[1]GMAC: Beltsville GRUAN Update
Site update, Current Activities, Plans

Belay Demoz - UMBC

Howard University: R. Sakai, A. Flores, D. Whiteman, A. Estifanos

NOAA/NWS/STAR: H. Diamond, J. Fitzgibbon, D. Brewer, M. Lataille, T. Reale, B. Sun, F. Tilley, N. Nalli, R. Smith, M. Hicks

NASA/GSFC: J. Sullivan, N. Abuhassan (UMBC)

[1]*GRUAN Mid-Atlantic Consortium is an association of scientists that are interested in GRUAN, Sat.-validation, upper-air instrumentation*

- *Serve as a USA-arm for GRUAN: science, advocacy, student and staff training*
- *Semi-Quarterly meetings for update and coordination*
- *Provide Science input to GRUAN and GRUAN-like activities by its members: NWS-SFSC; HU-Beltsville, STAR*

Outline

Part-I: The GRUAN Basics -

- *Burst altitude statistics*
- *Change management (RS92-RS41)*
- *Dave Whiteman (ALVICE) is fulltime at Beltsville*

Part-II: New developments and Collaboration in the works

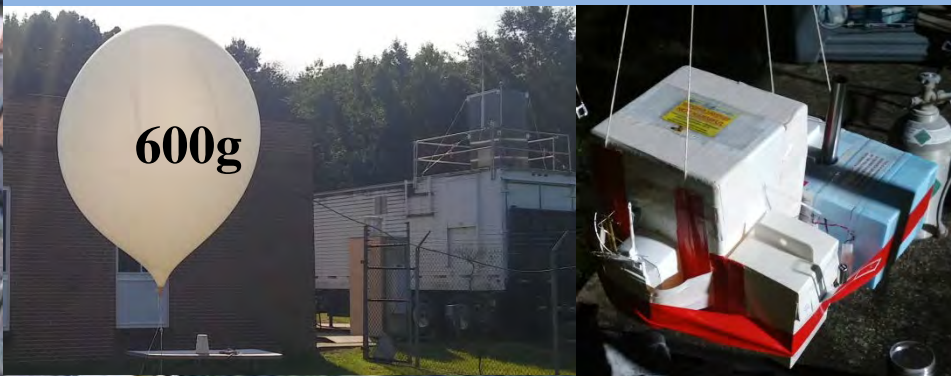- *Ozone: NDACC and Pandora net*

Part-III: GMAC - Collaboration work (this talk is the 2nd of three from GMAC)

- *Simultaneous NWS-Beltsville RS41 launches*
- *Then and now - and double CFH flight*
- *Use of Beltsville in NPROVS calibration work*

Beltsville: The GRUAN station

Certified for Weekly RS92 + Monthly CFH

600g

Year	O₃ Sondes
2017	23
2016	21
2015	14
2014	16
2013	21
2012	18
2011	44

Year	RS92-41 pairs	Comment
2016	2	December+
2017	45	all months
2018	13	ongoing

Occultation Overpassdata BEL: Total flight 7 +	
9/18/2017	11/10/2017
12/2/2017	12/11/2017
1/7/2018	2/8/2018
3/24/2018	

BV-NWS Coordinated pairs	
2017	8
2018	

QA/QC-2: Sonde statistics and burst altitude

HUBV: Min pressure
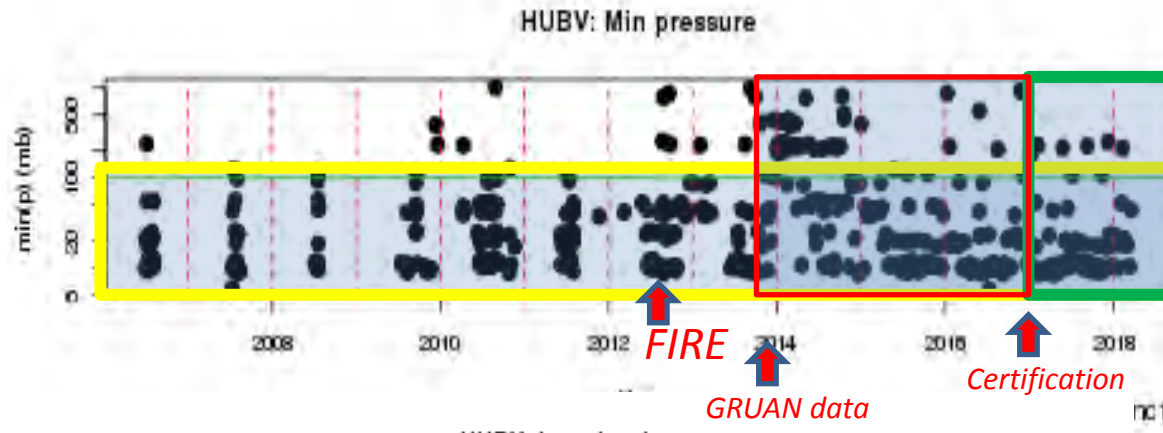
GRUAN altitude reach test
- *GRUAN data start 2014+*
- *Certification on 10/2016*
- "GRUAN Altitude" reach improving with time.

FIRE
GRUAN data
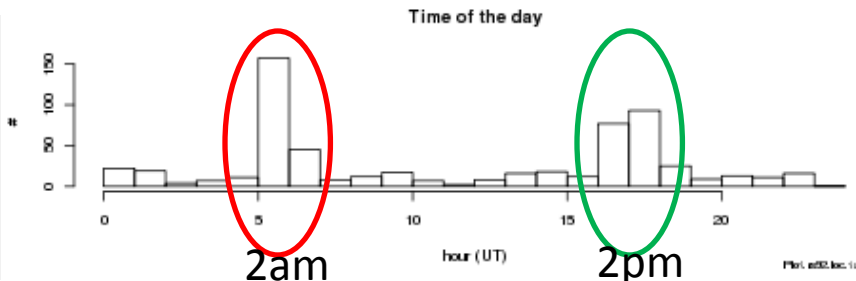Certification

HUBV: launches by year

20/yr
70/yr
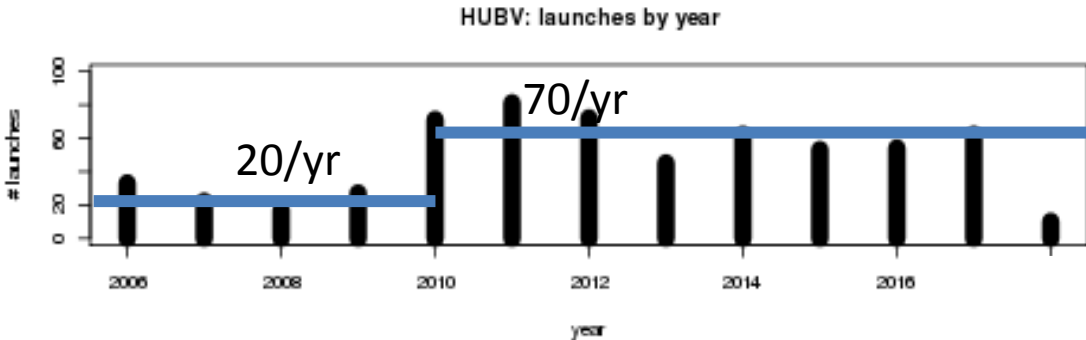
← GRUAN RS92
- *~ 70 launches per year*

Month
100

Summer biased: *IOP focus on air quality* ➔

Time of the day
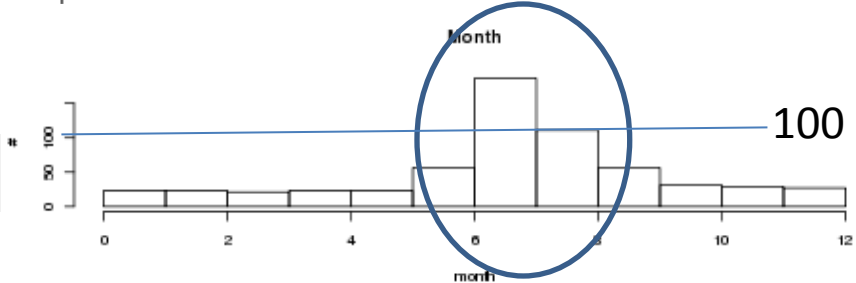
- *Data is satellite overpass coordinated* ➔
  - *~ 2am (hard to do)*
  - *~ 2pm (easy – standard work hrs)*

Would time of day matter for GRUAN?

