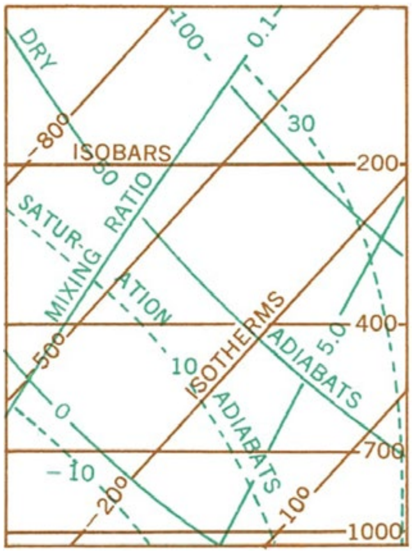
AVIATION REFERENCE MATERIAL

The Skew T - Log P Aerological Diagram

Bureau of Meteorology › Aviation Weather Services



The aerological diagram is used by forecasters to view the current vertical distribution of temperature and moisture in the troposphere, and to determine the atmosphere's stability.

Stability is of interest because if the atmosphere is unstable and moist, then showers or thunderstorms may develop, the severity dependent on the magnitude and depth of instability and the moisture availability. Alternatively, rain may occur when the atmosphere is moist but stable, and a mechanism exists to provide continuous lift.

There are a number of aerological diagram types. The Bureau uses the Skew T - Log P aerological diagram.

Although an understanding of the diagram is not a pre-requisite for pilots, the Skew T - Log P is discussed here because these diagrams are freely available on the internet; they are used extensively by glider pilots to calculate thermal activity; and they are useful for gaining a better understanding of changing weather conditions.

Australian Government
Bureau of Meteorology

The Skew T - Log P name reflects the fact that temperature is plotted on the horizontal axis with isotherms skewed from the lower left to the upper right of the chart; and pressure is plotted on the vertical axis with isobars spaced using a logarithmic scale. The diagram also includes saturation mixing ratios (lines of constant mass of water vapour divided by mass of dry air in a saturated air parcel), dry adiabats and saturation adiabats.

Superimposed on to these lines is a plot of the actual variation in air temperature and dewpoint with height. The temperature, dewpoint and pressure data for these plots are obtained from radiosonde flights which are released from thirty eight Bureau weather stations daily.

Wind direction and speed are plotted on the right-hand side of the diagram. This data is obtained from the balloon flights which carry the radiosonde through the atmosphere.

Additionally, indices calculated from the radiosonde data are displayed at the top-right of the image. These are explained on the following page.

The diagram allows forecasters to obtain a snapshot of the atmosphere above a specific location, from the surface to around the 100 hPa level. They can then determine the atmosphere's stability by comparing the actual temperature profile with the dry and saturation adiabatic lapse rates (DALR and SALR), given by the dry and saturation adiabats printed on the diagram.

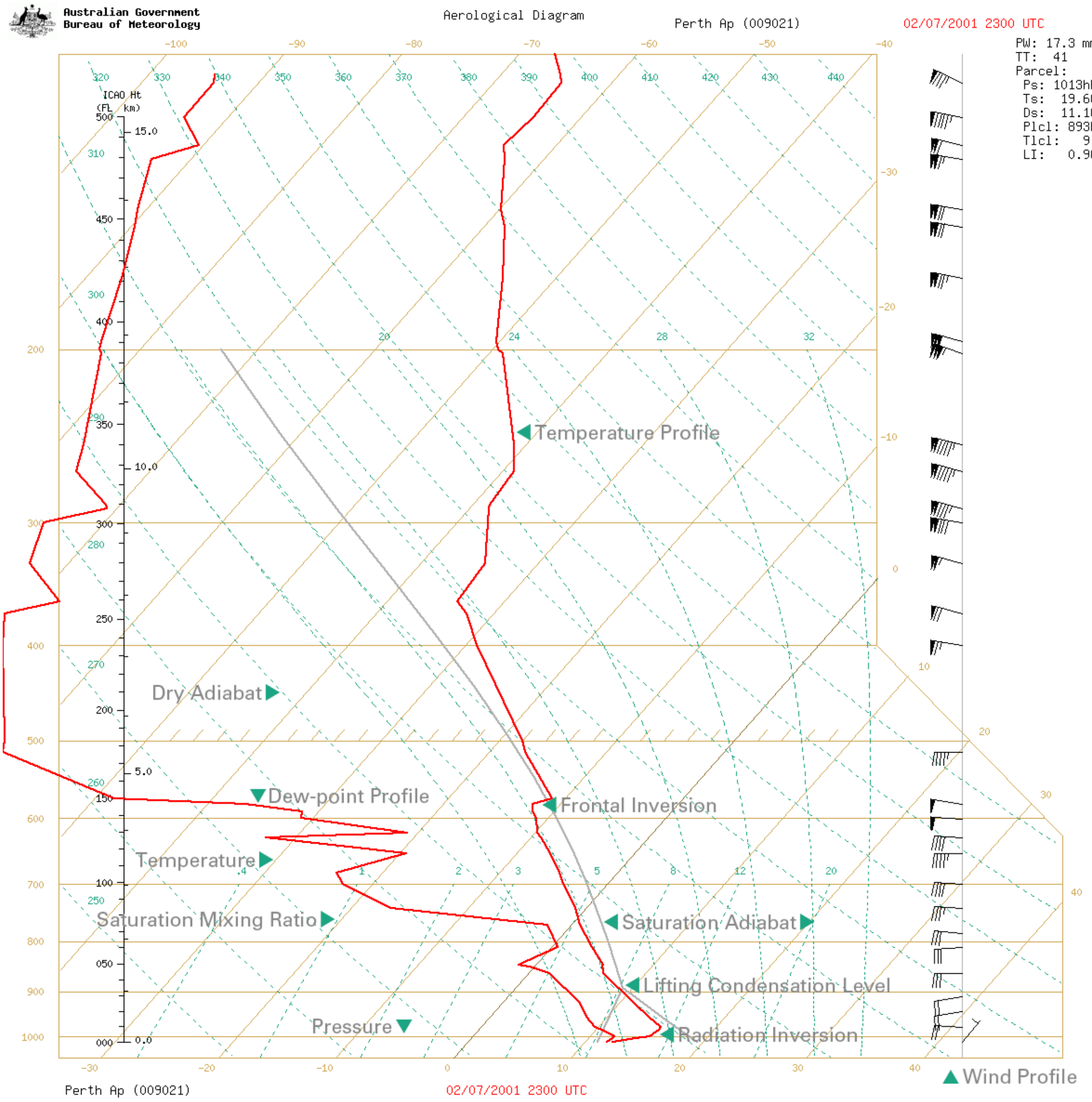
As an air parcel rises, it encounters lower pressure. As a result it expands and its temperature drops. If it is known how much the temperature changes, we can predict if the parcel will be warmer or cooler than its environment and thus the stability of the parcel can be determined.

