SMAPVEX08 PALS Backscatter Data, Version 1

USER GUIDE

How to Cite These Data

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

Yueh, S. 2015. *SMAPVEX08 PALS Backscatter 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/KEBHW2DGUGH8. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/SV08PLBK

National Snow and Ice Data Center

TABLE OF CONTENTS

1 DETAILED DATA DESCRIPTION

This data set contains backscatter data obtained by the Passive Active L-band System (PALS) microwave aircraft instrument collected as part of the Soil Moisture Active Passive Validation Experiment 2008 (SMAPVEX08).

1.1 Format

Table 1 describes each column in the ASCII data files. An associated XML metadata file is also provided for each data file.

Table 1. Contents of Data Fields

Column Number	Description
1	Time in seconds from PALS radar computer
2	Time in milliseconds from DADS
3	Latitude of the footprint center [°]
4	Longitude of the footprint center [°]
5	Azimuth angle of radar look direction with respect to north [°]
6	Polarization roll angle of the antenna beam [°]
7	Range to target [m]
8	Incidence angle [°]
9	VV normalized radar cross-section [dB]
10	HH normalized radar cross-section [dB]
11	HV normalized radar cross-section [dB]
12	VH normalized radar cross-section [dB]
13	Real part of cross-correlation: vvhh
14	Imaginary part of cross-correlation: vvhh
15	Real part of cross-correlation: vvhv
16	Imaginary part of cross-correlation: vvhv
17	Real part of cross-correlation: vvvh
18	Imaginary part of cross-correlation: vvvh
19	Real part of cross-correlation: hhhv
20	Imaginary part of cross-correlation: hhhv
21	Real part of cross-correlation: hhvh
22	Imaginary part of cross-correlation: hhvh
23	Real part of cross-correlation: hvvh
24	Imaginary part of cross-correlation: hvvh

1.2 File and Directory Structure

Data files are available at:

https://n5eil01u.ecs.nsidc.org/SMAP_VAL/SV08PLBK.001/

1.3 File Naming Convention

Files are named according to the following convention and as described in Table 2:

Example:

SV08PLBK_09291306.red

SV08PLBK_MMDDhhmm.red

Table 2. Contents of Data Fields

Variable	Description
SV08PLBK	Data Set ID
MM	2-Digit Month
DD	2-Digit Day
hh	2-digit hours of the start time
mm	2-digit minutes of the start time
.red	Indicates file extension

1.4 File Size

Files range in size from approximately 1 to 7 MB.

1.5 Volume

The approximate volume for this data set is 293 MB.

1.6 Spatial Coverage

Southernmost Latitude: 38.93°N

Northernmost Latitude: 39.09°N

Westernmost Longitude: 76.25°W

Easternmost Longitude: 75.55°W

1.6.1 Spatial Resolution

The 3 dB spatial resolutions of the instruments at two potential altitudes are 350 m (1000 m altitude, minimum for the radar operation) and 1100 m (3000 m, maximum).

1.6.2 Projection and Grid Description

Latitude/longitude (WGS84)

1.7 Temporal Coverage

29 September 2008 through 13 October 2008.

1.7.1 Temporal Resolution

Data were collected every 1 to 3 days.

1.8 Parameter or Variable

Parameters include normalized radar cross-section (dB), incidence angle (°), azimuth angle (°), polarization rotation angle (°), range (m), and complex cross-correlation.

1.8.1 Parameter Range

Valid parameter values are as follows:

Normalized radar cross-section: -40 - 0 dB
Incidence angle: 30° - 50°
Azimuth angle: 0° - 360°
Polarization rotation angle: -90° - 90°
Range: 0 - 10000 m

2 SOFTWARE AND TOOLS

2.1 Software and Tools

Any word-processing program or Web browser is sufficient for viewing ASCII text files.

3 DATA ACQUISITION AND PROCESSING

3.1 Theory of Measurements

Current microwave models and retrieval algorithms have significant limitations in their treatment of different vegetation types and heterogeneous scenes (mixtures of grass, crops, trees, streams, lakes) and quantitative treatment of algorithm scaling and error analysis for such heterogeneous scenes. Measurements over wide varieties of terrain are needed, with joint active and passive sensors, to develop algorithms and parameterizations that can work across all terrain types, and extract optimum information from the combined data. This will have direct impact on the design of dedicated soil moisture missions and development of methods to assimilate such data into land surface models.

Microwave radiometry and radar are well-established techniques for surface remote sensing. Combining passive and active sensors provides complementary information contained in the surface emissivity and backscatter signatures, which can improve the accuracy of retrieval of geophysical parameters. Over land, it has been demonstrated that the radiometer and the radar both provide information for estimating soil moisture and vegetation water content (Bolten et al. 2003, Njoku et al. 2002, Narayan et al. 2004).

3.2 Sensor or Instrument Description

The campaign, deployed by the Jet Propulsion Laboratory (JPL) with support from NASA, designed, built, and tested a precision Passive Active L-band System (PALS) microwave aircraft instrument for measurements of soil moisture and ocean salinity (Wilson et al. 2001). PALS provides radiometer products, vertically and horizontally polarized brightness temperatures, and radar products, 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 3. 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

PALS was flown in three major soil moisture experiments (SGP99, SMEX02 and CLASIC) before deployment in SMAPVEX08 (PDF). Beginning with CLASIC, a new flat-panel antenna array was substituted for the large horns. The planar antenna consists of 16 stacked-patch microstrip elements arranged in 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 35 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.

