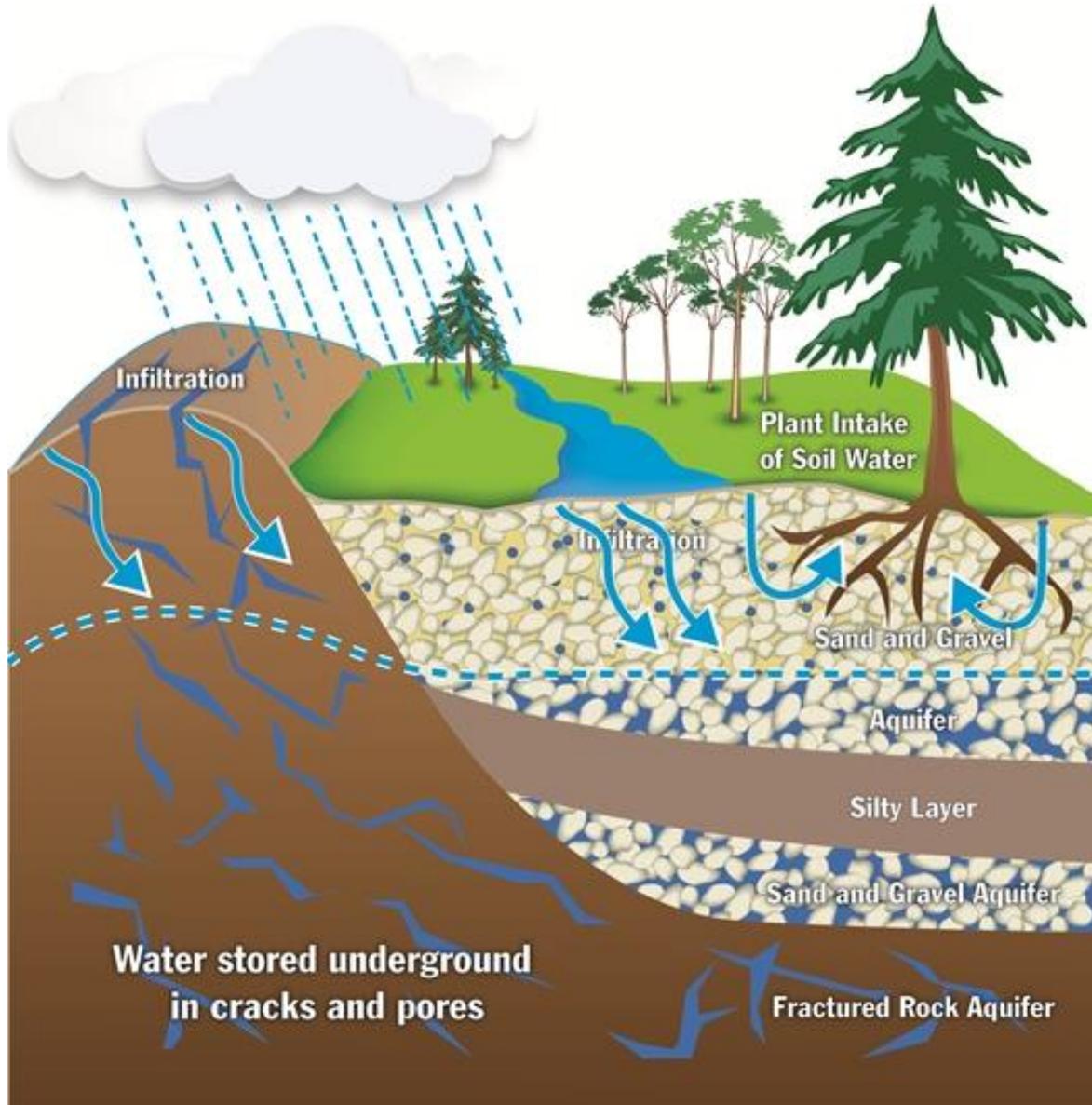


Groundwater



About **1/3** of **all freshwater on the planet** is found underground.

