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High-resolution mapping of biomass burning emissions in tropical regions across three continents

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Biomass burning emissions from open vegetation fires (forest [U+FB01]res, savanna fires, agricultural waste burning), human waste and biofuel combustion contain large amounts of trace gases (e.g., CO_2, CH4, and N2O) and aerosols (BC and OC), which signi[U+FB01]cantly impact ecosystem productivity, global atmospheric chemistry, and climate . With the help of recently released satellite products, biomass density based on satellite and ground-based observation data, and spatial variable combustion factors, this study developed a new high-resolution emissions inventory for biomass burning in tropical regions across three continents in 2010. Emissions of trace gases and aerosols from open vegetation burning are estimated from burned areas, fuel loads, combustion factors, and emission factors. Burned areas were derived from MODIS MCD64A1 burned area product, fuel loads were mapped from biomass density data sets for herbaceous and tree-covered land based on satellite and ground-based observation data. To account for spatial heterogeneity in combustion factors, global fractional tree cover (MOD44B) and vegetation cover maps (MCD12Q1) were introduced to estimate the combustion factors in different regions by using their relationship with tree cover under less than 40%, between 40-60% and above 60% conditions. For emission factors, the average values for each fuel type from field measurements are used. In addition to biomass burning from open vegetation fires, the emissions from human waste (residential and dump) burning and biofuel burning in 2010 were also estimated for 76 countries in tropical regions across the three continents and then allocated into each pixel with 1 km grid based on the population density (Gridded Population of the World v3). Our total estimates for the tropical regions across the three continents in 2010 were 17744.5 Tg CO_2, 730.3 Tg CO, 32.0 Tg CH4, 31.6 Tg NO_x, 119.2 Tg NMOC, 6.3 Tg SO_2, 9.8 NH3 Tg, 81.8 Tg PM2.5, 48.0 Tg OC, and 5.7 Tg BC, respectively. Open vegetation burning is the largest contributor to the total amount of emissions, followed by biofuel and human waste burnings. Spatial distribution of open vegetation burning showed extensive emissions in Southern and Central Africa, Amazon of South America, and Southeast Asia with high probability of fire occurrences. Human waste burning presented high emissions in India, Central Africa, and Mexico. Biofuel burning emissions also recorded that large amounts were released from India, Central Africa and Mexico. Our estimates for all trace gases and aerosols emissions from open biomass burning combined with estimates of those from biofuel burning are in the range of the estimates constrained by chemical transport models andand other bottom-up methods. Our high resolution CO_2 emission estimates will contribute to regional top-down CO_2 flux estimates using data from current satellites such as GOSAT and OCO-2 and future satellites such as TanSat, GOSAT-2, and Carbonsat.