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Regional emission metrics for assessing multiple environmental impacts of pollutants: The case of aerosols

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Anthropogenic emissions from a variety of sources are responsible for changes in climate that are being realised both on global and on regional scales. Constituents such as CO_2, methane, ozone, and tropospheric aerosols all exert radiative forcing in the Earth's atmosphere, and therefore affect temperatures, as well as weather phenomena and the hydrological cycle. This radiative forcing varies across species, with some of them affecting the Earth's radiation budget positively and some negatively, and with varying magnitudes of influence in different locations. To better understand the impact of such emissions on global and regional climate change and to inform climate-related policy making, there is a need for constructing simple metrics that reflect the climate effects of different emissions. Here, we propose novel emission metrics that take into account the region of emission, and represent the multiple environmental impacts of different emissions that go beyond global mean temperature, including regional precipitation and air quality effects. The results are based on recent state-of-the-art global composition-climate model simulations (using the HadGEM3 model), and focus on comparing the impacts of two different types of aerosols, namely sulphate and black carbon, as a case study.