SMAP Radiometer L1/L2 Cal/Val Overview

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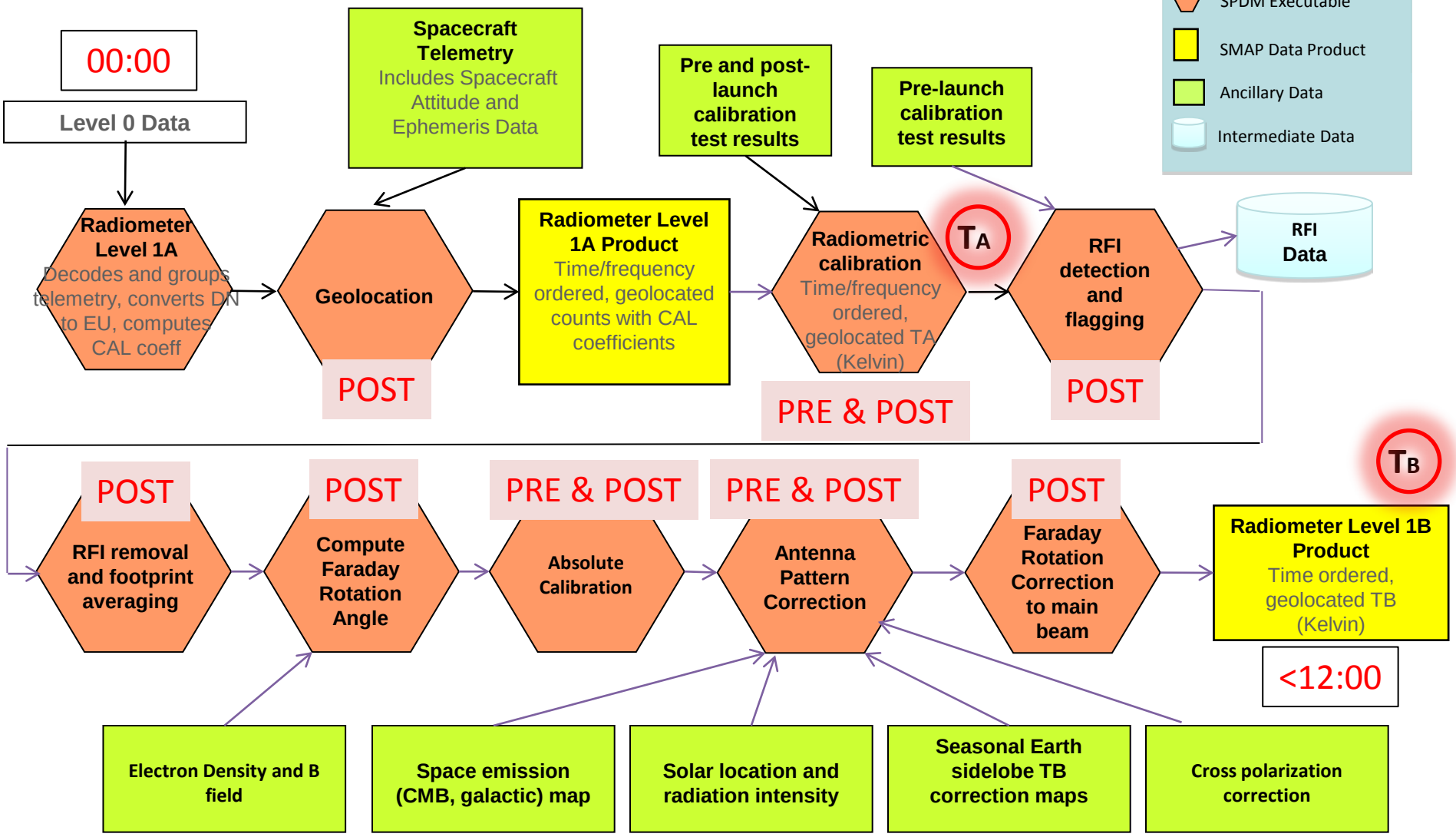
L1 radiometer cal requirements are derived from….

