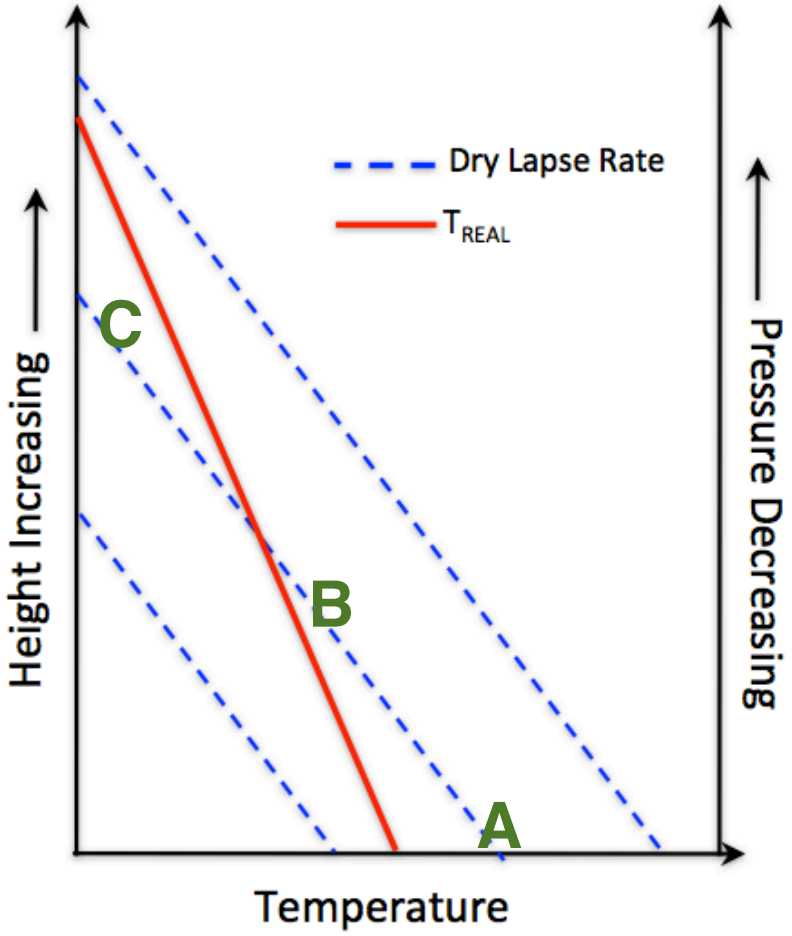
Determining Stability From Profiles of Temperature

An atmospheric profile is a useful way to display and interpret temperature data from a weather balloon sounding. Unlike most graphs where the independent variable is on the horizontal axis, in an atmospheric profile the height above the ground is on the vertical axis, while the measured temperature is on the horizontal axis. Please take a look at the sample temperature profile below.

