



Jet Propulsion Laboratory
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ACOS/GOSAT B3.3: Overview & Validation

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5/30/2013



B3.
3

B2.1
0

B2.9

B2.8

B2.
7

B2.6



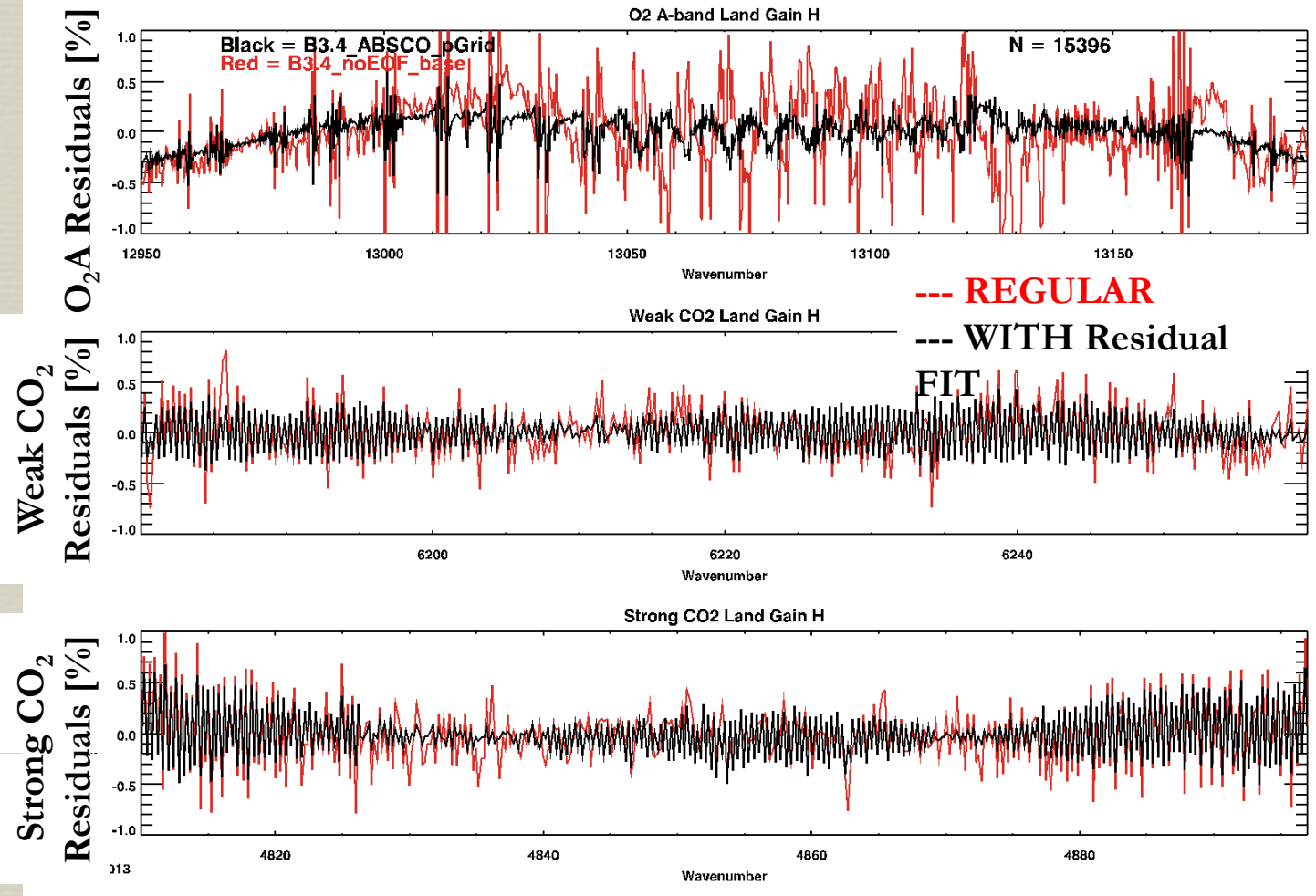
BETTER. STRONGER. FASTER.

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B3.3: Major Changes

- ↻ Updated ABSCO Spectroscopy (e.g O2A only requires scaling factor of +1.25% now)
- ↻ Residual Fitting of first residual EOF (per band) replaces empirical noise
- ↻ Reduced AOD prior to 0.05.
- ↻ Fit explicitly for Fluorescence over land from O2A band.
- ↻ Significantly tightened P_{surf} Prior error to +/- 1 hPa (roughly equal weight between data & prior)
- ↻ Only run on GOSAT v150151 L1B data files
- ↻ Updated radiometric calibration & degradation.

