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New York State Mesonet Snow Network Data

The data described here are created by New York State Mesonet at University at Albany. In the event that the data are used for any form of publications, please use the following statement in the acknowledgement:

> *"This research is made possible by the New York State (NYS) Mesonet. Original funding for the NYS Mesonet was provided by Federal Emergency Management Agency grant FEMA-4085-DR-NY, with the continued support of the NYS Division of Homeland Security & Emergency Services; the state of New York; the Research Foundation for the State University of New York (SUNY); the University at Albany, SUNY; the Atmospheric Sciences Research Center (ASRC) at SUNY Albany; and the Department of Atmospheric and Environmental Sciences (DAES) at SUNY Albany."*

1. Introduction

The New York State (NYS) Mesonet (http://nysmesonet.org) is a new advanced, statewide weather station network that provides unprecedented weather information across the state. This network is the first of its kind in New York and pioneered the building of three additional sub-networks. One of these subnetworks is the NYS Mesonet Snow Network (Fig. 1). The Snow Network is designed largely to complement similar monitoring across the Catskills. The twenty snow sites are deployed predominantly across the Adirondacks, Tug Hill, and Catskills regions (Fig. 1). The sites selected were deemed the most variable to seasonal snowfall and sensitive to hydrological impact. Site metadata including latitude, longitude, elevation, county, type are listed in Appendix A with additional information provided at: http://www.nysmesonet.org/about/sites#network=snow&stid=snow_clar. Thirteen snow sites are co-located with standard NYSM sites. Seven sites with less protection from the wind in more open areas are located nearby in a more sheltered location near the standard sites to limit the effects of drifting. They are referred as to "external" snow sites (Table A).

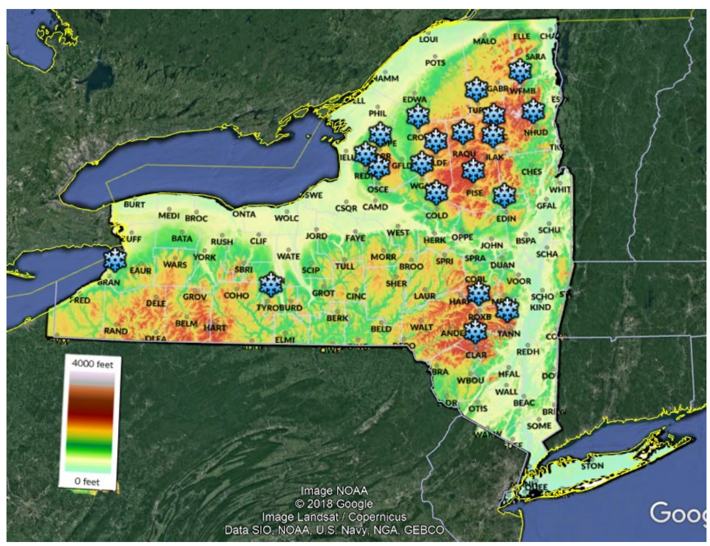

Figure 1. Network of 20 snow stations

2. Instrumentation

The snow sites measure Snow Water Equivalent (SWE) and snow depth. Snow depth is measured every 5 minutes using the Campbell Scientific, Inc. (CSI) SR50A snow depth sensor at all 126 standard sites. SWE is measured using the CSI CS725 sensor, estimated over a 6-hour period with observations provided up to four times daily. Figure 2 shows annotated views of a typical co-located (a) and external (b) snow site. For external sites, an additional Campbell Scientific SR50A is installed co-located with the CS725.

Snow Water Equivalent is a measure of the amount of water within the snowpack. The downward-pointing SWE sensor estimates the amount of water in a column between the ground and the sensor by detecting gamma rays emitted from two naturally-occurring elements in the soil: potassium (K) and thallium (Tl). Water in the soil and snow attenuates the signal emitted by each element, and the level of attenuation allows the sensor to estimate the amount of water present in the column. When combined with a near-surface soil moisture reading, an approximate liquid water content in the snow can be extracted. A collimator (Fig. 2) is used when there are sources of K and Tl at the site that will not be covered by snow such as trees. The collimator acts to reduce this radiation from affecting the measurement.

