Rain, Rain and More Rain

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A record precipitation total of 85.06 inches was observed at Juneau International Airport during l991. However, the airport is located at one of the driest places in the greater Juneau area. So, how wet was the rest of Juneau?

To answer that question, it is necessary to take a brief look at what causes rain in our mid-latitude rain forest.

The most important prerequisite is availability of moisture. The Gulf of Alaska has been called the graveyard of North Pacific storms since so many come to rest in the gulf after a long journey across the Pacific Ocean. These maritime low pressure centers often gather warm moist air from tropical latitudes and carry it along in the prevailing westerly winds.

That moisture is then pushed onshore over the rim of the gulf. Except for short periods of cold arctic outflows from Northwest Canada, all of Southeast Alaska has a maritime climate. Overall, there is abundant moisture available.

The other prerequisite for rain is a lifting mechanism to raise the moist air to cool it enough to condense into precipitation. Weather fronts associated with these North Pacific lows cause strong upward motion. Our fall and winter storms are a good example of frontal induced rains.

Instability, when cold air aloft allows the warmer air below to rise, is another main lifting mechanism. Heavy showers after a front moves through the area and our summer showers, including the very infrequent thundershowers, are the result of that instability.

However, the one lifting mechanism that is constant and is available year-round is orographic lifting. The steep terrain of Southeast Alaska forces any onshore flow to rise. The Fairweather Range is the steepest rise from tidewater anywhere in the world. The elevation rises from sea level to 15,000 feet in only a dozen miles. Steep terrain abounds, at lesser heights, throughout Southeast.

Precipitation over this steep terrain, mostly in the form of snow, is the source of the Juneau Icefield, as well as several of the largest glaciers in North America. During weak onshore flow, these mountain barriers are the primary lifting mechanism.

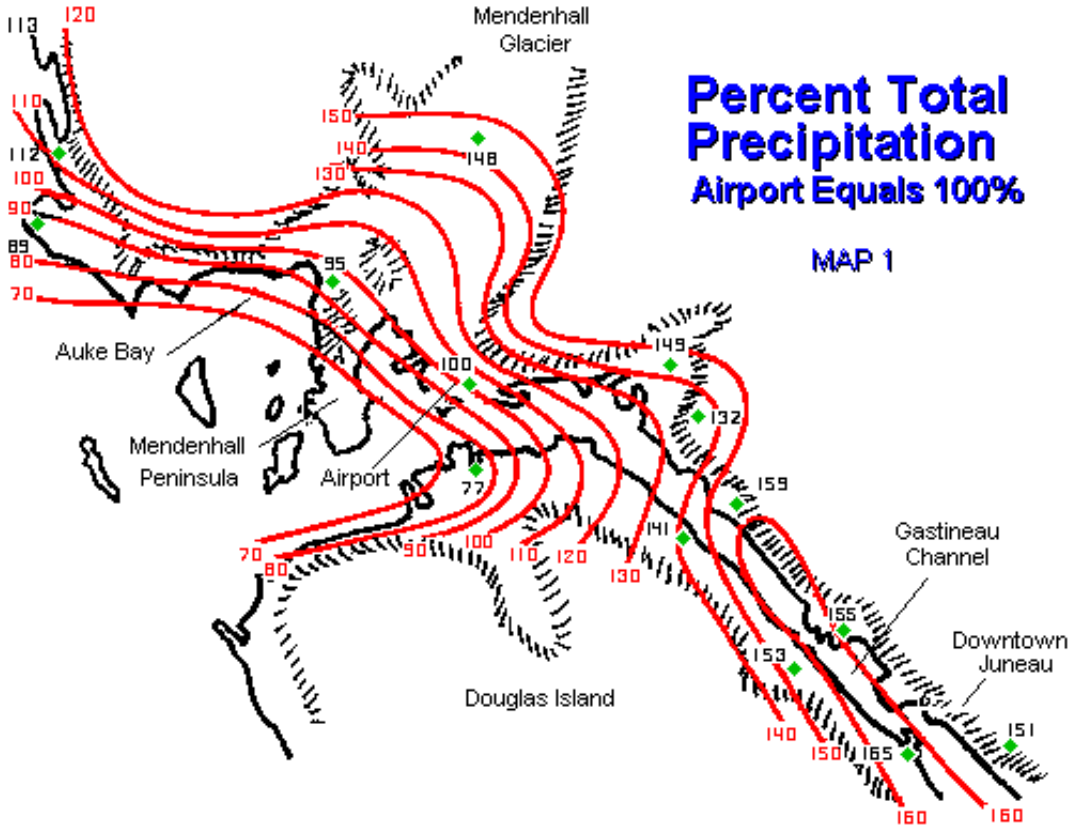
Any onshore flow is likely to produce precipitation in the Panhandle. Much of our rainfall occurs at a relatively high atmospheric pressure. This is often due to high pressure building over the eastern Gulf of Alaska, which gives an onshore component to the wind. In general, high pressure building from the south through west means wet weather for Southeast Alaska.

