Household Indoor Particulate Matter (PM) Measurement Using a Network of Low-Cost Sensors

Shruti Hegde [1], Kyeong Min [2], James Moore [3], Philip Lundrigan [3], Neal Patwari [2] and Kerry E. Kelly [1]

Department of Chemical Engineering [1], Department of Electrical and Computer Engineering [2], School of Computing [3]

University of Utah

The World Health Organization (WHO) estimates that 4.3 million people die annually from household air pollutant exposure, making indoor air quality (IAQ) a growing concern. PM of diameter 2.5μm or smaller is a particular concern because these can penetrate into the lungs and cause serious health effects. Indoor levels of PM are significant contributors to an individual's daily exposure, and sources of indoor PM include cooking, combustion activities like burning candles or heating/cooking with solid fuel, cleaning, and use of furnaces. Numerous studies of indoor PM measurement have employed passive air sampling or gravimetric methods. These samples are time-consuming to collect and analyze and do not capture temporal variation. Research-grade instruments can provide accurate and rapid measurements of PM2.5 measurements, but the cost of such instruments can be very high, limiting the ability to place networks of sensors in a home. The objective of this study is to (1) deploy a network of two types of PM sensors (i.e., research grade instruments and low-cost sensors) in a home environment and evaluate their performance, (2) characterize activities and conditions that affect PM concentrations, and (3) identify how these activities affect different rooms in a home. The low-cost sensors used in this study are the commercially available Dylos 1100 and the AirU sensors built at the University of Utah. These are compared to two research-grade instruments - the Grimm and DustTrak. The study was conducted in two households in Salt Lake City and during summer and winter. The PM measurements for typical activities are studied along with the effect of temperature and humidity. A few activities, like spraying of aerosols, exhibited a long PM decay period compared to other household activities, like vacuuming. In addition, this study captured the effect of a cold air pool on indoor PM levels.