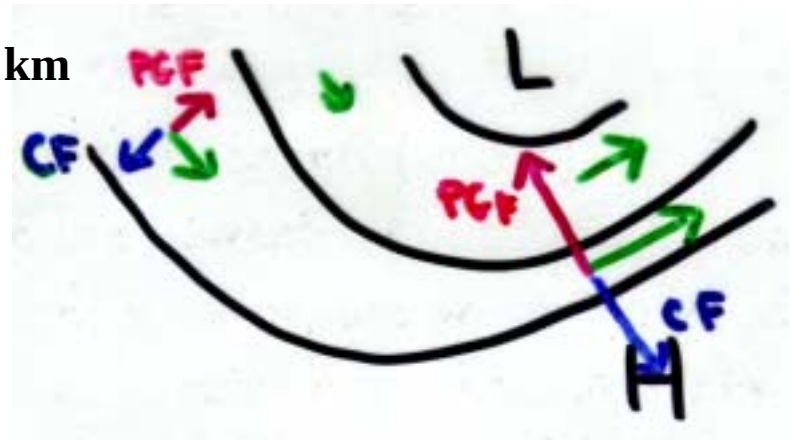
Lecture 12. Global Wind Systems

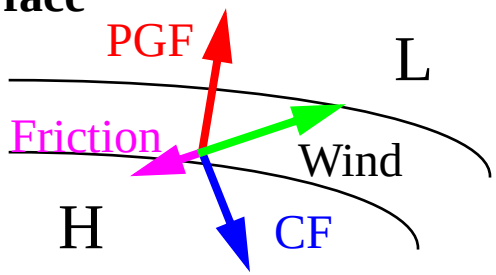
Review of Coriolis Force

- We see a Coriolis 'force' because wind is measured with respect to the rotating Earth -- an accelerating reference frame.
- Coriolis 'force' pushes moving objects to their right (in NH) or left (in SH).
- Above the lowest 1 km of the atmosphere, away from the Equator, the wind blows *along* isobars with high pressure on the right (NH), approximately balancing PGF and Coriolis forces.
- In the lowest 1 km or so, surface friction causes wind to spiral toward low pressure.

