The Historical and Future Climate Change Impact on the Human Health Burden from Changes in the Long-term Exposure to Surface Ozone

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Abstract

Elevated surface concentrations of ozone can lead to poor air quality and detrimental impacts on human health. Surface ozone concentrations are controlled by chemical production and loss, stratosphere-troposphere exchange, meteorological conditions and its removal by deposition. Here we use the Earth system model, UKESM1, to simulate the change in surface ozone concentrations from different sensitivity scenarios, conducted as part of the Aerosol and Chemistry Model Intercomparison Project (AerChemMIP). We calculate the annual maximum of the six-month running mean of the monthly average daily maximum 8 hour mixing ratio (OSDMA8) to assess the impacts of long-term exposure to ozone on human health. We find that OSDMA8 values have increased globally from 1850 to 2014 by 40 to 60%, which significantly increases the risk of adverse impacts to human health. By the present day, >90% of the world's population are exposed to values above the WHO air quality guideline value. In isolation, historical changes in anthropogenic NOx emissions and global CH_4 concentrations have caused OSDMA8 values to increase by 32% and 20% respectively. Historical changes in climate cause small changes in OSDMA8 values, with increases over polluted continental areas (up to 2%) and reductions in more remote regions (up to 3%). Under a high future warming scenario (global mean temperature increase of 5K by 2100), OSDMA8 concentrations increase across polluted continental regions by up to 9% in 2100, with reductions of a similar magnitude in remote regions. However, if ozone precursors are also reduced in the future scenario, then OSDMA8 values decrease by ~30% over continental regions, leading to human health benefits. These results suggest changes in anthropogenic emissions represent the largest contribution to adverse impacts on human health from long term exposure to surface ozone, although if future climate change is not mitigated it can also have important regional impacts.

Early Career Scientist

NO, I am not an early career scientist.

IGAC Activities

CCMi: Chemistry Climate Model Initiative, TOAR: Tropospheric Ozone Assessment Report