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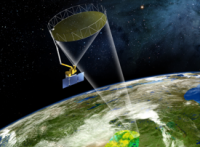

Soil Moisture Active/Passive (SMAP) L-band Microwave Radiometer Post-Launch Calibration Upgrade

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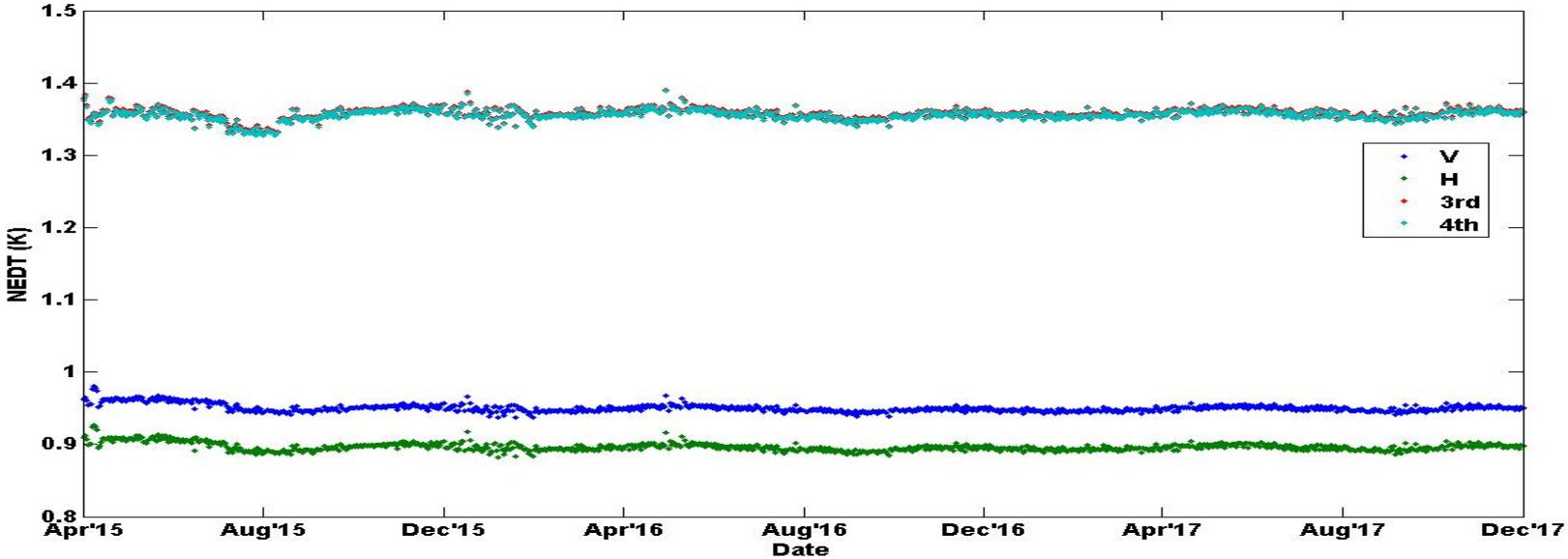
Outline

- Current Status
  - Performance
  - Existing problems
- Calibration algorithm Upgrades for Next Release
  - Algorithm
  - Performance
  - Validation
- Conclusion

Current Performance

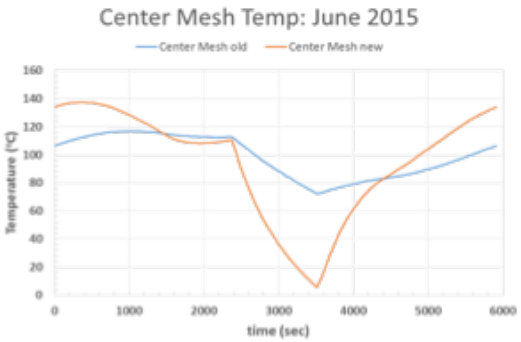
- Radiometer status is stable
  - L1B_TB Version 3 released in April 2016
  - Satisfy science requirements with margin
- NEDT is stable
  - Daily average include all qualified data