Residual Fitting



→ More accurate χ^2 , Faster convergence, Lower XCO₂ errors

Two Problems in B3.3

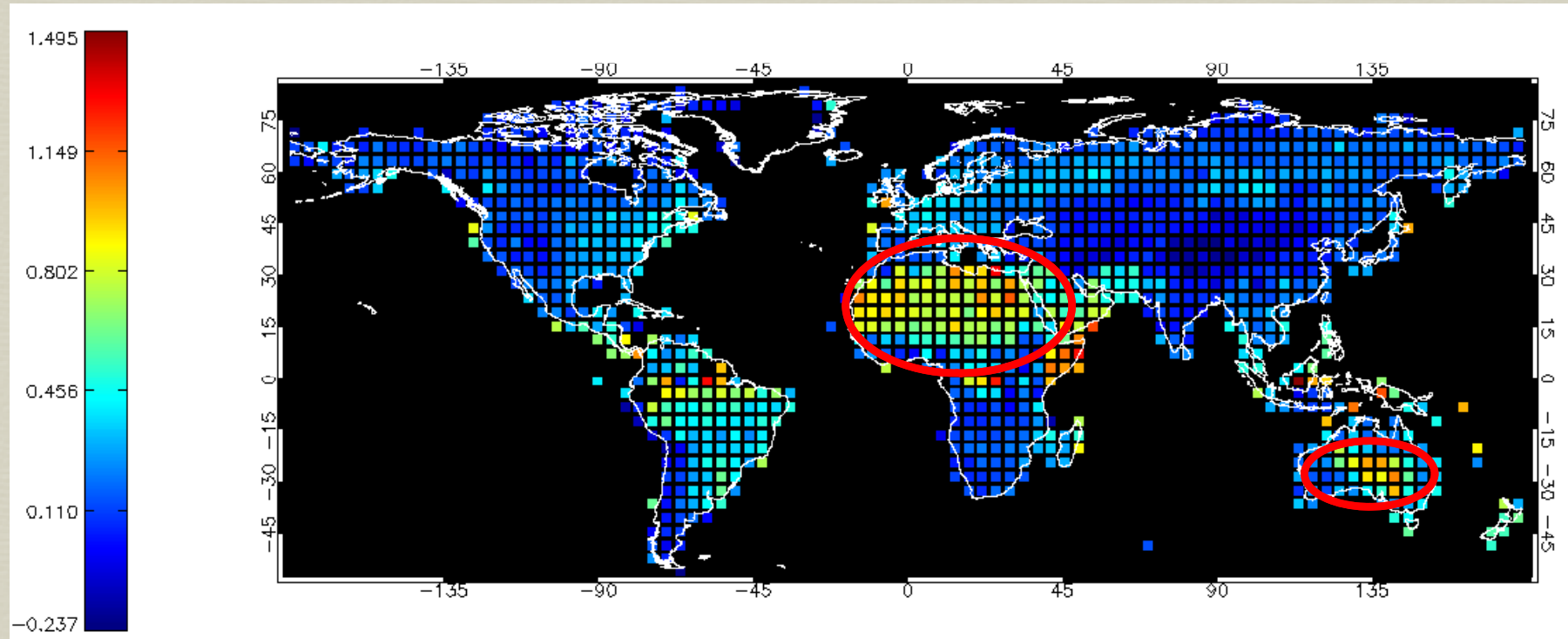
∞ Glint Retrievals:

- ∞ Convergence fails due the peculiarities of the set-up.
- ∞ Fixed in B3.4

∞ Land Gain M fluorescence retrievals

- ∞ Unreasonably high retrieved fluorescence and large XCO₂ errors
- ∞ Disabled in B3.4 (deserts should have little vegetation)

