National Institute for Environmental Studies

Climate change, air quality and health co-benefits in South Korea

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BACKGROUND & OBJECTIVE

Climate change mitigation efforts to reduce greenhouse gas (GHG) emissions have associated costs, but there are also potential benefits from improved air quality, such as public health improvements and associated cost savings. It is important to adopt this multidisciplinary modeling approach to better assess the co-benefits from climate mitigation for human health and to establish adequate climate change mitigation policies and public health actions for future climate challenges. Therefore, we adopted an integrated research framework by combining a computable general equilibrium model, an air quality model, and a health impact assessment model, to explore the long-term economic impacts of climate change mitigation in South Korea through 2050.

METHODOLOGY

In this study, we quantified the health co-benefits of air quality improvements in both $PM_{2.5}$ and ozone for achieving ambitious targets such as stabilization of the radiative forcing level at 3.4 W/m^2 by adopting an interdisciplinary multi-model approach combining air quality, health assessment, and economic models to evaluate the long-term health and economic impacts of air pollution under Shared Socioeconomic Pathway (SSP) scenarios in South Korea. Emissions data, with input from databases for SSPs and Representative Concentration Pathways (RCPs), were generated using the Asia-Pacific Integrated Assessment/Computable General Equilibrium (AIM/CGE) model Based on gridded emission data, an air quality model (the Community Multiscale Air Quality modeling system; CMAQ) was used to calculate annual atmospheric particulate matter with an aerodynamic diameter of <2.5 μm ($PM_{2.5}$) and ozone (O_3) concentrations in relevant Asian regions. The health impact assessment model estimated the health impacts of $PM_{2.5}$ and O_3 concentrations, which were then combined with the Integrated Model of Energy, Environment, and Economy for Sustainable Development/Computable General Equilibrium (IMED|CGE) to monetize the economic value of these health impacts in South Korea. Mitigation costs were estimated in the IMED|CGE model using carbon prices from multiple mainstream Integrated Assessment Models (IAMs) for comparison purposes. Finally, we quantified the health co-benefits of air pollution reduction resulting from climate change mitigation in South Korea.).

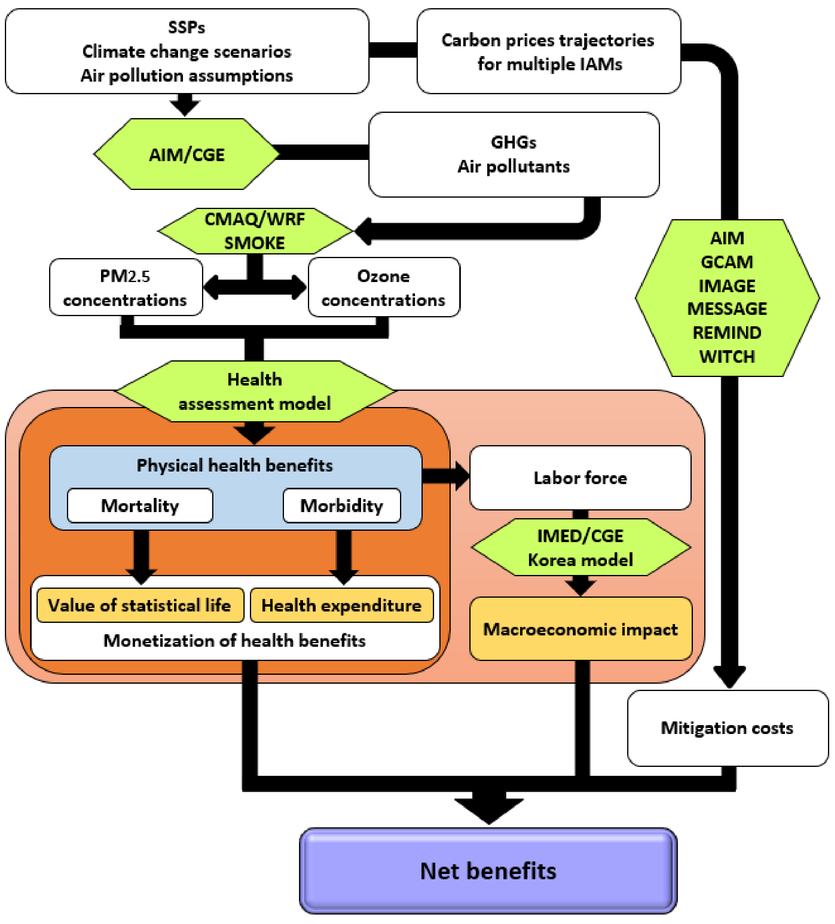

Fig 1. An interdisciplinary multi-model approach to evaluate health and air quality co-benefits of air pollution mitigation.

