

Mendenhall Valley Temperatures and Precipitation Type

Christopher Cox, NWS Juneau, AK

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Overview: The Mendenhall Valley is a local population center for nearly one third of Juneau's 30,000 residents. WFO Juneau is located approximately 4 miles northeast of the Juneau International Airport and sits squarely in the heart of the Mendenhall Valley (see Figure 1). WFO Juneau and the population center in the Mendenhall Valley frequently experiences large temperature differences compared to the airport and downtown Juneau. In the winter, trapped cold air masses in the Mendenhall Valley will often support snow in the Mendenhall Valley vs. rain or a rain and snow mix at the airport and downtown Juneau, and as a result snow accumulations in the Mendenhall Valley are often larger than what are experienced at the airport and near downtown Juneau. The Mendenhall Valley is glacier carved valley nearly 6 miles long and is located approximately 10 miles northwest of downtown Juneau (see Figure 1). The local area around Juneau consists of diverse terrain with elevations ranging from sea level to over 5000 ft. To the immediate east are the Coastal Mountains and the Juneau Ice Field. The Mendenhall Glacier is one of many glaciers that make up the Juneau Ice Field and descends into the Mendenhall Valley from the northeast end. The Mendenhall Valley is oriented northeast southwest and is nearly perpendicular to the Gastineau Channel (see Figure 1) which forms the southwest border of the valley and extends southeast toward downtown Juneau. The Mendenhall Valley spreads out to a relatively flat plain as the Mendenhall River dumps into the ocean at the northern end of Gastineau Channel where the Juneau International Airport is located. The Heintzleman Ridge (see Figure 1) serves as the Mendenhall Valley's southeast wall rising abruptly from near sea level to over 3,000 feet. The northwest side of the valley is composed of terrain that reaches 1,000 to 2,000 feet on the western portions and reaches elevations over 4,000 near Mt McGinnis (see Figure 1) along the eastern portion of the valley. On a larger scale, large mountain ranges and ice fields continue north and east through the Alaska Panhandle and British Columbia while additional channels and mountainous islands compose the region to the south, north, and west. The Gulf of Alaska sits approximately 80 miles to the west and the Pacific Ocean sits to its south and is the focus for storms that affect the region.

Synoptic Situation: During the winter, arctic air will often drain into the panhandle from the Canadian interior through the many mountain gaps and passes that exist along the Coastal Mountains between Alaska and Canada. The arctic air will then move through the marine channels and into the various inlets and valleys across the panhandle. The relatively warm water will modify the cold air, especially along the marine channels, and making it considerably warmer than inland locations. This situation is often noted with temperatures 5 to 10 degrees colder at WFO Juneau in the Mendenhall Valley as compared to the airport only 4 miles to the southwest but located on Gastineau Channel. Temperatures will often be 10 to 15 degrees colder on clear and calm nights where radiational cooling can be maximized. In fact a couple nights of strong radiational cooling is often enough to develop an air mass cold enough and deep enough to support all snow in the Mendenhall Valley as compared to all rain or a rain and snow mix at the airport and downtown as that air mass is later overrun with a warm and moist flow from the gulf of Alaska. The orientation of the valley is southwest to northeast with trapping terrain on all sides but the southwest. This orientation allows inflows to be more easily blocked, trapping the

cold air in the Mendenhall Valley which can be over-run by warm moist air from the southwest. The trapped air mass modifies very slowly compared to locations along the inner channels where better mixing occurs, and as a result the period of time that snow falls and accumulates in the Mendenhall Valley is often longer compared to the airport and downtown Juneau. The results can often be dramatic with several inches of snow falling at WFO Juneau in the Mendenhall Valley while a snow and rain mix with minor accumulations occurs at the airport and all rain occurs in downtown Juneau. It should be noted that strong southwest flows are more effective at eroding the cold air mass out of the valley than weaker flows.

Model and Forecast Considerations: Most global models do not have the resolution to resolve this terrain induced trapped air mass and will in general transition to a warmer air mass for the Juneau area more quickly than cold air can actually be eroded out of the Mendenhall Valley. However, a locally run WRF model at 3 km is beginning to reach the resolution needed to resolve this situation and may provide an interesting case study. Situational awareness of the conditions leading to a Mendenhall Valley trapped air mass and the conditions favorable to erode a Mendenhall Valley trapped air mass remains the key for forecasting significant temperature differences and precipitation type in the Mendenhall Valley.

Figure 1: Juneau Local Terrain

