



EarthCARE 2026 Science and Validation workshop

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Aircraft-Specific Contrail Identification from EarthCARE ATLID

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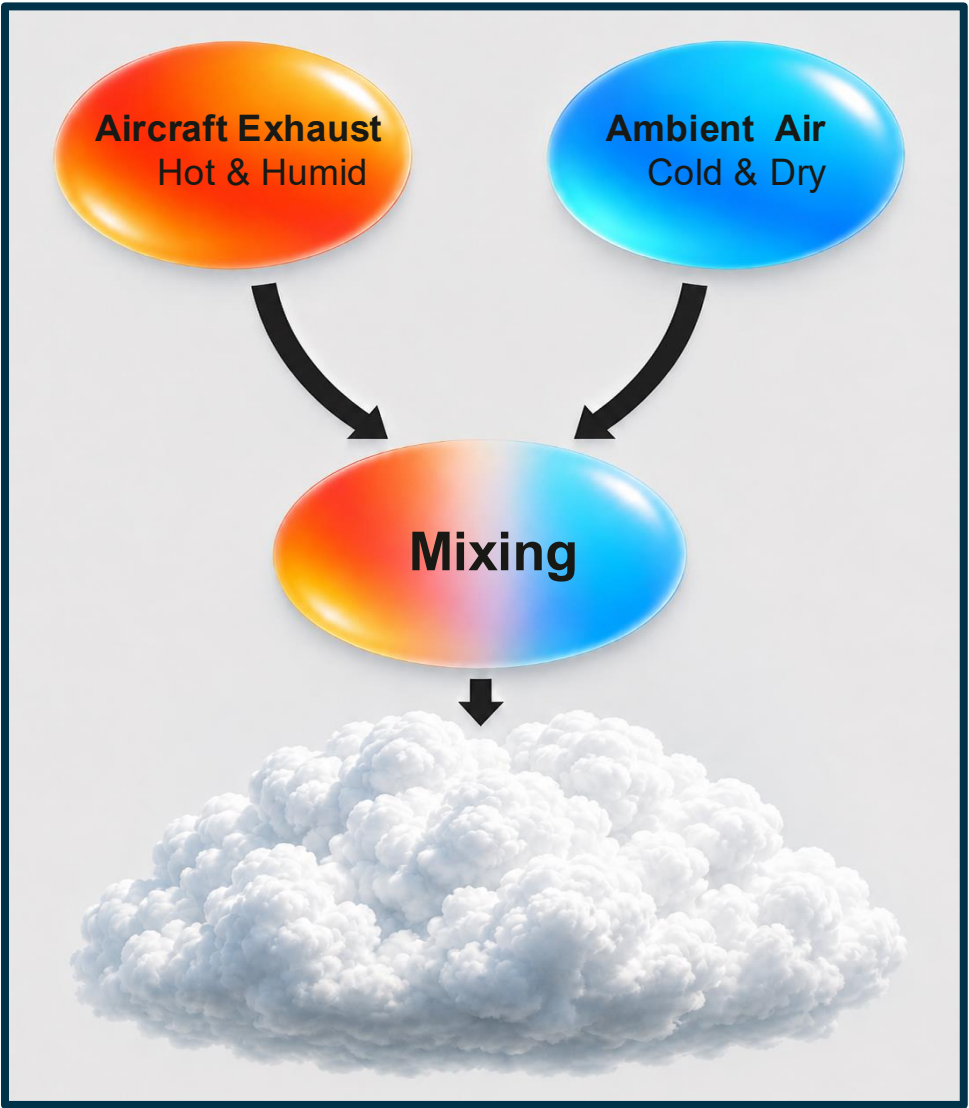
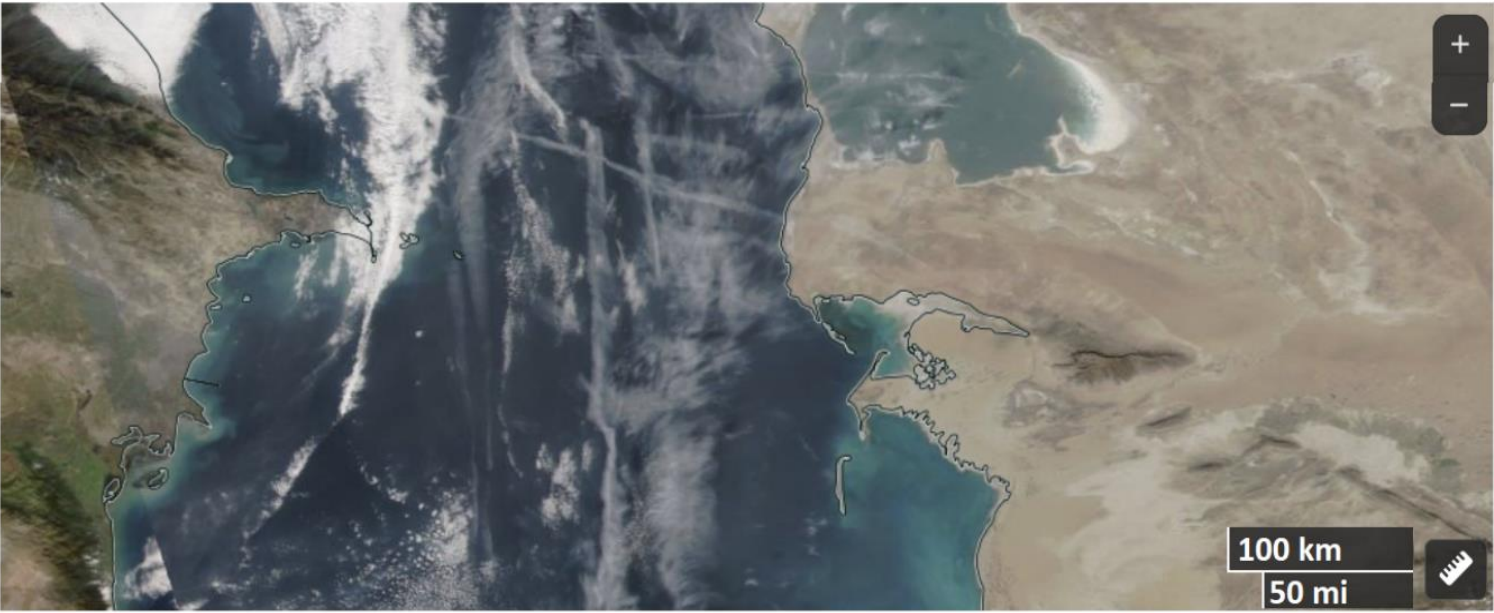
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² Department of Civil and Environmental Engineering, Imperial College London

What Is Contrail ???



(Aqua/MODIS) 06-Nov-2023 [40.33° N, 51.89° E]

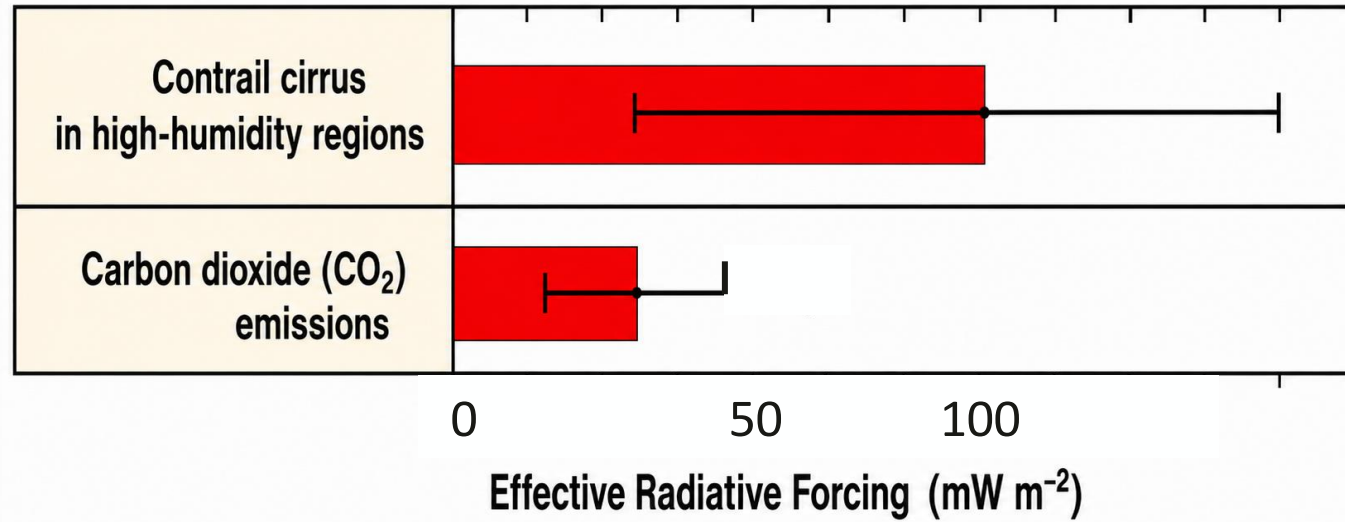


Why Do Contrails Matter ????



