Wind Systems

Ch. 8: Global Scale Winds

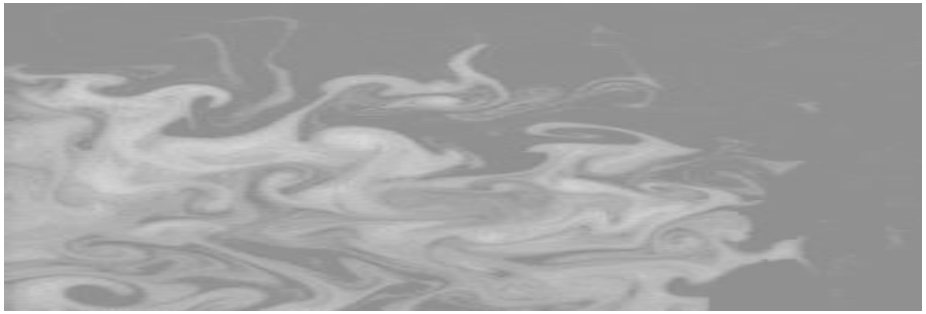
- Size Scales of Weather and Winds
- Circulation Cells—The General Circulation
- Surface Wind Patterns
- Semi-permanent Highs, Lows
- Upper-air Westerlies
- Jet Streams, Rossby Waves

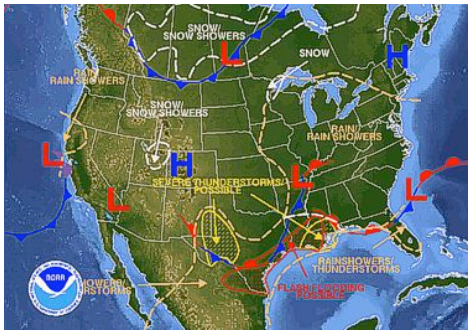
Ch. 8: Wind Systems

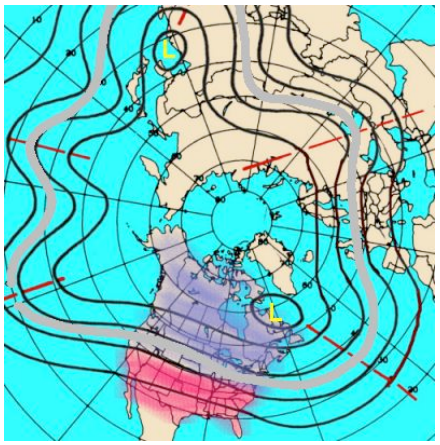
- Monsoon Circulations
- Chinook and Santa Ana Winds
- Sea and Land Breezes
- Mountain and Valley Breezes
- El Niño/La Niña

Size Scales

- **Microscale**
  - → **Less than about 1 km**
- **Mesoscale**
  - → **Up to about 100 km**
- **Synoptic-scale**
  - → **Up to about 10,000 km**
- **Global-scale**
  - → **Planetary-size**

