

International Master 2 Atmospheric Sciences: Research Training 2020-2021

Laboratory: LOA

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Eventually,

CaPPA Work Package: WP5: "Aerosol - Cloud Interactions"

Did COVID-19 restrictions in continental Europe offer low-hanging fruits for the understanding of aerosol - cloud interactions?

Understanding how clouds interact with their environment, and in particular aerosols, represents one of the grand challenges of current climate research. A change - natural or anthropogenic - of the aerosol amount in the atmosphere can indeed directly impact the nucleation of cloud particles. Further modifications of the water content, lifetime, extent or precipitation rate of these clouds, called adjustments, are also likely to occur. Overall, the radiative impact of these two effects, called the effective radiative forcing, is still poorly quantified and generates large uncertainties in current climate predictions.

Recent science on aerosol - cloud interactions increasingly relies on so-called natural laboratories, which means that these effects are assessed in the framework of controlled perturbations. For instance volcano eruptions, ship tracks, industrial tracks or contrails represent such laboratories. The question of the usefulness of the COVID-19 restrictions as a natural laboratory is still actively debated. Particularly in Europe, the occurrence of very specific meteorological conditions associated with a high pressure system during the peak of these restrictions make the analysis of the decrease of emissions during the sanitary conditions challenging to compare to climatologies.

This thesis will investigate if first-order understanding of aerosol - cloud interactions can be reached from the COVID-19 emission changes, in particular using satellite observations for cloud properties coupled with re-analysis data for aerosol emissions. It will be explored to which extent aerosol - cloud interactions quantified during this period can be compared to existing climatologies and literature findings, in particular when it comes to usual natural laboratory studies. This thesis will focus on continental Europe but comparisons to other regions (for instance, India or China) could be attempted.

Key words: aerosol - cloud interactions; natural laboratories; cloud-physics; covid-19