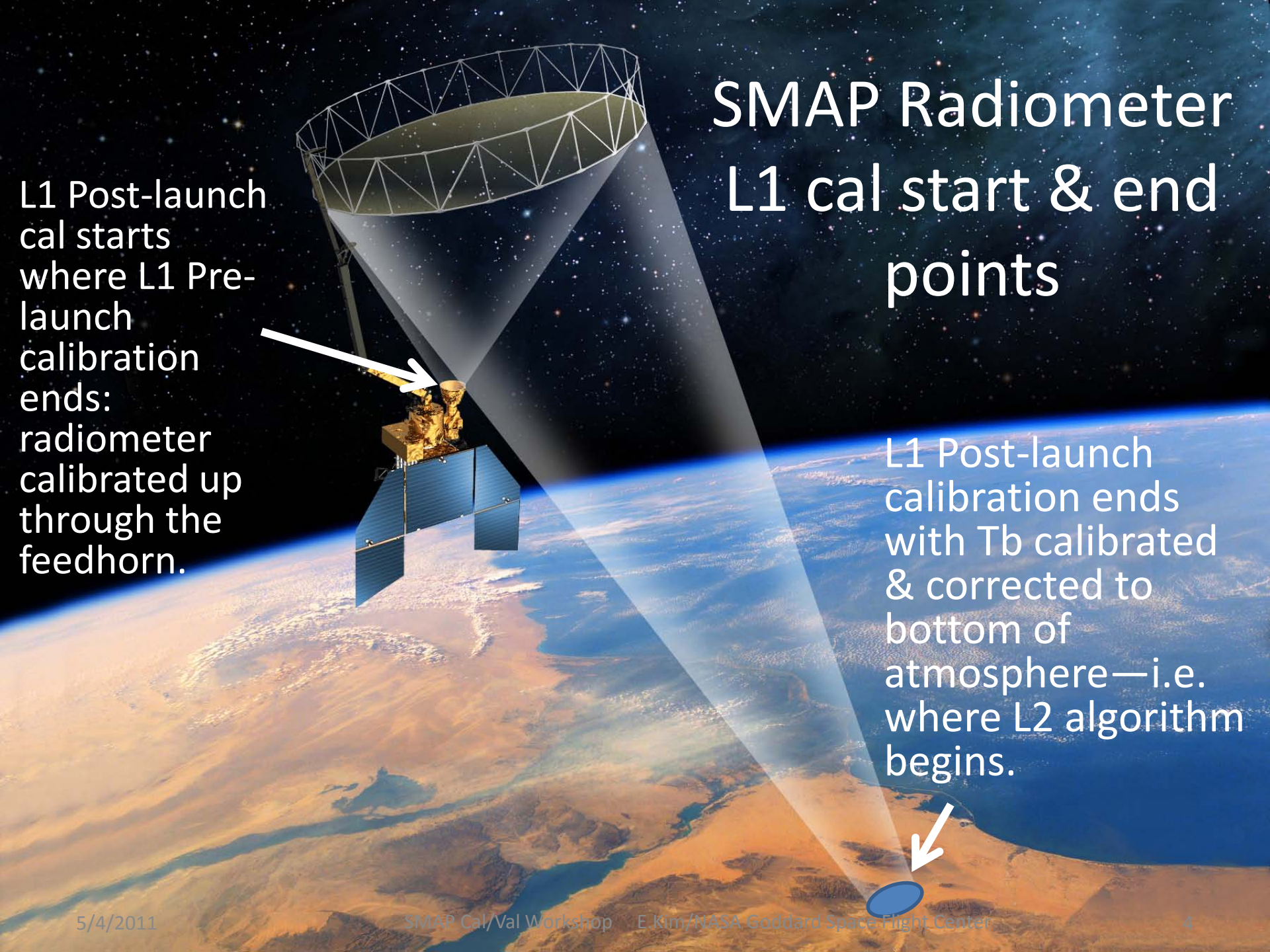
- The L2_SM_P algorithm requires calibrated absolute Tb (L1B's output) as an input parameter. Also, the L2_SM_A/P algorithm fundamentally depends on the passive-only algorithm to retrieve SM (radar is only used for resolution enhancement--aka disaggregation).
- The L3_SM_P and L3_SM_A/P products are composites of the respective L2 SM products, so these L3 products have the same requirement for calibrated absolute Tb as the corresponding L2 products.
- The L1C_TB product is a gridded version of the L1B product, so L1C requires calibrated absolute Tb, too.
- Relevant existing req's: L2-SR-45, L2-SR-388, & others
- **So the following products depend on calibrated absolute Tb's:**
  - **L1B_TB, L1C_TB**
  - **L2_SM_P, L2_SM_A/P**
  - **L3_SM_P, L3_SM_A/P**

