National Aeronautics and Space Administration

Soil Moisture Active Passive Mission

SMAP

SMAPVEX19: Motivation, Objectives, Overview

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Cal/Val Workshop #9

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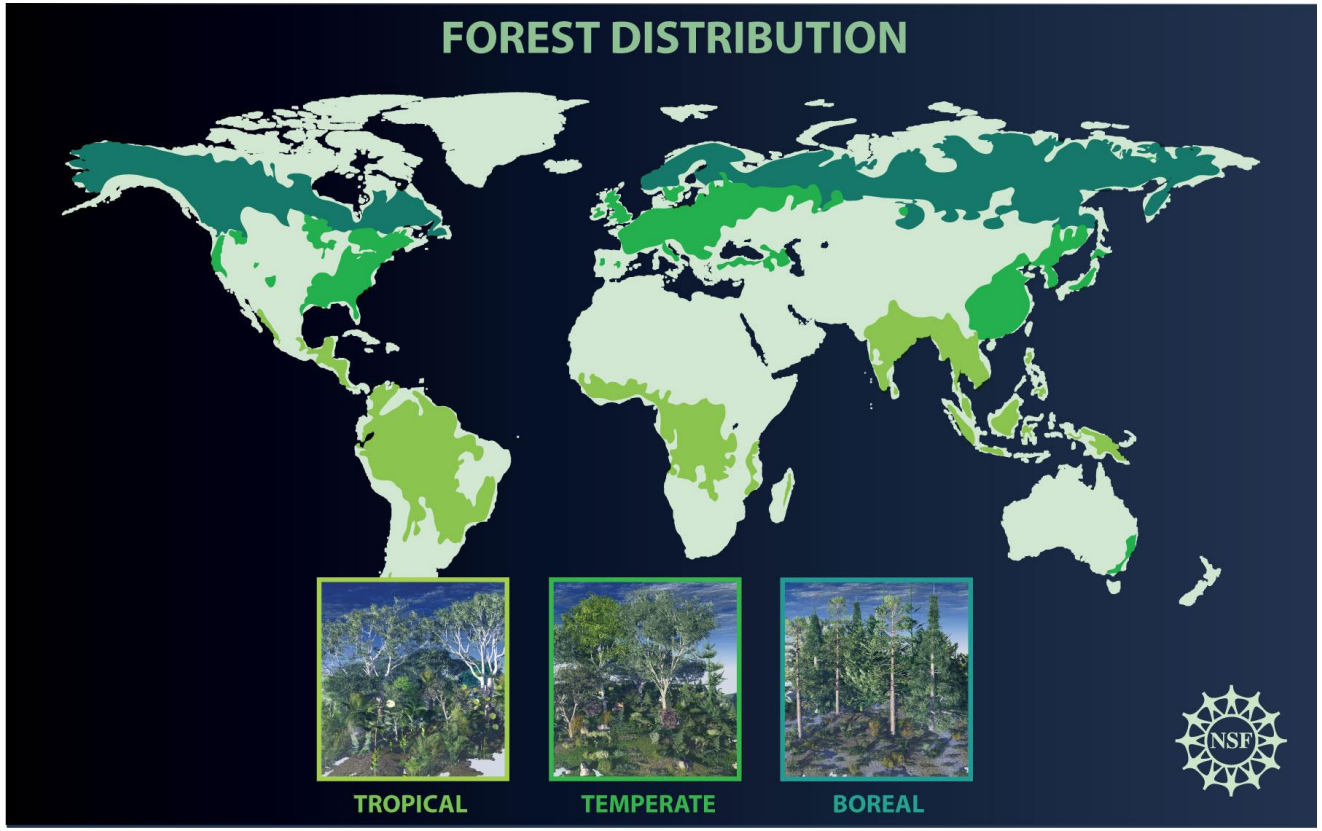
Background

- Extended mission objectives include expanding the retrieval domain
- About one third of the Earth's land mass is covered by forests
- Forests represent a major carbon storage where soil moisture has a significant influence on the uptake and release of carbon



