On the biases in AIRS retrieval of ozone
(work in progress)

AIRS Science Team Meeting – March 9, 2006

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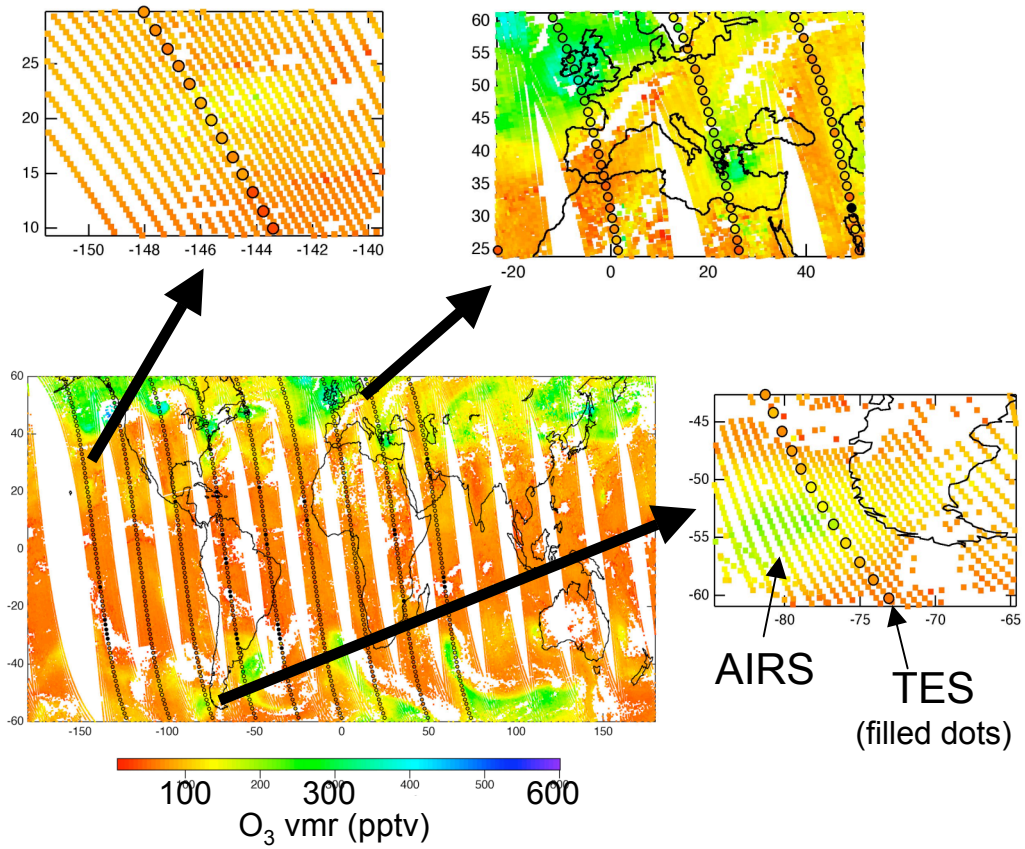
With thanks to Sung-Yung Lee, Bob Oliphant, John Worden, John Blaisdell, Chris Barnet and SHADOZ

