ATOC 1060-002
OUR CHANGING ENVIRONMENT

Class 13 (Chp 4)

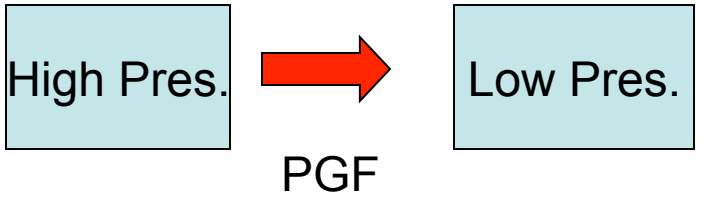
Objectives of Today's Class:

1. **Geostrophic balance; upper level atmospheric circulation;**
2. **Seasonal variability;**
3. **Global distributions of temperature**

1. Geostrophic balance

Forces in the system:

- Pressure Gradient Force (PGF)

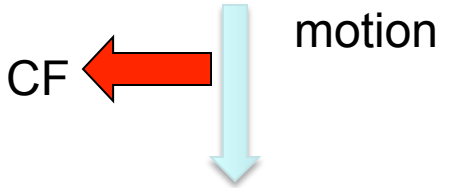


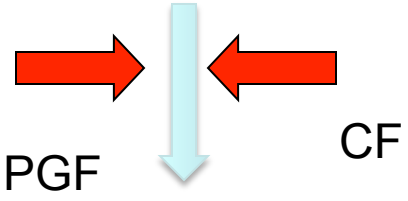
- Coriolis Force (CF)

  Deflect the initial motion to the right in Northern Hemisphere (NH), and to the left in Southern Hemisphere (SH);

- Frictional force, etc.

  ("friction" is negligible in upper atmosphere; but not negligible near the surface)





Geostrophic wind,
Geostrophic balance

Northern Hemisphere

Geostrophic balance

Geostrophic balance

- Balance between PGF and Coriolis force
  - Parallel to pressure lines
  - Low pressure to left (right) of flow in NH (SH)
- Not very accurate approximation near surface (friction)
- Very good in upper atmosphere The stronger the PGF (tighter the isobars), the stronger the Vg.

