Data and code for JC paper: Fire aerosols slow down the global water cycle

Fang Li1*, Yiquan Jiang3, Xiang Song1, Xiaohong Liu[4], David M. Lawrence[2], Zhongda Lin[5]

[1] International Center for Climate and Environment Sciences, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China
[2] 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
[3]National Center for Atmospheric Research, Boulder, CO, USA
[4] Department of Atmospheric Sciences, Texas A&M University, College Station, Texas, USA
5 State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China

Related manuscript:
https://journals.ametsoc.org/view/journals/clim/aop/JCLI-D-21-0817.1/JCLI-D-21-0817.1.xml

1. Model platform and Experimental design

We used Earth system model CESM as the model platform. It is comprised of the Community Atmosphere Model, version 5.3 (CAM5.3), the Community Land Model, version 4 (CLM4); the Slab Ocean Model (SOM); and the Community Ice Code, version 4 (CICE4).

Two simulations were performed: Fire and NOFIRE. The setup of the two simulations is identical but using different prescribed fire aerosol emissions. The FIRE simulation used daily fire BC, POM, and sulfur dioxide (SO_2) emissions from 2003 to 2011 (9 years). The fire emissions (Jiang et al. 2016) were based on daily satellite-based Global Fire Emissions Database version 3.1 (GFED 3.1) (van der Werf et al. 2010; Mu et al. 2011) and the vertical distribution of emissions in the AeroCom protocol (Dentener et al. 2006). In NOFIRE, fire aerosol emissions were set to zero.

The two simulations were run for 99 years with the fire emissions data cycling 11

times. The last 27 years of each simulation were analyzed. Both simulations used 0.9° (latitude) ×1.25° (longitude) horizontal resolution for the land and atmosphere (30 atmospheric levels), while the ocean and sea-ice components used a gx1v6 displaced pole grid. The model time step was 30 minutes. Input data except for fire aerosol emissions were the default (without any change) inputs provided with the CESM.

2. Introduction of files

-fire and -nofire: simulations with and without fire aerosols
Longitude (lon) and latitude (lat) are already included in each file

grid.nc：
area: grid cell area (km^2)
landfrac: land fraction (0 to 1)
landmask: land mask (0 for ocean and 1 for land)

Aerosol* files:
BC: BC vertically integrated concentration
POM: POM vertically integrated concentration
SO4: SO_4 vertically integrated concentration
AOD: AOD

PrE* files:
Pr: precipitation (mm/s)
E: ocean evaporation and land evapotranspiration (mm/s)

ETcomp* files:
ce: canopy evaporation (mm/s)
ct: canopy transpiration (mm/s
ge: ground evaporation (mm/s)

runoffs* files:
runoff: total runoff (mm/s)
srfr: surface runoff (mm/s)
dr: drainage (mm/s)
other: other runoffs (mm/s)

landhyd* files:
ci: canopy interception (mm/s)
thr: throughfall (mm/s)
iflt: infiltration (mm/s)
ssm: surface soil moisture (mm^3/mm^3)
rzsm: root-zone soil moisture (mm^3/mm^3)

snow-rad* files:
smlt: snow melt (mm/s)
snow: snowfall (mm/s)
fsnow: surface forcing of BC in snow (W/m^2)
svsr: surface visible solar radiation (W/m^2)
scf: snow coverage fraction

T-atmwater-seaice* files:
tas: surface air temperature (K)
icef: sea ice coverage fraction
wv: atmospheric water vapor (kg/m^2)

cwp: cloud water path (kg/m^2)
cdc: vertically-integrated droplet concentration ($1/m^2$)

UVRH850hPa* files:
U850: Zonal wind at 850hPa (m/s)
V850: Meridional wind at 850hPa (m/s)
RH850: Relative humidity at 850hPa (%)

code.tar: code and model setup