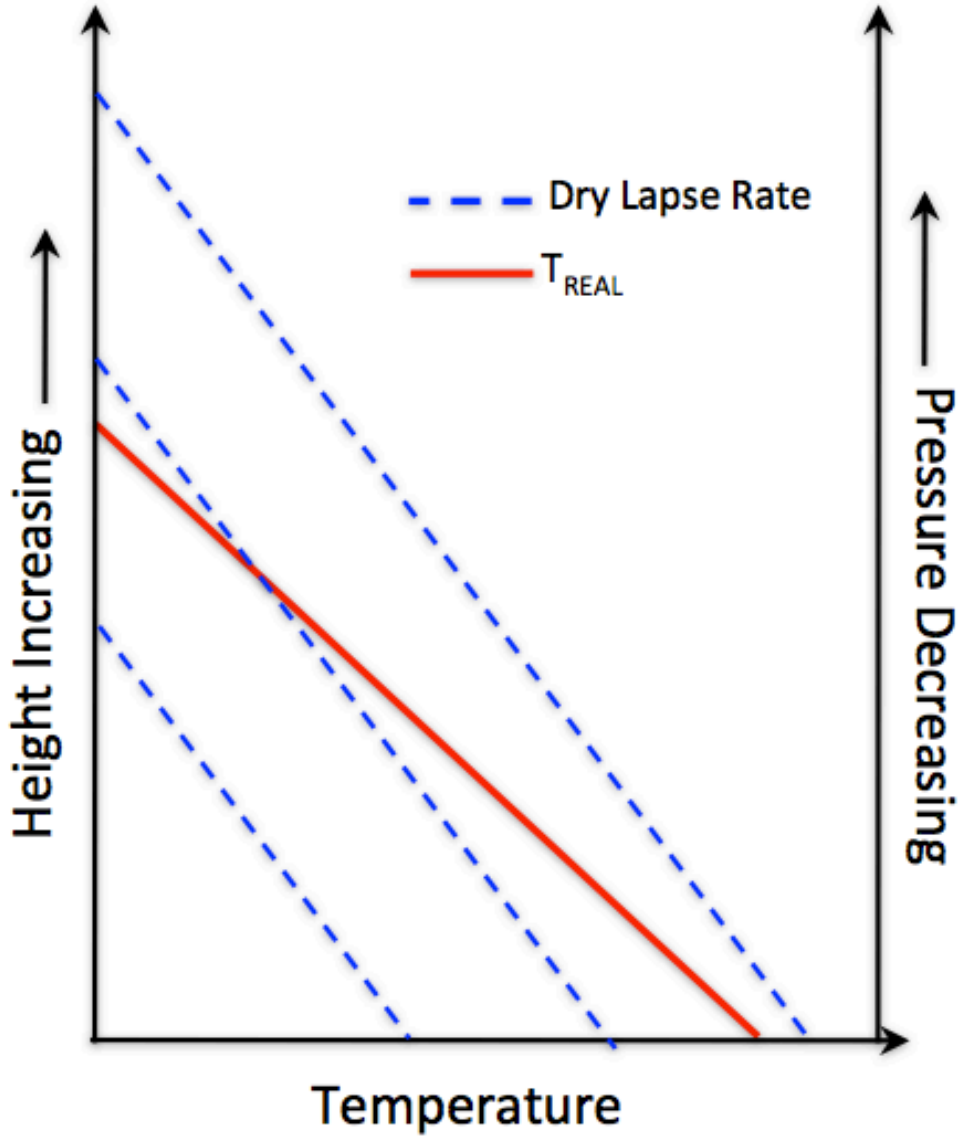


The red T_{REAL} line shows the actual atmospheric temperature as measured by a weather balloon sounding. This is the only actual data on the graph. A hypothetical volume of air (called an **air parcel**) in the atmosphere will drop 10° C in temperature every kilometer it rises. Therefore, it will follow a path parallel to the dashed blue **Dry Lapse Rate** lines.

Imagine an air parcel at point A near the ground which is warmer than the air surrounding it. This air parcel will begin to rise and cool, following the dry lapse rate line. At point B, the parcel is still warmer than the surrounding air and will continue to rise. At point C, the parcel is cooler than the surrounding air and will fall back down. This type of atmospheric profile is considered **stable** because parcels of air tend to return to the same height even when initially displaced.

Another Example

Here is an example of a different atmospheric profile. It could be from a sounding taken at a different location or the same location at a different time.

