Balloon soundings and the MORGANE campaign at Réunion

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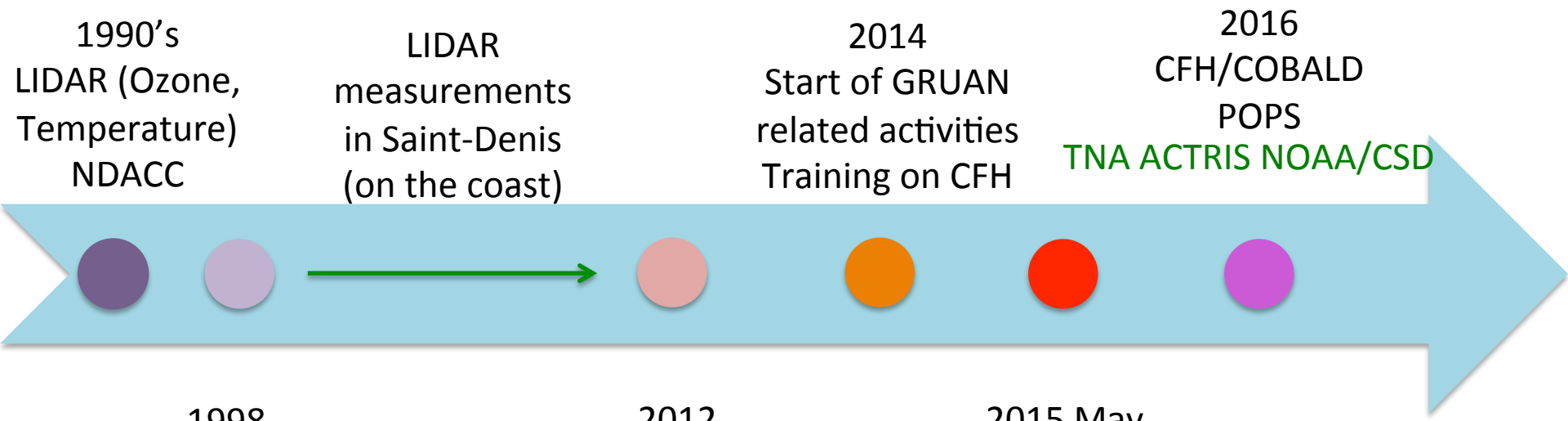
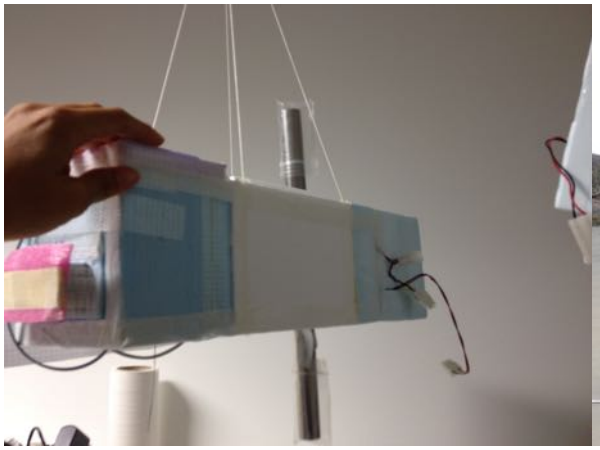
J.-M. Metzger, G. Payen, N. Marquestaut (OSU-R)
R. Dirksen, S. Meier (DWD)
S. Davis (CIRES/NOAA CSD)
H. Vömel (NCAR)

LIDAR/radiosonde measurements at Réunion



May 2015
MORGANE: Maïdo ObservatoRy Gas and Aerosols
NDACC Experiment

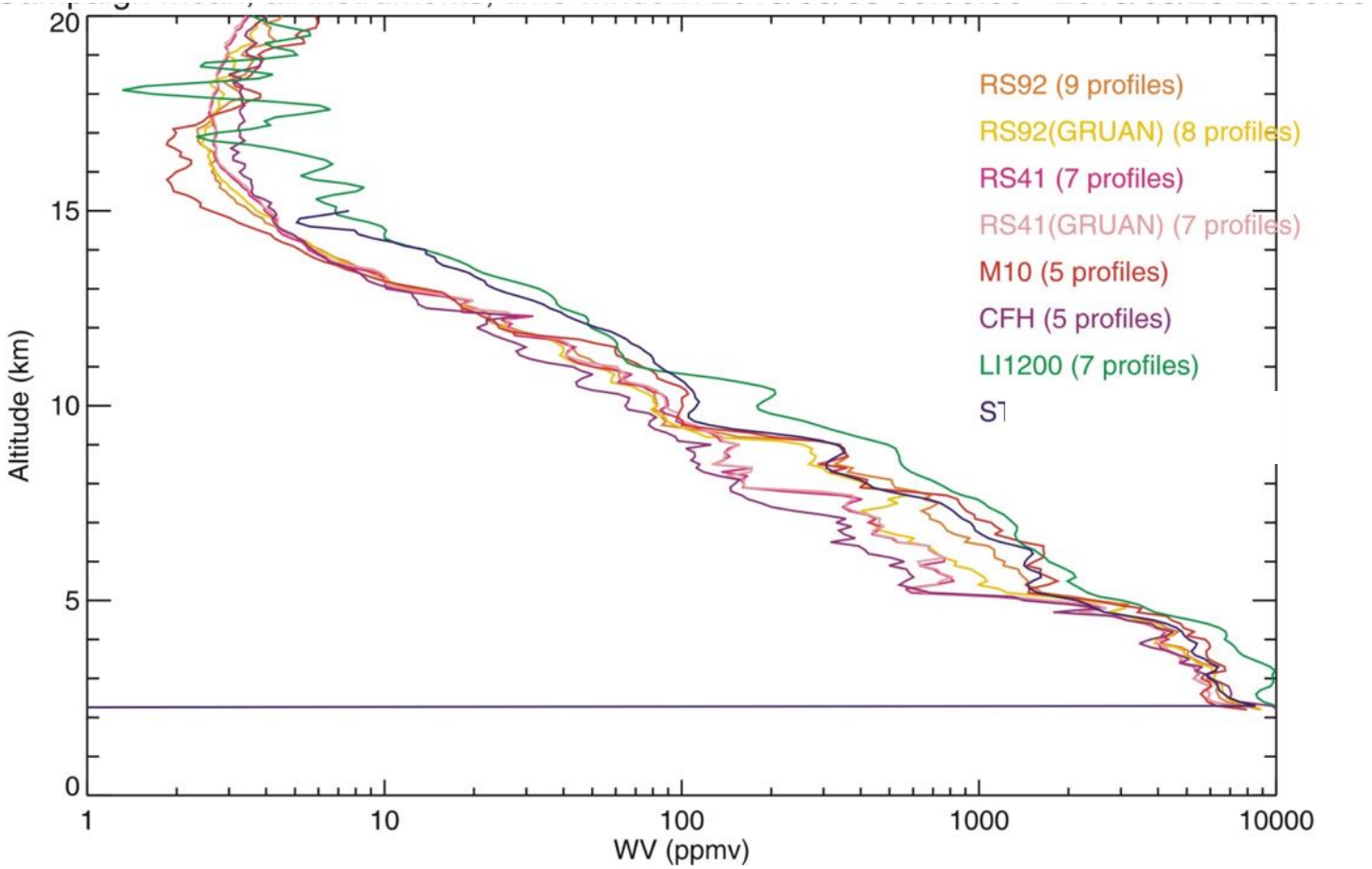
- Objectives: Validation of Maïdo LIDARS & Study of UTLS processes
- Blind test intercomparison between lidars (T, O_3, H_2O) from Maïdo & NASA
- Training on CFH and GRUAN ground-check procedure
- Night and daytime radiosoundings with GRUAN ground-check procedure 21 soundings of M10/RS41/RS92, 7ECC O3, 7CFH, 7COBALD, 1LOAC)
- Participants: OSU-R/LACy/LATMOS/SIRTA/LPC2E, NASA/DWD/ETHZ