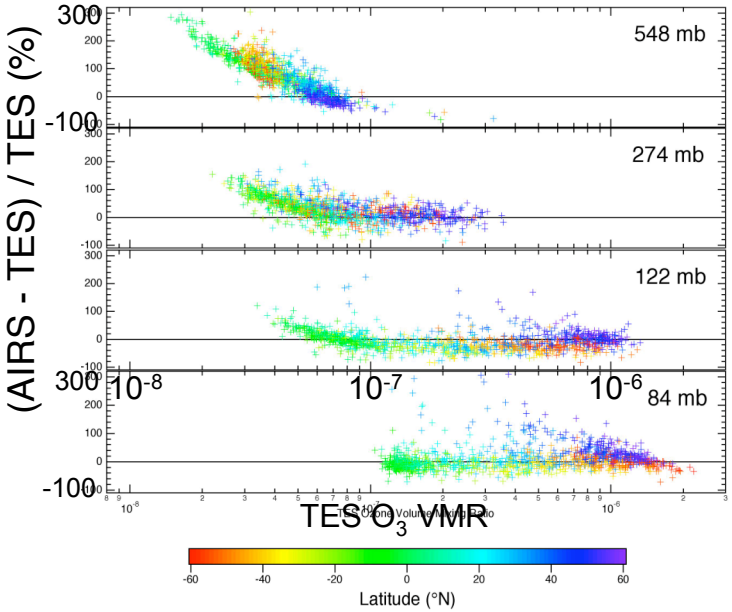
AIRS captures UTLS ozone events

May 21/2005 270 mb

Filled dots are TES observations

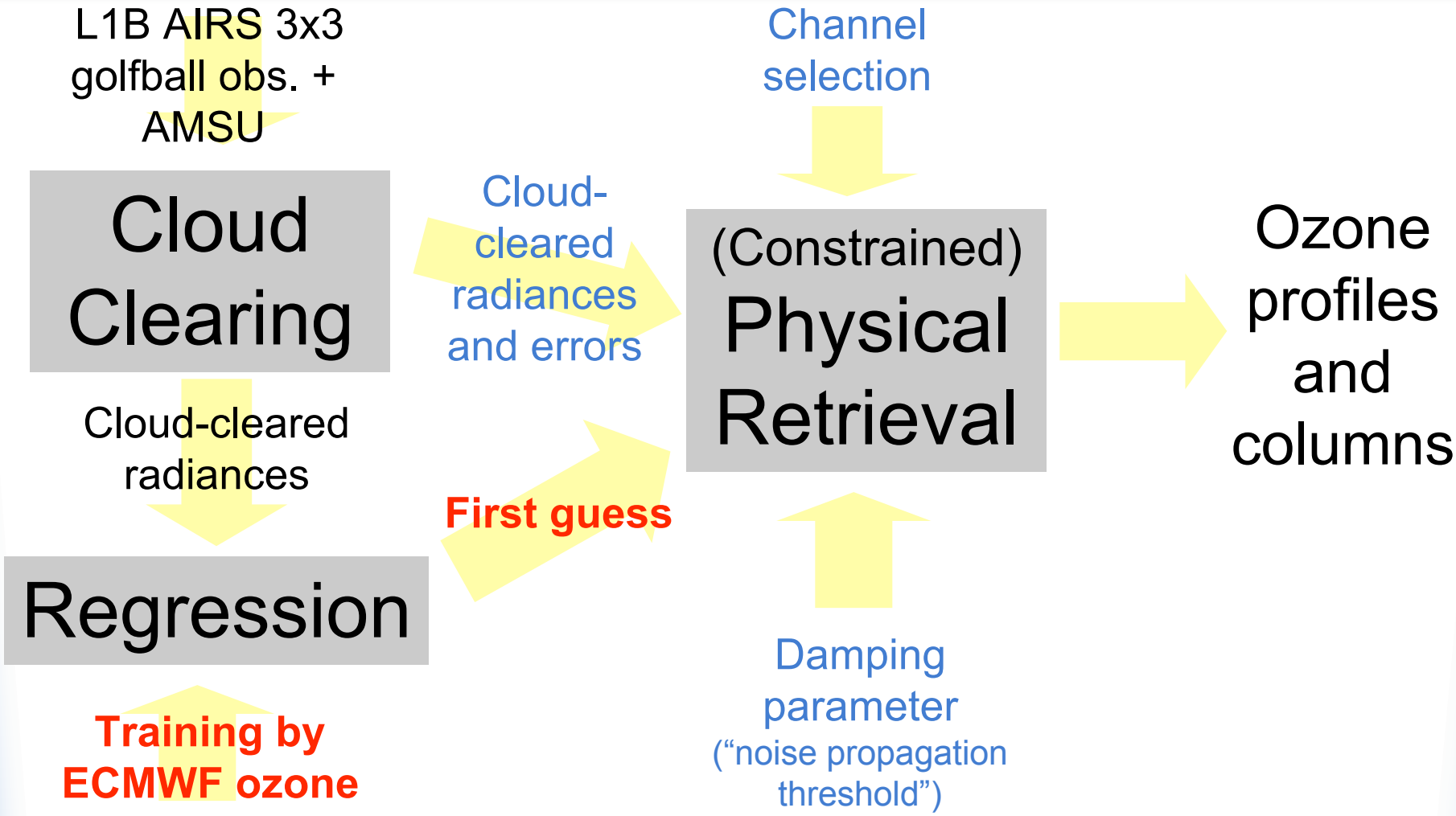


AIRS-TES relative difference



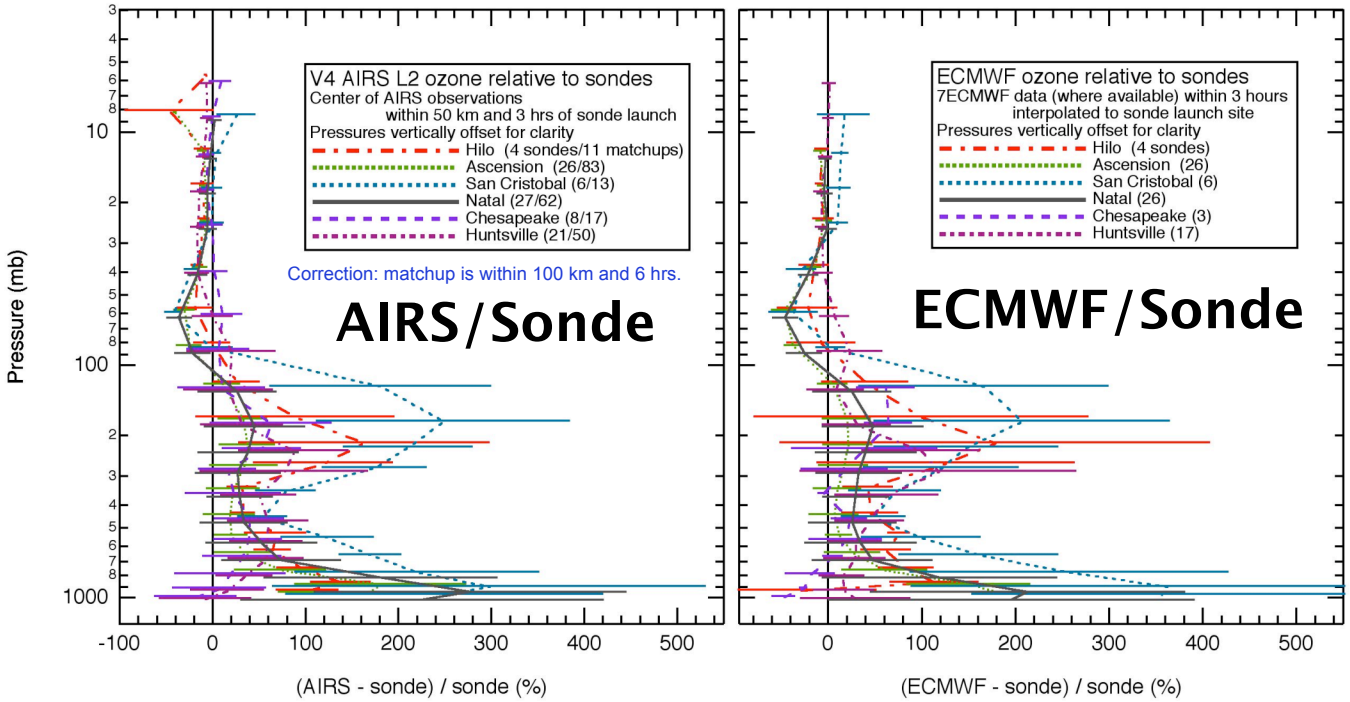
AIRS in qualitative agreement with TES in ozone regions > 100ppb.

Simplified AIRS retrieval of ozone



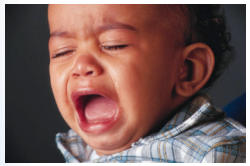
How much is AIRS getting its skill in ozone from regression?
…biases are similar to ECMWF.

Relative differences of AIRS & ECMWF vs ozonesondes



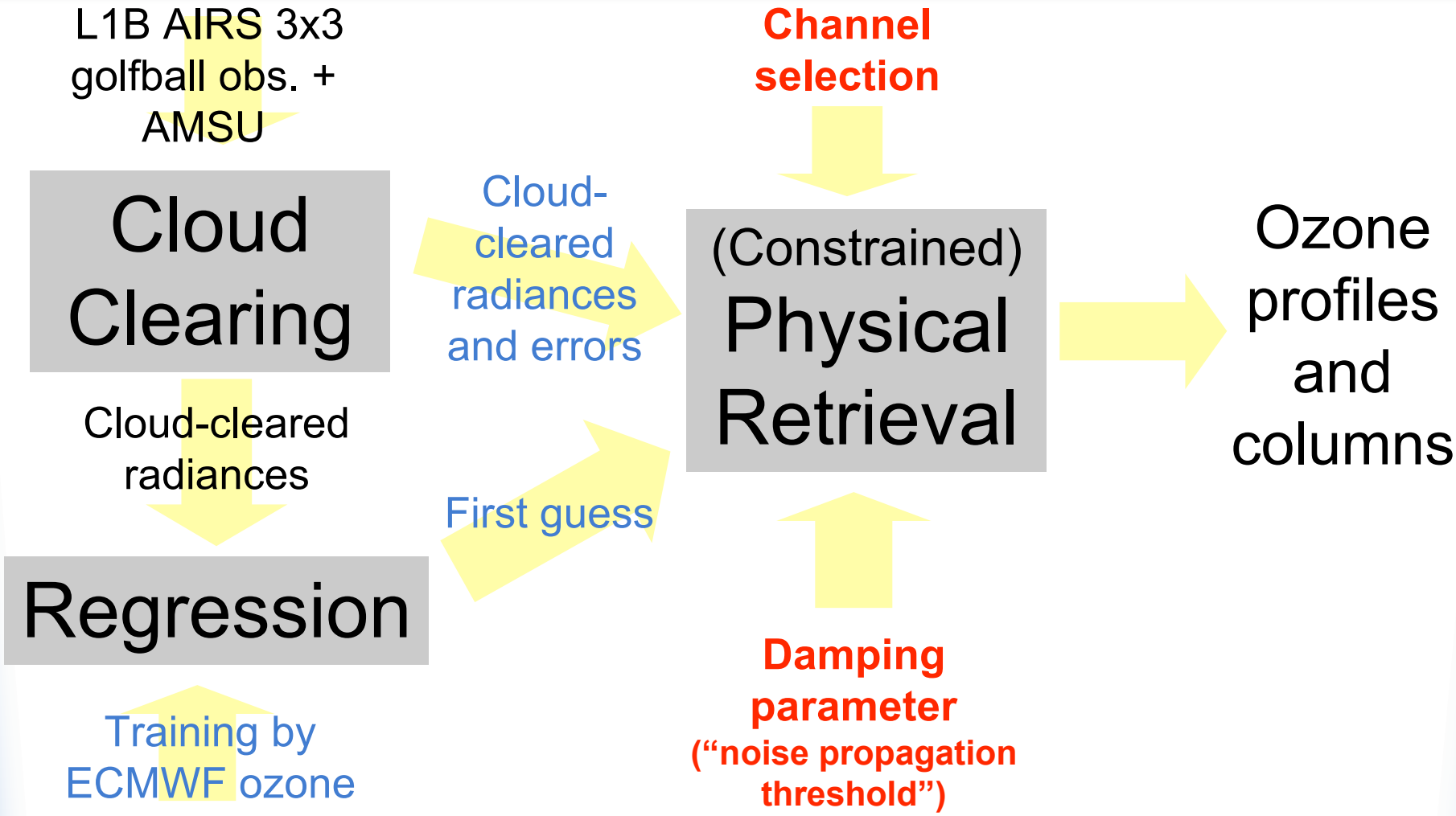
Standard deviations shown.

