## SMAP Data Products

<table>
<thead>
<tr>
<th>Data Product Short Name</th>
<th>Description</th>
<th>Beta Product Distribution Begins</th>
<th>Validated Product Distribution Begins</th>
<th>Average Latency to User Community after Acquisition</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1A_Radar</td>
<td>Parsed Radar Instrument Telemetry</td>
<td>8/1/2015</td>
<td>11/1/2015</td>
<td>12 hours</td>
</tr>
<tr>
<td>L1A_Radiometer</td>
<td>Parsed Radiometer Instrument Telemetry</td>
<td>8/1/2015</td>
<td>11/1/2015</td>
<td>12 hours</td>
</tr>
<tr>
<td>L1B_S0_LoRes</td>
<td>Low Resolution Radar $\sigma_o$ in Time Order</td>
<td>8/1/2015</td>
<td>11/1/2015</td>
<td>12 hours</td>
</tr>
<tr>
<td>L1C_S0_HiRes</td>
<td>High Resolution Radar $\sigma_o$ on Swath Grid</td>
<td>8/1/2015</td>
<td>11/1/2015</td>
<td>12 hours</td>
</tr>
<tr>
<td>L1B_TB</td>
<td>Radiometer $T_b$ in Time Order</td>
<td>8/1/2015</td>
<td>11/1/2015</td>
<td>12 hours</td>
</tr>
<tr>
<td>L1C_TB</td>
<td>Radiometer $T_b$</td>
<td>11/1/2015</td>
<td>5/1/2016</td>
<td>12 hours</td>
</tr>
<tr>
<td>L2_SM_A</td>
<td>Radar Soil Moisture</td>
<td>11/1/2015</td>
<td>5/1/2016</td>
<td>24 hours</td>
</tr>
<tr>
<td>L2_SM_P</td>
<td>Radiometer Soil Moisture</td>
<td>11/1/2015</td>
<td>5/1/2016</td>
<td>24 hours</td>
</tr>
<tr>
<td>L2_SM_AP</td>
<td>Active-Passive Soil Moisture</td>
<td>11/1/2015</td>
<td>5/1/2016</td>
<td>24 hours</td>
</tr>
<tr>
<td>L3_FT_A</td>
<td>Daily Global Composite Freeze/Thaw State</td>
<td>11/1/2015</td>
<td>5/1/2016</td>
<td>50 hours</td>
</tr>
<tr>
<td>L3_SM_A</td>
<td>Daily Global Composite Radar Soil Moisture</td>
<td>11/1/2015</td>
<td>5/1/2016</td>
<td>50 hours</td>
</tr>
<tr>
<td>L3_SM_P</td>
<td>Daily Global Composite Radiometer Soil Moisture</td>
<td>11/1/2015</td>
<td>5/1/2016</td>
<td>50 hours</td>
</tr>
<tr>
<td>L3_SM_AP</td>
<td>Daily Global Composite Active-Passive Soil Moisture</td>
<td>11/1/2015</td>
<td>5/1/2016</td>
<td>50 hours</td>
</tr>
<tr>
<td>L4_SM</td>
<td>Surface &amp; Root Zone Soil Moisture</td>
<td>11/1/2015</td>
<td>5/1/2016</td>
<td>7 days</td>
</tr>
<tr>
<td>L4_C</td>
<td>Carbon Net Ecosystem Exchange</td>
<td>11/1/2015</td>
<td>5/1/2016</td>
<td>14 days</td>
</tr>
</tbody>
</table>
SMAP Early Adopters

• SMAP was the first NASA Earth mission to sponsor an Early Adopter program
• Early Adopters foresee value in mission data for their design and implementation of applications
• Early Adopters gain access to product design and simulated data well before launch. Value is symbiotic:
  • Early Adopters build or modify applications to employ mission data well before launch
  • Early Adopters present plans to mission team and other Early Adopters
  • Early Adopters provide feedback about mission product design.
• SMAP currently has 55 Early Adopters
  – Topics are highly varied
    • Scientific
    • Social Scientific
    • Economic
Provisions for Early Adopters