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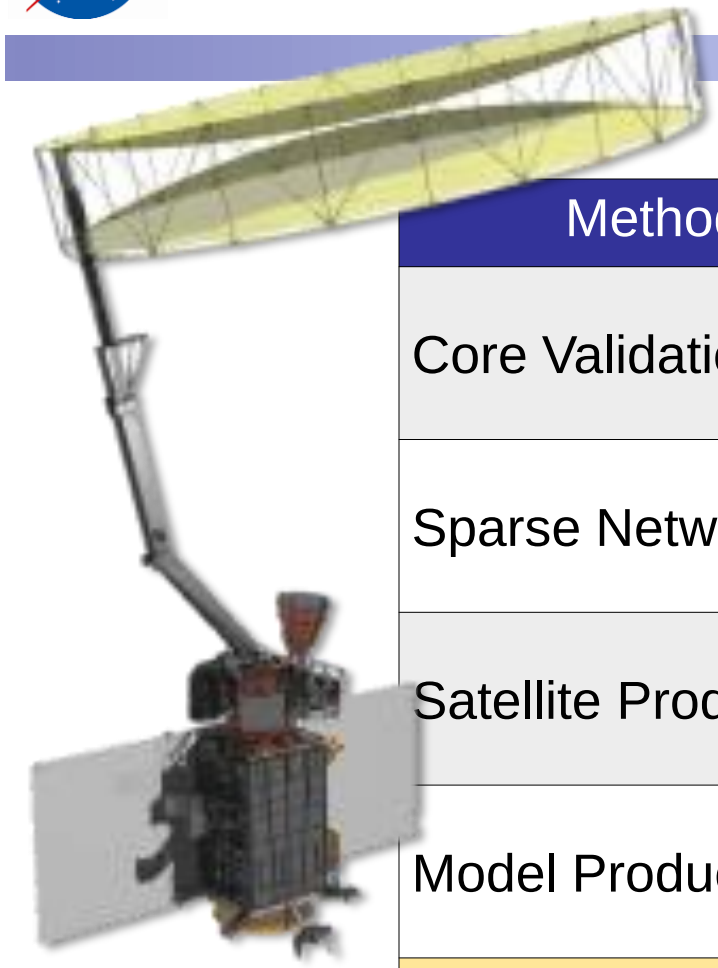
SMAP Mission Cal/Val Methodologies



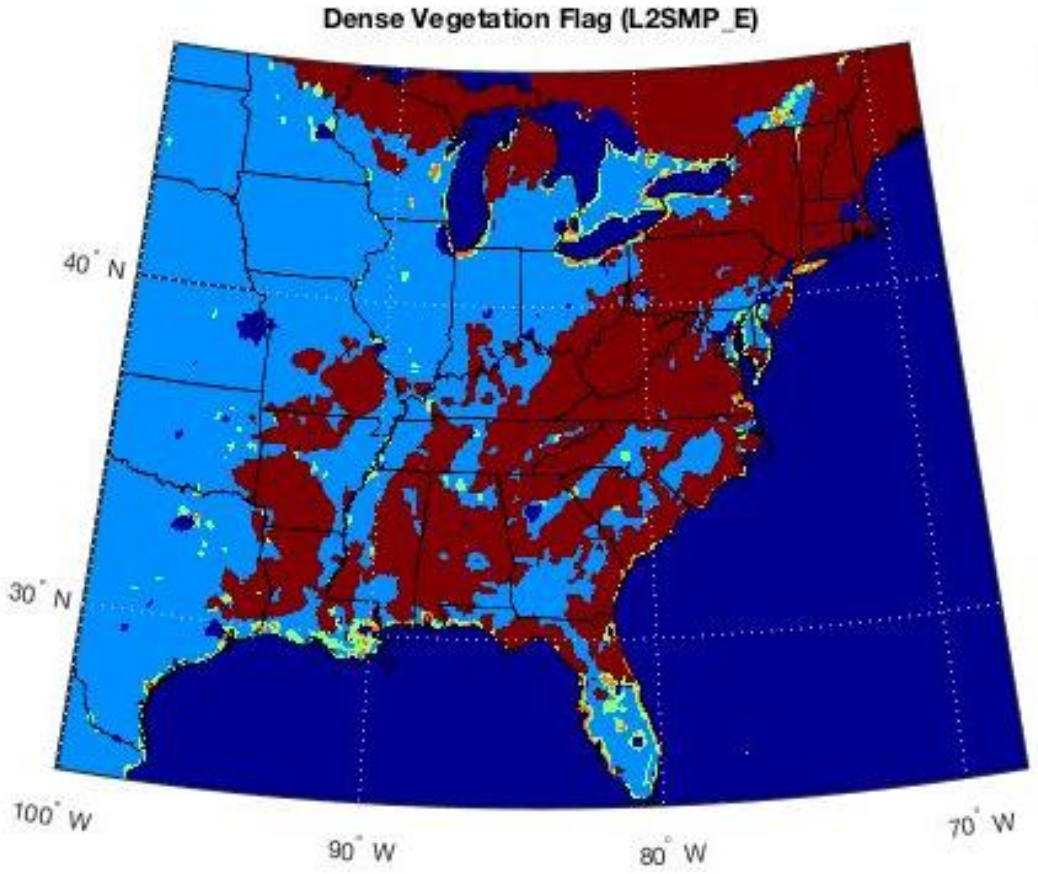
Methodology	Role
Core Validation Sites	Accurate estimates of products at matching scales for a limited set of conditions
Sparse Networks	One point in the grid cell for a wide range of conditions
Satellite Products	Estimates over a very wide range of conditions at matching scales
Model Products	Estimates over a very wide range of conditions at matching scales
Field Campaigns	**Detailed estimates for a very limited set of conditions**

