

GS10 Lab Answer Key - Oregon Climate

Pre-Lab Reading Questions

1. Polar Air Mass - cold air mass that originates at polar latitudes
2. Continental Air Mass - air mass that originates over continental interiors (tends to be dry air due to reduced evaporation)
3. Maritime Air Mass - air mass that originates over ocean water (tends to be moist air due to increased evaporation)
4. Orographic Lifting- forceful lifting of air up and over mountain ranges. Causes adiabatic cooling of the air, increased humidity to the dew point, with subsequent cloud formation and precipitation (e.g. Coast Range of Oregon)
5. Rainshadow Effect - dry, arid to semi-arid conditions that develop on the lee side of Mountain Ranges, due to orographic lifting releasing moisture on upwind side.
6. Jet Stream - fast flowing, upper level air (50-100 mi/hr). The jet stream flows faster than lower level air due to decreased friction with the surface of the earth.
7. Polar Front - boundary between cold polar air masses and mid-latitude air masses.
8. Weather vs. Climate - weather = short term atmospheric conditions, climate = long term average weather conditions for a geographic region.

Pre-Assessment

Location (from west to east)	Weather	Vegetation
Newport	_____ Rain / 40-50	_____ Spruce / Fir _____
Corvallis	_____ Rain 35-45	_____ Spruce / Fir Pine, Agriculture
Sweet Home	_____ Rain / Snow, 30-40	_____ Spruce / Fir / Pine
Santiam Pass	_____ Snow, Freezing	_____ Spruce / Pine _____
Bend	_____ Sun 20-30	_____ Sage, Juniper, Ponderosa
Burns	_____ Sun, 10-20	_____ Sage _____
Boise	_____ Sun / snow, 10-20	_____ Sage _____

The controlling factors of weather in the northwest are elevation, proximity to ocean and relationship to mountain ranges. The east side of mountains tend to be drier, the west side wetter. The coast of Oregon tends to be wetter and warmer in Winter, and cooler in Summer.

Activity 1

Physiographic Provinces

I -	Coast Range
II	Willamette Valley
III	Klamath Mountains
IV	Cascade Mountains
V	Great Basin Undifferentiated
VA	Great Basin - Great Sandy Desert
VB -	Steens Mountain
VC -	Alvord Desert
VI -	SNAKE RIVER REGION
VII -	Blue / Strawberry Mountains
VIIA -	Wallowa Mountains
VIII -	Columbia Plateau

Activity 2

See attached copy of state rainfall map.

Questions

1. The high elevation mountain areas are associated with the most rainfall. These areas include the Coast Range, West side of Cascades, and the Wallowa Mountains of northeast Oregon.
2. The driest regions are the central and southern interior of the state, which are located in the rainshadow of the Cascades.
3. The wettest regions are in the Coast Range and the west side of the Cascades.
4. Weather systems are directed primarily from the west
5. The west side of the state is wet, as the weather progresses to the east, the air and climate is drier... again part of the "rainshadow effect"
6. Rainshadow is the region of dry air on the lee side (downwind) side of mountain ranges. The rainshadow region is dry because orographic lifting on the upwind side of the mountains causes precipitation and drying of air. The central and eastern part of the state are the driest, and form the "rainshadow" of Oregon.

Activity 3 - Plotting Climate Data

Refer to the graph / plot of Table 1 data below.

Activity 3 Questions

- 1 - The coastal area is cooler compared to the continental interior. The ocean has a moderating effect on coastal air temperatures in Oregon, with cooler temperatures during summer, and warmer during winter. Water has a high heat capacity, compared to the continent, more slowly warms and cools. As a result, there is a lag behind heating / cooling of air over the continent (fast release of heat), and air over the ocean (slow release of heat).

2 - The High Cascades are at a higher elevation in the troposphere, and as a result, at cooler air temperatures. Elevation in the atmosphere is the controlling factor in this case, the higher the elevation of the land area, the cooler the air temperatures.

3 - Maritime regions of Oregon include the Coast Range and Willamette Valley provinces. Continental areas include the Great Basin, central and northeastern portion of the state.

