Future Carbon Research: Monitoring Regional Emissions and Developing Sequestration Strategies

— An Interview with Prof. ZENG Ning

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Dr. ZENG Ning. (Photo: BCAS)

Dr. ZENG Ning is Associate Professor at the Department of Atmospheric and Oceanic Science, University of Maryland. With a strong interdisciplinary background, Dr. ZENG has been engaged in the study of climate change and climate variability for many years, specializing in Earth system modeling. He is also interested in technical solutions and policy implications of climate change.

As Conference Chair of ICDC9, Dr. ZENG envisioned the future of global carbon cycle research and offered suggestions on China's carbon science and policy during talks with BCAS reporter XIN Ling in Beijing in June.

***BCAS:** How is ICDC9 different from previous ICDC meetings?*

Dr. ZENG: First I'd like to say there are many similarities. It's a continuation of a long tradition of the world's best scientists in carbon cycle research getting together to discuss the newest research results in the field.

In terms of difference, I think there are two big differences. One is now that climate change has become an extremely important issue, arguably the No.1 environmental problem in the 21st century, and that carbon cycle is at the center of climate change, there is so much society interest as well as implication to the development of economy, energy and so on. In that sense, compared to the previous ones, there is more focus in this meeting on, for example, anthropogenic emissions, the drivers of fossil fuel emissions, land use change and how these factors come about. Much more detailed knowledge has now come to light. We used to just take the total production of fossil fuels and convert that into global total fossil fuel emissions in gigatons of carbon per year. But now we're talking about consumption-based emissions. We're talking about how much the city of New York and Paris emit carbon dioxide and how they compare with Beijing and Shanghai. And we're talking about how rich people are responsible for a lot more carbon emissions than poor people, and how rich countries are responsible for indirect emissions. For example, China's fossil fuel emissions have more than 20% related to the products produced here but exported and consumed by countries like the US and European nations. So there's a lot of these very precise information that is useful in terms of climate policy, or even useful for ordinary people who are concerned about climate change so that they can modify their lifestyle and personal habit for the sake of a better environment.

The other difference has to do with the carbon cycle scientists. Besides fundamental scientific questions like the long-lasting mystery of the carbon cycle and the missing carbon sinks which are still unresolved, we are also talking a lot more about if the society wants to mitigate climate change by reducing carbon emissions, what the scientists can do to help with these goals. We discussed how to monitor carbon emissions. For instance, China is ready to start carbon trading in seven cities and provinces. If Factory A says, "I have reduced carbon emission by 20% last year", how do you trust what he says? You need scientific measurement, independently from what they claim, so that you have accurate numbers that can be put on the table. Once you

Dr. ZENG chairs the opening of the 9th International Carbon Dioxide Conference (ICDC9) at the Beijing International Convention Center on June 3, 2013. (Photo: Institute of Atmospheric Physics, Chinese Academy of Sciences)

start carbon trading, you want to encourage the real carbon reductions, not the false ones. So scientists come up with fantastic ways, many of them still in the process of being tested or some just being envisioned, like using satellites to monitor the plume coming out of a factory chimney.

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BCAS: *So monitoring and understanding regional emissions will be a very important task for carbon scientists.*

Dr. ZENG: I think so. Since about 80% of the fossil fuel CO_2 actually comes from cities, especially specific places like power plants, scientists have already started to look at urban areas, some at factory level. In terms of scientific significance, emission monitoring is important because it will serve as a confirmation of our present conclusions about global CO_2 emissions, which are mainly based on statistical analysis. Monitoring data will also enable us to infer emission sources from very small concentration gaps detected in the atmosphere.

We have to develop monitoring methodologies such as satellite remote sensing, in situ observation and isotopes networks. A model-data combined methodology will provide us with the most comprehensive picture of the global carbon cycle.

The US Environmental Protection Agency has lately developed a system on its website to present a full view of the country's major emission sources including big power plants and landfills. I think it'll be very effective in promoting public scrutiny over emission and emission changes.

BCAS: *What about carbon sequestration?*

Dr. ZENG: Carbon management and sequestration is highly relevant. We've been talking a lot about emission reduction, but reduction alone is not enough. With the Copenhagen Accord, countries agree to keep the global temperature increase to below 2 degrees Celsius. However, the situation is, even we stabilize emissions right now, the carbon dioxide in the air and global temperature will continue to rise and the 2°C target would be a mission impossible. Here carbon management and sequestration, or negative emissions, can be an important addition to prevent "dangerous interference with the climate system".