Objectives

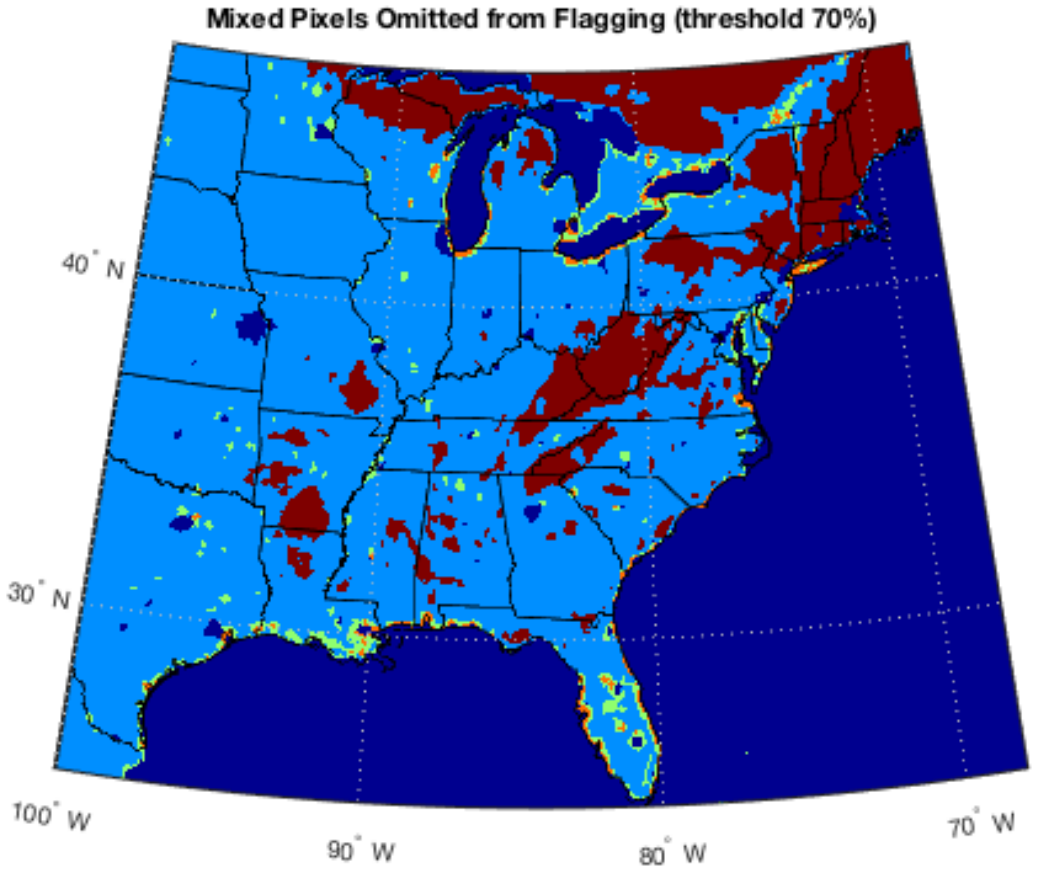
1. Improved retrieval of soil moisture for biomes with high levels of vegetation
   a. Define algorithm approach; determine and validate algorithm parameters (specific focus on temperate forests)
   b. Understand microwave interaction in the vegetation and ground (with respect to algorithm forward model)
   c. Based on the observed range of TB at some forest sites, achieving a highly accurate estimate of soil moisture a challenge => 2-tier approach: study mixed pixels and fully vegetated pixels separately
2. Provide a basis for evaluating new disaggregation approaches (SMAP-Sentinel product)

