SMAP Microwave Radiometer Calibration Revisit Approaches and Performance

Soil Moisture Active Passive Mission (SMAP)

IGARSS 2020
Virtual Meeting
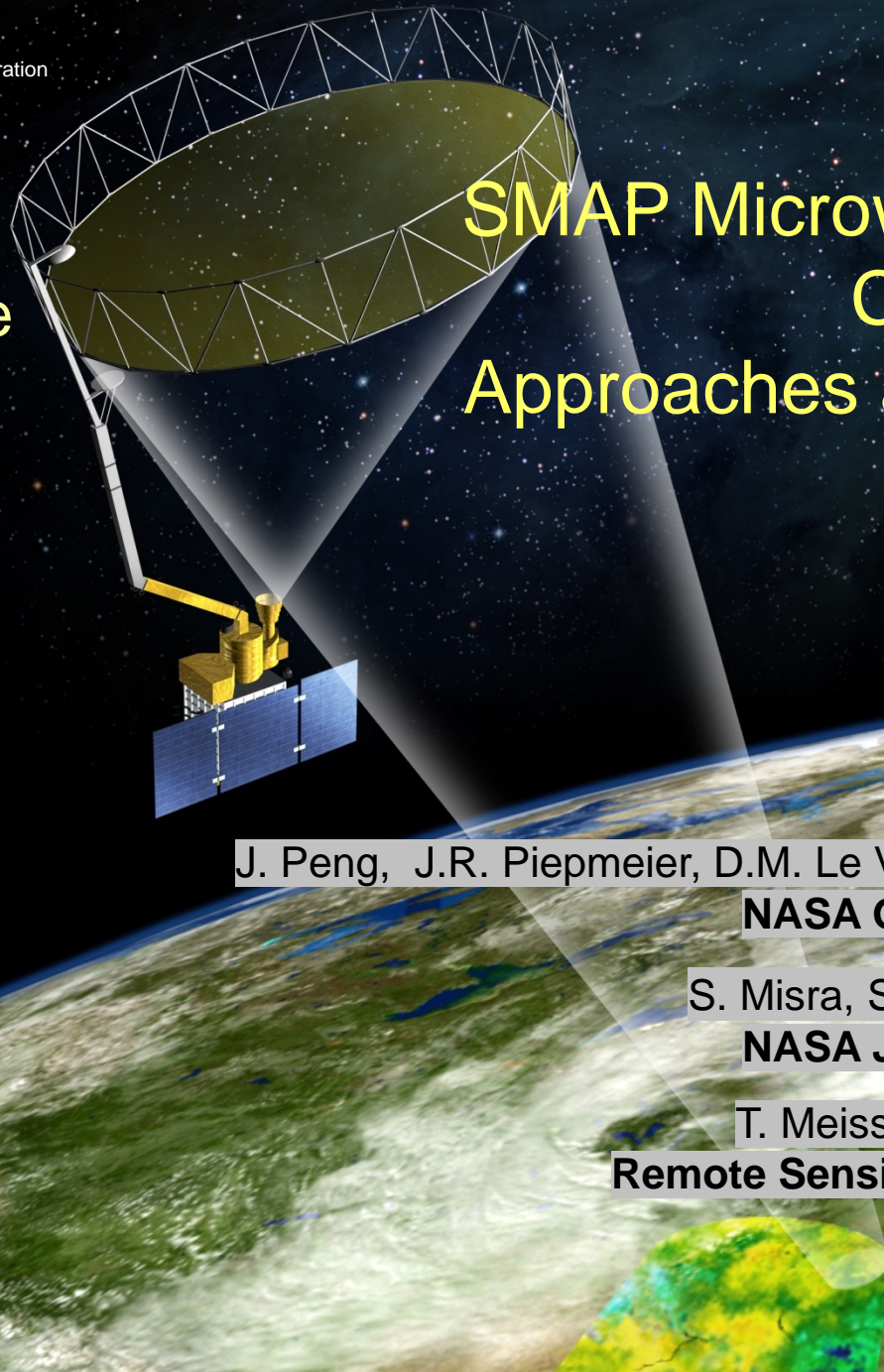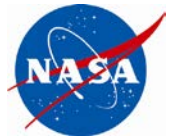
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Current Performances

