Update: GRUAN Related Activities

@

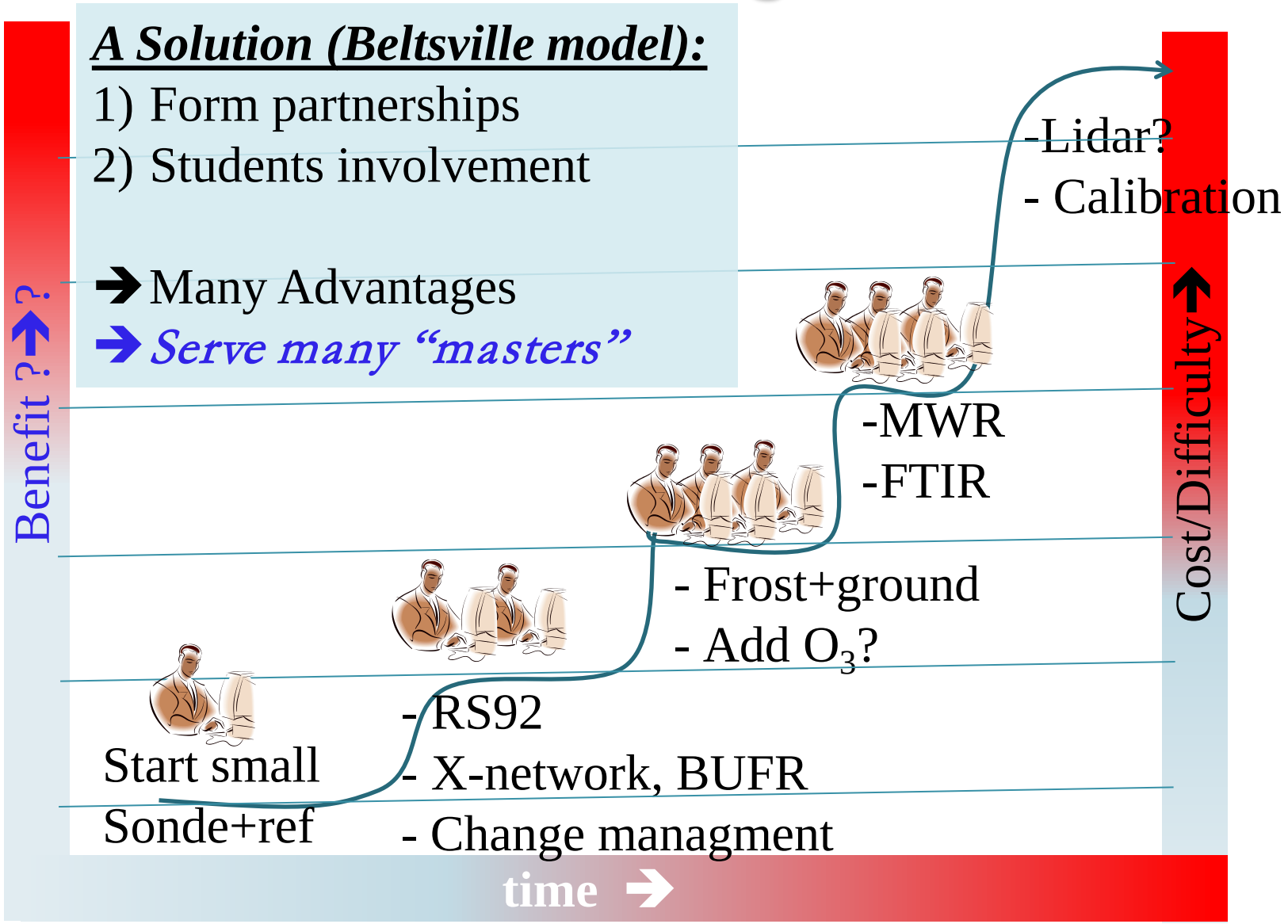
Howard University Beltsville Campus.

Report by

Belay Demoz and Ricardo Sakai

Certification: application submitted

GRUAN: a site managers view?



GRUAN @ Beltsville - Summary

Take home: We Serve many "masters"

NASA [ALVICE]: *D. Whiteman,* ***M. Walker*,*** *K. Vermeesch*

NOAA [NWS]: ***M. Hicks*,*** *J. Fitzgibbons, Howard. Diamond*

NGIA: ***T. Creekmore****

Howard University (HU): *D. Venable, R. Sakai, V. Morris, Grad. Students*

UMBC/JCET: *B. Demoz (Leave of Absence from HU)*

Operations/Funding:

- Ozone observations *(O_3 - MDE and NGIA)*
- Satellite Cal/Val. *(RS92/CFH - NOAA)*
- *Lidar:* HURL *(NCAS);* ALVICE *(NASA)*
- *+ many other sensors*

Scheduling:

- 1/wk
- *1/month CFH started.*

**** Former students***

Outline

1) Summary of GRUAN @ Beltsville.

- ***Highlights of updates, statistics, etc.***
- ***Ozone as an example***

2) Examples of ongoing activities

a) Satellite-sonde-lidar "validation": A methodology

b) Wind – A "forgotten" GRUAN priority-1 variable

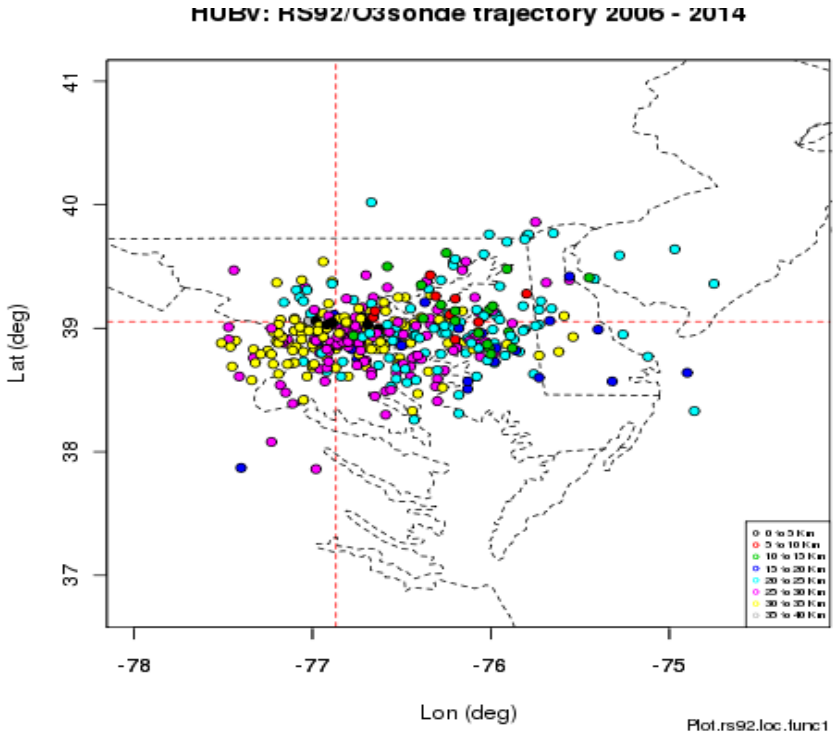
c) Temperature trend – from AIRS (FYI only)

