Total points: 100
ATOC 1060-001 Homework #3
Due Tuesday Oct 26, 2010

INSTRUCTIONS: Make sure that you answer all of the questions for maximum credit. Use appropriate units on all numerical answers and answer non-numerical questions with complete sentences. Please write neatly when completing this assignment – if we can't read your answer you will not get credit for it.

1. 1a) Draw a graph showing the variation of incoming solar energy and outgoing infrared radiation with latitude (3pts), and indicate the regions of energy surplus and energy deficit. (3pts)

   1b) Explain why the latitudinal distribution of energy surplus and energy deficit is important for atmospheric circulation. (4pts)

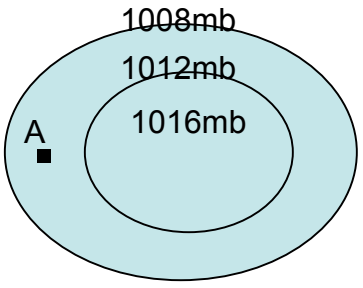
2. 2a) Use a schematic diagram to illustrate the Hadley Cells. On the diagram, label each part of the Hadley Cells – convergence, divergence, uplift, subsidence; also label the latitudes at which each process happens, and the sea level pressure (high or low) associated with the uplifts and subsidences. (6pts)

   2b) Why do the Hadley circulations change seasonally? (3pts)

   2c) How are the tropical northeasterly trades and southeasterly trades formed? (3pts)

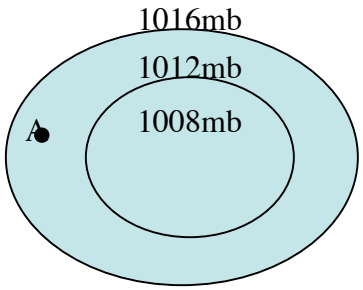
3. 3a) Assume Figure 1a shows the surface pressure distribution in middle latitude, which includes the state of Colorado. Point A represents Boulder, Colorado. Assume the atmosphere is frictionless. At point A, draw the pressure gradient force (PGF) (3pts), Coriolis Force (CF) (3pts), and geostrophic wind (Vg) (4pts).

Figure 1a. Surface pressure distribution.



3b) Figure 1b shows the pressure distribution and Point A represents Hobart, Australia. At point A, draw the PGF (3pts), CF (3 pts), and Vg (4pts).

Figure 1b. Surface pressure distribution.



4. Discuss the land-ocean contrasts in (i) absorbing/reflecting solar radiation, (3pts) (ii) upward/downward heat transfer, (4pts) and (iii) heat capacity. (3pts) These contrasts play important roles in causing land-sea breeze and monsoon.

5. 5a) Sketch the Asian summer and winter monsoons (4pts).

5b) Explain the processes that drive the Asian summer monsoon and winter monsoon. (summer monsoon 3pts; winter monsoon 3pts)

6. What is latent heat of vaporization? (2pts) Write down its quantitative value at 100°C (2pt) Explain why latent heat is important for the redistribution of energy between atmosphere and ocean (or between atmosphere and land). (4pts)

7. Explain the causes of relatively high rainfall in ITCZ (3pts) and Polar Front Zone (PFZ) (3pts), and low rainfall in the subtropical high regions. (4pts)

8.In the subtropics, oceanic circulations are dominated by the Subtropical Gyres (STG). Describe the formation mechanism of the STG. (5pts)

9. Figure 2 shows the surface wind direction in the mid-latitude North Pacific. In figure 2 draw the direction of Ekman transport. (5pts)

Figure 2

10. Figure 3 shows the observed surface winds and sea surface temperature (SST) in the eastern tropical Pacific Ocean. Explain how the equatorial cold tongue and cold SST near the eastern boundary of the south Pacific are formed. [You may use schematic diagrams to support your discussion; but the schematics are not required.] (10pts)

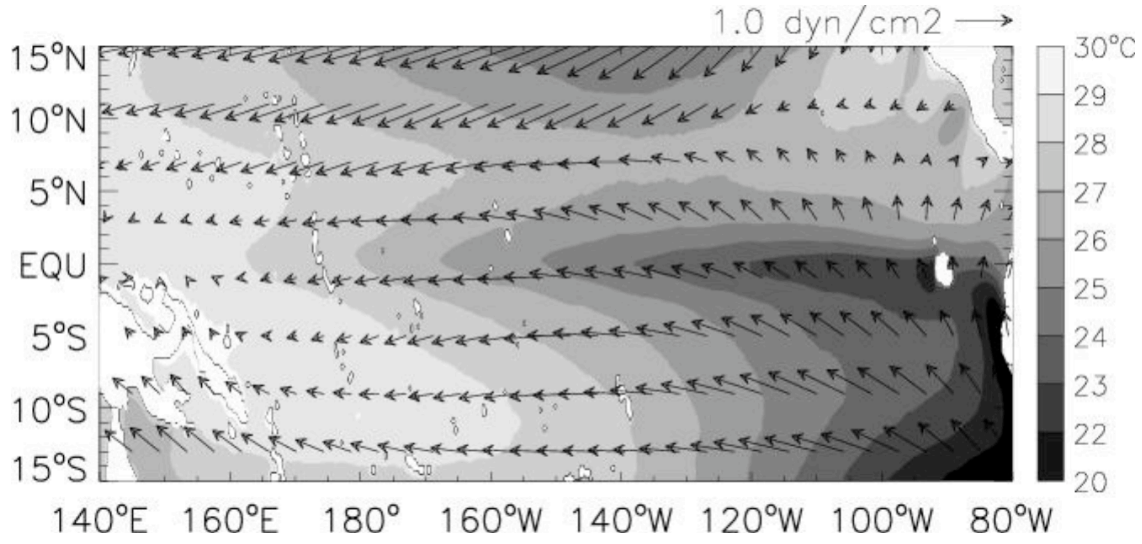


Figure 3. Observed SST (gray shade) and surface wind stress (arrows) in the eastern tropical Pacific Ocean. The water is cold in the eastern equatorial basin and along the east coast of the south Pacific.