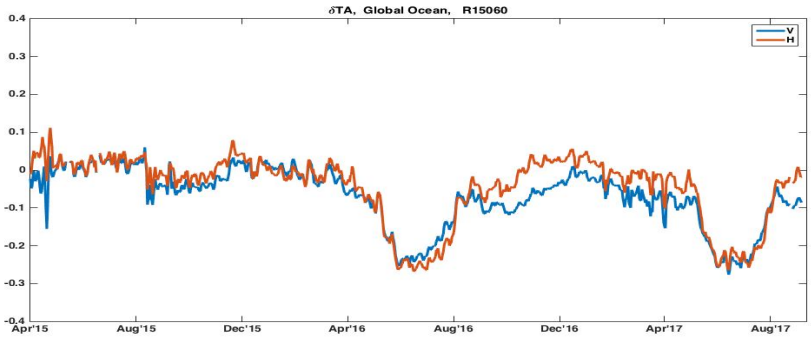
Metric	Allocation	Measured
Ocean Model RMSD (incl. NEDT)	1.4 K	1.2 K
NEDT (land)	1.6 K	1.2 K
NEDT (ocean)	1.1 K	0.95 K
Monthly Drift	0.4 K	+0.1/-0.25

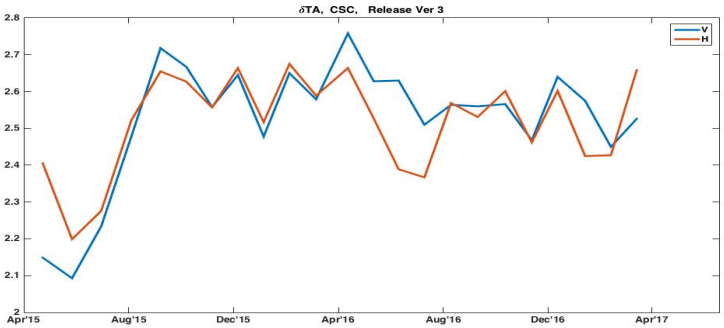


Existing Problems

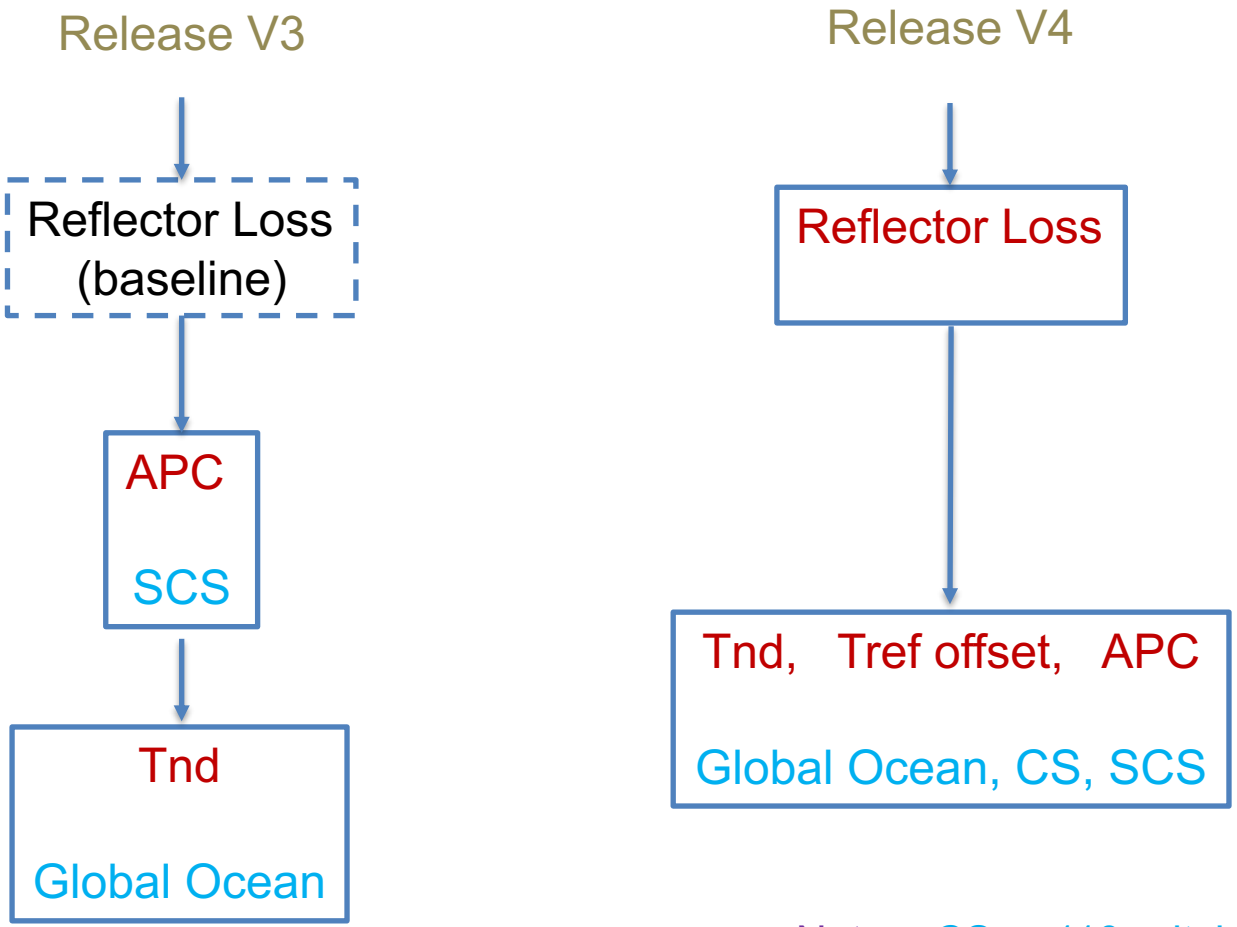
- Reflector thermal model update
  - Reflector loss reset to baseline value
  - Drift during eclipse season