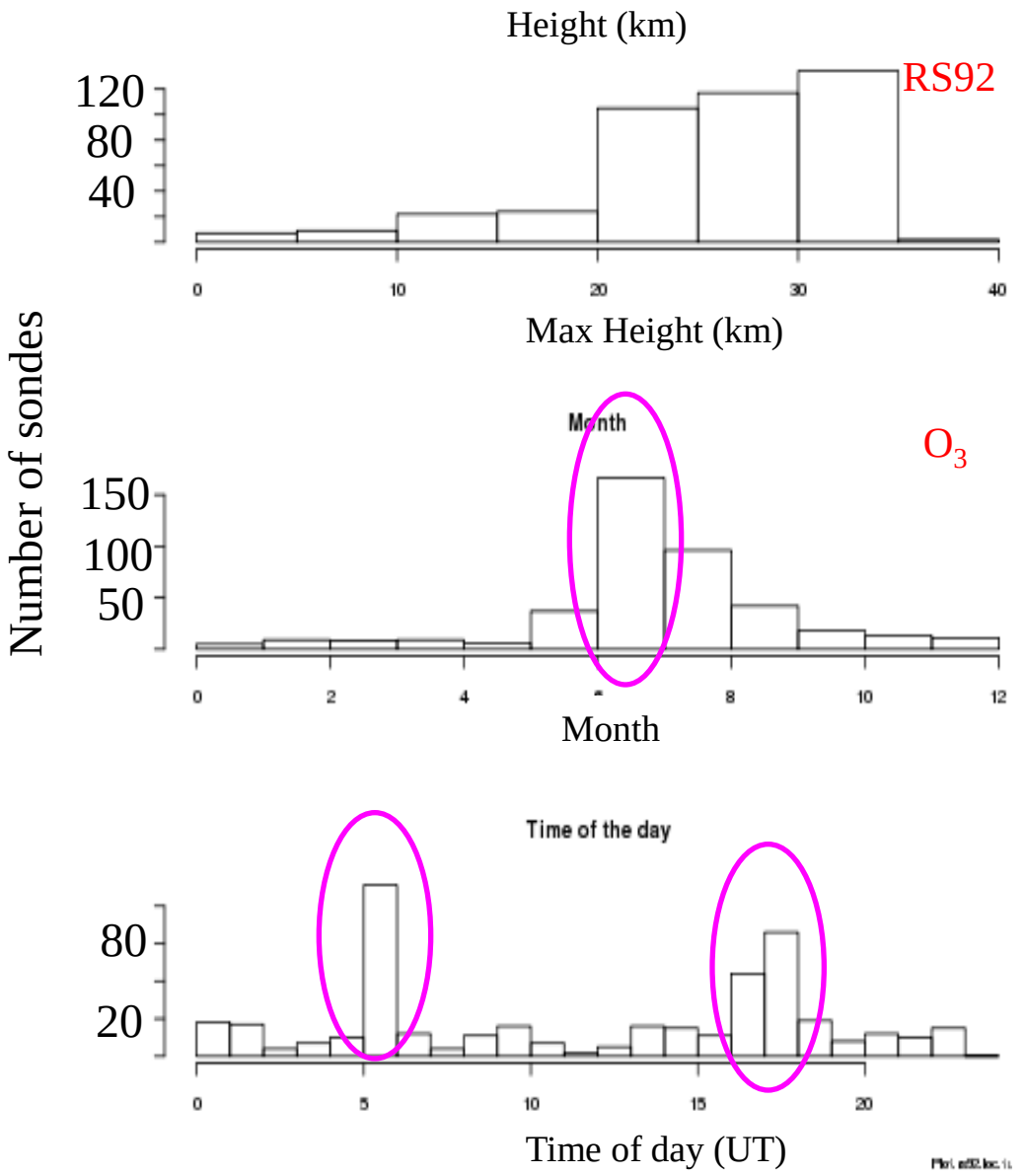
3) Beltsville GRUAN (Re)Organization

a) Who/what is contributing and potential for expansion

b) NWS – Sterling: A GRUAN welcome

Sonde launches: re-processing station stat.



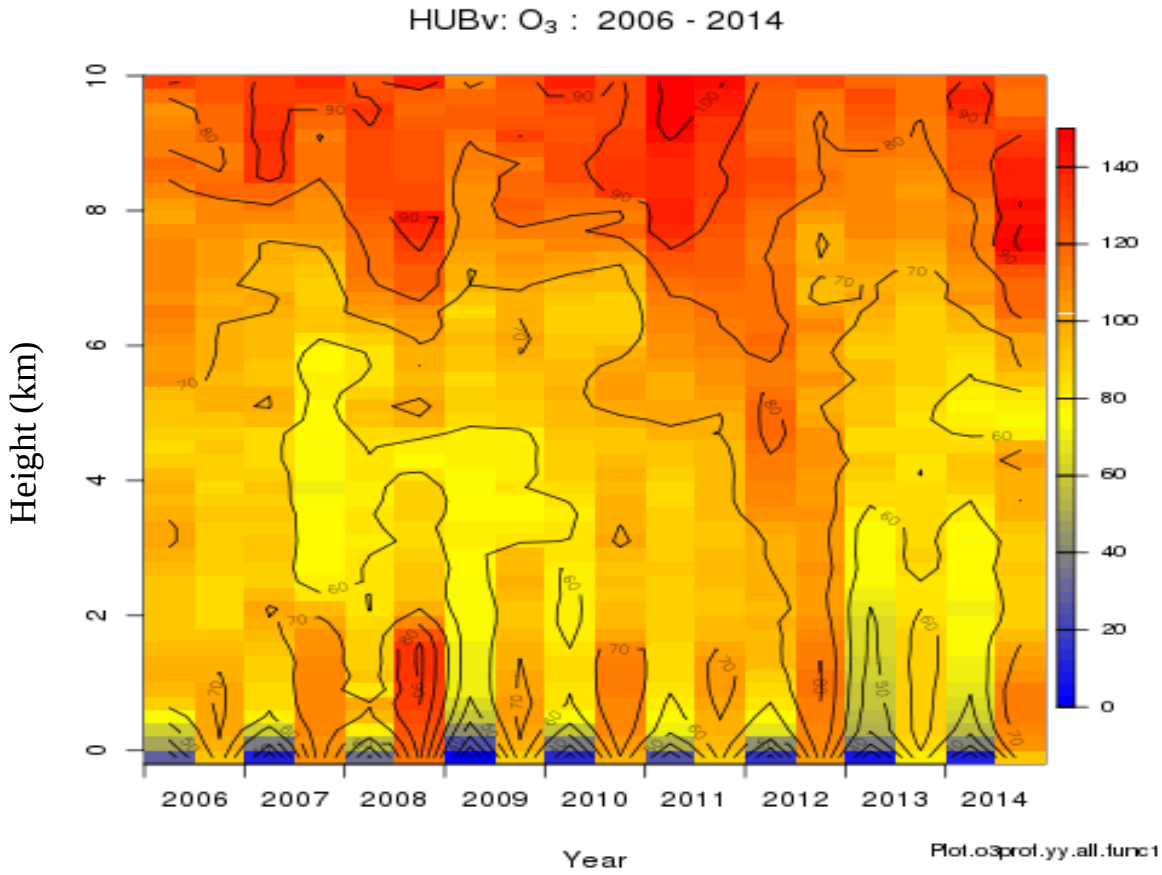


Burst altitude (red-DNA)

- Every sonde is tracked
- Instant feedback would help
- Signal dropout (working with LC & Vaisala to rectify).
- Starting 100% RH check

Sakai et al. *Towards Ozone climatology at Beltsville.*

- Since 2004
- ECC (MDE, WAVES, AFWEX, NGIA, DISCOVER-AQ, and others)
- Biased to summer months.
- 89% reach > 25km
- ***2012-2014: biweekly***
- Coordination has started with SHADOZ, and TOLNet lidar.



Annual average Ozone mixing ratio profiles from 2006 to 2014. Plotted only to 10 km altitude.

2) Examples of ongoing activities

a) Satellite-sonde-lidar "validation": A methodology

b) Wind – A "forgotten" GRUAN priority-1 variable

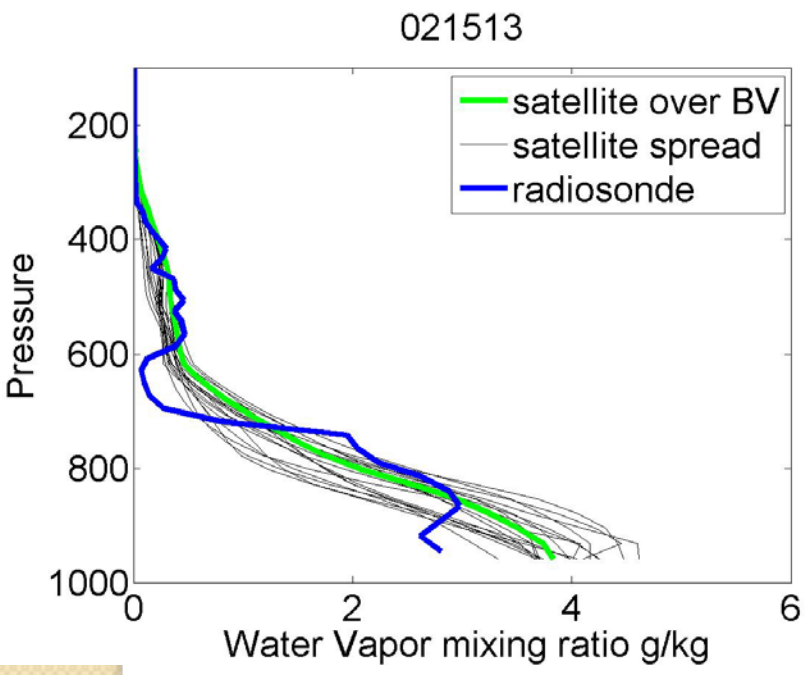
c) Temperature trend – from AIRS (FYI only)

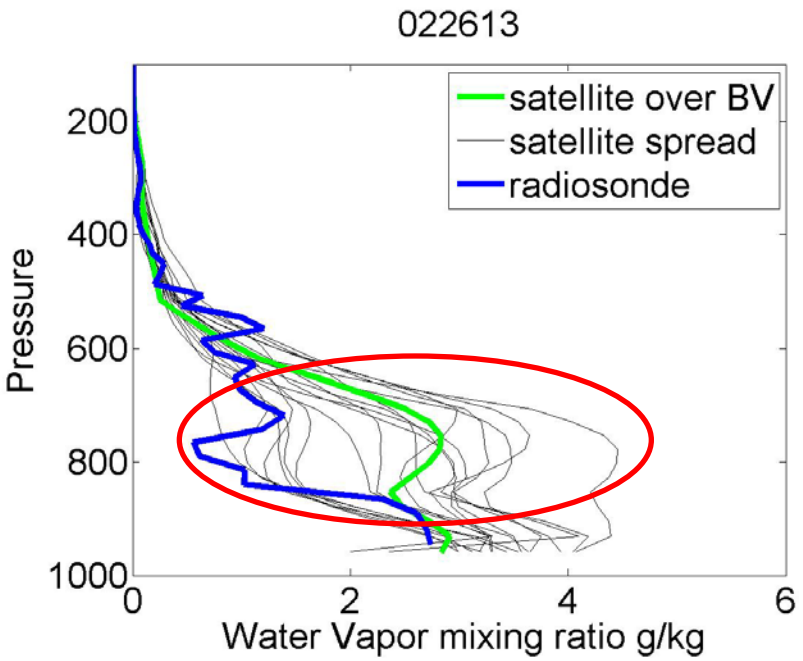
Walker et al (2015): *Satellite-sonde-lidar "validation"*

How variable is the atmosphere - near a satellite overpass time?