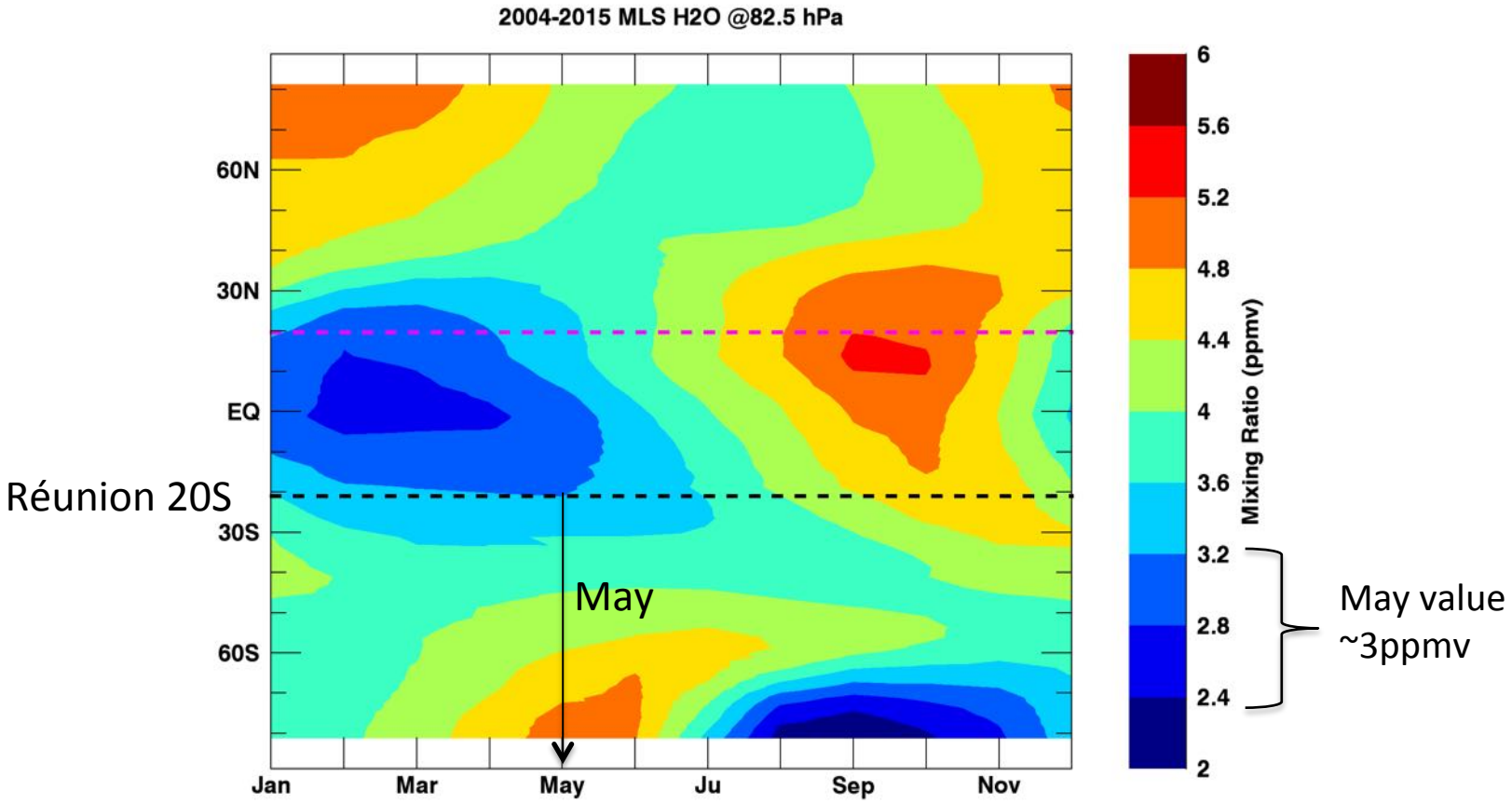
Water vapor profiles from MORGANE

Instruments

Campaign mean



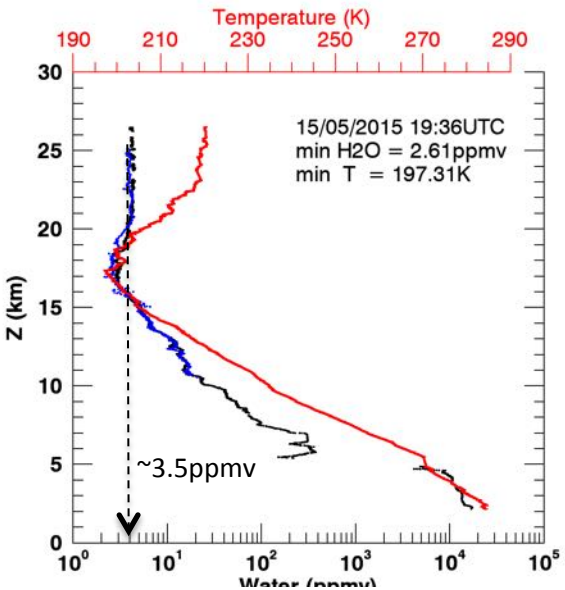
Annual cyle of MLS Lower Stratospheric H_2O

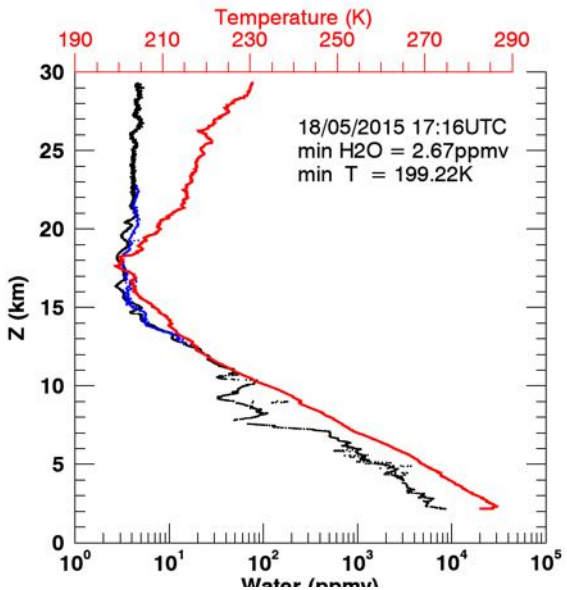


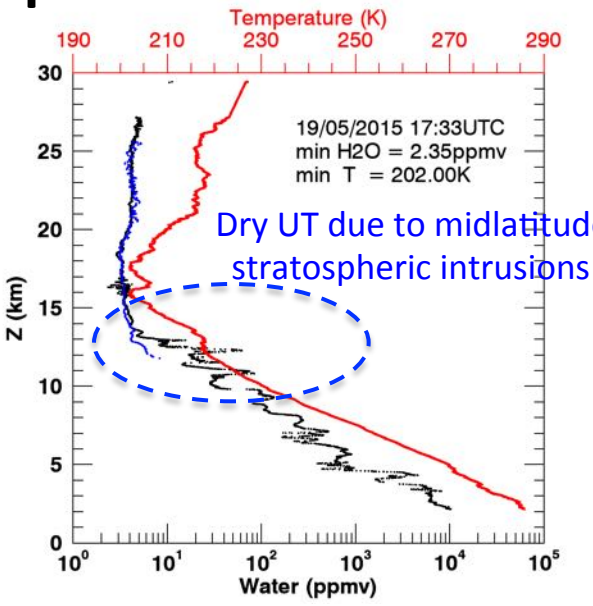
MLS water vapor @82hPa 2004-2015

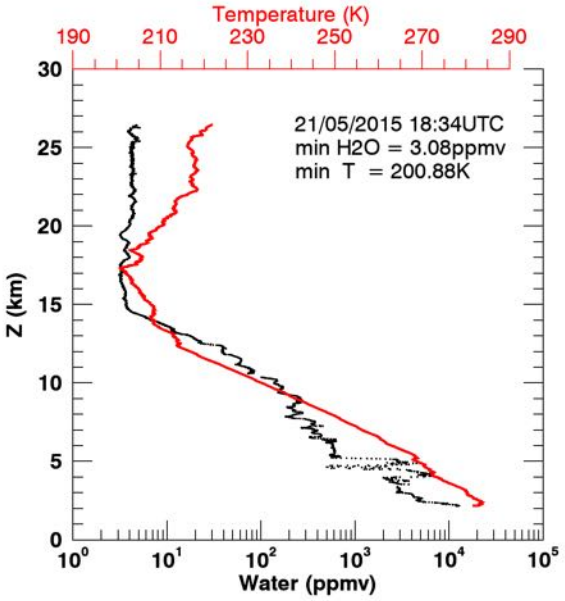
MLS data from SWOOSH dataset, S. Davis, http://www.esrl.noaa.gov/csd/groups/csd8/swoosh/