2am   2pm

Beltsville: Personnel addition

- *David Whitman is now full time at the Beltsville Site*
- Installed in a new lidar lab at Beltsville.

- Unique set of instrumentation for atmospheric characterization transferred from NASA/GSFC to Howard University

- Raman water vapor, aerosol, temperature, cloud lidar

- Vaisala, Intermet, Cryogenic Frostpoint Hygrometer launch capabilities

- GPS total column water

- Ventilated NIST traceable surface reference station (P, T, RH) for radiosonde pre-launch accuracy studies and continuous atmospheric characterization
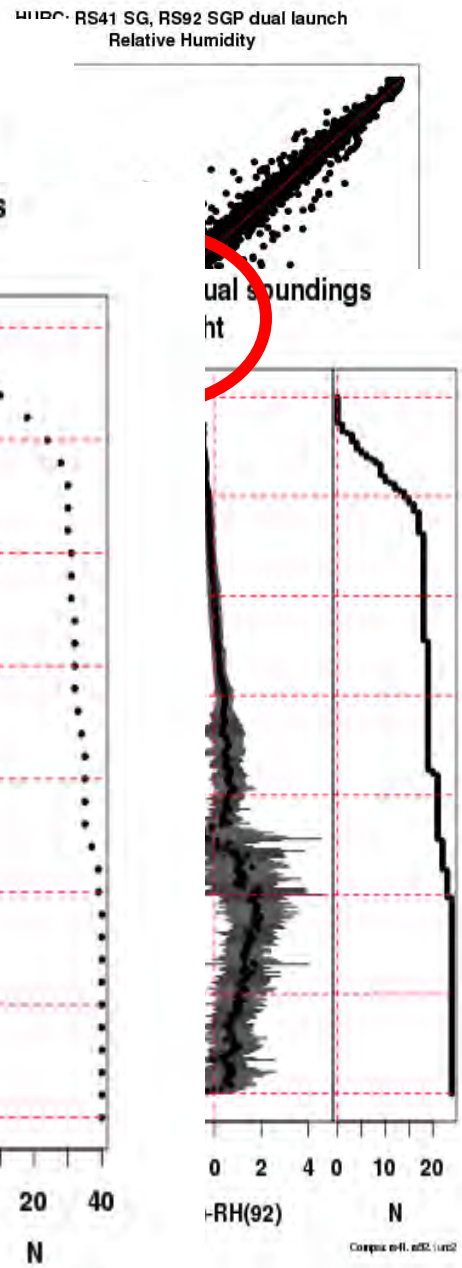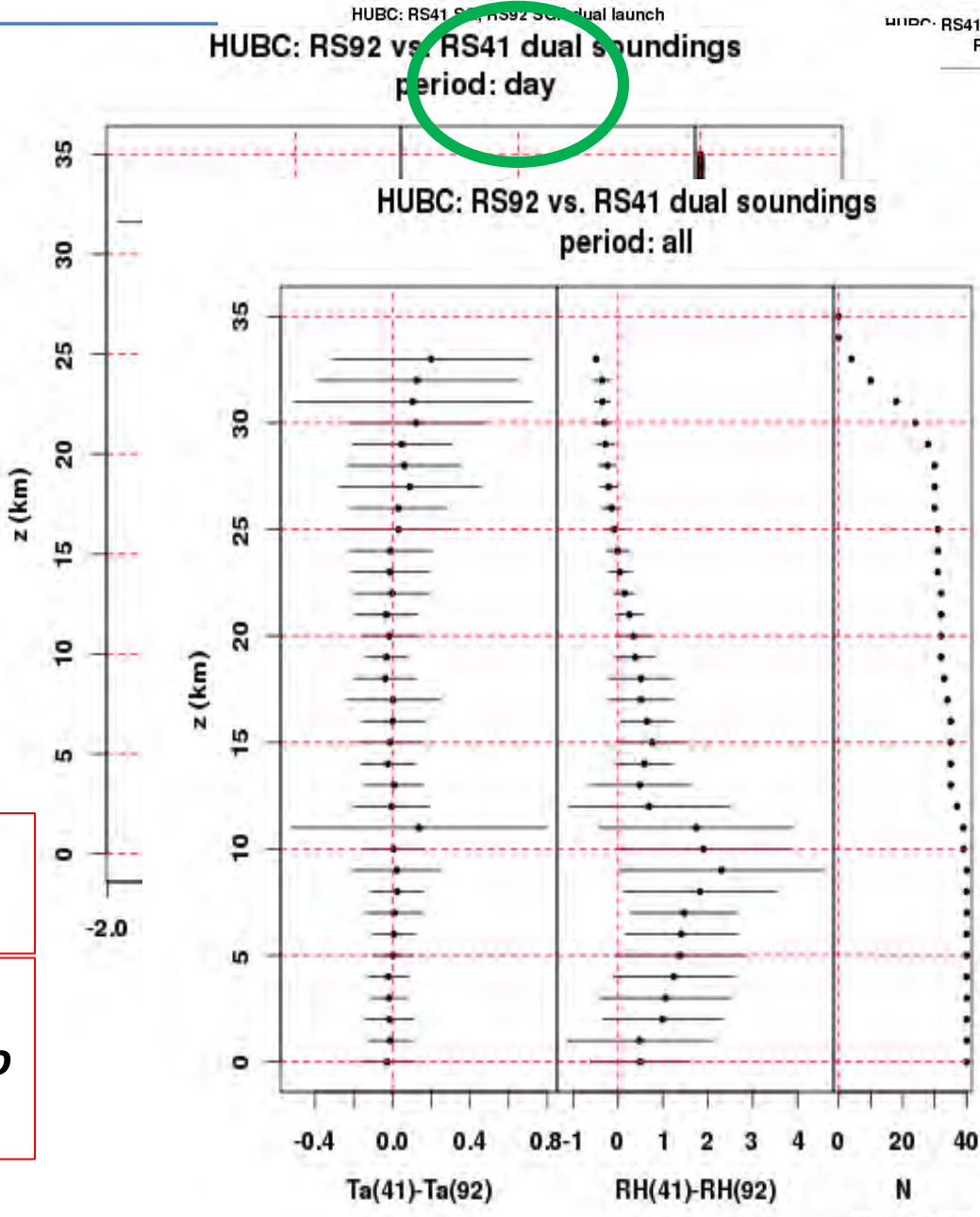
ALVICE
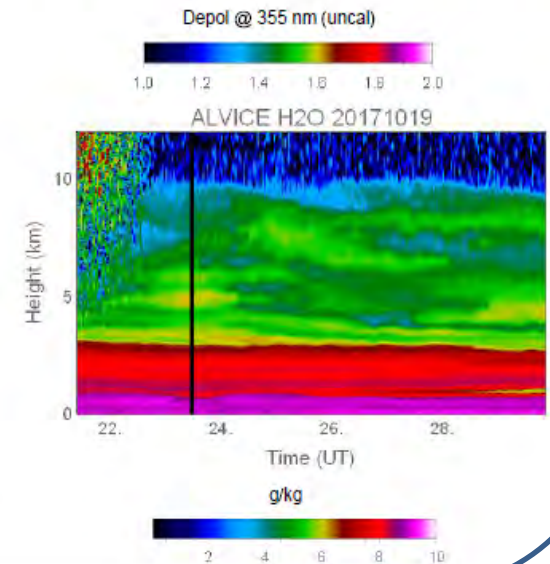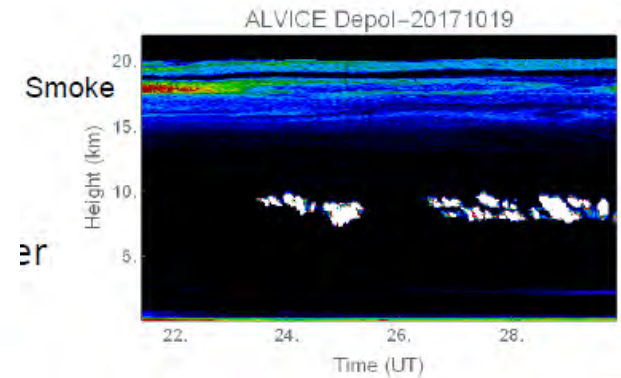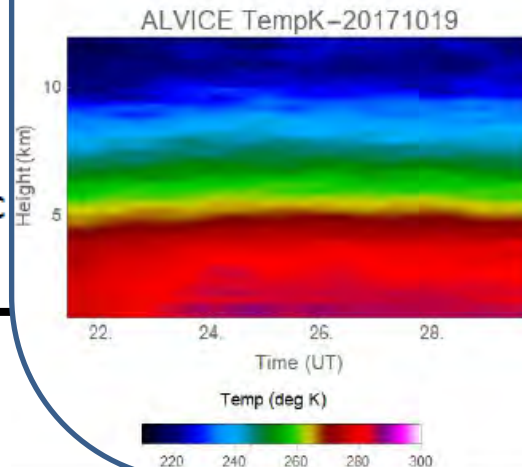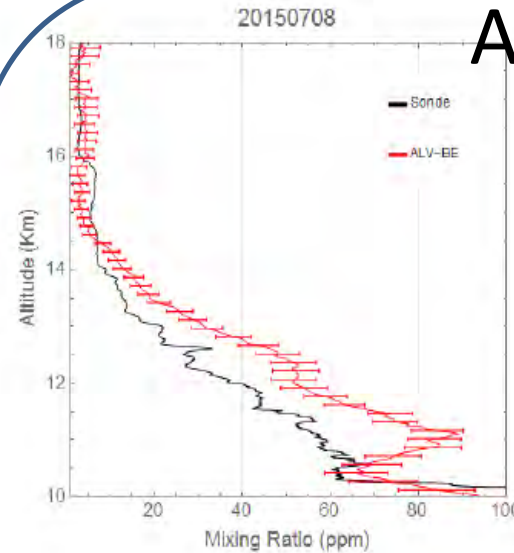
QA/QC-3: Change is gone come (RS92 → RS41)

