SnowEx Meteorological Station Measurements from Grand Mesa, CO Raw, Version 1 Technical Reference

1 INTRODUCTION

1.1 DATA SET OVERVIEW

This data set contains raw observations from five meteorological stations installed in Grand Mesa, Colorado as part of NASA SnowEx field campaigns. A processed version of this data set with corresponding User Guide are also available. The User Guide contains the spatial and temporal information, data acquisition details, and instrumentation applicable to the raw data.

2 DATA DESCRIPTION

2.1 Parameters

Table 1. Metadata Parameters

Variable	Unit	Description
TIMESTAMP	hours	yyyy-mm-dd hh:mm:ss
Record number	-	n

Table 2. Datalogger/Operator Diagnostic Parameters

Variable	Unit	Description
BattV_Avg	volts	Average battery voltage of Campbell Scientific CR6 datalogger
PTemp_C_Avg	°C	Average internal temperature of CR6 datalogger
RTempC_Avg	°C	Average internal temperature of AM25T multiplexer
CDM1BattV_Avg	volts	Average battery voltage of CDM-A116 Input Module
CDM1PTempC1_Avg	°C	Average internal temperature bank 1 of CDM-A116
CDM1PTempC2_Avg	°C	Average internal temperature bank 2 of CDM-A116
CDM1PTempC3_Avg	°C	Average internal temperature bank 3 of CDM-A116
CDM1PTempC4_Avg	°C	Average internal temperature bank 4 of CDM-A116

Table 3. Air Temperature Parameters

Variable	Unit	Description
AirTC_10ft	°C	Sample Campbell HC253 Air Temperature, 10ft tower level
AirTC_10ft_Avg	°C	Average Campbell HC253 Air Temperature, 10ft tower level
AirTC_10ft_Max	°C	Maximum Campbell HC253 Air Temperature, 10ft tower level
AirTC_10ft_Min	°C	Minimum Campbell HC253 Air Temperature, 10ft tower level
AirTC_10ft_Std	°C	Standard Deviation of Campbell HC253 Air Temperature, 10ft tower level
AirTC_20ft	°C	Sample Campbell HC253 Air Temperature, 20ft tower level
AirTC_20ft_Avg	°C	Average Campbell HC253 Air Temperature, 20ft tower level
AirTC_20ft_Max	°C	Maximum Campbell HC253 Air Temperature, 20ft tower level
AirTC_20ft_Min	°C	Minimum Campbell HC253 Air Temperature, 20ft tower level

Table 4. Relative Humidity Parameters

Variable	Unit	Description
RH_10ft	%	Sample Campbell HC253 Relative Humidity, 10ft tower level
RH_10ft_Max	%	Maximum Campbell HC253 Relative Humidity, 10ft tower level
RH_10ft_Min	%	Minimum Campbell HC253 Relative Humidity, 10ft tower level
RH_20ft	%	Sample Campbell HC253 Relative Humidity, 20ft tower level
RH_20ft_Max	%	Maximum Campbell HC253 Relative Humidity, 20ft tower level
RH_20ft_Min	%	Minimum Campbell HC253 Relative Humidity, 20ft tower level

Table 5. Wind Speed/Direction (Vector) Parameters

Variable	Unit	Description
WSms_10ft_S_WVT	m/s	RM Young 05103 unit vector mean wind speed, 10ft level
WindDir_10ft_D1_WVT	°	RMY05103 unit vector mean wind direction, 10ft
WindDir_10ft_SD1_WVT	°	RMY05103 unit vector standard deviation wind dir, 10ft
WSms_10ft	m/s	RMY05103 horizontal wind speed, 10ft
WSms_10ft_Avg	m/s	Average RMY05103 horizontal wind speed, 10ft
WSms_10ft_Max	m/s	Maximum RMY05103 horizontal wind speed, 10ft
WSms_10ft_Min	m/s	Minimum RMY05103 horizontal wind speed, 10ft
WSms_10ft_Std	m/s	Standard Deviation of RMY05103 horizontal wind speed, 10ft
WindDir_10ft	°	Sample RMY05103 wind direction, 10ft
WSms_20ft_S_WVT	m/s	RM Young 05103 unit vector mean wind speed, 20ft level
WindDir_20ft_D1_WVT	°	RMY05103 unit vector mean wind direction, 20ft
WindDir_20ft_SD1_WVT	°	RMY05103 unit vector standard deviation wind direction, 20ft
WSms_20ft	m/s	Sample RMY05103 horizontal wind speed, 20ft

