CLPX-Ground: Ground-based L and Ku band polarimetric scatterometry, Version 1

USER GUIDE

How to Cite These Data

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

Sarabandi, K. 2003. *CLPX-Ground: Ground-based L and Ku band polarimetric scatterometry, Version 1.#*. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. https://doi.org/10.5067/JWGEFX2FALQR. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/NSIDC-0166

National Snow and Ice Data Center

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1 DETAILED DATA DESCRIPTION

This data set consists of fully polarimetric backscattering coefficients of snow, collected with truck-mounted L- and Ku-band scatterometers. The calibrated radar systems were used to measure the amplitude and phase of backscattered signal over a relatively wide bandwidth at L-band (1.1-1.4 GHz) and Ku-band (15.25-15.75 GHz). Backscatter measurements of an open snow pack were collected at three different incidence angles (20, 35 and 50 degrees), several times a day. Radar data were collected over an open snowpack at approximately 39.95 N, 105.9 W. The spatial resolution of these data was ~2.5 m x 3.0 m (at 35 degrees) for L-band radar and ~0.6 m x 0.6 m for Ku-band radar.

Despite the extreme complexity of typical snowpacks, there is a growing interest in and need to characterize the physical parameters of snow from active and passive microwave sensors (radars and radiometers). There is also a need to investigate the influence of water content within a snowpack on these parameters throughout diurnal cycles of freezing and thawing. Traditional scatterometers use only a single polarization for transmitting and receiving, but polarimetric scatterometers provide the full polarimetric response of a target, which contains valuable information about the structure and composition of the target. Two frequencies were chosen for this study so that the responses obtained were influenced by different parts of the snowpack. At L-band, where the wavelength (~20cm) is long enough to allow penetration all the way through to the bottom of the snowpack, the scattered wave is expected to have a significant if not dominant contribution from the underlying ground. At Ku-band (and to a greater extent at millimeter-wave frequencies), the roughness and the effective dielectric constant of the snow top can have a major influence, and the total penetration depth will probably be relatively shallow.

1.1 Format

Data files are in ASCII format. Two Microsoft Excel files provide a summary listing of results (one for IOP3 and one for IOP4).

Each data file contains:

- the Mueller Matrix (described in Sarabandi, 1992) averaged over the number of spatial samples (typically between 20 and 60 independent spatial samples)
- the Mueller Matrix averaged over both frequency and spatial samples (351 frequency points are kept in this averaging)
- the Mueller Matrix parameters (radar backscattering coefficient [in dB] for all four polarizations, degree of correlation [alpha], polarized phase difference [Zeta,in degrees], and the "cross-pol/co-pol" ratio [in dB])

1.2 File Naming Convention

Data files are named with the band name (Ku or L), the date, and the time of measurement. For example, the file called "Ku02191349.mdt" contains data collected by the Ku-band radar, on 19 Feb (0219) 2003. Data collection began at 13:49 (1:49 pm) local time.

1.3 File Size

Data files range in size from 140 to 142 KB. The MS Excel summary files are 236 and 406 KB.

1.4 Spatial Coverage

Measurements were taken at the Fraser Experimental Forest Headquarters, Colorado, USA (39.95 N, 105.9 W). This area is known as the CLPX Local-Scale Observation Site (LSOS).

1.4.1 Spatial Resolution

Spatial resolution for the L-band radar was ~2.5m x 3.0m (at 35 degrees); for the Ku-band radar resolution was ~0.6m x 0.6m.

1.5 Temporal Coverage

Measurements were taken during 17-26 February and 26-30 March 2003, between 9 am and 6 pm local time.

