UNITED STATES MARINE CORPS

LESSON PLAN

VERTICAL CROSS SECTIONS

INTRODUCTION:

1. Gain Attention. Have you ever been introduced to a meteorological concept that you couldn't quite grasp? A concept that required you to internally visualize the atmosphere three dimensionally? There are a lot of individuals in the weather community that have a difficult time visualizing three-dimensional concepts from a two-dimensional chart. Vertical cross sections can be one way to aid forecasters in understanding atmospheric phenomena three dimensionally.

2. Overview. The purpose of this period of instruction is to introduce the student(s) to vertical cross sections and explain the some of the uses vertical cross sections can provide. This class also instructs the student(s) on one method of creating a vertical cross section for further analyses.

3. Introduce Learning Objectives.

a. Terminal Learning Objective. Without the aid of references, depict a vertical pressure cross-section between two specified synoptic scale systems within a half-hour time limit.

b. Enabling Learning Objective(s). Without the aid of references, but in accordance with the instruction,

(1) Define the various uses vertical cross sections may be used for.

(2) State the procedures for constructing a vertical cross section.

4. Method/Media. This period of instruction will be taught using the lecture method with aid of QMMCBT-001 "Introduction to the Dynamics of the Atmosphere".

5. Evaluation. You will be evaluated at the end of this period of instruction by manually creating two (2) vertical cross sections to produce a visual comparison of pressure gradients between three (3) synoptic scale pressure systems (two Low pressure systems and a High pressure system or two High pressure systems and a Low pressure system).

TRANSITION. Many tools are used in the meteorological field to visually aid forecasters in depicting the current and future locations of atmospheric phenomena. Vertical cross sections provide for one way to visualize atmospheric parameters.

BODY:

1. Vertical Cross Section Representation.

a. A vertical pressure cross section depicts the slope of a constant pressure surface along a horizontal line. It is essentially taking a vertical slice (3-dimensional) of the atmosphere to examine the heights of constant pressure surfaces 2-dimensionally. Vertical cross sections depict the height of a constant pressure surface above ground level. Cross sections are mainly computed using gridded field from numerical weather models; however, one may construct a vertical cross section between any two points.

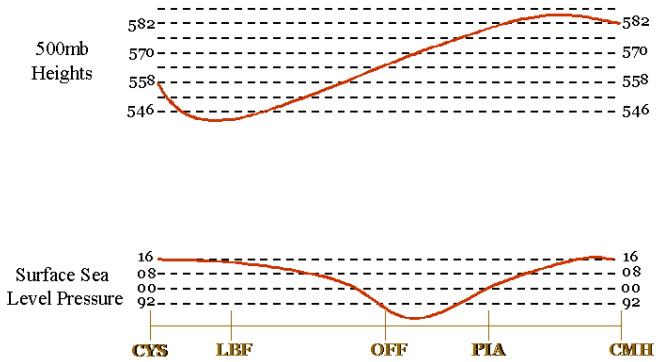

Figure 1 - Vertical Cross Section.

b. By evaluating the pattern of isoheights, one can determine the pressure slope or pressure gradient of a specific region or area for that given pressure level. Cross sections may not be plotted to actual scale, but are rather used for the visual representation of pressure patterns. In addition to using vertical cross sections for pressure, they can also be used to further investigate essentially any weather parameter specified.

(1) Thickness. Thickness can be defined as the distance between any two constant pressure surfaces. By depicting thickness on a vertical cross section, a visual representation of the location of cold and warm air can be shown. Colder temperatures correspond to low thickness values, while higher temperatures correspond to warmer temperatures. By constructing a vertical cross section, one may be able to determine estimated locations of warm and cold air advection. Thickness values are directly related to determining precipitation type, such as liquid, freezing, or frozen.

