



Aviation Impacts on Climate

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Overview of talk

- 1 Our changing climate
- 2 How does aviation affect climate?
- 3 Conclusions and outlook



Section 1

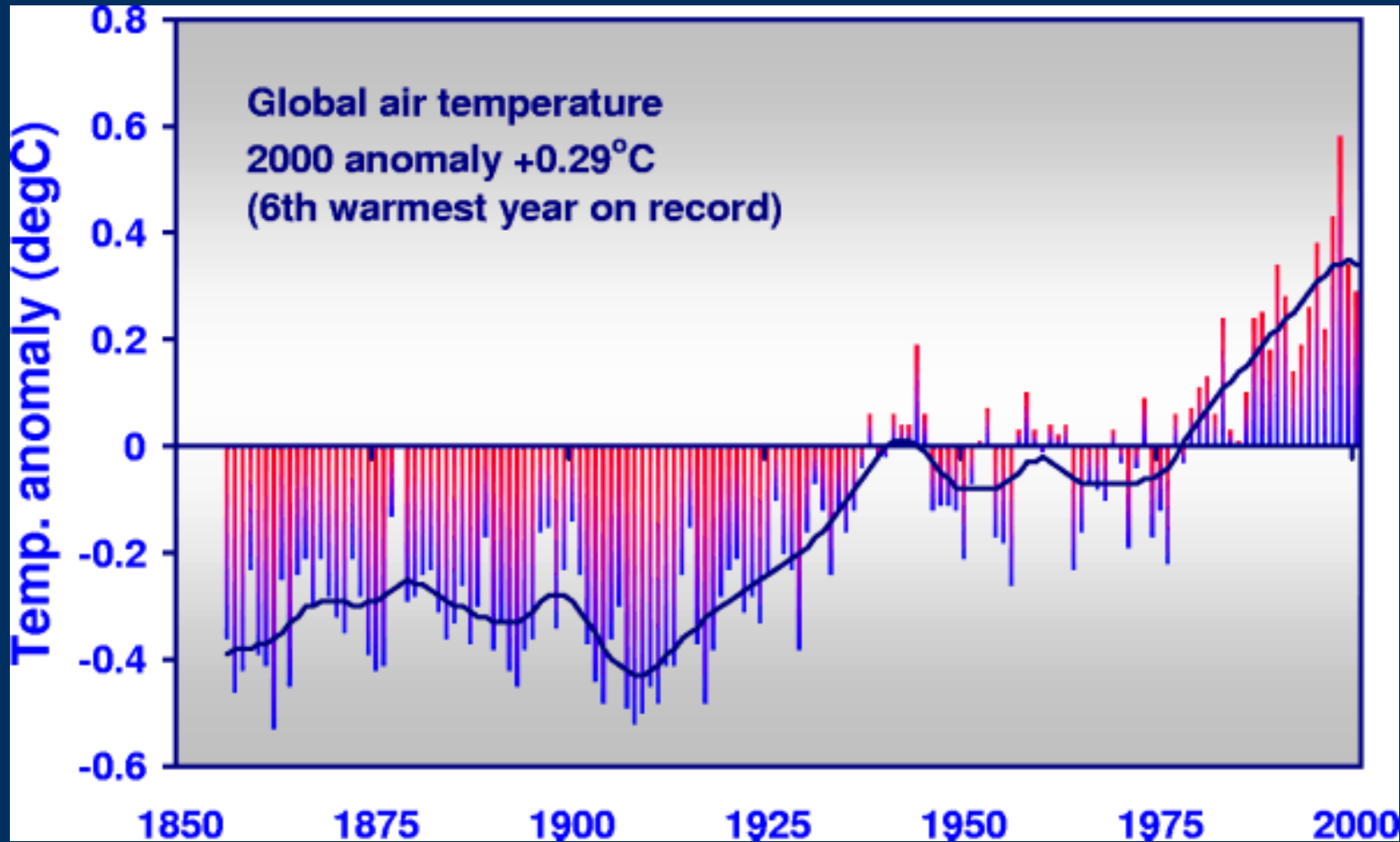
Our changing climate

“The global average surface temperature has increased over the 20th Century by about 0.6 °C”

“The globally averaged surface temperature is projected to increase by 1.4 to 5.8 °C over the period 1990 to 2100”