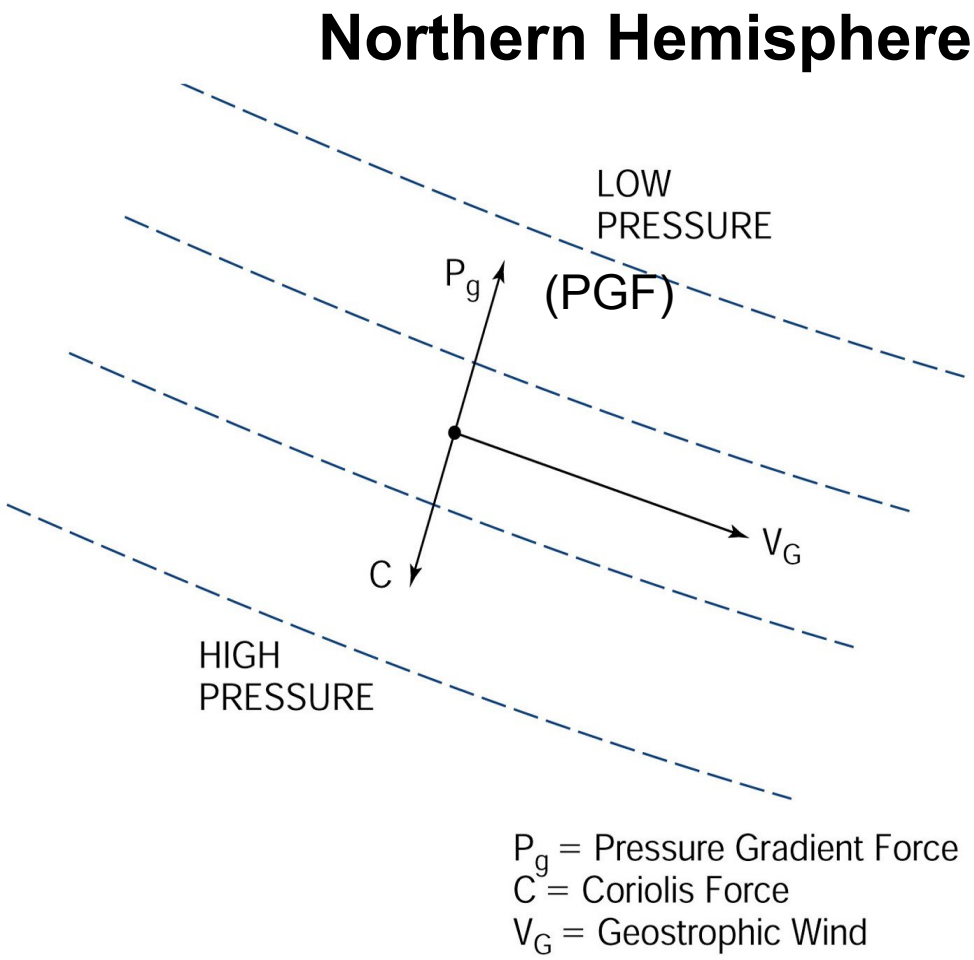


Fig. 4-13

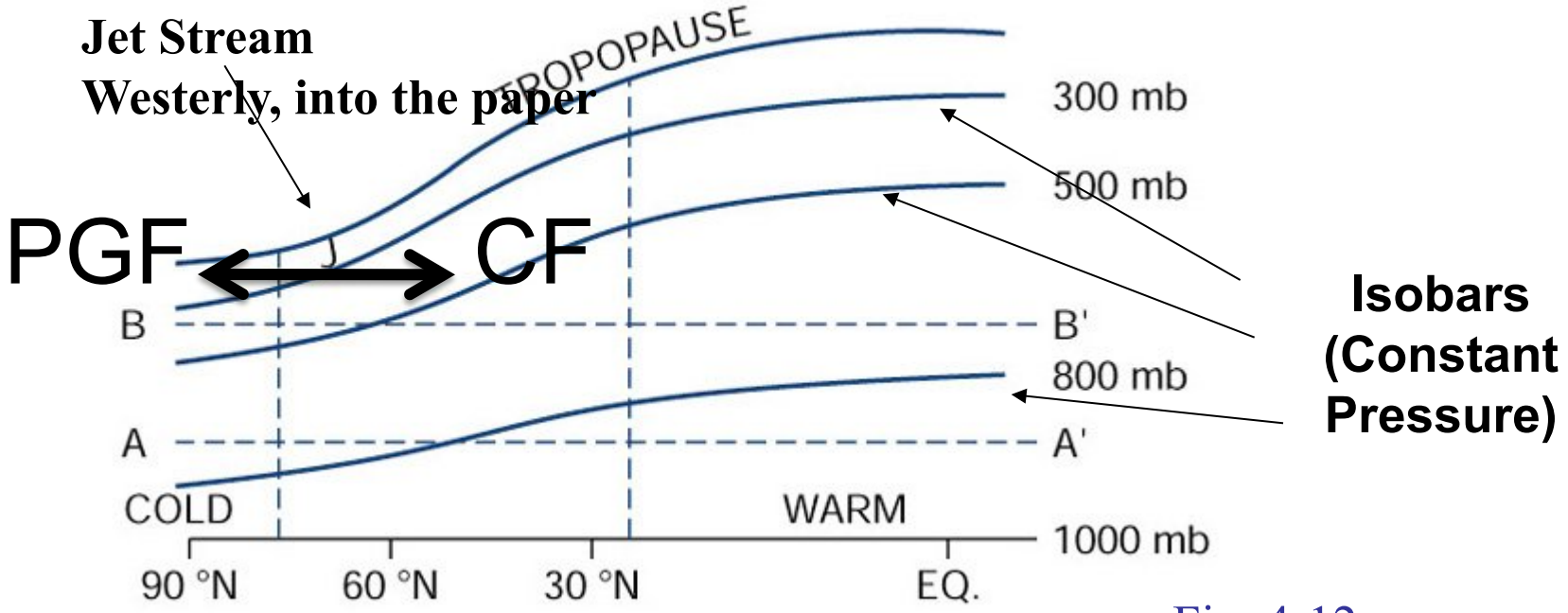
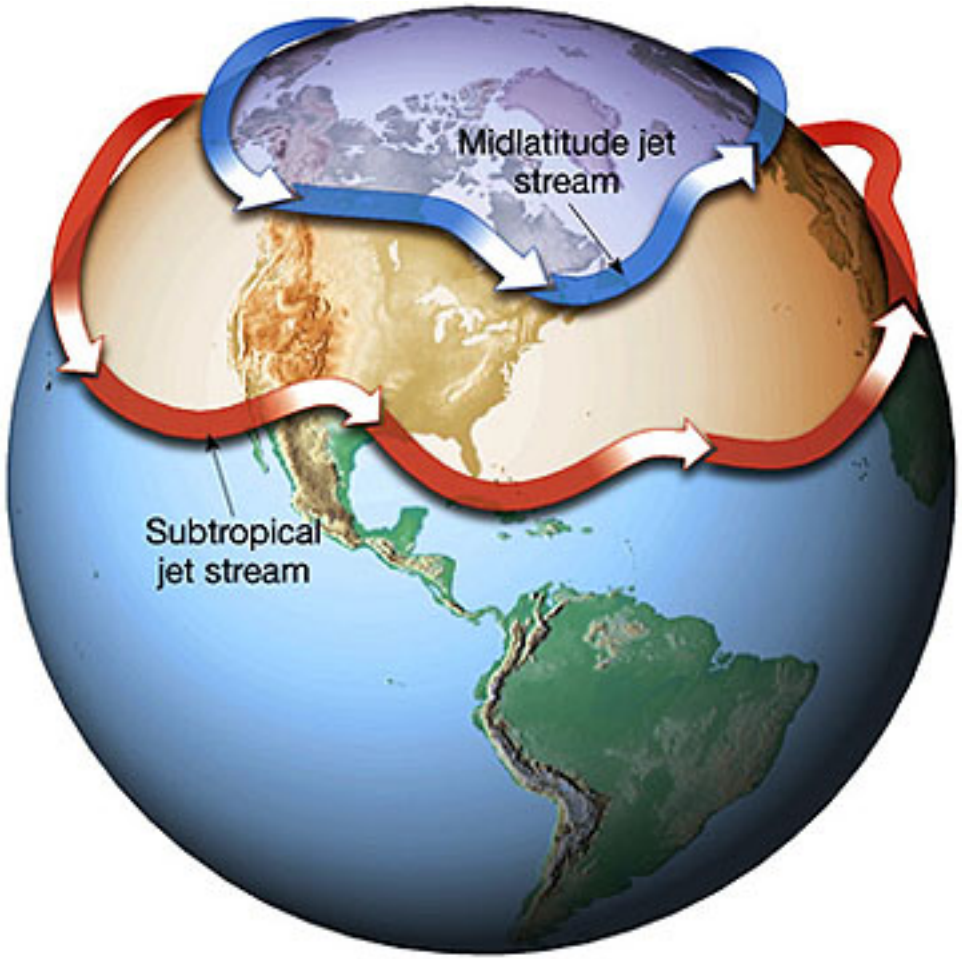


