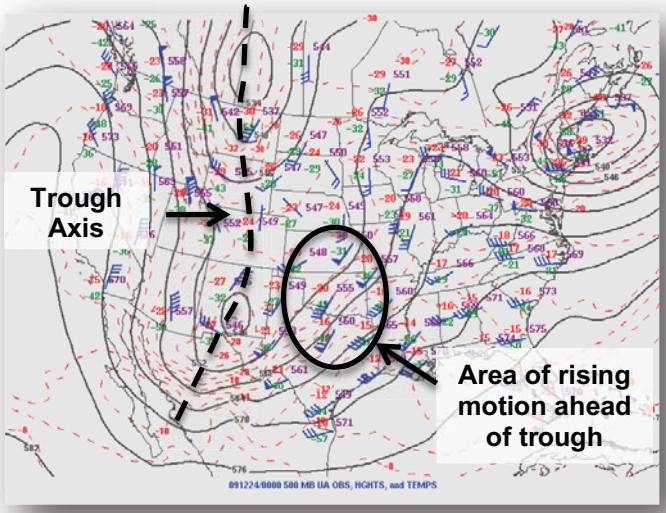
Winter Storms

Winter storms are among the most hazardous types of weather events due to the variety of impacts they can have on different areas (such as transportation, commerce, power distribution, etc.) and with coverage that tends to be more significant than many other weather hazards (hail, tornado, winds, etc.). This winter storm help page highlights the weather ingredients necessary for winter storms, the different types of precipitation they can produce, and several products to monitor once a winter storm is underway.

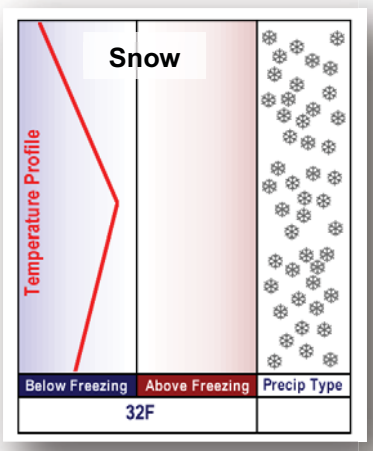
Winter Storms Ingredients

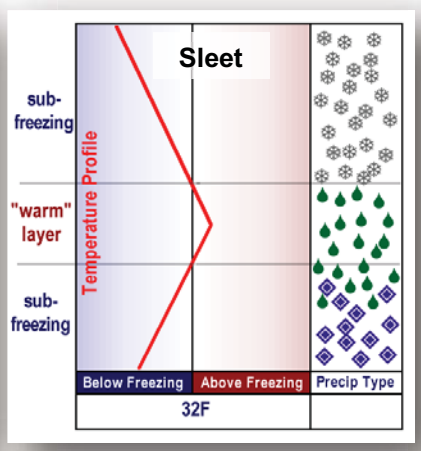
Though extremely difficult to forecast, only two ingredients are required for frozen precipitation in a winter storm: rising motion and freezing conditions.

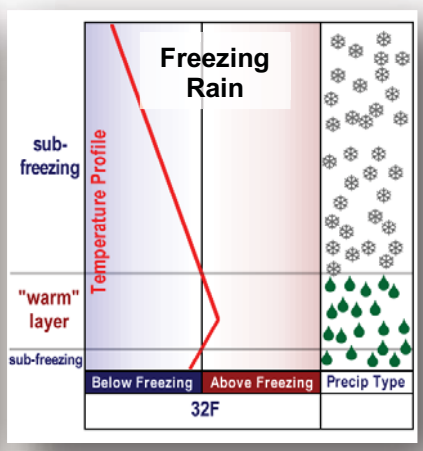
Rising motion is necessary to develop clouds and precipitation and can be produced in a number of ways including fronts, surface low pressure centers, and approaching upper atmospheric troughs (typically we look for them at 500 millibars or ~18,000 feet up). Among these different mechanisms the most significant, deep, and widespread rising motion occurs in advance of an upper atmospheric trough as shown in the example to the right from 24 December 2009. In this 500 millibar map, a trough extends from Canada south across the Rocky Mountains to Mexico (the axis of the trough is marked with a dashed line). Areas east of a trough axis are most favorable for rising motion. During this event, a major blizzard impacted much of Oklahoma including the Tulsa and Oklahoma City metro areas.



The other key ingredient for wintry precipitation is freezing conditions, including conditions at both the ground and in the atmosphere (called a “temperature profile”). The below scenarios show three different atmospheric profiles (red line) and the resultant wintry precipitation at the ground. Subtle variations in the location, depth, and magnitude of a “warm layer” (layer of air at some height that is warmer than air above or below it) dictate whether an event will produce snow, sleet (ice pellets), or freezing rain (rain that freezes onto objects). In some winter storms a location may experience each of these wintery precipitation types at different points in time as atmospheric conditions change.