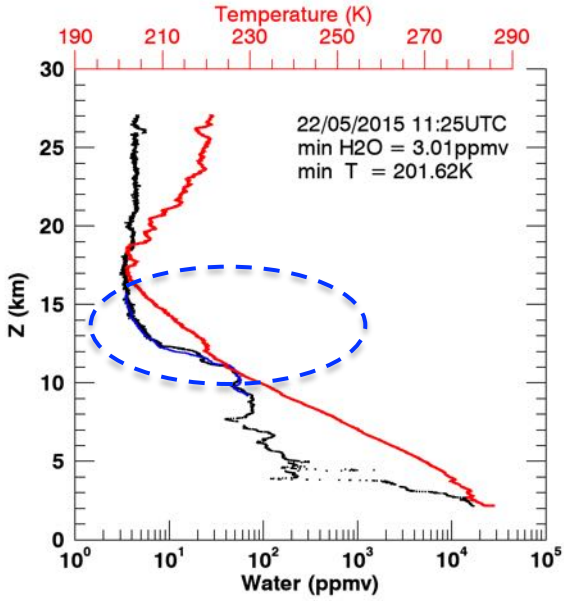
MORGANE : CFH water vapor

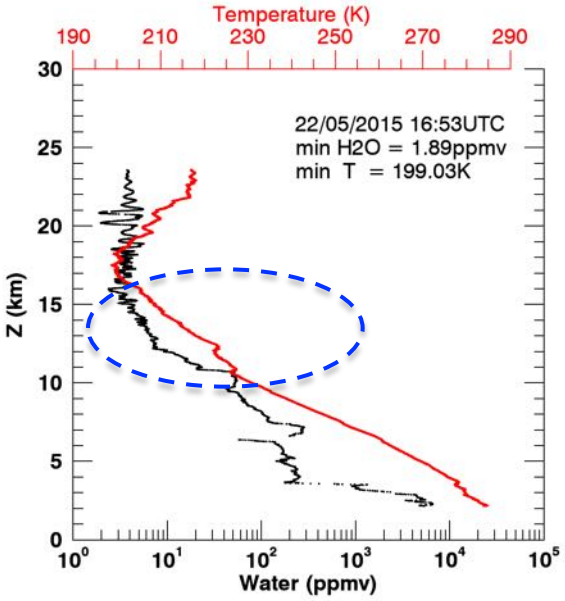




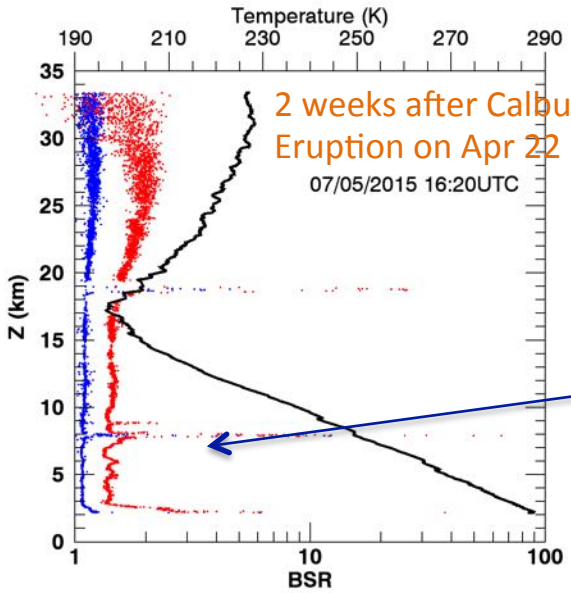


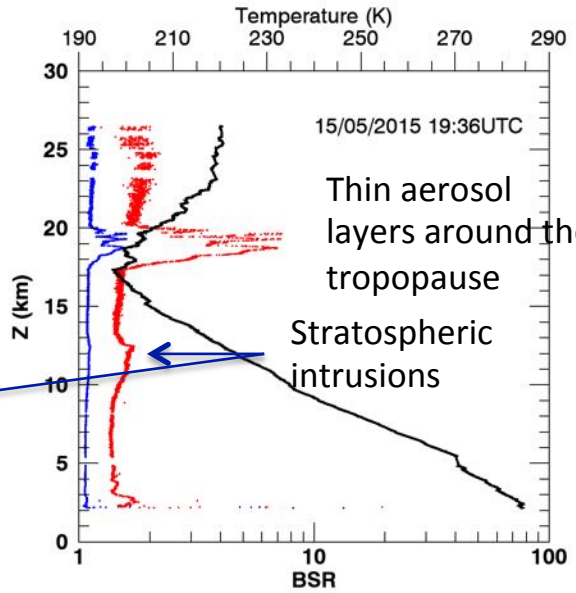


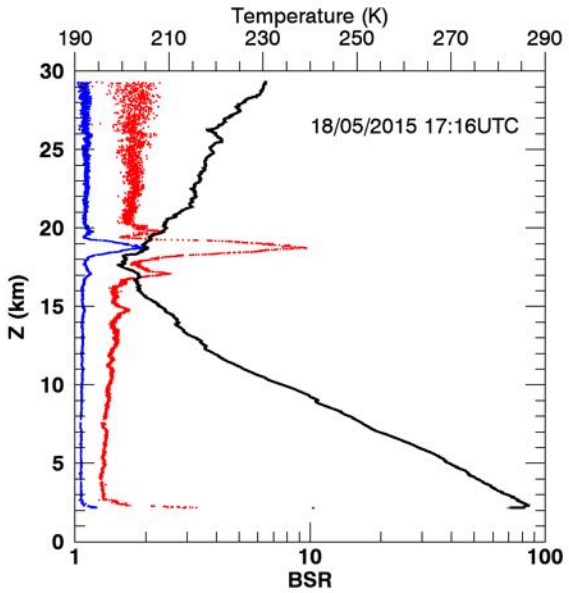


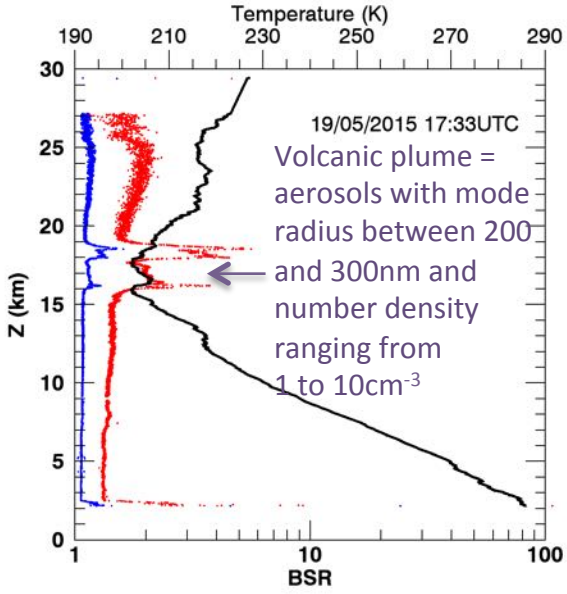


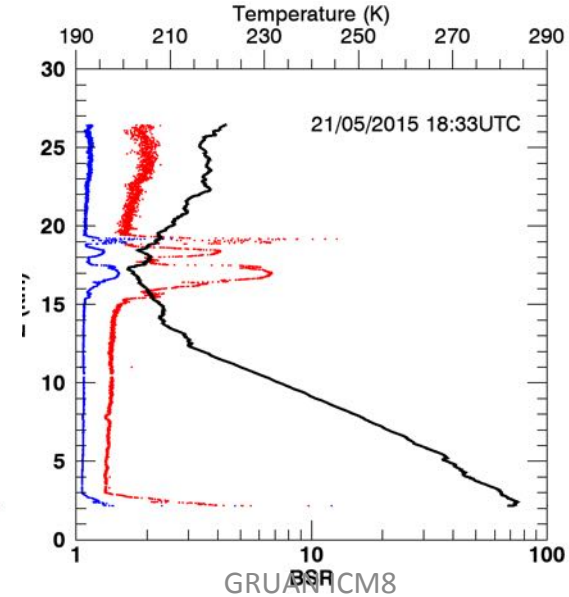
MORGANE: COBALD Backscatter & Cabulco Eruption

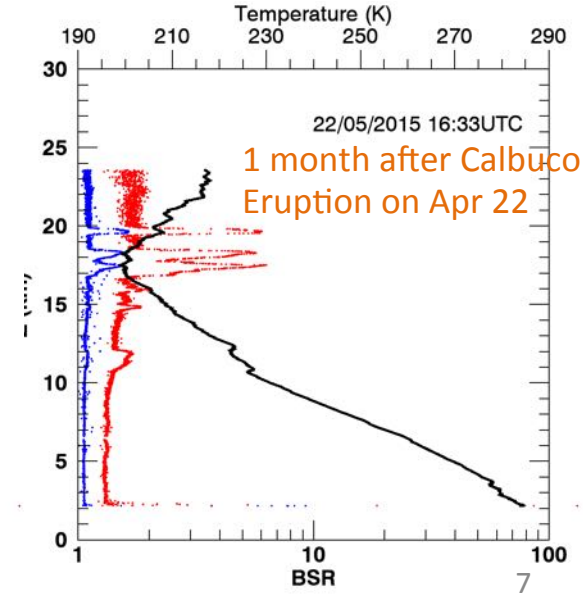






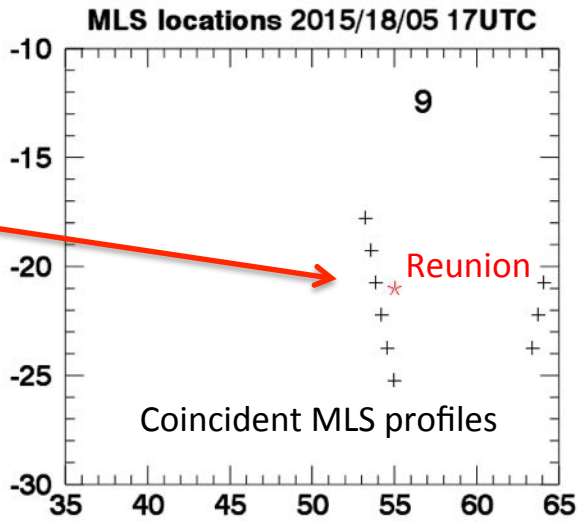


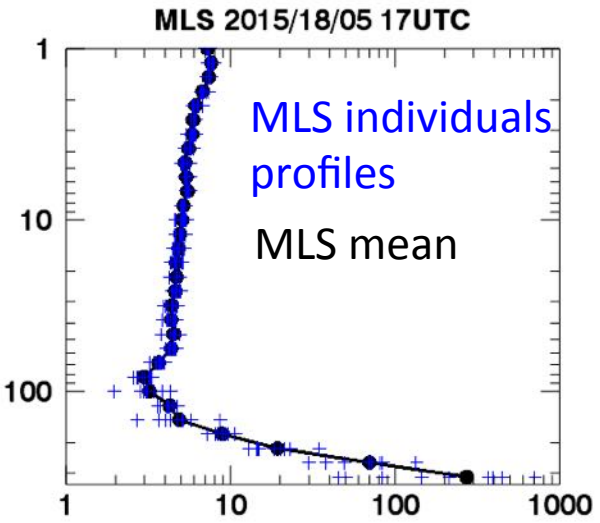


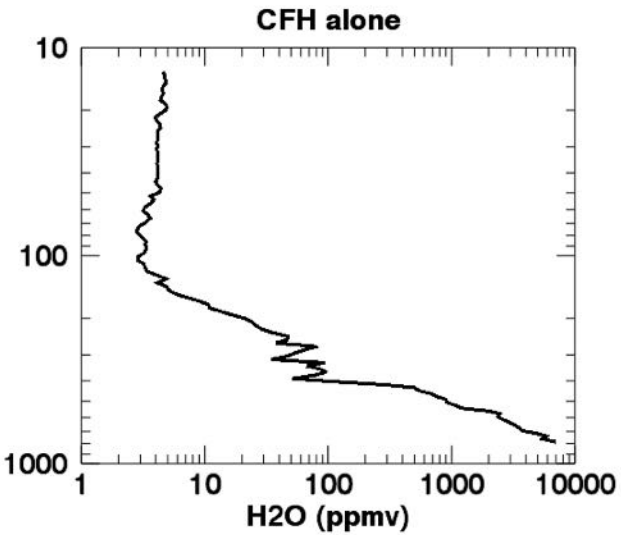


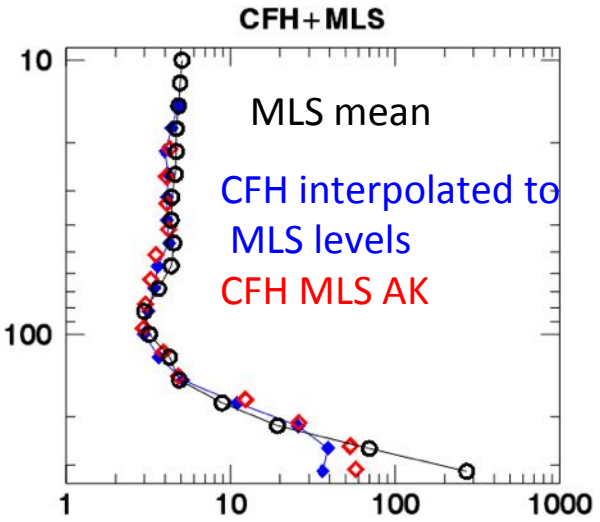
Comparison CFH & MLS May 2015

Criteria for MLS coincidences with CFH flights:
+- 500km N-S
+- 1000 km E-W
+-18 hours
+-5° equivalent lat (averaged over 316-70hPa)