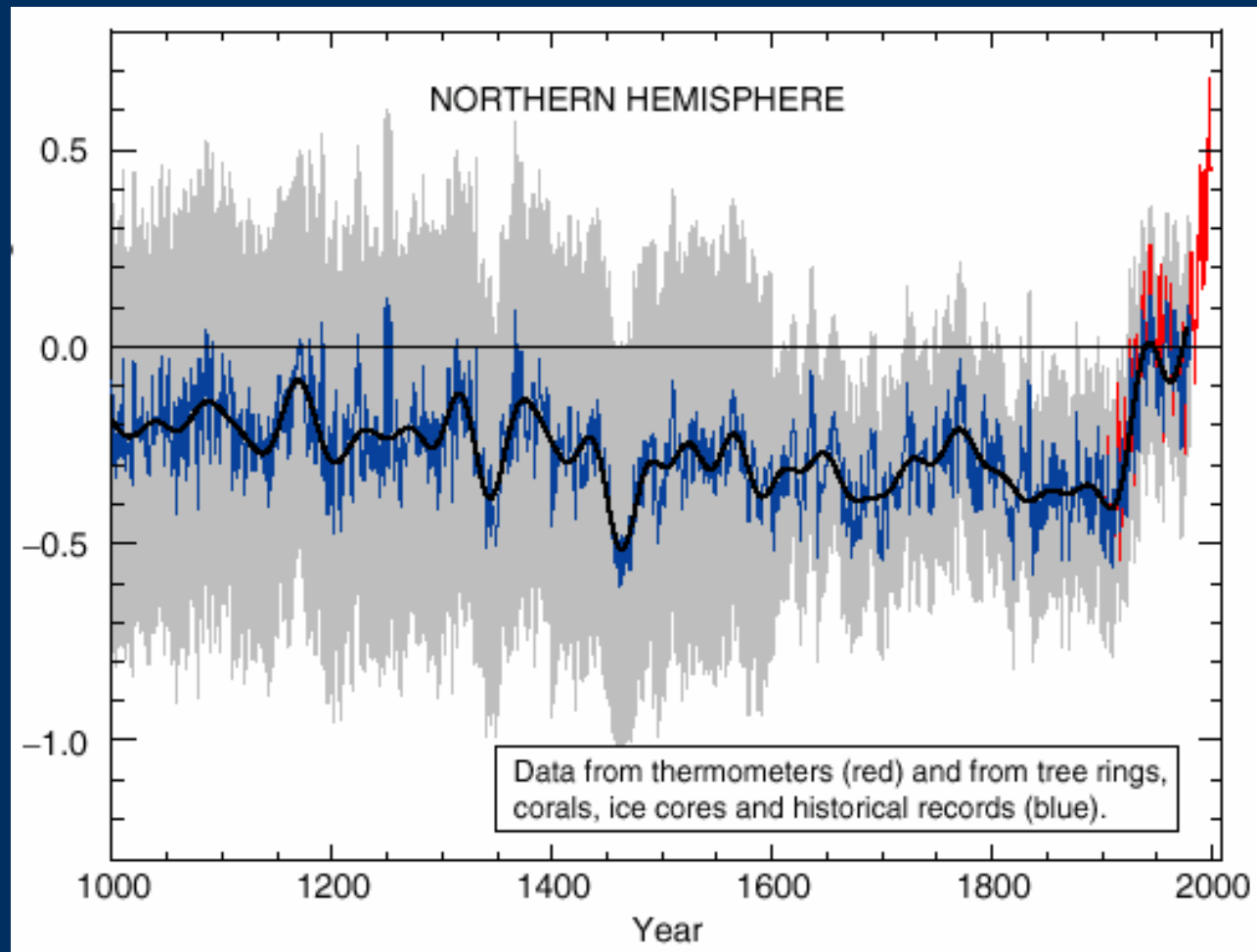
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IPCC TAR
(2001)

