Experiment in a box suggests a few cold falling rain drops could lead to a rain shower

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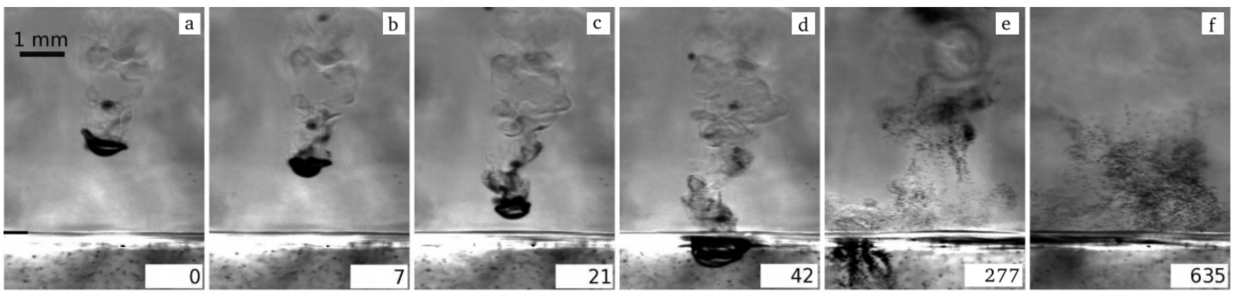

Contrast enhanced image sequence of an SF6 drop falling through the gaseous SF6-He layer. Shown is the lower part of the cell. The black mark on the left indicates the position of the liquid-vapor interface located at about 6 mm from the bottom plate. The time stamp (in ms) for each of these figures is indicated at the bottom right corner. Credit: arXiv:1705.10501 [physics.ao-ph]

(Phys.org)—A team of researchers from Germany, France and the U.S. has found a possible explanation for the onset of sudden rainstorms. In their paper published in the journal *Physical Review Letters*, the group describes experiments they conducted with stand-ins for water and atmospheric gases in a box in their lab and what they witnessed.

A half-century ago, scientists discovered that dumping dry ice on top of cumulus clouds caused the clouds to release rain, but to this day, nobody knows why. Similarly, scientists are still baffled by sudden rainstorms. Why do some clouds suddenly release rain while others that appear nearly identical do not? No one knows, because the factors at play in rain clouds are too difficult to study. For that reason, scientists are trying to recreate atmospheric conditions in the lab or via computer simulations. Unfortunately, neither approach has led to answers regarding sudden rainstorms. In this new effort, the researchers have taken a new approach to better understand rainstorms.

Because it is difficult to mimic normal upper atmospheric conditions in a lab container, the researchers chose to use sulphur hexafluoride as a stand-in for water in the atmosphere because it can exist as a liquid and a gas at surface level pressure and also because it forms into droplets when chilled. They used helium as a stand-in for general atmospheric gasses. The chemicals were pumped into a box which was then heated slightly on the bottom and chilled slightly at the top. The researchers used a high-speed camera to film the action.

They report that some of the sulphur hexafluoride pooled at the bottom of the tank and some of it remained as a gas in the upper portions of the tank. But then, the sulphur hexafluoride began to form droplets on the top of the box, which eventually detached, falling through the gas to land in the pool below. But the team found that as they fell, they caused smaller droplets to form in their wake—this was because the drops were colder than the gas they were passing through. These smaller drops than fell into the pool below as rain.

The researchers acknowledge that they have no evidence that their experiment mimicked nature, but note that if something similar is happening in the atmosphere, it could explain the onset of sudden rainstorms.

More information: Prasanth Prabhakaran et al. Can Hail and Rain Nucleate Cloud Droplets?, *Physical Review Letters* (2017). DOI: 10.1103/PhysRevLett.119.128701 , On *Arxiv*: arxiv.org/abs/1705.10501

Abstract

We present results from moist convection in a mixture of pressurized sulfur hexa-flouride (liquid and vapor) and helium (gas) to model the wet and dry components of the earth's atmosphere. To allow for homogeneous nucleation, we operate the experiment close to critical conditions. We report on the nucleation of microdroplets in the wake of large cold liquid drops falling through the supersaturated atmosphere and show that the homogeneous nucleation is caused by isobaric cooling of the saturated sulfur hexaflouride vapor. Our results carry over to atmospheric clouds: falling hail and cold rain drops may enhance the heterogeneous nucleation of microdroplets in their wake under supersaturated atmospheric conditions. We also observed that under appropriate conditions settling microdroplets form a rather stable horizontal cloud layer, which separates regions of super and sub critical saturation.

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