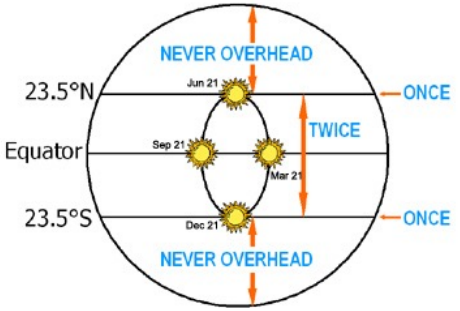
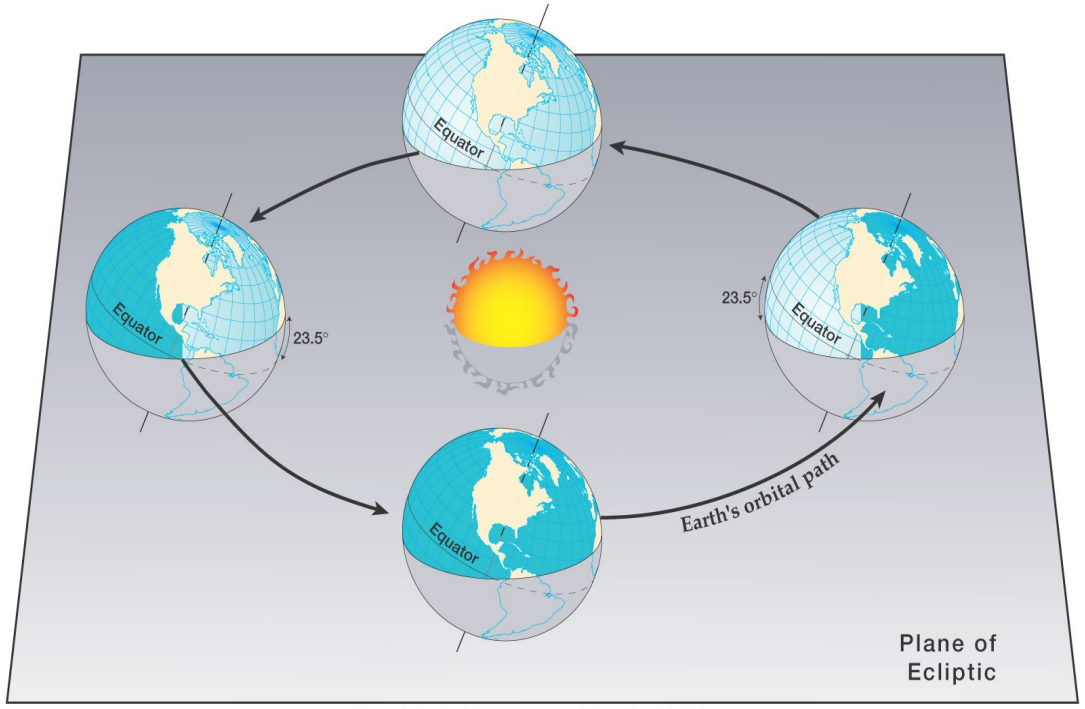
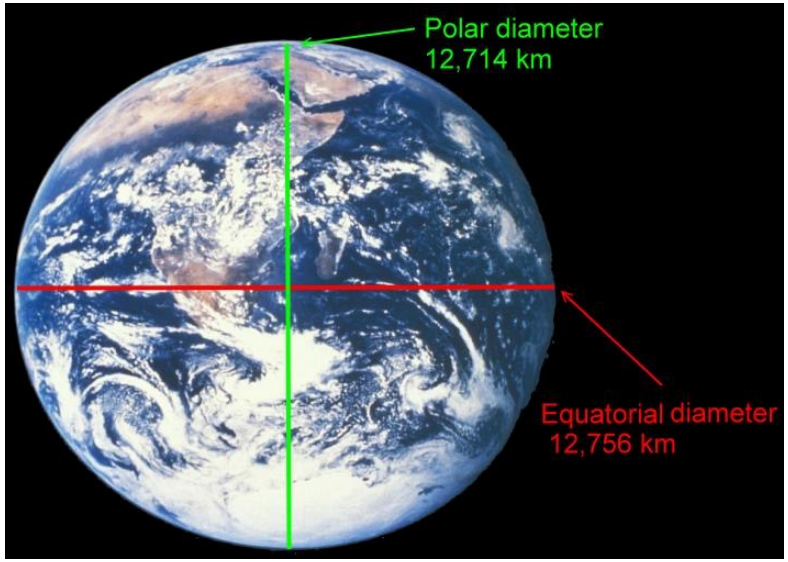
What, and where, are the tropics?

Geography: The region of the Earth bounded by the Tropic of Cancer (23.5° N) and the Tropic of Capricorn (23.5° S), where the sun reaches the zenith once per year at the summer solstices.



The region between 30° N and 30° S that divides the Earth into two equal halves.





What, and where, are the tropics?

Processes: The tropics are those parts of the world where atmospheric processes differ significantly from those at higher latitudes (Riehl 1979).

~ The tropics are different from the midlatitudes in two primary ways:

1) **Dynamical constraint** (i.e., the equations of motion):

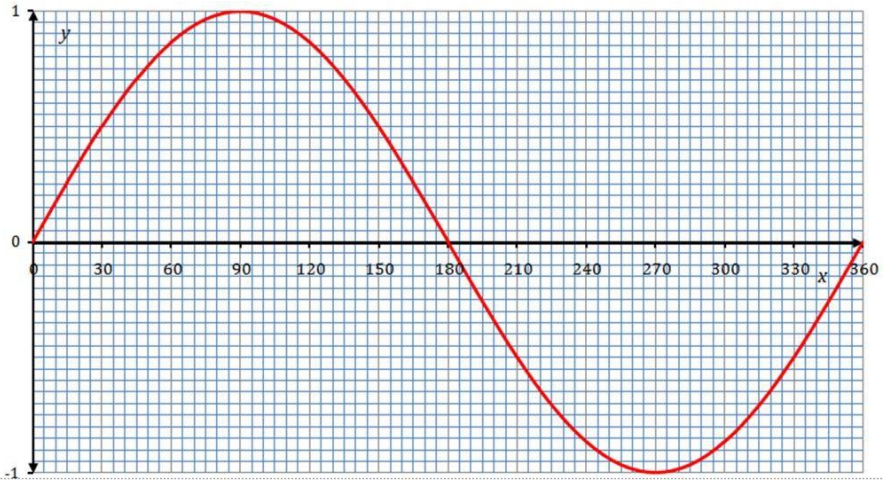
Midlatitudes: Governed by geostrophic, or quasi-geostrophic, balance:

Pressure gradient force ≅ Coriolis force

$$-\frac{1}{\rho}\vec{\nabla}p \cong 2\Omega\sin\phi\ (\text{or}\ f)\vec{V}$$

Tropics: The Coriolis force goes to zero at the equator, **BUT** the meridional gradient of the Coriolis force is large:

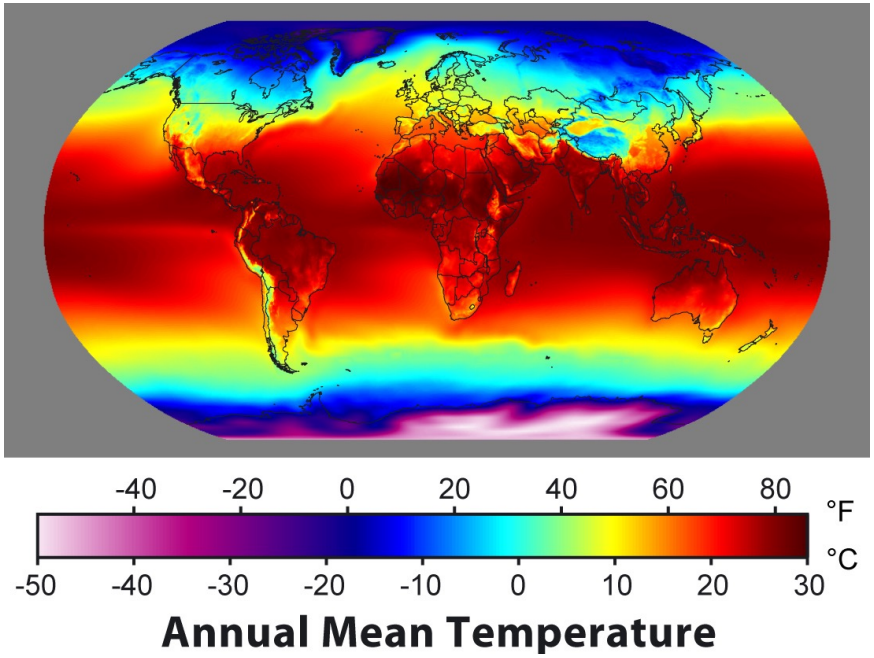
$$\frac{df}{dy} = \beta >>> 0$$

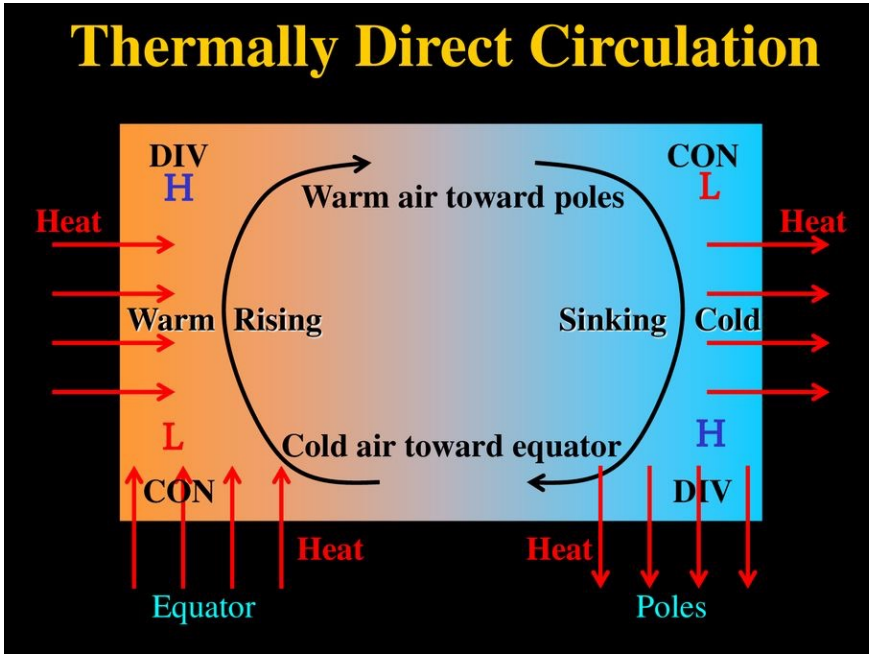


What, and where, are the tropics?

2) **Energy source that drives disturbances:**

Midlatitudes: Large temperature gradients (baroclinicity; potential energy) is converted into kinetic energy (wind!) via thermally direct circulations (warm air rising & cooling; cold air sinking & warming) in an attempt to achieve equilibrium

