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Influence of Atmospheric Teleconnections on Interannual Variability of Arctic-boreal Fires

Zhiyi Zhao[1,2], Zhongda Lin[3], Fang Li[4], and Brendan M. Rogers[5]
[1]State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China (zhaozhiyi@mail.iap.ac.cn)
[2]College of Earth and Planetary Sciences, University of Chinese Academy of Sciences, Beijing, China
[3]State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China (zdlin@mail.iap.ac.cn)
[4]International Center for Climate and Environmental Sciences, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China (lifang@mail.iap.ac.cn)
[5]Woods Hole Research Center, Falmouth, MA, USA (brogers@woodwellclimate.org)

Fires across the Arctic-boreal zone (ABZ) play an important role in the boreal forest succession, permafrost thaw, and the regional and global carbon cycle and climate. These fires occur mainly in summer with large interannual variability. Previous studies primarily focused on the impacts of local surface climate and tropical El Niño-Southern Oscillation (ENSO). This study, for the first time, comprehensively investigates the influence of summer leading large-scale atmospheric teleconnection patterns in the Northern Hemisphere extra-tropics on interannual variability of ABZ fires. We use correlation and regression analysis of 1997–2019 multiple satellite-based products of burned area and observed/reanalyzed climate data. Results show that eight leading teleconnection patterns significantly affect 63±2% of burned areas across the ABZ. Western North America is affected by the East Pacific/North Pacific pattern (EP/NP) and the West Pacific pattern (WP); boreal Europe by the Scandinavia pattern (SCA); eastern North America, western and central Siberia, and southeastern Siberia by the North Atlantic Oscillation (NAO); and eastern Siberia /Russian Far East by the East Atlantic pattern (EA). NAO/EA induces lower-tropospheric drier northwesterly/northerly airflow passing through the east of boreal North America/Eurasia, which decreases surface relative humidity. Other teleconnections trigger a high-pressure anomaly, forcing downward motion that suppresses cloud formation and increases solar radiation reaching the ground to warm the surface air as well as brings drier air downward to reduce surface relative humidity. The drier and/or warmer surface air can decrease fuel wetness and thus increase burned area. Our study highlights the important role of the extra-tropical teleconnection patterns on ABZ fires, which is much stronger than ENSO that was thought to control interannual variability of global fires. It also establishes a theoretical foundation for ABZ fire prediction based on extra-tropical teleconnections, and has the potential to facilitate ABZ fire prediction and management.