Year	RS41-92 pairs	C...
2016	2	D...
2017	45	a...
2018	13	c...

Goal is to also have MWR, lidar, and satellite data

Will probably continue RS92-41 through 2018

RS41 ~2% moist in the troposphere

RS41 > 0.2C above 26Km compared to RS92.

HUBC: RS92 vs. RS41 dual soundings period: day

HUBC: RS92 vs. RS41 dual soundings period: all

HUBC: RS41 SG, RS92 SGP dual launch Relative Humidity

CFH history (and plan) at Beltsville

We want to be like Boulder 30yrs from now -☺

CFH Altitude Intervals of Stratospheric Water Vapor Mixing Ratio over HUBC
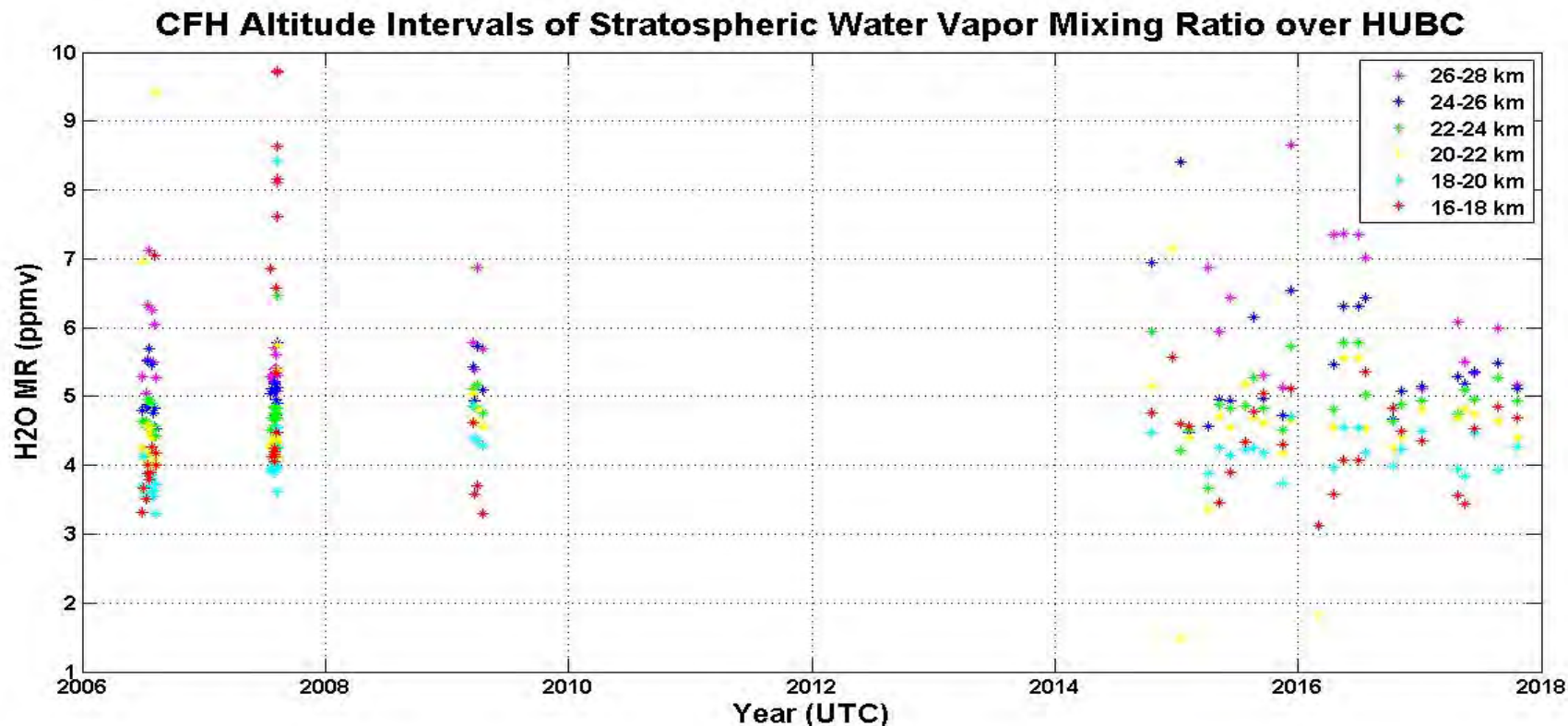
Cumbersome, Finicky and Hard:
Need an alternative technology.