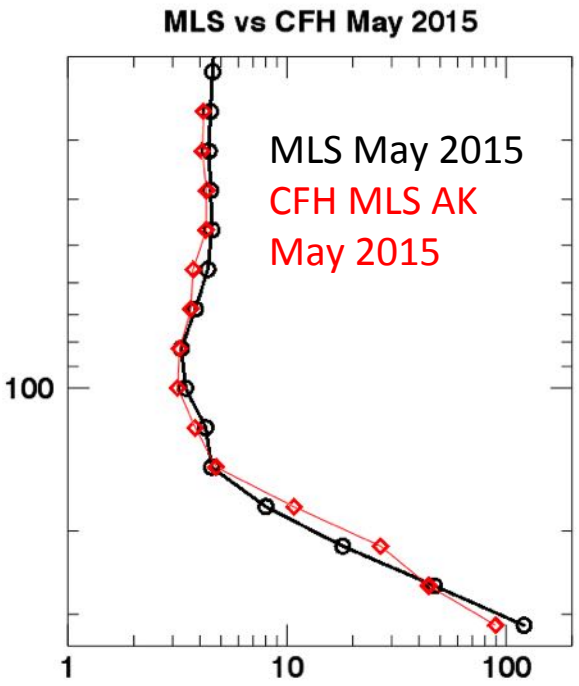


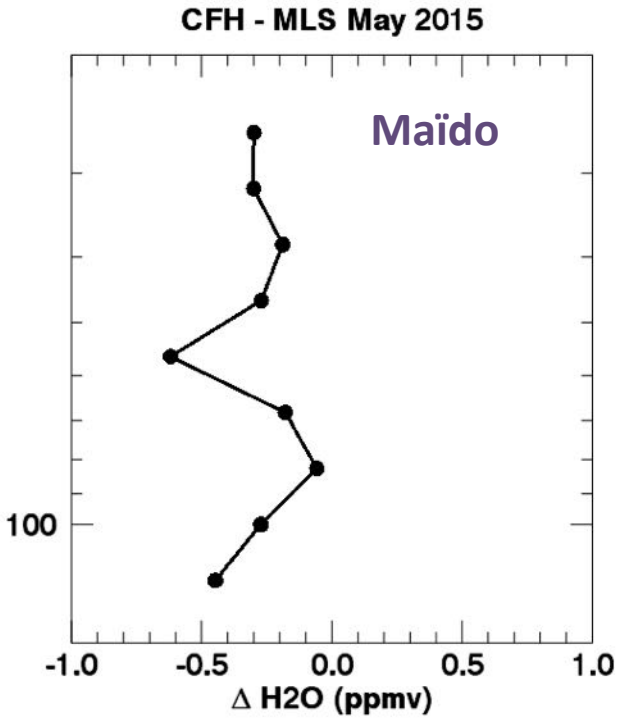


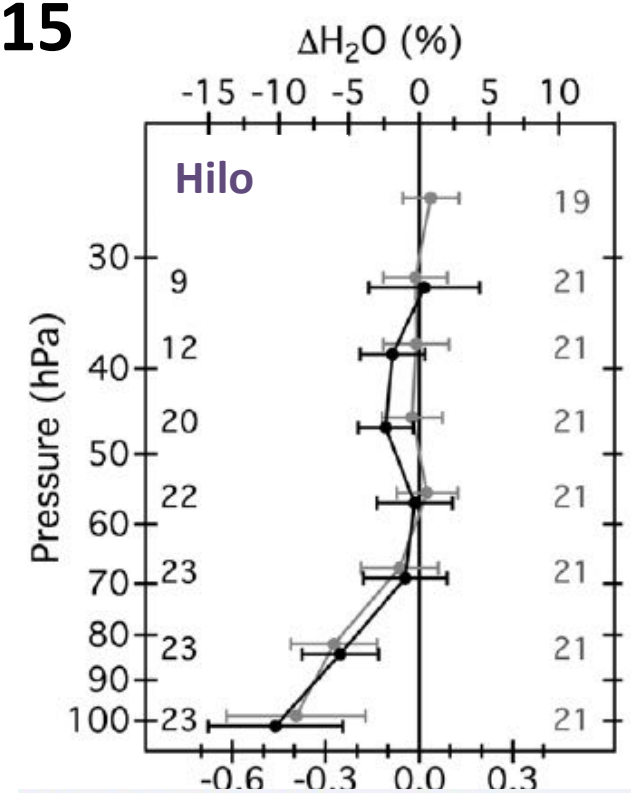


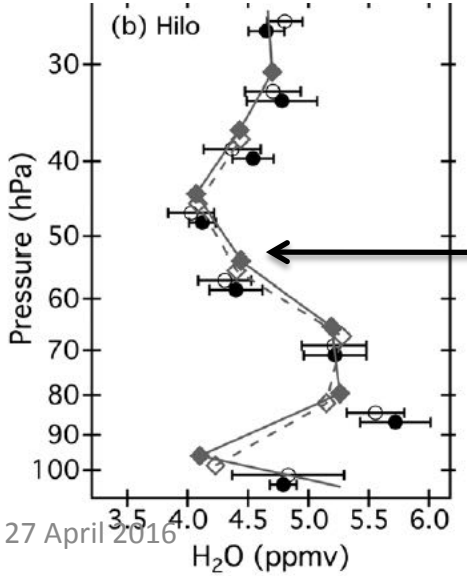


CFH vs MLS for May 2015









From Hurst et al., JGR, 2014

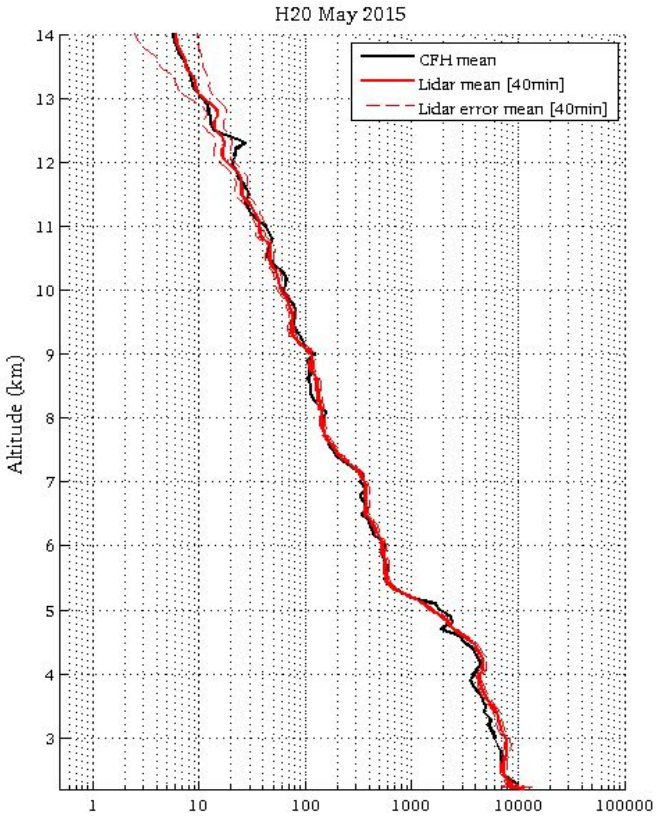
Mean FPH H_2O Hilo

Hilo

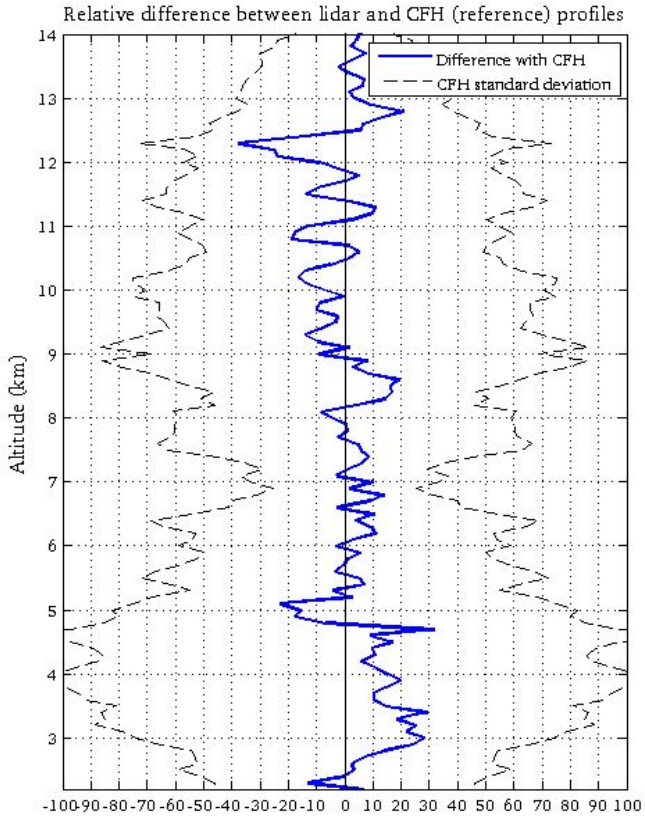
Pressure (hPa)	B1 ΔH_2O (ppmv)	A2 ΔH_2O (ppmv)
26		0.04 ± 0.09
32	0.02 ± 0.18	−0.01 ± 0.10
38	−0.09 ± 0.11	−0.01 ± 0.11
46	**−0.11 ± 0.09**	−0.02 ± 0.10
56	0.03 ± 0.12	0.03 ± 0.10
68	−0.05 ± 0.13	−0.06 ± 0.12
83	**−0.25 ± 0.12**	**−0.27 ± 0.14**
100	**−0.46 ± 0.22**	**−0.40 ± 0.22**

