

Consistency between Gain H and M using V201 central Australia

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7, June, 2016

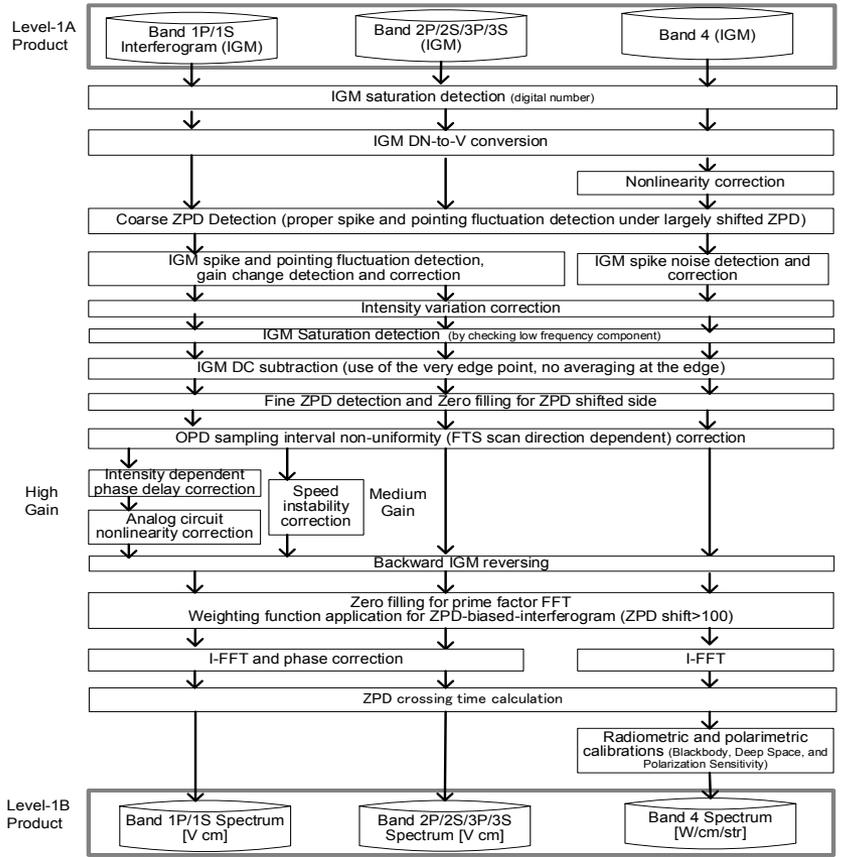
IWGGMS-12@ Kyoto University, Kyoto

Electronic, Circuit Educational & Testing Devices

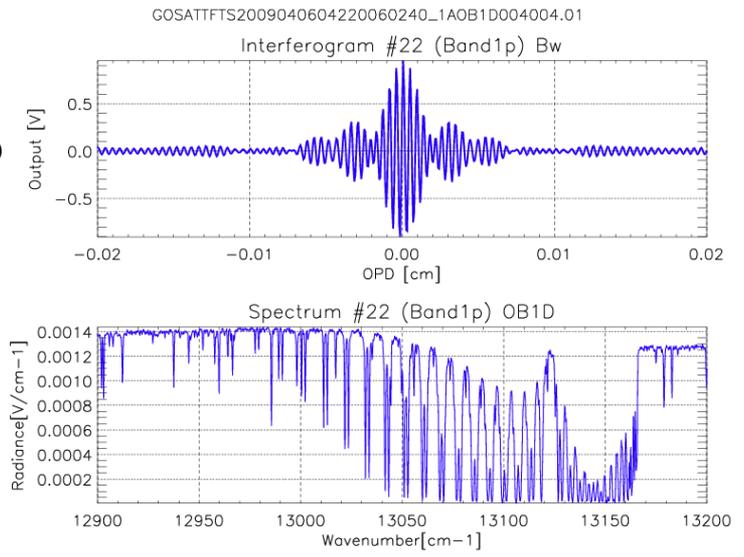


Characterization of spectra quality and updated L1 processing

L1 Processing

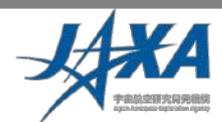


L1 Processing



- Oxygen A-band directly affect accurate XCO₂ and XCH₄.
- Several revisions in non-linearity correction have been applied.

Kuze et al, 2016 AMT
Suto et al, 2013 Appl. Opt.



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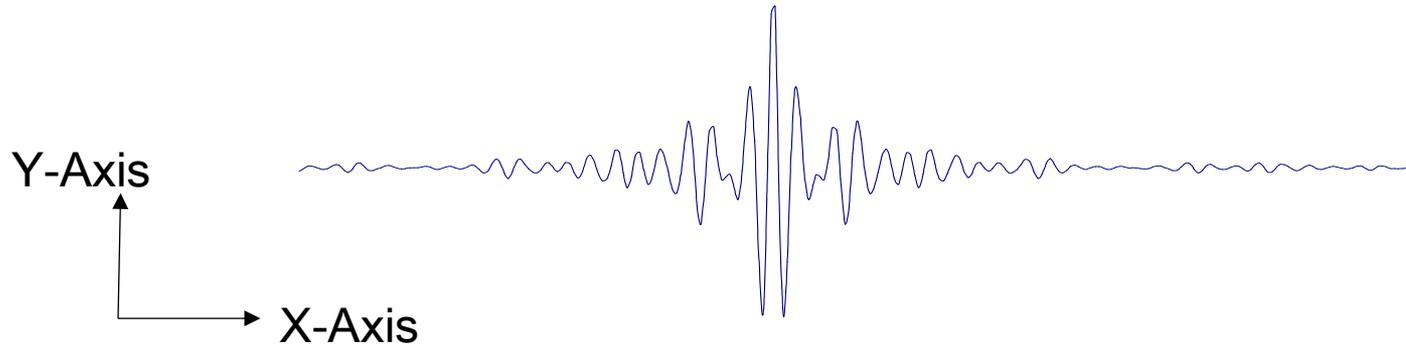




Why L1 V201 is needed?

#	Items	Needs
1	Band1 input dependent phase delay	Band1 analogue chain has non-linear phase delay against input signal level, due to impedance mismatch between pre-amplifier and LPF. The zero-level offset both in-band and out-band are existed.
2	Modified Sampling non-uniform interval correction	Systematic sampling non-uniform interval distort the spectra. Link with ZPD position. Correction table is optimized.
3	Reduction of spectral resolution due to biased ZPD position	The spectral resolution is depended on the maximum optical path difference. Biased ZPD position lead the reduction of maximum optical path difference.
4	Modified low frequency correction	Low frequency correction was applied from v050050. Asymmetric TANSO-FTS intergerogram created the artificial signal through the processing.
5	New format	Adding new parameters such as category of target observation, best-estimated pointing location etc.

