SNOW MEASUREMENTS PRACTICES

Collection, Quality Control, and Use of Snowfall Observations in the New York State Climatological Network

By

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INTRODUCTION

I would like to present a brief resumé of the Climatological Network of New York State, as it pertains to snowfall observations and their usefulness. In my work I deal with the observer in the field, the meteorologist, the hydrologist, and the research climatologist, in a program of basic weather measurements designed to provide hydrologic and long-term climatological records.

The network of stations operated by the United States Weather Bureau in New York State consists of a basic grid of temperature and precipitation stations, designed to provide a historical record of the climate of New York. Supplementing this record is a network of stations which provide weather data for a specific area of purpose, most of which are hydrologic. At the present time there are five major river districts in the state, each containing a network of stations reporting various forms of precipitation and river stages.

Figure 1 shows the climatological network map for New York with the distribution and type of stations, and the river districts. Each station shown measures precipitation, all use the eight-inch standard rain gauge, except 50 stations with recording rain gauges only - which are indicated on the map by a solid circle.

Most of the stations take one observation per day and 240 of them measure precipitation at 7 to 8 a.m. in the morning. At stations in the river districts the morning observation is entered on a post card and mailed to the appropriate district office. At other stations the readings are entered on a monthly form and mailed to our processing center at Asheville, North Carolina. There, a monthly bulletin known as Climatological Data for New York is published about six weeks after the end of the month. This publication includes daily precipitation amounts for about 335 stations, and annually the July issue contains monthly snowfall amounts for approximately 300 stations, covering the previous winter season.

During the winter months the observers record three measurements when it snows (Fig. 2). First, the amount of water content in the snow that fell during the previous 24-hour period. This is obtained by melting the snow and measuring it the same as for rain. Second, the amount of new snowfall for the 24 hours measured to the nearest tenth of an inch. We hear a lot of discussion about the futility of measuring snowfall amounts of one-tenth or two-tenths and from a hydrologic point of view it seems meaningless. But these amounts can add up to 10 to 12 inches over a winter season, almost as much as the 15.6-inch total snowfall at the John F. Kennedy International Airport last winter. The third measurement is a running account of the total snow depth on the ground to the nearest inch.

Our primary interest is maintaining a continuous collection of accurate climatological data, processing them, and making them available to the public at a minimum cost to the taxpayer. To do this we have to standardize, centralize, and mechanize our data processing. The large number of observers with varying training, equipment and degree of dedication make the job of quality control a very difficult one; however, we are continuously striving to upgrade the quality of the observations. Since 1958 we have discontinued publishing 75 stations in an effort to streamline the network and eliminate poor observers and unsuitable exposures.

There is a relationship between the type of station and observer, to the quality and value of the observations. Figure three shows a breakdown of the types of co-operators in the network. The largest group is in the paid precipitation category. They are paid by a private or governmental agency to provide precipitation reports for a specific purpose, and the sponsor may provide the rain gauge and choice of location. There are 16 different organizations that sponsor 105 stations, and most own the equipment and pay the observer. Quality control of the observer's work and the rain gauge exposure are often difficult at these locations, since the sponsor may move the rain gauge and change the observer without prior notice.

All of the rain gauges used by the Weather Bureau in New York are equipped with a receiver that measures exactly eight inches in diameter. Shown in Figure 4 is the standard 8-inch rain gauge with its component parts. The ratio of the receiver opening to the measuring tube is 10 to 1, and one inch of rain is actually 10 inches deep in the measuring tube, allowing for graduations in hundredths of inches on the measuring stick. During the winter the receiver and measuring tube are removed, and the overflow can expose to catch snow. At observation time the snow is rapidly melted by pouring a known amount of hot water from the measuring tube into the can, then pouring the melted snow back into the tube and subtracting the amount of hot water. Shown on the right is the measuring stick, and a three-foot hardwood snow measuring stick graduated in tenths of inches. During the past few years we have furnished these snow sticks to most of the observers, resulting in a notable improvement in snowfall entry.

We have about 100 stations in our network making observations of water equivalent to snow on ground and reporting them weekly to our river district offices. These stations use the 8-inch overflow can as a snow tube, inverting it and forcing it through the snow, in an area where the depth is representative. To retrieve the sample it is necessary to slide a shovel or flat piece of metal under the can at ground level, and then tilt the can upright. Water content is determined by weighing the can on a scale graduated in .05 hundredth inch increments, as indicated on the left portion of figure 5. Although the method appears awkward it gives an accurate indication of the water content in most cases. If there is a layer of ice at the ground surface it becomes very difficult to obtain a complete sample. We have equipped many of the observers with an extra can with a hard cutting edge attached, to cut through layers of ice or crust. Also shown is a fiberglass

Adirondack Snow Tube which we have distributed to observers in the heavier snow areas. We have had favourable results with this, providing we can get a leaf core to contain the sample. In grass areas where the ground is frozen, it becomes necessary to dig around the tube and slide a shovel under it to contain the sample.

