

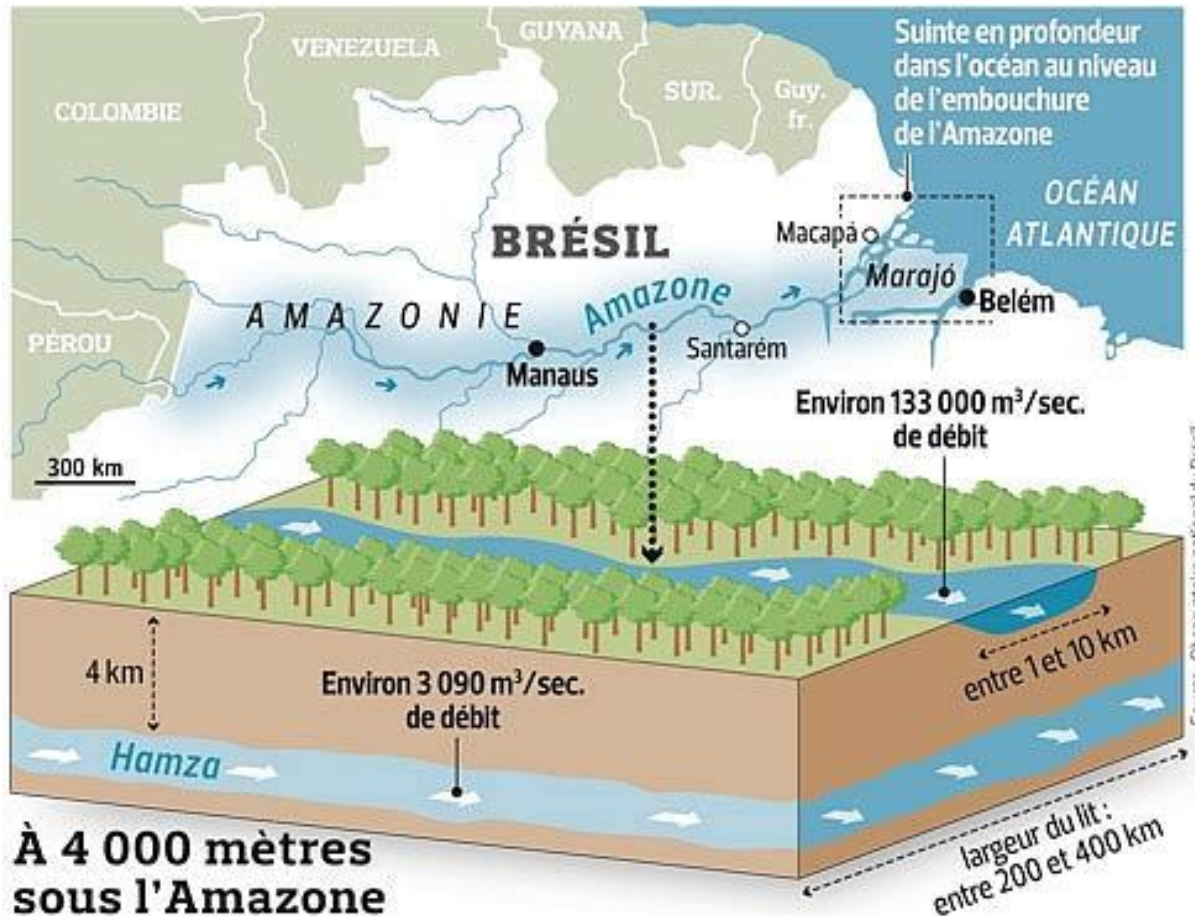
# THE HYDROSPHERE



**PART 3**

# Rio Hamza (slowly flowing aquifer)

The Amazon River has an **underground “twin sister”** named **Hamza** (*discovered in 2011*)! It runs for a length of 6,000 km (3,700 mi) at a depth of nearly 4,000 m (13,000 feet).

