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Re-assessment of pre-industrial fires in CMIP6 models and the implications for radiative forcing

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Assessment of anthropogenic radiative forcing requires a robust understanding of the composition of the pre-industrial baseline atmosphere from which calculations are made

It is often assumed that fire activity and the associated aerosol emissions were lower in the pre-industrial period than in the present day. However, some lines of evidence suggest that fire activity may have halved since the pre-industrial period.

Here we compare the simulated ratio of pre-industrial (c.1750CE and c.1850CE) to present-day black carbon surface concentrations in five ESMs (CNRM-ESM2-1, EC-Earth3, IPSL-CM6, NorESM1.2, UKESM1), using historical fire emissions from the Sixth Coupled Model Intercomparison Project (CMIP6), to the ratio in Northern Hemisphere ice-core records.

We find that when forced with CMIP6 fire emissions all ESMs overestimate the present-day to pre-industrial black carbon ratio. This is consistent with previous studies and suggests that the contribution of fire to the composition of the pre-industrial atmosphere may be too low. If the contrast between the pre-industrial and present-day atmospheres in these models is too great, they are likely to overestimate the strength of the anthropogenic aerosol radiative forcing.

We extend our analysis to include additional ESMs providing historical simulations for CMIP6, as included in the IPCC's Sixth Assessment Report.