Geophysical Research Abstracts
Vol. 18, EGU2016-11887, 2016
EGU General Assembly 2016

Climate and air quality impacts of altered BVOC fluxes from land cover change in Southeast Asia 1990 - 2010

Kandice Harper, Xu Yue, and Nadine Unger
School of Forestry & Environmental Studies, Yale University, New Haven, United States

Large-scale transformation of the natural rainforests of Southeast Asia in recent decades, driven primarily by logging and agroforestry activities, including rapid expansion of plantations of high-isoprene-emitting oil palm (Elaeis guineensis) trees at the expense of comparatively low-emitting natural dipterocarp rainforests, may have altered the prevailing regime of biogenic volatile organic compound (BVOC) fluxes from this tropical region. Chemical processing of isoprene in the atmosphere impacts the magnitude and distribution of several short-lived climate forcers, including ozone and secondary organic aerosols. Consequently, modification of the fluxes of isoprene and other BVOCs from vegetation serves as a mechanism by which tropical land cover change impacts both air quality and climate. We apply satellite-derived snapshots of land cover for the period 1990 - 2010 to the NASA ModelE2-Yale Interactive Terrestrial Biosphere (ModelE2-YIBs) global carbon-chemistry-climate model to quantify the impact of Southeast Asian land cover change on atmospheric chemical composition and climate driven by changes in isoprene emission. NASA ModelE2-YIBs features a fully interactive land carbon cycle and includes a BVOC emission algorithm which energetically couples isoprene production to photosynthesis. The time-slice simulations are nudged with large-scale winds from the GMAO reanalysis dataset and are forced with monthly anthropogenic and biomass burning reactive air pollution emissions from the MACCity emissions inventory. Relative to the year 1990, regional isoprene emissions in 2010 increased by 2.6 TgC/yr from the expansion of Southeast Asian oil palm plantations and decreased by 0.7 TgC/yr from the loss of regional dipterocarp rainforest. Considering only the impact of land-cover-change-induced isoprene emission changes in Southeast Asia over this period, we calculate a spatially heterogeneous impact on regional seasonal surface-level ozone concentrations (minimum: -1.0 ppb, maximum: +1.3 ppb) in conjunction with an increase in ozone concentration in the free tropical troposphere (maximum zonal-average increase of 1.3 ppb in the climate-sensitive upper tropical troposphere). The resulting long-wave radiative forcing from changes in the ozone concentration exhibits a moderate regional signature in the tropics (+4 mW/m2 tropical average).