SMEX02 Passive and Active L and S band System (PALS) Data, Version 1

USER GUIDE

How to Cite These Data

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

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National Snow and Ice Data Center

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1 DETAILED DATA DESCRIPTION

PALS is a non-scanning, real-aperture, combined microwave radiometer and radar. The radiometer operates at 1.41 and 2.69 GHz; the radar at and 1.26 and 3.15 GHz. The radiometer operates at V (vertical) and H (horizontal) polarizations, while the radar operated at VV, HH, and VH polarizations. Two conical horn antennas were used. An L-band horn of 1.2 m diameter was shared between the 1.41 and 1.26 GHz radiometer and radar frequencies. An S-band horn of 0.54 m diameter was shared between the 2.69 and 3.15 GHz radiometer and radar frequencies.

The PALS instrument was designed for flight on a C-130 aircraft, with the antennas installed on the rear ramp, viewing downwards to the rear of the aircraft. The antennas were set to view the surface at a constant incidence angle of 45°. The instrument sampled a single footprint track along the flight path. In SMEX02 PALS was operated nominally at ~3500 feet, with one set of flights (6 July) at ~7000 feet.

1.1 Format

Data are provided as ASCII text files or as two tar files that contain the text files.

1.2 File and Directory Structure

Data are contained in two directories. The directory "radr" contains the radar files. The directory "radm" contains the radiometric files.

1.3 File Naming Convention

All file names consist of month, day, and hour in the form: MMDDHHHH. The Radar files have a ".red" file extension to distinguish them from the radiometric files, which have a ".txt" extension. For example, "06250841.red" is the radar file, and "06250841.txt" is the radiometric file. Data for both files was obtained on 6 June at 08:41.

1.4 File Size

File size ranges from 7 KB to 220 KB.

1.5 Spatial Coverage

Southernmost Latitude: 41.9213° N
Northernmost Latitude: 41.9952° N
Westernmost Longitude: 93.7750° W

Easternmost Longitude: 93.4013° W

1.5.1 Spatial Resolution

Each sample has a footprint resolution of approximately 330 x 470 m.

1.6 Temporal Coverage

25 June through 8 July 2002.

1.6.1 Temporal Resolution

Daily coverage for June 25, 27, and July 1, 2, 5-8 2002.

1.7 Parameter or Variable

1.7.1 Parameter Description

The following tables explain the columns in the data files. The first table defines the columns in the radiometric files found in the "radm" directory.

Table 1. Parameter Description of “radm” Directory

Column heading	Description (unit of measure)
time	Instrument local time from midnight(sec)
L-H	L-band H-pol calibrated brightness temperature (TB) (K)
L-V	L-band V-pol calibrated TB (K)
S-H	S-band H-pol calibrated TB (K)
S-V	S-band V-pol calibrated TB (K)
boresight	Thermal infrared surface temperature (boresight camera) (°C)
nadir	Thermal infrared surface temperature (nadir camera) (°C)
ant_angle	Antenna beam incidence angle (deg)(nominally 45°)
roll_angle	Aircraft roll angle (deg)
lat	Footprint center latitude (deg) (corrected for aircraft altitude and attitude)
long	Footprint center longitude (deg) (corrected for aircraft altitude and attitude)
ant_azimuth	Antenna azimuth viewing angle relative to North (deg) (East is 90 deg)
altitude	Aircraft altitude (m)
sample#	Sample number in original instrument data record

The next table defines the columns in the radar files found in the "radr" directory.