Pressures offset for clarity.

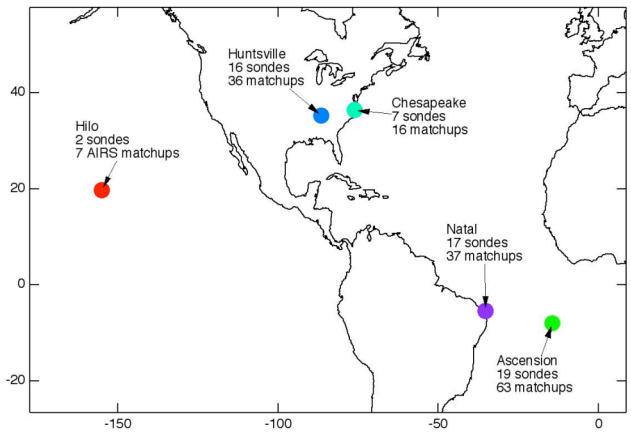


Like ECMWF, AIRS is too high in troposphere and too low in stratosphere; column OK.

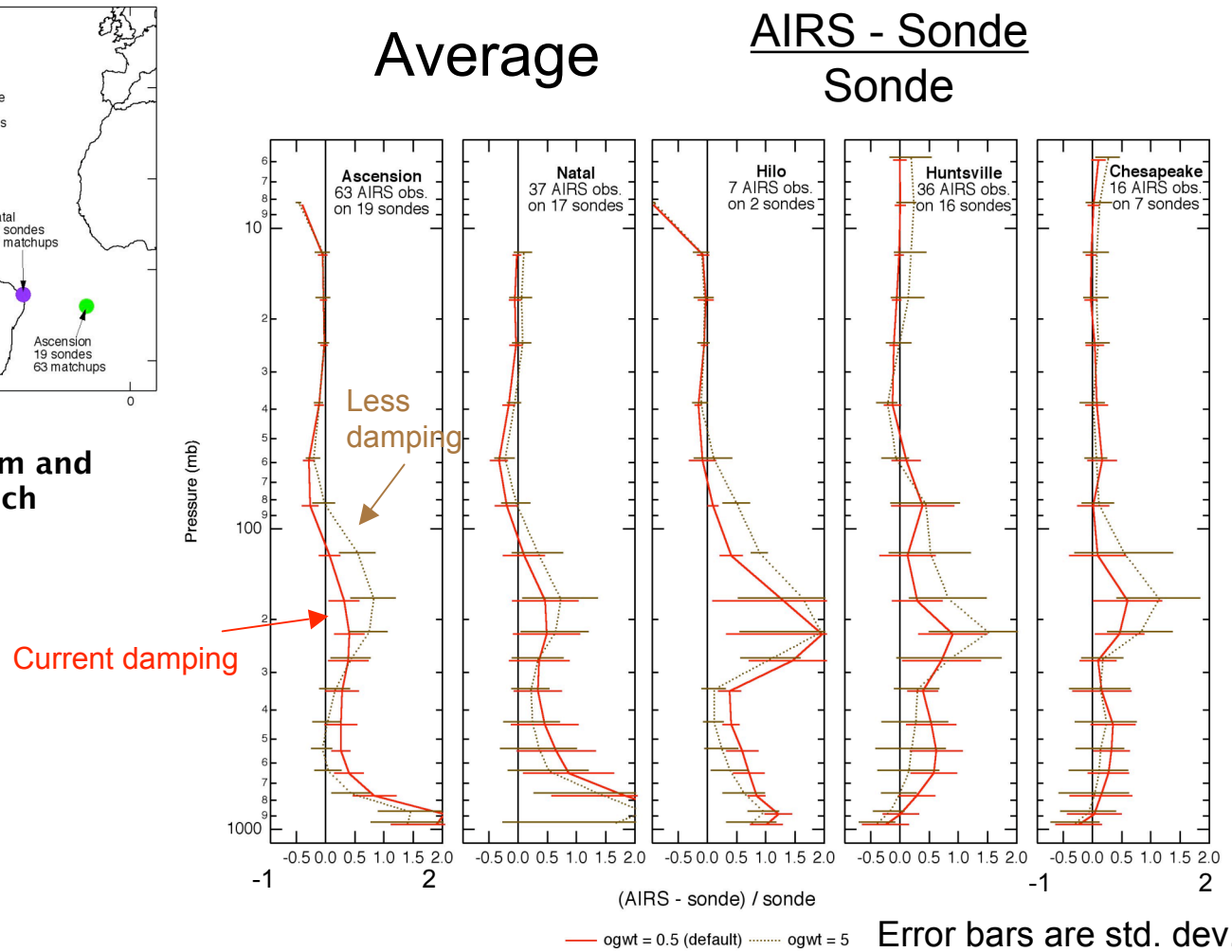
How does channel selection and damping affect the retrieval?



