ATOC 1060-002
OUR CHANGING ENVIRONMENT

Class 14 (Chp 4)

Objectives of Today's Class:

1. Global distribution of temperature
2. Global distributions of rainfall

Previous class: 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

Night

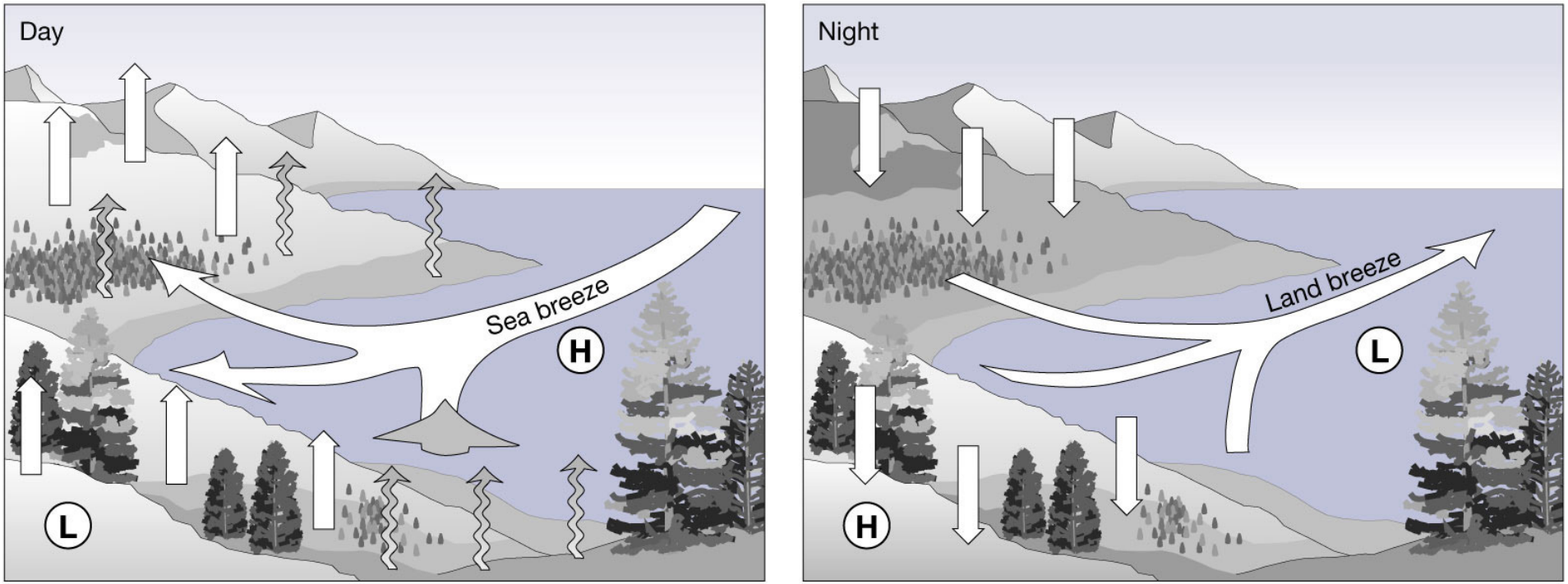
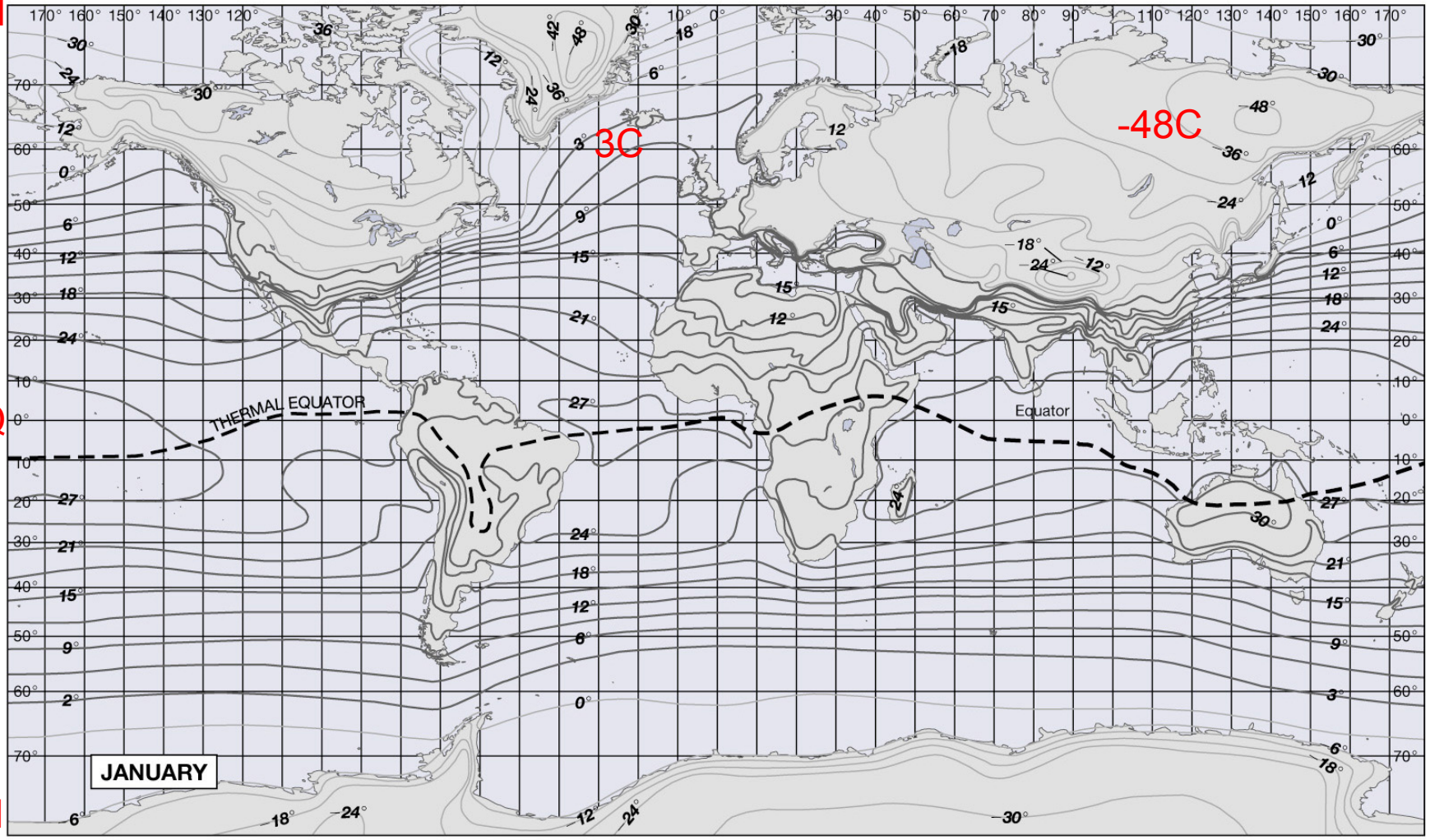