	Maritime climate	Continental climate
Summer Temp.	Cool	Hot
Winter Temp.	Moderate / warm	Cold / extreme
Summer Precip.	Moderate to dry	Very dry
Winter Precip.	Very wet	Moderate to dry

Activity 3B - see graph plots below.

3B Questions

1 - Based on a relatively good fit to the graph data, it seems that there is a linear correlation between elevation of land area and mean annual precipitation. The higher the elevation the more annual precipitation.

2- Based on a relatively good fit to the graph data, it seems there is a linear correlation between elevation of land area and mean annual temperature. The higher the elevation the less the mean annual temperature. The data is not as linear as the precipitation data, but a linear trend is visible.

3 - The Mean Annual Precip. - Temp. plot shows no linear relation. This plot reflects a "shot-gun" pattern.

4- The mean annual precipitation increases and air temperature decreases with increasing elevation in central Oregon. This suggests that as lower level air is pushed to higher elevations over the landscape, the air temperatures cool, the dew point is reached, and precipitation is encouraged.

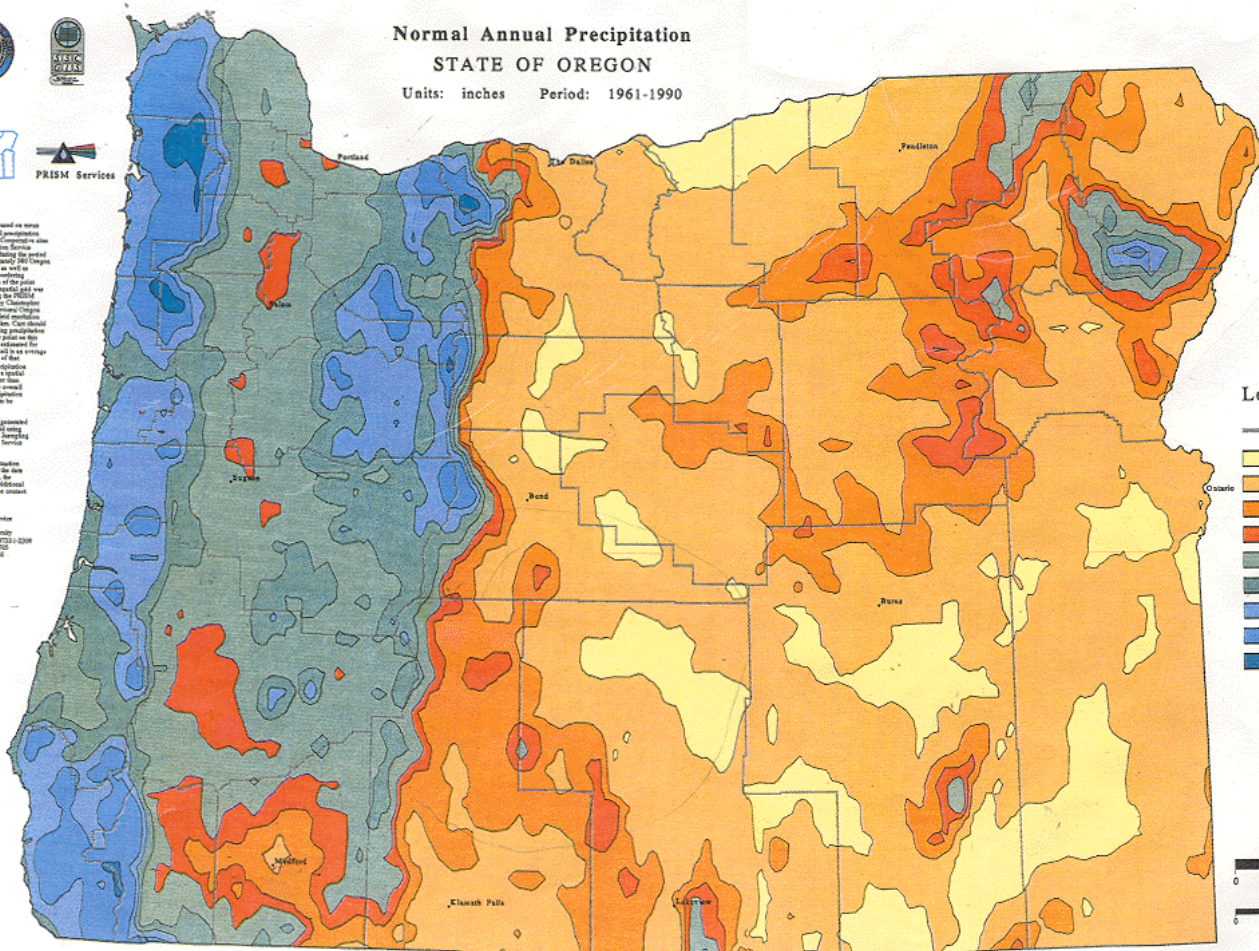


PRISM Service

Normal Annual Precipitation STATE OF OREGON

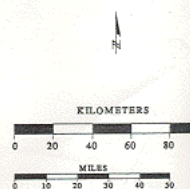
Units: inches Period: 1961-1990

This analysis was based on mean monthly and annual precipitation reported to NOAA by the National Weather Service during the period 1961-1990. Approximately 200 Oregon stations were used, as well as nearby stations in neighboring states. Characteristics of the precipitation are described in the accompanying text. The PRISM Service Oregon Data User's Guide, and manual to the PRISM Service Oregon Data User's Guide, should be taken as minimum requirements for use of the PRISM Service Oregon Data. For additional information regarding this map, the user should refer to the PRISM Service Oregon Data User's Guide, and manual to the PRISM Service Oregon Data User's Guide. For additional information regarding this map, the user should refer to the PRISM Service Oregon Data User's Guide, and manual to the PRISM Service Oregon Data User's Guide.



Legend

- County Boundaries
- < 10 inches
- 10-20
- 20-30
- 30-40
- 40-60
- 60-80
- 80-100
- 100-150
- 150+



