ICAO Symposium on Non-CO_2 Aviation Emissions

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Montréal, Canada

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Speaker

Session 1: Scientific Knowledge

Historical overview & State-of-the-art

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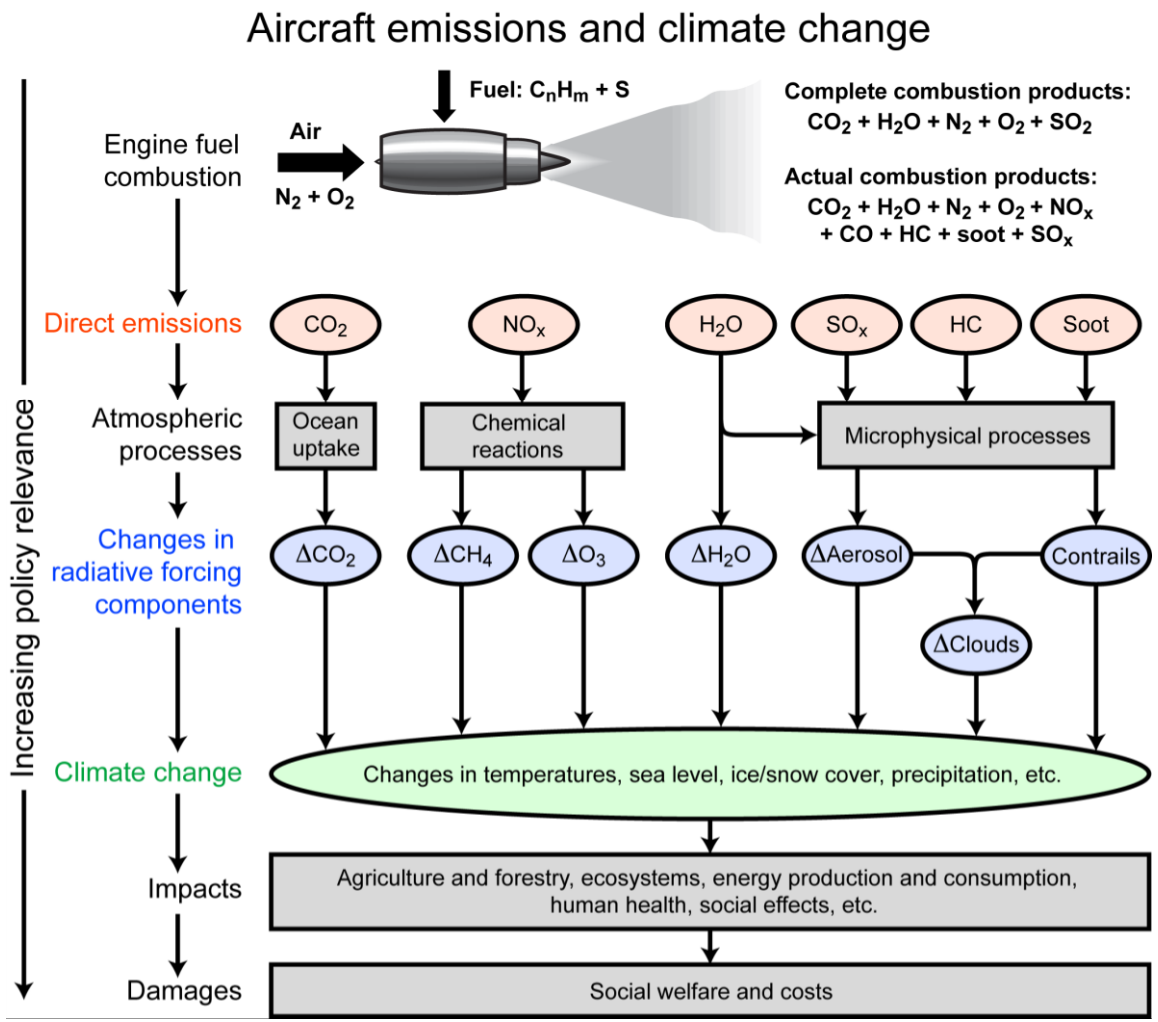
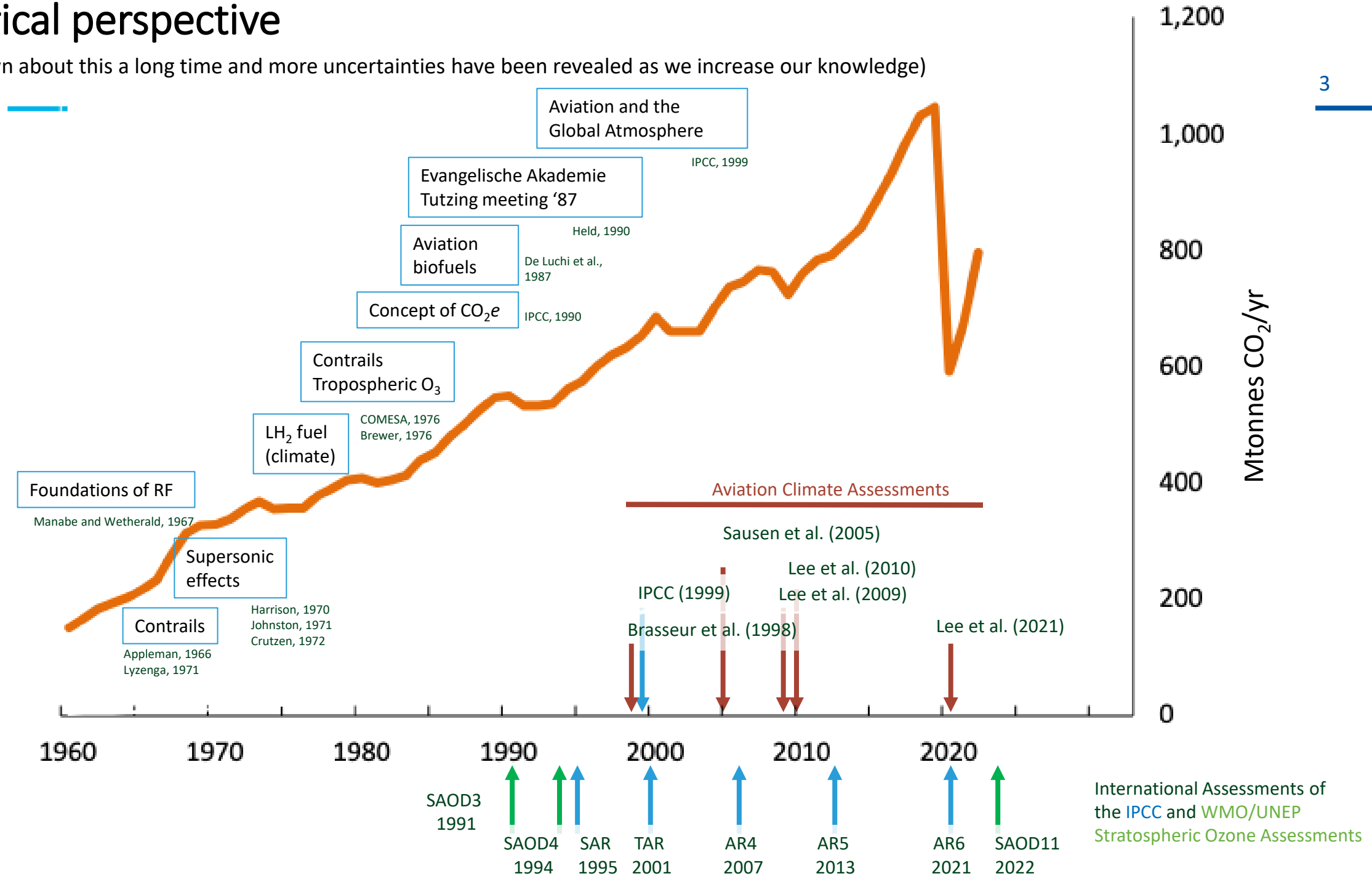
What are 'non-CO_2 emissions'? (as distinct from 'effects')