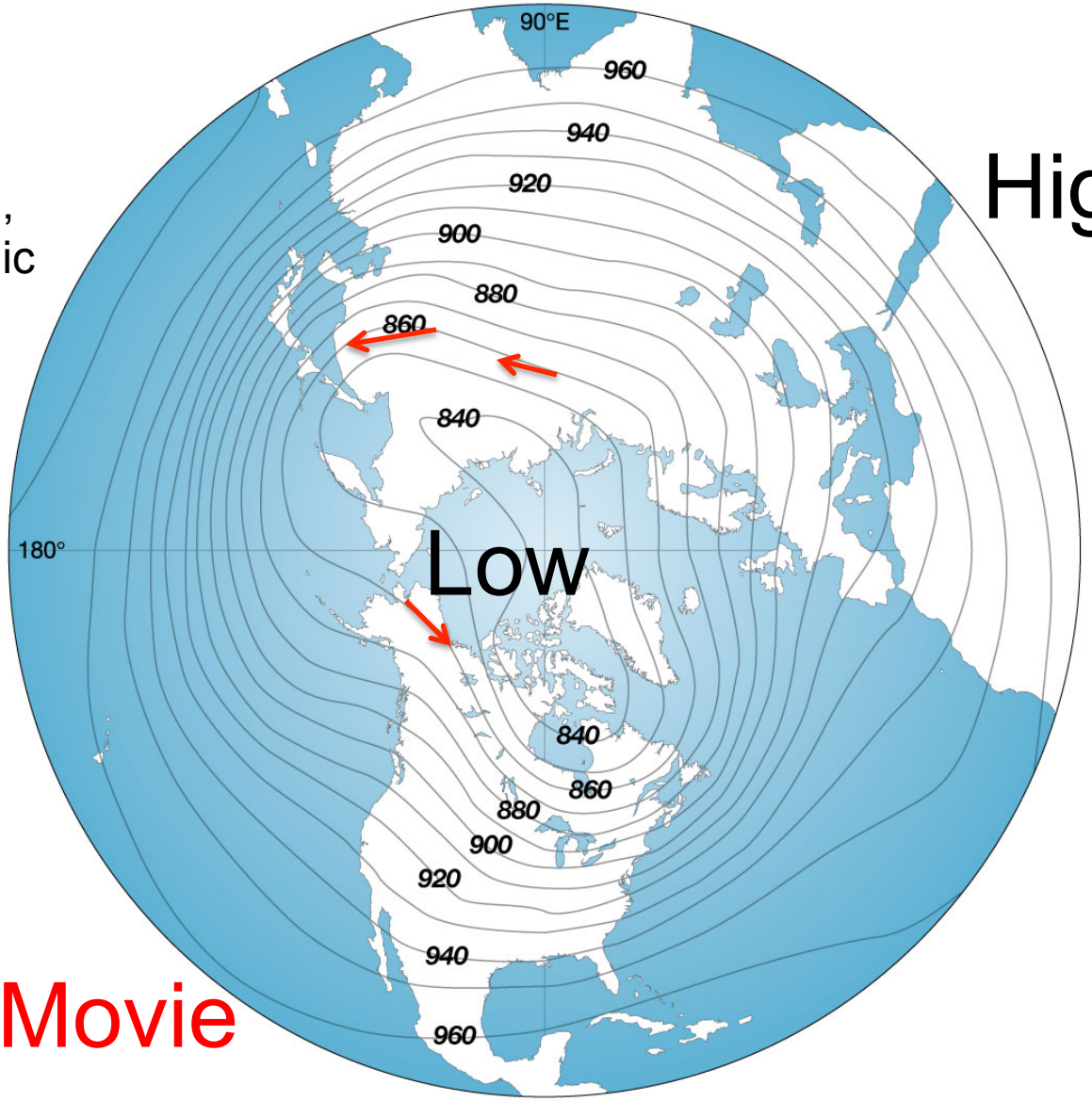
Fig. 4-12c

- Adding Coriolis: Westerly geostrophic flow
- Fastest flow in tightest isobars (Jet Stream)

Upper level flow - Jet stream: Geostrophic flow



Jet stream, Geostrophic flow



Show Movie

4-14. Northern hemisphere mean january 300-mbar geopotential heights (decameters; 1 decameter=10m).

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Idealized Hadley Cell Circulation

Develop Tropical and Midlatitude Components

Develop High Latitude Components

Develop Upper Atmosphere Flow

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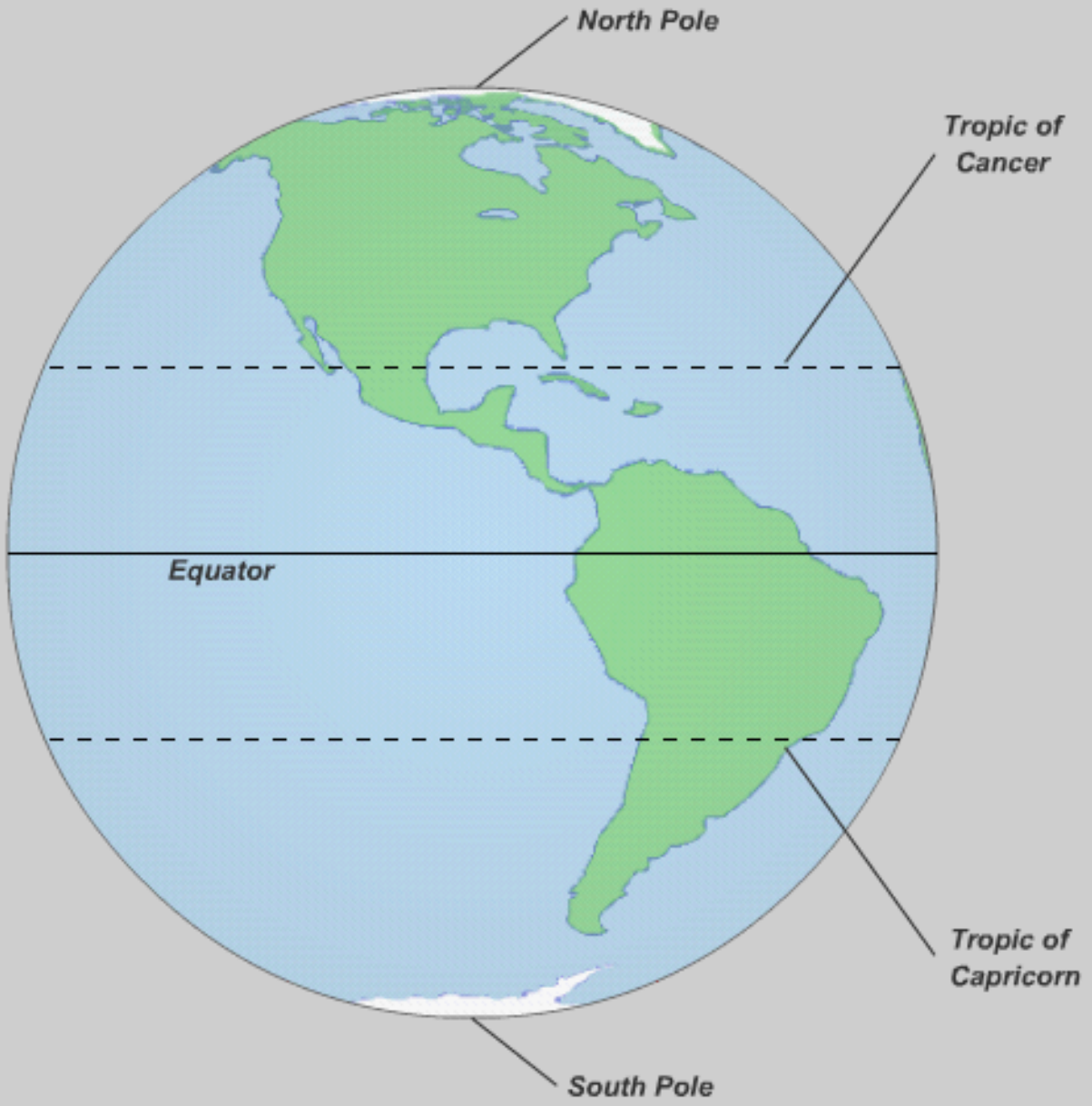


