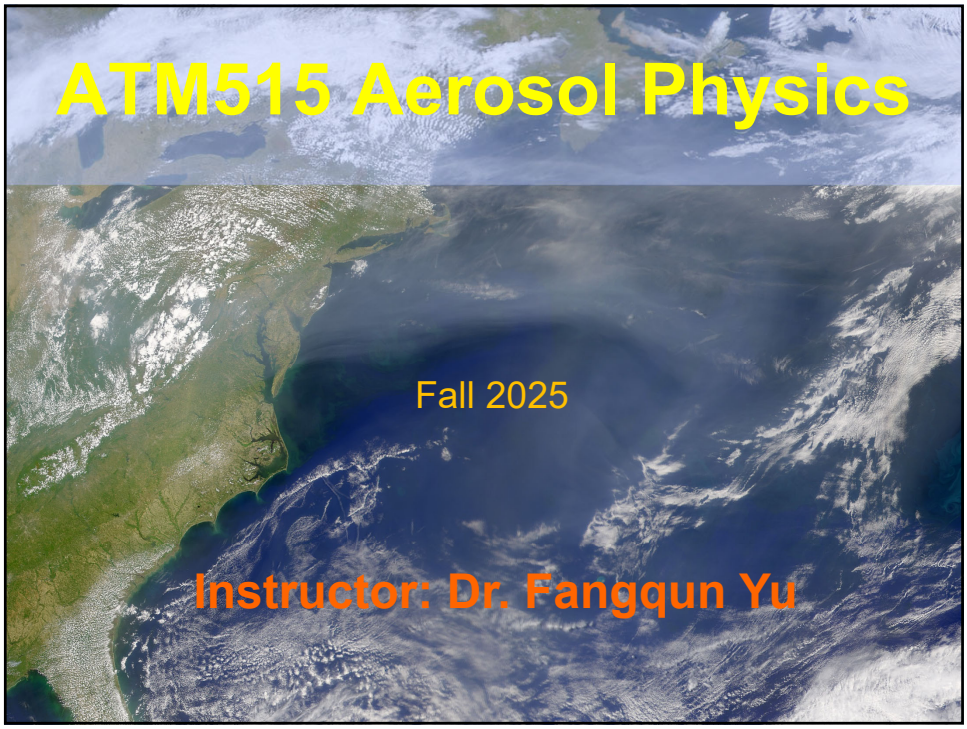


1

https://www.atmos.albany.edu/daes/atmclasses/atm515/

Introduction

Syllabus

Schedule

Advanced Particle Microphysics (APM) Model

2

IPCC, Climate Change 2021: The Physical Science Basis

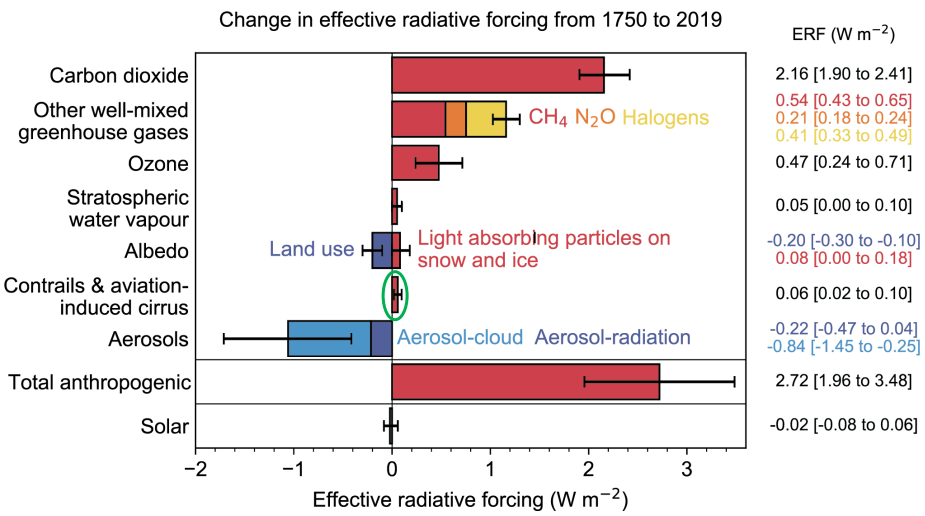
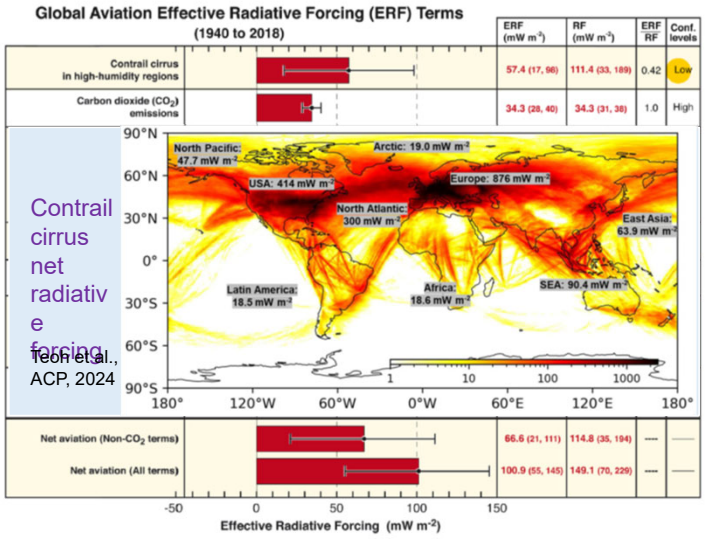


Figure 7.6 | Change in effective radiative forcing (ERF) from 1750 to 2019 by contributing forcing agents (carbon