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Biomass burning decline causes large reductions in NO2 burden over north equatorial Africa in spite of growing fossil fuel use

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Socio-economic development in low and middle-income countries has been accompanied by increased emissions of air pollutants such as nitrogen oxides (NO_x: nitrogen dioxide (NO_2) + nitric oxide (NO)), which affect human health. In sub-Saharan Africa, fossil fuel combustion has nearly doubled since 2000. At the same time, biomass burning—another important NO_x source—has declined in Africa's northern biomass burning region, attributed to changes in climate and anthropogenic fire management associated with agricultural development. Here we use satellite observations of tropospheric NO_2 vertical column densities (VCDs) and burned area to identify NO_2 trends and drivers over Africa. Across the northern ecosystems where biomass burning occurs—home to over 350 million people—mean annual tropospheric NO_2 VCDs decreased by 4.5% from 2005 through 2017 during the biomass burning season of November through February. Reductions in burned area explained the majority of these change in NO_2 VCDs, but there were also weaker relationships between changes in NO_2 VCDs and fossil fuel emissions over parts of West Africa, which were stronger during rainy season. Over Africa's biomass burning regions, NO_2 VCDs tended to decrease with increasing population density up to a threshold of approximately 180 people per km^2, suggesting that anthropogenic activity causes a net reduction in NO_2 emissions across roughly 90% of the continent's biomass burning regions. In contrast to the widely-held perception that socio-economic development worsens air quality in low and middle-income nations, our results suggest that countries in Africa's northern biomass burning region are following a different pathway, resulting in regional air quality benefits. However, these benefits may be lost with increasing fossil fuel use.