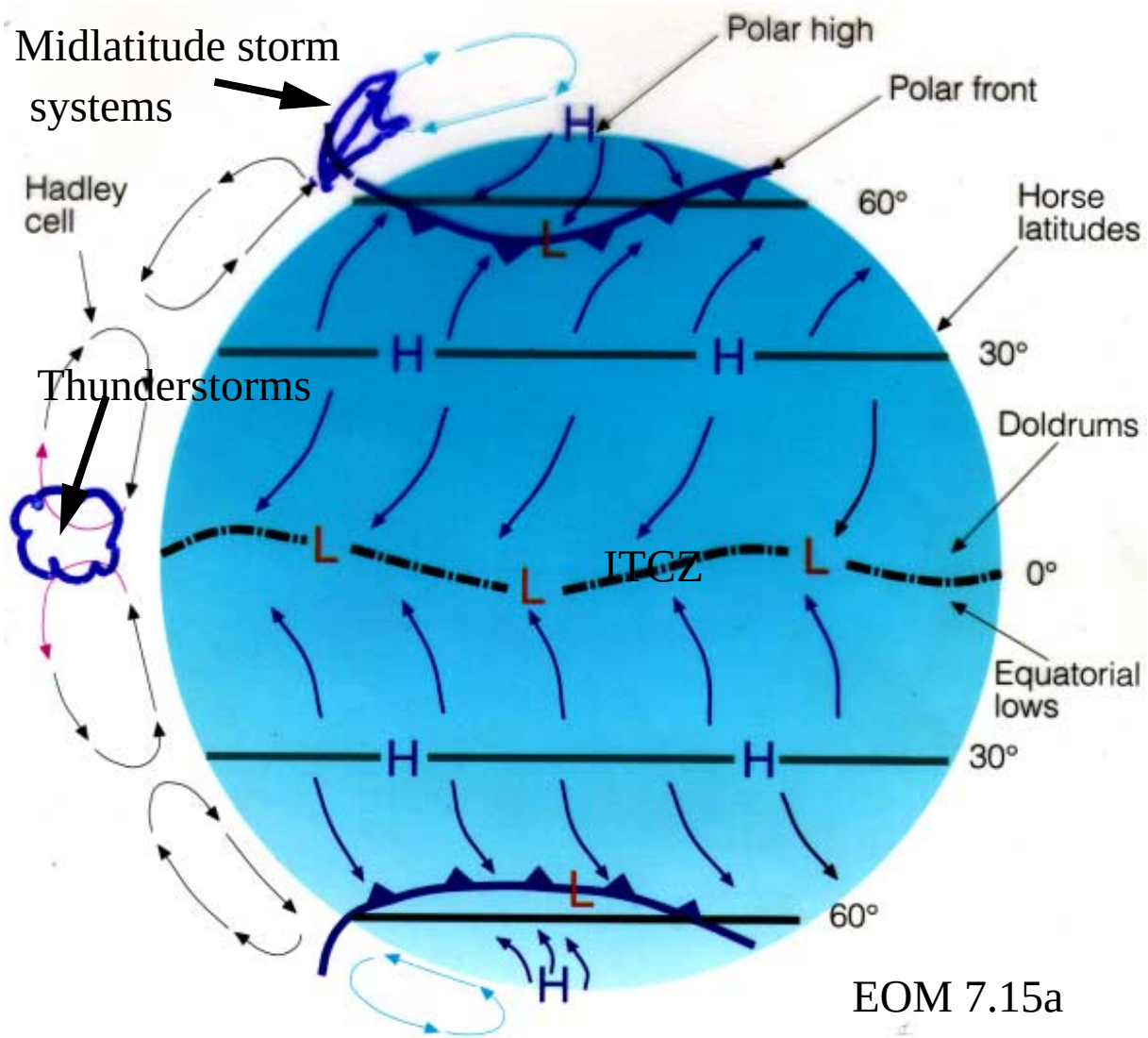
Above 1 km



Near surface



Idealized General Circulation of Atmosphere



EOM 7.15a

