**ESS 132 Week 2 Discussion tasks**

1. Air moves from the Pacific Ocean across California during the winter. The dew point of the air is 3 oC and an actual air temperature of 20 oC.

1. As the air continues moving west it is forced to rise over the Sierra Nevada mountains. Which lifting mechanism is this?

Orographic lifting

1. What is the relative humidity of the air?

P­v(3) = 611exp[(17.27\*3)/(3+237.3)] = 758 Pa

Pv(20) = 611exp[(17.27\*20)/(20+237.3)] = 2339 Pa

RH = 100\*758 Pa/2339 Pa = 32.4%

1. Use the following semi-empirical formula to calculate the total precipitable water in the air.



Where RH = relative humidity (%), T = surface temperature (K), and W = precipitable water (mm)

W = 0.0493(32.4%/293.15K)exp[26.23 – (5416/293.15K)] = 12.7 mm

1. The Central Valley is about 30m above sea level. At what altitude above sea level will clouds begin to form as the air is forced to rise over the Sierra Nevada mountains?

20C – 3C = 17C

17C/(10C/1km) = 1.7 km

1.7 km + 0.03 km = 1.73 km

This answer was derived after assuming that the dew point doesn’t decrease with altitude

1. The Sierra Nevada mountains rise to 4,400m above sea level. What would the air temperature be at that altitude?

4.4 km – 1.73 km = 2.67 km; at this point, the actual air temperature matches the dew point (3C), and an air parcel starts cooling at the wet adiabatic lapse rate (5.5C/km)

2.67 km \* 5.5C/km = 14.685C change in temperature after the actual air temperature matches the dew point.

3C – 14.685C = -11.685C

1. At what altitude would you expect to see snow fall to the ground?

Snow falls when the temperature of an air parcel reaches 0C. An air parcel starts cooling at the wet lapse rate (5.5C/km) after reaching 1.73 km in altitude. The rise in altitude after rising 1.73 km to reach a temperature and dew point of 3C can be calculated using the following equation:

0C = 3C – alt\*5.5C/km

alt\*5.5C/km = 3C

alt = 3C/(5.5C/km)

alt = (6/11) km

Adding this to the initial rise of 1.73 km:

1.73 km + (6/11) km = 2.28 km

Snow can be expected at around 2.28 km or higher.

2. The environmental lapse rate on this day was 3 oC. You can assume the air at the top of the mountain is saturated (i.e. at its dew point temperature). The valley on the east of the Sierra Nevada mountains is 100m.

1. What will happen to the air once it reaches the top of the mountain and why?

1. Calculate the relative humidity of the air in the valley at 100m.
2. What is the name that we use to describe the dry area downwind from a mountain range?
3. Building on these principles, and on your general knowledge, explain why Santa Ana wind events are associated with wildfires.