Decreasing damping worsens results in upper-trop/lower-strat with current channel selection



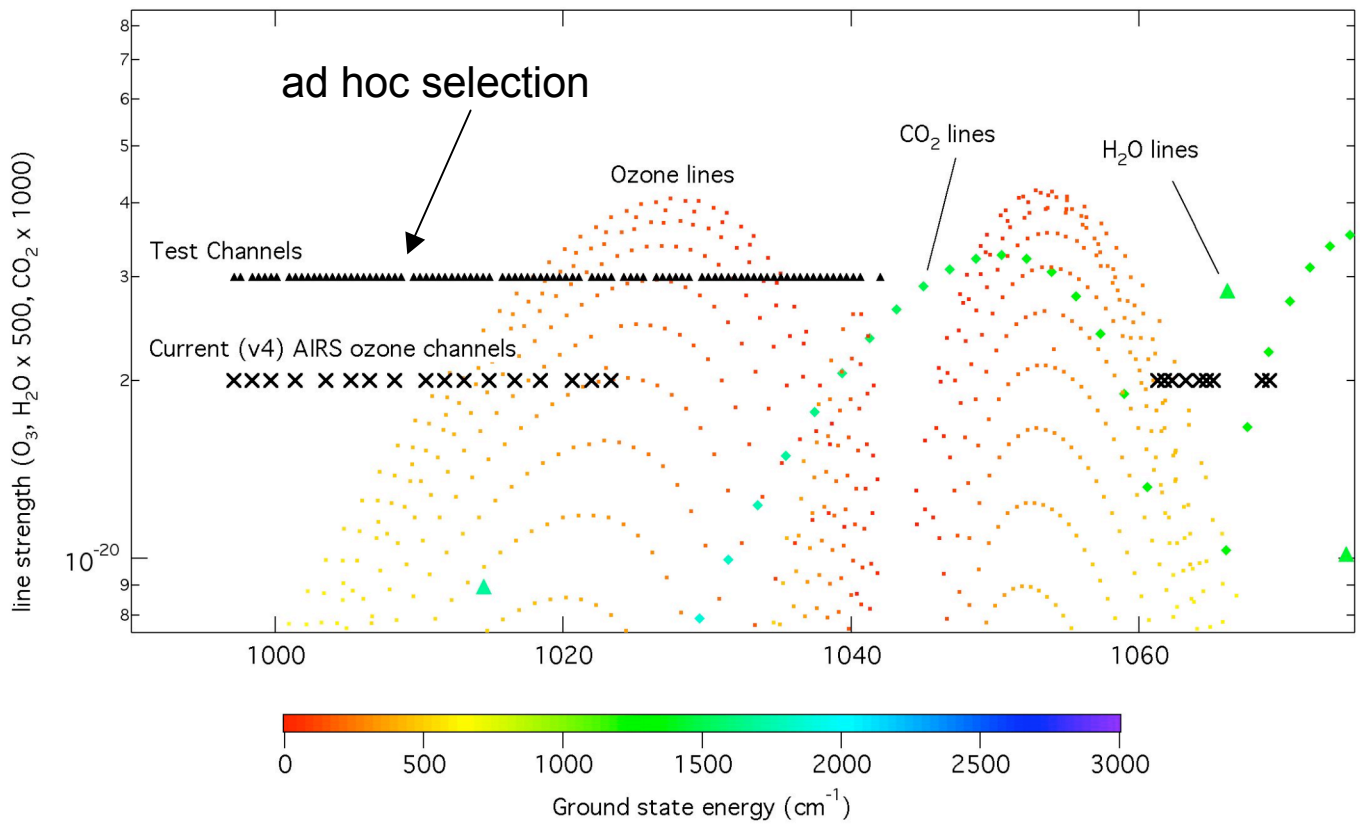
Matchups within 100 km and 3 hrs of sonde launch



Error bars are std. dev.

If results worse with decreased damping, let's give the retrieval more information

O_3, CO_2 and H_2O line strengths, frequencies and O_3 retrieval channels

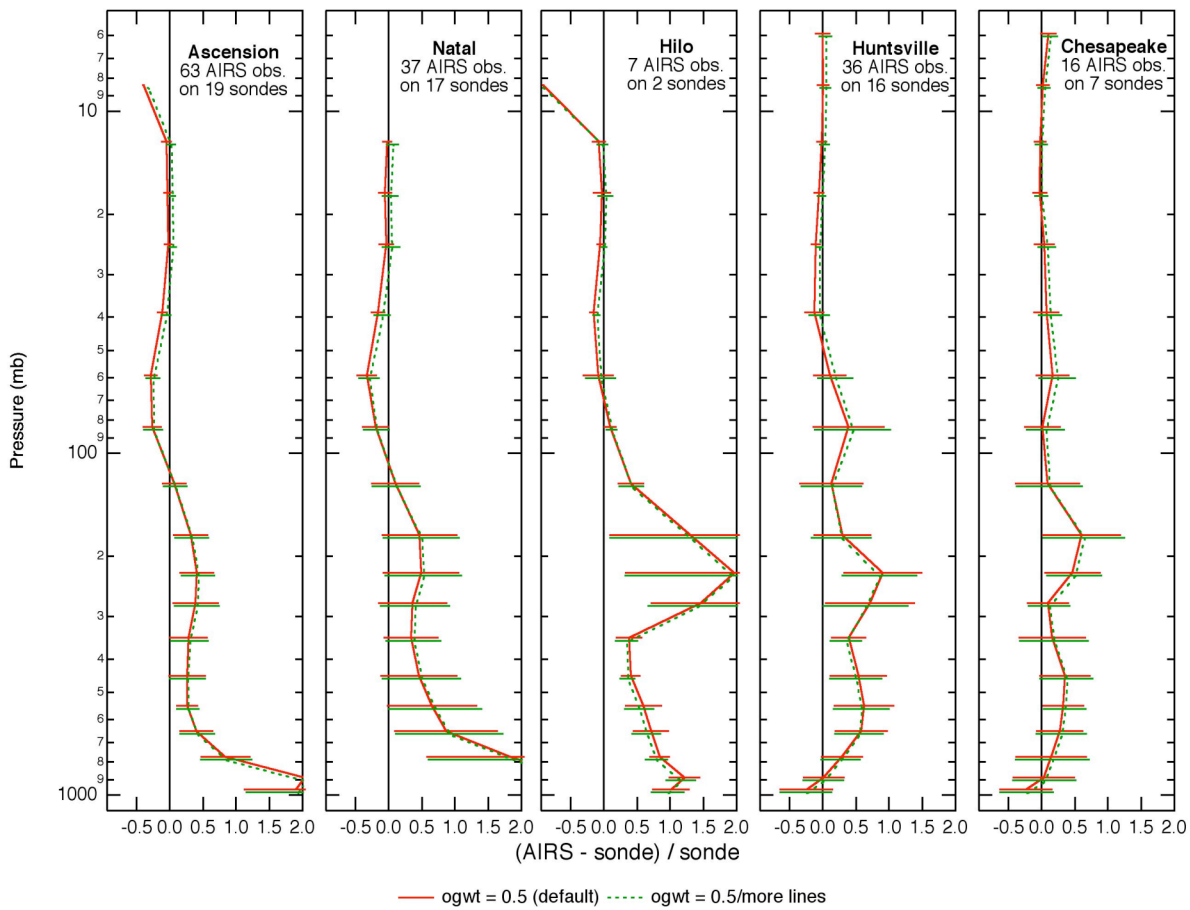


Adding channels at current damping doesn't change anything.

Average

$$\frac{\text{AIRS - Sonde}}{\text{Sonde}}$$

Error bars are std. dev.