2. Seasonal variability

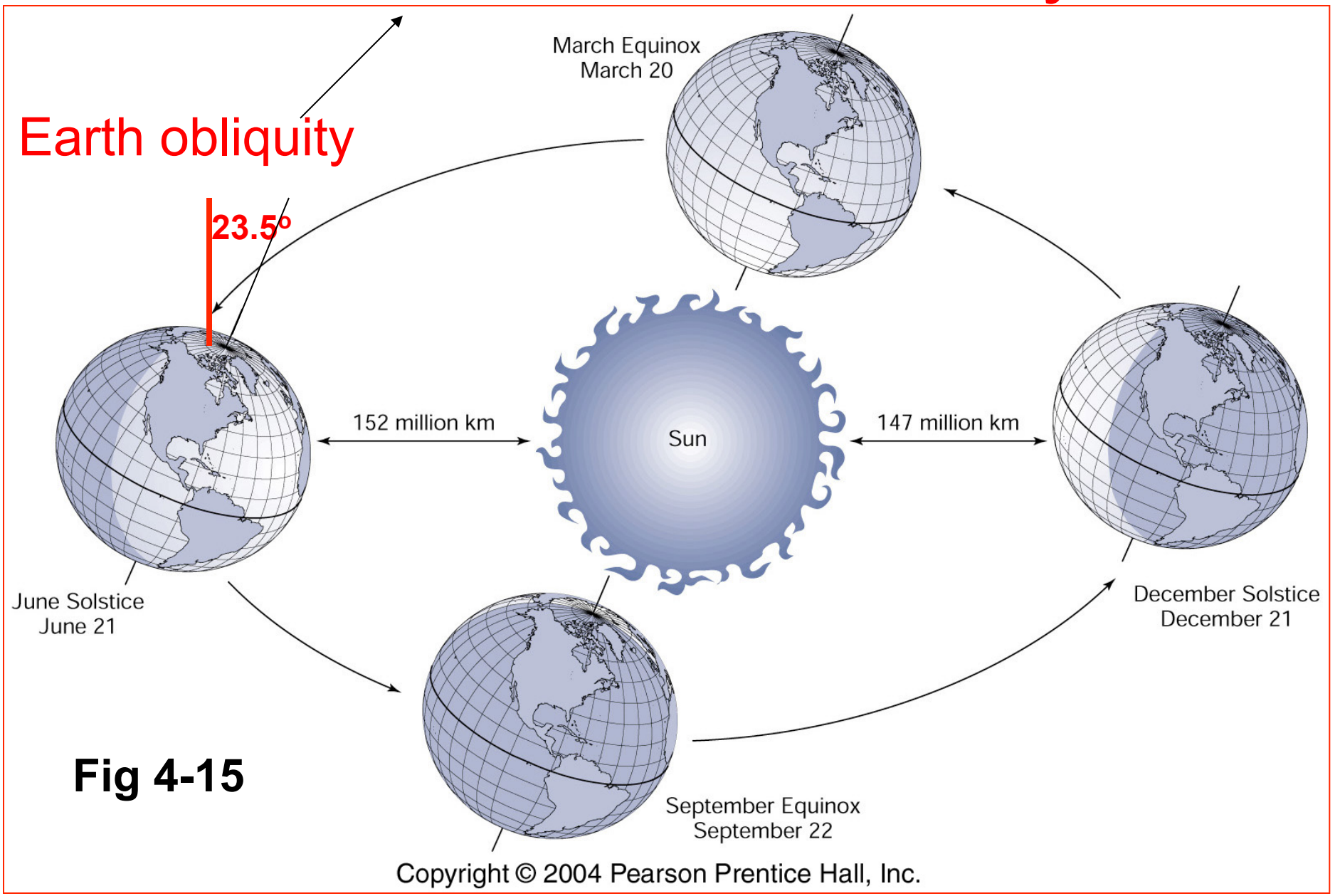
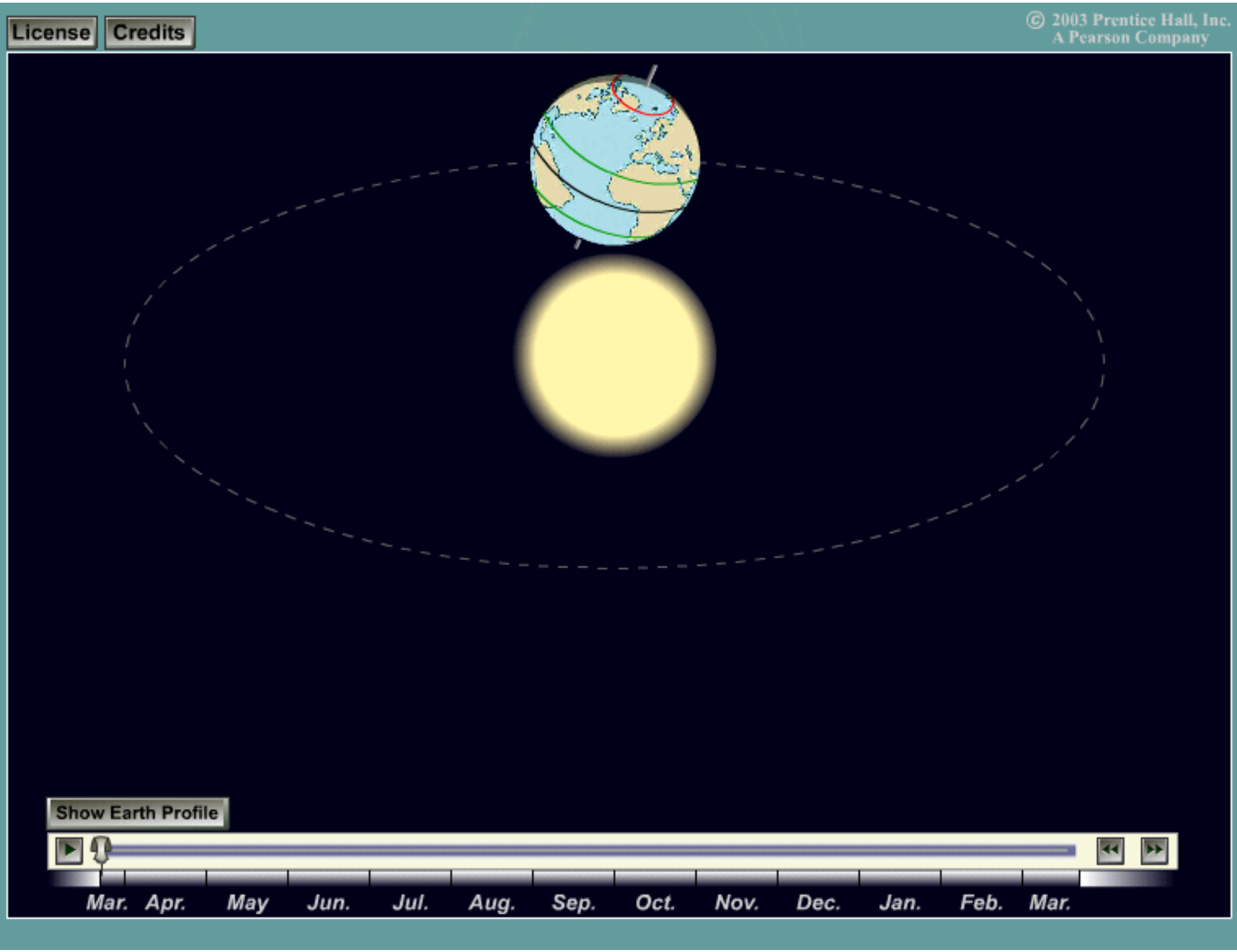