Fig. 4-17

1. Continentality: January

Latitudes: NH / EQ / SH

Temperature



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)

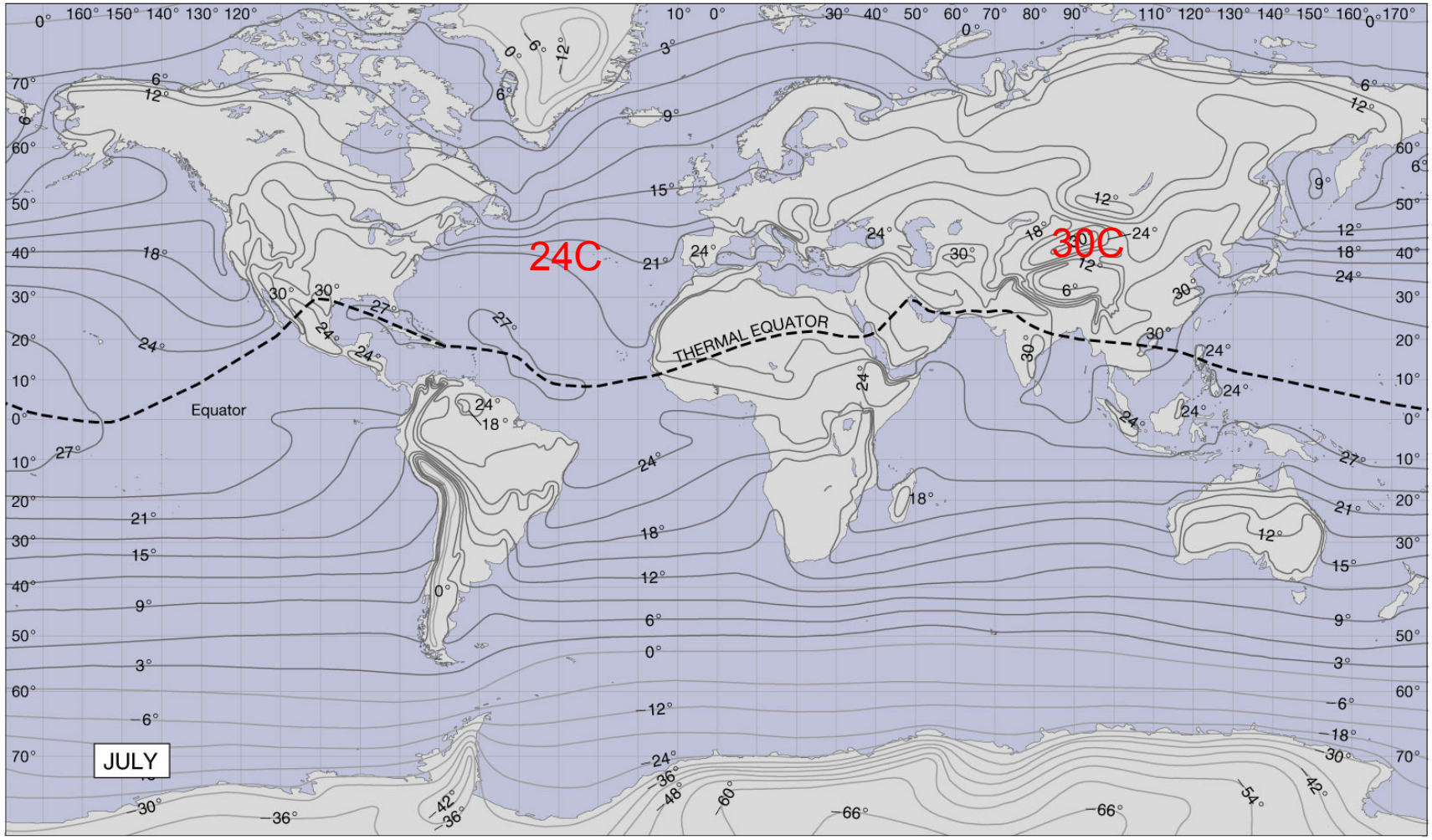
Fig. 4-18a

July

NH

EQ

SH



0 1500 3000 Miles

0 1500 3000 Kilometers

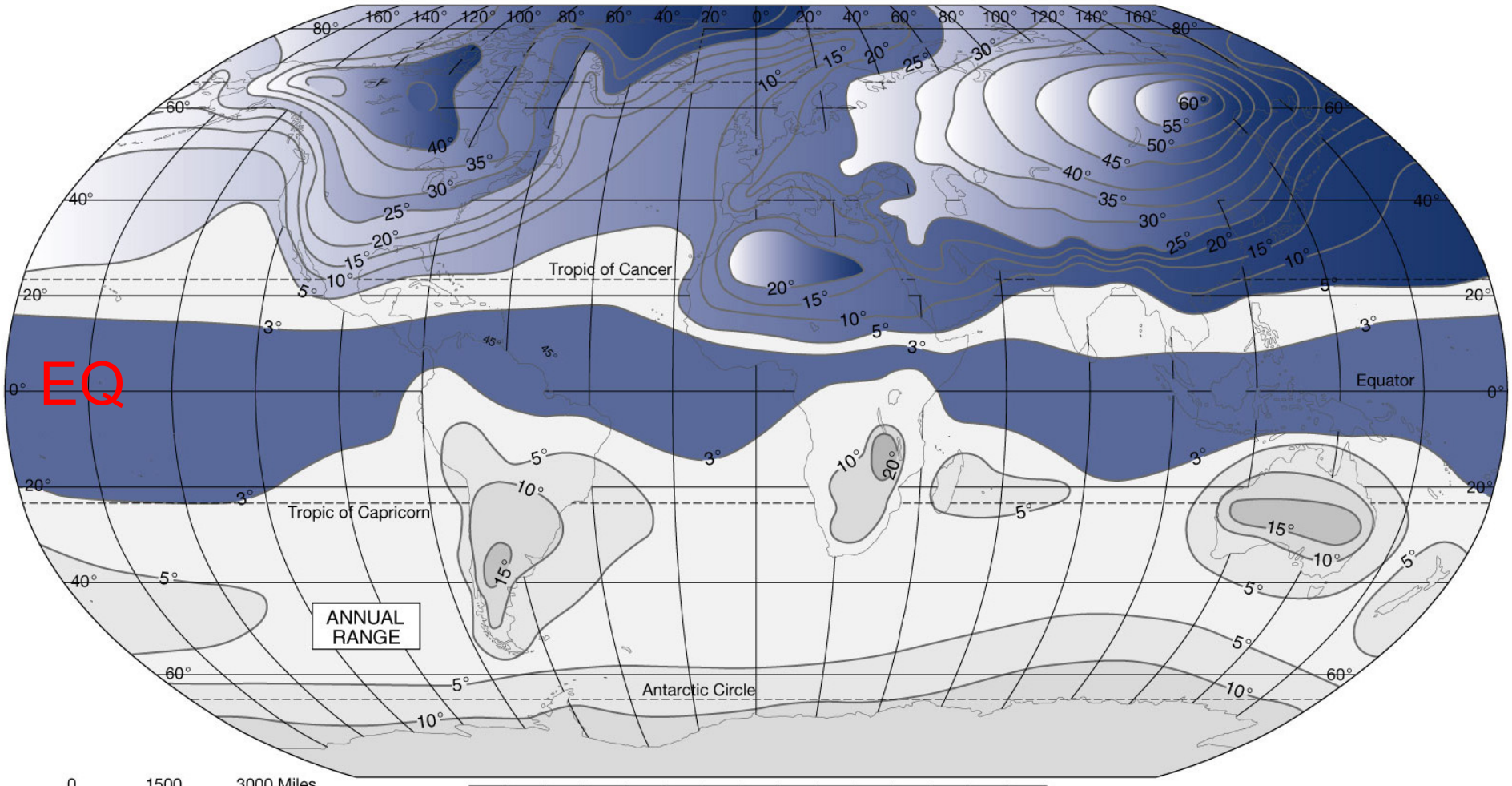
°F -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100 110 120 °F

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

Fig 4-18b

(b)

