



SnowEx20 COSMOS Stationary Soil Moisture, Version 1

USER GUIDE

How to Cite These Data

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

Lewis, M. and A. Fisher. 2021. *SnowEx20 COSMOS Stationary Soil Moisture, Version 1* [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. <https://doi.org/10.5067/WCKDBPDU85KO>. [Date Accessed].

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

FOR CURRENT INFORMATION, VISIT https://nsidc.org/data/SNEX20_CSSM



National Snow and Ice Data Center

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1 DATA DESCRIPTION

1.1 Parameters

This data set contains the raw and processed data files from the Grand Mesa Stationary COSMOS soil moisture probe. The parameters for the raw data are listed in Table 1 and the parameters of the processed data are listed in

Table 2.

Table 1. Raw Data Parameters

Parameter	Description
RecordNum	Record number
Date Time (UTC)	Date time in yyyy/mm/dd hh:mm:ss format (e.g. 2020/02/01 00:02:00)
P4_mb	Atmospheric pressure in mbar (gauge 1)
P1_mb	Atmospheric pressure in mbar (gauge 2)
T1_C	Temperature in °C (sensor 1)
RH1	Relative humidity (sensor 1)
T_CS215	Temperature (sensor 2) – inoperative, all values are -99
RH_CS215	Relative humidity (sensor 2) – inoperative, all values are -99
Vbat	Battery voltage
N1Cts	Tube 1 counts
N2Cts	Tube 2 counts
N1ETsec	Tube 1 time in seconds
N2ETsec	Tube 2 time in seconds

Table 2. Processed Data Parameters

Parameter	Description
Date	Date in mm/dd/yyyy format (e.g. 2/18/20)
Time	Time in hh:mm format (e.g. 20:02)
Cosmic-ray Soil Water Content (cm ³ /cm ³)	Calculated volumetric soil moisture

1.2 File Information

1.2.1 Format

Each month of measurements has a separate .txt file for the raw data and a .csv file for processed data.

1.2.2 File Contents

The raw data files begin with a 21-row header that specifies the logger information and probe settings. For example, data file SnowEx_COSs_L1_20FEB010002.txt contains the following header:

```

//Hydroinnova CRS Probe Filename: 2002010002.648
//****Provide the full data file, with the header information, if support is needed.
//Logger FWVer = 2.073
//Logger SerialNum=15020648
//Probe BootType = 5
//Power Conservation Settings
//Conserve5VPwr=0
//Conserve12VPwr=0
//ConserveNPMpwr=0
//ConserveSDI12Pwr=0
//SDI-12 Port Power Configuration
//PwrSDI12On=3, Port 1 Pwr. On, Port 2 Pwr. On

//NumberOfNPMs= 2
NPM#1: SerialNum=15030172, FWVer=2338, HV=&H3e8,G= 4.00,D= 11,UT= 62, DeadTime= 500, RemoteLEDMode=0, NBins= 64
NPM#2: SerialNum=15030168, FWVer=2338, HV=&H3e8,G= 3.90,D= 11,UT= 62, DeadTime= 500, RemoteLEDMode=0, NBins= 64

//Recordperiod = 60 minutes.
//DataSelect=p4p1t1h1t7h7bn1n2e1e2
//--Data Column Info:
    
```

Figure 1. Example header for raw data file SnowEx_COSs_L1_20FEB010002.txt

The raw data file then continues with 13 columns of parameters listed in Table 1. The processed data files contain 3 columns with the parameters listed in

Table 2.

1.2.3 Naming Convention

Data files utilize the following naming convention which is described in Table 3:

SNEX20_CSSM_YYYYMMDDHHMM_LX.EXT

Table 3. File Naming Convention

Variable	Description
SNEX20_CSSM	SnowEx 2020 COSMOS stationary soil moisture probe data
YYYYMMDDHHMM	Year, month, day, hour and minute of file start
LX	L1/L2 for raw/processed data
.EXT	File extension: .txt for raw data files; .csv for processed data files

Examples:

- SNEX20_CSSM_202001100002_L1.txt
- SNEX20_CSSM_202001100002_L2.csv

Note: There is generally one file per month except for the files _201911010018_ and _201911042214_ which are partial files used in testing functionality during installation and calibration.

