RIDE Research on Infrastructure in Developing Economies

TRL Shaping transport

AUGUST 2026

AVIATION CONTRAIL MITIGATION

Evidence review and future research prioritisation

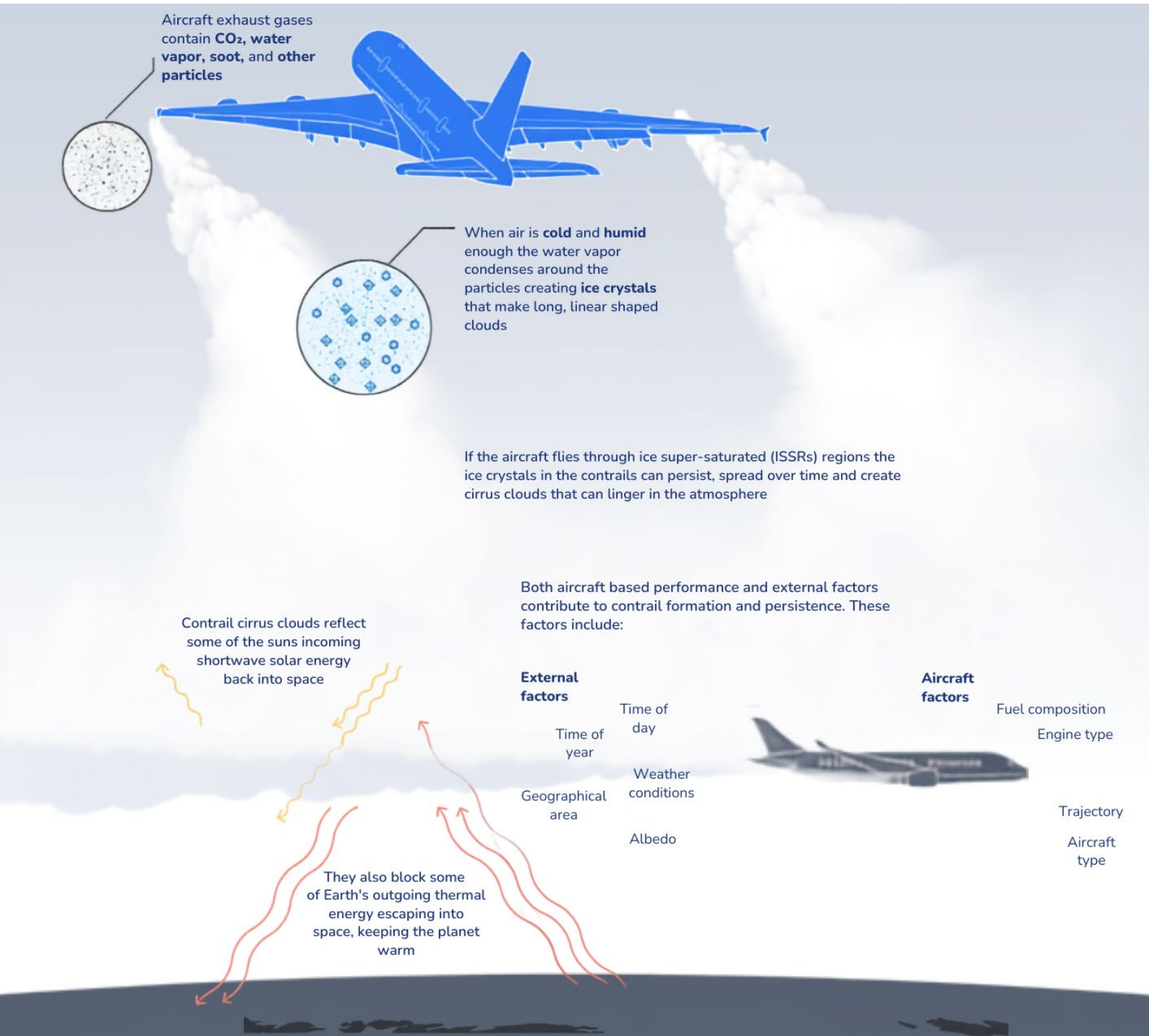
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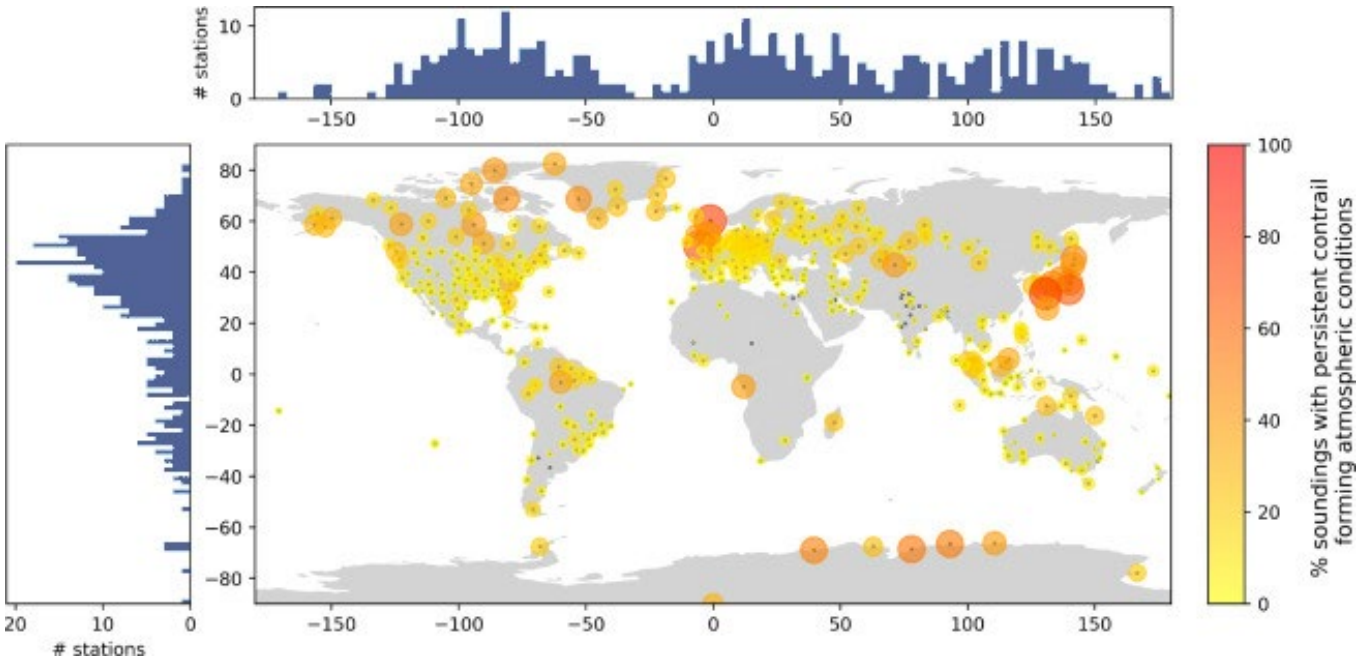
Why contrail mitigation matters