NUCAPS: *NOAA Unique CrIS/ATMS Processing System (see Gambacorta et al. AMS'2015)*

- Think AIRS processing for CrIS/ATMS (www.class.noaa.gov)



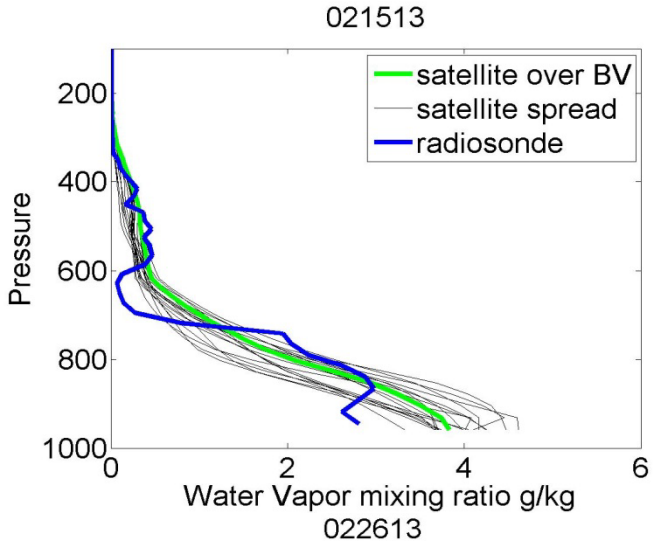


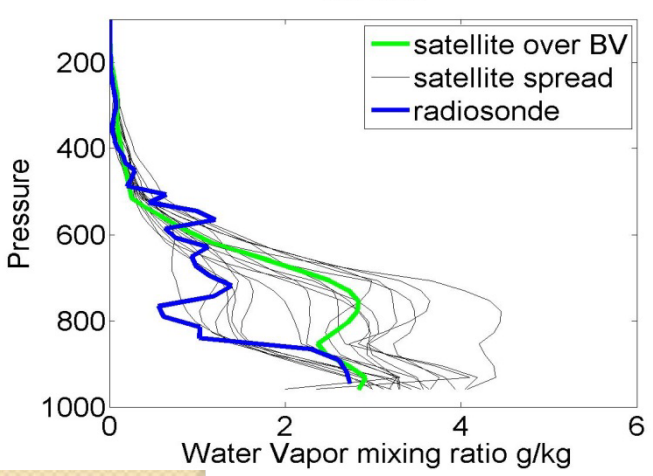
Two-cases as an example ***(q~3g/kg at surface for both cases):***

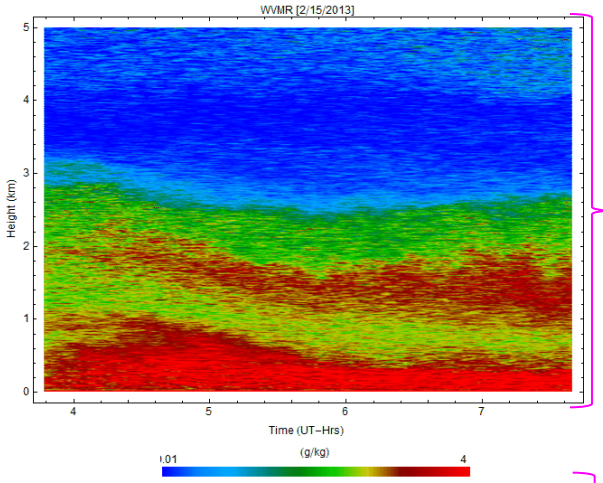
- Are these satellite retrievals real or algorithm issues?
- Do these retrievals show systematic space-time patterns?
- What is the atmospheric *variability?*

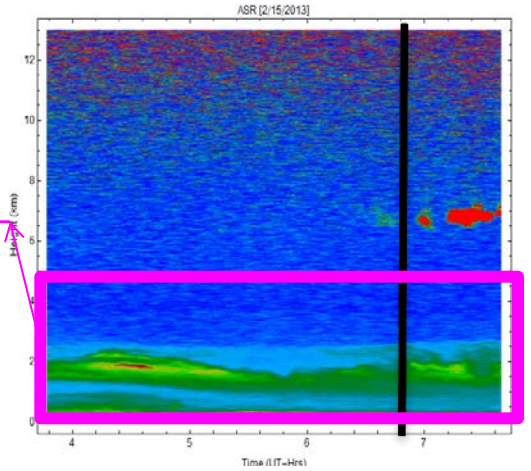
Example-1

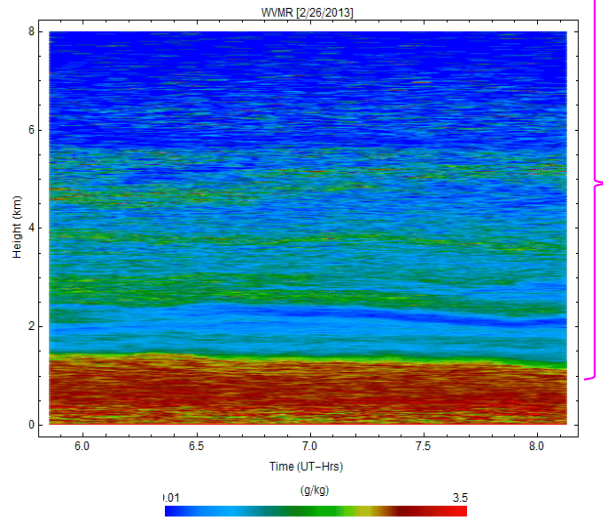
Walker et al: *An excellent use for lidar data*