- Contrails can warm more than aviation CO₂.
- Their effect is still highly uncertain, especially in clouds.
- Growing air traffic makes this increasingly important.

Global Aviation Effective Radiative Forcing (ERF) Terms (1940 to 2018)



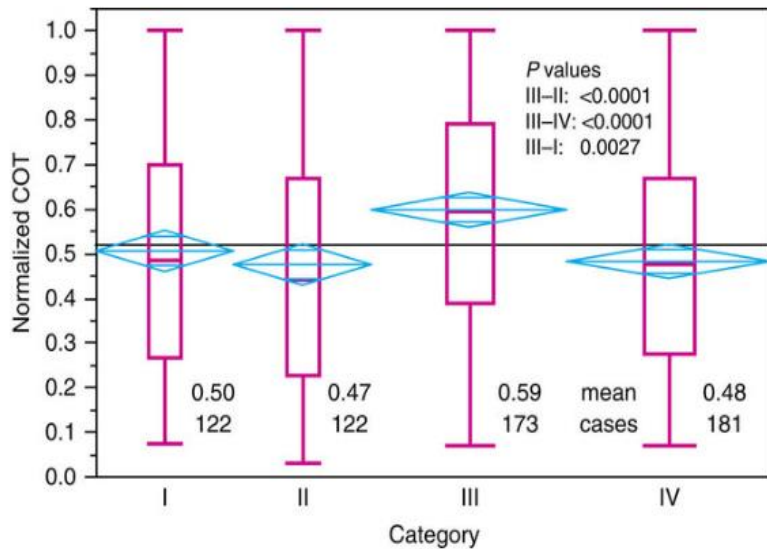
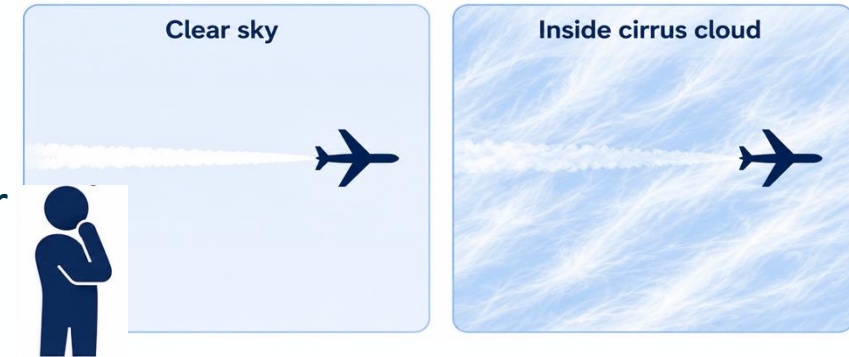
Lee et al., Atmospheric Environment, 2021



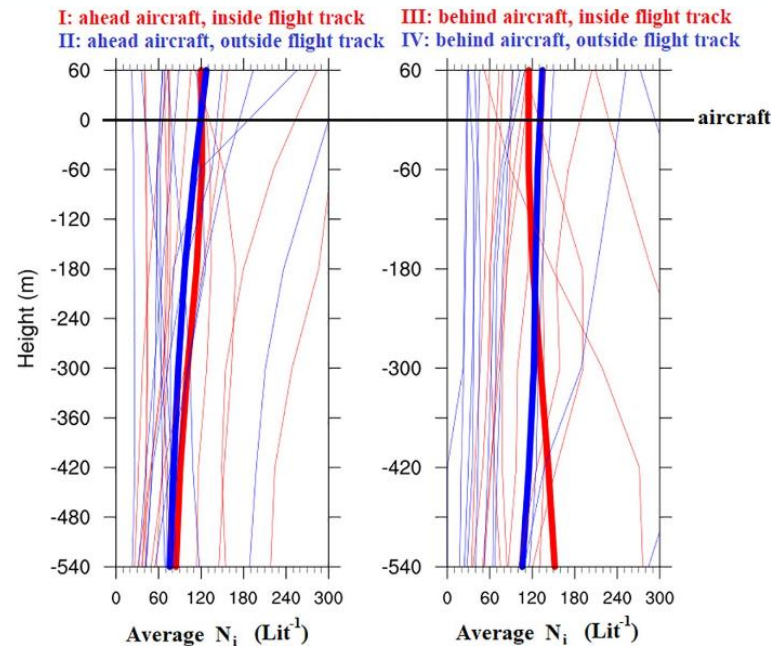
Embedded Contrails Impact



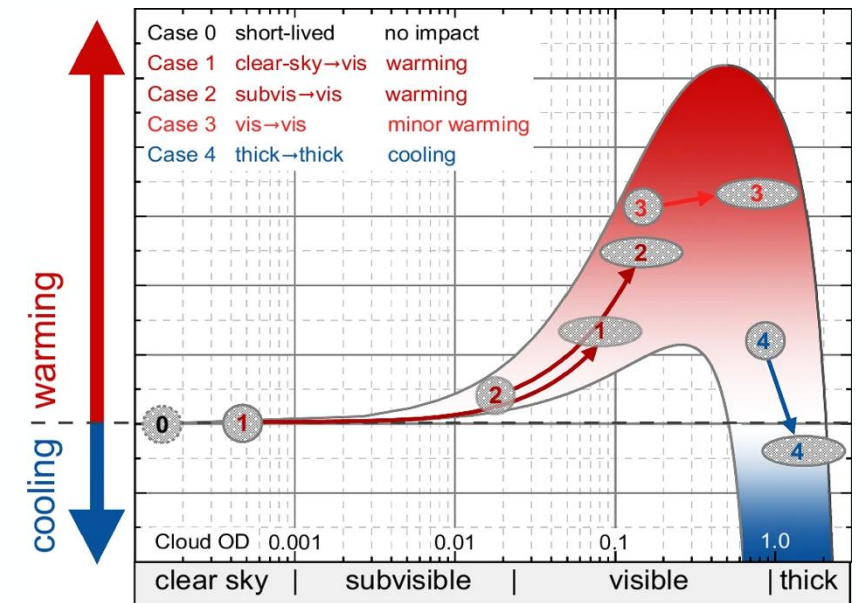
- Contrail **detection** in cloudy background is challenging
- Recent Studies show increase in cloud optical thickness and ice number
- Contrails climate impact is **ambiguous** in thick background cloud



Tesche et al. (2016), Nature Communications



Marjani et al. (2020), GRL



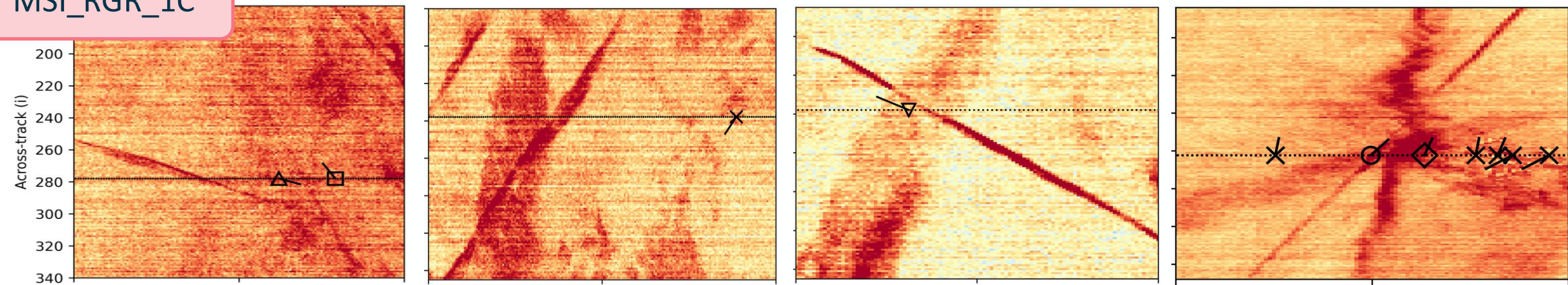
Petzold et al. (2025), Nature Communications

Can EarthCARE Detect Contrails?



