UNITED STATES MARINE CORPS

LESSON PLAN

DEPICTING PRESSURE

INTRODUCTION:

1. Gain Attention. On constant pressure charts as well as surface charts there are "H"s, "L"s, "A"s, "C"s, dashed brown lines, and black saw-tooth lines, but what are they? What do they mean? If you see a big blue "H" near where you are does it mean good weather, bad weather?

2. Overview. During this period of instruction, the student shall be introduced to several terms utilized when analyzing constant pressure and surface charts, as well as, proper applications for depicting pressure.

3. Introduce Learning Objectives.

a. Terminal Learning Objective. Given a unanalyzed constant pressure chart and an unanalyzed surface chart, perform the following tasks in accordance with this instruction, but without the aid of references, in a time limit of twenty minutes per chart:

(1) Properly analyze and depict lines of equal pressure every two millibars on a given surface chart.

(2) Properly analyze and depict lines of equal height at the appropriate increment for the mandatory levels on given constant pressure charts.

(3) Properly depict areas of elongated low and high pressure.

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

(1) Provide definitions for high and low pressure, troughs and ridges, isobars, and isoheights.

(2) Locate areas of enclosed high and low pressure.

(3) Locate areas of elongated high and low pressure.

(4) State the mandatory levels.

(5) Explain the difference between a constant pressure and constant height chart.

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

5. Evaluation. This period of instruction will be evaluated at the conclusion of the class with a question and answer session.

TRANSITION. Weather forecasters use atmospheric analysis to determine the location of different areas of lower and higher pressure. The first topic of the period of instruction focuses on two (2) specific types of charts that are used in pressure analyzation.

BODY:

1. Charts Depicting Pressure. The two (2) types of charts that depict pressure are constant height charts and constant pressure charts.

a. Constant Height Charts. This type of chart has the same height everywhere over an area of interest. The "constant" height is mean sea level or the surface. Two examples of a constant height chart are the surface and thickness charts.

(1) Stations with locations above or below mean sea level are corrected to sea level by using an estimation of atmospheric conditions.

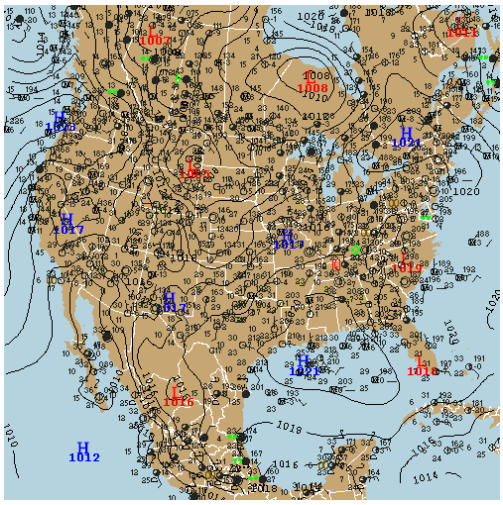


Figure 1 – Example of constant height chart.

(2) Corrections are made by computing the R-factor and utilizing the Pressure Reduction Computer.

(3) Uncorrected surface charts would show areas of consistent low pressure in higher terrain, or mountainous areas.

b. Constant Pressure Charts. The constant pressure chart is a chart that depicts the various heights of a specific pressure level. The atmosphere has similar characteristics to an ocean body, where air

molecules are in constant motion, both horizontally and vertically.

(1) Constant pressure charts allow for a relatively easy depiction of areas of higher and lower pressure by depicting lines of equal height at a specified pressure level.

(2) Recall from previous discussions that cold air is denser than warm air and is associated with lower height and higher pressure. Warm air is less dense and is associated with higher heights and lower pressure (see figure 1).

(3) Constant pressure charts are commonly referred to as "Upper-Air Charts" and are only produced by numerical weather models for mandatory pressure levels of 925, 850, 700, 500, 300, 250, and 200 millibars. However, hand plotted charts may be produced for any pressure level given an appropriate amount of data for a region or geographical area of interest.

