Cellphones as a Distributed Platform for Black Carbon Data Collection

Black carbon (BC), the visible component of soot that gives emissions such as diesel engine exhaust their dark color, has come to be recognized as a major contributor to global warming, and a frontline concern for climate change strategies (Ramanathan 2001, Jacobson 2010).

We have developed a new low-cost instrument for gathering and measuring atmospheric BC concentrations that leverages cellphones to transmit data from an air filtration unit to a centralized database for analysis. Our new system relies on image processing techniques, as opposed to other more expensive optical methods, to interpret images of filters captured with a cellphone camera. As a result, the entire system costs less than $500 (and is orders of magnitude cheaper than an Aethalometer, the prevailing method for measuring atmospheric BC).

We are working with three community groups in Los Angeles, and will recruit three groups in the San Francisco Bay Area, to enable 40 citizens to be actively engaged in monitoring BC across California. We are working with The Energy Resources Institute, an international NGO based in India, to deploy this instrument with 60 people in conjunction with Project Surya, which aims to deploy clean cookstoves and rigorously evaluate their impact on BC emissions. Field tests of this new instrument performed in California report an average error of 0.28 μg/m3 when compared with an Aethelometer. These excellent results hold the promise of making large-scale data collection of BC feasible and relatively easy to reproduce (Ramanathan et al., forthcoming).

The use of cellphones for data collection permits monitoring of BC to occur on a greater, more comprehensive scale not previously possible, and serves as a means of instituting more precise, variation-sensitive evaluations of emissions. By storing the data in a publicly available repository, our system will provide real-time access to mass-scale BC measurements to researchers and the public.

Through our pilot demonstration, we hope to better understand whether a scaled out implementation of our system could provide a means of improving the monitoring of nations' adherence to international climate change protocols and agreements regarding greenhouse gases, including the Kyoto and Copenhagen Accords. The improved cost basis of our collection method could help reduce the expense of such monitoring and encourage such oversight procedures to become more widely enacted. Moreover, we believe that the increased ease that our cellphone technology may bring to data collection may help develop public interest in not only BC generally, but also in actively self-monitoring BC concentrations and more broadly, in networked monitoring solutions to environmental issues. As a result, individual measurements of black carbon exposure can become an important component of global climate change strategies.

Jacobson, M. Z. (2010), Short-term effects of controlling fossil fuel soot, biofuel soot and gases, and methane on climate, Arctic ice, and air pollution health. J. Geophys. Res., 115.

Ramanathan, V., P. J. Crutzen, J. T. Kiehl and D. Rosenfeld (2001), Aerosols, Climate, and The Hydrological Cycle. Science, 294.