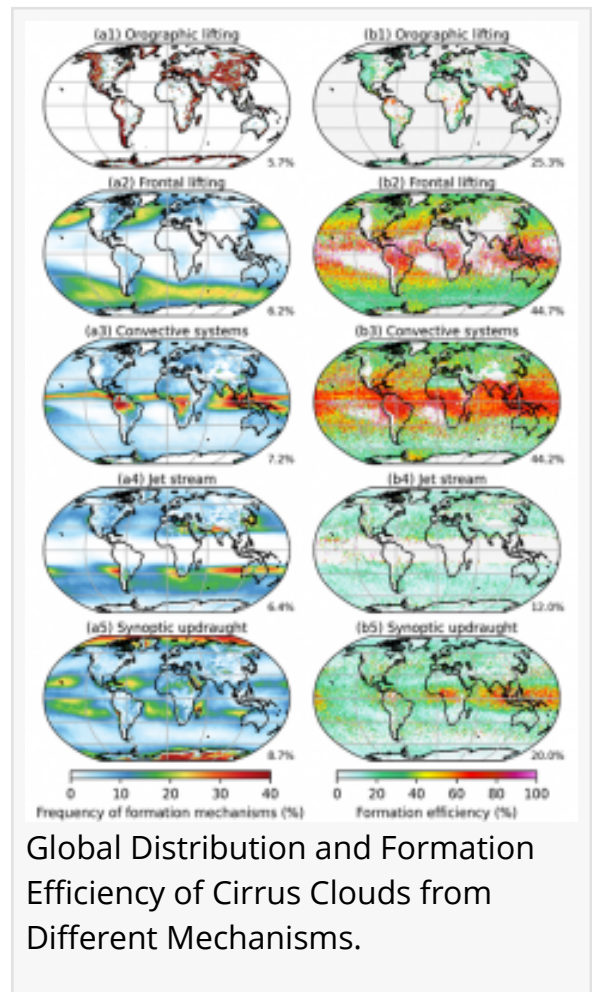


Exploring the global distribution and microphysics of cirrus clouds

FAYETTEVILLE, GA, UNITED STATES, September 3, 2025 /EINPresswire.com/ -- Cirrus clouds play a key role in Earth's radiative balance and climate. This study uses radar and lidar data from A-Train satellites, combined with the Identification and Classification of Cirrus (IC-CIR) system, to examine cirrus clouds formed through different atmospheric processes. The findings highlight how these clouds vary in distribution and properties, offering new insights into their radiative effects and importance in climate models.

Cirrus clouds significantly affect Earth's climate due to their role in radiative forcing. These clouds are formed by various mechanisms—such as orographic lifting, frontal systems, and convection—which influence their properties and distribution. However, simulating these clouds remains challenging due to the complex dynamics involved. Accurate cloud representation in models is critical for improving climate predictions. Based on these challenges, further research is essential to refine model simulations and understand cirrus clouds' behavior better.



This study (DOI: [10.34133/remotesensing.0666](https://doi.org/10.34133/remotesensing.0666)), published in [Journal of Remote Sensing](#) examines the characteristics of cirrus clouds formed through different atmospheric mechanisms. By combining data from CloudSat and CALIPSO satellites with the IC-CIR classification system, the research provides a global perspective on cloud distribution and microphysical properties. The study underscores the influence of formation mechanisms on cloud ice content, crystal size, and distribution, offering valuable insights into their role in Earth's climate system.

The study identifies how cirrus clouds differ based on formation mechanisms. Convective cirrus, common in tropical regions, exhibit the highest ice water content (IWC) and largest ice crystals, with altitudes reaching 17 km. Frontal cirrus clouds, formed along storm tracks over oceans,

show moderate IWC. Orographic cirrus, near mountain ranges, are more fragmented and influenced by terrain. The IC-CIR system found that convection and frontal systems are the most efficient mechanisms for forming cirrus clouds globally. These two mechanisms account for approximately two-thirds of cirrus cloud formation. In contrast, jet-stream cirrus are less effective, with lower IWC and smaller ice crystals.

Using joint observations from CloudSat and CALIPSO, cirrus clouds were classified through the IC-CIR system. Data from 2007 to 2013 revealed that convective clouds were most frequent in tropical regions and reached the highest altitudes. Frontal clouds, often found in extratropical storm tracks, had moderate IWC and were observed more during winter. The study also examined the microphysical properties of cirrus clouds, such as ice crystal size (Rice), ice number concentration (Nice), and IWC. Convective clouds showed the highest IWC, while jet-stream clouds were the thinnest and had the smallest ice crystals. The study highlights the global distribution patterns, showing that frontal and convective systems dominate cirrus cloud formation. Convective clouds were found to have a formation efficiency exceeding 90% in tropical regions. In comparison, jet-stream cirrus were the least efficient, with a global formation efficiency of only 12%.

Dr. Lang Zhang, the study's lead researcher, stated, "By analyzing global cirrus cloud data, we've uncovered how different formation mechanisms shape cloud properties. This research offers crucial insights into their radiative effects and climate role, ultimately aiding the improvement of climate models. Our findings pave the way for more accurate predictions of cirrus cloud behavior and their impact on Earth's climate."

The research utilized CloudSat and CALIPSO satellite data, combined with the IC-CIR system, to classify cirrus clouds formed by different mechanisms. The ice water content (IWC), ice crystal radius (Rice), and ice number concentration (Nice) were derived from radar and lidar observations. These datasets provided detailed insights into the vertical distribution and microphysical properties of cirrus clouds. The study analyzed global data from 2007 to 2013 to assess cirrus cloud formation efficiency and their distribution patterns across different mechanisms.

This research opens avenues for improving cirrus cloud representation in climate models. Future studies will focus on enhancing satellite observations and refining classification systems to better simulate cirrus cloud behavior. By improving our understanding of these clouds, we can better assess their impact on Earth's radiative balance, offering crucial insights into climate change and its future impacts. Further research will also address current data limitations and enhance predictions for climate and weather forecasting.

References

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