Retrieved Fluorescence



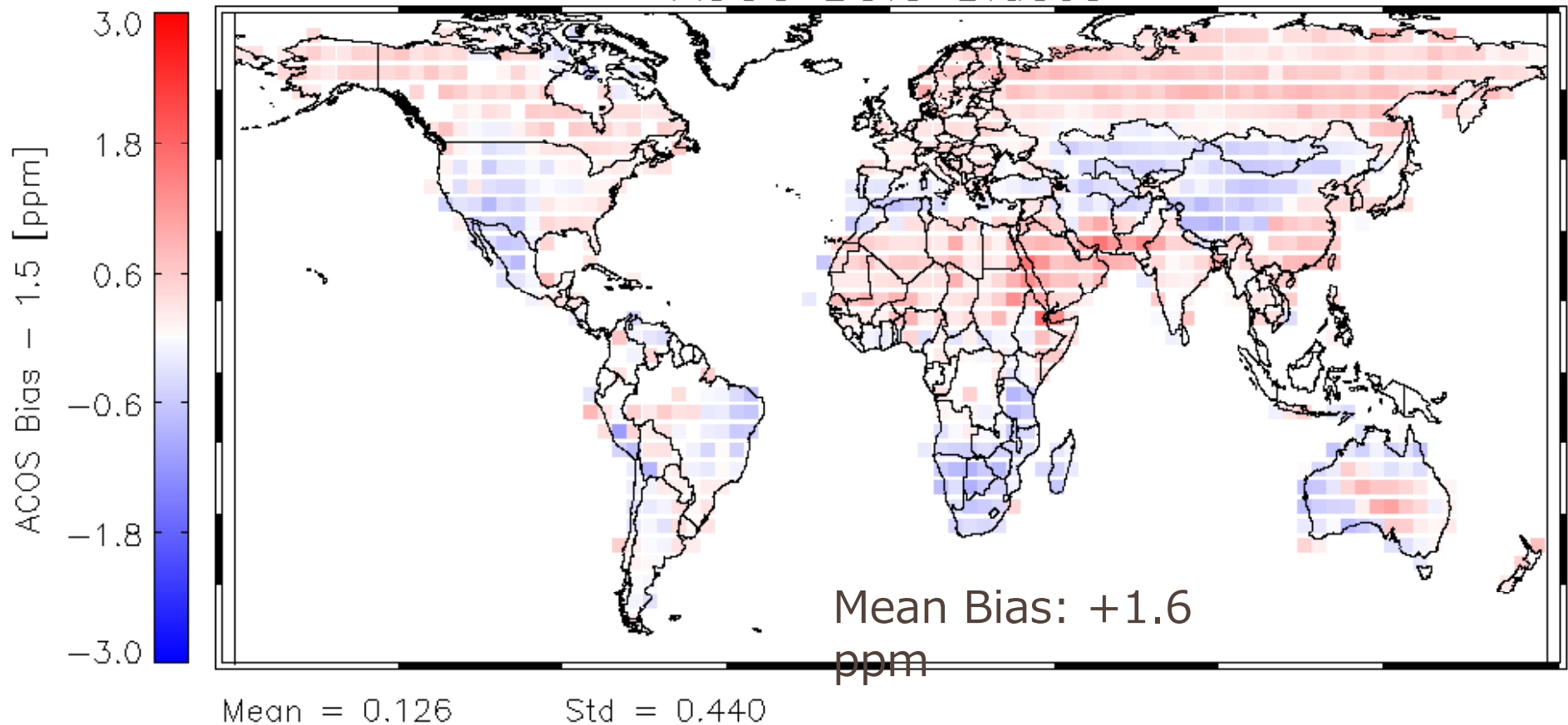
Gain M Fluorescence much too high!
Solution: Turn off fluorescence fit in
Gain M (over deserts)

Filtering & Bias Correction

- ∞ TCCON & Model-based comparisons
- ∞ Filtering similar to B2.10 but a little simpler
- ∞ There is a **+1.5 ppm overall global bias** due to spectroscopy changes in B3.3
- ∞ 2-parameter regression for land gain H (3 for land gain M)
- ∞ Good news: the corrections are generally smaller than in B2.10.