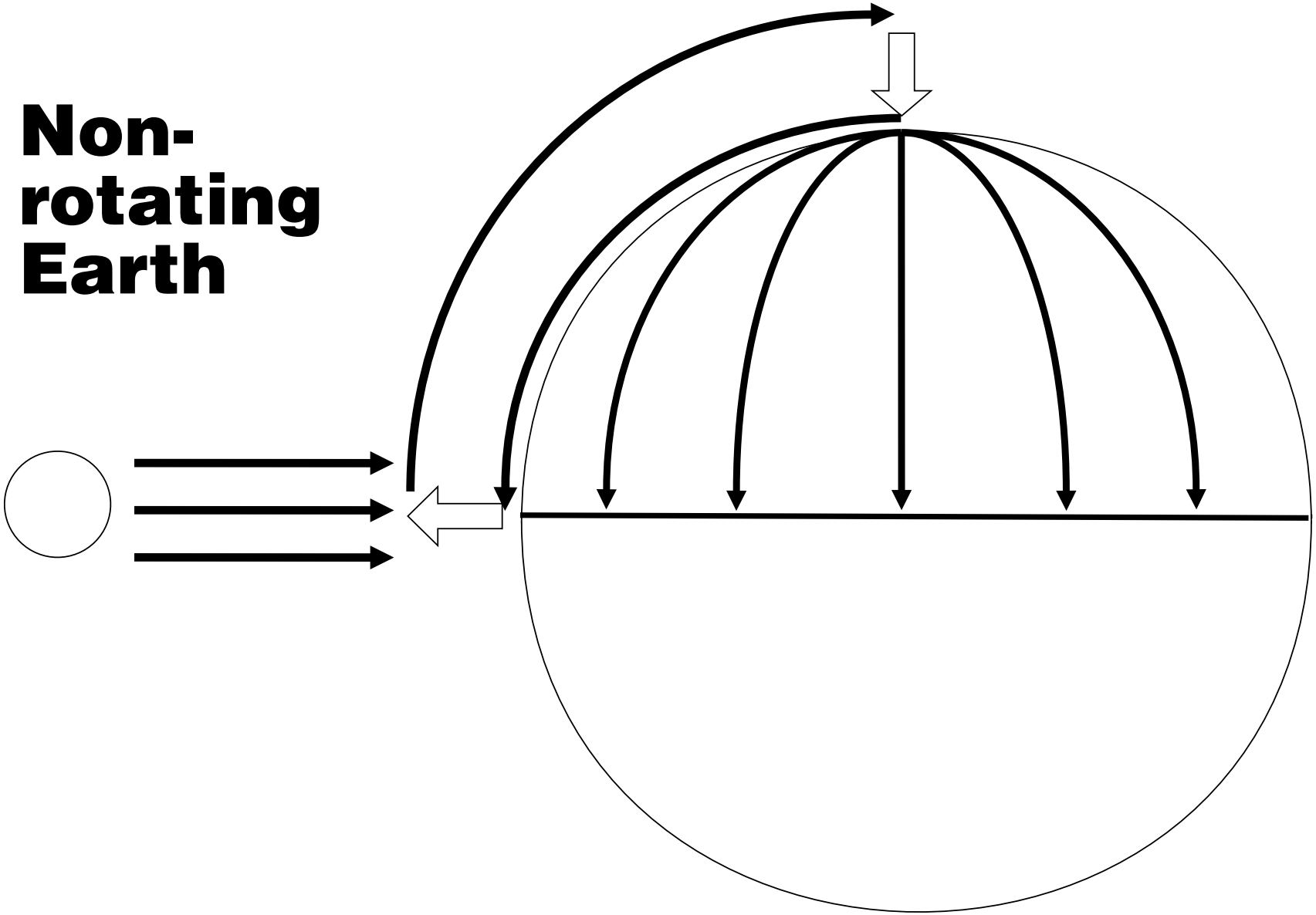




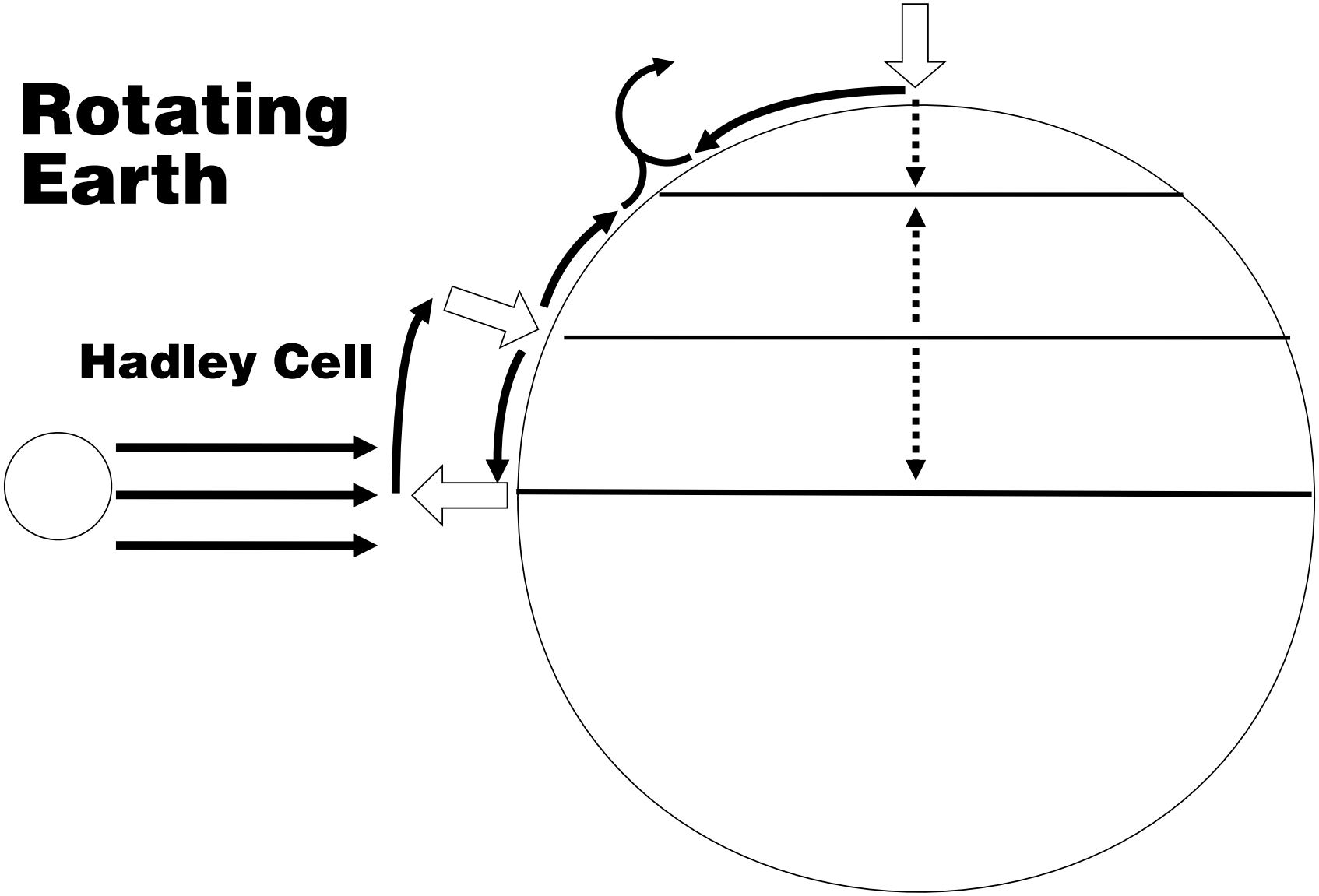


The General Circulation

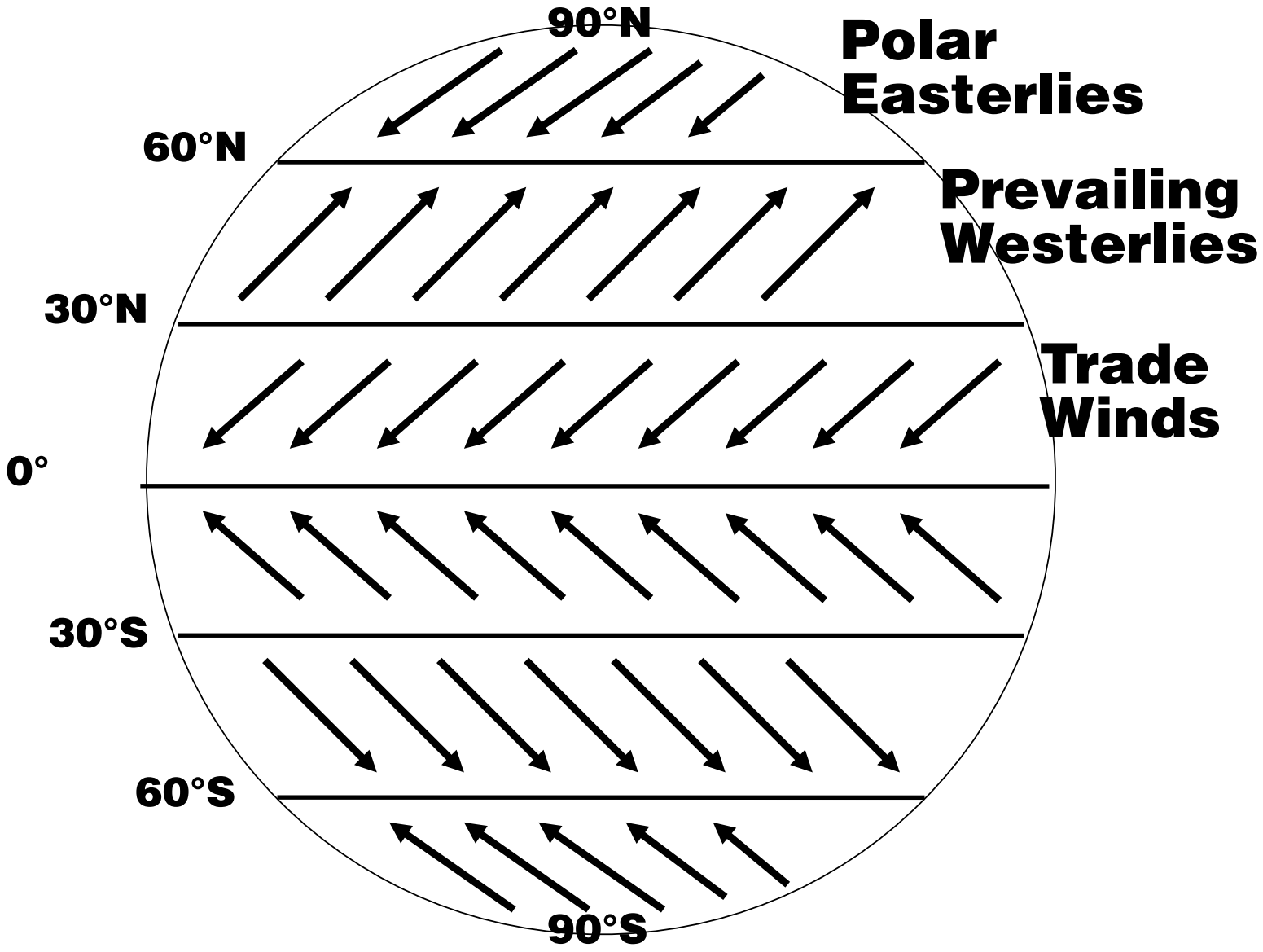
Non-rotating Earth



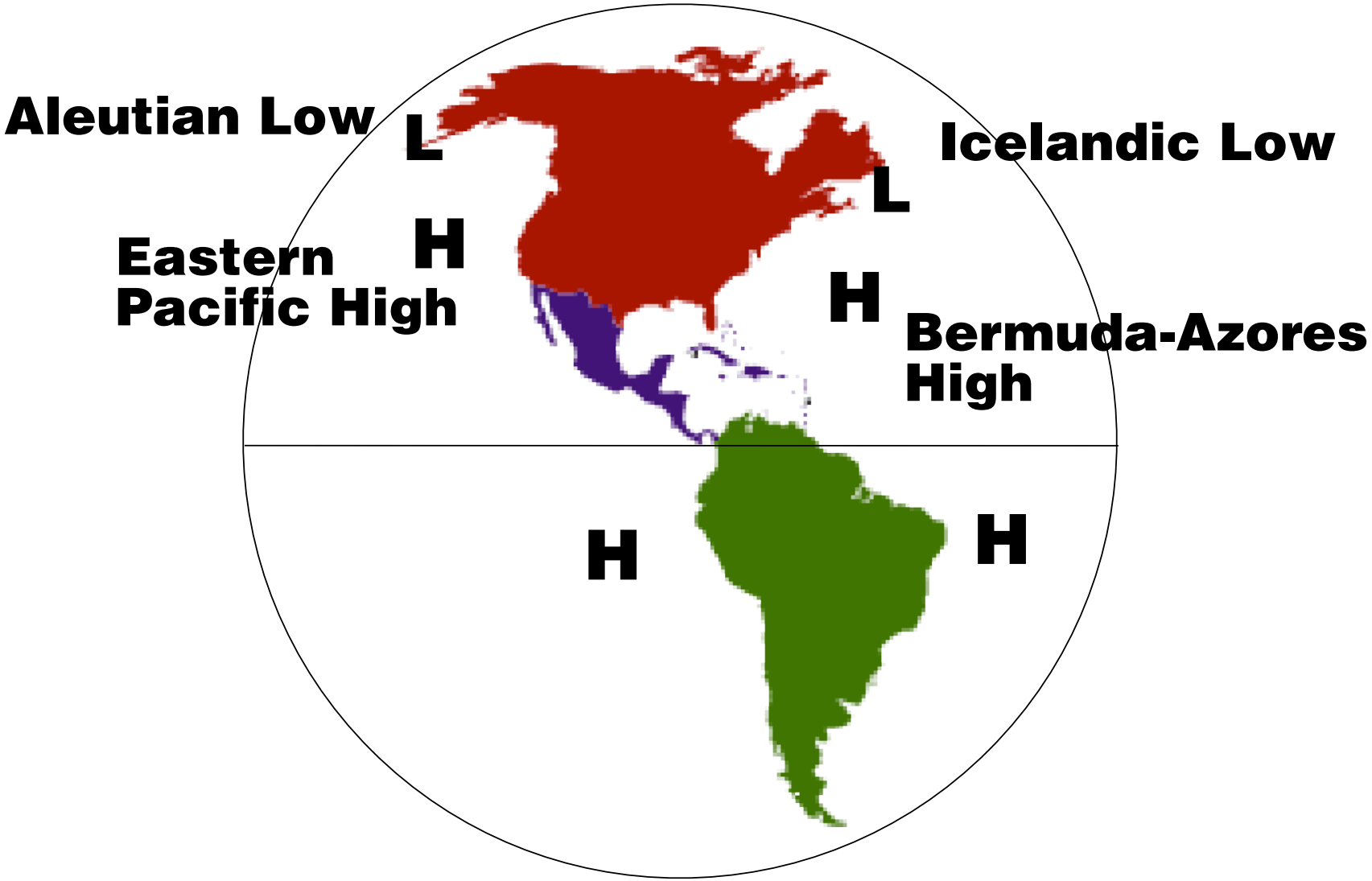
The General Circulation

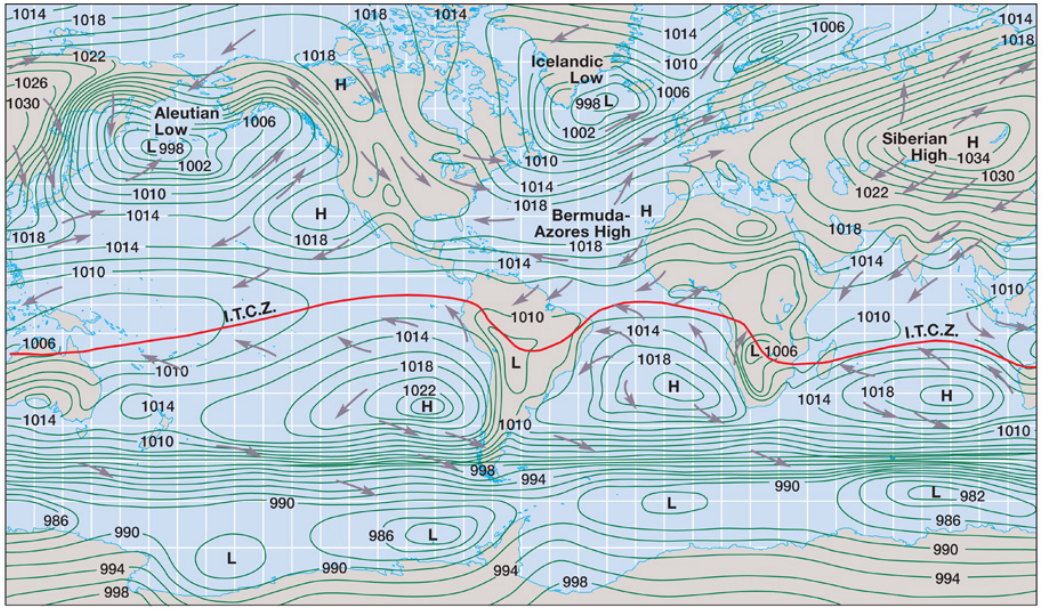


GC Surface Winds

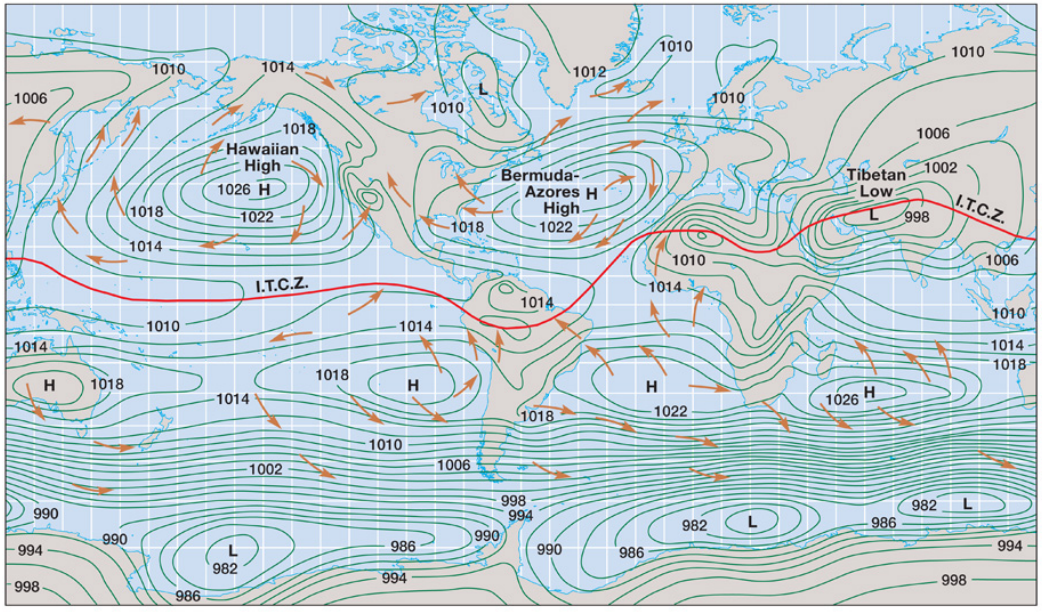


Surface Pressure Distribution



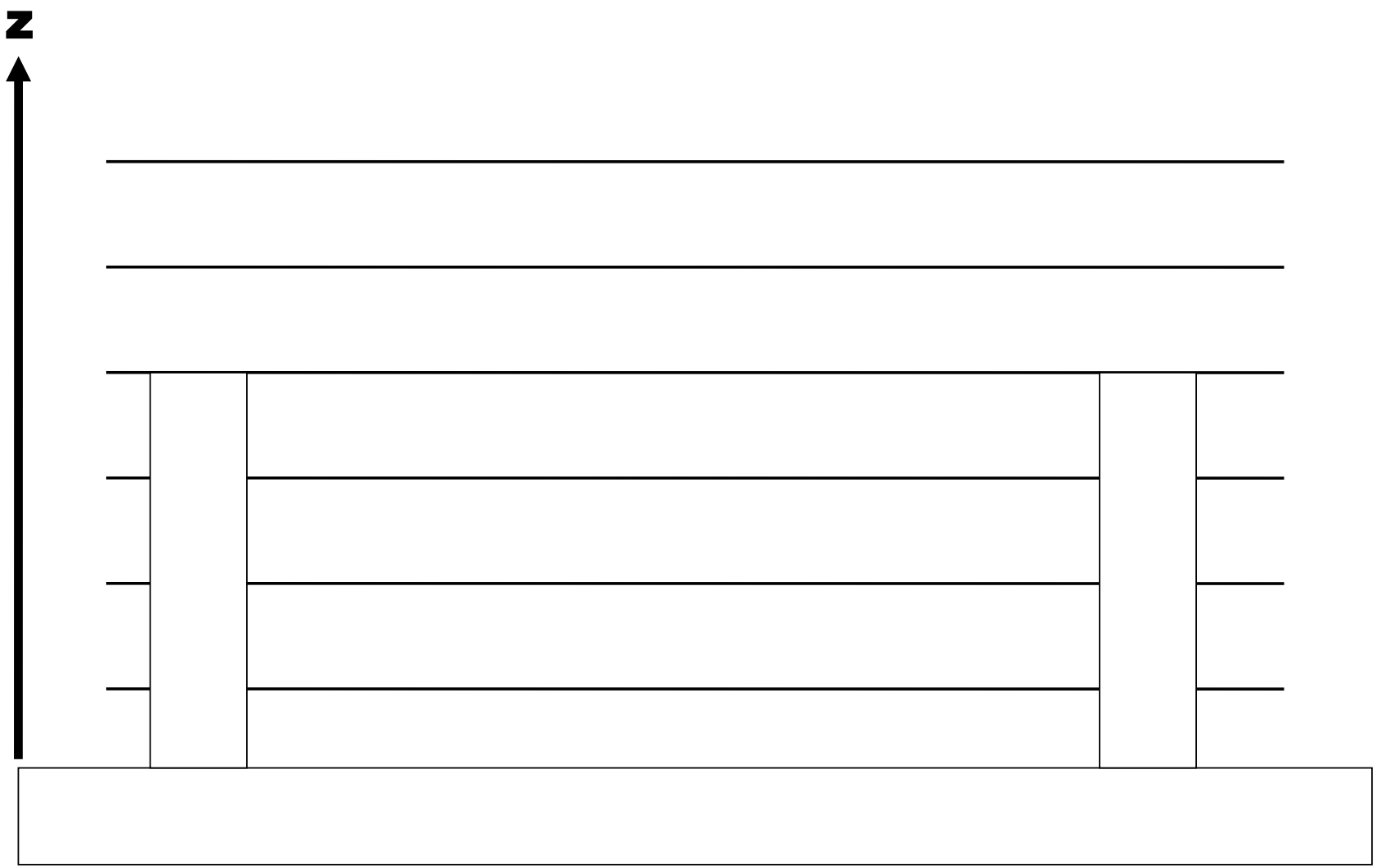