Mean Sea Level Pressure - January

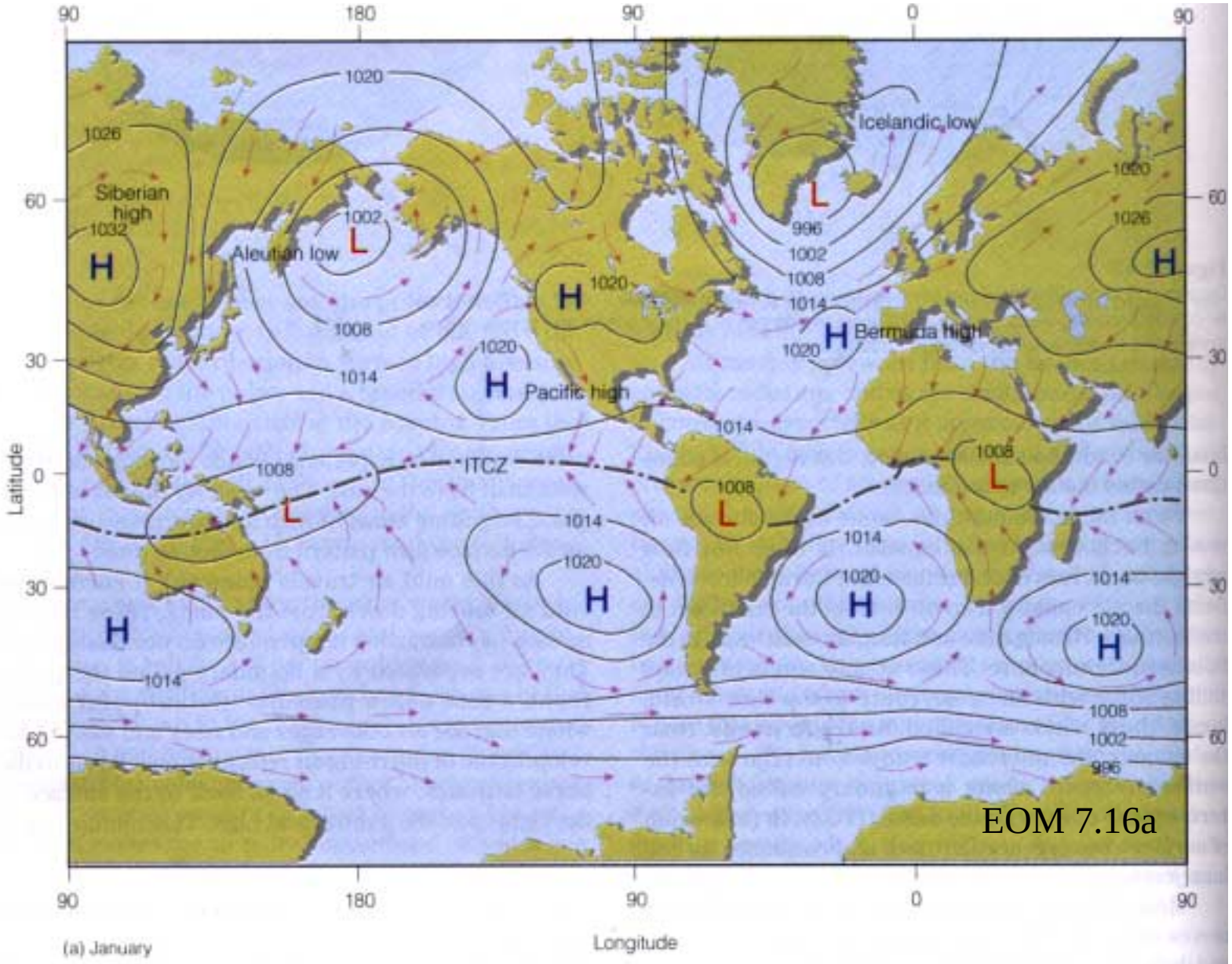
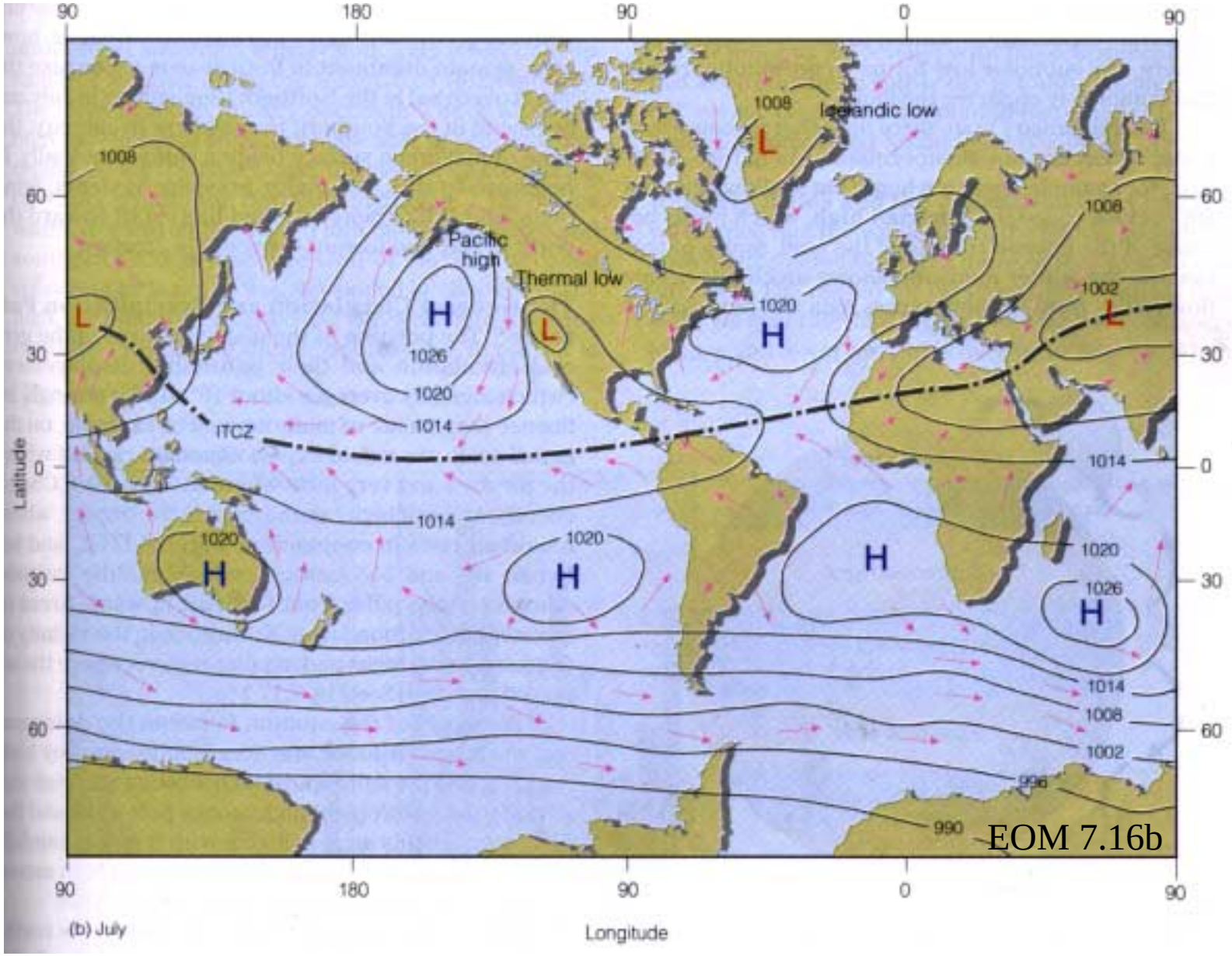