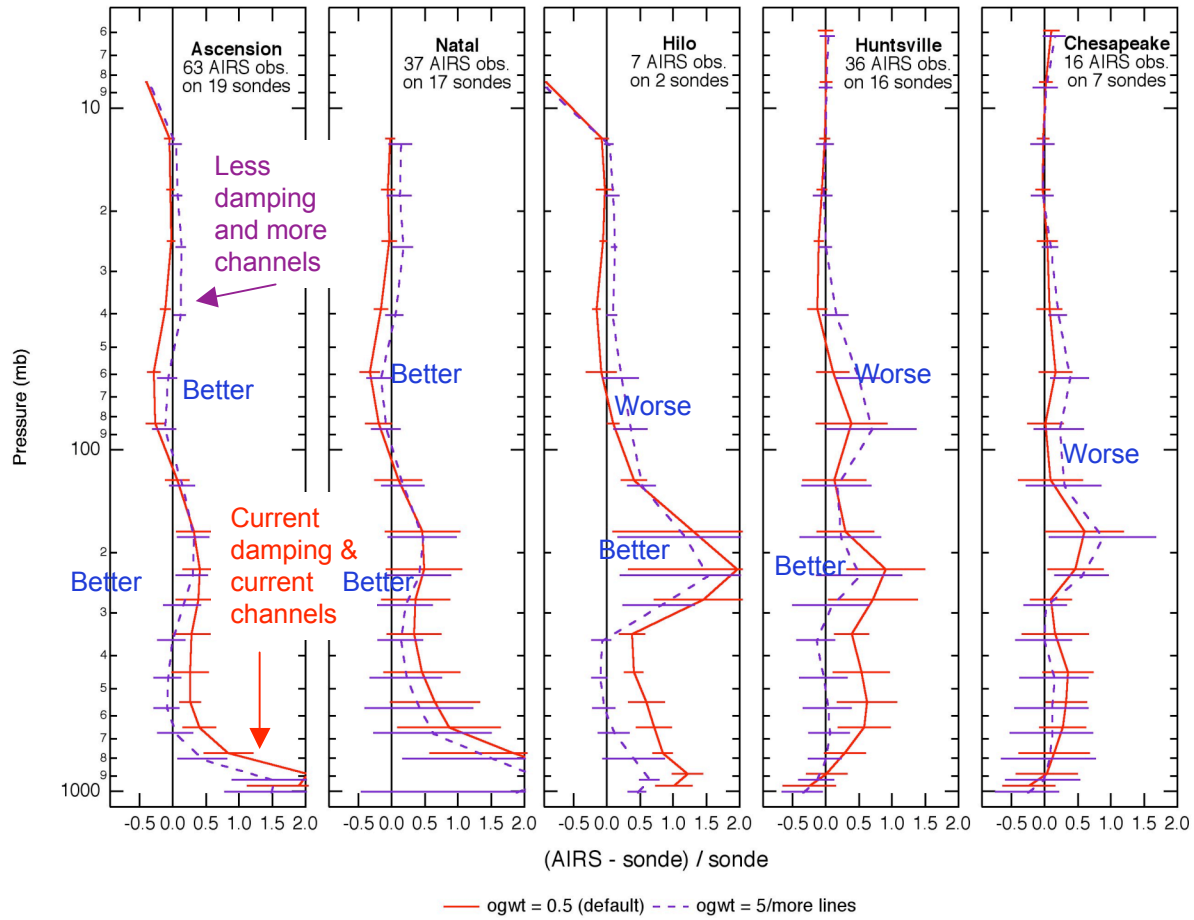


Adding channels and decreasing damping gives mixed results

Average

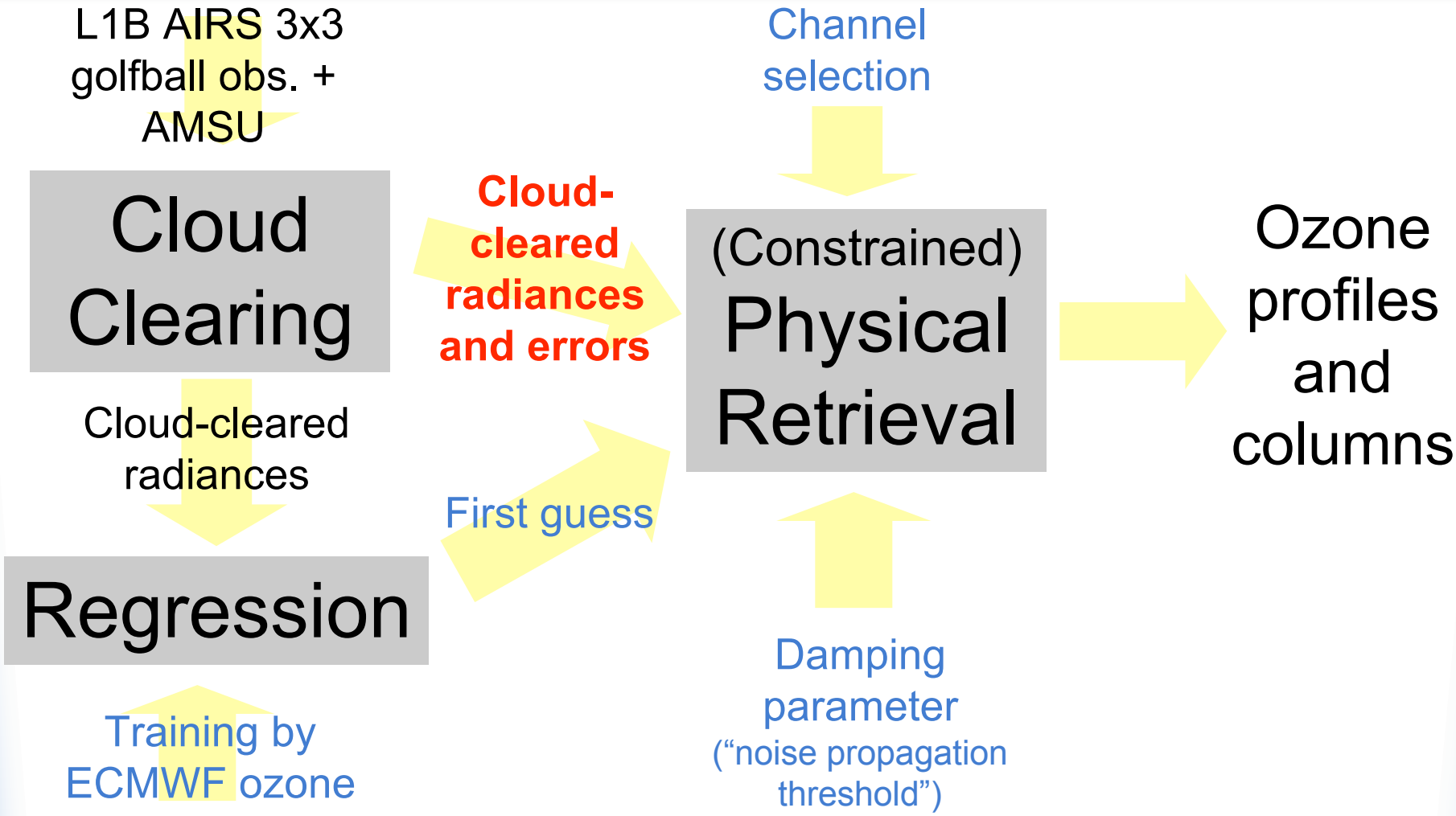
AIRS - Sonde
Sonde

Error bars are std. dev.
Pressures offset for clarity

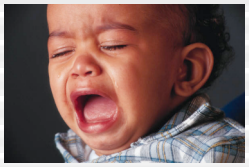


Point: there's some tradespace with decreased damping and additional channels.

