

IC 4.3: Snowfall Disparity along the Wasatch Front Based on Flow Direction

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The Wasatch Mountains near the Salt Lake valley are well known for the amount and quality of snowfall received each year. Little Cottonwood Canyon, in particular, gets a large amount of snowfall each winter. Both Alta and Snowbird, the two ski resorts in Little Cottonwood canyon, receive on average 500 inches of snowfall each winter. Due to the orientation of Little Cottonwood canyon, proximity to the Great Salt Lake, and the dramatic terrain relief leading to the top of the canyon, snow reports from Little Cottonwood will oftentimes be double those of the surrounding canyons and areas. Forecasters and most local residents are aware of this phenomenon. During a winter storm, the forecast usually reflects this knowledge, and snow forecast numbers will be higher in Little Cottonwood Canyon. However, with recent outreach to surrounding resorts, forecasters have become aware of situations in which other mountainous locations in the area receive more snow than Little Cottonwood Canyon.

Synoptic Scale Pattern

Little Cottonwood Canyon receives the most snow during events where northwest flow is dominant throughout the event. This occurs behind our typical winter cold fronts. In the northwest flow following frontal passage, Little Cottonwood can see snowfall rates in excess of two inches per hour. Oftentimes snowfall will linger in the canyon for quite a long time after snowfall has ended in the Salt Lake Valley, due to orographic effects. Additionally, during lake effect events off the Great Salt Lake, if the flow is favorable, snowfall can be greatly enhanced up the canyon. However, forecasters have found that in different flow situations, Little Cottonwood Canyon doesn't do as well. For example, if the bulk of the snowfall occurs while the flow is from the southwest, Little Cottonwood Canyon experiences a "shadow" effect, where terrain to the southwest of the resort blocks the snowfall, as seen in Figure 2. However, different areas in the Wasatch Mountains that typically don't receive as much snow as those locations in Little Cottonwood, will do quite well in this scenario. Figure 3 illustrates this. Looking to the southwest, one can see that there is a terrain gap to the southwest, allowing storms to move unimpeded in to the Park City/Canyons area. In this same figure the terrain blockage for Little Cottonwood during southwest flow is also apparent.

Snowfall totals at the end of the day on Wednesday, March 31st 2010, were a good illustration of this. Snow reports from the afternoon of the 31st showed Alta Ski resort with nine inches, and Snowbird resort with eight inches. The Canyons Ski Resort, on the eastern side of the Wasatch Mountains was reporting eleven inches of snow, with locations in the town of Park City, just north of The Canyons and about 3500 feet lower in elevation, reporting snowfall totals around eight inches. This may not seem significant, but The Canyons and Park City typically don't do as well as the resorts up Little Cottonwood Canyon. The Canyons averages around 355 inches of snow each year, compared to the 500 inches per year average in Little Cottonwood canyon.

Impacts

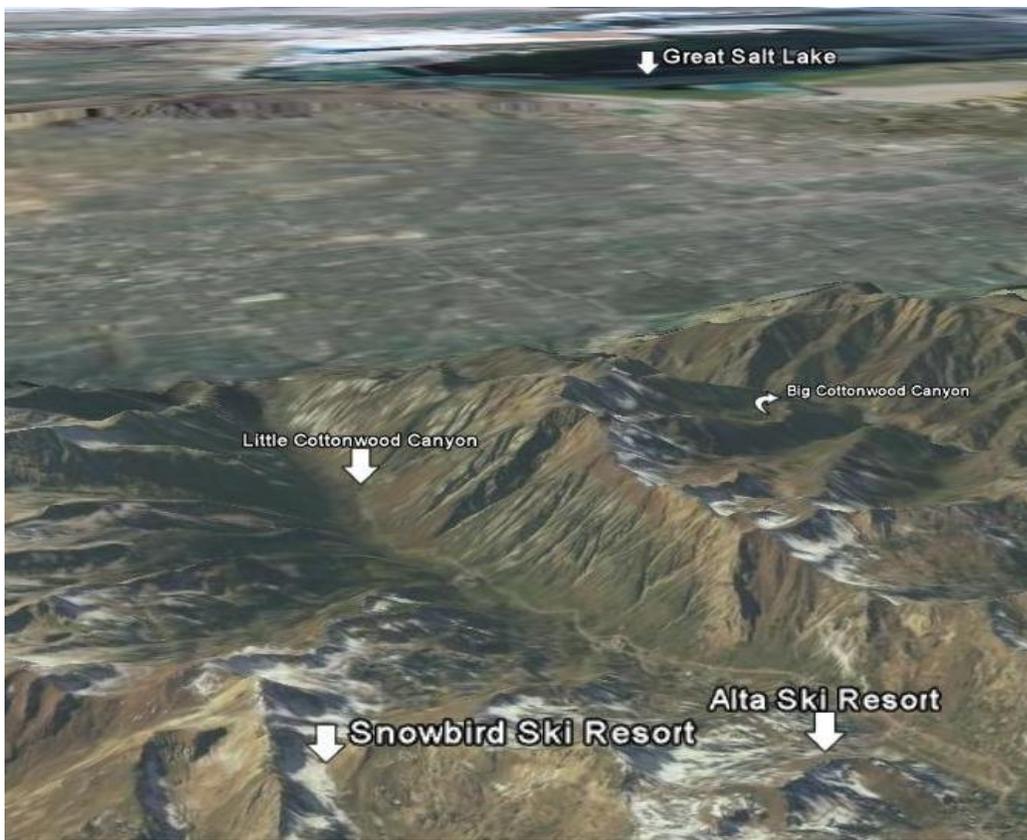
Looking at the climatology along the Wasatch Mountains, it would make sense to forecast more snow for Little Cottonwood canyon than along the “Wasatch Back,” or eastern side of the Wasatch Mountains, where The Canyons and Park City are located. However, if this approach was used during a southwest flow event, forecast snow totals could be wildly inaccurate. It is important that snowfall forecasts for the Wasatch Mountains are accurate, as they are used to make decisions in snow safety operations

