

The banner features a stylized illustration of a white airplane flying over a green and blue landscape. The sun is in the top left corner, and a globe is in the top right. The text is in white on a green background.

ICAO Symposium on Non-CO₂ Aviation Emissions

16 — 18 September 2024
Montréal, Canada

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Ph.D. Harry E. Preble Emeritus Professor, School of
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University of Illinois



Speaker

Session 1: Scientific Knowledge
Historical overview & State-of-the-art

Impacts of Non- CO₂ Aviation Emissions: Understanding and Uncertainties

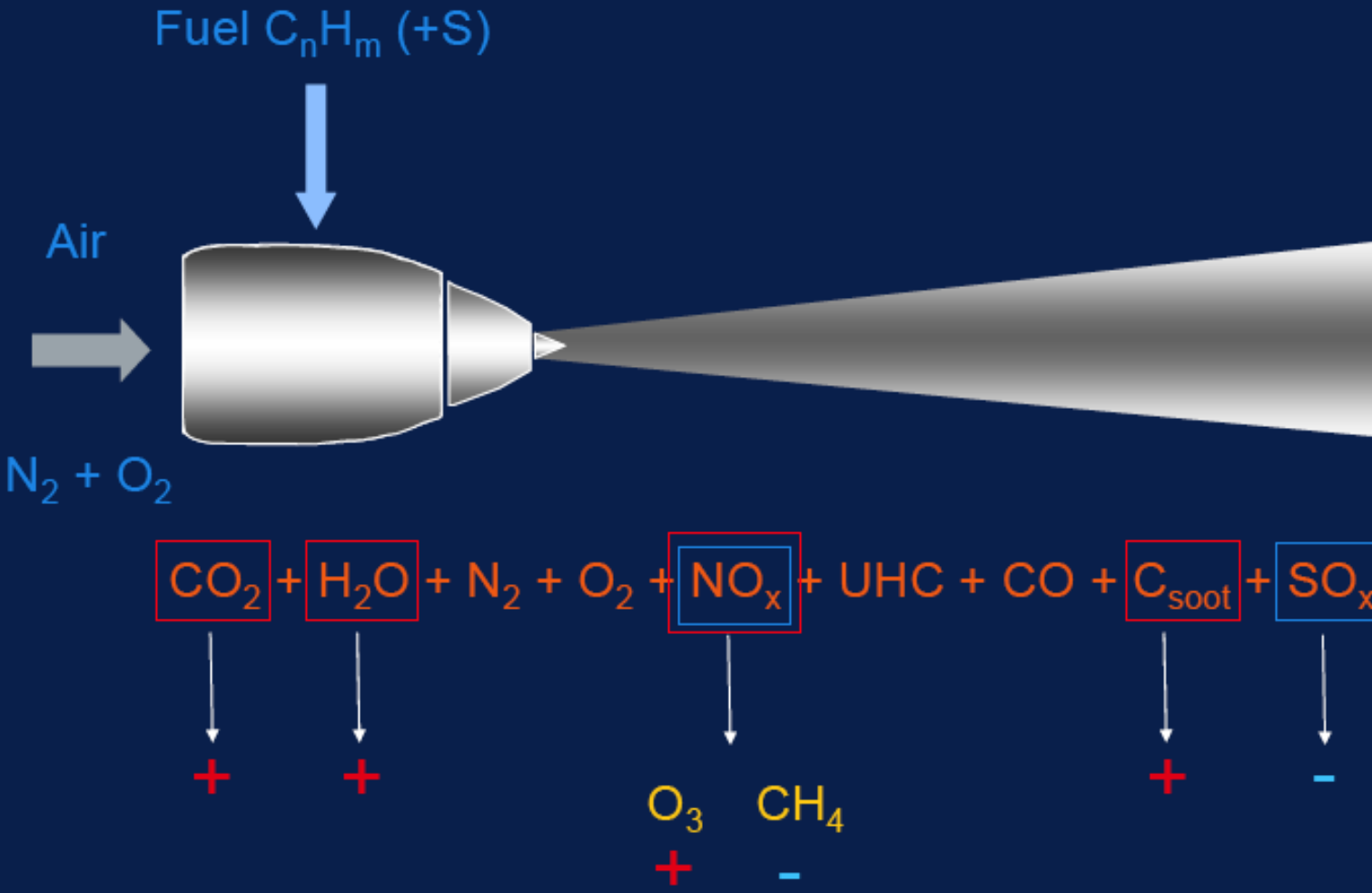
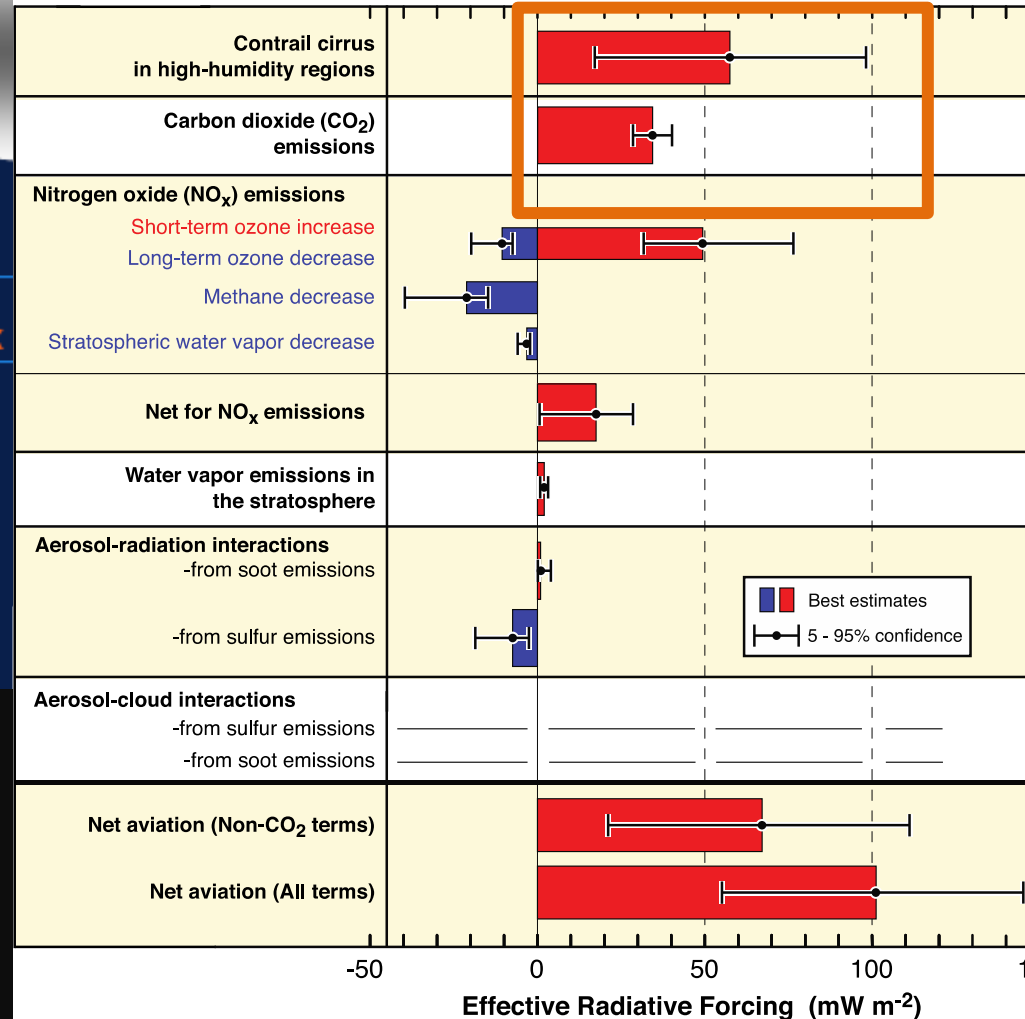
Don Wuebbles

