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CONCEPT OF CLIMATE-CHARGED AIRSPACE AREAS

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Abstract. Approximately two third of aviation's climate impact is caused by non-CO_2 effects, like the production of ozone and the formation of contrail-cirrus clouds, which can be effectively prevented by re-routing flights around highly climate-sensitive areas. Although climate-optimized re-routing results in slightly longer flight times, increased fuel consumption and higher operating costs, it is up to 60% more climate-friendly. However, if mitigation efforts are associated with a direct increase in costs, this immediately raises the question of the willingness of primarily profit-oriented airlines to act in a more climate-friendly manner and the passengers´ willingness to pay for environmental protection. In order to create an incentive for climate-optimized flying, a climate charge is imposed on airlines when operating in these areas. If climate-charged airspaces (CCAs) are (partly) bypassed, both climate impact and operating costs of a flight can be reduced: a more climate-friendly routing becomes economically attractive (explanation video). By implementing the precautionary and polluter-pays principles of environmental economics, the concept introduces key requirements of a sustainable development into the field of aviation. The proposed extension of the accounting system clearly reduces the discrepancy between the marginal costs estimated by the airlines and the consequential costs for society. Accordingly, this resolves the trade-off between economic viability and environmental compatibility and creates a financial incentive for climate mitigation. The feasibility of this concept is demonstrated on a small route network in the North Atlantic flight corridor (NAFC). If flights are completely re-routed around altered CCAs, on average more than 90 % of the mitigation potential of climate-optimized flying is achieved.

Keywords: Aviation, Non-CO_2 Effects, Climate Mitigation, Environmental Policy, Cost-Benefit-Analysis

INTRODUCTION

Global air traffic is projected to grow at rates (4-5%) well above the annual increase in fuel efficiency (1-2%). Consequently, aviation's contribution to anthropogenic emissions and the associated global warming is expected to increase. Almost two third of aviation's climate impact is caused by non-CO_2 effects, such as the NO_x-induced production of ozone or the formation of contrail induced cloudiness (CiC). These effects show highly non-linear dependencies on fuel consumption (Lee et al., 2009; Grewe et al., 2017). Therefore, the reduction of emission quantity alone is not a sufficient measure in order to mitigate non-CO_2 climate effects. Due to the high sensitivity of the climate impact on the location and the timing of the emission, the impact can be reduced by changing the flight pattern, represented by an adjustment in routing (see Fig. 1; Lührs et al., 2016; Grewe et al., 2017; Matthes et al., 2017) or a reduction of the general cruising altitude (Dahlmann et al., 2016). Although all of these changes result in slightly increased values of flight time, fuel burn and operating costs, they are significantly more climate compatible (up to -60%). If, however, mitigation efforts are associated with an increase in costs, questions immediately arise whether passengers are willing to pay for environmental protection and whether airlines are willing to act in a more climate-friendly manner. Within this study, the lack of incentivizing airlines to internalize their climate costs is tried to be closed by the introduction of climate-charged airspaces. The CCA concept addresses the question of how to include aviation's climate impact of non-CO_2 effects adequately into an environmental policy measure.