Integration of Low-Cost Sensors in Understanding the Impacts of Dust Events on Puerto Rico's Air Quality

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The Saharan Air Layer (SAL) is a mass of hot, dry, and dusty air that forms over the Sahara Desert propagating westward over the Atlantic Ocean. Saharan dust aerosol is most concentrated as coarse particulate matter greater than one micron in diameter, i.e. PM_1 to PM_{10} (PM_c). Due to its geographical location, Puerto Rico is impacted by SAL during mid-June to mid-August, when SAL activity peaks. Despite its vulnerability, the existing air quality monitoring network faces limitations, especially in the distribution of PM_{10} monitors and access to data. Nevertheless, low-cost sensors (LCS) for PM can provide monitoring opportunities and information to communities about their local air quality. This project analyzes how can LCS be utilized to enhance the characterization of major dust events in Puerto Rico. To address the observational gaps, five MODULAIR-PM monitors were installed in strategic locations across the island. Since these sensors use both a nephelometer-type optical sensor (Plantower PMS5003) and an optical particle counter (Alphasense OPC-N3) to quantify mass concentration and particle size, readings were compared to determine their strengths and weaknesses. Satellite imagery and HYSPLIT models were used to identify SAL summer 2023 events. Additionally, size distribution for these events, $PM_{2.5}$ chemical composition, and meteorological data were evaluated. Initial findings reveal that higher concentrations of PM_1 to PM_{10} during dust events imply dust particle diameters are greater than 1µm, therefore nephelometer-type sensors are not useful to measure these aerosols, consistent with previous literature evaluations of Plantower and similar devices. However, MOD-PM can effectively identify dust events, since it combines nephelometer and OPC measurements, which has a better ability to size particles. Additionally, around 80% of the $PM_{2.5}$ during dust events is composed of natural sources (dust and sea salt), highlighting the importance of understanding these aerosols and their associated connections with meteorology. Overall, the integration of LCS can aid in the understanding of Saharan dust events on the island, help create a network of air quality sensors to address the lack of monitoring, and allow communities to make informed decisions regarding their local air quality.