• Early Adopter candidates propose an application that uses mission data
• Team from Science and Science Data System review the candidate application and accept or reject them
  – Proposal must be viable and display an adequate understanding of product content
• Mission requires that approved applicants sign agreement that specifies:
  – The data are simulated, have no value for scientific research
  – The data may not be distributed beyond the Early Adopter team
• Based on additional criteria, some Early Adopters currently receive pre-Beta data
  – Early Adopter demonstrated effective use of simulated data
  – Data collected during pre-beta period is relevant to their research
The NASA Short-Term Prediction Research and Transition Center (SPoRT) is implementing the assimilation of soil moisture observations from SMOS into the WRF numerical weather prediction (NWP) model through coupling with the Land Information System to 1) investigate the impact of soil moisture observations on NWP models and 2) understand the mechanics needed to assimilate soil moisture from the upcoming SMAP mission.

By assimilating soil moisture observations, modelers can improve a land surface model’s ability to simulate evapotranspiration and latent and sensible heating at the surface, important inputs to NWP models. In addition, knowledge of the soil moisture helps calculate surface emissivity, improving the utilization of satellite observations of atmospheric temperature and water vapor within the data assimilation system, further improving weather forecasts.

- The NASA SPoRT Center is assimilating SMOS into the Weather Research and Forecasting numerical weather prediction NWP model through coupling with the Land Information System (LIS).
- By assimilating soil moisture observations, modelers can improve a land surface model’s ability to simulate evapotranspiration and latent and sensible heating at the surface, important inputs to NWP models.
Currently, weekly national maps of soil moisture condition are produced using sensors such as AMSR and SMOS.

AAFC will integrate the soil moisture information from SMAP into existing monitoring programs and achieve improvements from increased spatial resolution and data continuity that will enhance agricultural monitoring capacity.
Use of AMSR, SMOS and SMAP soil moisture for Agro-climate risk monitoring
The USDA National Agricultural Statistical Service (NASS) has launched a web-based U.S. crop vegetation condition assessment and monitoring application: VegScape (http://nassgeodata.gmu.edu/VegScape/).

This web-based application has been designed to be a platform for accessing, visualization, assessing and disseminating crop soil moisture condition derivative data products produced using SMAP data.
The figure describes areas of the world where the assimilation of AMSR-E surface soil moisture retrievals significantly impacts the sampled cross-correlation between soil moisture anomalies and NDVI anomalies. Red areas correspond to regions where the availability of satellite-based surface soil moisture retrievals significantly improves our ability to forecast agricultural drought relative to the water balance modeling system currently employed by USDA FAS.
Effect of the soil moisture on dust emission

Hosni Ghedira, Masdar Institute, UAE; SMAP Contact: Dara Entekhabi

Estimating and mapping the extent of Saharan dust emissions using SMAP-derived soil moisture data.

- The AERONET aerosol optical depth (AOT$_{870}$) was correlated to the SMOS soil moisture data collected from 2010 to 2011 in south Sahel.
- The results show that as the SMOS soil moisture increase, the AERONET AOT decrease up to a threshold moisture content above which no dust emission takes place.
Vehicle Mobility

Soil moisture can be used to estimate soil strength, which is a key factor in terrain trafficability.

This figure shows a sample of the difference in the estimated time to target for a military ground vehicle using satellite soil moisture data (left) versus not using satellite soil moisture data (right).

