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Editorial

Conference on Transport, Atmosphere and Climate (TAC)

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Editorial

In the light of the Paris COP21 agreement, i.e. to limit global warming to 2 °C by the end of the century, the transport sector is more and more in the focus of scientific research and political debates. Emissions of equivalent CO_2 from the transport sector are growing faster than any other mature sector of human activity.

However, estimating the climate impact of transport is more complicated than the already difficult task of determining emission inventories. Beyond the direct emission of long-lived greenhouse gases (those considered in the Kyoto Protocol), there are several other ways how transport can impact climate, some of them being unique. Transport also emits precursors of greenhouse gases, such as NO_x, which changes the atmospheric abundances of ozone and methane. Transport results in a change in the atmospheric abundances of particles, directly by particle emission and indirectly by emission of precursors. Finally, transport, in particular aviation and shipping, triggers additional clouds from its water vapour emissions (contrails and contrail cirrus) and particle emissions (ship tracks), and transport-induced aerosols modify cloudiness. All these cloud effects have an impact on climate.

Many of the transport emissions are short-lived; hence, they never become homogeneously distributed in the atmosphere. The same is true for emission products such as ozone or secondary aerosol. Therefore, the location and altitude of emissions are of particular importance. Most aircraft emissions occur at altitudes (around the altitude of the extra-tropical tropopause) where no other anthropogenic sources directly emit and where short-lived species have longer lifetimes. Similarly, a significant fraction of ship emissions occurs at locations distant from land. Because of the distinct background chemical composition of the marine boundary layer, different amounts of secondary products are formed than would occur for the same emissions on land.

All these facets make the investigation of the impact of transport on atmospheric composition and climate particularly complex but also interesting. Scientists working in this field are not only helping to increase our understanding of the relevant science, but they also are providing necessary information to the policy community, which needs to consider how emissions may be regulated in order to prevent dangerous anthropogenic interference with our climate system. An important question is, 'how does the total impact of transport compare with other sectors, and how do the various modes of transport (road, rail, aviation, and shipping) differ in their impacts'?

As a follow-up of the European Conference on Aviation, Atmosphere and Climate held at Friedrichshafen (Lake Constance, Germany) in 2003, a series of International Conferences on Transport, Atmosphere and Climate (TAC) have been held since then in order to update our knowledge on the atmospheric impacts of aviation, and to also include all other modes of transport. The various TAC conferences took place in 2006 at Oxford (United Kingdom), in 2009 at Aachen (Germany)/Maastricht (Netherlands), in 2012 at Prien am Chiemsee (Germany) and finally in 2015 at Bad Kohlgrub (Germany).

This issue of METEOROLOGISCHE ZEITSCHRIFT comprises 8 papers from contributions of the latest TAC conference which all cover aviation related topics. Several papers deal with detailed simulations of contrails, hereby focusing either on the formation stage (Khou, 2017), the early phase of contrail-to-cirrus transition (Paoli et al., 2017) or differences between contrail-cirrus and natural cirrus (Unterstrasser et al., 2017a,b). On the other hand, Pitari et al. (2017) focuses on chemistry effects of aviation and quantifies the radiative forcing by aircraft NO_x emissions.

Grewe and Linke (2017) study how both, economic and environmental aspect of aviation can be studied within a common framework. Linke et al. (2017) discuss the climate benefits of intermediate stop operations and their usefulness as an operational mitigation strategy. Grewe et al. (2017) assess the climate benefits of a novel aircraft design, a multi-fuel blended wing body aircraft.

Rick Miake-Lye (Aerodyne Research Inc., Billerica, MA, USA) and Darrel Baumgardner (Droplet Measurement Technologies Inc., Longmont, CO, USA) served as guest editors of this special issue of Meteorologische Zeitschrift. We would like to take this opportunity to thank them as well as the Editor-in Chief Stefan Emeis for their commitment and diligent work.

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