Figure 7.16
Average sea level pressure distribution and surface wind-flow patterns for January (a) and for July (b). The heavy dashed line represents the position of the ITCZ (Inter-Tropical Convergence Zone)

Mean Sea Level Pressure - July



Height of 500 mb surface - January

- 1 km higher at equator than poles.
- Much larger pressure differences than at surface drive jet stream (mean winds to 60 kts).

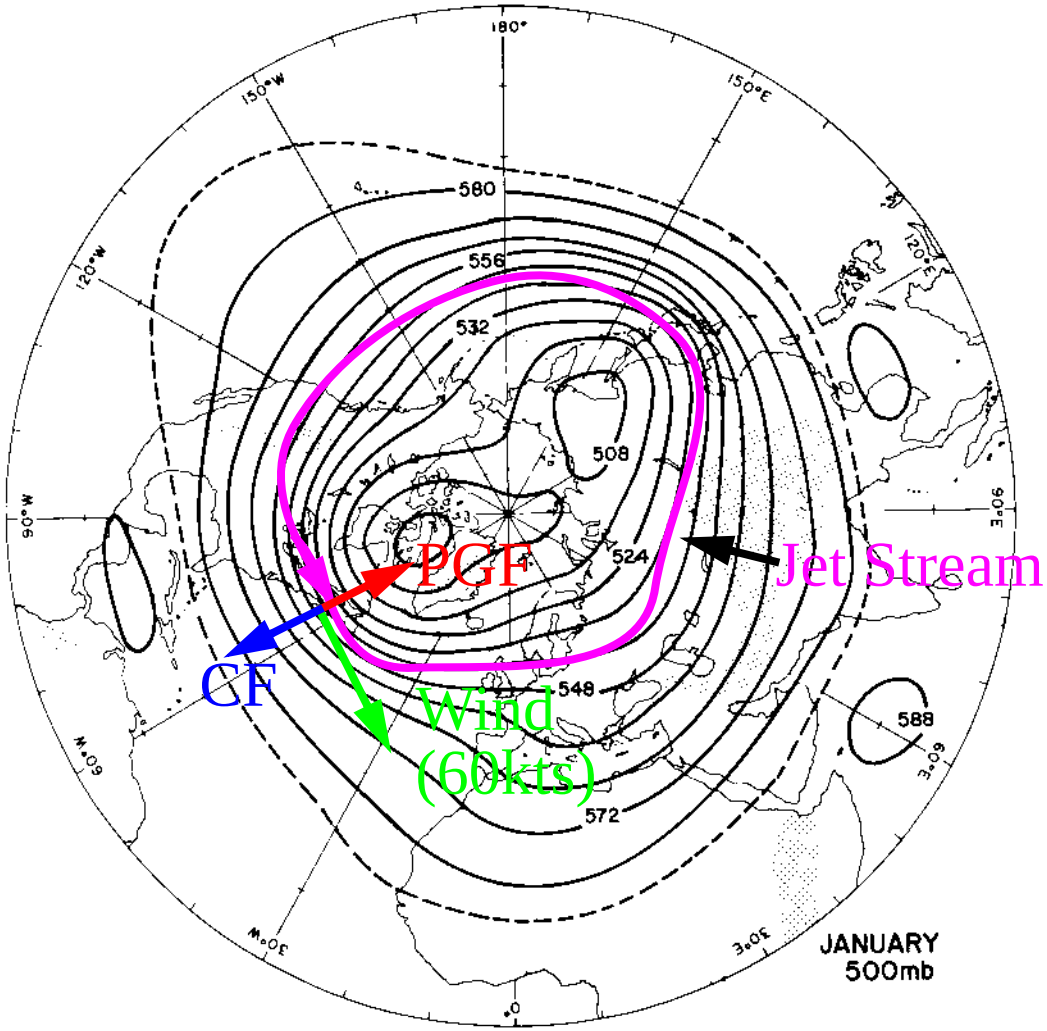