Rules of Thumb

Forecasters typically look at 700 mb flow to get a first estimate as to which areas will be favored during an event. If flow is from the northwest through a deep layer around 700 mb, then Little Cottonwood canyon will typically end up with the highest snowfall numbers. However, in different flow regimes, forecasters know that other areas may need more attention. To determine this, forecasters will analyze BufoKit soundings and time height charts to determine how the flow changes with height and with time.

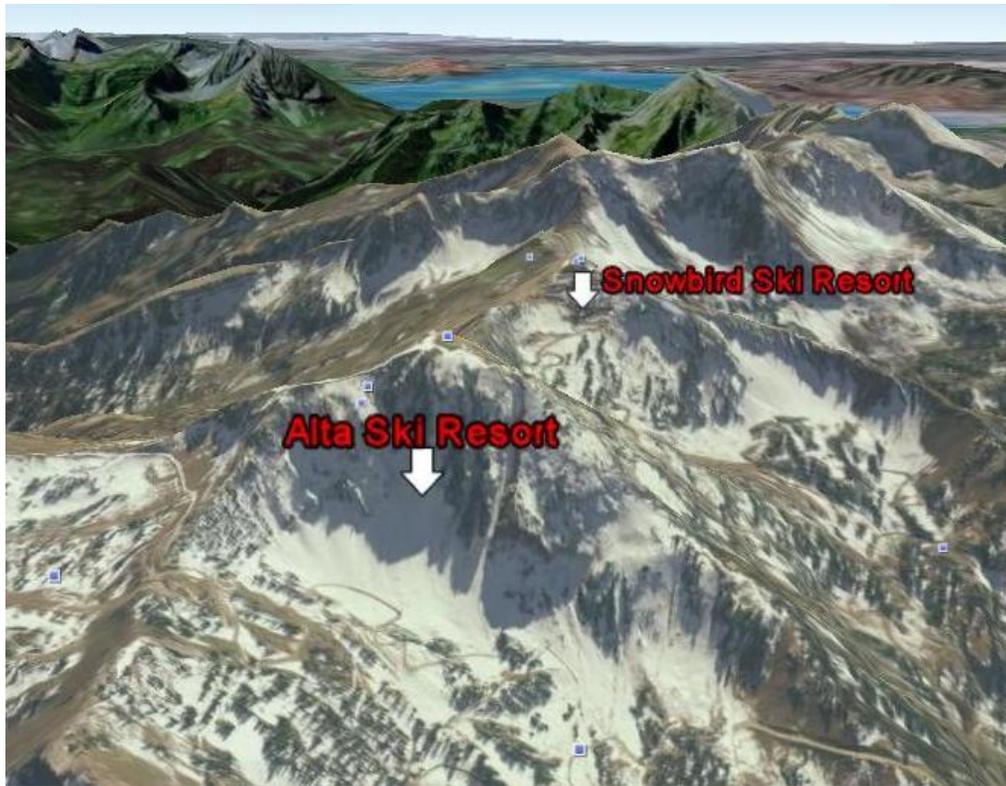
While the most important ingredients for snow in the Wasatch are instability and moisture, when those two things are in place, flow direction is the next most important factor in determining which areas of the Wasatch will receive the most snow. While skiers are always quite interested in where the most snow is going to fall, those most impacted by the snowfall forecast are those in charge of snow safety. Because the avalanche control crews make next day staffing and control decisions based on our snowfall forecasts, it is very important that snowfall forecasts are as accurate as possible. By considering flow direction during a winter storm, forecaster can more accurately predict which areas will be shadowed by terrain, and which areas will see enhanced snowfall.

