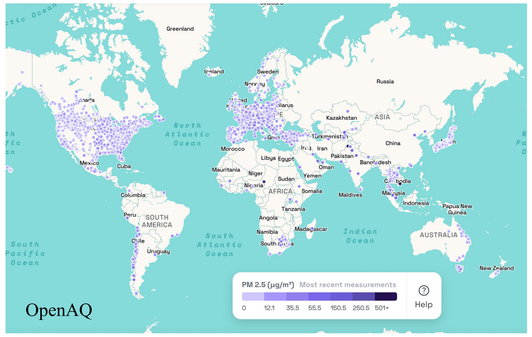
WRF-Chem Performance Evaluation and Source Estimation of PM2.5 in West African Cities

PRESENTER:
PennState
Aara'L Yarber auy57@psu.edu

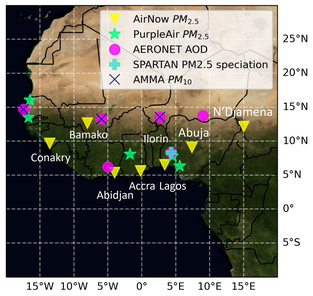
INTRODUCTION: West Africa, known for having the highest estimated particulate pollution rates in the world (Malings et al., 2020), is an intense emitter of Saharan dust, biomass burning, and urban emissions. Despite the region bearing the highest disease burden and premature death attributable to air pollution (Forouzanfar et al., 2016), air quality often goes unregulated due to a severe lack of air quality monitors.



Over the last five years, high-quality and low-cost air pollution monitors have emerged across West Africa. This study utilized newly available data to examine how well WRF-Chem can simulate PM2.5 levels and composition in West African cities throughout the year (2021). The relative importance of Saharan dust, biomass burning, and urban emissions on total PM2.5 in West African cities was examined.

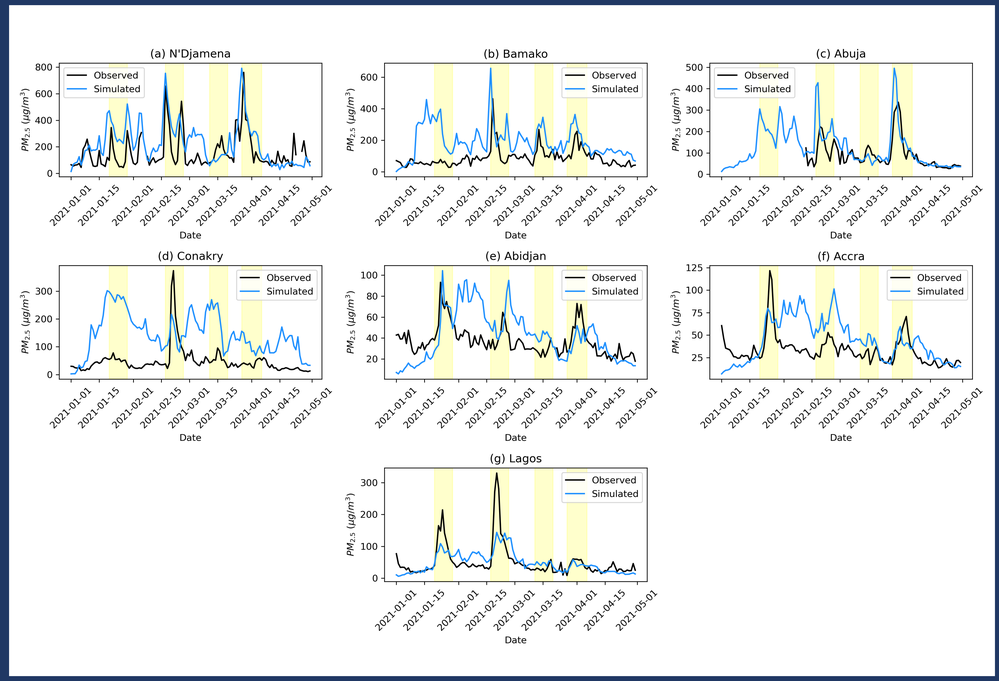
MODEL SETUP AND OBSERVATIONAL NETWORK:

MET IC/BC	NCEP reanalysis
Chem IC/BC	mozbc
Model grid spacing	20 km
Biomass burning inventory	FINN v2.5
Anthropogenic inventory	EDGAR HTAP v2
Gas-phase chemistry	MOZART
Aerosol scheme	GOCART
Run period	01/01/2021 to 12/31/2021



Only evaluations of AirNow and SPARTAN PM2.5 data are shown in this presentation.

WRF-Chem can capture **hazardous $PM_{2.5}$ pollution episodes** in **West African cities,** driven by **Saharan dust** emissions.



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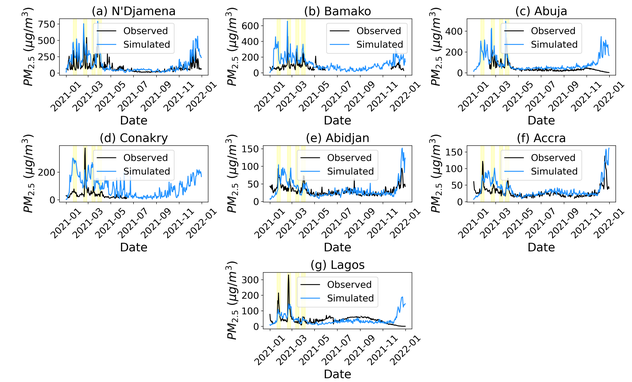
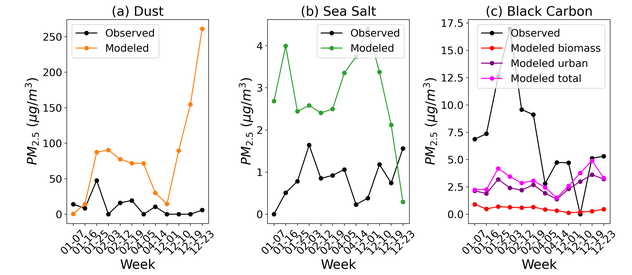
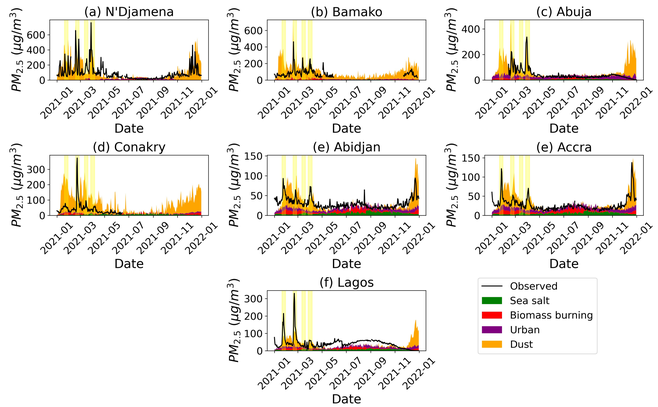
RESULTS: The model's performance varied by location, but the seasonality of daily PM2.5 was generally reproduced. The model represented many observed pollution peaks during the dry season, though it tended to significantly overestimate PM2.5 levels.



Weekly averages of Saharan dust and sea salt were significantly overestimated in Ilorin, Nigeria, while black carbon from biomass burning and urban emissions were underestimated. Thus, PM2.5 composition is likely biased throughout West Africa.



Saharan dust was overwhelmingly the dominant emission source during the dry season. During the wet season, urban emission was dominant in Abuja, Abidjan, Accra, and Lagos, followed by biomass burning advected from Central Africa.



FUTURE WORK: To fully refine models, improve inventories, evaluate pollution sources, and develop efficient control strategies, an extensive network of meteorological observations and speciated PM2.5 measurements is essential.