Climate impacts of changing aerosol emissions since 1996

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The re-distribution of anthropogenic aerosol emissions from Europe and North America towards China and India between 1996 and 2010 has surprisingly warmed rather than cooled the global climate. This result reinforces the notion that the recent hiatus in global warming is mainly caused by internal variability of the climate.

Anthropogenic aerosol emissions in Europe and North America have continuously decreased since the 1980's thanks to air quality legislations and the collapse of the Soviet Union. At the same time, however, emissions in China and India have started to increase at almost the same pace, totalling to an only slightly decreasing trend in global anthropogenic aerosol emissions. Due to the higher solar irradiance, anthropogenic aerosols emitted at lower latitudes are expected to have a stronger effect on climate, and thus this effective re-distribution of aerosol emissions towards the equator has been one of the suggested reasons for the recent hiatus in global temperature increase.

Researchers from the University of Eastern Finland, Finnish Meteorological Institute, and Argonne National Laboratory used a state-of-the-art aerosol-climate model to assess how the changing aerosol emissions between 1996 and 2010 have affected the global climate. Surprisingly, it was found that the cooling due the increased aerosol emissions in China and India is almost negligible compared to the warming caused by the decreasing aerosol emissions in Europe and North America.

The lack of cooling in China and India has two major causes. The first has to do with the influence of aerosols on cloud properties. Aerosol particles act as condensation nuclei for cloud droplets, and increased aerosol emissions cause clouds to consist of a larger number of droplets. Usually this leads to increased scattering of sunlight back to the space, which cools the climate. However, in South and East Asia this effect had almost "saturated" already at the beginning of the period, and the increased aerosol emissions had only a minor effect on the cloud properties. Secondly, in China and India the amounts of black carbon, a very effective absorber of solar radiation, increased also above the clouds, leading to a warming of the atmosphere both on sunny cloudy days, and thereby further decreasing the cooling effect of the sulphate aerosols there.

More information: T. Kühn, A.-I. Partanen, A. Laakso, Z. Lu, T. Bergman,S. Mikkonen, H. Kokkola, H. Korhonen, P. Räisänen, D. G. Streets, S. Romakkaniemi, A. Laaksonen: Climate impacts of changing aerosol emissions since 1996. onlinelibrary.wiley.com/doi/10 … 014GL060349/abstract

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