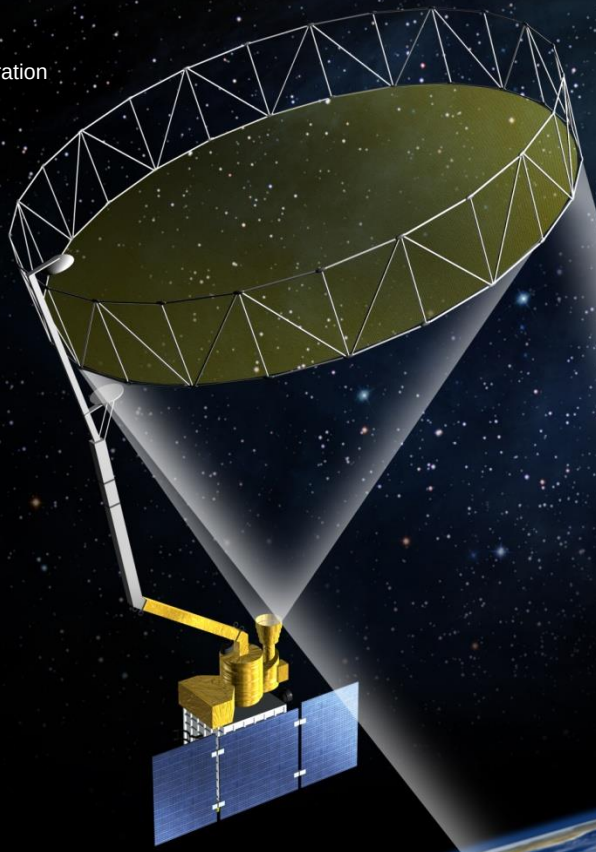
National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology

Soil Moisture Active Passive Mission

SMAP



L2-L4 Validation Overview

Tom Jackson

6th Cal/Val Workshop

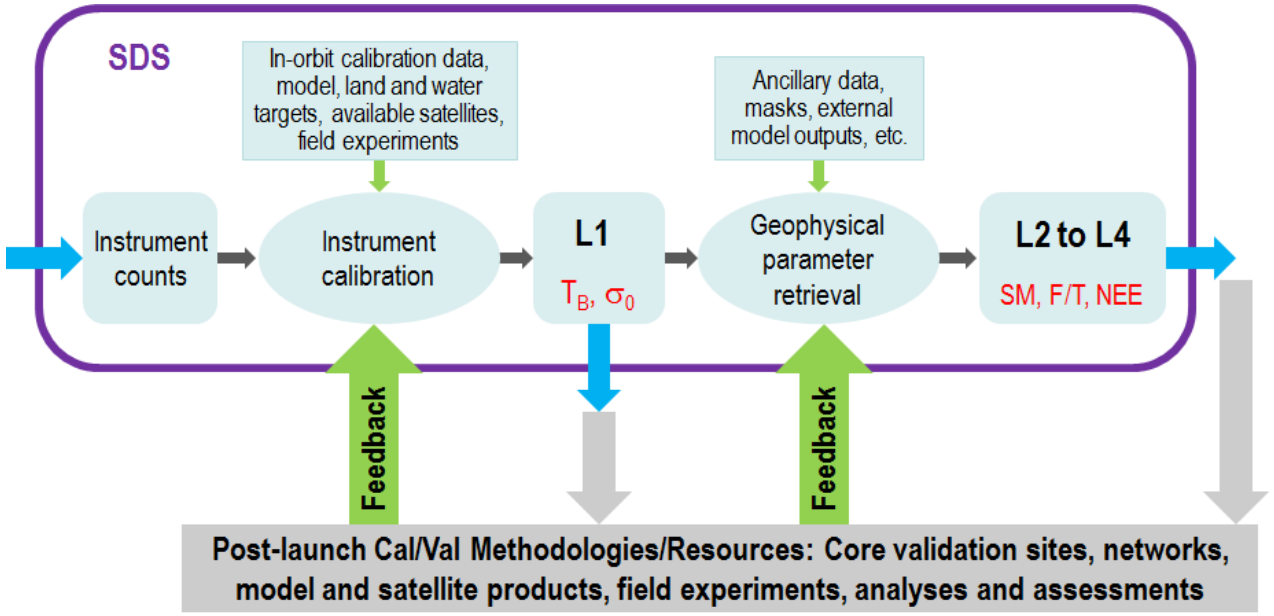
Sept. 1-3, 2015

6th SMAP Cal/Val Workshop Agenda-Day 1

Tuesday		
0815	Introduction	T. Jackson
0830	Mission Progress and Status	S. Yueh/K. Kellogg
0900	NASA HQ Science Perspectives	J. Entin
0915	SMAP Science Team Perspectives	D. Entekhabi
0930	SMAP Products Timeline and Cal/Val	S. Yueh
0945	***Break***	
	Level 1 Cal/Val	
	Radar Presentations and Validation Report	S. Yueh
1015	Radar Configuration Process	A. Freedman
1030	Radar Beta Calibration	R. West
1130	Looking Forward with SMAP Radar	R. West
1145	Discussion	S. Yueh
1200	***Lunch***	
	Radiometer Presentations and Validation Report	S. Misra
0100	Radiometer Calibration Overview	S. Misra
0110	Geolocation Assessment	G. DeAmici
0120	Calibration Assessment	J. Peng
0140	Cold Sky Calibration	E. Dinnat
0155	L1C Gridded Product & Quality Flags	S. Chan
0205	Radio-Frequency Interference Assessment	P. Mohammed
0220	L-band Inter-comparison – Rajat Bindlish	R. Bindlish
0230	Plans for Cal/Val Phase-I Release	S. Misra
0240	Eliminating RFI Sources is Possible: SMOS Example	R. Oliva (C)
0250	***Break/Posters***	
0340	SMAP SDS Processing for Cal/Val	D. Cuddy
0350	Data Archival and Resources	A. Leon/S. Arko
0420	Level 2-4 Cal/Val Methodologies	T. Jackson
0440	Validation and Standard Grids	R. Bindlish
0500	**End**	
(C) Contributed presentation, also a poster		

SMAP Cal/Val Objectives and Approach

- Validating that the products meet their quantified requirements
  - *Calibrate, verify, and improve the performance of the science algorithms*
  - *Validate accuracies of the science data products as specified in L1 science requirements according to Cal/Val timeline*



Level 1 Science Requirements

- The NSF Decadal Survey identified numerous potential applications for SM/FT observations.
- These were grouped into three categories with a spatial resolution, refresh rate, and accuracy.

Requirement	Hydro-Meteorology	Hydro-Climatology	Carbon Cycle	Baseline Mission		Threshold Mission	
				Soil Moisture	Freeze/ Thaw	Soil Moisture	Freeze/ Thaw
Resolution	4–15 km	50–100 km	1–10 km	10 km	3 km	10 km	10 km
Refresh Rate	2–3 days	3–4 days	2–3 days[a]	3 days	2 days	3 days	3 days
Accuracy	0.04-0.06 [c]	0.04-0.06 [c]	80–70% [b]	0.04 [c]	80%[b]	0.06 [c]	70%[b]
Mission Duration				36 months		18 months	

[a] North of 45N latitude, [b] Percent classification accuracy (binary freeze/thaw), [c] Volumetric water content, 1-σ in [cm^3/cm^3] units

- These are the L1 priority products and requirements. Other product accuracies derive from L2 requirements. Defines the baseline mission.
- The SMAP Project proposed the active-passive approach for meeting these requirements.

CEOS Validation Stages Adopted for SMAP

Validation: The process of assessing, by independent means, the quality of the data products derived from the system outputs. The quality is determined with respect to the specified requirements.

Validation Stage	Description
Stage 1	Product accuracy is assessed from a small (typically < 30) set of locations and time periods by comparison with *in situ* or other suitable reference data.
Stage 2	Product accuracy is estimated over a significant set of locations and time periods by comparison with reference *in situ* or other suitable reference data. *Spatial and temporal consistency of the product and with similar products have been evaluated over globally representative locations and time periods.* Results are published in the peer-reviewed literature.
Stage 3	Uncertainties in the product and its associated structure are well quantified from comparison with reference *in situ* or other suitable reference data. *Uncertainties are characterized in a statistically robust way over multiple locations and time periods representing global conditions.* Spatial and temporal consistency of the product and with similar products have been evaluated over globally representative locations and periods. Results are published in the peer-reviewed literature.
Stage 4	Validation results for stage 3 are *systematically updated* when new product versions are released and as the time-series expands.

Beta Release Products

- Early release is used to gain familiarity with data formats.
- Intended as a testbed to discover and correct errors.
- Minimally validated and still may contain significant errors
- General research community is encouraged to participate in the quality assessment and validation, but need to be aware that product validation and quality assessment are ongoing.
- Data may be used in publications as long as the fact that it is beta quality is indicated by the authors. Drawing quantitative scientific conclusions is discouraged. Users are urged to contact science team representatives prior to use of the data in publications, and to recommend members of the instrument teams as reviewers.
- The estimated uncertainties will be documented.
- May be replaced in the archive when an upgraded (provisional or validated) product becomes available.