Gary McWilliams, Army Research Laboratory (ARL); George Mason, U.S. Army Engineer Research and Development Center (ERDC) Geotechnical and Structures Laboratory (GSL); Li Li, Naval Research Laboratory (NRL); and Andrew Jones, Colorado State University (CSU); SMAP Contact: Susan Moran

Exploitation of SMAP data for Army and Marine Corps mobility assessment
The soil strength quantified using the Rating Cone Index (RCI) as an indicator of soil shear strength with climatological data (left) and SMAP simulated data (right). These images are used to map vehicle speeds for the Army maneuvers.
Conducted successful SMOS Ice validation campaign in the Barents Sea east of Svalbard (Left)

The advantage of the high-resolution active SMAP radar data (L1C_S0_HiRes) is to develop methods to account for the subpixel-scale heterogeneity for the retrieval of geophysical snow and ice parameters from the low-resolution brightness temperature measurements (L1B_TB or L1C_TB).

Coincident L-band radiometer (EMIRAD-2) and ice thickness measurements, CryoSat2 satellite underflights
An example of FFG estimated top-soil saturation fraction base map from operational Southern Africa Flash Flood Guidance system.

A pre-launch prototype of a Flash Flood Guidance System to ingest and assimilate L3_SM_A/P data.

Global Flash Flood Guidance

Konstantine Georgakakos, Hydrologic Research Center; SMAP
Contact: Narendra Das

Development of a strategy for the evaluation of the utility of SMAP products for the Global Flash Flood Guidance Program of the Hydrologic Research Center.
We have run about 10 years of daily ECMWF re-analysis rainfall data thru VIC to compute soil moisture as a surrogate for SMAP data.

Strong correlations of precipitation total and top layer soil moisture and the downstream floodplain inundation volume (m³) were derived (0.88 - using rainfall only gives 0.49 - 0.52, resp.), clearly indicating that both rainfall and soil moisture can be used as predictors for flood inundation in our region.
Flood Forecasting

Luca Brocca, Research Institute for Geo-Hydrological Protection, Italian Dept. of Civil Protection; SMAP contact: Dara Entekhabi

Use of SMAP soil moisture products for operational flood forecasting: data assimilation and rainfall correction

With existing satellite SM data
1) Improving flood forecasting through the assimilation of ASCAT and AMSR-E soil moisture products
2) Rainfall estimation from ASCAT, AMSR-E, and SMOS SM data

With SMAP simulated SM data
- Estimation of rainfall through SM2RAIN algorithm over Europe
**Water Resources Assessment**

- AWRA landscape water balance model runs operationally to generate stores and fluxes of water across Australia for legislated National Water Accounting and Assessment reporting.

- Land surface data assimilation (DA) component of the AWRA system focuses on AMSR-E (passive) and ASCAT (active) soil moisture products currently under testing and further development.

**Evaluating AWRA shallow root-zone SM against cosmic-ray moisture probes.**

Luigi Renzullo, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia; SMAP Contact: Jeff Walker

Preparing the Australian Water Resources Assessment (AWRA) system for the assimilation of SMAP data.

© California Institute of Technology. Government Sponsorship Acknowledged
Sea Ice Mapping

Georg Heygster, Institute of Environmental Physics, University of Bremen, Germany; SMAP Contact: Simon Yueh

SMAP-Ice: Use of SMAP observations for sea ice remote sensing

Retrieval algorithm for thickness of thin sea ice from SMOS observations 40...50° incidence angle running operationally. See examples for Oct 2013 and Nov 2013 (Left).

Current status: Reading and projecting SMAP simulated data. SMAP 1.4 GHz TBh (Left)
A water requirement satisfaction index (WRSI) based on SMAP-like soil moisture to improve crop yield estimates

Map of WRSI anomalies from different SM products in 2002.

In Niger, there are strong difference between the rainfall-derived WRSI (bucket and Noah) and the ECV* microwave WRSI.

*European Space Agency (ESA)
Essential Climate Variable (ECV)

Seamless use of AMSR, SMOS and SMAP soil moisture for agro-climate risk monitoring

Simulated SMAP data were used in agricultural models to show the usefulness of soil moisture for crop yield estimation.

Incorporating the SMAP data into the agricultural model reduced the uncertainty of modeled crop yields when the weather input data to the crop model are subject to large uncertainty.