Radiometer Level 1A/B Processing Flow

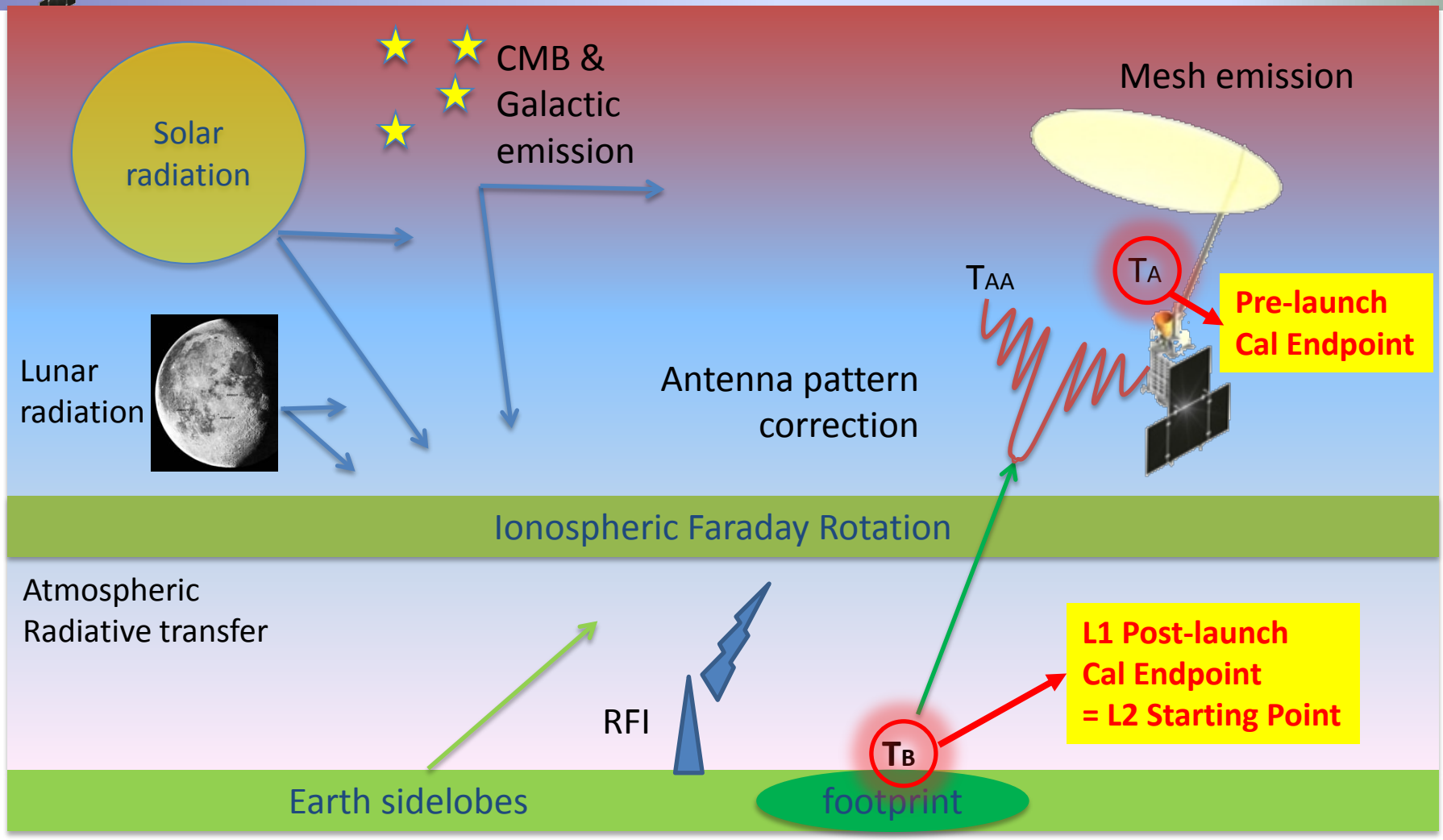
Radiometer L1 *Algorithm* is driven by processing flow L0→L1A→L1B
Radiometer *Calibration* is driven by information source (Pre vs. Post)