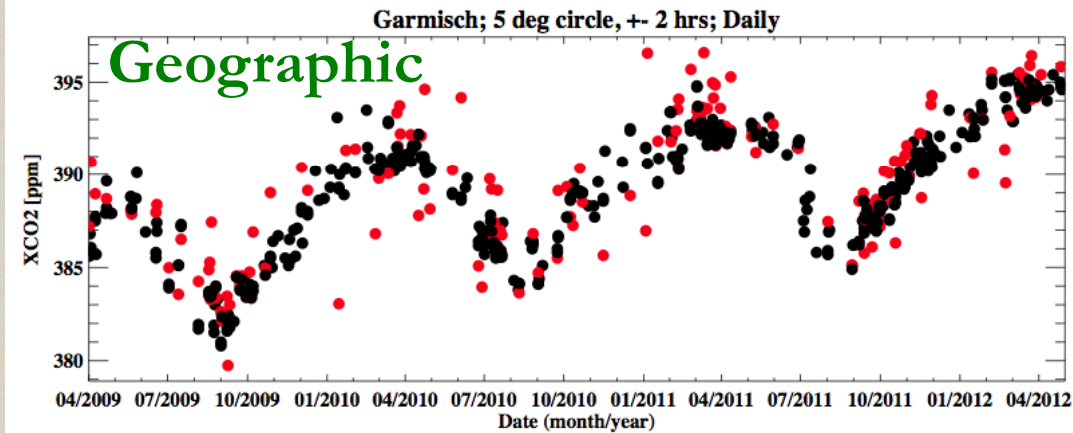
Mean Bias Correction: B3.3

ACOS B3.3 Biases



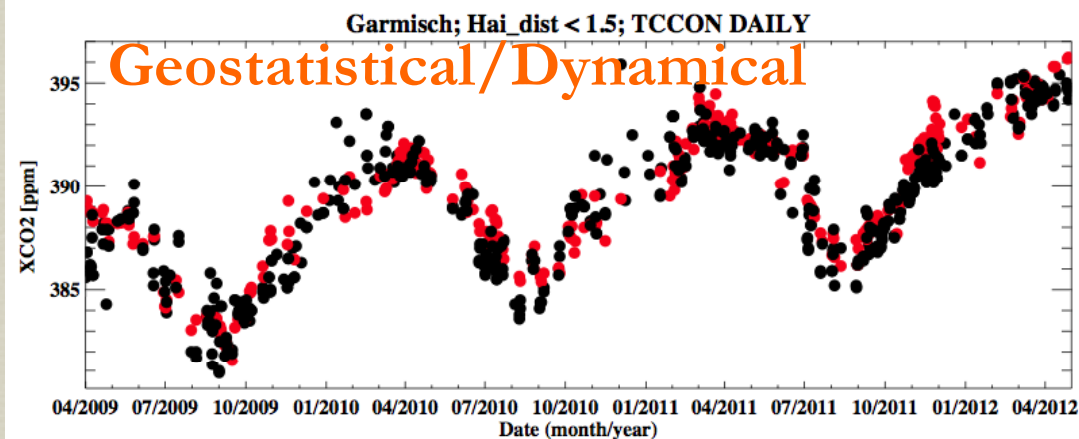
Geostat/Dynamical vs. Geographic Comparison to TCCON

