Addressing Disparities in Air Quality Monitoring: Using Machine Learning and Remote Sensing to Estimate the Distribution of PM2.5 in Mexico

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Air pollution is the single greatest environmental health threat, according to the WHO, and disproportionately impacts developing nations, which suffer 90% of the 5 million premature deaths globally per year due to air pollution. This is in part due to the "outsourcing" of pollution to countries with lesser air quality regulation and research on regional air pollution monitoring when compared to the United States, Europe, and East Asia, as most international treaties hold countries responsible only for emissions produced within their borders. Air pollution, however, is a global matter, and must be addressed with research at the regional level. To combat the disparity in the geographic focus of research, this project details the process of creating the first continuous map of fine particulate matter (PM2.5), the most dangerous pollutant, over Mexico, using data sources and methods that may be easily applied to other regions of the world as a baseline for more specialized regional studies. A nationwide model to estimate PM2.5 in regions with few ground stations is developed using satellite data, historical ground pollutant monitoring, and land use variables. This is compared to NASA's MERRA-2 hourly surface particulate matter estimates for 2018. To provide continuous estimates of air pollution in regions without monitoring stations, a machine-learning model that incorporates historical ground monitoring, meteorological parameters, and physical model simulations is developed and tested, with cross-validated R scores up to 0.88 - the first of its kind covering all of Mexico.

Awards Won:

Third Award of $1,000

Fondazione Bruno Kessler: Award to participate in summer school "Web Valley"

U.S. Agency for International Development: Third Award Climate and Environmental Protection