SMAP Radiometer L1 cal start & end points



SMAP Radiometer L1 Post-Launch Calibration Effects Considered



SMAP Radiometer L1 Cal/Val-related Top-Level Requirements

- L2-SR-45: Radiometer Grid Measurements shall have an uncertainty (including instrument precision, post-launch calibration error, and RFI-induced error) of 1.3 K or less (1-sigma) in the H and V channels.
  - Spatial & temporal = global, 6-month avg (clarified by SDT in Feb, 2010)

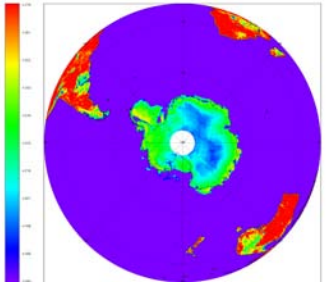
- L2-SR-34: The SMAP radiometer shall measure H, V, and 3rd and 4th Stokes parameter brightness temperatures. [T3 for Faraday Rot., T4 for RFI]

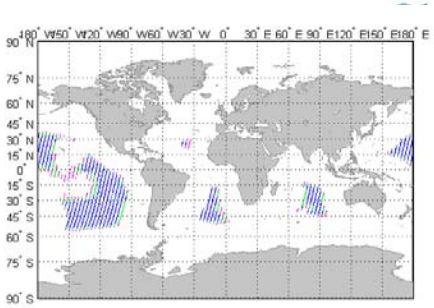
- L2-SR-295: Radiometer Level 1B Processing shall include compensation for effects of antenna sidelobes (outside the radiometer antenna main beam), cross-polarization, Faraday rotation, atmospheric effects (excluding rain), and solar, galactic and cosmic radiation.

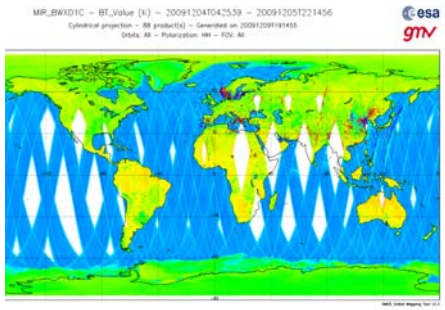
- L2-SR-388: The SMAP project shall conduct a calibration and validation (Cal/Val) program: (a) Pre-launch, to ensure the development of robust science algorithms, and (b) Post-launch, to verify and characterize the accuracies of the delivered science data products