(a) January

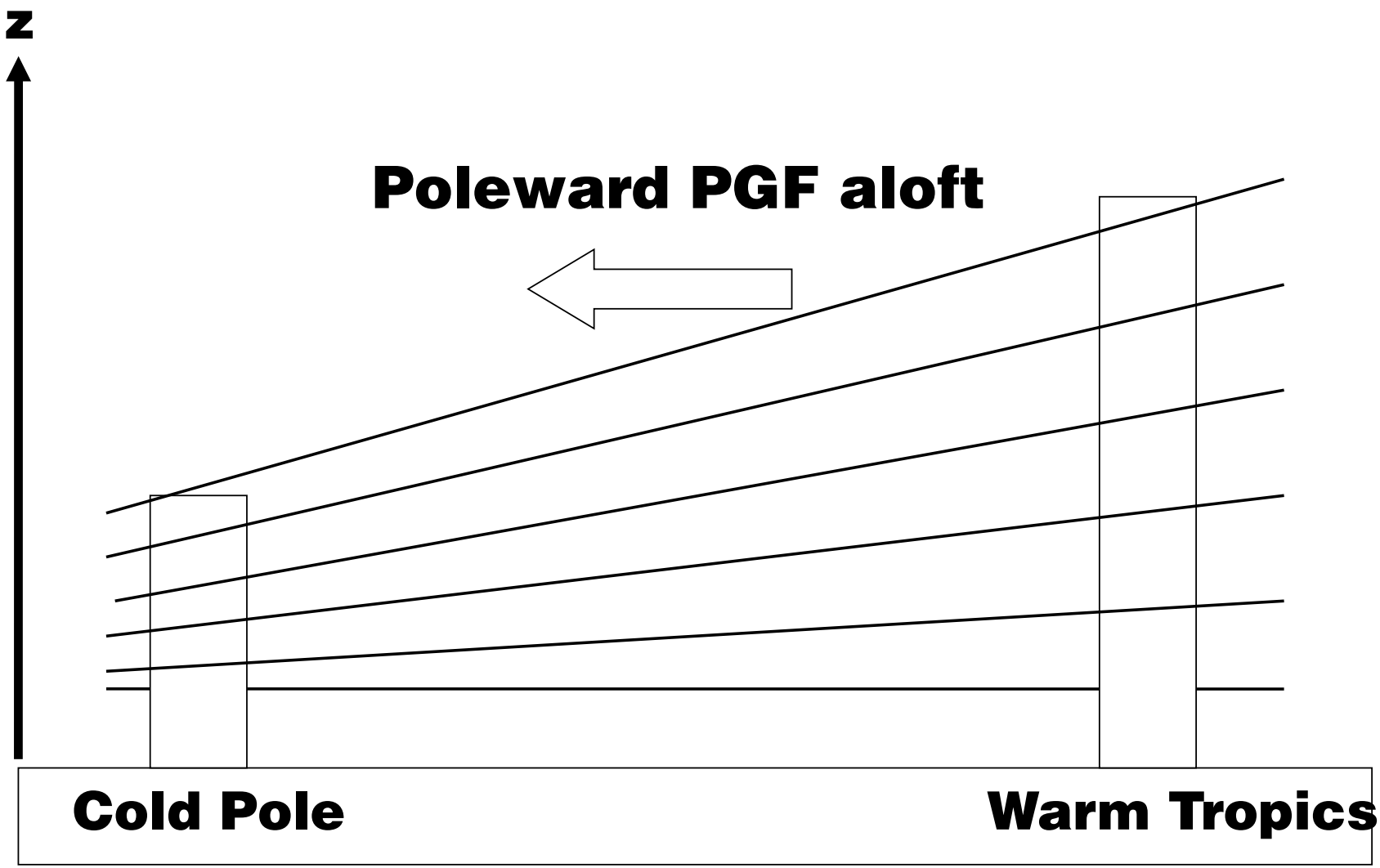


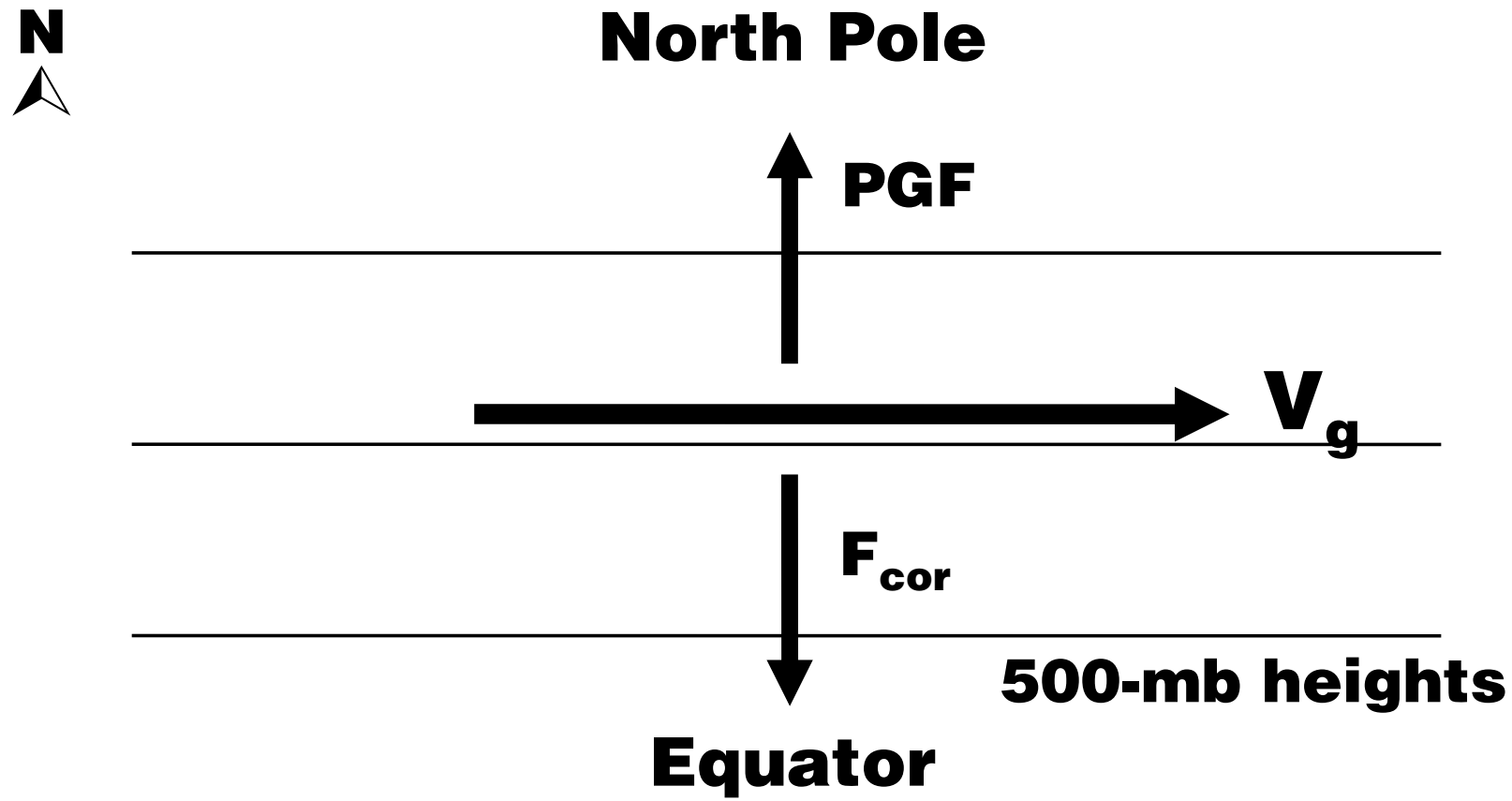
(b) July

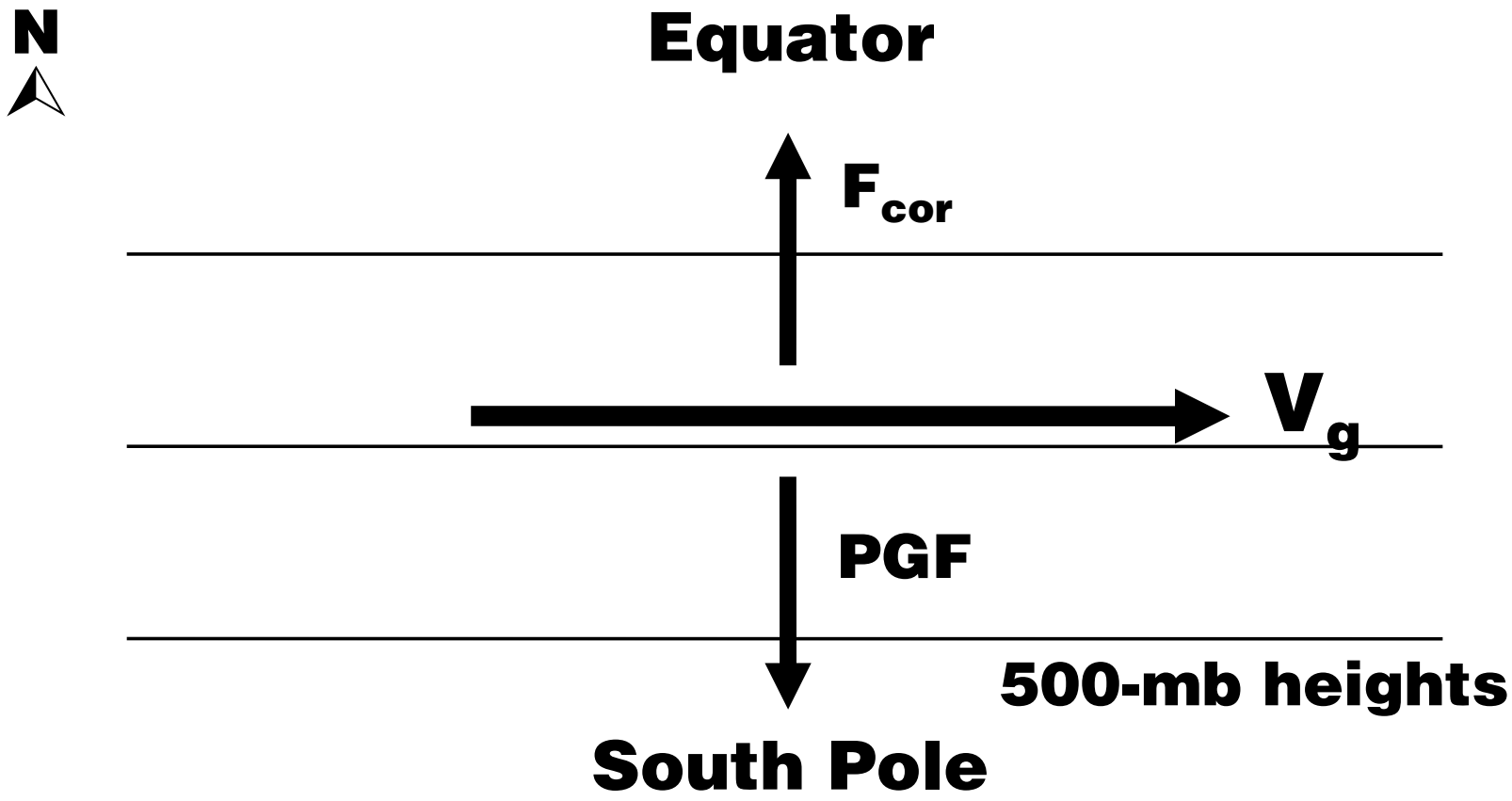
Upper-Level Westerlies



Upper-Level Westerlies

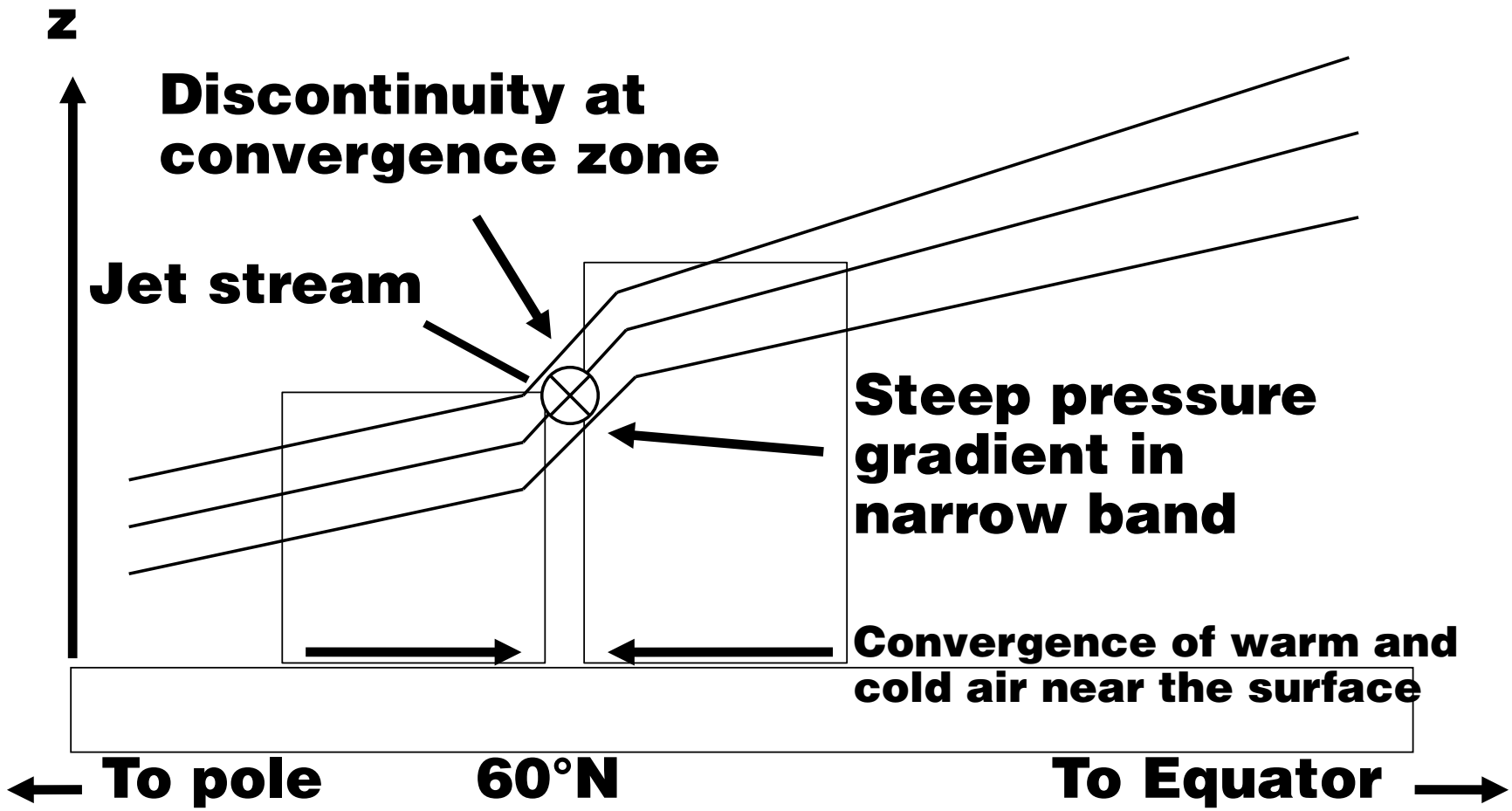


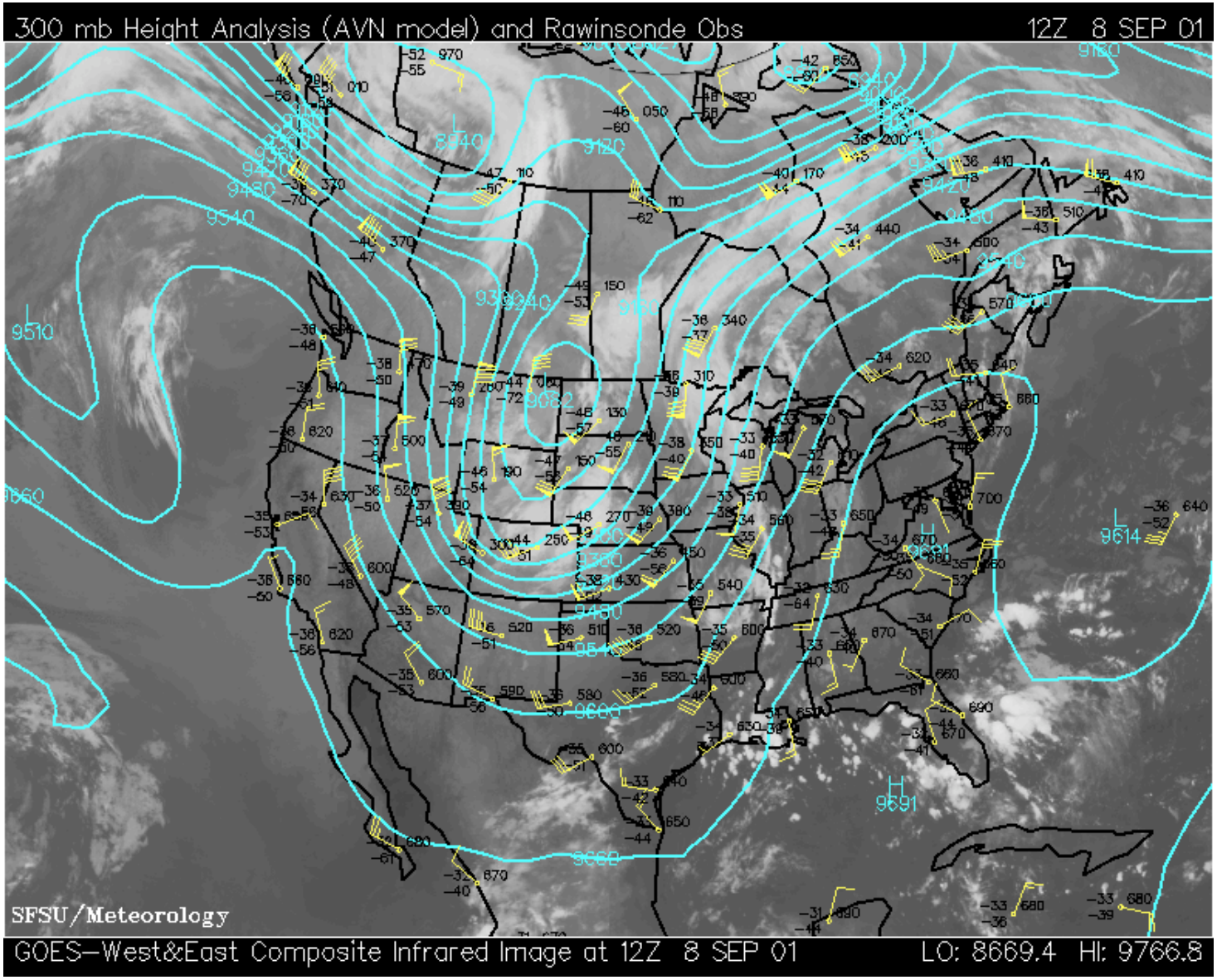

N
North Pole
PGF
V_g
F_{cor}
500-mb heights
Equator



Upper-level winds are generally west-to-east, both hemispheres

