Salt Lake Valley Weather Patterns

Natural History Museum of Utah – Nature Unleashed

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In the Salt Lake Valley, many different forces acting together give us a strange combination of weather patterns found across the world. The valley; bracketed by tall mountains to the east and west, on the shores of a large salty lake that never freezes, and at an altitude of 4200 feet can experience strange weather phenomena all at the same time.

Sea and Land Breezes

Normally found at the edges of monstrous bodies of water such as the great lakes and the ocean; the Great Salt Lake which is hardly the size of any of the previously mentioned bodies of water is large and shallow enough to exhibit the same properties of the great lakes and the ocean on a smaller scale. During the day, the land heats up faster than the water in the lake. As air over the land heats up, it begins to rise. This rising air sucks in cool air from the lake. As the rising air cools, it begins to fall. This falling air returns over the lake. Due to its proximity with the lake it cools more before being sucked back over the land restarting the cycle. This phenomenon is often at work in the salt lake valley unless it is overridden by a more powerful weather system. At the Salt Lake City International Airport, barring overriding weather systems, the wind in the morning blows to the north while the wind in the afternoon switches direction and blows to the south. This is an example of a Sea Breeze (Figure 1).

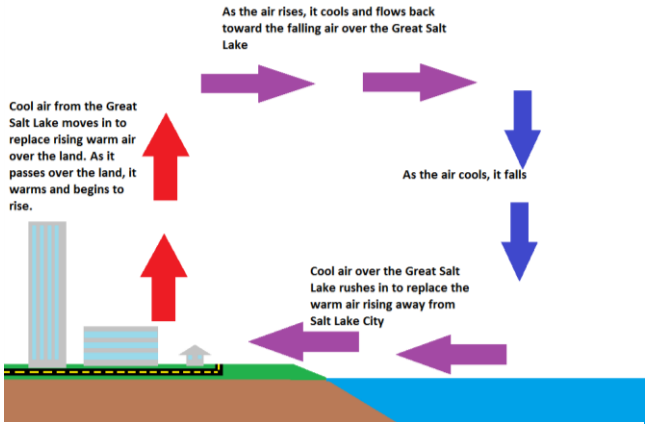

Figure 1: Sea Breeze

As with Sea Breezes, land breezes take effect near a large body of water. At night, the land cools faster than the lake; since air over the lake is absorbing heat from the lake it is warmer than the air over the land. It begins to rise pulling in the cooler air from the land over the lake. That cooler air heats up and also begins to rise. As the air rises it cools. Since the air is cooling, it begins to fall. At the same time it is being sucked over the land to replace the air that is moving over the lake. This endless cycle continues until the morning, when the land is heated by the sun and the Sea Breeze effect takes over.

Mountains and Their Effect on Weather Systems

The Salt Lake Valley is one of the few places on earth where a high valley (4220' Above Sea Level) is surrounded by extremely high mountains (Peaks breaking through 11,000') and open to the north and south on the shores of a great salty lake. This leaves the valley experiencing weather phenomena like Lake Effect Snow, Strong Wind Shear[1], Northerly-Southerly winds and specific areas of increased snowfall. Normally, these specific phenomena are found across the globe in different regions,

[1] Wind shear is a difference in wind speed and/or direction across different altitudes.

the stunning thing about the Salt Lake Valley is the fact that all of these phenomena are present at the same time. During a storm in Salt Lake City, it is not uncommon to watch a low layer of clouds roll in flowing from east to west. At the same time you can see smaller, lower clouds zipping through the valley going in a completely different direction.

Lake Effect Snow

Utah is well known around the world as having the *Greatest Snow on Earth*. Though there are many attributes to this claim, one of the strongest is our lake effect snow. Lake Effect snow forms in the winter when cold air masses move over warmer lake waters. As the warm lake water heats the bottom layer of air, lake moisture evaporates into the cold air. Since warm air is lighter and less dense than cold air, it rises and begins to cool. The moisture that evaporates into the air condenses and forms clouds, and snow begins falling. (NOAA) In the Salt Lake Valley, Lake effect snow passes normally from northwest to southeast leaving a narrow band of extreme snow accumulations across the valley (Figure 23). Because the valley floor is so high (~4220') snow accumulations can be somewhat immense. While no two storms are the same, a snowstorm followed by lake effect snow can produce several feet of snow. Not all the snow falls out of the clouds so quickly, most is carried by the lake effect clouds until reaching the Wasatch