Corrections in the Level 1 B processing in the interferogram domain



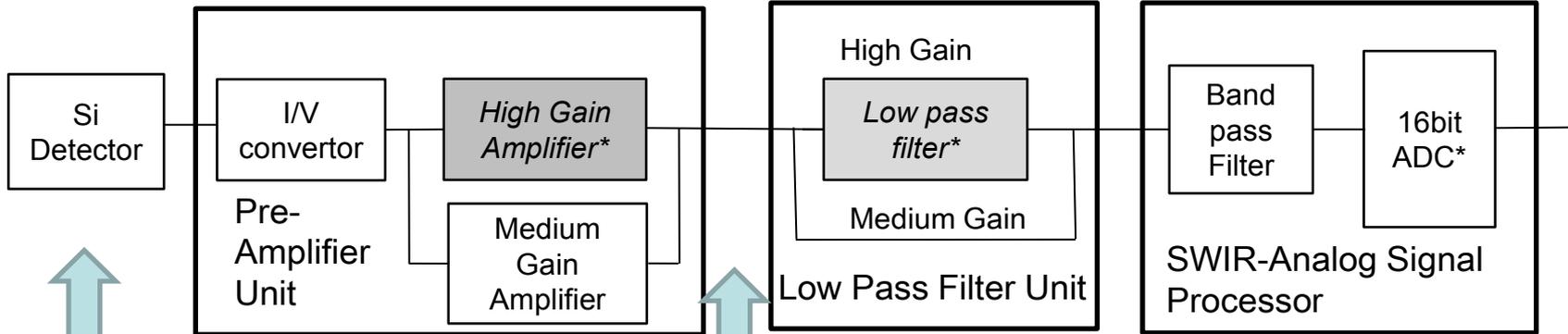
X-AXIS (Re-sampling)

- (1) FTS mechanism scan speed instability correction for medium gain (2 sinusoidal sources) (V110 and later)
- (2) *Sampling interval non-uniformity correction (SINUC) (V150 issue, not applied in V161, modified in V201)*
- (3) *Analogue circuit intensity dependent phase delay correction (V201)*
- (4) Doppler shift due to image motion compensation (forward to backward viewing) (not corrected)

Y-Axis (Intensity correction)

- (1) *Intensity variation (low frequency) component correction (V050, modified in V201)*
- (2) Band 4 detector nonlinearity correction (V110 and later, to be modified in the next version)
- (3) *Band 1 high gain amplifier nonlinearity correction (V150, modified in V201)*
- (4) ADC nonlinearity (not corrected, V130 issue)

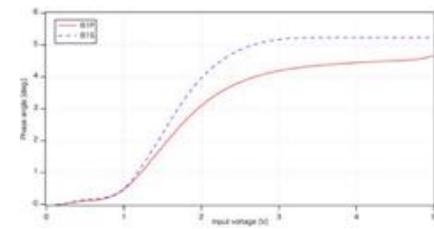
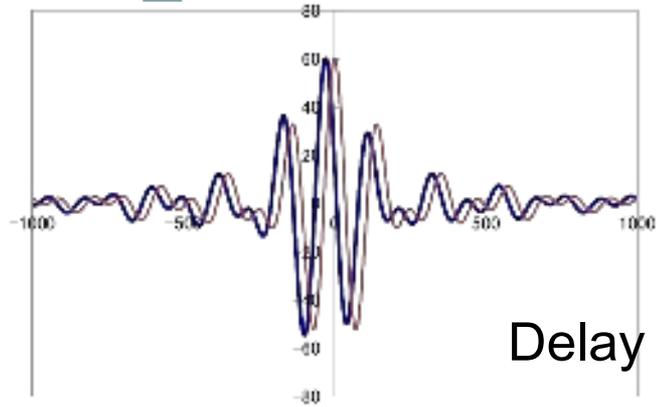
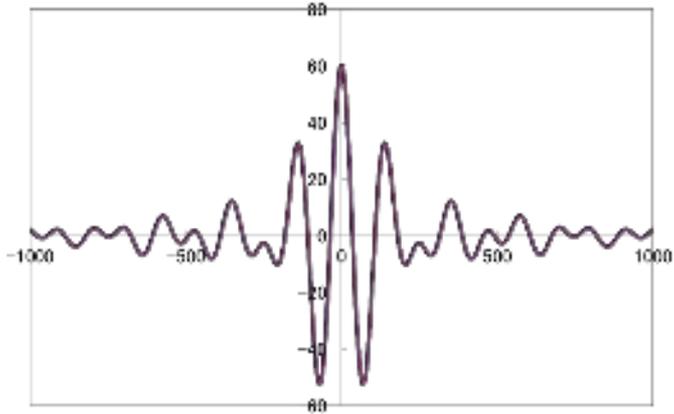
band1 analogue circuit



*Major intensity dependent phase source
Correction added in L1B 201

*Major nonlinearity
source in intensity
Correction modified in
L1B 201

*ADC has nonlinearity
but can not be corrected
in L1B 201.

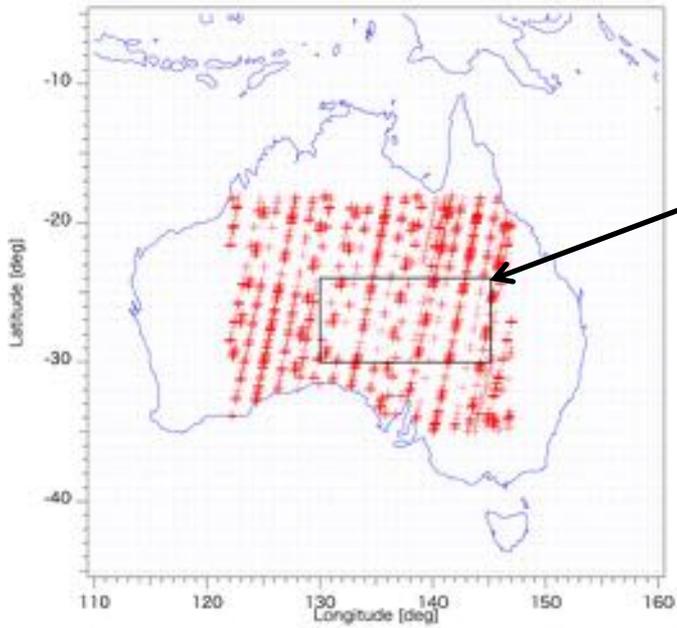


Real circuit
Delay is NOT constant.



