

## AIRS RTA Update Status

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# Overview

Concentrate on water vapor channels in this talk:

- Biases vs ECMWF
- Variation of Biases with airmass (secant)
- Biases vs proposed V6+ B(T) tuning
- WMO Gruan Site RS92 Sonde Intercomparisons

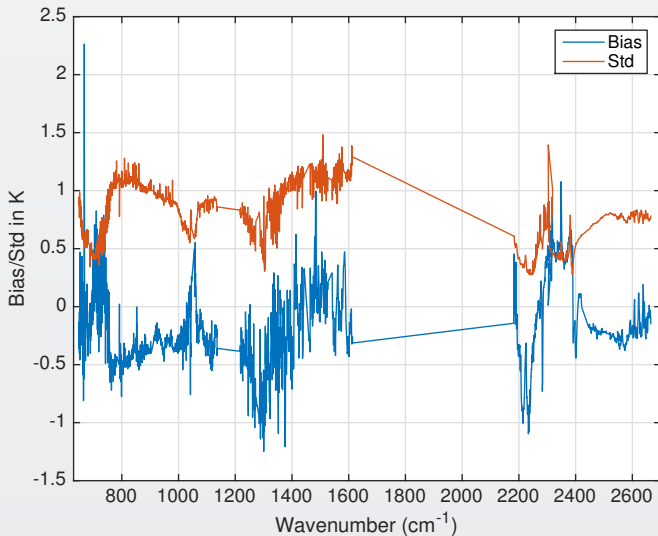
Need to decide on spectroscopy before doing a new SARTA parameterization.

## RTA Models

- SARTA: April 2008 model, no tuning, used HITRAN 2008
- SARTA\_Tuning: Above model with empirical absorption coefficient tuning based on radiosonde intercomparisons. One scaling factor for all levels.
- kCARTA 2008: UMBC's pseudo LBL code using HITRAN 2008
- kCARTA 2012: UMBC's pseudo LBL code using HITRAN 2012

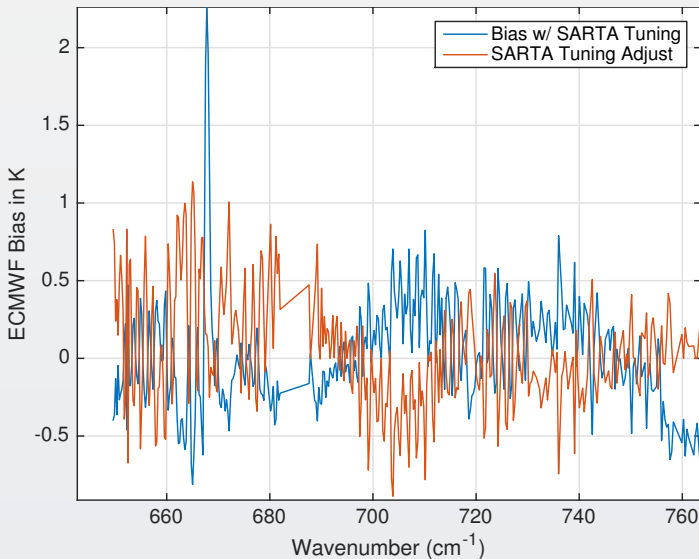
CO<sub>2</sub> varied using interpolation of NOAA-ESRL Mauna Loa measurements.