MSI_RGR_1C

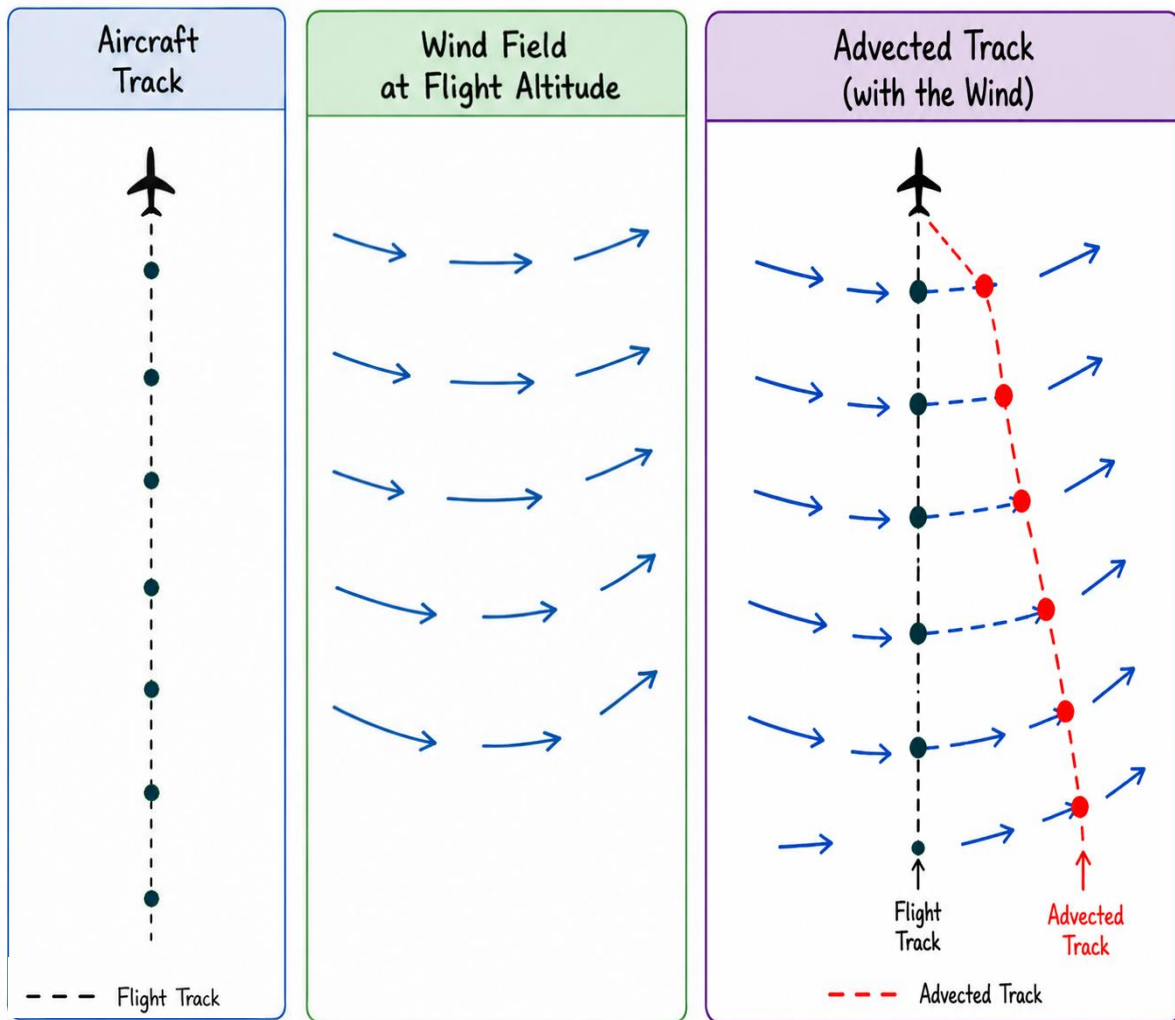
brightness temperature difference (tir2-tir3)



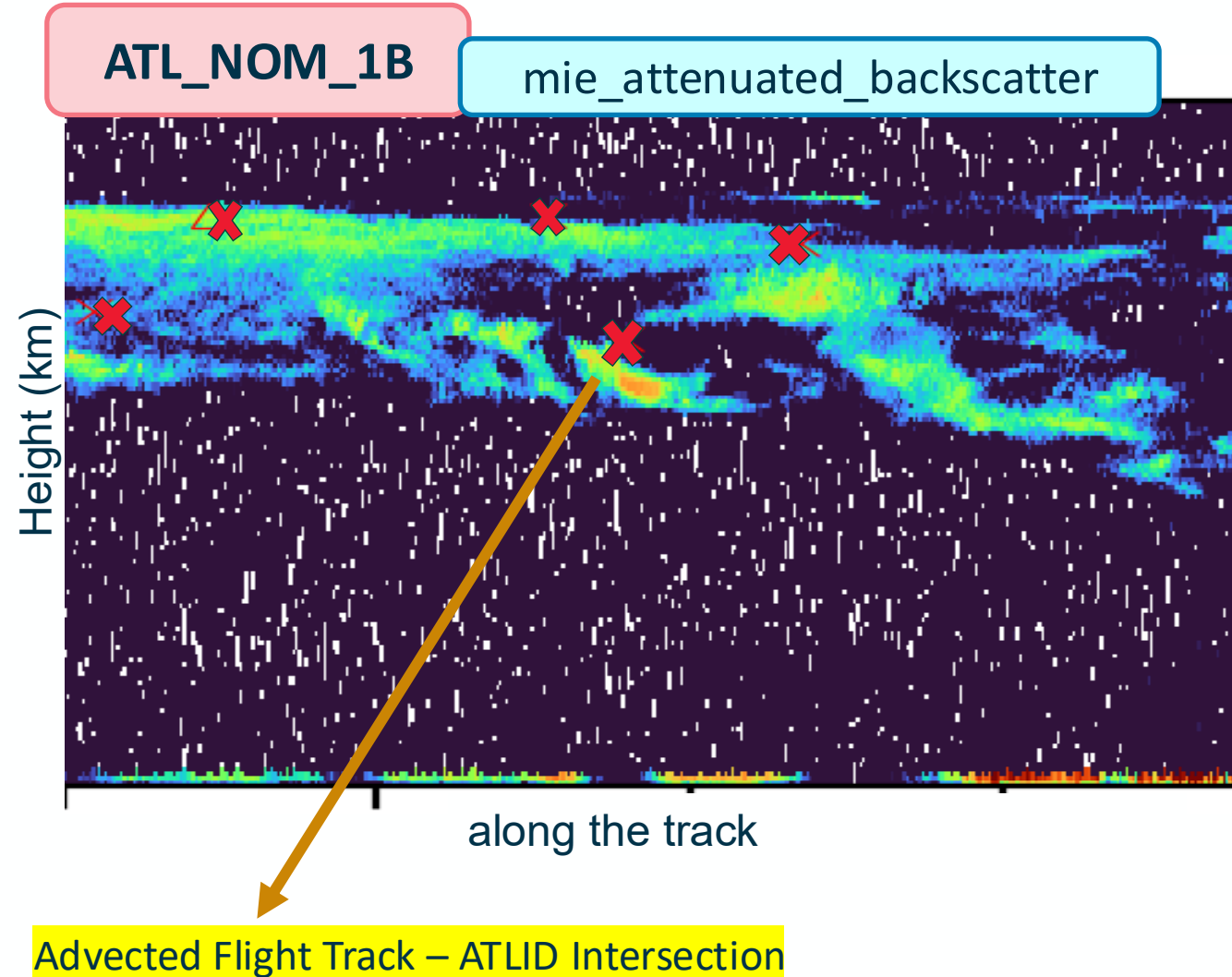
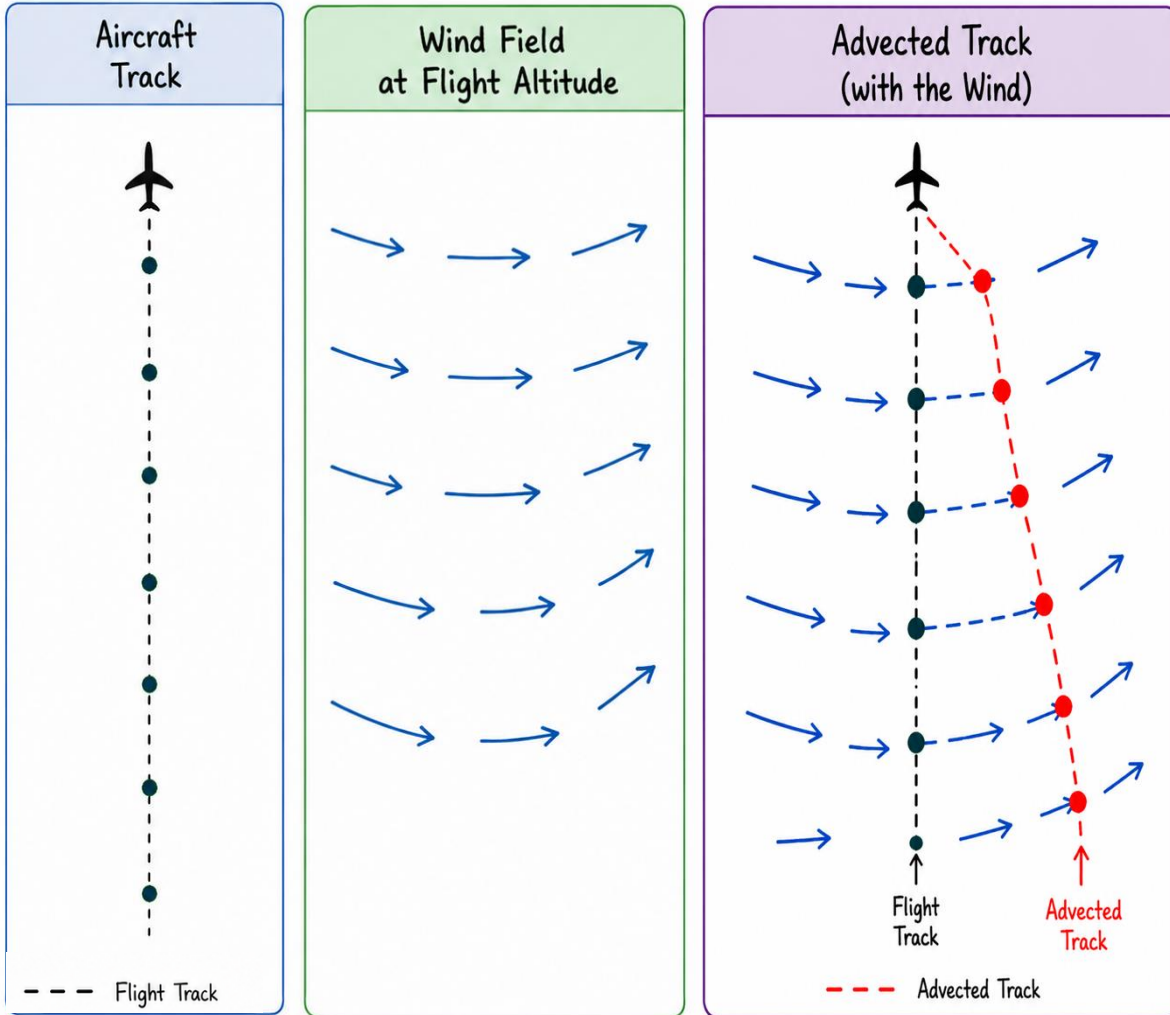
EUROPEAN SPACE AGENCY

