

China Gears up for Carbon Research and Management

By XIN Ling (Staff Reporter)

Since 1981, carbon scientists from around the world meet every four years to exchange the latest knowledge in carbon cycle research. When the 9th International Carbon Dioxide Conference (ICDC) opened in Beijing on June 3, 2013, over 500 scholars from 31 countries celebrated their “Olympics” once more.

As the first ICDC conference taking place in China, the Beijing meeting, which was hosted by the CAS Institute of Atmospheric Physics (IAP), was impressive in many ways. To many participants, it was carefully prepared, scientifically designed and well organized. More importantly, it offered a unique chance for Chinese scientists to show their research progresses to the world, and for the world to take a closer look at China’s endeavors in scientific carbon mitigation.

And Chinese scholars did a wonderful job. Their confident smile can be seen everywhere and their voices heard in almost all sessions; in many domains they are pushing back the scientific frontier. With China’s huge responsibility in emission reduction, Chinese scientists are increasingly making a difference in carbon cycle research.

Better science for worsening reality

“When ICDC was first convened in Bern in 1981, it had

only 40 participants,” recalled Prof. Martin Heimann, director of the Max Planck Institute for Biogeochemistry, in his speech immediately after the opening ceremony.

Despite the expanding scientific input, however, the overall emission situation has been deteriorating. As Prof. Heimann revealed, the past 30 years has witnessed more than 80% increases in global energy consumption and CO₂ emissions, as well as a rise of 0.76 degrees Celsius in the Earth’s temperature compared with the 1880s. Anthropogenic emissions from fossil fuels burning and land use change, among others, are largely to blame.

Fossil fuel emissions have been growing at an alarming rate, especially in the last decade. “The increase rate in the 1990s was about 1% each year. Since 2000, it has jumped to a yearly average of 3%. The carbon dioxide emitted from fossil fuels combustion and cement production in 2012 may arrive at a record high of 35.6 billion tons — without signs of slowing down,” warned Dr. Corinne Le Quéré, director of the Tyndall Center for Climate Change Research and co-chair of the Global Carbon Project.

Urbanization and land exploitation lead to massive carbon emissions, too. For instance, peatlands have served as a large belowground carbon pool on Earth for thousands of years. In warm climates, they tend to take in more carbon for sequestration, according to the study of Dr. YU Zicheng,





The Chinese carbon budget program: seeking emission facts

In 2011, with 130 million US dollars worth of funding, CAS launched a strategic priority research program on “Carbon Budget and Relevant Issues in Response to Climate Change”, engaging more than 1,000 scientists from within and outside the Academy to address a number of key scientific issues, ranging from the basic facts of greenhouse gas emissions in China to the nation’s ecosystem carbon fixation capacities and to policy suggestions for adaptation and green development.

According to Prof. LIAO Hong from IAP, who spoke at the ICDC Beijing meeting on behalf of Prof. LU Daren, the program’s chief scientist, the Chinese carbon budget program has achieved major progresses during the past two years.

On one hand, scientists are piecing together China’s emission inventories based on nationwide investigations. For example, they obtained data on the average carbon content of coals by analyzing coal samples from across China. They also observed an obvious decrease in agricultural emissions of nitrous oxide from wheat, rice and corn combined during the 2001–08 period compared with two decades before.

On the other hand, they are unraveling the status, mechanism and potential of carbon fixation by terrestrial ecosystems in China. Through satellite monitoring, field surveys and controlled experiments, researchers found that thanks to China’s ecological restoration efforts, the carbon density of forests has been on a slow rise in the past thirty years.

Scientists are also trying to reconstruct climate change over the past 2,000 years in China using tree rings, lake sediments and ice cores, and to understand possible climate evolvments in the next hundreds of years.

“The Chinese carbon budget program also has a project to examine historical changes and climate effects of aerosols. We have set up 36 ground stations for aerosol measurements and an aerosol-cloud-radiation measurement network to quantify the effects of aerosols in climate change and make their emission inventory,” she introduced.

At the same time, public policy experts from CAS and other institutions are pushing forward research on the impacts, adaptation and green development.

“Hopefully with all these research activities going on, we’ll acquire comprehensive datasets to support our understandings on China’s carbon budget, and come up with new results that may be interesting to many carbon scientists here,” she said.

a paleoecologist from Lehigh University who is leading an NSF program on the sensitivity of peatland carbon to Holocene climate change. Unfortunately, as his study implied, excessive land reclamation around the world has destroyed many peatlands and accelerated the release of carbon dioxide from them.