Let's look at the radiances and their uncertainties…



We need reliable errors in cloud-cleared radiances!



^2

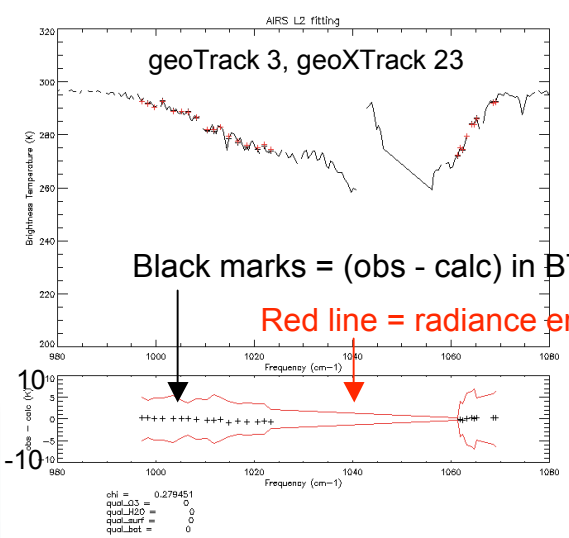
Goodness of fit diagnostic $\chi = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(\frac{obs_i - calc_i}{NESR_i}\right)^2}$

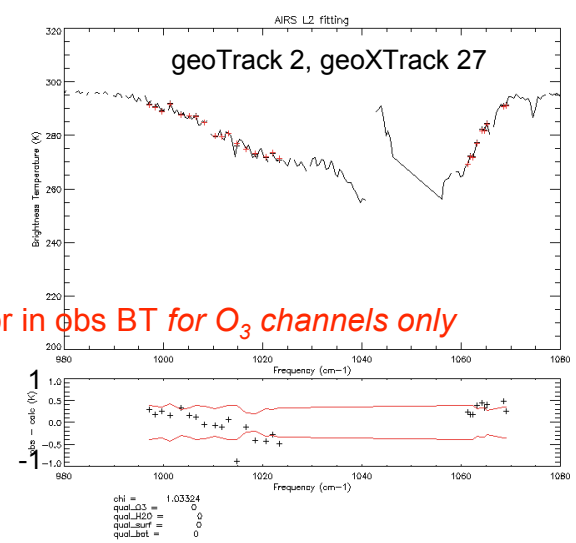
Cloud-cleared radiance error

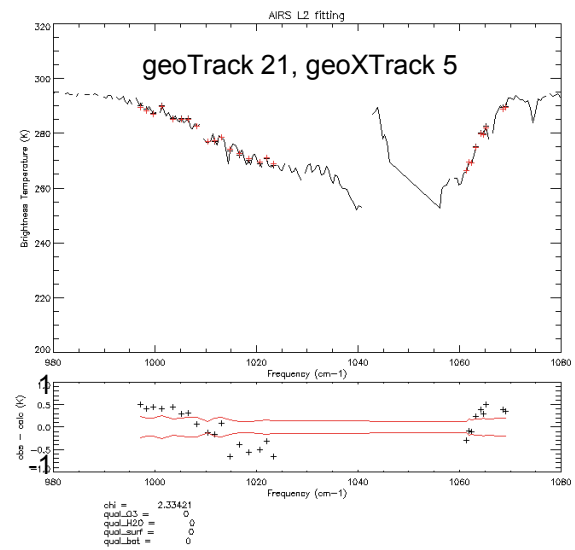
If $\chi >> 1$, bad fits or underestimating noise

If $\chi << 1$, fitting noise or overestimating noise

9/6/2002 granule 176







Black marks = (obs - calc) in BT

Red line = radiance error in obs BT *for O_3 channels only*

χ = 0.28
Error too high?

χ = 1.03
Error about right?

χ = 2.33
Error too low?

Overly high error in cloud-cleared spectral radiance helps drive over-constraint of retrieval.
Overly low errors help drive an under-constraint.

Systematic biases in radiance uncertainties?

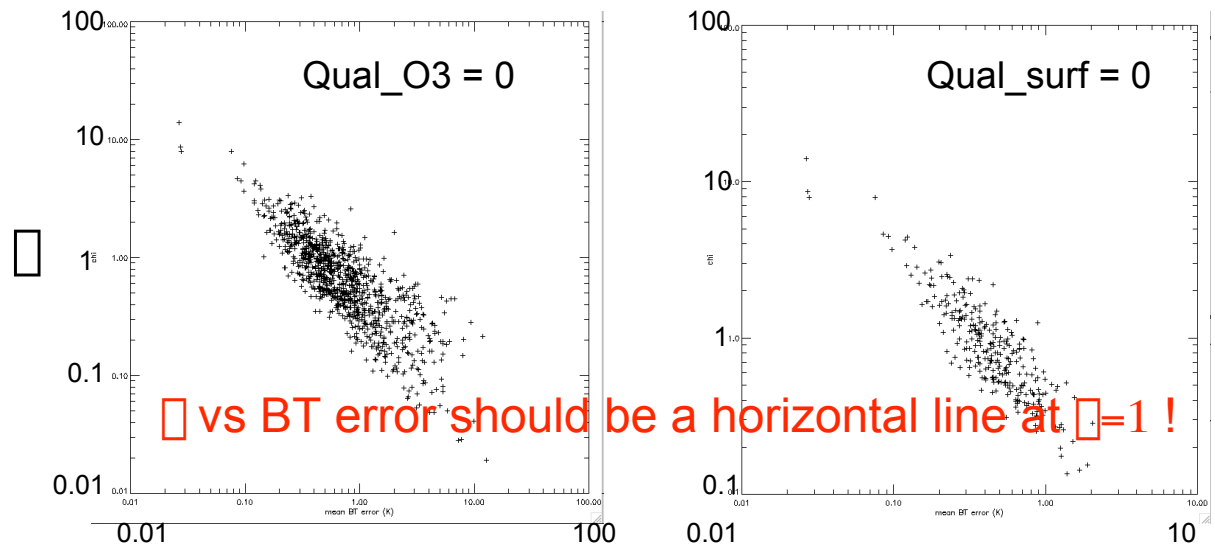
Sept 6/02 V4
Granule 176
(mostly ocean off US Northeast)

$$\chi = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(\frac{obs_i - calc_i}{NESR_i}\right)^2}$$

