Measurement of light extinction by single aerosol particles

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Cavity ring-down spectroscopy (CRDS) is increasingly being used to determine extinction of light by ensembles of aerosol particles, either in the laboratory or in field measurements. Under controlled laboratory conditions, with size-selection of the aerosol particles prior to CRDS detection, extinction efficiencies and refractive indices can be determined. However, the precision and accuracy of such ensemble measurements are limited by a number of factors inherent in the experiments [1,2]. One significant source of uncertainty is the distribution of sizes of the aerosol particles passing through the differential mobility analyser employed as the size-selecting device.

We have therefore developed a CRDS-based method to determine the optical cross sections and extinction efficiencies of *single* aerosol particles of diameter ~ 1 μm or less. A Bessel beam optical trap is used to confine and manipulate the position of the single aerosol particle. Particles smaller than 1 μm can be captured indefinitely and we have demonstrated the ability to study processes that change the size or refractive index, such as the evaporation of volatile components or the uptake of water. The measured extinction induced by the particle depends on the position of the particle within the cavity [3,4], so fine positional control is required. Results will be presented for a number of aerosol particle compositions. For example, the variation in extinction efficiency of a single trapped sodium chloride droplet with relative humidity agrees very well with predictions from Mie scattering theory. The advantages of single-particle over ensemble measurements will be discussed.

[1] Miles *et al.* (2011) *Aerosol Sci. Tech.* **45**, 1360-1375. [2] Mason *et al.* (2012) *J. Phys. Chem. A* **116**, 8547-8556. [3] Butler *et al.* (2007) *J. Chem. Phys.* **126**, 174302. [4] Miller *et al.* (2007), *J. Chem. Phys.* **126**, 174303

Temperature reconstruction for the last 1000 years at WAIS-Divide, Antarctica, from inert gas isotopes and borehole temperature.

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West Antarctica is warming, but it is not clear yet whether it is abnormal, in the context of natural background variability. The amplitude of natural climate variability on multi-decadal timescales remains poorly quantified, but it is essential to our understanding of the significance of the warming of the last 50 years.

Here, we present a 1000-year temperature record at WAIS-Divide, in the center of West Antarctica, reconstructed from the combination of inert gas isotopes from the ice core and borehole temperature measurements. Borehole temperature provides an absolute estimate of long-term trends, while noble gases track decadal to centennial scale changes. This method provides a temperature reconstruction that is independent of the water isotope of the ice, and allows us to improve our understanding of water isotopes as a temperature proxy at this site.

We found that the "Little Ice Age" cold period of 1400-1800 was 0.52°C colder than the last century, and that 50 to 100 year variability is on the order of 0.5 to 1°C.

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