Variations of the Earth's surface temperature over the past 140 years



IPCC TAR, 2001

Variations of the Earth's surface temperature over the past 1,000 years



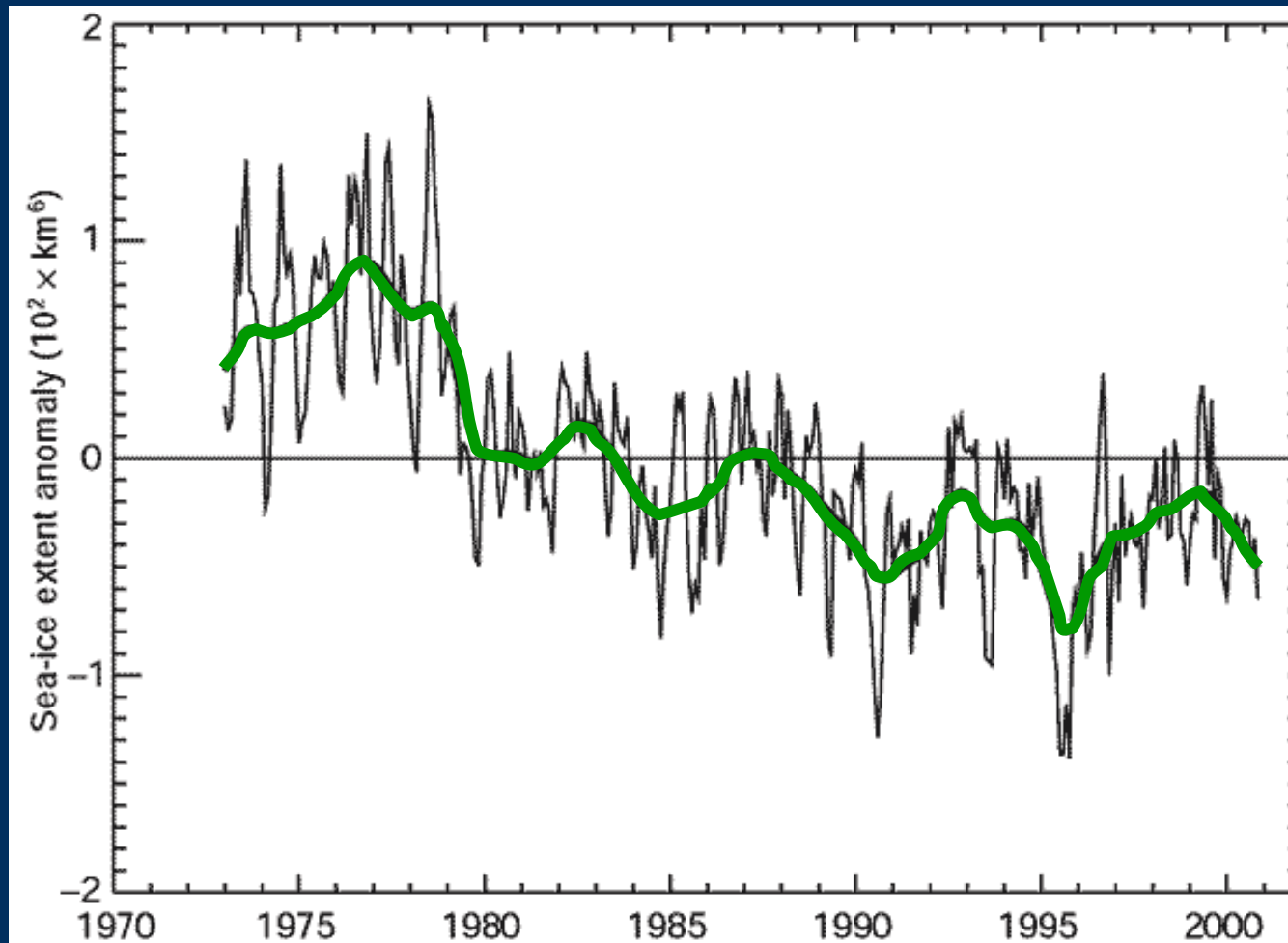
IPCC TAR, 2001

Snow cover and ice extent have decreased

IPCC TAR
(2001)



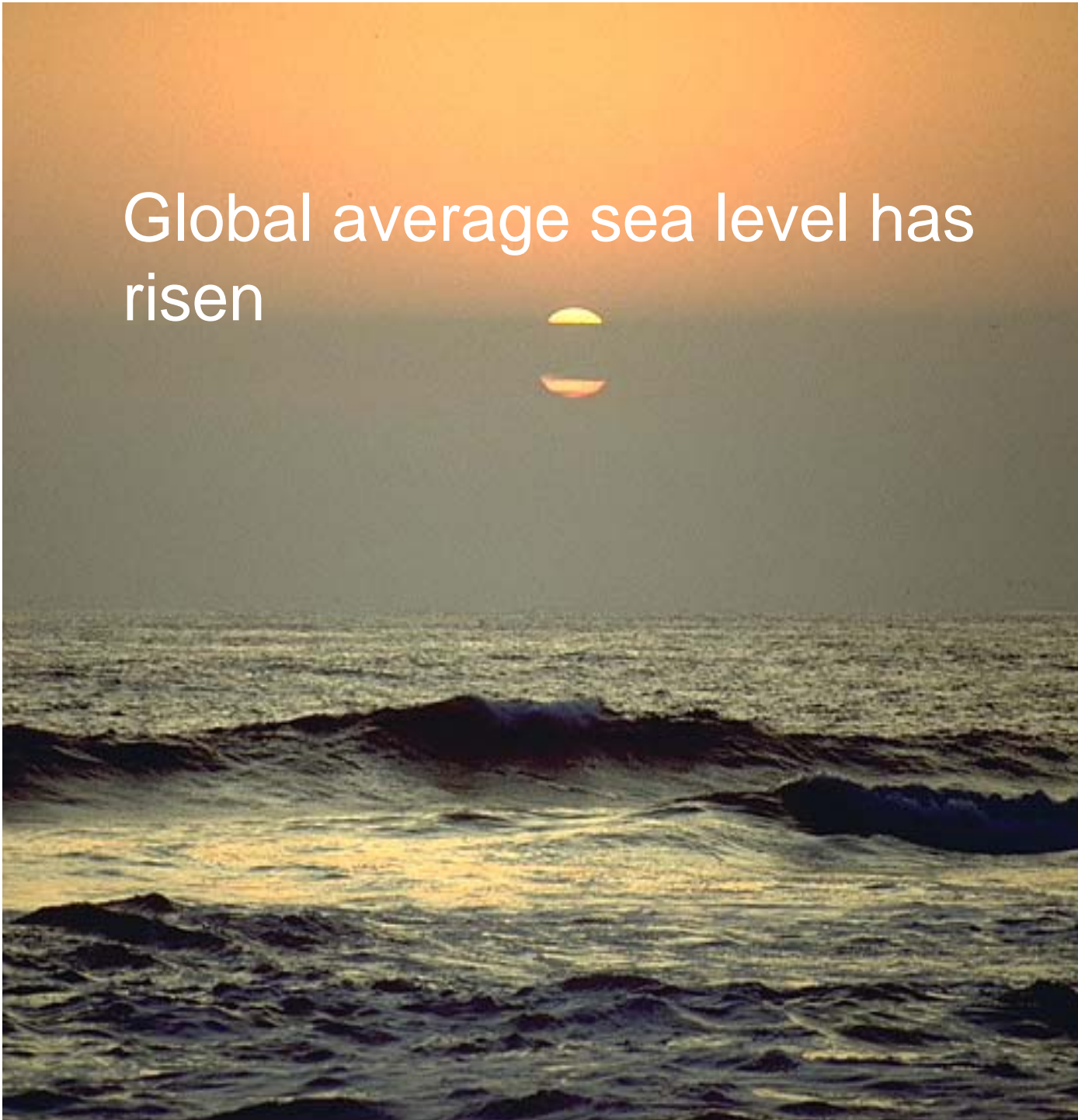
Trend in Arctic sea-ice extent (relative to 1973 to 1996)