Temperature difference between summer and winter

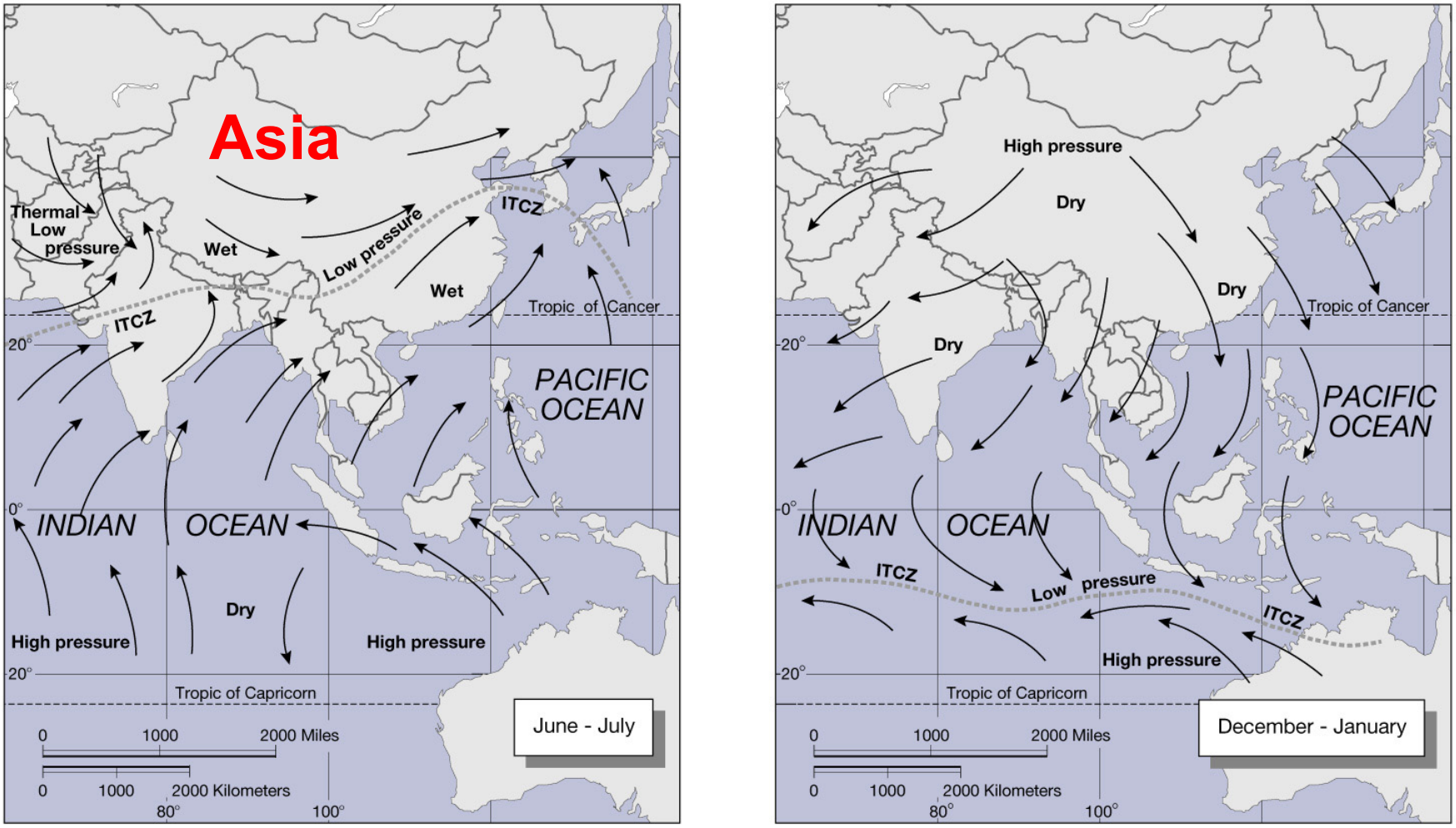


F°	5	9	18	27	36	45	54	63	72	81	90	99	108	F°
C°	3	5	10	15	20	25	30	35	40	45	50	55	60	C°

(c)

Fig 4-18c

Monsoons



(a) (b)

Fig 4-21

2. Global distribution of rainfall

The global hydrological cycle: water phase change

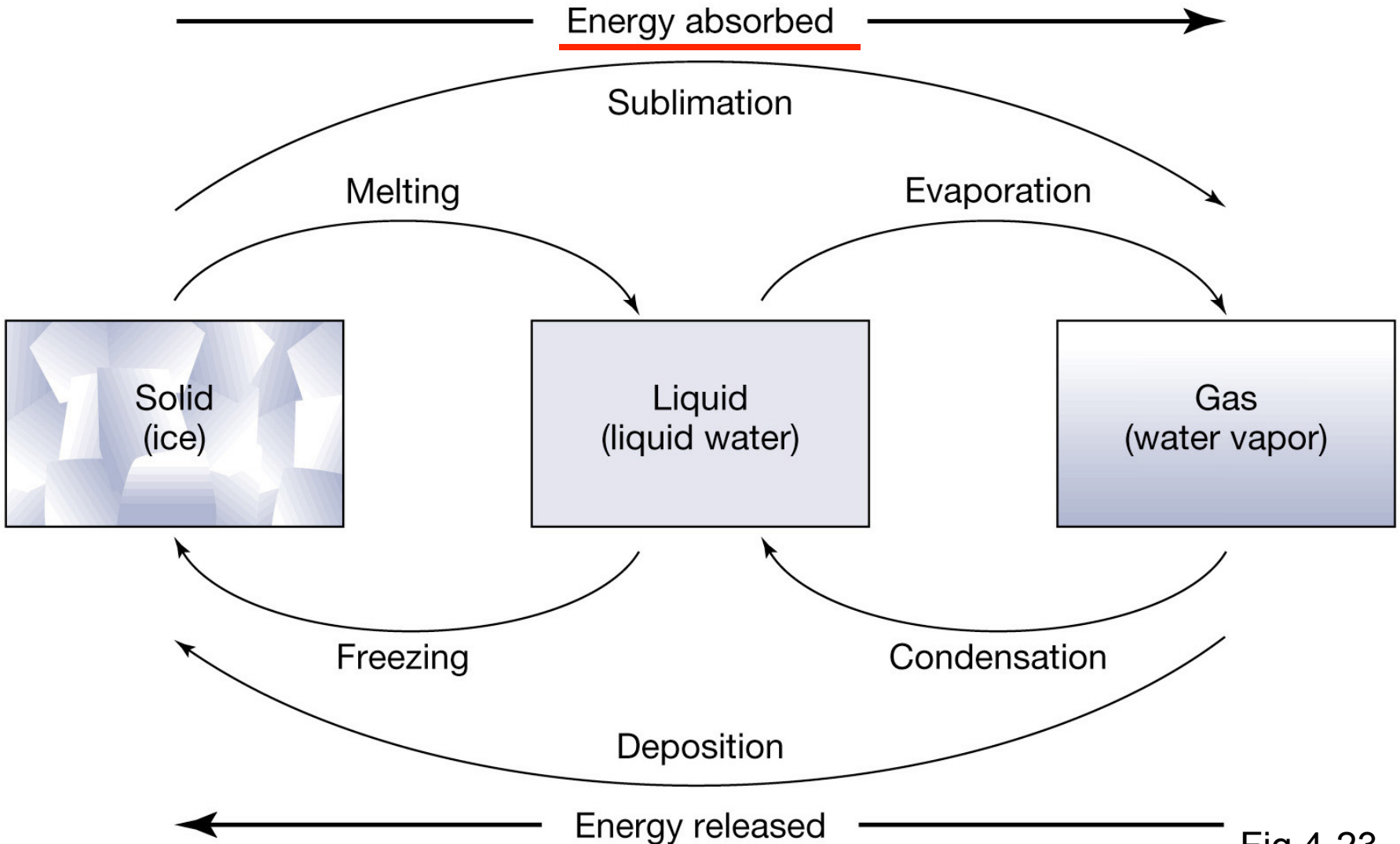


Fig 4-23

At sea level pressure:

Latent heat of vaporization: the energy needed to convert 1kilogram (kg) liquid water to water vapor:

2260kJ/kg at 100C;

Latent heat of fusion (melting): the energy needed to convert 1kg ice to liquid water: 335kJ/kg at 0C;

To raise the temperature of liquid water from 0C to 100C requires 419kJ/kg.

To convert 1kg ice to water vapor thus takes:

335+419+2260=3014kJ/kg.

Transports: important for energy balance

Water in the Earth system: reservoirs and cycles

The oceans - sea water;
The land surface - ice sheets, glaciers, snow, lakes, rivers, ground water;
The atmosphere - water vapor and clouds.

These reservoirs and the pattern of water storage and movement throughout the system comprise the global hydrologic cycle.