6

Advecting Flight Track



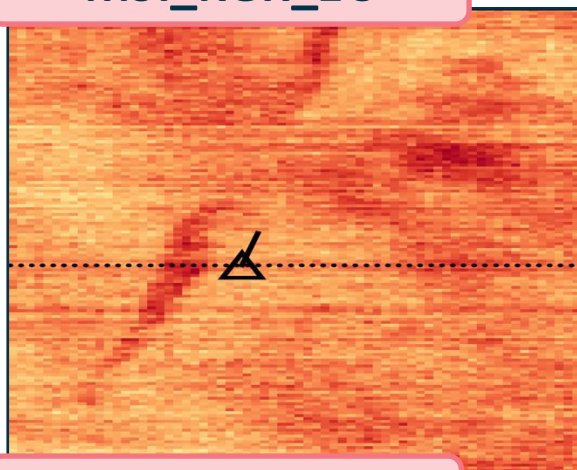
Advecting Flight Track



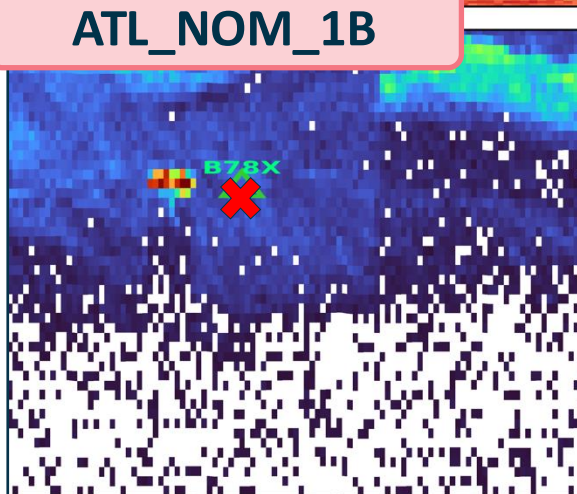
Aircraft-specific Contrail Identification



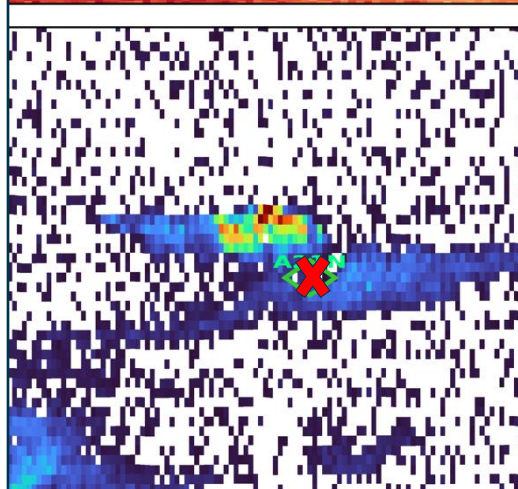
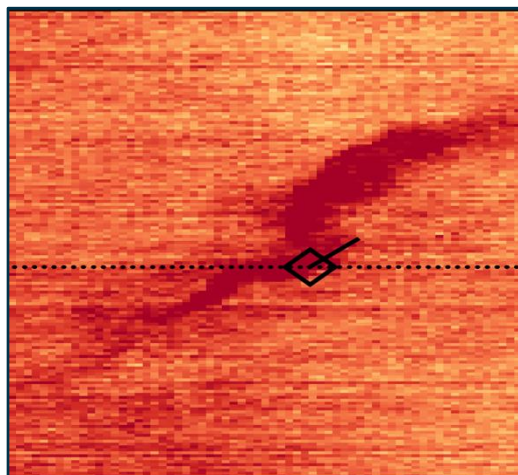
MSI_RGR_1C



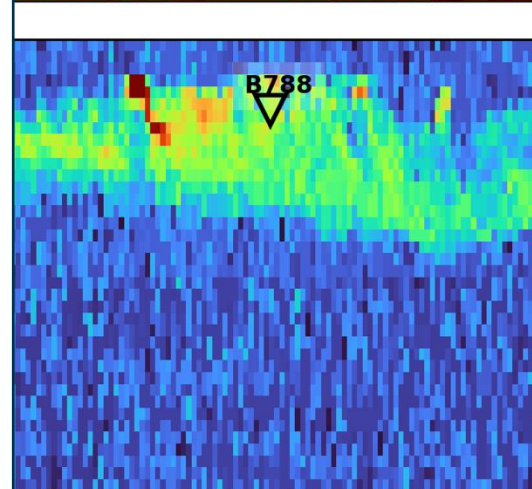
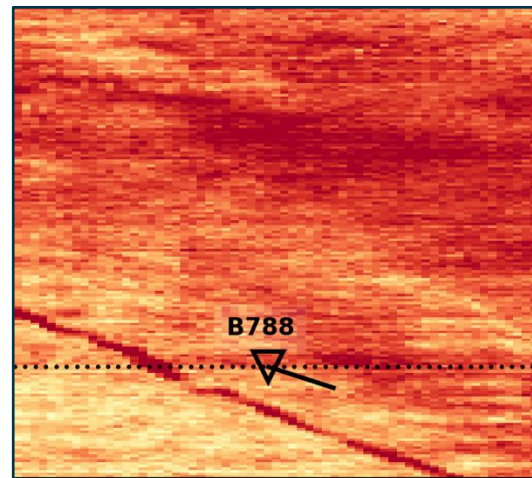
ATL_NOM_1B