# Biases with Recent ECMWF: Winter 2015

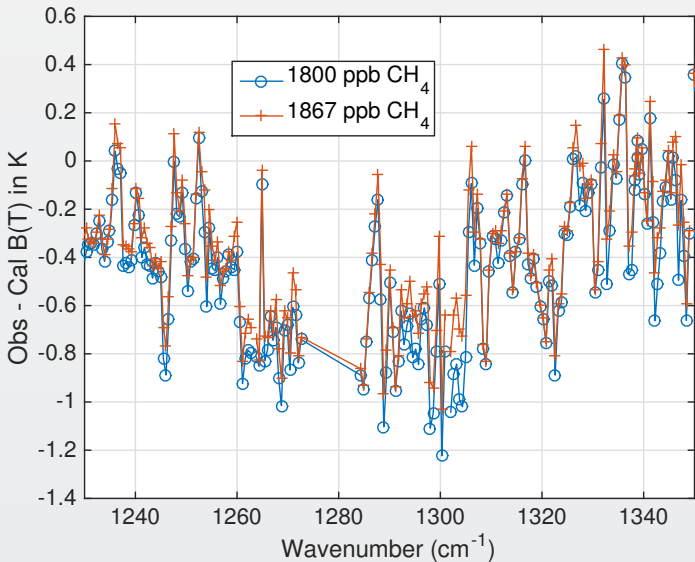


All results with ECMWF use SARTA Tuned

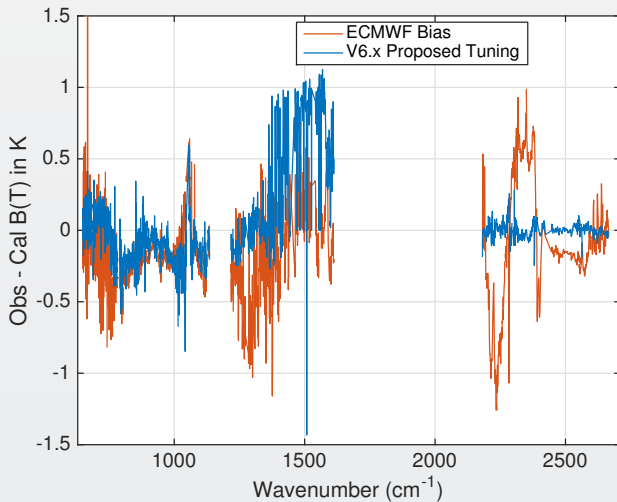
# Biases with Recent ECMWF: Winter 2015



# Updated Methane Slightly Lowers Biases



# ECMWF Bias versus V6.X Proposed Tuning



Water tuning seems more appropriate to match older versions of ECMWF model.

# Air Mass Dependence of Biases vs ECMWF

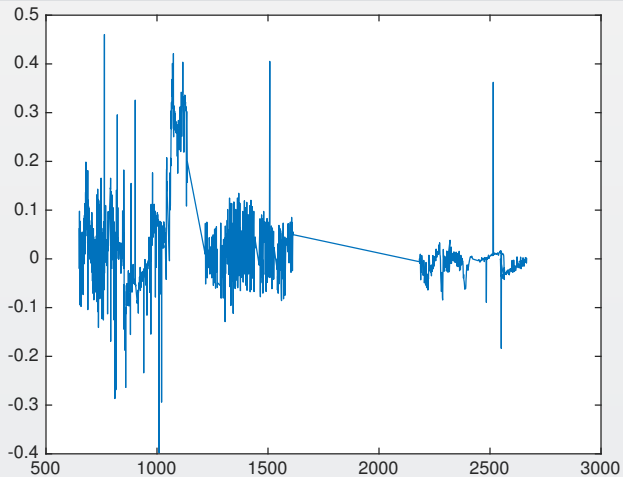
Examine variation in bias with scan angle.

$$O - C = a + b * (\secant(\theta)) + c * scan\_angle$$

- Spectroscopy errors in RTA will scale with secant angle. ECMWF water should not depend on observing geometry.
- Scan angle term is asymmetric about nadir. Polarization? and doppler effects.
- Constant term. Instrument? SRF shape?