Global hydrological cycle

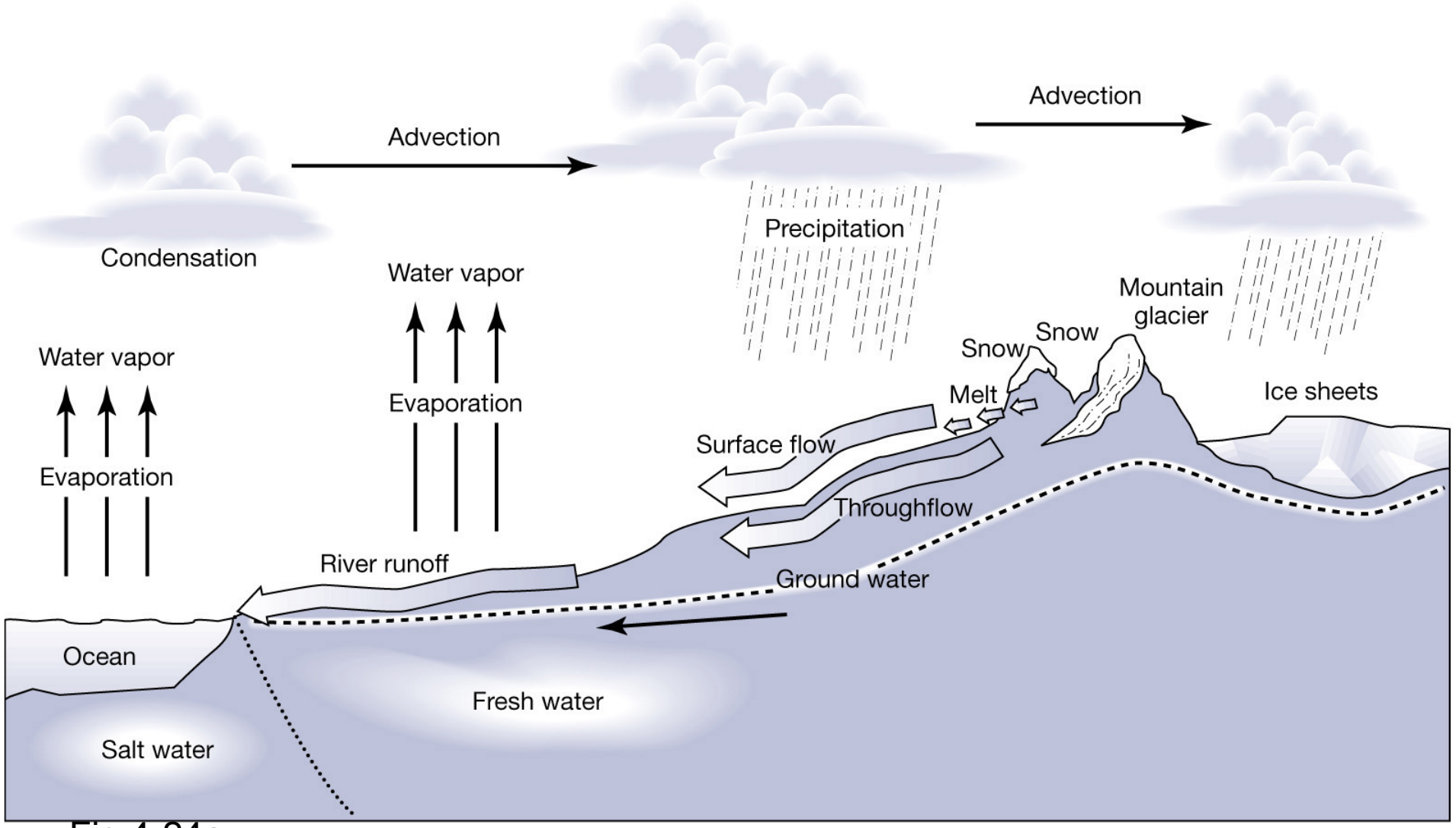


Fig 4-24a

Water Storage: (1)+(2)+(3)=100%

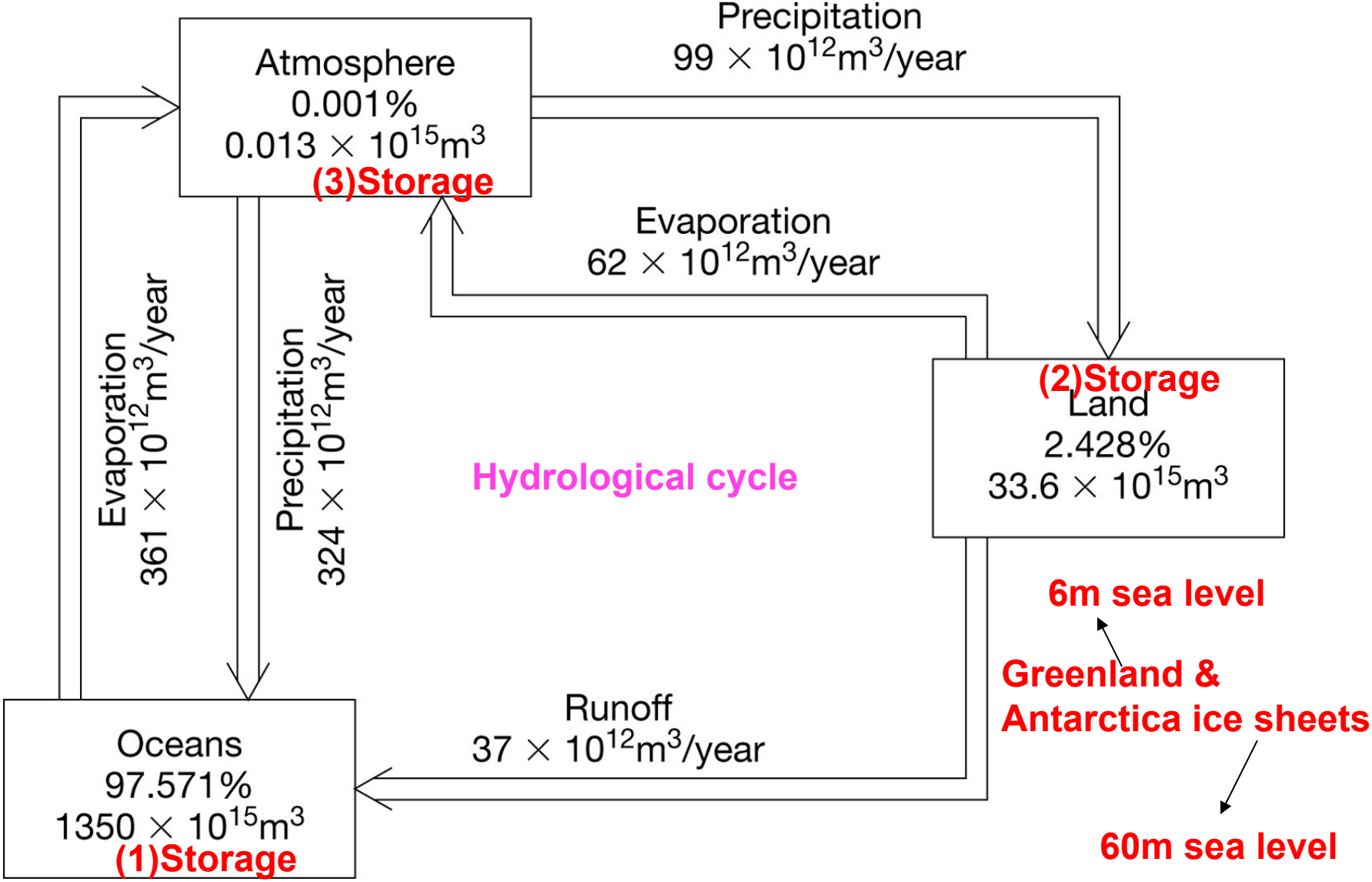


Fig 4-24b

(b)

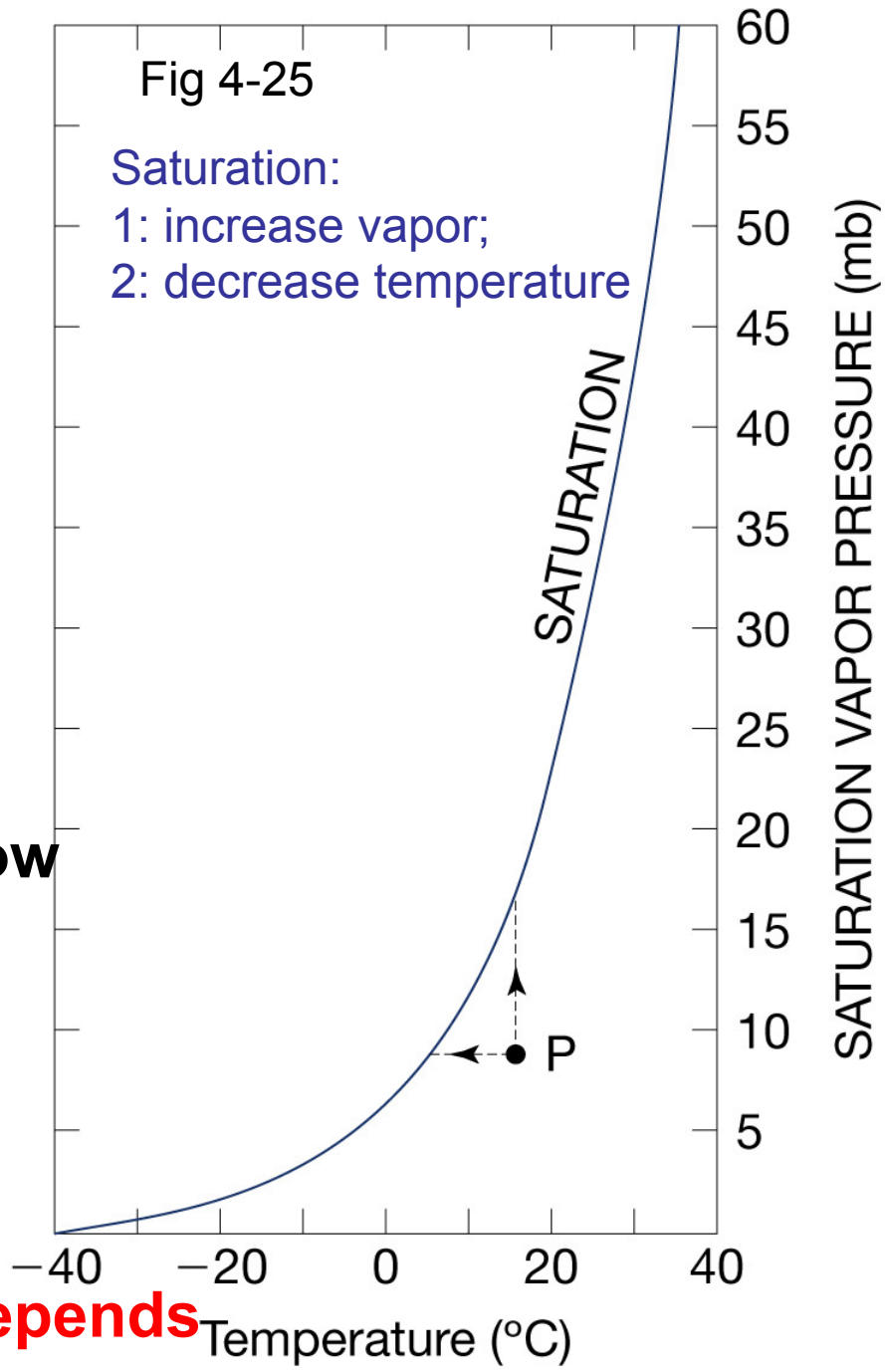
Precipitation and saturation vapor pressure

Land-ocean-atmosphere water transfer: evaporation & precipitation;

Precipitation: atmospheric water vapor condenses to form small droplets of liquid water - grow big - rainfall/snow

One way of expressing the amount of water vapor in the atmosphere: vapor pressure;

Saturation vapor pressure: depends on temperature;



Relative humidity: Ratio of actual vapor pressure to the saturation pressure at the same temperature; (percentage: 100%, saturated);

Precipitation: supersaturation;
Cloud condensation nuclei (CCN), aerosols.