ACOS BC: Mean=0.58; σ =1.99; N=148; R=0.858; a=0.929



- More comparison days
321 vs. 148
- Less Scatter
1.3 vs. 2.0 ppm

ACOS BC: Mean=0.37; σ =1.28; N=321; R=0.925; a=0.928

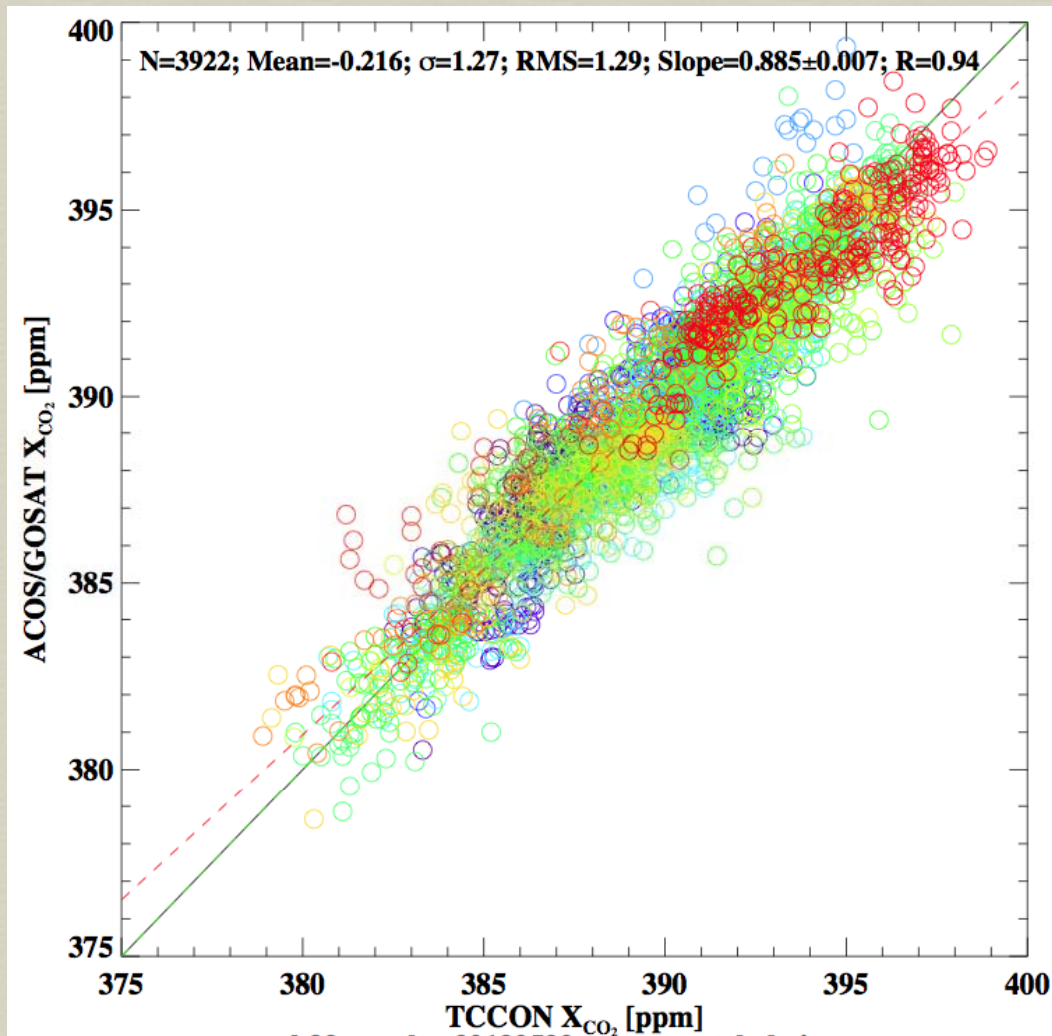


- Higher Correlation
0.93 vs. 0.86
- Similar Slopes
0.93 vs. 0.93

(Nyugen/Braverman @JPL, refinement of Wunch et al 2011 approach)

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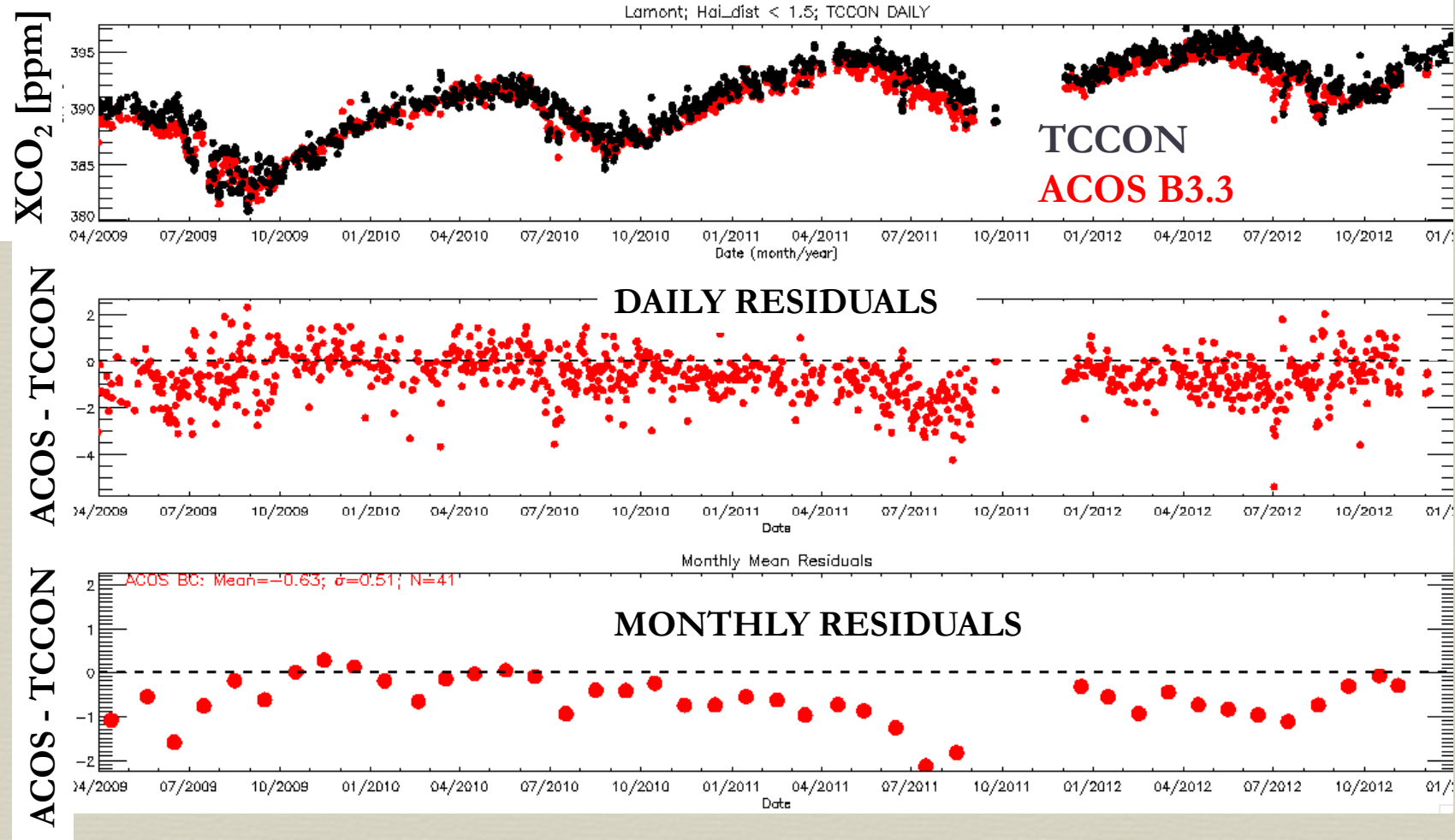
Comparison vs. 16 TCCON stations



