Courtesy of the California Department of Transportation

Chapter 16
Mountain Snowstorms

Why do we care about mountain snowstorms?

Water supply

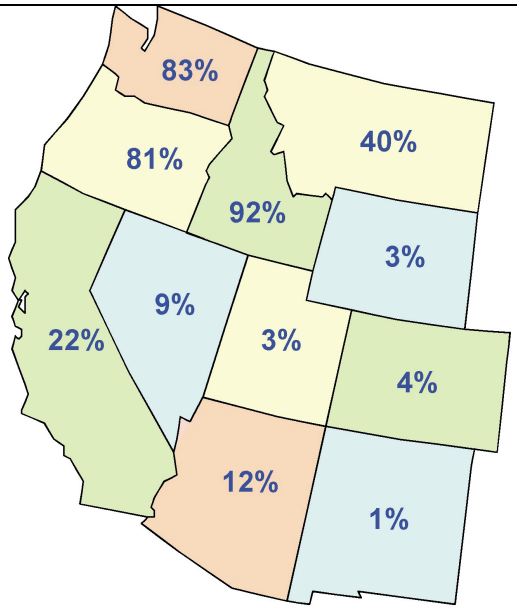
Hydroelectric power

Figure (at right) shows % of electricity derived from hydroelectric power in 2006 by state

Transportation problems

Avalanches

Tourism



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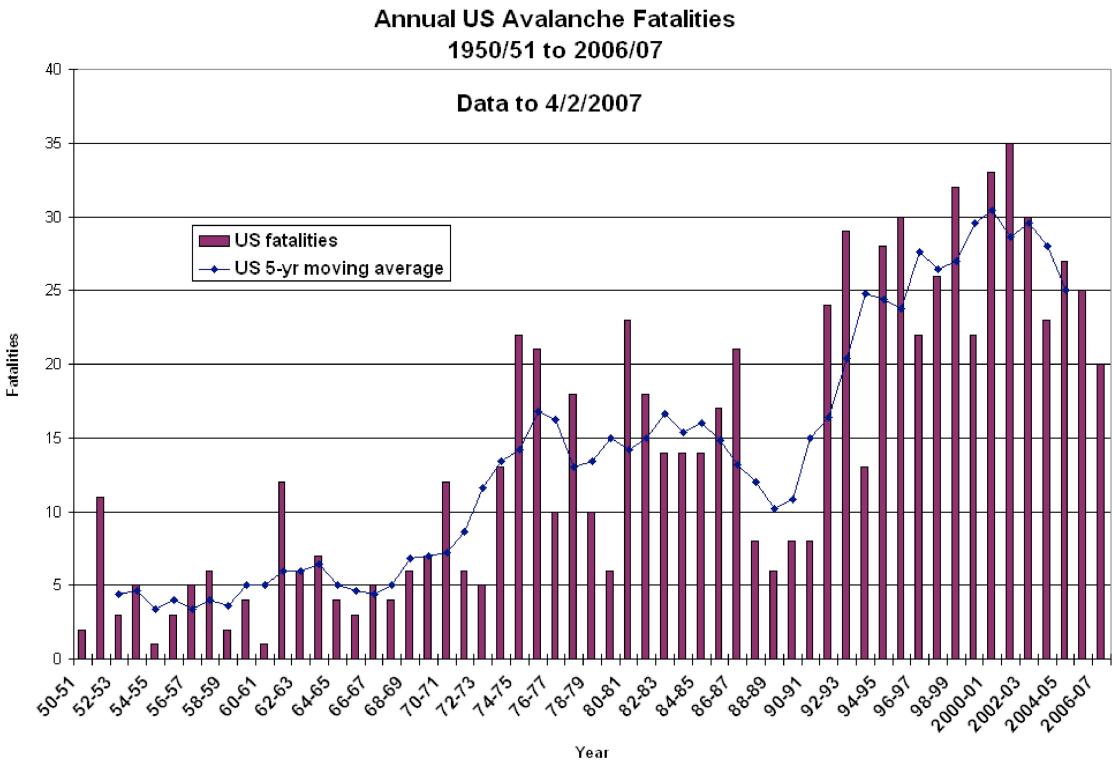
Cloud seeding – A method of adding particles to a cloud to aid in the development of precipitation

