ICAO UNITING AVIATION E-GAP

Aviation and Climate: An Update

by

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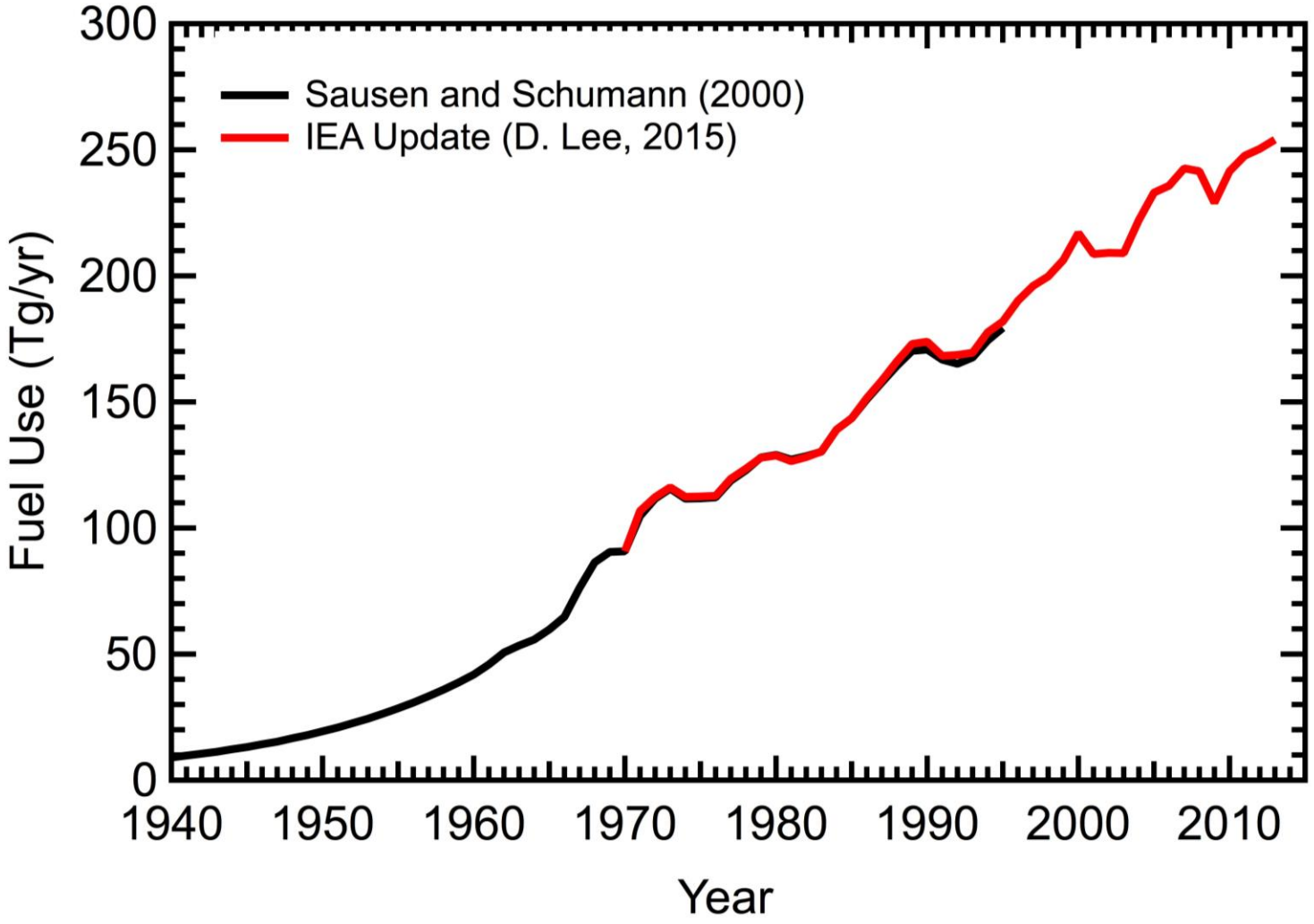
Photo: ICAO Journal, 2009.

