A sounding: is the vertical profile of temperature and other variables in the atmosphere over one geographic location.

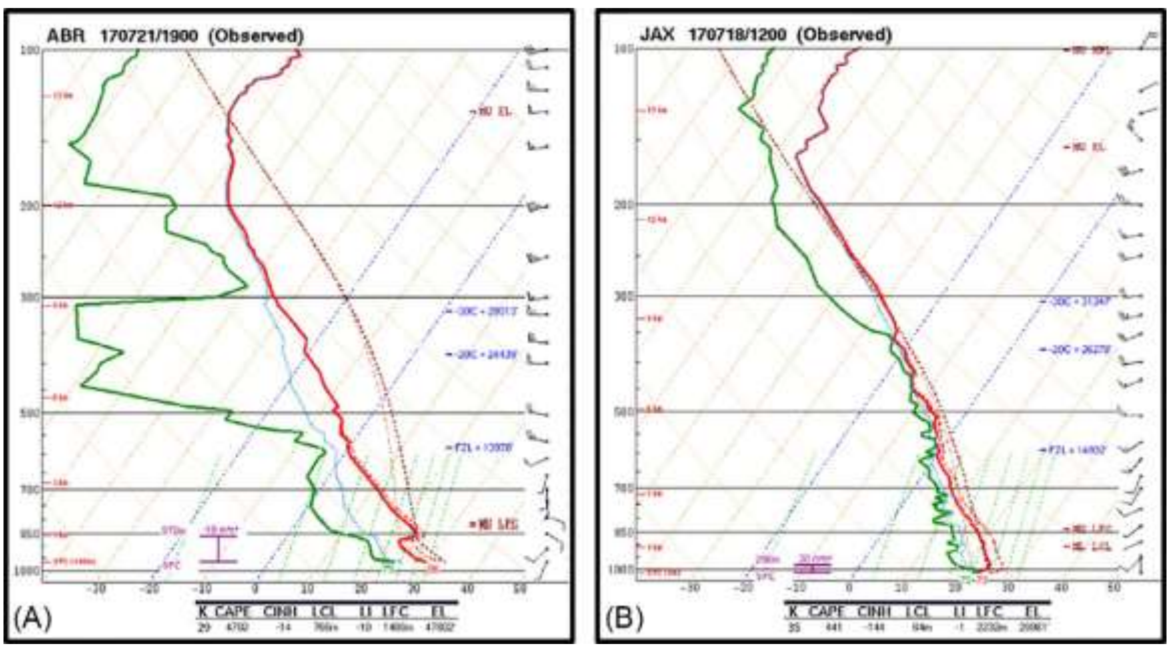
Thermodynamic diagrams are an incredibly useful tool for weather analysis and forecasting. Although there are a few types of thermodynamic diagrams (e.g., tephigram) used across the world, here we will focus on the Skew-T Log-P diagram.

The Skew-T Log-P diagram allows the analyst or forecaster to evaluate:

• How atmospheric variables (i.e., temperature, moisture) change with height.

• The vertical profile and stability of the atmosphere, particularly the troposphere, where most weather occurs.

• Relatively complex calculations of thunderstorm indices and other parameters, by using the multiple sets of reference lines on the chart.