dioxide, other well-mixed greenhouse gases (WMGHGs), ozone, stratospheric water vapour, surface albedo, contrails and aviation-induced cirrus, aerosols, anthropogenic total, and solar).

3

3



Contrail cirrus net radiative forcing

Teoh et al., ACP, 2024

Lee et al., 2021

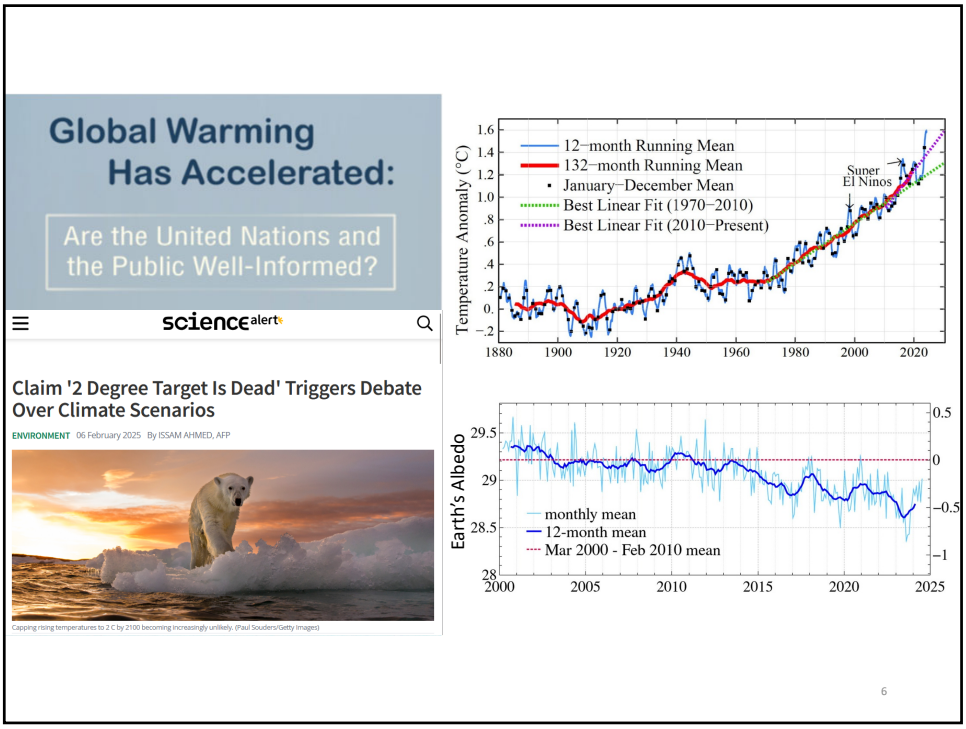
- Non-CO_2 accounts for 2/3 of aviation ERF
- Contrail cirrus dominates non-CO_2 ERF but has large uncertainty