RESULTS

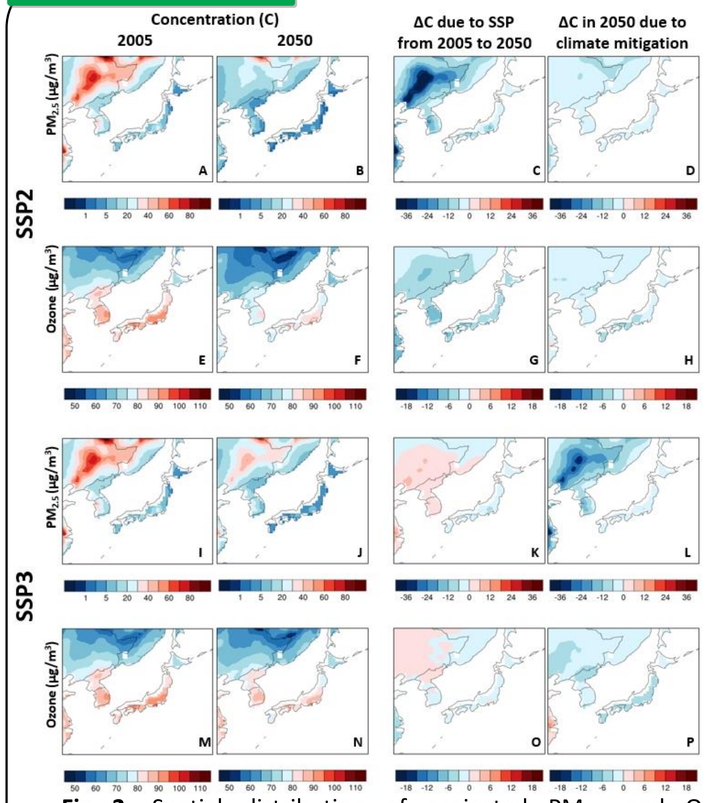

Fig 2. Spatial distribution of projected $PM_{2.5}$ and O_3 concentrations. The color indicates the magnitude of concentrations and their changes.

Improvements in air quality will decrease premature deaths and disability, which will lead to a reduction in direct health expenditure and work time loss. Benefits stemming from improvements in air quality and climate change mitigation are shown in Figure 4, including total economic benefits (23.6 billion USD) due to reduced avoided premature mortality, direct health expenditure savings (0.14 billion USD) due to reductions in morbidity risk, and GDP gains due to reduced work time loss from both morbidity and mortality (0.38 billion USD). The results provide evidence of the benefits of meeting greenhouse gas emission targets by comparing the mitigation costs and economic benefits of air pollution reduction from public health, including VSL-related savings, health expenditure, and work loss time reduction.

Climate mitigation will affect global air pollutant emissions significantly in this century. The annual averages for daily mean $PM_{2.5}$ (μg/m^3) and daily 8-h maximum O_3 (μg/m^3) concentrations, as well as changes with respect to SSP2 and SSP3 scenarios, are shown in Figure 2.