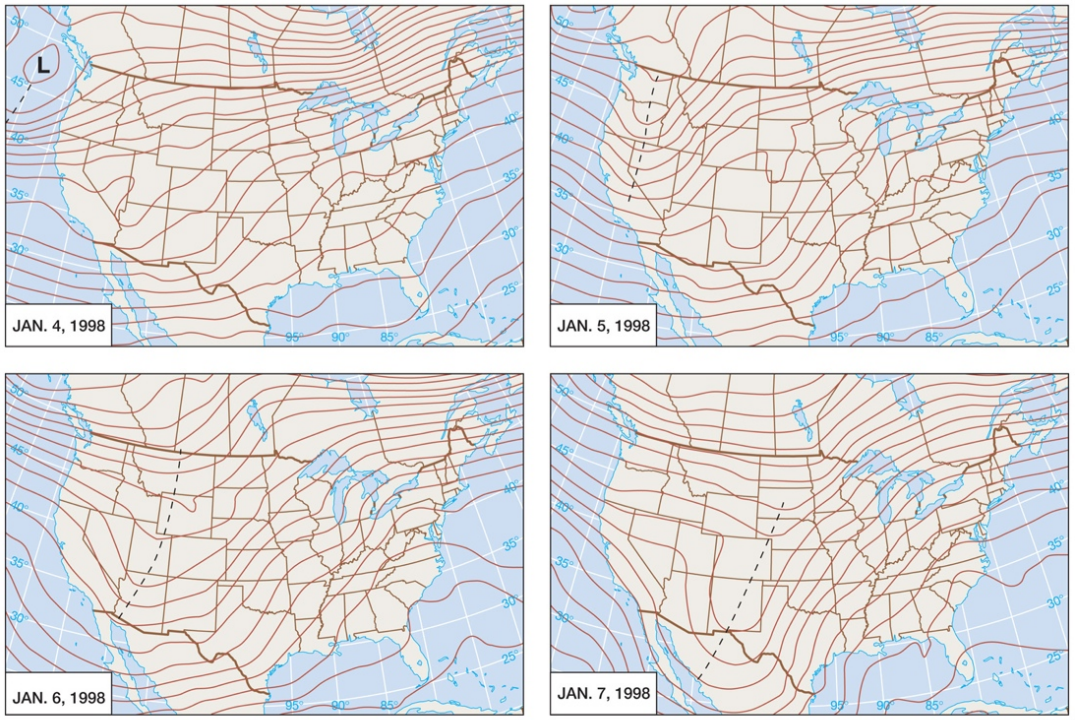
Jet Stream


z
Discontinuity at convergence zone
Jet stream
Steep pressure gradient in narrow band
Convergence of warm and cold air near the surface
To pole
60°N
To Equator


300 mb Height Analysis (AVN model) and Rawinsonde Obs
12Z 8 SEP 01
SFSU/Meteorology
GOES-West&East Composite Infrared Image at 12Z 8 SEP 01
LO: 8669.4 HI: 9766.8