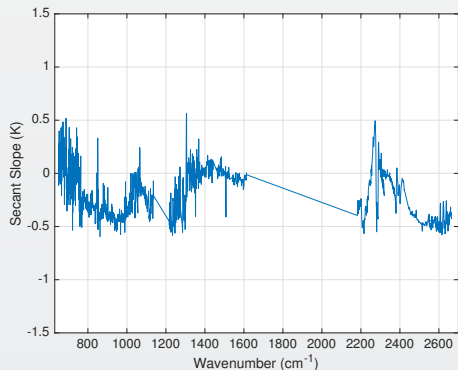
# Asymmetric Term



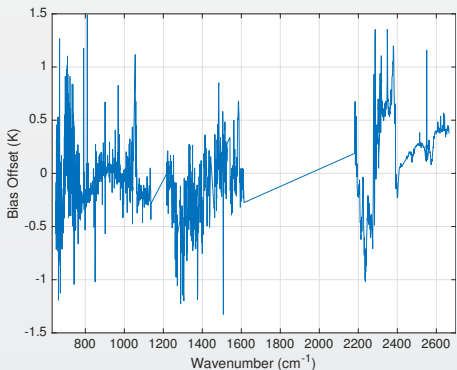
- Mostly Doppler hash, some small polarization errors

# Symmetric Term + Constant

Secant Term: b

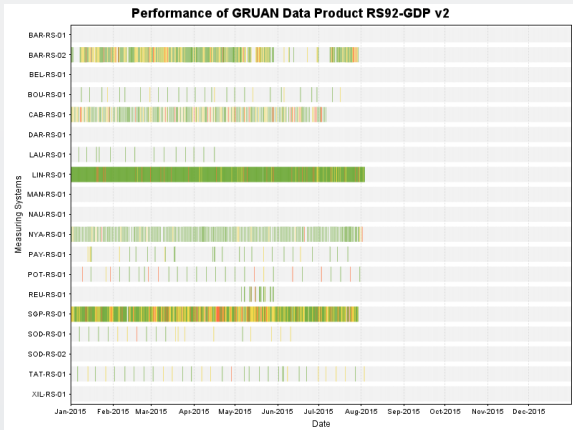


Offset Term: a



# WMO GRUAN Sites

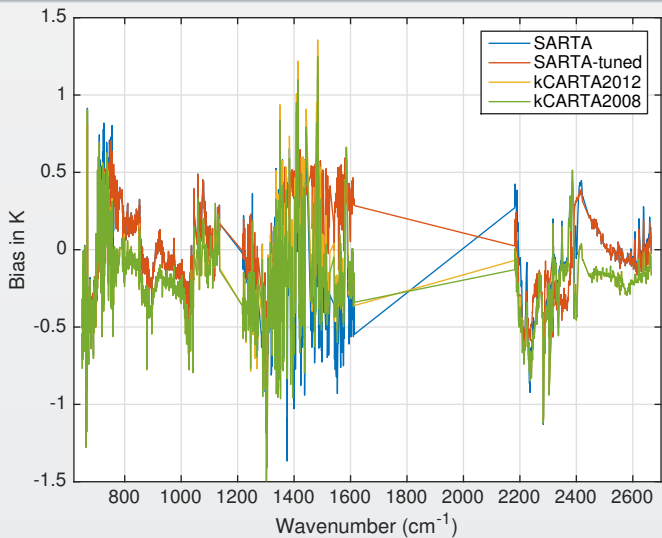
- WMO oversight, error analysis emphasized
- Independent data set from ARM TWP we used for existing water tuning.
- 0, 12Z launches