Ozone: Historical data at Beltsville

Year	# O_3 Sondes
2018	
2017	23
2016	21
2015	14
2014	16
2013	21
2012	18
2011	44

HUBv: O₃ : 2005 - 2017
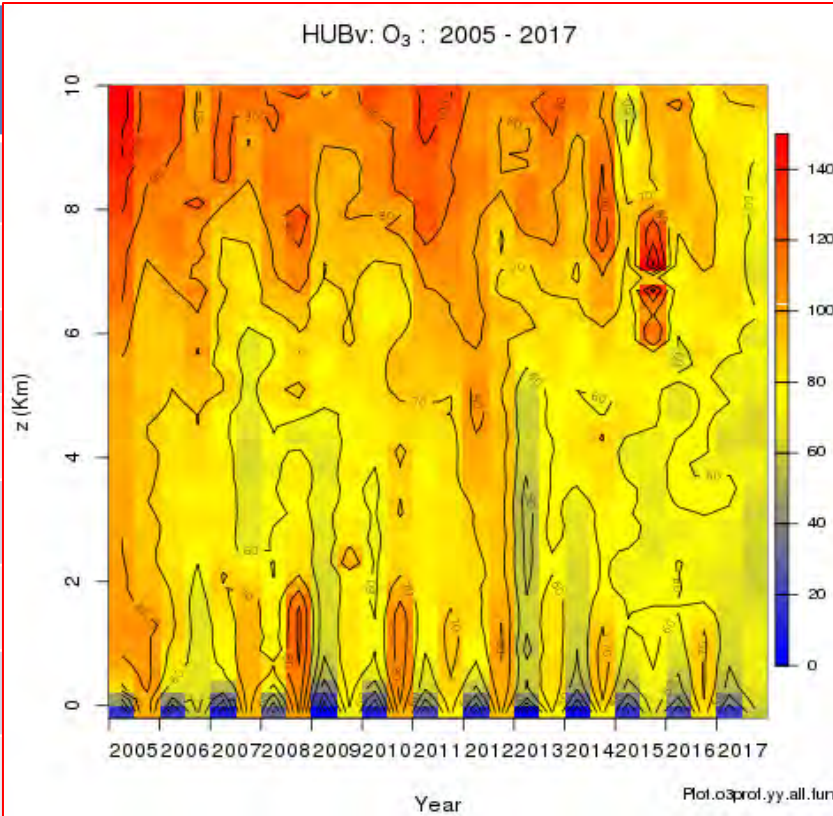
1. GRUAN O_3 repo needed?

- Many networks for ozone

- Many remote sensors measure Ozone

- Need "union" of networks
Examples are:
  - TROPOZ/TOLnet
  - Pandora

Ozone observations at Beltsville
- Started/funded with the state AQ focus in 2004
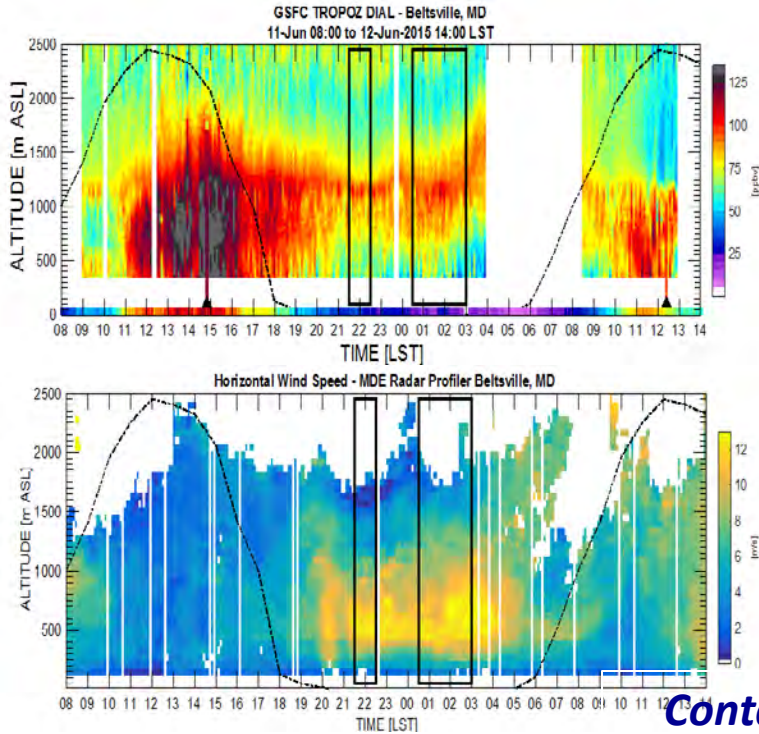- Complimented by NGIA
- Time consuming and expensive for Beltsville

2) Network coordination

New partnerships in the works at Beltsville

Ozone: historical data include lidar

NASA GSFC Tropospheric Ozone Lidar (TROPOZ) Deployment to HUBV

*Contact: John Sullivan, email: john.t.sullivan@nasa.gov*

- *Deployed in 2015 to HUBV, operated ~200 hrs to support MDE AQ forecasts*
  - See Sullivan et al., 2017 (At. Env) for recent science results and Sullivan et al., 2014 (AMT) for instrument performance specifications
- Return in Fall 2018/Spring 2019 to support AQ, NASA/NDACC ground based network objectives, and satellite cal/val activities

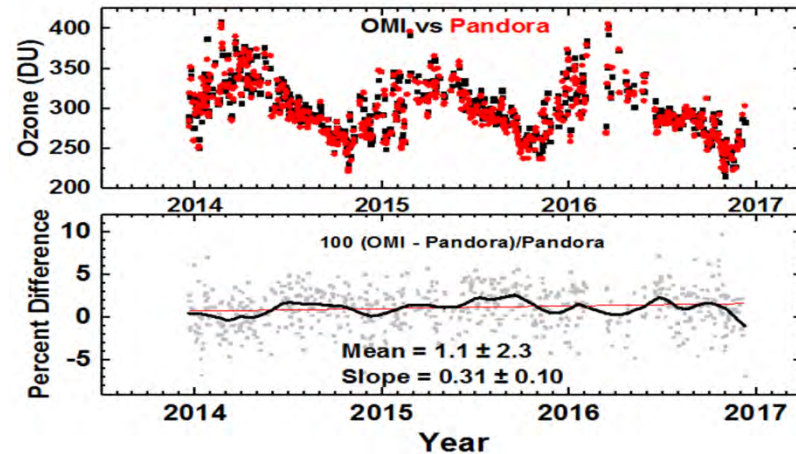*Future: exploring for ways to have it placed at Beltsville when not in travel*