Fig 4-15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Seasonal variability: atmospheric circulation

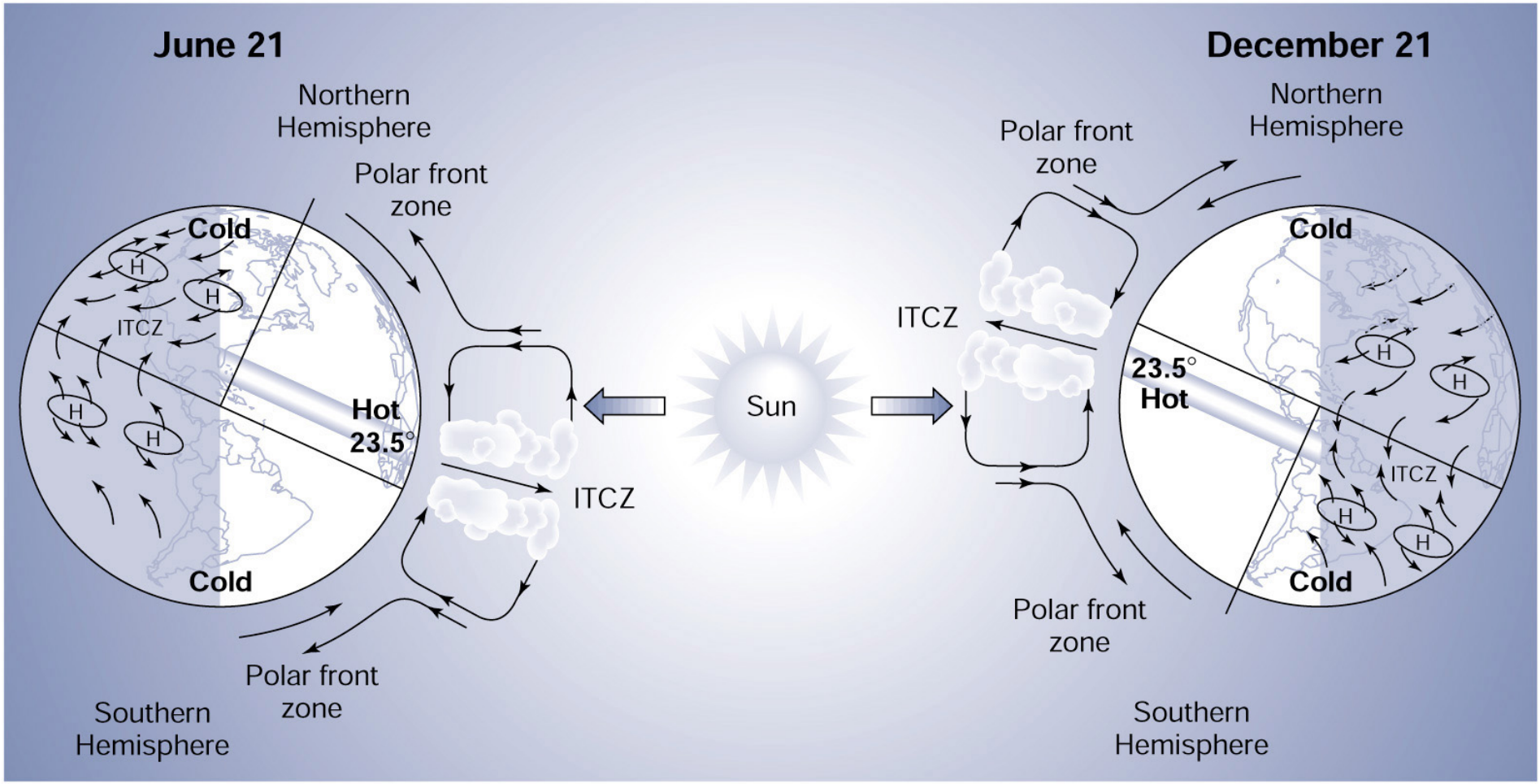


Fig. 4-16

3. Global distribution of temperature

Global atmospheric circulation =>
global temperature, rainfall distributions

INTERACTION:

.Radiation=> temperature=> atm circulation
=>transport heat=>regulate temperature;

.Transport of water (important to living organisms, dissolved materials);

.Temperature <=> water vapor & transport.

Land-Ocean contrasts

Albedo: ocean << than land;

Heat transfer: Ocean surface: quickly downward by mixing & upward to the atmosphere by convection;
Land - quickly upward by convection, but slowly downward by thermal conduction (land low, ocean high);

Heat capacity: water ~ 3-4 times of dry soil.

