Seasonal Impacts of Biomass Burning on Air Quality Across Southeast Asia

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Abstract

Mainland and maritime Southeast Asia is home to more than 655 million people, representing nearly 10% of the global population. The dry season in this region is typically associated with intense biomass burning activity, which leads to a significant increase in surface air pollutants that are harmful to human health, including ozone (O_3) and particulate matter (PM). Latitude-based differences in dry season and land use distinguish two regional biomass burning regimes: (1) burning of grasslands on the peninsular mainland peaking in March and (2) burning of peatlands across Indonesia peaking in September. The type and amount of material burned determines the chemical composition of emissions and subsequently their impact on regional air quality. Here, we use the nested GEOS-Chem atmospheric chemistry transport model (horizontal resolution of 0.25° × 0.3125°) to simulate atmospheric composition over Southeast Asia during March and September of moderate burning year 2014. Model simulations with GEOS-Chem indicate that regional surface levels of ozone and $PM_{2.5}$ (fine particulate matter with a diameter of ≤ 2.5 microns) exceed World Health Organization guidelines during both burning seasons, resulting in more than 10,000 premature deaths in a single month. We will present our analysis of these simulations, investigating how much biomass burning contributes to hazardous air quality conditions and the corresponding public health effects. We will show that model ozone values agree well with coincident satellite observations and ground-based measurements collected across Malaysia, and that biomass burning contributes about 30% of the regional ozone formation potential during both burning seasons. In contrast, the model substantially underestimates observed $PM_{2.5}$ levels, suggesting that model-derived health impacts from $PM_{2.5}$ may be significantly underestimated. Model errors tend to occur particularly over areas of fire activity, for which we will discuss possible sources of uncertainty and suggest methods for improvement.

Early Career Scientist

NO, I am not an early career scientist.

IGAC Activities

BBURNED: Biomass Burning Uncertainty: ReactioNs, Emissions and Dynamics, MAP-AQ: Monitoring, Analysis and Prediction of Air Quality