Biofuels Take Flight: How Advanced Jet Fuels Reduce Cloudiness and Aviation's Climate Impact

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ALEWERKS

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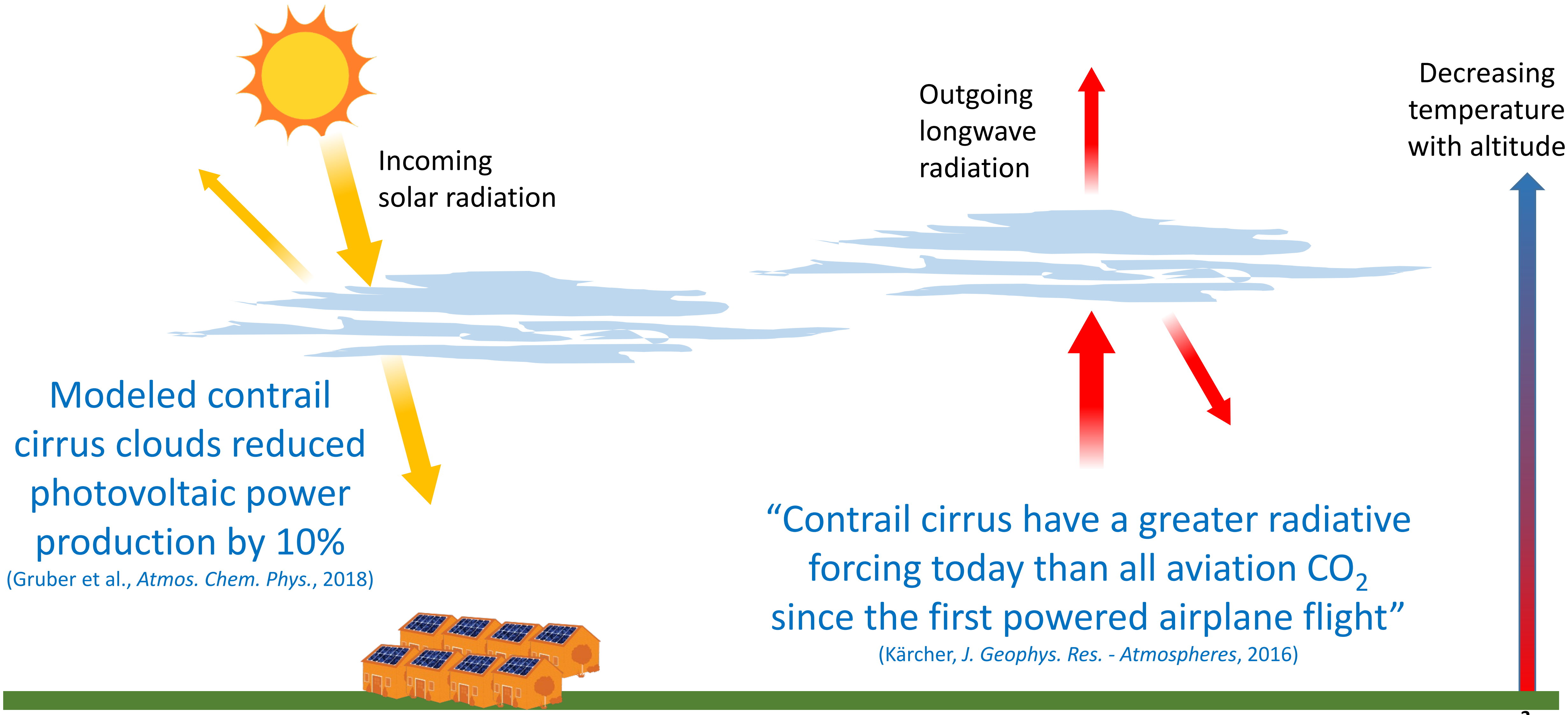
Why would society care about aviation contrail cirrus clouds?



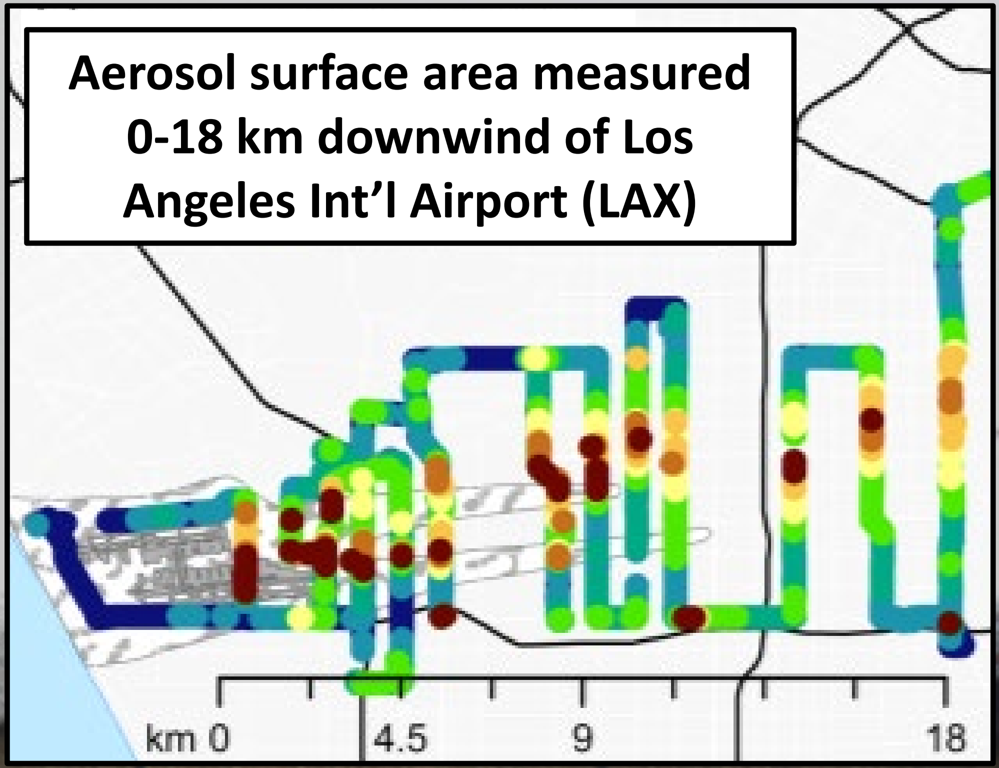
Modeled contrail cirrus clouds reduced photovoltaic power production by 10%