- Bias over CS
  - Change with SAR on/off







Calibration Algorithm Upgrade



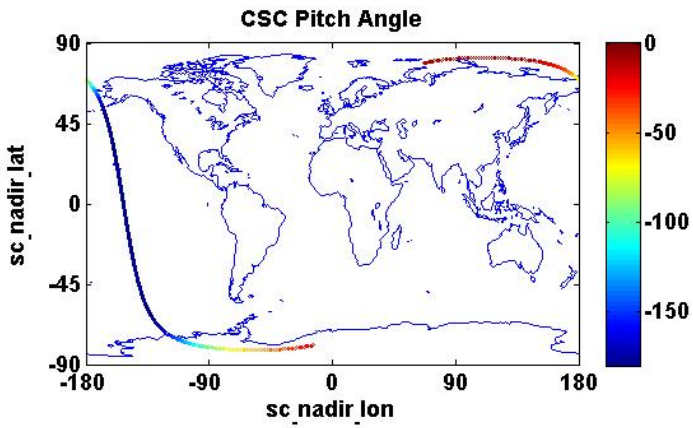
Note: CS: 110° pitch
SCS: 180° pitch

Reflector Calibration

- Excess Emissivity for Reflector/Radome derived by 3 independent groups

	Pol	JPL	GSFC	RSS	Baseline
Reflector	H	1.014	1.016	1.01	1.0026
	V	1.012	1.012	1.01	1.0023
Radome	H	NA	1.0023	NA	1.0003
	V	NA	1.0017	NA	1.0003