Rossby Waves

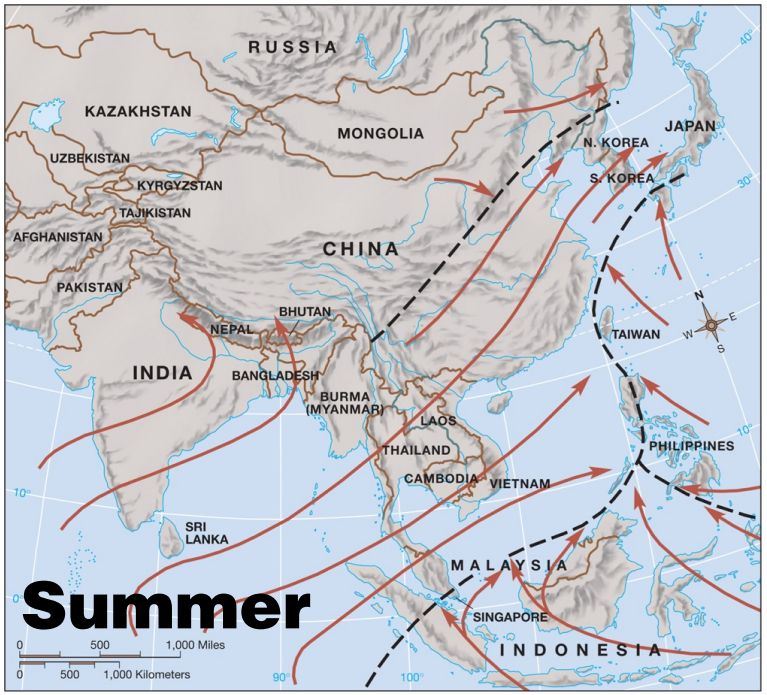
- **"Long waves"**
  - → **Global scale: large wavelength waves in upper-level westerlies, going around either pole**
  - → **Propagate very slowly**



Monsoon Circulation

- **Synoptic-scale thermally driven circulation**
- **Large size scale — longer cycle time — flips seasonally instead of daily**

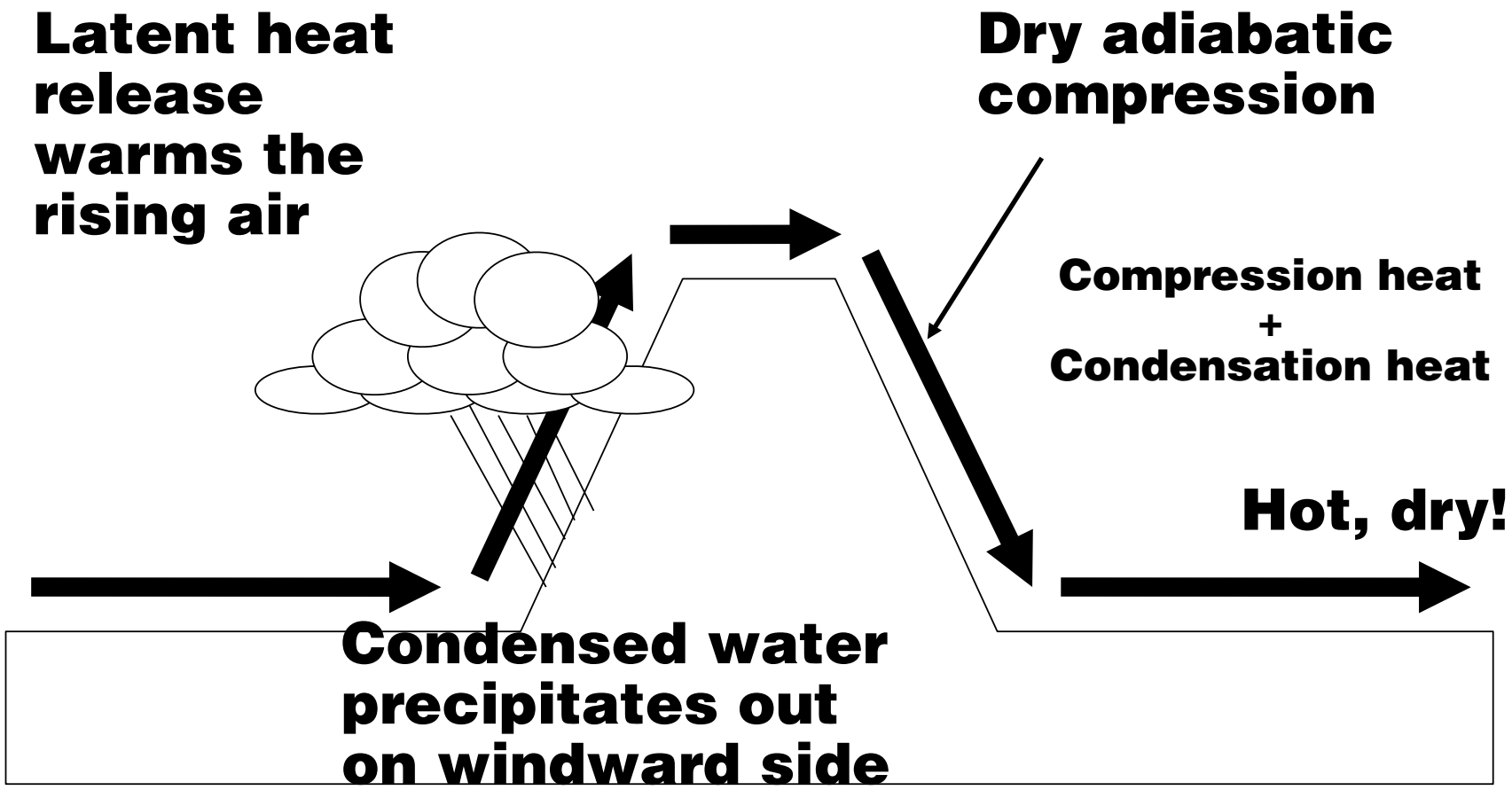
(a)



