A science primer on the non-CO_2 effects of aviation

Klima – Audran Borella

IFATCA meeting - Eurocontrol - Brussels

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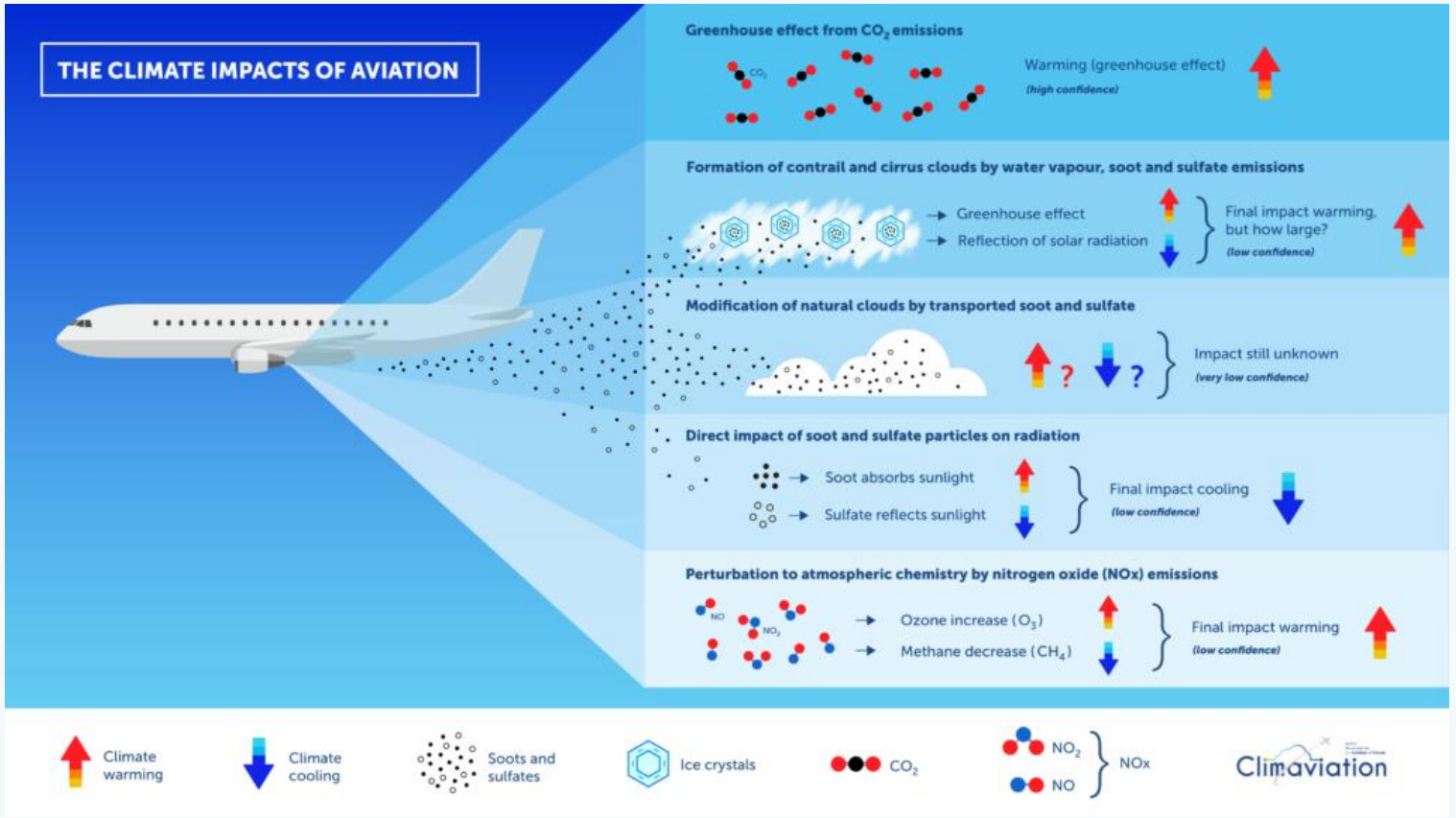
The climate impacts of aviation, beyond CO_2