Our biggest problem in obtaining good water equivalent measurements is the exposure where the sample is taken. Most of our headwater stations are at farm homes where observations are taken in yards near the rain gauge, and do not represent the overall terrain. However, they do have value in being consistent and readily available, which makes them useful in runoff computations.

Exposure of the rain gauge is of major importance in obtaining accurate precipitation reports. However, more important is the co-operation of the observer and we make an extra effort to locate the gauge where it will be convenient for the observer. Shown in figure 6 is a typical exposure in an observer's backyard with some protection from drifting conditions. In selecting a new exposure we predetermine from the observer where snow drifts are apt to form, and in what area snow tends to lay in a uniform depth. At the same time we avoid any wind streams caused by buildings, or any area where wind would cause a sweeping action, and deposit an excess of snow from a roof or driveway. This situation occurs much less frequently than the opposite effect, too much wind at the gauge.

Figure 7 is an eight-inch standard rain gauge in a wind-blown exposure. Here we get the effect of the snow-bearing wind stream flowing upward over the obstruction, and then downward with some eddying effect, to resume its normal course. This situation becomes more pronounced with increased wind velocity, and to combat it we equip some recording rain gauges with improved alter type windshields.

Figure 8 is the recording rain gauge at the Albany Airport equipped with a windshield. The effect of the free-swinging leaves is to deflect the wind downward at the top of the gauge, allowing a straight wind trajectory into the gauge orifice. This type of shield can improve the catch as much as 25% with winds up to 30 miles per hour.

The rain gauge exposure shown in figure 9 is typical of the problems encountered near buildings. We have a venturi effect between the hangar on the left and the building on the right. The view is to the west, and strong westerly winds are further compressed between the building on the right and the parked cars, resulting in a snow drift 25 feet to the right of the gauge. In an effort to check the accuracy of the gauge we have established a snow course one-half mile WNW on a slight wooded ridge, which can be seen in the background of the picture. Based on several measurements made last winter amounts received at the rain gauge site compared favourably with the snow samples. We are in a good position to continue making comparative readings here for the next five to ten years and I believe we will work out a more extensive study of the local area shown, including a recording rain gauge at the wooded site, and more frequent observations. We would also like to experiment with windshields just beyond the parking area, to develop a more uniform area for measuring snow depth.

Figure 10 shows an average yearly snowfall map for New York based on fourteen years of records and as you can see, we are dealing with a wide range of snow patterns. We can identify about 12 distinct snowfall patterns in the state, ranging from in excess of 150 inches on Tug Hill and the higher elevations of Southwestern New York, to less than 40 inches on Long Island.

We are limited in our efforts to improve our snow measuring techniques by our operational requirements and availability of observers at some locations. We have only two stations above 2000 feet elevation for which we publish snowfall data. We have added some new stations during the past two years for the primary purpose of snowfall observations, in the areas east of Lake Erie and Lake Ontario, Tug Hill, The Adirondacks, and the Central New York Highlands. We would like to continue adding this type of station with emphasis on higher elevations and in particular ski areas.

In conclusion, I believe that in the future we should establish a network of stations for the specific purpose of snowfall studies. There are many places where seasonal observations of snowfall are available that we are not utilizing. I think we have made some progress in the quality of our snowfall data in the past ten years, but more important we have realized our shortcomings and the need to improve our records. We have reached the point where we have the computers waiting to gobble up snowfall data, but we lack the quality input to feed them.

During the past few years Mr. Lansing and Mr. Lalley have expressed their concern to me about these problems, and I think it would be worthwhile for the Eastern Snow Conference to appoint a standing committee to investigate how we can improve our snow measuring practices, and make an annual report on what progress is being made.