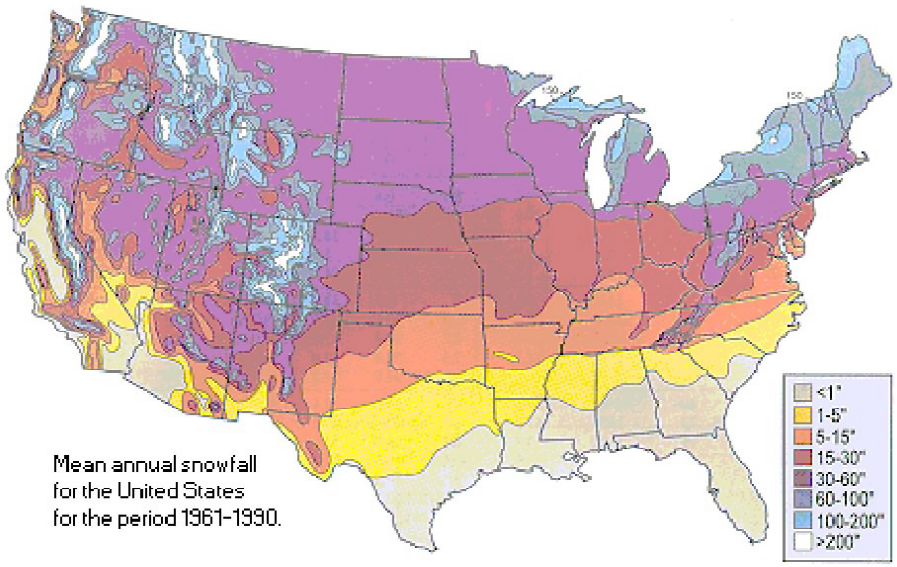
—To make more snowfall, silver iodide (AgI) particles are often added to clouds that contain supercooled liquid water

Supercooled water – water that has not frozen yet exists at temperatures colder than the freezing temperature of water (0°C)

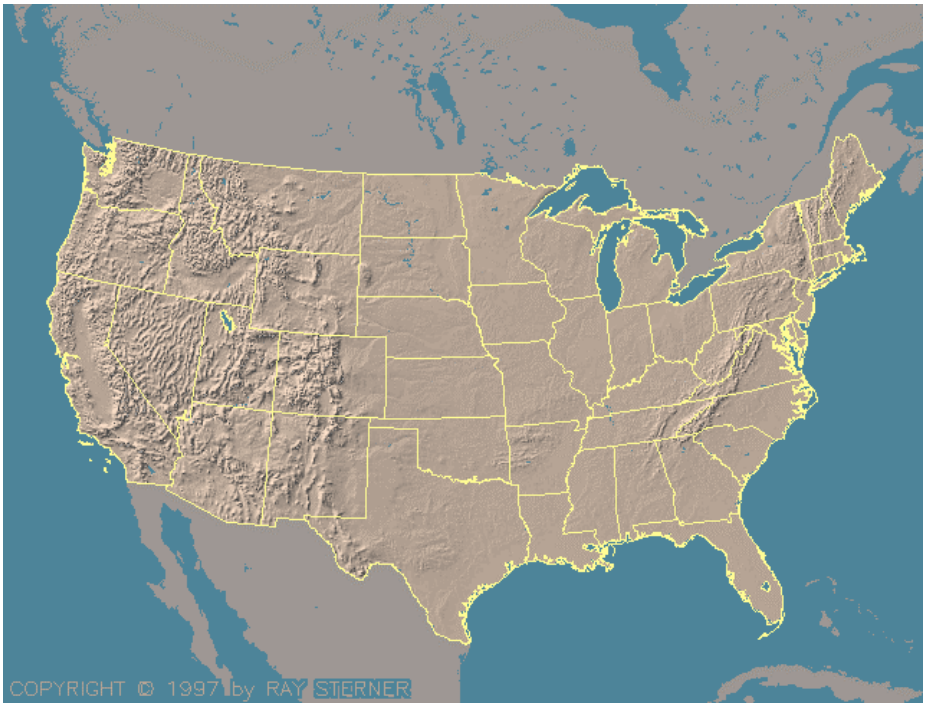
—AgI is used because it has a structure much like that of a real ice crystal and serves as good ice nuclei (the particles ice can form on when there is supercooled water)