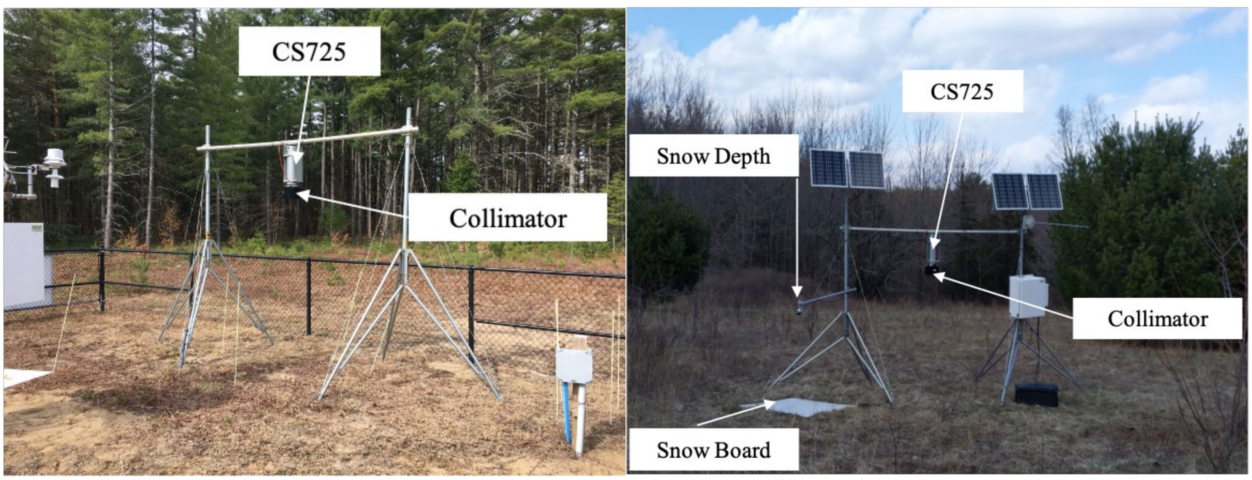

Figure 2 Annotated views of (a) the co-located NYSM snow site in Woodgate, NY and (b) the external NYSM snow site in Roxbury, NY. (Courtesy of Patrick Naple).

3. Data format

The preliminary 6-hourly SWE data are available for the 2020-2021 winter (from November 1 to April 30) in csv format. A list of SWE data variables is listed in Appendix B. Most variables are not of interest to most users. We recommend using Column 11 "SWE value generated from K". The differences between SWEs generated from K and Tl are small. All files are organized according to date, i.e. each file contains all data for that day for all stations. These files do not include any data averaging.

The 5min snow depth data at co-located sites can be requested through the standard sites. The snow depth data at external snow sites are available upon special request.

4. Special notes on the data:

1) The manufacturer-derived SWEs from CS725 measurements were compared with manual snow core measurements. The sensor derived estimates were found to be overestimated, most often when the ground was thawed (with larger soil moisture). Working with the

manufacturer, we tested different soil moisture algorithms for computing SWE and proposed a new method to more accurately derive SWE. Recalculated SWEs agreed much better with manual measurements with insignificant mean errors and significantly reduced root-mean-square errors. Based on these results, an improved algorithm was implemented during the 2020-2021 season.