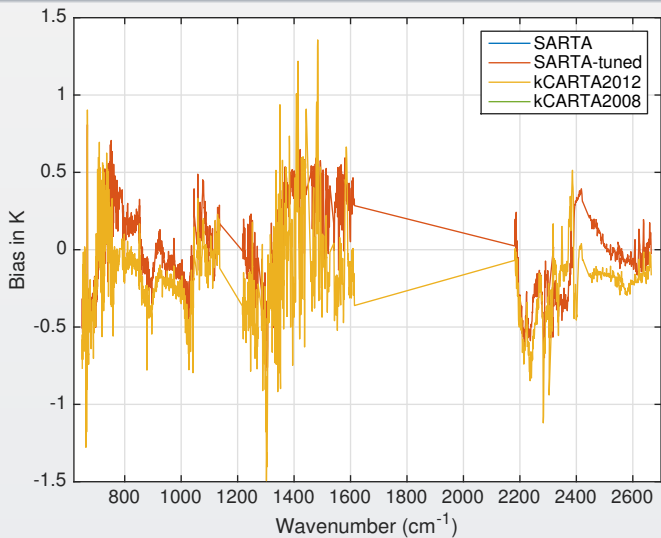
# Procedures

- Match to AIRS: 20 km, 2 hours (saw no dependence on these variables)
- Water profiles to 150 mbar, temperature to 25 mbar
- Fill in remaining levels using ERA
- Subset results to nominally achieve zero bias in window region
- Northern European sites best.

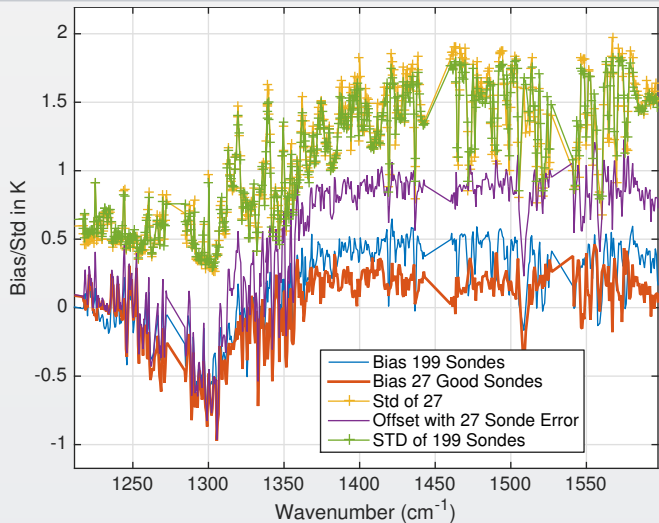
## Site: LIN



## Site: LIN



## Site: LIN



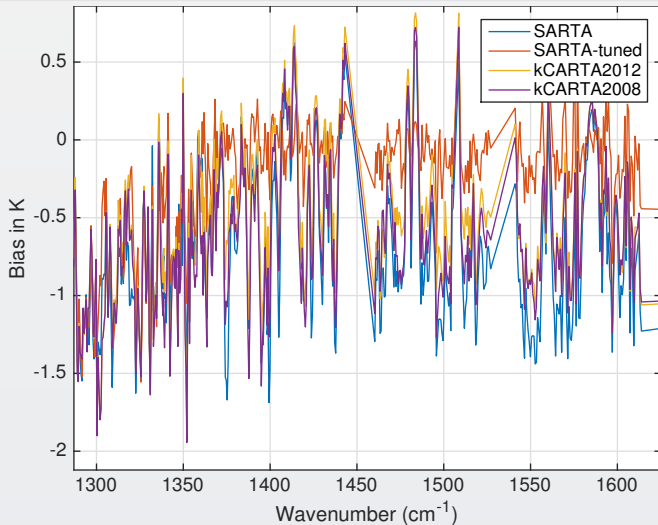
## Site: LIN Results for Water Vapor

- Tuning removes high spectral dependent biases
- Tuning only improves STD by 0.05K so so
- Had to limit 3400+ LIN sondes to 27 basied on (a) night (b) to keep accuracy of sondes to 10% at 200 mbar.
- Accuracy of sondes in mid- upper-trop is  $\pm 0.5K$
- Overall water and agreement is  $\sim 0.3K$  ( $\pm 0.5K$  due to sondes and  $\pm 0.3K$ ).
- HITRAN 2012 slightly better than 2008, but tuning even more important
- Other sites similar.