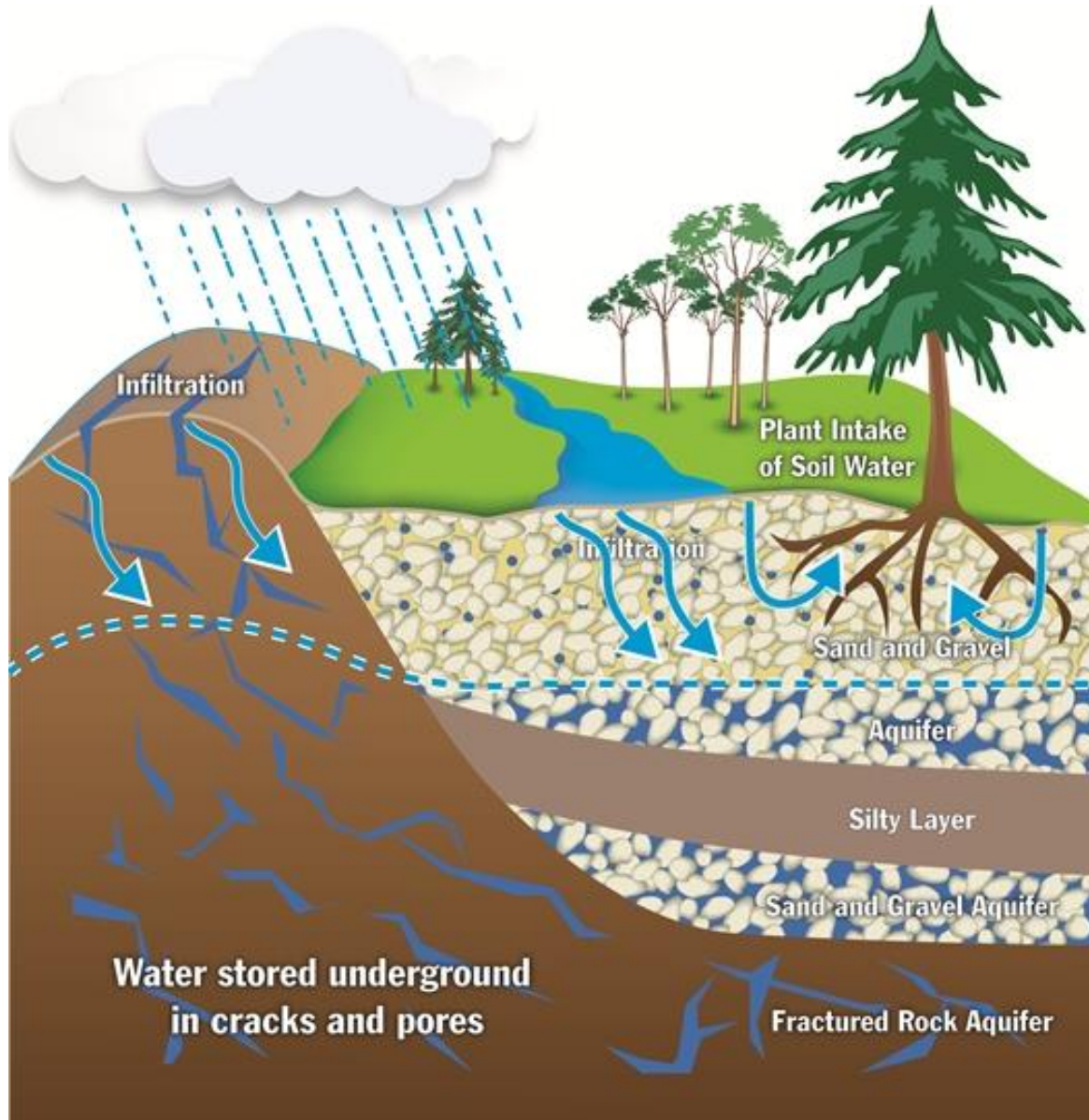


Except for the flow direction, the rivers have very different characteristics:

- **flow speed** - it is **5 m/s (16 feet/s)** in the Amazon and **less than 1 mm/s (0.039 in/s)** in the Hamza
- **width** - the Amazon is **1 km (0.62 mi) to 100 km (62 mi)** wide, the Hamza is **200 km (120 mi) to 400 km (250 mi)**, much wider

