Black carbon concentrations and fluxes during recent millennia from a developing array of Arctic ice cores

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Short-lived aerosols such as black carbon (BC) and dust are important components of climate forcing, although warming from increased carbon dioxide and other greenhouse gas concentrations is the long-term driver of climate change. With their short lifetimes in the atmosphere, aerosol concentrations and deposition rates are dominated by regional – rather than global – sources and intra- and inter-annual variability is high. Such aerosols in snow are especially important in the high latitudes because of their strong impact on albedo.

Because most BC aerosols in high latitudes originate in lower latitudes, changes in long range transport processes and pathways may dominate over changes in source strength in determining concentrations and deposition rates in these regions. However, detailed understanding of past and present concentrations, deposition rates, sources, and transport pathways of BC to and within the Arctic is lacking. Here we present and discuss detailed records of BC measured in a developing array of ice cores widely distributed around the Arctic. We use a range of elemental and chemical tracers measured in the same ice cores to identify likely sources and to investigate spatial and temporal patterns of BC deposition during recent centuries and millennia.

Transformational science with a new global volcanic gas emissions database

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Volcanic degassing is regularly monitored at many volcanoes worldwide, with direct sampling and both ground- and satellite-based remote sensing techniques. Recent years have seen a sea-change in instrument sophistication and capability. The literature contains a wealth of additional data arising from campaign measurements of degassing. However, there is currently no existing inventory of volcanic gas emission measurements in an easily accessible form, such as an online relational database.

Inspired by the Deep Carbon Observatory's DECADE initiative to estimate global volcanic CO_2 flux, we are building a new database incorporating all published degassing and volatile data for Earth's volcanoes. Appropriate metadata will be carefully defined and attention paid to data quality. Numerous factors influence the accuracy of gas emission measurements, and some categorisation or quantification of the uncertainty present in each data entry is crucial. Emissions fluxes and relevant metadata will be incorporated into the database of Smithsonian's Global Volcanism Program as we aim to directly link gas emissions to volcanic activity. Gas compositions will be incorporated into the EarthChem database with the intent to make these two databases interoperable.

Our vision is for the database to become an essential tool of the volcanological community, and we seek close collaboration with the volcanic emissions community from the onset. Close consultation with gas geochemistry and monitoring experts will ensure that the data and metadata types defined and implemented in the database are fit-for-purpose, and that the proposed database search capabilities, visualisation schemes and output standards meet the user needs of these researchers. We will build on lessons learned from the Italian volcanic gas database, GOOGAS. We are also working closely with cyber-infrastructure specialists to ensure the new database is fully inter-operable with existing online resources (e.g. EarthChem, WOVOdat, Global Volcano Model, GOOGAS, IRIS) and can be extended beyond gas emissions into other monitored parameters in the future.

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