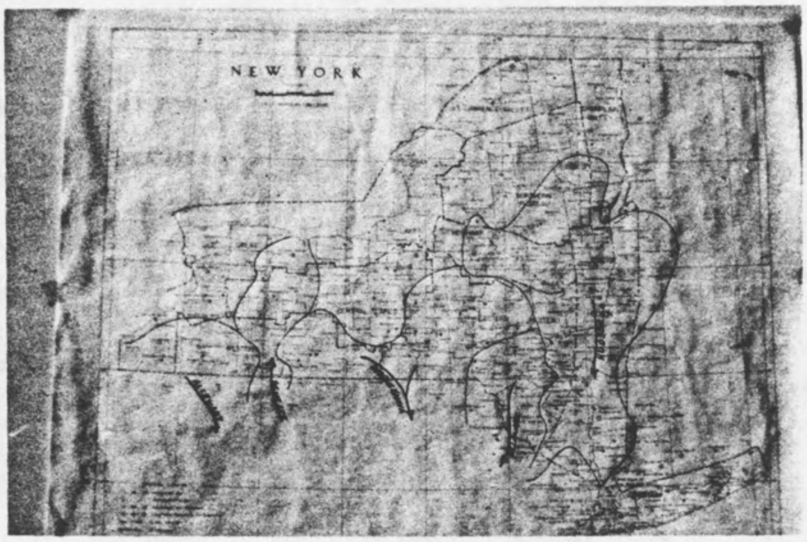
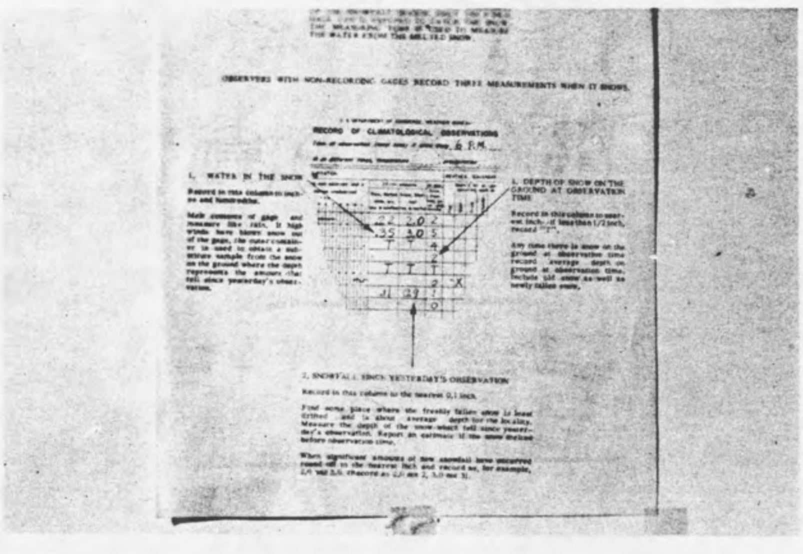


Fig. 1 Climatological Data Map of New York State with river districts



OBSERVERS WITH NON-RECORDING GAGES RECORD THREE MEASUREMENTS WHEN IT SNOWS.

RECORD OF CLIMATOLOGICAL OBSERVATIONS

1. WATER IN THE SNOW

3. DEPTH OF SNOW ON THE GROUND AT OBSERVATION TIME

2. SNOWFALL SINCE YESTERDAY'S OBSERVATION

Record in this column to the nearest 0.1 inch.