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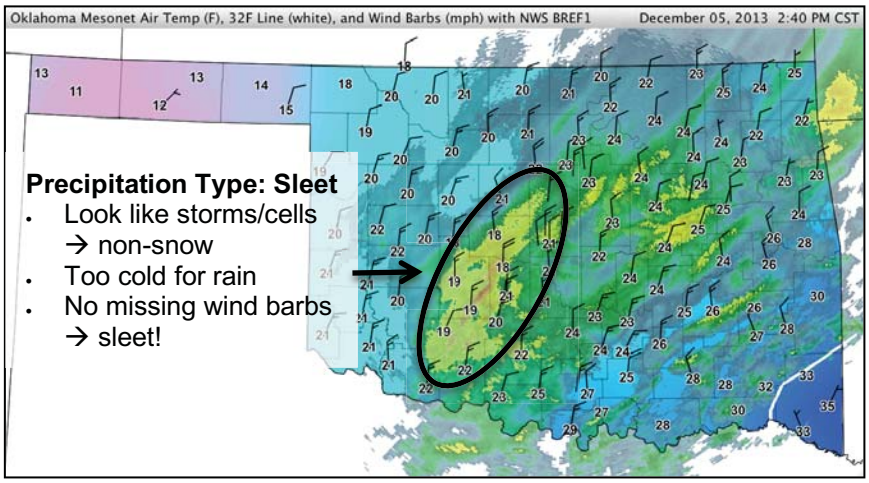
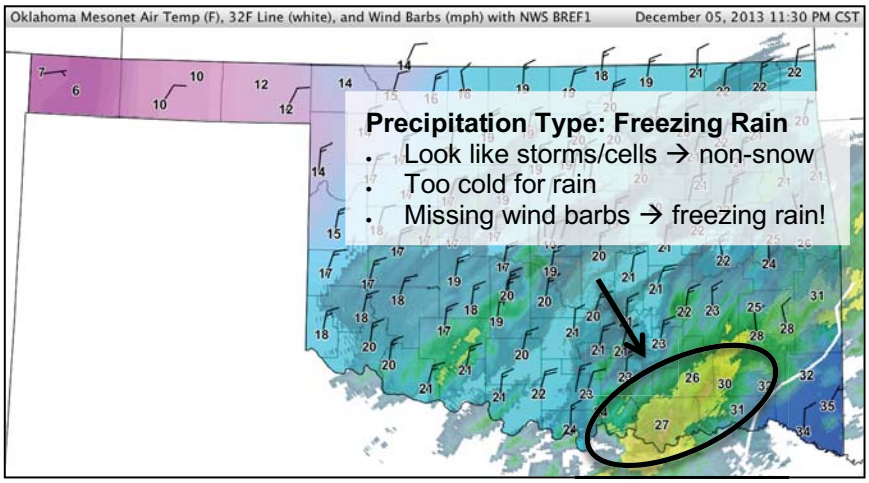
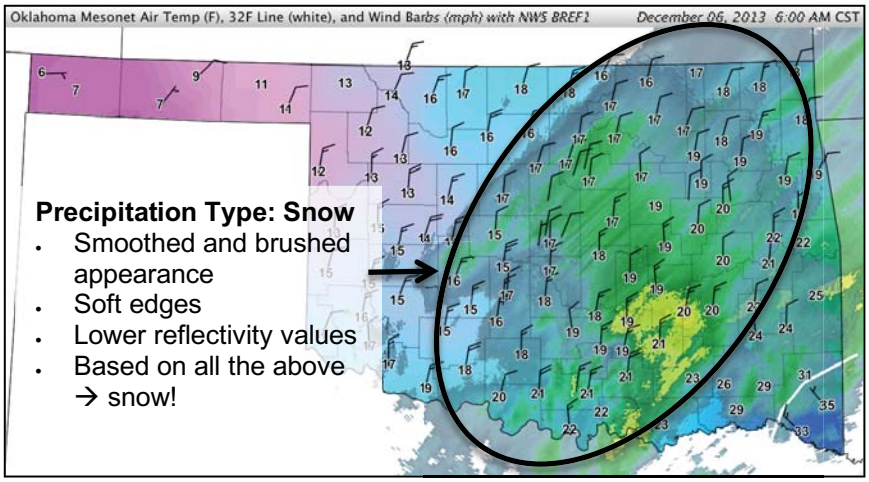
Monitoring Winter Storms with Mesonet and Radar

Once a winter storm is underway, there are a variety of weather products available to monitor the event and its evolution. Among the most valuable products to view during such events include Oklahoma Mesonet data and radar data, which together can aid in determining possible precipitation types that are occurring.

The Oklahoma Mesonet provides several key surface weather conditions to monitor during winter storm events, including air temperature and wind data. Air temperature maps provide real-time (within 5 minutes) temperatures statewide as well as a 32F line (also called the "freeze line"). The freeze line can be seen in far southeast Oklahoma in the examples to the right. Mesonet wind data are another key condition to watch – especially for wind shifts, increasing winds behind a front, and perhaps most importantly, missing wind data. There are several different causes of missing wind data, but when it occurs over multiple sites in an area with precipitation and below freezing conditions there is a high likelihood of it being caused by freezing rain accumulating on the wind sensors (see middle example to the right).







Weather radar also provides a wealth of useful information during wintry precipitation. In addition to providing information on the location of precipitation, the appearance of echoes in Base Reflectivity provides hints into the precipitation type. **Non-snow echoes (rain, sleet, or freezing rain)** have sharp edges, larger reflectivity values, and tend to look like storms or cells. **Snow echoes** have a distinctly different look characterized by softer edges, much lower reflectivity values, and a smoothed or brushed appearance. The catch with using radar to assess possible precipitation type is that it cannot be used in isolation. Instead, radar data need to be viewed in conjunction with Mesonet data, which provide crucial context of weather conditions at the surface. Examples of how this can be done are shown above from the 5-6 December 2013 winter storm event.

Mesonet