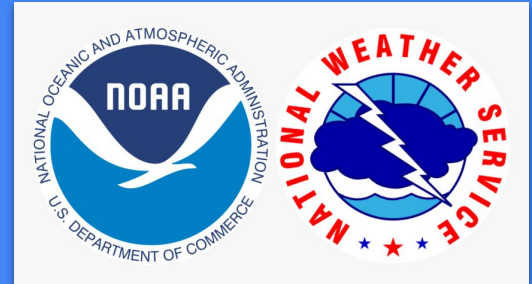


Winter Weather Observations

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- ❑ Types of winter precipitation
- ❑ Tools that are used to measure precipitation during the winter season
- ❑ How to record winter season precipitation accurately, especially during challenging conditions

How to Measure Snow



- ✓ Measure in a flat, open area
- ✓ Take an average from a few different measurements

Types of Winter Precipitation

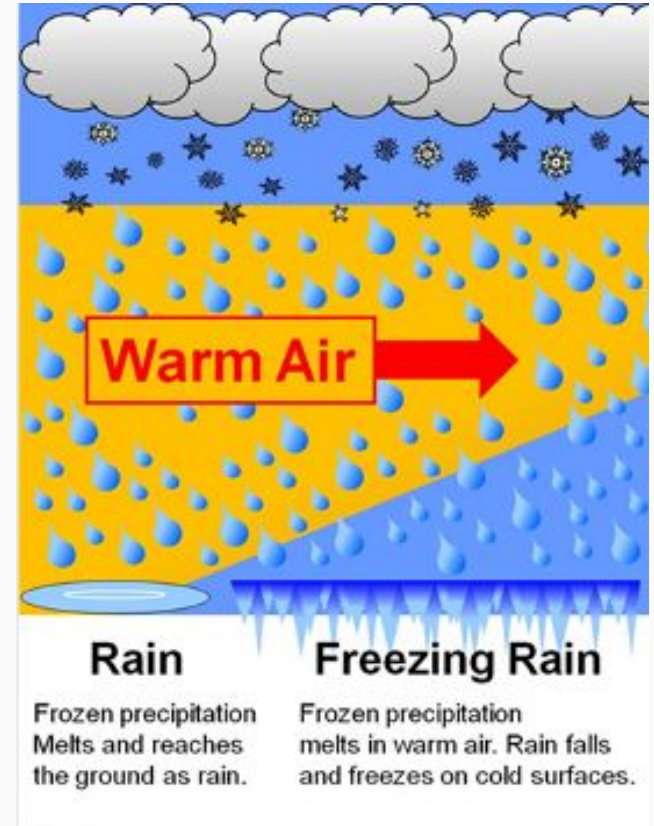
- ❑ Rain/Freezing Rain
- ❑ Drizzle/Freezing Drizzle
- ❑ Snow
- ❑ Sleet (Ice Pellets)
- ❑ Graupel (Snow Pellets)



Rain vs. Freezing Rain

During the winter season, **rain** falls when temperatures are above freezing between the cloud and the ground, completely melting snowflakes as they fall to the ground.

However, if the air right at the ground is below freezing (not enough time for the raindrop to refreeze), the raindrop will hit the ground and freeze on contact, leading to an accumulation of ice, which is called **freezing rain**.