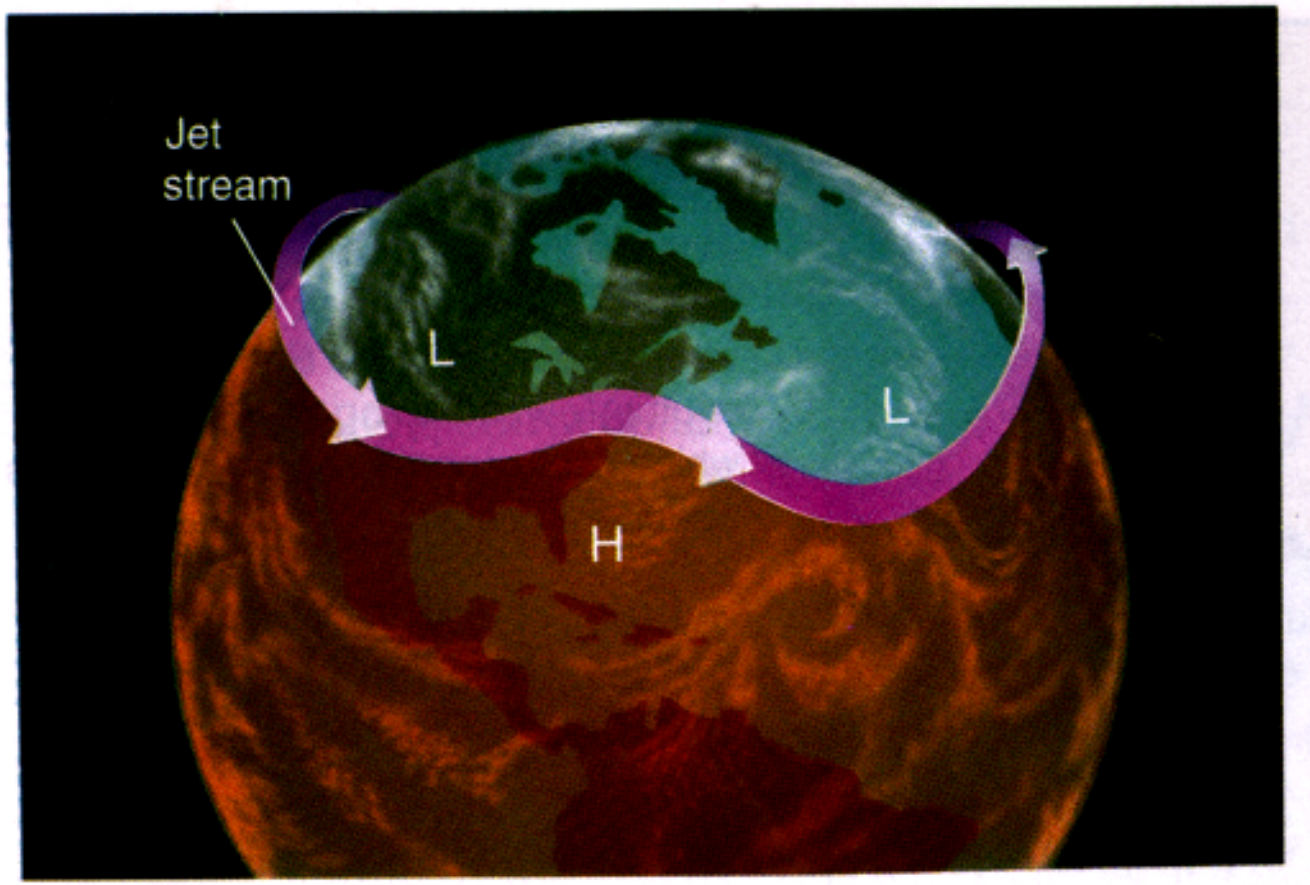


Fig. 1.14 The distribution of mean geopotential height (almost identical to geometric height above sea level) on the 500-mb surface for January. Contours are labeled in tens of meters. [Based on data in *Meteorol. Abhandl.*, **4**(2), Part II, 32 (1958) as adapted by E. Palmén and C. W. Newton, "Atmospheric Circulation Systems," Academic Press, New York, 1969, p. 68.]