If $\chi >> 1$, bad fits or underestimating noise

If $\chi << 1$, fitting noise or overestimating noise

χ vs mean BT error in ozone channels

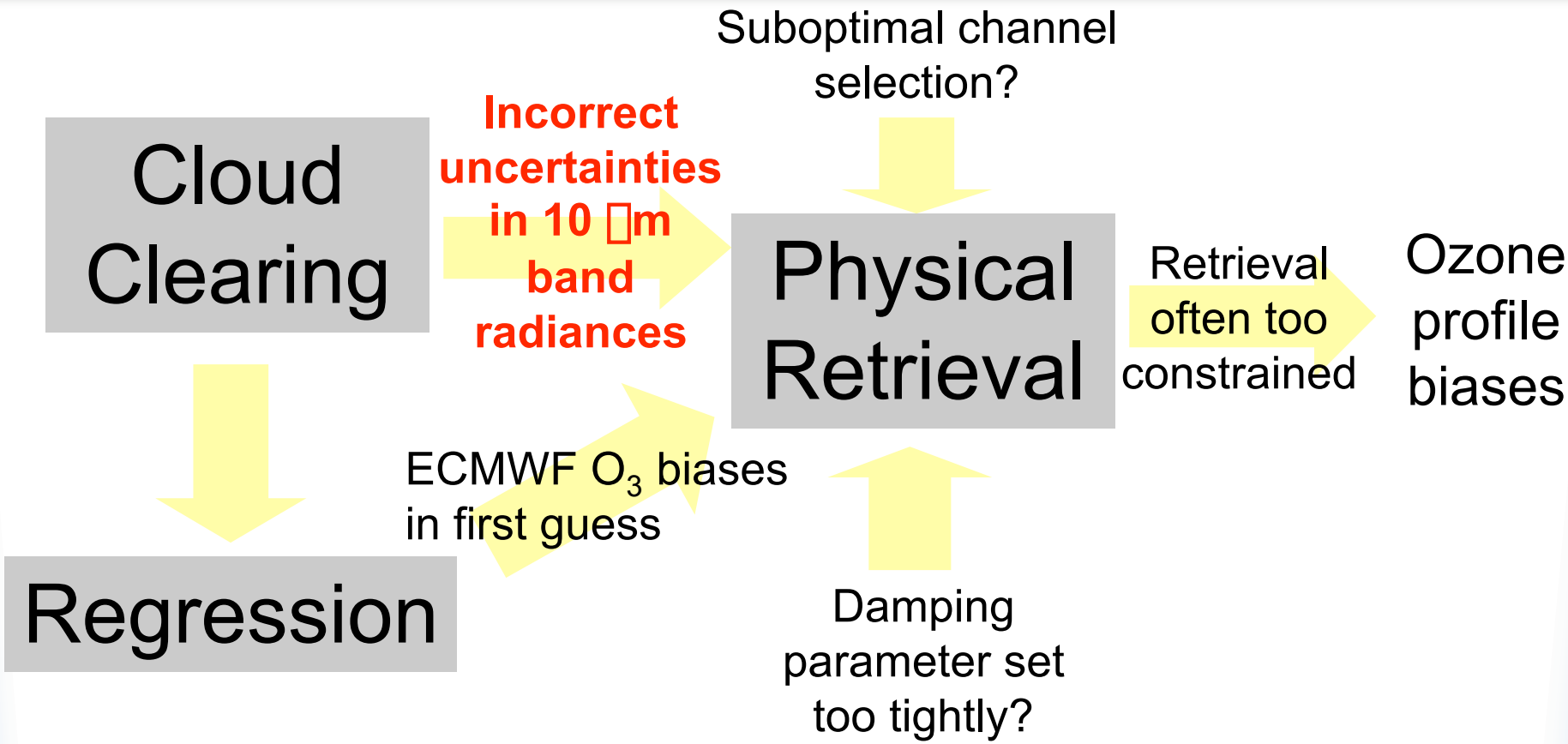


χ vs BT error should be a horizontal line at χ=1 !

Mean BT error in ozone channels (K)

The biggest problem with ozone may not be in the regression or the physical retrieval, but in the cloud-clearing.

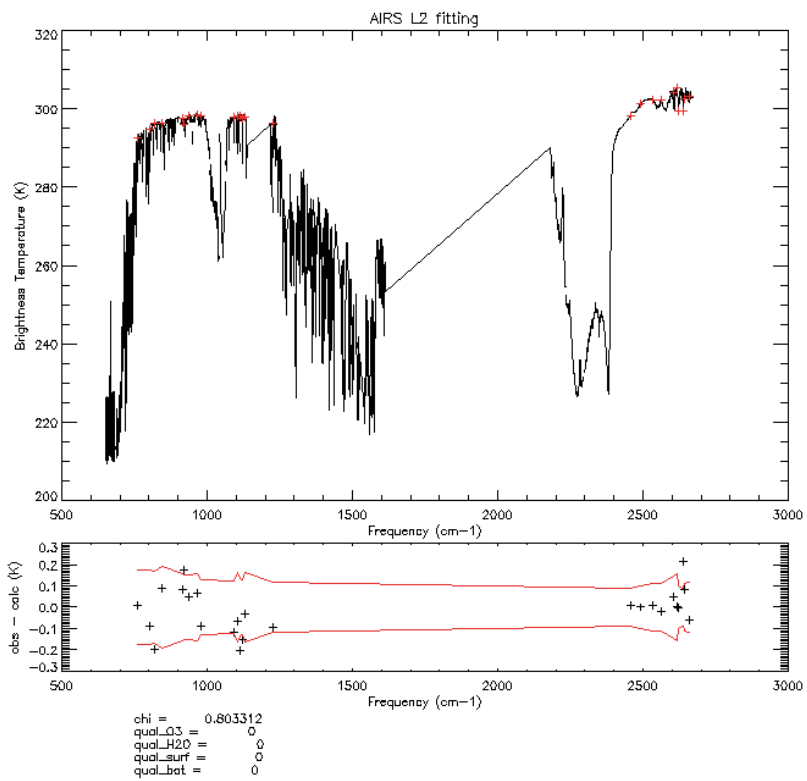
Summary

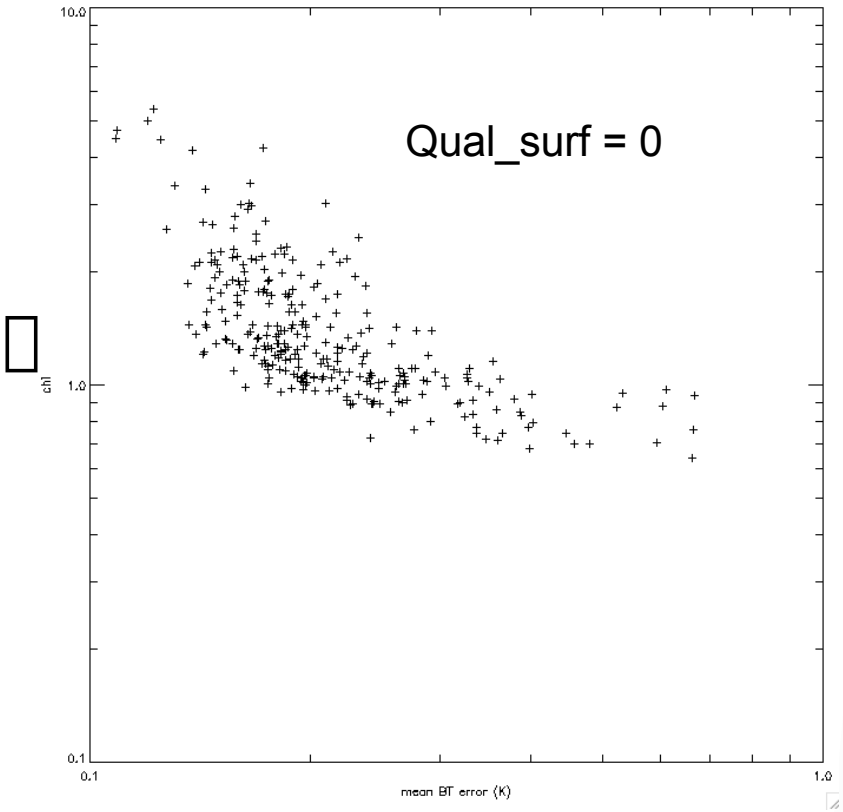


Work in progress. Note that for the moment I'm not taking into account trapezoids, biases in the spectroscopy, etc.

