

EGU2020-8332, updated on 05 Jul 2022

<https://doi.org/10.5194/egusphere-egu2020-8332>

EGU General Assembly 2020

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Aerosol - Climate Interactions, the Distribution of Aerosol Impacts, and Implications for the Social Cost of Carbon

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Here we demonstrate how the same aerosol emissions, released from different locations, lead to different regional and global changes in the physical environment, in turn resulting in divergent magnitudes and spatial distributions of societal impacts. Atmospheric chemistry and the general circulation do not evenly distribute aerosols around the globe, so aerosol impacts -- both direct and via interactions with the general circulation -- vary spatially. Our repeat-cycle perturbation experiment shows that the same emissions, when released from one of 8 different regions, result in significantly different steady-state distributions of surface particulate matter (PM_{2.5}), total column aerosol optical depth (AOD), surface temperature, and precipitation. We link these changes in the physical environment to established temperature, precipitation, AOD, and PM_{2.5} damage functions to estimate both local and global impacts on infant mortality, crop yields, and economic growth. Because the damages associated with these aerosol and aerosol precursor emissions are strongly emission-location dependent, the marginal dollar spent on mitigation would have very different returns in different locations, both locally and globally. This has important implications for calculating a realistic social cost of carbon, since these aerosol-mediated effects are ultimately inseparable from the processes producing CO₂ emissions.