Name _____

Date _____

ERTH 465
Fall 2017

Lab 7

Southern Hemisphere General Circulation
200 pts

1. All labs are to be kept in a three hole binder. Turn in the binder when you have finished the Lab.

2. Show all work in mathematical problems. No credit given if only answer is provided.

Charts

In this Lab Exercise, you will be obtaining climatological plots from the NOAA composites page. You will be examining aspects of the General Circulation in the Southern Hemisphere's winter.

Here's the web address for the composite page:

https://www.esrl.noaa.gov/psd/cgi-bin/data/composites/printpage.pl

You should complete your work in MS Word, and save the whole lab as a .pdf that you will email to me. This will allow the color graphics to appear in their full glory!!

Charts to Obtain:

For the Southern Hemisphere Winter (Choose Beginning Month May; Ending Month, July) all Other Settings Leave on Default (except as noted below). Please note that the Southern Hemisphere projection extends from 15^{o}S to the Pole. (15 pts each for a total of 75 pts)

- Potential Temperature; Level 1000 mb, Range of years, 1981-2017; Color with Shaded w/Overlying Contours; Map Projection Southern Hemisphere
- 1000-500 mb Thickness; Level Thickness; Range of years, 1981-2017; Color with Shaded w/Overlying Contours; Map Projection Southern Hemisphere
- Geopotential Heights; Level 500 mb, Range of years, 1981-2017; Color with Shaded w/Overlying Contours; Map Projection Southern Hemisphere
- Zonal Wind; Level 500 mb; Range of years, 1981-2017; Color with Shaded w/Overlying Contours; Map Projection Southern Hemisphere
- SeaLevel Pressure, Range of years, 1981-2017; Black and White; Black and White with Conturs;

In these plots only the Prime Meridian, the International Dateline, 90^{o}W and 90^{o}E are provided. As a reminder, the Thermal Wind Relation is:

$$V_t = -R/f \ln\left(\frac{p_1}{p_2}\right)\left(\frac{\partial \bar{T}}{\partial n}\right) \qquad (1)$$

Questions

1. Explain how and why the Potential Temperature analysis consistent with the 1000-500 mb thickness analysis using the concept embodied in the hypsometric equation. (10 pts)

2. At 45^{o} S, at each of the longitude lines given on the 1000-500 mb thickness chart, plot Thermal Wind vectors (make the vectors about ½ inch long; the issue here is the direction, not the magnitude). [Hint: you will have to figure out for yourself where 45^{o} S is. No trick here.] (10 pts)

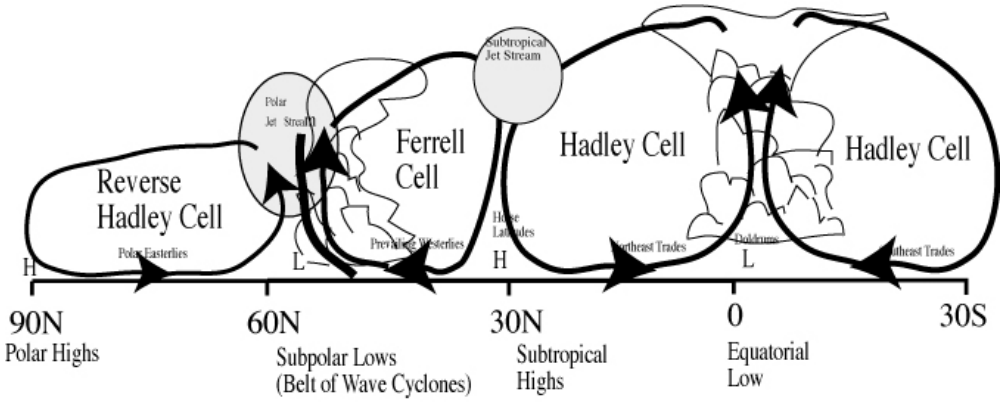
3. Explain how and why the 500 mb zonal wind field is consistent with what you'd expect given the Thermal Wind Equation. (10 pts)

4. Explain how and why the 500 mb chart is consistent with what you'd expect given the Potential Temperature and 1000-500 mb Thickness fields. (10 pts)

5. Label the sealevel pressure chart with highs and lows. (10 pts)

6. The three-cell model of the General Circulation is provided below:

Three Cell Model of the General Circulation at Equinox



(Please note that the default projection for the Southern Hemisphere in the composites page only extends from the Pole to around 15S latitude.)

Explain how your charts are consistent with the features in the three cell model at the International Dateline (180^o Longitude—again, not labeled on the charts, but you will be able to figure it out). (10 pts)

7. If the Pole-Equator temperature gradient decreases, as expected, during the 21^{st} Century, explain how you'd expect the average winter 500 mb chart to be altered generally. (20 pts)

8. If the Pole to Equator temperature gradient is decreased by an average of 3^o K, calculate what the change in the 500 mb zonal winds would because of this change. [Hint: See Inclass Exercise 6; a degree of latitude is ~111 km; Estimate ΔT from the map of mean potential temperatures] (45 pts)