The sea breeze: diurnal variability

Day Sea breeze

Night Land breeze

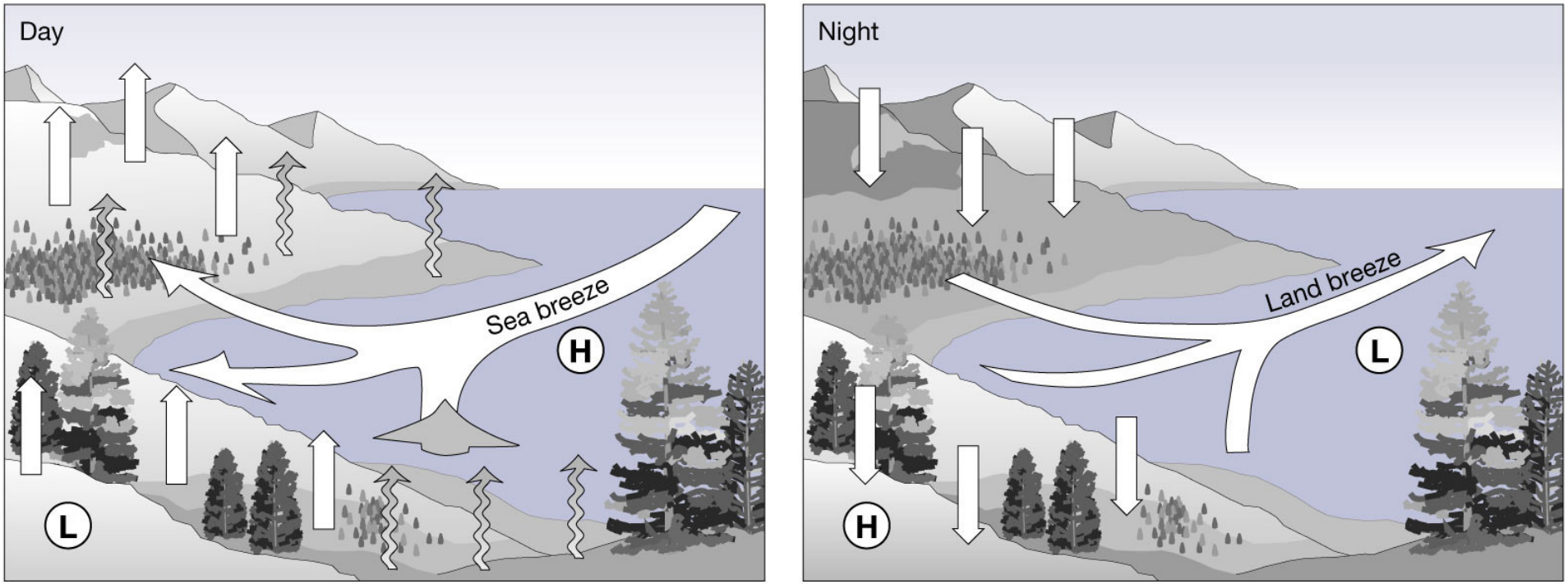


Fig. 4-17

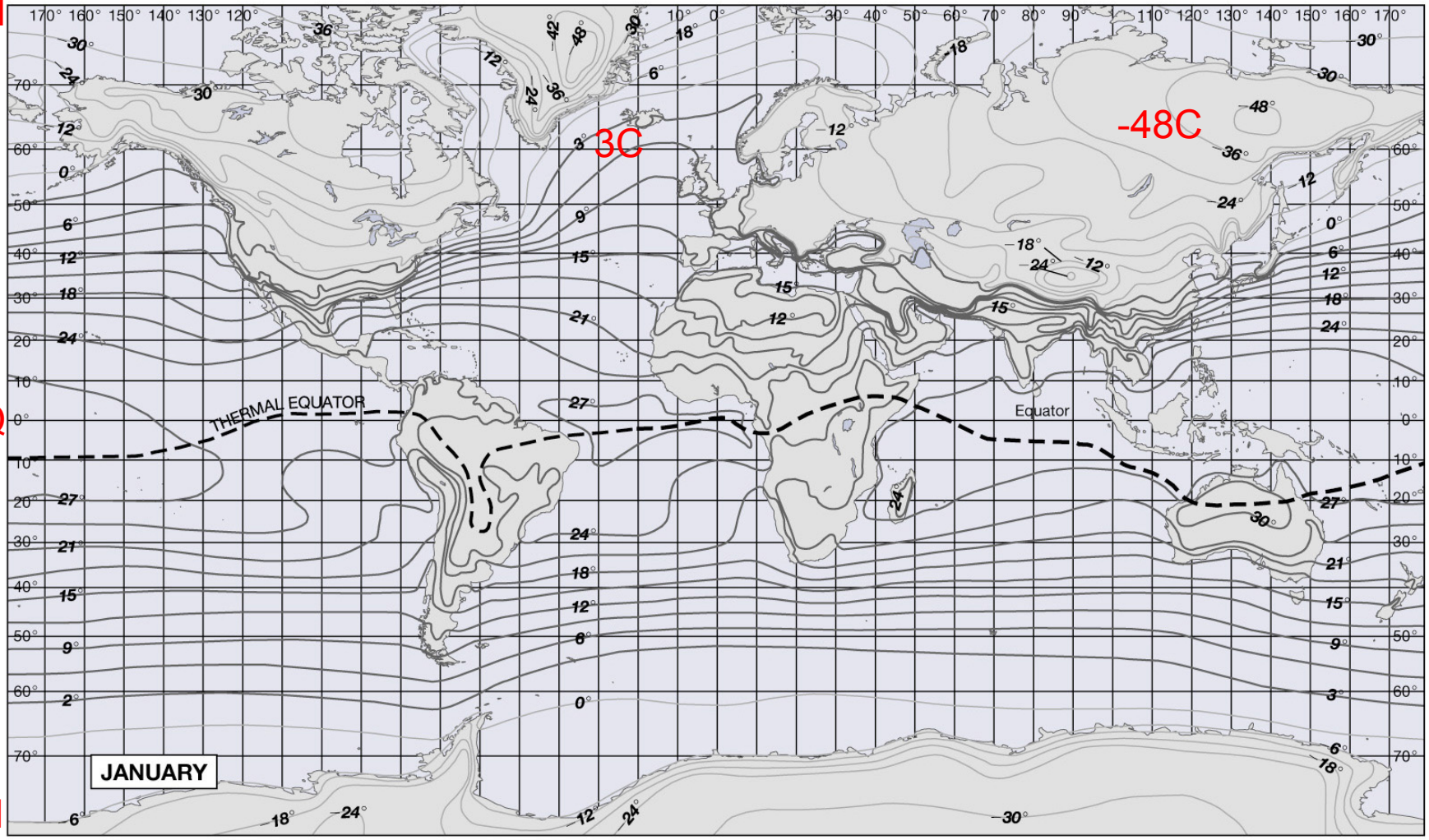
Continentality: January

Latitudes: **Temperature**

NH

EQ

SH



0 1500 3000 Miles

0 1500 3000 Kilometers

°F -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110 120 °F

°C -40 -30 -20 -10 0 10 20 30 40 50 °C

(a)