Fig. 2 Page 3, Instructions for Making and Recording Snow Measurements

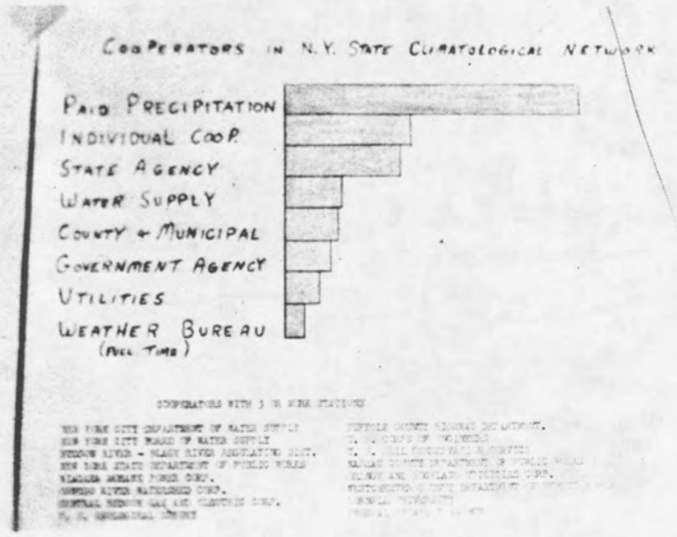


Fig. 3 Graph - Types of Co-operators
Lists of Larger Co-operators

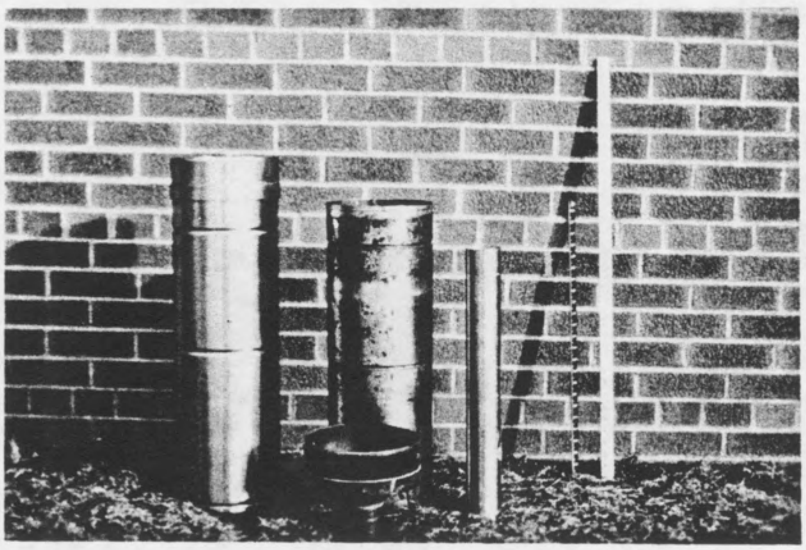


Fig. 4 Eight-inch Standard Rain Gauge-Receiver, Measuring Tube, Overlow Can, Snow Measuring Stick, Precipitation Measuring Stick

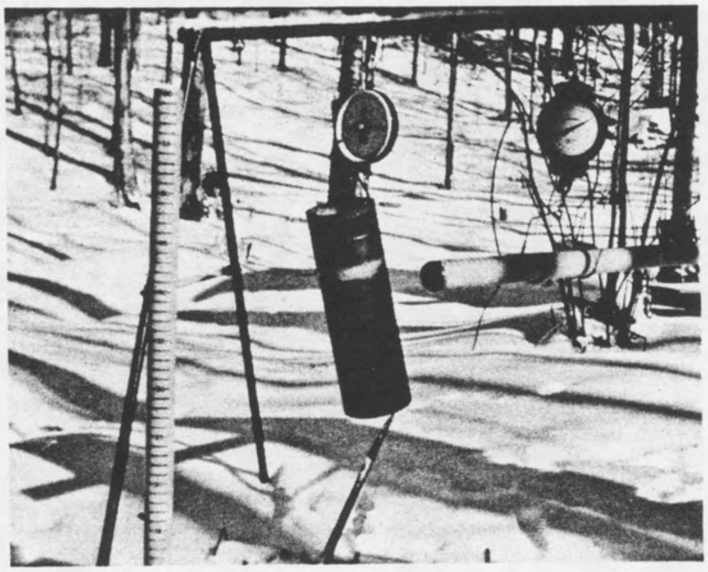


Fig. 5 Eight-inch Standard Overflow Can with Weighing Scale, Snow Tube in Snow, Snow Tube in Scale showing retaining leaf plug