Courtesy of the Northwest Weather Avalanche Center, US Forest Service



Mean annual snowfall
for the United States
for the period 1961-1990.



How does the mean annual snowfall change as you move from south to north in the Great Plains?

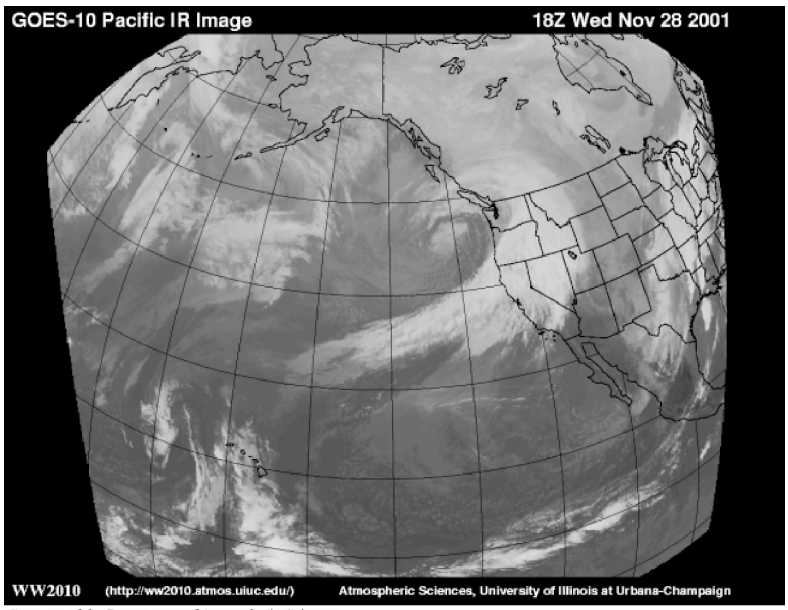
What factors control the annual snowfall on the Great Plains?

Does mean annual snowfall change smoothly from south to north in the western US?

What factors control the annual snowfall in the western US?

Source of Mountain Snowstorms

What weather elements are responsible for mountain snowstorms in the western US?



