Compilation of Snowfall Measuring Guidance During Blowing and Drifting Snow Events

<table>
<thead>
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<th>Guidance Source</th>
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<td>(1)World Meteorological Organization Snowfall Depth. Chapter 6.7.1, WMO8 _ Ed 2008</td>
<td>Chapter 6. MEASUREMENT OF PRECIPITATION 6.7.1 <strong>Snowfall depth</strong> “Direct measurements of the depth of fresh snow on open ground are taken with a graduated ruler or scale. A sufficient number of vertical measurements should be made in places where drifting is considered absent in order to provide a representative average. Where the extensive drifting of snow has occurred, a greater number of measurements are needed to obtain a representative depth. Special precautions should be taken so as not to measure any previously fallen snow. [Bolding and Underlining Added] This can be done by sweeping a suitable patch clear beforehand or by covering the top of the old snow surface with a piece of suitable material (such as wood with a slightly rough surface, painted white) and measuring the depth accumulated on it. On a sloping surface (to be avoided, if possible) measurements should still be taken with the measuring rod vertical. If there is a layer of old snow, it would be incorrect to calculate the depth of the new snow from the difference between two consecutive measurements of total depth of snow since lying snow tends to become compressed and to suffer ablation.”</td>
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<td>(2)CoCoRahs Snow Measuring</td>
<td>“Measuring new snow accumulation is easy when the snow falls without wind and isn't melting on the ground. But when the wind blows, measuring snow becomes a real challenge. We deal with drifted snow by simply taking many measurements from a variety of locations and averaging them to get a representative measure.” [Bolding added] <a href="http://new.cocorahs.org/Content.aspx?page=MeasureSnow">http://new.cocorahs.org/Content.aspx?page=MeasureSnow</a></td>
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<td>“Blizzard conditions and uneven snow conditions”</td>
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<td>“Yes, we always try to measure as accurately as we can – precipitation amounts to the nearest 0.01&quot;, snowfall to the nearest 0.1&quot; and total depth (old plus new snow) to the nearest …. half inch. But when the blizzard comes …. then throw that out the window and just do the best you can. <strong>The simple fact is that wind-driven snow is not inclined to land in our gauges or accumulate politely on our favorite snow measurement areas. The gauge</strong></td>
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may be nearly empty and there may be areas of bare ground showing while nearby are drifts 3-6 feet tall. In fact, in blizzard conditions we may have to disregard what lands in our gauge and revert, instead, to finding -- to the best of our reasoning abilities -- a "representative location" where the accumulation of new snow seems to be about the average. There you can report the average depth and take a core sample of the snow, measure the water content and then ponder, before you complete your report, if that reading seems reasonable. You may think that "professionals" know how to handle all situations with grace and precision, but the fact is that coming up with measurements from true blizzard storms is often a combination of measurement (usually an average from several locations), experience (comparing to past storms you have measured) and judgment. In other words, there are situations where a good guess is probably closer to the truth than any one particular measurement you can make.” [Bolding Added]

“There is no magic formula for how you determine how much snow fell and what its water content was. You just assess as best you can. I assure you, you can tell the difference between a 1" snow, a 6" snow and a 12" snow, even in blizzard conditions. So start crudely and then narrow it down to a better estimate. If you're in an open wind-swept area, chances are you will report less than if you are in a very protected area where the snow builds up. In fact, in ....[during 2 storms in 2 large cities] .... the deepest snows were measured in very densely populated neighborhoods. Because of the very strong winds with these storms, snow was blown from the many roofs and streets and deposited in the small yards. The backyard measurements may have been somewhat enhanced by the roof-blown snow.” [Bolding and Underlining Added]
http://www.cocorahs.org/Media/docs/TheCatch_2010-02-05R.pdf

“Blowing and drifting: This is arguably the greatest challenge we face. Windblown snow doesn't land in our gauges nor does it stay uniformly on the ground. Some places blow clear, while others pile up in drifts. Old snow and new snow mix together making measurement even harder. The wise observer takes an average of several measurements -- and also accounts for any old snow that may have blown in with the new. [Bolding and Underlining Added] There is no perfect solution here, but do make note in your remarks that you are dealing with a difficult wind-blown situation.

