

Preface to the Special Issue on the Program of “Carbon Budget and Relevant Issues”—A Strategic Scientific Pioneering Program of the Chinese Academy of Sciences

Daren LÜ

Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing 100029, China

Citation: Lü, D. R., 2017: Preface to the special issue on the program of “Carbon Budget and Relevant Issues”—A strategic scientific pioneering program of the Chinese Academy of Sciences. *Adv. Atmos. Sci.*, **34**(8), 939–940, doi: 10.1007/s00376-017-7001-x.

Global warming has been one of the biggest issues faced by the world in recent decades. It is closely related to anthropogenic emissions of greenhouse gases (GHGs)—mainly CO₂, CH₄ and N₂O—and the effects of reducing emissions and increasing the carbon fixation capability. China, as a large country with rapid economic and social development, has a major share in both GHG emissions and carbon fixation. During 2011–15, a “Strategic Scientific Pioneering Program of the Chinese Academy of Sciences (CAS)” was conducted to study the carbon budget and climate change.

Under the framework of the program, about 50 CAS institutes, universities and other national ministries, comprising some 4000 scientists, investigated major questions including the accurate estimation of national anthropogenic GHG emissions, quantitative verification of the terrestrial carbon budget, the carbon sequestration rate and potential of increasing the carbon sink, techniques and technology of such an increase in China, and uncertainties regarding the relationship between future global warming scenarios and concentrations of GHGs. Based on the research results of the program, a data resources system, scientific knowledge system and technical support system were built to provide consultation for decision-makers to address climate change—in particular, on the issues of reducing GHG concentrations, increasing the carbon sink, and a national sustainable development strategy. The program was aimed at promoting the whole research capability of China on the methodologies and technologies of verifying GHG emissions, the quantitative assessment and verification of the terrestrial carbon budget, ecosystem and climate change research, techniques and methods for increasing ecosystem carbon sinks, and policies for regional carbon budget management. The expectation was to make breakthroughs in China’s scientific and technological capacity to address climate change, and raise the country’s international profile and voice in related diplomacy.

The specific objectives of the program were to:

- (1) Establish independent carbon emissions measurement systems in the energy, cement and other industries, and quantitatively assess GHG emissions caused by particular land use;
- (2) Establish an independent atmospheric carbon concentration and carbon sink/source monitoring system that incorporates satellite remote sensing, airborne monitoring, surface network monitoring and atmospheric general circulation modeling, and build a land observation network to study the terrestrial carbon budget;
- (3) Synthetically study and quantitatively assess the carbon sequestration rate and the potential for carbon sink increments in various ecosystems in China, evaluate the sink contribution of major ecosystem projects in China, study the mechanisms and technical systems of carbon sink increment interventions, and establish a prototype carbon sink increment system;
- (4) Develop a more integrated new-generation climate system model, quantitatively project GHG concentrations corresponding to the scale of future global warming, understand the relationship between anthropogenic aerosols and climate change, and reduce uncertainties in the relationship;
- (5) Analyze the facts relating to climate change in the past century, millennium, and 10 000 years, study the natural climate variability of the past 10 000 years and the adaption of human beings, and enhance our understanding of natural climate change and its attribution;
- (6) Analyze the mechanisms of the international carbon trade market and its possible influence on China, propose the establishment of a carbon trade market in China, develop technology and economic policies related to carbon abatement and carbon sink incrementation in forestry, agriculture and animal husbandry, and provide consultation to domestic policy-making and the development of an inter-industry eco-compensation and carbon management system.

This 7200 million Chinese yuan program consisted of 15 projects falling into five research clusters: (1) GHG emissions inventory of China and its monitoring with satellites, surface monitoring, as well as a model assimilation system; (2) carbon sequestration rates and the potential of major ecosystems in China; (3) sensitivity of climate change and projection in China; (4) past natural climate change and human adaptation in China; and (5) policies for green and sustainable development in China.

Up to the end of 2016, more than 2900 papers related to above projects had been published in international and domestic scientific journals.

The present special issue of *Advances in Atmospheric Sciences* was organized to encourage the publication of research results from within this program. The issue consists of eight papers on various topics, including aerosols and their radiative forcing (Fu et al., Page 952–964; Zhang et al., Page 993–1002; Ma et al., Page 1017–1026), airborne observations of aerosols, CCN, and cloud–aerosol interaction (Yang et al., Page 1003–1016; Lü et al., Page 983–992), paleoclimatic reconstructions of the past 2000 and 160 years in China (Ge et al., Page 941–951; Liu et al., Page 977–982), and the monitoring of CO₂ from space (Yang et al., Page 965–976).

Despite being just a small part of the program's published output, the papers in the present special issue undoubtedly enhance our understanding of the climate change related to both natural and anthropogenic influences, thus demonstrating the importance of focused research programs of this type.