Pacific flights create most amount of ozone

September 4 2013

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The amount of ozone created from aircraft pollution is highest from flights leaving and entering Australia and New Zealand, a new study has shown.

The findings, which have been published today, Thursday 5 September, in IOP Publishing's journal *Environmental Research Letters*, could have wide-reaching implications for aviation policy as ozone is a potent greenhouse gas with comparable short-term effects to those of carbon dioxide (CO_2).

The researchers, from Massachusetts Institute of Technology, used a global chemistry-transport model to investigate which parts of the world are specifically sensitive to the creation of ozone and therefore which individual flights create the highest amounts.

The results showed that an area over the Pacific, around 1000 km to the east of the Solomon Islands, is the most sensitive to aircraft emissions. In this region, the researchers estimated that 1 kg of aircraft emissions – specifically oxides of nitrogen (NOx) such as nitric oxide and nitrogen dioxide – will result in an extra 15 kg of ozone being produced in one year.

The sensitivity in this area was around five times higher than the sensitivity in Europe and 3.7 times higher than the sensitivity in North America.

Lead author of the paper, Steven Barrett, said: "Our findings show that the cleanest parts of the atmosphere exhibit the most dramatic response to new emissions. New emissions in this part of the Pacific will result in a relatively larger response from the atmosphere."

In an analysis of around 83,000 individual flights, the researchers found that the 10 highest ozone-producing flights either originated, or were destined for, either New Zealand or Australia. A flight from Sydney to Bombay was shown to produce the highest amount of ozone – 25,300 kg – as the majority of the flight passed through the area in the Pacific where the sensitivity was the highest.

Furthermore, the aircraft leaving and entering Australia and New Zealand are usually very large and the flight times are often very long, meaning more fuel would be burnt and more NOx emitted.

Ozone is a relatively short-lived greenhouse gas, and its production and destruction relies heavily on the local chemical state of the atmosphere, so its effects are felt in specific regions at specific times rather than on a global scale.

The researchers found that flights in October cause 40 per cent more

NOx emissions than flights in April.

"There have been many studies of the total impact of civil aviation emissions on the atmosphere, but there is very little knowledge of how individual flights change the environment.

"The places that the sensitivities are highest now are the fastest growing regions in terms of civil aviation growth, so there could potentially be ways to achieve significant reductions in the climate impact of aviation by focusing on re-routing aircraft around the particular regions of the world where ozone formation is highly sensitive to NOx emissions.

"Of course, longer flights are going to burn more fuel and emit more CO2, so there will be a trade-off between increasing flight distance and other climate impacts, such as the effect of ozone. The scientific underpinning of this trade-off needs further investigation so that we have a better understanding and can see whether such a trade-off can be justified," continued Barrett.

More information: 'Temporal and spatial variability in the aviation NOx-related O3 impact' Christopher K Gilmore, Steven R H Barrett, Jamin Koo and Qiqi Wang 2013 *Environ. Res. Lett.* 8 034027. iopscience.iop.org/1748-9326/8/3/034027/article

Provided by Institute of Physics