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Overview and first analysis of the in situ microphysical measurement dataset collected during the CADDIWA mission

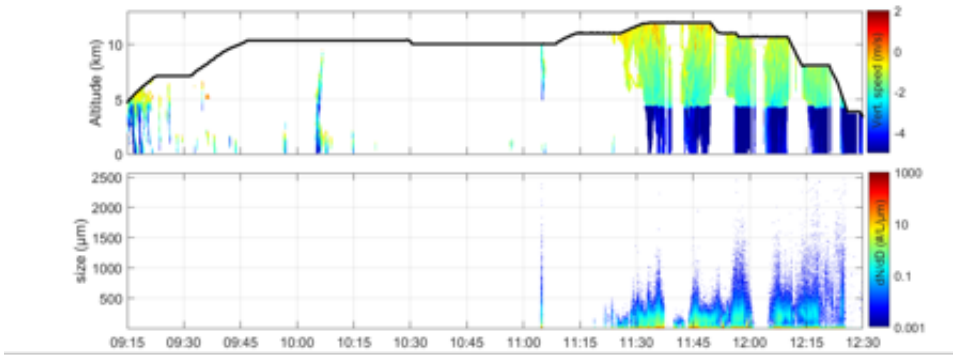
Pierre Coutris[1], Guy Febvre[1], Louis Jaffeux[1], Clément Bazantay[1], Clémantyne Aubry[2,3], Christophe Caudoux[2], Julien Delanoë[2], Alfons Schwarzenboeck[1], and Cyrille Flamant[1]

[1]Laboratoire de Météorologie Physique, UCA/CNRS, Aubière, France (p.coutris@opgc.fr)

[2]Laboratoire Atmosphères, Observations Spatiales, CNRS/UVSQ/Sorbonne Université/Université Paris Saclay, Paris, France

[3]Deutsches Zentrum für Luft- und Raumfahrt (DLR), Institut für Physik der Atmosphäre, Oberpfaffenhofen, Germany

In the frame of the Joint Aeolus Tropical Atlantic Campaigns, an airborne field campaign took place in Sal island of Cape-Verde from the 8th to 21st of September 2021, as part of the French CADDIWA mission. During this campaign, the SAFIRE F20 research aircraft equipped with in situ and remote sensing instruments performed nine 3 to 4 hour long flights sampling tropical environment underneath AEOLUS satellite tracks and performing exploration flights within the convective cloud systems of tropical disturbances. In this study, an overview of the available aerosol and cloud in situ dataset is given first, presenting the instrumental and methodological approaches relevant to the collection of data from a set of four instruments: the UHSAS (aerosol size range : 40 – 1000 nm, Cai et al. 2008), the SPP-300 (aerosol 0.3 – 20 µm, Baumgardner 1992) and the CDP-2 (droplets 2-50 µm, Lance et al. 2010) scattering probes, and the 2D-S imager (10-1280 µm, Lawson et al. 2006). Then a detailed microphysical analysis is conducted on two case studies: a tropical perturbation referred to as Pierre-Henri in this study (unnamed/numbered by NOAA National Hurricane Center (NHC)), sampled during F20 flight #7/8, and the Tropical Storm Rose (# AL172021 according to NOAA NHC) sampled during flights #12/13. The analysis includes a discussion on the main microphysical properties such as Particle Size Distribution (PSD), Ice Water Content (IWC) retrieved at different locations in the cloud convective systems, complemented by 95GHz reflectivity and Doppler vertical velocity measured by the airborne cloud radar RASTA (Delanoe et al. 2013). The data supporting this study is illustrated in the figure below: the vertical velocity (derived from 3 Doppler non colinear measurements of the radar) and PSD time series are given on top of two samples ice crystal images taken by the 2DS imager at different location in the TS Rose. A newly developed image classification algorithm (Jaffeux et al. 2022) is applied to the 2D-S data to derive statistics on the ice particles morphological properties, yielding to a discussion on the microphysical ice growth processes occurring in these systems.


Altitude (km)
10
5
0
2
0
-2
-4
Vert. speed (m/s)
size (µm)
2500
2000
1500
1000
500
1000
10
0.1
0.001
dN/dD (#/L/µm)
09:15
09:30
09:45
10:00
10:15
10:30
10:45
11:00
11:15
11:30
11:45
12:00
12:15
12:30