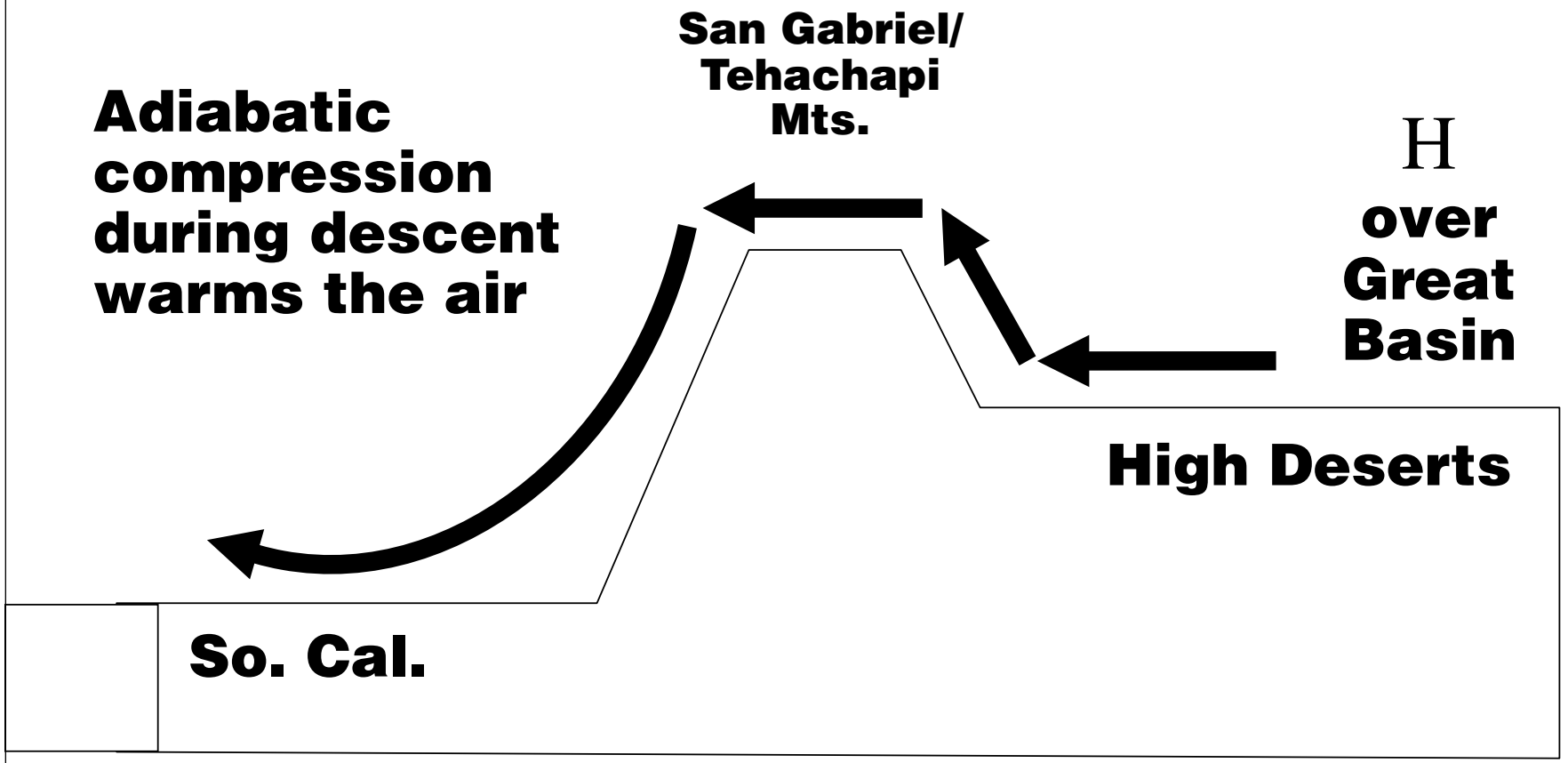
(b)