ICAO Global Aviation Partnerships on Emissions Reductions (E-GAP) Seminar
ICAO Headquarters, Montréal, 16 to 17 September 2015

ENV2015

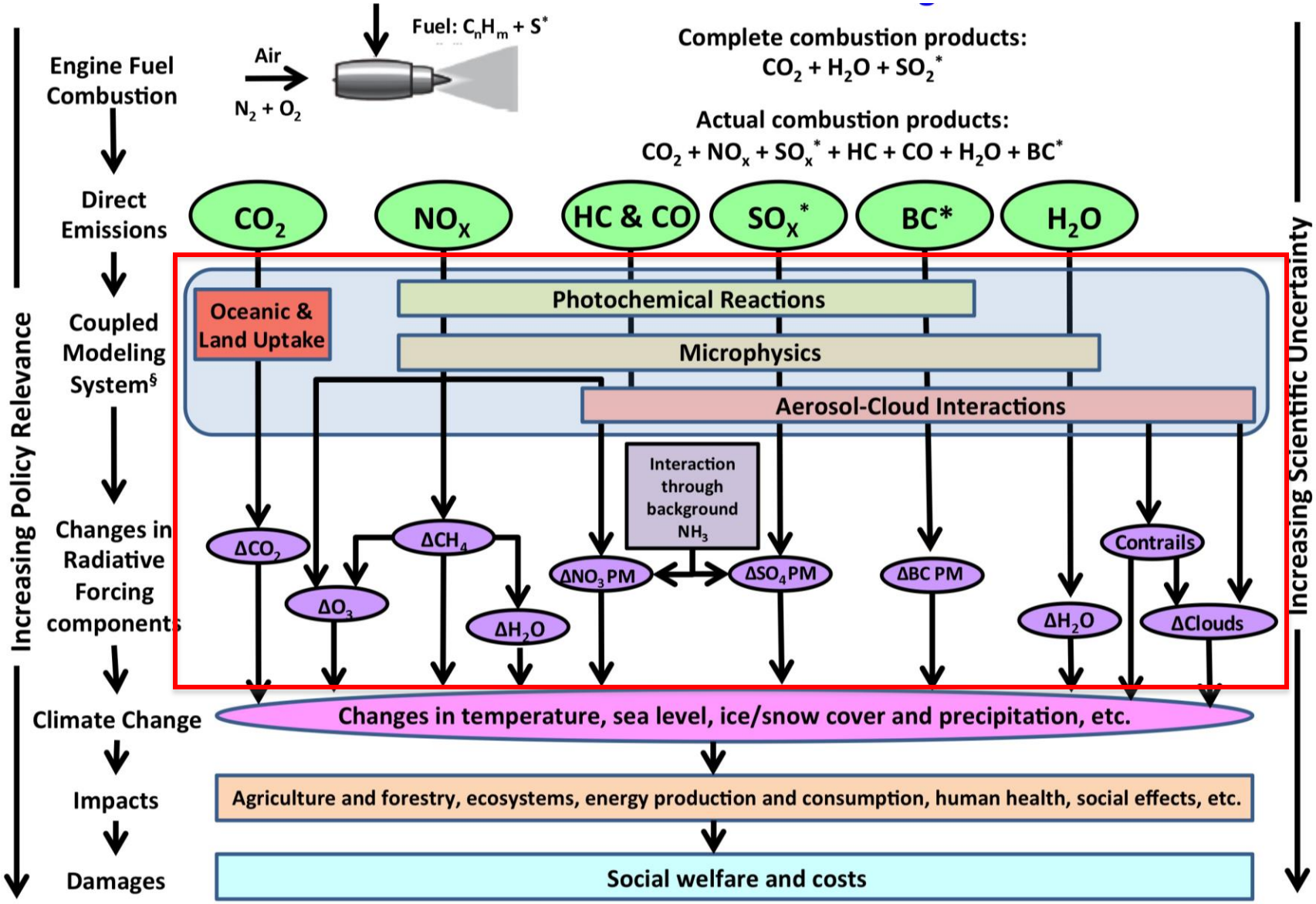
Growth of global aviation fuel use



• Aviation fuel use has increased linearly over the last 4+ decades despite world changing events.

Updated from Lee *et al.*, *Atmos. Environ.*, 2009

Aviation Impacts on Climate



*100% Alternative Jet fuels will have no sulfur related emissions and have lower black carbon (BC) emissions; other emissions could be lower (e.g., NO_X)

§Account for radiative, chemical, microphysical and dynamical couplings along with dependence on changing climatic conditions and background atmosphere

FAA/ACCRI: Brasseur *et al*., BAMS, 2015.

