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Session 7

GRUAN Site Report for La Réunion

(Submitted by Stephanie Evan)

Summary and Purpose of this Document

Report from the GRUAN site La Réunion for the period March 2016 to April 2017.

Overview

Reunion Island has three measurement sites: the Maïdo observatory on the western part of the island (2160 m ASL), Gillot Airport (northern part of the island, 10 m ASL) and the University of Reunion in Saint-Denis (northern part of the island, 80 m ASL). Maïdo Observatory is a unique location to perform atmospheric science, because

1. it is located in the Southern Hemisphere tropics;

2. it is in a convective atmosphere during austral summer that is mostly free from terrestrial influence;

3. it hosts several instruments to monitor atmospheric composition.

In addition, the observatory has an existing base of routine data sets available, and several major atmospheric research networks use Maïdo Observatory as part of their infrastructure, e.g. NDACC, SHADOZ, AERONET, GAW, ICOS. It has also been labeled as one of the major French observation sites by INSU-CNRS and therefore benefits from the financial support of INSU-CNRS and the University of Réunion Island. Several measurement programmes in Reunion may contribute to GRUAN data streams in the future, these are:

1. A Raman water vapor LIDAR (NDACC certified instrument, (PI Philippe Keckhut, LATMOS; Co-I Valentin Duflot, LACy): it provides 4 to 6 water vapor profiles per month since April 2013. the LIDAR water vapor observations extending into the lower stratosphere were validated during the MORGANE intercomparison exercise in May 2015 [Vérèmes et al., 2017, submitted to AMT].

2. CFH water vapor sondes (CFH sonde + Intermet Imet-1-RSB radiosonde, PI Stephanie Evan, LACy) providing water vapor profiles from the surface to $\tilde{3}0$ km. The CFH sondes are launched from the Maïdo Observatory on a campaign basis (with a minimum of 3 sondes per year since 2015).

3. Weekly SHADOZ ozone sondes (ECC ozone sonde + Modem M10 radiosonde, PI Franoise Posny, LACy) providing ozone profiles from the surface to mid stratosphere. The ozone sondes are launched from Gillot airport.

4. A Fourier Transform Infrared (FTIR, PI Martine De Mazire, BIRA-IASB) spectrometer providing partial column measurements of CH4, CO, NO2, O3, HCl, HF, HNO3, H2O. The FTIR is installed at the Maïdo observatory as part of a collaboration with the Belgian Institute for Space Aeronomy, BIRA-IASB. The FTIR is taking routine measurements since 2013 and is part of the NDACC network.

5. A GNSS station (PI Jimmy Leclair de Bellevue) that provides routine measurements of integrated water vapor (IWV). The GNSS operates at the Maïdo observatory since 2013 and the IWV measurements are used for the nighttime Raman water vapor LIDAR system calibration.

Change and change management

There are no changes in operators, instruments or operating procedures for the period March 2016 to April 2017.

Resourcing

The CFH radiosounding activities at the Maïdo observatory have been partially supported by the University of Réunion, INSU-CNRS, ACTRIS-FR and the GRUAN Lead Centre. ACTRIS-FR is the French component of the European research infrastructure ACTRIS (Aerosols, Clouds, and Trace Gases Research Infrastructure, European Research Infrastructure). However this budget is rather limited and allows for 3 CFH launches per year only although the GRUAN requirement is to observe a profile of stratospheric waper vapor (up to 25-30km) once per month. Using the CFH data from the May 2015 MORGANE campaign for comparison with the Raman lidar profiles, Vérèmes et al. (2017, manuscript under review in AMT), showed that the Raman water vapor lidar at the Maïdo Observatory can provide accurate measurements up to 22 km with a 48-hours integration time period (absolute error lower than 0.8 ppmv). However the more frequent cloudy nights during the austral summer season (November to April) restrict the number of nights during which the Raman lidar can operate. As a result, it is more challenging to obtain a water vapor lidar profile up to the lower stratosphere during austral summer. As a cost-effective mean to meet the GRUAN requirement of observing a monthly stratospheric water vapor profile, we suggest using a dual strategy with 6 CFH sondes during austral summer and the Raman water vapor lidar during the dry season. Due to manpower constraints, the Raman water vapor lidar can only operate 3 nights per week for a maximum integration of $\tilde{4}$ hours per night. However staff at the observatory will work toward an automated lidar system in the next two years, which would allow longer integration time per night and better lidar performance in the lower stratosphere. The lidar water vapor profiles would be still validated against the CFH water vapor profile. Another objective of the Maïdo Observatory is to become a GAW/GRUAN certified site in the next two years. OSU-R that manages the observatory and LACy laboratory are looking into hiring a researcher/engineer in the coming years to support the GAW/GRUAN activities in Reunion Island.