Variable	Unit	Description
WSms_20ft_Avg	m/s	Average RMY05103 horizontal wind speed, 20ft
WSms_20ft_Max	m/s	Maximum RMY05103 horizontal wind speed, 20ft
WSms_20ft_Min	m/s	Minimum RMY05103 horizontal wind speed, 20ft
WSms_20ft_Std	m/s	Standard Deviation of RMY05103 horizontal wind speed, 20ft
WindDir_20ft	°	Sample RMY05103 wind direction, 20ft

Table 6. Barometric Pressure Parameters

Variable	Unit	Description
BP_kPa	kPa	Sample Campbell Scientific CS106 Barometric Pressure
BP_kPa_Avg	kPa	Average Campbell Scientific CS106 Barometric Pressure
BP_kPa_Max	kPa	Maximum Campbell Scientific CS106 Barometric Pressure
BP_kPa_Min	kPa	Minimum Campbell Scientific CS106 Barometric Pressure
BP_kPa_Std	kPa	Standard Deviation of Campbell Scientific CS106 Barometric Pressure

Table 7. Radiation Parameters

Variable	Unit	Description
SUp	W/m^2	Sample CNR4 Pyranometer up facing (shortwave radiation)
SUp_Avg	W/m^2	Average CNR4 Pyranometer up facing (shortwave radiation)
SUp_Max	W/m^2	Maximum CNR4 Pyranometer up facing (shortwave radiation)
SUp_Min	W/m^2	Minimum CNR4 Pyranometer up facing (shortwave radiation)
SUp_Std	W/m^2	Standard Deviation of CNR4 Pyranometer up facing (shortwave radiation)
SDn	W/m^2	Sample CNR4 Pyranometer down facing (shortwave radiation)
SDn_Avg	W/m^2	Average CNR4 Pyranometer down facing (shortwave radiation)
SDn_Max	W/m^2	Maximum CNR4 Pyranometer down facing (shortwave radiation)
SDn_Min	W/m^2	Minimum CNR4 Pyranometer down facing (shortwave radiation)
SDn_Std	W/m^2	Standard Deviation of CNR4 Pyranometer down facing (shortwave radiation)
LUp	W/m^2	Sample CNR4 Pyrgeometer up facing (longwave radiation)
LUp_Avg	W/m^2	Average CNR4 Pyrgeometer up facing (longwave radiation)
LUp_Max	W/m^2	Maximum CNR4 Pyrgeometer up facing (longwave radiation)
LUp_Min	W/m^2	Minimum CNR4 Pyrgeometer up facing (longwave radiation)
LUp_Std	W/m^2	Standard Deviation of CNR4 Pyrgeometer up facing (longwave radiation)
LDn	W/m^2	Sample CNR4 Pyrgeometer down facing (longwave radiation)
LDn_Avg	W/m^2	Average CNR4 Pyrgeometer down facing (longwave radiation)