Raman Lidar water vapor vs CFH

Troposphere: 2-14km, 40 minutes integration



Water vapor Mixing Ratio (ppmv)



Relative difference (%)

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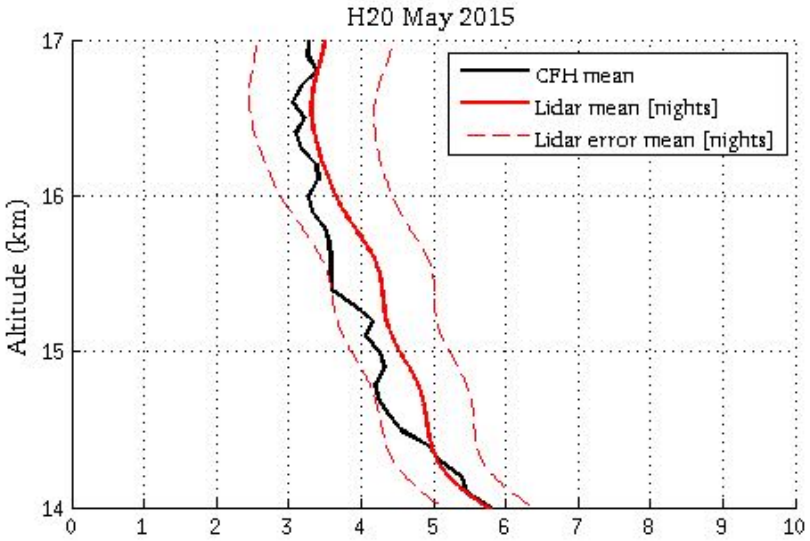
LIDAR calibration coefficients calculated through hourly GNSS IWV. Dionisi et al., 2015 AMT

Total Lidar absolute error=
Statistical error of the detectors+
Error linked to the calibration coefficient+
Error linked to the exctinction coeff

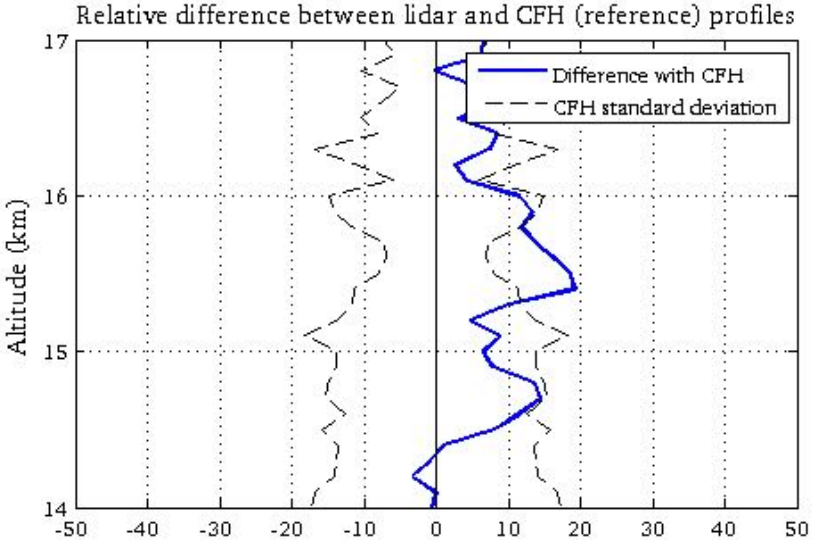
Raman Lidar vs CFH

Upper-troposphere: 14-17km

4-hour integration



Water vapor Mixing Ratio



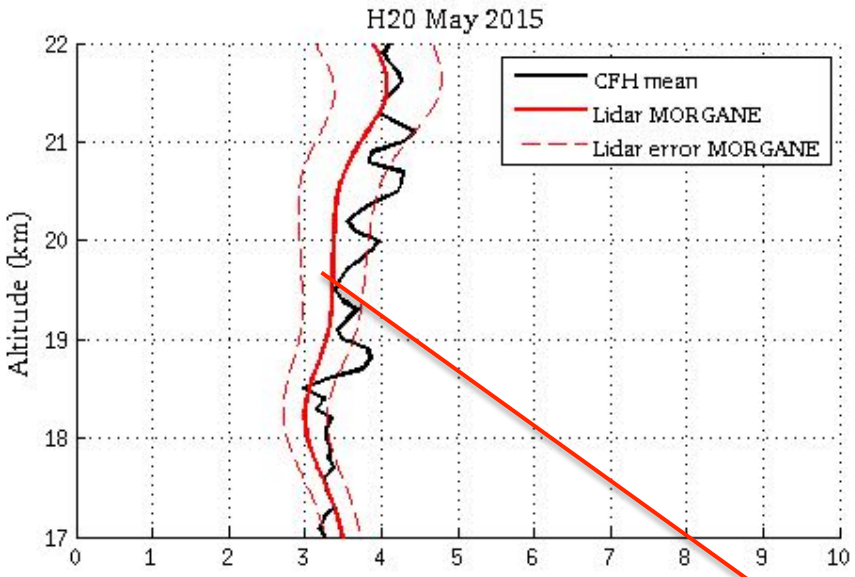
Relative difference (%)

PhD Hélène Vérèmes, 2016

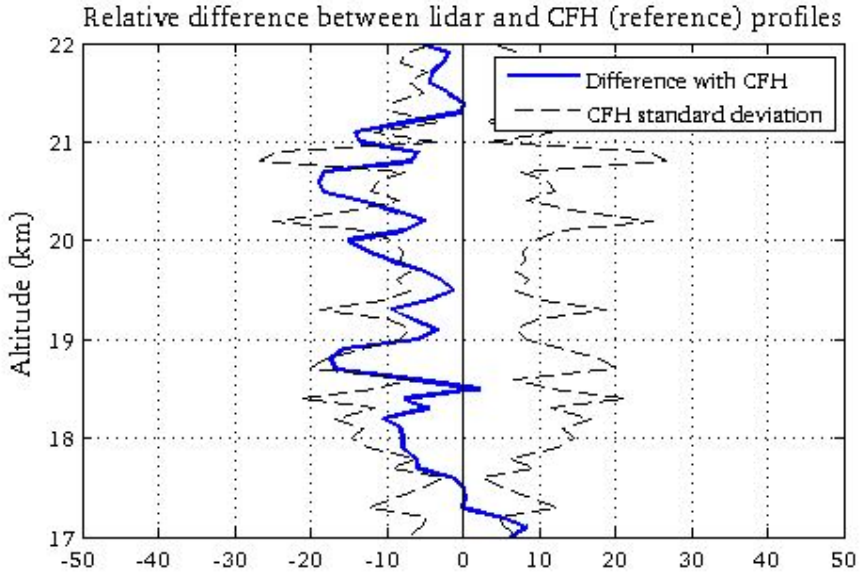
Raman Lidar vs CFH

Lower stratosphere: 17-22km

~50-hour integration over MORGANE campaign period



Water vapor Mixing Ratio

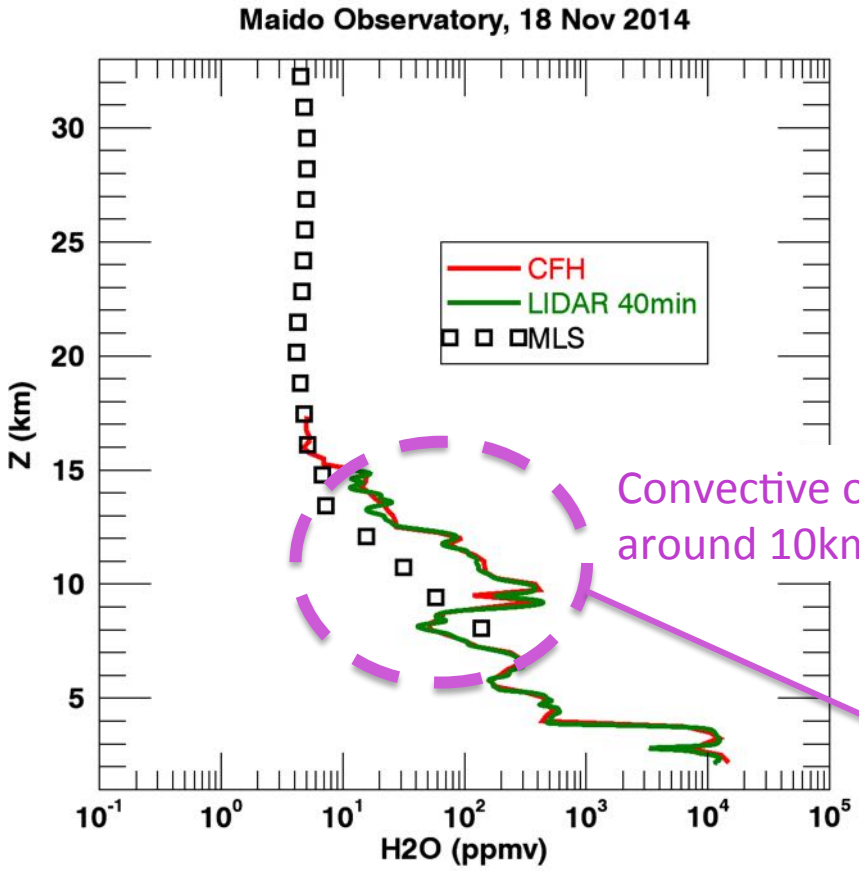


Relative difference (%)

