Measuring Rain and Snow

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Precipitation, whether it be rain, snow, sleet, or hail, is measured by a rain gage. On most typical rain gages, the precipitation that falls into the gage is measured directly, either with a measuring stick or ruler, or a graduated scale on the gage itself. Snow that falls into the gage has to be melted so that it can be converted to a liquid amount, the same as rain is. This liquid amount is typically measured to the nearest hundredth of an inch.

There are several types of rain gages. A metal cylinder that is 8 inches wide and 24 inches long has been the standard official rain gage at thousands of Nationals Weather Service cooperative observation sites for over 100 years. This gage holds up to 20 inches of rain. There is a smaller cylinder that fits inside this 8 inch cylinder. This cylinder allows for more precise

rainfall measurements to .01 inch. Although it holds two inches, when heavier amounts fall, the small cylinder overflows into the larger cylinder. Then the overflow can be re-measured by pouring it back into the small cylinder, and then added to the amounts already measured. The small cylinder is attached to a funnel that rests on top of the large gage. A measuring stick that is graduated to the nearest 0 .01 inch measures what is in the small cylinder. There is also a mounting bracket to keep the gage level and stable to the ground or other solid mounting ace surface.

The rain gage should be mounted a reasonable distance from trees and buildings, which if too close, can effect amounts caught in the gage.

There are 4-inch metal and plastic gages that are almost as accurate as the official 8-inch gage. The 4-inch plastic gage is in widespread use by National Weather Service storm spotters. The wedge shaped gage and many different kinds of smaller gages with 2-inch and 1-inch openings are in widespread unofficial use by many people for many purposes, and are reasonably accurate and also inexpensive.

Another rain gage that has had widespread National Weather Service use is the "Weighing Gage." This gage is a scale with a bucket on it that simply catches the rainfall in the bucket and weighs it. Through calibration, and through a series of gears connected to a pen, the amount of rainfall is recorded on a chart. The chart is fastened to a cylinder that moves by clockwork mechanism. Amounts can be read from the chart by hour or even less over a period that is typically up to a week. The chart and mechanism are protected from the weather by a metal shield shaped into a funnel at top, so that the precipitation falls directly into the weighing bucket. The bucket has oil added to protect against evaporation and also has antifreeze. Other common types of this gage record on 30 day rolls of paper by a punchblock mechanism, or are recorded electronically.

One problem in measuring rainfall is wind. This problem has never been completely solved, but it is known that as the winds increase, less rain will be caught in the gage. At National Weather Service sites, a circular shield of metal baffles around the rain gage, helps to get a more accurate amount by blocking some of the wind.

One advantage of this these types of weighing gages is that it also weighs snowfall the same as rainfall, so no melting of the snow is required to get a liquid amount.

With widespread automation of many different kinds of observing systems, electronic automatic weighing and automatic tipping bucket systems routinely report rainfall amounts at requested intervals, often at remote locations, with little or no human intervention needed for long periods of time. These are routed into computer systems for users to see. Thousands of these are in use at National Weather Service (NWS), FAA, DOT, and other federal, state, and

county, and local sites. Many more thousands have come into use by private individuals, as numerous varieties of relatively inexpensive observing systems have come into widespread use over the past 20 years. Often on these systems, the rain gage is part of a package of other weather instruments that measure temperature, wind, etc. The quality of the rain gage varies a lot though, and most have trouble measuring the precipitation when it falls as snow.

When snow falls, an additional measurement may be required, besides that liquid amount that is caught in the rain gage. This snowfall measurement is straightforward: a measuring stick that is shoved into the snow. The measuring stick is graduated to measure snow to the nearest tenth of an inch.

To get a realistic measurement, snowfall should made away from buildings, trees, pavement, etc. They should be taken on a flat and even surface, other than on grass or fields, which are not as accurate due to their naturally uneven surface.

The biggest problem with measuring snowfall is when winds cause drifting. The very uneven nature of drifting can make finding a representative place to measure difficult. Often multiple measurements are made and averaged to obtain a more reasonable average amount. During severe drifting, there may be bare spots and drifts several feet deep in the same area. Often an apparent flat spot that looks good for measuring snowfall will have actually been swept by the wind, so that the top part of the layer may have been carried some distance, say to a fence or coulee. In this case, snowfall amounts will probably be underestimated unless the drifts are considered. When the measuring location is on a wind-blown hill, or at the bottom of a valley or coulee, any representative snowfall amount may be very difficult to obtain.

Other difficulties in measuring snowfall occur when the snow is melting as it accumulates, or melts soon after accumulating. Then the snowfall is the maximum depth of the newly fallen snow. Sometimes snow accumulates, and then completely melts between observations, often when the observer is not available to measure it. The amount of liquid that was caught in the rain gage may be the only clue to how much snow fell.

Another snowfall amount difficulty occurs due to the fact that snow tends to settle with time, the heavier the amount, the more weight to cause this. This is a continual process, therefore the more often new snowfall is measured, the greater the amount will be. To standardize this, National Weather Service offices measure snowfall every 6 hours. Out of practicality, most co-operative observers measure only once per day, but are also permitted to measure every 6 hours. Measurements made more often, such as every hour, are not permitted for official purposes. Such measurements tend to give higher snowfall totals.

Ironically, there are few other options for measuring snowfall other than a human with a measuring stick. Automated options may consist of estimated snowfall from precipitation

reported in the rain gage, or by looking at a remote camera. While these are helpful, they are not very accurate, especially for climatic data.

When snowfall is measured, there is usually another measurement is taken, called “snow depth.” This is typically taken once per day at a standard observation time. Requirements and problems are similar to measuring daily “snowfall” The main difference is that “snow depth” is the sum of what is on the ground total, the accumulation of what may be weeks or months of multiple snowfalls, as well as what may be left over from several episodes of melting. The added difficulty of multiple snowfall, drifting, and uneven melting occurrences all added together, can make the “snow depth” measurement much more difficult than the daily “snowfall” measurement. Therefore, being less precise, this amount is typically rounded to the nearest inch when reported, in what sometimes might be little more than a reasonable estimate, or educated guess.