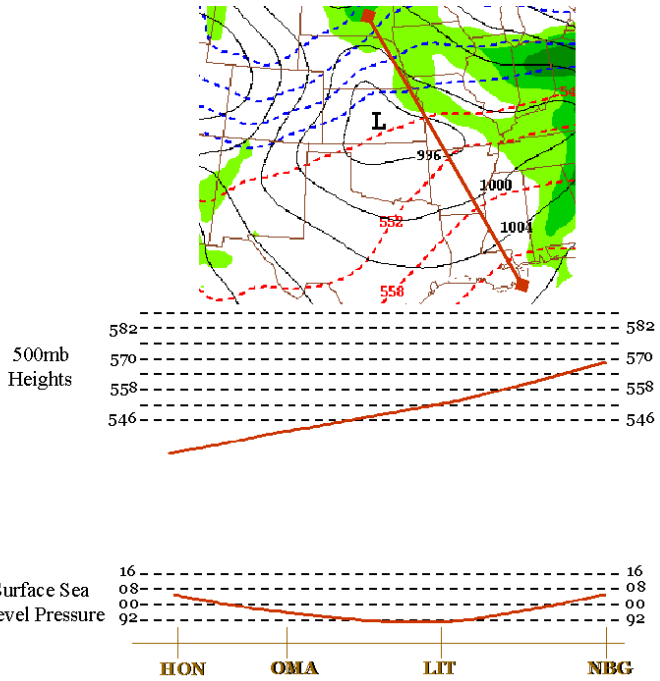

Figure 2 - Thickness on vertical cross section.

(2) Temperature. Directly related to thickness are isotherms, which are also sometimes depicted in vertical cross sections. Isotherms on a vertical cross section illustrate temperature patterns in the area of interest.

(3) Isentropes. Isentropes depict lines of equal potential temperature and are often displayed on vertical cross sections. By using an isentropic cross section, in conjunction with pressure, a forecaster is able to analyze for temperature advection, atmospheric stability, and frontal boundaries based on the sloping and spacing of the isentropes. A more uniform moisture advection process through the atmosphere may also be better visualized with the use of isentropic analyses. Isentropic cross sections also allow for a better depiction of vertical motion throughout the atmosphere than isobaric cross sections do because it allows the forecaster to identify vertical relationships between pressure and temperature.

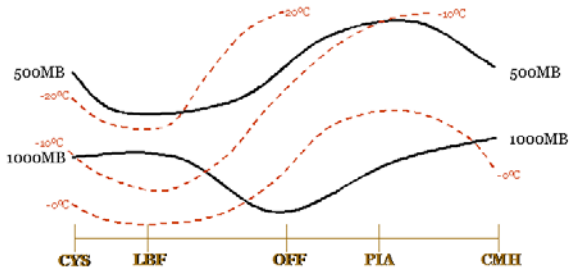

Figure 3 - Isentropic view.

TRANSITION. Depicting pressure utilizing cross sections is of great asset. The next topic shows us how to actual construct a vertical cross-section.

2. Vertical Cross Section Construction.

a. The following guidelines may be used in creating a vertical cross section:

(1) Select two (2) points, and create a line along which to do the cross section and label it on the chart.

(2) Set up the axes. The horizontal axis is the line drawn on the chart from two or more selected points (may use a blank sheet of paper). The vertical axis is the height of the pressure surfaces.

(3) Determine the upper-level height values along the horizontal axis.

(4) Plot the actual height values in between the point(s) of interest.

(5) Connect the plotted points together to complete the vertical cross section.

b. Vertical cross sections may be set up to analyze for any parameter depending on the needs and interest of the forecaster.

TRANSITION. With the knowledge presented from this class, one should be able to visual concepts three-dimensionally using a vertical cross section.

OPPORTUNITY FOR QUESTIONS:

1. Questions from the Class. At this time, are there any questions pertaining to any of the material that has just been presented?

2. Questions to the Class. There will be no questions to the class for this period of instruction. Knowledge shall be demonstrated by evaluation.

SUMMARY: During this period of instruction, the definition of a vertical cross section and what they represent were introduced to the student. The student was also made aware of the different atmospheric parameters that may be used while constructing a vertical cross section, as well as, the steps used to construct one.

INSTRUCTOR NOTE. USING A CURRENT SURFACE ANALYSES, DICTATE WHICH THREE (3) PRESSURE SYSTEMS WILL BE USED TO COMPLETE THE EVALUATION. SCENARIO SHOULD ENABLE THE STUDENT TO VISUALLY SEE A WEAK PRESSURE GRADIENT VERSUS A STRONG PRESSURE GRADIENT.