Fig. 6 Sheltered exposure - Eight-inch standard Rain Gauge

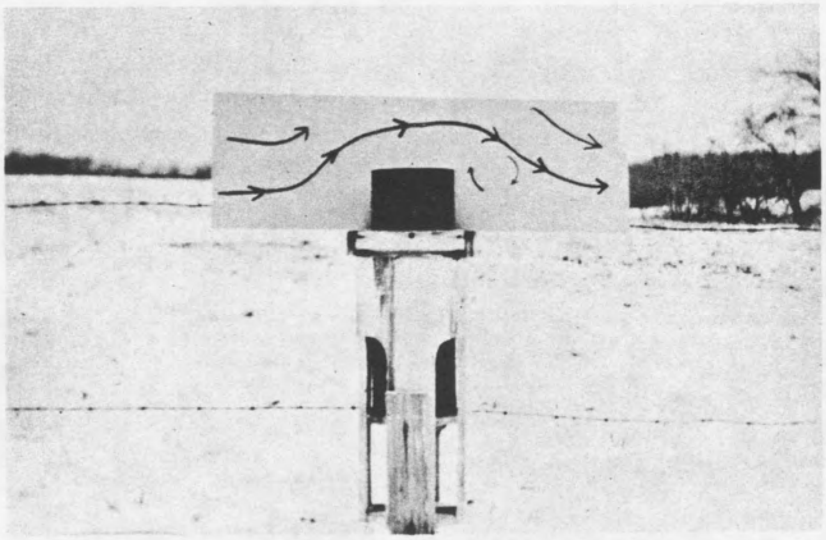


Fig. 7 Wind-blown Eight-inch Standard Rain Gauge with Flow Arrows in Background

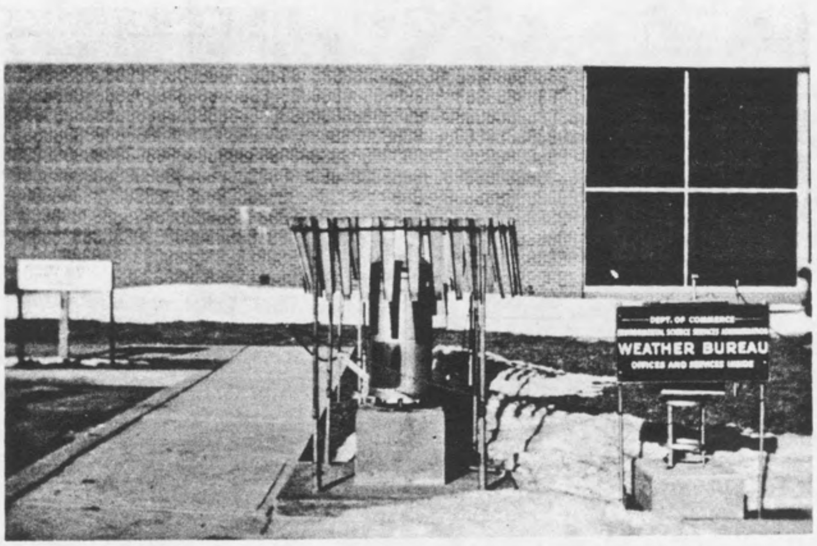


Fig. 8 Recording Rain Gauge and Windshield, Weather Bureau Airport Station, Albany, N.Y.

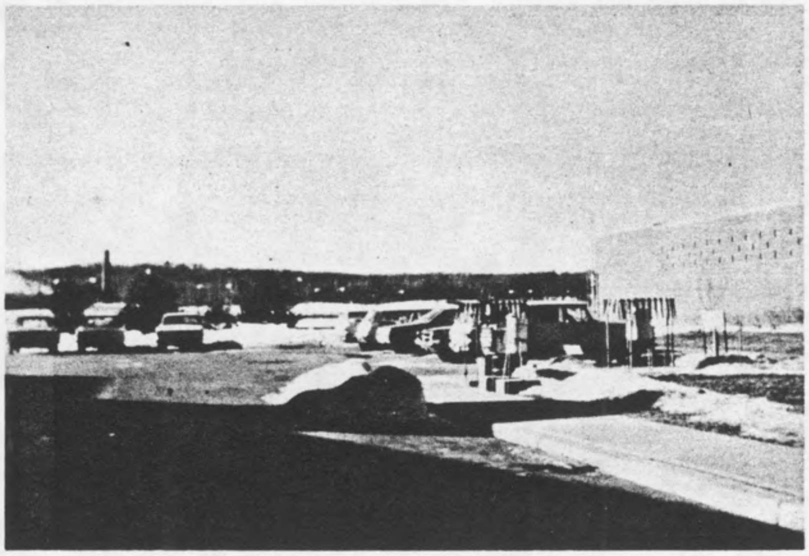


Fig. 9   Long view Albany Recording Rain Gauge and Buildings

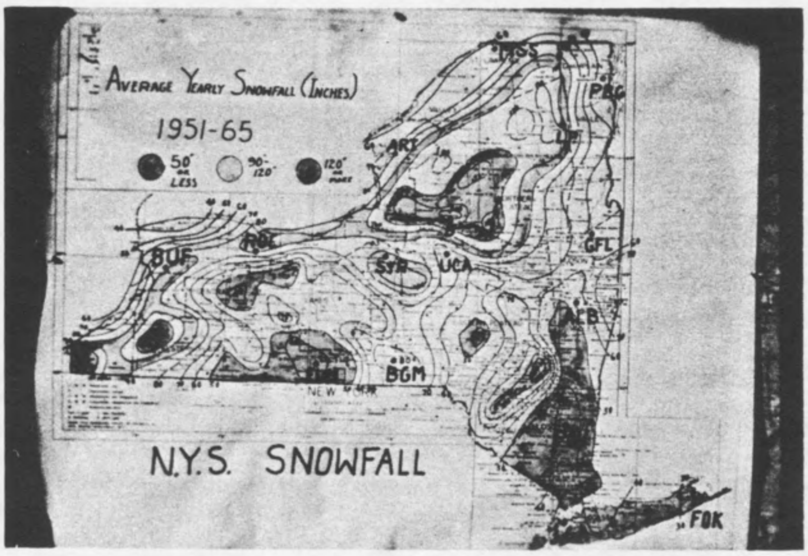


Fig. 10   New York State Average Snowfall map