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Deployment of Low-Cost, Carbon Dioxide Sensors throughout the Washington Metropolitan Area – The Capital Climate Initiative

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According to the IPCC from 1995 to 2005, atmospheric carbon dioxide (CO_2) concentrations increased by 19 ppm, the highest average growth rate recorded for any decade since measurements began in the 1950s. Due to its ability to influence global climate change, it is imperative to continually monitor carbon dioxide emission levels, particularly in urban areas where some estimate in excess of 75% of total greenhouse gas emissions occur. Although high-precision sensors are commercially available, these are not cost effective for mapping a large spatial area. A goal of this research is to build out a network of sensors that are accurate and precise enough to provide a valuable data tool for accessing carbon emissions from a large, urban area. This publically available greenhouse gas dataset can be used in numerous environmental assessments and as validation for remote sensing products. It will also be a valuable teaching tool for classes at our university and will promote further engagement of K-12 students and their teachers through education and outreach activities.

Each of our sensors (referred to as "PiOxides") utilizes a non-dispersive infrared (NDIR) sensor for the detection of carbon dioxide along with a combination pressure/temperature/humidity sensor. The collection of pressure and temperature increases the accuracy and precision of the CO_2 measurement. The sensors communicate using a serial interfaces with a Raspberry Pi microcontroller. Each PiOxide is connected to a website that leverages recent developments in open source GIS tools. In this way, data from individual sensors can be followed individually or aggregated to provide real-time, spatially-resolved data of CO_2 trends across a broad area. Our goal for the network is to expand across the entire DC/Maryland/Virginia Region through partnerships with private and public schools. We are also designing GHG Bluetooth beacons that may be accessed by mobile phone users in their vicinity.

In two additional applications, PiOxides are being deployed as a part of an innovative open networking platform being installed on LED street lights in Washington, DC and in a black spruce forest near Fairbanks, Alaska for the detection of carbon dioxide above thawing permafrost.