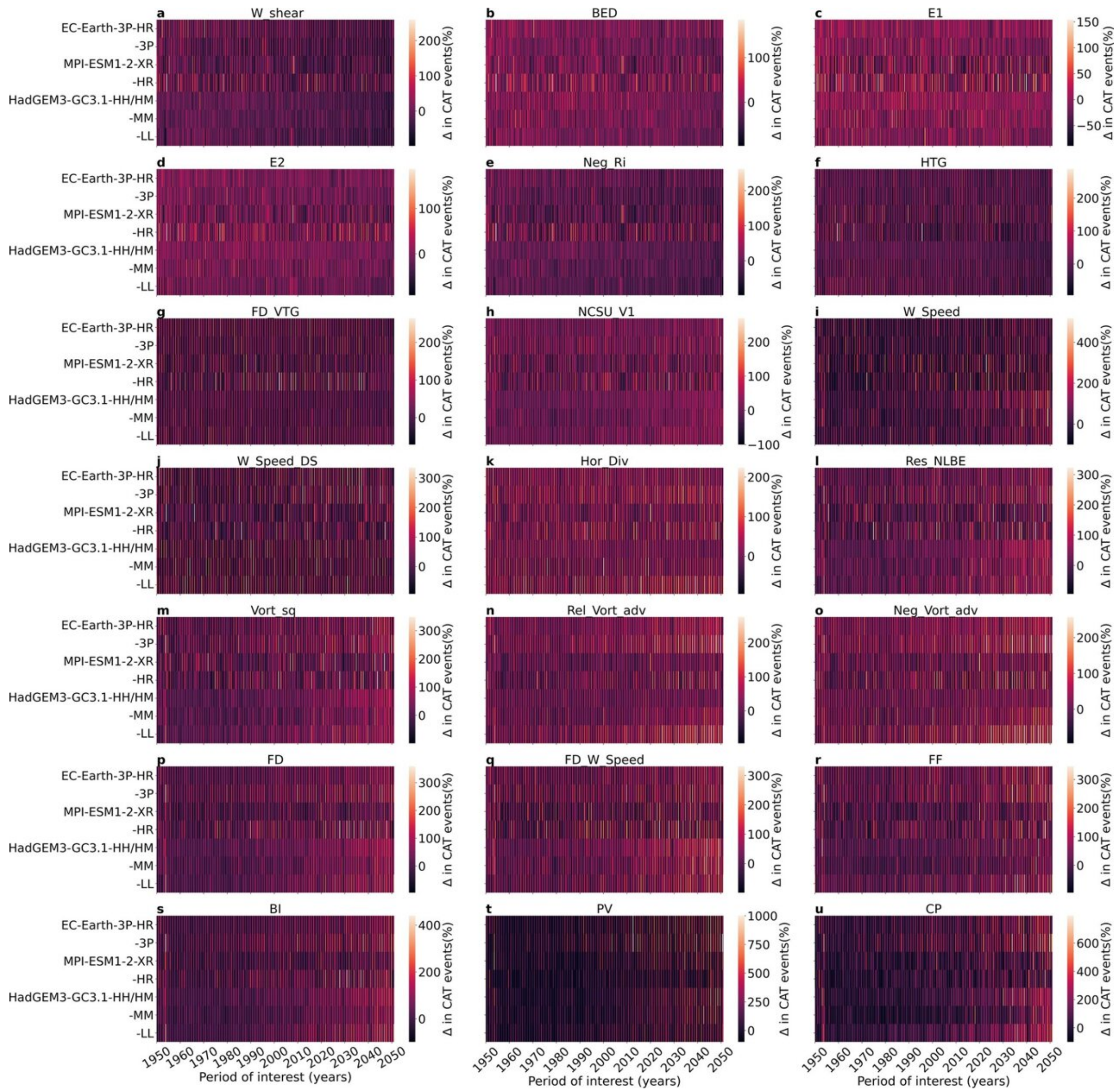
The hidden danger of climate change on air travel: A more turbulent future

