Soil Moisture Active Passive (SMAP) Applications and Early Adopter Research

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Introduction

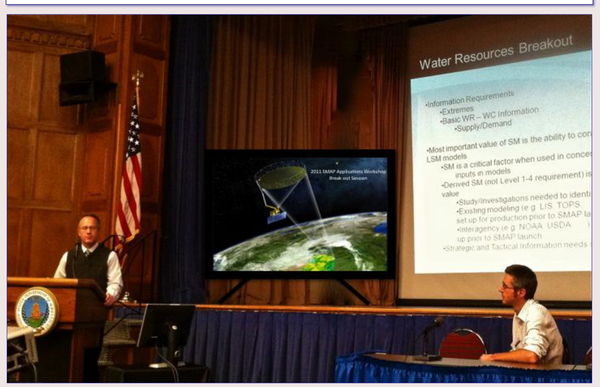
NASA depends on the science community to identify and prioritize leading-edge scientific questions and the observations required to answer them. The Soil Moisture Active and Passive (SMAP) Mission has been identified as a priority for NASA's Science Mission Directorate through the most recent decadal survey. **Following launch in 2014**, SMAP will deliver global maps of soil moisture content and surface freeze/thaw state. Global measurements of these variables are critical for terrestrial hydrologic and carbon cycle applications.

SMAP data are valuable for both scientific research and practical applications. SMAP has the potential to drive a diverse range of novel research in drought and flood guidance, agricultural productivity estimation, weather forecasting, climate prediction, human health risk analysis and defense systems. The accuracy, resolution, and global coverage of SMAP soil moisture and freeze/thaw measurements will provide new information for many science and applications disciplines.

This poster presents the most recent activity from the SMAP Applications Team and SMAP Early Adopter using prelaunch SMAP simulation data. During the 2011 SMAP Applications Workshop, seven Early Adopters presented prelaunch research using SMAP simulated soil moisture data. The focus of Early Adopter research is to understand future applications of SMAP and to address challenges with data, access and processing prior to launch so that after 2014, SMAP launch data can be ingested by a broad user community with ease. The feedback from Early adopter research was presented to the SMAP user community during the SMAP Application Workshop and is helping mold how SMAP data are delivered in the future.

SMAP Early Adopters were chosen through a selective process from within the SMAP Working Group Community of Practice and will have early access to pre-launch simulated SMAP data products. The pre-launch simulated SMAP data are managed and operated by JPL. These data are available to users who apply for access through JPL as Early Adopters of the SMAP mission

The results show that once launched, SMAP data will serve as a calibration tool as well as an enhancing data set for weather, health and agriculture. The SMAP Applications Team continues to explore more pre launch applications research.



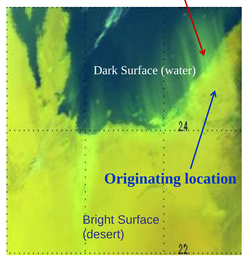
Product	Description	Gridding (Resolution)	Latency*	
L1A_TB	Radiometer Data in Time-Order	-	12 hrs	Instrument Data
L1A_S0	Radar Data in Time-Order	-	12 hrs	
L1B_TB	Radiometer T_B in Time-Order	(36x47 km)	12 hrs	
L1B_S0_LoRes	Low Resolution Radar σ_o in Time-Order	(5x30 km)	12 hrs	
L1C_S0_HiRes	High Resolution Radar σ_o in Half-Orbits	1 km (1-3 km)***	12 hrs	
L1C_TB	Radiometer T_B in Half-Orbits	36 km	12 hrs	
L2_SM_A**	Soil Moisture (Radar)	3 km	24 hrs	Science Data (Half-Orbit)
L2_SM_P	Soil Moisture (Radiometer)	36 km	24 hrs	
L2_SM_AP	Soil Moisture (Radar + Radiometer)	9 km	24 hrs	
L3_FT_A	Freeze/Thaw State (Radar)	3 km	50 hrs	Science Data (Daily Composite)
L3_SM_A**	Soil Moisture (Radar)	3 km	50 hrs	
L3_SM_P	Soil Moisture (Radiometer)	36 km	50 hrs	
L3_SM_AP	Soil Moisture (Radar + Radiometer)	9 km	50 hrs	
L4_SM	Soil Moisture (Surface and Root Zone)	9 km	7 days	Science Value-Added
L4_C	Carbon Net Ecosystem Exchange (NEE)	9 km	14 days	

