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Publication date
2018

Document Version
Final published version

Published in
Geophysical Research Abstracts

Citation (APA)
Matthes, S., Grewe, V., Lührs, B., Linke, F., Irvine, E., Shine, K., & Yin, F. (2018). Aviation MET Services for identifying climate-optimal aircraft trajectories. *Geophysical Research Abstracts*, *20*. https://meetingorganizer.copernicus.org/EGU2018/EGU2018-19180.pdf

Geophysical Research Abstracts
Vol. 20, EGU2018-19180, 2018
EGU General Assembly 2018

Aviation MET Service for identifying climate-optimal aircraft trajectories

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Air traffic management as currently under development by the Single European Sky ATM Research program has an important role to play in reducing environmental impact of aviation by operational means, in addition to the improvements to be derived from improved aircraft and engine technologies. Information on environmental and climate impact of aviation emissions are required during the flight planning process, in order to assess environmental impact of aircraft operations for an environmental optimization of aircraft trajectories. Modelling capabilities linking such environmental impact information with the air traffic management (ATM) are required to allow a multi-dimensional environmental impact assessment during the flight planning process. For this purpose, this study presents a concept for an advanced MET Service which enables to determine aviation emission climate impacts for carbon dioxide, nitrogen oxides, contrails, and water vapour, on a daily basis. This concept has been developed within the Exploratory Research Project ATM4E (Air Traffic Management for Environment, SESAR2020). It relies on so-called algorithmic environmental change functions (aECFs) which provide expected environmental impact of a local emission and which can be directly integrated in aircraft trajectory optimisation tools, based on weather forecast data.
We present how to transform environmental impact of aviation emissions calculated with state-of-the-art climate-chemistry-models into environmental change functions, and further on relating them to synoptical forecast information to generate aECFs. We present ideas on future implementation of such advanced meteorological services required for climate-optimization into air traffic management in a case study for Europe using prototype ECFs. We show that regions sensitive to aviation emissions can be avoided with only small changes in flight time and at low costs. Environmental performance parameters, e.g. overall climate impact given as average temperature change over a specific period, demonstrates environmental benefit of such routing options. Assuming market-based measures were in place, which include these non-CO_2 effects, climate optimal routing of aircraft would even be beneficial for airline operators. Having available such kind of comprehensive assessment framework in ATM integrating aECFs as advanced MET Service would allow studying and characterising changes in traffic flows due to environmental optimisation, as well as studying trade-offs between distinct strategic measures.

The current study has been supported by ATM4E project, which has received funding from the SESAR Joint Undertaking under grant agreement No 699395 under European Union's Horizon 2020 research and innovation program. High-performance computing simulations with the chemistry-climate model EMAC were performed at the Deutsches Klima-Rechenzentrum (DKRZ), Hamburg.