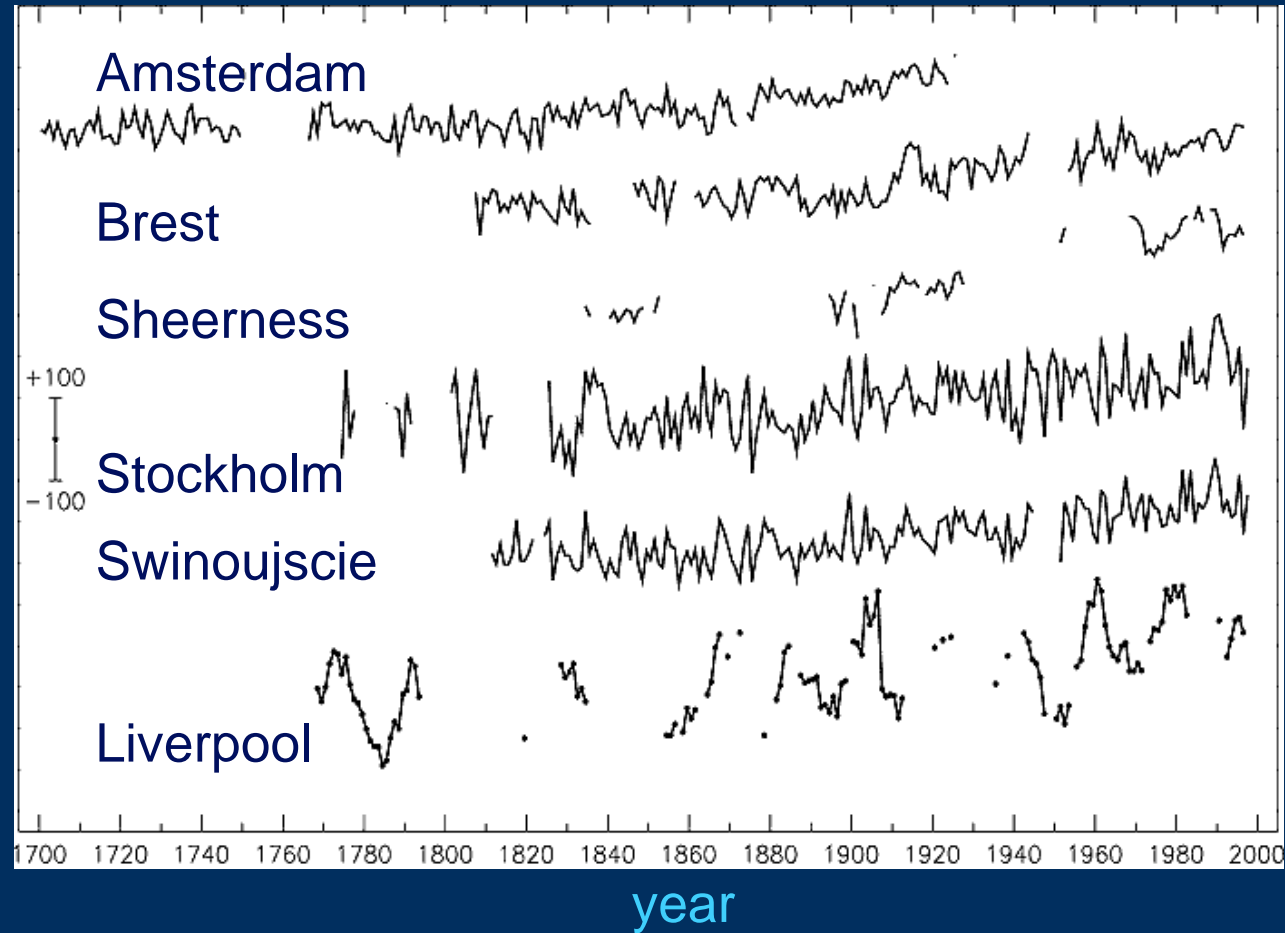
IPCC TAR, 2001

Global average sea level has risen

IPCC TAR
(2001)