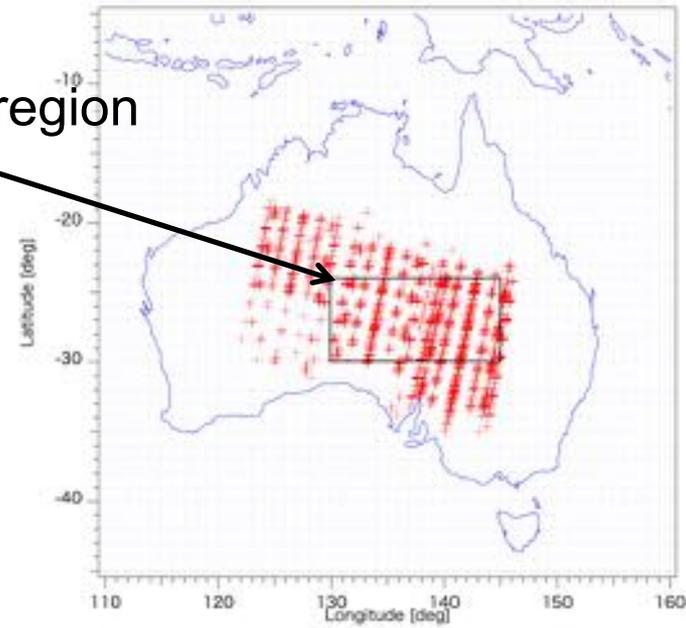
How the bias is reduced with new L1B and updated L2 algorithm?

Over Australia:
20090422 to 20140607



H-Gain

Analyzed region



M-Gain

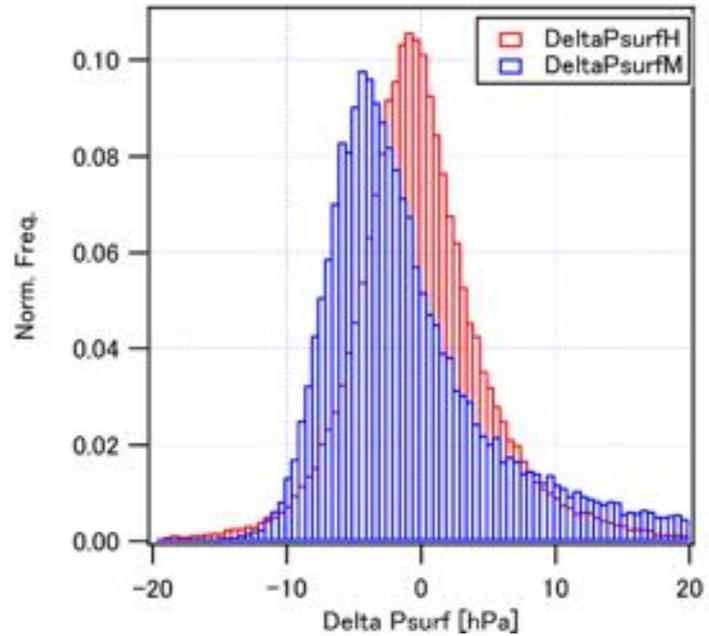
Every 3 day gains H and M have been switched over central Australia.
NIES, ACOS, RemoTeC data are compared.



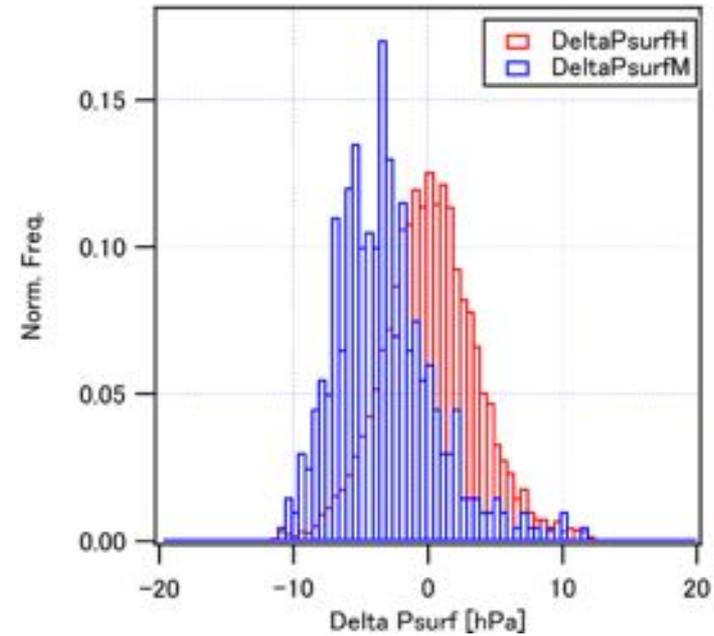
The difference between H/M spectra with previous L1B

Histograms of the residual between the retrieved surface pressure and a priori.

