One-on-One with Tier One: Dr. Xun Jiang

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by Kim Pierre

— Dr. Xun Jiang

Xun Jiang, associate professor of atmospheric science in the Department of Earth and Atmospheric Sciences at the University of Houston, received an award from the National Atmospheric Aeronautics and Space Administration (NASA) to study atmospheric carbon dioxide (CO_2). Jiang is currently working in collaboration with Yuk L. Yung, Smits Family Professor of Planetary Science at the California Institute of Technology. The researchers will use NASA's first dedicated Earth remote sensing satellite, the Orbiting Carbon Observatory (OCO-2), to measure carbon dioxide (CO_2) and identify the locations of carbon dioxide sources and sinks. As carbon dioxide is produced in abundance by human activities, it is considered the primary cause for climate change. Researchers hope after OCO-2 is launched in 2014, it will provide an accurate measurement of carbon dioxide so that they are better equipped to estimate the rate of global warming.

Your research was funded by NASA's Orbiting Carbon Observatory (OCO-2) to study the effects of the global carbon cycle. What is the global carbon cycle? Can you explain global carbon cycle modeling?

The global carbon cycle refers to the exchange of carbon amongst the Earth's systems, meaning the biosphere, atmosphere, and ocean. The numerical models are powerful tools of exploring the

global carbon cycle, which can be used to investigate the sources and sinks of carbon dioxide. Sinks are the locations where carbon dioxide is absorbed, such as the ocean and plants due to photosynthesis. In addition, the models of the global carbon cycle can be used to understand the transports of carbon dioxide.

What are the most common sources of carbon dioxide?

Sources for carbon dioxide include fossil fuel burning, biomass or organic matter burning, decay of vegetation, and volcano eruptions, amongst other sources. Human activities influence the concentrations of atmospheric carbon dioxide by releasing more carbon dioxide into the atmosphere and through deforestation.

Can you describe your current research and the methods used to make observations? What is your goal through this research?

The Orbiting Carbon Observatory (OCO-2) mission will make the first global, space-based measurements of atmospheric carbon dioxide with the precision and spatiotemporal coverage necessary to characterize carbon dioxide sources and sinks on regional scales. We intend to retrieve carbon dioxide vertical profilesfrom OCO-2 radiances by incorporating mid-tropospheric carbon dioxide from other instruments (e.g., the Tropospheric Emission Spectrometer and the Atmospheric Infrared Sounder).

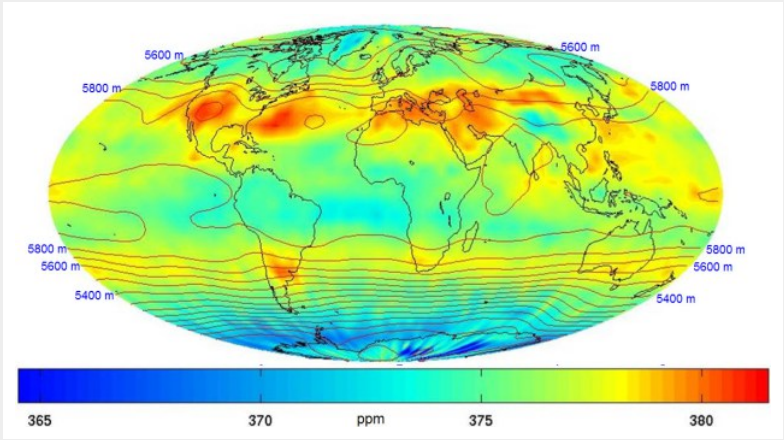
Through our research, we will extract carbon dioxide vertical information from OCO-2. It is important to obtain carbon dioxide near the earth's surface in addition to column carbon dioxide from OCO-2, for carbon dioxide emissions are the strongest in the lowest 1-2 kilometers. Existing model results suggest that carbon dioxide inversions are very sensitive to the vertical transport in the model. The extra vertical information on carbon dioxide will help better identify variability of carbon dioxide, and the methods in which we can reverse carbon dioxide sources and sinks in the future.

The information collected could help change our national policies regarding energy, and subsequently help policymakers form regulations to retain our quality of life. What changes could we make in our lives to help regulate our carbon dioxide output?

Reduce carbon dioxide emissions from fossil fuels and biomass burning. Vehicles release a significant amount of greenhouse gases each day. If citizens make simple adjustments to their daily lives, they can help decrease these gases. To help reduce their carbon footprint, some of my friends take the bus instead of driving a car to work. For those who currently have a car, try carpooling with a spouse or colleague. When you must replace your current vehicle, consider buying an automobile with increased fuel economy. If you have the resources, look into a hybrid or electric vehicle. Individuals can make their homes more efficient by utilizing energy efficient light bulbs and appliances, ensuring insulation is installed properly, and regulating their heating and cooling systems.

NASA states that before the Industrial Revolution, carbon dioxide levels in the atmosphere rose by less than 1 percent per year. NASA attributes land changes, cement manufacturing, and the burning of fossil fuels to the list of "human activities" that have attributed to the 37 percent increase in carbon dioxide levels since that time. From your perspective, what is the cause of increased carbon dioxide in the atmosphere?

The major reason for the positive trend in the carbon dioxide – at a rate of 2 parts per million each year – is fossil fuel emissions.



— Satellite shows CO2 variability, which can help to understand its effect on global climate change. Work funded by NASA ROSES OCO-2 Science Team, AIRS Science Team, and NASA Jet Propulsion Laboratory.

Previously you studied the influence of global warming on extreme weather through satellite data. Results suggested

global warming increased extreme weather patterns. What adverse changes could we notice with increased carbon dioxide in the atmosphere during our lifetime?

In another NASA-funded project, we found that, in the past two decades, wet areas got wetter and dry areas got dryer. Such trends intensified the extreme weather patterns by a mechanism called "rich-get-richer." Our investigations also suggest that global warming due to the historic increase of greenhouse gases can influence the progressive variations of precipitation and, hence, affect the extreme weather.

For more information on the Department of Earth and Atmospheric Sciences, visit their homepage.

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