March 1993

Activity 3: CLIMATE TRANSECT

COAST/OCEAN = COOL

COAST RANGE

WILLAMETTE
WARM VALLEY

IN THE INTERIOR

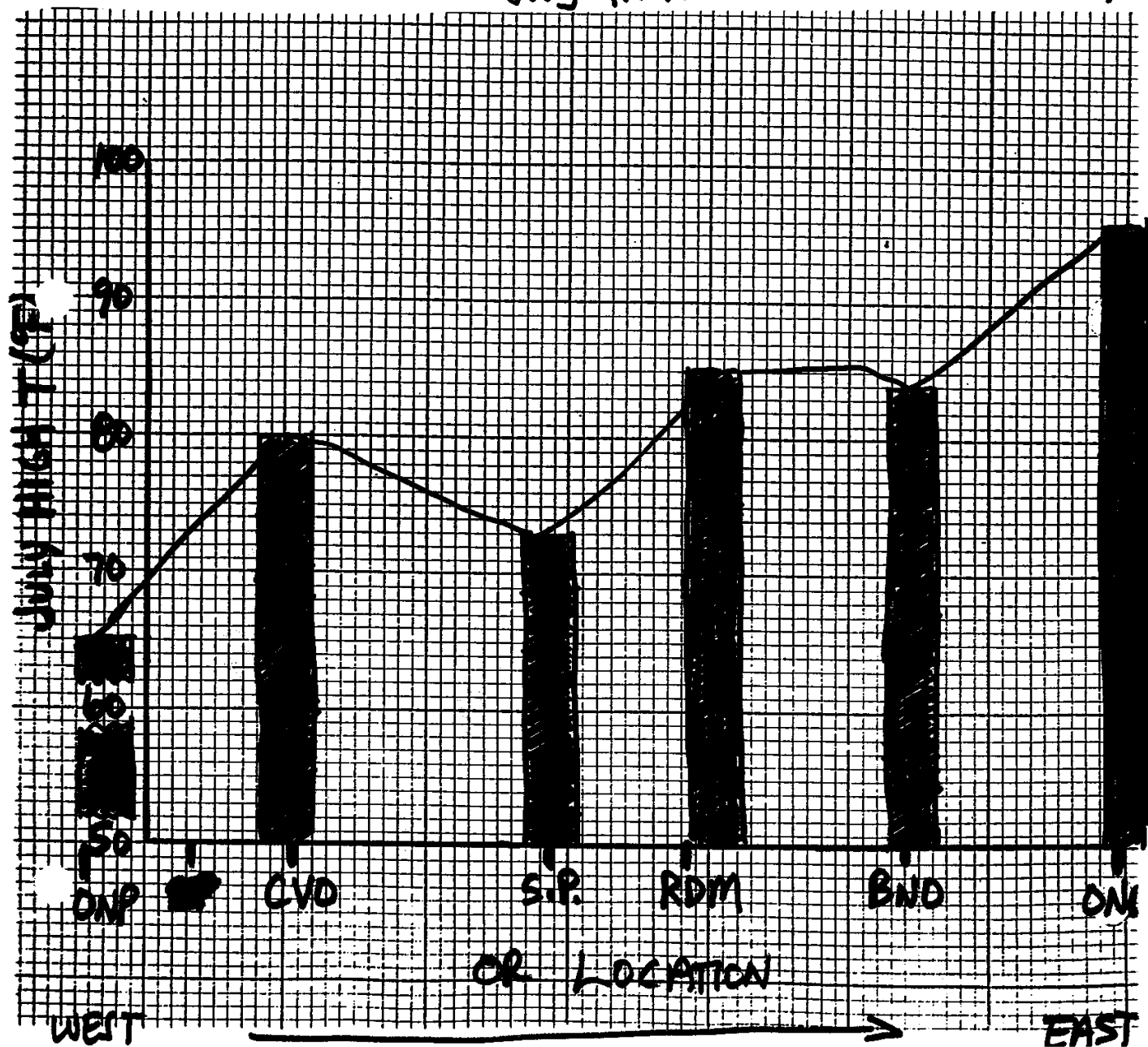