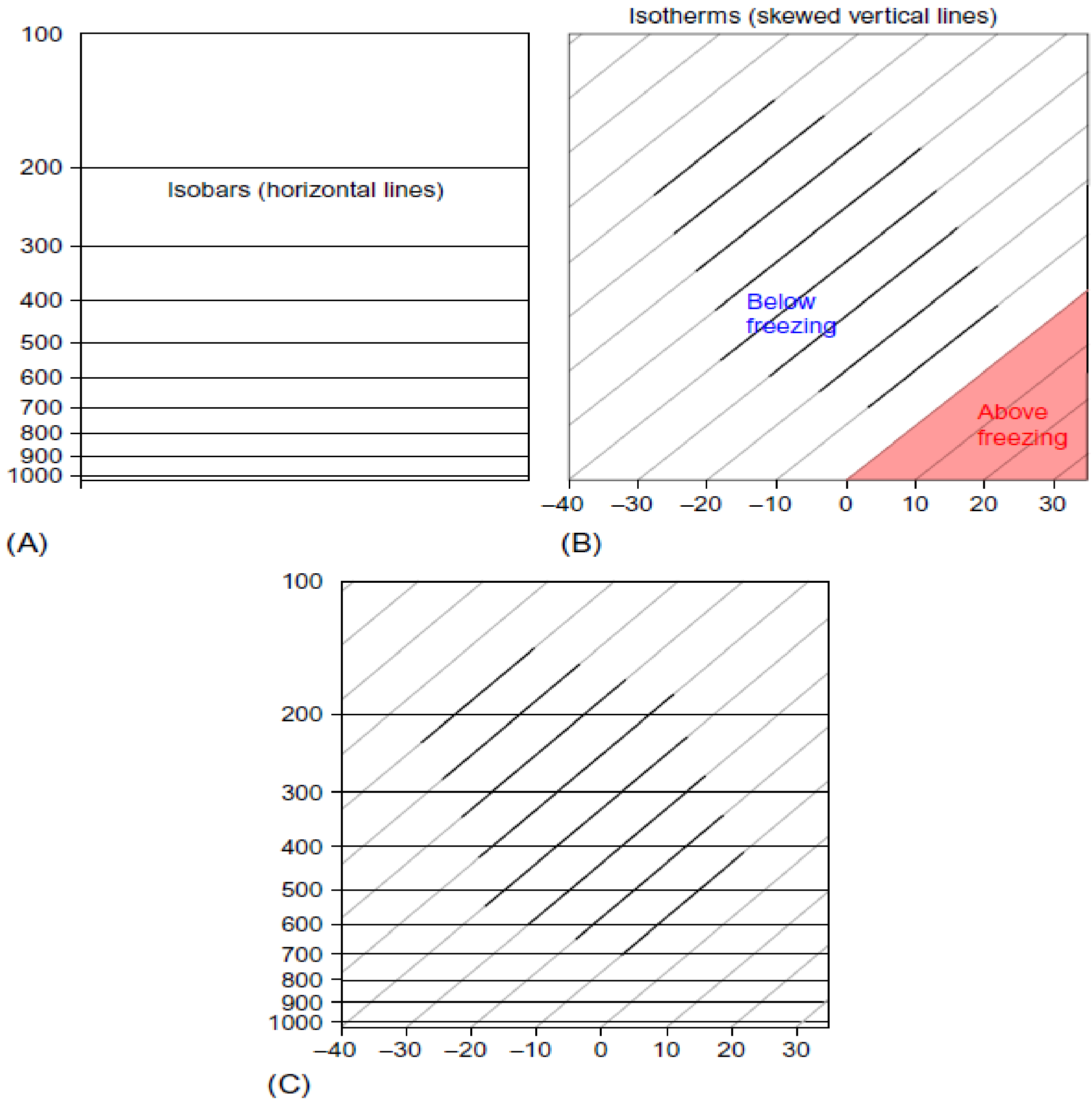


Fig. 1: Pressure and temperature lines on a Skew-T Log-P diagram: (1A) horizontal isobars (hPa), (1B) skewed isotherms (°C), with above- and below-freezing regions identified, and (1C) isobars and isotherms plotted together.

- The first set of lines are horizontal pressure lines (isobars), as seen in Fig. 1A. The isobars are irregularly spaced because pressure is plotted on a logarithmic scale, thus “Log-P.” The distance between each 100 hPa of pressure becomes larger with increasing height (Fig. 1A) because air density decreases with increasing altitude, meaning a given volume of pressure (e.g., 100 mb) will be more expansive (taller) as density decreases.

- Fig.1 B shows lines of constant temperature (isotherms) that skew across the diagram from bottom left to top right, thus "Skew-T." Temperature increases to the right (scale in Fig. 1B), such that if we examine the 0°C isotherm in Fig. 1B, above-freezing temperatures are located to the right, while below freezing temperatures are to the left. Finally, Fig. 1C shows the isobars and isotherms plotted together.