(Gruber et al., *Atmos. Chem. Phys.*, 2018)

“Contrail cirrus have a greater radiative forcing today than all aviation CO_2 since the first powered airplane flight”

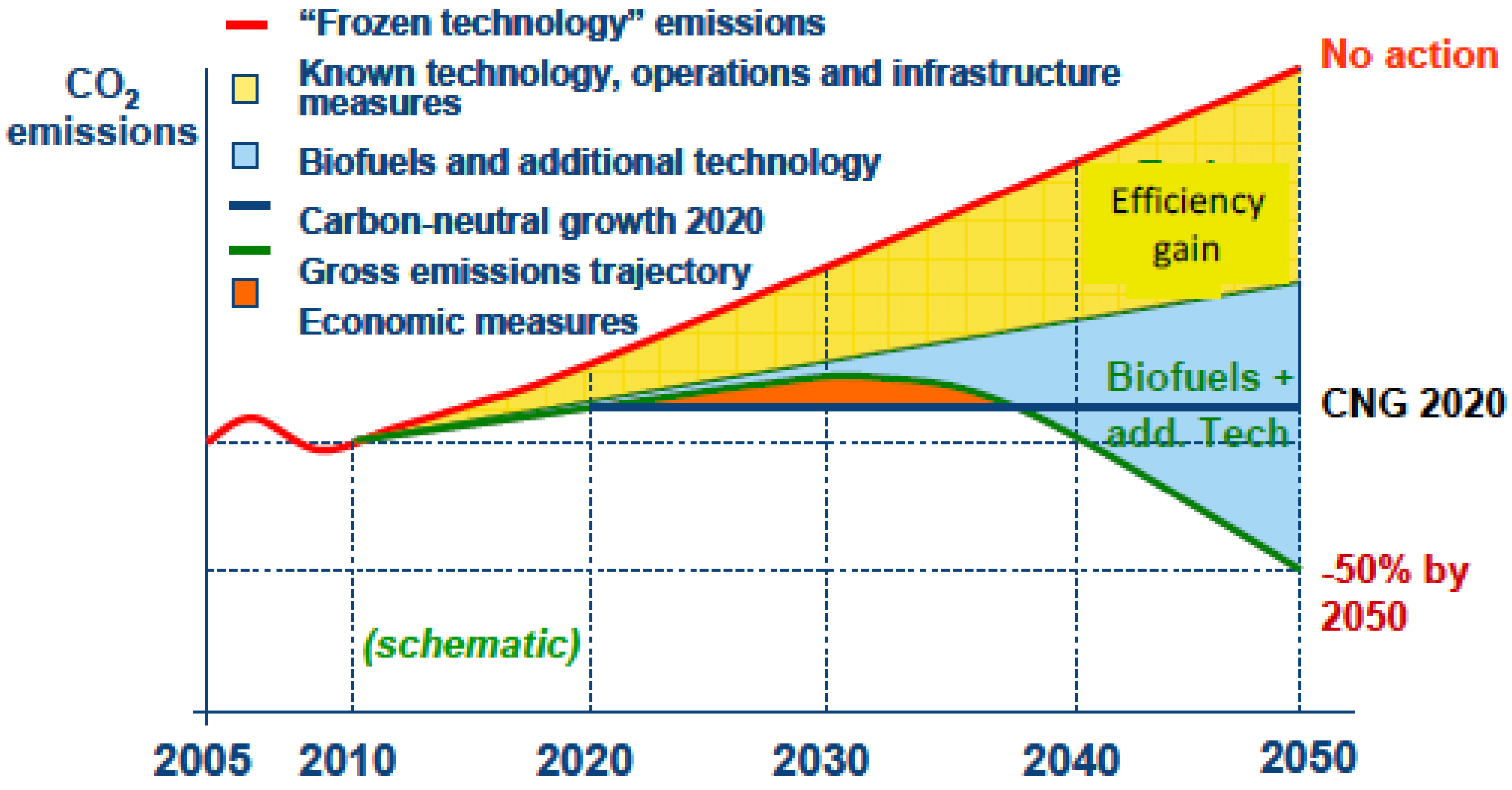
(Kärcher, *J. Geophys. Res. - Atmospheres*, 2016)

Aircraft emissions affect air quality downwind of airports, which can have adverse health impacts on society and the local population