Lee et al. (2009), based on Prather et al. (1999) and Wuebbles et al. (2007)

A historical perspective

(we have known about this a long time and more uncertainties have been revealed as we increase our knowledge)



International Assessments of the IPCC and WMO/UNEP Stratospheric Ozone Assessments

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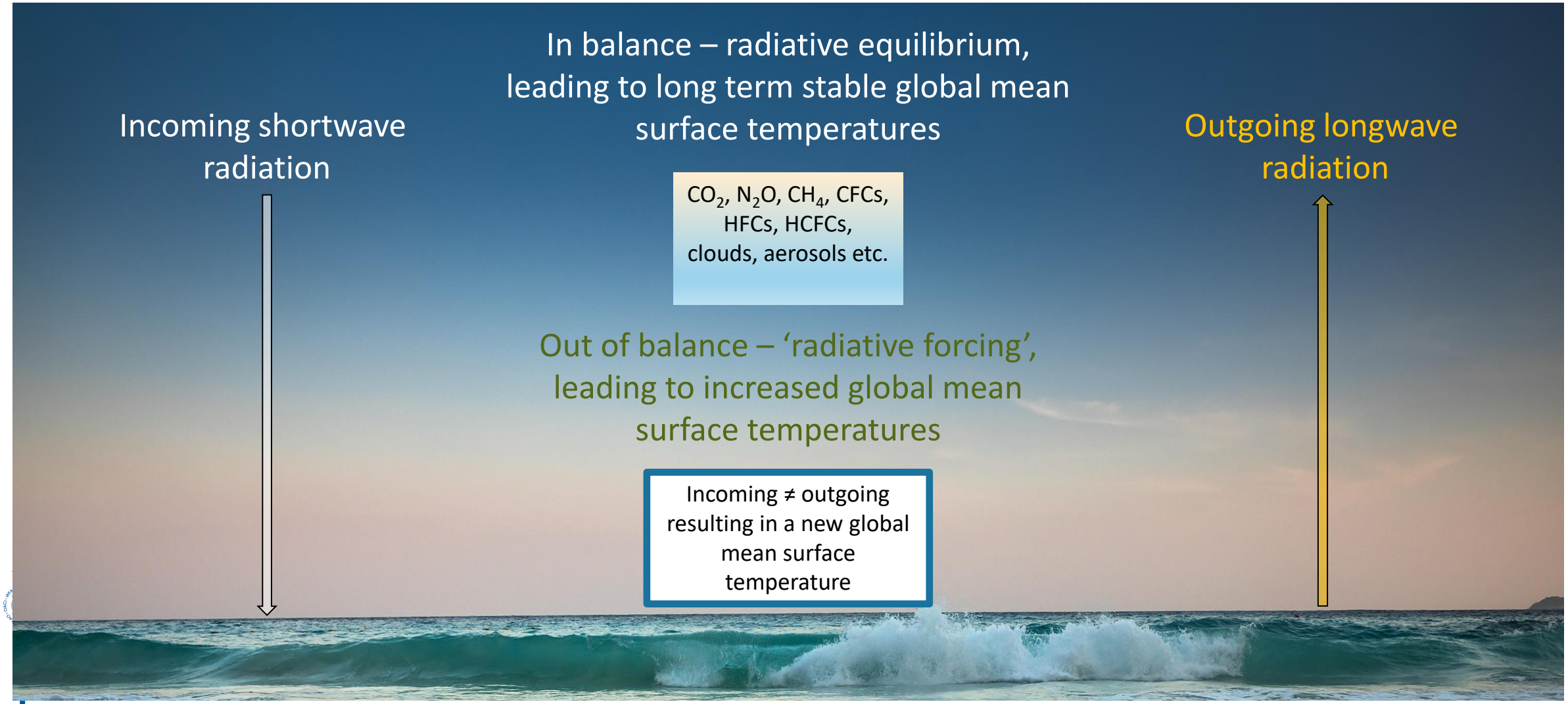
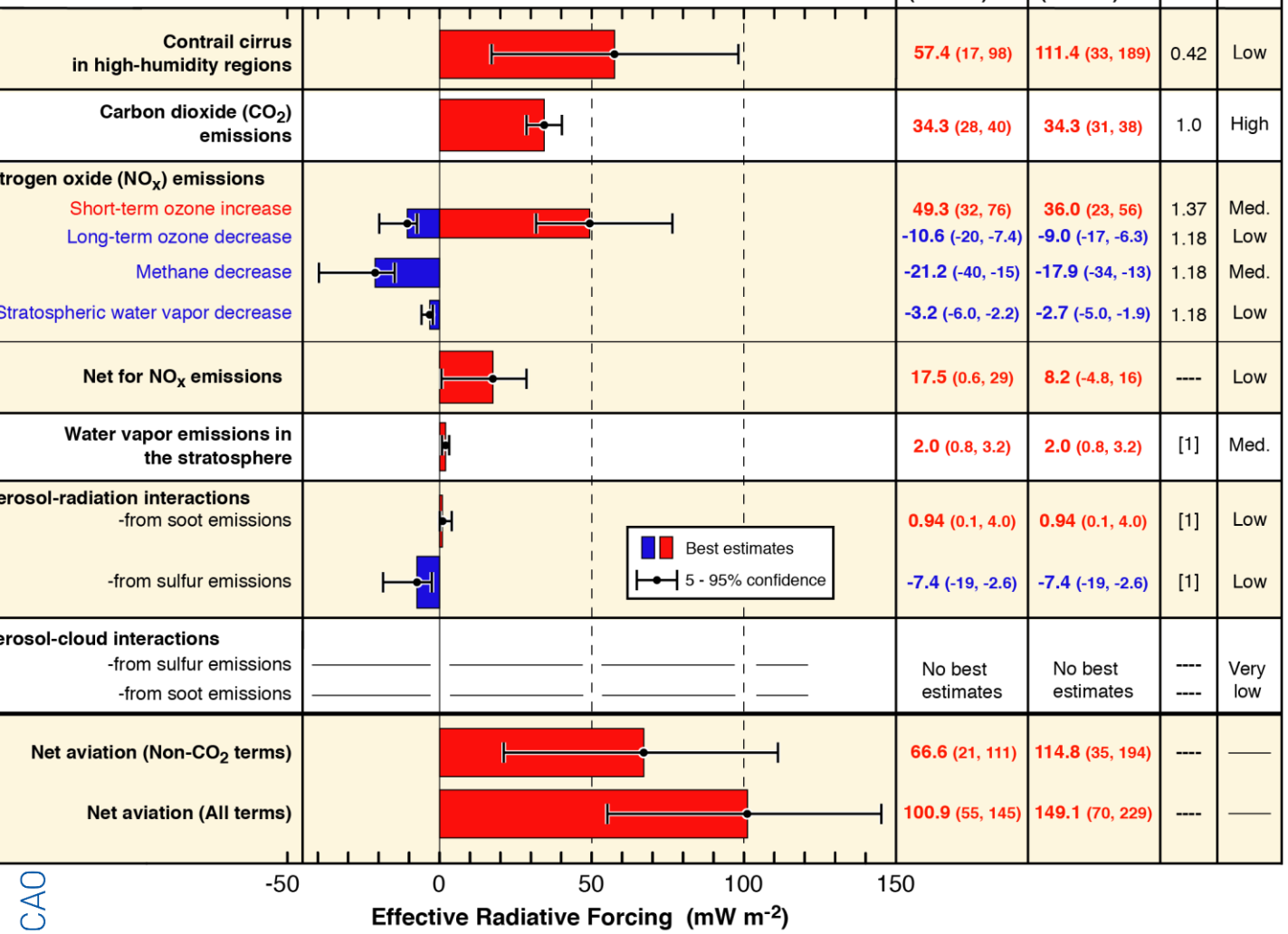
$$\Delta T_s = \lambda \, RF$$

