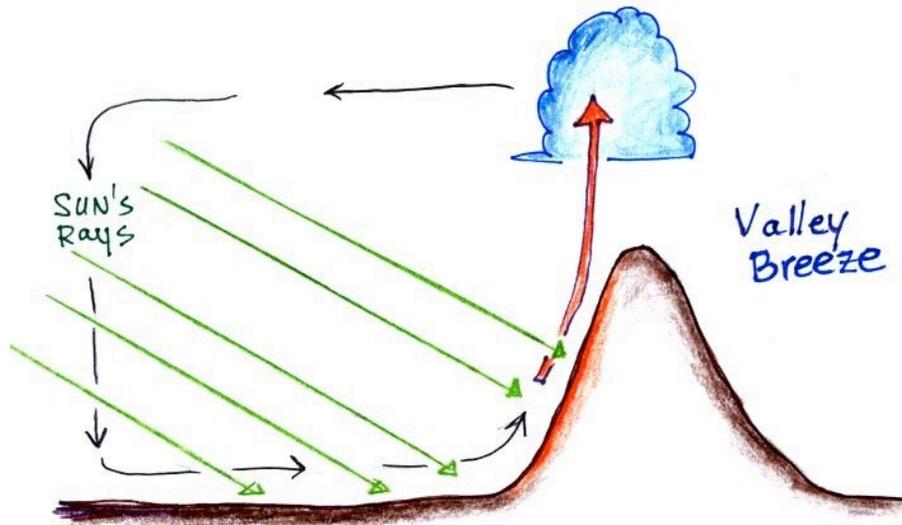


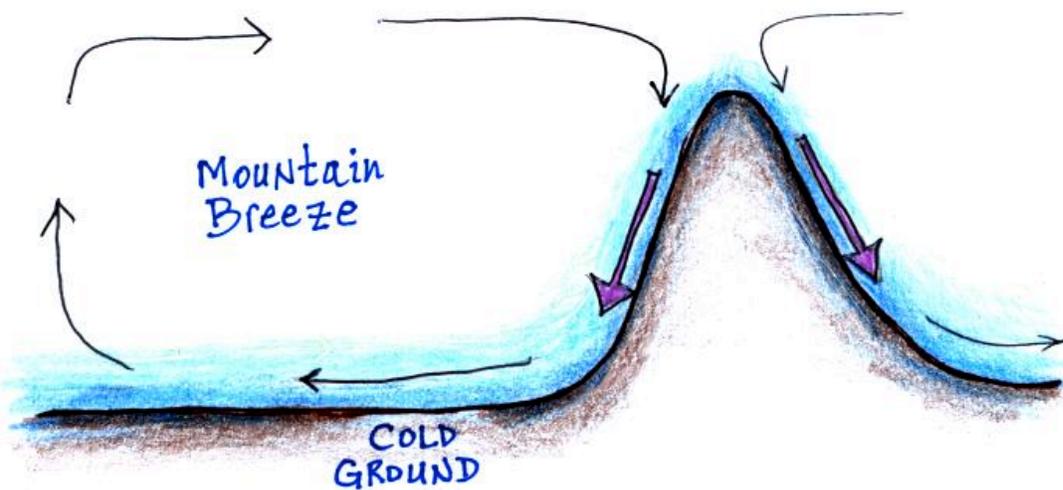
## Module 10 - Lecture 28

Many of the same concepts in our discussion of thermal circulations can be used to understand a variety of other relatively small scale regional wind circulations.

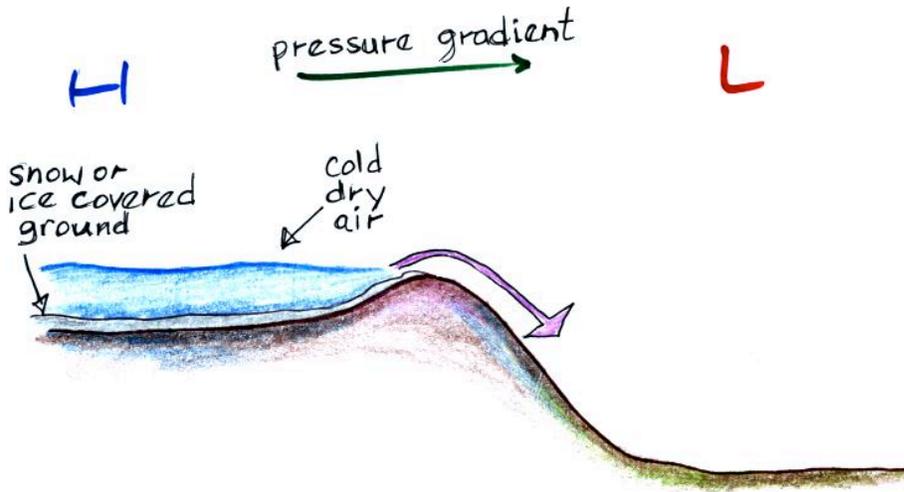
The first figure shows the development of a **valley breeze**. Early in the morning the sun's rays are striking the sides of a mountain more directly than the level ground in the valley and the mountain sides warm more rapidly than the valley floor. Air in contact with the side of the mountain becomes buoyant and creates an upslope breeze and the wind blows from the valley up the mountain sides to replace the rising air.