À 4 000 mètres sous l'Amazone

# 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.

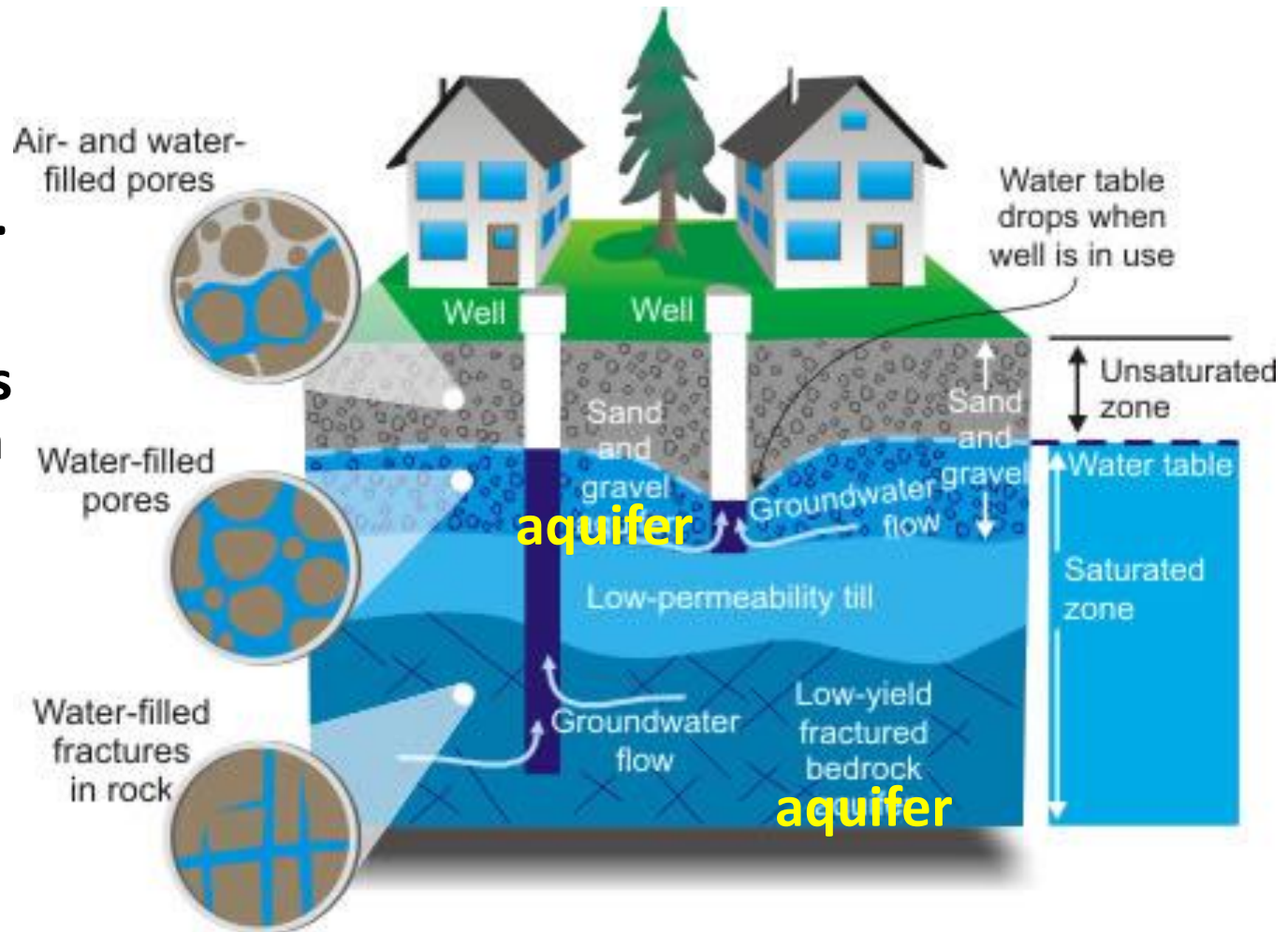


- Swamp: a wetland dominated by trees
- Bogs: a wetland dominated by peat moss
- Marshes: a wetland dominated by grasses

# Freshwater: Groundwater Aquifer

Aquifer is an underground sand/gravel or rock layer that stores water and allows water to flow through it.

- **Drinking water** supply.
- Anyone who has a well gets water from an aquifer.
- About **half of all Americans** get *most* of their water from wells.