- Verified by a half-orbit SCS (180° pitch angle) during eclipse 2017



Tnd, Tref Offset & APC Calibration

- Joint-calibration in general
- Divided into 3 segments
  - Segment 1: Jul 07, 2015 ~
    - Global ocean, CS (110° pitch), SCS (180 ° pitch) during non-eclipse season
    - Constant Tnd & Tref offset
    - Constant APC for all phases
  - Segment 2: 03/31~04/03, 04/14~07/07, 2015
    - Global ocean, CS (110° pitch)
    - Dynamic Tnd & Tref offset
  - Segment 3: Apr 03~13, 2015
    - Global ocean, Amazon
      - Same Amazon emissivity in April 2015
    - Constant Tnd & Tref offset

Calibration Model

- Model

$$C_r \delta T_{ND} + \delta T_{ref} = \frac{1}{L_{RF}} (-\delta T_A + S\delta G)$$

where $C_r = \frac{C_{ant} - C_{ref}}{C_{nd}}$

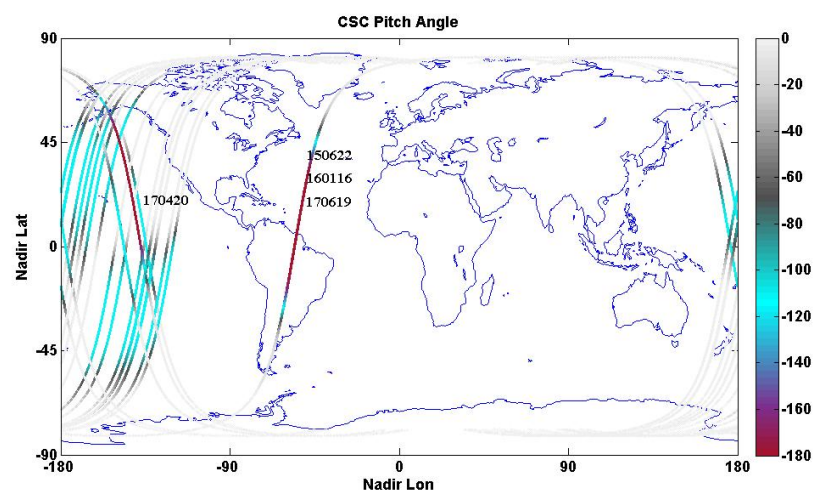
L_{RF}: loss of the radiometer RF front-end