Ozone: historical data should "include" Pandora

What is the Pandora ? Pandora is a small, ground-based Sun/Sky/Lunar observing spectrometer system using a commercially available spectrometer;

- Version 1 (270-530 nm); extended version (450-830nm)
- Total columns of (O3, NO2, SO2, HCHO, BrO) every 20sec, sunrise to sunset
- Operates autonomously; software runs on a small industrial PC found inside the weather resistant container.
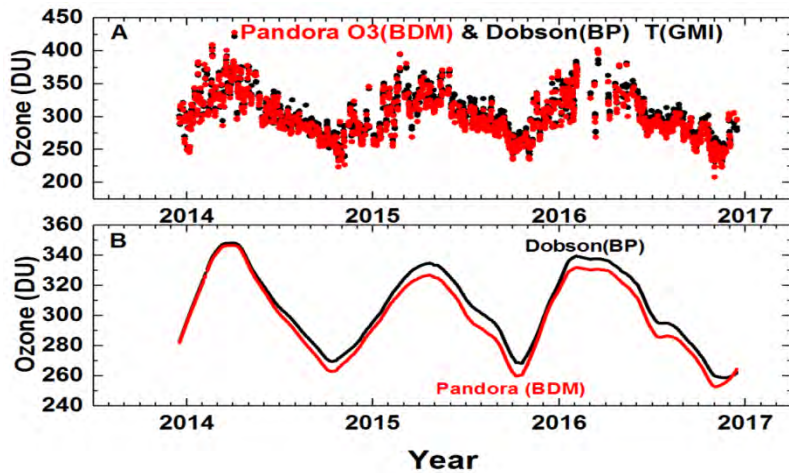
Pandora #34 Compared to Dobson #061 at Boulder CO.
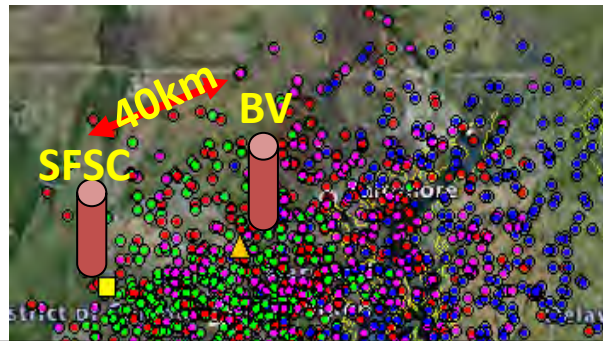Dec. 2013 - Dec. 2016 ; Herman et al., AMT 2015

Pandora vs OMI O3 Boulder Colorado; Dec. 2013 - Dec. 2016

*Future: exploring for ways to have one placed at Beltsville.*

GMAC Coordination examples

1) Simultaneous RS41 at Beltsville and NWS/SFSC

| Source of uncertainty		$\bar{\sigma}^2$	$\bar{\sigma}^2\%$
Total uncertainty	Δ_y	343.8	100%
Collocation drift	Δ_μ	343.0	-
Bias (adjustable)	β_0^2	11.6	3.4%
Environ. Error (reducible)	$x - \beta_0^2$	293.2	85.5%
Environ. Error (irreducible)	ω^2	37.1	10.8%
Sampling error	$\hat{\beta}$	0.21	0.1%
Measurement error	Δ_ε	0.81	0.2%
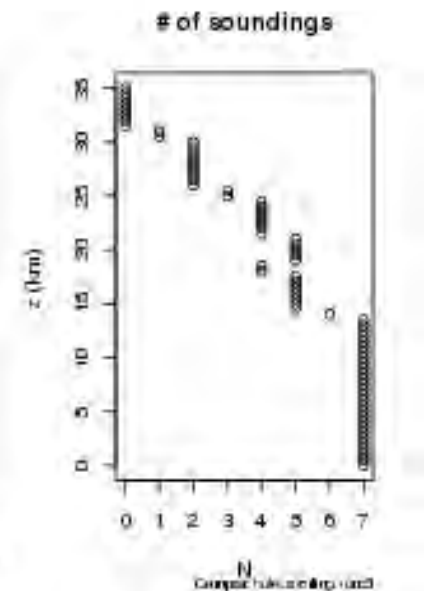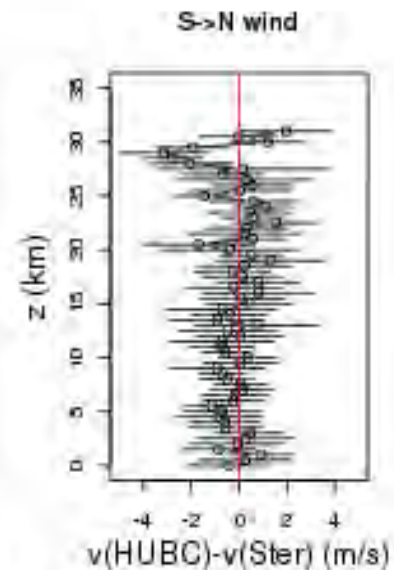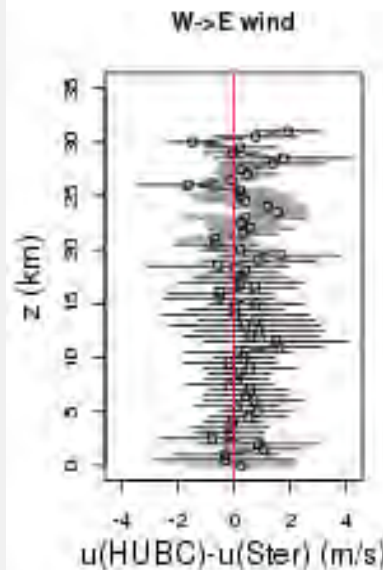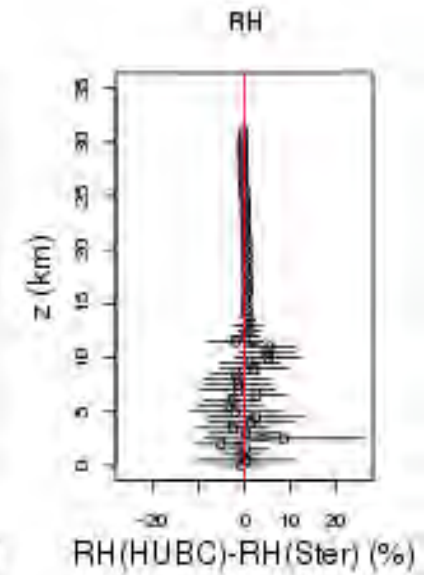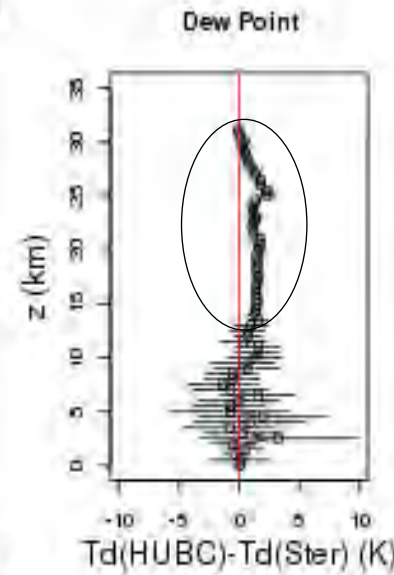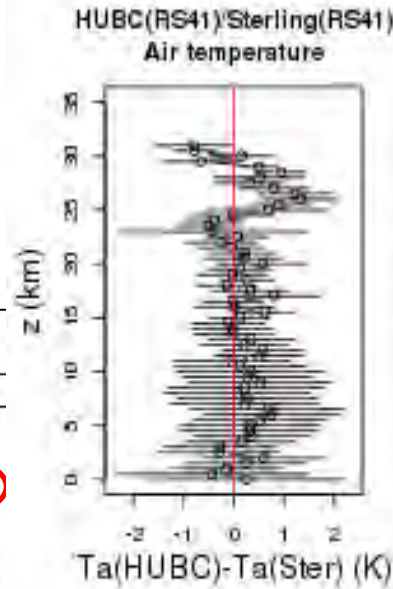
*Fasso et al (2014) results:
(Using RS92 & LMS6 sondes launched close in time)*

85% of the errors were "reducible" errors!