Part air part water
unsaturated zone



Water table



Saturated zone: water fills all pores and cracks

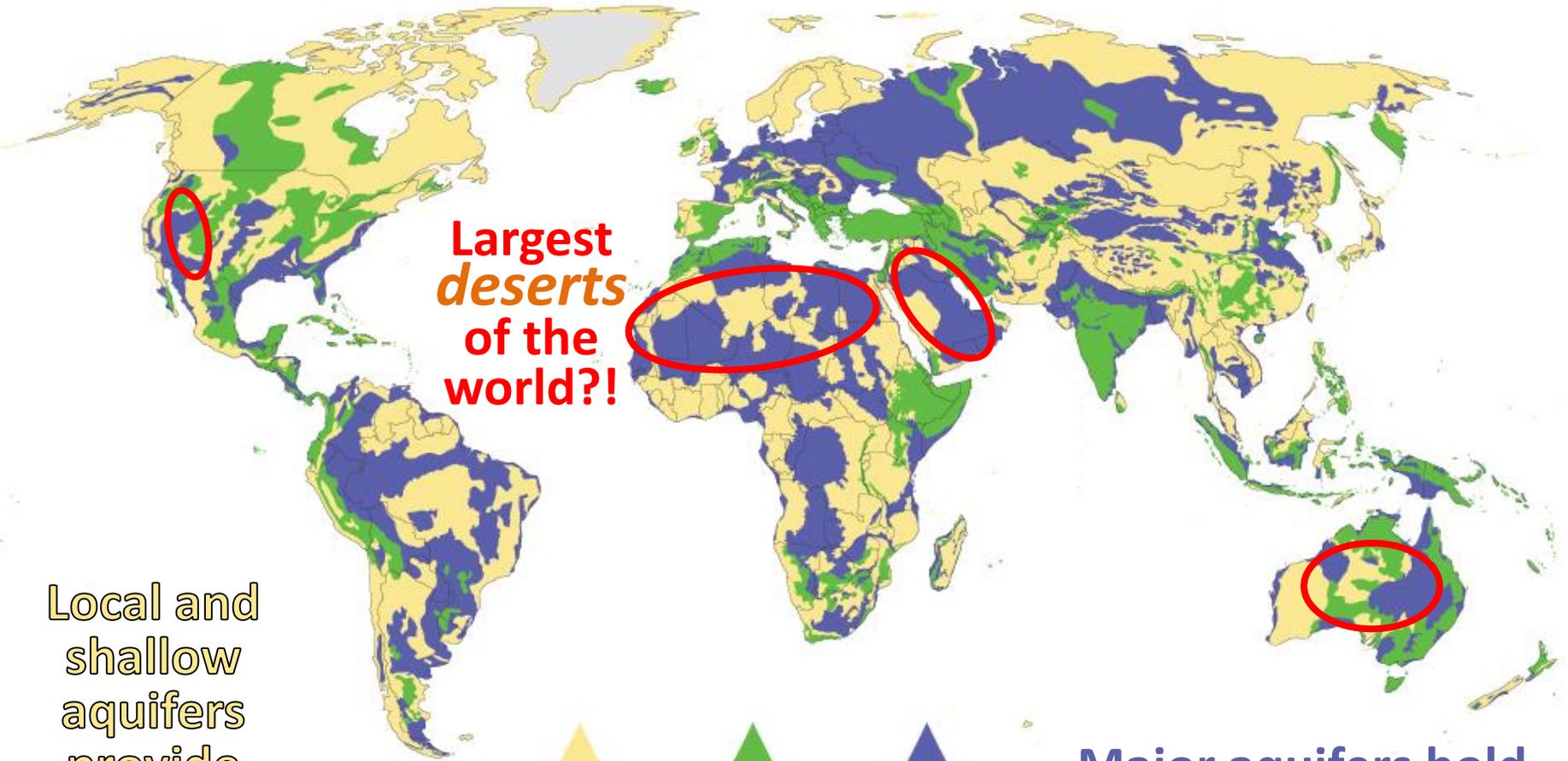
Wetlands

Wetland is an area where the **water table is at, near or above the land surface long enough** during the year to support adapted plant growth.



- Swamp: a wetland dominated by trees
- Bog: a wetland dominated by peat moss
- Marsh: a wetland dominated by grasses

Global Groundwater Resources



Largest
deserts
of the
world?!

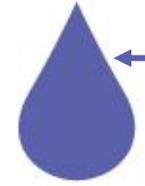
Local and shallow aquifers provide limited quantities of water.



