SMAPVEX12 PALS Soil Moisture Data, Version 1

USER GUIDE

How to Cite These Data

As a condition of using these data, you must include a citation:

Colliander, A. 2017. *SMAPVEX12 PALS Soil Moisture Data, Version 1*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/PGZVDAVFWVYQ. [Date Accessed].

FOR QUESTIONS ABOUT THESE DATA, CONTACT NSIDC@NSIDC.ORG

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/SV12PLSM/

National Snow and Ice Data Center

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1 DATA DESCRIPTION

1.1 Parameters

The retrieved parameter for this data set is soil moisture [m^3/m^3]. Parameters used as input to the algorithm are also provided, including brightness temperature [K], estimated soil temperature [°C], estimated vegetation temperature [°C], vegetation water content [kg/m^2], land cover class, sand fraction [%], and clay fraction [%].

1.1.1 Parameter Range

Valid parameter values are as follows:

Soil moisture: 0-1 m^3/m^3
Brightness temperature: 50-350 K
Temperature: 0-40°C
Vegetation water content: 0-40 kg/m^2
Sand and clay fractions: 0-100 %

Table 1 describes the land cover classes, which range from 1 to 11.

Table 1. Land Cover Classes

Class Number	Description
1	Unclassified
2	Water
3	Urban
4	Shrub
5	Wetlands
6	Pasture
7	Cereals
8	Corn
9	Canola
10	Soybean
11	Broadleaf

1.2 File Information

1.2.1 Format

Data are provided in ASCII comma-delimited text files. Table 2 provides descriptions for each column in the ASCII files.

An associated Extensible Markup Language (XML) metadata file is also provided for each data file.

Table 2. Description of Columns in Data Files

Column Number	Column Heading	Column Description
1	Date	Date in YYYYMMDD format [4-digit year, 2-digit month, two-digit day]
2	Row	Row number
3	Col	Column number
4	X (UTM)	Universal Transverse Mercator X (easting) coordinate of the boresight [m]
5	Y (UTM)	Universal Transverse Mercator Y (northing) coordinate of the boresight [m]
6	VSM	Volumetric soil moisture [m^3/m^3]
7	TaH	Horizontally polarized brightness temperature [K]
8	TaV	Vertically polarized brightness temperature [K]
9	Tsoil	Estimate of the soil temperature [°C]
10	Tveg	Estimate of the vegetation temperature [°C]
11	VWC	Average vegetation water content in the pixel [kg/m^2]
12	LC	Dominant land cover class in the pixel [-]
13	S%	Average sand fraction in the pixel [%]
14	C%:	Average clay fraction in the pixel [%]
Note: The fill value NaN, for Not a Number, indicates when no data are available.		

1.2.2 Naming Convention

Files are named according to the following convention:

SV12PLSM_PALS_VSM_2012MMDD_HiAlt_v01.txt

Example: `SV12PLSM_PALS_VSM_20120629_HiAlt_v01.txt`

Where:

Table 3. File Naming Convention

Variable	Description
SV12PLSM	Product Short Name
PALS	Passive Active L- and S-band (PALS) Data
VSM	Volumetric Soil Moisture
2012	2012 (indicates year of SMAPVEX12 campaign)
MM	2-Digit Month
DD	2-Digit Day
HiAlt	High-Altitude Data
vXX	Data Version (v01: version 1.0)
.txt	Indicates ASCII text file format

1.3 Spatial Information

1.3.1 Coverage

Southernmost Latitude: 49.44°N

Northernmost Latitude: 49.96°N

Westernmost Longitude: 98.51°W

Easternmost Longitude: 97.85°W

1.3.2 Resolution

The high-altitude footprint size is approximately 1500 m, with a flight overpass sampling area of approximately 46 km x 47 km.

1.3.3 Projection

Data are provided in Universal Transverse Mercator (UTM) World Geodetic System 1984 (WGS84) coordinates, Zone 14 U.

1.4 Temporal Information

1.4.1 Coverage

Data were collected every one to four days from 12 June 2012 through 19 July 2012.

2 DATA ACQUISITION AND PROCESSING

2.1 Background

A description of SMAPVEX12 experiment domain and data acquisition regime is given in McNairn et al. (2015).

2.2 Theory of Measurements

Soil moisture was retrieved using PALS brightness temperature observations. The algorithm uses a variant of the traditional t-w-h algorithm (Njoku and Entekhabi, 1996). A detailed description of the algorithm and processing is given in Colliander et al. (2016).

2.3 Quality, Errors, and Limitations

2.3.1 Error Sources

Refer to Colliander et al. (2016) for a detailed discussion on error sources impacting the soil moisture retrieval.

2.3.2 Quality Assessment

Metrics for the soil moisture retrieval performance in non-forested areas based on in situ measurements was found to be as follows: RMSD (root mean square difference) 0.058 m^3/m^3, bias -0.015 m^3/m^3, ubRMSD (unbiased RMSD) 0.056 m^3/m^3, and Pearson correlation 0.87. The performance is not defined for forested areas and usage of the retrievals over areas which are marked as broadleaf is not recommended for any scientific purposes. Refer to Colliander et al. (2016) for details.