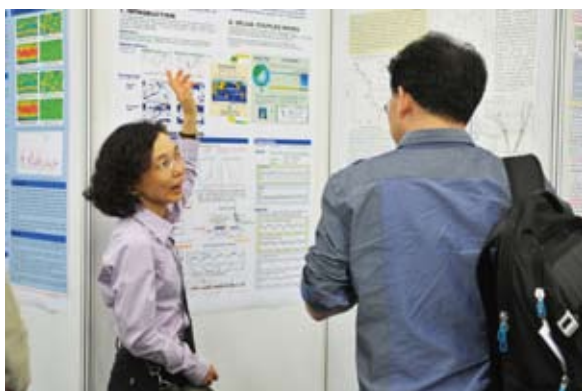
At the same time, as global temperature keeps going up, one of its negative feedbacks on the carbon cycle is to remarkably reduce the efficiency of natural carbon reservoirs. “In a warm climate, both the ocean and land sinks become less efficient,” Dr. Le Quéré noted.

“The fate of atmospheric CO₂ in the 21st century will be controlled by four factors. First, anthropogenic emissions from fossil fuel combustion and land use change emissions; second, direct carbon cycle response; third, climate feedback; and fourth, direct and indirect impacts on terrestrial and oceanic ecosystems,” Dr. Heimann pointed out.

As studies go deeper, a new major challenge has emerged for carbon scientists: the measurement of regional emissions, from the country level to factory level, by statistical analysis and monitoring.

“For a developing country like China, its strong economic growth naturally requires more energy consumption, which bears an impact on global climate and environment. And to reduce greenhouse emission is the responsibility of every nation including China,” said Prof. XIE Zhenghui, the meeting’s secretary general and deputy director of the National Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics (LASG) at IAP.

“To mitigate carbon emissions in China, we must first of all gain an objective and comprehensive understanding of the nation’s overall emission situation,” Prof. XIE emphasized. “By making our own emission inventory, we scientists may be able to help the government set emission reduction targets and measures.”



The Chinese Carbon Dioxide Observation Satellite (Tan-Sat) mission: monitoring CO₂ from space

Besides the carbon budget program, China is also developing a satellite to monitor atmospheric carbon dioxide from space.

“Satellite monitoring offers a new pathway to global and regional emission data acquisition,” Dr. TIAN Xiangjun from LASG told *BCAS*. “With the big eye in the sky, we’ll be able to combine observational data with numerical simulation to better understand the spatial and temporal distributions of CO₂ fluxes and concentration.”

The Tan-Sat, which means “Carbon-Sat” in Chinese, is scheduled to lift off between 2015 and 2016, according to Dr. TIAN, who is now leading a work group under the Tan-Sat Program to develop applied technologies for the quantitative detection of carbon dioxide.

By far, the Tan-Sat Team has come up with a primary data retrieval algorithm and applied it to retrieve XCO₂ from the GOSAT, Japan’s Greenhouse Gases Observing Satellite which is the only space-based CO₂ observing satellite in orbit at the moment.

“We found China’s emissions had probably been overestimated with GOSAT datasets,” he noted. In a couple of years’ time, Dr. TIAN and his coworkers will be able to analyze their own data when the Tan-Sat is put in orbit.

Carbon Management in China: Achievements and Challenges

As China’s carbon emissions continue to grow at a high rate, “it is highly expected that within a decade the Chinese emission will exceed the US and EU combined and take an unprecedented share of the global carbon budget,” confessed

Prof. QI Ye from Tsinghua University.

In his speech, Prof. QI analyzed how large-scale and rapid urbanization and industrialization had increased China’s carbon emissions.

However, his study also demonstrated some outstanding achievements by China’s low-carbon endeavor. For instance, he found there has been a sharp reversal in China’s energy and carbon intensity since 2005, and that the country has been overachieving its renewable energy targets since 2006.

Pointing at what he called “the X-shape curve”, he explained that the emission increase is driven by the economy while the decreasing trend of energy and carbon intensity is a result of low carbon policies.

“During the 10th Five-Year Plan between 2001 and 2005 when the central government did not set specific energy target for enterprises, the energy intensity turned out to have increased by 1.8%. In comparison, since 2006, a 20% mandatory target has been quite effectively implemented and fulfilled under local governments’ target responsibility system,” he remarked.

Funding is also important, he said. The money put in energy efficiency financing during the 11th Five-Year Plan reached 822.4 billion yuan, and the investment in renewable energy in the next Five-Year Plan will increase by 37.5%.

In 2010, five provinces and eight cities were named as low-carbon pilots in China. By far, they have scored encouraging results. This June, the city of Shenzhen became China’s first market for compulsory carbon trading. Though China still faces many difficulties in the implementation of carbon trading, but the move itself is a good start and well received around the world.

“The challenge for China is really incredible and remarkable, and I hope I’ll be there to see that,” said Prof. Le Quéré, one of many to wait and see China’s sustaining efforts in green development, not only for the nation itself, but also for the world at large.



Some of the organizers and volunteers of ICDC9, including Dr. ZENG Ning (fifth left), conference chair from the University of Maryland, and Prof. XIE Zhenghui (sixth left) and Jenny Lin (fourth left) from LASG.