Unfortunately, although scientists all over the world have made extensive explorations into carbon sequestration from geological, biological and geo-biochemical perspectives, there have been no truly proven technologies to date. From my point of view, biological sequestration is very promising thanks to its environment-friendly and low-cost nature.

BCAS: *Would you give an example of biological sequestration?*

Dr. ZENG: For example, we all know that young and fast-growing trees are good carbon sinks. But as they mature, the net carbon flux diminishes. When they die or are burnt down, the carbon in them will be released and return to the air. My colleagues and I have been working on a new sequestration strategy called "Wood Harvest and Storage" (WHS). Our main idea is to achieve carbon sequestration by harvesting a reasonable fraction of the wood in a forest and burying them underground or store above ground to prevent decomposition. In this way, we can make good use of the unused or abused forests to "preserve" carbon minimizing disturbance with ecosystem functions.

According to our study, the WHS strategy has a range of 1-3 $GtCy^{-1}$ sequestration potential. Compared with current carbon capture and storage (CCS) technologies which cost about several hundred dollars per ton of CO_2, it may be possible at only 50 dollars per ton.

BCAS: *How do you foresee the challenges of carbon research?*

Dr. ZENG: One challenge is how to disseminate the knowledge we have. In fact, many scientists including myself have been thinking a lot about this question. Scientists easily dive into answering sophisticated questions but politicians often need simple messages. In this regard, I think the Global Carbon Project has done a lot of work to spread scientific information to the public through media, and the information is often directly used by policymakers. Some policies are even suggested by scientists.

Dr. ZENG (right) and his student Dr. Jay Gregg during a trip to Antarctica in January 2010. (Photo courtesy of Dr. ZENG Ning)

BCAS: *I know you have a lot of cooperation with scientists from China, especially the Chinese Academy of Sciences. How do you evaluate China's contribution to carbon study and carbon reduction?*

Dr. ZENG: In many respects, Chinese scientists are making great advances in a relatively short period of time. They are going to drill the deepest ice core from Antarctica, launch a CO_2 satellite within a few years and soon have the fastest supercomputer dedicated to climate science.

In policy-related aspects, I'm impressed by the efforts China has made in reducing carbon intensity and improving energy use efficiency. According to a presentation given by Prof. QI Ye from Tsinghua University at the meeting, China's development has had carbon intensity decreasing since the 1980s. It's actually a conscious energy policy made by the Chinese government, basically all the way up to DENG Xiaoping who made a decision at the beginning of China's reform and open-up: since China doesn't have that much energy resources, it has to reduce its energy intensity. Therefore, while China has developed so fast with an increasing total carbon emission, its carbon intensity and the emission per GDP produce have decreased. For most of the developed countries like the US and UK, they developed their economy with a totally different pattern; their carbon intensity was increasing about 100 years ago.

China actually has very strong political will to spend billions and billions of dollars — 1 trillion yuan, that's the number Prof. QI quoted — in renewable industries and energy efficiency measures. But it's certainly a challenge to ensure the enormous input into this.

BCAS: *What makes a fair and feasible carbon emission target for China?*

Dr. ZENG: That's very complicated. Carbon dioxide has a long life time. Much of the CO_2 emitted at the beginning of the Industrial Revolution when James Watt invented the steam engine is still in the atmosphere. In that sense, we need to look at the human-related historical emission. We also need to look at per person emission because everybody has the same right of using natural resources. Of course, the reduction in carbon intensity is probably not enough given China's large population and high energy demand. China will have to develop its own new ways of sustainable development that is also good for climate.

In an idealized world, putting a price on carbon will be a way to go for relative fairness. For instance, although 20% of China's emissions are actually used to produce export goods, a carbon price can address the problem. The goods will become more expensive and foreign consumers will pay more money to buy it. However, there is a whole set of problems in the implementation. Australia and several states of the US are already doing carbon trading, and China will try it out in mid June in seven cities and provinces.

BCAS: *Your messages for young Chinese scholars in your field?*

Dr. ZENG: I have two pieces of advice. One is to do things scientifically and tell the truth. Scientists should not be short-sighted, even when you realize that your results are not good for certain short-term political purpose. If there is a real challenge, face it and take a realistic approach to solve it. Pretending that the problem doesn't exist will cause more troubles in the long run. The second is to do better research. For instance, you must try to come up with the best methodologies and technologies of carbon monitoring so that you can have your say during international negotiations. They will be useful for the whole world as well as for China's climate policy.