A rising air parcel will cool at a rate dependent on whether it is unsaturated or saturated, i.e. it will cool at either the DALR or the SALR. The dew-point lapse rate will follow the mixing ratios.

An air parcel will rise if it's warmer, and therefore less dense, than its surrounding atmosphere. Such an atmosphere is considered to be unstable. If the air parcel is cooler and more dense than its surroundings, it will sink, if it is allowed to do so. Such an atmosphere is considered to be stable. For more information on stability, readers can refer to our brochure *Vertical Stability of the Atmosphere*.

A sample diagram is shown overleaf. It plots a sounding from a radiosonde released at Perth Airport at 2300 on 02/07/2001 UTC (Bureau diagrams normally also display the plot from the previous sounding). The Lifting Condensation Level (LCL) shown is the level at which cloud will form if it is lifted to that level, assuming a surface air temperature of 19.6^{0}C, and dew-point of 11.1^{0}C is reached. The LCL is produced by an automated algorithm which uses (unlike the classic method), for the dry adiabat isopleth, the estimated maximum afternoon surface air temperature; and for the mixing ratio, the estimated surface dew-point temperature at that time. The LCL occurs where the dry adiabat isopleth crosses the mixing ratio.

The plot on the right shows the variation in wind with height at the time of the sounding. Wind staffs point to the direction from which the wind is blowing (with north at the top of the page). The solid barbs represent a speed of 50KT; the single line 10KT; and the half line 5KT. Note the light wind in the surface inversion layer compared to the westerly at 20KT above the inversion.



A SkewT - Log P aerological diagram depicting the vertical temperature, dew-point and wind structure over Perth on 3 July 2001.

KEY

PW = precipitable water. The amount of rainfall which would be generated if all of the water vapour in the atmosphere was precipitated to the surface.

TT = total totals. A measure of atmospheric stability based on the temperature difference between 850hPa and 500hPa. A value of 44 or higher indicates sufficient instability for thunderstorms to develop.

The following parcel data is automatically generated using an algorithm which attempts to predict the atmospheric conditions at the time of maximum surface temperature (i.e. maximum instability).

Ps – surface pressure of the parcel.

Ts – surface temperature of the parcel.

Ds – surface dew point of the parcel.

Plcl – pressure at the lifting condensation level. The lifting condensation level is the level at which the parcel becomes saturated when lifted dry-adiabatically.

Tlcl – temperature at the lifting condensation level. The lifting condensation level is the level at which the parcel becomes saturated when lifted dry-adiabatically.

LI – lifted index. A measure of atmospheric stability, generated by subtracting the temperature of the parcel when lifted to 500hPa from the observed temperature at 500hPa. Negative values indicate an unstable atmosphere.

Australian Government
Bureau of Meteorology

Airservices Australia is the official distributor of aviation forecasts, warnings and observations issued by the Bureau of Meteorology. Airservices' flight briefing services are available at www.airservicesaustralia.com. Telephone contact details for elaborative briefings are contained in Airservices' Aeronautical Information Publication Australia (AIP), which is available online through their website.

Other brochures produced by the Bureau of Meteorology's aviation weather services program can be found at www.bom.gov.au/aviation/knowledge-centre.