Drones soar up to clouds to understand ice-formation effect on climate

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Credit: AI-generated image (disclaimer)

EU-funded scientists used instrument-bearing drones to investigate the effect of aerosols on ice crystals in clouds which are thought to affect climate and climate change.

The interaction between clouds and aerosols is believed to play an

important role in climate change but its relevance is poorly understood. The EU-funded BACCHUS project brought together 20 institutions and organisations from a dozen countries—more than 60 researchers specialising in clouds containing ice—to investigate how aerosols alter cloud properties and affect precipitation.

Aerosols result from human activities or occur naturally as dust, pollen, fungal spores, bacteria or marine organics. "We investigated the importance of biogenic (natural or pre-industrial) versus anthropogenic (human-made) emissions for aerosol-cloud interactions in regions that are key regulators of the Earth's climate, such as the Amazon rain forest or the Arctic," says project coordinator Professor Ulrike Lohmann, Professor for Atmospheric Physics at the Institute for Atmosphere and Climate Science, ETH Zurich, Switzerland.

"Very little data is available for many of these regions, particularly over oceans," she notes. "To start with we wanted to know what fraction of the cloud is composed of water droplets versus ice crystals and then how this was affected by aerosols."

In Europe's mid-latitudes, even low-lying clouds can contain ice; this is significant because ice clouds precipitate more readily and influence the radiation budget more than water clouds. This balance between radiation from the Sun and what the Earth radiates back is an important equation in climate-change modelling.

Innovative use of drones to study clouds

As well as using satellite remote-sensing measurements and data from the ground, research vessels and large research aircraft, the project also used drones. These were equipped with commercially available lightweight temperature, humidity and aerosol sensors and sent a few kilometres into the sky. This was the first time scientists have used

drones for this kind of vertical profiling, enabling the project to take measurements that are more representative of the atmospheric conditions of ice formation in clouds than ground-based measurements.

Drones are preferable to research aircraft, which fly too fast through cloud. "You get only a few measurement points using aircraft," Professor Lohmann says. "Drones are light and highly flexible. They can also facilitate more frequent cloud measurements in different locations around the world, particularly remote regions where data is missing."

Unique database on ice clouds

The drones were first used over a remote location in Cyprus, where the air is often laden with desert dust. The information was fed into a unique database on ice clouds, bringing together long-term observations and field data on cloud microphysical properties, ice-nucleating particles around which the crystals form and aerosols.

"There are databases for aerosols, and databases for all meteorological variables, but a database for ice-nucleating particles did not exist. We built it from scratch," Professor Lohmann says. The first commercially available instrument for measuring ice-nucleating particles, based on a design developed by the project's researchers, only became available a few years ago. "It is a very young discipline," she explains.

With analysis of Greenland ice cores, the BACCHUS database will include data on the pre-industrial period going back to around 1300 AD.

A BACCHUS team circumnavigated the Antarctic on the research vessel Akademic Tryoshnikov to collect data for polar climate models. "We were able to get many measurements of ice-nucleating particles in a previously under-sampled area of the Southern Ocean," Professor Lohmann says.

"We also wanted to see how important future Arctic ship traffic could be for clouds and how much ship pollution matters in such a pristine environment." So far results have been too diverse to derive conclusions, partly due to uncertainty about the sources and longevity of natural aerosols.

Provided by CORDIS

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