This is the opposite of the continental climate of much of the Lower 48 states, where high pressure usually means a drying, clearing trend. So don't be surprised if it is raining when your home barometer is in the high pressure part of the scale, which is often marked, "fair."

In wet years Juneau has more than 250 days of precipitation. Only 3 percent of these rainy days produce more than an inch at the airport. This means that Juneau has many light precipitation events in which terrain provides the main lifting and defines the precipitation pattern.

Cooperative observers have provided the National Weather Service with precipitation observations around the Juneau area. A limited number of 15 locations and a data record that varies from as little as two years to more than 10 years exists. This small sample is best converted to a percentage for matching years at the airport. This allows a good estimate of the average precipitation pattern around the Juneau area.

Almost all the residents of Juneau live below 500 feet of elevation, so this is where the observations were taken. The increase in precipitation with elevation is several times greater than any horizontal difference. One summer, rain at about 2,500 feet above sea level on the ridge east of Mount Juneau was more than 300 percent more than downtown Juneau. This very large increase with elevation is probably representative throughout the Juneau area. Caution should be used in applying the precipitation maps close to the steepest slopes.



Compared to Downtown and the valley, North Douglas and Auke Bay are relatively dry.

Looking at Map No.1, the most noticeable feature is the large minimum that includes the airport and extends over much of the Mendenhall delta, the tip of North Douglas Island and all of Auke Bay. This relatively dry area is due to the distance from steep terrain and the result of the spreading out of the wind blowing up Gastineau Channel. Vertical lifting is least enhanced over this area. It should be noted that the main Indian settlement in the Juneau area was located on the north shore of Auke Bay in a very dry area.

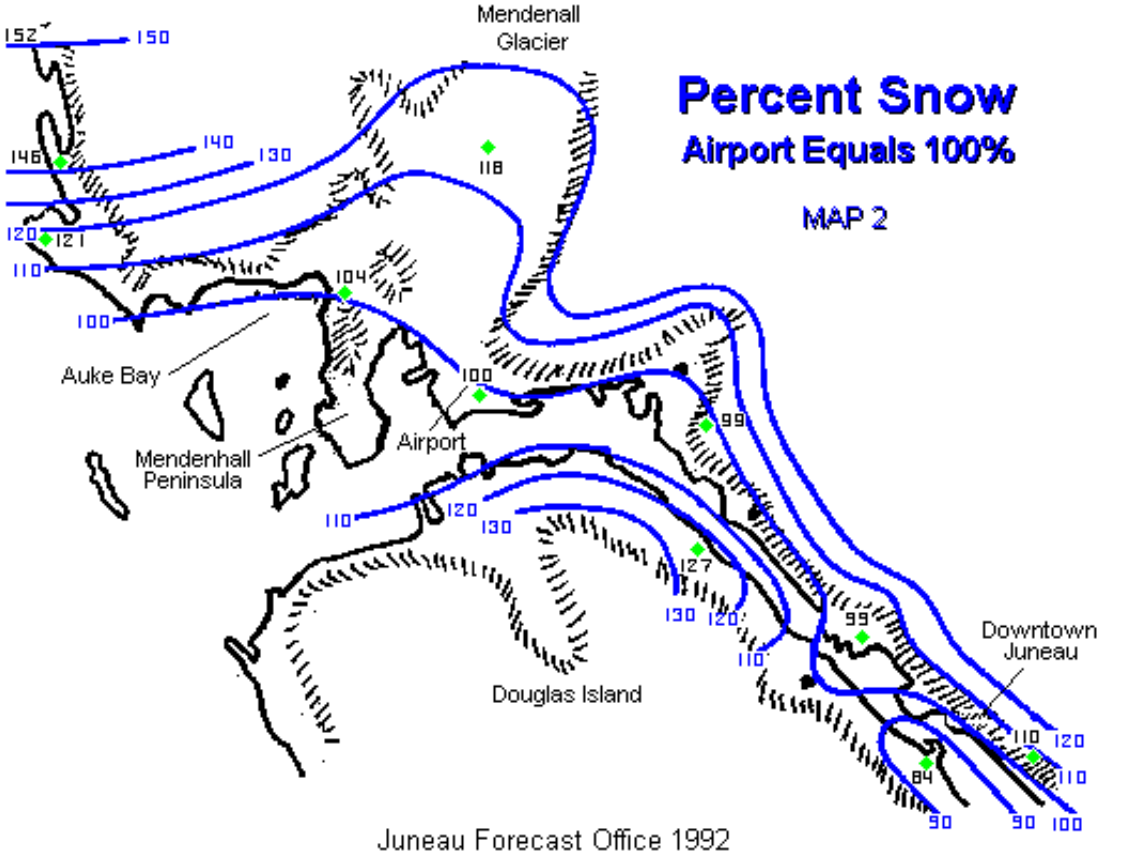
The wettest place in Juneau is the "rain belt," encompassing both sides of Gastineau Channel from approximately Sheep Creek extending north to Salmon Creek and including downtown. Average precipitation in the rain belt is 50 to 65 percent greater than the airport. In 1991, that translated into almost 130 inches of liquid sunshine in West Juneau.

