Field Notes: Air Pollution, Clouds, Monsoons, and Our Inspiring Experience in Manila

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September 2018

Field Notes is an occasional series in which UA faculty members write about their field research. If you have an idea for a Field Notes column, send an email to Kyle Mittan at mittank@arizona.edu.

Armin Sorooshian is a professor and a University Distinguished Scholar in the Department of Chemical and Environmental Engineering, and also is a member of the Department of Hydrology and Atmospheric Sciences faculty. Three doctoral students in chemical engineering – Rachel Braun, Alexander MacDonald and Connor Stahl – accompanied him for fieldwork in Manila, Philippines, to investigate the nature of particulate pollution with the goal of identifying how it affects public health and monsoon activity in Southeast Asia.

A series of text messages at 1 a.m. confirmed that our whole team was awake and ready to go. We piled into a van with some of our new Filipino colleagues and began the 11-hour journey to visit one of the most important global landmarks in the history of aerosol pollution: Mount Pinatubo in the Philippines. Following our van ride from metro Manila, a four-wheel-drive vehicle ride to the trailhead, and a four-hour hike, it was noon when we came face to face with our destination.

Mount Pinatubo's eruption in 1991 was one of the most obvious natural experiments demonstrating the powerful impact of tiny airborne particles, called aerosols, on our everyday lives as the global mean temperature decreased, skies became hazy, and sunsets became redder. Our research group did not travel to Manila for the sole purpose of visiting Mount Pinatubo. In fact, this was our day off from work. The reason we visited became very present on our hike back to the trailhead: torrential rainfall associated with the southwest monsoon of Southeast Asia.

The Philippines has more than 7,000 islands, which are highly susceptible to the effects of climate change, as has been observed in recent years with the devastation of drought and typhoon. We got a sneak peek of how harsh the weather can be in the three weeks we visited. As one example, our four-wheel-drive vehicles struggled to get us back from the trailhead to our van, owing to significant flooding that appeared almost instantly when the rain started.

We are participants in a major NASA project called the Cloud, Aerosol and Monsoon Processes Philippines Experiment. The experiment is intended to explain the effects of tiny particulates and meteorology in driving cloud and precipitation processes associated with the monsoons they experience. Clouds are not made of pure water alone; they are formed by having seed particles that water vapor can condense on in order to make droplets. Our
research is partly motivated by understanding why certain particles become droplets and others do not, and also how the number and size of droplets in a cloud at a given time affect its ability to produce rain. The monsoons have a remarkable impact on the Philippines. The water is critical for survival and the natural ecosystem, but too much can cause devastating floods and landslides. NASA satellites are providing a unique perspective on the nature of monsoons, but airborne measurements are needed to calibrate and validate space-borne remote sensors.

While aircraft measurements will take place in fall 2019, we got a head start this July by initiating a collaboration with a wonderful group of scientists at the Manila Observatory, a Jesuit research institution based on the campus of Ateneo de Manila University. The main purpose of our field trip was twofold: to set up instrumentation to collect size-resolved aerosol particles on filters to then examine what they are made of chemically, and to train our colleagues to operate these instruments so they can continue sampling for a full year without our supervision. Knowing the composition of particles in different size ranges is critical to know how they affect our health? particles of different sizes impact different parts of the respiratory system? as well as visibility, climate and cloud formation.

Our three-week field trip was inspiring and eye-opening for a number of reasons. The amount of aerosol pollution in metro Manila surpassed anything any of us had witnessed in our lives, specifically the amount of black carbon, often referred to as soot. We are normally accustomed to black carbon accounting for less than 5 percent of the total aerosol mass in parts of the United States we have studied, including major cities such as Los Angeles, Phoenix and Houston. In stark contrast, it is not uncommon in metro Manila for black carbon to account for half of the total aerosol mass budget? a truly stunning amount.

We were also inspired by the scientists at the Manila Observatory, who were remarkably hospitable and energized us even more for the research due to their ambition to tackle one of the great environmental issues facing Manila. My students and I had the pleasure of presenting lectures to their group about various aspects of aerosol science and to teach them about the theory of the instrumentation we set up in their observatory.

The coming months will be an exciting time as we process the data from samples we collected during our trip, in addition to samples our colleagues will continuously send to us from Manila for chemical analysis here at the UA. We will work with them to draft manuscripts to report important new scientific findings. Finally, the research results from the coming year's collaboration with the Manila Observatory will provide important context for the two months of flights we will participate in next summer around the Philippine Islands to continue unraveling the complexity of the aerosol-cloud-meteorology system.

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