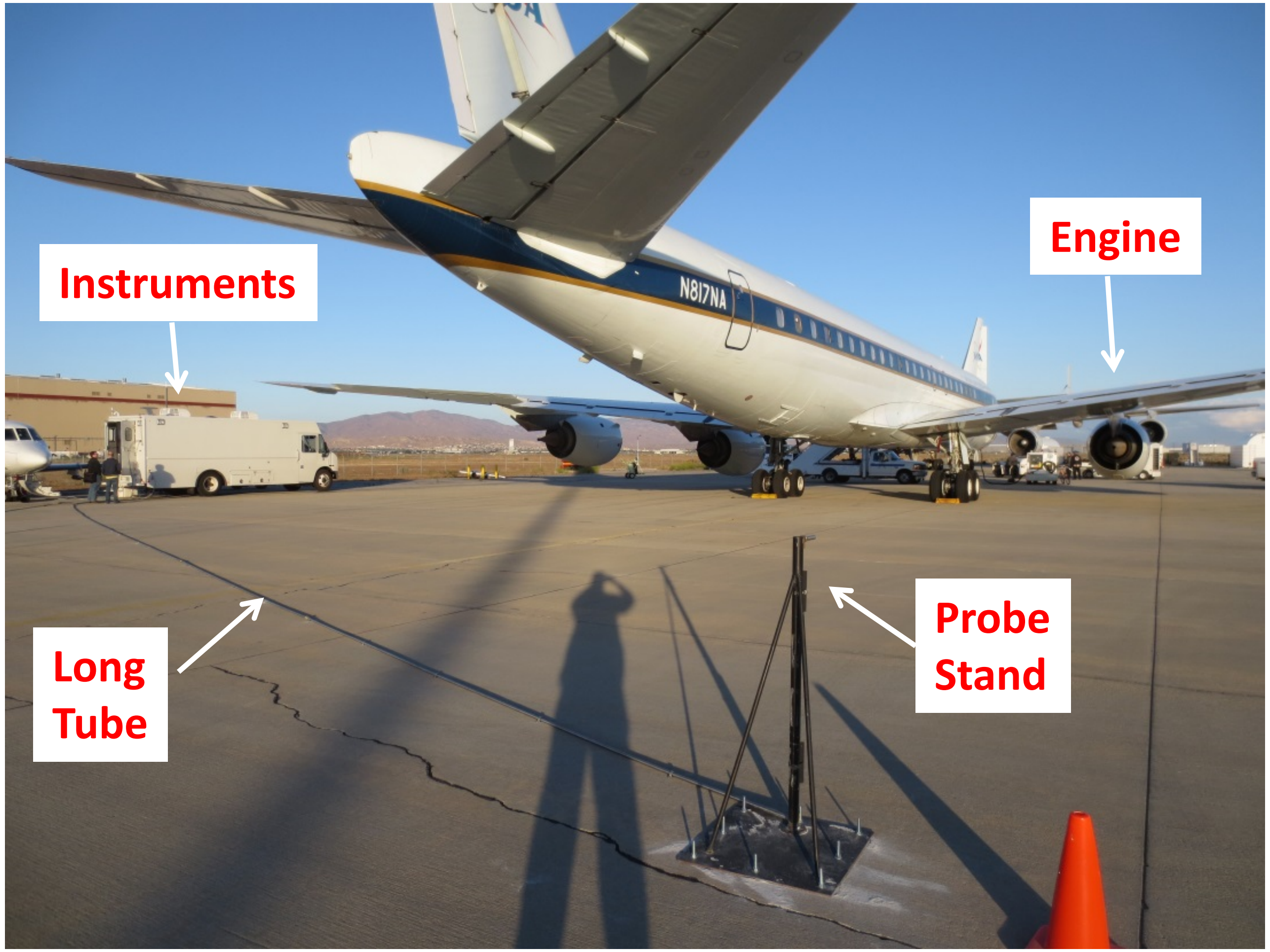
Hudda and Fruin, *Environ. Sci. Technol.*, 2016

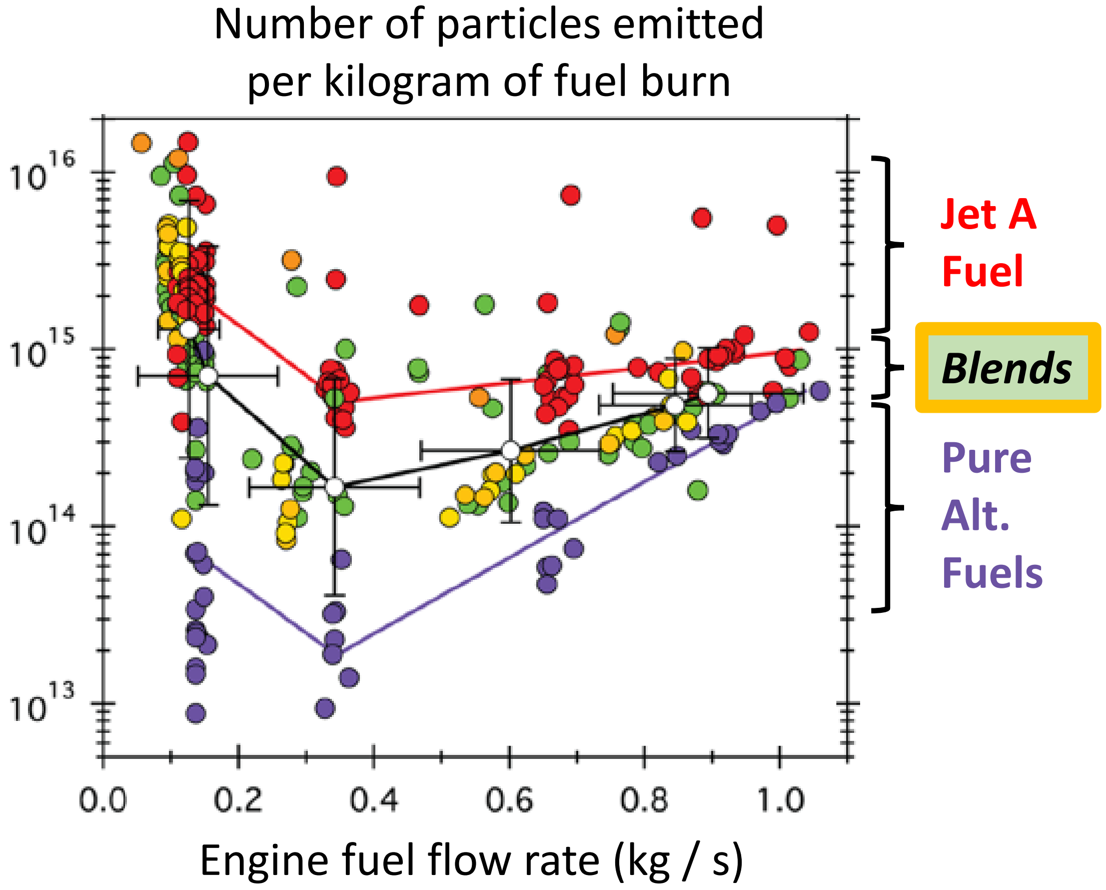
These environmental effects will only increase in the future, as air travel continues to grow at a rate of 2-3% per year.