Emeritus Professor of Atmospheric Sciences

University of Illinois

Current Global Aviation Effects on Climate

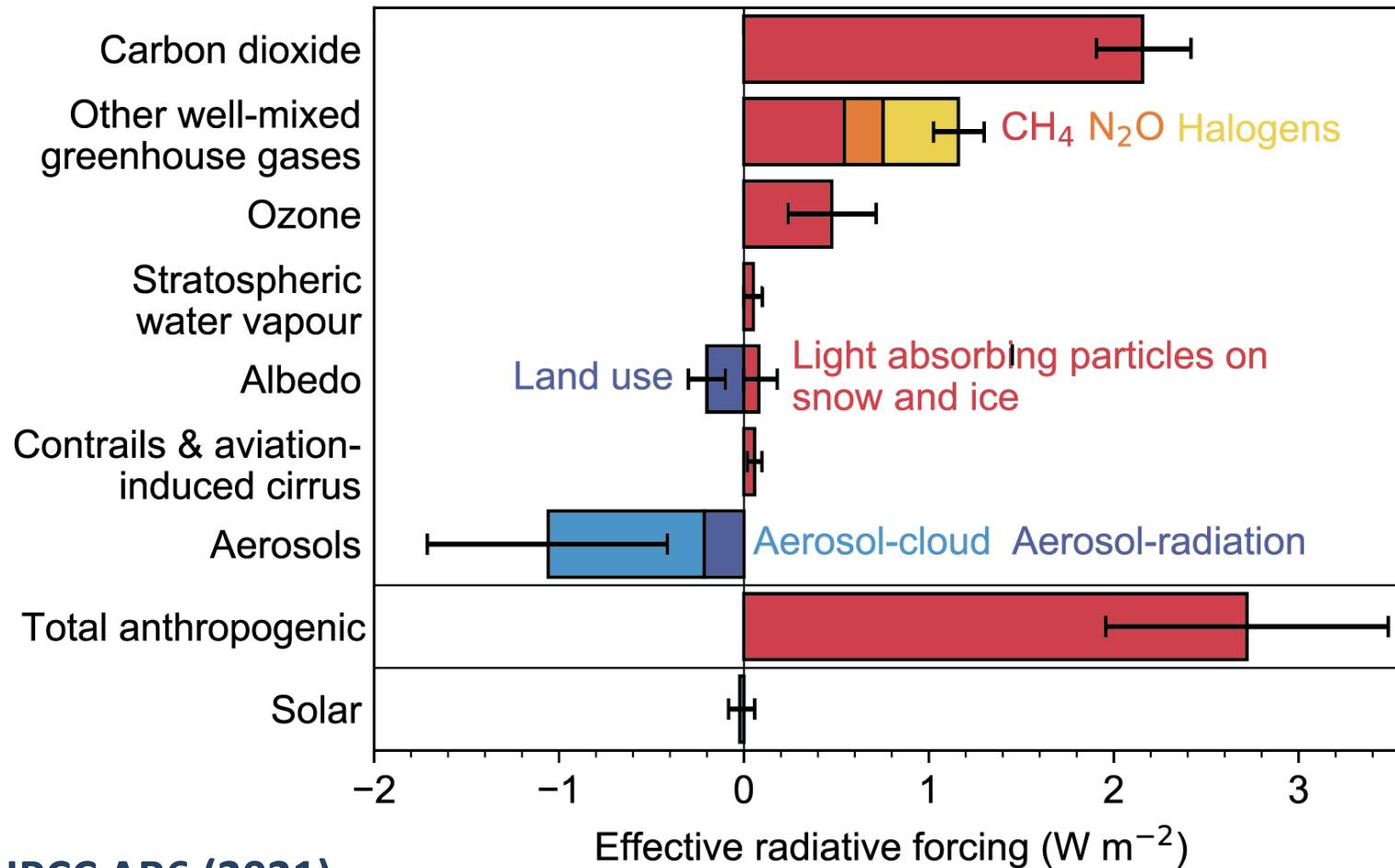
Global Aviation Effective Radiative Forcing (ERF) Terms (1940 to 2018)