Thanks for your time!

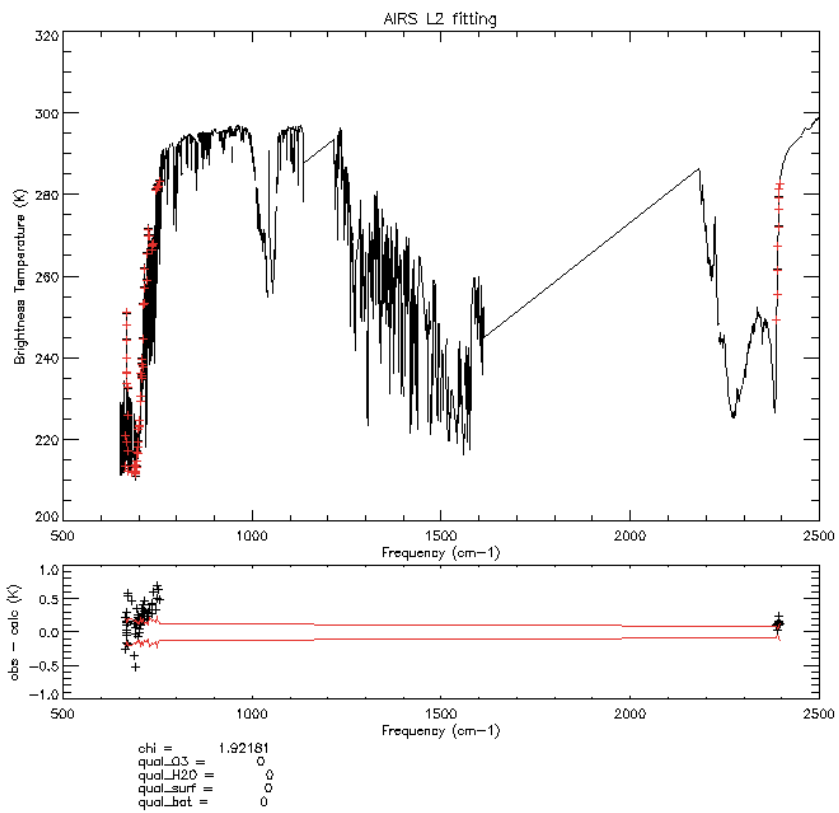
Surface Temperature

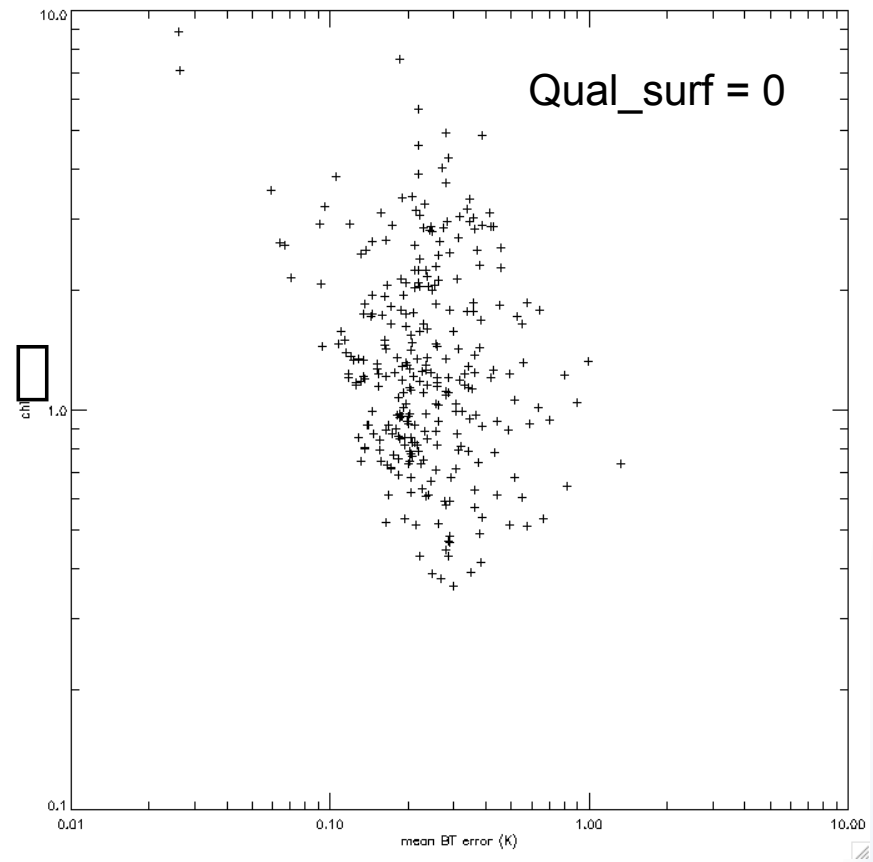




Mean BT error in fitted channels (K)

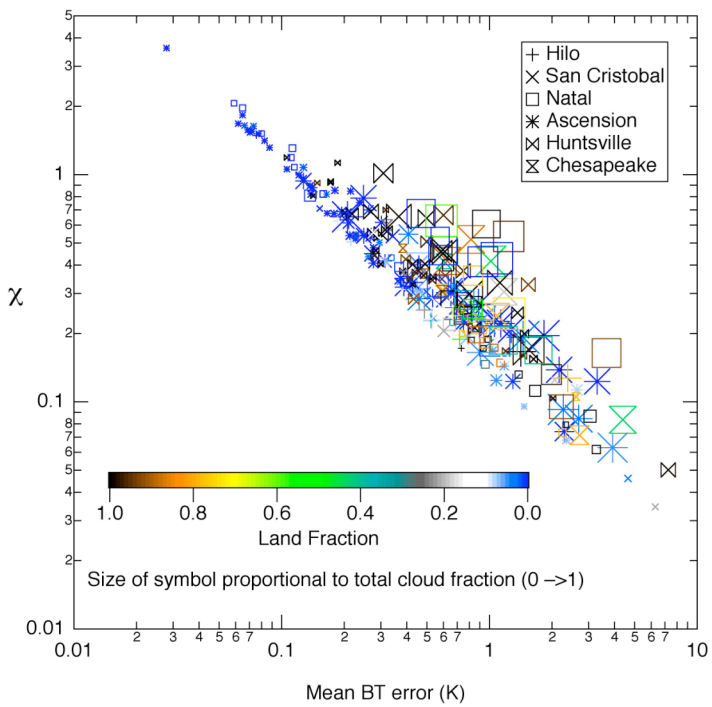
Temperature Profile





Mean BT error in fitted channels (K)

χ vs Brightness Temperature Error
Optimal Estimation Retrieval



$$\chi = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(\frac{obs_i - calc_i}{NESR_i}\right)^2}$$

If $\chi >> 1$, bad fits or underestimating noise

If $\chi << 1$, fitting noise or overestimating noise