At night the ground will cool more quickly and becomes colder than the air above. The air in contact with the ground cools and the cold, more dense air slides down slope into the valleys. Because the surface winds blow from the mountain into the valleys, this is called a **mountain breeze**.



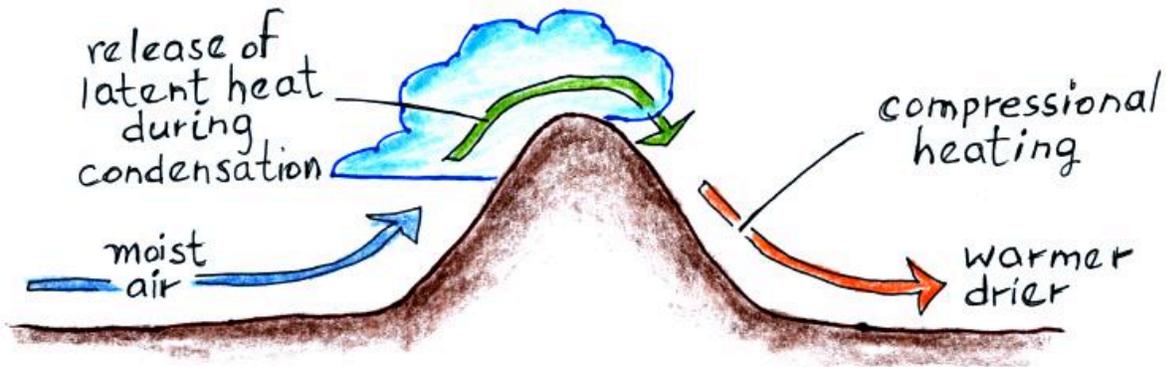
The term **katabatic wind**, which means “going downhill” wind, is a more general term for a high density, gravity driven, down slope or drainage wind. A katabatic wind can affect a much larger area than a simple mountain breeze. Katabatic winds often originate over high elevation, snow covered plateaus where stagnant air can become very cold and dry. A large scale weather pattern can move the air away from its source region. When the downward moving air is confined by canyon walls, winds can reach hurricane force. Though generally cold, katabatic winds can also be warm or hot because the air warms as it moves downhill and is compressed. Antarctica (Greenland to a lesser degree) has ferocious katabatic winds of hurricane force that can blow for days.



The **mistral** is a strong, cold and dry katabatic wind that affects southeast France. In this case the downward flow of the air is enhanced by a large scale pressure pattern. The winds can persist for several days. This picture is from a [Wikipedia article](http://en.wikipedia.org/wiki/Mistral_%28wind%29) ([http://en.wikipedia.org/wiki/Mistral\\_%28wind%29](http://en.wikipedia.org/wiki/Mistral_%28wind%29)) on the mistral.



**Chinook and foehn** winds are warm, dry down slope winds caused by [orographic lifting](http://en.wikipedia.org/wiki/Orographic_lift). ([http://en.wikipedia.org/wiki/Orographic\\_lift](http://en.wikipedia.org/wiki/Orographic_lift)) This is the rain shadow effect that we discussed in Lecture 20. As moist air flows up and over a mountain range, clouds and rain are observed on the upslope side of the mountain. As the air travels down slope, the air is compressed and becomes warm. Chinook winds occur in the Great Plains states after air descends from the Rocky Mountains. **Foehn winds** ([http://en.wikipedia.org/wiki/Foehn\\_wind](http://en.wikipedia.org/wiki/Foehn_wind)) occur when moist air from the Mediterranean Sea descends from the Alps into central Europe.