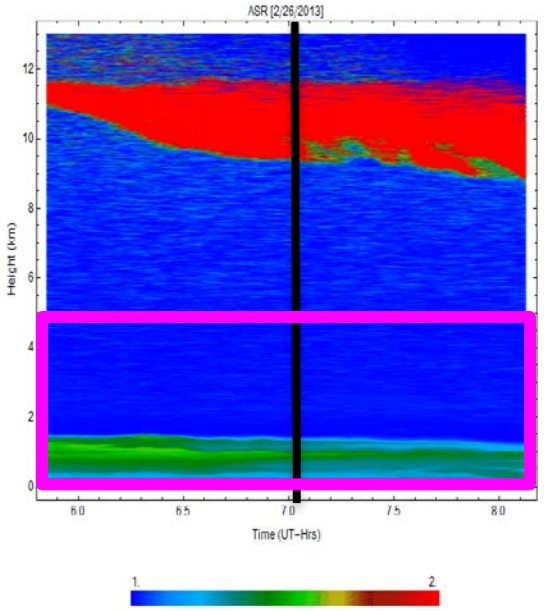








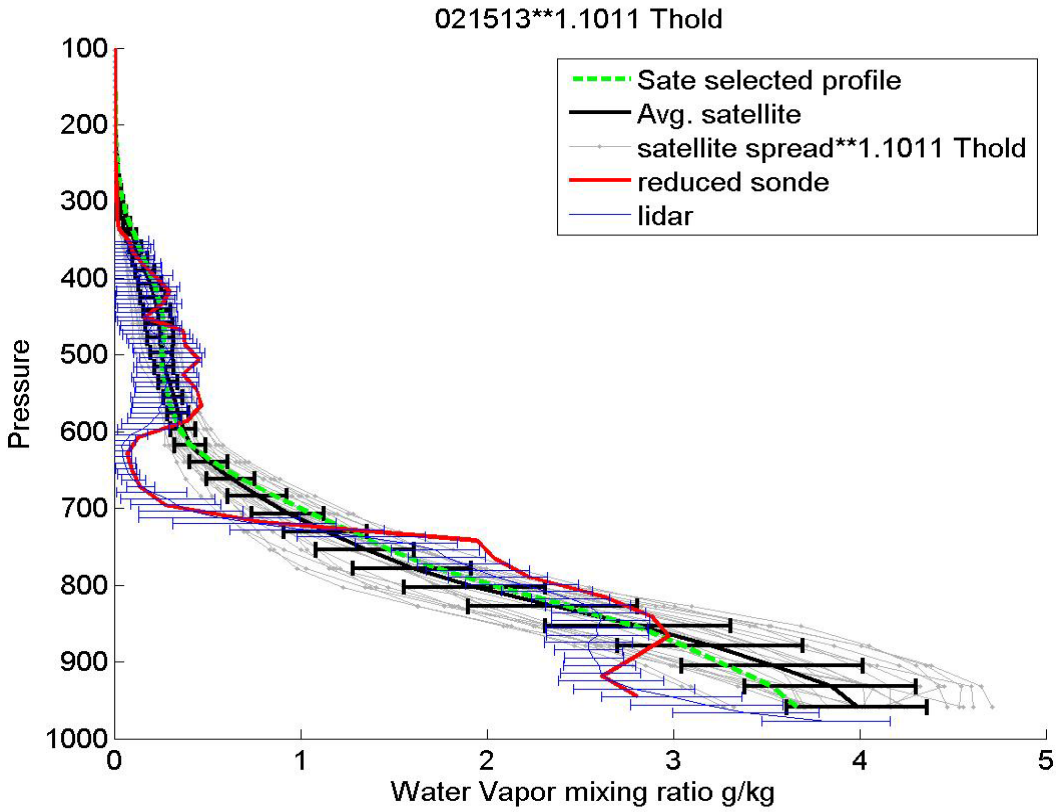


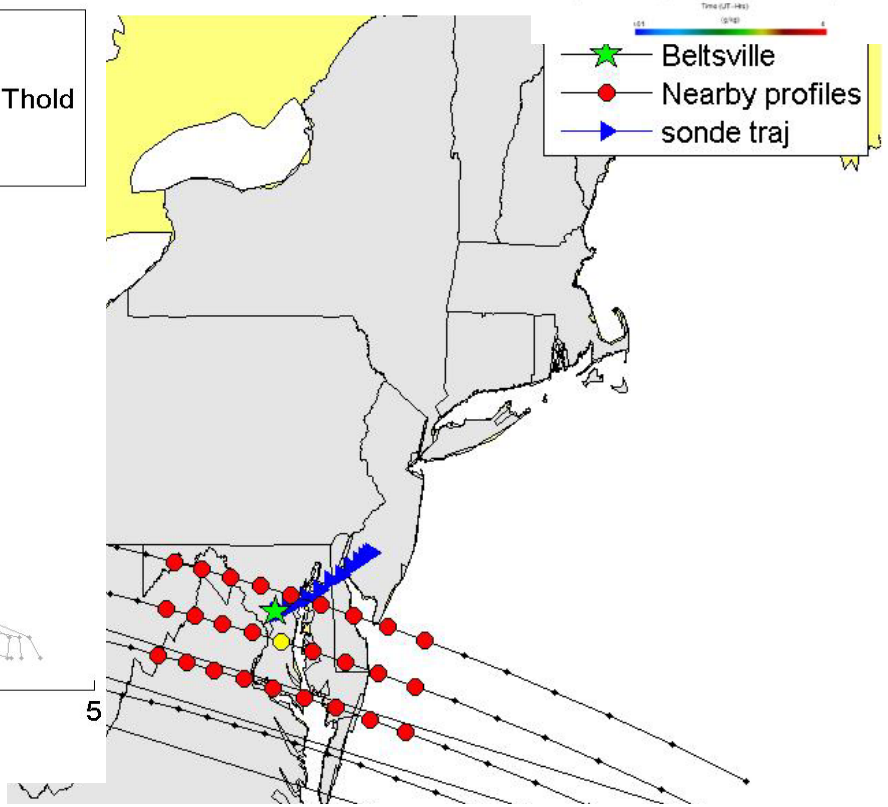


- 0226 is highly layered and thin cirrus (lidar). Cirrus can sometimes be sub visual.
- *Relatively same moisture values.*

Example-1

Walker et al: *An excellent use for lidar data*

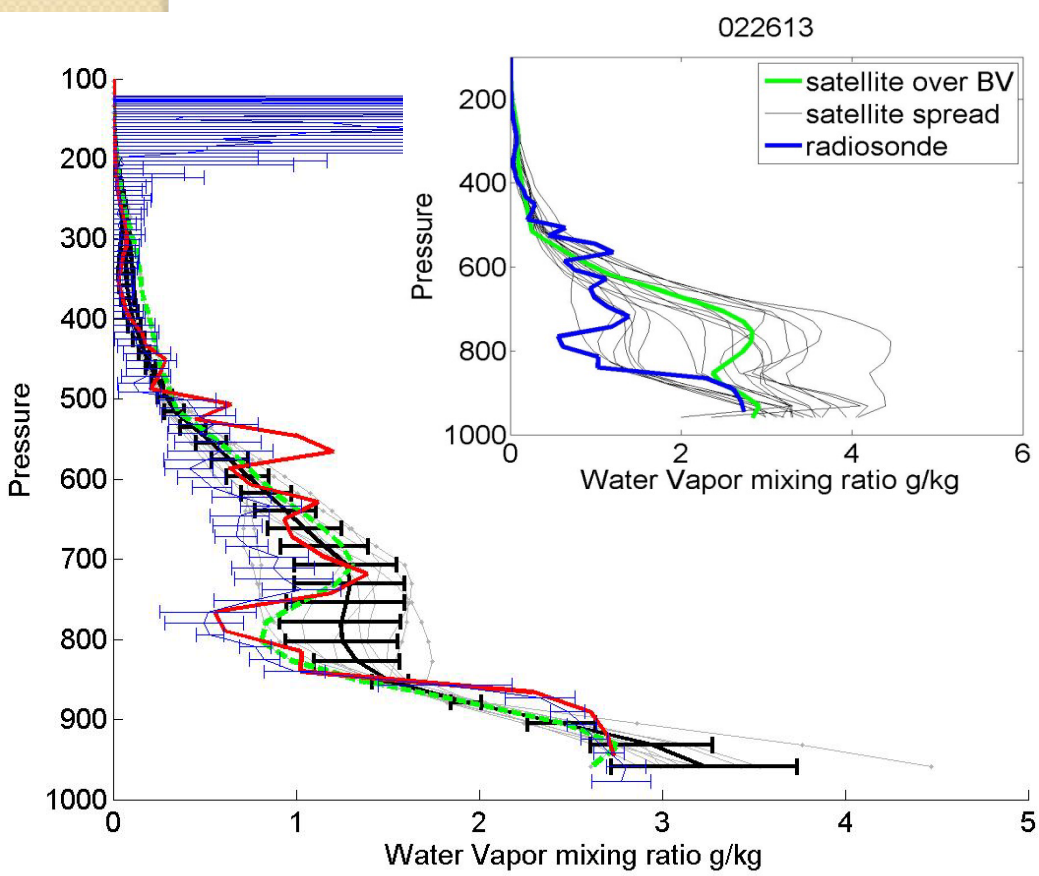


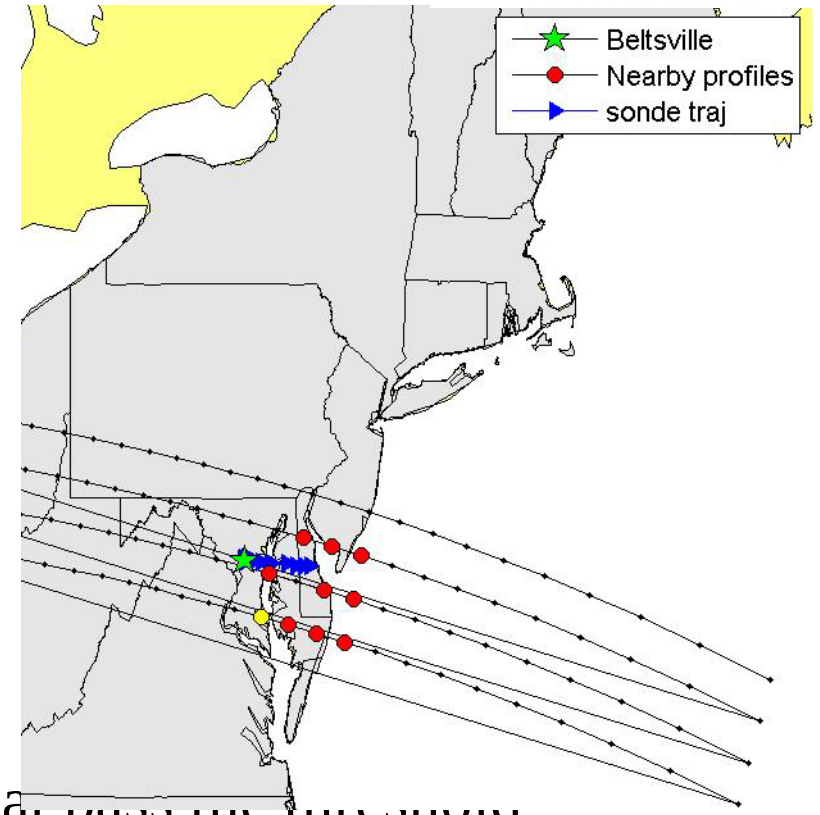


- HURL used to define atm. Variability and select : 3xStd and RMS between satellite and sonde profiles determined.
- Select satellite (yellow dot) profile that best satisfy this threshold and form average. *Not: Balloon path was not a factor.*

Example-1

Walker et al: *An excellent use for lidar data*





- Allows you to "prune" the profiles that pass the threshold
- *Still working to explain why the best-match is not on balloon path.*
- *Working to build a good statistics by cirrus AOD, wind dir., etc.*
- *Contribute to the GRUAN SASBE work.*

Example-1

Tesfay et al. (2015) : Quantifying wind speed/direction variability

NASA/GSFC [GLOW]: *Bruce Gentry, Huailin Chen, Kevin Vermeesch*
Howard: *Belay Demoz, Sium Tesfay*, Demetrius Venable*

Motivation:
- Upcoming ADM wind Satellite
- NASA Decadal Survey Plan
- Wind is a "neglected" GRUAN priority-1 product

Take Home:
- Large instrument-to-instrument variability
- Think of future satellite-based validation sites
-