How to make air saturated? Drop T & increase evaporation - forced uplifting (polar front) & convection (ITCZ);

Global precipitation

Polar front zone

ITCZ

Uplifting near mountain range;

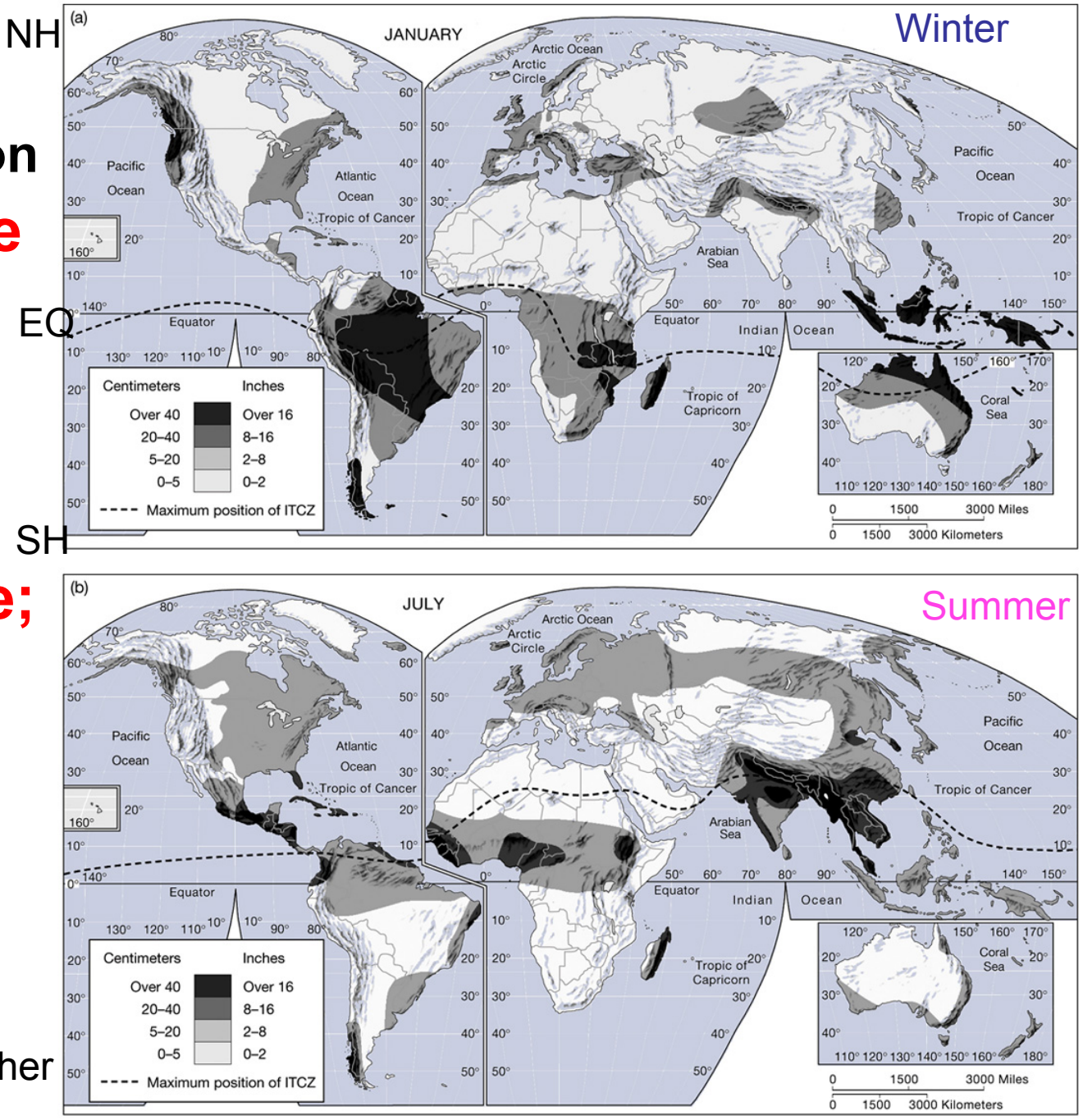


Fig 4-26
The darker the higher

Deserts:

Descending branch of Hadley circulation

Farther inland away from moisture sources

Leeward slopes of mountains

Cold currents, littoral (alongshore) deserts

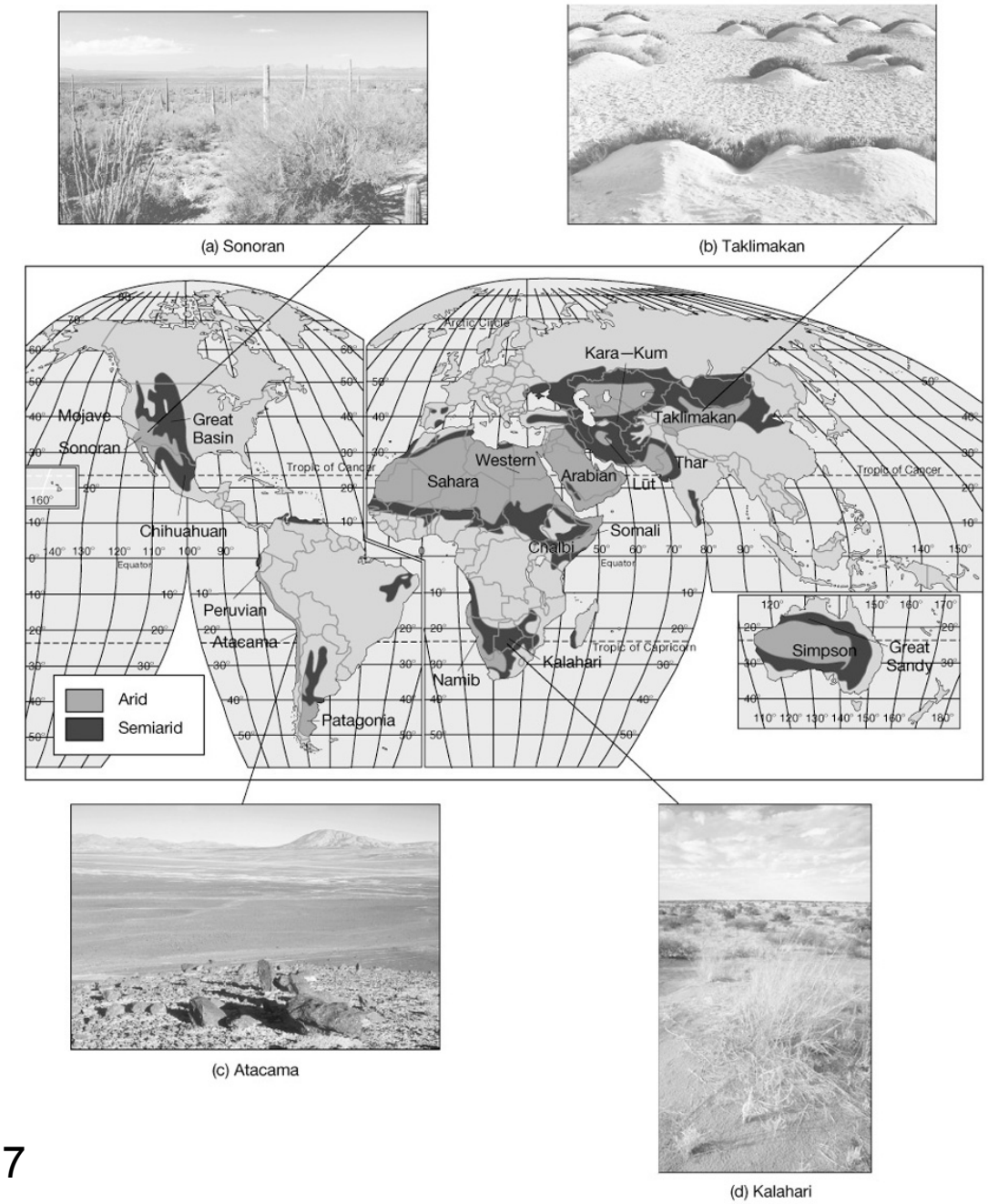


Fig 4-27

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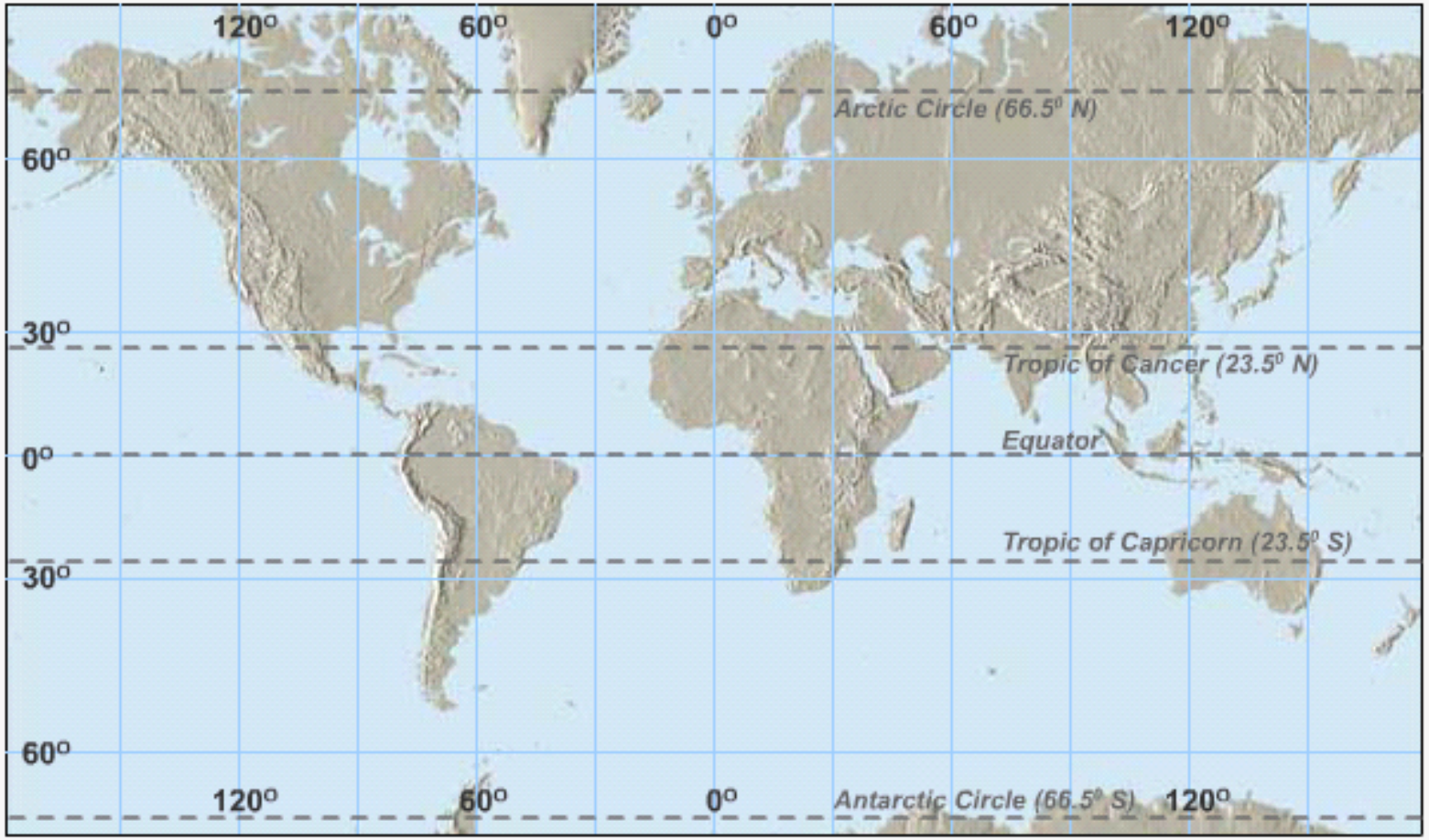

Labels Off

Show Hadley Cells Profile

Show ITCZ

Show Pressure

Show Precipitation

Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.