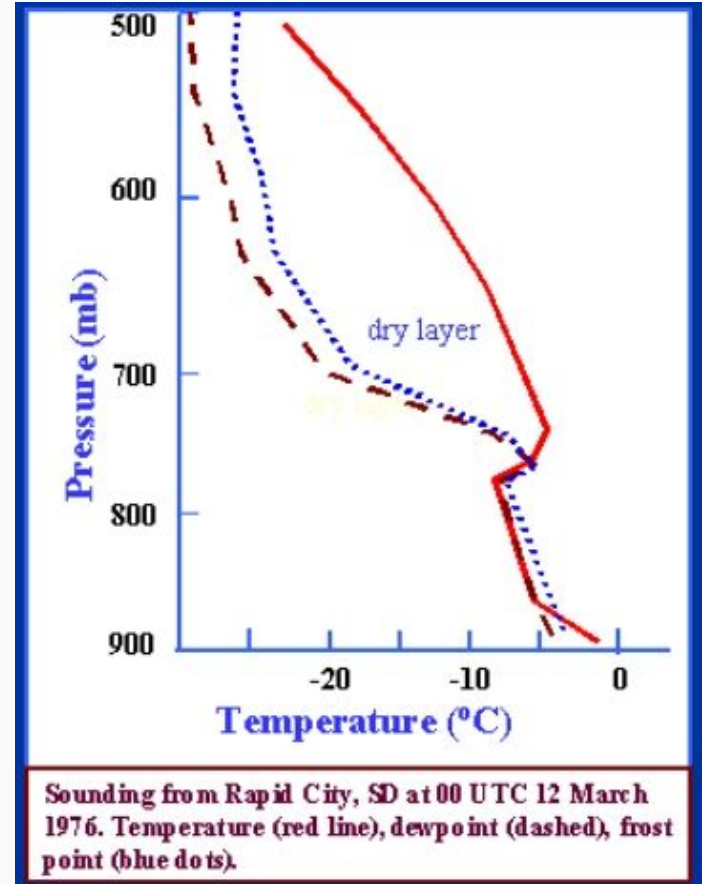


Drizzle vs. Freezing Drizzle

Drizzle forms when there isn't enough moisture to form rain drops or snowflakes.

It occurs when clouds are shallow, when moisture is limited to the lowest parts of the atmosphere, where temperatures are too warm for ice crystals to form (15 to 32 degrees).

If temperatures are below freezing at the ground, the drizzle freezes on impact with objects, leading to ice accumulation.



Snow

Snow falls when air is below freezing from cloud to ground.

Type of snowflake depends on temperature of cloud and available moisture.

Amount of snow accumulation depends on type of snowflake, rate at which snow is falling, and temperature of ground.

Warmer air can hold more moisture, so larger snowfalls occur when temperatures are closer to freezing.

However, liquid to snowfall ratios (the amount of snowfall per amount of precipitation) is higher with colder temperature (i.e. more fluffy/airy ice crystals).