- Calibration drift in Ver 4
    - Over global ocean & Cold Sky (CS)
        - ❑ Long-term cal drift: ≤ 0.035 K/year (requirement ≤0.4 K/month)
            (Note: Dips over CS during eclipse seasons 2017/2018 excluded)

- Existing problems in Ver 4
    - Dips in the calibration drift over CS during eclipse season in 2017/2018
        - ❑ Not in 2015 & 2016
    - Ascending / descending difference in the calibration drift over the global ocean during eclipse seasons (all years)
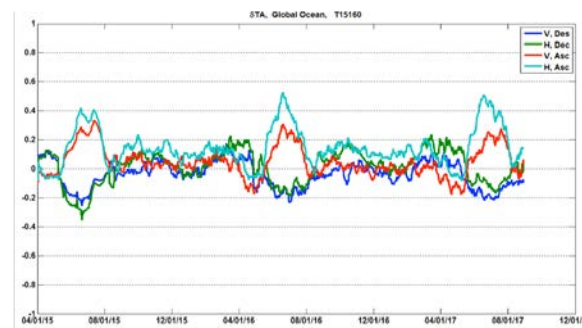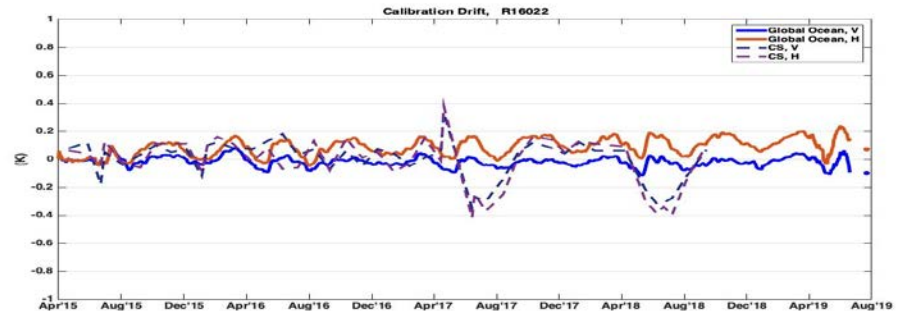
ReVisit Approaches

- Approaches
  - Concurrently retrieve all calibration parameters
  - Separate ascending and descending data
  - Include more CS data with wider dynamic range of reflector temperature
  - Two options with different hot calibration targets
    - ❑ Global Ocean (GO), used by the latest post-calibration
      - ➤ Unknown bias
    - ❑ Radiometer internal Reference Load (RL)

CS: Cold Sky maneuver with 110° pitch
SCS: Cold Sky maneuver with 180° pitch, transition from ocean to Amazon

Reflector Loss, Tnd,
Antenna Pattern Correction
Offset to T_{RL}

Global Ocean, CS, SCS,
Nadir-looking

Option '**CS + GO**'

Reflector Loss,   Tnd
Antenna Pattern Correction

Ref. Load, CS, SCS

Option '**CS + RL**'

- The performances of the two options will be compared and one option will be selected for next data release (Ver 5).

Calibration Results & Performance

- **Results**

Options	T_{ND} adjustment (K)	Refl. Loss adjustment	Ant. Gain adjustment (dB)	Offset to T_{RL} (K)
CS + RL	-2.2 (V) -2.2 (H)	1.004 1.004	-0.004 -0.016	
CS + GO	-0.1 (V) 0.8 (H)	1.007 1.007	-0.006 -0.019	2.8 2.8

- **Performance**
  - Both Cal. Options have almost the same calibration drifts over both CS and GO except bias
    - ❑ Dips' magnitude during eclipse seasons reduced by half in cal drift over CS
    - ❑ Ascending/Descending difference ≤ 0.2 K in cal drift over GO
    - ❑ Bias exists in the cal drift over GO for Option 'CS+RL'
 - TB over land changed by comparing to TBs of previous versions