4

4


CTO PANEL
July 23, 2024
AIRBUS
BOEING
GE Aerospace
RTX
At the Farnborough International Airshow, chief technology officers of major aerospace companies released a joint statement and held a panel on the importance of accelerating efforts critical to understanding and reducing aviation's non-CO2 effects. Participating ir
https://www.rtx.com/news/2024/07/23/cto-joint-statement
5

5


Global Warming Has Accelerated:
Are the United Nations and the Public Well-Informed?
sciencealert
Claim '2 Degree Target Is Dead' Triggers Debate Over Climate Scenarios
ENVIRONMENT 06 February 2025 By ISSAM AHMED, AFP
Capping rising temperatures to 2 C by 2100 becoming increasingly unlikely. (Paul Souders/Getty Images)
12–month Running Mean
132–month Running Mean
January–December Mean
Best Linear Fit (1970–2010)
Best Linear Fit (2010–Present)
Suner El Ninos
Temperature Anomaly (°C)
1880 1900 1920 1940 1960 1980 2000 2020
Earth's Albedo
monthly mean
12-month mean
Mar 2000 - Feb 2010 mean
2000 2005 2010 2015 2020 2025
6

6

Getting tipsy!

Science

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RESEARCH ARTICLE | CLIMATE CHANGE

Exceeding 1.5°C global warming could trigger multiple climate tipping points

DAVID I. ARMSTRONG MCKAY, ARIE STAAL, JESSE F. ABRAMS, RICARDA WINKELMANN, [...], AND TIMOTHY M. LENTON +5 authors Authors Info & Affiliations

SCIENCE · 9 Sep 2022 · Vol 377, Issue 6611 · DOI: 10.1126/science.abn7950

149,569 1,035 CHECK ACCESS

Getting tipsy

Climate tipping points are conditions beyond which changes in a part of the climate system become self-perpetuating. These changes may lead to abrupt, irreversible, and dangerous impacts with serious implications for humanity. Armstrong McKay *et al.* present an updated assessment of the most important climate tipping elements and their potential tipping points, including their temperature thresholds, time scales, and impacts. Their analysis indicates that even global warming of 1°C, a threshold that we already have passed, puts us at risk by triggering some tipping points. This finding provides a compelling reason to limit additional warming as much as possible. —HJS

7

The challenge: To define and navigate toward a safe and just future for people and the planet

