



HAL
open science

Comparisons of radiosonde water vapor measurements with ECMWF ERA-5 and contrails observations above Clermont-Ferrand (France)

Sidy Diarra, Jean-Luc Baray, Nadège Montoux, Patrick Fréville, Frédéric Peyrin, Philippe Cacaault, Philippe Keckhut

► To cite this version:

Sidy Diarra, Jean-Luc Baray, Nadège Montoux, Patrick Fréville, Frédéric Peyrin, et al.. Comparisons of radiosonde water vapor measurements with ECMWF ERA-5 and contrails observations above Clermont-Ferrand (France). EGU General Assembly 2024, Apr 2024, Vienna, Austria. pp. EGU24-10040, 10.5194/egusphere-egu24-10040 . insu-04597174

HAL Id: insu-04597174

<https://insu.hal.science/insu-04597174>

Submitted on 1 Jun 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License



Comparisons of radiosonde water vapor measurements with ECMWF ERA-5 and contrails observations above Clermont-Ferrand (France)

Sidy Diarra^{1,3}, Jean-Luc Baray^{1,2}, Nadège Montoux¹, Patrick Fréville², Frédéric Peyrin², Philippe Cacault², and Philippe Keckhut³

¹LaMP, UMR6016, CNRS, Université Clermont Auvergne, Clermont-Ferrand, 63100, France

²OPGC, UAR833, CNRS, Université Clermont Auvergne, Clermont-Ferrand, 63100, France

³LATMOS, UMR8190, CNRS, Université Versailles St Quentin, Guyancourt, 78280, France

The cirrus clouds impact on the radiation budget of the Earth depends mainly of their optical thickness and altitude (Heymsfield et al., 2017). The contrails formed from aircraft emissions bring an additional impact to that of natural cirrus clouds (Kärcher, 2018). Their formation and potential evolution in cirrus clouds depend on the thermodynamical state of the atmosphere at fine scales, in particular of the saturation of water vapour with respect to ice. However, at their altitude of formation (~10 km), few reliable measurements of the water vapour are available.

In this study, we use observational data on the presence of crystals through their scattering observed by lidar and water vapor measurements using the Raman scattering technique (Fréville et al., 2015). Observations from standard meteorological balloon soundings (temperature, water vapor, and wind) (Dupont et al., 2020), as well as meteorological reanalyses (ECMWF), will be also analyzed to better characterize the overall context, considering finer vertical resolutions.

A first part of this study is to evaluate the quality of Modem M10 radiosondes humidity measurements available from the MeteoFrance network by comparison with ECMWF ERA-5 analysis. A second part of this study is to document contrails formation and evolution using a combination of instruments: an ADS-B recorder to identify aircraft type and position, a full sky camera to detect the presence of contrails and a collocated lidar to retrieve water vapour concentration profiles and macrophysical and optical properties of the contrail. The methodology and first results will be presented on a case study identified the 2nd of June 2023 above Clermont-Ferrand (France). Contrails have been observed when ECMWF ERA-5 relative humidity was around 115% and stay visible on the full-sky camera during more than 2 hours. This study is carried out in the framework of the European project BeCoM (Grant agreement ID: 101056885) whose main objective is to reduce the contrail radiative forcing.

Keywords: water vapour, cirrus, contrail, Lidar, camera.

Bibliography:

Kärcher et al., (2018). Formation and radiative forcing of contrail cirrus. *Nature communications*, 9(1), 1824.

Heymsfield et al., (2017). Cirrus clouds. *Meteorological Monographs*, 58, 2-1.

Fréville et al. (2015). Lidar developments at Clermont-Ferrand – France for atmospheric observation, *Sensors*, 2015, 15, 3041-3069; doi:10.3390/s150203041

Dupont et al., (2020). Characterization and corrections of relative humidity measurement from Meteomodem M10 radiosondes at midlatitude stations. *Journal of Atmospheric and Oceanic Technology*, 37(5), 857-871.