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From Clusters to Atmospheric Aerosol Particles: Nucleation in the CLOUD Experiment at CERN[1]

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Globally, a significant source of cloud condensation nuclei for cloud formation is thought to originate from new particle formation (aerosol nucleation). Despite extensive research, many questions remain about the dominant nucleation mechanisms. Specifically, a quantitative understanding of the dependence of the nucleation rate on the concentration of the nucleating substances such as gaseous sulfuric acid, ammonia, water vapor and others has not been reached. This is of relevance for climate as the atmospheric concentrations of sulfuric acid, ammonia and other nucleating agents are strongly influenced by anthropogenic emissions. By providing extremely well controlled and essentially contaminant free conditions in the CLOUD chamber, we were able to show that indeed sulfuric acid is an important component for such new particle formation, however, for the typical temperatures encountered in the planetary boundary layer the concentrations of sulfuric acid are not high enough to explain the atmospheric observations [1]. Moreover, the effect of ammonia [1], amines [2] and oxidized organic molecules [3] on the nucleation rate of sulfuric acid has been investigated in CLOUD so far. Recent developments in instrument technology such as the Atmospheric Pressure interface-Time Of Flight (APi-TOF) mass spectrometer have allowed us to investigate the chemical composition of charged [4] as well as neutral [5] clusters during such nucleation experiments. References [1] Kirkby, J. et al., Nature, 476, 42-433, 2011 [2] Almeida, J. et al., Nature, 502, 359-363, 2013. [3] Riccobono et al., Science, 344, 717-721, 2014. [4] Schobesberger S. et al., Proc. Nat. Acad. Sci., 110, 17223-17228, 2013. [5] Kürten, A. et al., Proc. Nat. Acad. Sci., 111, 15019–15024, 2014.

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