

Forest Hydrology: Lect. 1

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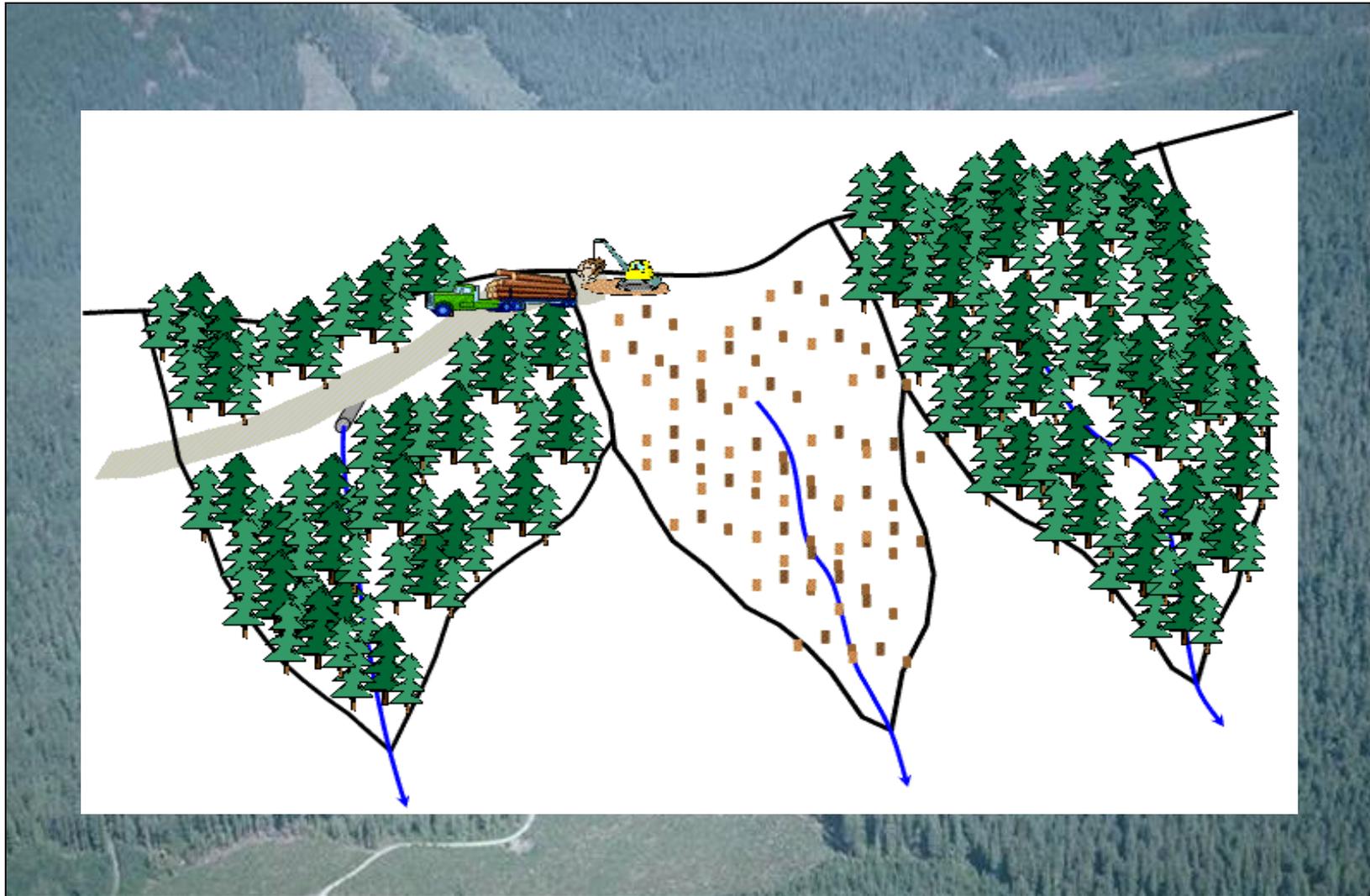
Hydrology and the hydrologic cycle

- **HYDROLOGY** comes from two greek words:
- Hydro (water)
- Logos (knowledge, study)
- Hydrology is the **science of water**, that is concerned with the **origin, circulation, distribution** and **properties** of water of the earth.