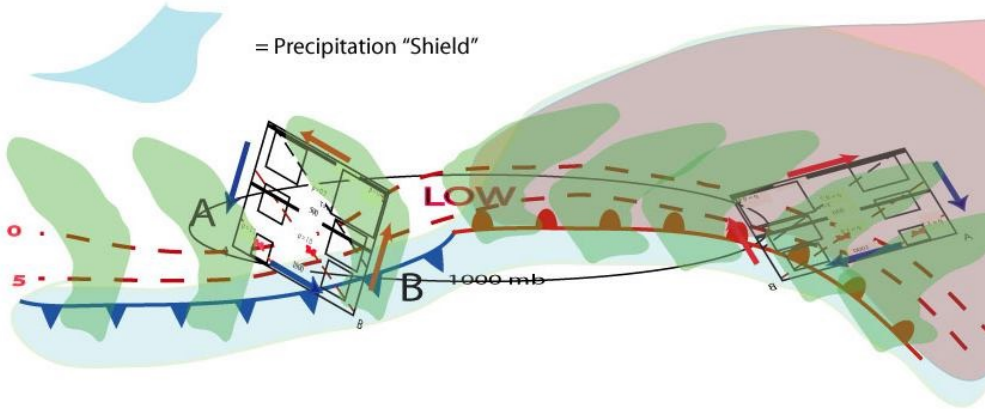


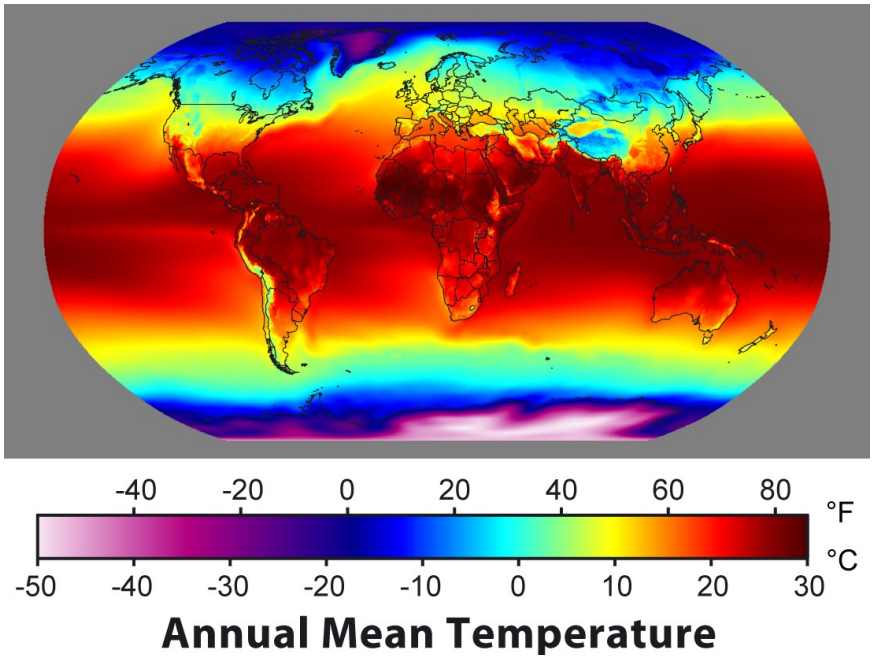


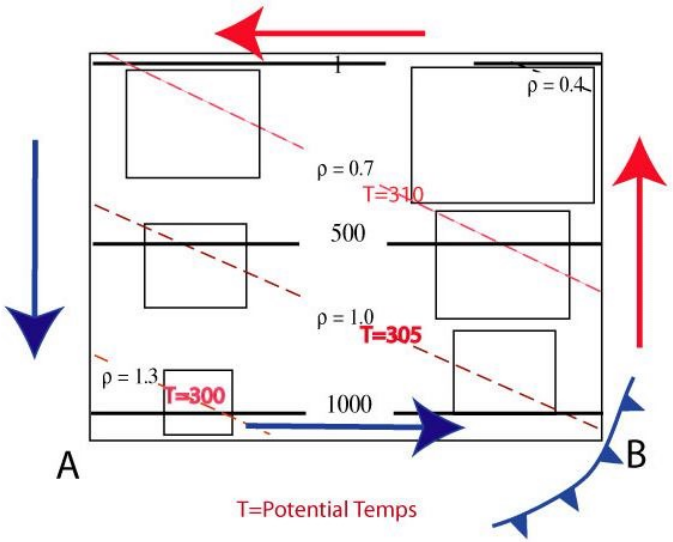
What, and where, are the tropics?

2) Energy source that drives disturbances:

Midlatitudes: Large temperature gradients (baroclinicity; potential energy) is converted into kinetic energy (wind!) via thermally direct circulations (warm air rising & cooling; cold air sinking & warming) in an attempt to achieve equilibrium



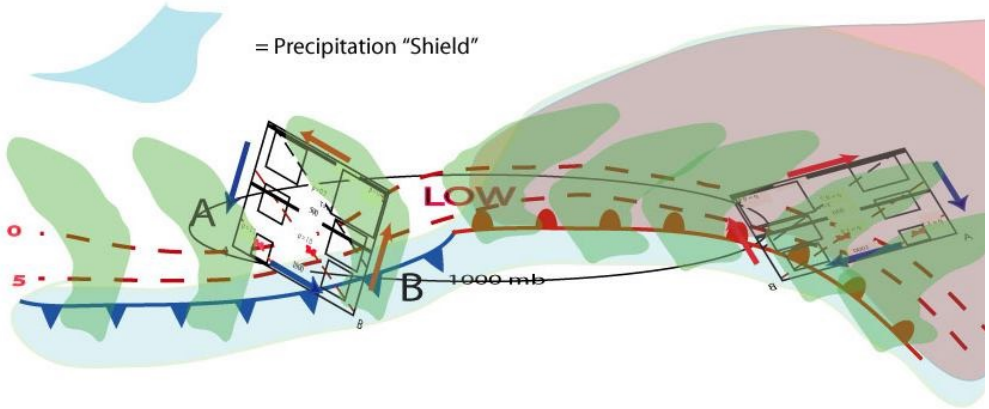


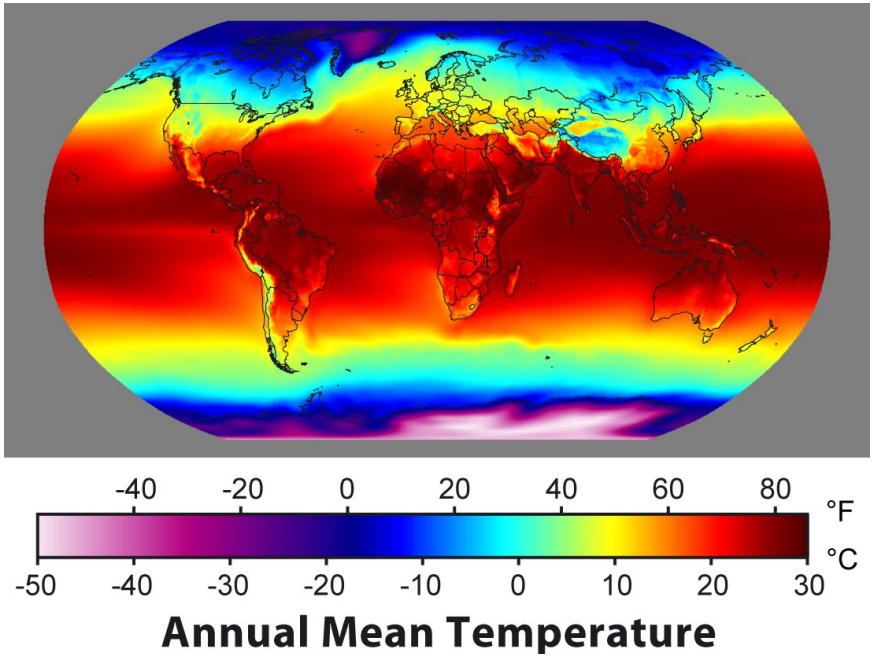


What, and where, are the tropics?

