

Researchers suggest global warming will cause more weight restriction days for airlines

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An airliner lands at sunset

(Phys.org)—A pair of researchers with Columbia University is suggesting that global warming could cause airlines to experience more weight restriction days in the future. In their paper published in the *American Meteorological Society Journal*, Ethan Coffel and Radley Horton describe a study they conducted on the likely impact on the airline business as temperatures worldwide heat up.

One of the things that impacts an airplane's ability to take off is temperature—the warmer it is, the less dense the air, which impacts lift. In practical terms, that means that an airplane will have to be traveling faster to become airborne on a hot day, than a cold day, if it weighs the

same for both trips. For commercial airliners, moving faster generally means remaining on the ground longer to give the craft more time to build up speed. The other alternative is to reduce weight. For airports with short runways, this is a problem—many already experience weight restriction days when it gets hot. In this new effort, the researchers suggest that because the future it likely to present us with more hot days, that will mean more weight restriction days for some airports.

To gain a better perspective on what airlines (and their passengers) might be facing, the researchers looked at four airports: Denver International, Phoenix Sky Harbor, La Guardia in New York and Dulles Airport, outside of Washington D.C. They noted annual average temperatures in the past and altitude then factored in an increase in temperature—the [worst case scenario](#) of a four to five degree rise by 2100. They noted also the number of weight restriction days already experienced by the four airports. They calculated that the airport in Phoenix is likely to experience very few extra weight restriction days, as it has very long runways. Denver, La Guardia and Dulles on the other hand, are all likely to see up to 45 more weight restriction days a year as early as 2070.

Airlines, the team suggests, will have to adjust by dropping luggage weight, or the numbers of passengers a plane can carry, as it's not likely runway length will be increased. It's also possible that airplane technology will carry the day, offering lighter planes and engines with more thrust.

More information: Climate change and the impact of extreme temperatures on aviation, *American Meteorological Society Journal*, dx.doi.org/10.1175/WCAS-D-14-00026.1

Abstract

Temperature and airport elevation significantly influence the maximum allowable takeoff weight of an aircraft by changing the surface air

density and thus the lift produced at a given speed (Anderson 1999). For a given runway length, airport elevation, and aircraft type there is a temperature threshold above which the airplane cannot take off at its maximum weight and thus must be weight restricted. The number of summer days necessitating weight restriction has increased since 1980 along with the observed increase in surface temperature. Climate change is projected to increase mean temperatures at all airports and significantly increase the frequency and severity of extreme heat events at some (Scherer and Diffenbaugh 2013; Donat et al. 2013; IPCC 2012). These changes will negatively affect aircraft performance, leading to increased weight restrictions especially at airports with short runways and little room to expand. For a Boeing 737-800 aircraft, we find that the number of weight restriction days between May and September will increase by 50-200% at four major airports in the United States by 2050-2070 under the RCP8.5 emissions scenario (Moss et al. 2010). These performance reductions may have a negative economic effect on the airline industry. Increased weight restrictions have previously been identified as potential impacts of climate change (National Research Council 2008; US Global Change Research Program 2009), but this study is the first to quantify the effect of higher temperatures on commercial aviation. Planning for changes in extreme heat events will help the aviation industry to reduce its vulnerability to this aspect of climate change.

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