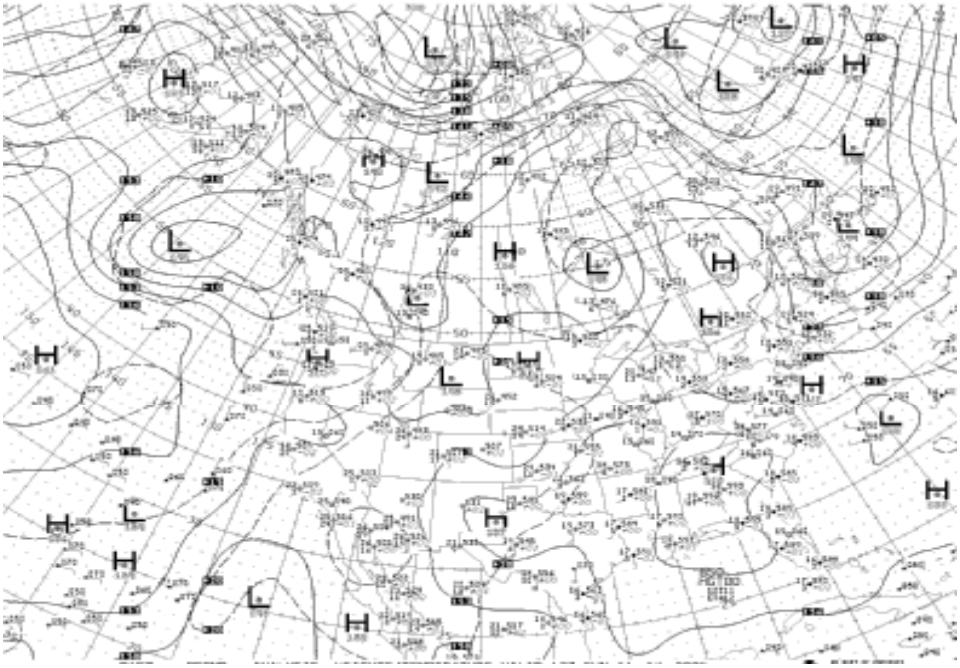


Figure 2 – 850mb constant pressure chart.

TRANSITION. The constant pressure and height charts are charts that represent pressure variations or patterns in the atmosphere. The next topic focuses on how pressure is depicted on these charts.

2. Charts Providing Pressure Depiction.

a. Constant Height Charts. Variations in pressure are determined by connecting lines of equal pressure values (sea level pressure) on the surface chart and are called *isobars*.

(1) Isobars are generally drawn in four (4) millibar (mb) increments, with a base of 1000mb, to show pressure patterns, but may be drawn at various increments depending on the amount of available data and area of interest.

(2) They are depicted as solid black lines.

(3) As isobaric values increase the pressure increases and are therefore associated with higher pressure. As values decrease, pressure decreases and is therefore associated with lower pressure.

b. Constant Pressure Charts. In the upper levels of the atmosphere, pressure patterns and variations are determined by analyzing for the height of a given pressure level. These values are commonly called *isoheights* or *contours*.

(1) Contours are lines that connect equal height and are expressed in decameters.

(2) Contours change interval depending on what pressure level is being analyzed:

(a) 300, 250, and 200mb charts – every 12 dam.

(b) 500mb chart – every 6 dam.

(c) 700 and 850mb charts – every 3 dam.

Table 1 – Standard Height Values.

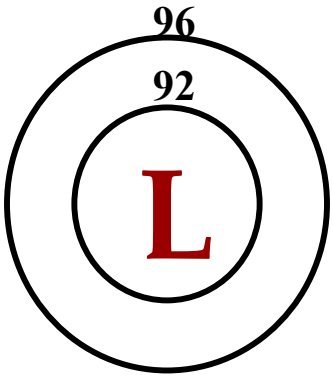
HEIGHTS		
Meters	**Feet**	
9,164	30,065	**300 mb**
5,574	18,289	**500 mb**
3,012	9,882	**700 mb**
1,457	4,781	**850 mb**
111	364	**1000 mb**

TRANSITION. After the isobars or contours are analyzed, pressure patterns and variations may become visible. The next topic discusses the fundamental pressure patterns that are analyzed for.

