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A Scalable Approach to Modelling Health Impacts of Air Pollution Based on Globally Available Data

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A Scalable Approach to Modelling Health Impacts of Air Pollution Based on Globally Available Data

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Abstract: Integrated assessment of air pollution and its impacts typically requires pre-calculated atmospheric transfer relations on a fine spatial resolution. While such concepts have been applied successfully for Europe and other regions with high data coverage, extending calculations to world regions with low local data availability is challenging and needs to be based on globally available data sets. Here we introduce a scalable approach which has been developed to expand the calculations of health impacts from exposure to ambient fine particulate matter ($PM_{2.5}$) in the Greenhouse Gas-Air Pollution Interactions and Synergies (GAINS) integrated assessment model to (almost) any desired region on the globe, depending on actual requirements for policy analysis. We use global sensitivity simulations of the EMEP atmospheric chemistry transport model to derive linear transfer coefficients at a resolution of 0.5 degrees. A major challenge lies in the realistic representation of inner urban $PM_{2.5}$ concentrations, which depend to a large extent on local pollution sources on scales below grid resolution. We derive sub-grid concentration increments from emission densities of primary PM from low-level sources, based on (almost) globally available gridded population data with approximately 100m resolution. From ambient $PM_{2.5}$ concentrations, increased risk of mortality is then calculated following the methodology of the Global Burden of Disease studies. We have implemented and validated the described approach for India, China, and Indonesia, with extensions to other G-20 member countries underway. Health impact projections under different energy policy scenarios are discussed. Due to the inherent treatment of urban areas, the effects of urbanization trends are captured explicitly, which lead to higher average population exposure as people move into polluted cities.

Keywords*:* particulate matter PM2.5; ambient air pollution; health impacts; downscaling