

**Mid-December Winter Storm**  
**14-18 December, 2016**  
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**Meteorological Overview:**

A winter storm brought heavy snow, freezing rain, and strong winds to a large area from the Pacific Northwest to New England from 14-18 December, 2016. The event began early on 14 December with a period of onshore flow in the Pacific Northwest ahead of a weak incoming mid/upper-level shortwave and surface warm front. At this time, snow fell across the Oregon Cascades as well as the higher elevations of the northern Intermountain West. At the lower elevations of Oregon, along the Columbia River and west of the Cascades, the intrusion of shallow arctic air along with warm air advection aloft led to the development of a mixture of snow and freezing rain. By 15 December, heights began to fall more substantially across the Northwest as a more vigorous shortwave approached the coast (*Fig. 1*). Also in response to this shortwave, a stronger area of low pressure developed at the surface along the frontal boundary, which moved onshore in northern California late on 15 December (*Fig. 4*). The rapidly falling heights across the Northwest as the shortwave moved onshore early on 16 December (*Fig. 1*) helped to quickly move the surface low into the Great Basin by 12 UTC. Snow rapidly developed across much of the northern Great Basin and northern Rockies during this time, with moderate to heavy snow reported at times. Snowfall totals of 1-4 inches fell at the lower elevations of southwestern Washington and northwestern Oregon, with higher totals exceeding 3 feet in the southern Cascades. Additionally, ice accumulations exceeded 0.25 inch across some of the lower elevations in western Oregon, near Eugene. Elsewhere, snowfall totals of 2-3 feet fell at the higher elevations of the Sierra Nevada and east across the Intermountain West and the central/northern Rockies.

Large-scale ascent ahead of the shortwave along with lift across an arctic surface front draped along the eastern slopes of the Rockies also led to the development of light to moderate snow across portions of the central/northern plains and Upper Midwest during the afternoon of 16 December. Coincidentally, a surface low developed along the front over the central plains (*Fig. 4*). As the new surface low progressed eastward toward the mid-Mississippi valley by the morning of 17 December, snow spread east across the Midwest and Upper Great Lakes, with areas of sleet and freezing rain across the mid-Mississippi and portions of the Ohio valley. As northwesterly low-level flow developed across the Great Lakes on 17 December, lake-effect enhancement of snowfall occurred downwind of Lake Superior and Lake Michigan. Also on 17 December, the cold front continued to move south across the plains, with rain changing to snow and areas of freezing rain across portions of the southern plains. Behind the front, the coldest air mass in nearly three years spread across portions of the northern/central plains and Upper Midwest. Wind chill values as low as -50 deg F were reported. Additionally, high winds

accompanied the arctic front southward, with wind gusts in excess of 60 mph reported across portions of the southern plains. A gust to 79 mph was reported in Denver City, TX.

As upper-level energy associated with the system moved east (*Fig. 1*), a surface low developed along a coastal front on the Mid-Atlantic coastline on 17 December (*Fig. 4*). As this wave of low pressure moved north along the coast through the day, a period of moderate to heavy snow fell across portions of the Northeast. In the wake of this low, the Northeast remained in broad southwesterly flow aloft, given that the primary upper trough remained over the Great Lakes. As warm advection increased ahead of this upper trough, areas of freezing rain developed across the Northeast and persisted into early on 18 December until the upper trough (*Fig. 1*) and associated cold front cleared the region.

A large swath of 4-8 inches of snow fell in association with this system from the northern plains to New England, with embedded areas of heavier snowfall. Snowfall amounts of 1-2 feet were common in the lake effect areas of Michigan, with 30 inches reported in Paradise, MI. Additional lake effect enhancement occurred across western New York, where snowfall amounts of 8-10 inches fell. Ice accumulations exceeding 0.25 inch were reported across some interior areas of the Ohio valley, Mid-Atlantic, and the Northeast, with 0.50 inch reported near Wakeman, OH.

### **Impacts:**

Snow and freezing rain brought vehicle traffic to a halt on Interstate 5, and caused a number of accidents in Portland, OR and surrounding areas. Ice accumulation in the Eugene, OR vicinity resulted in a number of downed trees and power lines. As the system moved east, the high winds accompanying it caused downed trees and power lines, with some minor structural damage reported. In Nevada, one person was injured when a traffic pole was blown down on their vehicle. The extremely cold arctic air mass on the northern side of this system resulted in 8 fatalities and 2 injuries due to exposure/hypothermia. Automobile accidents attributed to icy roads associated with this system results in 5 fatalities and 23 injuries. All total, 13 fatalities and 26 injuries were directly attributed to the system, along with a total of \$3.72 million in property damage.