Data time periods:
NIES: 2009/06/01 – 2010/07/31
ACOS: 2012/04/17 – 2012/05/17



NIES v02.00

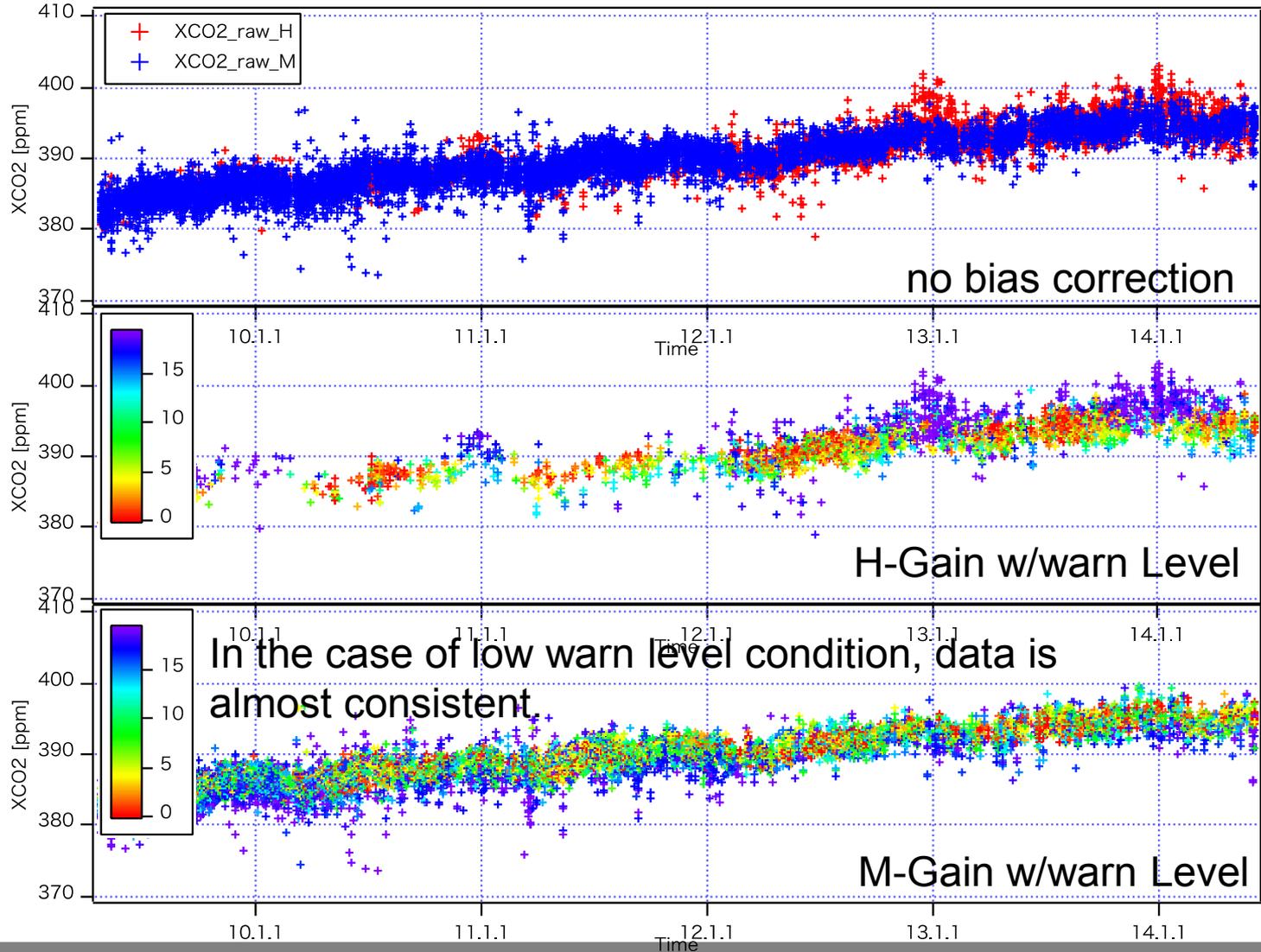


ACOS B2.9

Both NIES and ACOS data show around -5hPa difference between gain H and M.

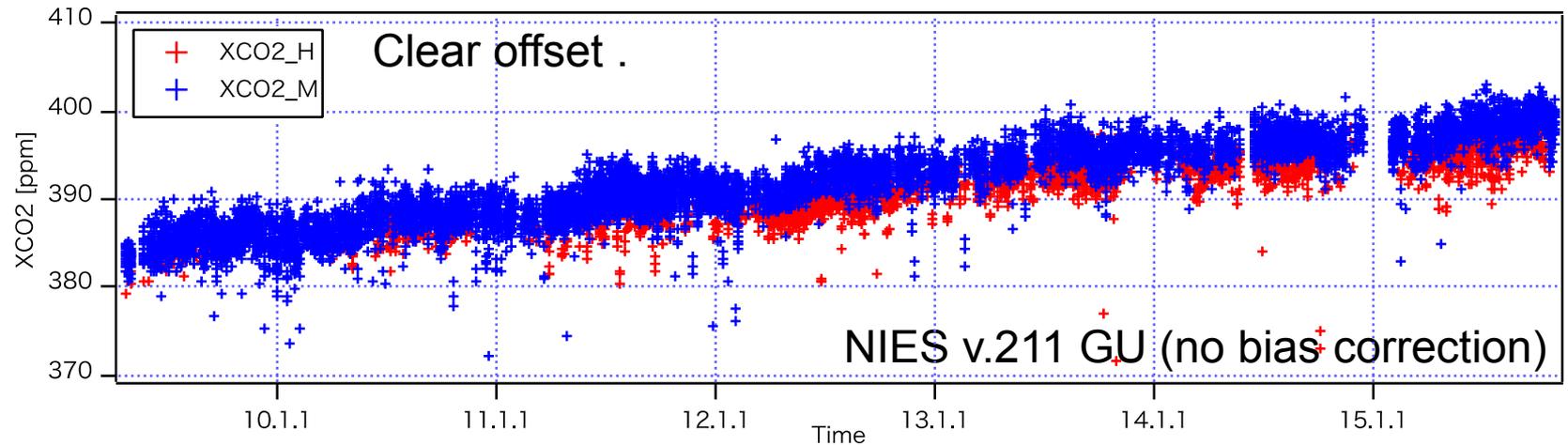
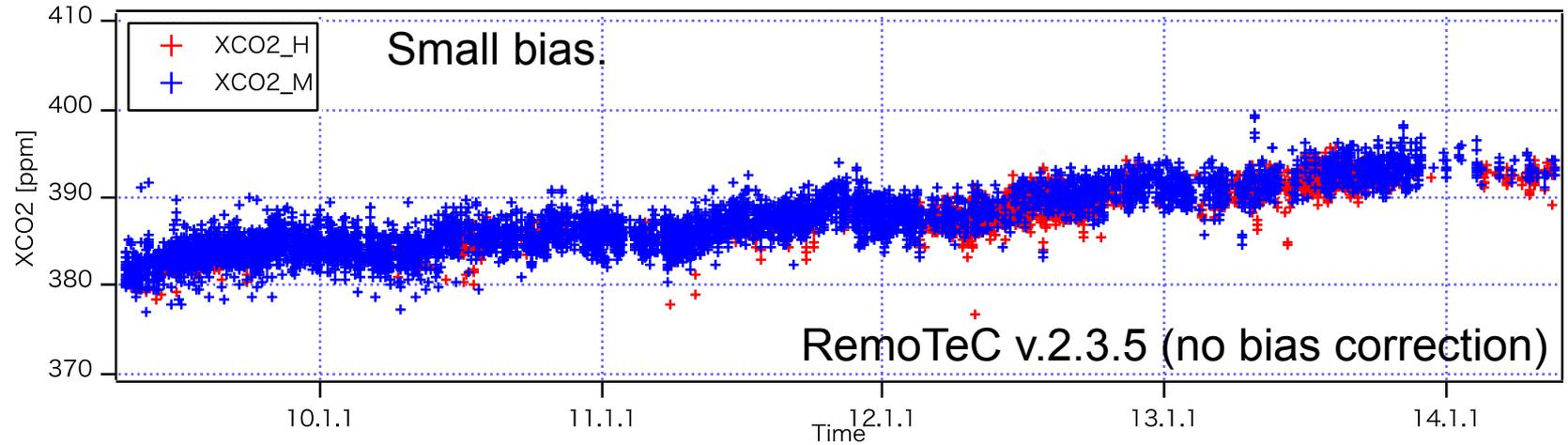