Variable	Unit	Description
LDn_Max	W/m^2	Maximum CNR4 Pyrgeometer down facing (longwave radiation)
LDn_Min	W/m^2	Minimum CNR4 Pyrgeometer down facing (longwave radiation)
LDn_Std	W/m^2	Standard Deviation of CNR4 Pyrgeometer down facing (longwave radiation)
CNR4TC	°C	Sample CNR4 body temperature
CNR4TC_Avg	°C	Average CNR4 body temperature
CNR4TC_Max	°C	Maximum CNR4 body temperature
CNR4TC_Min	°C	Minimum CNR4 body temperature
CNR4TC_Std	°C	Standard Deviation of CNR4 body temperature
CNR4TK	K	Sample CNR4 body temperature
CNR4TK_Avg	K	Average CNR4 body temperature
CNR4TK_Max	K	Maximum CNR4 body temperature
CNR4TK_Min	K	Minimum CNR4 body temperature
CNR4TK_Std	K	Standard Deviation of CNR4 body temperature
RsNet	W/m^2	Sample CNR4 net shortwave radiation
RsNet_Avg	W/m^2	Average CNR4 net shortwave radiation
RsNet_Max	W/m^2	Maximum CNR4 net shortwave radiation
RsNet_Min	W/m^2	Minimum CNR4 net shortwave radiation
RsNet_Std	W/m^2	Standard Deviation of CNR4 net shortwave radiation
RlNet	W/m^2	Sample CNR4 net longwave radiation
RlNet_Avg	W/m^2	Average CNR4 net longwave radiation
RlNet_Max	W/m^2	Maximum CNR4 net longwave radiation
RlNet_Min	W/m^2	Minimum CNR4 net longwave radiation
RlNet_Std	W/m^2	Standard Deviation of CNR4 net longwave radiation
Albedo	-	Sample CNR4 albedo
Albedo_Avg	-	Average CNR4 albedo
Albedo_Max	-	Maximum CNR4 albedo
Albedo_Min	-	Minimum CNR4 albedo
Albedo_Std	-	Standard Deviation of CNR4 albedo
Rn	W/m^2	Sample CNR4 net radiation
Rn_Avg	W/m^2	Average CNR4 net radiation
Rn_Max	W/m^2	Maximum CNR4 net radiation
Rn_Min	W/m^2	Minimum CNR4 net radiation
Rn_Std	W/m^2	Standard Deviation of CNR4 net radiation
LUpCo	W/m^2	Sample Temperature corrected pyrgeometer up facing
LUpCo_Avg	W/m^2	Average CNR4 Temperature corrected pyrgeometer up facing

Variable	Unit	Description
LUpCo_Max	W/m²	Maximum CNR4 Temperature corrected pyrgeometer up facing
LUpCo_Min	W/m²	Minimum CNR4 Temperature corrected pyrgeometer up facing
LUpCo_Std	W/m²	Standard Deviation of CNR4 Temperature corrected pyrgeometer up
LDnCo	W/m²	Sample CNR4 Temperature corrected pyrgeometer down facing
LDnCo_Avg	W/m²	Average Temperature corrected pyrgeometer down facing
LDnCo_Max	W/m²	Maximum CNR4 Temperature corrected pyrgeometer down facing
LDnCo_Min	W/m²	Minimum CNR4 Temperature corrected pyrgeometer down facing
LDnCo_Std	W/m²	Standard Deviation of CNR4 Temperature corrected pyrgeometer down facing

Table 8. Snow Depth Parameters

Variable	Unit	Description
DT	m	Sample SR50A Distance from sensor to soil/snow surface
DT_Avg	m	Average SR50A Distance from sensor to soil/snow surface
DT_Max	m	Maximum SR50A Distance from sensor to soil/snow surface
DT_Min	m	Minimum SR50A Distance from sensor to soil/snow surface
DT_Std	m	Standard Deviation of SR50A Distance from sensor to soil/snow surface
Q	-	Sample SR50A measurement quality number
Q_Avg	-	Average SR50A measurement quality number
Q_Max	-	Maximum SR50A measurement quality number
Q_Min	-	Minimum SR50A measurement quality number
Q_Std	-	Standard Deviation of SR50A measurement quality number
TCDT	m	Sample SR50A temperature compensated (AirTC_10ft) distance
TCDT_Avg	m	Average SR50A temperature compensated (AirTC_10ft) distance
TCDT_Max	m	Maximum SR50A temperature compensated (AirTC_10ft) distance
TCDT_Min	m	Minimum SR50A temperature compensated (AirTC_10ft) distance
TCDT_Std	m	Standard Deviation of SR50A temperature compensated distance