Source IATA

Ground tests with the NASA DC-8 CFM56 engines demonstrate particle emissions reductions from burning alternative fuels





Anderson, B.E. et al., NASA/TM-2011-217059, 2011
Beyersdorf A.J. et al., *Atmos. Chem. Phys.*, 2014
Moore, R.H. et al., *Energy & Fuels*, 2015

However, cruise conditions are very different from conditions on the ground, which necessitates in-flight testing

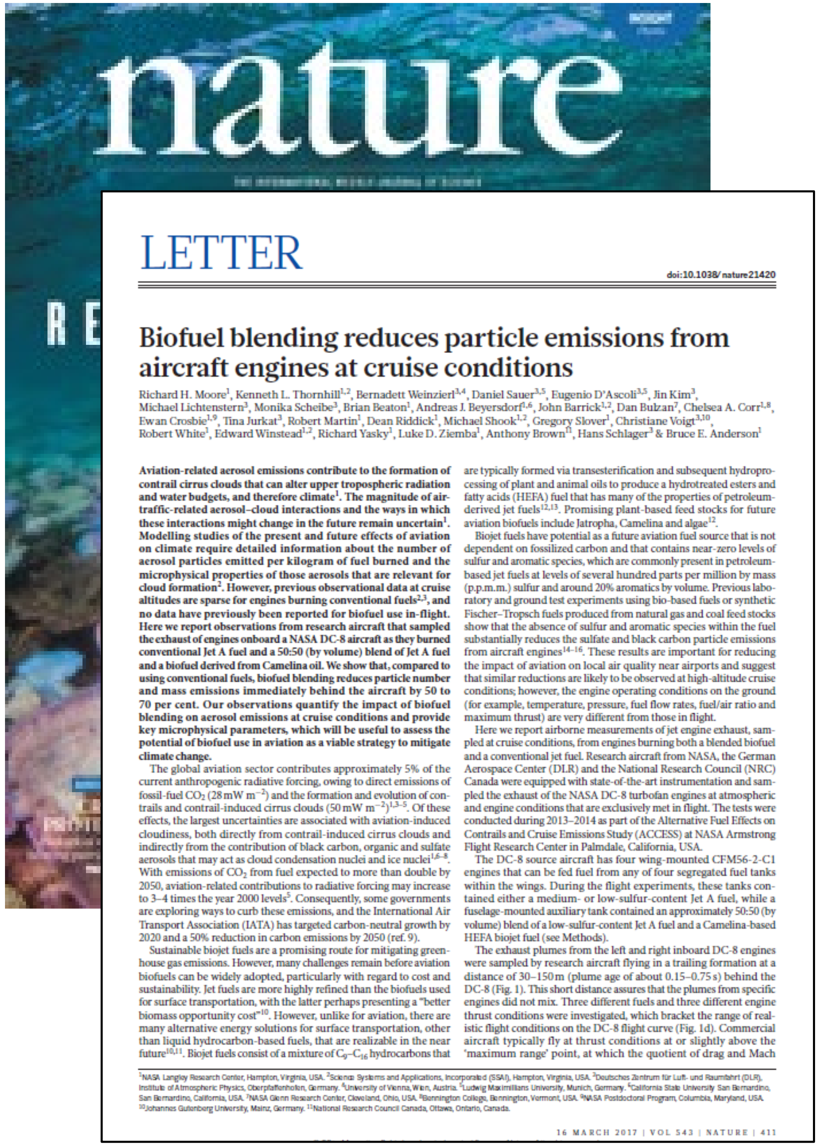
ACCESS 2013-2014

- Flight test series conducted at Edward AFB complex
- Falcons are slow, but can sample exhaust up close
- Two fuels: Jet A and 50:50 Jet A and Biofuel Blend
- Corresponding ground test to link to past studies

