Anmeldung eines Themas für eine Bachelorarbeit

Thema Datum	Effects of embedded contrails on cirrus clouds from height-resolved data 12.06.2019
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Kurzbeschreibung:	Aviation affects the Earth's energy balance in multiple ways [1]. Besides the emission of exhaust gases, it causes a variety of non-CO2 effects. The most familiar of those are linear contrails [2]. They form from aircraft effluent, can develop into widespread and persistent contrail cirrus, and affect the occurrence rate of cirrus clouds. While optically thick cirrus can have a net cooling effect on the atmosphere, optically thin cirrus generally causes warming. Aircraft emissions and contrails can lead to the formation of optically thin and thick cirrus [3]. As a third option, aircraft that fly through an already existing cirrus can cause the formation of contrails that are embedded in those clouds and alter their radiative effect. As of today, the latter effect is virtually unstudied as a lack of direct measurements inhibits its proper description in process models. Tesche et al. (2016) present the first and only quantitative assessment of the effect of embedded contrails based on matching flight tracks of individual aircraft with observations from spaceborne lidar. They showed a statistically significant increase in cloud optical thickness due to contrails forming within existing cirrus. This implies that embedded contrails could affect the properties of cirrus to a degree that inverts its climate effect from net warming to net cooling. Tesche et al. (2016) only considered layer-mean properties of the identified cases of embedded contrails. This thesis will expand the analysis of the 100 cases in Tesche et al. (2016) towards height-resolved information on cloud optical and microphysical properties [5,6] that have the potential to resolve local effects of aircraft that pass through an already existing cirrus at flight level. These enhanced observations of the effects of aircraft on cirrus cloud properties are needed to help understand, bound and quantify their possible effects.
Literatur:	[1] Brasseur et al. (2016), Impact of Aviation on Climate: FAA's Aviation Climate Change Research Initiative (ACCRI) Phase II, doi:BAMS-D-13-00089.1. [2] Duda et al. (2019), Northern Hemisphere Contrail Properties Derived from Terra and Aqua MODIS Data for 2006 and 2012, doi:acp-19-5313-2019. [3] Kärcher (2017), Cirrus clouds and their response to anthropogenic activities, doi:s40641-017-0060-3. [4] Tesche et al. (2016), Aviation effects on already-existing cirrus clouds, doi:ncomms12016. [5] Winker et al. (2009), Overview of the CALIPSO mission and CALIOP data processing algorithms, doi:2009JTECHA1281.1. [6] Cazenave et al. (2019), Evolution of DARDAR-CLOUD ice cloud cloud retrieval: new parameters and impacts on the retrieved microphysical properties, doi:amt-12-2819-2019.