FRONTAL ANALYSES.

The features presented in this section are only available with the optional Fronts & Forecast module.

Overview.

The RAOB program provides the user with a vast array of analytical tools and displays. RAOB's editing and interactive functions allow the user to simulate or estimate what-if scenarios and more importantly – provides users rudimentary ability to create forecast soundings. RAOB's "Fronts & Forecast" module now offers the user a fast and objective method for creating reliable short-term forecast soundings.

RAOB's Fronts & Forecasts module can locate frontal zones and create short-term forecasts solely from the sounding data itself. RAOB creates forecast soundings via two different methods: (1) Temperature advections derived from thermal wind data, and (2) Temperature/dewpoint & wind advections derived from upstream soundings. RAOB offers a variety of forecast options for both forecast modes. The first forecast method (using only thermal wind data) is described below.

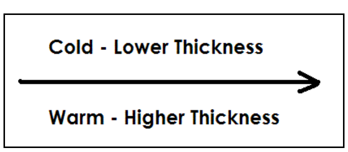
Thermal Wind Theory.

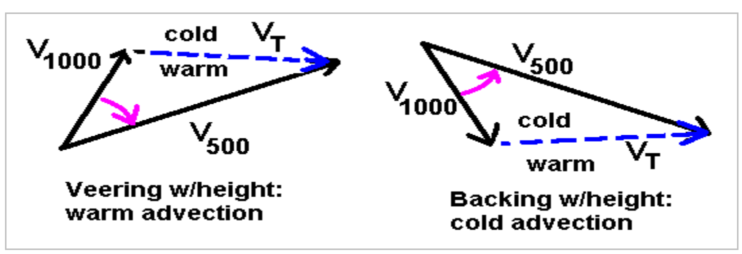
Forecasts created using the "thermal wind" method use classic thermodynamic relationships to identify temperature advection and frontal layers from a sounding's wind data. This method historically involved manually intensive procedures to arrive at a forecast sounding, which have mostly been abandoned since the advent of numerical products. RAOB automates those manually intensive and cumbersome procedures, turning thermal wind theory into a powerful forecast tool. In cases where the user only has a surface observation and a local sounding, RAOB systematically applies thermal wind theory to create a forecast sounding. In the "old days" this process was known as *single station analysis*.

The earliest comprehensive examination of thermal wind theory was documented by Oliver & Oliver (1945). It is important to note that the thermal wind is not a wind, but is the difference in geostrophic wind between two levels in the atmosphere – it is a wind shear vector (V_T). The thermal wind is a theoretical wind that blows parallel to the thickness lines, which is analogous to how the geostrophic wind blows parallel to the height contours. The significance of the thermal wind is that it correlates the vertical geostrophic wind shear between two levels of a sounding to the mean horizontal temperature gradient in the layer between the same two levels. Furthermore, looking downwind of the thermal wind vector, colder air is always on the left side and warmer air is on the right side. In the Southern Hemisphere, this relationship is reversed. The summary importance of thermal wind (V_T) theory is two-fold:

(1). When the geostrophic winds turn clockwise (or veer) with height, warm air advection occurs.
(2). When the geostrophic winds turn counter-clockwise (or back) with height, cold air advection occurs.

Thermal wind (V_T)





By applying the above correlations to a sounding's hodograph, thermal advections can be inferred and a reliable short-term forecast sounding can be created. Following several requests from RAOB users to apply thermal wind theory to this program, manual techniques from several sources were consolidated into the procedures described on the following pages. Some of these sources, originally in German, were translated by Gilbert Christoffel, who also provided valuable assistance with converting these long established manual procedures into RAOB program algorithms.