➔ *Repeat study with same sonde and time (RS41-RS41)!*
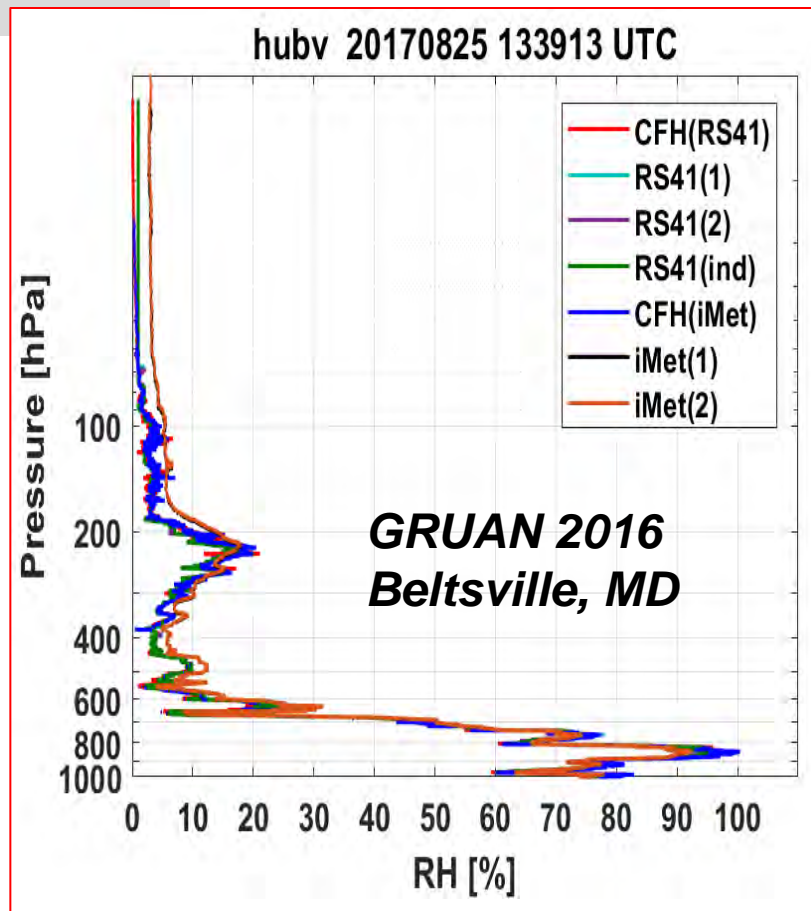
2) Dual CFH flight by Beltsville – NWS/SFSC

- CFH (RS41)
- RS41 (HUBC MW41)
- RS41 (2) (MW41, ALVICE)
- RS41 (ind)(SFSC MW41)
- CFH (iMet) (STRATO)
- iMet (1) (attached to CFH)
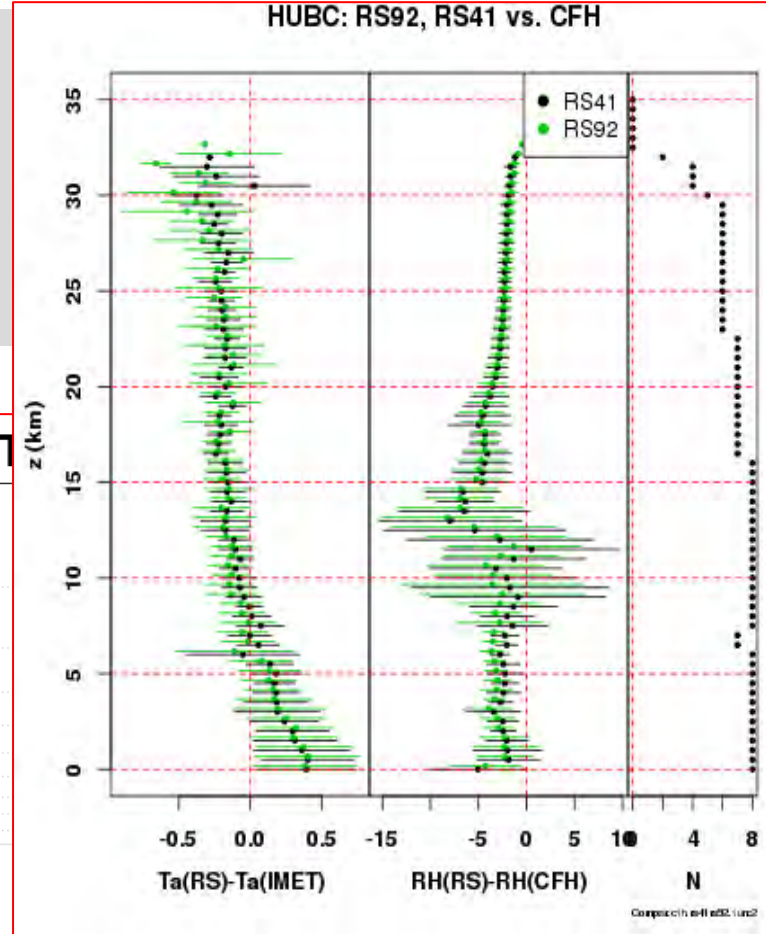- iMet (2) (SkySonde)
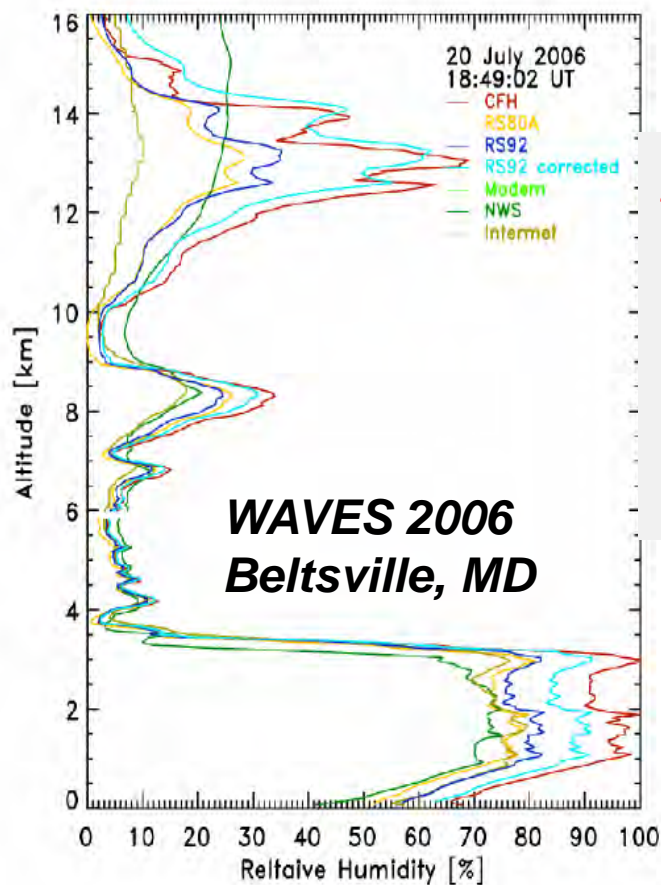
10 years later?
➔

Has GRUAN assisted ?