LOCAL AND SHALLOW AQUIFERS



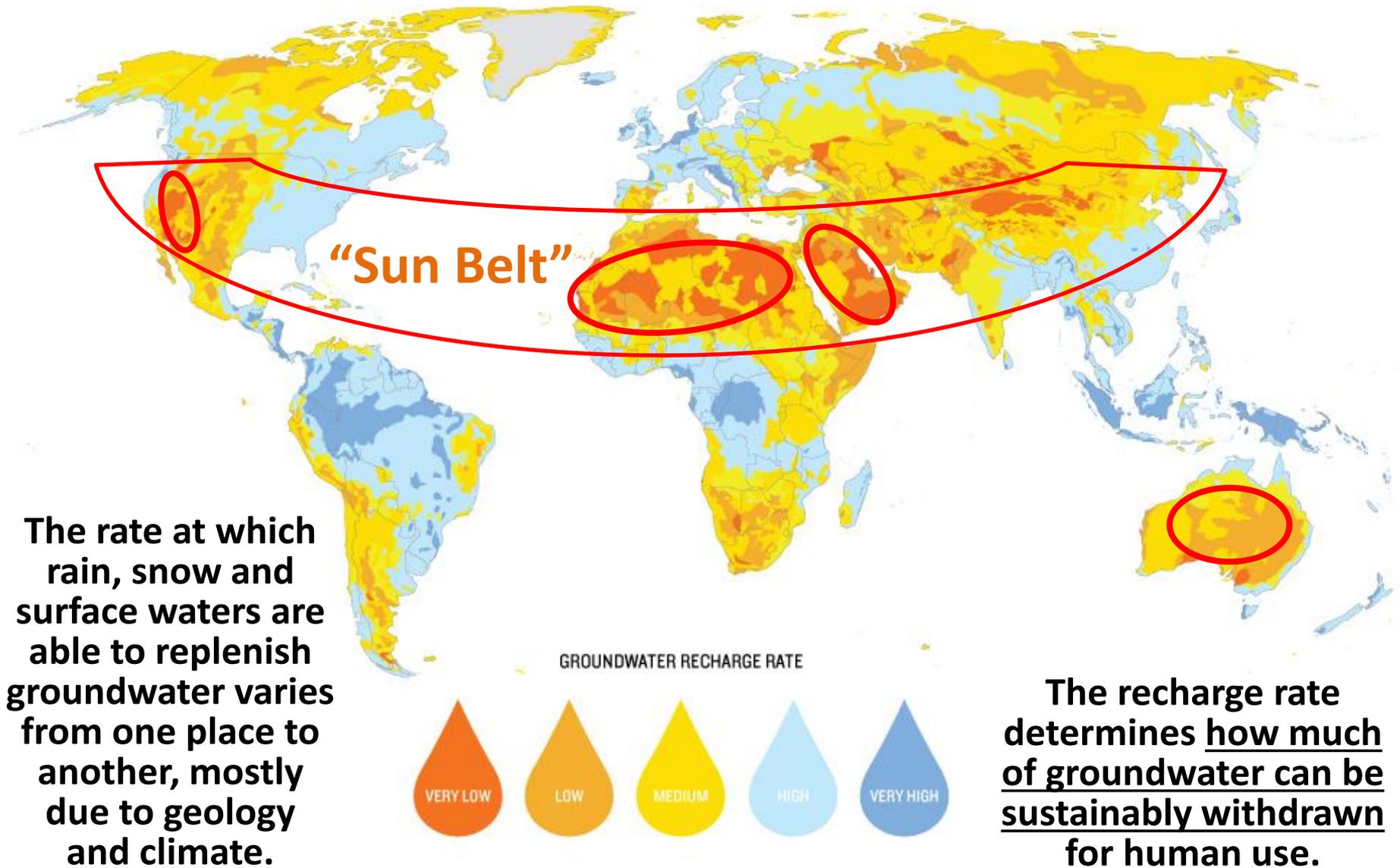
COMPLEX HYDROGEOLOGICAL STRUCTURE



MAJOR GROUNDWATER BASIN

Major aquifers hold abundant, relatively easily extracted groundwater.

