The contribution of aviation to climate change is increasing. A recent study uses radiative forcing (RF) to quantify and update values on the impact of aviation on the climate. It reveals an increase in total aviation RF of 14 per cent over the period 2000-2005.

Radiative forcing (RF) is a measure of the imbalance between incoming solar radiation and outgoing infrared radiation at the surface of the atmosphere. It is measured in watts per square metre (W/m²). Aviation produces a number of pollutants which influence how much radiation becomes trapped within the atmosphere. These pollutants include CO₂, nitrogen oxides, water vapour, condensation trails, aviation-induced cloudiness (AIC), sulphate particles and soot particles.

In the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report¹, aviation RF was quantified for 2005 using data from 2000. However, the average annual passenger traffic growth rate has increased by 38 per cent between 2000 and 2007.

This international study, supported by the EU QUANTIFY project², calculated current and future figures on aviation RF in the light of the recent growth in air traffic and fuel use. It used several models to account for the different components of aviation RF. No adequate model exists for AIC so this was estimated using fuel usage figures.

The total aviation RF for 2005, excluding AIC, is 0.055 Watts/m², which is an increase of 14 per cent over the estimation for 2000. This is about 3.5 per cent of overall anthropogenic RF in 2005. When AIC is included, the total aviation figure is 0.078 Watts/m², which comprises about 4.9 per cent of total anthropogenic RF. However, there is a level of uncertainty around the RF calculations. According to IPCC’s five grade system, the total aviation RF is rated as having a low level of scientific understanding i.e. it has a high uncertainty. This is mainly due to the non-CO₂ factors, particularly AIC.

To estimate future values of aviation RF, the research used two IPCC scenarios of climate change (A1 and B2). In basic terms, A1 involves technological solutions to climate change and B2 focuses on local solutions. Simplified calculations of total aviation RF in 2050 indicate increases by factors of 3 to 4 over the 2000 value which represents about 4 to 4.7 per cent of the total RF.

Considering these updated figures, the research outlines a range of options for reducing emissions, mainly focusing on CO₂. The efficiency of aircraft could be improved though technologies such as blended wing body aircraft and lightweight materials. Alternative fuels have less potential to reduce emissions since liquid hydrogen requires development and there are environmental and social concerns about biofuels.

In terms of policy, fuel taxation is unpopular in many countries so a market-based tool seems more appropriate, such as the EU Emissions Trading Scheme (EU-ETS). Earlier this year, a directive was passed to incorporate air emissions into the EU-ETS³. In order to inform policy, more accurate measures of the effects of non-CO₂ emissions are needed, including a model to assess the effects of AIC.

2. QUANTIFY was supported by the European Commission under the Sixth Framework Programme. See: http://www.pa.op.dlr.de/quantify/


Contact: d.s.Lee@mmu.ac.uk

Theme(s): Climate change and energy, Sustainable mobility