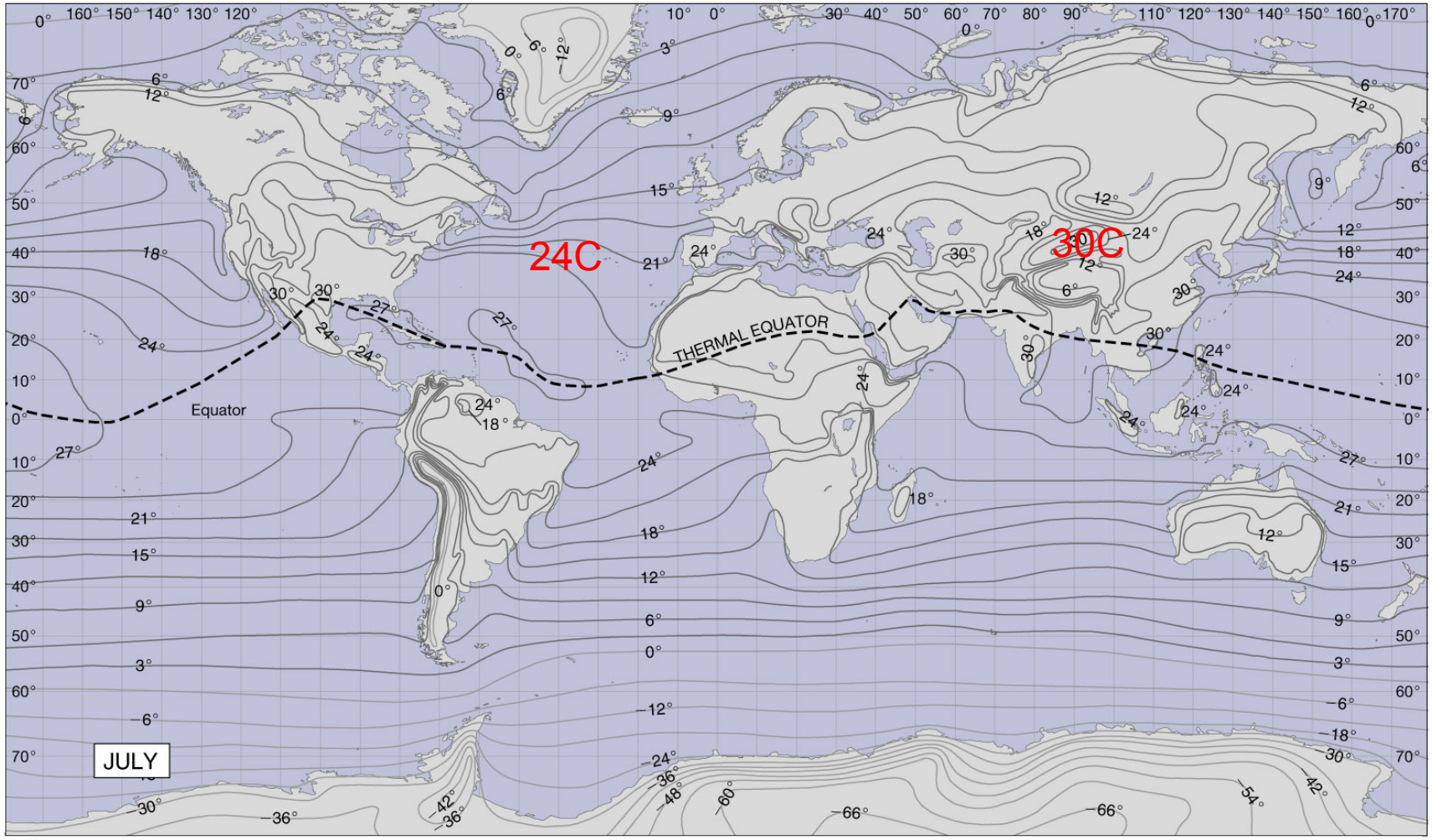
Fig. 4-18a

July

NH

EQ

SH



0 1500 3000 Miles

0 1500 3000 Kilometers

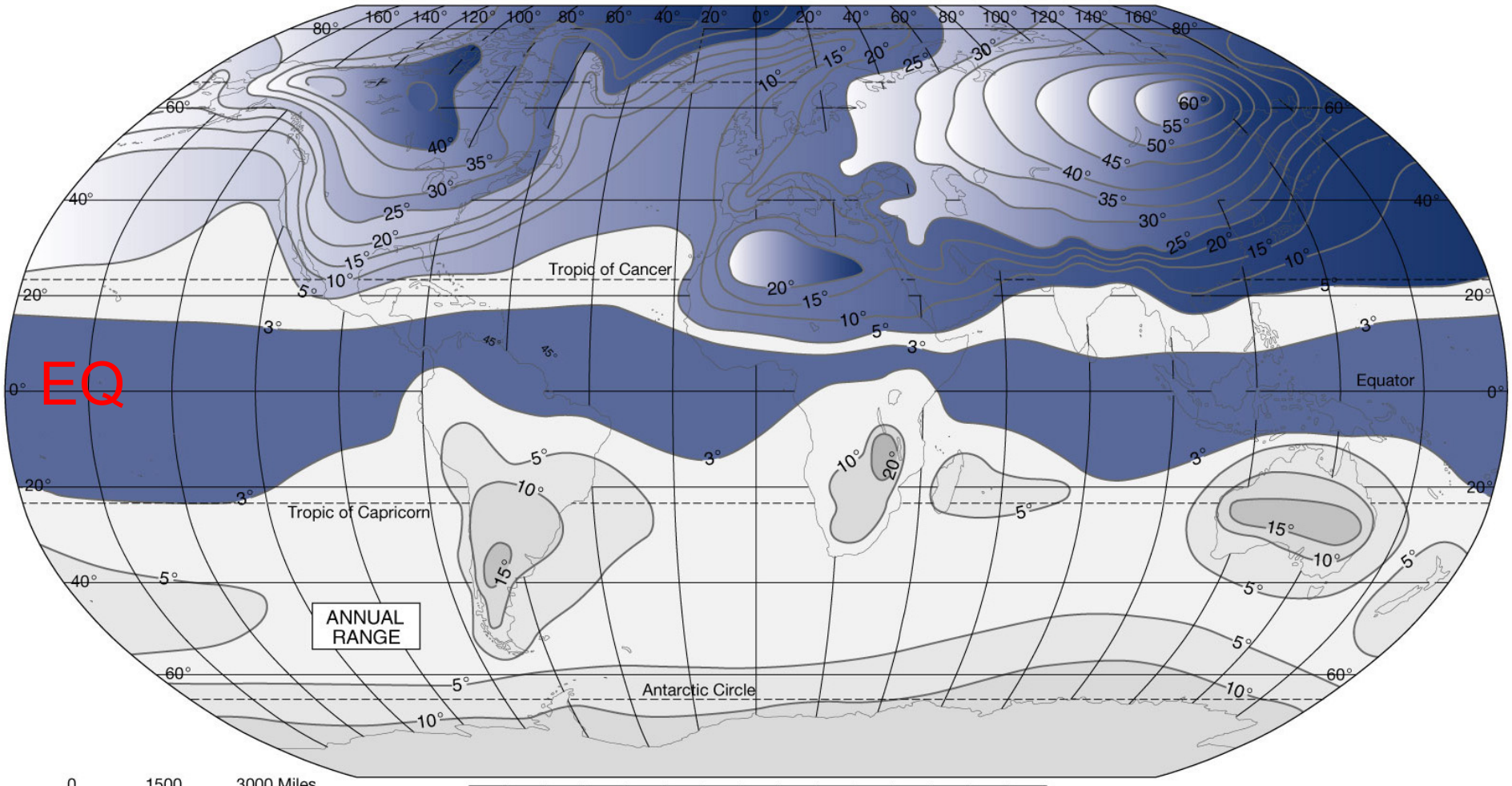
°F -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110 120 °F

°C -40 -30 -20 -10 0 10 20 30 40 50 °C