Table 2. Parameter Description of "radr" Directory

Column heading	Description (unit of measure)
time	Instrument local time from midnight (sec)
GPS_time	Aircraft GPS time (UT) from midnight (sec)
lat	Footprint center latitude corrected for altitude and attitude (deg)
long	Footprint center longitude corrected for altitude and attitude(deg)
ant_azimuth	Antenna azimuth viewing angle relative to North (deg) (East is 90°)
polar_angle	Antenna polarization rotation angle (deg)(Angle of the V and H polarizations of the horn antennas relative to nominal)
range	Range from surface footprint to aircraft (m)
beam_angle	Antenna beam incidence angle (deg) (nominally 45 degrees)
L_HH	L-band HH-pol radar backscatter (sigma 0) (dB)
L_VV	L-band VV-pol radar backscatter (sigma 0) (dB)
L_VH	L-band VH-pol radar backscatter (sigma 0) (dB)
L_HV	L-band HV-pol radar backscatter (sigma 0) (dB)
S_HH	S-band HH-pol radar backscatter (sigma 0) (dB)
S_VV	S-band VV-pol radar backscatter (sigma 0) (dB)
S_VH	S-band VH-pol radar backscatter (sigma 0) (dB)
S_HV	S-band HV-pol radar backscatter (sigma 0) (dB)
LR_HHVV	Normalized real part of L-band HH and VV complex correlation
LI_HHVV	Normalized imaginary part of L-band HH and VV complex correlation
LR_HHVH	Normalized real part of L-band HH and VH complex correlation
LI_HHVH	Normalized imaginary part of L-band HH and VH complex correlation
LR_HHHV	Normalized real part of L-band HH and HV complex correlation
LI_HHHV	Normalized imaginary part of L-band HH and HV complex correlation
LR_VVVH	Normalized real part of L-band VV and VH complex correlation
LI_VVVH	Normalized imaginary part of L-band VV and VH complex correlation
LR_HVVV	Normalized real part of L-band HV and VV complex correlation
LI_HVVV	Normalized imaginary part of L-band HV and VV complex correlation
LR_HVVH	Normalized real part of L-band HV and VH complex correlation
LI_HVVH	Normalized imaginary part of L-band HV and VH complex correlation
SR_HHVV	Normalized real part of S-band HH and VV complex correlation
SI_HHVV	Normalized imaginary part of S-band HH and VV complex correlation
SR_HHVH	Normalized real part of S-band HH and VH complex correlation
SI_HHVH	Normalized imaginary part of S-band HH and VH complex correlation
SR_HHHV	Normalized real part of S-band HH and HV complex correlation

Column heading	Description (unit of measure)
SI_HHHV	Normalized imaginary part of S-band HH and HV complex correlation
SR_VVVH	Normalized real part of S-band VV and VH complex correlation
SI_VVVH	Normalized imaginary part of S-band VV and VH complex correlation
SR_HVVV	Normalized real part of S-band HV and VV complex correlation
SI_HVVV	Normalized imaginary part of S-band HV and VV complex correlation
SR_HVVH	Normalized real part of S-band HV and VH complex correlation
SI_HVVH	Normalized imaginary part of S-band HV and VH complex correlation

1.7.2 Sample Data Record

The following sample is taken from "07060831.txt," a radiometric file acquired 6 July 2002.

Table 3. Sample Data Record

time	L-H	L-V	S-H	S-V	bore sight	nadir	ant_angle	roll_ angle	lat	long	ant_az imuth	altitude	sam ple#
30697.2	260.33	283.13	272.57	286.31	25.1	25.6	44.3	0.3	41.9277	-93.7849	273	1152	44
30698.2	259.71	281.97	273.67	287.22	25.0	25.6	44.3	0.5	41.9277	-93.7838	273	1153	46
30699.2	258.61	280.75	272.89	285.96	24.9	25.7	44.3	1.1	41.9278	-93.7828	273	1154	48
30700.3	257.24	279.87	271.65	283.33	25.4	25.9	44.2	2.0	41.9279	-93.7817	273	1156	50
30701.3	255.91	279.17	270.42	283.18	26.2	26.5	44.2	3.0	41.9279	-93.7804	274	1158	52

2 DATA ACQUISITION AND PROCESSING

The following tables define the flight paths covered in each of the data files. The tables are arranged by date, the same as the directory structure.

2.1 25 June 2002 Files

Table 4. Flight Paths from 25 June 2002

Pass #	Line #	Radiometer Files	Radar Files	Comments
1	1e	06250752.txt	06250752.red	RFI in S-band. Flown at 820-m altitude.
2	1w	06250801.txt	06250801.red	RFI in S-band
3	2e	06250812.txt	06250813.red	RFI in S-band. Timing computer crash.
4	3e	06250845.txt	06250846.red	RFI in S-band.
5	3w	06250854.txt	06250854.red	RFI in S-band.
6	4e	06250905.txt	06250905.red	RFI in S-band.