ICAO/CAEP/Impacts and Science Group (ISG) Partnership
2015 White Papers

Aviation IMPACTS on climate: State of the science

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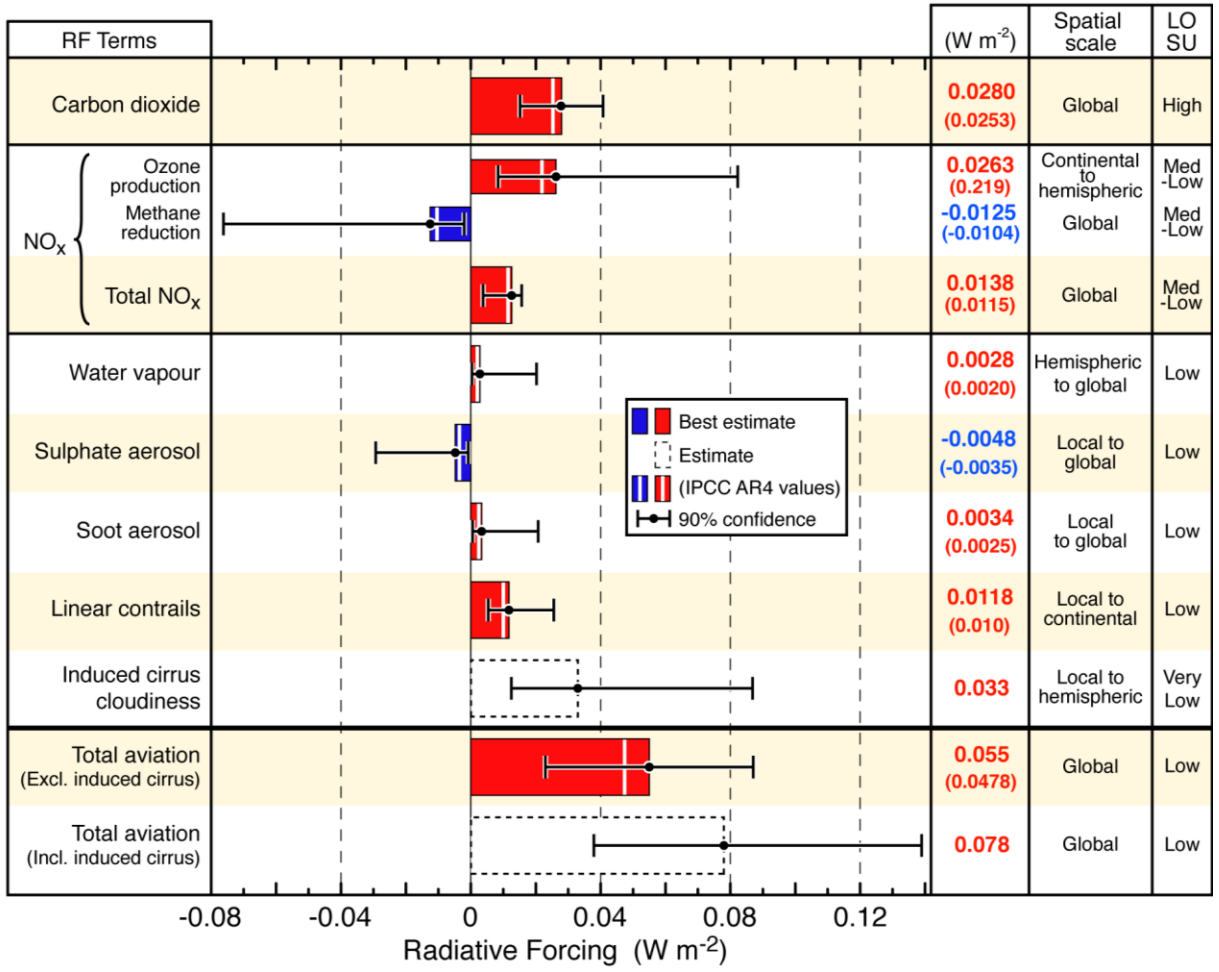
Outline