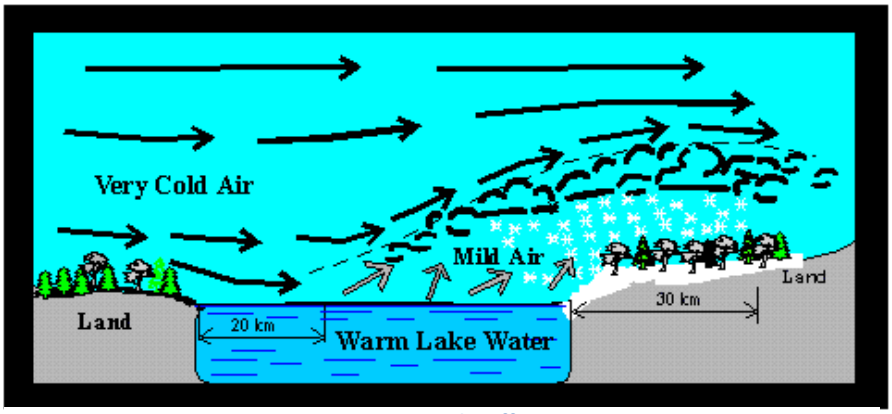

Figure 3: Lake Effect Diagram

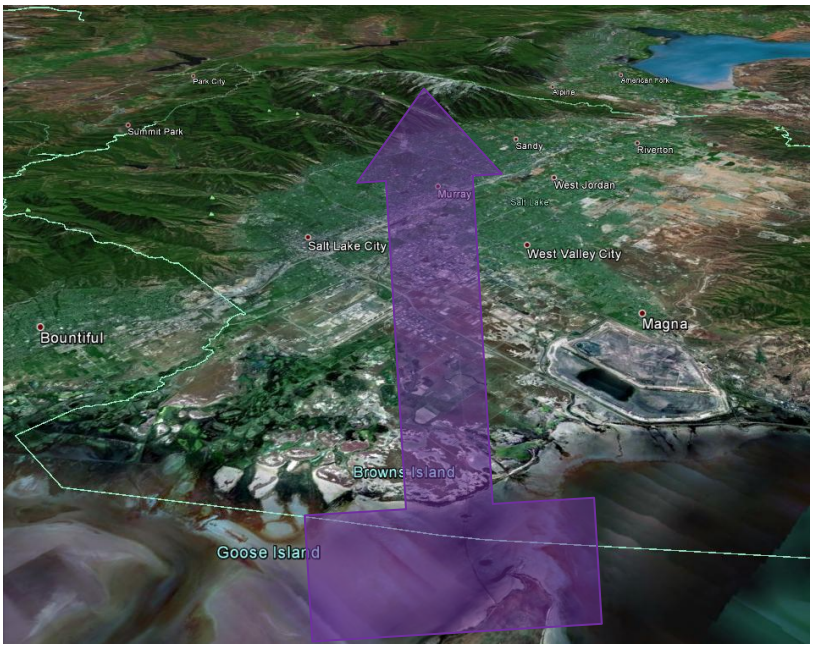

Figure 23: Common Lake Effect Track

Mountains to the east where it is deposited. This light, fluffy snow is known as Utah Powder and is every skiers dream. Accumulations of 6' and more in a single storm are possible due to lake effect.

Strong Wind Shear

In the Salt Lake Valley, tall mountains protect the valley floor from strong easterly and westerly winds, however winds from the north and south, though uncommon, can roar through as immense speed. During some storms, moist air from the west coast moves to the east. As it does it encounters the Oquirrh Mountains to the west of the Salt Lake Valley. As it does, it is forced to rise. As air rises it cools and its capacity to hold moisture is reduced. When 100% relative humidity is reached clouds form. Large layers of clouds formed in this way, and preexisting clouds can move across the Salt Lake Valley to the east. Not all the air moved up the sides of the Oquirrh Mountains, some of it wraps around the sides and blows either north or south through the valley depending on the original direction of the storm. This phenomenon can create a very interesting demonstration of wind shear. It is not uncommon to see single clouds moving at high speeds to the north or south in the Salt Lake Valley while the upper cloud layer (Ceiling) is moving briskly to the east.

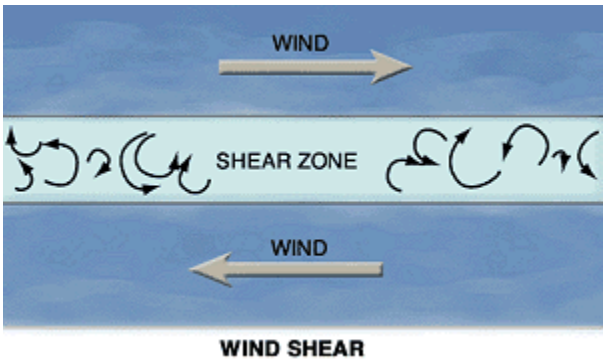

Figure 4: Wind Shear Diagram

Northerly and Southerly Winds

The floor of the Salt Lake Valley often finds itself dealing with moderate winds blowing north or south. This is due to the valley being bracketed by two very tall mountain ranges, the Oquirrh range to the west and the Wasatch Range to the east. The ranges act like the walls of a wind tunnel, redirecting and focusing the wind in a