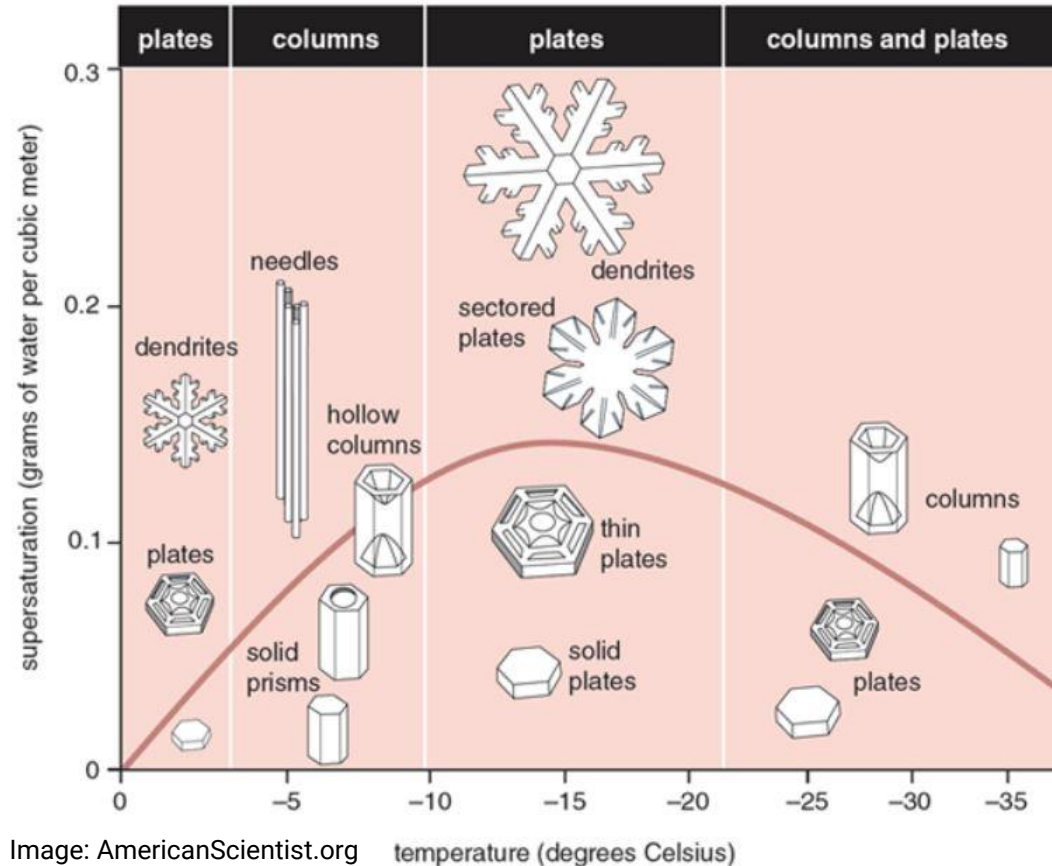
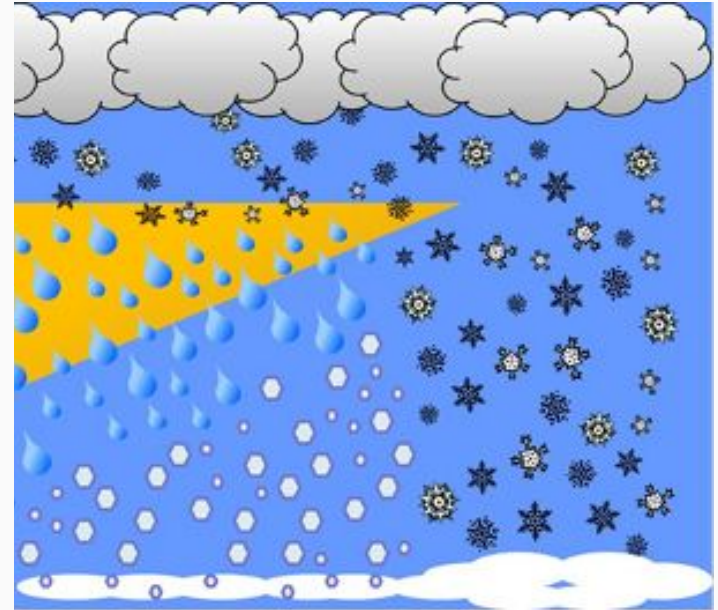


Image: AmericanScientist.org temperature (degrees Celsius)

Sleet (Ice Pellets)

When snow falls through a layer of air below the cloud that is above freezing it melts completely into a raindrop.

However, if there raindrop encounters air that is below freezing again as it falls toward the ground, the raindrop can refreeze into an ice pellet. This is called **sleet**.



Sleet

Frozen precipitation melts in shallow warm air. Then refreezes into sleet before reaching the surface.

Snow

Snow falls through cold air and reaches the surface

Graupel (Snow Pellets)

Graupel forms when supercooled water droplets coat a snowflake.

Graupel occurs when there is a lot of wind circulation in the cloud (unstable rising air) that causes the snowflake to travel through portions of the cloud with supercooled water droplets.

Graupel looks like “styrofoam” or “dippin’ dots”.

Sleet is frozen rain drops. **Graupel** is rimed snowflakes.

Is it SLEET or GRAUPEL?



Sleet
Liquid precipitation that freezes before reaching the ground.

Graupel
Snowflake that collects supercooled water droplets on its surface.