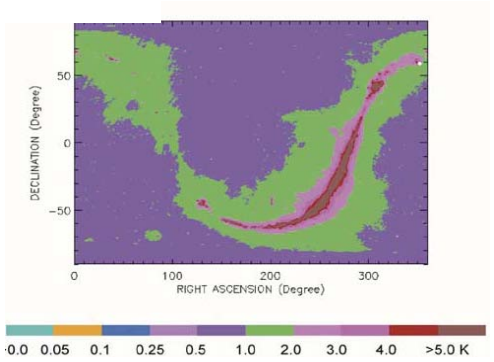
Absolute Tb calibration

- **Why?** To meet needs of multiple SMAP data products
- **Methods**
  - External targets since an on-board beamfilling target is not feasible
  - Use at least 2 views of external targets w/different Tb's (2-point cal)
- **Candidate targets**
  - **Antarctica** (~200K)
    - SMOS work shows promise
    - Near pole→Visible multiple times/day
    - No maneuver or special mode required
    - RFI unlikely
  - **Ocean** (~100K)
    - leverage Aquarius work on same
    - No maneuver or special mode required
    - Absolute Tb cal depends on ocean model accuracy
    - RFI still possible
  - **cold space** (~10K)
    - Requires s/c maneuver; limits how often (monthly)
    - Avoid looking toward celestial source regions
    - RFI unlikely



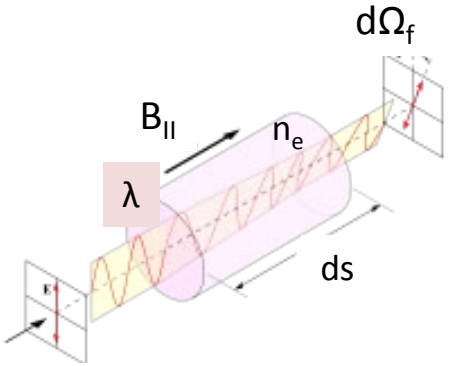




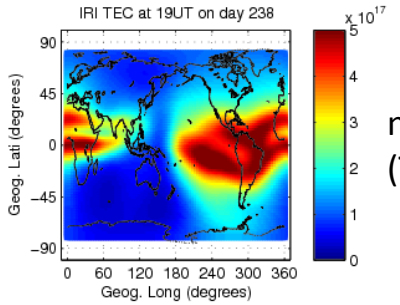


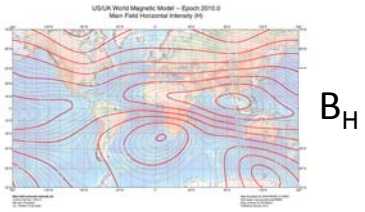
Faraday rotation correction

$\Omega_f = 2.62 \times 10^{-13} \lambda^2 \int n_e B_{ll} ds$



- **Objective**
  - Correct for polarization rotation due to ionosphere
  - relevant to L2-SR-295, L2-SR-45
- **Method**
  - Baseline is same as Aquarius, adapted for SMAP conical scan; leverage Hydros L1B work; check using SMOS
  - n_e from GSFC using International Reference Ionosphere (IRI)
  - B-field from International Geomagnetic Reference Field (IGRF)
  - Compute Faraday rotation & rotate SMAP polarization basis
- **Expected outputs**
  - Corrections to Tb's for APC and absolute Tb cal

