MARGINAL CLIMATE AND AIR QUALITY COSTS OF AVIATION EMISSIONS

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ABSTRACT

Aviation emissions have been found to cause 5% of global anthropogenic radiative forcing and ~16,000 premature deaths annually due to impaired air quality. When aiming to reduce these impacts, decision makers often face trade-offs between different emission species or impacts in different times and locations. To inform rational decision-making, this study computes aviation's marginal climate and air quality impacts per tonne of species emitted and accounts for the altitude, location, and chemical composition of emissions. Climate impacts are calculated using a reduced-order climate model, and air quality-related health impacts are quantified using marginal atmospheric sensitivities to emissions from the adjoint of the global chemistry-transport model GEOS-Chem in combination with concentration response functions and the value of statistical life. The results indicate that 90% of the global impacts per unit of fuel burn are attributable to cruise emissions, and that 64% of all damages are the result of air quality impacts. Furthermore, nitrogen oxides (NO_x), carbon dioxide (CO_2), and contrails are collectively responsible for 97% of the total impact. Applying our result metrics to an example, we find that a 20% NO_x stringency scenario for new aircraft would reduce the net atmospheric impacts by 700m USD during the first year of operation, even if the NO_x emission reductions cause a small increase in CO_2 emissions of 2%. In such a way, the damage metrics can be used to rapidly evaluate the atmospheric impacts of market growth as well as emissions trade-offs of aviation-related policies or technology improvements. This research has been published in Environmental Research Letters and the talk will cover the background, methods, and key results from the study.