Objectives

- Resolving soil moisture under mixed pixel conditions (similar to Millbrook) will allow “unmasking” of majority of dense vegetation flag in the Eastern US



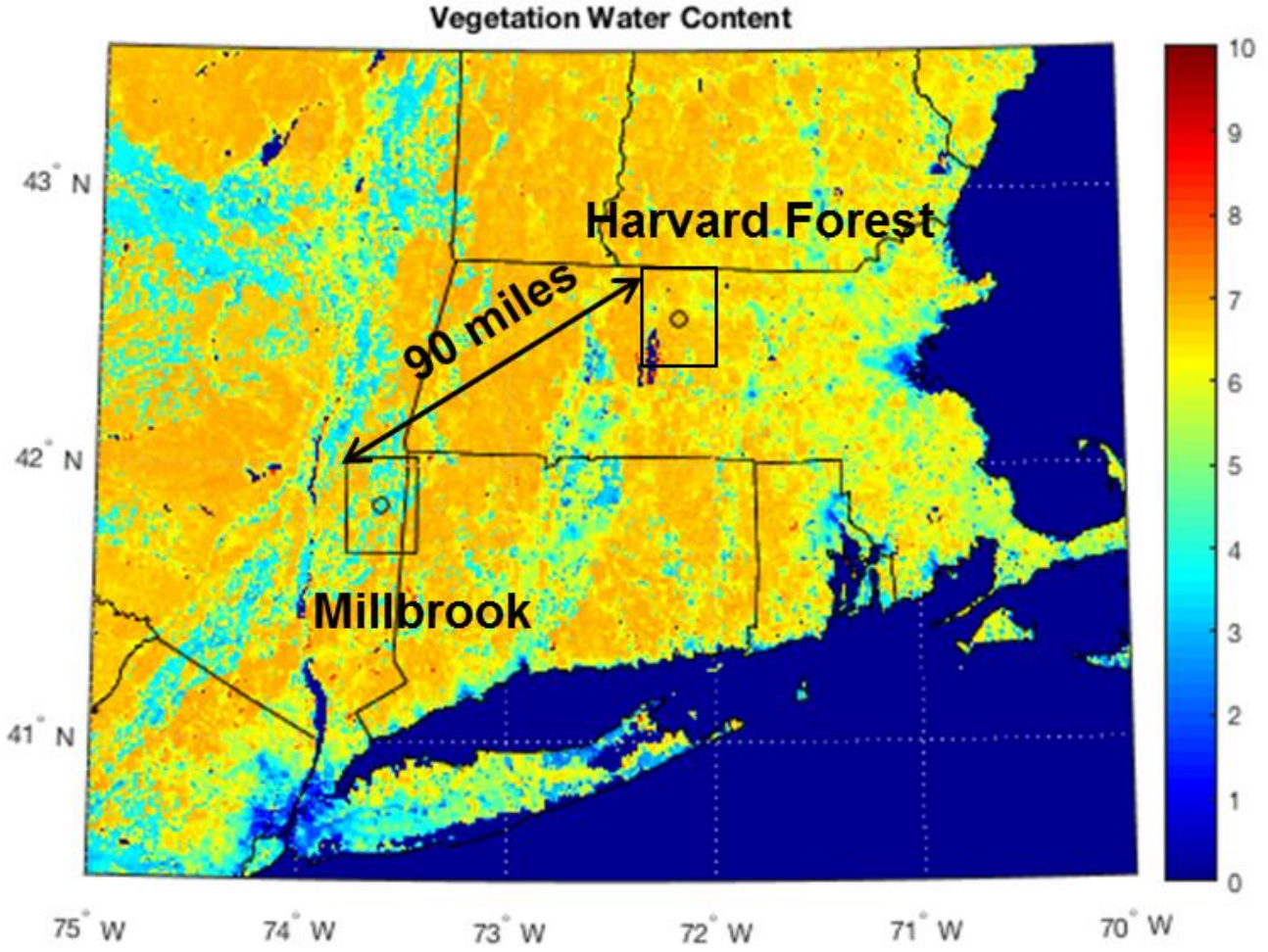
Current flag



Mixed pixels included

Approach

- The focus will be on deciduous forest type (boreal forests may come in the future); the experiment will be located in the Northeast US
- The experiment will feature airborne mapping of two SMAP radiometer resolution cells several times over the growing cycle
- Harvard Forest and Millbrook sites will provide both homogeneous fully forested and mixed landscapes (mixed landscape covers a large fraction of high biomass areas)



