UNITED STATES MARINE CORPS

LESSON PLAN

ADVECTION

INTRODUCTION:

1. Gain Attention. Have you ever wondered how clouds are lifted in to the sky? Or what advection is? What about all the things advection effects in weather. Do you know all of them? Do you know the advection process?

2. Overview. During this period of instruction, the student(s) shall review the definition of advection and discuss the significance of and how to determine the advection of atmospheric parameters.

3. Introduce Learning Objectives.

a. Terminal Learning Objective. Without the aid of references, but in accordance with the period of instruction, utilize a specified method for determining a specified parameter within a time limit of ten (10) minutes.

b. Enabling Learning Objective(s). With the aid of the instructor and in accordance with the period of instruction, the student(s) shall complete the following:

(1) Explain the ways advection effects weather in general.

(2) Provide three (3) examples of atmospheric parameters that may be advected.

(3) Describe the various methods utilized to determine what typr of advection is occuring at the point of interest.

4. Method/Media. This period of instruction will be taught using the lecture method with the aid of a Macromedia Flash presentation “QMMCBT-001 Introduction to the Dynamics of the Atmosphere”.

5. Evaluation. The student(s) shall not be evaluated upon the conclusion of this period of instruction.

TRANSITION. Although the entire process of heated air rising spreading out, and finally flowing back toward its original location is known as convective circulation, meteorologists usually restrict the term convection to the process of the rising and sinking part of the circulation.

BODY:

1. The Advection Process. Recall that *advection* is a type of heat transfer that horizontally carries an atmospheric property (such as temperature, moisture, dryness, etc…) throughout the atmosphere. These properties that exist within the atmosphere are significant when they are advected because they have a daily and/or climatological effect on

the weather that an area or region will receive. For example, a coastal area that borders a cold ocean current will receive a relatively consistent effect from the cooler temperature directly above the ocean flowing onshore over the relatively warmer land (during the summer). The cooler temperatures are being advected over land by the wind.

TRANSITION. Meteorologists have the need to determine the strength of the advection that is taking place. They can do this by looking at surface and upper-level charts.

1. Determining the Magnitude of Advection. There are two (2) factors to consider when determining the advection strength of a property, (1) the direction and speed of the wind and (2) the gradient of the property being advected (temperature for example). The following focuses on the techniques of using a surface or upper-level chart.

a. Direction and speed of the wind flow.

(1) When there is a strong pressure or contour gradient, the wind speeds will be strong. The tighter the gradient, the faster the wind speeds. Faster wind speeds allow for more of the property to be advected. The opposite holds true for weaker pressure gradients that produce relatively weaker wind speeds; therefore a weaker force to transport the property of interest.

(2) This determination can be made by looking at the level of interest, such the surface, 700 or 300 millibar charts. Where the pressure or height contours are closely spaced together, the pressure or height gradient force is strong.

b. The gradient of the property being advected. When analyzing the gradient of the property of interest (temperature and moisture are two parameters that are looked at most often), attention needs to be paid to the orientation of the temperature gradient.

(1) Strength of the gradient. The same guidelines that were just stated apply to any gradient. The greater the change over a distance, the stronger the gradient, and therefore the stronger the advection.

(2) Orientation of the isopleth gradient.

(a) When the isopleth gradient is parallel to the pressure gradient, there is no advection occurring. No advection is occurring because there are no temperature differences occurring.

(b) When the isopleth gradient is perpendicular to the pressure or height gradient, it is strong advection.

(c) Isopleth gradients may also be orientated at angles to the pressure gradients. Angles are directly proportional to the intensity of the advection, with stronger advection occurring where isopleths intersect pressure gradients at right angles (perpendicular). The greater the angle, the greater the amount be advected.

(d) Strong advection is associated with strong pressure or contour gradients, strong isopleth gradients, and isopleths that are perpendicular to the pressure or contour gradient.

(e) Weak advection is associated with weak pressure or contour gradients, weak isopleth gradients, and isopleths that are orientated parallel to the pressure or contour gradients.

2. Analyzing for Advection. There are several different techniques that may be used for determining advection, and usually vary from forecaster to forecaster and the availability of products. The following provides a brief introduction to several common techniques.

a. Satellite Imagery. By using satellite imagery, one may determine the point of interest and look upstream (what is coming at you) for moist or dry air advection. (Further discussion on satellite imagery is focused in Phase Two training.)

b. Surface and Upper-level Charts. When using these charts, determine the area or point of interest and look upstream for what is coming at you. This method may be used for a variety of atmospheric parameters to include, but is not limited to, temperature (warm or cold air advection), moisture (dry or moist air advection), pressure, wind speed and direction, height falls or rises, or even synoptic scale systems.

c. Surface Observations. For a more detailed or local analysis, one may refer to surface observations in the local area. The key point here is to ensure that you are looking upstream to pull the appropriate station data. Upstream may be from the east, north, or any direction depending on the synoptic scale flow.

d. Radar Imagery. Radar imagery is commonly used to determine the type, intensity, and speed of precipitation (if any) that may be advecting towards the point of interest.

TRANSITION. These techniques provide an introduction to different methods for determining advection. It is recommended that several techniques or methods be used together to provide for the most accurate assessment. Further discussion on analyzing advection using the surface-500 mb chart will be discussed in QMMPH1-061.

OPPORTUNITY FOR QUESTIONS:

1. Questions from the Class. At this time, are there any questions concerning the content that has just been introduced?

2. Questions to the Class. There are no questions for the class at this time.

SUMMARY: Advection is an extremely important process in transferring elements and atmospheric properties on a global scale. There are various methods and techniques that may be used when determing what is advecting into the area of interest. This class provided a fundamental understanding of advection and the methods used to determine advection.

REFERENCE.

None.