# CERN's CLOUD experiment shines new light on climate change

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Credit: NASA

(Phys.org) —In a paper published today in the journal *Nature*, the CLOUD experiment at CERN reports a major advance towards solving a long-standing enigma in climate science: how do aerosols - tiny solid or liquid particles suspended in the air - form in the atmosphere, and which gases are responsible? This is a key question in understanding the climate, since aerosols cause a cooling effect by reflecting sunlight and by seeding cloud droplets.

The CLOUD researchers made two key discoveries. Firstly, they found

that minute concentrations of amine vapours combine with sulphuric acid to form aerosol particles at rates similar to those observed in the atmosphere. Then, using a pion beam from the CERN Proton Synchrotron, they found that ionising radiation such as the cosmic radiation that bombards the atmosphere from space has negligible influence on the formation rates of these particular aerosols.

"Thanks to CERN's expertise in materials, gas systems and ultra-high vacuum technologies," said CLOUD spokesperson Jasper Kirkby, "we were able to build a chamber with unprecedented cleanliness, allowing us to simulate the atmosphere and introduce minute amounts of various atmospheric vapours under carefully controlled conditions – in this case amines and sulphuric acid."

Amines are atmospheric vapours closely related to ammonia, and are emitted both from human activities such as animal husbandry, and from natural sources. Amines are responsible for odours emanating from the decomposition of organic matter that contains proteins. For example, the smell of rotten fish is due to trimethylamine. The CLOUD experiment's unique ultra-clean chamber allowed the collaboration to demonstrate that the extremely low concentrations of amines typically found in the atmosphere - a few parts per trillion by volume - are sufficient to combine with sulphuric acid to form highly stable aerosol particles at high rates.

The measured sensitivity of aerosol formation to amines came as a surprise, and points to a potentially significant climate cooling mechanism. Moreover, since amine scrubbing is likely to become an important technology for capturing carbon dioxide emissions from fossil-fuelled power plants, this effect is likely to rise in future.

The CLOUD result adds another significant measurement in understanding the climate. But it does not rule out a role for cosmic

radiation, not does it offer a quick fix for global warming.

"This is the first time that atmospheric particle formation has been reproduced with complete knowledge of the participating molecules", said Kirkby. "However our measurements leave open the possibility that the formation of aerosols in the atmosphere may also proceed with other vapours, for which the effect of cosmic rays may be different. This is an important step forward, but we still have a long way to go before we fully understand the processes of aerosol formation and their effects on clouds and climate."

**More information:** Molecular understanding of sulphuric acid–amine particle nucleation in the atmosphere, DOI: 10.1038/nature12663

Provided by CERN

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