Design Outline

- **IOP1**: 3 weeks mid-summer – peak vegetation
  - Airborne coverage: 7 SMAP & 2 Sentinel-1 overpasses
- **IOP2**: 1 week in the fall – before snow, dry leaves
  - Airborne coverage: 3 SMAP & 1 Sentinel overpasses
- Instrumentation
  - PALS (Passive/Active L-band System)
  - Tower-based active/passive
- Ground measurements
  - Soil moisture temporary networks: installed in early 2019
  - Soil moisture manual sampling
  - Vegetation characterization

PALS flights and resolution

PALS Acquisition Plan:
10 flight lines with 1500 m altitude (AGL)
=> ~750 m resolution (2.5 hours per box)

- Captures the forest vs non-forest heterogeneity
- Compatible with the highest SMAP-Sentinel resolution of 1 km

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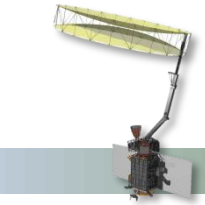
Overpass schedule



July

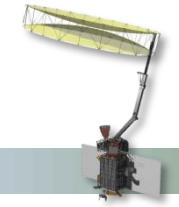
Date	SMAP AM	Sentinel
7/5		
7/6	X	
7/7		
7/8		H
7/9	X	
7/10		
7/11	X	
7/12		
7/13		M
7/14	X	
7/15		
7/16		
7/17	X	
7/18		
7/19	X	
7/20		H
7/21		
7/22	X	
7/23		
7/24		
7/25	X	M
7/26		
7/27	X	
7/28		
7/29		
7/30	X	
7/31		
8/1		H
8/2	X	
8/3		
8/4	X	

October

DateH	SMAP AM	Sentinel
10/18	X	
10/19		
10/20		
10/21	X	
10/22		
10/23	X	
10/24		H
10/25		
10/26	X	
10/27		
10/28		
10/29	X	M
10/30		
10/31	X	
11/1		
11/2		
11/3	X	
11/4		
11/5		H
11/6	X	
11/7		
11/8	X	
11/9		
11/10		M
11/11	X	
11/12		
11/13		
11/14	X	
11/15		
11/16	X	
11/17		H

H-Harvard Forest
M-Millbrook

Algorithm input for vegetation

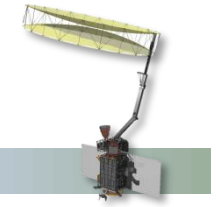


- The prioritization of the ground sampling is largely driven by algorithm forward model and some other models (for helping to understand the interactions)
- The current baseline algorithm (SCA-V) has three relevant inputs:
  - Forest category -> b and w
  - VWC (NDVI climatology based) -> tau
  - Temperature
- Conceivable input parameters for a new algorithm:
  - Forest type (better defined class)
  - Tree height/Biomass (would account structure variation within class)
  - VWC (tau variability)
  - Temperature

SMAPVEX19 - Organizations

Org	Responsibilities
JPL	SMAP • Experiment lead • PALS NISAR • UAVSAR
USDA	Temporary networks Ground operations lead Soil measurements lead
Michigan Tech	Vegetation measurements lead
Cary Institute	Facilities at Millbrook domain
Harvard Forest & NEON	Facilities at Harvard Forest domain
U. Quebec	Tower-based radiometer
NOAA CREST	Tower-based radiometer

Science Questions



- Developing a set of science questions that the measurements can help to answer
- For example:
  - How does the seasonal variation in surface SM influence canopy phenology, productivity and CO2 in the eastern deciduous forests?
  - What is the relationship between SM variability, atmospheric humidity and the associated moisture constraints on forest productivity and carbon fluxes?
  - How microwave opacity captures plant water storage dynamics (stress and non-steady hydraulics in the soil-plant-atmosphere continuum)?
- Input appreciated also on this front!

We are looking for volunteers for ground sampling