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How will climate change affect aviation?

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The climate is changing, not just where we live at ground level, but also where we fly in the upper troposphere and lower stratosphere. Climate change has important consequences for aviation, because the atmosphere's meteorological characteristics strongly influence flight routes, journey times, and turbulence. This presentation will review the possible impacts of climate change on aviation, which have only recently begun to emerge (as opposed to the impacts of aviation on climate change, which have long been recognised).

Turbulence currently injures hundreds of air passengers each year worldwide, costing airlines hundreds of millions of dollars and occasionally causing structural damage to planes. To investigate the influence of climate change on turbulence, we diagnose an ensemble of 21 clear-air turbulence measures from climate model simulations. We find that turbulence strengthens significantly under climate change, all around the world, in all seasons, and at a wide range of aircraft cruising altitudes. For example, within the transatlantic flight corridor in winter at around 39,000 feet, the occurrence of light turbulence increases by an ensemble-mean value of 59% (with an intra-ensemble range of 43–68%), light-to-moderate by 75% (39–96%), moderate by 94% (37–118%), moderate-to-severe by 127% (30–170%), and severe by 149% (36–188%). These findings underline the urgent need to improve the skill of operational clear-air turbulence forecasts, to avoid increases in on-board discomfort and injuries in the coming decades.

To investigate the influence of climate change on flight routes and journey times, we feed atmospheric wind fields generated from climate model simulations into a routing algorithm of the type used operationally by flight planners. We focus on transatlantic flights between London and New York, and how they change when the atmospheric carbon dioxide (CO_2) concentration is doubled. We find that a strengthening of the prevailing jet-stream winds causes eastbound flights to significantly shorten and westbound flights to significantly lengthen in all seasons. For example, eastbound and westbound crossings in winter become approximately twice as likely to take under 5 hours 20 minutes and over 7 hours, respectively. Even assuming no future growth in aviation, the extrapolation of our results to all transatlantic traffic suggests that aircraft will collectively be airborne for an extra 2,000 hours each year, burning an extra 7.2 million gallons of jet fuel at a cost of US$ 22 million, and emitting an extra 70 million kg CO_2.

The above findings provide further evidence of the two-way interaction between aviation and climate change, which is an emerging research area that deserves further study.