Chapter 16: Mountain Snowstorms

- Source of Mountain Snowstorms
- Storms along the West Slope of the US
- Storms on the East Slope of the Rockies
East of the Rockies, except locally around the Great Lakes and Appalachian Mountains, snowfall increase from south to north.

From the Rockies westward to the Pacific, the amount of snowfall is related to elevation and mountains.

All the mountain ranges are regions of heavy snowfall.
Importance of Mountain Snowstorms

- Water from winter snowfalls is the primary source of agricultural and urban water supplies.
- Water from melting snow also provides hydroelectric power, which provide one third power generated in the western states.
- Mountain snowstorms are monitored by National Weather Service, State Department of Transportation, and the Forest Service.
From west to east, the major mountain ranges include the **Coast Range**, the **Sierra Nevada**, the **Wasatch Range**, and the **Rocky Mountain**.

The characteristics of heavy snowfalls on each of these mountains vary because of their distance to moisture sources and their elevations.
Snowstorms in the mountains of western North America develop during the passage of large-scale weather systems, such as extratropical cyclones, fronts, and upper-level troughs, over the mountain ranges.

Many of these weather systems have their origins over the central and western Pacific Ocean.

The moisture streams in the atmosphere are concentrated along the frontal systems associated with extratropical cyclones.

These moisture streams are termed “atmospheric rivers.”
Pacific Winter Cyclones

- Strong cyclones develop regularly over the Pacific, primarily south and east of the Aleutian Islands of Alaska.

- Most of these cyclones arrive at the West Coast during their occluded stage, with very deep low pressure and strong winds.

- Thunderstorms are rarely found with cyclones that originate over the cold North Pacific Ocean because the surface air temperatures are rarely warm enough to cause buoyancy-induced convections.
Mountains block the flow within these large weather systems, forcing air to rise sharply along their windward slopes, a process called orographic lifting.
Storms along the Western Slope of the US

Average Annual Precipitation
Continental United States

Legend (inches):
- Less than 5
- 5 to 10
- 10 to 15
- 15 to 20
- 20 to 25
- 25 to 30
- 30 to 35
- 35 to 40
- More than 40

Period: 1981-1990

Modeling performed by Christopher Daly using the PRISM model, based on 1961-1990 normals from NOAA Cooperative stations and NRCS SNOTEL sites. Sponsored by USDA-ARS Watershed and Climate Center, Portland, Oregon.

Oregon Climate Service
George Taylor, State Climatologist (541) 737-5705
Water Equivalent

- The water equivalent of snowfall is the depth of water that would be obtained if snow is melt.

- This number varies depending on many environmental conditions.
Storms on the Eastern Slope of Rockies

- The term “upslope storm” is used to describe a winter storm that occurs along the eastern slopes of the Rocky Mountains and on the Plains directly east of the mountains.

- These storms occur with low-level winds that have an easterly component.

- Upslope storms can produce enormous amounts of snow. Nearly 3 ft (~ 1 meter) of snow can fall during a single event in the foothills west of Denver.
Two Pressure Patterns for Upslope Storms

- Upslope storms occur when relatively moist, easterly winds blow westward across the plains and up the east slope of the Rockies.
- Two pressure patterns produce easterly winds: (1) a high-pressure system located north of the Colorado and (2) a low-pressure system located south of Colorado.
- For the high-pressure system, cold and relatively dry Canadian air produces light snow accumulation.
- For the low-pressure system, warm and moist air from Gulf of Mexico produces snow with higher water equivalent.
- Exceptionally blizzards occur when both pressure patterns occur simultaneously.
Vertical Profile of Upslope Storm

Cold air from the high-pressure system to the north
Warm air from the low-pressure system to the south