ND-MAX ECLIF 2018

- Flight test series conducted in German air space
- DC-8 is fast, but was required to sample > 5 km in trail
- Three fuels: Jet A and 2 blends of varying composition
- Corresponding ground test
- Also sampled commercial aircraft flights of opportunity in the national air space targeting advanced engines

Finding: Jet Biofuels Reduce Soot Particle Emissions by 50-60%!


nature

LETTER

doi:10.1038/nature21420

Biofuel blending reduces particle emissions from aircraft engines at cruise conditions

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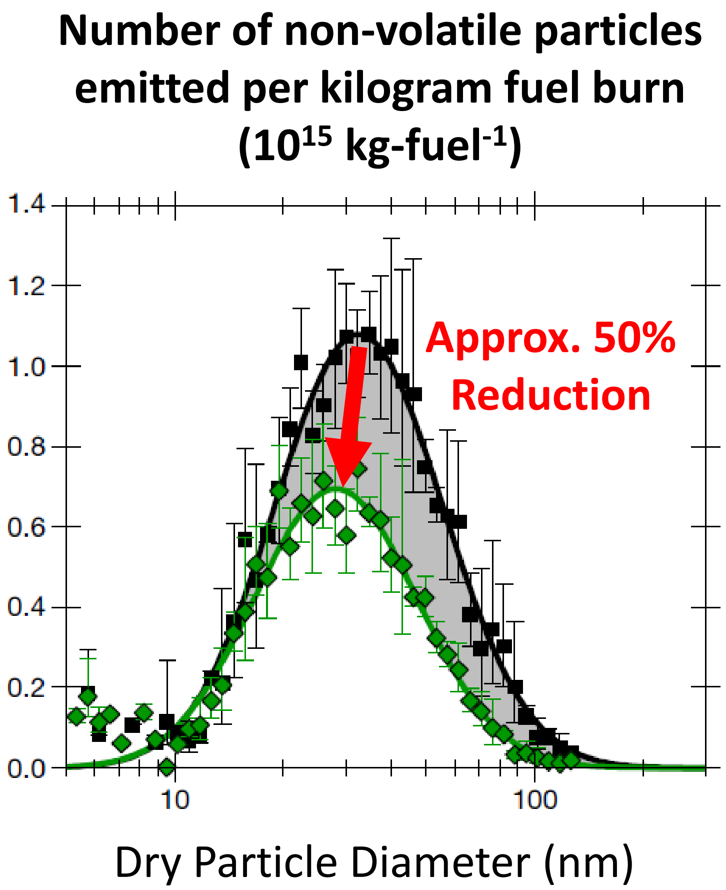
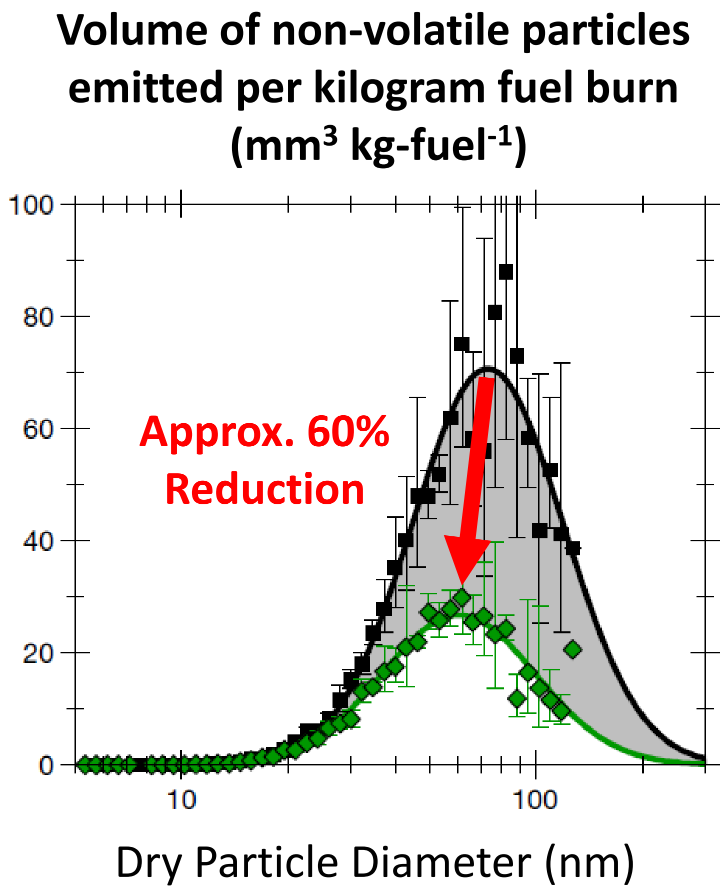


