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Studying the pre-industrial to present-day radiative forcing from wildfire aerosols using EC-Earth

Rafaila Nikola Mourgela[1,2], Eirini Boleti[1,2], Konstantinos Seiradakis[1,2], Klaus Wyser[3], Phillipe Le Sager[4], Angelos Gkouvousis[5,6], and Apostolos Voulgarakis[1,2]
[1]Laboratory of Atmospheric Environment and Climate Change, School of Chemical and Environmental Engineering, Technical University of Crete, Chania, Greece (rmourgela@tuc.gr)
[2]Leverhulme Centre for Wildfires Environment and Society, Imperial College London, London, UK
[3]Rossby Centre, Swedish Meteorological and Hydrological Institute, Norrköping, Sweden
[4]Royal Netherlands Meteorological Institute, De Bilt, Netherlands
[5]Environmental Chemical Process Laboratory (ECPL), Department of Chemistry, University of Crete, Heraklion, Greece
[6]Center for the Study of Air Quality and Climate Change (C-STACC), Institute of Chemical Engineering Sciences, Foundation for Research and Technology Hellas, Patras, Greece

The occurrence of more frequent and extensive wildfires is a widely discussed potential consequence of climate change, stemming from a vicious cycle of cause and effect in which wildfires are taking part. Global and regional wildfire patterns and changes are driven by climate-related factors such as land cover, heat waves, and rainfall patterns. Wildfires can, in turn, cause climate perturbations through the emissions of greenhouse gases and aerosols, and through the alteration of landscapes. For these reasons, understanding wildfires and their interactions with the Earth's atmosphere is crucial for assessing a potentially important climate feedback.

The current study focuses on the interconnection between wildfires and the atmosphere, and more precisely on the radiative effect of wildfire emissions on a global scale. To achieve this, simulations using the EC-Earth Earth System Model (ESM) were employed. More specifically, a 30-year atmosphere-only (fixed-SST) control simulation was performed for the pre-industrial period, and repeated with the wildfire aerosol emissions set to present-day values. Using the output of these simulations, we estimate the global effective radiative forcing (ERF) of wildfire-emitted aerosols from pre-industrial times to the present day. We also identify which regions experience stronger forcing from wildfire emissions, and separate the role of black carbon and organic carbon in driving this forcing. Finally, we identify mechanisms that lead to fast atmospheric adjustments following wildfire emissions, including changes in temperatures, humidity, precipitation, and clouds. This analysis contributes to the better understanding of the historical evolution of radiative forcing and the role of wildfires in the climate system.