Fig 4-18b

(b)

Temperature difference between summer and winter

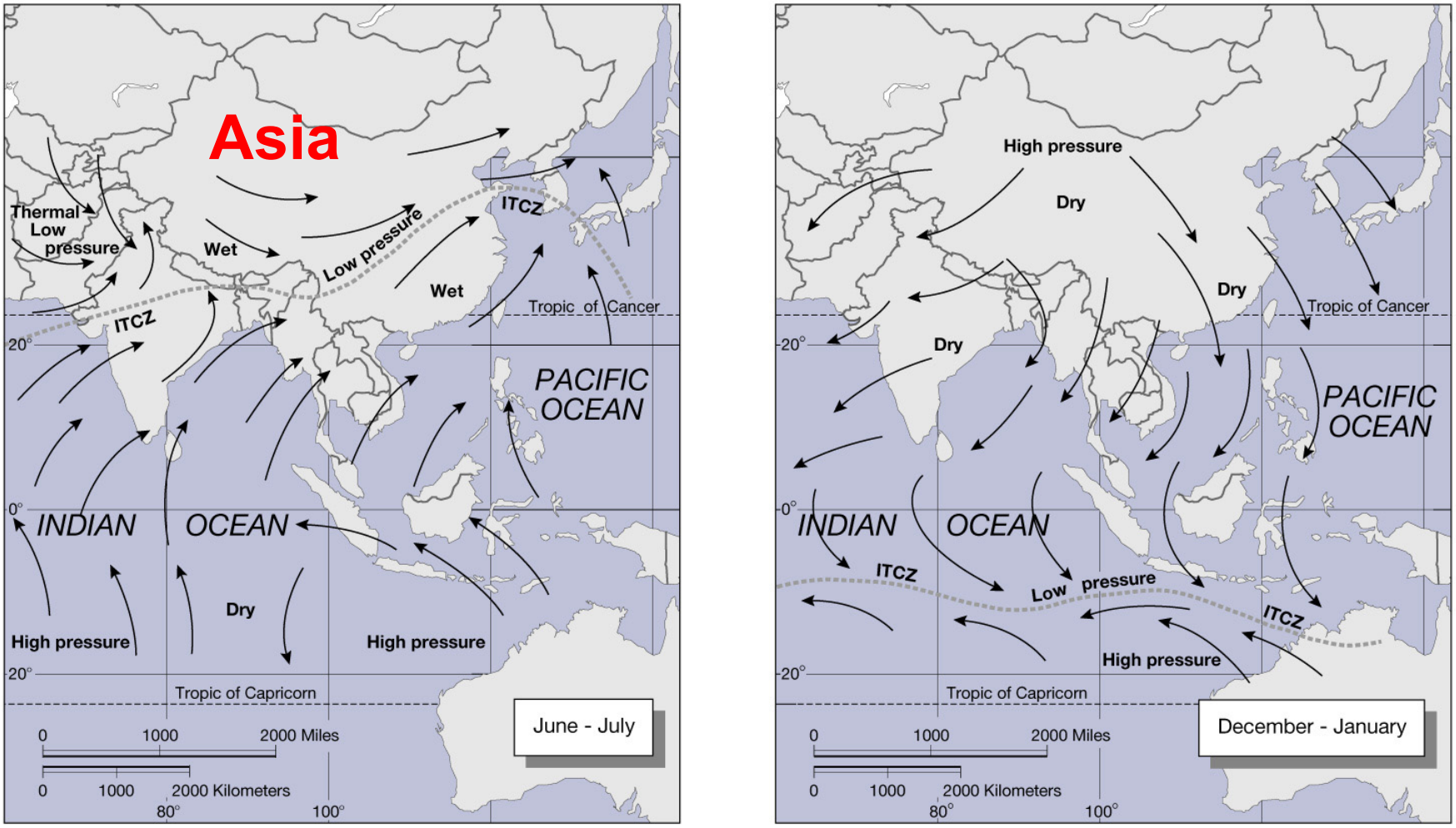


F°	5	9	18	27	36	45	54	63	72	81	90	99	108	F°
C°	3	5	10	15	20	25	30	35	40	45	50	55	60	C°

(c)

Fig 4-18c

Monsoons



(a) (b)

Fig 4-21

Indian monsoon flood