Hydrology and the hydrologic cycle

- **FOREST HYDROLOGY** is the branch of hydrology which deals with the **effects** of vegetation and land management on the quantity, quality and timing of water yields, including **floods, droughts, erosion** and **sedimentation**

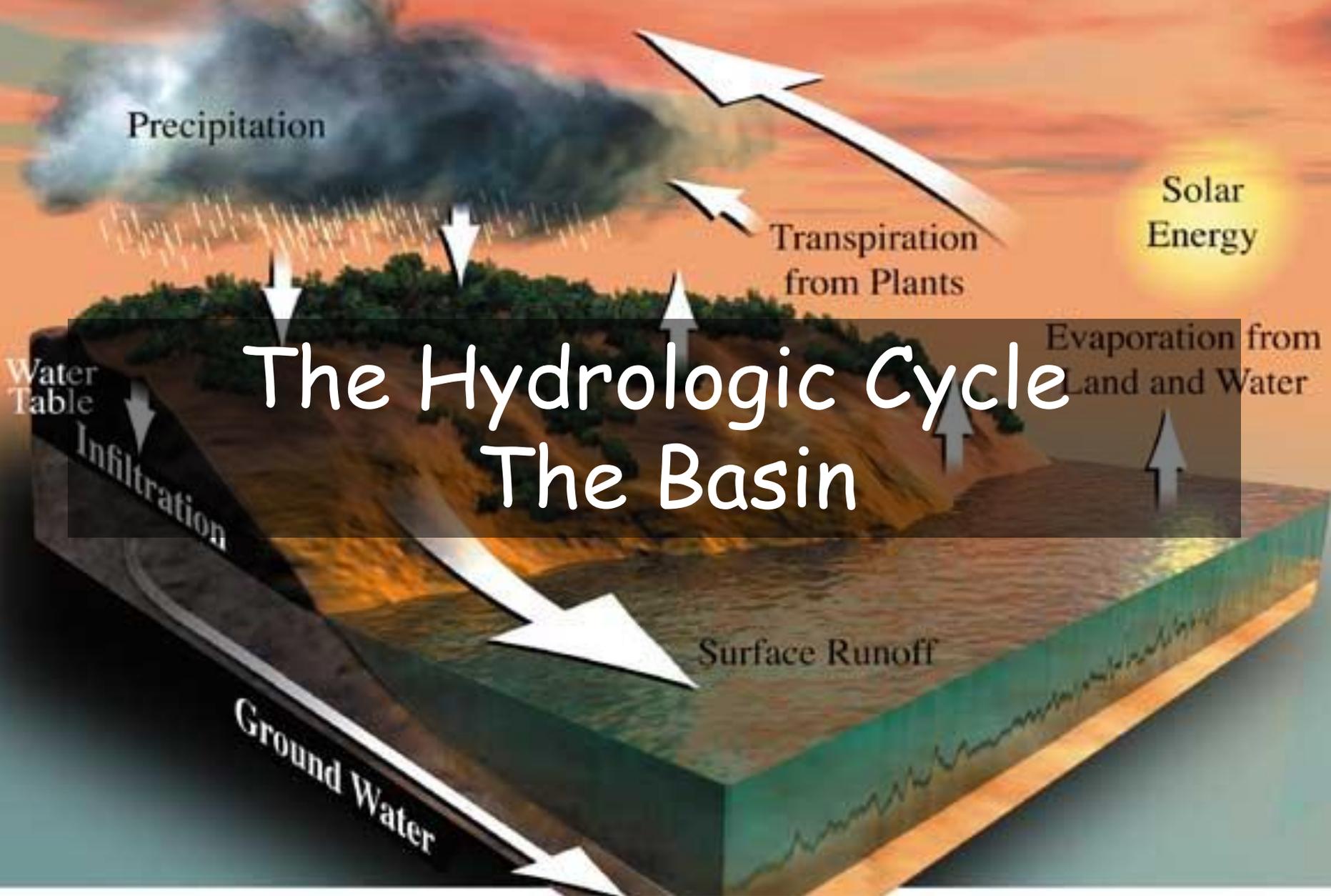
Land use change



Hydrology and the hydrologic cycle

- HILLSLOPE HYDROLOGY: **hillslope** is the part of the landscape which is not channelised. Hillslope hydrology is concerned with the physical hydrological processes which are emerging at the hillslope scale.





The hydrologic cycle

The hydrologic cycle is the *continual transfer* of water, in various phases, among reservoirs (stores) in the atmosphere, ocean, and continents.