2) Energy source that drives disturbances:

Midlatitudes: Large temperature gradients (baroclinicity; potential energy) is converted into kinetic energy (wind!) via thermally direct circulations (warm air rising & cooling; cold air sinking & warming) in an attempt to achieve equilibrium



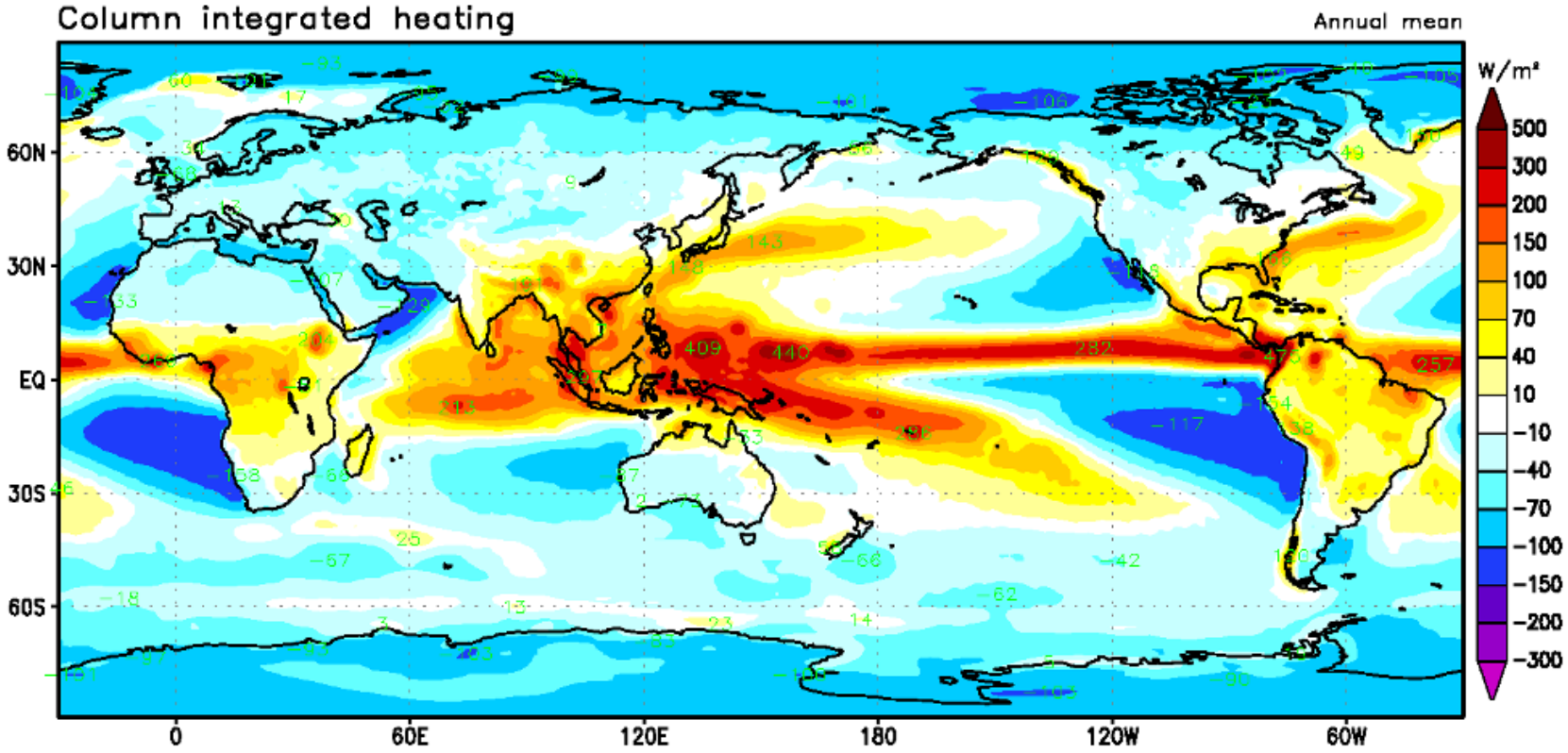


What is the primary energy source for tropical disturbances (and a secondary source for midlatitude storms)?

What, and where, are the tropics?

2) <u>Energy source that drives disturbances</u>:

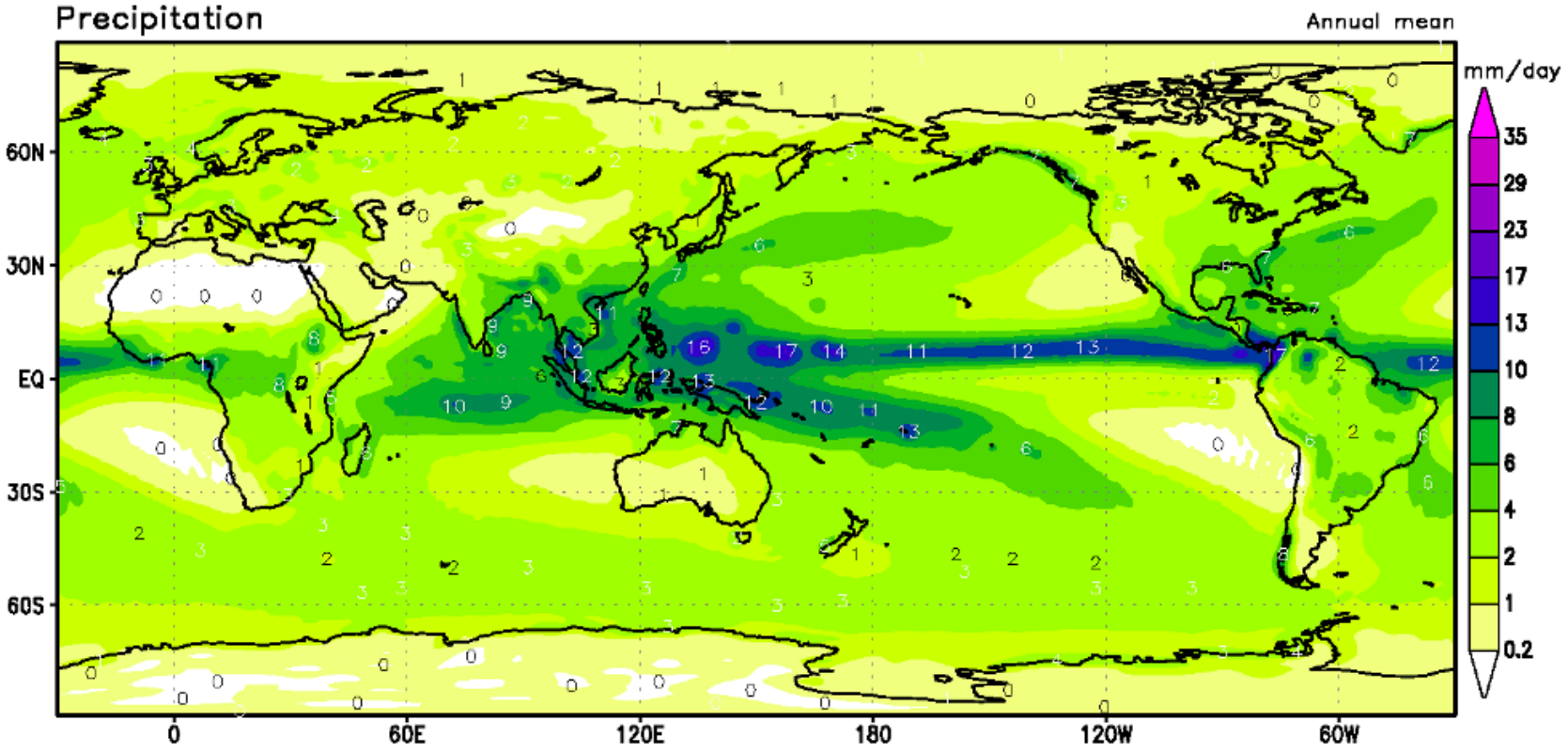
<u>Tropics</u>: Latent heating (the #2 energy source in the midlatitudes), intimately tied to evaporation over the **warm oceans** and **moist convection**, is the driver of tropical weather systems (tropical cyclones, the Madden–Julian Oscillation, etc.).