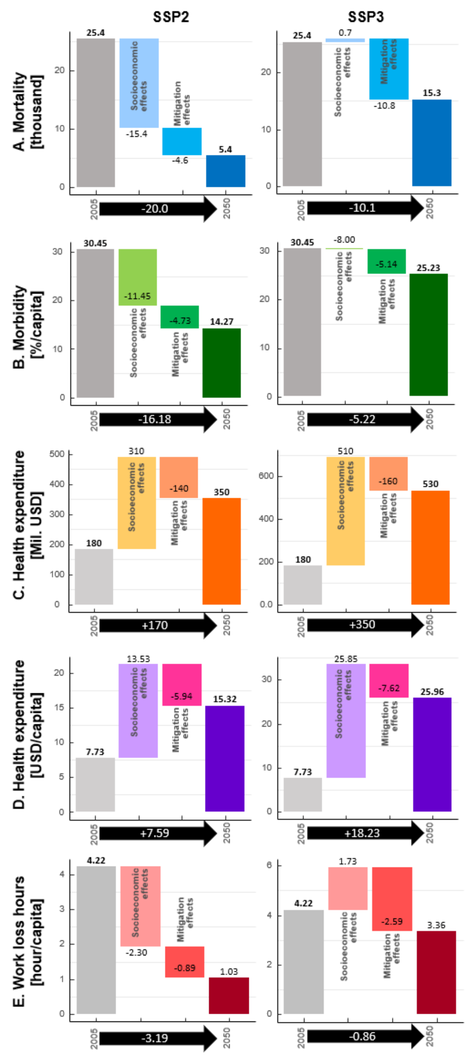

Fig 3. Country-level values between 2005 and 2050 due to $PM_{2.5}$ and O_3 concentrations with respect to climate change mitigation scenarios and SSPs in South Korea.

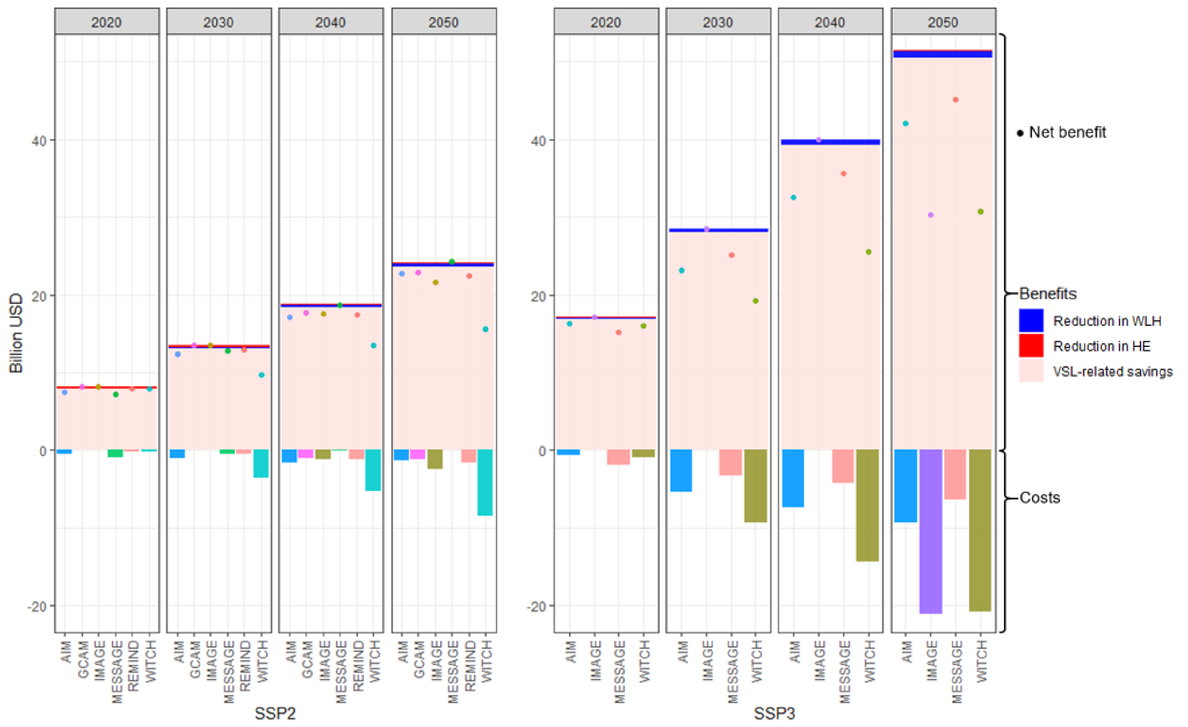

Fig 4. Health co-benefit analysis of climate change mitigation in South Korea towards 2050 (billion USD).

CONCLUSION

We found that substantial health gains can be achieved from taking action to slow down climate change and the benefits of air quality and health improvement could offset the total costs of climate mitigation in South Korea.

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