There are three main reasons for the rain belt. First, any southerly flow in Gastineau Channel is squeezed and forced up as the channel narrows because of the protruding terrain along Salisbury Ridge, Mount Roberts and Mount Juneau.

Secondly, the rain belt is bounded by very steep terrain. Lastly, the lifting of the onshore flow over the mountains on Douglas Island produces a spillover effect as precipitation in the higher elevations moves over Gastineau Channel.

Many Juneau residents perceive the Mendenhall Valley to be a relatively dry area. This may be due to the easy-to-remember sunny afternoons when it is still raining in town. Actually, most of the valley is quite wet and is a close second to the rain belt with nearly 50 percent more precipitation than the airport.

It is wet because the valley is narrow and few places are very far from steep terrain. The valley also faces any onshore flow like a large funnel. Heintzleman Ridge (Thunder Mountain) is another choke point in the flow up Gastineau Channel and lifting over the ridge may add spillover rain into the valley. Heintzleman Ridge is also a preferred area for summer showers due to heating along its slopes. For similar reasons, the Lemon Creek area is another wet location.



Note the sharp increase in average snowfall North of Auke Bay.

Greater snowfall over the mountains surrounding Juneau is highly visible. The pattern of snowfall near sea level is quite different from the total precipitation pattern. Referring to Map No. 2, the most noticeable feature is the sharp increase in snow north of Auke Bay.

Driving out the road one can see the increase in snow, which on average is more than 50 percent greater than the airport. The main reason for more snow in this area, which otherwise is drier than the rain belt or the valley, is cold air. When cold air invades the Juneau area, Lynn Canal is usually

the last place the warm maritime air reaches to change the snow to rain. There is more snow north of Auke Bay simply because the duration of snow is longer.

Snow duration is also longer in the Mendenhall Valley due to cold air drainage from the glacier and the snow cover tends to persist longer than at the airport.

There is another snowfall maximum just north of the rain belt along the North Douglas Highway. The increase in amount of snow along the road during a normal winter is quite apparent as one drives north from the Douglas Bridge toward the Eaglecrest Ski Area. More snow in this area is due to a bit longer duration of snowfall compared to downtown and the rest of the rain belt. Spillover effects over the mountains on Douglas Island also enhance snowfall. In addition, the sun is blocked by the mountains for much of the winter, so local cold air drainage from snow covered hillsides prevails.

While downtown Juneau is much wetter overall than the airport, the snowfall there is equal to the airport. The snowfall minimum is south of downtown close to the water's edge. This is due primarily to the shorter duration of snow events: The warming of a southerly flow up the channel takes place sooner, and changes snow to rain. This is in contrast to the delay of hours north of downtown, and even days later north of the airport, before the snow becomes rain.

The variability of precipitation around Juneau can be explained in terms of the complex and steep terrain. By converting a limited data base in the Juneau area to a percentage of airport precipitation, we have a useful estimate of the pattern throughout the Juneau area. Using this percentage difference scheme, it would be valid to compare the longer term averages, such as multi-year totals near sea level, to any of the available airport data back to 1943. One can also use these maps to estimate precipitation amounts in any given area knowing the corresponding airport total.

Robert Kanan, former Warning Coordination Meteorologist at the National Weather Service office in Juneau, retired June 3, 2000.

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