Sea-level rise at N. European locations over the last 300 years



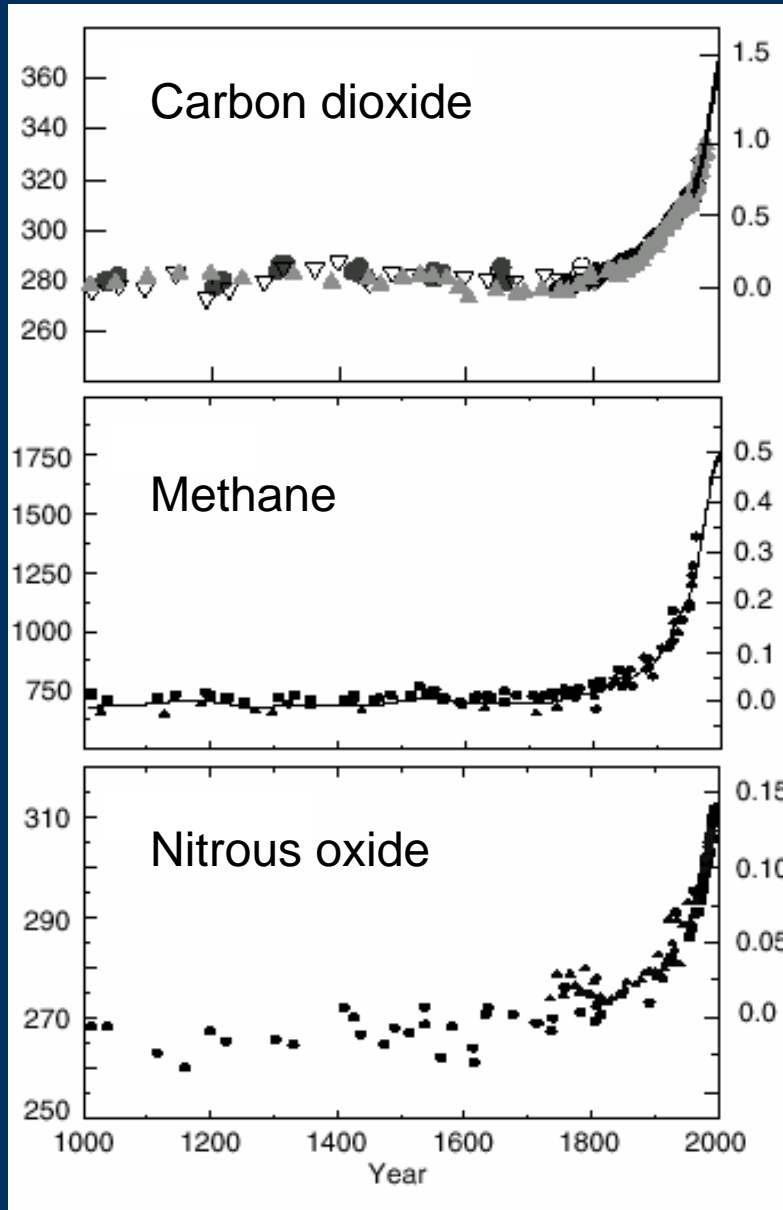
IPCC TAR, 2001

Atmospheric concentration

CO₂
(ppm)

CH₄
(ppb)

N₂O
(ppb)



Radiative forcing (W m⁻²)

Trends in
some
radiatively
active gases

IPCC TAR, 2001



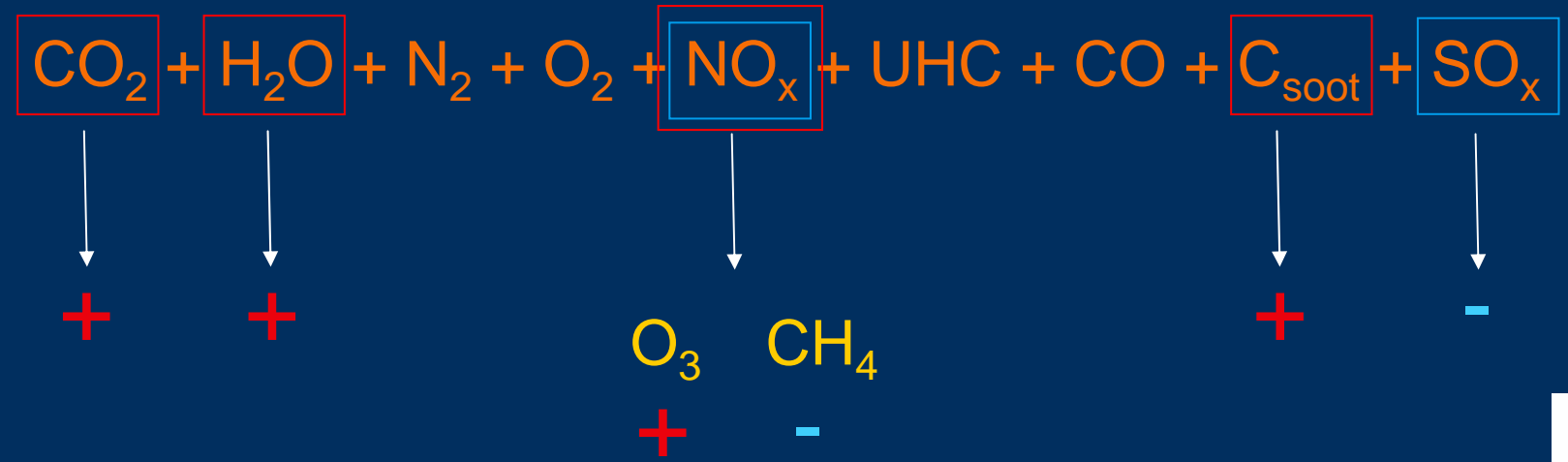
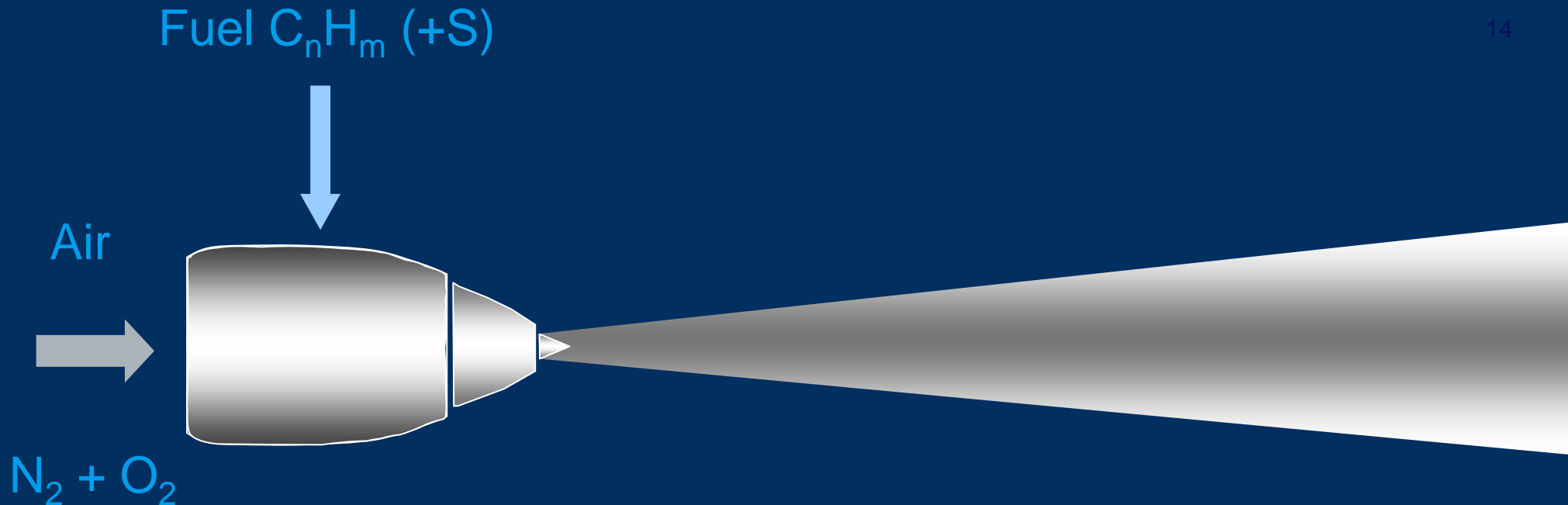
“An increasing body of observations gives a collective picture of a warming world and other changes in the climate system”

