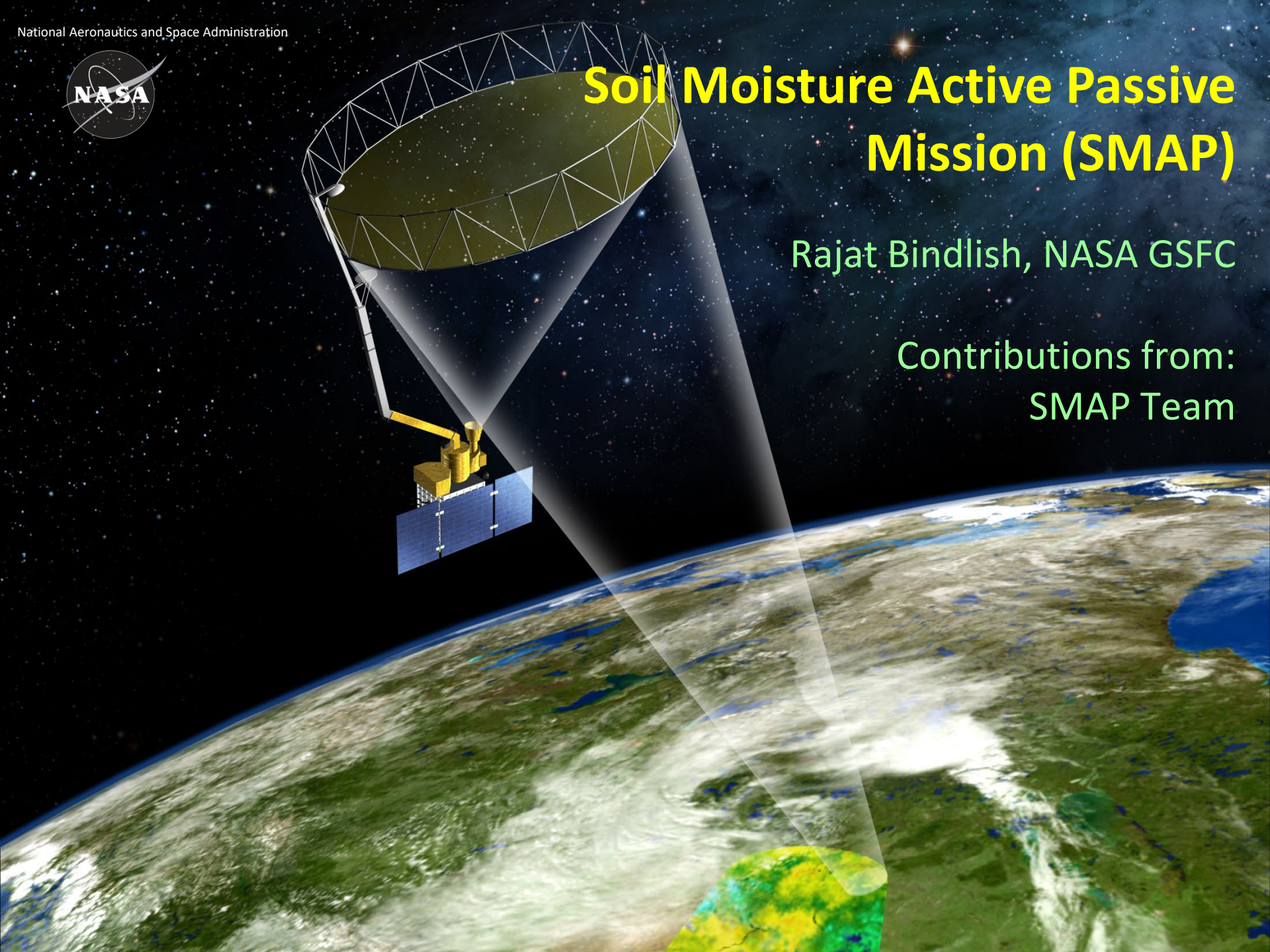
National Aeronautics and Space Administration



