Project Goal:

Create statistics about contrail occurrence and its effect on climate change.

If the effect would be as important as we presume, next step will be preparation of suitable strategies hot to approach this problem.

Project Scope:

The aviation emissions are responsible for the formation of contrails. In this work the formation and chemical processes of contrails will be studied with in-situ measurements by the use of experimental airplanes to estimate their additional impact on climate. Contrails form in the wake of aircraft under certain meteorological conditions of temperature and humidity (Schumann 1996), predominantly through the formation of water droplets around particles emitted by aircraft, which serve as ice nuclei (IN) that lead to ice crystals predominantly through heterogeneous freezing. Aircraft-emitted IN are mainly nonvolatile particles, in particular soot (Karcher & Yu, 2009; Schumann, 2012), although the role of volatile particles is uncertain especially in low soot conditions (Karcher & Yu, 2009), and homogeneous nucleation is potentially significant as well. In an ice-supersaturated atmosphere, contrails can last several hours, evolving into contrail cirrus indistinguishable from natural cirrus (Burkhardt & Karcher, 2011; Haywood et al., 2009).

Acting like high altitude, thin ice clouds, contrails are both trapping outgoing long wave radiation and at reflecting incoming shortwave radiation back to space (Burkhardt & Karcher, 2011; Hartmann et al., 1992; IPCC, 2013; Schumann & Graf, 2013). As a result, it is possible that contrails are the largest radiative forcing (RF) component attributable to aviation (Burkhardt & Karcher, 2011; IPCC, 2013).

Scope of the proposed project is to estimate the impact of contrails more precisely with respect to radiative forcing of individual contrails.

1 task - We would like to use data transmitted by Secondary surveillance radar of aircraft (ADS-B) and combine them with ground-based observations to be able to produce complete contrails inventory. (Basically, estimation what part of sky is covered by these artificial clouds a which aircraft are responsible.)

This part of research is already in process. We have expertise in area or aircraft surveillance and contrails observation. We are able to interrogate data from aircraft (SSR) and we have ground based cameras to record sky. We are able to automatically connect individual contrail from camera recording with specific aircraft. We have information about dimensions of contrail from camera, and data about aircraft from SSR system.

2 task – estimation of impact of these contrails to Earth RF and represent the impact of this effect in comparable unit – for this part we are looking for partner – we need some suitable metrics how to evaluate the impact of contrails toward the ERF. Probably the necessary aspect will be the optical thickness of clouds. We hope to find out some suitable way how to estimate the optical thickness based on data about meteorological information and aircraft type.

3 task – if we would be able to estimate the impact of contrails towards ERF, there would be plenty opportunities how to follow. For example, research of ATM procedures to avoid contrails, implementation contrails into EU ETS, improvement of meteorological information to better

predict contrails or technical countermeasures to decrease contrails occurrence. The follow up research is very wide, but for first the goal of task 2 has to be solved.