VOLCANIC, WEATHER AND CLIMATE EFFECTS ON AIR TRANSPORT

Ulrich Schumann
ulrich.schumann@dlr.de

Keywords: *volcanoes, weather, climate, ATM*

Abstract

Volcanic events, weather effects and climate have one thing in common: they require an intelligent air traffic management (ATM) to minimize the impact of volcanic eruptions, weather events and climate effects by proper aircraft operations. This paper presents examples from recent research, including the impact of the Eyjafjallajökull volcano eruption in Iceland in April 2010 affecting European air space over several weeks time, investigations of weather impact of safety such as from deep convection, and climate impact of aircraft emissions by aviation, in particular from contrails. This paper just provides as short summary of the issues discussed without details, which are described elsewhere.

1 Introduction)

This paper shows that volcanic events, weather effects and climate have one thing in common. All of them require a flexible flight route management for safe and efficient air transport. This paper summarizes experiences and results from all the three title key words:

2 The Eyjafjalla eruption in 2010 and the volcanic impact on aviation

DLR investigated the Eyjafjallajökull (short: Eyjafjalla) eruption and its impact on aviation. The visual detectability of airborne volcanic ash at various distances from the volcano is discussed based on observations and simulations with a radiative transfer model. Ash loads above threshold conditions for safe aviation (2 mg m^{-3}) as in spring 2010 should not be considered exceptional. A future research strategy to better prepare the aviation sector for future volcanic eruptions is outlined.

3 Mitigating the impact of adverse weather on aviation

Weather has a significant impact on the safety and efficiency of air traffic during all phases of flight. Especially information on adverse weather must be tailored to the user's needs, easy to understand, self-explaining and clear in its message. Progress has been achieved to develop a concept and tools to detect, track and predict hazardous weather elements and provide this information in simple unambiguous form to controllers and pilots. It has been demonstrated that these products make a significant contribution to raising the safety and efficiency of the air transport system.

4 Climate optimized air transport

Aviation climate impact is caused by CO2 and non-CO2 emissions where the climate effect of non-CO2 emissions depends on weather and aircraft route. Recent research shows that the largest climate impact form aviation results from contrail cirrus. Considerable potential exists to reduce the climate impact of aviation by weather-dependent climate-optimized air traffic management ("smart routing"). Here we summarize recent results on aviation cliamte impact and discuss various approaches to minimize the climate impact on a weather basis, requiring alternative operational concepts.

5 Air transport system requirements

Aircraft may deviate from their routine routes for safety, weather and climate reasons. Volcanic eruption presents an infrequent occurrence where aircraft are forced to deviate from their routes for safety. Safe flying under

weather aspects is a standard requirement. In addition better route optimizing may be required for safety and climate protection reasons. It is well possible that an improved optimizing of routes can contribute to reduced fuel consumption and costs if taking best weather information into account.

Intelligent ATM operations need to be developed to minimize the impact of weather events, large scale perturbations like volcanic ash clouds on efficient aircraft operations and to minimize the climate impact of aviation by selecting routes with minimum climate impact. A unique advantage of improving aviation operations by developing new ATM flow operations for all these purposes is that they are applicable to current and future aircraft designs. Future aircraft and ATM systems should provide more flexibility in flight routing (laterally and vertically). It may be possible to reduce fuel consumption and costs by better exploiting weather information at the same time as achieving safe, efficient and climate compatible operations.

Reference

Schumann, U. *Atmospheric Physics – Background, Methods, Trends.* Springer, Heidelberg, 2012, pp. 877, ISBN 978-3-642-30182-7, DOI: 10.1007/978-3-642-30183-4.

Copyright Statement