Biomass-burning and anthropogenic emissions of black carbon, CO, and CO_2 from South East Asia and China: an integrated analysis of Regional Air Quality Model (CMAQ) and EMeRGe-Asia aircraft observations during early spring 2018

Phuc T M Ha

Research Institute for Global Change, JAMSTEC, Yokohama, 236-0001, Japan, Japan

Author list (excluding presenting author)

Yugo Kanaya, Kazuyo Yamaji, Takashi Sekiya, Maria Dolores Andrés Hernández, John Philip Burrows, Hans Schlager, Michael Lichtenstern, Mira Poehlker, Bruna Holanda, EMeRGe-Asia science team

Abstract

To effectively assess and mitigate climate change, precise emission estimates of short-lived climate forcers and their precursors are needed. However, there are still large uncertainties associated with the emissions from Asia. Moreover, carbon emissions from widespread biomass burning play an important role in degrading air quality; their resulting haze events have drawn much attention in recent years in Southeast Asia. Here, we use the Community Multiscale Air Quality (CMAQv5.2.1) model and the EMeRGe-Asia aircraft observations from March–April 2018 to diagnose and better constrain combustion-related emissions of black carbon (BC) and carbon monoxide (CO). Our case studies focused on fire emissions from the Indochinese Peninsula and anthropogenic emissions from China and the Philippines. We chose the three cases as the model captured the observed spatio-temporal variations reasonably well; therefore, the emission inventory used as input to the model could be diagnosed. Including CO_2 in the analysis allowed the diagnosis of combustion efficiency from fires, technology development on anthropogenic emissions, and derivation of emission factors. The GFEDv4.1 inventory was appropriate for fire emissions near the Gulf of Thailand. The observed BC/CO and CO/CO_2 ratios from fires were 7.1 ng m^{-3} ppb^{-1} and ~ 4%, respectively, in agreement with previous reports and GFEDv4.1 on flaming-dominant fires from the savanna. However, the anthropogenic emissions from the Philippines (REASv2.1) significantly underestimated BC and CO. Positive and negative emission biases for BC and CO in the Chinese air mass were found with HTAPv2.2z (HTAPv2.2 + updated Chinese emission from Zheng et al., ACP, 2018). Our best estimate for Chinese emissions was 0.63±0.19 Tg BC, obtained by linearly scaling the BC emission using an observation/model ratio (E(BC)=0.46±0.01). Further estimations of 160±49 Tg CO and $11.6±3.5×10^3$ Tg CO_2 emissions were made using the measured BC/CO and CO/CO_2 ratios.

Early Career Scientist

YES, I am an early career scientist.

IGAC Activities

AMIGO: Analysis of eMIssions usinG Observations, GEIA: Global Emissions Initiative, BBURNED: Biomass Burning Uncertainty: ReactioNs, Emissions and Dynamics

IGAC Regional Working Groups

MANGO: Monsoon Asia and Oceania Networking Group, Japan National Committee