

LAB ASSIGNMENT #13

due Thursday, November 17

Learning Objectives –

Upon completion of this lab, you will be able to:

- Articulate the role of transverse ageostrophic circulations in supporting the development of upper-level fronts.
- Identify the atmospheric conditions supportive of upper-level frontogenesis.
- Understand how to numerically solve for the transverse ageostrophic circulation.

In this lab, we'll examine the transverse ageostrophic circulation associated with the particularly strong jet over the central North Pacific. For this lab, you'll want to use the following parameters in GEMPAK (I will put the .gem file on Learn@UW as a backup):

GDFILE = \$MODELDATA/16110512_avn003.gem

GDATTIM = f30

PROJ = ced

GAREA = 30;170;65;-120

1. (a) Create ONE plot with the following at 18Z 06 November 2016 (no multiple panels):
 - 300 mb geostrophic isotachs every 10 m s^{-1} beginning at 30 m s^{-1} (or every 20 knots, starting at 60 knots)
 - 300 mb geostrophic cold air advection every $-2 \times 10^{-4} \text{ K s}^{-1}$ beginning at $-2 \times 10^{-4} \text{ K s}^{-1}$
 - 300 mb geostrophic warm air advection every $2 \times 10^{-4} \text{ K s}^{-1}$ beginning at $2 \times 10^{-4} \text{ K s}^{-1}$
 - 300-700 mb thickness every 60 m

Use whatever fill/contour patterns you desire. Try to make your plot as high quality as possible.

(b) Using your plot, focus on the jet over the central North Pacific. What type of geostrophic temperature advection is occurring in the jet entrance region/jet core south of the Aleutian Islands? What type of vertical circulation would you expect in this location? Where would you expect ascent, descent, or no vertical motion through the jet in this case based on this forcing for the Sawyer-Eliassen Circulation Equation? (Hint: Use the diagram on the last page of your handout.)

(c) Take a cross section through jet, perpendicular to the thickness contours/jet axis, and through the local minimum in geostrophic temperature advection near the entrance region. Identify this cross section on your horizontal plot from 1a by tracing its location with a dark pen or taking a screen shot.

2. (a) Using GDCROSS, construct a plot of your cross section with the following variables:

- Potential temperature
- Geostrophic isotachs
- Upward vertical motion (negative omega) using a suitable CINT, solid lines.
- Downward vertical motion (positive omega) using a suitable CINT, dashed lines.

Tip: You will not be able to plot multiple variables at once in GDCROSS. Instead, plot one at a time and use clear=no until you've constructed your full plot.

(b) How is the vertical motion field distributed with respect to the jet? How does this vertical motion field agree with what you concluded in 1b?

3. (a) Use the bounds of this cross section as input to the Sawyer-Eliassen Equation Solver. Create a plot of the Sawyer-Eliassen streamfunction, upward and downward vertical motion, geostrophic winds normal to the cross section, and potential temperature due to the full QG forcing term (this might look a little crazy, but that is okay).

(b) What type of vertical circulation (thermally direct/indirect) is observed in this cross section (focus on the circulation in which psi has the largest absolute value)? How does this circulation agree with what you anticipated in 1b? Compare the ascent in this plot to that in 2b. What fraction of the descent near the jet core in 2b is explained by the Sawyer-Eliassen circulation?

EVALUATION OF THE SAWYER-ELIASSEN SOLVER

(Place an X in the box that best characterizes your answer)

	Definitely Disagree	Disagree	Agree	Definitely Agree
This lab has enhanced my understanding of transverse ageostrophic circulations.				
Visualizing these circulations has helped my understanding.				
I felt confident in my understanding of transverse ageostrophic circulations before this lab.				
I understand the process needed to solve the Sawyer-Eliassen Equation numerically.				
The Sawyer-Eliassen Solver scripts were easy to use.				

Please provide any additional comments you may have about this lab or the Sawyer-Eliassen Solver.