CASE STUDY | PUBLISHED IN GEOPHYSICAL RESEARCH LETTERS

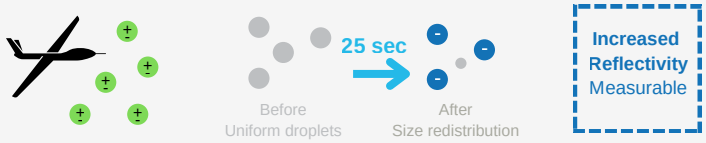
25-SECOND RESPONSE

UAE Drone Study Proves Real-Time Ionization Effects on Fog

What if you could prove that ionization affects atmospheric moisture not in days or hours, but in mere seconds? In 2022, researchers Harrison, Nicoll, Marlton, Airey, and Williams published groundbreaking work in Geophysical Research Letters demonstrating that ion emissions from a remotely piloted aircraft could measurably modify fog properties within 25 seconds of emission. This wasn't theoretical modeling or statistical inference—it was direct, real-time observation of ionization changing fog microphysics.

The research team equipped a small unmanned aerial vehicle (UAV) with bipolar corona ion emitters and integrated meteorological sensors, creating what they described as "the first empirical study to use drones for fog modification." By flying the instrumented drone through natural fog conditions and carefully controlling when ions were emitted, the researchers could directly measure cause-and-effect relationships between ionization and fog properties.

Ion-Fog Interaction Process



1. UAV emits bipolar ions
2. Ions interact with fog droplets
3. Droplet sizes redistribute
4. Fog properties change (25 sec)

The breakthrough finding: Unipolar ion emission increased fog reflectivity with a peak response approximately 25 seconds after emission, indicating rapid redistribution of droplet sizes. The study used both clear-air and foggy-air conditions as controls, enabling robust analysis of the ionization effects. This represented the first time scientists had intentionally modified fog microphysics and radiative properties under natural atmospheric conditions using controlled ion emissions.

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25 sec
Peak Response Time After Ion Emission

First
UAV-Based Fog Modification Study

2021-22
Published Research (Multiple Papers)

Natural
Field Conditions (Not Laboratory)

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Why This Study Matters for Water Resource Management

Proof of Rapid Response: The 25-second timeframe demonstrates that ionization effects on atmospheric moisture aren't slow or uncertain—they're immediate and measurable. This validates the fundamental mechanism underlying all ionization-based precipitation enhancement.

Microphysical Verification: By directly measuring droplet size redistribution, the study provides the kind of detailed microphysical evidence that previous large-scale trials couldn't capture. This bridges the gap between theory and observable atmospheric changes.

Scalability Insight: While this study used a small UAV in fog, the demonstrated ion-droplet interaction mechanism applies across different atmospheric moisture conditions—including the clouds targeted for rainfall enhancement.

25 sec	Direct	Natural
Response Time Proves Rapid Effect	Microphysical Measurements	Atmospheric Conditions

SCIENTIFIC INNOVATION

- **Real-Time Measurement:** First study to demonstrate measurable fog modification effects within seconds of ion emission
- **Controlled Experiments:** Clear-air and foggy-air conditions used as controls, enabling robust cause-effect analysis
- **Integrated Sensors:** UAV equipped with ion emitters plus thermodynamics, droplet concentration, and space charge sensors
- **Bipolar Ion Emission:** Lightweight, controllable corona emitters designed specifically for low-speed aircraft operations
- **Field Validation:** Natural atmospheric conditions rather than laboratory settings, proving real-world applicability

THE RET CONNECTION

- **Same Physical Principle:** The ion-droplet interaction mechanism observed in the UAE fog study is the same microphysical process that drives ground-based ionization systems deployed by RET for precipitation enhancement.
- **Real-Time Validation:** The 25-second response time proves that ionization effects on atmospheric moisture are immediate and measurable—supporting the operational effectiveness of continuous ground-based systems.
- **Scientific Foundation:** Publication in Geophysical Research Letters and related atmospheric science journals provides peer-reviewed validation of the ionization mechanism that underlies RET's technology approach.

*Source: Harrison, R.G., Nicoll, K.A., Marlton, G.J., Airey, M.W., & Williams, P.D. (2022). Ionic charge emission into fog from a remotely piloted aircraft. Geophysical Research Letters, 49, e2022GL099827.AND the 2021 platform paper: Harrison, R.G., et al. (2021). Demonstration of a remotely piloted atmospheric measurement and charge release platform for geoengineering. Journal of Atmospheric and Oceanic Technology, 38, 63-74.

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