The use of NOx-O3 algorithmic climate change functions for air-traffic optimisation

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The analysis of NO_x-O_3 effects from optimised air traffic using algorithmic climate change functions (aCCFs)

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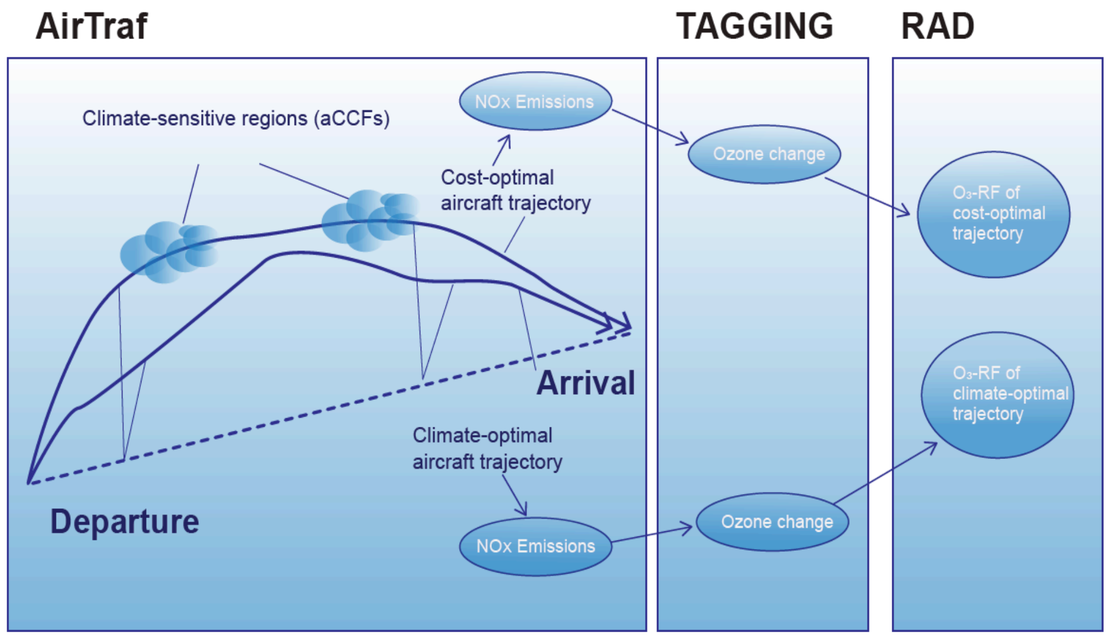
Motivation

- Aviation induced warming includes CO_2 (<35%) and non-CO_2 effects (>65%) from NO_x, H_2O, contrails and direct aerosols [1].
- The climate impact of non-CO_2 emissions are characterised by the meteorology, emission location and time [2].
- Algorithmic Climate Change Functions (aCCFs) [3] are response models that use meteorological data to estimate the climate impact of emissions at a given location and time.
- We need to **verify the effectiveness of aCCFs in generating green trajectories** that avoid climate sensitive regions.
- The focus here is specifically on **verifying O_3 aCCFs** which are expected to predict NO_x impact on Ozone.



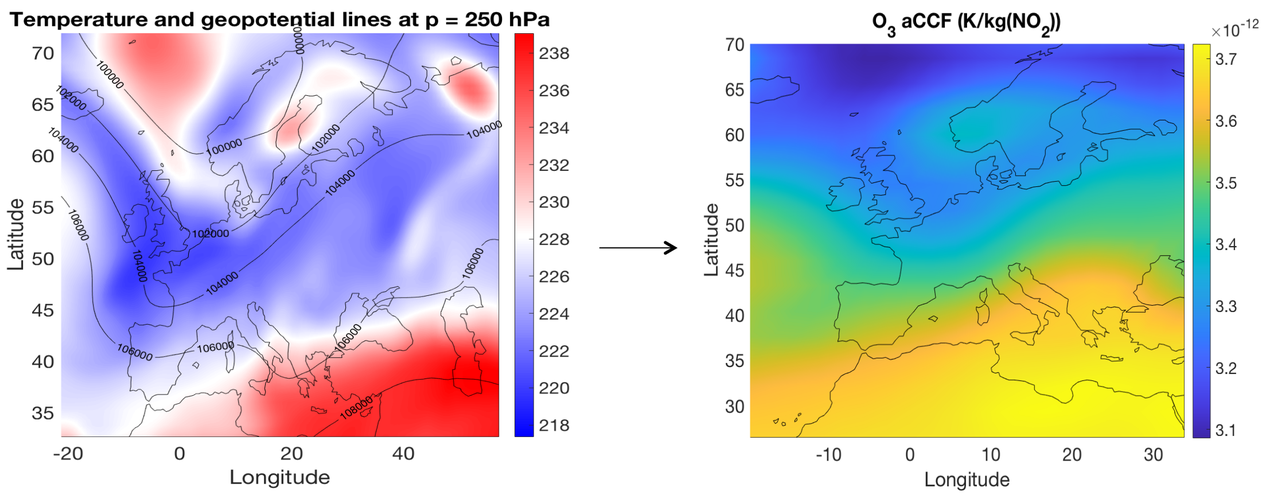
Simulation setup

Ozone aCCFs

- O_3 aCCFs are dependent on temperature and geopotential:

$$\mathrm{aCCF}_{\mathbf{O_3}}(\mathrm{T}, \mathbf{\Phi}) = \beta_{\mathbf{0}} + \beta_{\mathbf{1}}\mathrm{T} + \beta_{\mathbf{2}}\mathbf{\Phi} + \beta_{\mathbf{3}}\mathrm{T}\mathbf{\Phi}$$

- The verification process will provide insight on the capability of O_3 aCCFs in predicting NO_x effects on Ozone from optimised air traffic.



Weather situation (T, Φ) → *Climate impact of NOx on O_3*

Verification Approach

- Optimise EU air traffic on days characterised by high variability of NO_x-O_3 aCCFs.
- Both horizontal and vertical re-routing is considered.
- The flight traffic emissions are tracked and used in a 4-month chemistry simulation.
- A direct climate impact comparison is made with cost-optimised air traffic.

Expected results

At the end of the project, the following is expected:

- The extent to which O_3 aCCFs are useful in predicting NO_x-O_3 impact from aviation re-routing procedures.
- Radiative forcing of Ozone from climate-optimised air traffic is lower than for cost-optimised traffic at the end of the simulation.

Air traffic optimised on:	Cost optimal	Climate optimal	Difference
Winter day	10.67	10.64	0.03
Summer day	8.85	8.73	0.12

Mean-adjusted O_3 RF (mW/m^2) from optimised air traffic

References

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