- Introduction
- Aviation fuel use and CO_2 Emissions
- Radiative forcing of current-day aviation from CO_2 and non-CO_2 agents
- NO_x effects
- Aviation cloudiness
- Soot and sulfur emissions
- Short-term vs. long-term climate forcing agents
- Emissions from alternative aviation fuels
- Contrail avoidance for climate change mitigation

Aviation Radiative Forcing in 2005

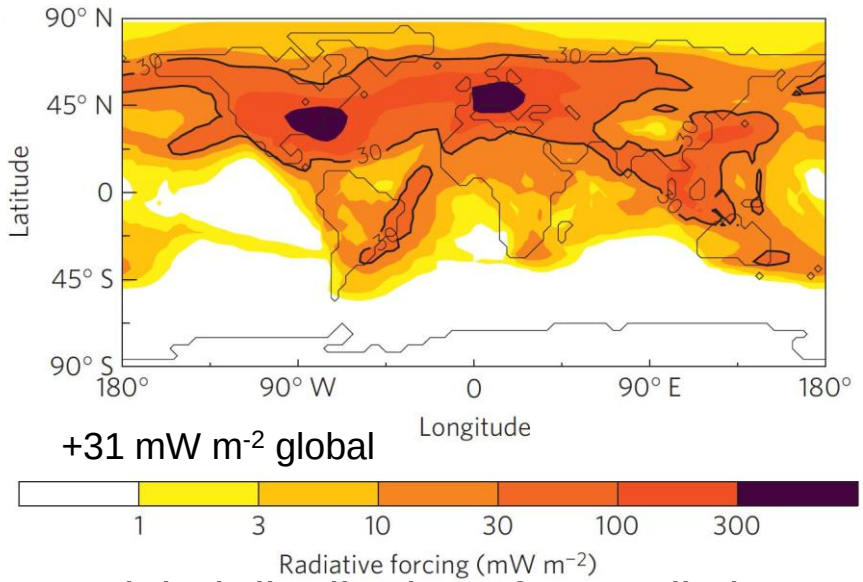


Few percent of total anthropogenic RF relative to 1750