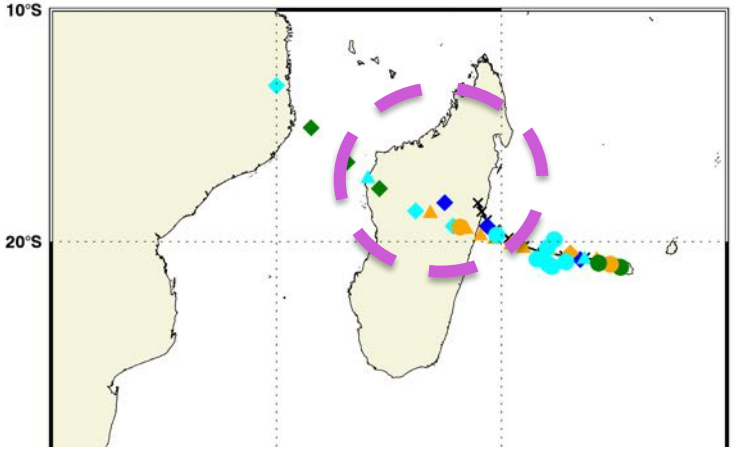
PhD Hélène Vérèmes, 2016

Relatively good agreement with CFH H2O can be achieved up to 20km if combined ~50h of LIDAR measurements but vertical resolution in the lower stratosphere on the order of 1 to 2km

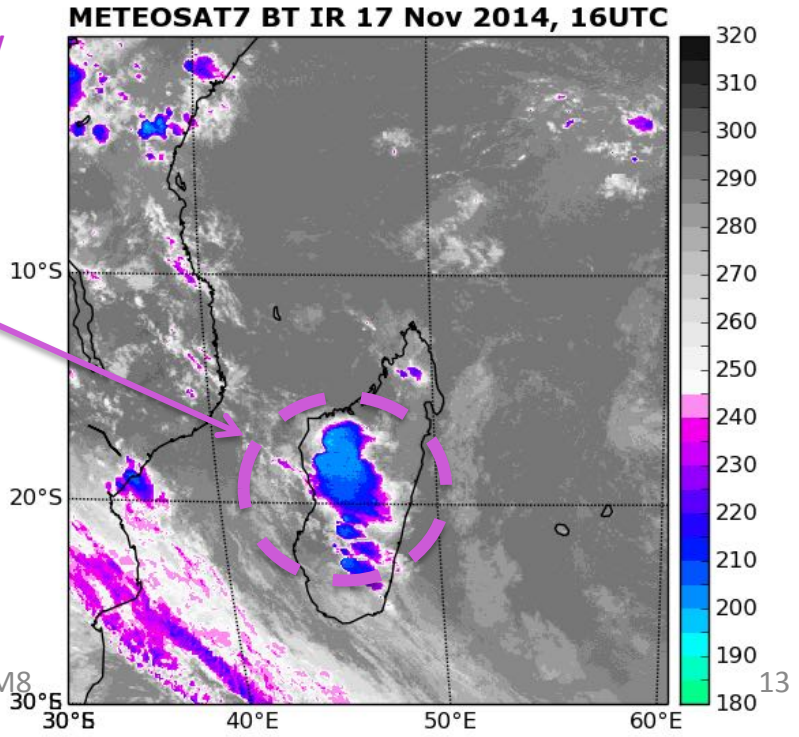
Reunion and Convective Outflow, 18 Nov 2014 CFH/LIDAR



Convective outflow around 10km

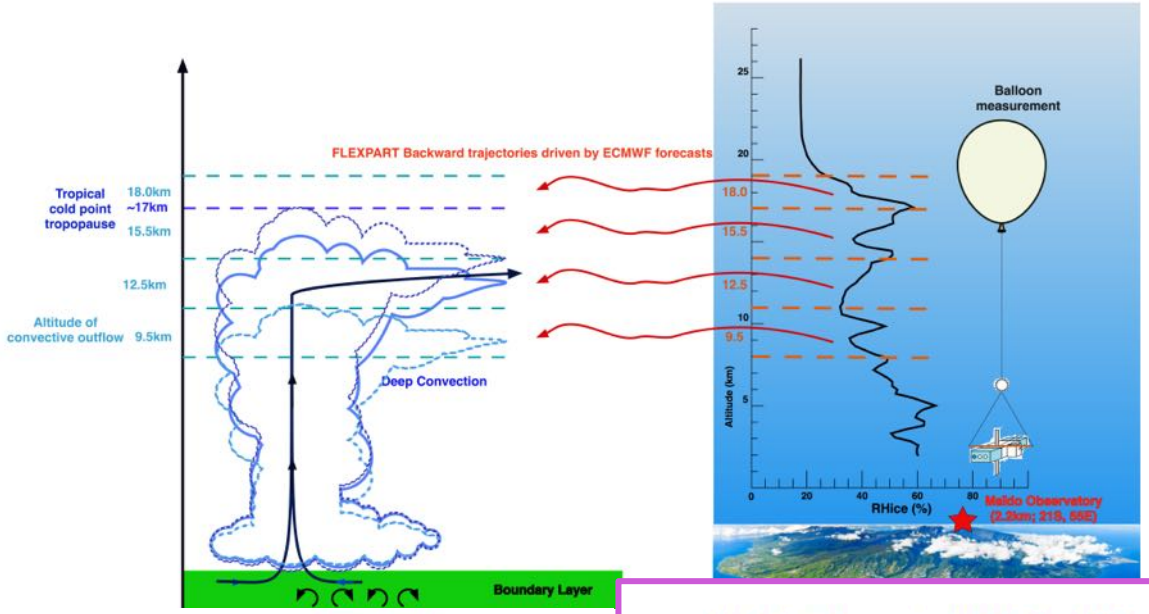


FLEXPART backward trajectories:
10-20% total mass, 20-30% total mass, 30-50% total mass



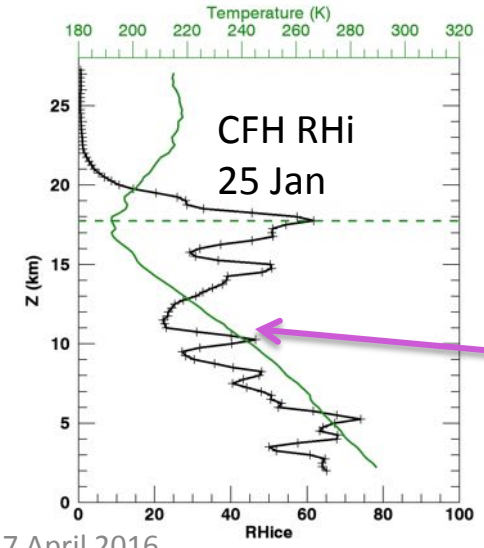
FOOT: Flexpart cOnvective Outflow Tool

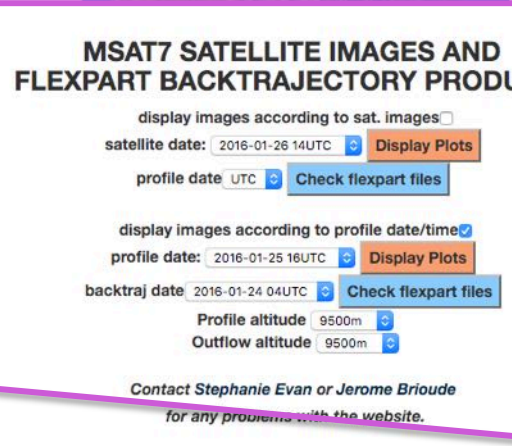
http://geosur.univ-reunion.fr/public_html/cgi-bin/web/display_image_vapeurdo.py

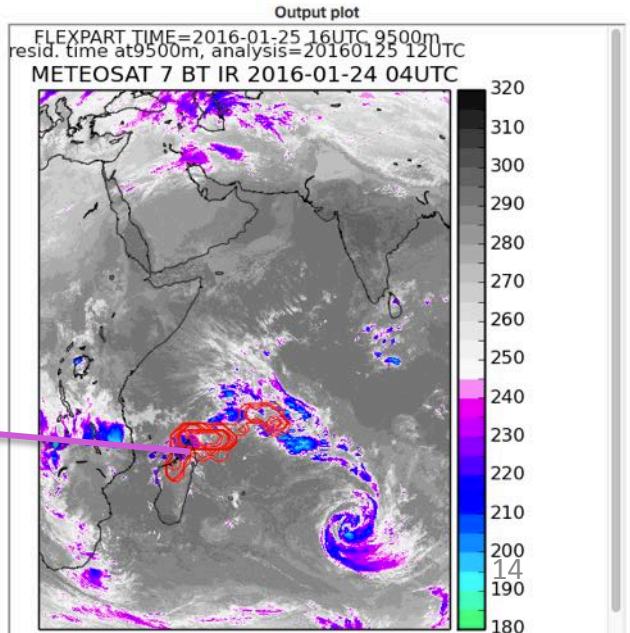


FOOT: online tool to analyze H_2O/O_3 measurements from Maïdo, flexible can be deployed for other observation sites.

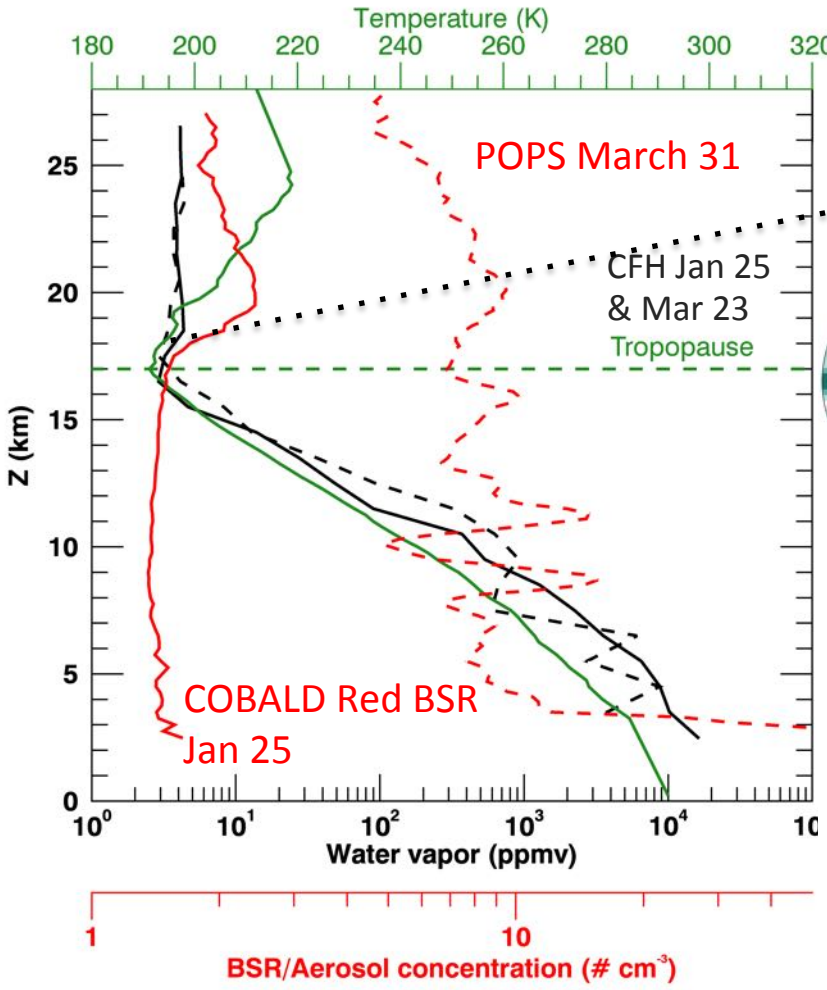
FLEXPART Lagrangian trajectories +METEOSAT 7 geostationary satellite observations on a daily basis for the Indian Ocean