“Snow comes off the roof and blows about such that the snow is often deeper close to the house (on your deck, for example).”
http://www.cocorahs.org/Media/docs/TheCatch_2007-11-211.pdf
“There are times when measuring snow and its water content are fairly easy. When the winds are light and temperatures are well below freezing, it’s pretty easy to stick the ruler in the snow to get the snowfall amount and bring in the snow in the gauge to get the melted water content. But throw in some sleet, some freezing rain, and a whole lot of wind and things get really messy in a hurry. Even experienced professionals struggle. Here are a few tips on measuring snow under duress -- 16 tips to be exact. Read at your leisure or as the next snowstorm approaches.

[Tips 1) through 4) omitted.]

5) If there is a lot of blowing and drifting, you may not find any ideal place to measure the accumulation of new snowfall. Your favorite snow measurement surface may be blown clear or may be buried by a drift. Plan to take several measurements and compute an average. Under extreme blizzard conditions you may need to simply provide an "educated guess" based on reasonable measures. Use of estimated data must be noted in the Remarks section of the B-91. 6) When you compute an average, don’t include the depth of the largest drifts in your sample. 7) If there are many buildings and roofs in your neighborhood, keep in mind that the snow often blows off the roofs and collects below. As a result, we sometimes see measurements that are likely too high from densely populated neighborhoods. Keep that in mind as you measure. 8) When there is considerable wind, your gauge will likely catch only a fraction of the snow that fell. What you find in your gauge may be very unrepresentative. ……This is certainly possible for dry snows with lighter winds, but wind-driven blizzard snows are usually compact and dense and will likely have between 0.07" and 0.12" for each 1.0" of new snow. 9) If you suspect undercatch (less snow landing in your gauge than what actually fell) then take a representative core sample of the new snow on the ground. Take a core at a location where the snow is an average depth. [10) Omitted.] 11) The rain gauge outer cylinder is for collecting snow to measure its water content. Do not measure the new snowfall in the outer cylinder. Measure new snowfall on the ground at one or more locations. [12) Omitted] 13) Before submitting your daily report, always do a "reasonableness check". Does each measurement make sense and do the set of readings match up? For example if you measured 10" of new snow and 2.05" of water content is that reasonable? It might be if the snow was extremely wet or if there was a lot of rain mixed in with the snow. [Bolding and Underlining Added, paragraph above]

If it was only snow with a fairly typical density, then this report would be unreasonable -- either the snowfall is
too low or the water content is too high. While snow rarely has an exact ten to one ratio of snow to water, that may be a good first guess for a wet or wind compacted snow.

14) (similar to 8) Always check your snow-to-water-content ratio. You can tell a lot about snow just by walking through it, shoveling it, squeezing it, etc. You may be able to make a good estimate of the water content just by lifting a shovelful of snow. Five inches of wet snow may have 0.50 to 0.60" of water content and it will feel very heavy when you lift it. But a dry, low density snow of 5" may weigh very little and may only contain 0.15 - 0.30" of water content or even less. 15) Report your total depth of snow on ground. That is a separate measure from your daily snowfall. Report total depth to the nearest 0.5" [NWS nearest inch] whenever there is any snow on the ground even if no precipitation fell today or in recent days. ....16) Snow depth decreases quite rapidly after recent large snowfalls. (this is called "settling", "compaction" or "densification". Find a favorite representative location and measure in that [same area each day if the snow is no longer blowing and drifting. An average of several measurements may be necessary to get a good reading of the total depth of snow on ground. Watch the snow settle. And measure the water content (Snow Water Equivalent) too. It is fascinating to see that as snow depth goes down, its water content may or may not go down....."