March 14 2023, by Justin Jackson



The projected change in moderate CAT encounters from the threshold values for twenty-one indices that represent CAT across time. The percentage change in time for the three chosen CMIP6 GCMs is also shown, with each sub model included. Findings are averaged across each ensemble member (if applicable). The range of percentage change, shown through color bars within the subplots, differ and increase from a to u. Credit: *Climate Dynamics* (2023). DOI: 10.1007/s00382-023-06694-x

Atmospheric turbulence accounts for 71% of in-flight weather-related injuries, and according to scientists at the University of Reading, U.K., turbulence is only worsening with global warming. While winter is typically the most turbulent season, modeling suggests that by the year 2050, summers will be as turbulent as winters were back in the 1950s.

The paper, "Clear-air turbulence trends over the North Atlantic in high-resolution climate models," has been published in the international journal *Climate Dynamics*.

Clear-air turbulence (CAT) is one of the more dangerous weather-related hazards. It usually develops in cloud-free environments of the upper-level atmosphere; offering no visual clues to pilots and undetectable by onboard radar, these events seemingly come out of nowhere. Prolonged exposure to turbulence will shorten the fatigue life, which is the time the aircraft can be in service. Aircraft fittings can be damaged and severe structural damage can result from more intense clear-air turbulence. In extremely rare cases, this could even lead to the break-up of the aircraft. During moderate turbulence, unrestrained items of cargo, passenger luggage or passengers themselves can collide, causing damage or injury.

In December 1997, a Boeing 747, flight UA826 operated by United Airlines, encountered a CAT event en route from Tokyo to Hawaii. The

Boeing moved upward at 1.8 g (g-force), sideways at 0.1 g, and six seconds later, the aircraft dropped rapidly, causing a negative g-force of -0.8g. One passenger died and several passengers and crew sustained serious injuries. The aircraft was retired early, by one year.

Transatlantic air travel often confronts CAT due to the presence of the mid-latitude, eddy-driven jet stream over the North Atlantic. According to the researchers, CAT events develop in regions of shear-driven instability. They are often found in upper-level jet streams, narrow bands of intense winds, which have a strong seasonal dependence.

The intensity of a jet stream depends on latitudinal horizontal temperature gradients. Due to the steepening of the pole-to-equator temperature gradient in the upper troposphere and lower stratosphere, jet streams are expected to intensify in wind shear with anthropogenic climate change.

The study used three global climate modeling simulators covering the period 1950–2050 in the formation analysis: the Hadley Center Global Environment Model in the Global Coupled configuration 3.1, the Max-Plank Institute model MPI-ESM1-2, and EC-Earth-3, a model created by 27 European research organizations and universities. By combining these models with 21 mechanisms for turbulent air flow, the researchers created a robust range of CAT-generated situations.

Based on the assessment, for every 1 °C of global near-surface warming, moderate CAT events will increase by 14% in summer and autumn and by 9% for winter and spring. Moderate turbulence is described as inflicting vertical accelerations of up to 0.5g.

In a previous study by co-author physicist Paul D. Williams, professor of atmospheric science in the Department of Meteorology at the University of Reading, titled "Increased light, moderate, and severe clear-air turbulence in response to climate change," CAT encounters were projected to increase by 40% to 170% over the North Atlantic with double the preindustrial CO_2 atmospheric concentrations.

With increased turbulence in all seasons, more fights will encounter CAT events on current flight paths. One option for airlines will be to attempt to avoid areas where CAT forms. This might cause longer transatlantic flight times and thousands of additional hours of accumulated flight and fuel costs—a good reminder that the seatbelt sign is there for a reason, and keeping yours on even when the light is off might be the safest plan in the future.

More information: Isabel H. Smith et al, Clear-air turbulence trends over the North Atlantic in high-resolution climate models, *Climate Dynamics* (2023). DOI: 10.1007/s00382-023-06694-x