(Wallace and Hobbs, 1977, *Atmospheric Science*, fig. 1.14)

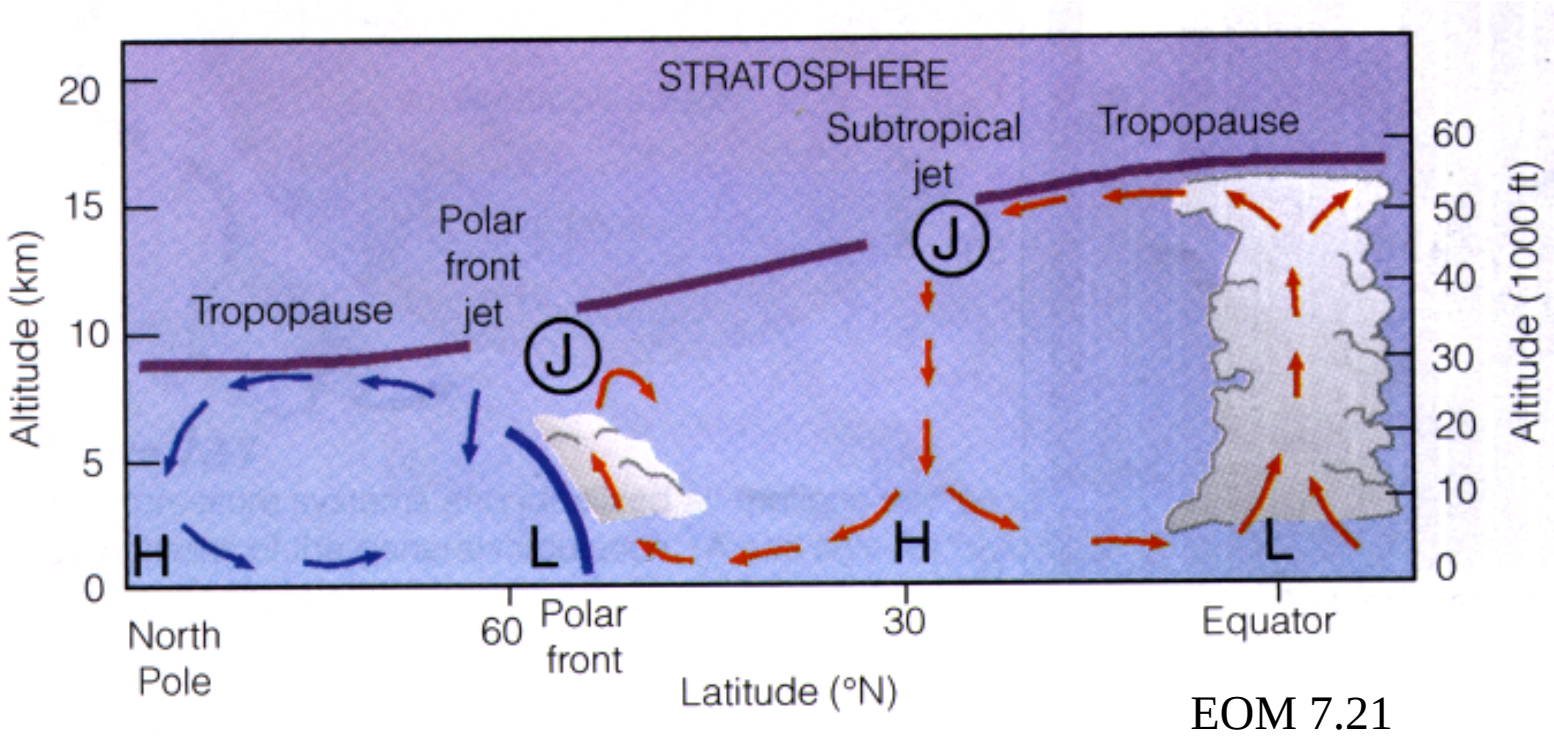
Jet Streams



EOM **Figure 7.20**

A jet stream is a swiftly flowing current of air that moves in a wavy west-to-east direction. It forms along a boundary where colder air lies to the north and warmer air to the south.

Typical height of jet streams and tropopause



EOM 7.21

- Note tropopause is higher near equator than near poles
- Jet stream winds are strongest near the tropopause
- Sometimes the jet stream separates into two wind maxima, a *polar* and a *subtropical* jet, but at most longitudes and times, a single jet is seen.

Formation of Jet Streams

- Temperature is colder (air denser) toward the poles in tro-posphere (below tropopause, typically about 300 mb).
- Pressure drops faster with height in cold air

⇒ Hor. pressure gradient grows up to 300 mb

⇒ Jet stream maximum winds are at 300 mb.