	CS + RL		CS + GO	
	V	H	V	H
Ver 4	-3.1 K	-2.6 K	0.1 K	0.3 K
SMOS (est.)	-2.2 K	-1.3 K	1.0 K	1.6 K

Note: Options - Ver 4
Options - SMOS Ver 620

L1B_TB Performance of Ver 5

- Science Team choose Option 'CS+RL' for next release
  - Unknown bias in the GMF (ocean TB model) used by SMAP
  - Modeled TB of the reference load has temperature sensor measurement
  - Prefer colder TB over land
- Calibration drift
  - Drift rate over GO & CS: $\leq$ 20 mK /year
  - Uncertainty (std): $\leq$ 0.07 K (GO); $\leq$ 0.11 K (CS);
  - Bias over GO: -1.22 K (V);   -1.05 K (H)
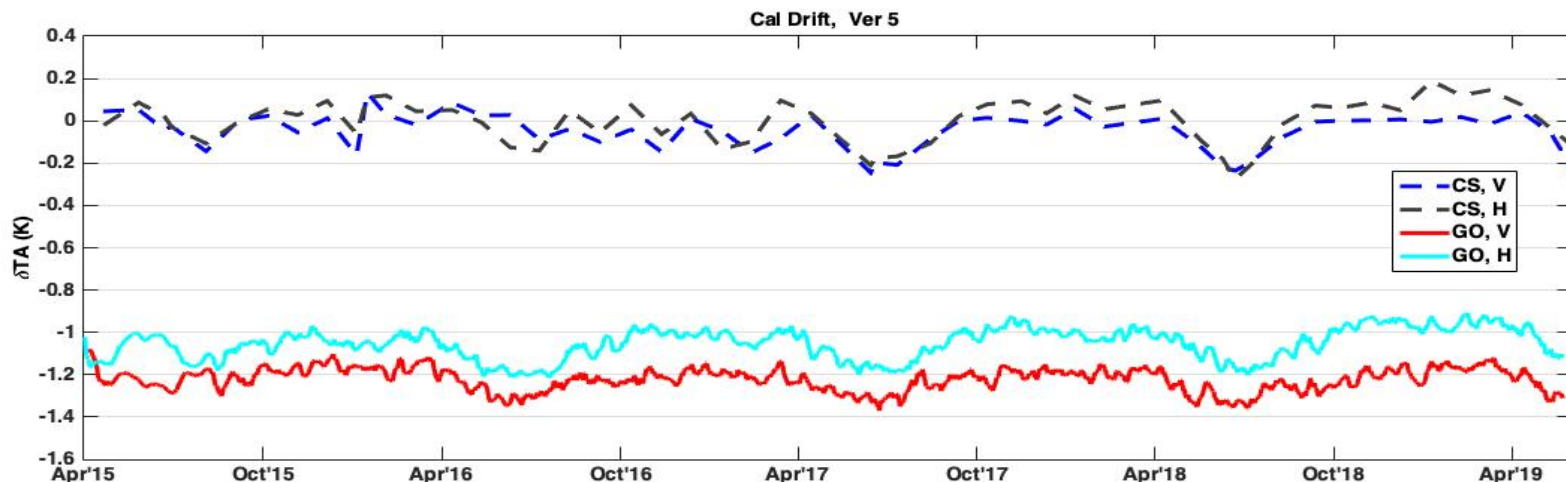
Summary

- Calibration has been revisited with two options compared.
  - Lesson learned: Bias in ocean TB model could be larger than expected
  - Problems in Ver 4 have been resolved or relieved
  - Two options have almost the same calibration drift performance except bias over GO
    - ❑ Different TB over land
- Option 'CS+RL' is selected for next release (Ver 5).
  - Lower TB over land than SMAP Ver 4 (current release) and SMOS Ver 620