S: δT_A sensitivity to antenna gain uncertainty

δG: antenna gain uncertainty

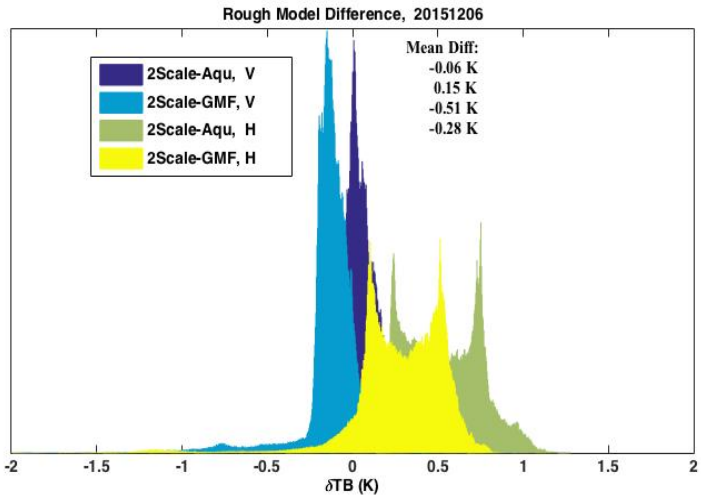
δT_A: = measured TA - modeled TA

- Data for Calibration
  - Non-eclipse
  - Global ocean, CS, and SCS

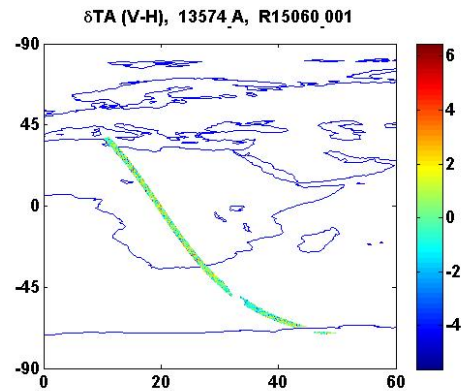


Expected TA Adjustment

- TB changes vs Ver 3 without adjustment
  - Land TB increment: 2.90 K (V), 5.01 K (H)
  - Amazon TB difference (V-H): -0.68 K
- Bias need to be added to expected TAh for external cal targets
  - Three ocean roughness models compared
    - GMF
    - Aquarius
    - 2-scale roughness model
- Nadir looking maneuver performed
  - Bias for H-pol determined



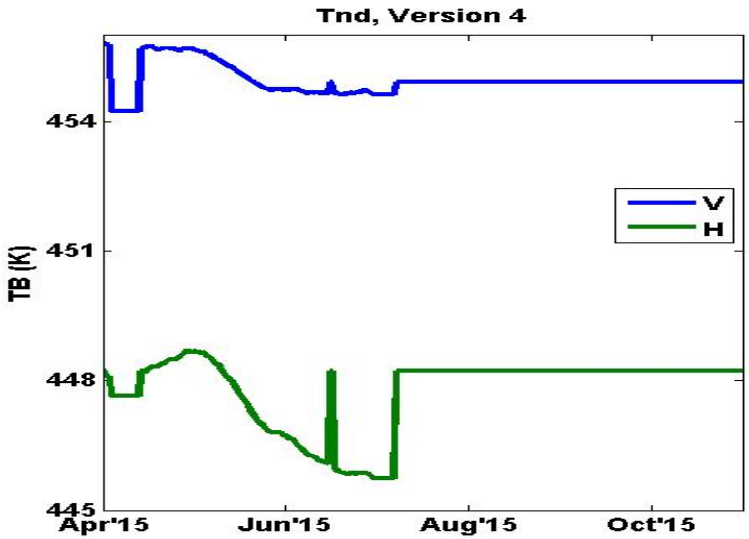
Nadir-Looking Result

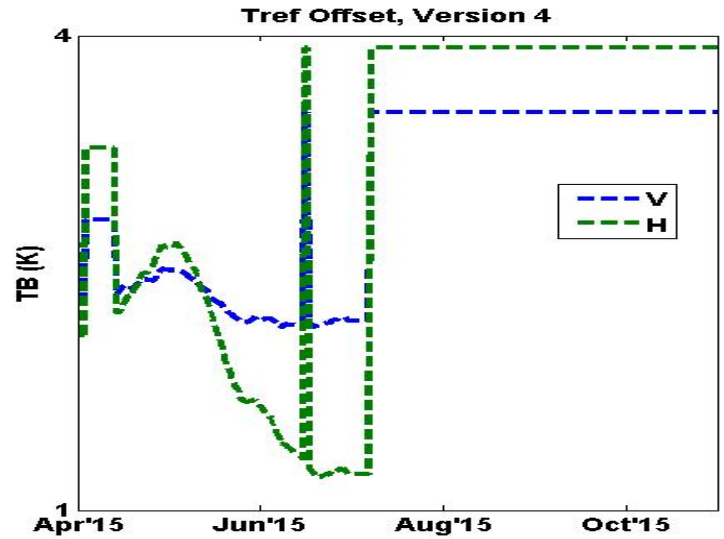


- Biases for TAexp_h
  - -0.25 K for CS
  - -0.65 K for GO
- Validation
  - Apply these biases to generate new calibration coefficients for V4
  - Apply new calibration coefficients to TA measurement & simulation
  - δTAs for nadir looking: 0.00 K over ocean and land, respectively.