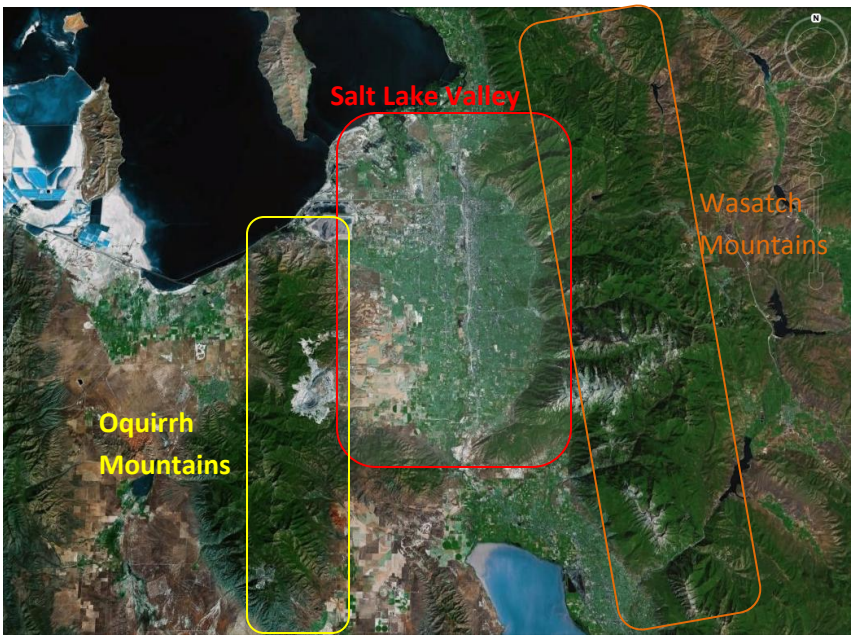

Figure 5: Layout of Salt Lake Valley Geography

specific direction. If you have ever driven on I-15 Southbound past the Point of the Mountain, you have probably noticed two large wind turbines. These turbines sit on the Camp Williams military base. The location of these turbines is ideal because of the geography of the Salt Lake Valley.

US Weather Patterns and the Hadley Cell

In the US, Weather primarily flows from the west to the east as it follows the jet stream. (Fig 6) Occasionally, overriding high and low pressure systems can force the jet stream to do odd and unusual things such as flow to the south and back to the north, flexing from Seattle Washington to the Texas panhandle and back up to anchorage, Maine. These pressure systems are mainly effected by the Hadley and Ferrel Cells.(Fig 7) The Hadley and Ferrel cells are the two southernmost northern cells. These cause a near constant high pressure at the 30 degree latitudes known as the "Horse Latitudes" and a near constant low pressure at the 60 degree latitudes. These cells regulate location of the jet stream pretty well, though pressure systems can override them.

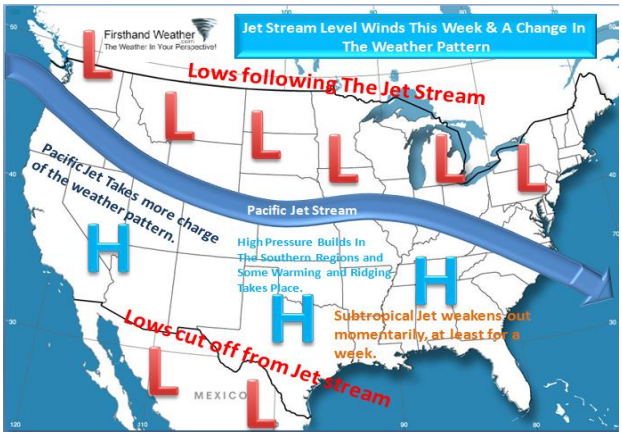

Figure 6: Standard U.S. Weather Pattern

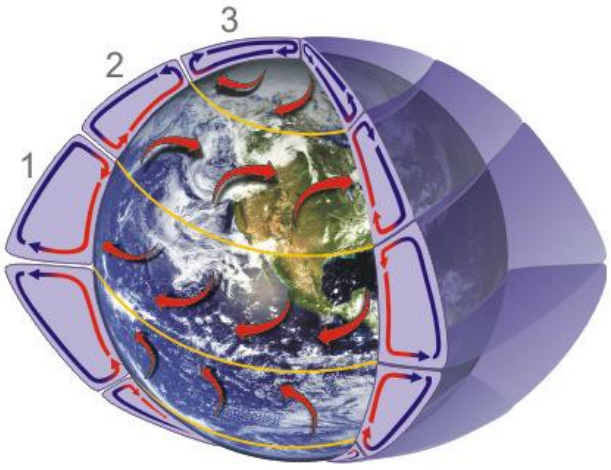

Figure 7: 1- Hadley Cell 2- Ferrel Cell 3-Polar Cell

Selected Questions for Gallery Interpreters

1. What have you noticed about snowfall accumulations while driving through Salt Lake after a snow storm?
2. Next time you are outside in the Salt Lake Valley, take note of which way the wind is blowing. Does this correlate with the information presented? If not, why?
3. Have you ever heard the weather man on the local news mention "Lake Effect Snow"? Has that prediction ever seemed to change the amount of snow you thought you would get?
4. Next time you go into the mountains for recreation during the winter, what do you think you will see in different canyons across the Wasatch Range?