What, and where, are the tropics?

2) **Energy source that drives disturbances:**

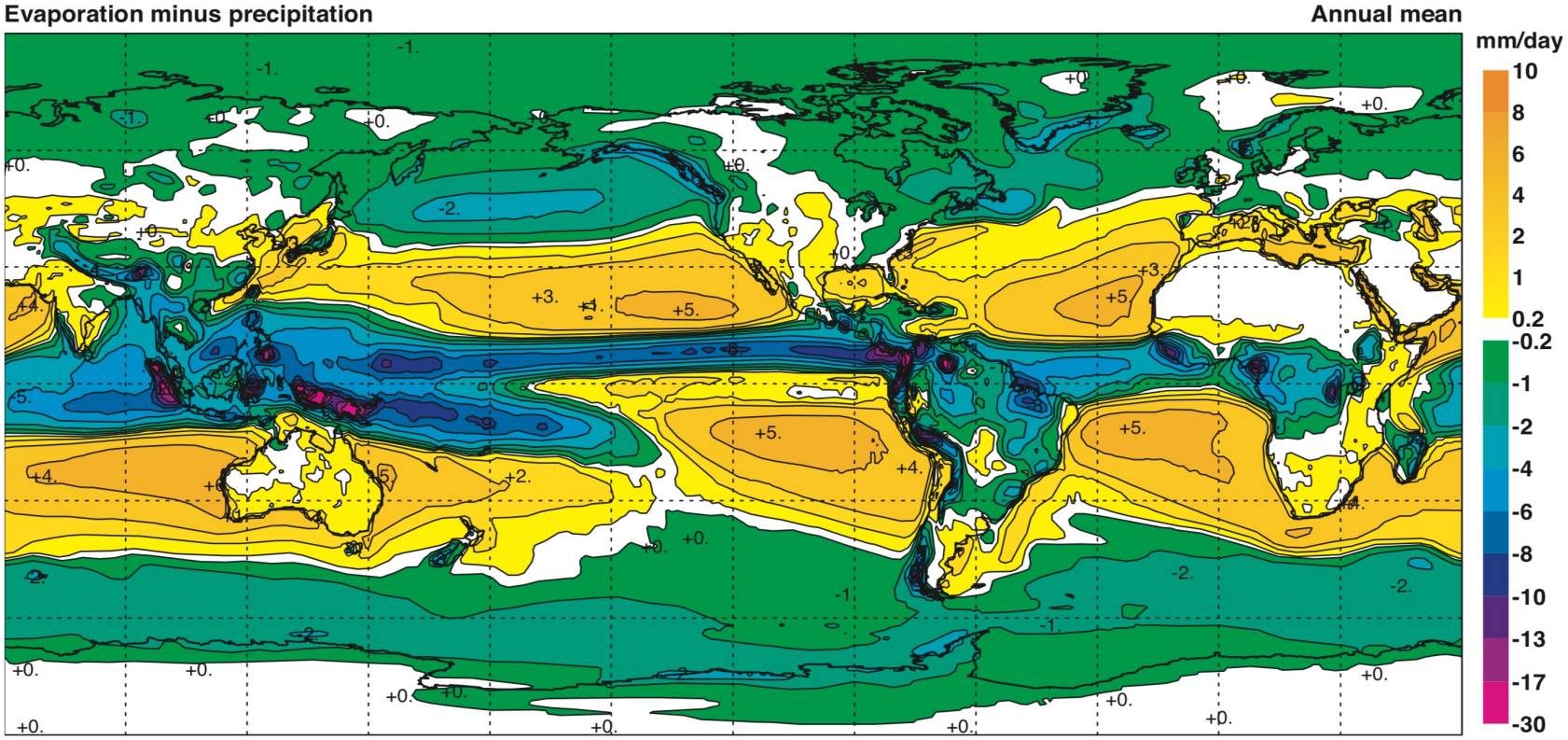
Tropics: Latent heating (the #2 energy source in the midlatitudes), intimately tied to evaporation over the **warm oceans** and **moist convection**, is the driver of tropical weather systems (tropical cyclones, the Madden–Julian Oscillation, etc.).



What, and where, are the tropics?