CASCADES

HIGH
ELEVATION =
COOL

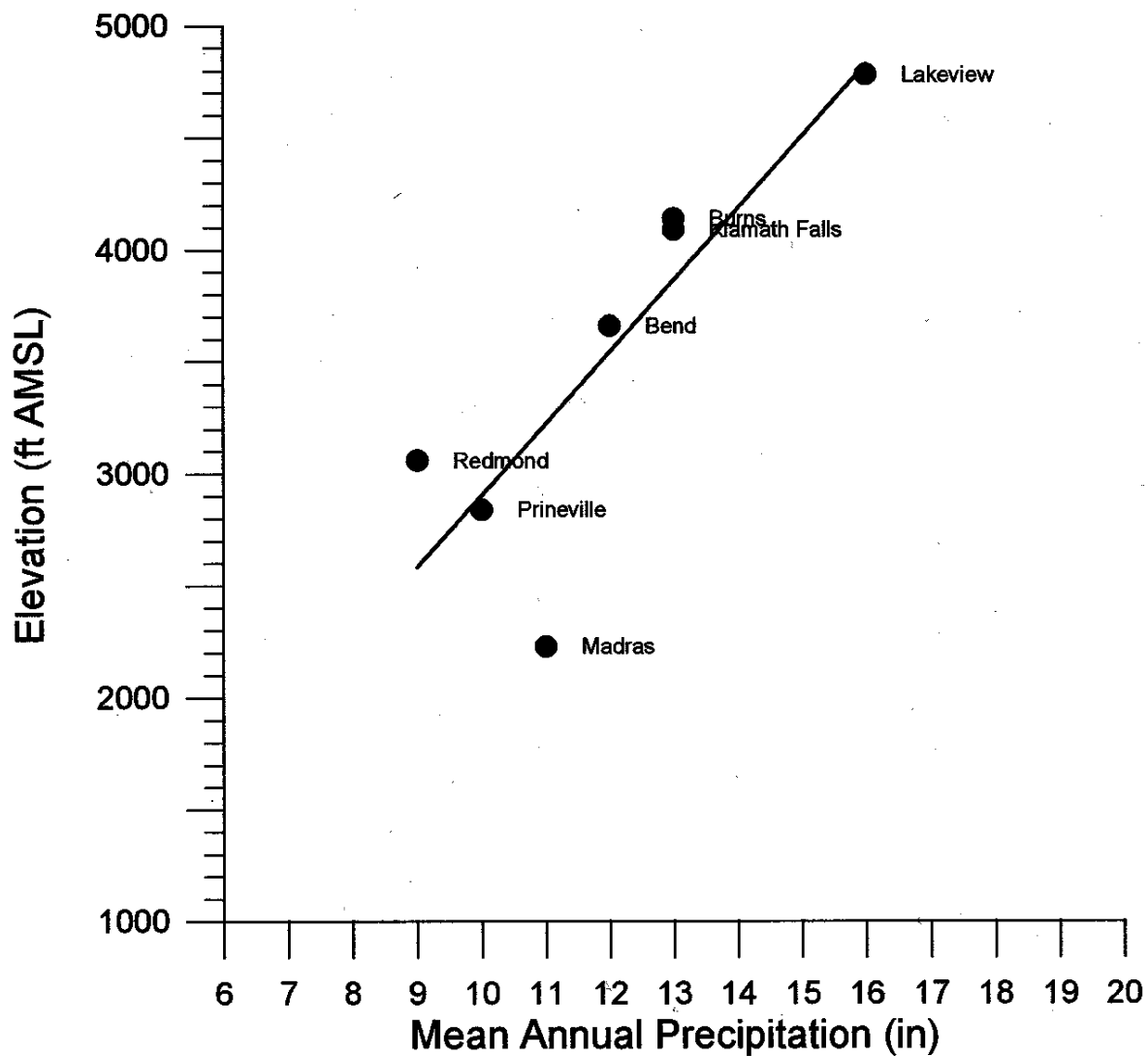
CONTINENTAL
INTERIOR = HOT

IDaho

July Temp.



