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The contribution of China's short-lived pollutants to global climate forcing

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Knowledge of the contribution that individual countries have made to global radiative forcing is important to the implementation of the agreement on "common but differentiated responsibilities" reached by the United Nations Framework Convention on Climate Change.

Over the past three decades, China has experienced rapid economic development, accompanied by increased emission of greenhouse gases, ozone precursors and aerosols, but the magnitude of the associated radiative forcing has remained unclear.

Here we use a global coupled biogeochemistry-climate model, and a chemistry and transport model to quantify China's present-day contribution to global radiative forcing due to well-mixed greenhouse gases, short-lived atmospheric climate forcers, and land-use-induced regional surface albedo changes.

We find that China contributes 10% $\pm$ 4% of the current global radiative forcing. China's relative contribution to the positive (warming) component of global radiative forcing, mainly induced by well-mixed greenhouse gases and black carbon aerosols, is 12% $\pm$ 2%. Its relative contribution to the negative (cooling) component is 15% $\pm$ 6%, dominated by the effect of sulfate and nitrate aerosols.

China's strongest contributions are 0.16 $\pm$ 0.02 watts per square metre for CO_2 from fossil fuel burning, 0.13 $\pm$ 0.05 watts per square metre for methane, -0.11 ± 0.05 watts per square metre for sulfate aerosols, and 0.09 $\pm$ 0.06 watts per square metre for black carbon aerosols.

Therefore, in relative terms, China contributes more strongly to cooling climate down than to warming it up. Although, in absolute terms, China's emission of active species still has a net warming effect. This overall picture is mostly painted by the key role of Chinese short-lived pollutants, as China contributes substantially to the global radiative forcing induced by aerosols (for example, 28% $\pm$ 10% of sulfate aerosols, 24% $\pm$ 8% of nitrate aerosols, and 14% $\pm$ 6% of black carbon aerosols).

These estimates exclude the effect of aerosol-cloud interactions (also driven by short-lived species). A tentative inclusion of this effect (and other secondary effects that are not well constrained) further reduces China's contribution to the global radiative forcing, albeit at the cost of a great increase in uncertainty. We estimate that China's global contribution would then be 8% $\pm$ 8%.

China's eventual goal of improving air quality will result in changes in radiative forcing in the coming years: a reduction of sulfur dioxide emissions would drive a faster future warming, unless offset by larger reductions of radiative forcing from (sometimes co-emitted) well-mixed greenhouse gases, ozone precursors, and/or black carbon.