Emissions from Aircraft of Concern to Climate and to Atmospheric Composition

Aviation Today: Small Component of Radiative Forcing on Climate

Change in effective radiative forcing from 1750 to 2019

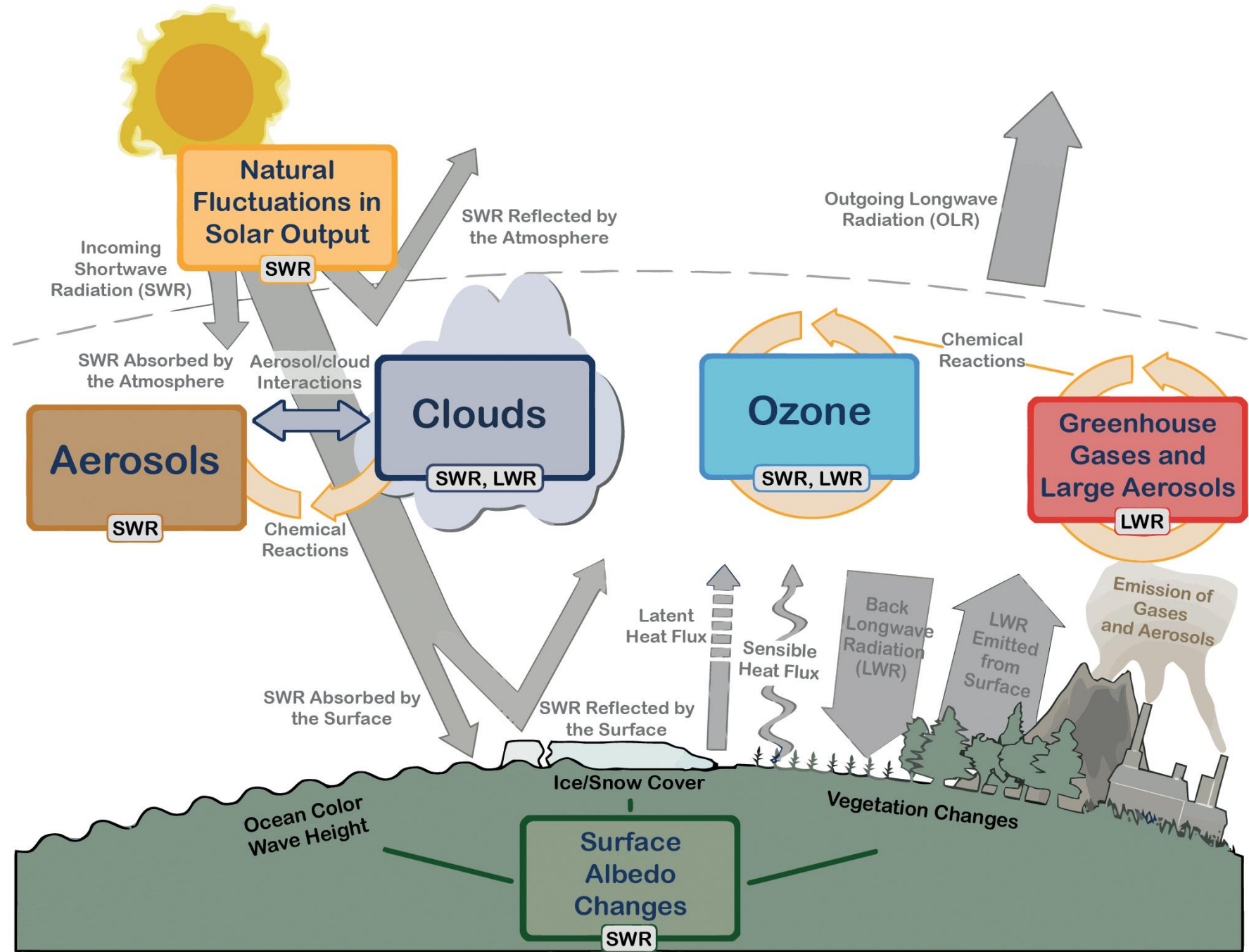


IPCC AR6 (2021)

Time Scales (after emission)