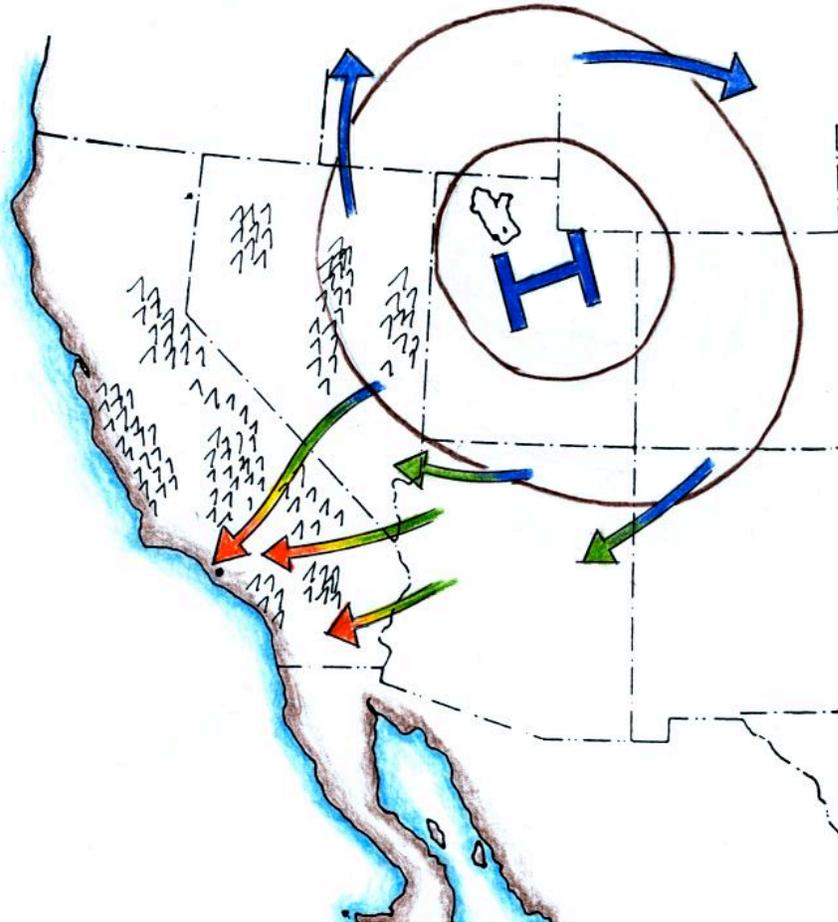
Chinook winds can produce record setting changes in weather and temperature (these records are from a [Wikipedia article](#) on Chinook winds).

Greatest temperature change in a 24 hour period	Most rapid temperature change ever recorded
103 F change (-54 F to +49 F) Jan. 1972, Loma, Montana	49 F in 2 minutes (-4 F to +45 F) Spearfish, South Dakota

The Santa Ana winds are probably the best known of the regional winds we will be discussing. These are warm (hot) dry winds that originate in the high deserts of the Great Basin and blow southwestward across southern California, usually in the fall. They are often associated with devastating wild fires.

When high pressure systems form over the Great Basin, some of the cool (cold) dense air moves downhill toward the coast. As the air descends it is compressed and warms (this is the main source of warming). The winds pick up speed when the air is funneled through canyons near the coast. There is often a marked improvement in visibility in the Los Angeles basin when the Santa Ana winds are blowing, assuming there is no wildfire activity.

The Santa Ana winds can quickly turn a relatively small wildfire into a catastrophic fire event. Nine people were killed, 85 injured, at least 1500 homes and 500,000 acres were burned during a series of wildfires in [Southern California in October, 2007](http://en.wikipedia.org/wiki/Southern_California_in_October_2007) ([http://en.wikipedia.org/wiki/California\\_wildfires\\_of\\_October\\_2007](http://en.wikipedia.org/wiki/California_wildfires_of_October_2007)). Drought and the Santa Ana winds were major contributing factors.



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In addition to being a fire danger, winds in desert regions like southeastern Arizona can produce dust storms. This is a particularly good photograph of a dust storm approaching a military camp in Al Assad, Iraq. The picture was taken just before nightfall on April 27, 2005 by Corporal Alicia M. Garcia (US Marine Corp.). Dust or sand storms like this are often called a **haboob**. Dust storms are a particular hazard to highway travel because they can reduce visibility to near zero very rapidly.



This photograph, taken in August 2003, shows a dust cloud moving into the Phoenix area (Ahwatukee) in August, 2003. The dust probably marks the leading edge of cold downdraft winds that are moving outward from underneath a thunderstorm (the gust front). Here are [some suggestions](http://www.wikihow.com/Survive-a-Dust-Storm-or-Sandstorm) (<http://www.wikihow.com/Survive-a-Dust-Storm-or-Sandstorm>) about what you should do if you are caught in a dust storm.