Mean Annual Precipitation vs. Elevation South-Central Oregon



Fit Results

Fit 1: Linear, $Y=B*X+A$

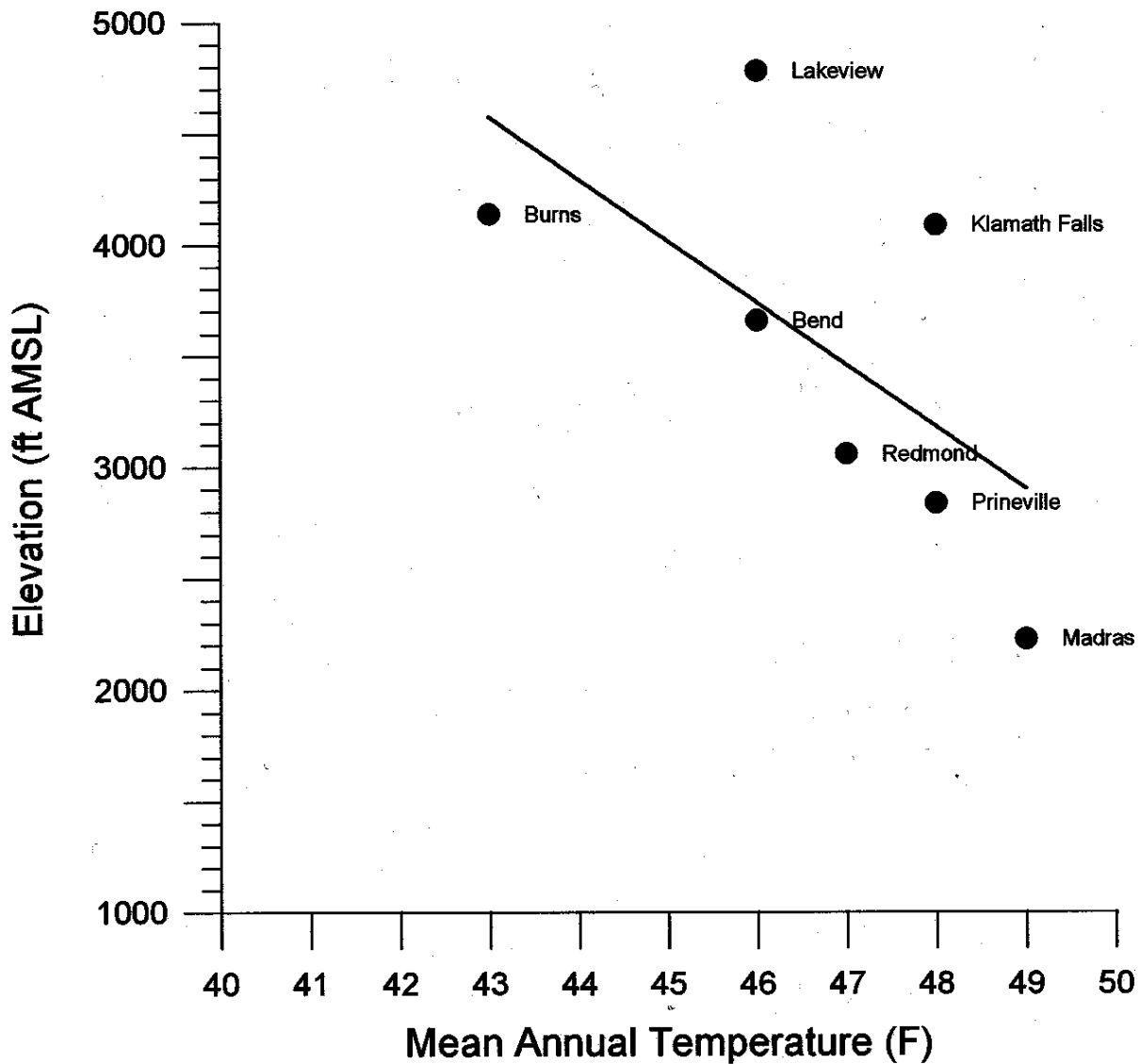
Equation:

$$Y = 320.625 * X + -304.643$$

Number of data points used = 7

Coef of determination, R-squared = 0.71

Mean Annual Temperature vs. Elevation South-Central Oregon



Fit Results

Fit 3: Linear, $Y=B \cdot X + A$

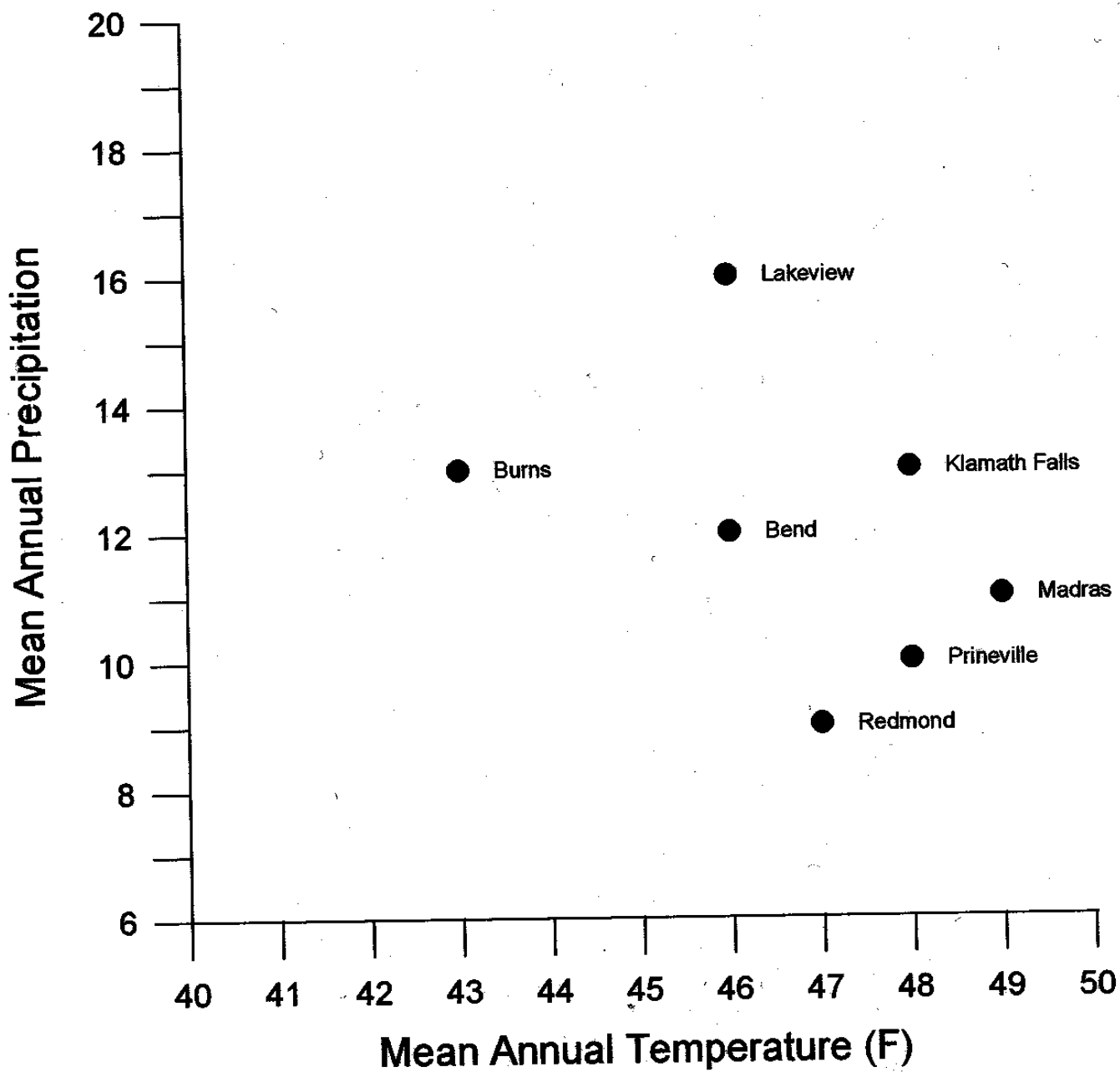
Equation:

$$Y = -278.476 \cdot X + 16551.6$$

Number of data points used = 7

Coef of determination, R-squared = 0.390642

Mean Annual Temperature vs. Precipitation South-Central Oregon

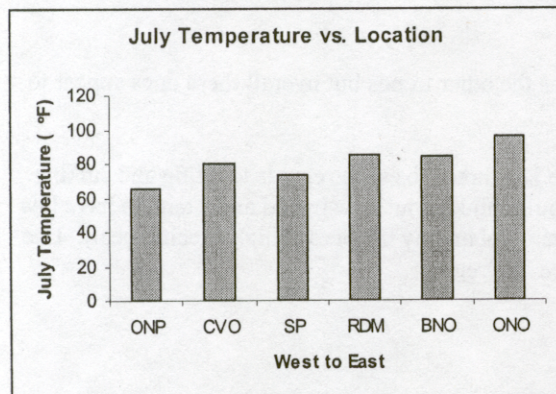


GS106 Key
Lab 7

Provinces:	Name:
I	Coast Range
II	Willamette Valley
III	Klamath Mountains
IV	Cascades
V	Great basin (undifferentiated)
VA	Great basin (great sandy desert)
VB	Great basin (Steens Mountains)
VC	Great basin (Alvord Desert)
VI	Snake river basin
VII	Blue/Strawberry mountains
VIIA	Wallowa Mountains
VIII	Columbia Plateau

Questions on Precipitation map and province map:

- 1) Your precipitation map should show large amounts of precipitation on the west side of the state and on the lee side of the cascade's it should be relatively dry (with a few exceptions). The regions that get the most precipitation tend to be the regions where there are mountains. The Coast range, the Cascade mountains, The Klamath mountains, The Steen's mountains and the Blue/Strawberry/Wallowa mountains. The areas that are more level and lower in elevation have lower precipitation values.
- 2) The East of the Cascades is where the driest part of the state is.
- 3) The wettest region is the region closest to the ocean (the coast range, The Klamath Mountains and the Cascade mountains)
- 4) By looking at the precipitation map you created you can see that the West edge of our state is the wettest. We can also see that the division of precipitation has an N-S trend. This shows that the wet air masses come off the pacific ocean and move to the east. On the west side of the Cascades they drop some of their water as they are forced up over the mountains (think about last weeks lab) and then when they descend on the leeward side of the mountain they expand creating a warmer, dryer air mass. This air mass continues across the state. If the weather systems came from the other direction (e-W) then the East side of the Cascades would have received most of the rain.
- 5) See the above answer
- 6) A rainshadow is created as an air mass is pushed up over a mountain and it drops it's moisture out on the windward side of the mountain due to the cooling of the air. Then, as it drops back down on the leeward side of the mountain, the air mass warms and creates a dry region "behind" the mountain. This area is the rainshadow. A place that doesn't get the rain. In OR we see a large rainshadow on the East side of the Cascades and smaller ones by the Steens, Blue and Wallowa mountains.