Where λ is the climate sensitivity parameter in K $(Wm^{-2})^{-1}$



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

	ERF (mW m^{-2})	RF (mW m^{-2})	ERF / RF	Conf. levels
Contrail cirrus in high-humidity regions	57.4 (17, 98)	111.4 (33, 189)	0.42	Low
Carbon dioxide (CO_2) emissions	34.3 (28, 40)	34.3 (31, 38)	1.0	High
Nitrogen oxide (NO_x) emissions				
Short-term ozone increase	49.3 (32, 76)	36.0 (23, 56)	1.37	Med.
Long-term ozone decrease	-10.6 (-20, -7.4)	-9.0 (-17, -6.3)	1.18	Low
Methane decrease	-21.2 (-40, -15)	-17.9 (-34, -13)	1.18	Med.
Stratospheric water vapor decrease	-3.2 (-6.0, -2.2)	-2.7 (-5.0, -1.9)	1.18	Low
Net for NO_x emissions	17.5 (0.6, 29)	8.2 (-4.8, 16)	----	Low
Water vapor emissions in the stratosphere	2.0 (0.8, 3.2)	2.0 (0.8, 3.2)	[1]	Med.
Aerosol-radiation interactions				
-from soot emissions	0.94 (0.1, 4.0)	0.94 (0.1, 4.0)	[1]	Low
-from sulfur emissions	-7.4 (-19, -2.6)	-7.4 (-19, -2.6)	[1]	Low
Aerosol-cloud interactions				
-from sulfur emissions	No best estimates	No best estimates	----	Very low
-from soot emissions			----	
Net aviation (Non-CO_2 terms)	66.6 (21, 111)	114.8 (35, 194)	----	
Net aviation (All terms)	100.9 (55, 145)	149.1 (70, 229)	----	