Traditional view of the hydrologic cycle

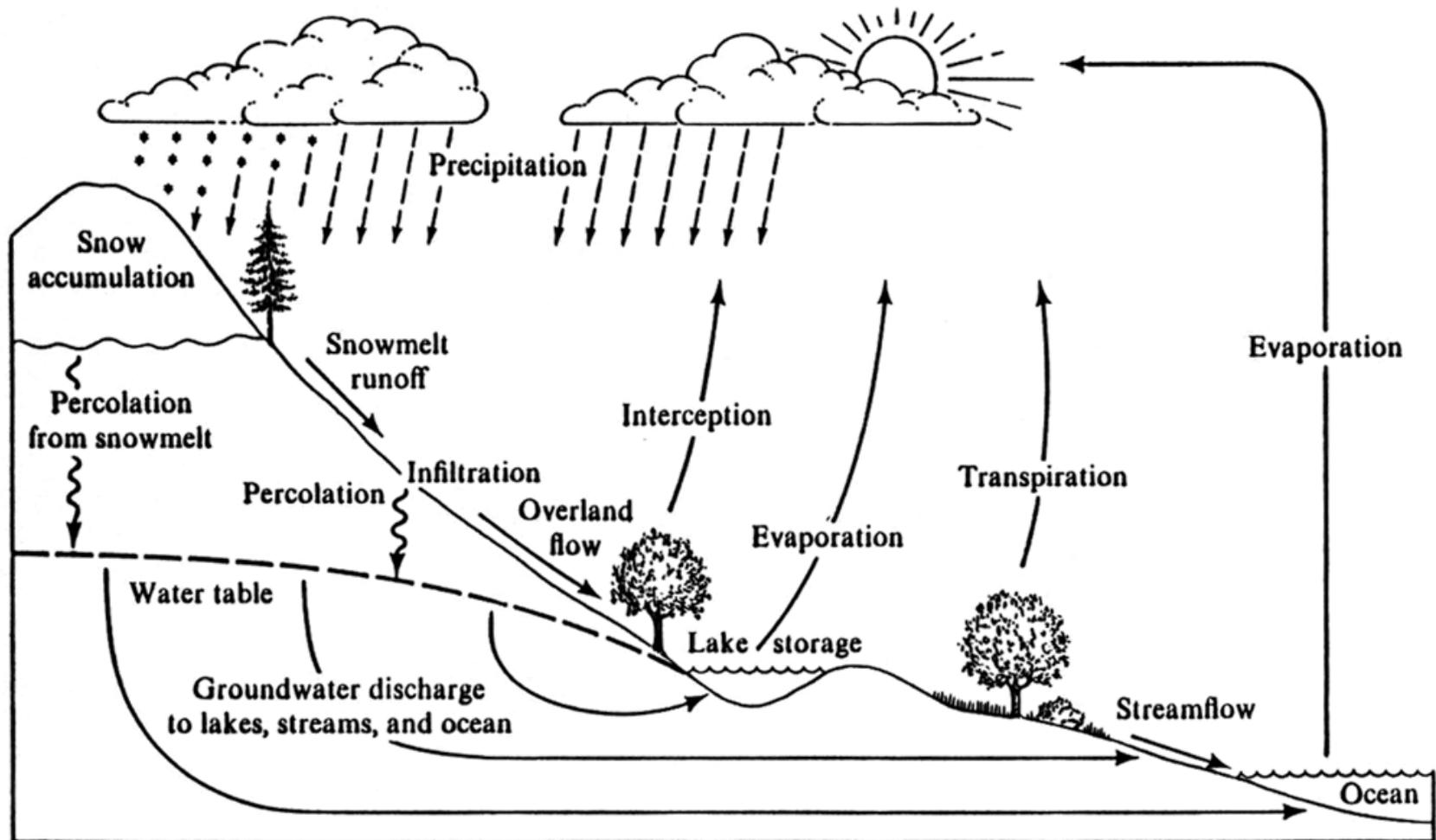