- In 2009, aviation radiative forcing components were quantified with *best estimates* except for induced cirrus cloudiness.
- Since 2009, significant progress has occurred in the evaluation of aviation climate processes and in quantitative modeling of global forcing.

Lee *et al.*, *Atmos. Environ.* (2009)

Radiative forcing from contrails and contrail cirrus



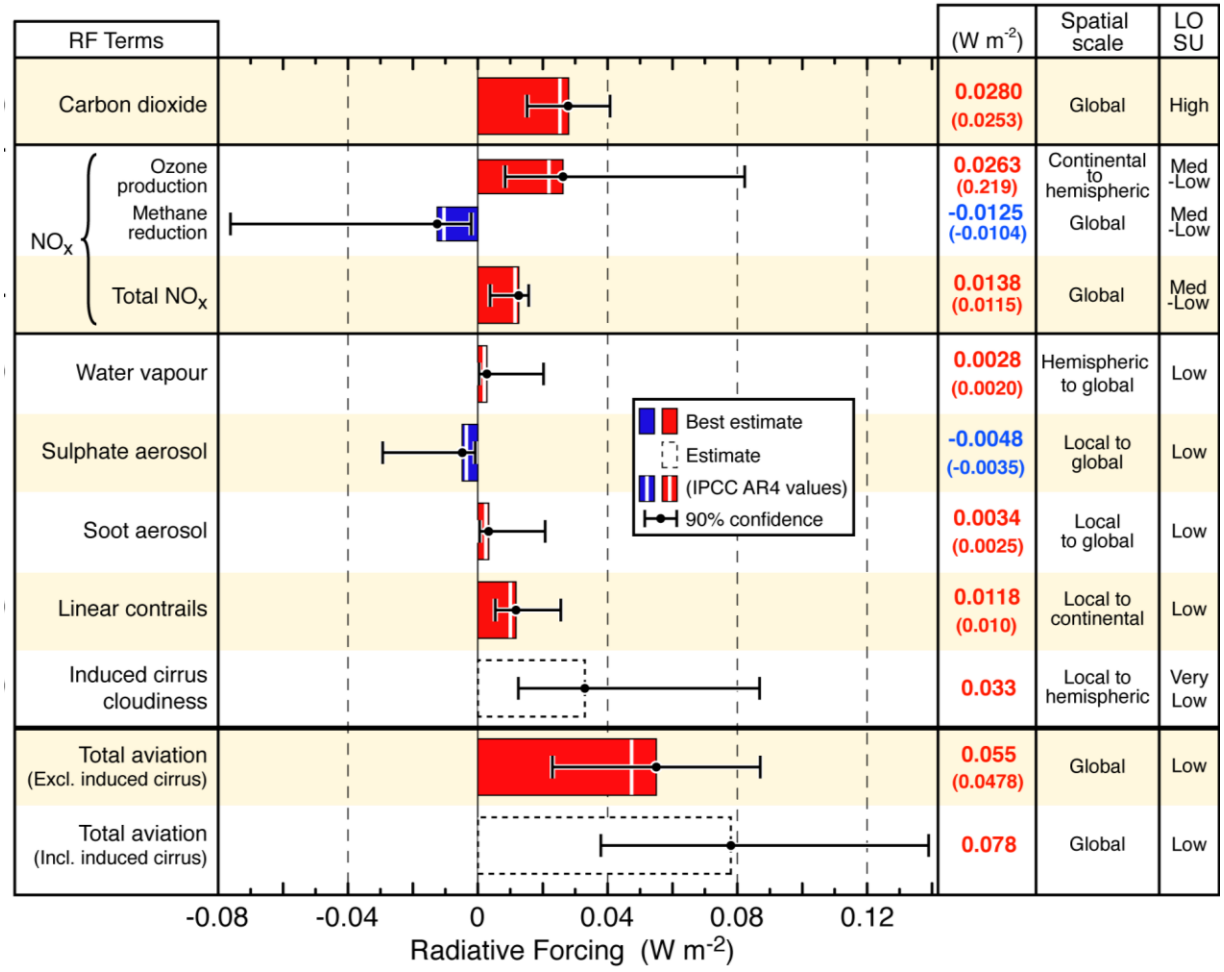
- Global distribution of contrail cirrus radiative forcing for the aviation fleet in year 2002 using global climate model.