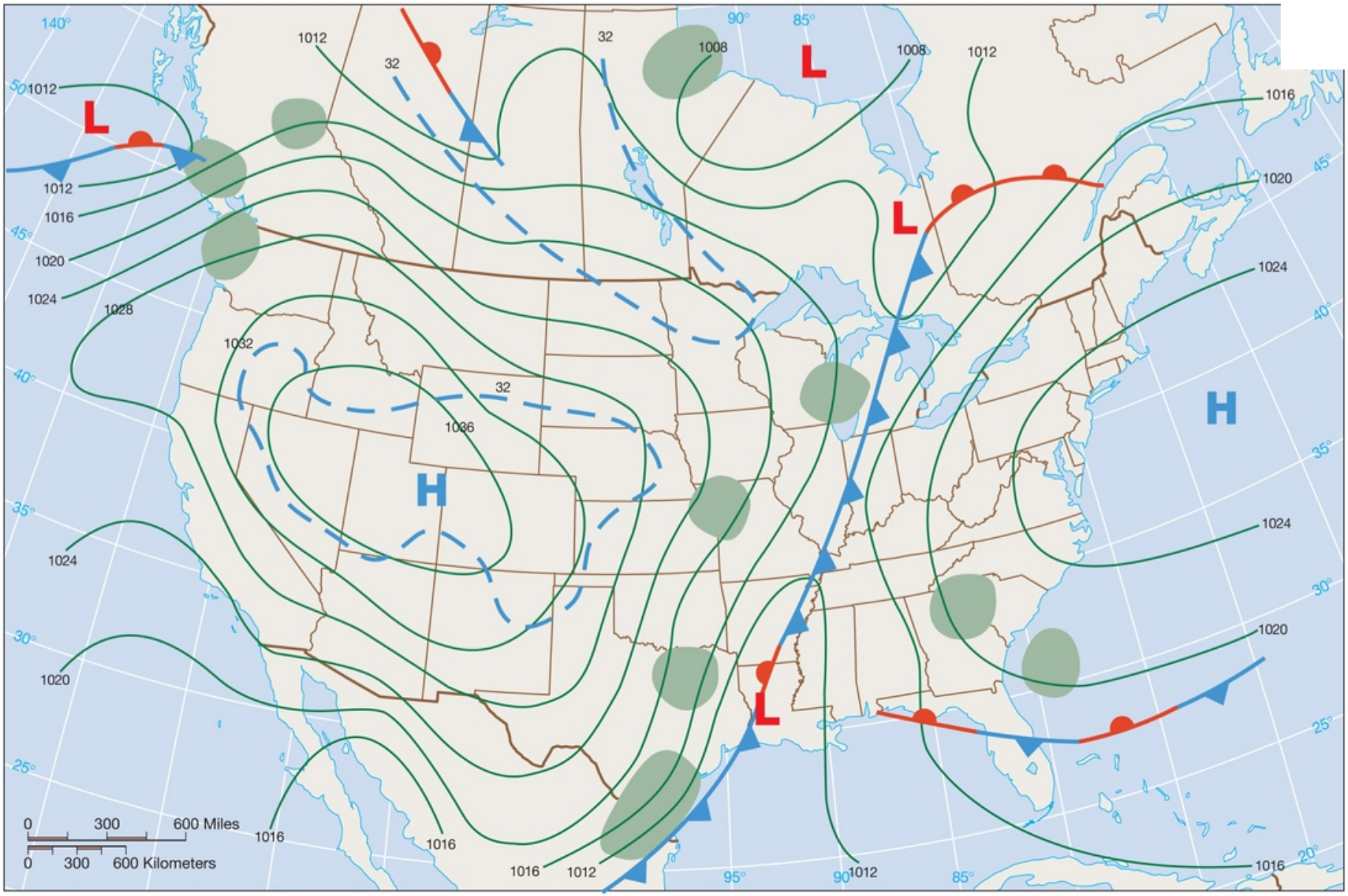
Chinook Wind

In Europe/Asia: Foehn Wind

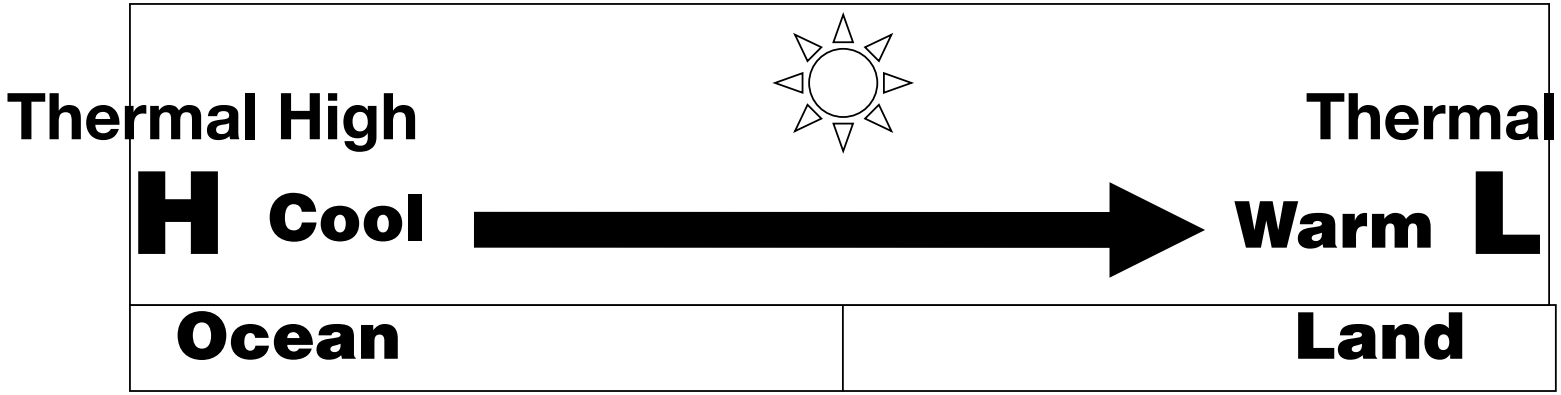


Santa Ana Wind





Thermally Driven Winds: Sea and Land Breezes



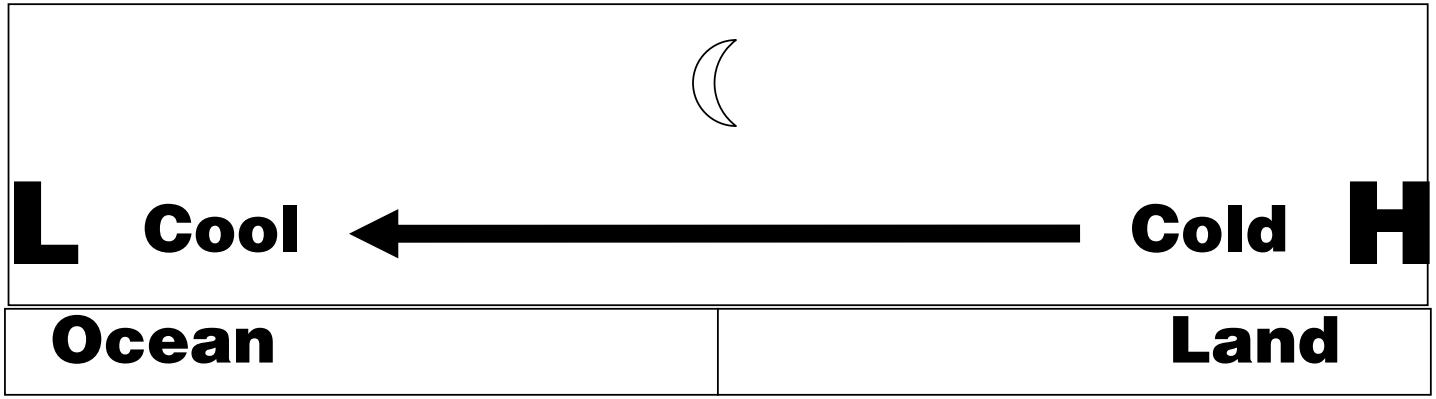
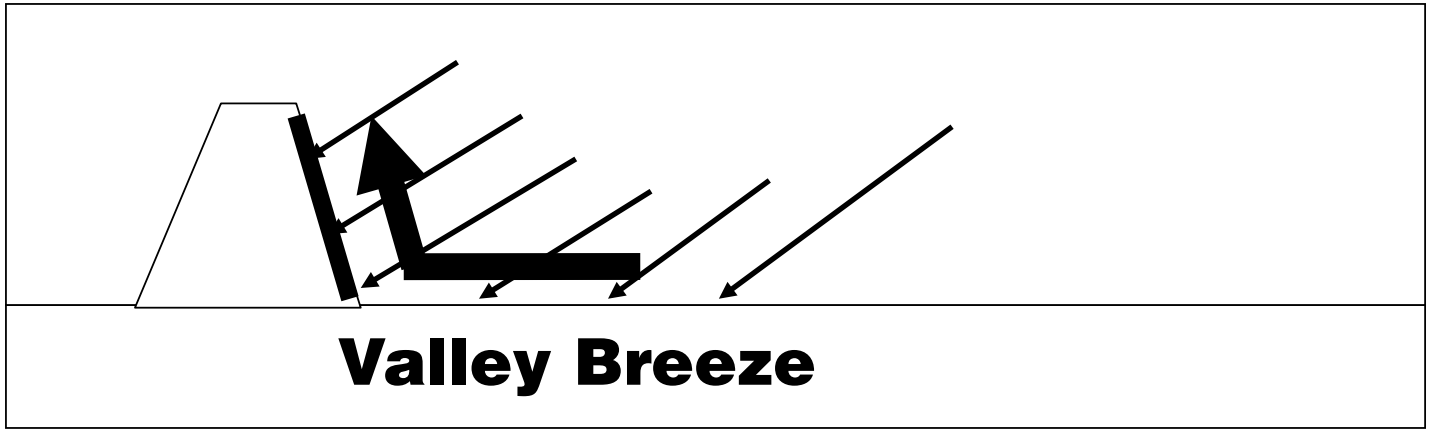


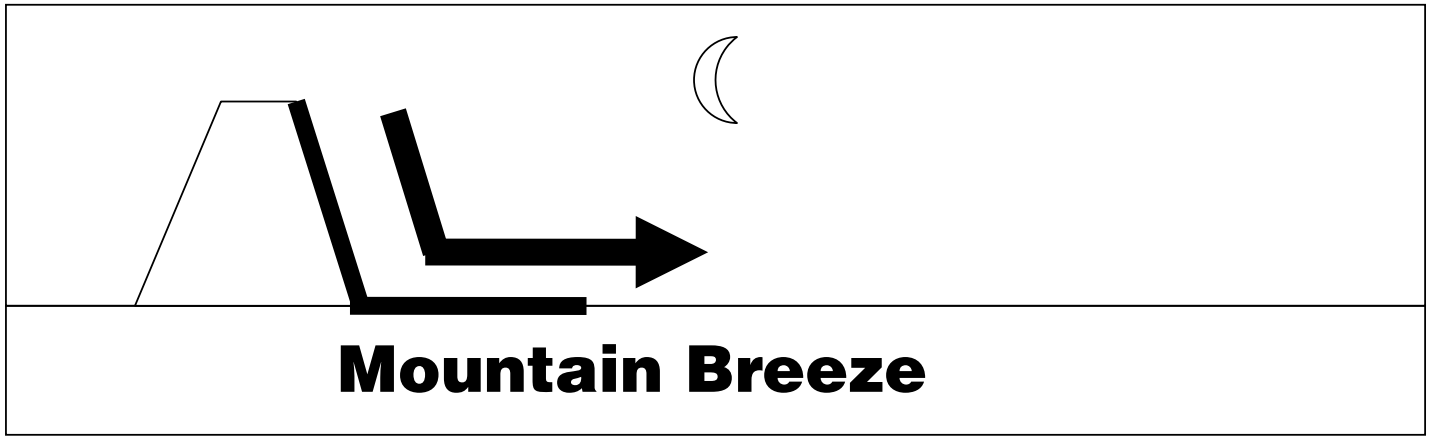
TABLE 8–1 Average Wind Speed and Direction—Los Angeles, CA

	Winter		Spring		Summer		Fall	
Time (PST)	Dir	Speed (m/s)	Dir	Speed (m/s)	Dir	Speed (m/s)	Dir	Speed (m/s)
4 A.M.	ENE	1.0	E	0.5	WSW	0.4	ENE	0.6
10 A.M.	ENE	1.4	WSW	1.9	WSW	3.2	WSW	1.0
1 P.M.	WSW	2.5	WSW	5.3	WSW	5.5	WSW	4.5
4 P.M.	WSW	3.5	WSW	5.5	WSW	5.8	W	5.1
10 P.M.	NE	0.5	W	1.6	WSW	2.4	W	0.7
1 A.M.	ENE	1.0	—	0	WSW	1.0	NNE	0.2

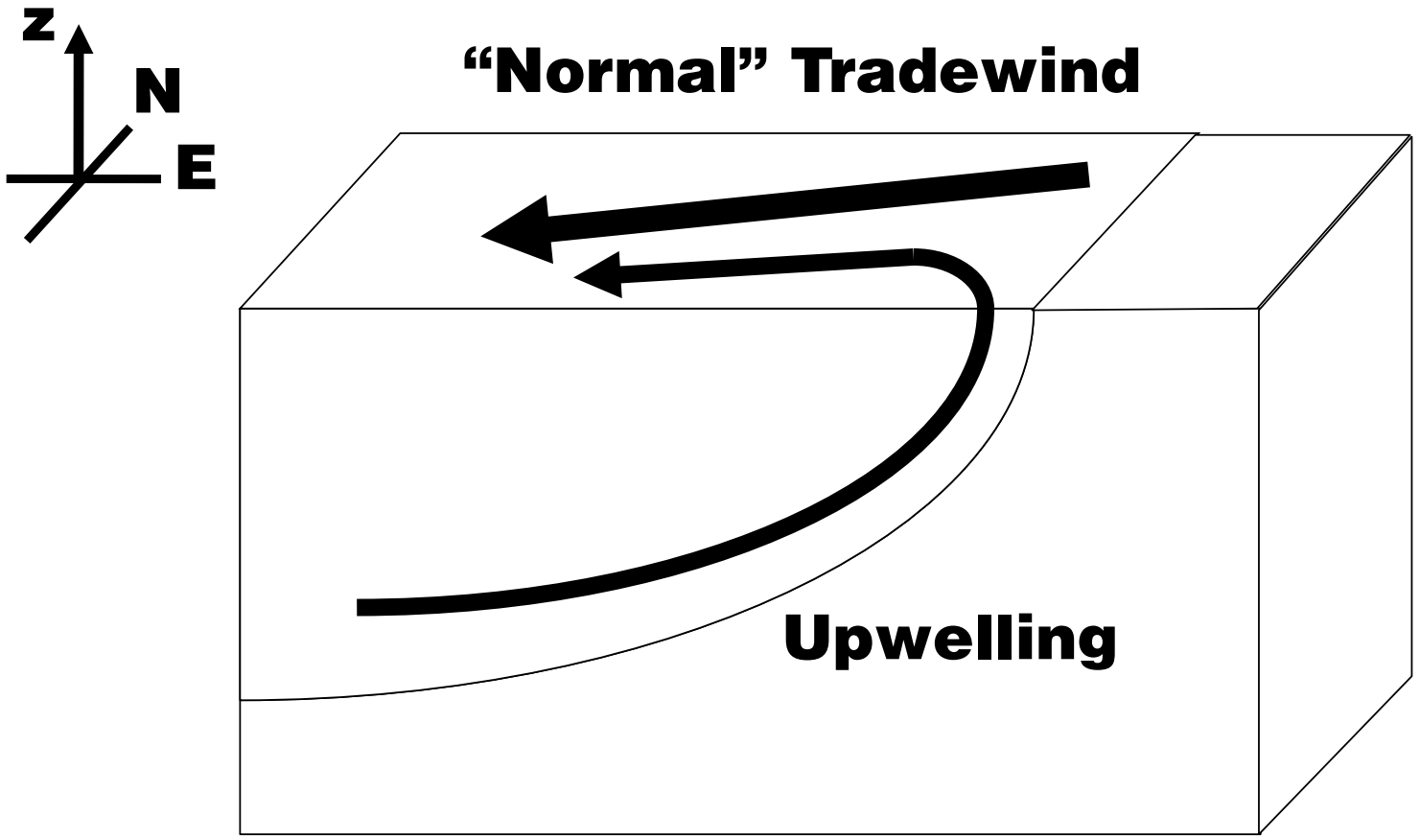
Source: California Air Resources Board.