SMAP L2-L4 Validation 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

SMAP L2-L4 Validation Methodologies

Methodology	Role	Constraints	Resolution
Core Validation Sites	Accurate estimates of products at matching scales for a limited set of conditions	• In situ sensor calibration • Limited number of sites	• In Situ Testbed • Cal/Val Partners
Sparse Networks	One point in the grid cell for a wide range of conditions	• In situ sensor calibration • Up-scaling • Limited number of sites	• In Situ Testbed • Scaling methods • Cal/Val Partners
Satellite Products	Estimates over a very wide range of conditions at matching scales	• Validation • Comparability • Continuity	• Validation studies • Distribution matching
Model Products	Estimates over a very wide range of conditions at matching scales	• Validation • Comparability	• Validation studies • Distribution matching
Field Campaigns	Detailed estimates for a very limited set of conditions	• Resources • Schedule conflicts	• Airborne simulators • Partnerships

Preparation for Beta Release of L2-L4

- Each product team identified the CV methodologies that would be primary and secondary in their assessments.
  - *Strive for transparency*
- Decide if the minimum requirements have been met
  - *This Workshop is one part of the process*
- Provide
  - *Product Specification Document*
    - Describes the file format and data contents for external software interfaces
  - *User's Guide*
  - *Assessment Report*
- Reports from Teams on Wednesday

6th SMAP Cal/Val Workshop Agenda-Day 2

Wednesday		
	Level 2-4 Product Assessments	E. Njoku
0800	L2 SM P Algorithm Team Report	S. Chan
0900	A Climatology of Optical Thickness (Tau) May Not be Appropriate in Agricultural Regions	B. Hornbuckle (C)
0905	Improved Vegetation Parametrization for SMAP's Passive Retrieval Algorithms	M. Kurum (C)
0915	L2 SM P Discussion	P. O'Neill
0930	***Break/Posters***	
1015	L2 SM AP Algorithm Team Report	N. Das
1115	Two Methods to Downscale Radiometer Soil Moisture	V. Lakshmi (C)
1120	Intercomparison of Alternate Soil Moisture Downscaling Algorithms Using Active-Passive Microwave Observations	J. Walker (C)
1125	L2 SM AP Discussion	D. Entekhabi
1145	***Lunch***	
0100	L2 SM A Algorithm Team Report	S. Kim
0200	L2 SM A Discussion	J. Van Zyl
0215	***Break/Poster***	
0300	L3 FT Algorithm Team Report	C. Derksen/X. Xu
0345	L4 SM Algorithm Team Report	R. Reichle
0430	L4 C Algorithm Team Report	J. Kimball/N. Stavros
0515	***End***	

SMAP L2-L4 Validation Methodologies

Methodology	Status (Sept., 2014)
Core Validation Sites	• Good progress in establishing partnerships and data acquisition. • Engagement of Partners is mixed. • Scaling functions for sites have not been supported as strongly as hoped for. Additional efforts are needed. • In Situ Testbed has worked. How do we use this info? Can we reduce reported RMSE by using it? • A Validation Grid Tool is needed to reduce uncertainty in validation. • *A priori* decisions on whether to use each site as a core or supplemental resource must be made.
Sparse Networks	• Good progress in establishing partnerships and data acquisition; several important resources being pursued. • Engagement of Partners is about as expected. • Some progress in establishing how sparse network data can be utilized through Triple Co-location. How do we use this in Cal/Val?
Satellite Products	• Excellent progress in data acquisition. • Work needed on comparability of products (contributing depth, time of acquisition, spatial scale, …) • Work needed on validation using SMAP resources. • Some progress in establishing how satellite products can be utilized through Triple Co-location. • Resolve the role of this methodology: TC or direct validation?
Model Products	• Excellent progress in data acquisition and developing model products for all SM spatial scales. • Work needed on comparability (contributing depth,…..) • Work needed on validation using SMAP resources. • Some progress in establishing how model products can be utilized through Triple Co-location. • Resolve the role of this methodology: TC or direct validation?
Field Campaigns	• Plans are in place for N.A. campaigns in August 2015 and July 2016 and Australia April and September 2015. • Airborne simulators will be available to support post-launch field campaigns. • Resources are not confirmed for N.A.