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The radiative effect of anthropogenic aerosols is one of the largest uncertainties in Earth's energy budget over the industrial period. This uncertainty is in part due to sparse observations of aerosol concentrations in the pre-satellite era. Climate models require information of the pre-industrial aerosol state and its evolution since 1750 to estimate the anthropogenic climate warming. Ice-core records of past aerosol concentrations document atmospheric variations caused by natural and anthropogenic drivers. Anthropogenic drivers include changes in land use associated with settlement, agriculture, mining, wild fires and even mineral dust emissions and biomass burning. Industrial activity caused a substantial increase in aerosol emissions. All of these emissions led to a substantial release of elemental and organic carbon and acidic aerosol particles. To date, ice core observations have been underutilised for evaluating aerosol concentrations as simulated by state-of-the-art Earth system models. Here I review and report recent work on long term trends in concentrations of sulfate, black carbon and other constituents found in ice cores and CMIP6 class Earth system models. It appears, for instance, that sulfate concentration trends from climate model generally agree with ice core records, while BC concentration trends differ. The accuracy of ice core records is important to confirm and/or falsify emission inventories. Ice core data collected from a range of locations can also be used to constrain the global modelling of the transport and removal of aerosol components. The value of such findings for a better estimate of climate forcing by aerosols will be discussed.

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