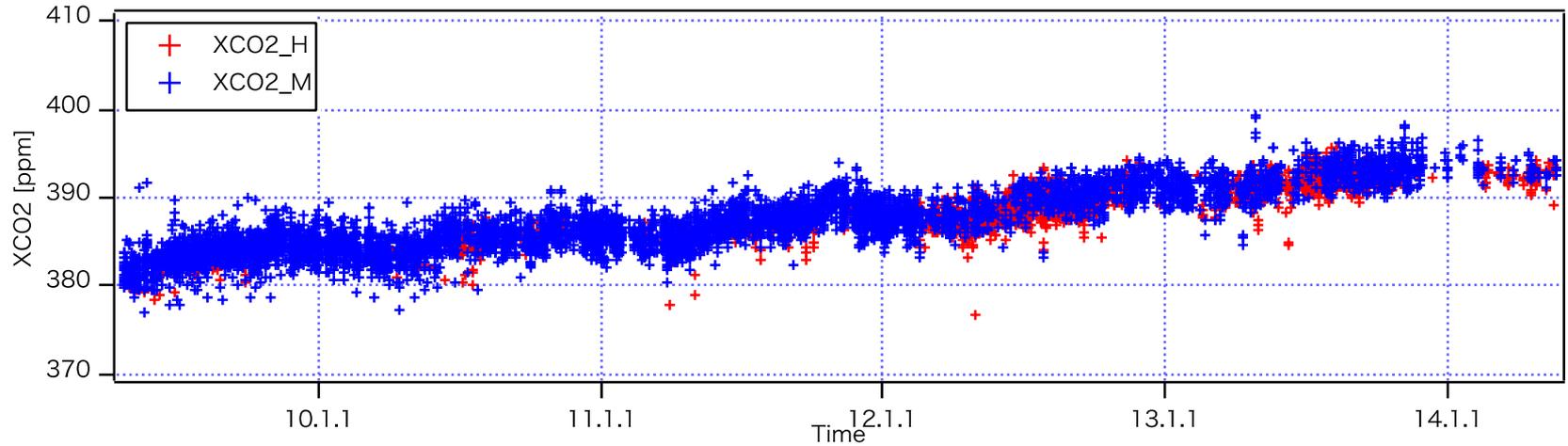
ACOS B3.5 with v160





NIES & RemoTeC with v160





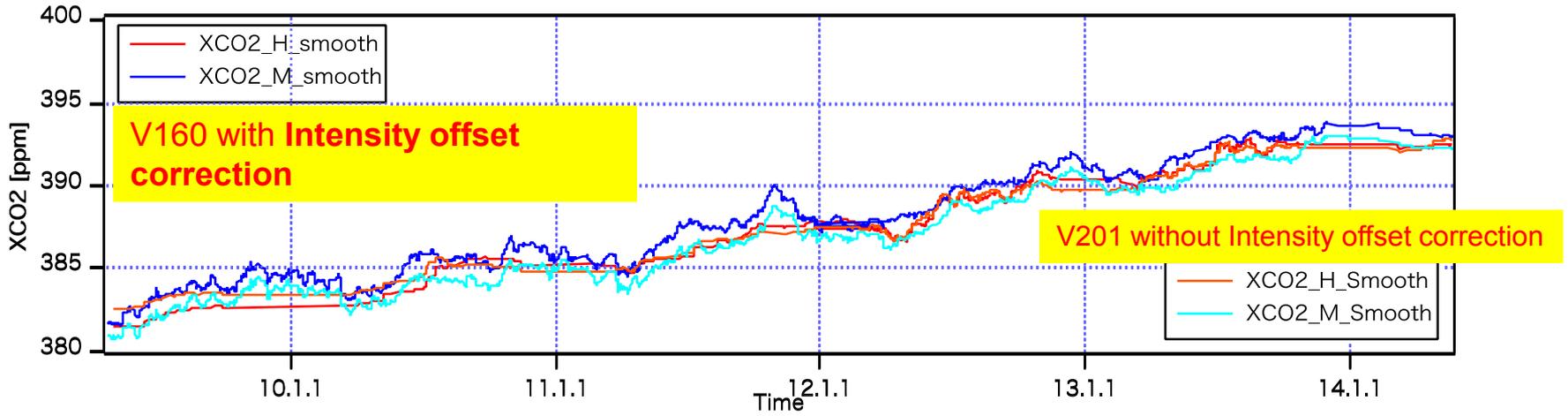
Limited v201 dataset were proceed with RemoTeC, to validate v201 products.

RemoTeC v.2.3.5

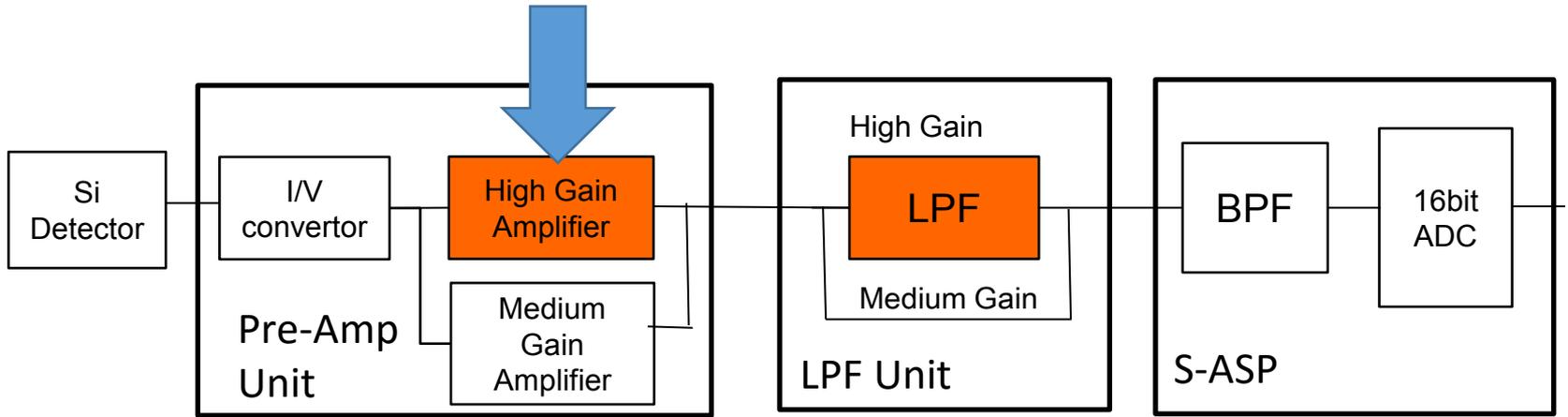
No bias correction is applied.