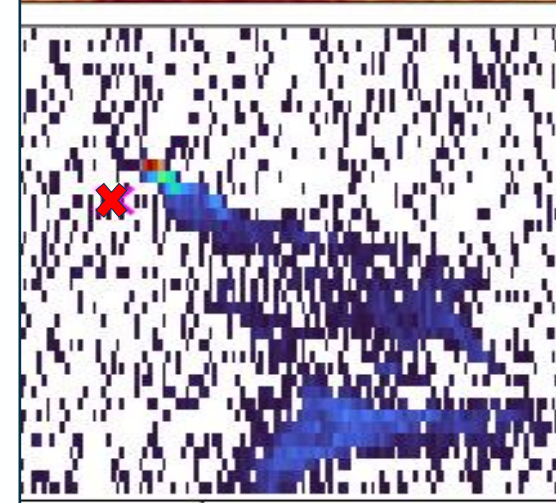
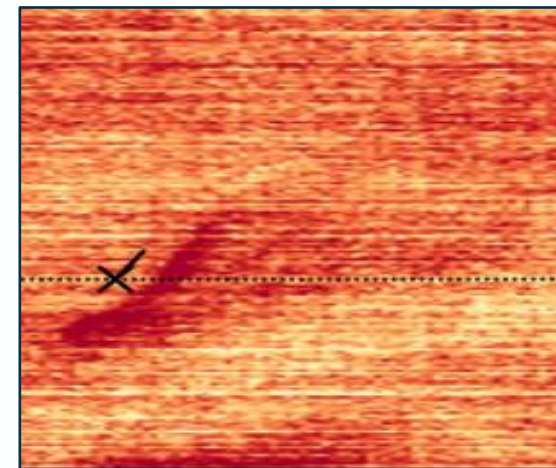
47.84°
-22.25°
02:54:06



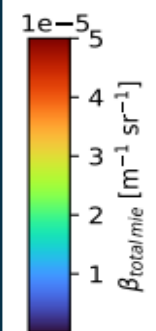
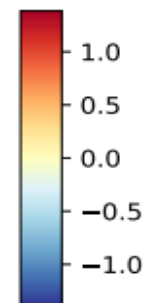
42.98°
-25.24°
03:10:58



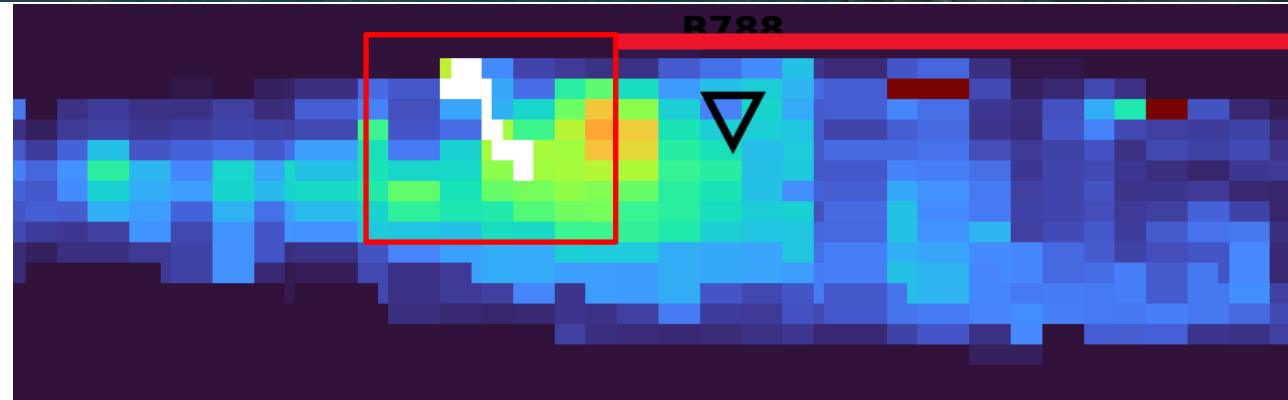
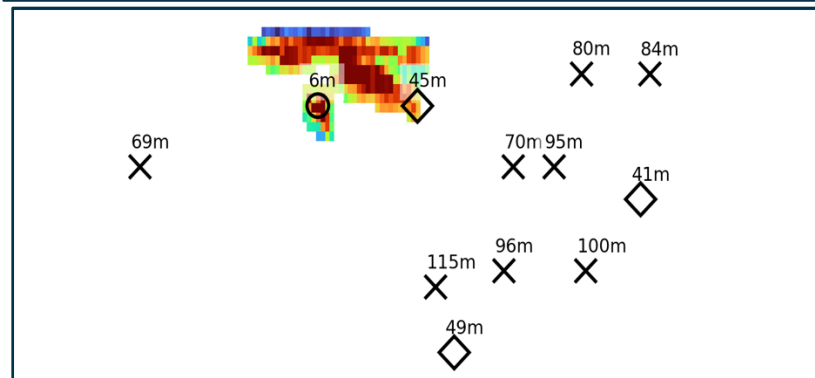
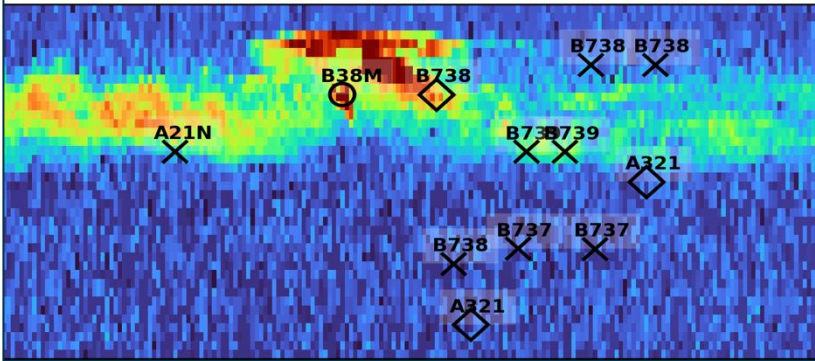
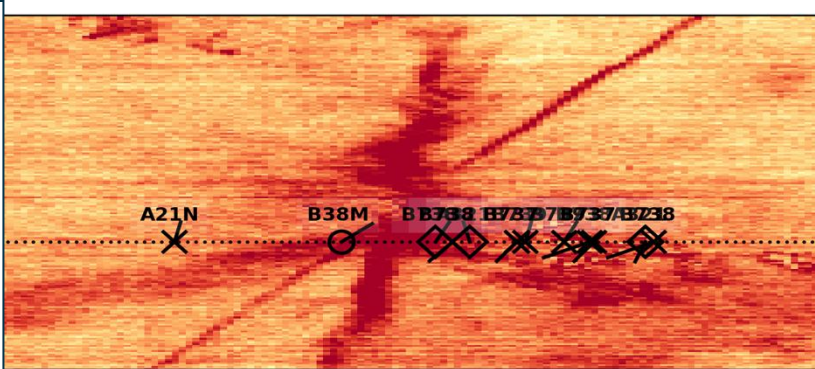
41.15°
-37.75°



56.37°
-38.58°
03:48:30



Extracting Contrail Mask & Immediate Background



EarthCARE_Product

Main product used for detection:

MSI_RGR_1C

ATL_NOM_1B

Other product used for features:

microphysics

ACM_CAP_2B

optical properties

ATL_EBD_2A

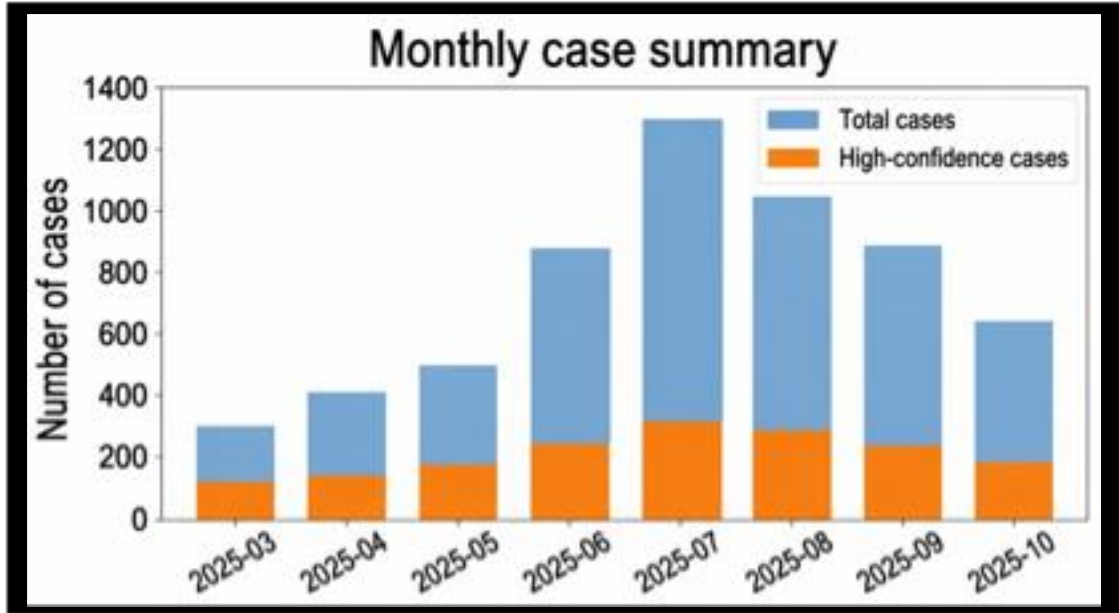
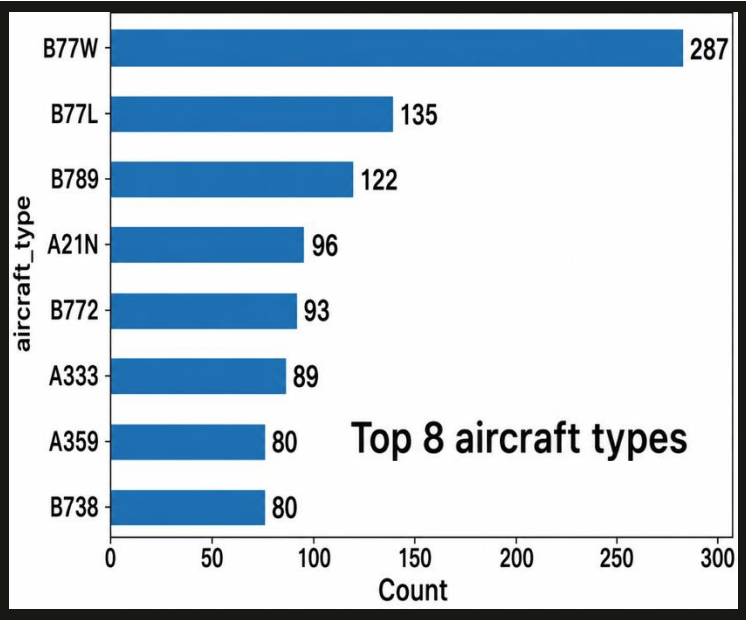
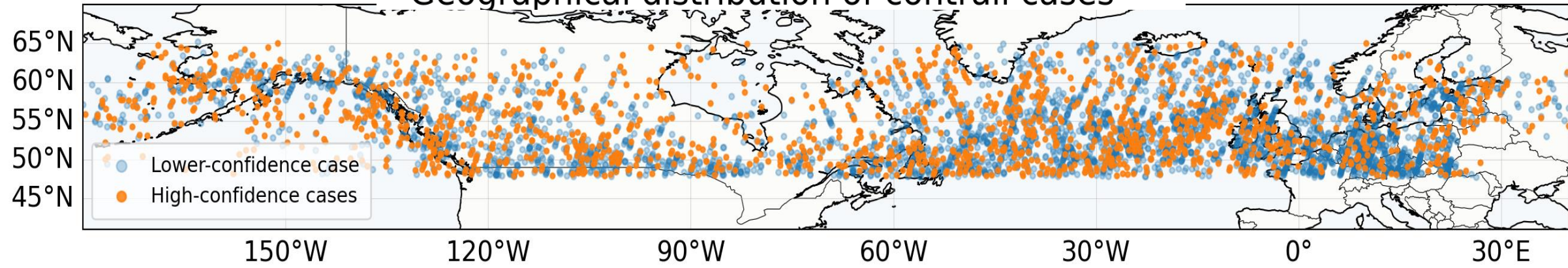
cloudiness

