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Wind tunnel studies on the growth of ice particles by riming and determination of retention coefficients of trace gases

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In tropospheric mixed phase clouds ice particles grow by the diffusion of water vapor or by riming. To calculate the growth rate of ice particles by riming knowledge of the collision kernel for collisions between ice particles and liquid drops is essential. So far, there exist only few measurements from laboratory experiments. Another important issue is the retention of trace gases from the liquid phase during riming. Previous laboratory measurements resulted in strongly differing retention coefficients. Experiments are carried out at the Mainz vertical wind tunnel where individual freezing and riming events are simulated under atmospheric conditions in a temperature range between -8 and -15°C. An initial ice particle of up to 700 μm diameter is suspended in the wind tunnel while a cloud of super-cooled droplets is generated upstream. The cloud droplet size spectrum is determined by an optical scattered light detection showing sizes between 8 and 50μm. Temperature and dew point are recorded during the experiments to calculate the liquid water content. After various growth times the graupel particles are sampled from the wind tunnel to determine their volume and mass. When trace gases are present in the liquid phase the graupel particles are melted afterwards and the concentration of the trace gas in the ice phase is determined by ion chromatography. Based on the graupel growth experiments the collection kernel was calculated as a function of the collector's momentum, i.e. the product of its mass and volume. Our results fit well into the range of values reported by earlier studies and complete previous experimental investigations with data for larger cloud droplets and collector particles. First experiments to determine the retention coefficients of nitric acid are under way. Further experiments are planned with other trace gases, e.g. hydrogen peroxide. Results from these measurements will be shortly available.