- Highlights the importance of contrail shielding and changes in natural cloudiness (-20%).

- Increased studies of the potential of contrail mitigation through route planning.

Burkhardt and Kärcher, *Nature Climate Change*, 2011

Aviation Radiative Forcing in 2005

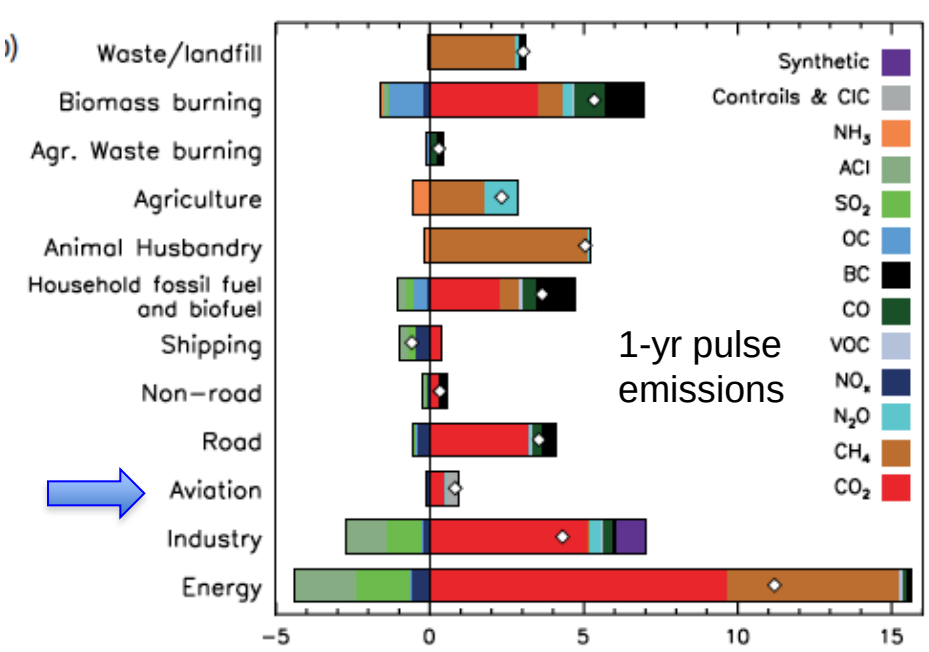


Updating required

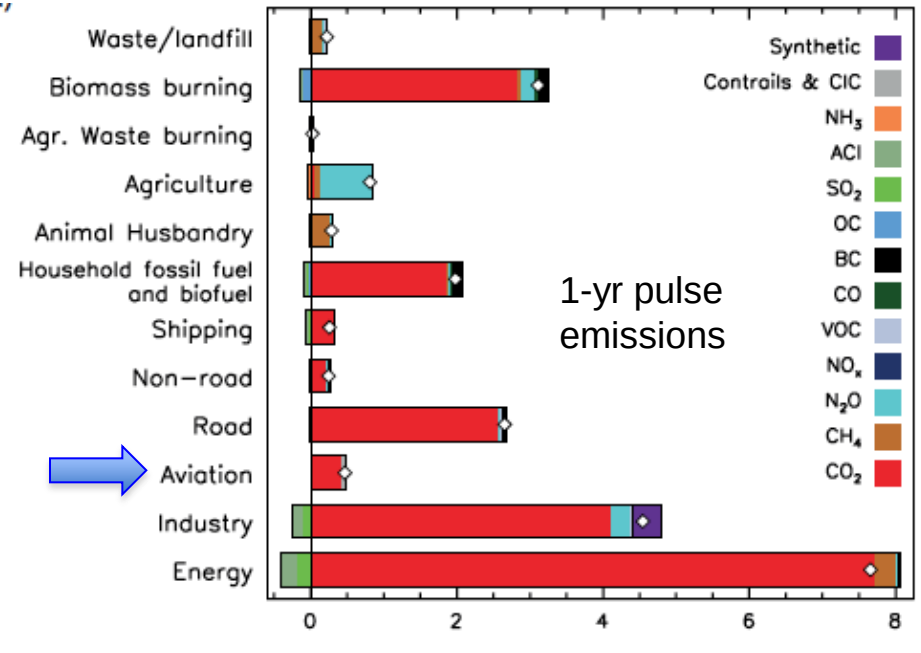
- Based on new modeling and analysis results, many of the earlier best estimates and uncertainties of aviation climate forcing terms require updating by the aviation and atmospheric sciences communities.
- CO_2 is the exception since based on fuel use.

Lee *et al.*, *Atmos. Environ.* (2009)

Final point: Climate change metrics



Global mean temperature change at 20 yrs (mK)



Global mean temperature change at 100 yrs (mK)

- The use of climate change metrics is hampered by significant challenges related both to scientific issues and policy choices.

- No single metric has been exclusively adopted by policymakers (e.g., RF, GWP, GTP, ATR, etc.) or time scale.

IPCC, AR5, Fig.8.34, 2013

Updated messages on aviation and climate

- ICAO/CAEP/ISG White Paper partnerships are a principal way to inform policy makers of the state of science for aviation climate contribution.
- Significant progress has occurred in the evaluation of aviation climate processes since the IPCC-1999 and ISG 2012 results.
- Observational and model results have increased confidence in contrails and aviation cirrus RF. Biofuels and route planning may help mitigate contrails and contrail cirrus.
- Care must be used in applying aviation climate metrics and making comparisons to other sectors.
- With many new studies, aviation climate terms and total forcing are lacking best estimates increasing the need for an assessment effort to update IPCC-1999.