ATL_FM_2A

Catalog of Aircraft–Contrail Matches

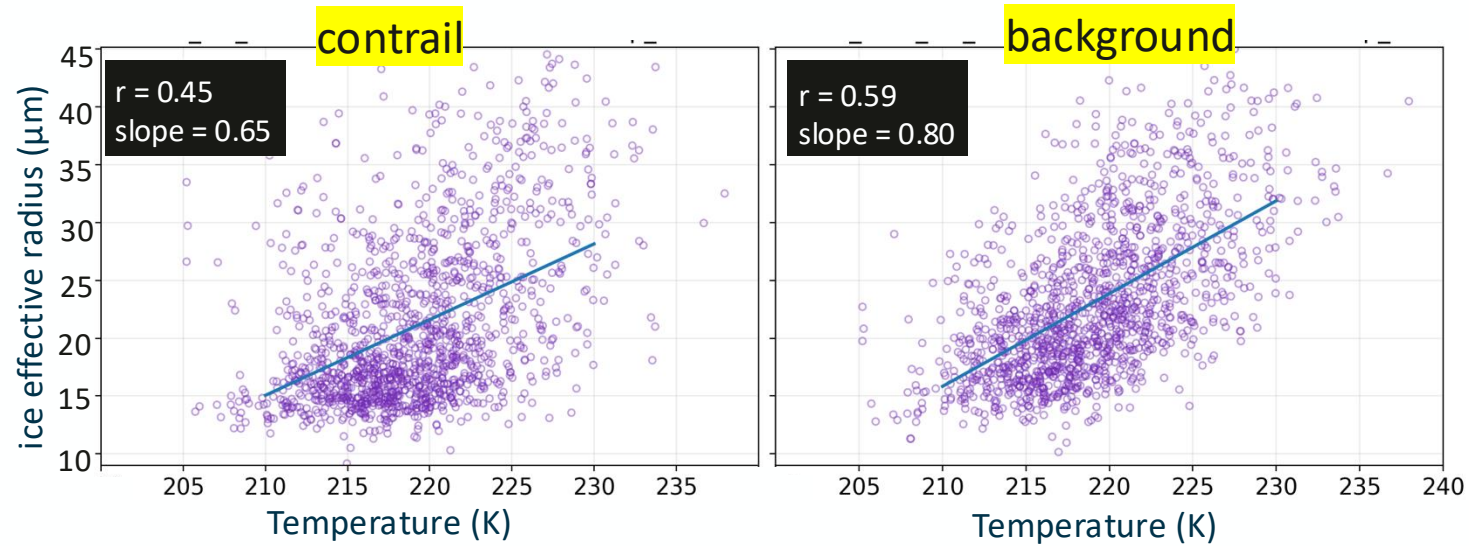


Geographical distribution of contrail cases



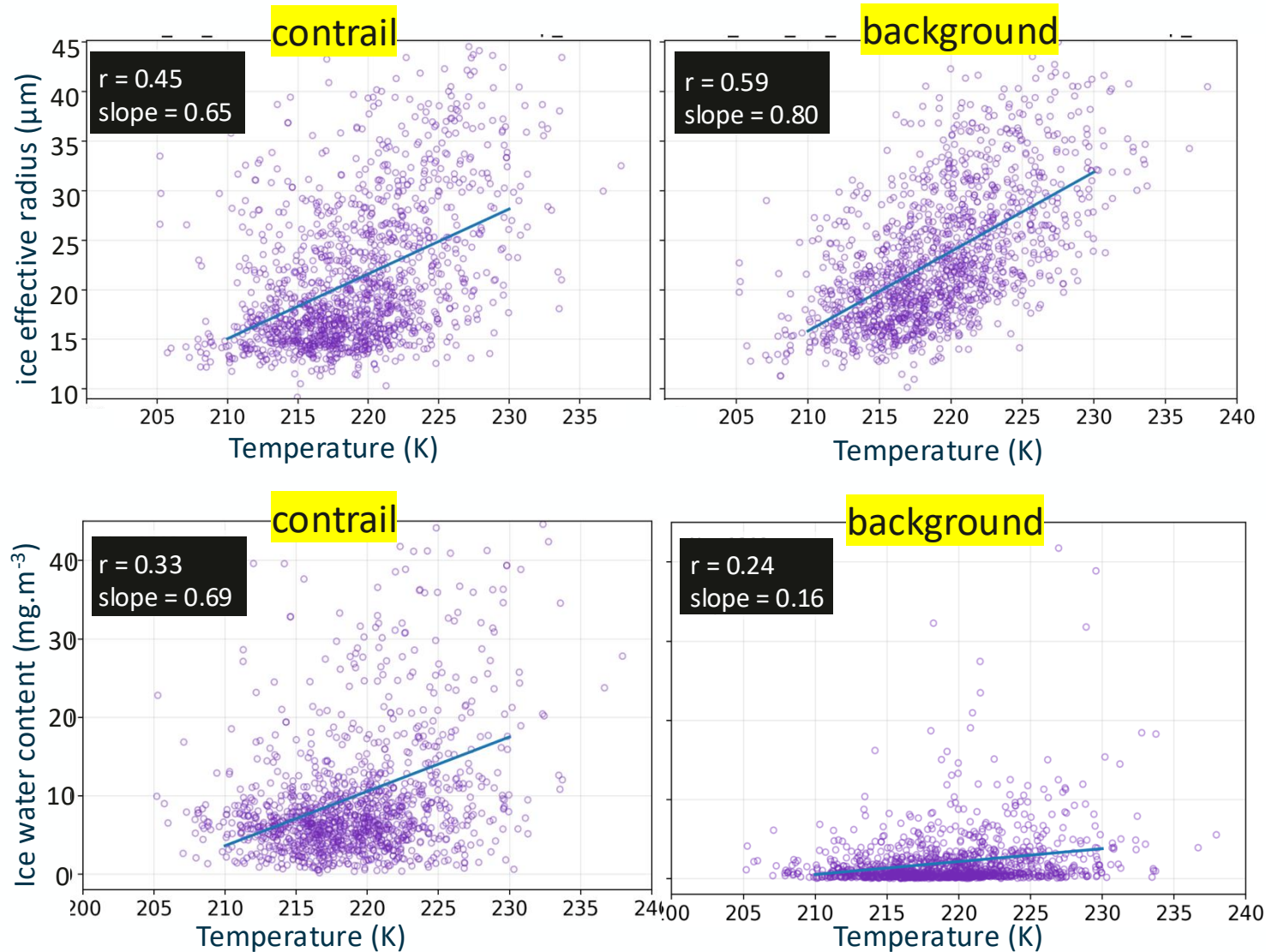
• **1690** High Confident Matches (more on the way)

Result: Ice Microphysics, ACM_CAP_2B



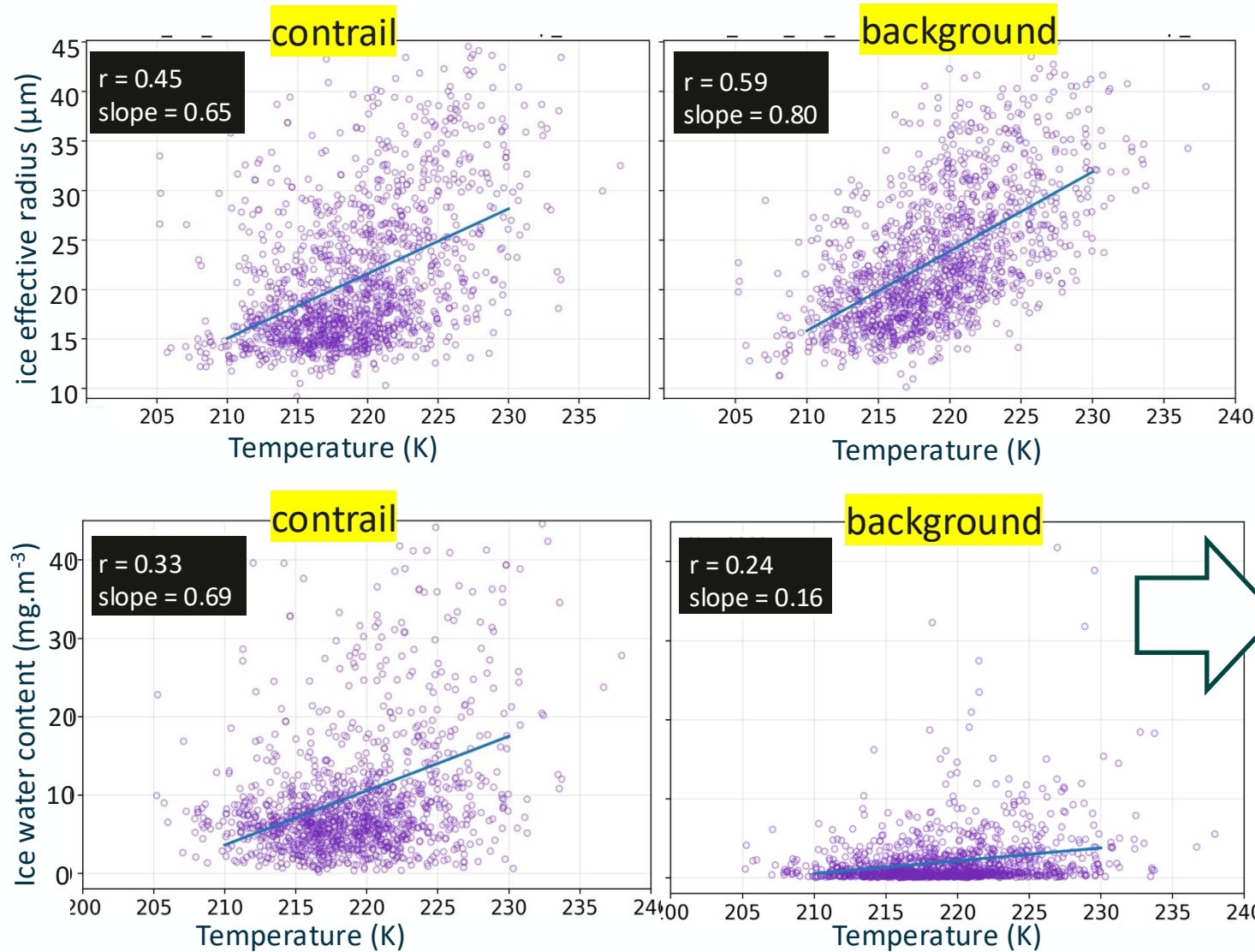
- Weaker ice crystal growth with increasing temperature in contrails

Result: Ice Microphysics, ACM_CAP_2B

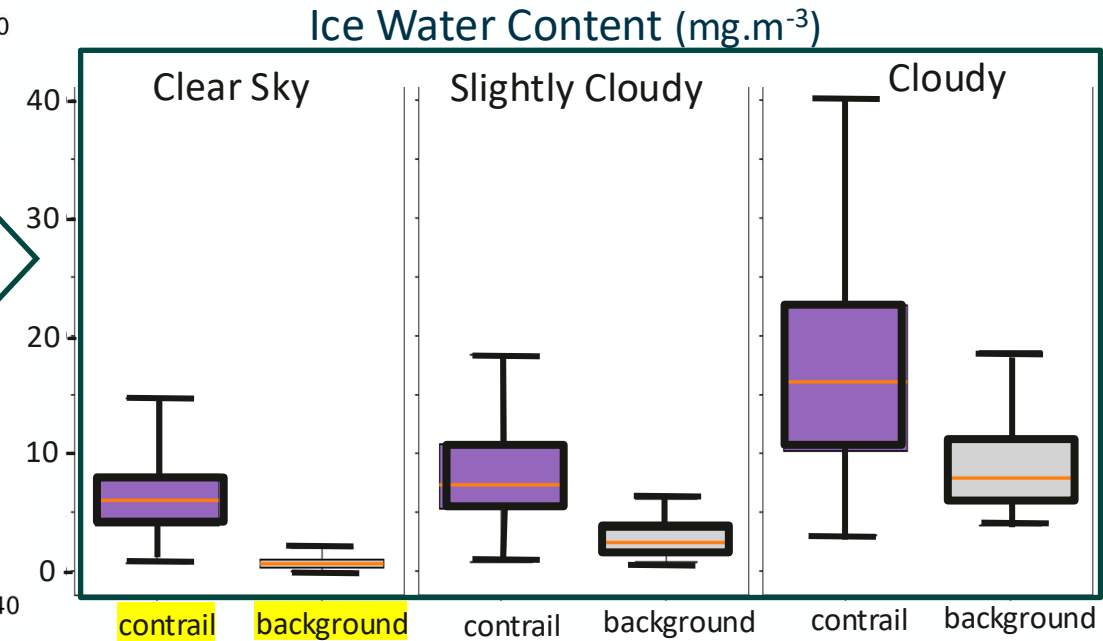


- Weaker ice crystal growth with increasing temperature in contrails
- Contrails show higher ice water content,