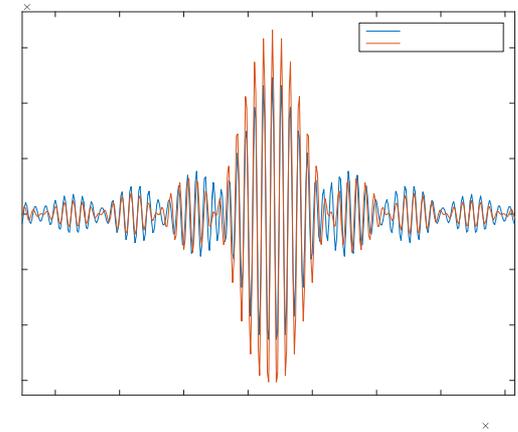
V160 vs v201 with RemoTeC



The difference was reduced with v201.
No bias correction is needed.



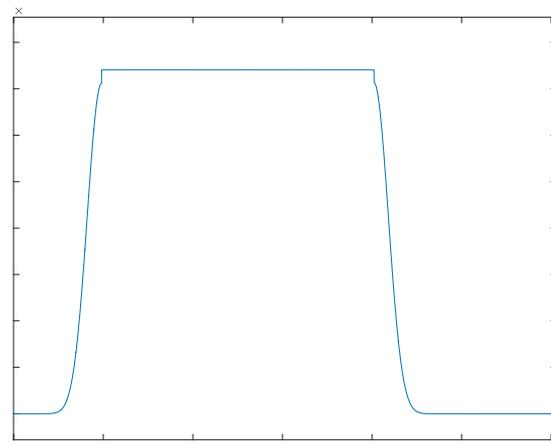
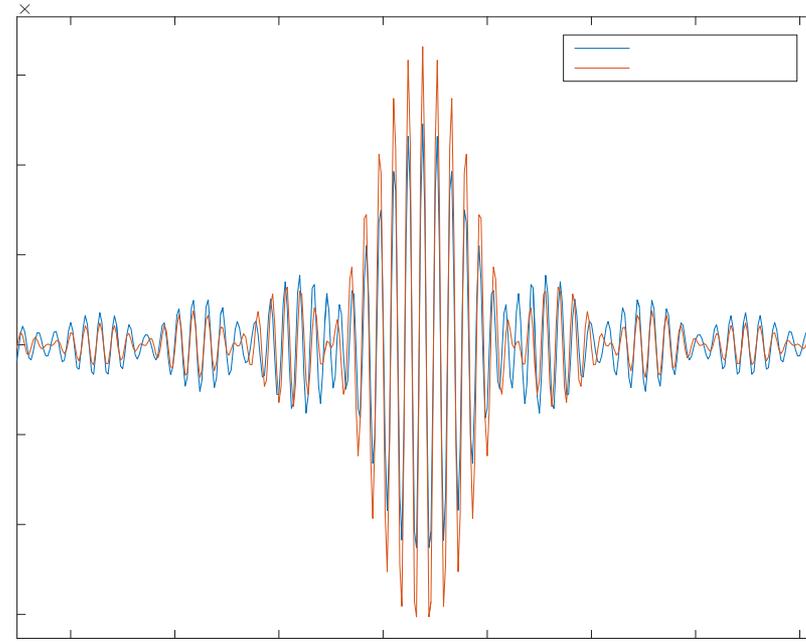
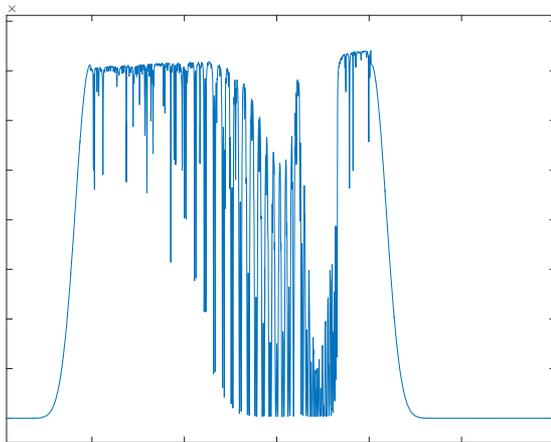
- Band 1 has complicated analogue circuits.
- Not only ADC but also preamplifier have saturation possibility.
- The latter one difficult to detect.
- Quality flag should be modified.



1. XCO₂ based on H/M gain of GOSAT is compared over central Australia.
2. XCO₂ based on v201 is consistent between H/M at least with RemoTeC.
3. No offset is not needed (To be confirmed).
4. In the case of thick cloud or bright target with high gain (rare), saturation flag must be modified.
5. After ACOS and NIES new L2 with V201 become available, comparison will be updated.