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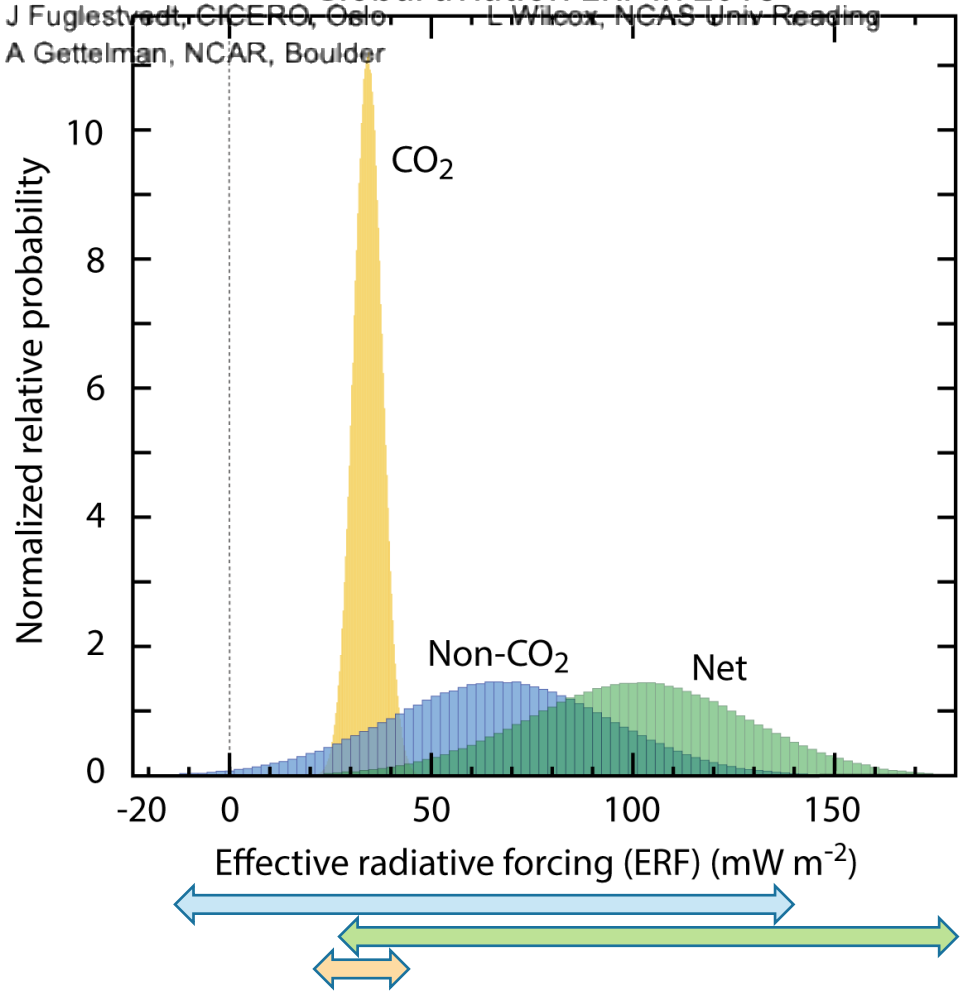
G Pitari, Univ l'Aquila
M Prather, Univ Irvine Cali
R Sausen, DLR
L Wilcox, NCAS Univ Reading