Table 9. Skin Temperature (Surface Radiometric Temperature) Parameters

Variable	Unit	Description
IRtarget_nadir1_C_Avg	°C	Average Apogee SI-111 infrared skin temperature, nadir 1
IRtarget_nadir1_C_Std	°C	Standard Deviation of SI-111 skin temperature, nadir 1
IRsensor_nadir1_C_Avg	°C	Average SI-111 sensor body temperature, nadir 1
IRsensor_nadir1_C_Std	°C	Standard Deviation of SI-111 body temperature, nadir 1

Variable	Unit	Description
IRtarget_nadir2_C_Avg	°C	Average SI-111 infrared skin temperature, nadir 2
IRtarget_nadir2_C_Std	°C	Standard Deviation of SI-111 skin temperature, nadir 2
IRsensor_nadir2_C_Avg	°C	Average SI-111 sensor body temperature, nadir 2
IRsensor_nadir2_C_Std	°C	Standard Deviation of SI-111 body temperature, nadir 2
IRtarget_nadir3_C_Avg*	°C	Average Apogee SI-111 infrared skin temperature, nadir 3
IRtarget_nadir3_C_Std*	°C	Standard Deviation of SI-111 skin temperature, nadir 3
IRsensor_nadir3_C_Avg*	°C	Average SI-111 sensor body temperature, nadir 3
IRsensor_nadir3_C_Std*	°C	Standard Deviation of SI-111 body temperature, nadir 3
IRtarget_30degN_C_Avg	°C	Average SI-111 skin temperature, 30 degrees north of nadir
IRtarget_30degN_C_Std	°C	Standard Deviation of SI-111 skin temperature, 30 degrees north of nadir
IRsensor_30degN_C_Avg	°C	Average SI-111 sensor body temperature, 30 degrees north of nadir
IRsensor_30degN_C_Std	°C	Standard Deviation of SI-111 sensor temperature, 30 degrees north of nadir
IRtarget_30degS_C_Avg	°C	Average SI-111 skin temperature, 30 degrees south of nadir
IRtarget_30degS_C_Std	°C	Standard Deviation of SI-111 skin temperature, 30 degrees south of nadir
IRsensor_30degS_C_Avg	°C	Average SI-111 sensor body temperature, 30 degrees south of nadir
IRsensor_30degS_C_Std	°C	Standard Deviation of SI-111 sensor temperature, 30 degrees south of nadir
IRtarget_60degN_C_Avg*	°C	Average SI-111 skin temperature, 60 degrees north of nadir
IRtarget_60degN_C_Std*	°C	Standard Deviation of SI-111 skin temperature, 60 degrees north of nadir
IRsensor_60degN_C_Avg*	°C	Average SI-111 sensor body temperature, 60 degrees north of nadir
IRsensor_60degN_C_Std*	°C	Standard Deviation of SI-111 sensor temperature, 60 degrees north of nadir
IRtarget_60degS_C_Avg*	°C	Average SI-111 skin temperature, 60 degrees south of nadir
IRtarget_60degS_C_Std*	°C	Standard Deviation of SI-111 skin temperature, 60 degrees south of nadir
IRsensor_60degS_C_Avg*	°C	Average SI-111 sensor body temperature, 60 degrees south of nadir
IRsensor_60degS_C_Std*	°C	Standard Deviation of SI-111 sensor temperature, 60 degrees south of nadir

*Parameter only available for station Grand Mesa Study Plot (GMSP)