- RMS is reasonably low, though many soundings averaged per day.
- Slope is still about 10% low. Appears to be driven by northern-hemisphere seasonal cycle.
- Some inversion models indicate that GOSAT data imply a strong Eurasian sink: “wrong slope” may be related.

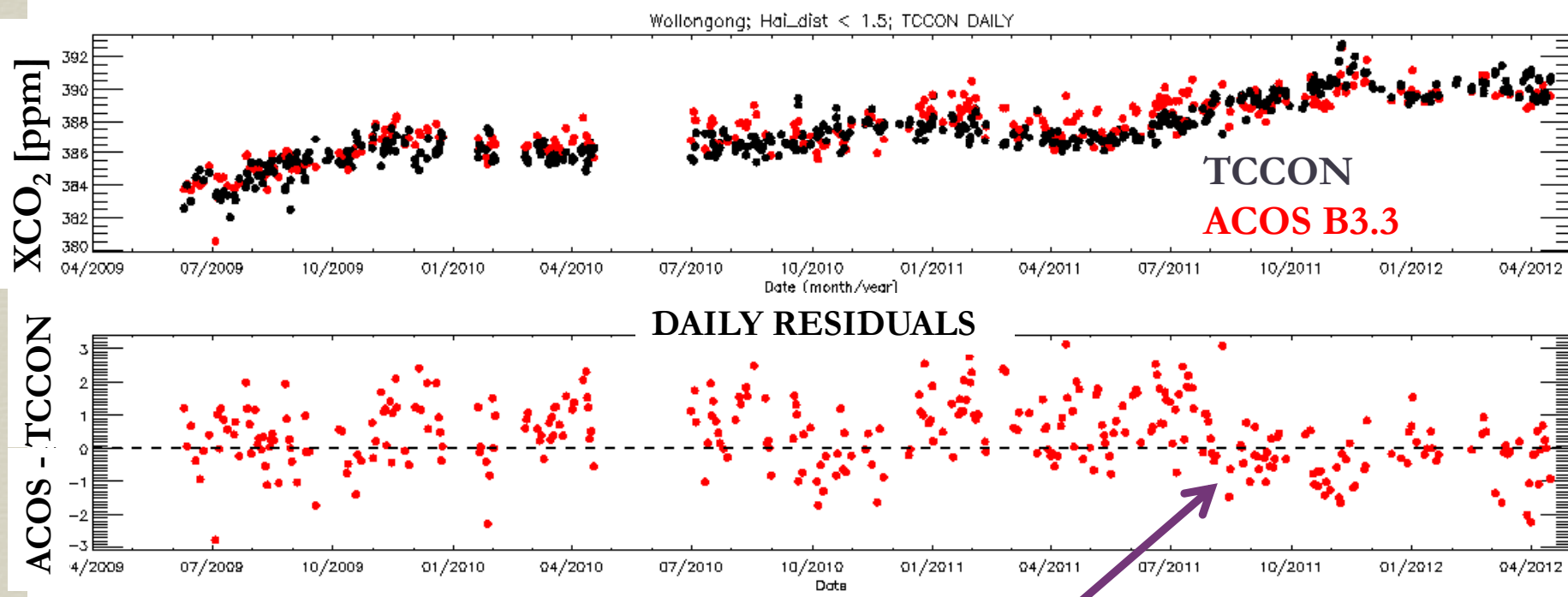
Lamont

ACOS BC: Mean=-0.67; σ =0.97; N=968; R=0.953; α =0.899



Wollongong