Mountain and Valley Breezes

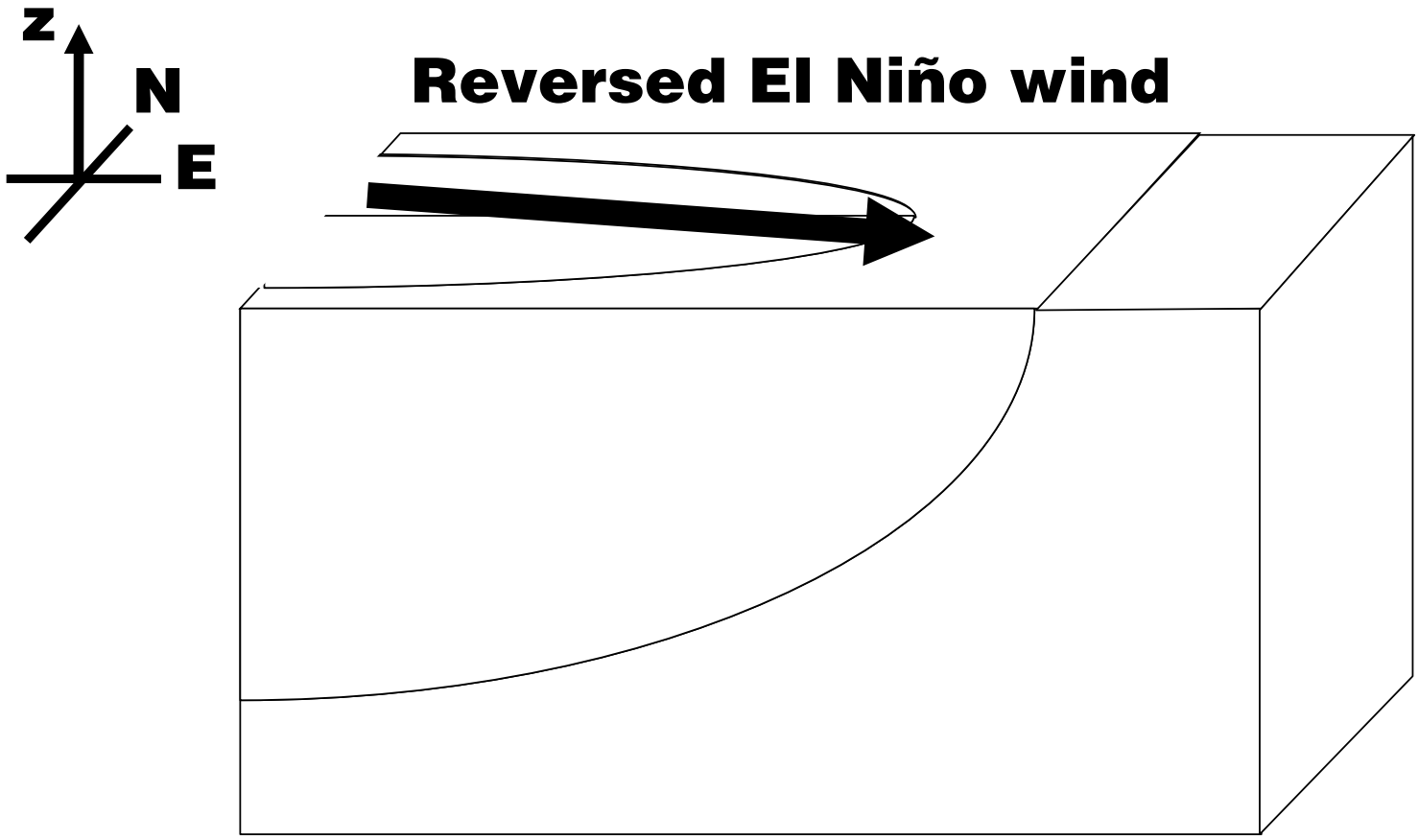




El Niño/Southern Oscillation

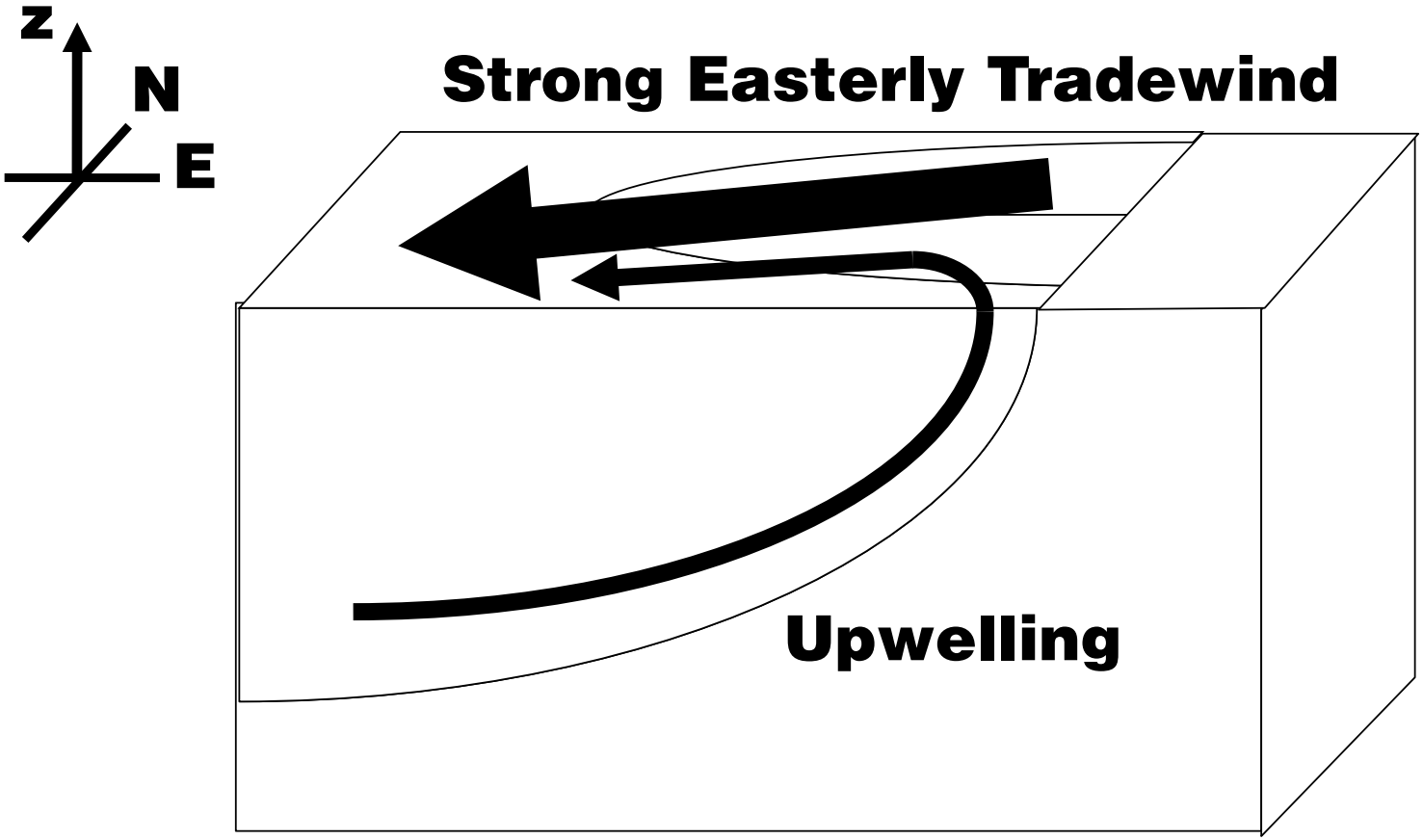


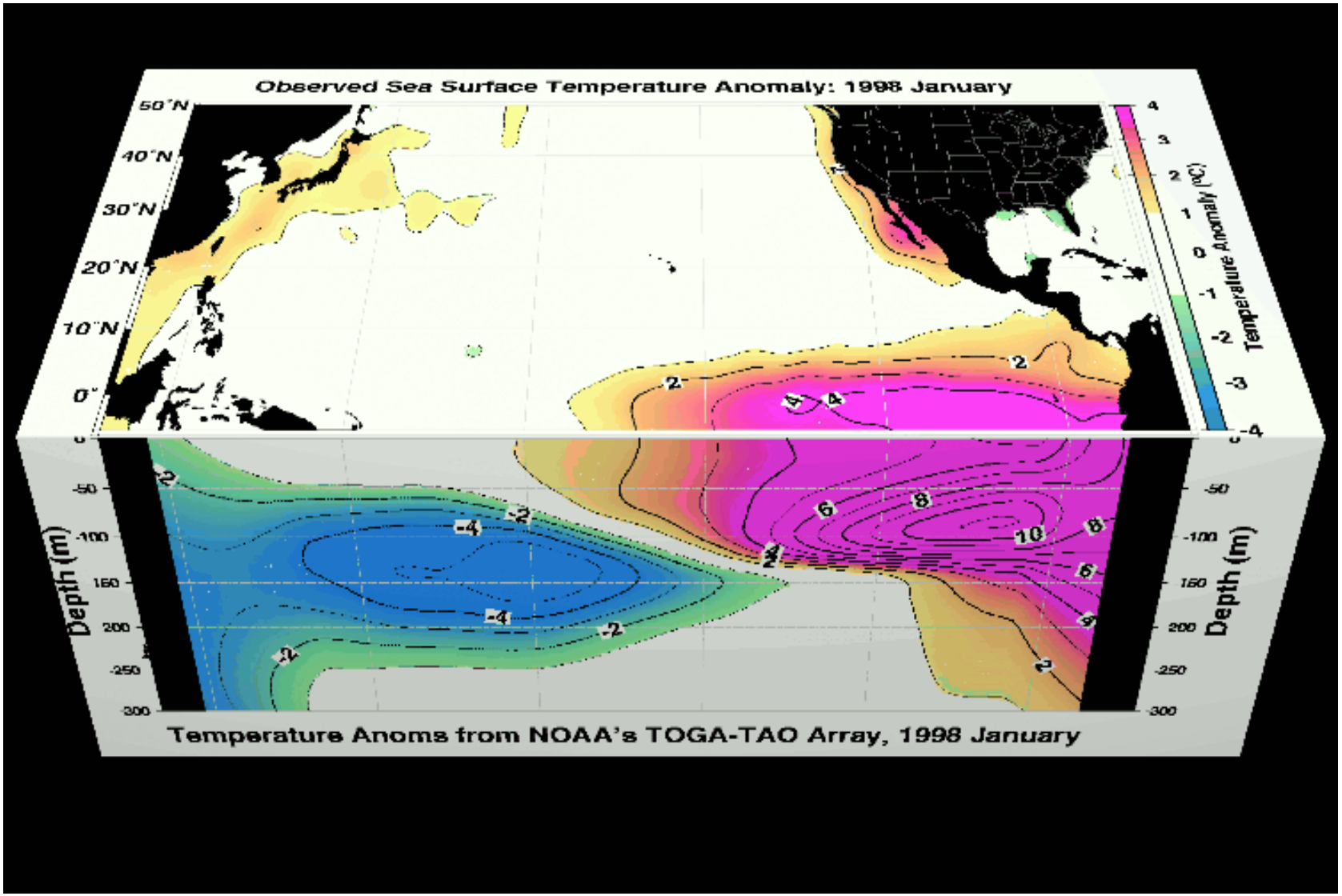
El Niño/Southern Oscillation



Oscillation period: 3–7 years

La Niña: The Pendulum Swings Back




Observed Sea Surface Temperature Anomaly: 1998 January
50°N
40°N
30°N
20°N
10°N
0°
Temperature Anomaly (°C)
Depth (m)
Temperature Anoms from NOAA's TOGA-TAO Array, 1998 January