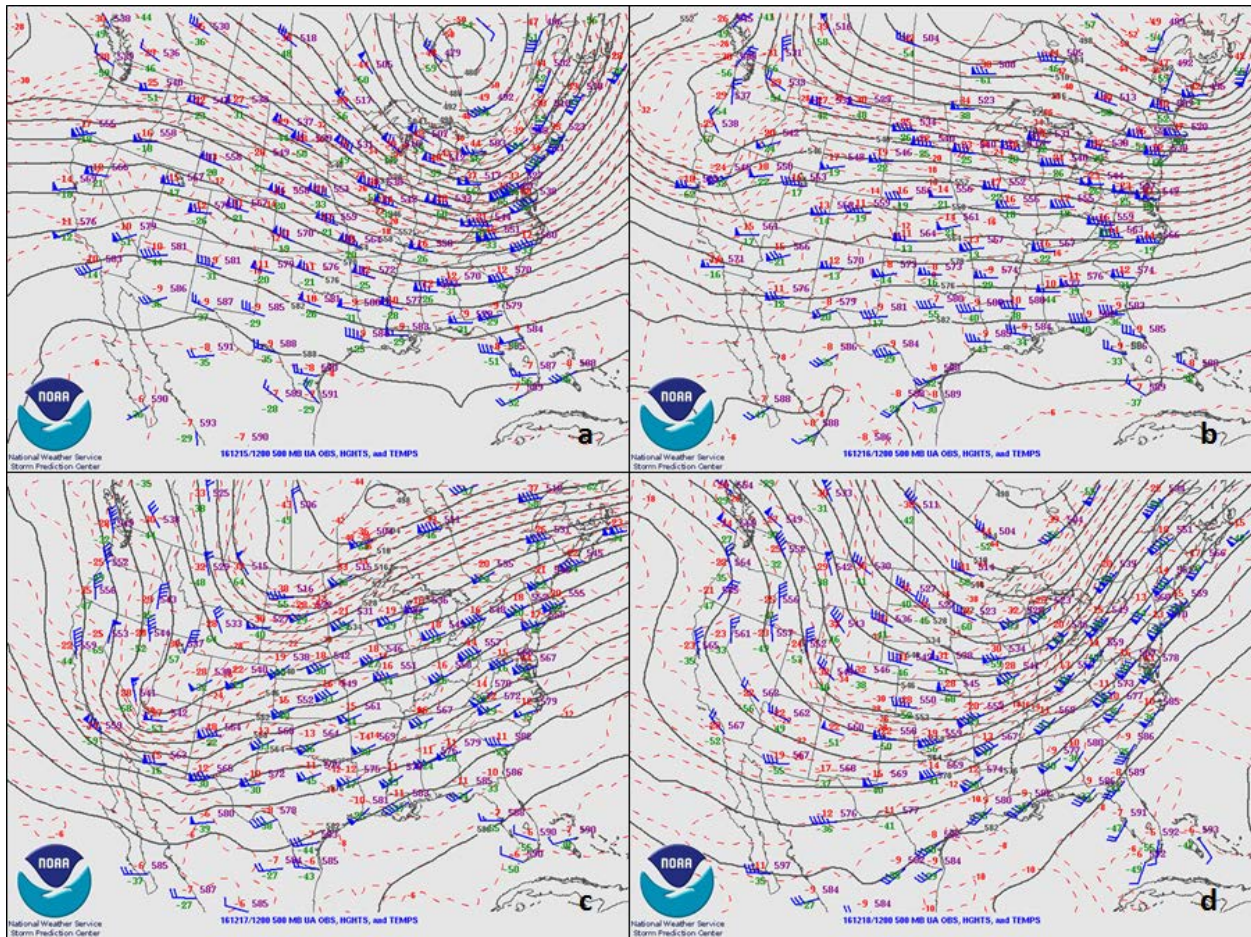


Figure 1: 500 hPa geopotential height (black) and temperatures (deg C, red dashed) along with upper air observations for 12 UTC on 15 Dec (a), 16 Dec (b), 17 Dec (c), and 18 Dec (d).

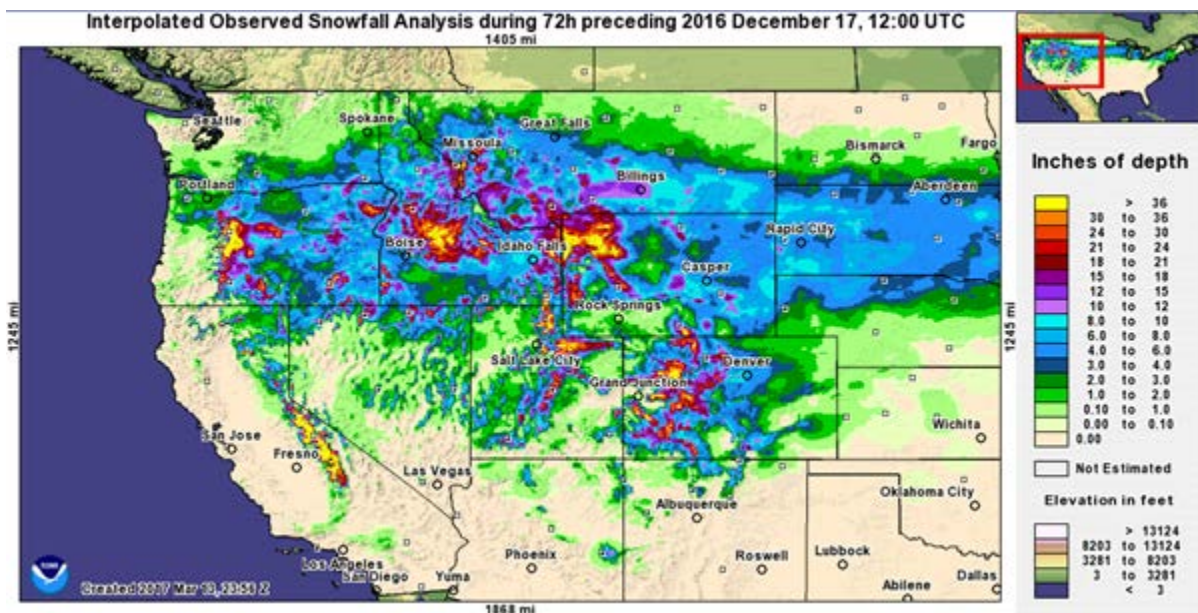




Figure 4: 500 hPa trough (black), surface low track (blue), approximate areas of snow accumulations greater than 6 inches (magenta), and approximate areas of ice accumulations 0.25 inch or greater (dark blue).