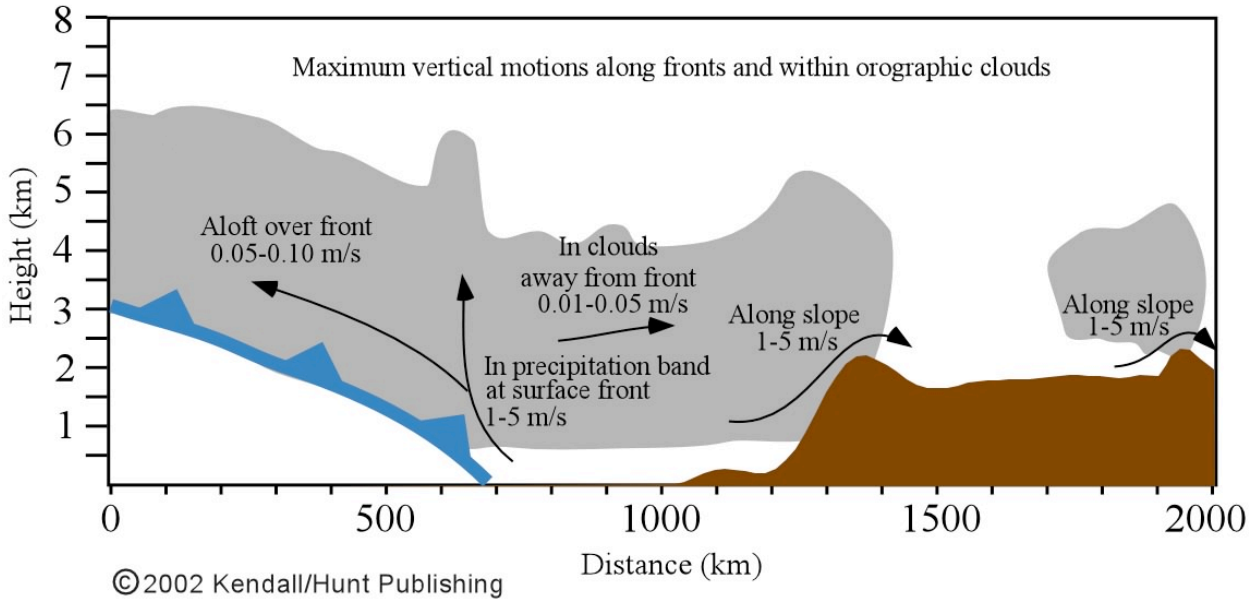
Courtesy of the Department of Atmospheric Sciences
University of Illinois at Urbana-Champaign

Storms develop in the Pacific Ocean and come ashore in western North America.

Moisture streams (atmospheric rivers) accompany these storms

What happens when these moisture streams encounter the mountains of North America?

How does the lifting of air over mountains compare to the lifting of air along a front?



Why are local precipitation amounts often larger in the mountains than along a front?

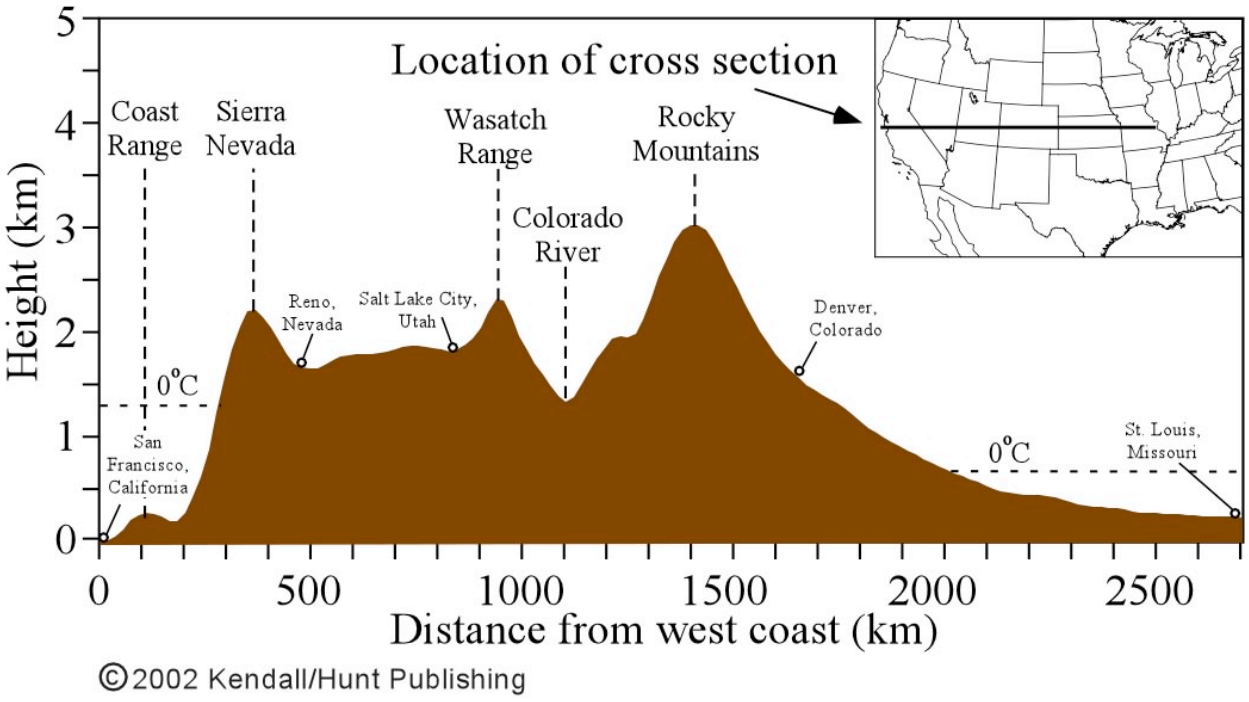
Orographic lifting – air is forced to rise as it encounters a mountain