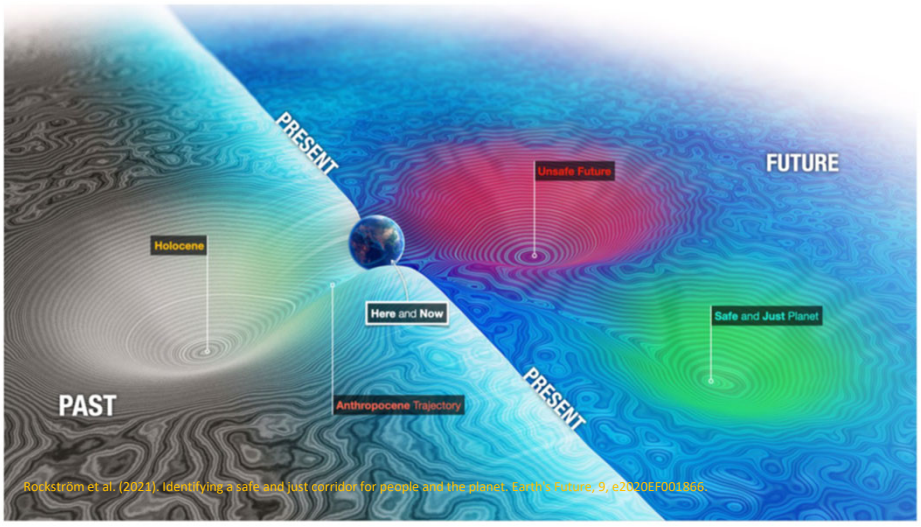
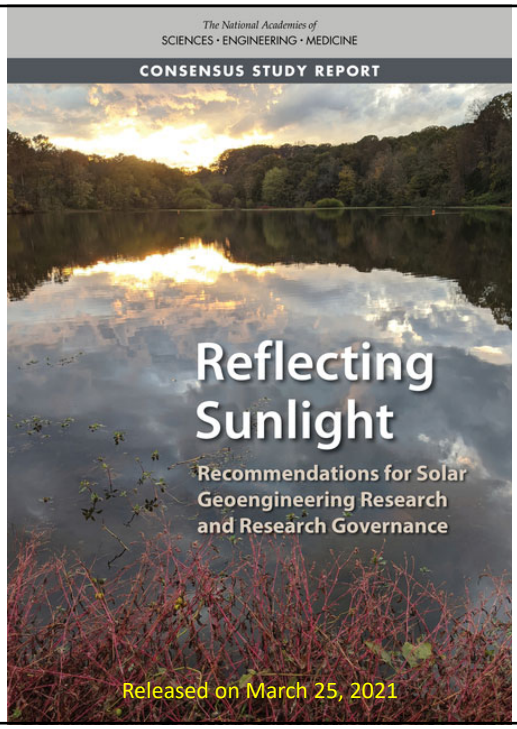


Figure 1. The challenge: To define, and navigate toward, a safe and just future for people and the planet.

8


The National Academies of
SCIENCES · ENGINEERING · MEDICINE
CONSENSUS STUDY REPORT
Reflecting Sunlight
Recommendations for Solar Geoengineering Research and Research Governance
Released on March 25, 2021
9

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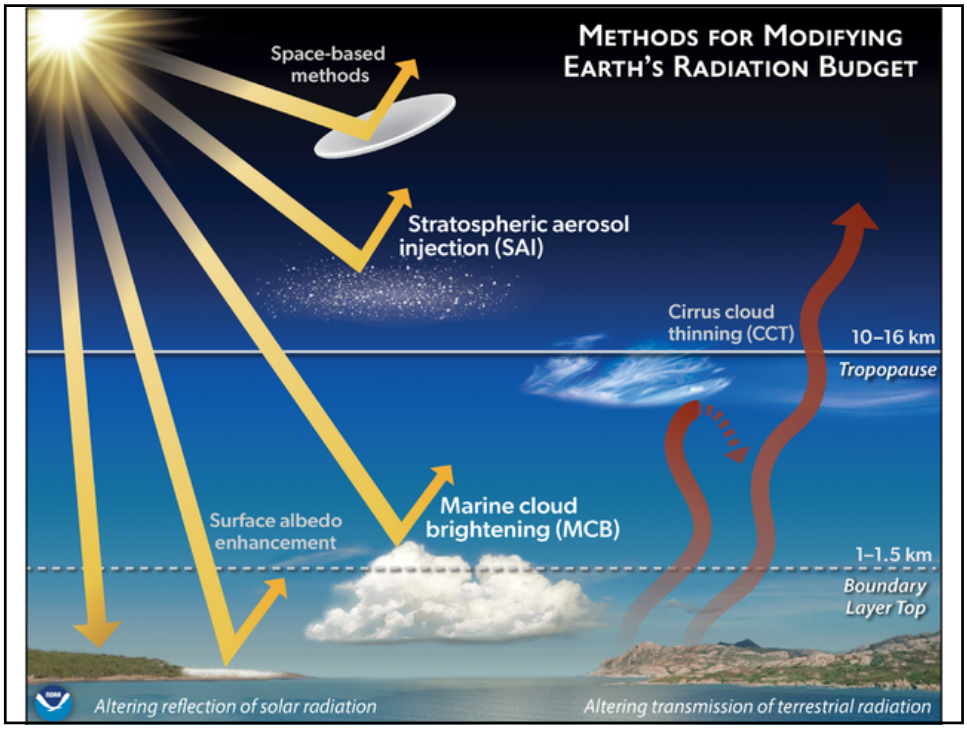