# Global Groundwater Resources



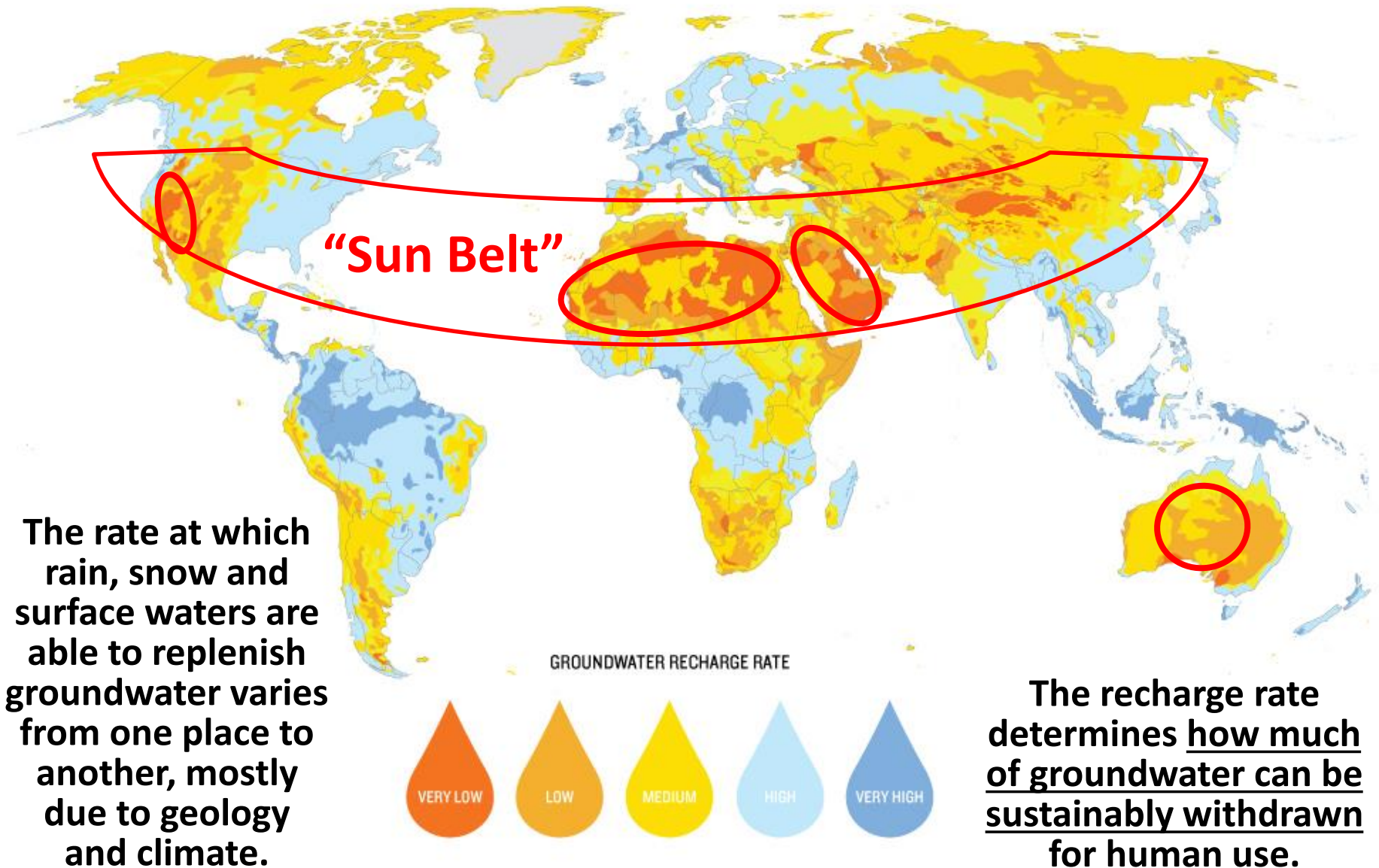
**Largest  
deserts of  
the world?!**

Local and shallow aquifers provide limited quantities of water.



Major basins hold abundant, relatively easily extracted groundwater.