Calibration Coefficients

- For data release V4

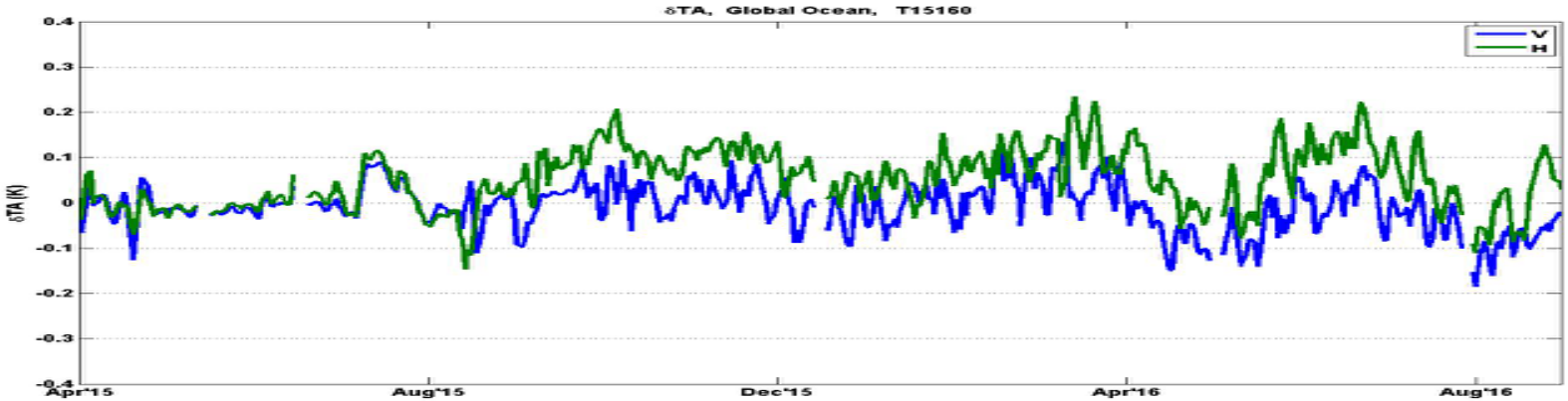


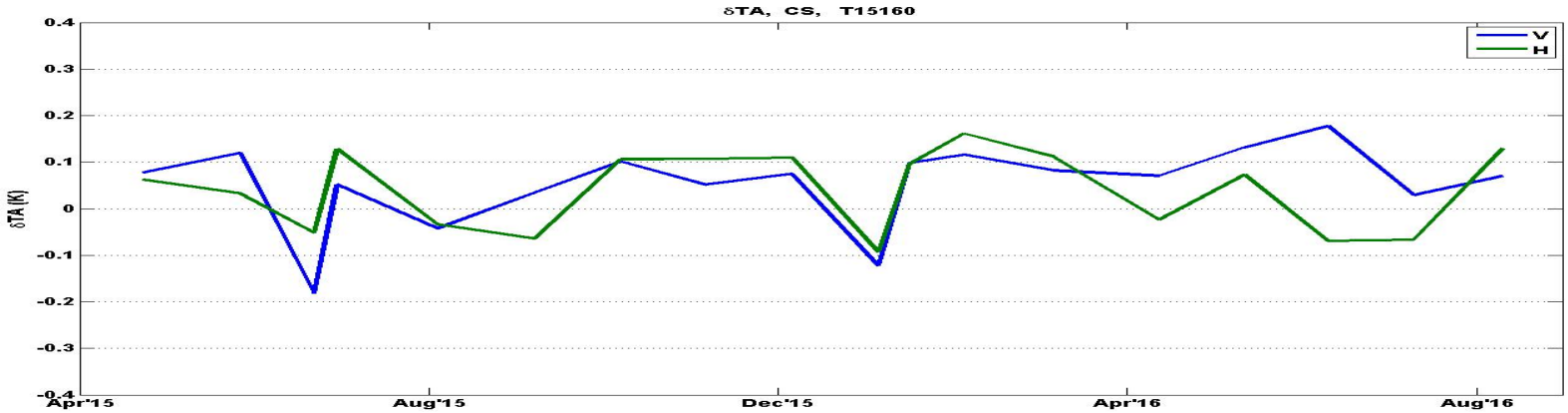


	δG
V-pol	-0.23%
H-pol	-0.46%

Calibration Drift over Global Ocean

- RMSD over global ocean: 0.06 K (V) 0.10 K (H)
- RMSD over CS: < 0.10 K





TA/TB Difference over Amazon

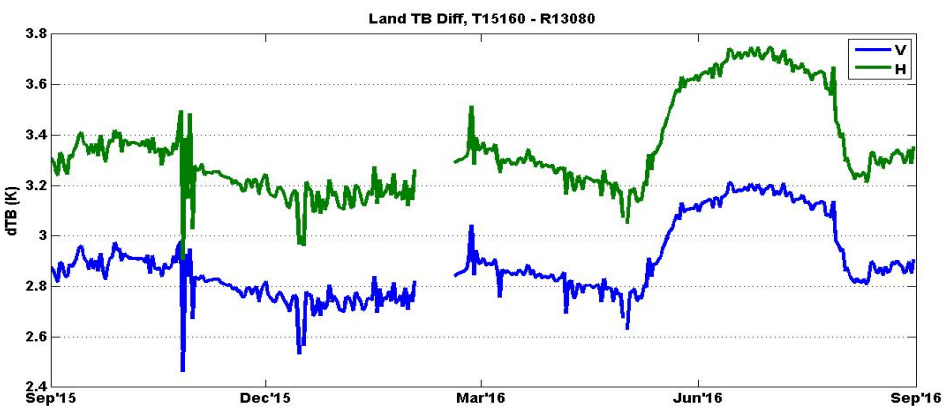
- TAv-TAh: 2.1 K
- TBv-TBh: 1.9 K

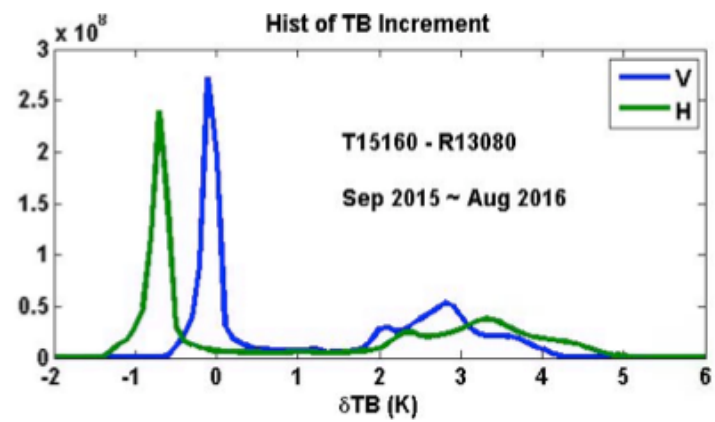
Land TB Increment (V4 – V3)

- Tested using T15160 (Version 4, Sep 2015 ~ Aug 2016)
- Compared to R13080 (Version 3)

	Estimated*	Actual	Actual |lat|<45
V	2.90 K	2.87 K	3.43 K
H	3.20 K	3.32 K	3.96 K

* Based on using CS, SCS and GO. Additional CS and GO adjustment for H-pol.





Conclusion

- SMAP radiometer are calibrated using upgraded calibration algorithm
  - Biases are added to modeled TAh for global ocean and CS based on nadir-looking analysis
- Problems in V3 have been solved
  - Cal coefficients have been tested
  - Cal coefficients have been validated by using nadir-looking data.
- Land TB increment (V4 – V3)
  - 2.87 K (V), 3.32 K (H)
- Amazon TA/TB difference (V4)
  - 2.1 K for TA
  - 1.9 K for TB