Quantifying Disagreement Between Air Pollution Data Sets and Metrics in Global Urban Areas

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Surface monitoring of fine particulate matter ($PM_{2.5}$) remains sparse in many cities, making global modeled concentration data sets essential for PM2.5 exposure analyses. We compare two leading modeled data sets, SatPM2.5 and LGHAP v2, across selected cities, to evaluate how data-set choice affects estimates of urban $PM_{2.5}$ exposure. After harmonizing the products we calculate unweighted and population-weighted correlations, root mean squared differences, and quantile-specific differences. We then use LGHAP v2 and GHS-POP to compare five population-weighted measures of inter- and intra-city burden: mean exposure, daily upper-tail exposure, exceedance days per resident, exposure inequality, and persistent relative rank.

Agreement between the two products varies widely across cities. Delhi exhibits high spatial correlation but large differences in concentration magnitude, whereas Nairobi shows weak agreement that declines after population weighting. Across most cities, disagreement is greatest at the upper end of the pollution distribution. Burden measures also identify different cities and residents as most affected: inequality and persistence substantially alter inter-city rankings, while intra-city overlap depends on both the metric and the local concentration distribution.

These findings show that uncertainty arises from both the modeled data set and the definition of burden. A population-weighted, multi-product, and multi-metric framework therefore provides a more complete basis for interpreting urban $PM_{2.5}$ exposure where monitoring remains limited.