Since the CLASIC experiment in 2007, the PALS was augmented with additional components designed to detect and mitigate Radio Frequency Interference (RFI). The demonstration and evaluation of these elements was an important consideration in the SMAPVEX08 design.

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 350 m (1000 m altitude, minimum for the radar operation) and 1100 m (3000 m, 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 (see Figure 1).

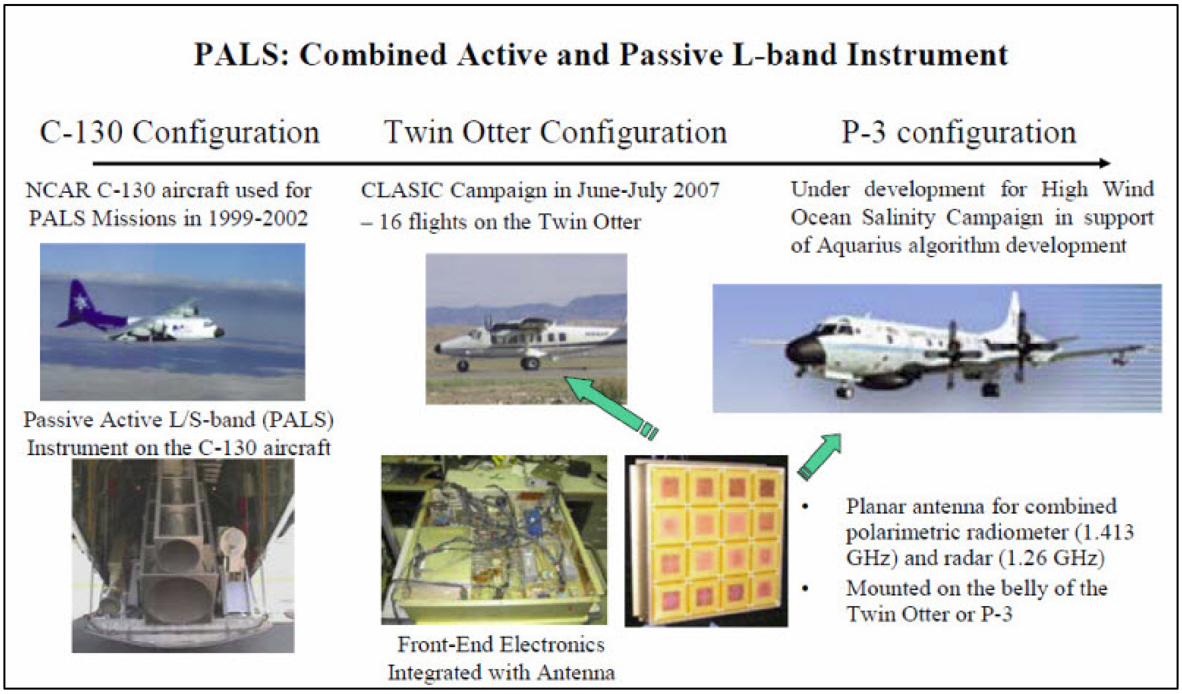

Figure 1. Images showing three different aircraft installations of the PALS Combined Active and Passive L-band Instrument.

3.3 Errors and Limitations

The quality of the normalized radar cross-section relies on internal calibration utilizing a calibration loop. The external calibration utilizes predetermined coefficients of the antenna and front-end. These references assure good quality of the data and there are no exceptional error sources for this data set.

3.4 Version History

Version 1 (June 2015)

4 REFERENCES AND RELATED PUBLICATIONS

Bolten, J., V. Lakshmi, and E. Njoku. 2003. Soil Moisture Retrieval Using the Passive/Active L- and S-band Radar/Radiometer. *IEEE Trans. Geosci. Rem. Sens.*, 41:2792-2801.

Narayan, U., V. Lakshmi, and E. Njoku. 2004. Retrieval of Soil Moisture from Passive and Active L/S Band Sensor (PALS) Observations during the Soil Moisture Experiment in 2002 (SMEX02). *Rem. Sens. Environ.*, 92:483-496.

Njoku, E., W. Wilson, S. Yueh, S. Dinardo, F. Li, T. Jackson, V. Lakshmi, and J. Bolten. 2002. Observations of Soil Moisture Using a Passive and Active Low Frequency Microwave Airborne Sensor during SGP99. *IEEE Trans. Geosci. Rem. Sens.*, 40:2659-2673.

Wilson, W. J., S. H. Yueh, S. J. Dinardo, S. Chazanoff, F. K. Li, and Y. Rahmat-Samii. 2001. Passive Active L- and S-band (PALS) Microwave Sensor for Ocean Salinity and Soil Moisture Measurements. *IEEE Trans. Geosci. Rem. Sens.* 39, 1039-1048.

5 CONTACTS AND ACKNOWLEDGMENTS

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6 DOCUMENT INFORMATION

6.1 Publication Date

June 2015

6.2 Date Last Updated

October 2020