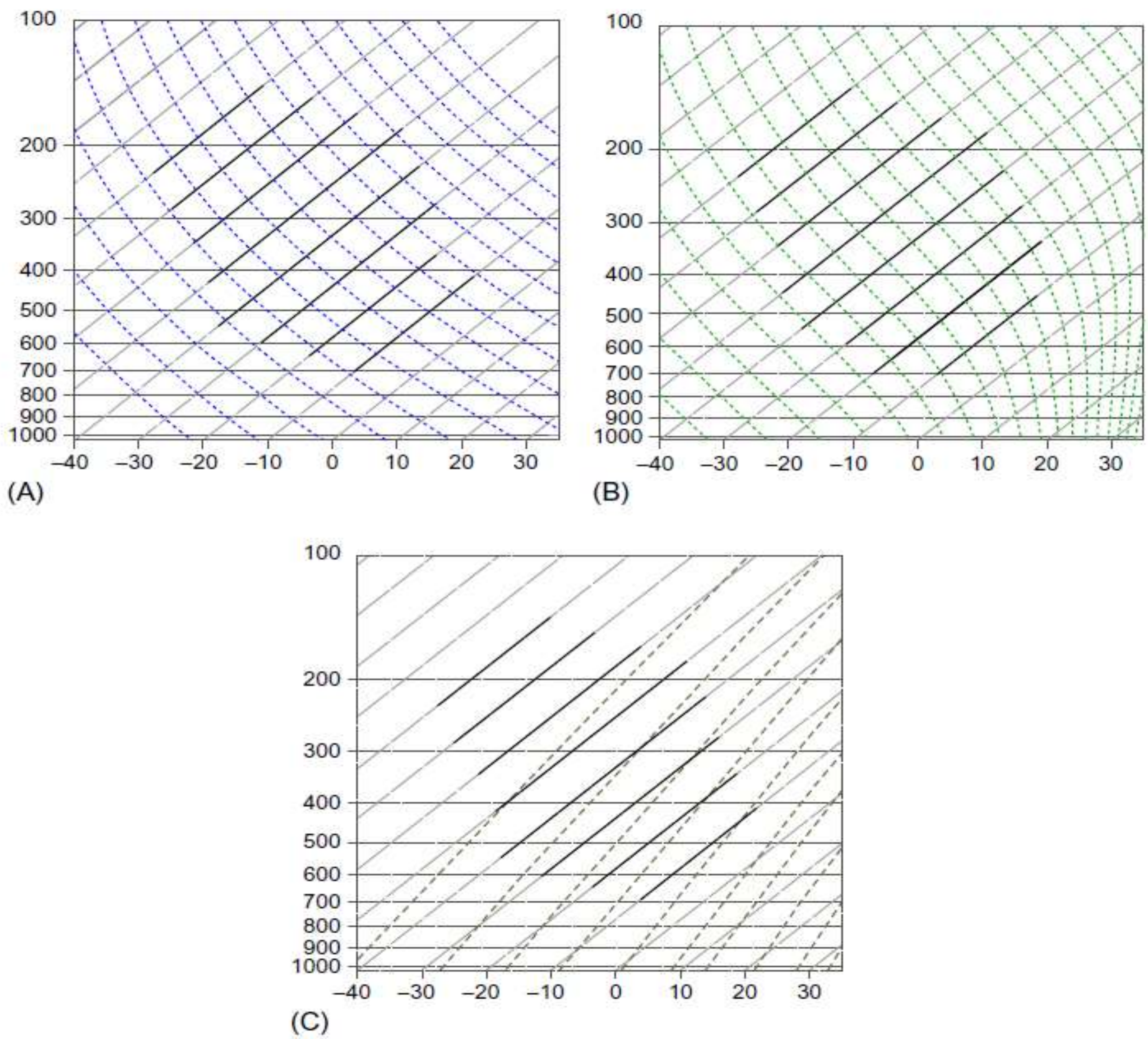


Fig.2: Isobars and isotherms plotted together with other components of a Skew-T Log-P diagram added: (2A) dry adiabats (blue dashed), (2B) moist adiabats (green dashed), and (2C) lines of constant mixing ratio (brown dashed).

- Fig..2 details the remaining three sets of lines on the Skew-T Log-P diagram. In Fig.2A, there is a set of dashed blue lines drawn from lower right to upper left; these are called “dry adiabats” and they represent the dry adiabatic lapse rate (DALR). Recall that an adiabatic process is one during which the temperature of an air parcel can only cool or warm through expansion or compression, respectively. As air parcels rise, they expand and therefore cool adiabatically; as air parcels sink, they compress, and therefore warm adiabatically. The DALR is the rate at which unsaturated [relative humidity (RH) < 100%] air parcels cool or warm and is a constant 9.8°C km at any temperature or pressure level.
- The curved green dashed lines in Fig.2B are moist adiabats, representative of the moist adiabatic lapse rate (MALR). The MALR is the rate at which saturated (RH > 100%) air parcels cool or warm, but unlike the DALR, it is not constant. When rising saturated parcels cool adiabatically, they release latent heat, which offsets some of the adiabatic cooling. Therefore, the MALR is smaller than the DALR and its magnitude is dependent on temperature, because warmer saturated parcels release more latent heat. At warmer temperatures, the MALR is less steep than it is at colder temperatures (Fig. 2B), indicating that as warmer saturated air parcels rise, they cool more slowly than colder saturated air parcels. In general, 6°C km can be thought of as an average MALR value, but as Fig. 2B shows, the MALR is larger at colder temperatures and higher altitudes. In fact, if an air parcel is cold and/or high enough, the MALR will nearly equal the DALR.
- Finally, moist adiabatic rising and sinking is often referred to as a psuedoadiabatic process, because it is not reversible. When a saturated parcel sinks, there is typically less cooling due to evaporation than there is latent heat due to condensation when that same air parcel rises. The result is that a saturated parcel can arrive back at its original pressure level with a different temperature and/or dew point than when it started rising.
- The final set of lines are the dashed brown lines that skew up and to the right in Fig. 2C, These are called lines of constant mixing ratio, and can be identified by their slope, which is not as steep as the isotherms. Recall that mixing ratio is a measure of atmospheric humidity, defined as the ratio of the mass of water vapor to mass of dry air in an air parcel. The typical units are grams of water vapor per kilogram of dry air (g kg _1).