Caveat: This is all preliminary student project

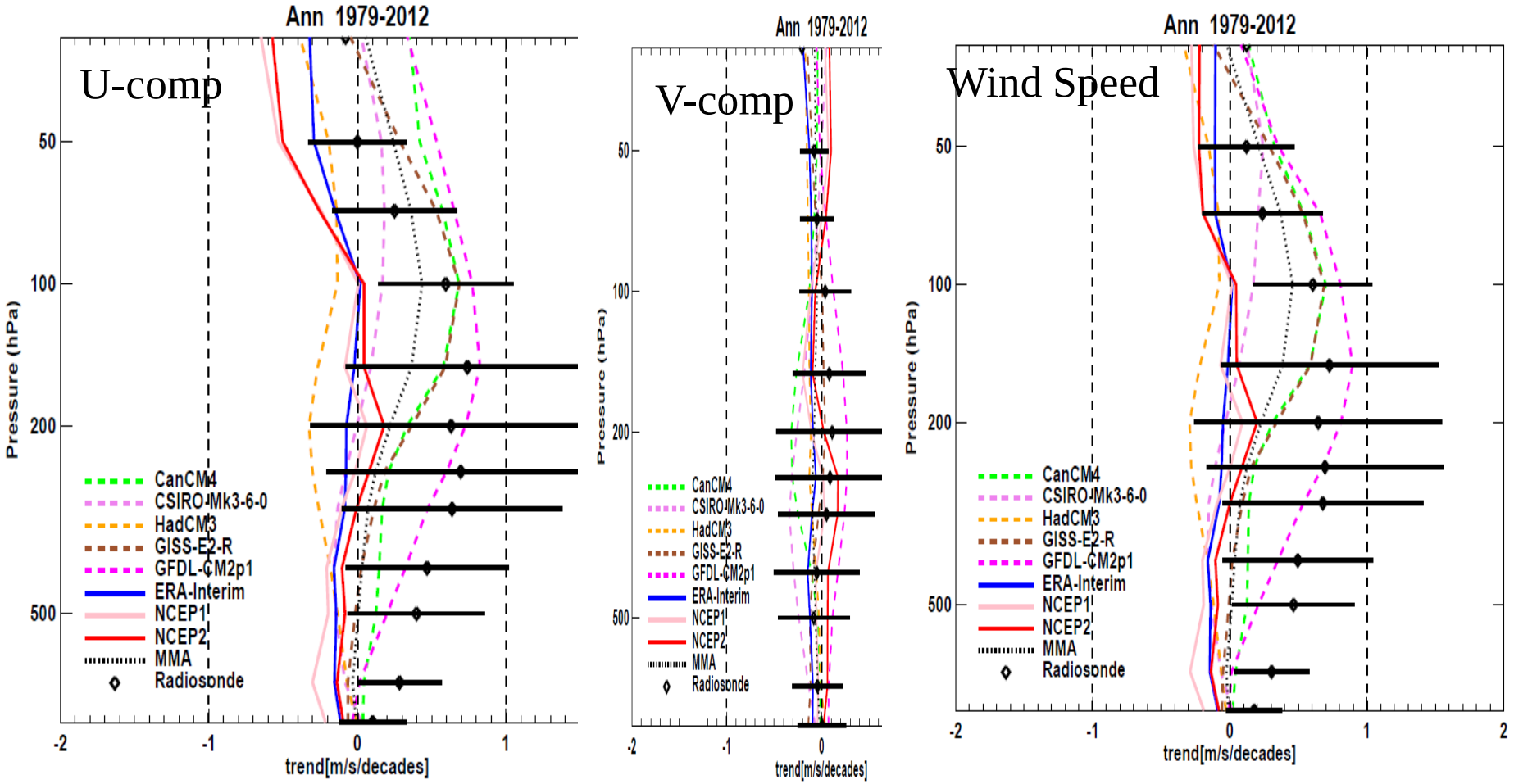
** Grad Student*

Example-2

Tesfay et al. (2015): *Quantifying wind speed/direction variability*

Data: Monthly mean wind (U and V); CMIP5 models, reanalysis, sonde

Method : linear least squares reg.



Radiosonde: averaged 00Z and 12Z

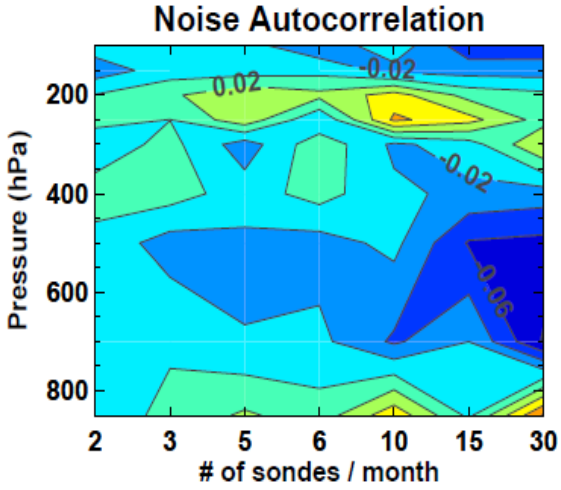
Black lines are uncertainty at the 95% con.

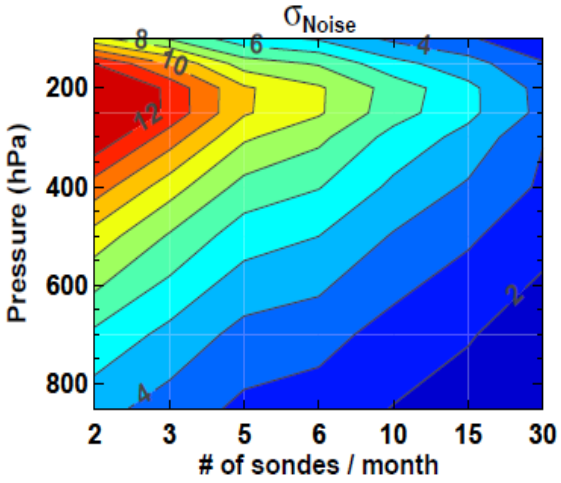
Example-2

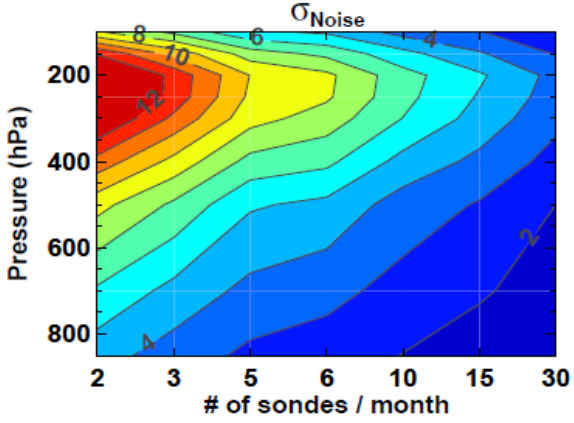
Tesfay et al.: *Quantifying wind speed/direction variability*

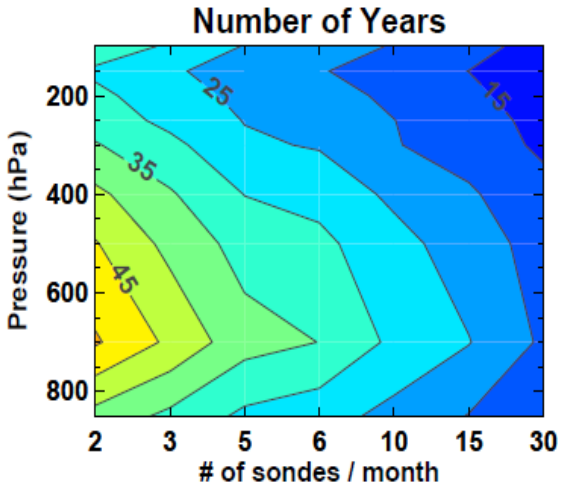
Meridional Wind speed

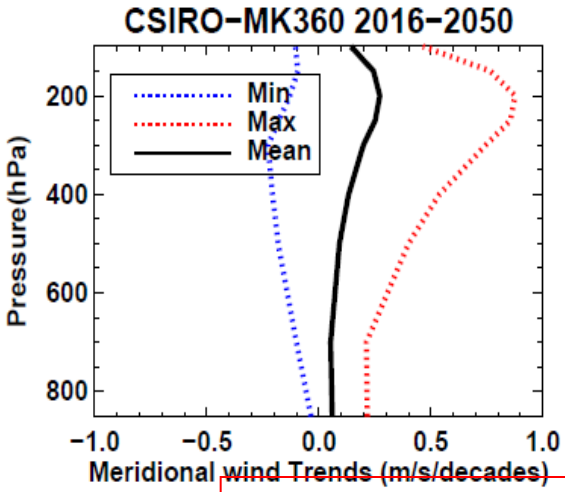
Zonal Wind speed

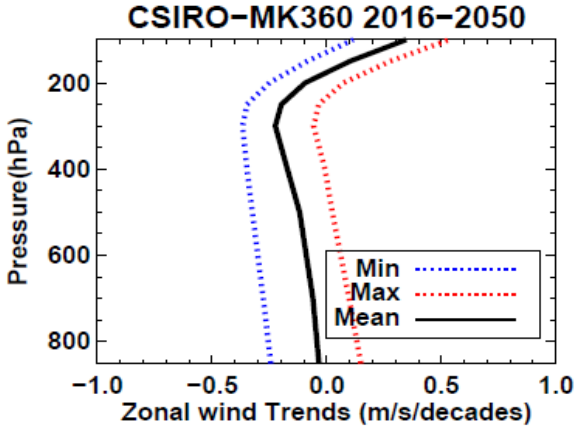












Preliminary result: CSIRO-mk3.6 future model simulations (need ω_0)