IPCC TAR, 2001

Section 2



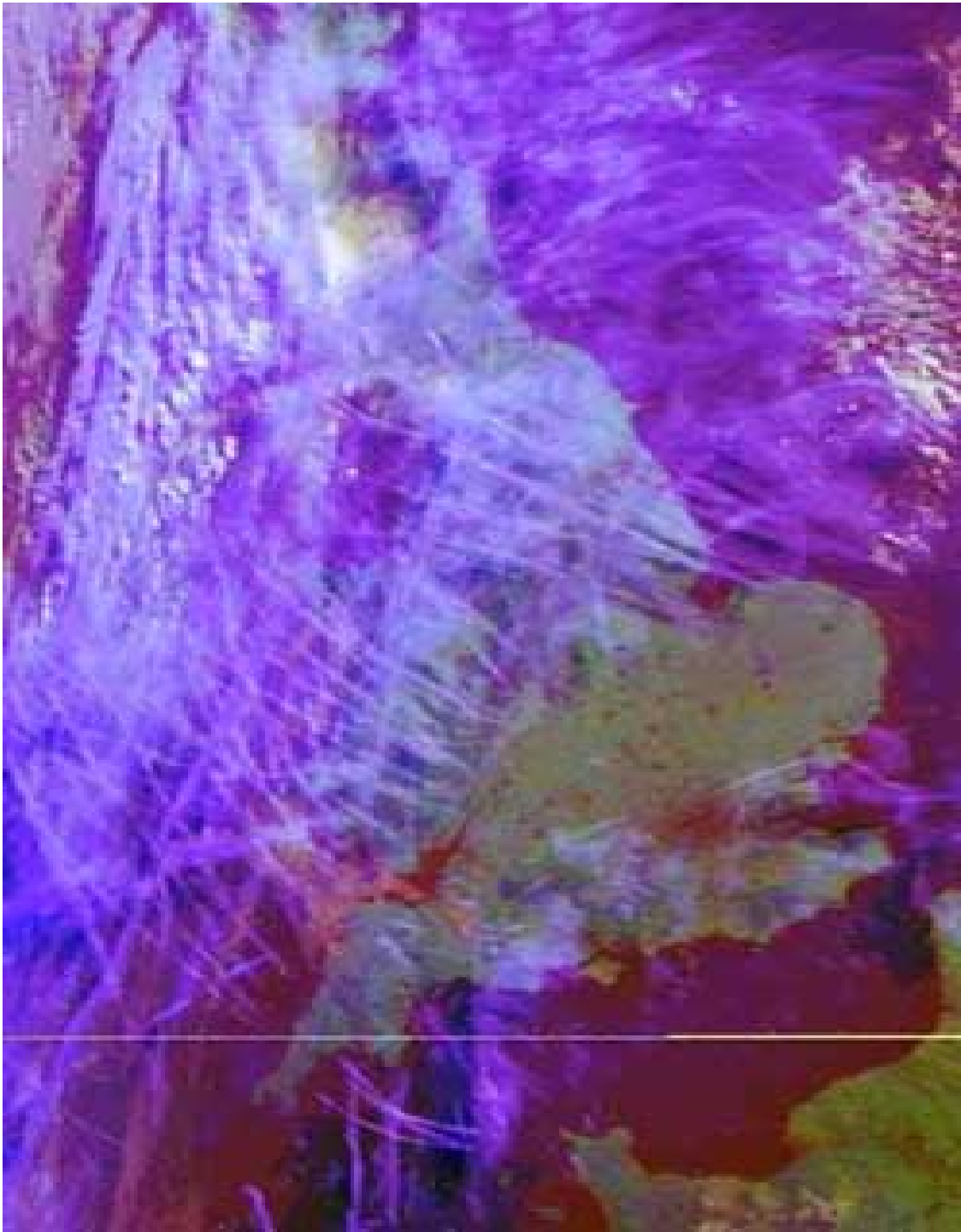
How does
aviation
affect
climate?





...and contrails (+)

...and results in
enhanced cirrus
cloud coverage (+)