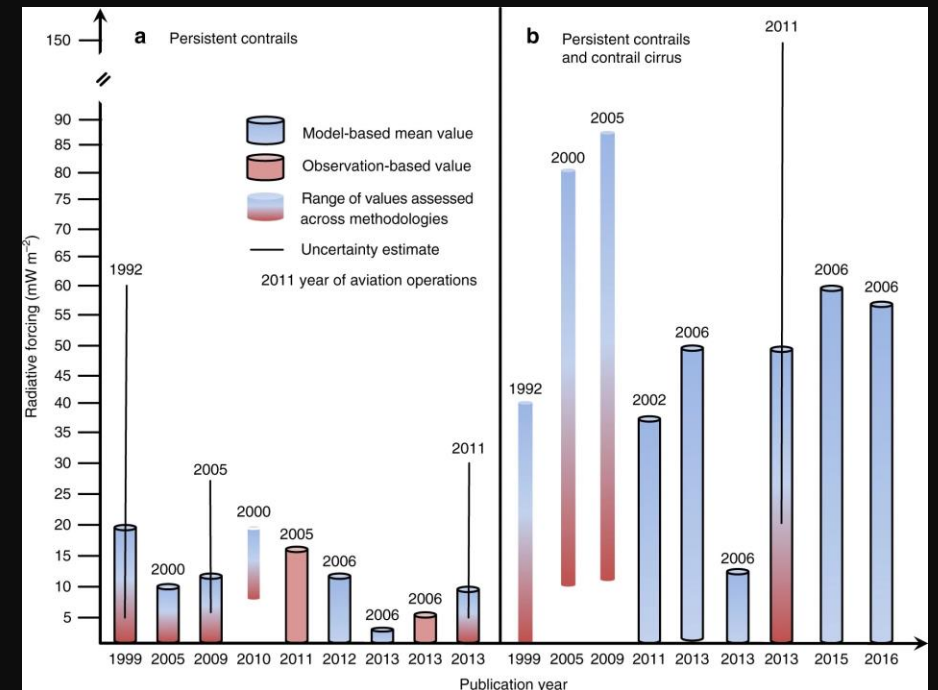
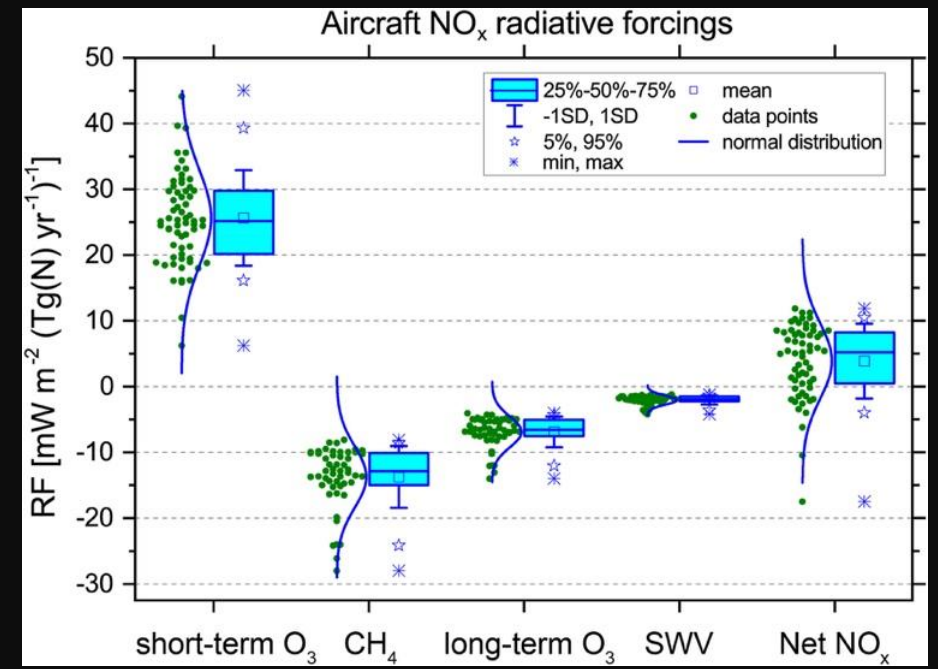
CO ₂	centuries
NO _x	<1-2 weeks
H ₂ O	<1-2 weeks
O ₃	<1-2 years
CH ₄	~10-12 years
Particles	weeks to months (<1 year)
Contrails	2-3 hours direct to days for contrail cirrus
How well we know impacts decreases as go down list	

Global Atmospheric Processes Relevant to Chemistry-Climate Models to Study Aviation Impacts



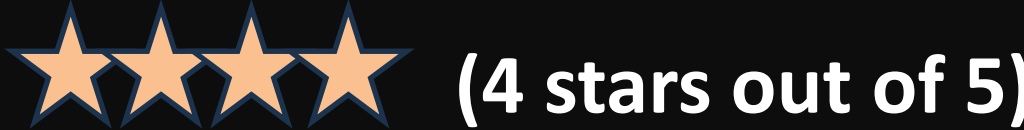
Overall Climate RF from NO_x Effects on Ozone are Small from Current Aviation Fleet

Overall Climate Effects from Contrails Depends Heavily on Impacts of Contrail Cirrus from Current Aviation Fleet



How Well Do We Model Atmospheric Processes?

Atmospheric dynamics
Atmospheric chemistry



Gases



Heterogeneous



Particles



Clouds

Stratus




Convective




Cirrus





Aviation Impacts


Ozone 

Particles 

Contrails

Linear 

C-Cirrus 

Overall Radiative Forcing  ?

Conclusions: Climate Effects from Aviation

- **Ozone:** Direct NOX effects on ozone are significant
 - Counteracted by effects on CH₄ and on stratospheric ozone
- **Water vapor:** Small effects except for stratospheric emissions
- **Particle emissions:** significant uncertainties; likely small direct effects
- **Contrails:** Could be significant but major uncertainties still exist
 - Do contrails have significant effects on cirrus or not? (big uncertainty)
 - Would cirrus have formed naturally?

Sustainable Aviation Fuel

- No CO₂ (carbon produced from nature)
- Switching to SAF unlikely to affect Ozone or Water Vapor effects
- Contrail effects may change with SAF (different aerosol distribution)

Thank You