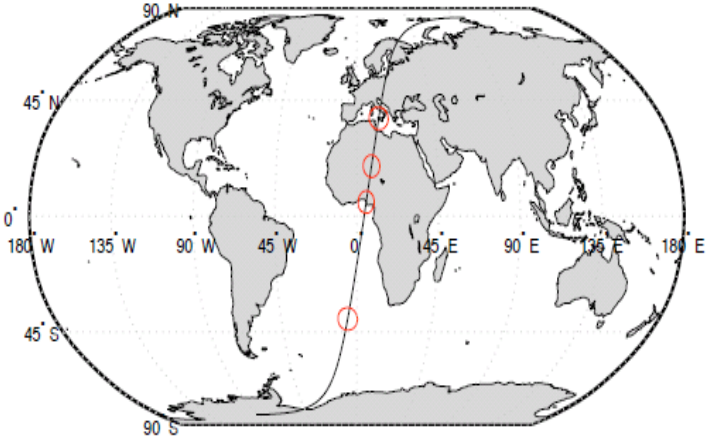


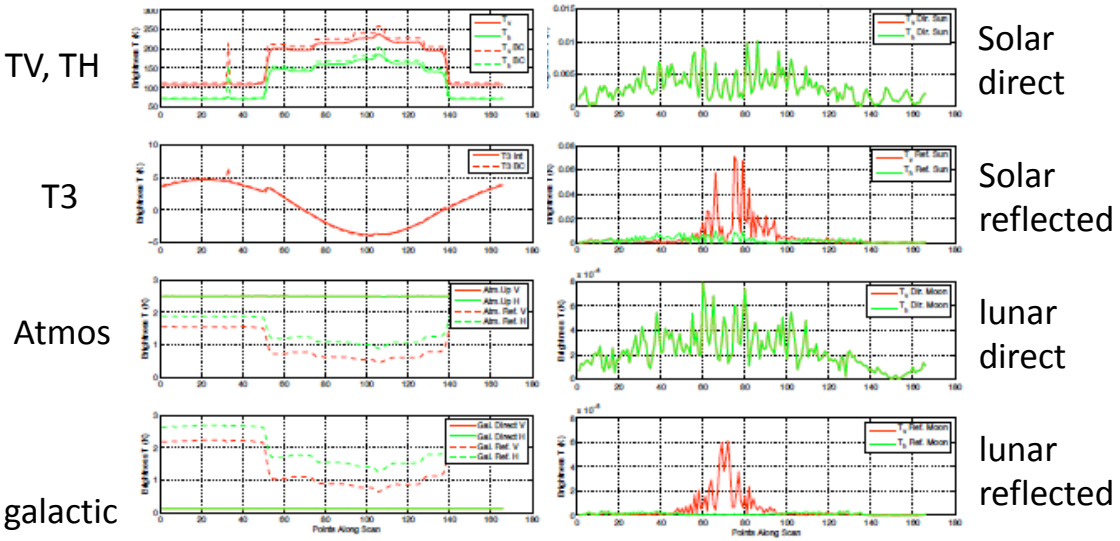


SMAP T_B Forward Simulator

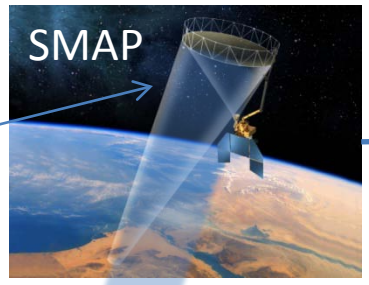
(used heavily by Antenna Pattern Correction)

- Strategy: leverage Aquarius simulator as much as possible
- Major differences vs. Aquarius
  - Conical scanning vs. fixed beam
  - Different antenna pattern
  - Land focus vs. ocean
- Proof-of-concept exercise completed
  - used sources already in Aquarius simulator
  - Simulated 4 cases along 1 descending orbit
  - Examined results for L1 error budget implications





SMAP radiometer L1/L2 integrated cal/val flow



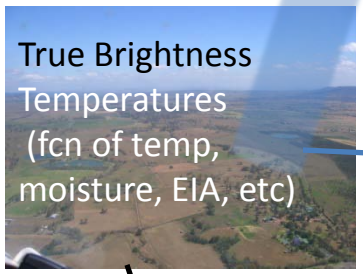
Unwanted Contributions (sun, moon, sidelobes, etc)

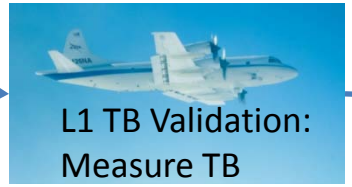
L0 Radiometer counts

L1 Calibration Process aka "L1 Tb algorithm"

L1 Brightness Temperatures (Tb)

L1 passive val consists of comparing these and then adjusting this.





Upscale to SMAP pixel size

TB "truth" at SMAP resolutions

L2 passive algorithm

SMAP L2 passive retrieved SM

Measured SM from cal/val field experiment

Upscale to SMAP pixel size

SM "truth" at SMAP resolutions

L1/L2 passive Cal/val consists of comparing these and then adjusting these.