



## Investigating the link between cosmic rays and Earth's climate: the CLOUD experiment at CERN

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Galactic cosmic rays produce ions in Earth's atmosphere. These ions can act as seeds for the formation of aerosol particles in the atmosphere. Globally, a significant source of cloud condensation nuclei for cloud formation is thought to originate from new particle formation (nucleation). Despite an extensive research effort, many questions remain about the dominant nucleation mechanisms. The potential influence of ions from galactic cosmic rays on the atmospheric aerosol nucleation processes may play an important role relevant for aerosol production, cloud formation and climate. Variability of galactic cosmic rays due to modulating influences from the sun therefore may affect (regional) climate on various time scales. In this presentation first an overview is given of the potential processes by which cosmic rays may affect climate and examples of the correlations of atmospheric and paleo-climatic parameters suggesting this connection are briefly reviewed. Then, the first results from the CLOUD experiment at CERN are presented. CLOUD is a new aerosol chamber facility at CERN which can be exposed to a pion beam from the CERN Proton Synchrotron to simulate various levels of atmospheric ionization. CLOUD has been set up to investigate the potential links between cosmic rays, aerosols, clouds and climate under well-controlled laboratory conditions. We find that cosmic ray ionisation substantially increases the nucleation rate of sulphuric acid particles. For mid-tropospheric temperatures, typical atmospheric concentrations of sulphuric acid and water vapour are sufficient for nucleation to take place via an ion-induced binary nucleation mechanism. Our results constitute quantitative measurements of purely-neutral and ion-induced nucleation of sulphuric acid particles. Furthermore, in the CLOUD experiment, for the first time chemical composition of the growing clusters and the nucleation mechanism at the molecular level are revealed.

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