ACOS BC: Mean=0.39; σ =1.02; N=335; R=0.847; α =0.782

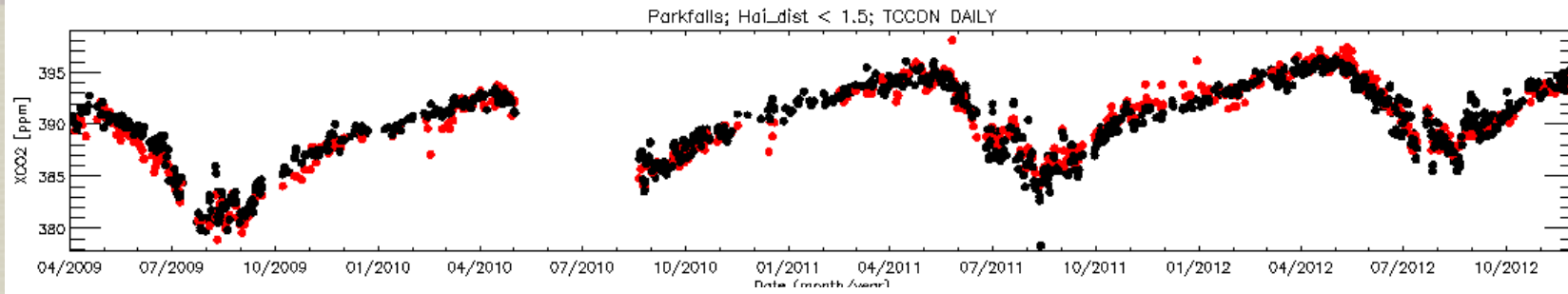


Did some instrument change occur? Yes!

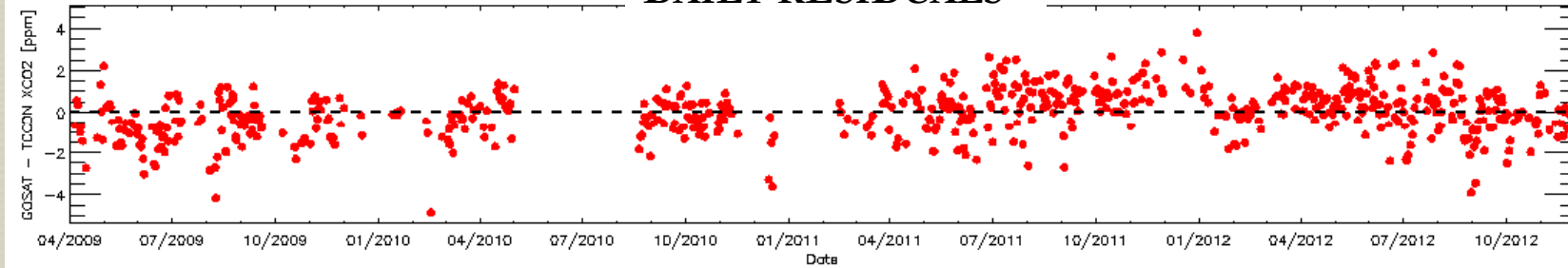
- Affects several TCCON sites.
- Will be fixed in next TCCON release.
- See TCCON data guide and Dohe *et al.* (AMTD) for details.

Park Falls

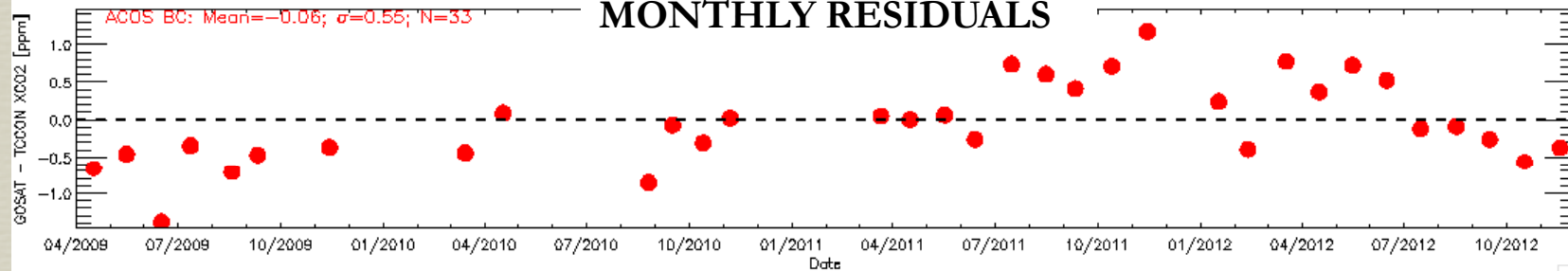
ACOS BC: Mean=-0.05; σ =1.15; N=642; R=0.954; α =1.012