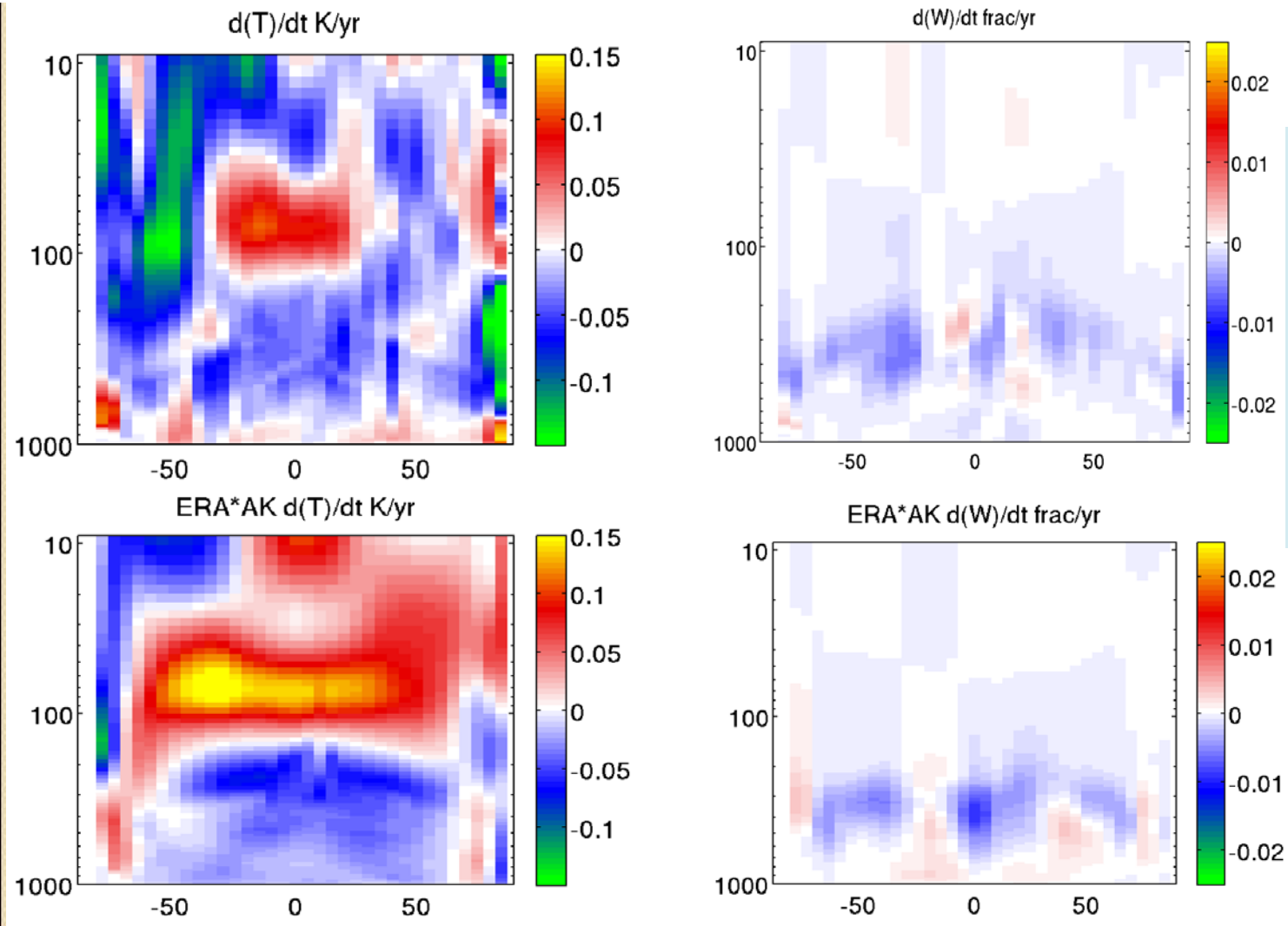
$$n^* = \left[\frac{3.3\sigma_N}{|\omega_o|} \sqrt{\frac{1+\phi_N}{1-\phi_N}} \right]^{\frac{2}{3}}$$

Example-2

Satellite-based temp/moisture change

UMBC/JCET: *L. Strow, S. DeSouza-Machado A. Tangborn*

- ***12+ years of AIRS data, plenty more to come (IASI, CrIS …)***
- ***Check stability (Use clear ocean scenes, daily,10 yrs, etc)***

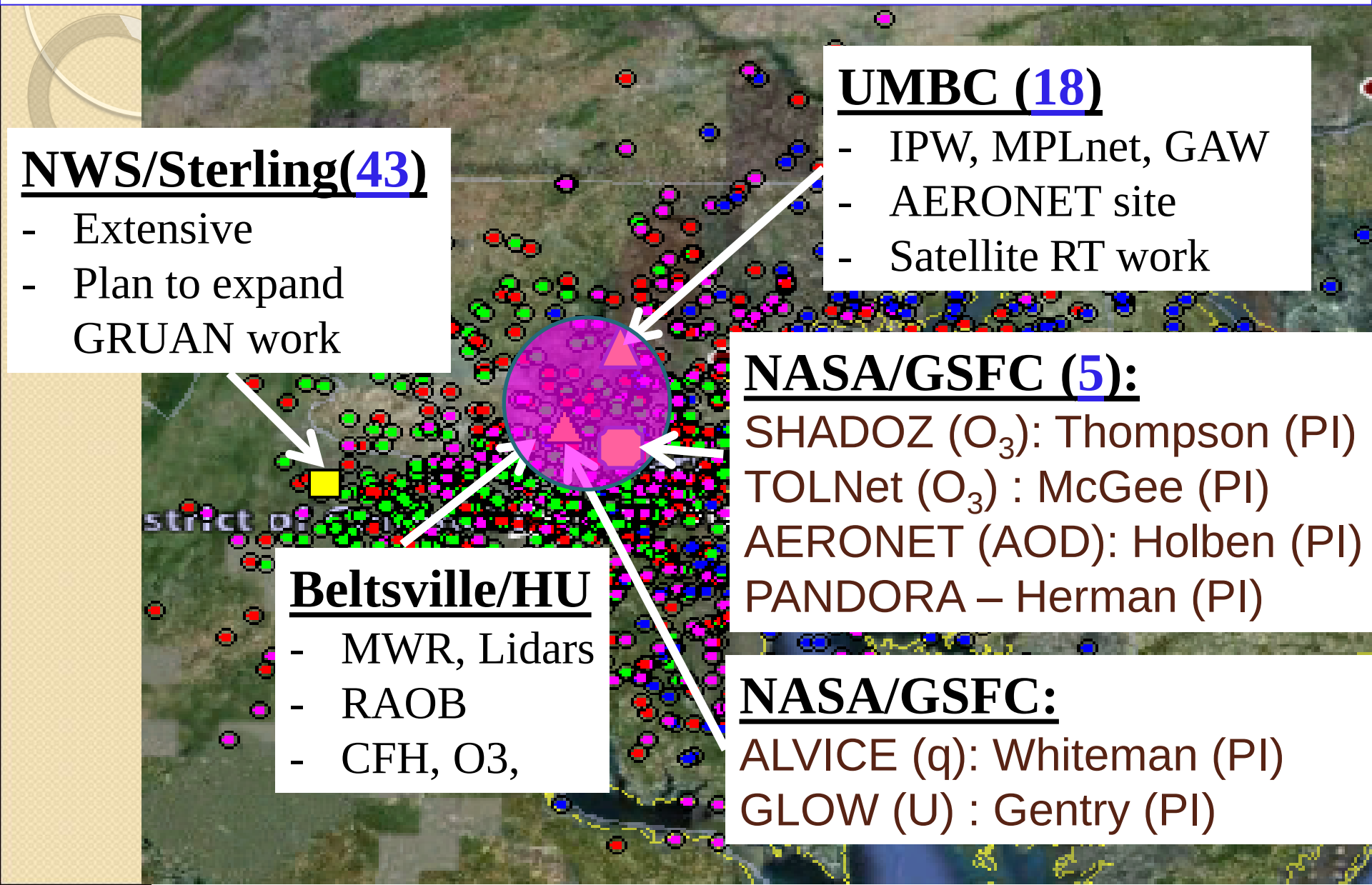


Preliminary!

See me for a full discussion and contact if interested.

Example-3

Organization: *Started by saying we serve many "masters"*
Howard University Beltsville GRUAN Site Partners



NWS/Sterling(43)
- Extensive
- Plan to expand GRUAN work

UMBC (18)
- IPW, MPLnet, GAW
- AERONET site
- Satellite RT work

NASA/GSFC (5):
SHADOZ (O_3): Thompson (PI)
TOLNet (O_3) : McGee (PI)
AERONET (AOD): Holben (PI)
PANDORA – Herman (PI)

Beltsville/HU
- MWR, Lidars
- RAOB
- CFH, O3,

NASA/GSFC:
ALVICE (q): Whiteman (PI)
GLOW (U) : Gentry (PI)

Organization: A Vision for NWS-Sterling Role in GRUAN

Today (T=0yrs)

An active discussion is in progress
NOAA/NWS-Sterling site reps are here.
What does "GRUAN" want to see??

Future (T=??yrs)

My views and only meant for starting a discussion

Many science questions

- *Qualifying new sonde/sites (e.g. LMS; Hilo station)*
- *Surface sensor leadership (Precip., T/q, others)*
- *Co-location issues (e.g. wind; Satellite Validation)*
- *GUAN-GRUAN coordination;*
- *GRUAN BUFR submissions*

