

Name _____

Date _____

Partners _____

Section _____

Convergence and Divergence

Purpose:

Develop the ability to contour two dimensional data and use the resulting information to locate a cold front.

Equipment:

Station Thermometer

Min./Max. Thermometer

Anemometer

Barometer

Psychrometer

Rain Gauge

Psychometric Tables

Barometric Correction Tables

I. Surface observation. (Optional)

Begin the first 1/2 hour of lab performing a surface observation. Make sure you include pressure (station, sea level, and altimeter setting), temperature, dew point temperature, wind (direction, speed, and characteristics), precipitation, and sky conditions (cloud cover, cloud height, & visibility). From your observation generate a METAR and a station model.

A. Generate a METAR for today's observation

B. Generate a station model for today's observation.

**II. Convergence and Divergence**

In this lab we will look at conditions that result in the weakening and intensification of surface pressure systems. From our discussion of thermal circulations we recognize that warm air results in a rising column of air. As the air rises, some of it spreads out, diverges, aloft thus reducing the surface pressure. At the surface, colder surrounding air moves in to replace the rising air. This inward motion at the surface low is called "convergence."

In a cold column of air we get sinking air and a surface high. The spreading out of the cold surface air we call "divergence." As the air sinks it results in an upper air low pressure system. Air in the vicinity of the upper air low experiences convergence.

Other processes in the atmosphere can enhance the convergence and divergence at the surface and aloft. These in turn can result in enhancing already existing low and high pressure systems. The goal of this lab is to look at three of these processes. They are 1) cold and warm air advection, 2) jet streaks and 3) vorticity.

A. 500 mb Map

Winds at the 500 mb level are sometimes called the steering winds. That name comes from the fact that winds at this level determine the general motion of surface high and low pressure systems. Several weeks ago we examined the geostrophic winds, which run parallel to the height contours. In general we expect the height contours to run parallel to the latitude lines. Colder air is to the north and, therefore, has lower heights. Warm air is to the south and is represented by greater height contours. Under this condition the geostrophic winds come directly from the west and we will call this “zonal flow.”

If cold air penetrates further south, the height contours at 500 mb become lower. When lower contours extend further south than usual, we call this a “trough.” In like manner, warm air penetrating further north increases the height contours at 500 mb and we call this a “ridge”

You have to be careful to distinguish between what is happening aloft and what is happening at the surface. The 500 mb level cuts the atmosphere roughly in half. If the 500 mb height contours extend further north (ridge), this results in a upper level high pressure. Sometimes the term “high pressure ridge” is used to describe this situation; however, this does not necessarily determine where the high pressure is located at the surface. The same goes for a “low pressure trough.”

Go to <http://weather.unisys.com> and click on the Upper Air Data link. Click on the current 500 mb map. Indicate below where you observe a ridge and a trough on the map. On the map you will see height contours drawn in solid gray and isotherms drawn in dashed yellow. If these lines cross each other, there is an indication of either warm or cold air advection. If the winds are traveling from colder air to warmer air, we have cold air advection. When this occurs upwind to a trough, the trough will deepen. Cold air advection also results in convergence of air aloft. This upper level convergence will cause the air to sink and will give generally clear skies. If the winds travel from warm to cold air, we have warm air advection and a ridge will strengthen. Warm air advection results in divergence aloft and rising air, which is cloudy and possibly results in precipitation.

Are there any ridges and troughs on the 500 mb map? If so, in what part of the country are they located?

Where are the regions of cold air advection?

Where are the regions of warm air advection?

Will the observed trough and ridge become stronger or will they weaken?

B. 300 mb Map

Go to the 300 mb level of the AVN model. Select the analysis map or initial map for the 300 mb level. The 300 mb map is useful for identifying the location of jets, regions of high wind speed. The wind speeds increase as the height contours get closer together. As the contours get closer, it indicates that the air parcels are being squeezed into a smaller area. If the increase of wind speed at the jet can not handle the increased volume of air parcels entering the jet, the air is forced downward. This is called “convergence” and will result in building an anticyclone (surface high). The convergence is strongest to the left entrance to the jet streak.

At the exit of the jet streak, the height contours spread out. There is not enough air provided by the jet to fill the increased volume represented by the spreading contours and, therefore, air is drawn up from below. This is called “divergence” and will result in intensifying a cyclone (surface low). The region of highest divergence is to the left of the exit to the jet streak.

Where are the jet streaks located?

Where on the map would you expect a surface high pressure system to build?

Where on the map would you expect a surface low pressure system to intensify?

C. Vorticity

Go to the 500 mb level of the AVN model. Select the analysis map or initial map for the 500 mb level. The color contours represent the vorticity of the air, which is an indication of the air parcels amount of spin. Each parcel of air in the Northern Hemisphere has a small amount of cyclonic spin due to the rotation of the earth. As the air travels across a ridge, it will gain anticyclonic vorticity. As it travels through a trough, it gains cyclonic vorticity. The vorticity indicated on the 500 mb map is the total vorticity of the air parcels.

The region to the east of a vorticity maximum results in rising air, which will diverge aloft. The divergence of air aloft will reduce the total amount of air in the column and result in a lower surface pressure. If a surface low pressure system is

located in this region, it will intensify. Likewise, west of a vorticity maximum the air is sinking resulting in upper air convergence and surface divergence.

Where are the regions of upper air convergence and divergence as indicated by the vorticity maxima?

Does the location of upper air convergence and divergence agree between the cold and warm air advection and the location of the jet streaks? How do they differ?