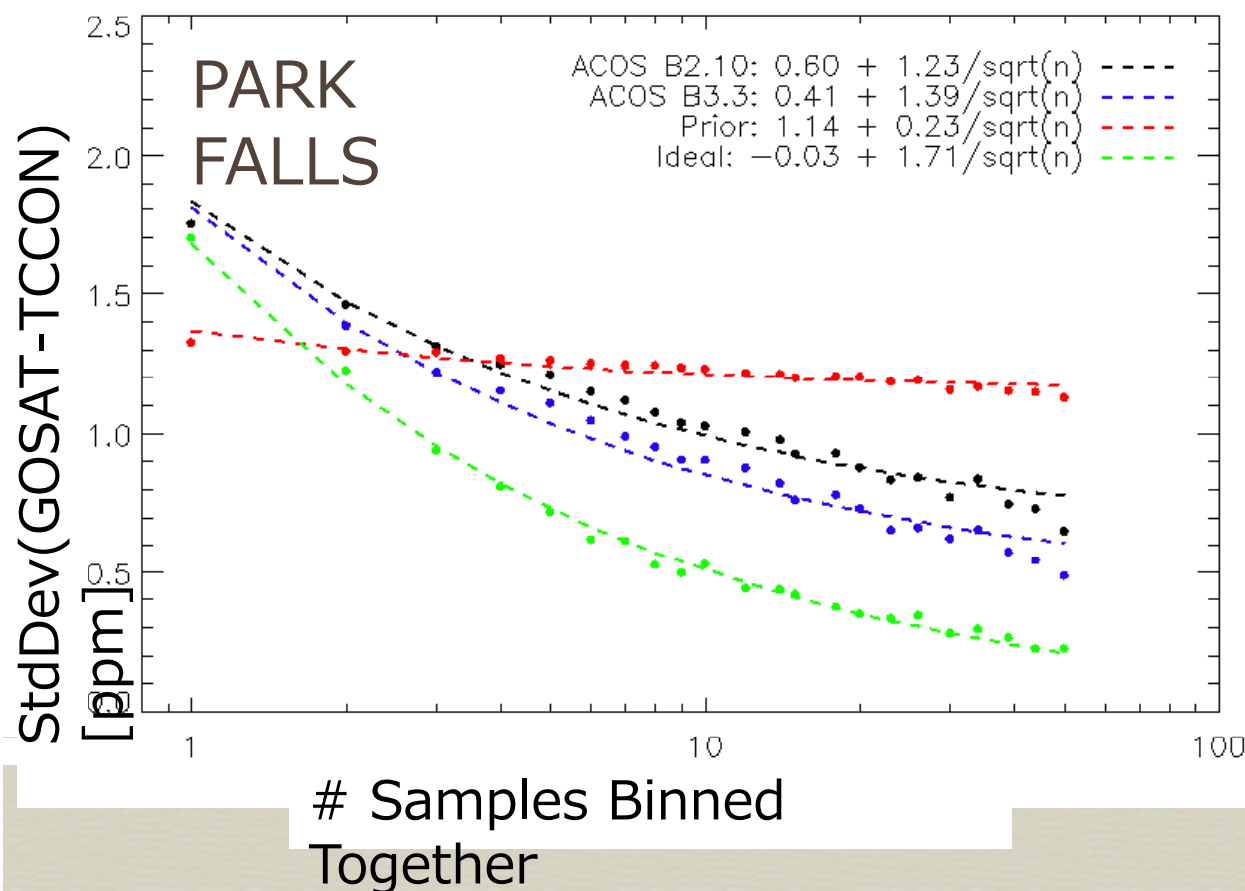
DAILY RESIDUALS



MONTHLY RESIDUALS



How do errors “integrate down”?



- **Prior is initially better (no noise), but barely integrates down.**
- **ACOS B2.10 and B3.3 both eventually beat prior, but B3.3 is typically better.**
- **ACOS seems to asymptote to about 0.4 ppm typically; this forms an estimate of our fundamental biases.**
- **Ideal case is shown for comparison.**

Idea from Susan Kulawik

Summary (thus far)

- ❧ Several changes to L2 algorithm & processing from B2.10.
- ❧ Some new features have cropped up:
 - ❧ +1.6 ppm high bias
 - ❧ high ocean failure rate
 - ❧ M-gain fluorescence problem
- ❧ Relative Bias correction was generally smaller than for B2.10
- ❧ Comparison to TCCON is similar or slightly better than for B2.10.
- ❧ Northern hemisphere seasonal cycles still appear $\sim 10\%$ low.

Plans for B3.4

- ∞ Fix Glint Failure problem
- ∞ O2A-band ILS change to theoretical sinc+boxcar
- ∞ Re-train EOF residual patterns on V150 L1B data
- ∞ Turn off Fluorescence retrieval in M-Gain
- ∞ Finished ~ Dec 2013.

B3.3 data access

- ✧ Email odell@atmos.colostate.edu for FILTERED, ASCII data.
- ✧ We recommend to only use Land Gain H from B3.3. Recommend using B2.10 for land gain M and ocean.