Change Management

- *Advise GRUAN and other sites*

Partnership with LC in GRUAN admin

- *Help with "Frost Point" Documentation/production?*

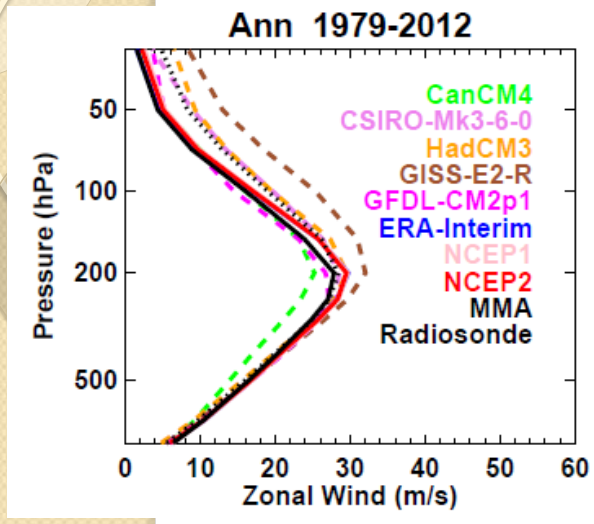
Thank you

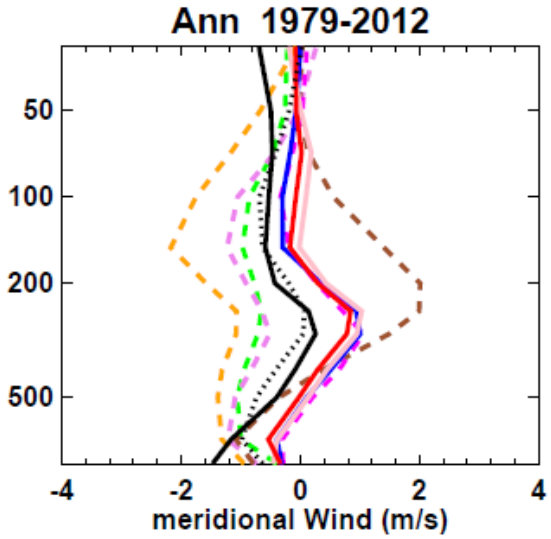
Extra

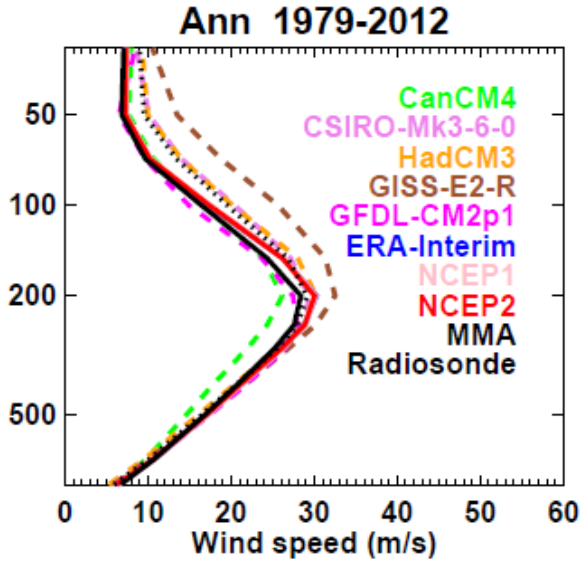
Wind intercomparison of CMIIP5, Reanalysis and Radiosonde at Sterling Virginia Station for 1979-2012

1. Climatology mean
2. Interannual variability
3. Trends

1. Annual mean climatology

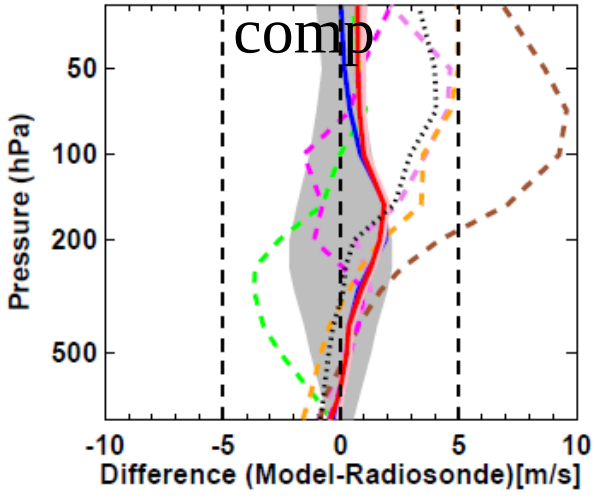




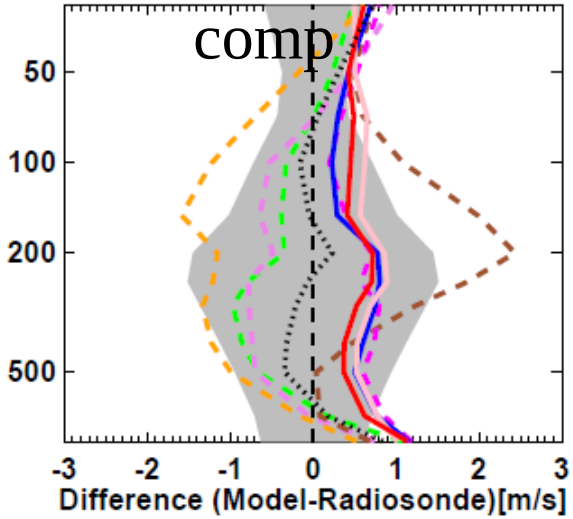


2. Annual mean climatology Bias with respect to Radiosonde

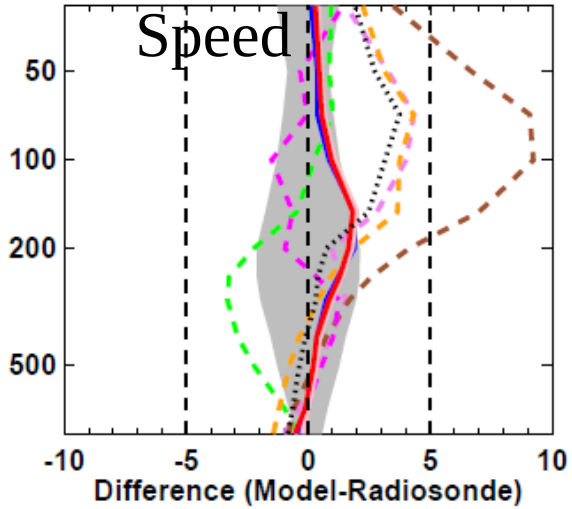
U-comp



V-comp



Wind Speed



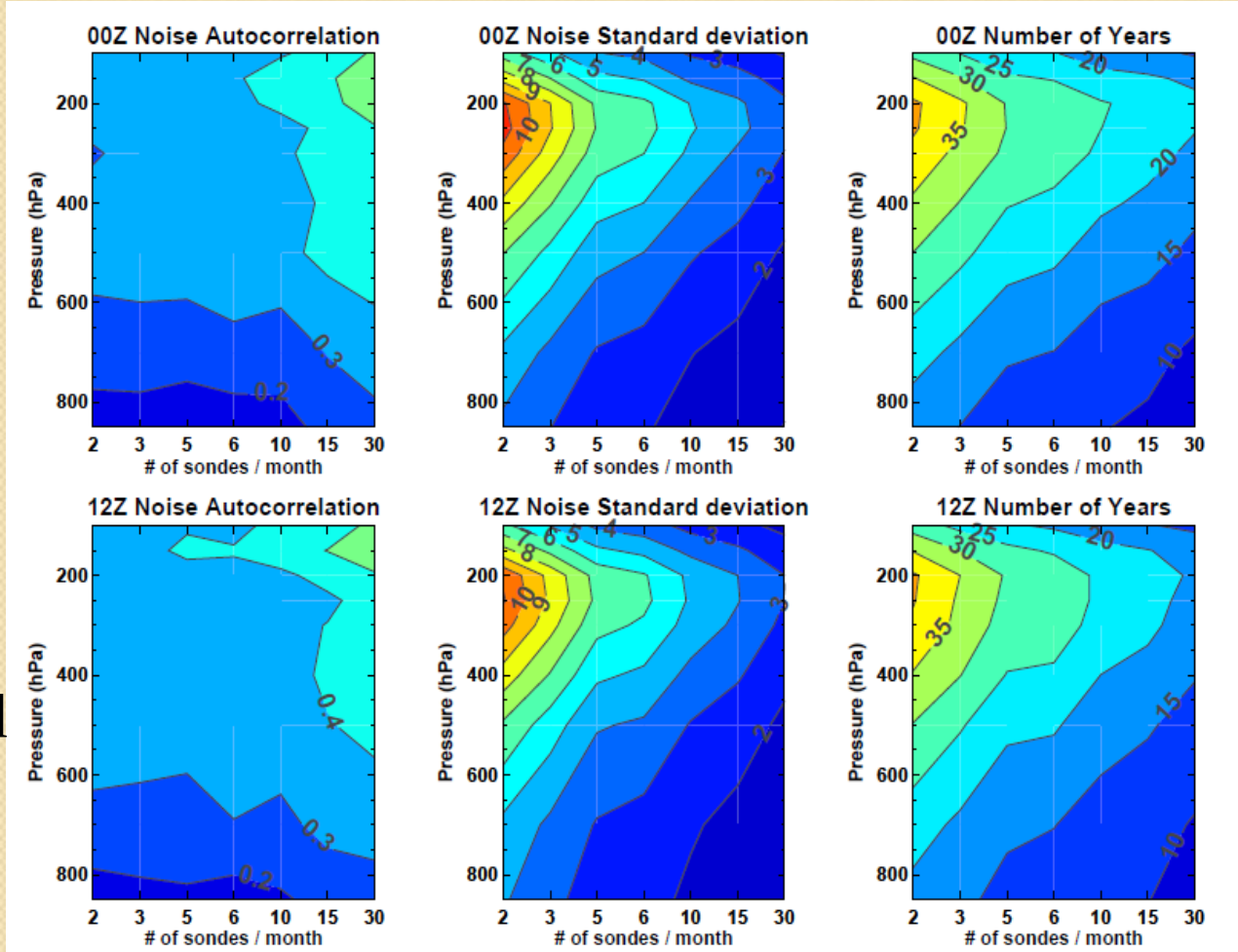
NUMBER OF YEARS TO DETECT STATISTICALLY SIGNIFICANT WIND SPEED TRENDS AT STERLING STATION

Daily wind speed at 00Z and 12 Z

$$n^* = \left[\frac{3.3\sigma_N}{|\omega_o|} \sqrt{\frac{1+\phi_N}{1-\phi_N}} \right]^{\frac{2}{3}}$$

n^* - # of years needed to detect expected trend (ω_o).

