Proposal for TA Bias Correction Using Deflection Ratios

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• Problem: freely forcing radiometer calibration bias to $<dTA> = 0$ could mask geophysical modeling errors

• Objective: constrain bias correction to instrument behavior

• Approach and algorithm
  • Extrapolation in time and ops concept
  • Comparison to V1.2
  • Convergence of model parameters
75 Days of TA Bias Drift

Blue = $dTA(V1.1)$ 7-day smoothed

UTC Day

$dTA \ (K)$

Beam 1, Chan 1

Beam 2, Chan 1

Beam 3, Chan 1

Beam 1, Chan 4

Beam 2, Chan 4

Beam 3, Chan 4

V-pol

H-pol

Aquarius Cal/Val WG
Approach

• Near term: Use deflection ratios (DR’s) of
  – Internal noise diode (ND) counts
  – External correlated noise diode (CND) counts
• Fit linear combination of deflection ratios to \( <dTA> \) (L2V1.1)
• Extrapolate fit in time until \( <dTA'> \) (L2V1.3) exceeds threshold
• Refit data and continue with previous step

• Caveats:
  – Indirect handling of instrument physics
  – Offset bias correction only

• Long term plan:
  – Separate \( <dTA> \) into gain and offset bias terms
  – Parameterize RF model coefficients instead of fitting DR’s
  – Utilize same extrapolation/threshold/refit algorithm
75 Days of Deflection Ratios

Blue = ND(DL)/CND
Green = ND(ANT)/ND(DL)
Current Fitting Algorithm

- Compute daily means of orbital medians
  - ND(ANT)/ND(DL)
  - CND/ND(DL)
- Compute daily mean of \( dTA = (TA - TA_{exp}) \) for 99.9% ocean
- LMMSE fit to \( dTA \) (using pseudoinverse)
  - \( c_0 \) – offset term
  - \( c_1 \) – weighting of \( ND(DL)/CND \)
  - \( c_2 \) – weighting of \( 10 \times \left[ ND(DL)/ND(ANT) - 1 \right] \)

- Notes
  - Orbital medians used to filter RFI
  - ND(DL)/CND and ND(DL)/ND(ANT) have positive correlation to \( dTA \)
  - Offset in ND(DL)/CND causes \( c_0 \) and \( c_1 \) to be anticorrelated
  - Offset and scaling ND(DL)/ND(ANT) to make \( c_2 \) similar range to \( c_0, c_1 \)
Blue = $d\Delta A$
Green = $d\Delta A$ estimated by projection of DR signatures onto $d\Delta A$
Black = residual difference

75 Days of LMMSE Fitting

UTC Day

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Ability to Extrapolate

- If dTA caused by hardware problem (and can be modeled using DR’s), then should be able to extrapolate dTA correction in time

- Implementation concept for V1.3
  - Initialize \([c_0,c_1,c_2]\) with all available data at beginning of V1.3
  - Monitor dTA(V1.3) and wait until exceeds threshold
  - When exceeds, recompute \([c_0,c_1,c_2]\) with all available data

- Questions
  - What is threshold?
  - Compute and compare 7-day dTA?
Blue = \(dTA\)
Green = \(dTA\) estimated by projection of DR signatures onto \(dTA\)
Black = error in fitted \(dTA\)
Red = error in predicted \(dTA\)
Blue = dTA
Green = dTA estimated by projection of DR signatures onto dTA
Black = error in fitted dTA
Red = error in predicted dTA
Blue = dTA
Green = dTA estimated by projection of DR signatures onto dTA
Black = error in fitted dTA
Red = error in predicted dTA
Blue = dTA
Green = dTA estimated by projection of DR signatures onto dTA
Black = residual difference

UTC Day

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12/11/17
Comparison to V1.2

Blue = dTA V1.1
Green = dTA estimated by projection of DR signatures onto dTA V1.1
Black = error in fitted dTA V1.1 using all data
Red = dTA V1.2 (7-day smoothed)
Model coefficients converged within ~ 40 days
(Rad 3V is exception with c2 flipping signs)
Offset (c0) and CND/ND (c1) are anticorrelated
• Model fit RMSE slowly increasing with time
• Extrapolation RMSE < 0.15 K for >20 days of fitted data
• (Rad 3V is exception with c2 flipping signs)

Days of fitted data
Convergence – 3

Model coefficients

75 days->

Extrapolation error

Interpolation error

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