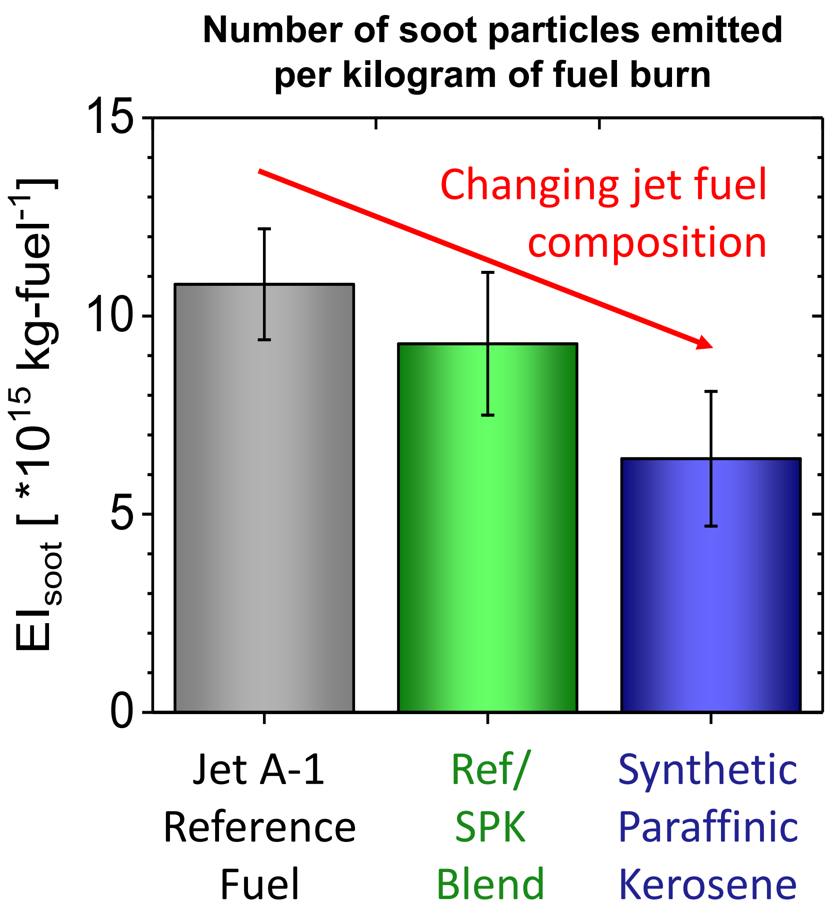


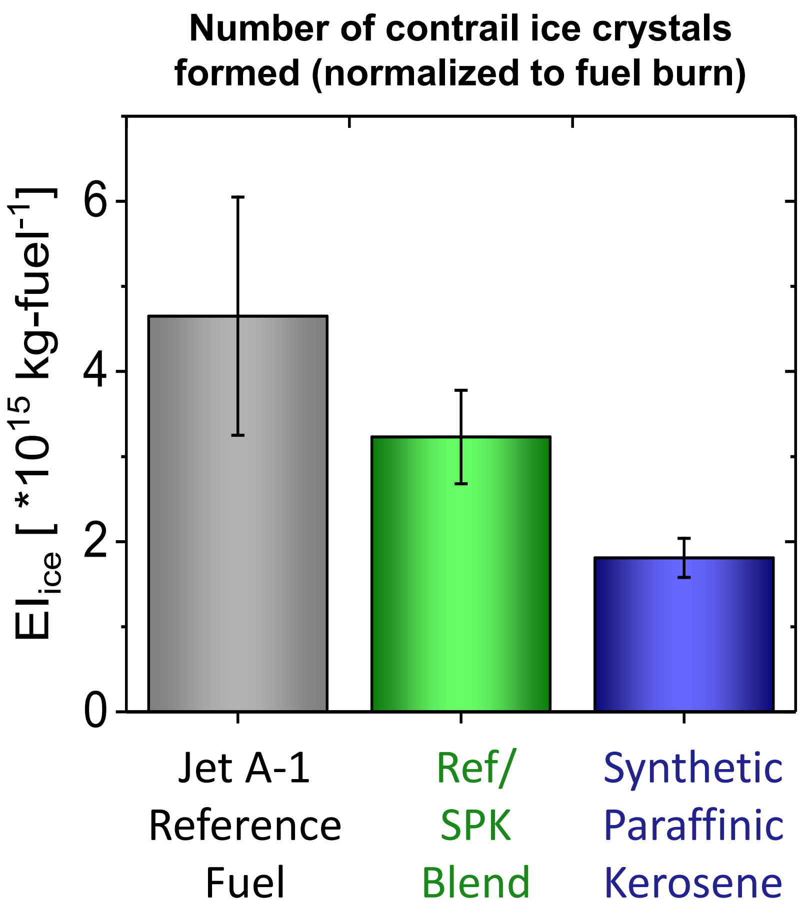
■ Jet A Fuel

◆ Biofuel Blend

Moore, R.H. et al., *Nature*, 2017

Finding: These Soot Particle Emissions Reductions Directly Translate Into Contrail Ice Crystal Number Reductions!