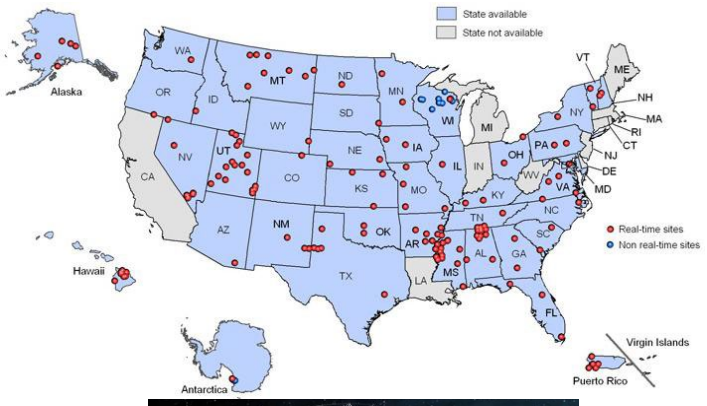
Soil Moisture Active Passive Mission (SMAP)

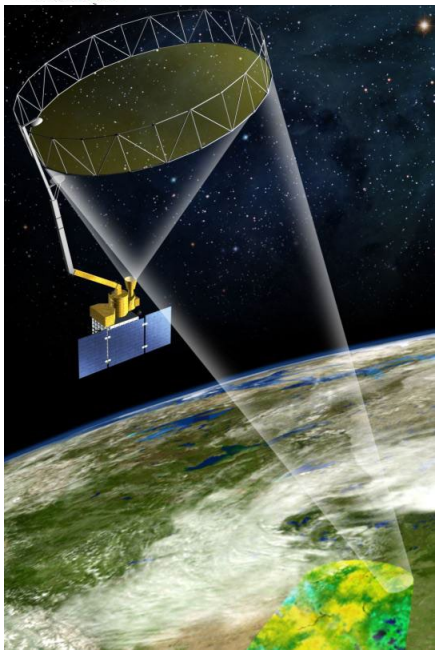
Rajat Bindlish, NASA GSFC

Contributions from:
SMAP Team

Objectives of Satellite soil moisture missions

Objective of a Soil Moisture mission is to provide high-resolution and frequent-revisit global maps of soil moisture.





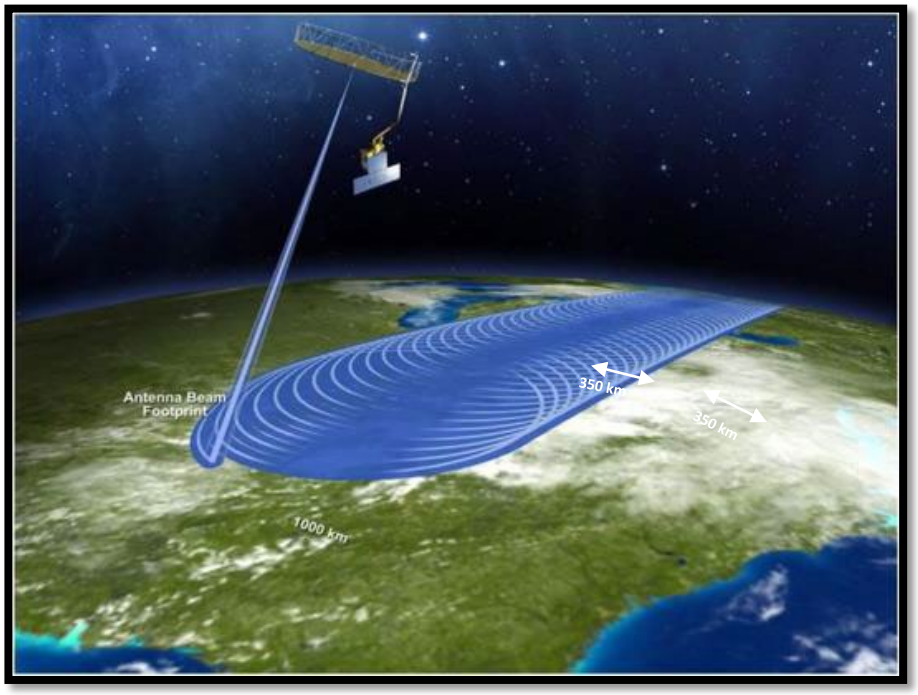
Science and applications addressed SMAP:

- Understand processes that link the terrestrial water, energy and carbon cycles
- Estimate global water and energy fluxes at the land surface
- Quantify net carbon flux in boreal landscapes
- Enhance weather, flood and drought prediction
- Other applications such as agricultural productivity and human health

Requirement	Soil Moisture
Resolution	**9 and 36 km**
Refresh Rate	3 days
Accuracy	**0.04** [cm^3/cm^3]

SMAP Overview

SMAP objective is to provide high-resolution and frequent-revisit global mappings of soil moisture and landscape freeze/thaw state



SMAP Instrument Configuration

Radiometer
Frequency: 1.41 GHz
Polarizations: H, V, 3rd & 4th Stokes
Resolution: 40 km
Relative Accuracy: 1.3 K

Shared Antenna
6-m diameter deployable mesh antenna
Conical scan at 14.6 rpm
Constant incidence angle: 40 degrees
1000 km-wide swath

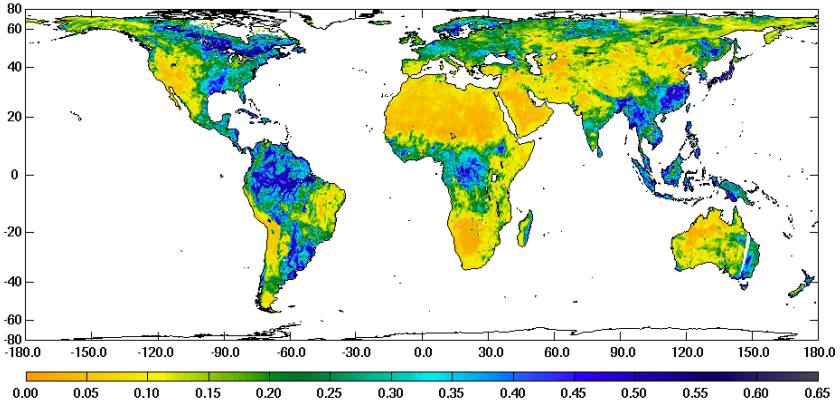
Orbit
Sun-synchronous, 6 am/pm orbit, **685 km** altitude

- ~~***Radar*** - High spatial resolution (1-3 km) but more sensitive to surface roughness and vegetation~~ (Radar anomaly)
- ***Radiometer*** - High accuracy (less influenced by roughness and vegetation) but coarser spatial resolution (40 km)
- **Combined Radar-Radiometer** product provides optimal blend of resolution and accuracy to meet science requirements (SMAP radar replaced with Sentinel observations)

