WV-PROFILES-MAIDO (November 2014, Maïdo Observatory)

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- Introduction and motivation

Water vapor is a crucial climate variable. It strongly controls the energy budget of our planet via its greenhouse effect (e.g. Kiehl and Trenberth, 1997). It plays a key role in many aspects of UTLS chemistry, e.g. being the main precursour of HOx radicals contributing to the catalytic destruction of ozone in the lower stratosphere (e.g. Wennberg et al., 1994). Stratospheric water vapor is an important driver of decadal global surface climate change (Solomon et al., 2010).

- Scientific objectives

The scientific objective of this proposal is the analysis of accurate measurements of water vapor in vertical profiles performed at the Maïdo observatory in the framework of NDACC (Network for the Detection for Atmospheric Composition Changes) and ACTRIS programs.

- Reason for choosing station

Reunion Island is appropriately located to monitor how most air enters the stratosphere in the tropics (Holton et al., 1995) by a combination of rapid vertical motion in convection and slow diabatic ascent.

Upper-air soundings of water vapor in the tropical band are of great interest as water vapor is a crucial climate variable. The OPAR (Observatoire de Physique de l' Atmosphère à La Réunion) observatory at Maïdo will join the GCOS Reference Upper Air Network (GRUAN) by providing high-quality upper-air water vapor records from Cryogenic Frost point Hygrometer (CFH) sondes (Vömel et al., 2007) and from a newly designed Raman water vapor lidar (Baray et al., 2013; Dionisi et al., 2015; Keckhut et al., 2015).

- Method and experimental set-up

We plan to reinforce the water vapour observations during the field experiment MORGANE (Maïdo ObservatoRy Gaz and Aerosols Ndacc Experiment) scheduled in September 2014 by bringing in expertise gained in the GRUAN framework for new water vapor measurement technologies (CFH and Vaïsala RS92/RS41 radiosondes), and to collaborate with other principal investigators of the field experiment in sharing datasets.

The MORGANE campaign in the framework of NDACC will take place in cooperation with NASA at Maïdo in September 2014. The main objective of the campaign is to perform blind inter comparisons of vertical profiles of ozone, water vapour, aerosols and temperature with lidars and radiosoundings. The NDACC data validation protocol requires that each NDACC instrument undergoes periodic validation campaigns that ensure the quality of the measurements. To this aim, NASA has developped a mobile lidar instrument capable of measuring high quality vertical distributions of aerosols, water vapor, ozone and temperature. NASA will install its mobile validation instrumentation at the Maïdo facility to participate in the MORGANE validation campaign with the OPAR lidar profiling instruments. In addition, multiple radiosoundings with several types of operational meteorological sondes (Modem M10, France ; Vaisala RS92 and RS41, Finland), water vapor research sondes (CFH, DMT, Boulder, USA), and Electrochemical Concentration Cell (ECC) ozone sondes will be launched in order to reinforce the intercomparison exercise and to better evaluate the performance of the lidars.

The CFH water vapor measurements are expected to be used as absolute reference in the comparison of the different lidar systems. In the framework of GRUAN, DWD will be in charge of preparing the CFH and Vaisala radiosoundings (about 6 over the campaign) and of the training of the OPAR technical staff (launch, calibration, data acquisition and data analysis) in the new water vapor measurement techniques.

- Preliminary results and conclusions

The MORGANE campaign had to be postponed until after the ACTRIS period (due to the blockage of the NASA station during its shipment to La Réunion in Chinese customs and due to the subsequent arrival of the rainy season in La Réunion), and has been rescheduled to take place in May 2015.

The WV-PROFILES-MAIDO project (MAIDO-3) has been reduced to preliminary technical tests for radiosoundings in November 2014 at MAIDO. One radiosounding with a payload of 3 different sondes (Modem M10, Vaïsala RS92 and CFH) was successfully performed on November 18, 2014 (Figure 1). On a technical side, this radiosounding was used to train the OPAR technical staff (preparation and calibration, launch, and data acquisition) in the new water vapor measurement techniques with the CFH sonde and to bring in expertise gained by DWD within the GRUAN framework.

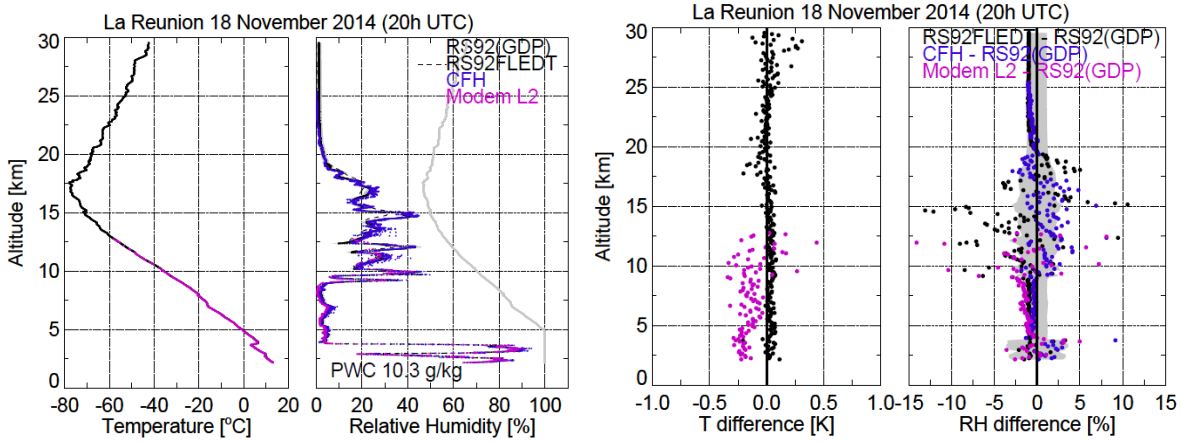

Figure 1: Radiosounding at Maïdo observatory on November 18, 2014 during the Pre-MORGANE experiment (ACTRIS TNA: MAIDO-3 WV-PROFILES-MAIDO project). Left: Temperature (°C) and relative humidity (%RH). Right: as for left but for differences between sondes or data processing methods. Employed radiosondes are MODEM M10, Vaïsala RS92 and CFH.

- Outcome and future studies

This first CFH launch coincided with a 120 minutes window of operation of the Raman water vapor lidar at Maïdo observatory. The comparison between CFH and the lidar profiles shows good agreement up to the upper troposphere (tropopause at 17 km) considering the lidar total error (Vérèmes et al., 2015). These results open good perspectives for future water vapor lidar and CFH sondes comparisons, especially those of the coming MORGANE experiment (May 2015). Highly accurate vertical profiles measurements of meteorological parameters, ozone, aerosols and water vapor will be provided by lidars and by night- and day-time radiosoundings in the frameworks of NDACC, GRUAN, and ACTRIS-2 programs to further promote research studies on the composition and on the dynamics of the tropical UTLS (upper troposphere and lower stratosphere) in the southern hemisphere.

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