

**Northern Plains to Northeast Winter Storm**  
**10-12 December, 2016**  
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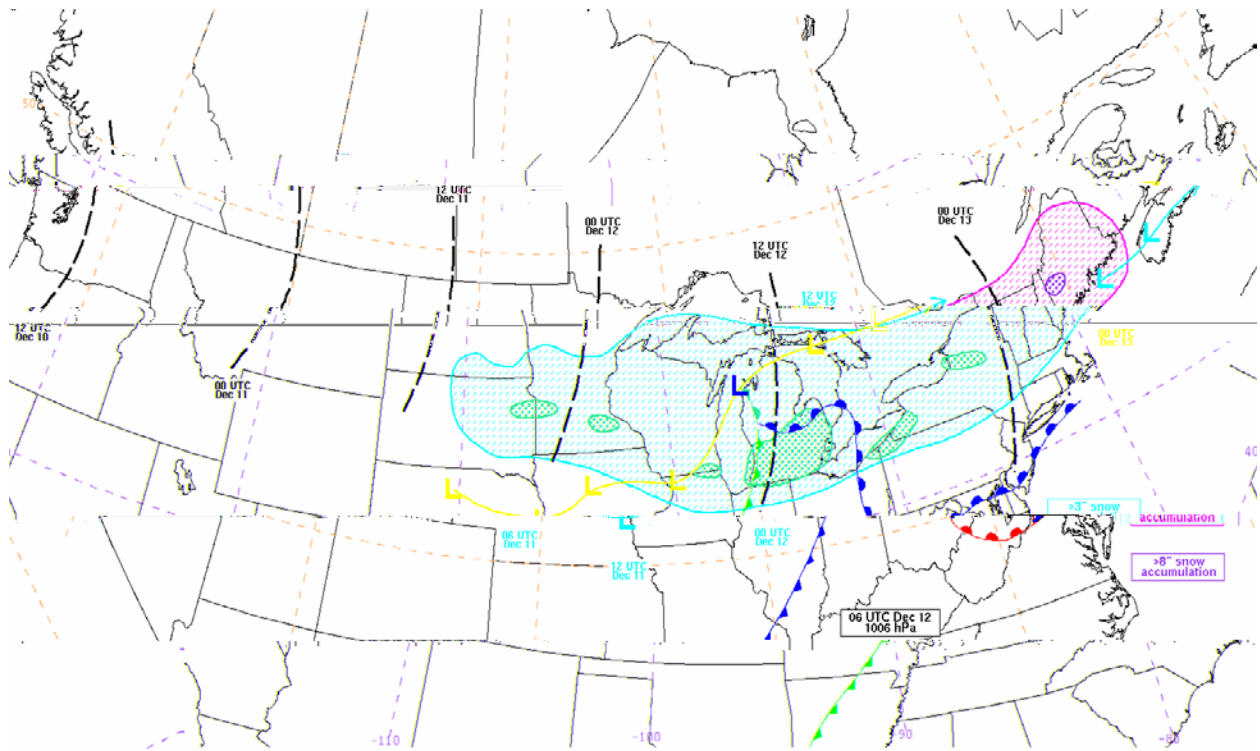
**Meteorological Overview:** A long duration winter storm impacted portions of the northern tier of the U.S. between 10-12 December, 2016 bringing moderate to locally heavy snow totals across parts of the northern plains, Upper Midwest, and the Northeast. By 12 UTC on 10 Dec, a weak surface baroclinic zone had set up from the northern central plains eastward into the middle Mississippi valley with plenty of arctic air to the north. Initially, snowfall started to the north of this boundary as moist southerly flow overran the boundary and weak shortwave energy moved through in the flow aloft. At the same time however, a shortwave trough was entering the Pacific Northwest (Figure 1). Once the trough emerged into the plains and a surface low developed by 06 UTC on Dec 11, the baroclinic zone strengthened and snowfall intensified across the Upper Midwest within an area of positive vorticity advection in the middle to upper levels. As the surface low progressed across the central plains, the middle Mississippi valley, and into the Upper Midwest and Great lakes, the heavy snowfall continued across the Upper Midwest, and spread eastward into the Lower Great Lakes, eventually reaching the Northeast. Snow across the Upper Midwest and the Great Lakes came to an end by the early morning hours of 12 Dec as the upper level system accelerated into southeast Canada.

By 12 UTC on 12 Dec, the surface low had fully occluded and was weakening over the upper Great Lakes. The upper level system was interacting with a weak area of low pressure along the New England coast and a frontal boundary draped across the northern Mid-Atlantic states and up the Northeast coastline. This helped to spread heavy snow eastward into portions of the Northeast. Compared to the Upper Midwest, snow across the Northeast was relatively short-lived as this new coastal low raced northward along the coast bringing snowfall to an end by the afternoon on 12 Dec.

From the Dakotas to Maine, snow totals were generally in the 4 to 8 inch range except for localized areas where heavier snow bands produced totals as high as a foot (Figure 2). Higher snowfall amounts were also found across lower Michigan and downwind of the lower Great Lakes where lake effect enhancement contributed to totals in the 10 to 15 inch range. Some light freezing rain also occurred closer to the frontal boundary across the northern Mid-Atlantic where warmer air spread over the top of a shallow cold air layer at the surface. This same system also brought accumulating snows to portions of the Pacific Northwest and northern Rockies in the days prior, with as much as 1 to 2 feet across portions of the Washington and Oregon Cascades, the Sawtooth Mountains of central Idaho, and the higher terrain of northwest Wyoming. Snow also fell in the lower elevations, and the bigger metropolitan areas of Portland and Seattle saw anywhere from 1 to 4 inches of snow.

**Impacts:** Even though total snow accumulations from this event were relatively light to moderate, there were still some significant impacts. Roadways quickly became hazardous and slippery with numerous reported accidents all across the affected region. This event was

blamed for the deaths of at least 8 people, mostly due to traffic accidents. Air travel was also significantly disrupted due to cancellations and delays at area airports, including over 1000 flight cancellations at Chicago's O'Hare and Midway airports. In Detroit, a commercial flight slid off an icy runway as it was taxiing to the gate, but fortunately, there were no reported injuries to passengers.



**Figure 1:** 500 hPa shortwave track (black), surface low track (cyan), approximate areas of snow accumulations greater than 3 inches (pink) and 8 inches (purple), and frontal position valid at 06 UTC on 12 Dec.

**Figure 2:** 72-hour total accumulated snowfall analysis valid from 12 UTC on 10 Dec to 12 UTC on 13 Dec (courtesy of NOHRSC).