Table 10. Thermocouple String Temperature (Soil/Snow/Air Temperature) Parameters

Variable	Unit	Description
TCstringC_s50cm_Avg	°C	Average thermocouple temperature measured using Campbell Scientific AM25T, 50cm below soil surface
TCstringC_s50cm_Std	°C	Standard Deviation of Temperature, 50cm below soil surface
TCstringC_s40cm_Avg	°C	Average Temperature, 40cm below soil surface
TCstringC_s40cm_Std	°C	Standard Deviation of Temperature, 40cm below soil surface
TCstringC_s30cm_Avg	°C	Average Temperature, 30cm below soil surface
TCstringC_s30cm_Std	°C	Standard Deviation of Temperature, 30cm below soil surface
TCstringC_s20cm_Avg	°C	Average Temperature, 20cm below soil surface
TCstringC_s20cm_Std	°C	Standard Deviation of Temperature, 20cm below soil surface
TCstringC_s10cm_Avg	°C	Average Temperature, 10cm below soil surface
TCstringC_s10cm_Std	°C	Standard Deviation of Temperature, 10cm below soil surface
TCstringC_s5cm_Avg	°C	Average Temperature, 5cm below soil surface
TCstringC_s5cm_Std	°C	Standard Deviation of Temperature, 5cm below soil surface
TCstringC_s2cm_Avg	°C	Average Temperature, 2cm below soil surface
TCstringC_s2cm_Std	°C	Standard Deviation of Temperature, 2cm below soil surface
TCstringC_0cm_Avg	°C	Average Temperature, at soil surface
TCstringC_0cm_Std	°C	Standard Deviation of Temperature, at soil surface
TCstringC_2cm_Avg	°C	Average Temperature, 2cm above soil surface
TCstringC_2cm_Std	°C	Standard Deviation of Temperature, 2cm above soil surface
TCstringC_5cm_Avg	°C	Average Temperature, 5cm above soil surface
TCstringC_5cm_Std	°C	Standard Deviation of Temperature, 5cm above soil surface
TCstringC_10cm_Avg	°C	Average Temperature, 10cm above soil surface
TCstringC_10cm_Std	°C	Standard Deviation of Temperature, 10cm above soil surface
TCstringC_20cm_Avg	°C	Average Temperature, 20cm above soil surface
TCstringC_20cm_Std	°C	Standard Deviation of Temperature, 20cm above soil surface
TCstringC_30cm_Avg	°C	Average Temperature, 30cm above soil surface
TCstringC_30cm_Std	°C	Standard Deviation of Temperature, 30cm above soil surface
TCstringC_40cm_Avg	°C	Average Temperature, 40cm above soil surface

Variable	Unit	Description
TCstringC_40cm_Std	°C	Standard Deviation of Temperature, 40cm above soil surface
TCstringC_50cm_Avg	°C	Average Temperature, 50cm above soil surface
TCstringC_50cm_Std	°C	Standard Deviation of Temperature, 50cm above soil surface
TCstringC_75cm_Avg	°C	Average Temperature, 75cm above soil surface
TCstringC_75cm_Std	°C	Standard Deviation of Temperature, 75cm above soil surface
TCstringC_100cm_Avg	°C	Average Temperature, 100cm above soil surface
TCstringC_100cm_Std	°C	Standard Deviation of Temperature, 100cm above soil surface
TCstringC_125cm_Avg	°C	Average Temperature, 125cm above soil surface
TCstringC_125cm_Std	°C	Standard Deviation of Temperature, 125cm above soil surface
TCstringC_150cm_Avg	°C	Average Temperature, 150cm above soil surface
TCstringC_150cm_Std	°C	Standard Deviation of Temperature, 150cm above soil surface
TCstringC_175cm_Avg	°C	Average Temperature, 175cm above soil surface
TCstringC_175cm_Std	°C	Standard Deviation of Temperature, 175cm above soil surface
TCstringC_200cm_Avg	°C	Average Temperature, 200cm above soil surface
TCstringC_200cm_Std	°C	Standard Deviation of Temperature, 200cm above soil surface
TCstringC_225cm_Avg	°C	Average Temperature, 225cm above soil surface
TCstringC_225cm_Std	°C	Standard Deviation of Temperature, 225cm above soil surface
TCstringC_250cm_Avg	°C	Average Temperature, 250cm above soil surface
TCstringC_250cm_Std	°C	Standard Deviation of Temperature, 250cm above soil surface
TCstringC_275cm_Avg	°C	Average Temperature, 275cm above soil surface
TCstringC_275cm_Std	°C	Standard Deviation of Temperature, 275cm above soil surface
TCstringC_300cm_Avg	°C	Average Temperature, 300cm above soil surface
TCstringC_300cm_Std	°C	Standard Deviation of Temperature, 300cm above soil surface