Case of high radiance scene

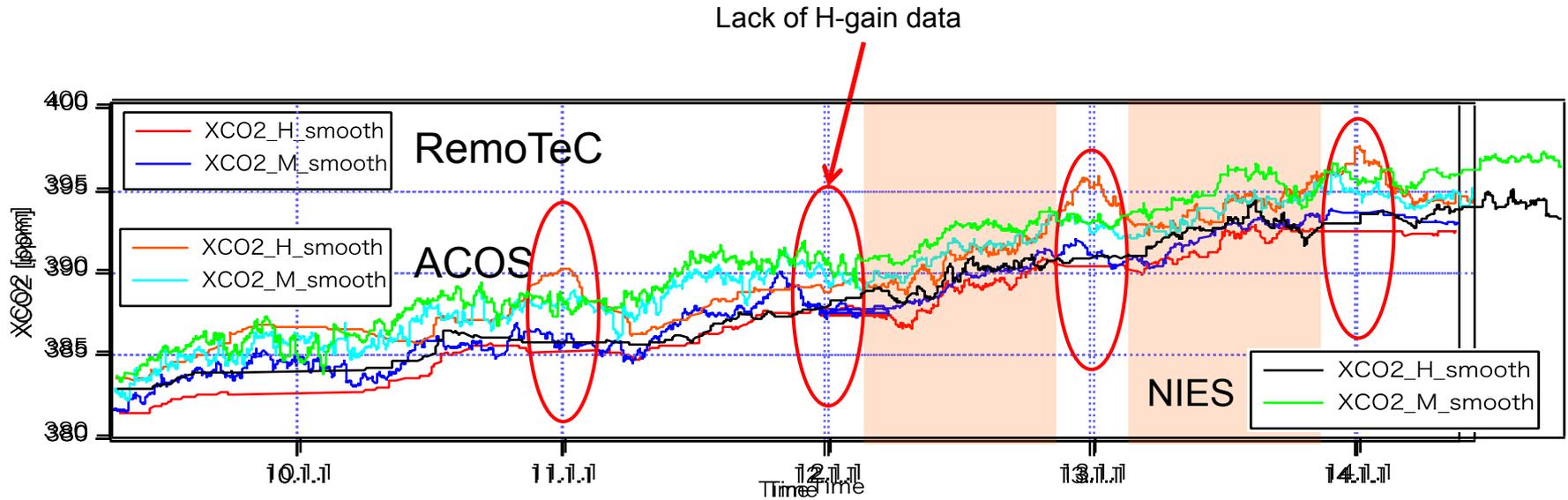


Also, cloud contamination case, the weak absorption might be observed.

In this case, the peak intensity of interferogram will be increased around 1 to 1.5 times than nominal case.

It also assists the non-linear behavior of pre-amplifier.

Comparison between products



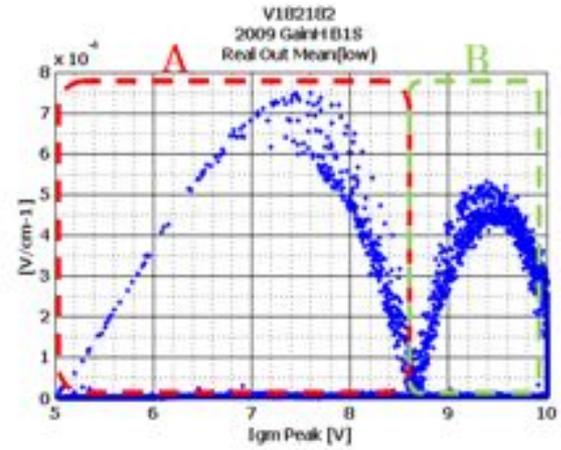
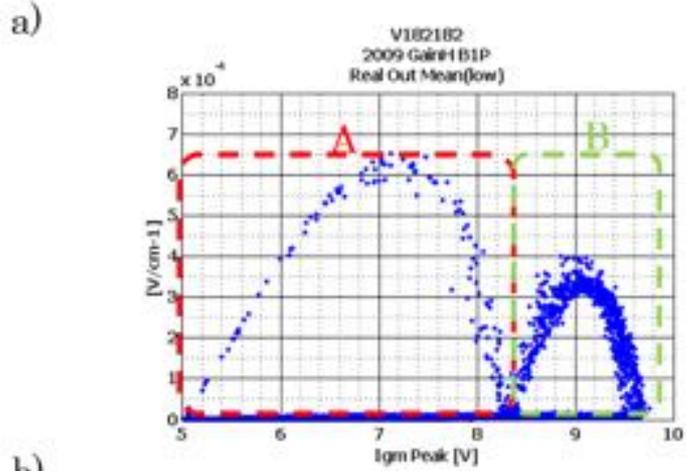
M-gain data of ACOS B3.5 and RemoTeC have similar trend.

In contrast, the trend of H-gain is different, especially in Summer season.

Since 2012/02, the periodical observation with H/M was applied.

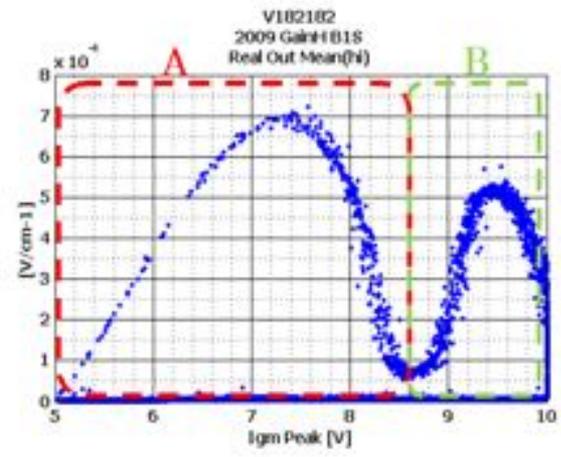
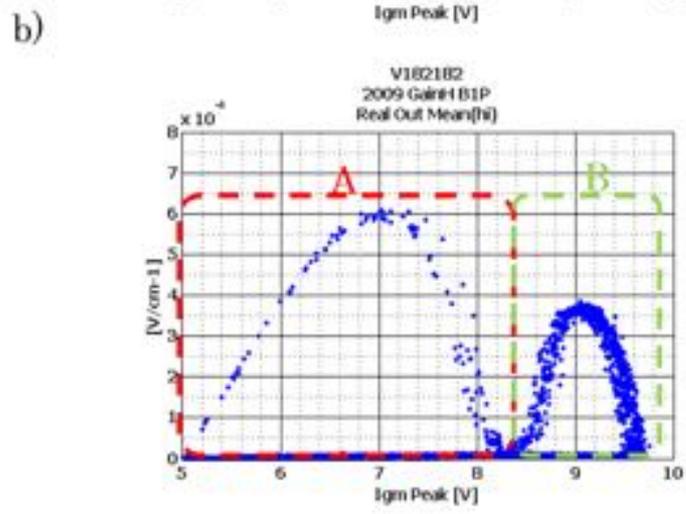
Both ACOS and RemoTeC of H-gain data have small offset against M-gain data.

Case of high radiance scene



Kink is known issue.

