UNITED STATES MARINE CORPS

LESSON PLAN

INERTIAL WIND

INTRODUCTION:

1. Gain Attention. What kind of motion does a ball have as it rolls down a hill? Why do we think it has this motion?

2. Overview. In the following class, the student shall be introduced to the fundamental concepts of an inertial wind.

3. Introduce Learning Objectives.

a. Terminal Learning Objective. Without the aid of, but in accordance with the period of instruction, the student(s) shall

b. Enabling Learning Objective(s). With the aid of the references, the student(s) shall complete the following:

(1) Explain the definition of inertial wind.

(2) Explain the atmospheric situations in which inertial oscillations are observed.

(3) Define the equation relating to inertial wind.

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 at the end of this period of instruction.

TRANSITION. We should now be familiar with the pressure/height gradient, coriolis, centrifugal and frictional forces. The next topic of discussion focuses on an inertial wind.

BODY:

1. Active Forces. An *Inertial wind* is a wind that is produced when the Coriolis (Cof) force is balanced by the Centrifugal force (Cef). In order for these two forces to balance each other, they must occur in a region where the pressure gradient force (pgf) in negligible or non-existent. Imagine the wind as it flows over the Rocky Mountain range and down into the wide-open plains of the Central United States. If there were no pressure gradient affecting the wind, the parcel of air would begin to rotate in a circle. This slow rotation is known as "inertial" motion. The Coriolis force is responsible for the initial rotation, which is then balanced by Centrifugal force. The rotation is anticyclonic in nature.

(a) The inertial period (the time needed to complete one circle) equals 2π /f, where f is the Coriolis parameter. At 30° latitude the period is exactly 1 day, and at 60° it is about 14 hours.

(b) It is an uncommon occurrence that the pressure gradient force is negligible within the atmosphere. An inertial wind or circulation is much more commonly seen in the fluid ocean.

(c) Inertial oscillations are usually observed is in the center of large anti-cyclones and cyclones.

(d) Another atmospheric situation in which inertial flow is usually observed in is in ocean currents where winds are driving the current instead of internal pressure gradients

TRANSITION. Now that you have a solid foundation concerning inertial oscillations you can know go into the equation that deals with the creation of an inertial wind.

2. Computing Inertial Wind Flow.

(a) The equation for inertial wind is $V = -fr_t$, where "V" is the wind speed, "f" is the force, and "r_t" is the radius of curvature.

(b) Inertial wind is a simplified equation derived from the balance of centrifugal force and coriolis force, which mathematically stated is $-v^2/r_T = fv$, where "$-v^2/r_T$" equals the Centrifugal force (Cef) and "-fv" equals the Coriolis Parameter. Figure 1 below graphically shows the balance between forces.

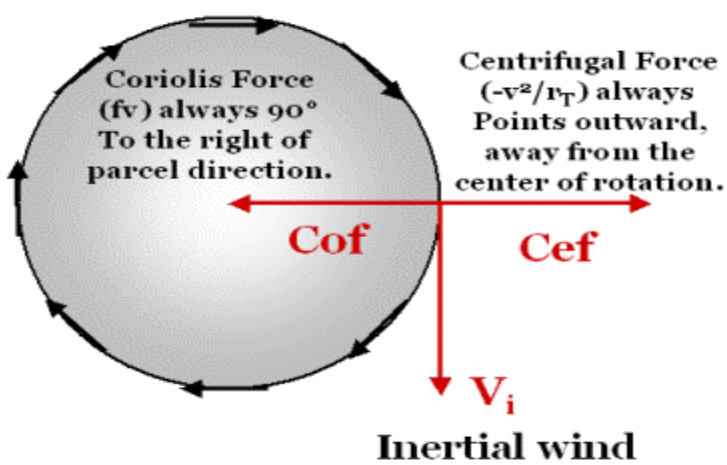

Figure 1 - Diagram of the balance of forces within inertial wind flow.

TRANSITION. While an inertial wind is a real wind, it is rarely seen. There are few excepts where the pressure or height gradient force does not occur.

OPPORTUNITY FOR QUESTIONS:

1. Questions from the Class. Are there any questions pertaining to the material that has just been presented to you?

2. Questions to the Class.

a. QUESTION. Name the two (2) forces that oppose each other to create an inertial wind?

b. ANSWER. Centrifugal force and Coriolis force.

SUMMARY: Inertial winds are very rare in our earth's atmosphere, but they are important to understand. During this period of instruction, the student(s) were introduced to the definition of an inertial wind, examples of when inertial winds exist, and the mathematical equation for inertial wind flow.

REFERENCES:

Glossary. Department of Atmospheric Sciences, University of Washington. Last accessed 03 August 2004. www.atmos.washington.edu/gfd_exp/exp_e/glossary/inertial.htm

The Inertial Wind Equation. Jim Koermer, Plymouth State University. Last accessed 3 August 2004. http://vortex.plymouth.edu/winds/webpage/inertial.html

Cyclostrophic, antitriptic, and inertial winds. Geerts, B. University of Wyoming, Department of Atmospheric Science. Created Jan. 1999, last accessed 8/23/04. http://www-das.uwyo.edu/~geerts/cwx/notes/chap13/antitriptic.html.