Below is a Google Earth image illustrating the proximity of Little Cottonwood Canyon to the Salt Lake Valley and the Great Salt Lake:



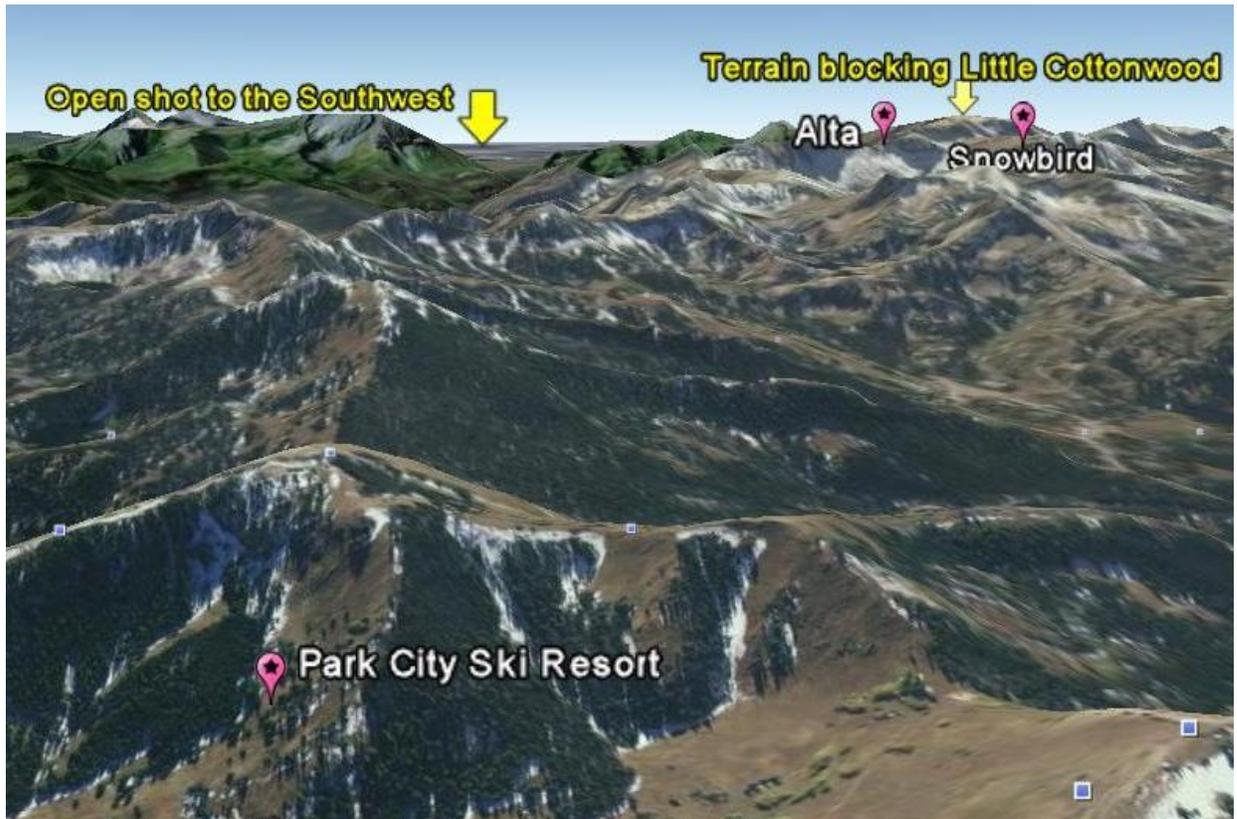
(Figure 1: Looking to the West)

The image below shows the top of Little Cottonwood Canyon, looking to the southwest. This demonstrates how terrain to the southwest of the two ski areas blocks snowfall during southwest flow:



(Figure 2: Looking Southwest)

Finally, this last image shows those areas that are open to southwest flow, and typically do better than little cottonwood canyon on southwest flow events:



(Figure 3: Looking Southwest)