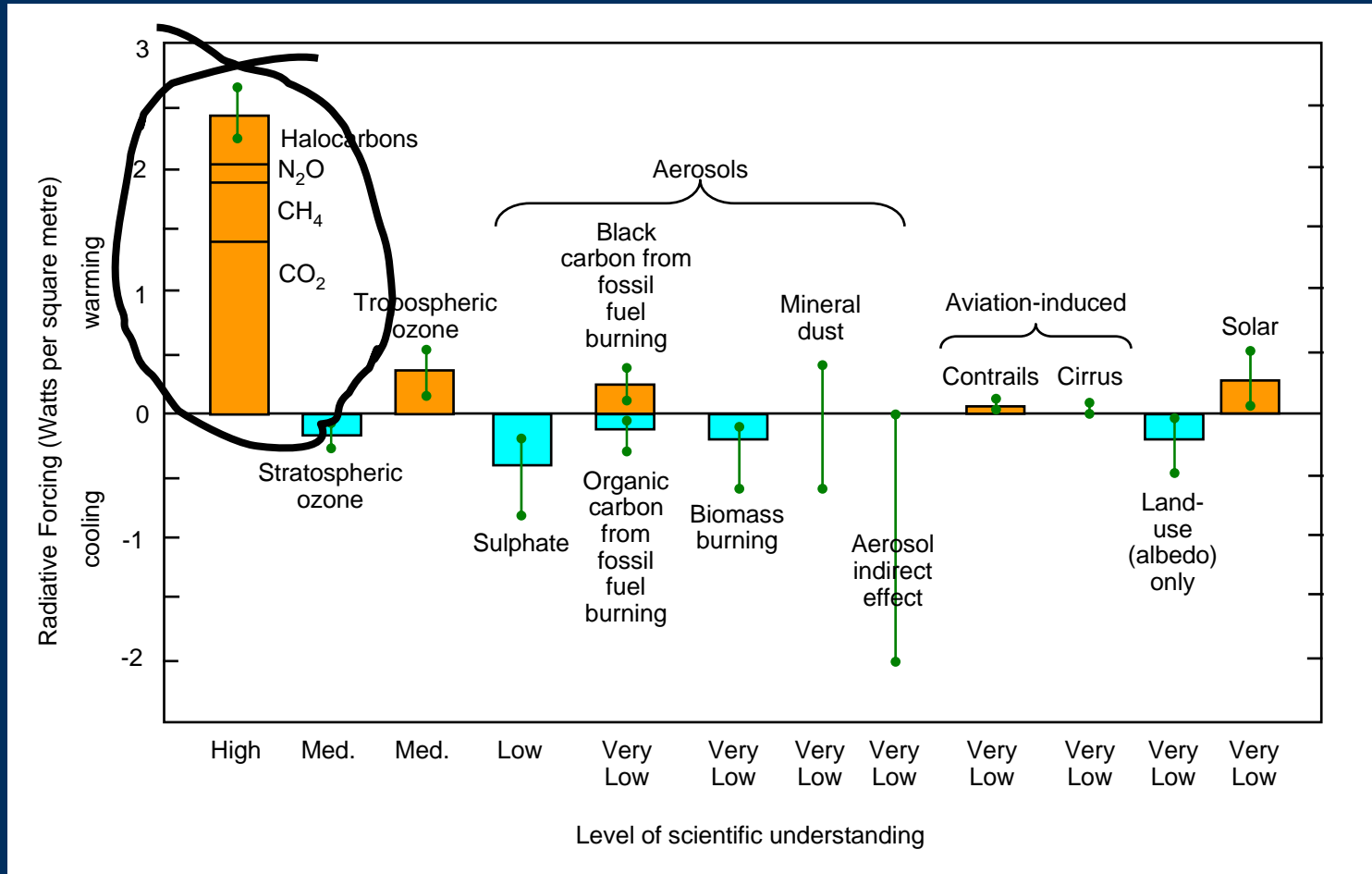


How do we measure these effects?

- **Radiative forcing** is an index of the importance of a factor as a potential climate change mechanism
- It is expressed in Watts per square metre (W m^{-2})

