join us in thanking her.

GCTE's research over the past 15 years provides a sound base for the new Global Land Project, and the community that GCTE has built will make many further contributions to the GLP. This book highlights the exciting work that was carried out during the second half of GCTE and points towards the new challenges to be undertaken under the GLP banner. We congratulate the authors and editors on a fine effort. We thank the GCTE community for its many achievements and wish the GLP all the best for the future.

Brian Walker and Will Steffen
November 2006
Canberra

Acknowledgments

The implementation and success of GCTE was possible thanks to the commitment and contributions of many scientists from around the world who have volunteered for leading roles to drive activities, established networks, and run workshops and synthesis efforts for almost 15 years. Over 100 scientists played roles as members of the scientific steering committee, and as activity and task leaders. To all of them we want to show our appreciation and gratitude for their valuable time and intellectual contributions. Their willingness to contribute well beyond their own interest provided an invaluable service to the development of a globally coordinated understanding of science. Particular thanks go to the chairs of GCTE: Brian Walker, Ian Noble, and Louis Pitelka; and Harold Mooney for being such a motivating and inspiring leader.

We also want to thank to a smaller group of individuals who invested their careers in the roles of executive and project officers to support the implementation of the GCTE science plan. Without those individuals who were able to be full time facilitators, coordinators, and leaders, the GCTE would have not been able to operate successfully. Those individuals include: William Batista, Pep Canadell, Sara Duke, Pablo Inchausti, John Ingram, Elisabeth Huber-Sannwald, George Koch, Diane Pataki and Will Steffen. We also want to thank Rowena Foster who supported with great proficiency the International Project Office (IPO) in Canberra for the entire life of the project.

No GCTE activity or office would have been possible without the engagement and long term commitment of the many funding agencies which supported the offices and the development of networks, workshops, and synthesis efforts.

These long term funding relationships were key to the success of GCTE, enabling the establishment of an IPO and several focus offices that continuously supported the operations of GCTE. The IPO was based in Canberra, Australia and funded by the Australian Greenhouse Office (AGO) of the Department of the Environment and Heritage, and the Australian Commonwealth Scientific and Research Organization (CSIRO); initially in the Division of Sustainable Ecosystems and later on in the Division of Marine and Atmospheric Research. Both AGO and CSIRO Marine and Atmospheric Research are continuing their invaluable support to international research coordination through their support to the Global Carbon Project, a joint project of the Earth System Science Partnership (IGBP, IHDP, WCRP, and Diversitas).

The US-National Science Foundation (NSF), the National Aeronautics and Space Administration (NASA), Stanford University, and the University of Utah in Salt Lake City supported the focus 1 office on ecosystem physiology and biogeochemistry; the US-Department of Energy (DOE) funded many activities related to ecosystem physiology. The Natural Environment Research Council (NERC) through the Centre for Ecology and Hydrology in Wallingford, UK supported the focus 3 office on agroecology and production systems. The Inter-American Institute for Global Change based in Brazil, the University of Buenos Aires, and the CNRS-Ecole Normale Supérieure in Paris supported the focus 4 office on functional biodiversity.

On behalf of the GCTE and its sponsor program, the International Geosphere-Biosphere Program, we want to express our appreciation and thanks for the long

term commitment and significant contributions to the coordination of international science. This support has enabled the GCTE to leave behind a legacy of improved understanding of the effects of global change on terrestrial ecosystems, and a large community with the scientific capacity to continue this work into a new phase.

Finally we want to thank all the authors of chapters in this book for their time and valuable contributions towards this final GCTE effort.

Josep Canadell, Diane Pataki, Louis Pitelka

The editors

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