San Francisco State University   Name _____
Department of Earth & Climate Sciences

Inclass Exercise 11: Practical Applications of the Hypsometric Equation

Due Friday 27 April 2018

(100 points)

This exercise has you working with two graphics: (a) a schematic cross-section of the troposphere on the day of the Winter Solstice with the tropopause (300 mb level) and the 500 mb levels shown; and (b) the 500 mb chart for the United States for 12 UTC March 27 2012 ; and (c) the side-by-side comparison of the soundings (on a diagram similar to the Stuve Diagrams we've been seeing so far, called a Skew-T Log P diagram, as explained in class) at Dodge City, KS, Denver, CO, and Glasgow, MT.

Please note that Questions 3 and 4 require an essay type discussion response. Please answer in complete sentences organized into a few coherent paragraphs. Answer Questions 3 and 4 on the back or on separate sheets.

1.   On map (a), draw in on the cross section the height contours for the other (900, 800, 700, 600, 400 mb) levels in the troposphere. We'll assume that the 1000 mb level is at the ground. (25 points)

2.   On map (b), complete the following table along the cross section A-B. (20 points)

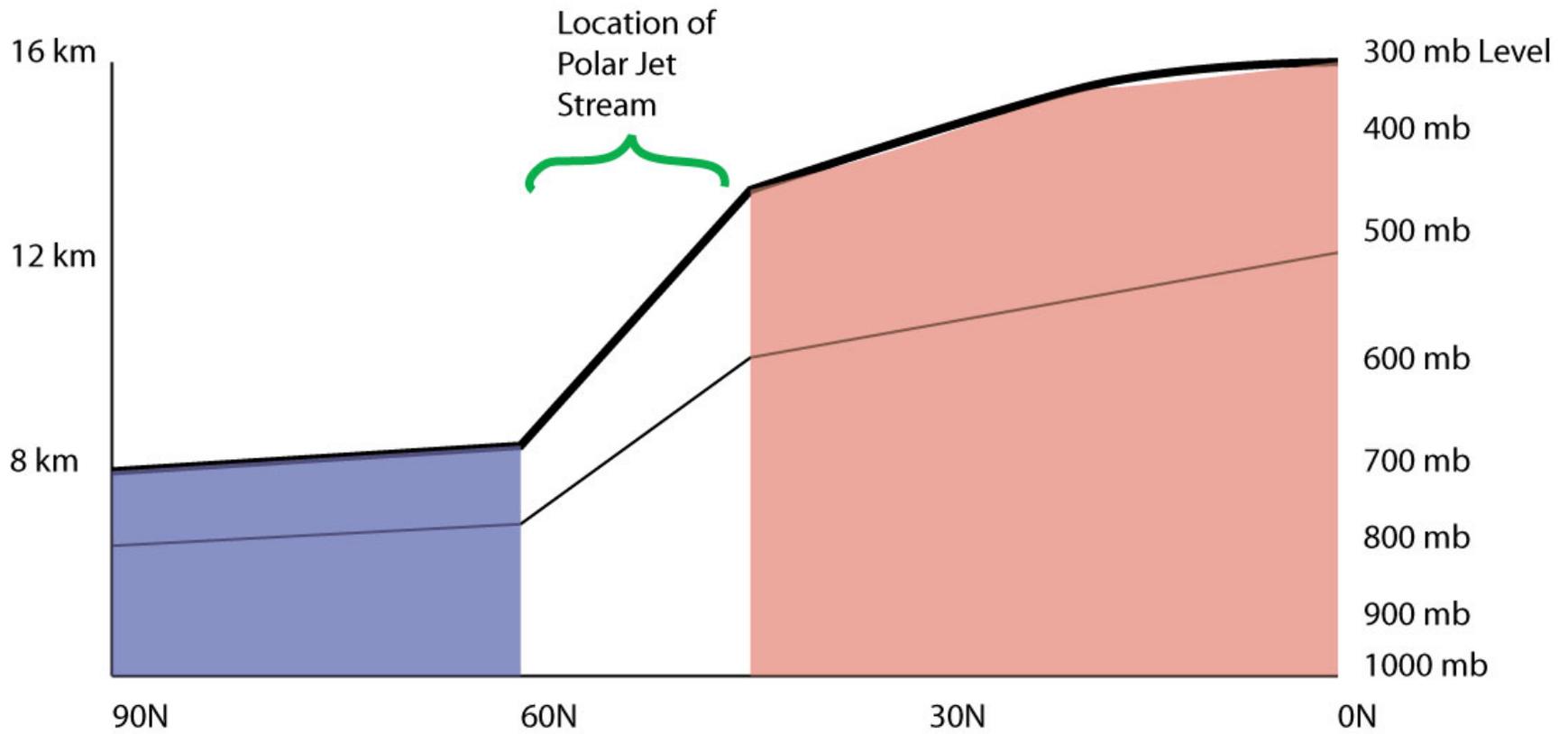| Locations on the Cross section	500 mb Height (in Meters)	500 mb Temperature (in Centigrade)
1		
2		
3		
4		
5		

3.   The hypsometric equation given below says, qualitatively. that the thickness, given by Δz, of an atmospheric layer bounded by two pressure surfaces (say 1000 mb at the bottom and any other level like

the 500 mb level at the top) is directly proportional to the mean (virtual) temperature of the layer. To put it in different words, the warmer an air column between the 1000 mb level and, say, 500 mb, the taller it is and vice versa. Discuss how your results in (1) and (2) above are consistent with this. (35 points)

$$\Delta z = (z_2 - z_1) = \frac{R_d}{g} \cdot \overline{T_v} \cdot \ln\left(\frac{p_1}{p_2}\right)$$

4.   Examine the side by side comparison of the soundings given in (c) above, paying special attention to the environmental lapse rates beneath from the surface through 500 mb. Discuss how this side-by-side comparsion is consistent with the 500 mb height data you found in (2). (35 points)

5.   The "polar front" is the deep (through the whole troposphere) boundary between the polar air masses and the subtropical air masses (in the figure, the blue and the red colors, respectively). On surface weather maps, the convention is to draw a line (with symbols, as explained in class) on the warm air side of the boundary. Place a blue "X" where you would expect the polar front to be at the surface for this schematic pattern. (5 points)

Mean cross-section of atmosphere in Northern Hemisphere at the time of th Winter Solstice

12Z 27 Mar 2012 500 hPa

A

B

1 2 3 4 5

CURRENT.RAWINS // 72451 - KDDC - DODGE CITY, KS US   at 12Z 27 Mar 2012
CURRENT.RAWINS // 72469 - KDNR - DENVER, CO US   at 12Z 27 Mar 2012
CURRENT.RAWINS // 72768 - KGGW - GLASGOW, MT US   at 12Z 27 Mar 2012