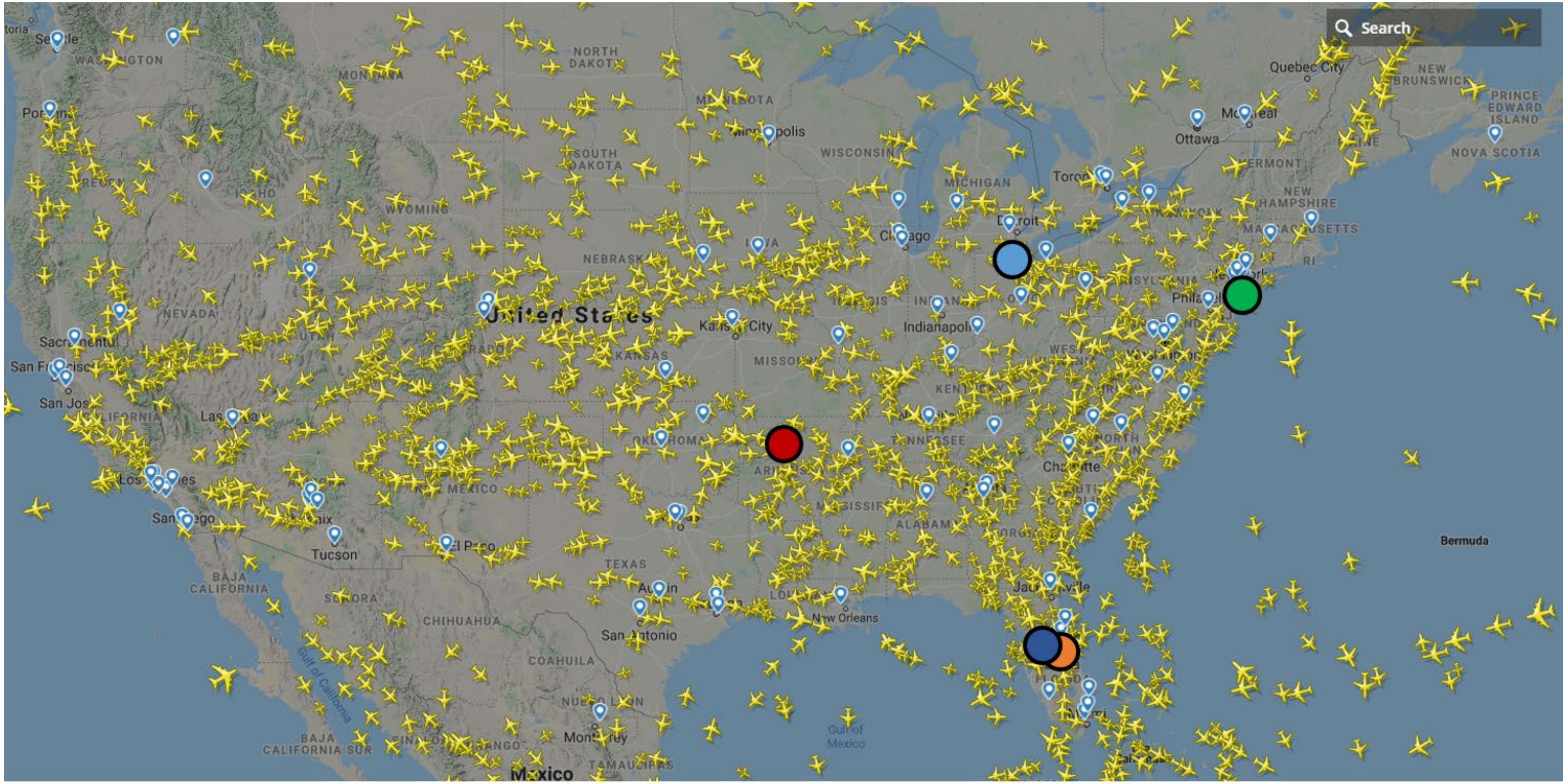




Schripp, T. et al., *Environ. Sci. Technol.*, 2018

Voigt, C. et al., *in review*

New Citizen Science Project Combining GLOBE Observer With FlightRadar24 Aircraft Augmented Reality



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● Treadway Elementary, Leesburg, FL
● Lexington School for the Deaf, East Elmhurst, NY
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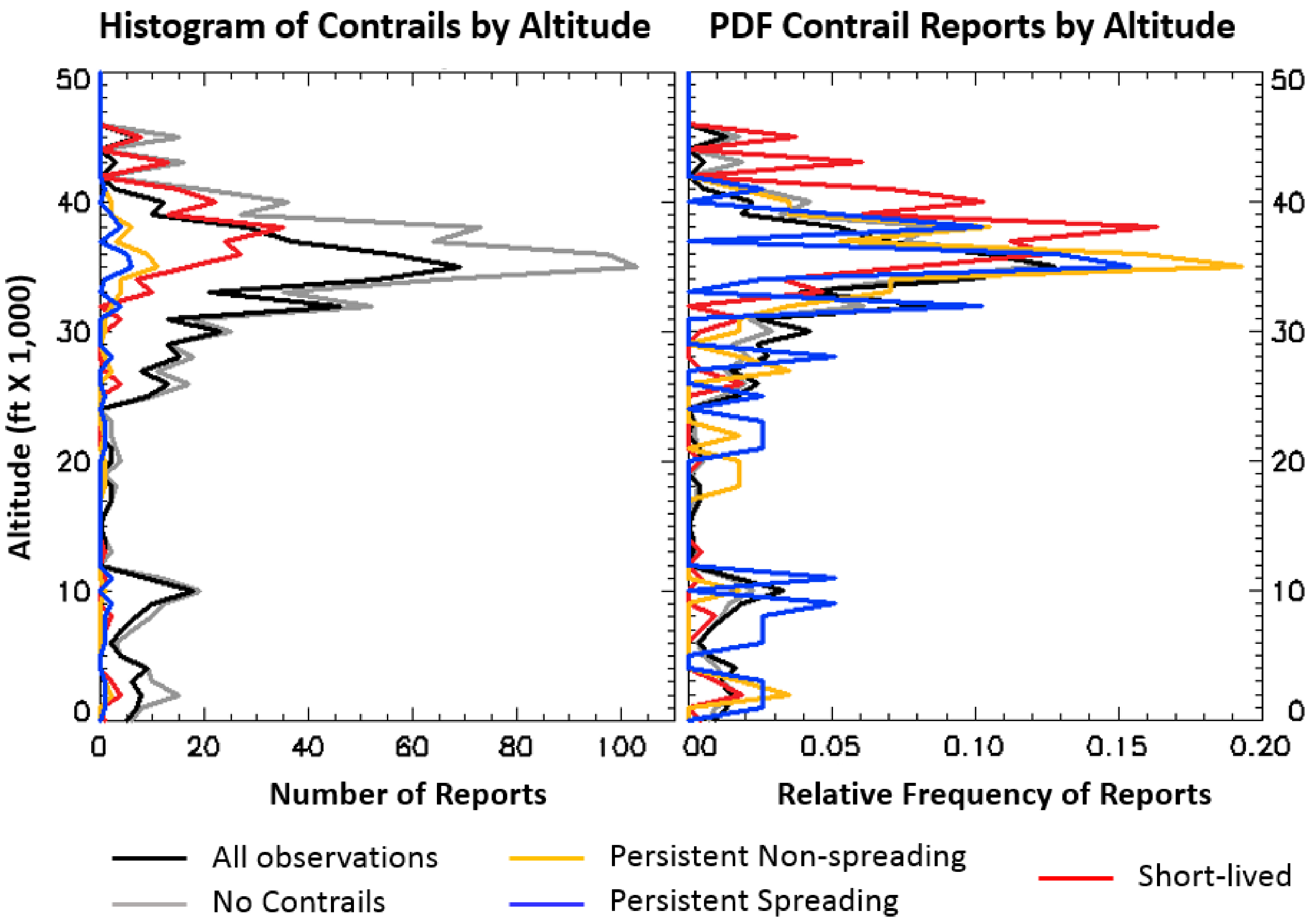
Statistics Provided By The Students Enable NASA Researchers To Test Their Contrail Prediction Models