WAVES 2006 Beltsville, MD

GRUAN 2016 Beltsville, MD
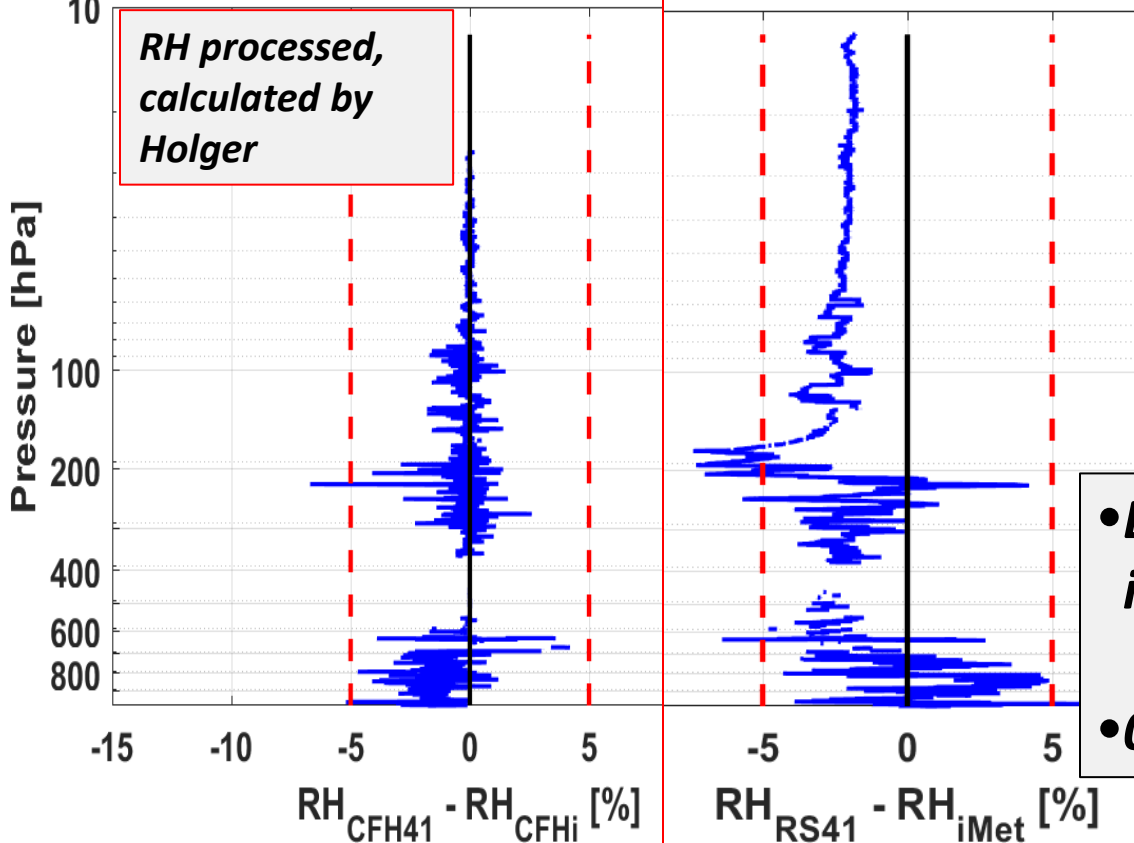
3) Dual CFH flight by Beltsville – NWS/SFSC

- CFH (RS41)
- RS41 (HUBC MW41)
- RS41 (2) (MW41, ALVICE)
- RS41 (ind)(SFSC MW41)
- CFH (iMet) (STRATO)
- iMet (1) (attached to CFH)
- iMet (2) (SkySonde)

HUBC: RS92, RS41 vs. CFH

RH processed, calculated by Holger

hubv 20170825 133913 UT

ubv 20170825 133913 UT

- *Differences may be from the iMet temperature?*

- *0.1 to 0.3C → 1-2% in RH diff.*

4) NPROVS analysis by STAR

NOAA Products Validation System (NPROVS)
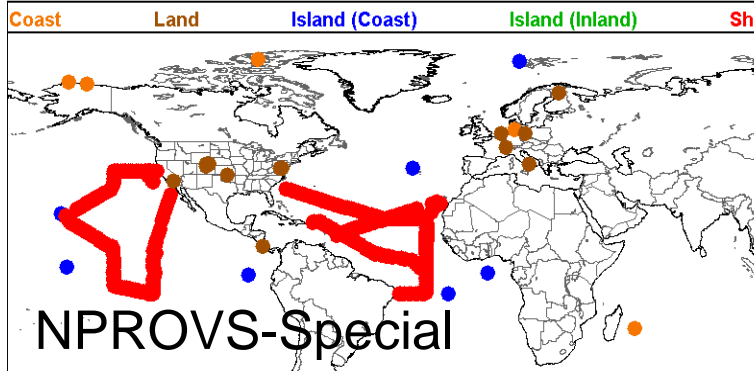
NPROVS-Special