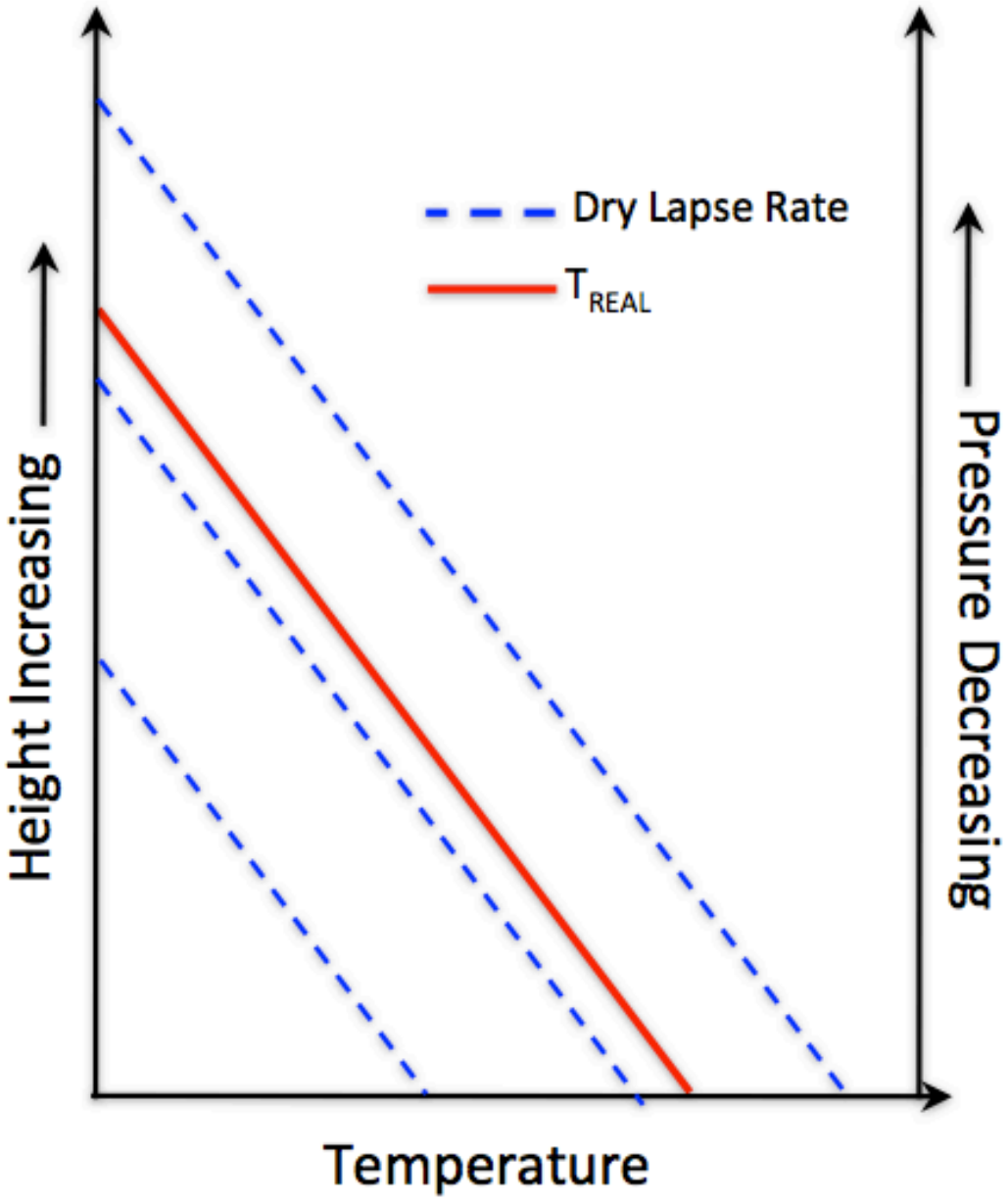


Again, imagine you have an air parcel near the ground that is slightly warmer than the surrounding air. What will happen as the air parcel begins to move up?

Is this atmospheric profile **stable, unstable or neutral**?

One Final Example

And for good measure, here is one more atmospheric profile.