Pass #	Line #	Radiometer Files	Radar Files	Comments
7	4w	06250914.txt	06250914.red	RFI in S-band.
8	5e	06250925.txt	06250925.red	RFI in S-band.
9	5w	06250935.txt	06250935.red	
10	6e	06250945.txt	06250945.red	
11	6w	06250957.txt	06250957.red	
12	7e	06251007.txt	06251007.red	
13	7w	06251016.txt	06251016.red	
14	8e	06251027.txt	06251027.red	
15	8w	06251037.txt	06251037.red	
16	9e	06251047.txt	06251047.red	
17	9w	06251056.txt	06251056.red	
18	10e	06251107.txt	06251107.red	
19	10w	06251116.txt	06251116.red	
20	2e	06251126.txt		Repeat of earlier pass. Radar problem.
21	2w	06251135.txt	06251135.red	

2.2 27 June 2002 Files

Table 5. Flight Paths from 27 June 2002

Pass#	Line#	Radiometer Files	Radar Files	Comments
1	1e	06270814.txt	06270814.red	
2	2w	06270825.txt	06270825.red	
3	3e	06270836.txt	06270836.red	
4	4w	06270847.txt	06270847.red	
5	5e	06270857.txt	06270857.red	
6	6w	06270909.txt	06270909.red	RFI in LH.
7	7e	06270919.txt	06270919.red	
8	8w	06270930.txt	06270930.red	RFI in LH. IR camera problem.
9	9e	06270941.txt	06270941.red	
10	10w	06270952.txt	06270951.red	RFI in LH.
11		06271000.txt	06270959.red	Pass over trees.

2.3 1 July 2002

Table 6. Flight Paths from 1 July 2002

Pass#	Line#	Radiometer Files	Radar Files	Comments
1	1e	07010833.txt	07010833.red	
2	2w	07010845.txt	07010845.red	
3	3e	07010857.txt	07010858.red	
4	4w	07010907.txt	07010907.red	Computer problem, end of day's mission.

2.4 2 July 2002

Table 7. Flight Paths from 2 July 2002

Pass#	Line#	Radiometer Files	Radar Files	Comments
1	1e	07020831.txt	07020831.red	
2	2w	07020841.txt	07020842.red	
3	3e	07020855.txt	07020855.red	
4	4w	07020906.txt	07020906.red	
5	5e	07020918.txt	07020918.red	
6	6w	07020929.txt	07020929.red	
7	7e	07020941.txt	07020942.red	
8	8w	070020952.txt	07020952.red	
9	9e	07021005.txt	07021005.red	
10	10w	07021015.txt	07021015.red	
11		07021025.txt	07021025.red	Pass over trees.

2.5 5 July 2002

Table 8. Flight Paths from 5 July 2002

Pass#	Line#	Radiometer Files	Radar Files	Comments
1	1e	07050832.txt	07050832.red	
2	1w	07050843.txt	07050843.red	
3	2e	07050855.txt	07050855.red	
4	2w	07050906.txt	07050906.red	
5	3e	07050917.txt	07050917.red	
6	3w	07050928.txt	07050928.red	
7	4e	07050939.txt	07050939.red	

Pass#	Line#	Radiometer Files	Radar Files	Comments
8	4w	07050950.txt	07050950.red	
9	5e		07051002.red	Radiometer bad acquisition
10	5w	07051013.txt	07051013.red	
11	6e	07051024.txt	07051024.red	
12	6w	07051034.txt	07051035.red	
13	7e	07051046.txt	07051046.red	
14	7w	07051056.txt	07051057.red	
15	8e	07051108.txt	07051108.red	
16	8w	07051118.txt	07051118.red	
17	9e	07051130.txt	07051130.red	
18	9w	07051141.txt	07051141.red	
19	10e	07051152.txt	07051152.red	
20	10w	07051202.txt	07051203.red	
21		07051212.txt	07051212.red	Pass over trees.
22	5e	07051215.txt		Repeat radiometer pass aborted earlier.