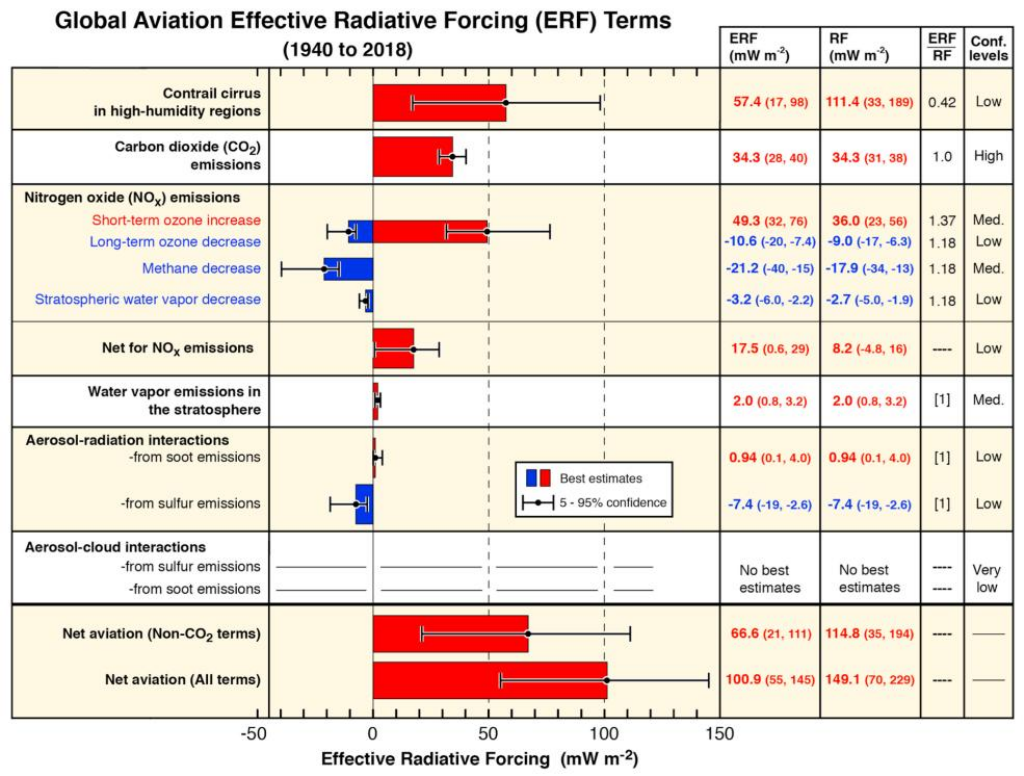


Small but significant climate effects for aviation

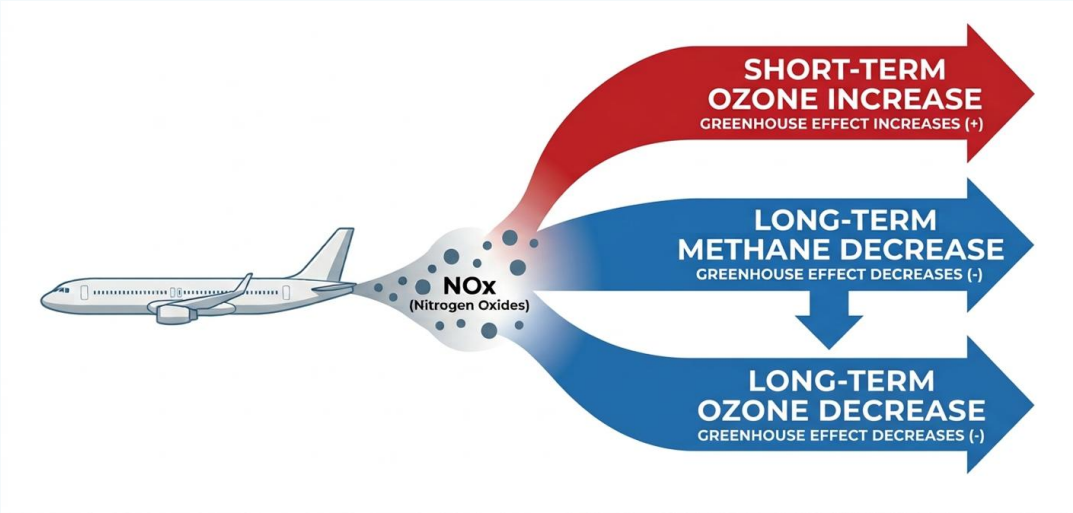
-> most recent global assessment dates from 2021

-> aviation non-CO_2 effects must be accounted for

-> the overall uncertainty is dominated by non-CO_2 effects



NOx: the science is not yet mature



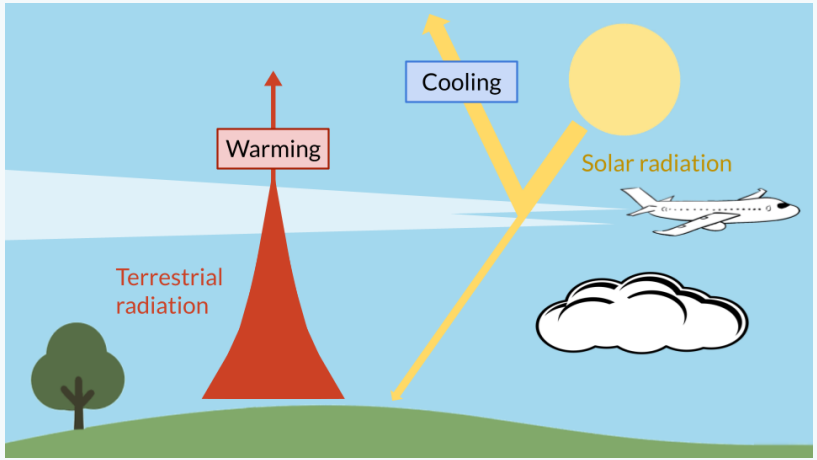
+ small effect from stratospheric water vapor

