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Aqueous phase oxidation of SO_2 by O_3 measured at the CERN CLOUD chamber

Christopher Hoyle (1,4), Claudia Fuchs (1), Martin Gysel (1), Jasmin Troestl (1), Imad El Haddad (1), Carla Frege (1), Josef Dommen (1), Antonio Dias (2,3), Emma Jaervinen (5), Ottmar Moehler (5), Urs Baltensperger (1), and the The CLOUD collaboration Team

(1) Paul Scherrer Institute, Laboratory of Atmospheric Chemistry, Villigen, Switzerland (christopher.hoyle@psi.ch), (4) Swiss Federal Institute for Forest Snow and Landscape Research (WSL)-Institute for Snow and Avalanche Research (SLF), 7270 Davos, Switzerland, (2) CERN, Geneva, Switzerland, (3) University of Lisbon, Lisboa,1749-016, Portugal, (5) Institute for Meteorology and Climate Research, Karlsruhe Institute of Technology, Germany

Measurements of aerosol growth due to the oxidation of SO_2 by O_3 in cloud droplets at temperatures of 10˚C and -10˚C are presented. Although this reaction has been well studied in bulk solutions at temperatures above 0˚C, this is, to the best of our knowledge, the first time the reaction rate has been studied in laboratory formed, super-cooled cloud droplets. These experiments were made possible by utilising the adiabatic expansion system in the 27 m^3 CLOUD (Cosmics Leaving Outdoor Droplets) chamber at CERN. Experiments were performed on both acidic (sulphuric acid) and neutral (ammonium sulphate) seed aerosol. During 6 minute cloud cycles, droplets of approximately 10μm diameter were formed, and the growth of the aerosol due to the uptake and oxidation of SO_2 was measured with a scanning mobility particle sizer (SMPS). A microphysical model was developed to simulate the cloud droplet activation and growth as well as the aqueous phase chemistry. The ability of the model to accurately represent the observed aerosol growth is assessed, and the implications for the extrapolation of the SO_2+O_3oxidation rates to sub-zero temperatures are discussed.