2.6 6 July 2002

Table 9. Flight Paths from 6 July 2002

Pass#	Line#	Radiometer Files	Radar Files	Comments
1	1e	07060831.txt	07060831.red	
2	2w	07060840.txt	07060841.red	
3	3e	07060852.txt	07060853.red	
4	4w	07060902.txt	07060902.red	
5	5e	07060914.txt	07060914.red	
6	6w	07060924.txt	07060925.red	
7	7e	07060936.txt	07060936.red	
8	8w	07060947.txt	07060947.red	
9	9e	07060059.txt	07060059.red	
10	10w	07061009.txt	07061010.red	
11		07061019.txt	07061019.red	
12	1e	07061028.txt	07061028.red	Timing glitch in radiometer.
13	1e	061033.txt		Restarted file (lost ~0.5 mins data).
14	2w	07061038.txt	07061038.red	
15	3e	07061050.txt	07061050.red	
16	4w	07061100.txt	07061100.red	

Pass#	Line#	Radiometer Files	Radar Files	Comments
17	5e	07061111.txt	07061111.red	
18	6w	07061122.txt	07061122.red	
19	7e	07061133.txt	07061133.red	
20	8w	07061143.txt	07061143.red	
21	9e	07061154.txt	07061154.red	
22	10w	07061204.txt	07061204.red	

2.7 7 July 2002

Table 10. Flight Paths from 7 July 2002

Pass#	Line#	Radiometer Files	Radar Files	Comments
1	1e	07070959.txt	07070959.red	
2	2w	07071015.txt	07071015.red	
3	3e	07071027.txt	07071027.red	
4	4w	07071037.txt	07071037.red	
5	5e	07071049.txt	07071049.red	
6	6w	07071100.txt	07071100.red	
7	7e	07071111.txt	07071111.red	
8	8w	07071122.txt	07071122.red	
9	9e	07071134.txt	07071134.red	
10	10w	07071144.txt	07071144.red	
11		07071153.txt	07071153.red	Pass over trees.

2.8 8 July 2002

Table 11. Flight Paths from 8 July 2002

Pass#	Line#	Radiometer Files	Radar Files	Comments
1	1e	07080817.txt	07080817.red	
2	2w	07080827.txt	07080827.red	
3	3e	07080841.txt	07080841.red	
4	4w	07080851.txt	07080851.red	Significant LH RFI.
5	5e	07080905.txt	07080905.red	
6	6w	07080915.txt	07080915.red	Significant LH RFI.
7			07080926.red	Pass over trees.
8	7e	07080929.txt	07080929.red	
9	8w	07080938.txt	07080938.red	Significant LH RFI.

Pass#	Line#	Radiometer Files	Radar Files	Comments
10	9e	07080952.txt	07080952.red	
11	10w	07081001.txt	07081001.red	
12		07081012.txt	07081012.red	Pass over trees.

2.9 Theory of Measurements

To minimize radio-frequency interference (RFI), the PALS radiometers incorporated narrow-band filters at 20 MHz for L-band and 5 MHz fort S-band. At a nominal flight altitude of 1 km and incidence angle of 45° the instantaneous 3-dB footprints at the surface were approximately 330 x 470 m. The received radar and radiometer signals were detected and output by the instrument data system at 0.8-s and 0.5-s intervals, respectively. The radiometer data are further averaged in the post-processing to 1-s intervals. Aircraft location and navigation data and downward-looking thermal IR temperatures were recorded at 1-s intervals and inserted into the PALS data stream.

The radiometric sensitivities, ΔT, for a 1-s integration time are 0.25 K and 0.6 K at L and S bands, respectively. The velocity of the C-130 aircraft was approximately 70 m s-1, resulting in oversampling of the footprints at 1-s intervals. The oversampling of the footprint permits approximate collocation of time-averaged radiometer and radar footprints. There is an uncertainty of a few microseconds in the time delay between command and operation of the radar switches, which places a lower limit of about 1 km on the altitude at which the radar can reliably operate.

3 REFERENCES AND RELATED PUBLICATIONS

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.

4 CONTACTS AND ACKNOWLEDGMENTS

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5 DOCUMENT INFORMATION

5.1 Publication Date

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5.2 Date Last Updated

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