Windward side – the upwind side of a mountain
Leeward side – the downwind side of a mountain

How do precipitation totals differ between the windward and leeward side of a mountain range?

Characteristics of Snowstorms Over Individual Mountain Ranges

What mountains does air coming from the Pacific Ocean encounter in the western US?



The Coast Range

These are the first mountains encountered as air comes ashore from the Pacific Ocean.

Does the precipitation that falls in the Coast Range fall mainly as snow or as rain?

Melting level – the altitude in the atmosphere where the temperature = 0 degrees C.

The Sierra Nevada and the Cascade Mountains

These are the second range of mountains encountered by air coming ashore from the Pacific Ocean.

How does the elevation of the Sierra Nevada compare to the elevation of the Coast Range?

What effect does this have on the type and amount of precipitation that falls in the Sierra Nevada?

The Wasatch Range and the Rocky Mountains

These are interior mountain ranges that are further from the Pacific Ocean.

How does the amount of snow that falls in the interior mountains compare to the amount of snow that falls in the Sierra Nevada mountains?

Snow water equivalent – the depth of water that would be obtained by melting snow

This is often expressed as the number of inches of snow per inch of water.

What are typical and extreme values for the number of inches of snow per inch of water?

What factors cause this variability?

Storms on the East Slope of the Rockies

Upslope storm – a winter storm that occurs along the eastern slope of the Rocky Mountains when the low-level winds have an easterly component

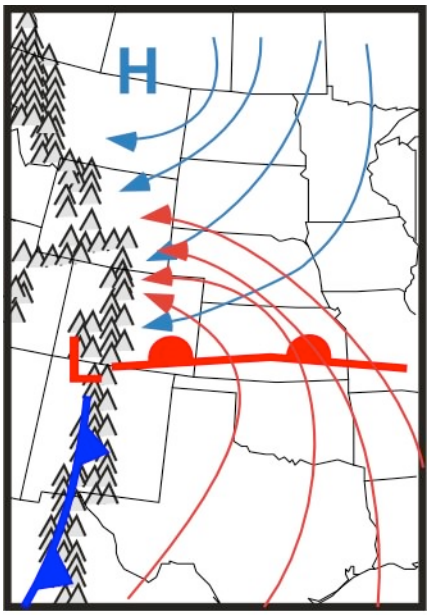
As air comes from the east it rises from near sea level along the Mississippi River valley to near 5,000 feet in Denver and Boulder, and rises another 6,000+ feet as it rises up the Rocky Mountains.

What happens to the air is it is forced to rise?

- Temperature
- Relative humidity
- Formation of clouds and precipitation

What weather patterns can create upslope (easterly) flow in Colorado?