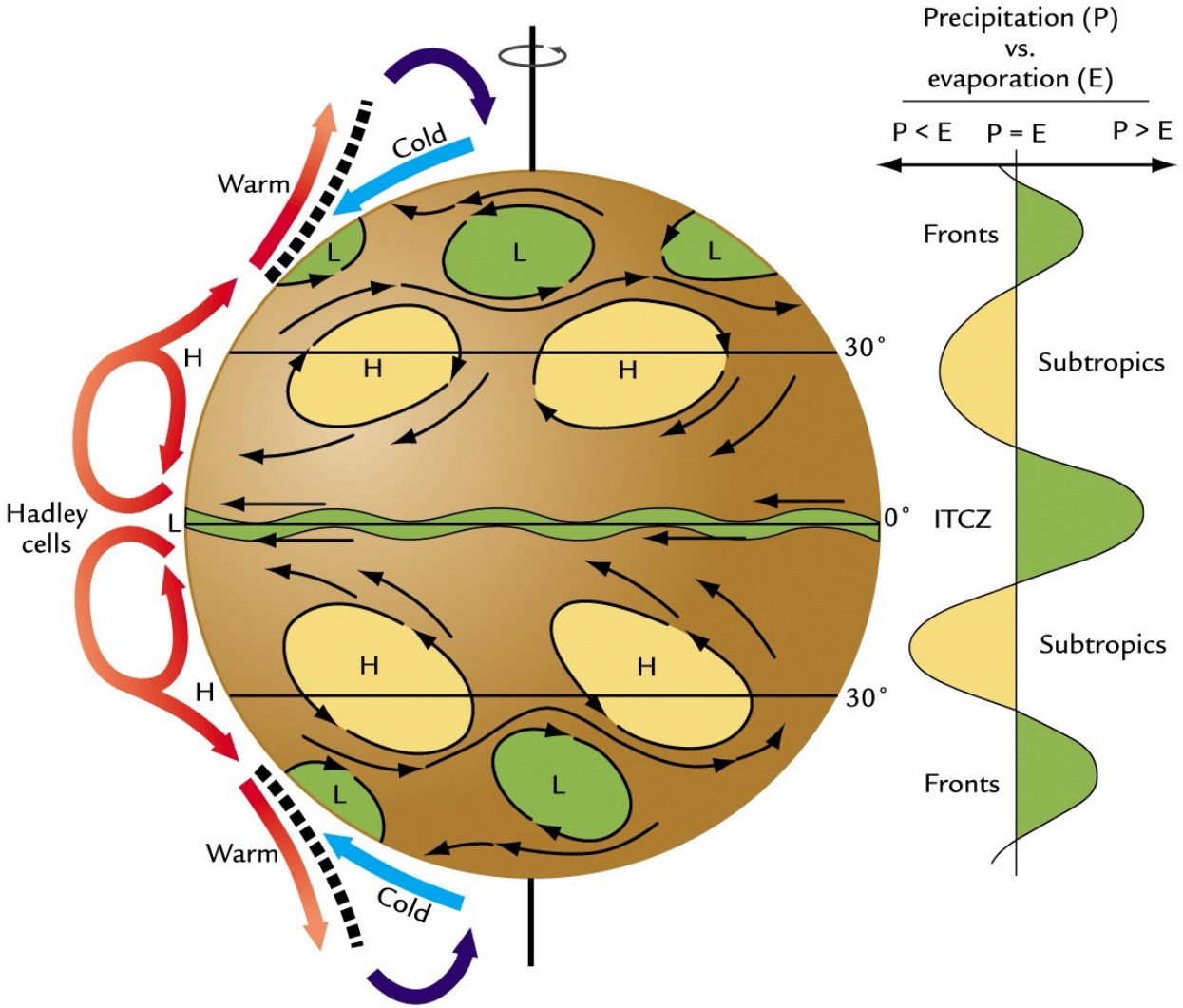
2) Energy source that drives disturbances:

Tropics: Latent heating (the #2 energy source in the midlatitudes), intimately tied to evaporation over the **warm oceans** and **moist convection**, is the driver of tropical weather systems (tropical cyclones, the Madden–Julian Oscillation, etc.).



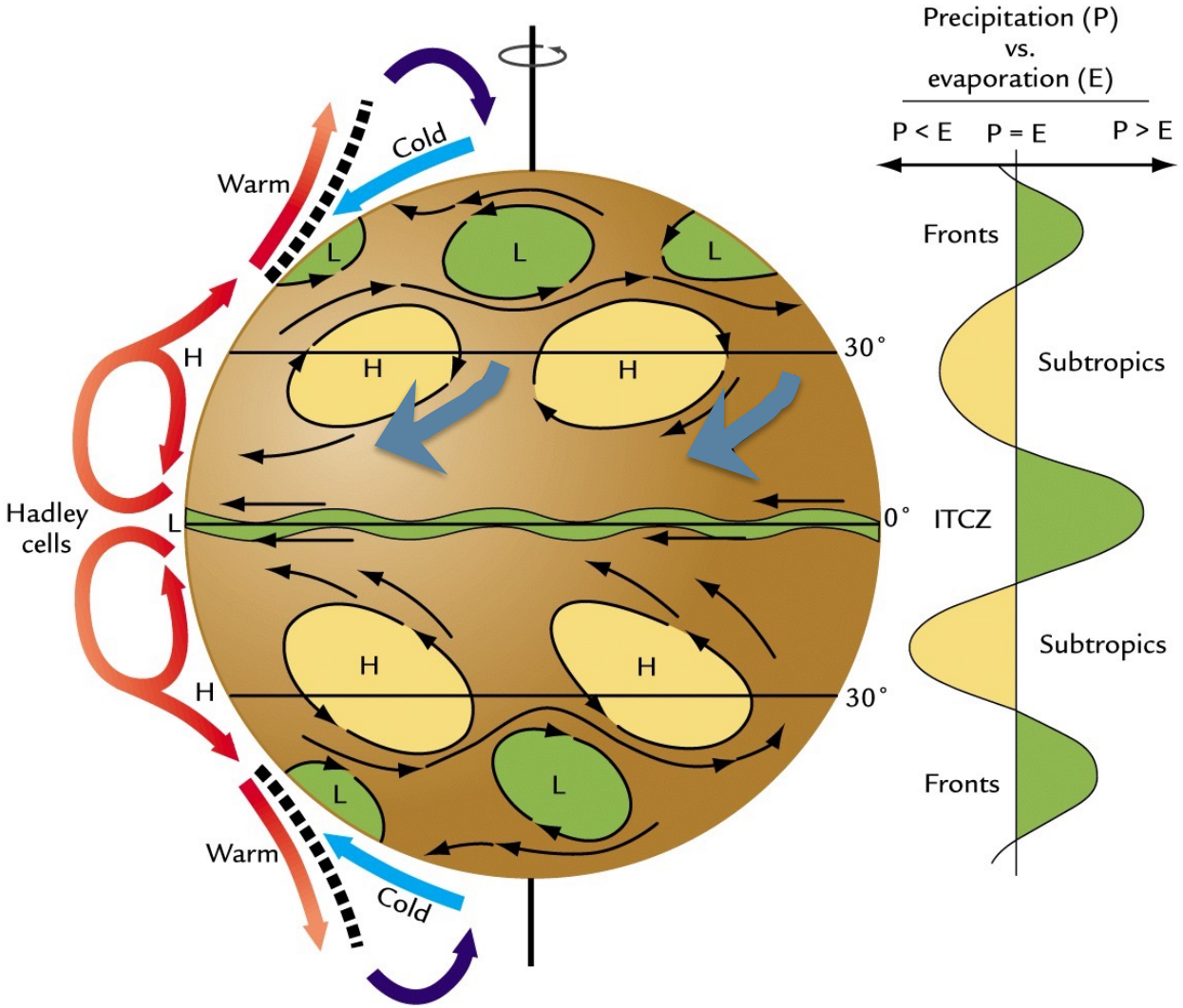
What, and where, are the tropics?