Contrails form when aircraft fly through cold, humid air and exhaust particulates trigger ice crystals. **Persistent contrails can develop into cirrus clouds that unbalance the Earth's radiation budget and add warming.** A small share of flights may cause a large share of contrail warming, so targeted avoidance could deliver disproportionate benefit. Modelling studies suggest that a relatively small proportion of flights may account for a large share of contrail warming, creating potential for targeted mitigation with resulting disproportionate benefits. The UK's role in managing strategically important North Atlantic airspace also provides an opportunity to test and influence mitigation approaches at scale.



Where contrails form

Contrail-forming conditions cluster in specific regions and latitudes



Share of atmospheric soundings with persistent-contrail-forming conditions, by station.

Susceptible regions

The North Atlantic corridor, Europe and North America are especially prone to persistent contrails.

Prediction is advancing

Research can now predict where persistent contrails are likely to form.

Impact is harder

Knowing where a contrail will form is not the same as knowing its climate impact. Impact depends on ice particles, lifetime, atmospheric conditions and radiative effects, which are not yet fully understood.

From understanding to implementation

The science is maturing. Small trials have demonstrated the technical feasibility of contrail avoidance. The next step is to establish whether it works reliably and delivers measurable climate benefits at operational scale. The next challenges are operational, verifiable and international.

PROGRESSED

Scientific understanding → **Prediction** → **Operational trials**

THE NEXT CHALLENGES

- Estimate the climate impact of individual contrails with greater confidence
- Evaluate and compare prediction and physics models
- Independently verify whether mitigation delivers measurable climate benefits
- Demonstrate mitigation at large operational scale, including across wider air traffic management regions*
- Build governance and international coordination for implementation

A systems approach is required

Contrail mitigation is not a replacement for wider decarbonisation. It sits alongside CO_2 reduction, aircraft efficiency, sustainable aviation fuels (SAF), future propulsion and operational optimisation, and these interact. SAF, hydrogen, and changes in fuel composition can themselves alter exhaust and contrail formation.

The challenge is not to eliminate uncertainty, but to understand it, quantify it, and build it into risk-informed decisions.

**A £5m, 30-month UK trial led by Google, the Department for Transport (DfT), the Met Office, NATS, the University of Cambridge and Imperial College London will test whether AI can predict warming contrail formation and enable aircraft to make small altitude changes to avoid these areas in North Atlantic airspace. The trial is expected to cover around 10,000 flights across winters 2026-27 and 2027-28.*

Where FCDO investment can add value

There is already substantial investment in contrail research across the UK, Europe and the US. The DfT's Non-CO_2 R&D Programme has funded 20 projects worth more than £20 million. Future FCDO investment should therefore focus on evidence gaps, international application and areas that complement rather than duplicate existing programmes.



Independent verification

Credible, scalable ways to check that interventions deliver their predicted climate benefits.



International application and transferability

Test whether contrail prediction and mitigation approaches developed in Europe and North America remain effective under different atmospheric, geographical and aviation conditions.



Knowledge transfer

Connect research communities; share methods, data, evidence and expertise across borders.



Governance & implementation

Internationally compatible monitoring, verification, standards, regulation and collaboration.



Connecting research to decisions

Bring science, modelling and operational evidence together for practical climate decisions.

KEY MESSAGE

The question is no longer simply whether we can predict or avoid contrails. It is whether we can identify which contrails matter, demonstrate that avoiding them works, and build the evidence and international frameworks needed to apply that knowledge at scale.

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