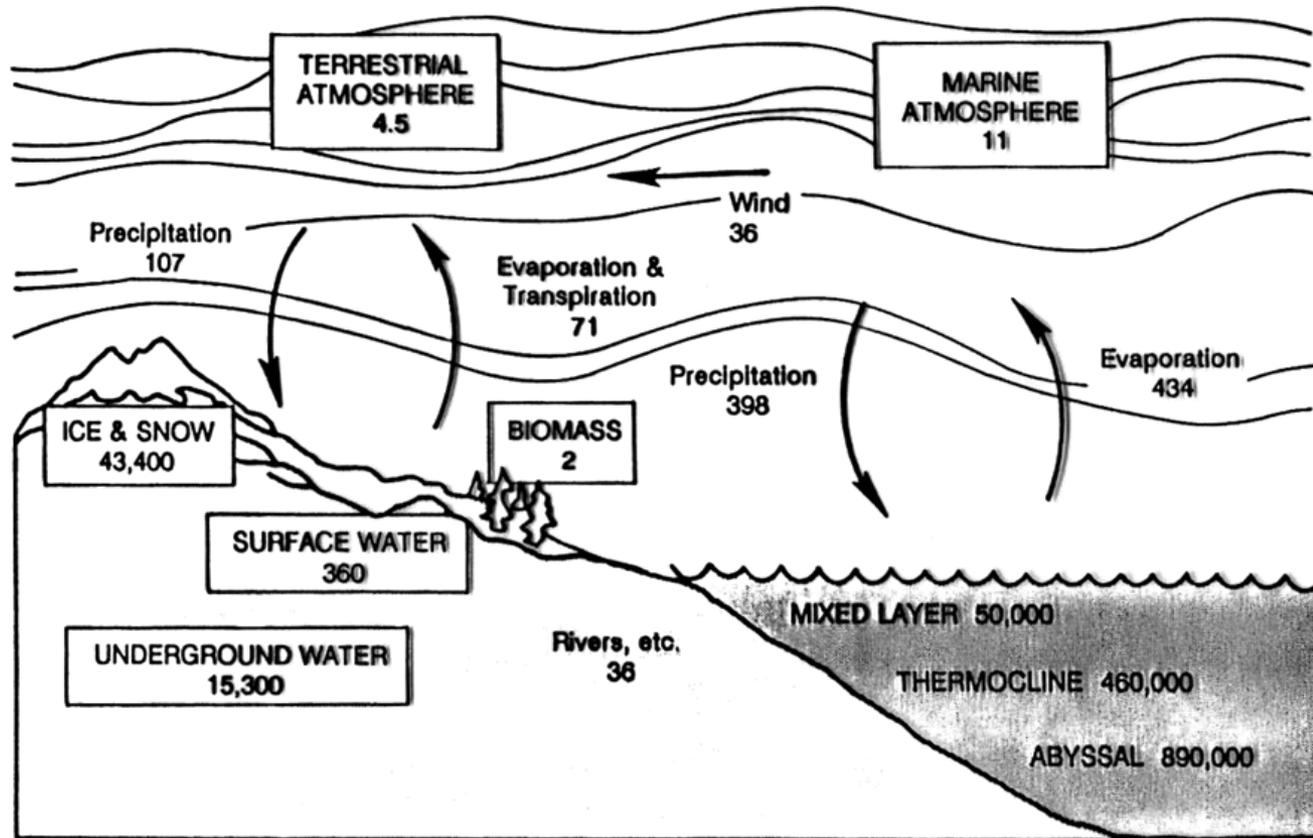