1.6 Parameter or Variable

The following is a sample of the header information and the first line of data in file "Ku02191349.mdt".

```
 Time of Measurement: 1:49:00 PM,  Date: Wednesday, February 19, 2003
 Frequency Band:
 Ku
 Center Frequency, Start Frequency, and Stop Frequency (GHz) are:
 15.50         15.25          15.75
 Number frequency points:
 401
 Number of frequency points saved:
 401
 Number of spatial samples (positions):
 100
 Comments on the Target/Experiment:
 25 degrees outside, sunny
 Height Above Ground from H-frame(m), and Incidence Angle From Vertical (deg):
 11.3          20
 Time of Gating: 3:11:14 PM,  Date: Friday, April 25, 2003
 Gate Start and Stop in nanosec. are:
 385.1         390.2

 Final Product File Name: Ku02191349.mdt
 Target Data File (gated) used: Ku02191349.gdt
 Sphere Data File (gated) used: Ku02191544.gcl
 Background Data File (gated) used: Ku02191554.gbk
-------------------------------------------------------------------------------------

Mueller Matrix averaged over Spatial Samples

 Freq No.      25
 1.931087E-02                8.549867E-04               -2.551991E-03               -3.303421E-04
 1.666165E-03                8.444589E-03               -1.237152E-03               -9.992628E-04
-4.504739E-03               -3.474953E-03                9.894152E-03                3.939702E-03
etc....

Mueller Matrix averaged over Both Frequency and Spatial Samples

 7.858613E-03                7.297072E-04                1.090616E-05               -8.492468E-05
 7.61836E-04   6.813205E-03              -2.268498E-04              -9.295072E-05
-3.783498E-04               -1.173277E-04                5.346445E-03                1.335911E-03
-1.485124E-04               -2.276916E-04               -1.093896E-03                5.027399E-03

-------------------------------------------------------------------

sig_vv      sig_hh      sig_vh      sig_hv       alpha_c       zeta_c       xpol/copol
-10.05457     -10.67452     -20.37667     -20.18954     0.7280458     13.18243     -9.928607
```

1.6.1 Microsoft Excel Summary Files

IOP3_UM_Radar_Measurements.xls has three worksheets. Worksheet 1 has three subsections:

- Plots of co- and cross-polarized backscattering coefficients as a function of incidence angle for each measurement session in IOP3. These are not new data products, but they are graphical representations of the data in the *mdt files.
- Plots of degree of correlation and polarized phase difference (degrees) as a function of incidence angle. Two new products are derived from the following two equations

$$\alpha = \frac{1}{2}\sqrt{\frac{(M_{33}+M_{44})^2+(M_{34}-M_{43})^2}{M_{11}M_{22}}}$$

$$\zeta = \tan^{-1}\left(\frac{M_{34}-M_{43}}{M_{33}+M_{44}}\right)$$

- Other plots showing how the backscattering coefficient changes over time in vv and hh polarizations for Ku and L bands at the three different incidence angles (20, 35, 50).

Worksheet 2 provides a summary spreadsheet of all the Mueller Matrices parameters (found at the end of each *.mdt file) from IOP3. This includes the data from which the 'other plots' in Worksheet 1 were created.

Worksheet 3 repeats some of the data for the 'other plots' on Worksheet 1 but also compares it to 'real' data.

IOP4_UM_Radar_Measurements.xls has two worksheets. Worksheet 1 has three subsections:

- Plots of co- and cross-polarized backscattering coefficients as a function of incidence angle and time for each measurement session in IOP4. These are not new data products, but they are graphical representations of the data in the *mdt files.
- Plots of degree of correlation and polarized phase difference (degrees) as a function of incidence angle. Two new products are derived from the following two equations:

$$\alpha = \frac{1}{2}\sqrt{\frac{(M_{33}+M_{44})^2+(M_{34}-M_{43})^2}{M_{11}M_{22}}}$$

$$\zeta = \tan^{-1}\left(\frac{M_{34}-M_{43}}{M_{33}+M_{44}}\right)$$

- Other plots showing how the backscattering coefficient changes over time in vv and hh polarizations for Ku and L bands at the three different incidence angles (20, 35, 50).

Worksheet 2 provides a summary spreadsheet of all the Mueller Matrices parameters (found at the end of each *.mdt file) from IOP4. This includes the data from which the 'other plots' in Worksheet 1 were created.

2 DATA ACQUISITION AND PROCESSING

Site specifications at the Fraser Experimental Forest Headquarters, Colorado, USA, are:

- Open snowpack of approximately 200 m2
- Snow Conditions: dry during IOP3, wet and melting during IOP4 (limited)
- Ground Conditions: rough surface.

The data were collected with the following radars:

L-band polarimetric scatterometer
Center Frequency: 1.25 GHz

Bandwidth: 300 MHz

Ku-band polarimetric scatterometer
Center Frequency: 15.50 GHz
Bandwidth: 500 MHz

3 incidence angles: 20, 35 and 50 degrees
4 linear polarizations: VV, VH, HV, HH

3 REFERENCES AND RELATED PUBLICATIONS

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3.1 Related Data Collections

All CLPX Data Sets

4 CONTACTS AND ACKNOWLEDGMENTS

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5 DOCUMENT INFORMATION

5.1 Publication Date

5 September 2003

5.2 Date Last Updated

8 April 2021