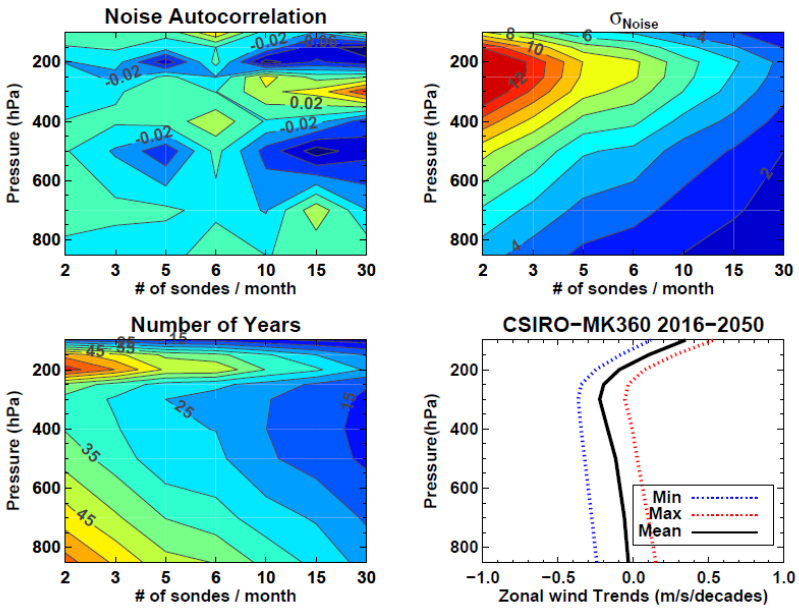
σ_N and ϕ_N are standard deviation and autocorrelation of windspeed time series noise, respectively



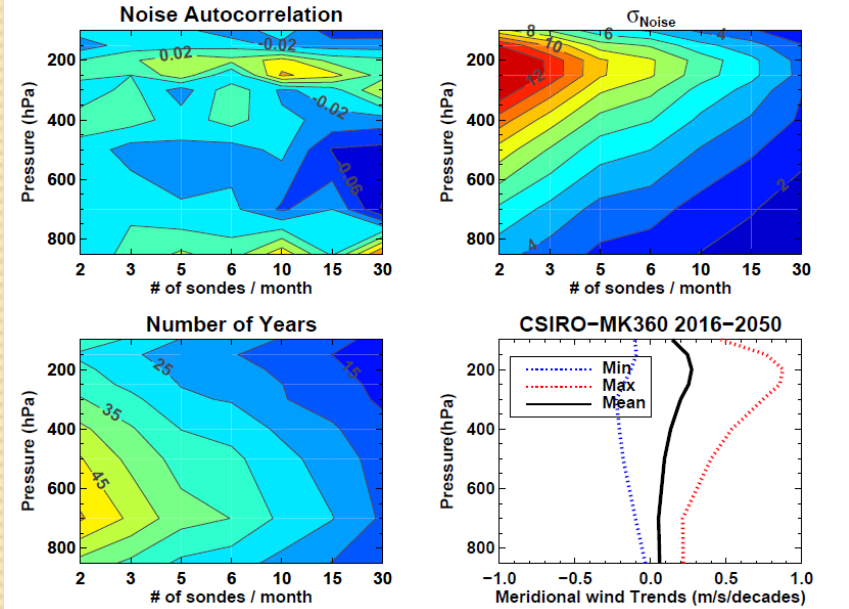
Noise autocorrelation, standard deviation and number of years to detect 0.2 m/s per decade trends .

Number of years to detect statistically significant trends at Sterling Station

Zonal Wind speed



Meridional Wind speed

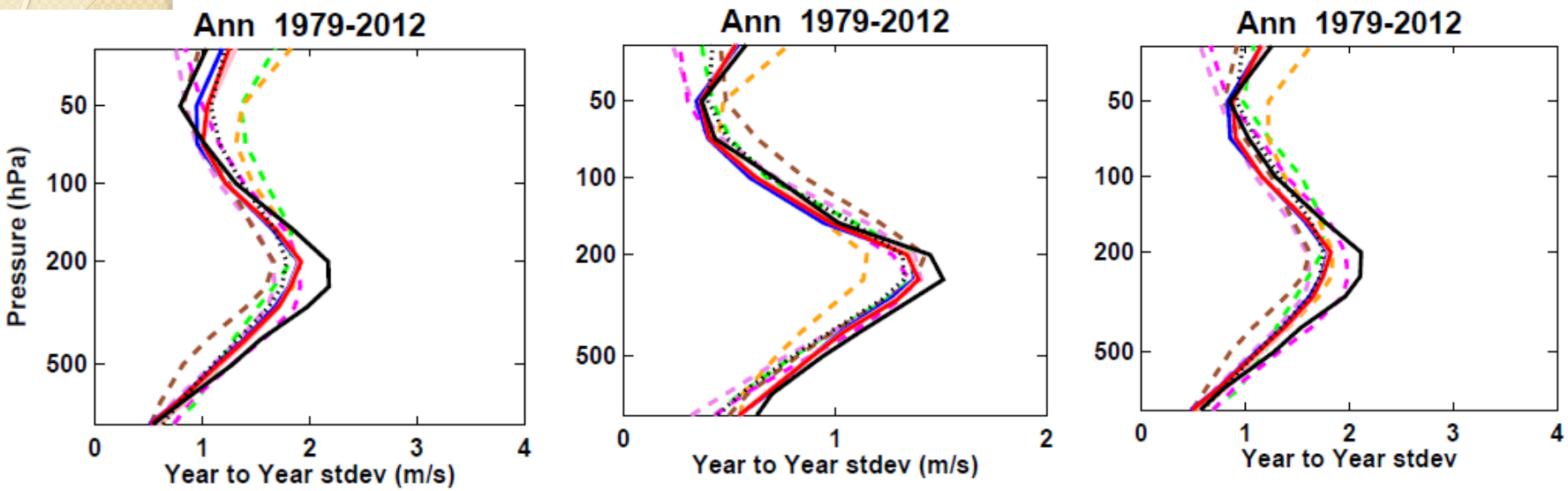


$$Y(t) = \mu + \omega\frac{t}{12} + S + N$$

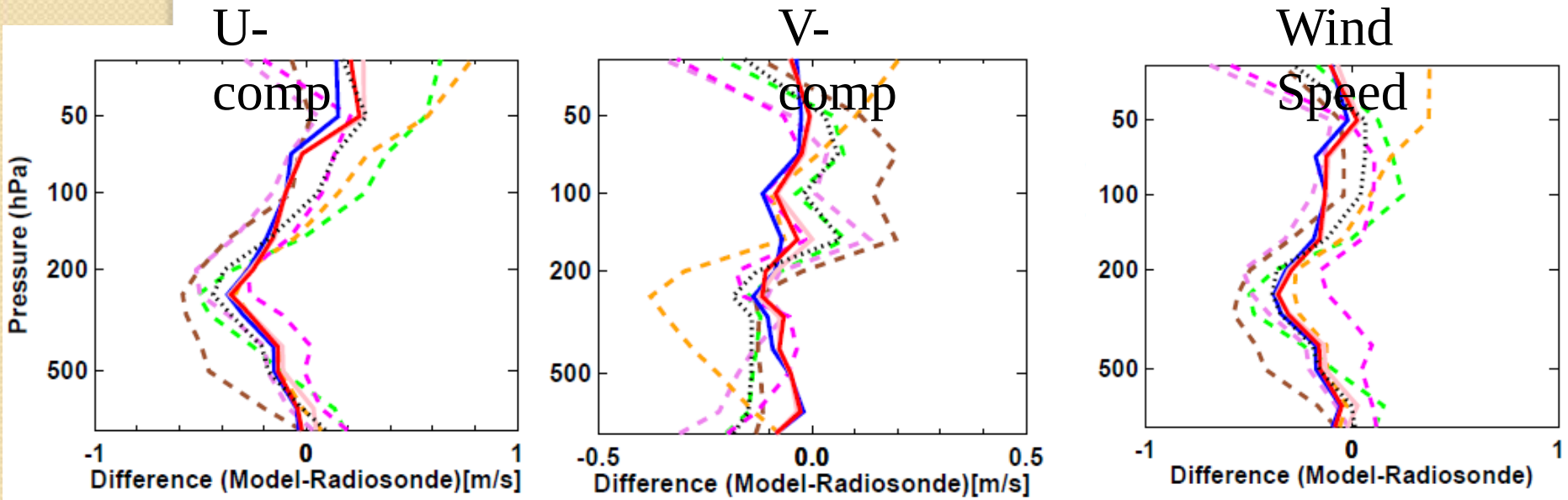
$$n^* = \left[\frac{3.3\sigma_N}{|\omega_o|}\sqrt{\frac{1+\phi_N}{1-\phi_N}}\right]^{\frac{2}{3}}$$

$$St = \sum_{j=1}^{4}\left[\beta 1,j\sin\left(\frac{2\pi jt}{12}\right) + \beta 2,j\cos\left(\frac{2\pi jt}{12}\right)\right]$$

1. Inter-annual Variability



2. Inter-annual Variability Bias with respect to radiosonde



Vaisala
CL31

Towards a ~~Ceilometer~~ *Lidar* network in the USA

Funding: NOAA/NWS

NOAA [NWS]: *Michael Hicks*, Dennis Atkinson*

Howard [NCAS]: *Belay Demoz, Demetrius Venable, Ricardo Sakai*

UMBC [CREST]: *Ruben . Delgado*

GSFC [ALVICE]: *K. Vermeesch, D. Whiteman, M. Walker*,*

PHASE I:

- mini computer to collect through maintenance port

- cellular/network to transmit (*~20 MB/day; compressed: ~8.5 MB/day)*

Phase II: PBLH variability

- Test algorithms, 1-yr data archive, evaluate.

Phase III: National Test *(In formulation)*

- apply nationally; Proposed to be at NCAS partner sites.

- NOAA requirments document is being developed