Another defining **characteristic** of the **tropics** is that **precipitation** **exceeds** **evaporation**.

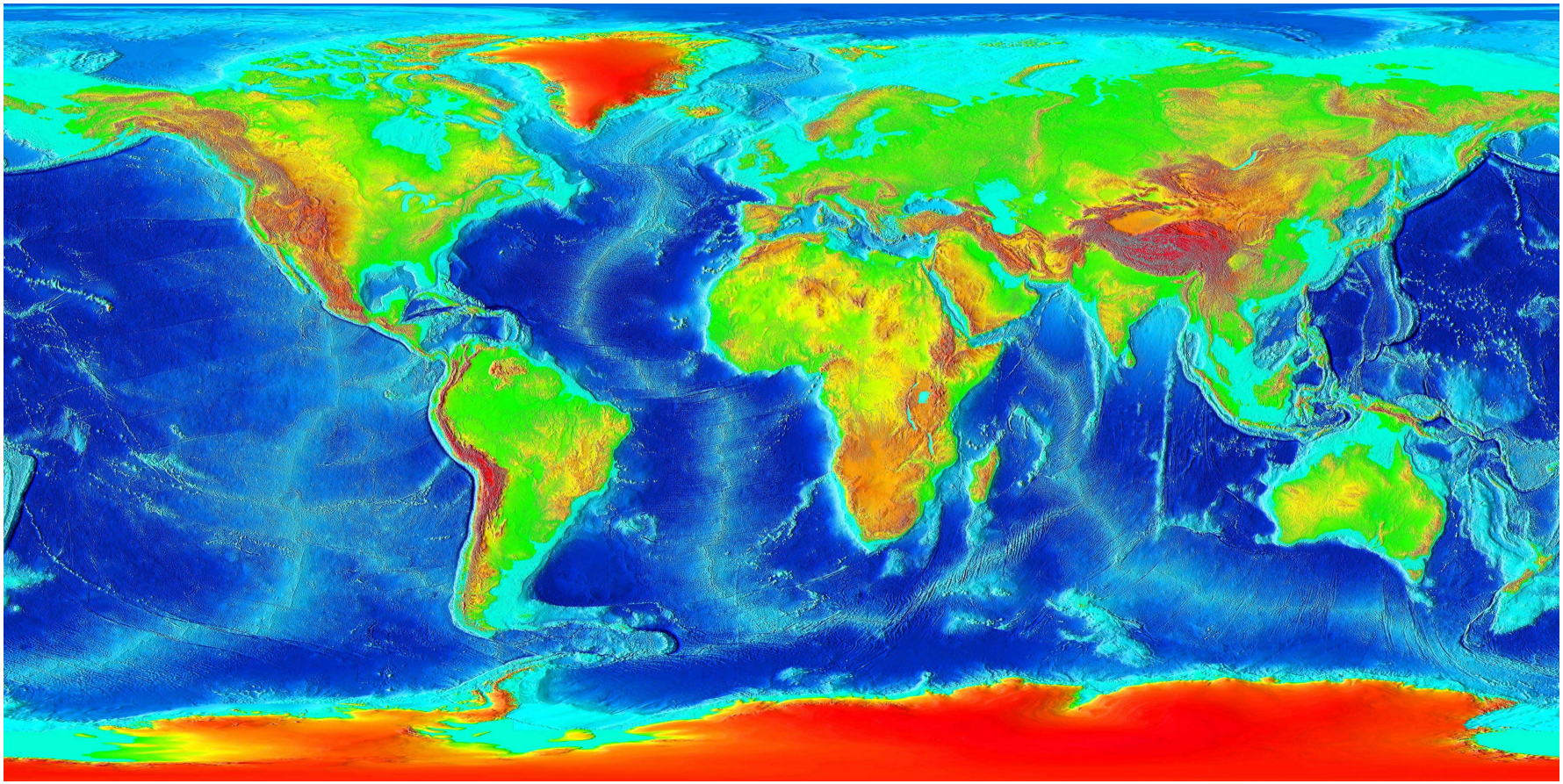


What, and where, are the tropics?

The **moisture** necessary for **precipitation** in the **tropics** is **imported from** the **subtropics**.

