Filter Measurements of Chemical Composition During the Airborne Antarctic Ozone Experiment

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During the Airborne Antarctic Ozone Experiment campaign, a filter sampler was flown to measure the bulk chemical composition of the aerosol and gas phase. On three of the flights, a separation of the aerosol and the acidic vapor composition was affected with a pre-filter to collect the aerosols followed by an impregnated filter to collect the acidic vapors. The Multi Filter Sampler (MFS) that was flown was the same sampler used in the past with the addition of NH_3 to the filter storage compartment. The filter storage compartment was also modified so that it could be maintained at near dry ice temperature to further retard volatilization of the collected aerosol.

The background sulfate aerosol was measured in regions inside and outside of the chemically perturbed region (CPR) of the polar vortex. The mass ratio of sulfate outside to inside was 2.8. This is indicative of a cleansing mechanism effecting the CPR or of a different air mass inside versus outside. The absolute value of the sulfate mixing ratio shows that the background aerosol has not been influenced by recent volcanic eruptions. The sulfate measured on the ferry flight returning to NASA Ames shows a decrease towards the equator with increasing concentrations in the northern hemisphere.

Nitrate in the aerosol phase was observed on 2 flights. The largest amount of nitrate measured in the aerosol phase was 44% of the total amount of nitrate observed. Other samples on the same flights show no nitrate in the aerosol phase. The presence of nitrate in the aerosol is correlated with the coldest temperatures observed on a given flight.

Total nitrate (aerosol plus acidic vapor nitrate) concentrations were observed to increase at flight altitude with increasing latitude north and south of the equator. Total nitrate was lower inside the CPR than outside.

Chloride and fluoride were not detected in the aerosol phase. From the concentrations of acidic chloride vapor, the ratio of acidic vapor Cl to acidic vapor F and a summing of the individual chloride containing species to yield a total chloride concentration, there is a suggestion that some of the air sampled was dechlorinated. Acidic vapor phase fluoride was observed to increase at flight altitude with increasing latitude both north and south of the equator. The acidic vapor phase fluoride was the only compound measured with the filter technique that exhibited larger concentrations inside the CPR than outside.