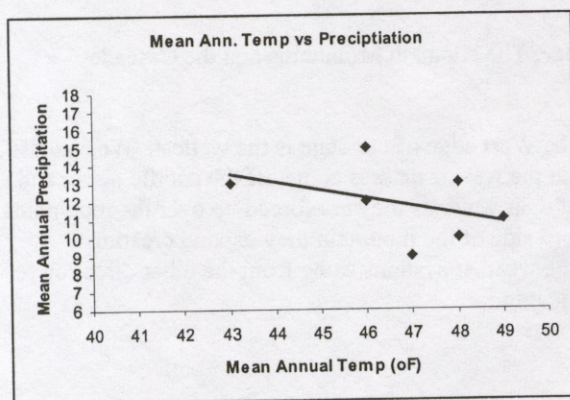
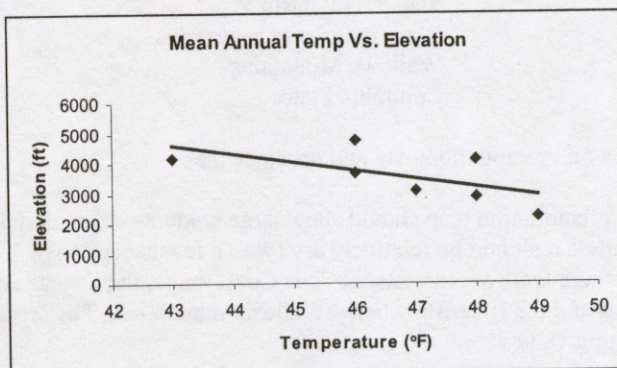
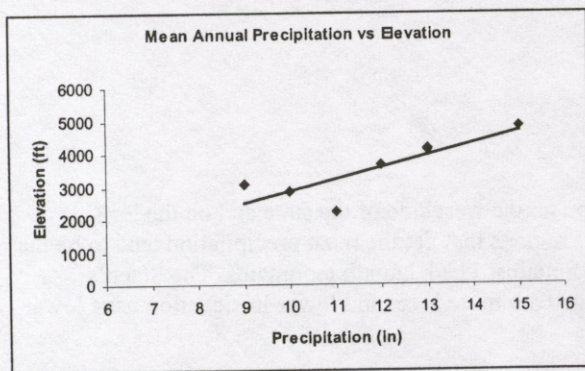


Part B:

1) The temperatures in July as we go from west to east, in general increase. This is due primarily to the ocean which releases heat slowly into the atmosphere near the coast and the low albedo of rock and sand which are found inland. The low albedo allows the rock and sand to absorb the short wavelengths of radiation from the sun and re-radiate it at longer wavelengths which heat up the atmosphere. The low temperature reading at SP is due to the high elevation of this station (it is located in the Cascade mountains)

2) See above

3) Maritime are regions that are affected by ocean. For the state of Oregon this would include the Coast range and the Blue mountains. Continental regions would be areas that are not directly influenced by the oceans constant heat and atmospheric regulation. Basically anywhere east of the Coast range and the Blue mountains.



Activity 2

1) The relationship between precipitation and elevation is that as elevation increases so does precipitation. In generally this is a fairly good fit

2) In general the relationship of temperature to elevation is that as elevation increases temperature decreases. This is also a fairly good fit

3) The relationship between temperature and precipitation isn't as good as the other trends but overall there does appear to be a relationship of lower temperature equals higher precipitation.

4) For this answer you should summarize what you have learned over the last three labs with regards to rising and sinking air masses and how they relate to relative humidity. Additionally you should think about how inland areas tend to have low albedos which cause atmospheric heating while maritime regions are more regulated by the ocean (high specific heat). Use the information from last lab and this lab to discuss rainshadow effect here in Oregon.