“Measuring Horizontal Snow”
“....Unfortunately, most of the snow that falls there [high CO. mountain location] falls horizontally accompanied by furious and frigid winds. They asked me some good questions. "Where should we put our snow measurement board?" "Do we clear it and lay it on top of the snow after each observation?" "Should we measure in the open near our rain gauge or in the trees where the snow doesn't blow as much?" "What do we do if the total depth of snow on the ground is deeper than our yardstick?" I tried to answer as best I could, but when it comes to windblown snow, perfect measurements may not be possible. Instead you must rely on your best judgment and do an average of several measurements (or eyeball assessments) over both drifted and wind-scoured areas. Our gauge may not catch all the snow that actually tried to fall, so you may need to find an area where the accumulation of new snow appears to represent an average for your neighborhood. Take a core sample of the new snow on the ground there to get a better estimate of the water content of the precipitation. [Bolding Added]http://www.cocorahs.org/Media/docs/TheCatch_2006-11-15.pdf
“What if the wind is so strong that the snow is badly drifted?”

Wind-drifted snow is very difficult to measure accurately. Do your best to come up with an average accumulation of new snow -- and then take a core sample at a point with average accumulation to get the water content. Check the numbers to see if they appear reasonable -- and also mention your challenging plight in your "comments"

http://new.cocorahs.org/Content.aspx?page=MeasureSnow

“In Depth Snow Measuring”

“Note that we do not ever measure the depth of snow in the rain gauge itself. Any frozen precipitation in the rain gauge must first be melted, and then measured.”


“Snow is not deposited uniformly on the ground and it melts even more unevenly depending on factors such as shading, slope, aspect, wind exposure, vegetation height, color and amount.”  Page 256

“Although perfectly consistent measurements may not be possible due to the nature of fresh snow, the following criteria can produce a high degree of consistency.”

• The location for taking measurements is critical. An unobstructed yet relatively protected location (such as a forest clearing or open back yard away from buildings, trees and fences) is best to ensure uniform and undrifted snow accumulations that are representative of the average.”

• The use of a snowboard (a square or rectangular flat, white surface positioned on the ground and repositioned daily on the top of the existing snow surface) for measuring the accumulation of new snowfall provides a smooth, solid surface on which to measure and from which core samples can be taken [photo omitted].”  Page 250 [photo omitted]
How To Measure Snow, February 16, 2010, NWS New York, NY WFO

| “To account for blowing and drifting snow and the resulting uneven accumulation patterns, observers should assess the representativeness of the snowboard measurement by taking an average of several measurements in the surrounding environment making sure to include only that snow which has fallen since the previous observation. If the snowboard measurement is found to be unrepresentative (due to snow being partially or totally blown clear; drifts forming in its immediate vicinity; or snow melting on the snowboard but not on most ground surfaces), the reported snowfall should be the average of as many readings as are needed to obtain an appropriate average over an area including both moderate drifts and moderate clearings (avoiding the largest and least representative drifts).” Page 261 |
| “N.J. Doesken  
Colorado Climate Center, Department of Atmospheric Science, Colorado State University, Fort Collins, CO 80523, USA  
e-mail: nolan@atmos.colostate.edu” |
| “D.A. Robinson  
Global Snow Lab, Department of Geography, Rutgers University, Piscataway, NJ 08854. USA  
e-mail: drobins@rci.rutgers.edu” |

Measure Snow Using a Snowboard - The goal is to achieve the most representative and accurate measurement of snow accumulation, which is widely known to be obtained using a snowboard. A snowboard should be any lightly colored board that is about 2 feet by 2 feet. A piece of plywood paint white works very well. Ideally, it should be painted white to minimize heating by sunlight. Place your snowboard in the spot you have chosen. Mark the location of the snowboard with a stake so you can find it after a fresh snowfall.

**Note**: The location of the snowboard can change from snow event to snow event, depending on the wind speed and direction. [Bolding added]  
**Measuring Snowfall - Special cases**: Snow has blown or drifted onto the snowboard. In this case, take several measurements from around the yard where the snow has not drifted, being careful only to measure new snow. Take an average of the various measurements to arrive at a total.” [Bolding Added] Regarding siting it states, “**Before the First Snow** First choose a convenient spot away from the
obstacles such as house, garage, shed, fence, **larges bushes** [Bolding Added], and trees. Generally it should be about 10-12 feet from a 6 foot fence. These objects aid in the piling up (drifting) of the snow near them. The ideal spot will usually be in the middle of your back or front yard away from trees and not in an area frequently disturbed by pets.

http://www.erh.noaa.gov/okx/Skywarn/measuringsnow2.html