* The SMAP Project will make a best effort to reduce the data latencies beyond those shown in this table
** Research product with possible reduced accuracy
*** Over Outer 70% of Swath

SMAP Early Adopter Research

The workshop highlighted seven Early Adopter research demonstrations, ranging from weather modeling, agriculture, flood monitoring, and food security monitoring. These presentations gave an overview of the applied research that is ongoing and the approaches that are being taken in incorporating the data into current systems and processes.

1. Stephane Belair and Marco Carrera (*Environment Canada*)-***seen below***
2. Patricia de Rosnay and Lars Isaksen (*European Center for Medium-Range Weather Forecasts*)-***seen below***
3. Xiwu Zhan (*NOAA*)
4. Hosni Ghedira and Imen Gherboudj (*Masdar Institute*)-***seen below***
5. Zhengwei Yang, Rick Mueller (*UDSA/NASS/RDD*)
6. Catherine Champagne (*Agri-Environment Services Branch*)
7. Amor Ines and Steve Zebiak (*International Research Institute for Climate and Society*) -***seen below***



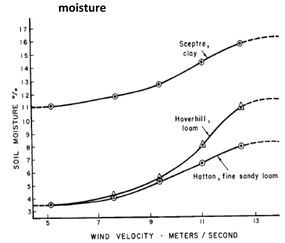
Public Health

Hosni Ghedira, Imen Gherboudj, Sagar Prasad Parajuli

Earth Observation and Environmental Remote Sensing Laboratory

Abu Dhabi, United Arab Emirates

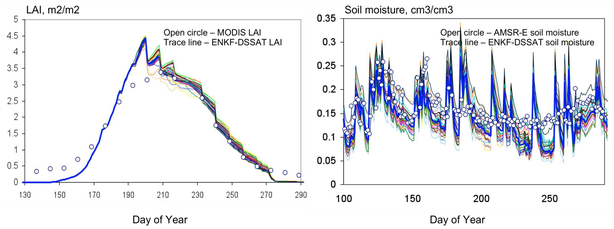
Threshold friction velocity related to soil moisture



Food Security

Amor Ines and Steve Zebiak
International Research Institute for Climate and Society (IRI)
Columbia University, NY

MODIS LAI, AMSR-E Soil moisture, Story Co., IA (2003)



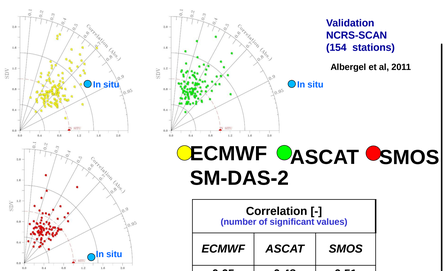
Model Calibration and Validation

Patricia de Rosnay and Lars Isaksen

ECMWF

Stephane Belair and Marco Carrera

Science and Technology Branch, Environment Canada

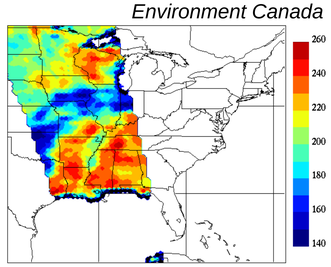


Validation NCRS-SCAN (154 stations)

Albergel et al, 2011

ECMWF ASCAT SMOS SM-DAS-2

Correlation [-] (number of significant values)		
ECMWF	*ASCAT*	*SMOS*
0.65 (131 stations)	0.48 (125 stations)	0.51 (106station s)



Workshop Results

During its existence, the SMAP mission has been committed to the dual role of providing useful data products for both science and applications, as described in the 2007 NRC Decadal Survey report. Through successive applications workshops, the SMAP mission has and will continue to involve users of satellite data products in its mission activities. As NASA increases its focus on engaging with missions, SMAP applications will continue to be pathfinders for the broader community.