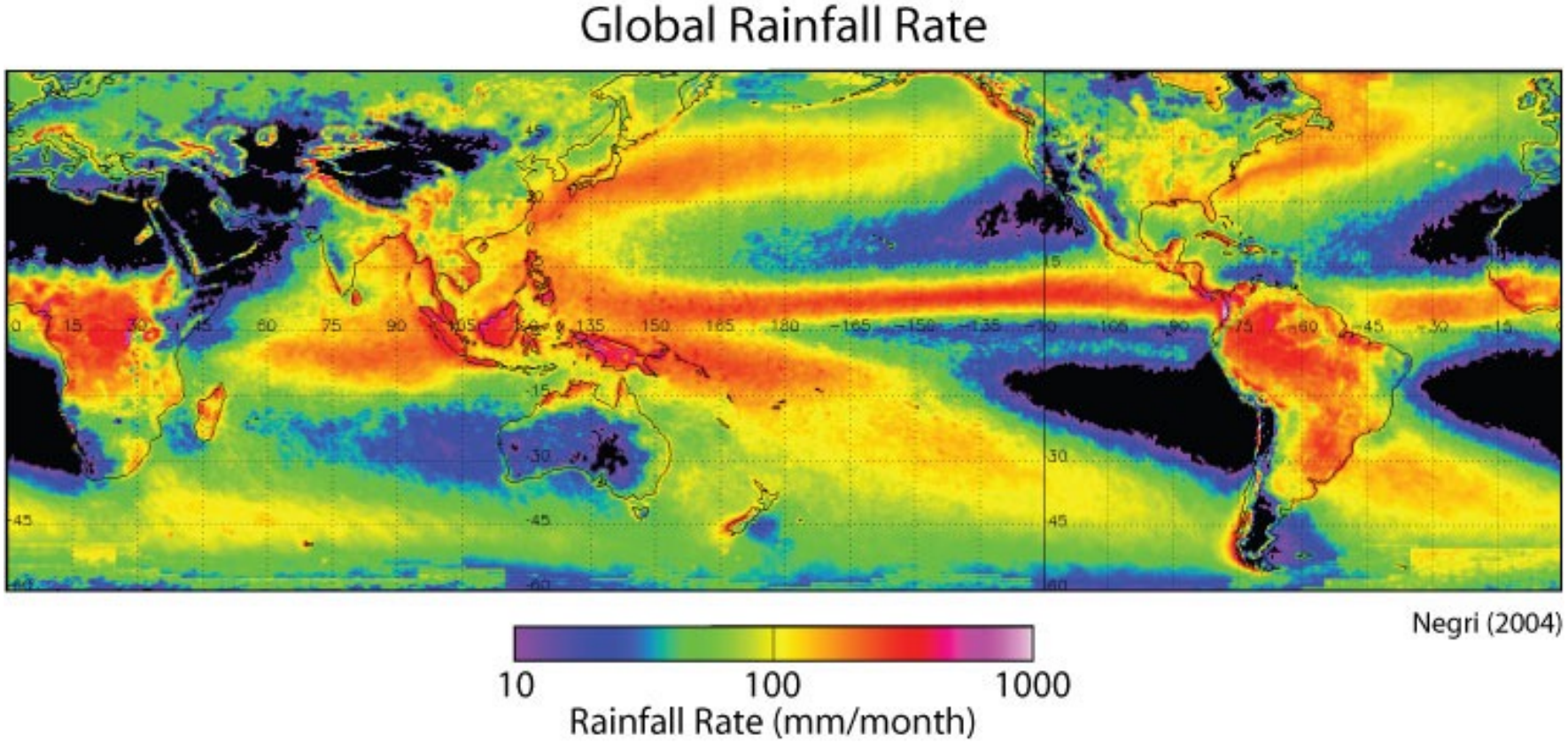


What else makes the tropics special?



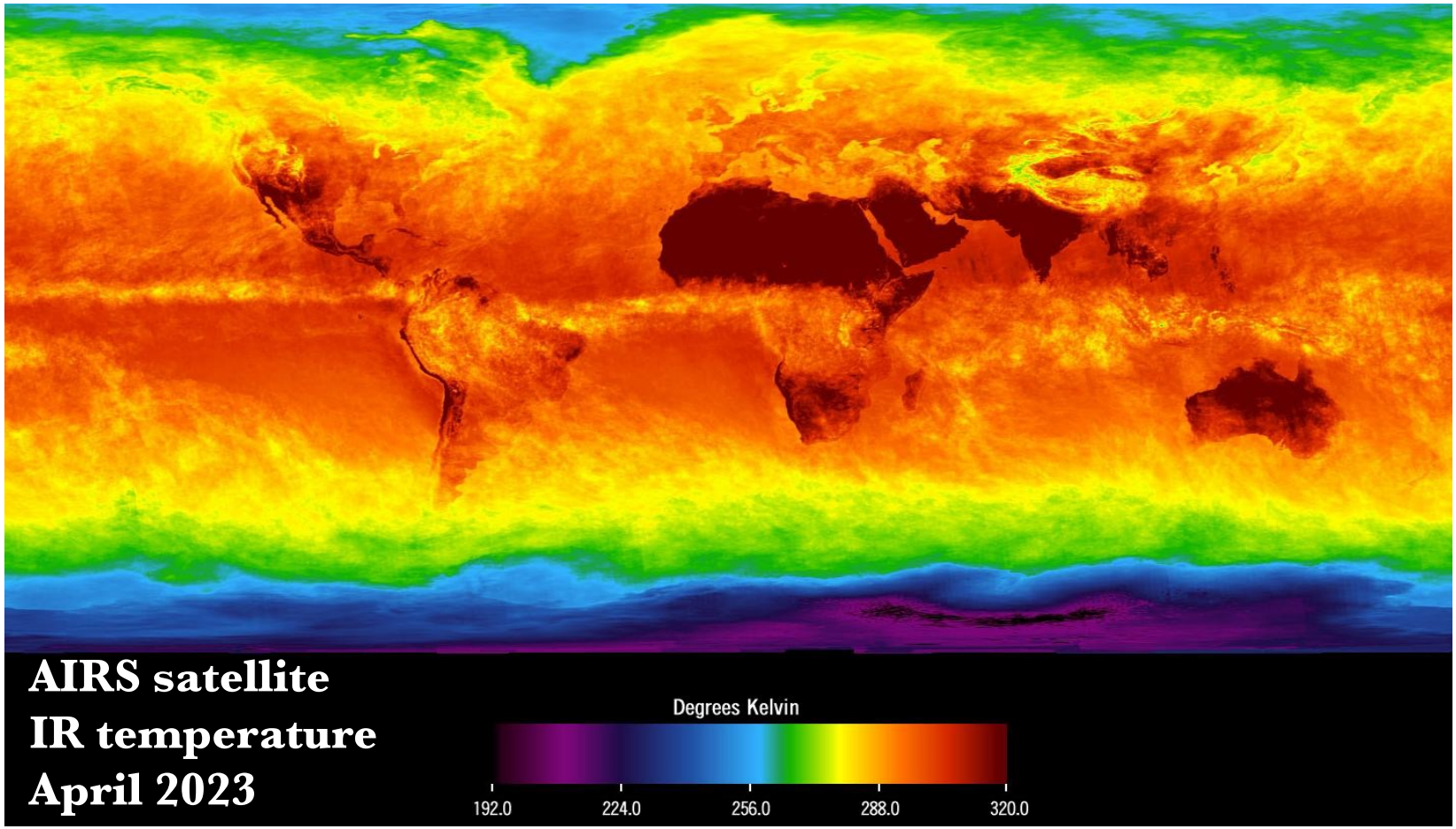
The markedly, non-uniform distribution of **land** and **ocean**, and **topography**, in the tropics will significantly influence the meteorology.

What else makes the tropics special?



The markedly, non-uniform distribution of land and ocean, and topography, in the tropics will significantly influence the **meteorology**.

What else makes the tropics special?



What else makes the tropics special?

Annual (horizontal) and diurnal (vertical) variation of surface temperature

Berlin, Germany (52° N)
Quito, Ecuador (0°)

The **diurnal variation** greatly exceeds the **annual range** in the tropics, while the **annual cycle** is larger than the **diurnal range** in the midlatitudes.

World Climate website