Groundwater Recharge

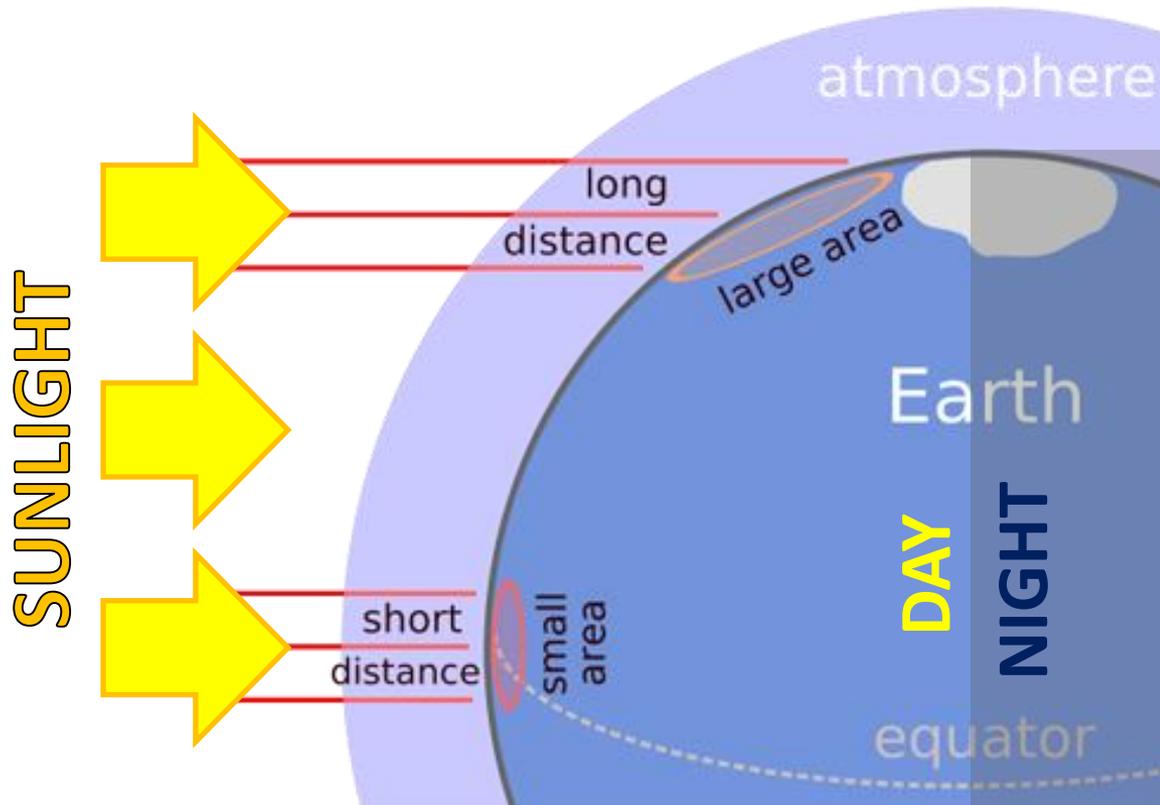


The rate at which rain, snow and surface waters are able to replenish groundwater varies from one place to another, mostly due to geology and climate.

The recharge rate determines how much of groundwater can be sustainably withdrawn for human use.

Angle of Sunlight

Due to the Earth's curvature, the **amount of sunlight (energy)** reaching any given point on the surface **varies greatly with latitude**.

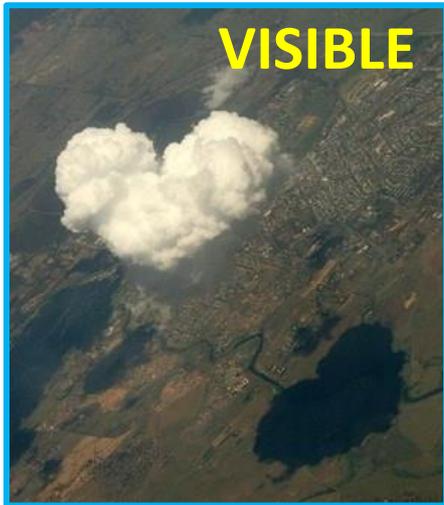


- Regions near the **Equator** receive most direct, that is concentrated Sun rays.
- At **high latitudes**, the same amount of the incoming Sun energy is spread over much greater area of surface.

Sun Belt deserts combine relatively low average precipitation with high moisture removal due to very effective evaporation.

Atmospheric Water

Atmospheric water plays a **crucial role** in the **weather**.



