National Institute of Environmental Health Sciences

Potential impact of climate change on air pollution-related human health effects

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Abstract:

The potential health impact of ambient ozone and PM2.5 concentrations modulated by climate change over the United States is investigated using combined atmospheric and health modeling. Regional air quality modeling for 2001 and 2050 was conducted using CMAQ Modeling System with meteorology from the GISS Global Climate Model, downscaled regionally using MM5,keeping boundary conditions of air pollutants, emission sources, population, activity levels, and pollution controls constant. BenMap was employed to estimate the air pollution health outcomes at the county, state, and national level for 2050 caused by the effect of meteorology on future ozone and PM2.5 concentrations. The changes in calculated annual mean PM2.5 concentrations show a relatively modest change with positive and negative responses (increasing PM2.5 levels across the northeastern U.S.) although average ozone levels slightly decrease across the northern sections of the U.S., and increase across the southern tier. Results suggest that climate change driven air quality-related health effects will be adversely affected in more then 2/3 of the continental U.S. Changes in health effects induced by PM2.5 dominate compared to those caused by ozone. PM2.5-induced premature mortality is about 15 times higher then that due to ozone. Nationally the analysis suggests approximately 4000 additional annual premature deaths due to climate change impacts on PM2.5 vs 300 due to climate change-induced ozone changes. However, the impacts vary spatially. Increased premature mortality due to elevated ozone concentrations will be offset by lower mortality from reductions in PM2.5 in 11 states. Uncertainties related to different emissions projections used to simulate future climate, and the uncertainties forecasting the meteorology, are large although there are potentially important unaddressed uncertainties (e.g., downscaling, speciation, interaction, exposure, and concentration-response function of the human health studies).

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Resource Description

Climate Scenario :

specification of climate scenario (set of assumptions about future states related to climate)

Special Report on Emissions Scenarios (SRES), Other Climate Scenario

Other Climate Scenario: A1B

Exposure :

weather or climate related pathway by which climate change affects health

Air Pollution

Air Pollution: Ozone, Particulate Matter

Geographic Feature:

resource focuses on specific type of geography

None or Unspecified

Geographic Location:

resource focuses on specific location

United States

Health Impact:

specification of health effect or disease related to climate change exposure

Cardiovascular Effect, Morbidity/Mortality, Respiratory Effect

Cardiovascular Effect: Other Cardiovascular Effect

Cardiovascular Disease (other): hospital admissions for cardiovascular diseases

Respiratory Effect: Asthma, Bronchitis/Pneumonia, Other Respiratory Effect

Respiratory Condition (other) : hospital visits for respiratory diseases; chronic bronchitis

Model/Methodology:

type of model used or methodology development is a focus of resource

Exposure Change Prediction, Outcome Change Prediction

Resource Type:

format or standard characteristic of resource

Research Article

Timescale:

time period studied

Medium-Term (10-50 years)