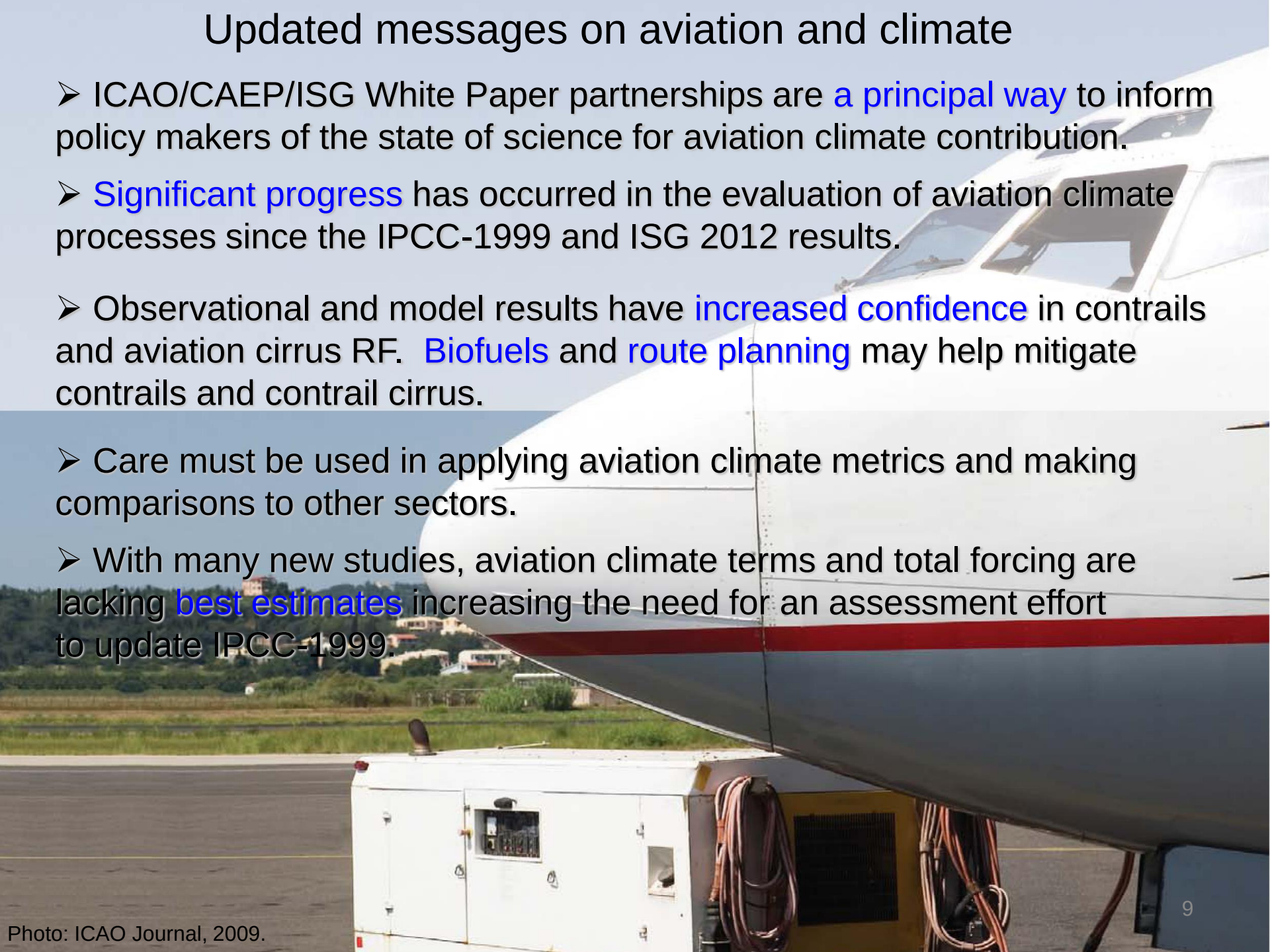


Photo: ICAO Journal, 2009.

ICAO Partners multiplying environmentally sustainable aviation action

Partners of the Aviation and Climate ISG WP

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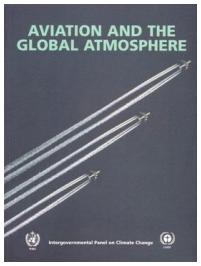
Thank you for your attention

Scientific Basis for Aviation Climate Forcing

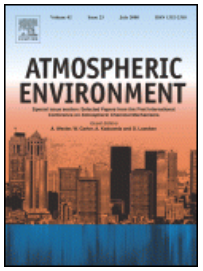


Aviation and the Global Atmosphere

A Special Report of IPCC Working Groups I and III

Intergovernmental Panel on Climate Change (IPCC), 1999

'first comprehensive and quantitative evaluation'



Aviation and global climate change in the 21st century

D. S. Lee, *et al., Atmos. Environ.,* 2009.

Update of IPCC 1999 & IPCC AR4 Climate Assessment

Intergovernmental Panel on Climate Change (IPCC)

Working Group I, 4th and 5th Assessment Reports

2007, 2014

Aviation Climate Change Research Initiative (ACCRI)

Brasseur *et al.*, 2015

Sponsored by the US Federal Aviation Administration (FAA) for 2010-2012