Table 11. Soil Moisture and Temperature Parameters

Variable	Unit	Description
SM_5cm_Avg	-	Average Hydra Probe II soil moisture (water fraction by volume), 5cm below soil surface
SCt_5cm_Avg	-	Average Hydra Probe soil conductivity (temp. corrected), 5cm
TC_5cm_Avg	°C	Average Hydra Probe soil temperature, 5cm
TF_5cm_Avg	°F	Average Hydra Probe soil temperature, 5cm
SC_5cm_Avg	S/m	Average Hydra Probe soil conductivity, 5cm
RD_5cm_Avg	*	Average Hydra Probe real dielectric permittivity, 5cm
ID_5cm_Avg	*	Average Hydra Probe imaginary dielectric permittivity, 5cm
RDt_5cm_Avg	*	Average Hydra Probe real dielectric permittivity (temp. corrected), 5cm
IDt_5cm_Avg	*	Average Hydra Probe imaginary dielectric permittivity (temp. corrected), 5cm
SM_20cm_Avg	-	Average Hydra Probe II soil moisture (water fraction by volume), 20cm below soil surface
SCt_20cm_Avg	S/m	Average Hydra Probe soil conductivity (temp. corrected), 20cm
TC_20cm_Avg	°C	Average Hydra Probe soil temperature, 20cm
TF_20cm_Avg	°F	Average Hydra Probe soil temperature, 20cm
SC_20cm_Avg	S/m	Average Hydra Probe soil conductivity, 20cm
RD_20cm_Avg	*	Average Hydra Probe real dielectric permittivity, 20cm
ID_20cm_Avg	*	Average Hydra Probe imaginary dielectric permittivity, 20cm
RDt_20cm_Avg	*	Average Hydra Probe real dielectric permittivity (temp. corrected), 20cm
IDt_20cm_Avg	*	Average Hydra Probe imaginary dielectric permittivity (temp. corrected), 20cm
SM_50cm_Avg	-	Average Hydra Probe II soil moisture (water fraction by volume), 50cm below soil surface
SCt_50cm_Avg	S/m	Average Hydra Probe soil conductivity (temp. corrected), 50cm
TC_50cm_Avg	°C	Average Hydra Probe soil temperature, 50cm
TF_50cm_Avg	°F	Average Hydra Probe soil temperature, 50cm
SC_50cm_Avg	S/m	Average Hydra Probe soil conductivity, 50cm
RD_50cm_Avg	*	Average Hydra Probe real dielectric permittivity, 50cm
ID_50cm_Avg	*	Average Hydra Probe imaginary dielectric permittivity, 50cm

Variable	Unit	Description
RDt_50cm_Avg	*	Average Hydra Probe real dielectric permittivity (temp. corrected), 50cm
IDt_50cm_Avg	*	Average Hydra Probe imaginary dielectric permittivity (temp. corrected), 50cm

* Units not provided

2.2 File Information

2.2.1 Format

The data are available within a zipped folder as comma-separated value (CSV) files. A single CSV is available for each of the five weather stations. The folder also contains two additional CSV files, which list the weather station locations and available variables for each station.

2.2.2 Naming Convention

The data files containing the raw data for each weathers station follow the naming convention `SNEX_Met_Raw_[STATION]_[YYYYMMDD_YYYYMMDD].csv`. SNEX refers to the ongoing NASA SnowEx field campaigns. `[STATION]` refers to the location of each weather station. `[YYYYMMDD_YYYYMMDD]` refers to the start and end date of data collection for each station. `SNEX_Met_Raw_variables.csv` contains a list of variables for each weather station, while `SNEX_Met_Raw_locations.csv` contains a list of each station and its geographic location.

3 RELATED DATA SETS

SnowEx at NSIDC | Data Sets

SnowEx Meteorological Station Measurements from Grand Mesa, CO, Version 1