# Groundwater Recharge



# 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)

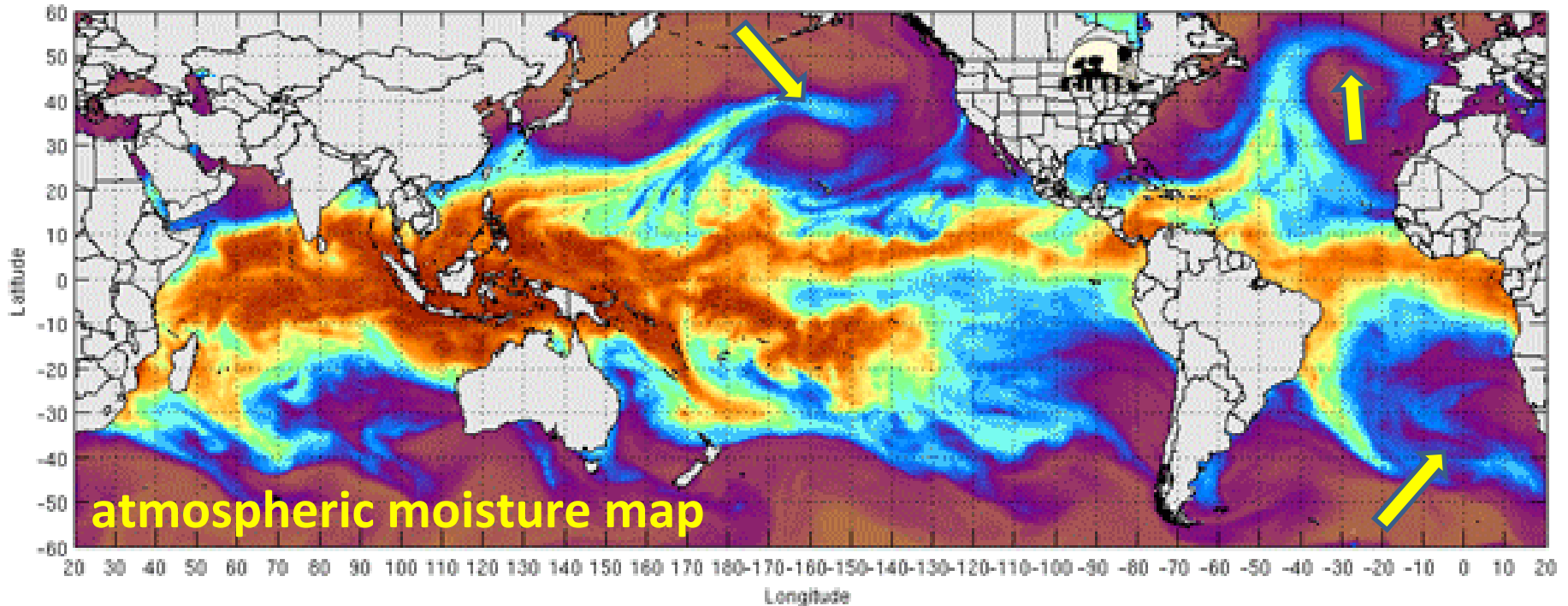


- The mean global amount of water vapor in the atmosphere is roughly sufficient to cover the surface of the planet with a layer of liquid water about one inch (25 mm) deep.
- On average, the **residence time of a water molecule in the troposphere** is about **9 to 10 days**.