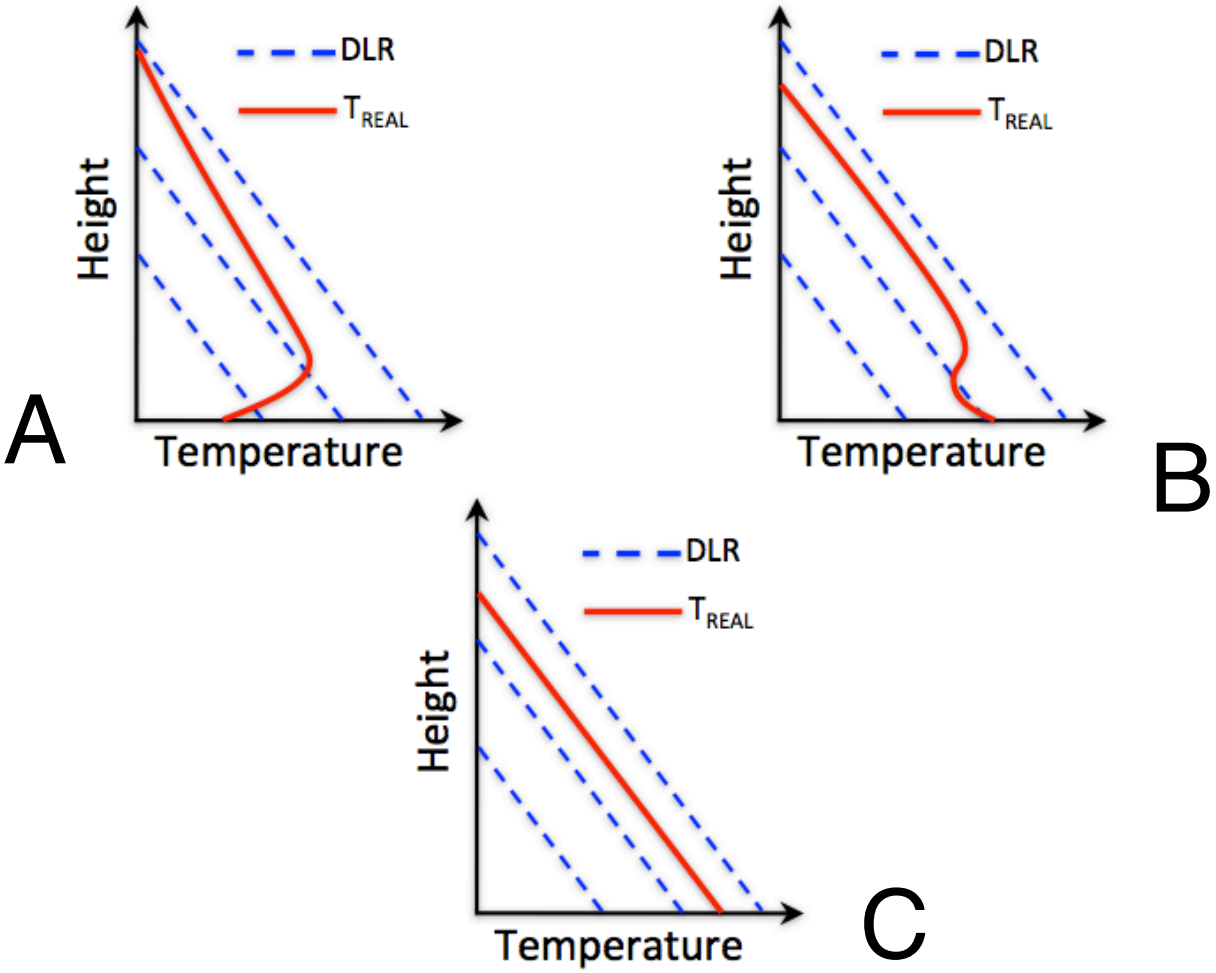


What would happen to an air parcel near the ground that is warmer that the surrounding air?

Is this atmospheric profile **stable, unstable or neutral**?

Exercise 1: Matching

Now we can take a look at some more complicated temperature profiles. On the next page there are pictures of smoke rising (or not) under various atmospheric conditions. Your job is to match the pictures to the appropriate graphs on this page.



Try thinking of the smoke as a parcel of air which begins close to the ground and has a temperature that is warmer than the air around it. What would a parcel of warm air near the ground do in each of the above temperature profiles?

1

2

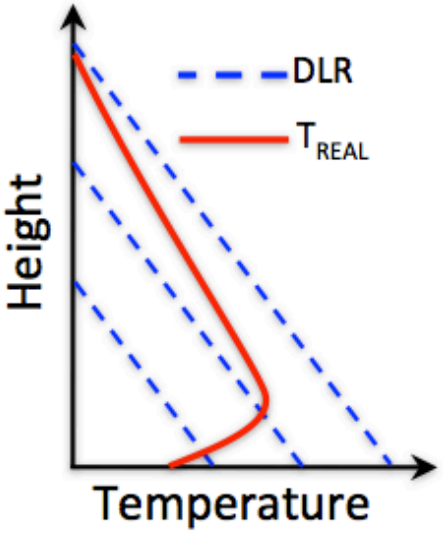
3

Exercise 2: More Difficult Matching

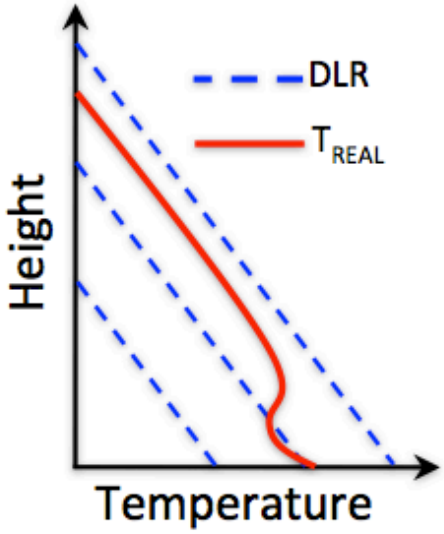
Below are four hypothetical soundings from a single summer day in Colorado. On the next page are pictures that go with the atmospheric profiles. Your task is to match the correct picture with its profile.

One strategy is to think about what the temperature is going to be near the surface of the Earth over the course of a day. You can use this information to put the atmospheric profiles on this page into chronological order.

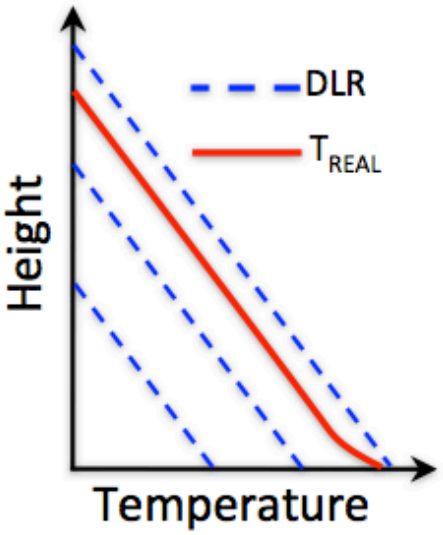
1



2



3



A

B

C