← **Clouds and precipitation**
(water droplets and ice crystals or a mixture of the two)

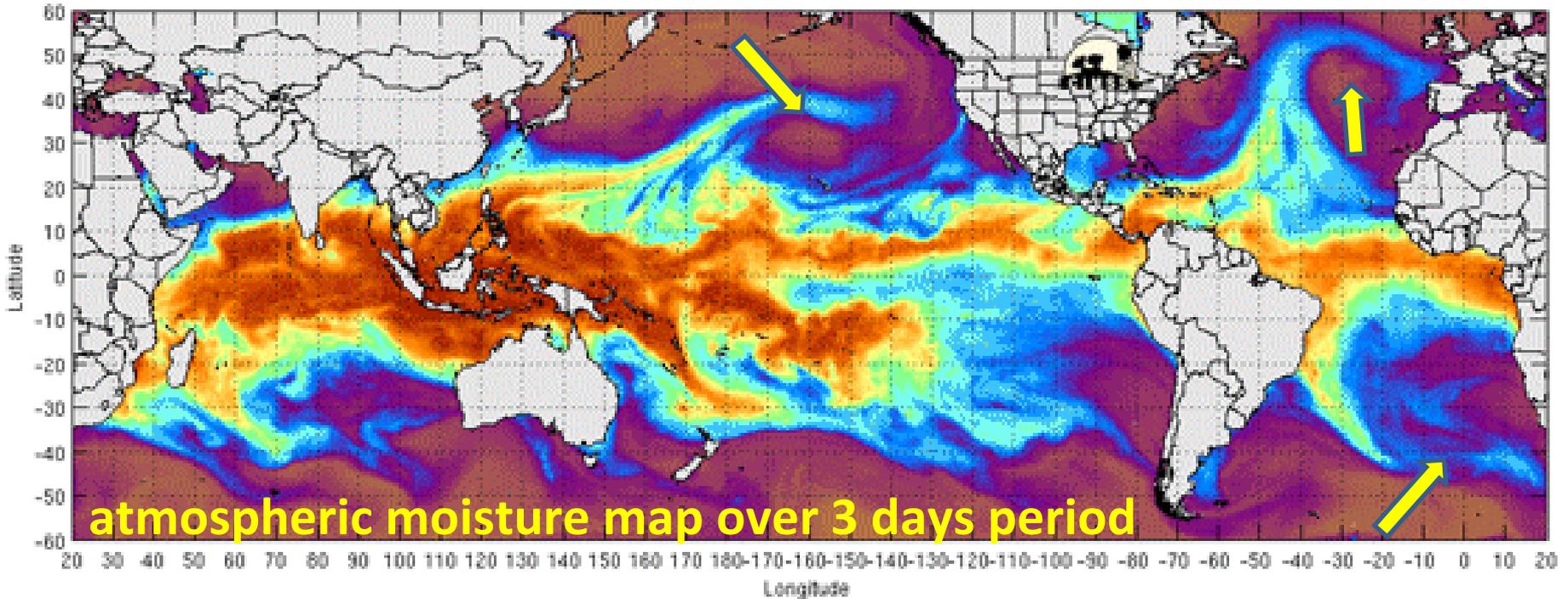
Water vapor →
(gas lighter than air; continuously generated by evaporation and removed by condensation)



- The mean global amount of water vapor in the atmosphere is roughly sufficient to cover the surface of the planet with a layer of liquid water about one inch (25 mm) deep.
- On average, the **residence time of a water molecule in the troposphere** is about **9 to 10 days**.

