Mitigating Arctic warming

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In these days of global warming and climate change leading to melting icebergs and glaciers in the Arctic and Antarctic regions, here comes some cheer in the form of a study that finds that warming in the Arctic region can be reduced by 0.2 degrees C by 2050 by cutting down emissions of short-lived climate forcers — black carbon, sulphur dioxide, nitrogen oxides (NOx), volatile organic compounds, organic carbon and tropospheric ozone The study was published recently in Nature Climate Change.

Short-lived climate forcers are particulate matter of various kinds emitted into the atmosphere by natural and anthropogenic sources and which stay in the atmosphere for at most a period of one month. Cutting down their emissions can bring in results quickly. They are unlike carbon dioxide and other greenhouse gases which stay in the atmosphere for years.

Black carbon and ozone precursors lead to warming, while sulphur-rich and organic carbon-rich emissions form sunlight-scattering aerosols that have a cooling effect, or negative radiative forcing. Ozone precursors (CO, NOx and VOCs) affect climate through the formation of ozone, a potent greenhouse gas and cause warming.

The effect of emission of each of these agents on Arctic temperature and contribution to warming or cooling is the focus of the study. Six different SLCPs across seven emission regions and six emission sectors were studied and each one's contribution to arctic surface temperature was quantified. The emission sectors studied were domestic activities, energy/industry/waste, transport, agricultural fires, forest fires and gas flaring. And the seven emission regions were U.S., Canada, Russia, Nordic countries, Asia and south Asia, Rest of Europe and Rest of the world.

The amount of temperature rise or fall caused by a single unit of each SLCF from each region was determined. This was done using five different chemistry transport models and allows quantification of contributions that happen within and outside of the Arctic region. For instance, high black carbon emissions at lower latitudes can warm the local atmosphere, thus creating a larger temperature gradient towards higher latitudes, resulting in increased northward heat flux. Inside the Arctic, warming contributions are more direct — black carbon pollution just above the ground will trap heat and warm the surrounding air immediately.

The study found that the largest absolute contributor (including both warming and cooling emissions) was the Asian region with domestic activities emitting large amounts of

black carbon. However, the highest per unit warming was from flaring emissions from Russia followed by forest fires and flaring from Nordic countries. These BC emissions have a stronger impact than those from Asia due to the doubling effect — they warm the atmosphere while also reducing snow and ice reflectivity.

A small number of cooperating nations within the Arctic region itself could have a large impact on the problem of warming. While practical efforts can start with a few Arctic nations and a few sectors, they must expand if Arctic warming is to be avoided more fully, notably, to include the large but diffuse emissions from Asia.

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