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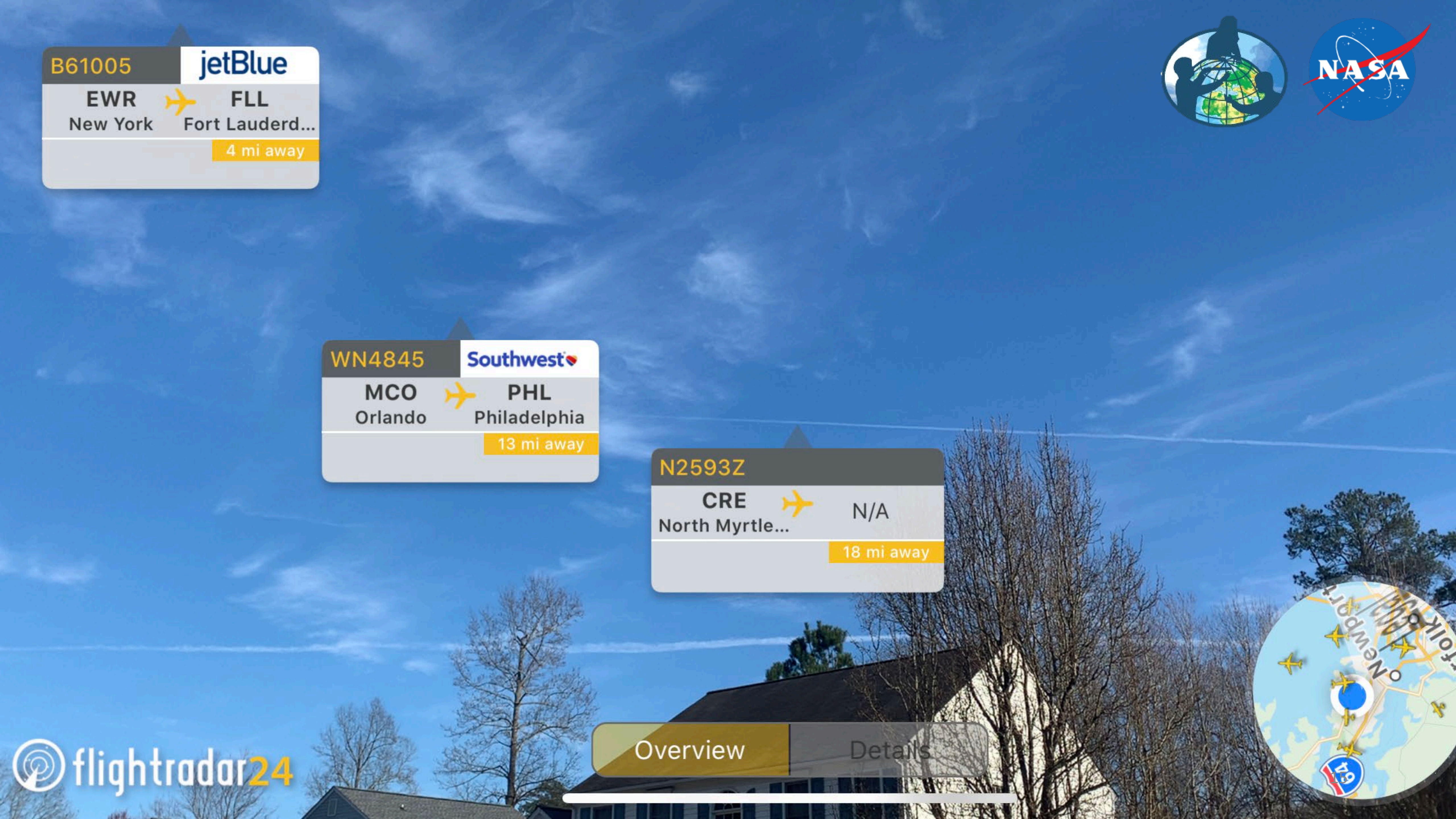

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