Type	Beltsville	Sterling
RS41	35	140
RS92	228	290
other	??	609
total	263	1039

Sterling · · Beltsville
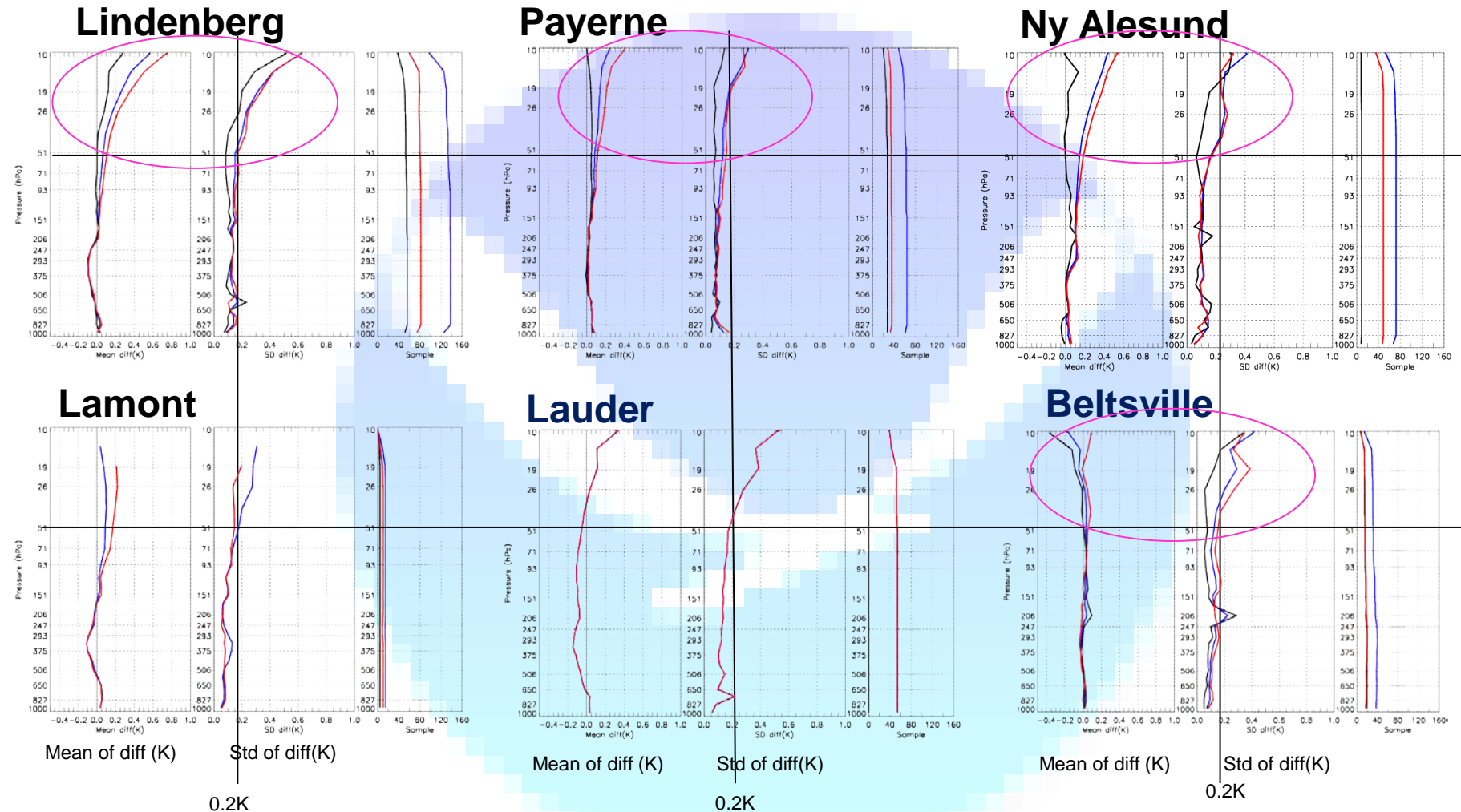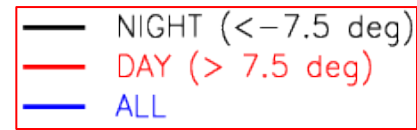
GMAC

February 7, 2017 to February 15, 2017
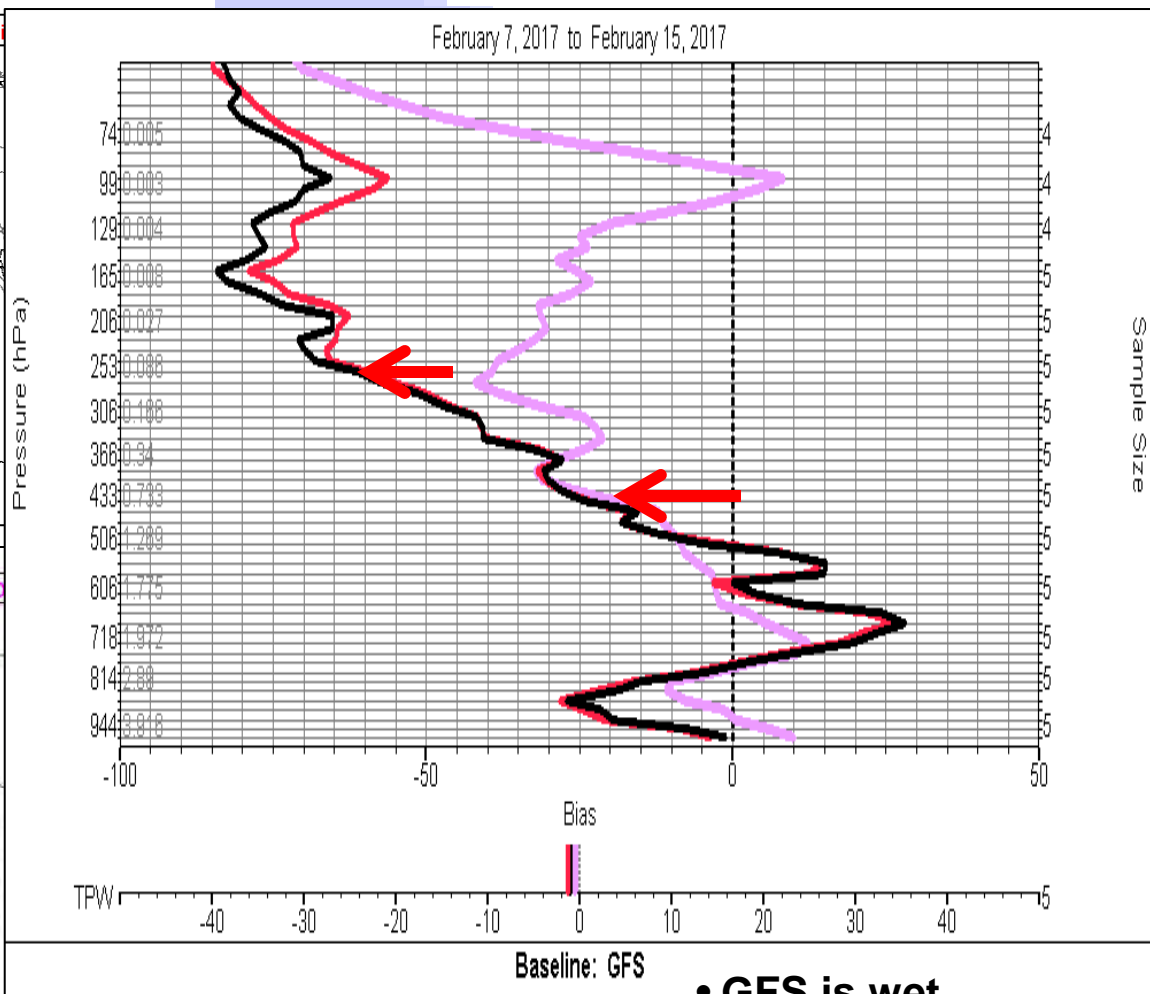
Mean water vapor fraction differences for collocated **CFH**, RS41, **ECMWF Analysis** and NOAA GFS (baseline) for water vapor fraction (*Delta MR / GFS (MR); %*) (Wallops 2017)

- **GFS is wet**
- **ECMWF is less wet**
- **RS41 tracks CFH 20 253hPa**

5) NPROVS analysis by STAR

Dual RS92-minus-RS41; Temperature

The mean difference and Std for data "rich" and data "poor" site show similar numbers.
Two questions:
   1) GRUAN – What value? GRUAN Vs non-GRUAN error at Beltsville.
      2) When is enough – enough?

Concluding remarks

Beltsville GRUAN site
- *Site is improving and building relationships and networks*
- *Focus on education and training continue... we have now two of our students employed by NWS*

- *GRUAN Mid-Atlantic Consortium is working well.*

Questions to GRUAN community:
- *Would time of day matter for GRUAN?*
- GRUAN O_3 reprocessing is needed?
- Will we know when we have enough RS92-RS41 pair launches?

A stronger union with NDACC, TOLnet, Pandora net
GRUAN – What value after 10years? Highlight achievements.

Norman - 1

Lindenberg - 0

De Bilt - 5

Payerne - 2

Greenbelt - 6

Thank you!

Queenstown - 3

Matera - 7

Tokyo - 4

Helsinki-9

Boulder-8