As evidenced by the lack of curvature in the lines, mixing ratio is conserved for arising unsaturated air parcel.

- Fig3 shows the complete Skew-T Log-P diagram. Although the number of lines can seem daunting at first, once proper identification and procedures are learned, it becomes one of the most powerful tools in weather analysis and forecasting.

the analyst or forecaster can recognize, for example, that isobars are horizontal, and isotherms skew up and to the right, more steeply than the mixing ratio lines, he or she will always be able to correctly identify each set of contours.

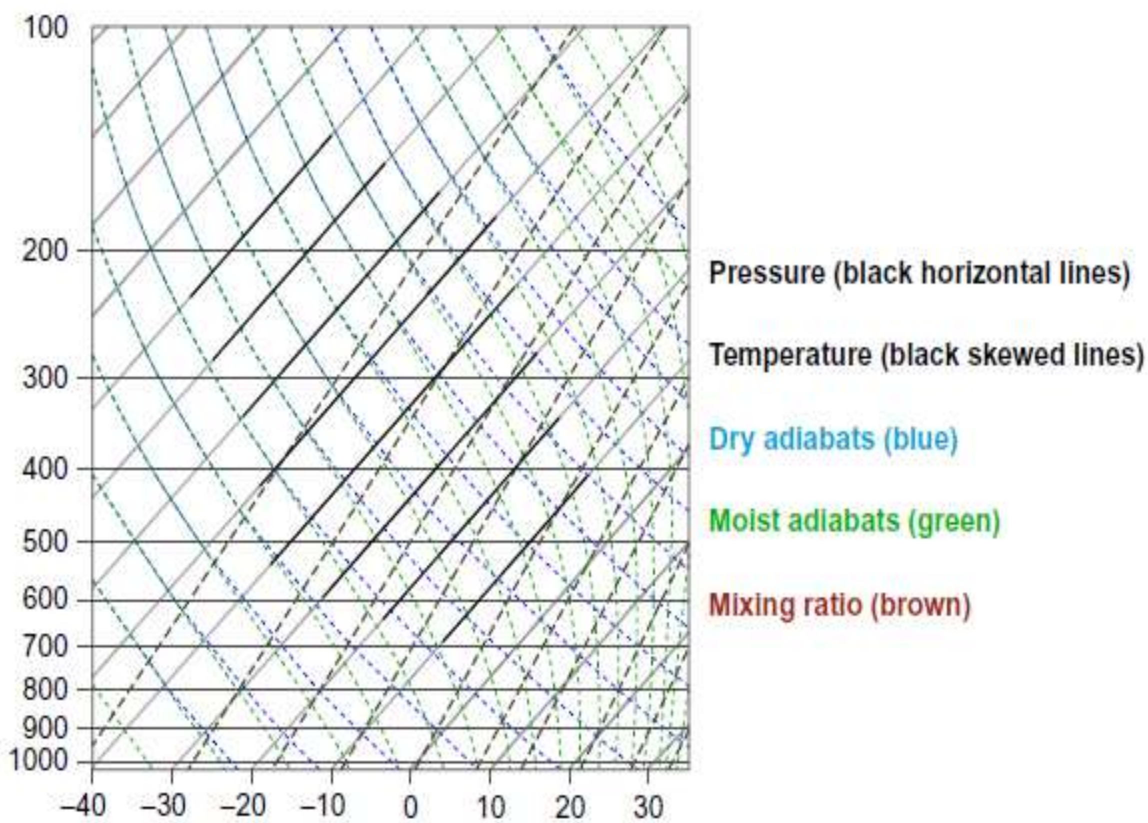


Fig.3 A complete Skew-T Log-P diagram, incorporating all of the components in Figs. 1 and 2.

Conclusion :

Skew-T Log-P Diagram:

•is labeled linearly along the abscissa,

•the isotherms are parallel, straight, diagonal lines tilting upward to the right.

•The Skew-T gets its name because the isotherms are not vertical, but skewed.

•Pressure decreases logarithmically upward along the ordinate,

•and the isobars are parallel, horizontal, straight lines.

•Dry adiabats are diagonal lines slanted up towards the left, with a pronounced curve concave upward.

•Moist adiabats are more sharply curved concave left near the bottom of the diagram, changing to less curved, concave to the right, as they merge into the dry adiabats at higher altitudes and colder temperatures.
•Isohumes are almost straight lines, tilting upward to the right.

Reference:

Synoptic analysis and forecasting, by Shawn Milrad ,Ch13.THERMODYNAMIC DIAGRAM BASICS.