Exposure to ambient air pollution is detrimental to health. This research uses modeled concentrations of anthropogenic ozone and fine particulate matter (PM2.5) to quantify global premature mortality, in the present and through 2100, considering chronic cardiopulmonary diseases and lung cancer in adults. Also, the impact of past and future climate change on air pollution-related mortality is isolated, and the present-day contribution of five emission sectors (Energy, Industry, Residential & Commercial, Land Transportation, and Shipping & Aviation) is estimated. Using output from the ACCMIP ensemble of 14 chemistry climate models, present-day global mortality is estimated to be 470,000 (95% CI, 140,000 to 900,000) ozone-related premature deaths/year and 2.1 (1.3 to 3.0) million PM2.5 deaths/year. Over two-thirds of ozone global mortality and over half of PM2.5 mortality occur in East Asia and India. Using future concentrations modeled by the ACCMIP ensemble for four Representative Concentration Pathways (RCP) scenarios, and projected future population and baseline mortality, global PM2.5 mortality is estimated to decrease relative to 2000 concentrations, particularly in 2100: -1.93 million (RCP2.6), -2.39 million (RCP4.5), -1.76 million (RCP6.0) and -1.31 (-2.04 to -0.17) million (RCP8.5) deaths/year. Ozone mortality increases in some scenarios/periods, particularly in RCP8.5 in 2100 (316,000 [-187,000 to 1.38 million] deaths/year), but decreases in others. While past climate change is estimated to have little effect on present-day air pollution mortality, RCP8.5 climate change in 2100 is likely to be strongly detrimental: 215,000 (-76,100 to 595,000) PM2.5 deaths/year and 127,000 (-193,000 to 1.07 million) ozone deaths/year. Using new MOZART-4 global model simulations at fine horizontal resolution (0.67°x0.5°), present-day global mortality is estimated to be 493,000 (122,000-989,000) ozone deaths/year and 2.2 (1.0 - 3.3) million PM2.5 deaths /year. Globally, the Land Transportation and Residential & Commercial sectors contribute most to ozone mortality (16%) and PM2.5 mortality (30%), respectively. However, relative sectoral contributions vary among world regions and within each region. Air pollution is likely the most important environmental exposure for global human health at present. Air pollution regulations and climate change mitigation will reduce global air pollution-related mortality, but different policies targeting different emission sectors may be appropriate in particular locations.

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