

# REDUCING AVIATION EMISSIONS AND FUEL BURN BY RE-ROUTING TRANSATLANTIC FLIGHTS

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**Abstract.** After decades of limited situational awareness in the mid-North Atlantic, full satellite coverage will soon be available. Routes could now be altered to exploit the wind field fully and reduce fuel use. When aircraft speed and altitude are constant, the fuel flow rate per unit time is also constant and the optimal route has the minimum journey time. Here we show that changes to current practice could significantly reduce fuel use.

Flights between New York and London, from 1<sup>st</sup> December, 2019 to 29<sup>th</sup> February, 2020 are considered. Optimal control theory is used to find the minimum flight time through wind fields from a global atmospheric re-analysis dataset. The aircraft is assumed to fly at Flight Level 340 with airspeeds ranging from 200 to 270 m s<sup>-1</sup>. Since fuel burn and greenhouse gas emissions are directly proportional to the product of time of flight and airspeed, this quantity, air distance, is used as a measure of route fuel efficiency.

Minimum time air distances are compared with actual Air Traffic Management tracks. To allow clearer comparisons between the fuel efficiency of daily ATM tracks and optimised routes a new quantity,  $W_{\text{route}}$ , is introduced. This is defined as the ratio of the average headwind along the route to the airspeed. Potential air distance savings range from 0.9 to 7.5% when flying west and from 0.8 to 16.3% when flying east. Thus large reductions in fuel consumption and emissions are possible immediately, without waiting decades for incremental improvements in fuel-efficiency through technological advances.

**Keywords:** route optimisation, fuel efficiency, ATM tracks, minimum flight time, mid-North Atlantic wind field