EGU22-4394
https://doi.org/10.5194/egusphere-egu22-4394
EGU General Assembly 2022

Fire aerosols slow down the global water cycle

Fang Li[1], David Lawrence[2], Yiquan Jiang[3], and Xiaohong Liu[4]

[1]Institute of Atmospheric Physics, Chinese Academy of Sciences, China (lifang@mail.iap.ac.cn)
[2]National Center for Atmospheric Research, Boulder, CO, USA (dlawren@ucar.edu)
[3]China Meteorological Administration–Nanjing University Joint Laboratory for Climate Prediction Studies, and Jiangsu Collaborative Innovation Center of Climate Change, School of Atmospheric Sciences, Nanjing University, Nanjing, China (yqjiang@nju.edu.cn)
[4]Department of Atmospheric Sciences, Texas A&M University, College Station, Texas, USA (xiaohong.liu@tamu.edu)

Fire is an important Earth system process and the largest source of global primary carbonaceous aerosols. Earlier studies have focused on the influence of fire aerosols on radiation, surface climate, air quality, and biogeochemical cycle. The impact of fire aerosols on the global water cycle has not been quantified and related mechanisms remain largely unclear. This study provides the first quantitative assessment and understanding of the influence of fire aerosols on the global water cycle. This is done by quantifying the difference between simulations with and without fire aerosols using the fully-coupled Community Earth System Model (CESM). Results show that presentday fire aerosols weaken the global water cycle significantly. They decrease the continental precipitation, evapotranspiration, and runoff by 4.1±1.8, 2.5±0.5, and 1.5±1.4 $\times 10^3$ km^3 yr^{-1} as well as ocean evaporation, precipitation, and water vapor transport from ocean to land by 8.1±1.9, 6.6±2.3, and 1.5±1.4 $\times 10^3$ km^3 yr^{-1}. The impacts of fire aerosols are most clearly seen in the tropics and the Arctic-boreal zone. Fire aerosols affect the global water cycle mainly by cooling the surface which reduces ocean evaporation, land soil evaporation and plant transpiration. The decreased water vapor load in the atmosphere leads to a decrease in precipitation, which contributes to reduced surface runoff and sub-surface drainage.