2) Although SWEs generated from K and Tl are generally small, the optimal variable may be site dependent. Precise recommendations on which variable to use at which site is yet to be determined.
3) The SWE data have not been quality-controlled. Users should be mindful about potential erroneous data. Quality-controlled SWE data are not yet available but are expected to be available later. Negative SWE values should be treated as zero, i.e. no snow on the ground.
4) When compared with precipitation and snow depth data, the 6 hourly SWE data appear smooth but lagged the maximum rain gauge and snow depth data. This is due to the nature of the CS725 measurement. As described in the CS725 manual:

   "Each time a gamma ray is detected by the CS725, it is placed in its corresponding bin in the energy histogram. This histogram is the basic data set required for the SWE calculation. Since it is statistical in nature, the accuracy of the SWE evaluation is proportional to the square root of the measurement time. The CS725 builds each histogram for a 24 h period in order to achieve the specified accuracy."

   Therefore, it takes 24 hours for the CS725 to generate its SWE value. The 6 hour resolution is based on a staggered observation. For example, the SWE value at 16Z on Feb. 8 represents the accumulated effect from 16Z on Feb. 7 to 16Z on Feb. 8.

APPENDIX A: SITE INFORMATION

Site ID	Name	Latitude	Longitude	Elevation (m)	County	External Snow site
SNOW_BRAN	Brant	42.59494	-79.02154	219	Erie	
SNOW_CLAR	Claryville	41.97920	-74.51710	584	Sullivan	
SNOW_COLD	Cold Brook	43.26189	-74.98475	433	Herkimer	Yes
SNOW_CROG	Croghan	43.97496	-75.20100	419	Lewis	
SNOW_EDIN	Edinburg	43.22839	-74.11200	325	Saratoga	Yes
SNOW_HARR	Harrisburg	43.80392	-75.68873	495	Lewis	Yes
SNOW_ILAK	Indian Lake	43.79067	-74.23933	494	Hamilton	
SNOW_NEWC	Newcomb	43.97329	-74.22273	501	Essex	
SNOW_NHUD	North Hudson	44.01310	-73.70516	299	Essex	
SNOW_OLDF	Old Forge	43.74149	-74.97833	534	Herkimer	Yes
SNOW_OSCE	Osceola	43.49915	-75.71175	333	Lewis	
SNOW_PISE	Piseco	43.46474	-74.50432	536	Hamilton	
SNOW_RAQU	Raquette Lake	43.82275	-74.62509	540	Hamilton	
SNOW_REDF	Redfield	43.62136	-75.87813	385	Oswego	Yes
SNOW_ROXB	Roxbury	42.33120	-74.46918	573	Delaware	Yes
SNOW_TANN	Tannersville	42.17071	-74.11343	711	Greene	
SNOW_TUPP	Tupper Lake	44.22128	-74.43826	503	Franklin	
SNOW_TYRO	Tyrone	42.40319	-77.05350	367	Schuyler	Yes
SNOW_WFMB	Whiteface Mountain Base	44.39324	-73.85883	615	Essex	
SNOW_WGAT	Woodgate	43.53241	-75.15860	443	Oneida	

APPENDIX B: VARIABLE LIST

Column	Description	Unit
1	Station_ID	
2	File name	
3	Time_string	
4	Sequential record number	
5	Integration ending time	
6	Network name	
7	Serial number	
8	K counts total (uncorrected)	
9	K counts total (corrected) - this value is used in the SWE calculations	
10	Tl counts total (corrected) -this value is used in the SWE calculations	
11	SWE value generated from K	mm
12	Ratio generated from K and Tl	mm
13	SWE value generated from Tl	mm
14	Soil Moisture values generated from K	Gravimetric Soil Moisture in %
15	Soil Moisture values generated from Tl	Gravimetric Soil Moisture in %
16	Soil Moisture values generated from K and Tl	Gravimetric Soil Moisture in %
17	Precipitation index: Flag indication recent snowfall or rain	Ignore
18	Crystal temperature min	deg C
19	Crystal temperature max	deg C
20	Total number of histogram blocks used for the analysis	
21	Displacement of the K peak from its nominal position (in bins)	
22	Statistical significance of the SWE Tl measurement	
23	Power input voltage at the CS725 (after protection diode drop)	