3. Pressure Depiction on Charts.

a. Cyclones. Cyclones are areas of low atmospheric pressure characterized by winds that rotate in a counter-clockwise (cyclonic) manner and converge at the center to produce ascending air.

(1) Depicting a cyclone.



(a) A cyclone is marked with a red "L" at the center of the lowest pressure and the center of rotation.

(b) When using streamline analysis to depict cyclones it would be illustrated with a red "C".

(2) Characteristics of a cyclone.

(a) Low surface pressure.
(b) Counterclockwise wind flow.
(c) Convergence at the surface.
(d) Divergence aloft.
(e) Inclement weather is usually associated with a cyclone.
(f) Cyclones are steered by upper level flow.
(g) Warmer temperatures are located in front of a cyclone.
(h) Cooler temperatures are located behind a cyclone.

Figure 3 – Cyclone.

b. Anti-cyclones. Anticyclones are areas of high atmospheric pressure characterized by winds that rotate in a clockwise (anticyclonic) manner and diverge at the center to produce descending air.

(1) Depicting an anti-cyclone.

(a) An anti-cyclone is marked with a blue "H" at the center of the high pressure and at the center of rotation.

(b) When using streamline analysis to depict cyclones they would be illustrated with a blue "A".

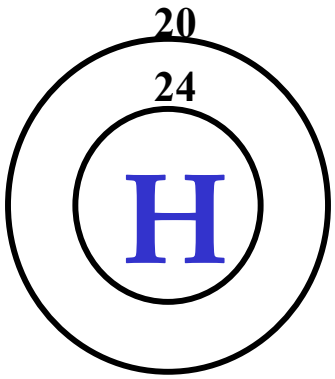


Figure 4 – Anticyclone.

(2) Characteristics of a anti-cyclone.

(a) High surface pressure.

(b) Clockwise wind flow.

(c) Divergence at the surface.

(d) Convergence aloft.

(e) Fair weather is associated with an anti-cyclone.

c. TROUGHS. A trough is an elongated area of low pressure. It does not have complete cyclonic flow, which would be represented by a closed isobar or contour.

(1) Depicting a trough.

(a) The center of a trough is the area with the maximum cyclonic turning of the wind field.

(b) A dashed brown line is drawn in the center of the trough.

(2) Characteristics of a trough.

(a) Lower pressure.

(b) Cyclonic curvature may include one or more low pressure circulations within it.

(c) Upper-level trough may be associated with a closed surface Low.

d. Ridges. A ridge is an elongated area of high pressure. It does not have complete anticyclonic flow, which would be represented by a closed isobar or contour.

(1) Depicting a ridge.

(a) The line of connecting points through the maximum anti-cyclonic curvature of the wind field is called the ridgeline.

(b) A black saw-toothed line is drawn in the maximum anti-cyclonic curvature of the wind field to illustrate a ridge.

(3) Characterizations of a ridge.

(a) Higher pressure

(b) Anti-cyclonic curvature

(c) Upper-level ridges may be associated with a closed surface high.

TRANSITION. Now knowing that you don't have to stamp a chart with a low just because you have lower pressure in that area will greatly assist you in your analyzation of charts and in the future proper forecasting of synoptic systems.

OPPORTUNITY FOR QUESTIONS:

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

2. Questions to the Class.

a. QUESTION. What does a large blue "A" stand for on weather chart?

b. ANSWER. Anti-cyclone as depicted on the streamline analysis.

c. QUESTION. What does an isobar represent?

d. ANSWER. Lines of equal pressure.

e. QUESTION. What is the difference between a surface chart and the 500mb level chart?

f. ANSWER. Surface charts use lines of equal pressure where as the 500mb level chart uses lines of equal height.

SUMMARY: This period of instruction provided the student with a fundamental understanding of the two different chart types that are used to determine pressure variations and patterns. It also gave the student knowledge on terminology relating to the analyzation of pressure and pressure systems.

REFERENCE.

Lutgens, Frederick K. and Tarbuck, Edward J. The Atmosphere, An Introduction to Meteorology. 9th edition. Pearson Education Inc. 2004

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Glickman, Todd S. Glossary of Meteorology, 2nd Edition. American Meteorological Society, Boston Massachusetts, U.S.A.

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