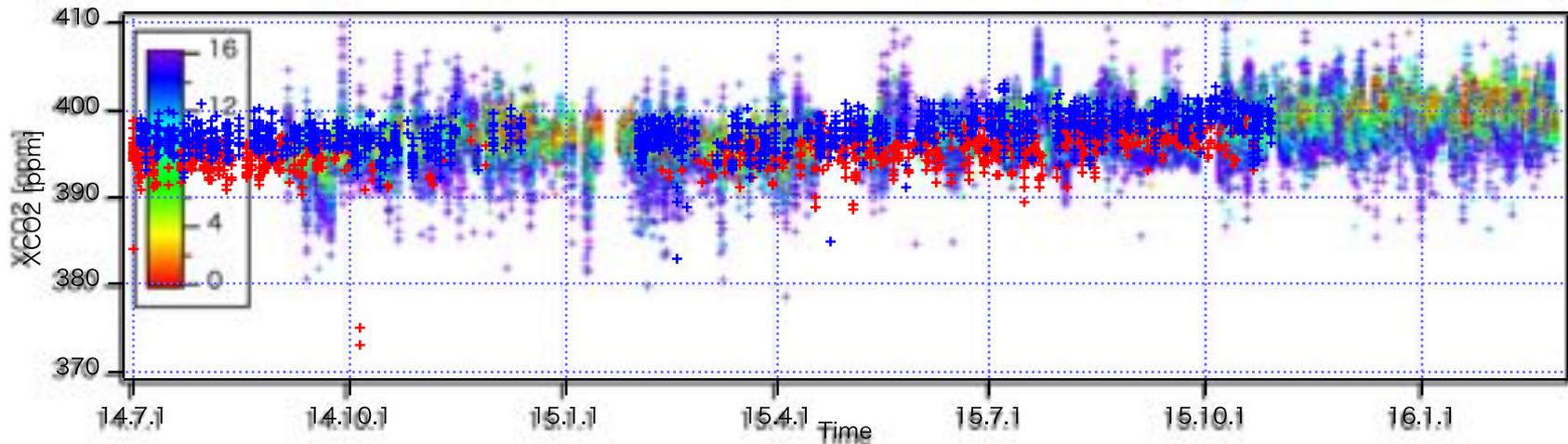
In parallel, the feature of anomalous out-band intensities are observed without scene selection.



These signals are strongly related with the saturation and phase delay at first amplifier.

The investigation is on going.

The out-band intensities without scene selection



Since 2014/09, OCO-2 v7r data is available.

NIES v2 is only ready for comparison this time frame.

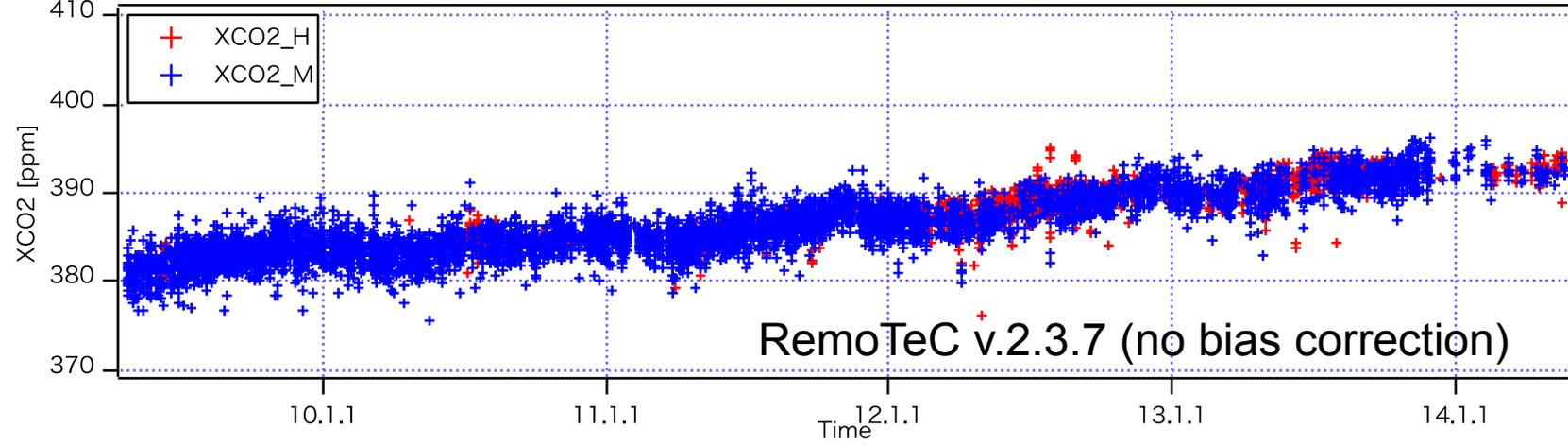
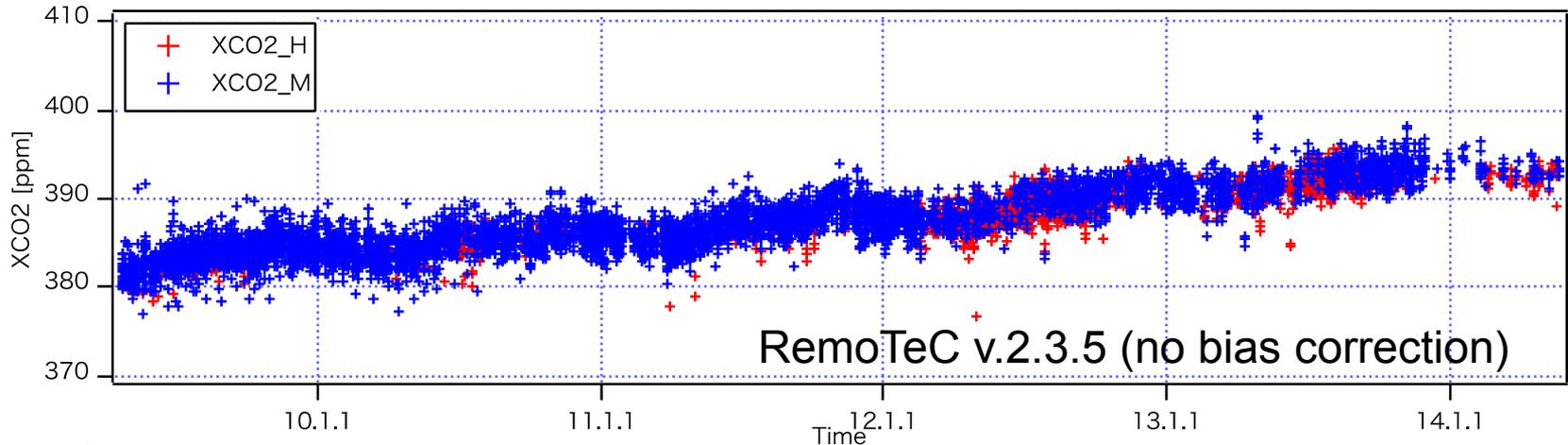
XCO₂ based on H-gain data is quite similar with OCO₂ product.

However, M-gain based XCO₂ have bias.

RemoTeC suggests us if v201 will be applied, the consistency between H & M and NIES & RemoTec will improve.



Improvement with v201



Limited v201 dataset were retrieved with RemoTeC, to validate v201 products.