2.4 Instrumentation

2.4.1 Description

With NASA support, the Jet Propulsion Laboratory (JPL) designed, built, and tested the Passive Active L-band System (PALS) microwave aircraft instrument and deployed the instrument for measurements of soil moisture and ocean salinity (Wilson et al. 2001). PALS provides radiometer products, such as vertically and horizontally polarized brightness temperatures, and radar products, such as normalized radar backscatter cross-section for V-transmit/V-receive, V-transmit/H-receive, H-transmit/H-receive, and H-transmit/V-receive. In addition, it can also provide the polarimetric third

Stokes parameter measurement for the radiometer and the complex correlation between any two of the polarized radar echoes (VV, HH, HV and VH).

The following table provides the key characteristics of PALS:

Table 4. Description of the PALS instrument

Passive	Frequency	1.413 GHz
	Polarization	V, H, +45, -45
	Calibration stability	1 K (bias); 0.2 K (stability)
Active	Frequency	1.26 GHz
	Polarization	VV, HH, VH, HV
	Calibration accuracy	<2 dB (bias); 0.2 dB (stability)
Antenna	Half Power Beamwidth	20° (passive); 23°(active)
	Beam Efficiency	94%
	Directivity	18.5 dB
	Polarization isolation	> 35 dB

The PALS instrument was flown in four major soil moisture experiments (SGP99, SMEX02, CLASIC07 and SMAPVEX08 [Colliander et al. 2012]) before deployment in SMAPVEX12. Beginning with CLASIC07, a new flat-panel antenna array was substituted for the large horns. The planar antenna consists of 16 stacked-patch microstrip elements arranged in a four by- four array configurations. Each stacked-patch element uses a honeycomb structure with extremely low dielectric loss at L-band to support the ground plane and radiating patches. The measured antenna pattern shows better than 33 dB polarization isolation, far exceeding the need for the polarimetric measurement capability. This compact, lightweight antenna has enabled PALS to transition to operating on small aircraft, such as the Twin Otter (Yueh et al. 2008).

PALS was mounted at a 40° incidence angle looking to the rear of the aircraft. The 3 dB spatial resolutions of the instruments at two potential altitudes are 500 m (due to 1000 m altitude, minimum for the radar operation) and 1500 m (due to 3000 m altitude, maximum). It is important to note that PALS provides a single beam of data along a flight track and that any mapping must rely upon multiple flight lines at a spacing of the footprint width.

The calibration of the PALS brightness temperature during SMAPVEX12 is described in Colliander et al. (2015).

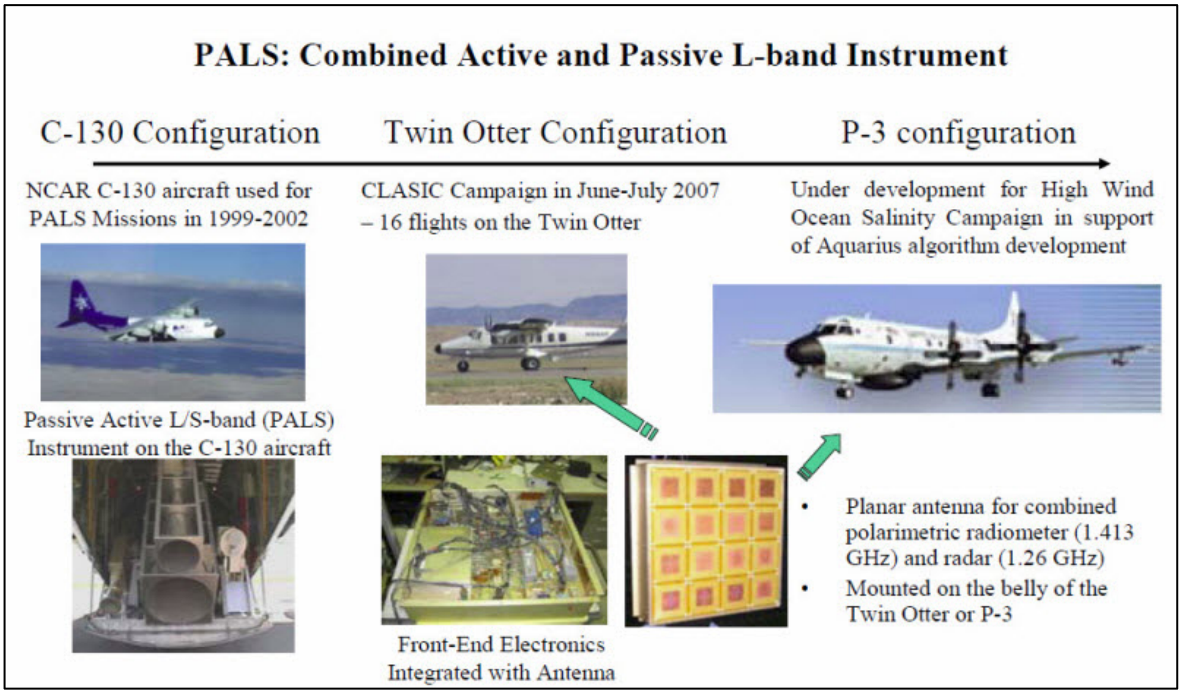

Figure 1. Images of Three Different Aircraft Installations of the PALS Combined Active and Passive L-band Instrument

3 SOFTWARE AND TOOLS

No special tools are required to view these data. Any word-processing program or Web browser will display the data.

4 CONTACTS AND ACKNOWLEDGMENTS

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5 REFERENCES

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6 DOCUMENT INFORMATION

6.1 Publication Date

June 2017

6.2 Date Last Updated

February 2025