National Weather Service Missoula

Tools for Winter Weather Measurements

Rain Gauge

Precipitation Measurements (including liquid equivalent of freezing and frozen precipitation)

Snowboard

Snowfall Measurements (including sleet and graupel)

Ruler

Used to measure snowfall, snow depth, and ice accumulation



Manual Rain Gauge

- ❑ During below freezing season, remove the funnel and inner tube to prevent cracking due to water freezing in tube
- ❑ Let all types of precipitation fall into the outer cylinder (rain, freezing rain, snow, sleet, graupel)
- ❑ Take contents of cylinder inside to let them melt
- ❑ Add a measured amount of warm water to the sample to speed up melting
- ❑ Use funnel and inner tube to measure melted sample
- ❑ Make sure to subtract amount of warm water added, if applicable



Rain Gauge - Location

Placement of the **rain gauge** is critical for the most representative measurements possible.

- ❑ Top of rain gauge should be about 3-5 feet above ground level
- ❑ Located in a relatively flat area away from buildings/trees
- ❑ Should have an open view of the sky, ideally with any obstructions as far away as they are tall
- ❑ Top of rain gauge should be at least 6" above the top of a stand-alone post to avoid catch issues.



Rain Gauge - Limitations

Some **automated rain gauges** are installed higher than 5 feet above the ground along with other equipment, which may impact the accuracy of the measurements due to higher winds with height.

Automated rain gauges may also have challenges measuring heavy rainfall and wintry precipitation due to limitations with the tipping bucket.

Comparing automated rain gauge data to manual measurements is helpful in determining if the automated measurement is representative. Most NWS climate stations use manual precipitation measurements.



Rain Gauge - Windy Conditions

The catch in all types of rain gauges can be affected by high winds.

If high winds caused the precipitation from snowfall to be undercounted in the rain gauge, you can take a “**core**” of the new snow using a manual rain gauge.

In the area where you measure the new snowfall accumulation, take a biscuit of the snow by turning your rain gauge upside down and pushing it down to the ground.

Place a flat object under the gauge opening, then turn it right side up to capture the snow, and take the snow inside to melt for the precipitation value.