- Uniqueness: Continuous observations every 2-3 days

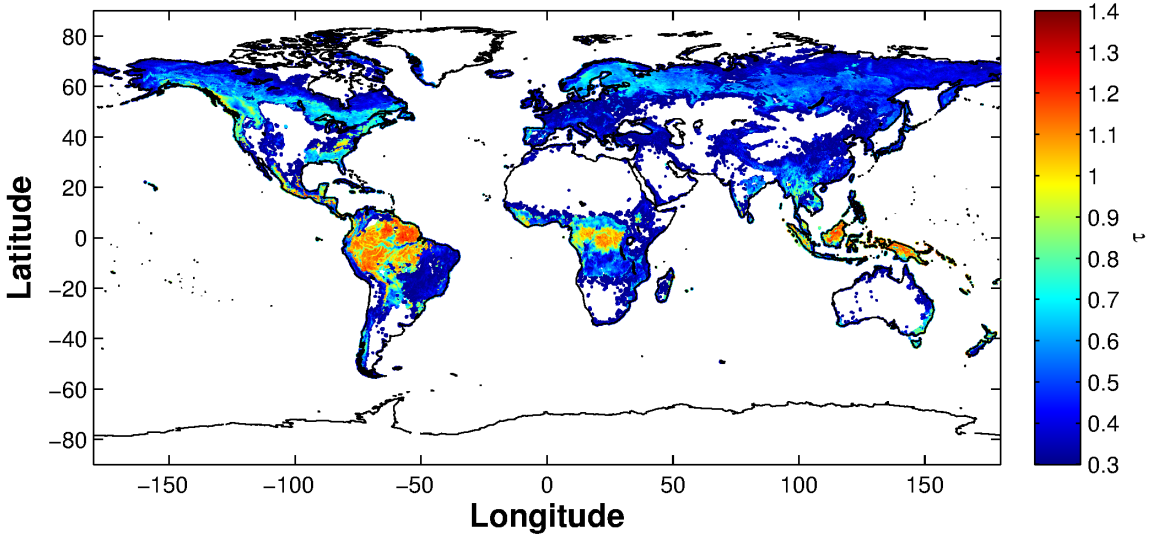
SMAP Soil Moisture

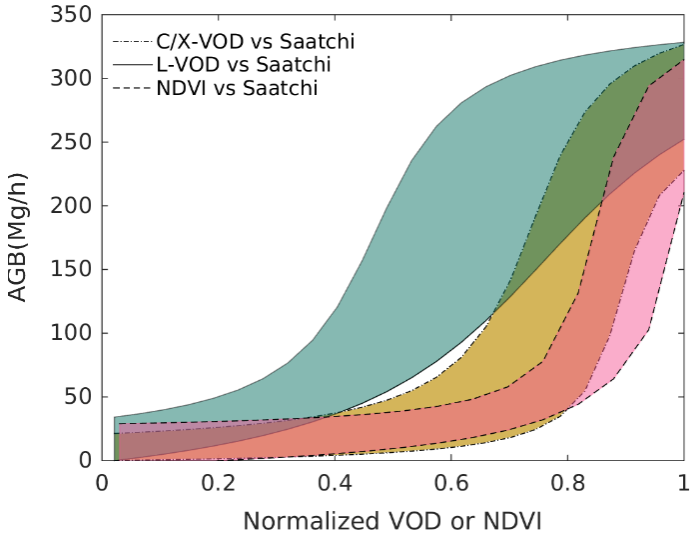
- SMAP successfully demonstrated the ability to estimate soil moisture
  - Use of low frequency for secondary applications was also demonstrated (Ocean Salinity, Freeze/thaw, Sea Ice, Ocean surface Winds)
- SMAP provides soil moisture with an accuracy of better than 0.04 m^3/m^3 (validated using in situ observations)
- Over 750 science publications using SMAP data have been released, many based on how landscape hydrology affects the water, energy and carbon balance linkages regionally and globally.
- U.S. Federal agencies continue to increase their use of SMAP soil moisture data to meet or improve operational requirements.
- Air Force 557 Weather Wing is operational with use of SMAP near-real-time data in their forecasts
- Other agencies using data operationally or as a decision tool include USDA FAS, USDA NASS, Environment Canada, NASA SPoRT, and the National Drought Mitigation Center; NOAA also downloads the NRT data



Vegetation Optical Depth

- Approach
  - L-band observations can be used to retrieve both soil moisture and vegetation opacity
    - NDVI from Optical sensors saturate at lower levels
- Results
  - Short term variations related to vegetation water content (low vegetation)
  - Long term variations (forest) associated to biomass and / or tree height
  - No saturation below 350 T/ha → unique





SMAP Soil Moisture Anomalies