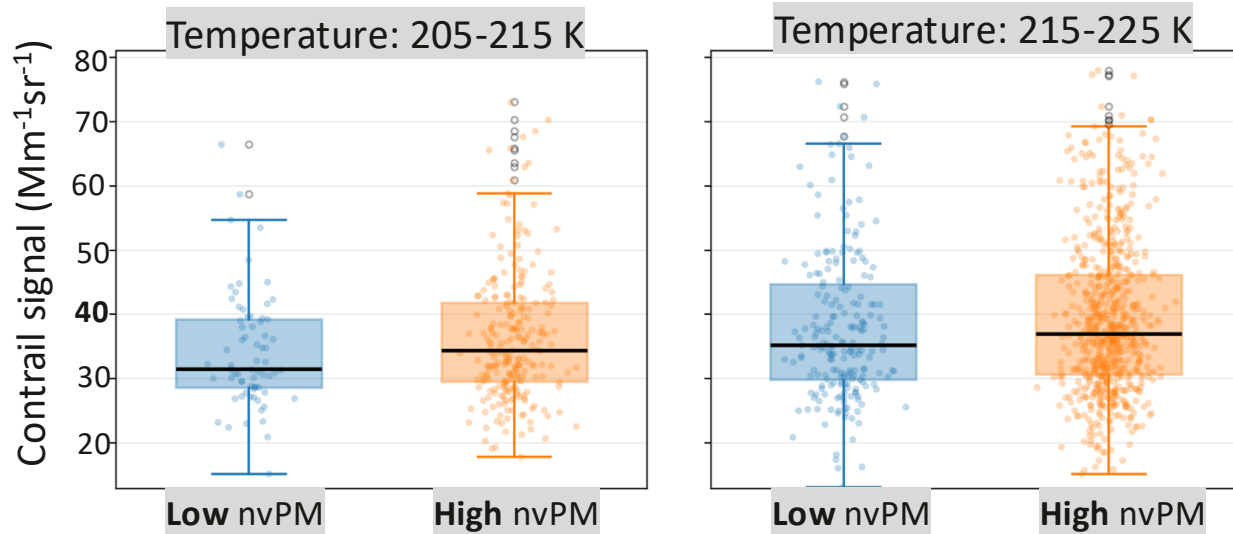
Result: Ice Microphysics, ACM_CAP_2B



- Weaker ice crystal growth with increasing temperature in contrails
- Contrails show higher ice water content, especially in cloudy skies

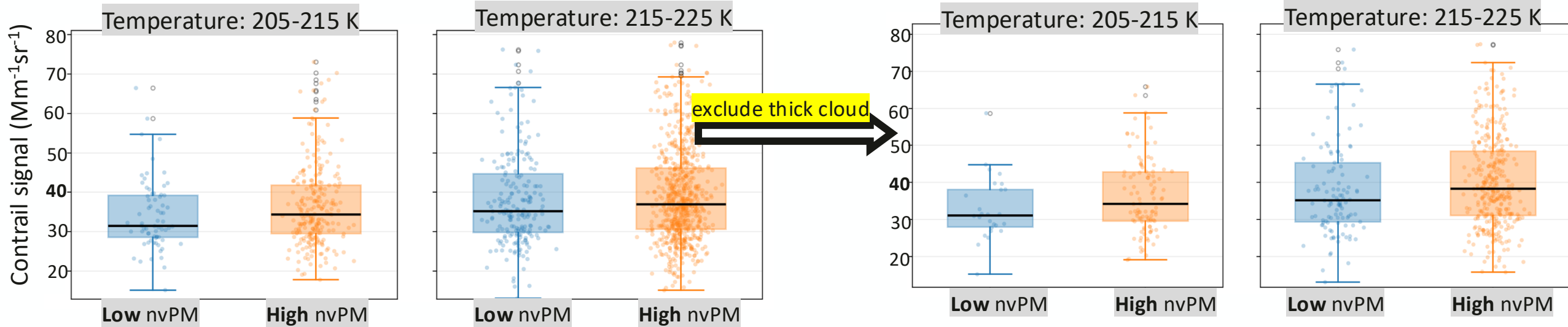


Contrail Properties Across Fuel Emission Regimes



- High-nvPM aircraft show slightly stronger contrail signal.

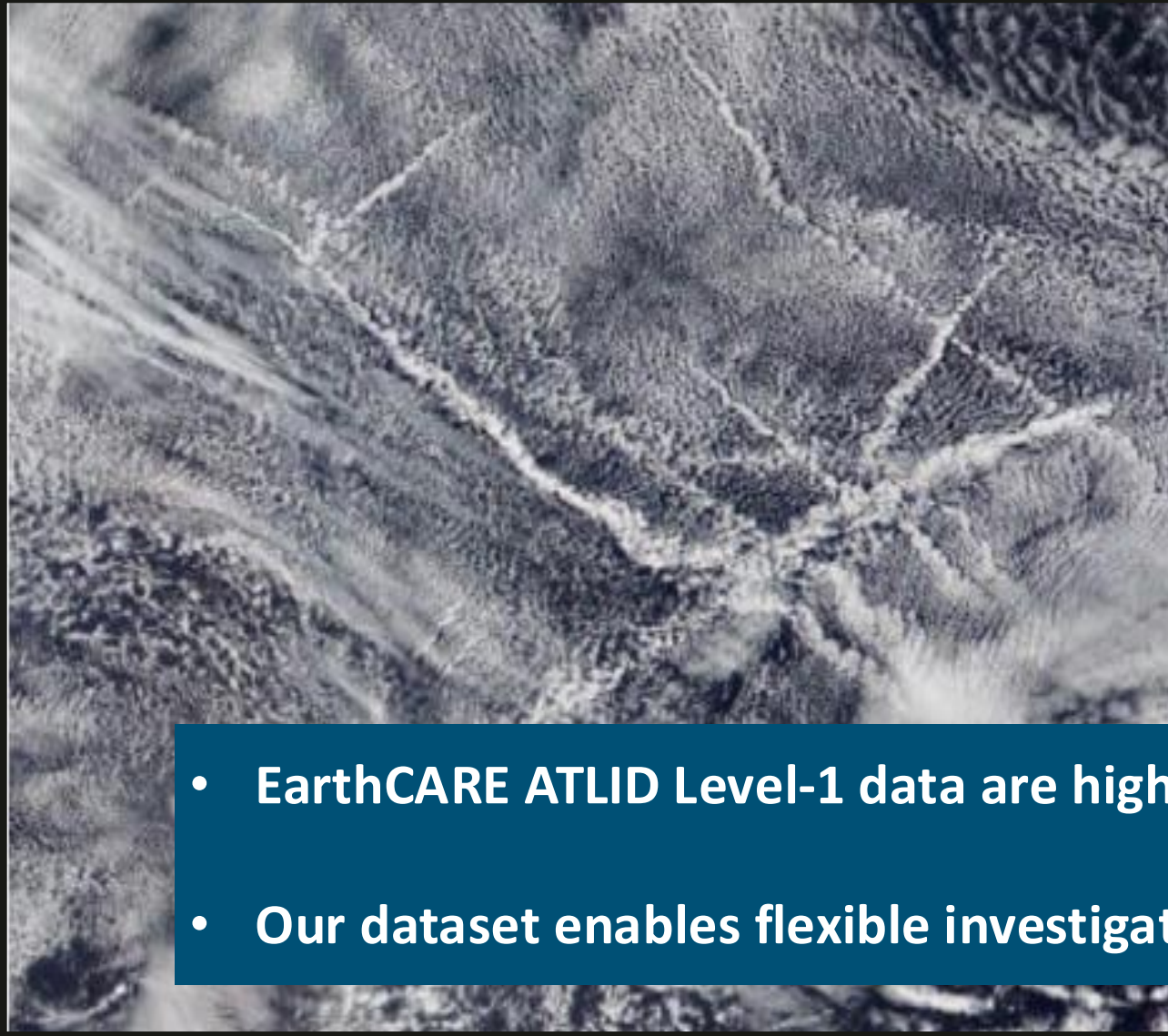
Contrail Properties Across Fuel Emission Regimes



- High-nvPM aircraft show slightly stronger contrail signal.
- This contrast persists after excluding thick-cloud backgrounds.

Thank You !!!



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- EarthCARE ATLID Level-1 data are highly valuable for contrail research.
 - Our dataset enables flexible investigations of selected contrail populations.