METHODS FOR MODIFYING EARTH'S RADIATION BUDGET
Space-based methods
Stratospheric aerosol injection (SAI)
Cirrus cloud thinning (CCT)
10–16 km
Tropopause
Surface albedo enhancement
Marine cloud brightening (MCB)
1–1.5 km
Boundary Layer Top
Altering reflection of solar radiation
Altering transmission of terrestrial radiation

10

A Study of the Formation and Evolution of **Aerosols and Contrails in Aircraft Wakes**: Development, Validation and Application of an **Advanced Particle Microphysics (APM)** Model

Yu, 1998, Ph.D. Dissertation, UCLA

Advisor: Prof. Richard Turco

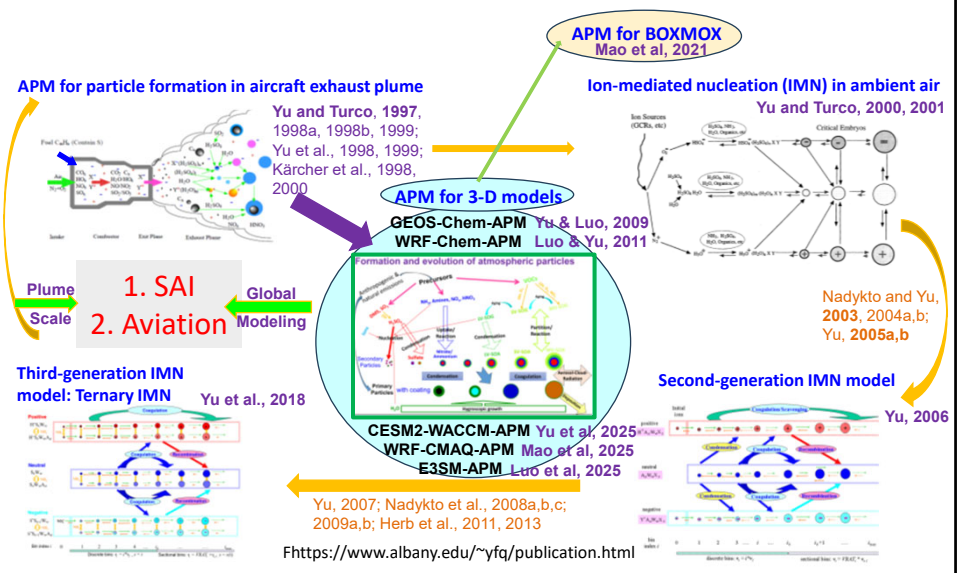
Results and findings related to this study were reported in 11 papers (Yu and Turco, 1997, 1998a, 1998b, 1999; Yu et al., 1998, 1999; Turco and Yu, 1997, 1998, 1999. Kärcher et al., 1998, 2000)

Field data used to constrain the model:

- Measurements taken in the Concorde Supersonic Aircraft in the Lower Stratosphere (Fahey et al., 1995)
- SULFUR missions (Schumann et al., 1996; Schröder et al., 1998)
- SNIF (Subsonic Assessment: Near-field Interactions Flight) (Anderson et al., 1998)
- SUCCESS (Subsonic Assessment: Cloud and Contrail Effects Special Study) (Toon and Miake-Lye, 1998)

11

Two versions of APM model: one for kinetic nucleation and another for 3-D models



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