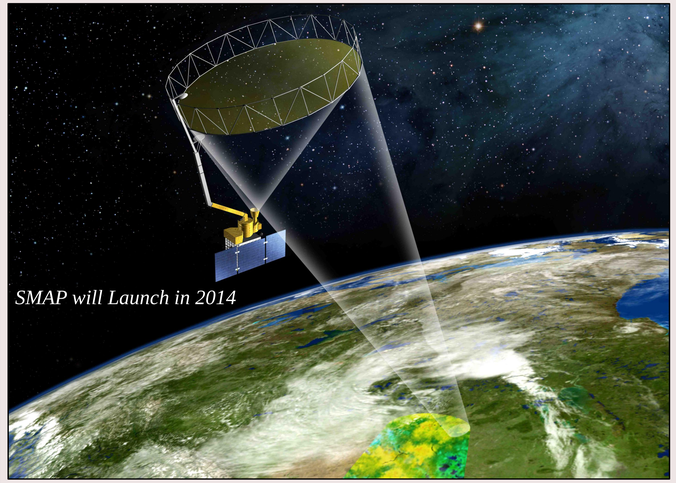
At the workshop, the AppWG emphasized the benefits of coordinating the applications plans of all NASA Decadal Survey missions, in particular the Global Precipitation Mission (GPM) and ICESat2. Additional workshops in 2012 and 2013 will be conducted in smaller, thematic-based formats. Five workshops are planned as an outcome of this year's SMAP workshop to include a SMAP-ICESat2 freeze/thaw joint mission workshop, a GRACE-GPM-SMAP multi-sensor water cycle workshop, and three thematic workshops in the forestry, computer modeling and simulations, and disasters and hazards domains.

One of our future early and developing SMAP application will includes combining models and data to explore ways to measure interaction and integration of SMAP data with the Emergency Management User community of Maryland in order to produce quantitative metrics related to long-term projects, milestone completion, and movement of SMAP products into routine operations for emergency response.

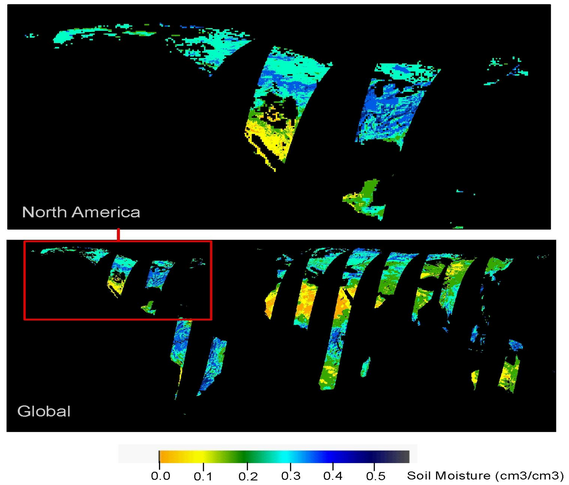
StormCenter's On-Site Support to the Maryland Emergency Management Agency (MEMA) and Maryland Governor Martin O'Malley

User Community Recommendations

1. **Improve access** to SMAP data products through the use of graphical data formats and databases.
2. Make SMAP products available with the **shortest possible latencies** (within budgetary constraints)
3. Make **proxy soil moisture datasets** (from SMOS or SSM/I) available for application development.
4. Conduct research on **long-term soil moisture data records** and anomalies
5. Work with NASA Applied Sciences Program (ASP) **principal investigators**
6. Engage end-users in pre- and post-launch **calibration and validation activities**



SMAP Soil Moisture from Radiometer Radar Combined Product
SMAP_L3_SM_AP_20030501_001.H5 (soil moisture)



Literature cited

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Acknowledgments

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For further information

Please contact ***vanessa.escobar@nasa.gov or molly.brown@nasa.gov***. More information on this and related projects can be obtained at *http://smap.jpl.nasa.gov/science/wgroups/applicWG/*