

Use of Low-cost Instruments and Calibration Models to Analyse Temporal Variability and Regional Influences of PM_{2.5} in West African Cities: A case study of Abidjan and Accra

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Abstract

Particulate Matter Low-Cost Sensors (LCS) can be used to monitor air quality in regions with limited access to reference monitors. This study carried out within the framework of the Improving Air Quality in West Africa (IAQWA) project provides high temporal resolution of data on fine aerosol (PM_{2.5}) mass concentrations in Abidjan (Cote d'Ivoire) and Accra (Ghana) through the deployment of field calibrated Real-time Affordable Multi-pollutant (RAMP) monitors. From February 2020 to June 2021, RAMPs were deployed at five sites in Abidjan and four sites in Accra. Using a temporal resolution of 15 seconds, the datasets provided by RAMPs allowed a comparative analysis of diurnal, daily and seasonal variability of PM_{2.5} concentrations for different urban sites with distinct pollution sources, over an extended period of time. Diurnal variations in PM_{2.5} concentrations showed prominent morning peaks related to traffic rush hours reaching up to 50 µg m⁻³. Evening peaks were significant for sites in residential neighborhoods, and pointed to residential type pollution sources. Seasonal differences are analysed over a yearly cycle and maximum values are found during the so-called long dry season (Harmattan), between December and February. During a prominent pollution episode in January 2021 observed by the ground network, analysis of 3D satellite data, revealed Saharan dust transport as an additional source of (fine) aerosol pollution significantly increasing PM_{2.5}. The same episode also revealed a limitation of LCS – an inability to adequately capture dust-dominated pollution, which can be quantified by reference monitors. Annual average PM_{2.5} concentrations vary between 17 and 26 µg m⁻³. PM_{2.5} differences between sites within a city, especially between traffic impacted and urban background sites, are larger than the differences between the two cities. These annual averages exceed World Health Organization (WHO) annual pollution thresholds from the 2005 (10 µg m⁻³) and 2021 (5 µg m⁻³) guidelines.

Early Career Scientist

NO, I am not an early career scientist.

IGAC Activities

MAP-AQ: Monitoring, Analysis and Prediction of Air Quality

IGAC Regional Working Groups

ANGA: African Group on Atmospheric Sciences