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Carbon sciences for a new world

Editorial overview

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J. Canadell is Executive Director of the Global Carbon Project (GCP) and research scientist in the Commonwealth Scientific and Industrial Research Organization in Australia. His research interest and contributions include the development of global and regional carbon budgets, insights into processes driving carbon exchanges between the biosphere and atmosphere, and assessment of CO_2 stabilization pathways, particularly on the potential for biospheric climate mitigation options. He has published more than 100 scientific papers and books, and he is a member of the Intergovernmental Panel on Climate Change. Through his leadership and support in the GCP, he emphasizes global and regional interdisciplinary analyses and syntheses on a variety of topics of the carbon cycle and its disturbance by human activities.

Carbon cycle sciences have evolved from a rather academic activity confined to the specialist quarters of research institutions, to the forefront of policy and public discussions on the causes of climate change and the ways we can achieve stabilization of atmospheric CO_2. This issue of Current Opinion in Environmental Sustainability is a great example of how the very same fundamental science that let us gain insights in the functioning of our planet are now informing and constituting building blocks of national and international policy processes to address the challenges of climate change.

This transformation is resulting from the evolution of carbon cycle sciences in at least two important ways. Firstly, new and rapidly emerging climate policies at the national and international level are calling for a better alignment of some of the ongoing research. One can see this pressure arising from (1) the need to better constrain the carbon-climate feedback, now a large uncertainty in climate projections; (2) the interest in resolving the effects of natural versus human-induced carbon sinks to develop fair international mitigation policies; more recently with a call to enhance the capacity to measure, report and verify the outcomes of mitigation policies; and (3) the need to define stabilization pathways by exploring allowable carbon emissions, sharing, timing, and governance for emission reductions.

Secondly, the rapid acceleration of the human disturbance on the carbon cycle is calling for more sophisticated and faster ways to observe and anticipate changes in the earth system. Particularly, changes on essential goods and services that societies depend upon, and on unexpected shifts in the dynamics of the climate system. Examples of the latter are the need to create a capability to detect and attribute changes in carbon fluxes from the largest and most vulnerable carbon pools in the earth system, such as permafrost carbon, peatlands, methane hydrate deposits, tropical forests, and the Southern Ocean sink.

The collection of papers presented in this issue highlights some of this scientific evolution led or facilitated by the efforts of the GCP, a joint project of the Earth System Science Partnership. It includes both new scientific results from global and regional syntheses, and key future research and operational needs to meet the growing demand for carbon-climate information. I want to thank all contributing authors for making this issue possible and for their commitment to a globally coordinated effort to advance carbon cycle sciences.