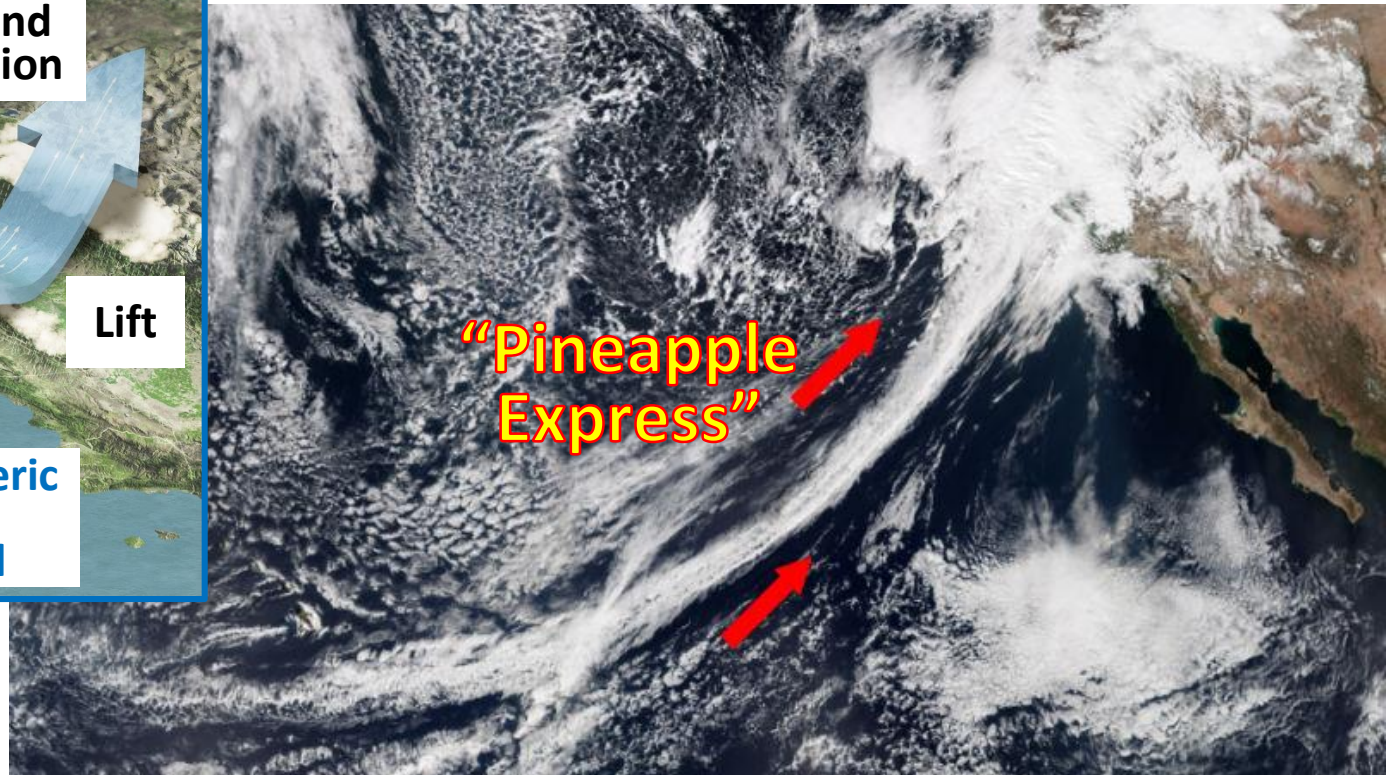
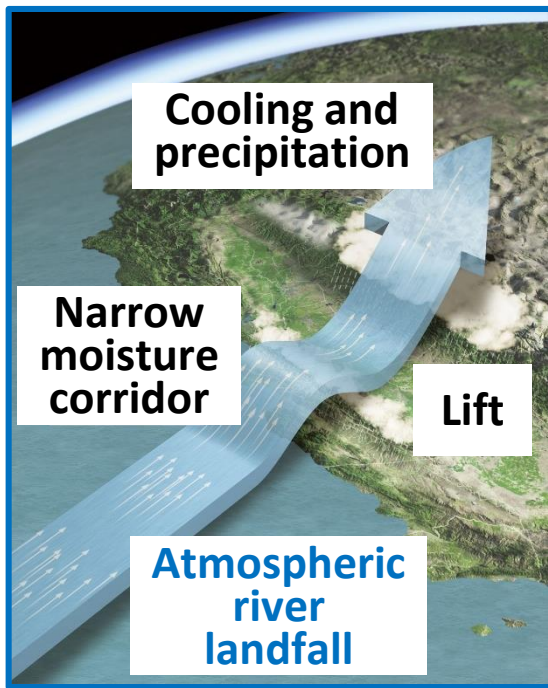
# Rivers in the Sky?

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



- In early October 2016, **after nearly five years of drought**, California has faced **an ambush of atmospheric rivers**.
- Flood and landslide warnings have been issued in many counties, at least 30 major roads have been flooded, and spillways have been opened at the Oroville, Anderson, and Monticello dams.