1.3 Spatial Information

1.3.1 Coverage

These data are collected on a fixed station location in Grand Mesa with:

Latitude: 39.033 N

Longitude: 108.215 W

1.3.2 Resolution

Single readings cover an area of 200 m to 300 m in radius from the instrument.

1.3.3 Geolocation

The following table provides information for geolocating this data set.

Table 4. Geolocation Details

Geographic coordinate system	WGS 84
EPSG code	4326
PROJ4 string	+proj=longlat +datum=WGS84 +no_defs
Reference	https://epsg.io/4326

1.4 Temporal Information

1.4.1 Coverage

26 August 2019 to 31 May 2020

1.4.2 Resolution

Hourly

2 DATA ACQUISITION AND PROCESSING

2.1 Background

The COsmic-ray Soil Moisture Observing System (COSMOS) measures soil moisture via counting of neutrons. Cosmic rays, i.e., high-energy subatomic particles, originating in outer space generate fast neutrons once they penetrate the atmosphere and interact with atmospheric nuclei. Additional neutrons are generated when the cosmic rays interact with the land surface. The produced fast

neutrons collide with other atoms in the air and soil, but only if they collide with H atoms, they lose their kinetic energy efficiently as they are similar in mass. As H atoms in the land surface are mostly present in the form of soil moisture, the fast neutron intensity above the land surface is inversely correlated with soil moisture. For more details on the theoretical basis for measuring soil moisture by fast neutron detection, see Zreda et al. (2012).

2.2 Acquisition

This data set is generated by a single COSMOS stationary sensor probe from [Hydroinnova](#). The COSMOS is a neutron detector using ambient background neutrons generated by collisions of primary cosmic rays with atmospheric nuclei. These data have been corrected for fluxes using Jungfraujoch neutron monitor data, kindly provided by the Cosmic Ray Group, Physikalisches Institut, University of Bern, Switzerland.

2.3 Processing

All read periods below 3600 seconds were removed. The calibration was done by lab analysis of lattice water and soil organic carbon as well as volumetric soil moisture sampling. Soil bulk density estimation is done from field measurements. Air pressure correction and water vapor correction was performed using the internal sensor data while neutron intensity corrections utilize data from the Jungfraujoch neutron monitor.

2.4 Quality, Errors, and Limitations

Power fluctuations and user interaction with the instrument may precipitate a reading below the standard time period of 3600 seconds.

2.5 Instrumentation

A typical stationary COSMOS probe consists of two neutron detectors with different energy sensitivities, one is sensitive to fast neutrons and the other to thermal neutrons. The detectors are mounted on a pole approximately one meter above the soil surface. The horizontal footprint of a COSMOS probe is dependent on atmospheric pressure and atmospheric water vapor. At sea level the horizontal footprint it is ~600 m. The effective measurement depth is ~76 cm. See more details on the instrumental details in Zreda et al. (2012).

3 SOFTWARE AND TOOLS

The .txt and .csv files can be accessed using software that reads ASCII text.

4 VERSION HISTORY

Table 5. Version History Summary

Version	Release Date	Description of Changes
1	04 Feb 2021	Initial release

5 RELATED DATA SETS

[SnowEx at NSIDC | Data Sets](#)

[SnowEx 20 COSMOS rover soil moisture data set](#)

6 RELATED WEBSITES

[SnowEx at NSIDC | Overview](#)

[SnowEx at NASA](#)

7 CONTACTS AND ACKNOWLEDGMENTS

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8 REFERENCES

Zreda, M., W. J. Shuttleworth, X. Zeng, D. Desilets, T. Franz and R. Rosolem. 2012. COSMOS: the Cosmic-ray Soil Moisture Observing System, *Hydrology and Earth System Sciences* 16, 4079-4099. doi: [10.5194/hess-16-4079-2012](https://doi.org/10.5194/hess-16-4079-2012).

9 DOCUMENT INFORMATION

9.1 Publication Date

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9.2 Date Last Updated

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