Assessing Drift Correction over Antarctica and Amazon

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Objective

• Antarctica reference model serves as a means to assess the radiometer TA calibration stability independent of the ocean model

• Does the exponential gain drift correction remove the observed drift over Antarctica?

• Is there evidence for “calibration wiggles” observed over ocean in Aquarius - Antarctica model differences (or Aquarius - Amazon depolarized model differences)?
  – If yes: then they are due to instrument variability (identify magnitude over ice, warm end -> gain vs offset correction)
  – If no: then they are likely due to residual model errors
  – Not easy (e.g. 0.1K gain “wiggle” would be 0.05K over ice, lesser over Amazon)
Summary

• Exponential drift correction successfully removes observed drift over Antarctica
  – Confirms gain (e.g. noise diode) drift as source

• Calibration wiggles are observed in Antarctic model differences and have the same magnitude as those observed over the ocean

• Calibration wiggles are observed over warm rainforest regions in inter-channel differences and have a similar magnitude as those observed over the ocean
  – Suggests quasi-monthly variability observed in TA-TAexp over ocean is due to TA calibration drift
  – Suggests that correction should be implemented as an offset correction
Antarctic Modeling
(Drift)
Antarctica Ice Model

- Coupled thermodynamic/radiative transfer model
  - MEMLS model (Wiesmann and Matzler, 1999) used to compute upwelling TB
  - Heat transport equation solved for ice $T(z,t)$ profile

- Tuned using multi-frequency AMSR-E TBs and in situ surface temperature data
  - Generated random snow layer structures to find a realization that gave best fit 6-37 GHz V&H-pol TBs
  - Ice dielectric model from Tiuri et al., (1984) gave best fit AMSR-E data

- Currently does not account for short time scale near surface firn variability
  - Limits ability for H-pol, particularly at higher incidence angle
  - Initial results using higher frequency 6-37 GHz observations (e.g. WindSat, AMSR-2) to constrain dynamic snow snow variability shows promise
• Horn 3 V-pol shown here as an example to assess exponential drift correction since ice model performs best near Brewster angle (minimizes sensitivity to surface variability, wind crusts)
• Exponential TND correction removes long term drift over Antarctica
  – Note, if offset correction was applied instead of a gain correction, a ~ +0.5K drift would have been introduced over Antarctica
Aquarius V-pol Horn 3 minus Model over Antarctica

After removing TA-TAexp ocean bias and applying scaled galaxy correction
V-pol Drift Corrected v1.3.5 TB with Model

- All channels in good agreement with model after applying gain drift correction based on ocean TA drift estimates
H-pol Drift Corrected v1.3.5 TB with Model

- H-pol comparisons nosier due to ice surface variations currently not accounted for in model, but no evidence of residual drift
Amazon Modeling
(Wiggles)
Warm Rainforest Regions

- Offset error should be apparent in rainforest comparisons
- Currently, uncertainty in TA over rainforest regions at > 0.1K level on time scales < 30 days mainly due to uncertainty in $T_{\text{canopy}}$, but...

Amazon Region TMI 10 GHz De-polarization

these uncertainties largely cancel if looking at inter-channel differences

$\left( T_V - T_{V_{\text{Expected}}} \right) - \left( T_H - T_{H_{\text{Expected}}} \right)$
Inter-Channel Differences over Rainforest

- Uncertainty in $T_{\text{canopy}}$ largely cancels in V-pol – H-pol difference over the rainforest regions
- Assuming that surface emissivity is stable (and depolarized), then these inter-channel differences allow us to assess relative offsets compared to ocean
Quick Look – Current Wiggle Correction
Horn 3 V-pol Antarctica

V1.3.5 with exponential drift correction

V1.3.7 with exponential drift correction + wiggle offset correction
Inter-Channel Differences over Rainforest

- Uncertainty in $T_{\text{canopy}}$ largely cancels in V-pol – H-pol difference over the rainforest regions.

- Assuming that surface emissivity is stable (and depolarized), then these inter-channel differences allow us to assess relative offsets compared to ocean.

V1.3.5

Horn 1

Horn 2

Horn 3

V1.3.7
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Backup Slides
• Deviation from model in July 2012 appears to be from reflected galaxy
  – Need to scale galactic contribution in L2 file to remove
Surface temperature values obtained from near by AWS station (JASE) used as top boundary condition.

Solved heat equation numerically to determine $T(z,t)$ assuming only vertical heat transport.

Thermal diffusivity increases as a function of density (Paterson, 2000).
Snow structure near top surface contains layers with variable thickness, density and grain size (e.g. Steffen et al., 1999; Macelloni et al., 2006).

- Wind crusts (thin, high density) can be present.
• MEMLS model (Wiesmann and Matzler, 1999) used to compute upwelling TB
  - Started with exponentially increasing density profile and increasing correlation length profile
  - Generated multiple realizations of snow structure by randomly adding layers of varying density, correlation length and thickness to first 20 m
    • Density variations based on measurements found in literature (e.g. Steffen et al., 1999; Paterson, 2000; Macelloni et al., 2007)
    • Correlation length profile based on Matzler (2002)
      - Chose realization that provided best fit to AMSR-E 6.9 – 36.5 GHz V-and H-pol TBs
      - Ice dielectric model from Tiuri et al., (1984) gave best fit AMSR-E data