Operations

At the moment, no data are submitted to the GRUAN Lead Centre using the RsLaunchClient. This problem was discussed with Ruud Dirksen during his visit in La Réunion in May 2017. The RsLaunch-Client was installed on a laptop here and S. Evan will receive further guidance from Michael Sommer on how to use the RsLaunchClient to submit the CFH data during the ICM-9 meeting. Currently the additional ground check at 100% relative humidity (RH) is not used for the Modem M10 sonde. Jean-Pierre Cammas (head of OSU-R) suggested that the 100% check will be implemented for the weekly SHADOZ ozone sounding in 2018. Discussion is still ongoing between the GRUAN Lead Centre, Le Sirta Observatory and OSU-R/LACy on how to set up and logistically organize the M10 data stream for GRUAN.

Site assessment and certification

The Modem M10 technical document has to be finalized for the GRUAN validation and the M10 RH uncertainties in the tropics still need to be better quantified. We are also in the process of seeking additional funding to support GRUAN activities in La Réunion (SOURCE project, University of La Réunion). We are looking at later 2018/early 2019 for the complete certification process.

GRUAN-related research

In May 2017, the SHUTLS (Composition of the Southern Hemisphere Tropical UTLS) project was funded by ACTRIS as part of the transnational access (TNA) activity. This project funded the visits of Ruud Dirksen and Frank Wienhold (ETH Zurich) in La Réunion. By bringing in expertise from the GRUAN Lead Centre and ETH, the overall objective of the project was to support the long-term development of a balloon sonde program in Reunion Island for the monitoring of atmospheric composition over the tropical Southern Hemisphere. During a 2-week campaign we flew 4 balloon payloads including CFH, COBALD and a M10 radiosonde. During one flight we had 2 COBALD sondes on the same payload to compare the performance of a new COBALD design to the previous one. The last payload also included the POPS (Printed Optical Particle Spectrometer) instrument in addition to the CFH, COBALD and ECC ozone sondes. POPS is an aerosol counter developed by NOAA and CIRES (Cooperative Institute for Research in Environmental Sciences at the University of Colorado Boulder) researchers. The POPS instrument provided additional information to improve the calibration of the COBALD sonde. We obtained as well 4 good CFH water vapor profiles which will be used to improve the estimate the RH uncertainties of the M10 sonde. The preliminary results of this campaign will be presented at the ICM 9 meeting.

GRUAN-related publications: Vérèmes, H., Payen, G., Keckhut, P., Duflot, V., Baray, J.-L., Cammas, J.-P., Leclair De Bellevue, J., Evan, S., Posny, F., Gabarrot, F., Metzger, J.-M., Marquestaut, N., Meier, S., Vömel, H., and Dirksen, R.: A Raman lidar at Maïdo Observatory (Reunion Island) to measure water vapor in the troposphere and lower stratosphere: calibration and validation, Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2017-32, in review, 2017.

WG-GRUAN interface

Currently no request.

Items for ICM-9 plenary discussions

Rising cost of the CFH sonde.

Future plans

- Finalize estimate of RH uncertainties of the M10 sonde using the CFH/M10 data gathered since 2014 (12 dual CFH/M10 profiles) in concertation with Le Sirta Observatory in Paris/ MODEM/ Météo-France.
- Acquisition of humidity chamber ?
- Finalize publications on CFH profiles for austral summer and the influence of tropical convection, results from the SHUTLS campaign.
- The CONCIRTO project (PI Stephanie Evan) has been submitted to the french national research agency (ANR) in April 2017. The goal of this project is to understand how cirrus clouds and deep convection affect TTL humidity over the tropical Southern Hemisphere tropics. If funded, a campaign will be organized in summer 2019 with balloon sondes to measure water vapor, aerosols and ozone as well as a cloud RADAR from the University of Leeds (PI Ryan Neely).

GRUAN Station Report for LaReunion (REU), 2016/17

Reported time range is Mar 2016 to Apr 2017
Created by the Lead Centre
Version from 2017-06-06

1 General GRUAN station information

Info	Value
Station name	LaReunion
Unique GRUAN ID	REU
Geographical position	-21.0797 °S, 55.3831 °E, 2165.0 m
Operated by	UNIV-REUNION | Univers de La Réunion
Main contact	Evan, Stephanie
WMO no./name	-
Operators	current 5, change +0 / -0
Sounding Site	1

1.1 General information about GRUAN measurement systems

System	Type	Setups	Measurements	As scheduled
REU-RS-01	Sounding Site	3	0	not scheduled

1.2 General comments from Lead Centre

1.2.1 General

No dataflow to GRUAN LC so far.

2 System: Radiosonde Launch Site (Maïdo) (REU-RS-01)

Info	Value
System name	Radiosonde Launch Site (Maïdo)
Unique GRUAN ID	REU-RS-01
System type	Sounding Site (RS - Radiosonde)
Geographical position	-21.0797 °S, 55.3831 °E, 2164.6 m
Operated by	UNIV-REUNION | Univers de La Réunion
Instrument contact	Evan, Stephanie
Started at	-
Defined setups	3 (MALICCA-1, CFH, MORGANE)
Possible streams	CFH, COBALD, ECC, IMET-1, RS41, RS92

2.1 Lead Centre comments

2.1.1 Dataflow

No radiosonde dataflow to GRUAN LC as yet.