Global aviation ERF in 2018

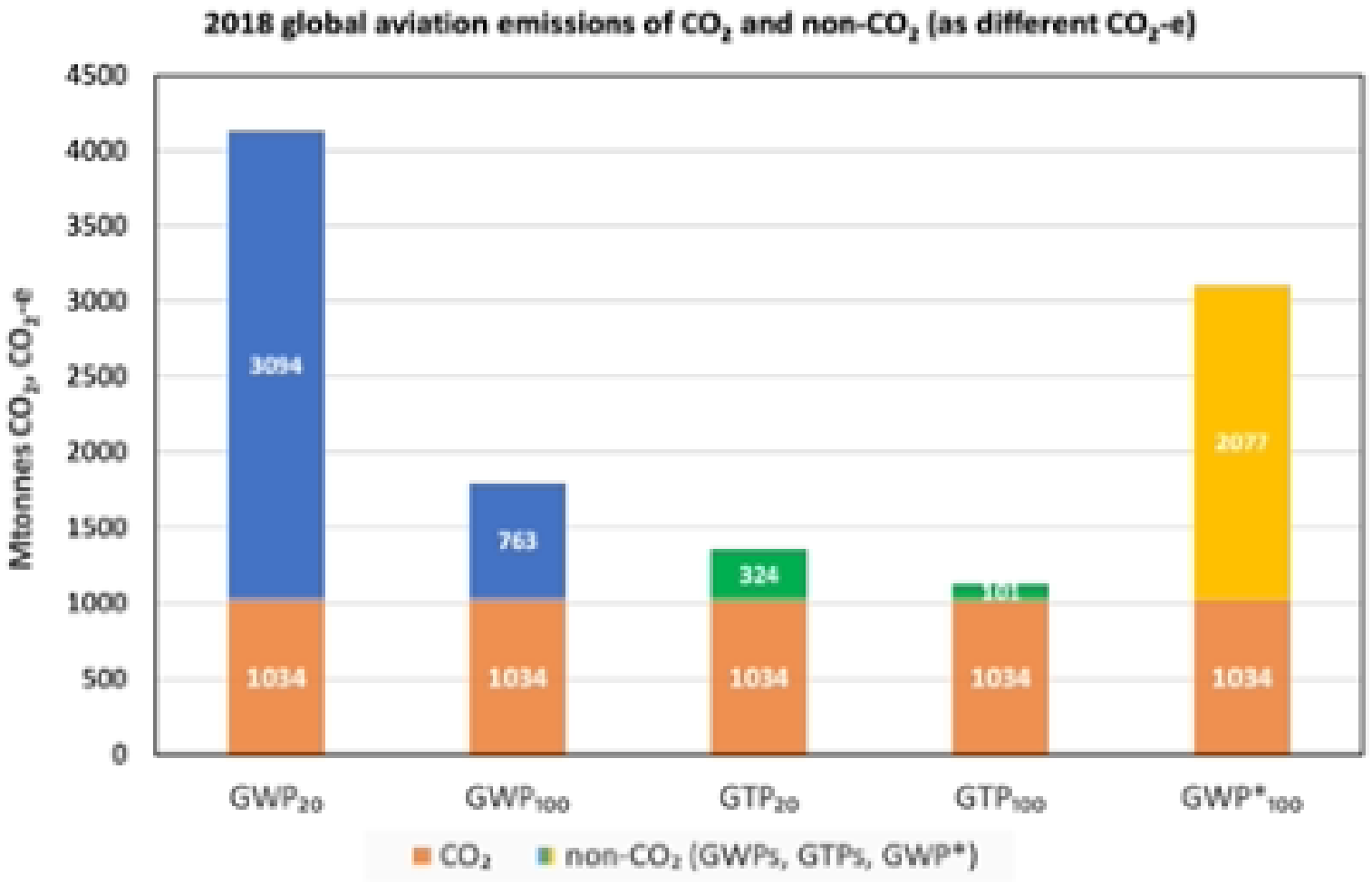


Lee et al. (2021) *Atmospheric Environment*

CO_2-equivalence metrics

There are a number of different CO_2-e metrics, they do different things and there are two issues:

- Underlying inherent radiative uncertainty, extending into climate sensitivity
- User related choices of metric, application, time horizon



Lee et al. (2023) *Atmospheres*
(based on data from Lee et al., 2021)

Thank You

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