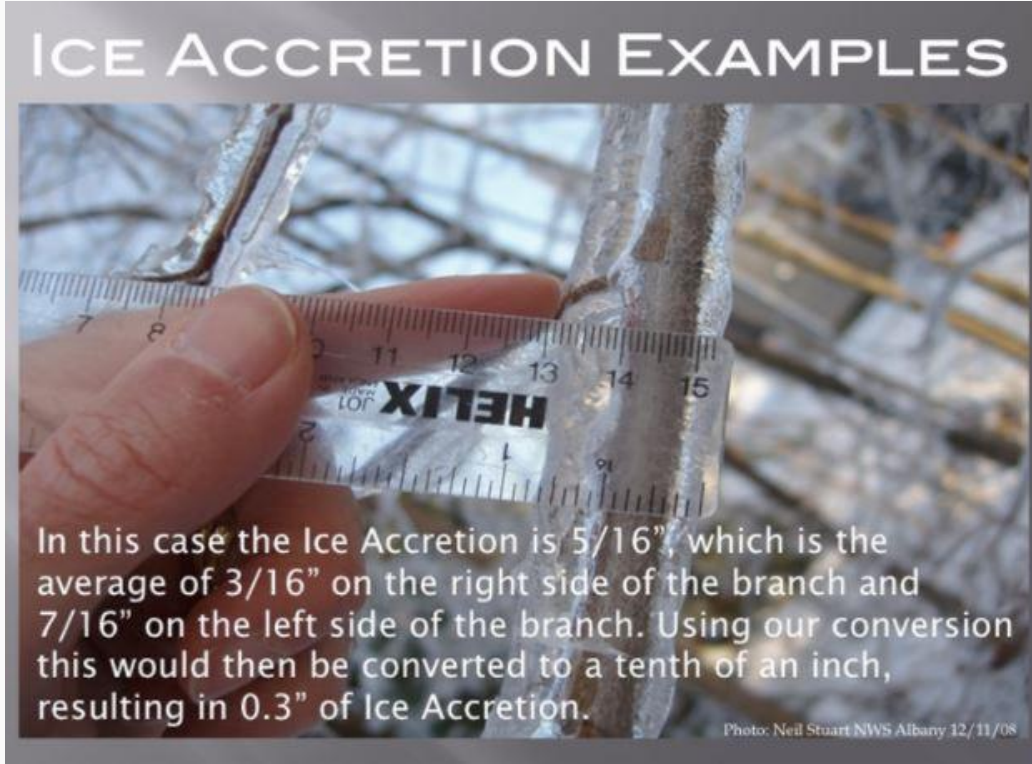


Freezing Rain - Ice Accumulation

Rain that freezes on contact can lead to **ice accumulation**. Reporting the amount of ice accumulation helps determine the severity of the impact.

Use a ruler to measure the amount of ice accumulation on each side of an object (tree branch, metal pole, etc.) Add both measurements together, and divide by 2 to get the ice accumulation.

If rain freezes in your rain gauge, take the rain gauge inside to let the ice melt so you can include it in the precipitation measurement.



Snowfall

Measuring the newly fallen snow can be tricky if there is already snow on the ground. Using a snowboard can help.

Snowboard: Flat piece of plywood about 18 to 24" in diameter, painted white, marked with stakes to find after snow falls, wiped clean after measurement. Place in vicinity of rain gauge.

A snowboard should not be cleared more than once every 6 hours to allow for natural compaction/settling to be included in the measurement.

Other options: Areas that were snow-free before the reporting period started like a picnic table, sidewalk, or driveway (if temperatures are well below freezing).

Avoid measuring in the grass. Grass can add a few inches to your measurement, depending on how deep the grass is.



Snowfall - Windy Conditions

Windy Conditions

- ❑ May need to find alternate site to measure snowfall if snow didn't accumulate in normal measuring location (i.e. snowboard blown clean by wind).
- ❑ Try to find a spot that appears to have an **average amount of accumulation** (away from structures, drifts, and low accumulation spots). Sample several areas to get an average snowfall amount.
- ❑ If all else fails, compare the total depth of snow on the ground at the last observation to the total depth of snow now, and use the difference as the snowfall amount.



Photo: NOAA

Snowfall - Melting Snow

If temperatures are at or above freezing as the snow is falling, the snow may melt on contact with the ground, or partially melt before a measurement is taken.

- ❑ The **snowfall amount** is the highest accumulation of snow during the measurement period.
- ❑ If the snow accumulated to 4.5" the evening before, but partially melted to 2.4" at the time of your observation the next morning, report 4.5" of snow accumulation.
- ❑ If it snowed, but it melted on contact with the ground, report a trace of snowfall.
- ❑ If the snow accumulated, but melted before you could measure it, do not report 0 for snowfall (which means no snow fell).



Sleet and Graupel

Sleet (ice pellets) and **graupel** (snow pellets) are included in the snowfall measurement.

Include any accumulation of sleet or graupel in your snowfall measurement area in your snowfall total.

Ice accumulation (which is rain that freezes on contact) is not included in the snowfall measurement.



Snow Depth

The snow depth is the average depth of snow (both old and new) on the ground (i.e. snowpack).

Take an average of 4 to 6 measurements of the snow depth on the property with a yardstick.

Measure in areas that are away from drifts and structures, where it appears that an average amount of snow has settled.

The snow depth can decrease from day to day, even if temperatures are below freezing due to compacting and sublimation (snow being absorbed by atmosphere).

The change in snow depth from the previous observation can help estimate snowfall during windy conditions.



Thank you for volunteering as a weather observer!

