Graphical Operations

The most frequently evaluated quantities on the skew T–log p diagram are illustrated in Fig. 5-1. This is a part of a complete chart, with lines selected for evaluating several of the variables in the example that follows. Usage of the graph can be demonstrated with a parcel of air having pressure p = 900 mb = 9E4 Pa, temperature T = 15°C = 288 K, and relative humidity r = 50%. These variables could be directly measured by the radiosonde. In the diagram in Fig. 5-1, p and T are represented by the doubly circled point A.

The quantities that follow can be evaluated using the diagram:

—The saturation mixing ratio w_s can be read directly from the chart using the printed isopleths of w_s. In original diagrams these lines are dashed and green. In our example we have w_s = 12 g kg^{-1}. This ratio is a function of temperature and pressure. Units of g kg^{-1} are commonly used. In equations, w_s must be used as the original ratio. In this example, w_s = 0.012.

—The mixing ratio w, the ratio of densities of water vapor and dry air, is evaluated from the definition of relative humidity (5-4):

$$w = rw_s$$

In our example w = 6 g kg^{-1}.

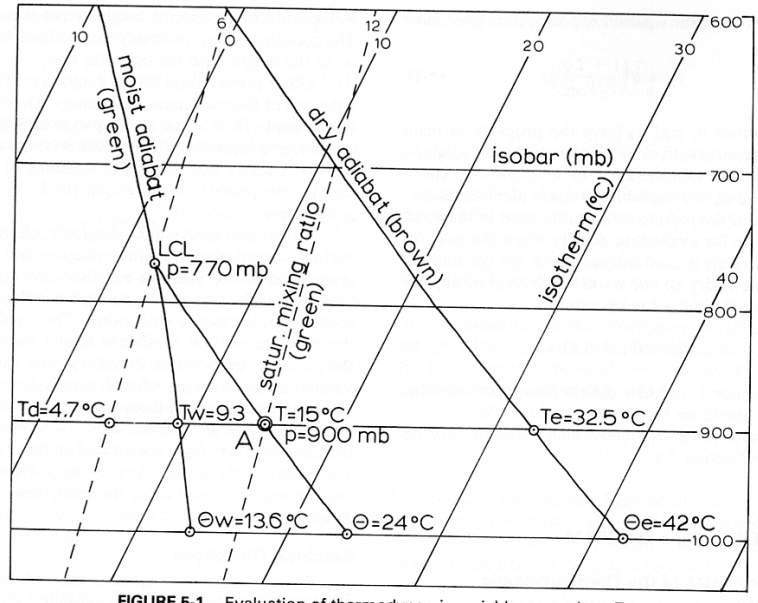

FIGURE 5-1. Evaluation of thermodynamic variables on a skew T–log p diagram. The observations of temperature and pressure are at A; other circled points show evaluated quantities.

—The dew point T_d can be found at the same pressure (900 mb), but at the isopleth w_s = 6 g kg^{-1}. This value is equal to 50% (observed relative humidity) of the evaluated mixing ratio. The dew point is the temperature where the current mixing ratio w becomes the saturation mixing ratio (w_s = w).

—The potential temperature θ is at the intersection of the dry adiabat through A and the isobar of 1000 mb. Here we have θ = 24°C. Potential temperature is commonly expressed in kelvins; therefore, here also θ = 297 K.

—The pressure at the lifting condensation level p_{LCL} is found at the intersection of the printed w_s isopleth for the evaluated w (that is w = 6 g kg^{-1} in our example) and dry adiabat through A. In our example, p_{LCL} is at 770 mb.

—The wet-bulb temperature T_w is at the intersection of the moist adiabat through the point indicated as LCL and the isobar through A; T_w = 9.3°C.

—The wet-bulb potential temperature θ_w is equal to T on the continuation of the moist adiabat through the LCL point to 1000 mb; θ_w = 13.6°C.

—The equivalent temperature T_e can be found by following the moist adiabat through LCL until very low values of temperature are found near the upper left corner of the complete chart, outside the domain shown in Fig. 5-1. There the wet adiabat becomes tangent to a dry adiabat. From there we follow that tangent dry adiabat to the original pressure of 900 mb. In this way we find T_e = 32.5°C. The choice of printed adiabats and moist adiabats is such that the same values appear in both sets of lines. In this way, we may see which are the pairs of adiabats (one moist, one dry) that are tangent to each other, even if they touch outside of the printed diagram.

—The equivalent potential temperature θ_e is on the same dry adiabat as T_e, but at 1000 mb. Therefore, in Fig. 5-1 we have θ_e = 42°C = 315 K.