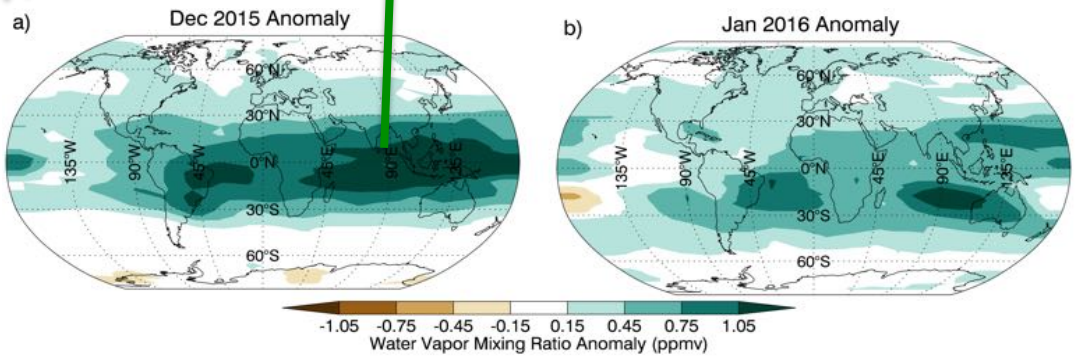


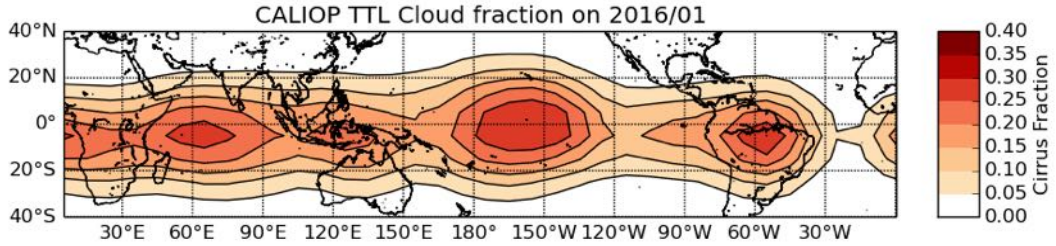


Jan-March 2016: CFH/COBALD/POPS



Dec 2015 MLS H2O anomaly ~0.7ppmv due to El Nino



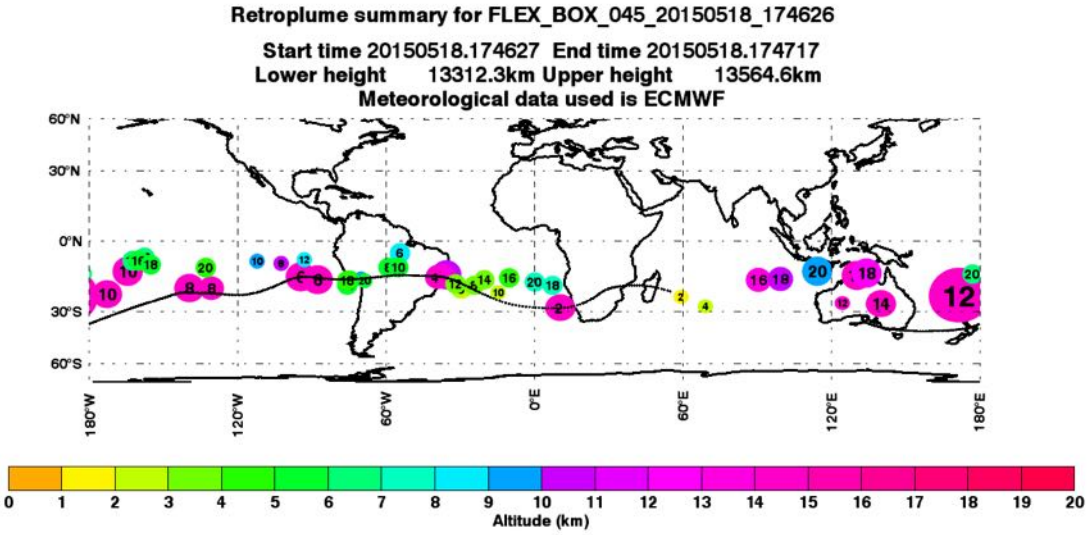


Top: MLS H2O anomalies at 82 hPa for (a) December 2015 and (b) January 2016 (plot courtesy of Sean Davis NOAA/CSD).
(Bottom): January 2016 CALIPSO-derived TTL cirrus cloud fraction

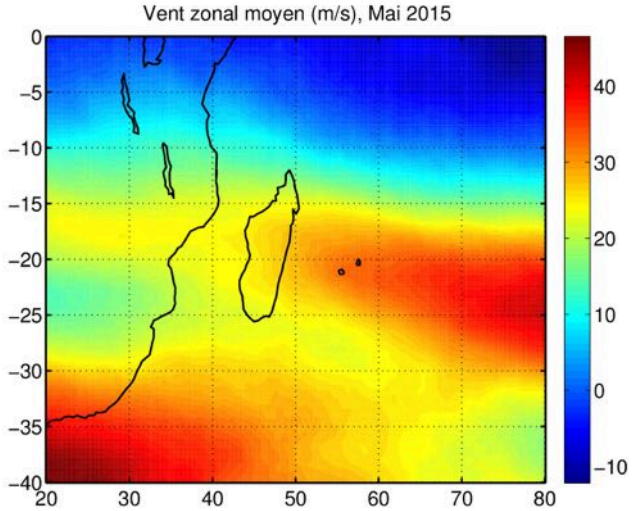
Near-future plans

- Publications on MORGANE campaign (Validation of Raman water vapor LIDAR using the radiosonde data, Calbuco Eruption, Stratospheric intrusion…)
- Develop more in-situ measurements of UTLS water vapor and aerosols-> Minimum of 2 per year
- Apply GRUAN ground-check procedure for the weekly SHADOZ ozone launch by 2017
- Go through GRUAN certification by 2018

MORGANE May 2015: FLEXPART Lagrangian analysis



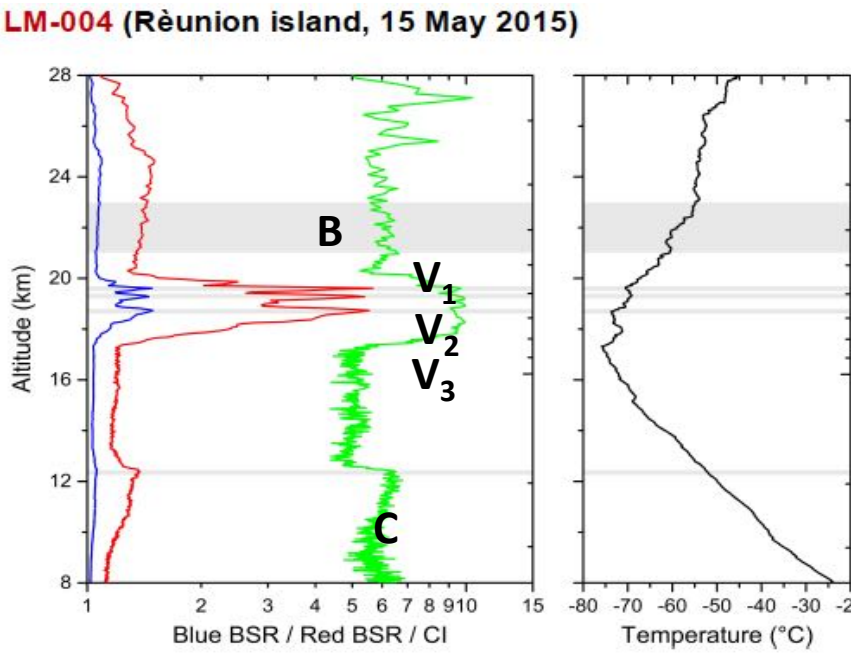
FLEXPART backward trajectory on 18/05/2013 for 13km