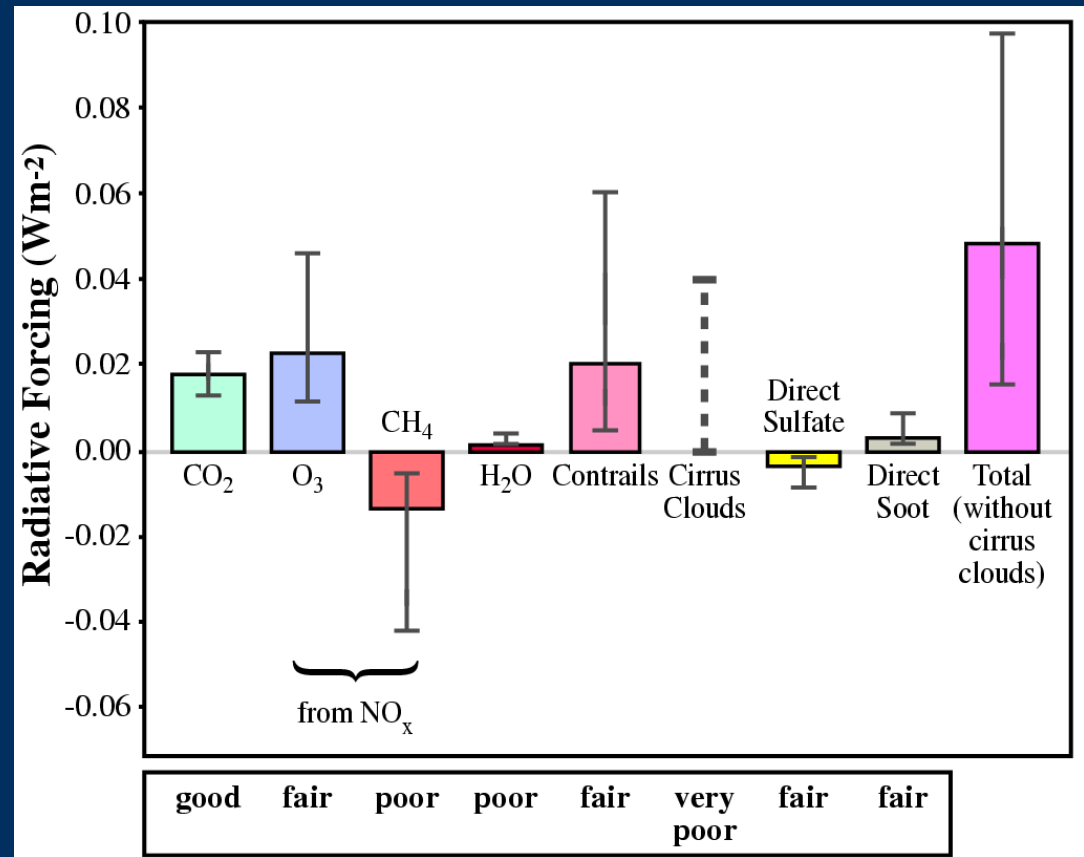


The global mean *radiative forcing*, all agents



Radiative forcing from aviation in 1992

- A radiative forcing of 0.05 W m^{-2} in 1992
- About 3.5% of the total radiative forcing from all anthropogenic activities

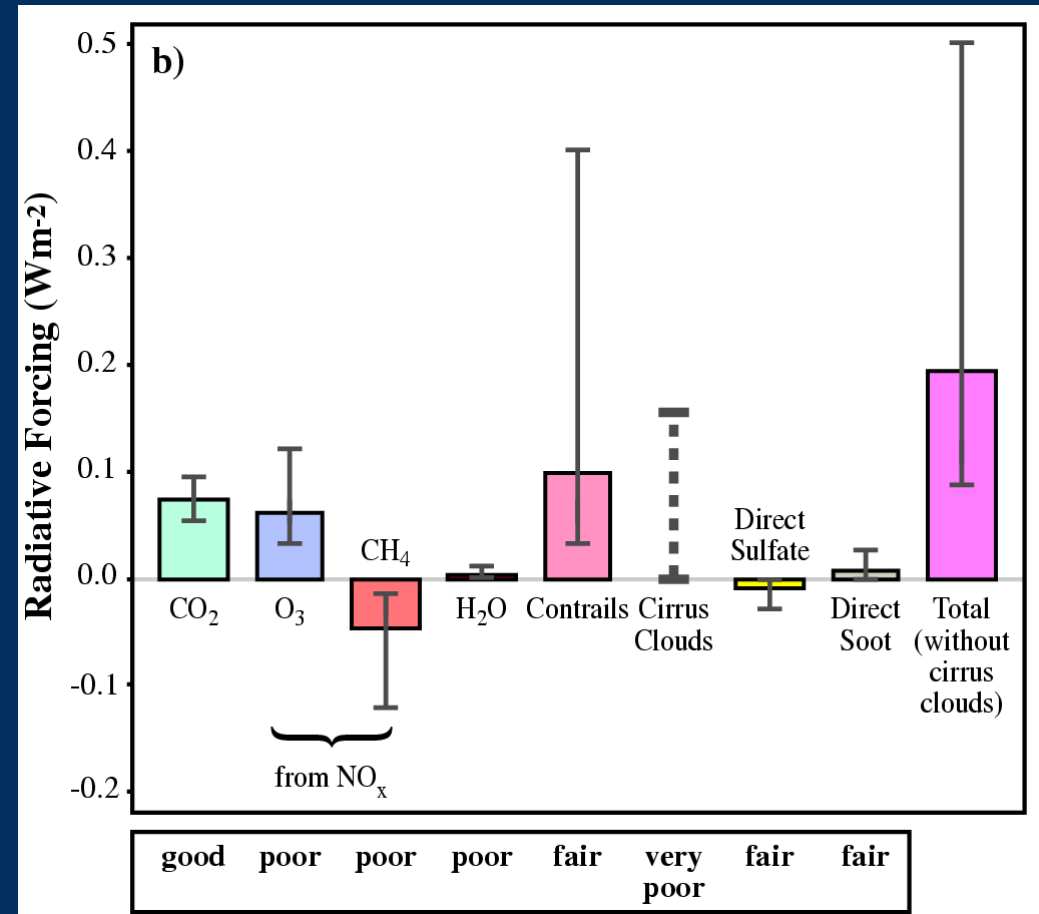


IPCC, 1999

Radiative forcing from aviation in 2050

20

- A radiative forcing of 0.19 W m^{-2} in 2050 for the reference scenario (Fa1)
- About 5% of the total radiative forcing from all anthropogenic activities



IPCC, 1999

Section 7

Conclusions

Myths: growth, technology and mitigation

- There are technological ‘fixes’ under current and projected rates of growth with evolutionary technology development

“Although improvements in aircraft and engine technology and in the efficiency of the air traffic system will bring environmental benefits, these will not fully offset the effects of increased emissions resulting from projected growth in aviation”

IPCC (1999)

Conclusions

- Aviation “is more than just CO₂”
- Aviation invokes a range of *non-Kyoto* effects including O₃, CH₄ (reduction) (both from NO_x), particles, contrails & cirrus
- The quantification of some effects remains uncertain
- The enhancement of cirrus could amount to more than all the other effects together
- There are complex tradeoffs in effects, technology and operations

SUMMARY OF OPTIONS

- Speed up rate of technological improvement;
- Deliver step change in aircraft technology;
- Speed up the rate of fleet replacement;
- Improved operational practices;
- Emissions trading;
- Emissions charges/taxes;
- Carbon offset;
- Constrain growth – and hence benefits.

A FINAL THOUGHT

WHAT ARE WE WILLING TO SACRIFICE ?

- Access aviation by public transport.
- In flight entertainment and catering – 5% annual emissions.
- 5 Tons Catering on Transatlantic B747.
- 25 kgs. of baggage.
- Duty free on collection.
- Go to work by bus.
- Energy efficiency at home?