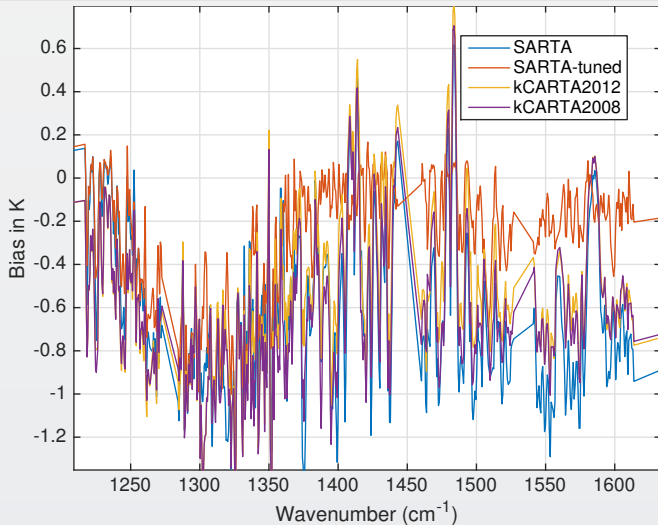
# Site: SGP

No sonde subsetting based on supplied accuracy



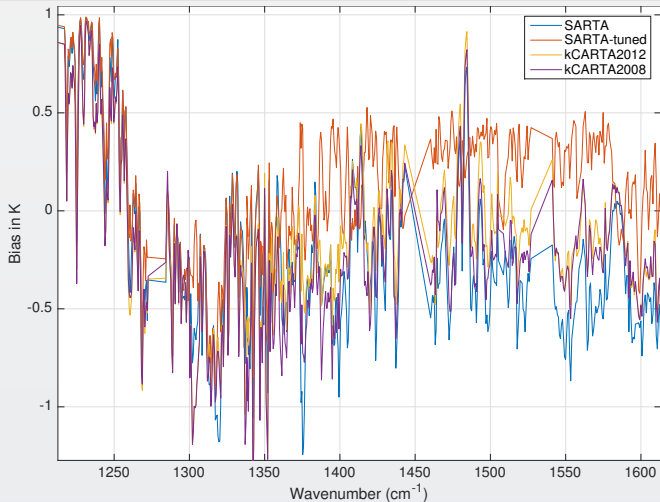
# Site: SOD

No sonde subsetting based on supplied accuracy



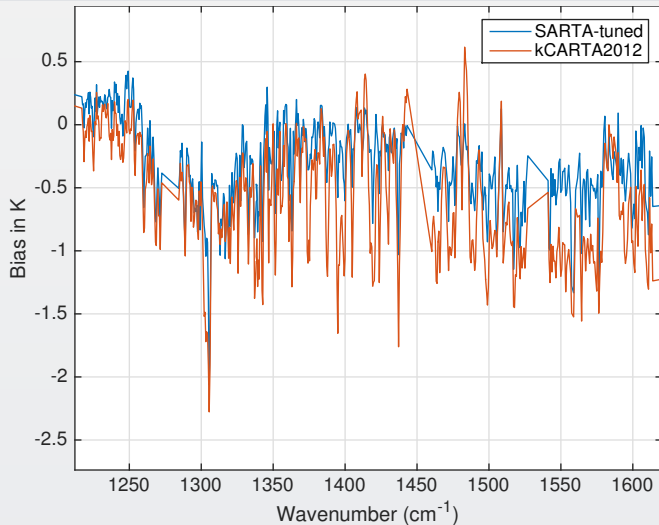
# Site: NYA

No sonde subsetting based on supplied accuracy



# Site: BAR

No sonde subsetting based on supplied accuracy



# Conclusions

- Water vapor tuning robust with time across many GRUAN sites
- GRUAN accuracy limits us to about 0.3K at best
- HITRAN 2012 better than 2008, but improvements relatively small compared to tuning
- Large tuning is mostly a bias: AIRS SRFs?
- Careful Q/A of sondes needed for all sites.
- Bias vs Secant with ECMWF also points to large nearly constant offset, SRFs?
- Much more work needed on mid-trop CO<sub>2</sub> channels.
- Very difficult to validate high-peaking channels, no truth.
- Tropospheric CO<sub>2</sub> channels good to about 0.5K, more work needed.
- Do not understand why V6+ L2 B(T) proposed tuning is so large.