

HOMEWORK

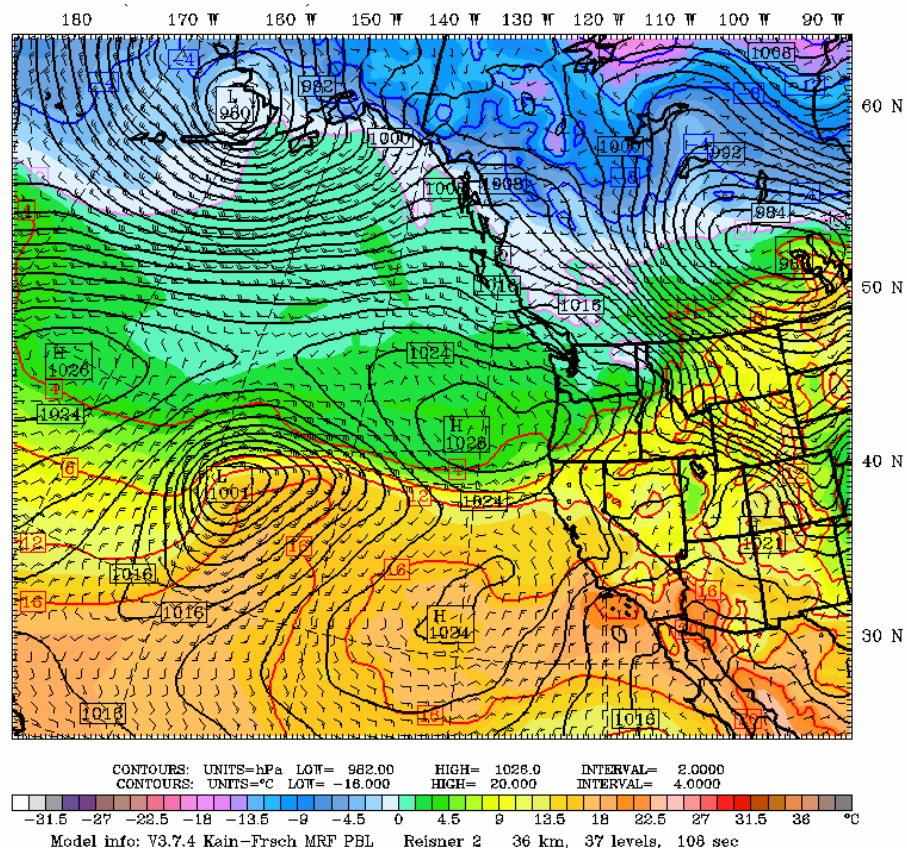
Dynamics 1

Read Chapter 7 of W&H, especially 7.2 up to 7.2.7, also section 7.3

1. Take a look at the analysis below, which shows contours of sea-level pressure, the temperature at 925 hPa (colors), and wind vectors at 10 m. Estimate the pressure gradient force vector (per unit mass of air) at the following locations:

- (a) $30^{\circ}\text{N}, 130^{\circ}\text{W}$
- (b) $40^{\circ}\text{N}, 145^{\circ}\text{W}$

Given the wind speeds at these locations on the map, estimate the horizontal components of the Coriolis force at these points. For each location, draw a vector diagram showing the pressure gradient and the Coriolis forces. What can you infer from these vector diagrams? [3]



2. Explain why surface winds are closer to being in geostrophic balance over the oceans than over the land. Draw a force-balance vector diagram for a geostrophic balance but with friction and use this to explain why the wind converges into the center of surface low pressure systems. Use the continuity principle to explain the effect of this convergence upon the vertical motion within low pressure systems. How does this impact the clouds and precipitation? [2]

3. The gradient wind is the wind vector resulting from a force balance between which three forces? From the analysis in Question 1, estimate the magnitude and direction of the centrifugal force (per unit mass) at the two locations. Include this on a new vector diagram which includes the centrifugal force. Is this force important at these locations? [3]

4. Explain what a barotropic fluid is.

Use the thermal wind equation(s) and the hypsometric equation, to draw geostrophic wind vectors at the surface and aloft for a barotropic fluid in which the temperature is constant with height and decreases to the north. Assume that the geostrophic wind vector at the surface is aligned from south to north.

Do the same, but now assume that the geostrophic wind vector at the surface is from north to south. What does this tell you about the typical winds aloft in the midlatitudes? [2]