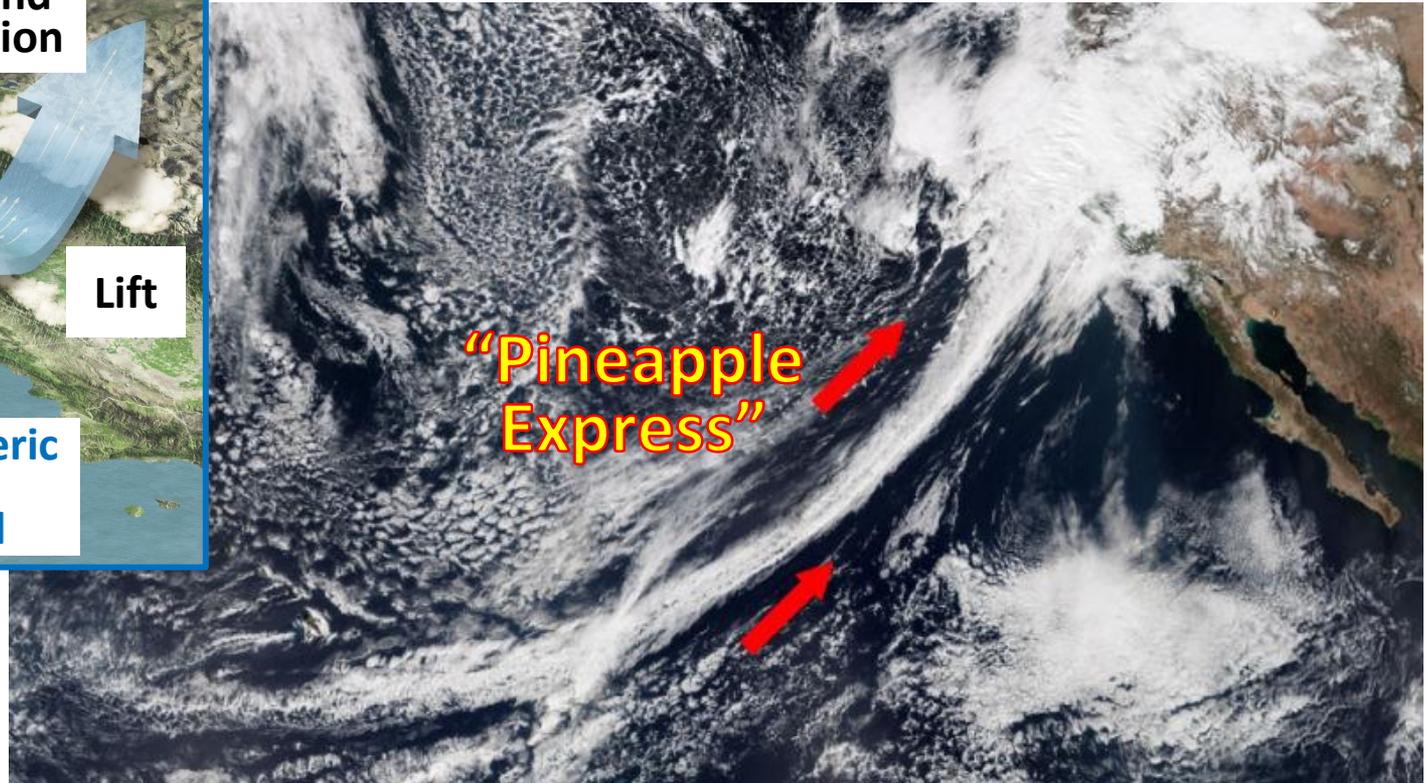
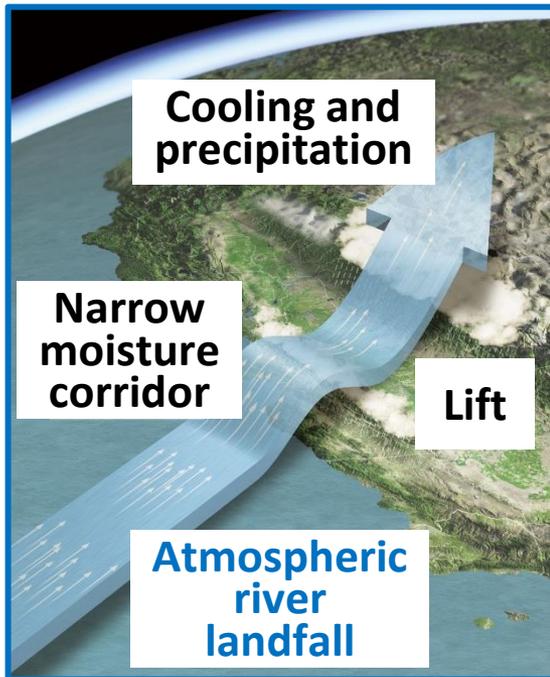
Rivers in the Sky?

An **atmospheric river** is a moving narrow corridor of concentrated moisture in the atmosphere.



- get their start over warm tropical waters
- flow eastwards and towards the poles about a mile above the ocean surface
- may extend for thousands of miles, but are only a few hundred miles wide
- can transport up to 10 times more water than the Mississippi river!
- when making landfall, often release a lot of precipitation

California: from drought to flood



- **Not enough atmospheric rivers:** the region gradually falls into **drought** which may last *years*.
- **Too many atmospheric rivers:** **floods** can occur.

Saltwater (Saline Water)

- Saltwater is water that contains a **certain amount of salts** with dissolved salt concentration of **more than 1%**.
- **Oceans and seas.**
- Saltwater is also found in some lakes and ponds as well as underground.