Overall, **NOx emissions warm the climate**, but the warming for a specific flight strongly depends on the background atmosphere

-> no strong consensus on the modelling of the NOx impact at the flight level

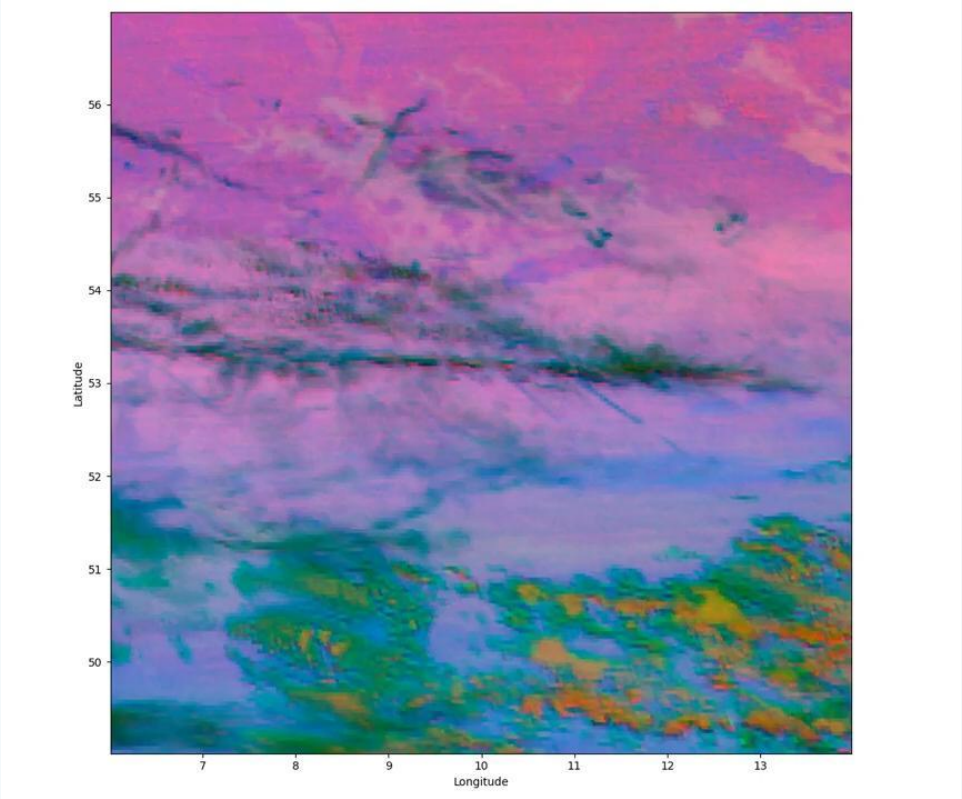
-> mitigation solutions: mostly next generation of engines rather than in operations, so a topic for engine manufacturers

Contrails: the science is more advanced



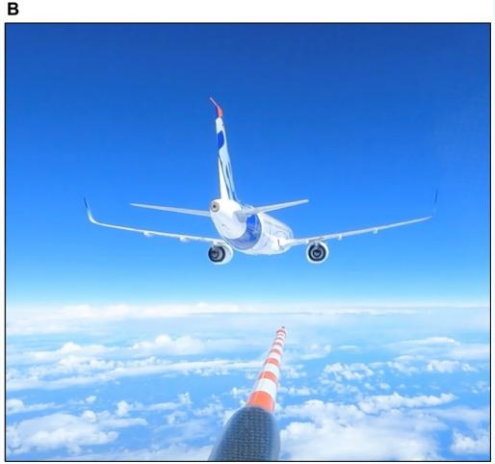
-> Contrails exert a greenhouse effect and reflect sunlight, being **warming on average**

-> **A few number of flights** are responsible for the majority of



Contrails: the science is more advanced

Various observation campaigns conducted (e.g., VOLCAN)

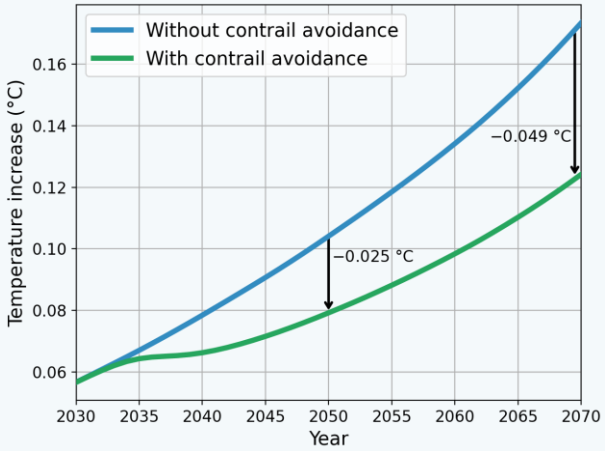


Dischl et al. (2026)

Modelling improvements Weather forecasts and contrail impact models

Contrails.org map

"The most significant climate risk associated with contrail avoidance is inaction." *Smith et al. (2026)*



Klima calculations using AeroMAPS

Turning uncertainty into climate advantage

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