EGU22-9144
https://doi.org/10.5194/egusphere-egu22-9144
EGU General Assembly 2022

Aviation-induced changes in cirrus clouds over Europe during COVID-19 and in a ten-year period before COVID-19

Qiang Li[1] and Silke Groß[2]
[1]DLR, Institut für Physik der Atmosphäre, Wessling-Oberpfaffenhofen, Germany (qiang.li@dlr.de)
[2]DLR, Institut für Physik der Atmosphäre, Wessling-Oberpfaffenhofen, Germany (silke.gross@dlr.de)

Aviation affects the Earth's radiation budget through a combination of multiply processes which warm the atmosphere. Linear contrails and contrail cirrus induced by water vapor and soot emissions from air traffic in the upper atmosphere are expected to contribute a large part of the climate impact of avation. Furthermore, contrails cause a significant increase in cirrus optical thickness as well as an indirect effect on the microphysical properties of naturally formed cirrus clouds. During the first lockdown in April 2020, air traffic over Europe was significantly reduced to about 80% compared to the year before. This unique situation provides a good opportunity to study the effect of air traffic on cirrus. Based on the analysis of the spaceborne lidar measurements with CALIPSO, we found a significant reduction in the particle linear depolarization ratio (PLDR) of cirrus clouds measured in April 2020 compared to the previous years 2014-2019 under normal conditions, especially at colder temperatuers ($T < -50^{o}C$). However, we note that civil aviation over Europe before the COVID-19 pandemic (i.e., before March 2020) grew strongly in terms of CO2 emission and flight densities, e.g. on average by 233 MTon/year over Germany, over the past years (2010-2019, especially 2013-2019, source: EUROCONTROL). In order to study the aviation effects of cirrus properties in a longer period (with, of course, milder change in air traffic than the case due to the COVID lockdown), we further extend our analysis to all the observations from Mar. 2010 to Feb. 2020. We found a long-term trend of 0,0087/year (~2.4% per year) in PLDR for all the cirrus observations (day+night) and a trend of 0.0107/year for only the day-time observations at altitudes between 6 and 13 km. In addition, seasonal variations of PLDR are also drived showing higher PLDR-values in winter than in summer for all the measurements as well as for the measurements in different altitude bins. In the end, we compared the background meteorological conditions including the ambient temperature, relative humidity, and vertical updrafts determined with ECMWF and analyzed the correlation between PLDR and the corresponding CO2 emissions as a proxy of air traffic densities.

Key words: CALIPSO; Cirrus cloud; Lidar; Depolarization ratio; PLDR; COVID-19