Figure 1-1 Schematic diagram of the hydrologic cycle.

Modern view of the hydrologic cycle



Reservoirs, volumes in 10^{15} kg (10^3 km^3)
 Fluxes, in $10^{15} \text{ kg yr}^{-1}$ ($10^3 \text{ km}^3 \text{ yr}^{-1}$)

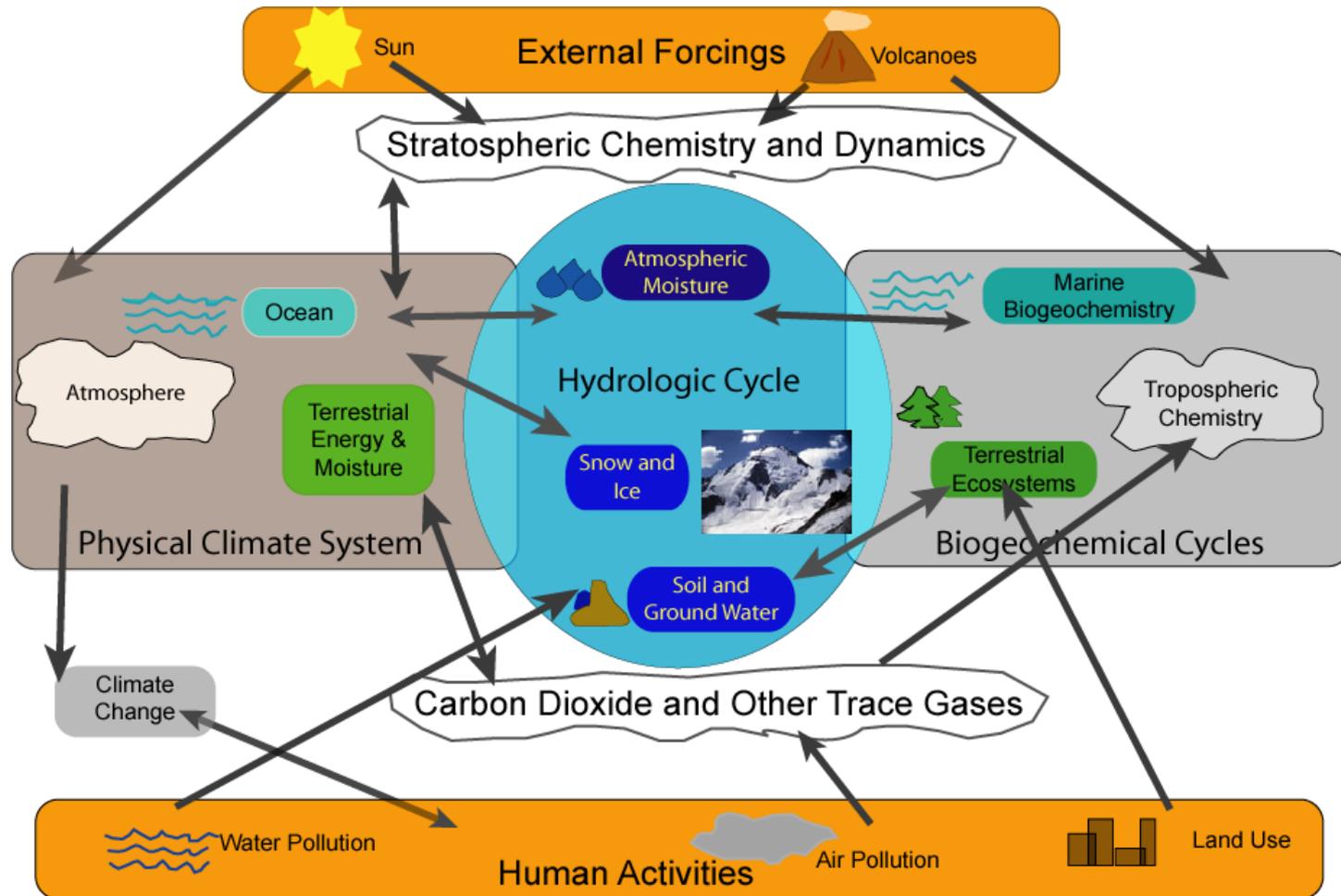
Total Reservoir Volume = $1.46 \times 10^9 \text{ km}^3$

A question...

Why are the deserts there?



Earth System: physical climate and biogeochemical systems, coupled by the hydrologic cycle



The hydrologic cycle is driven by ...

- Solar energy
 - Exchanges of this energy within the Earth system results in evaporation/condensation, freezing/thawing, changes of density
- Gravity
 - Wind (pressure gradients caused by gravity)
 - Rivers/glaciers flowing downhill
 - Groundwater moving because of potential energy gradients in the water

Water on Earth (approx. $1.4 \times 10^9 \text{ km}^3$)

• Oceans	97.2%
• Ice	2.0
• Groundwater - deep (750-4000m)	0.4
• Groundwater -shallow (<750m)	0.3
• Lakes	0.01
• Soil	0.005
• Atmosphere	0.001
• Rivers	0.0001
• Biosphere	0.00004

Read: Black, P.E. On the critical nature of “useless” resources; *Water Resources Bulletin* (1995)

Never at Rest ...

Water moves continually between the reservoirs by a number of processes:

- *Evaporation* from the ocean, *precipitation* onto the ocean, transfer of a portion over continents
- *Precipitation* on continents (rain, snowfall, snowpack storage and meltwater release)
- *Evaporation* from continents (if it occurs directly from a water surface or soil surface), *evapotranspiration* if the evaporation is modulated by plant processes.
- *Infiltration*
- *Percolation* through soils and rocks
- *Streamflow* (stormflow and baseflow); flow through lakes
- Flow through the ocean
- Evaporation from the ocean etc., etc.

Energy (and its spatial variability) is the key to the continual transfer of water mass

Fluxes between stores

Note that the ocean area is about twice the land area; these numbers are in volumes per unit area of surface)

Evaporation from ocean	117 cm/yr
Precipitation onto ocean	107 cm/yr
Precipitation onto land	74 cm/yr
Evaporation from land	49 cm/yr
Runoff from land	25 cm/yr

Over the ocean, $E > P$

Over land, $P > E$. Suggests that the storage of water on land causes some kind of "resistance" to evaporation, so that some of the precipitated water "escapes" evaporation and survives to run off the continents as streamflow (R).

Explain the conservation of mass given...

...that the ocean area is about twice the land area; these numbers are in volumes per unit area of surface)

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