1. High pressure north of Colorado
2. Low pressure south of Colorado



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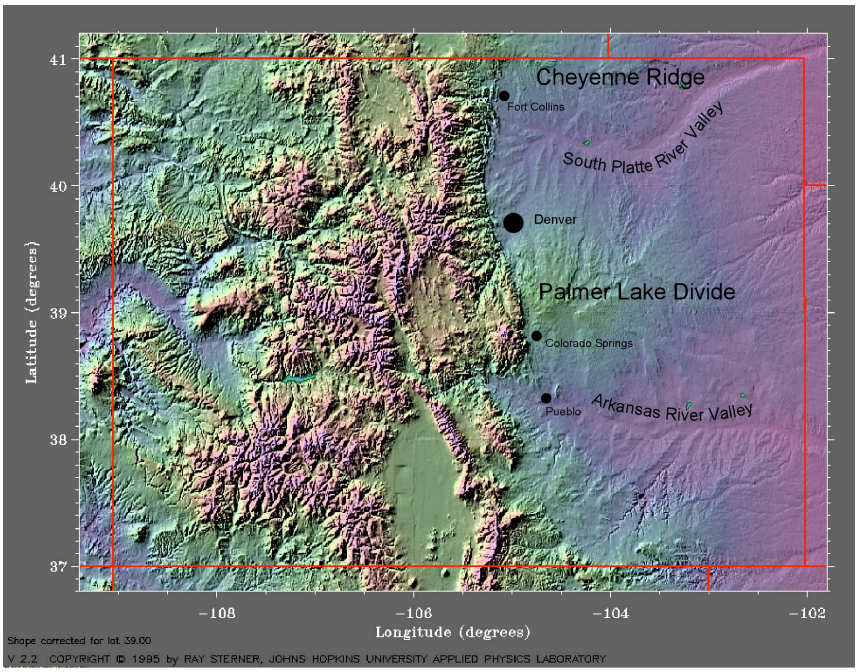
Where does the air that ends up in Colorado come from for these two weather patterns?

How does the amount of moisture and temperature in the air vary for these different weather patterns?

Which of these patterns can cause the largest snowfall amounts? Why?

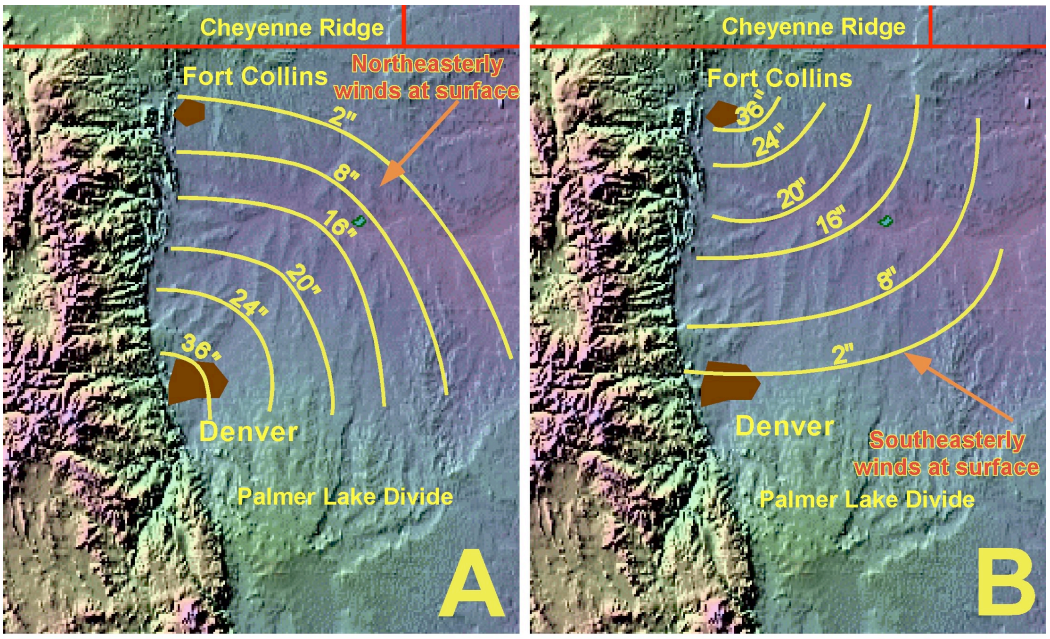
What happens if both weather patterns occur at the same time?

Local snowfall amounts in upslope storms can be very variable.



What local topographic features are important for upslope snowstorms?

Courtesy of Ray Steiner, Johns Hopkins University



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Where would you expect the heaviest snowfall for northeasterly or southeasterly surface winds?

Why?