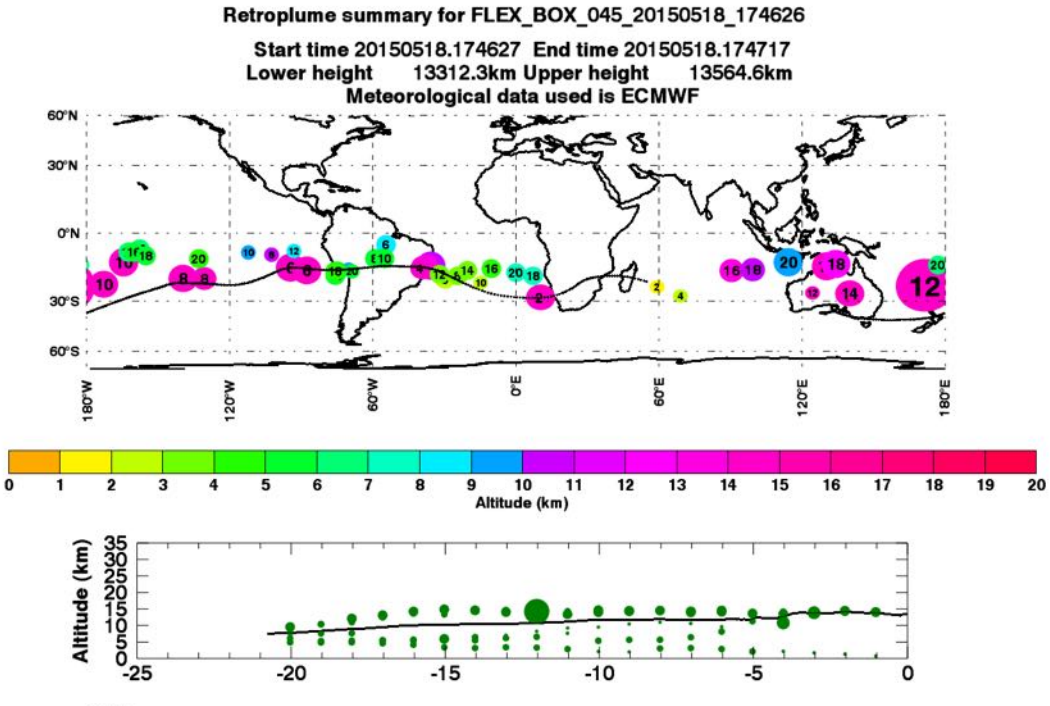


ECMWF U @ 200hPa May 2015

All MORGANE FLEXPART Lagrangian backtrajectories available at
http://osur-wikis.univ-reunion.fr/mediawiki/index.php/Morgane#FLEXPART_Lagrangian_modeling_products

MORGANE Campaign May 2015: Calbuco eruption

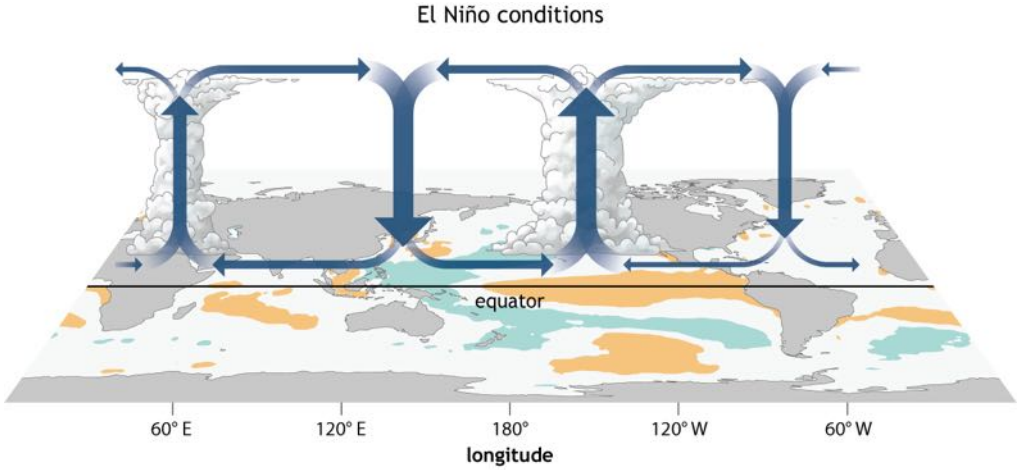


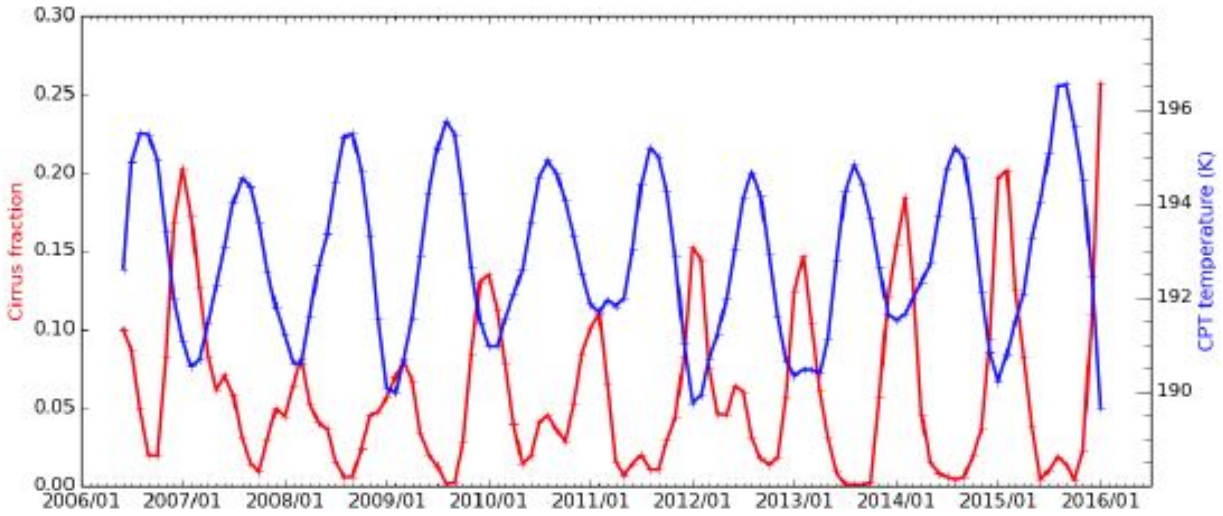


Optical modeling of COBALD:
Simone Brunamonti, ETHZ

	B	V_1	V_2	V_3	C
Mode Radius	68 nm	287 nm	280 nm	264 nm	47 nm
Number Density	12.5 cm^{-3}	2.3 cm^{-3}	2.5 cm^{-3}	3.6 cm^{-3}	220 cm^{-3}

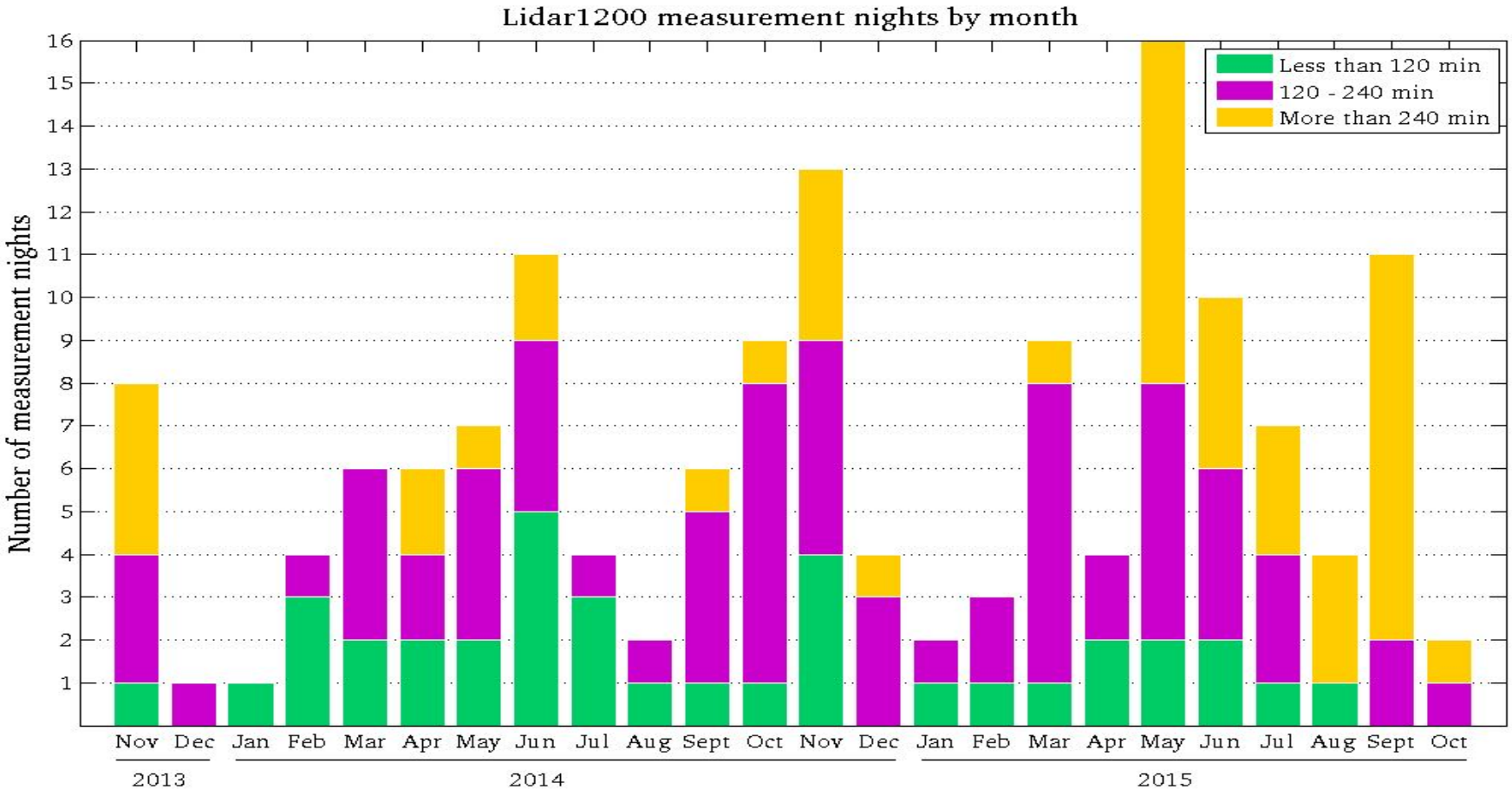
El Nino Convection and the Indian Ocean





Monthly mean values of COSMIC GPS cold point temperature (blue) and CALIPSO cloud fraction (red) with base above 15 km within a 10^{o} latitude x 10^{o} longitude region centered above Réunion from June 2006 to January 2016

RAMAN H2O LIDAR DATA SINCE 2013



PhD Hélène Vérèmes, 2016