

# **Watershed Hydrology**

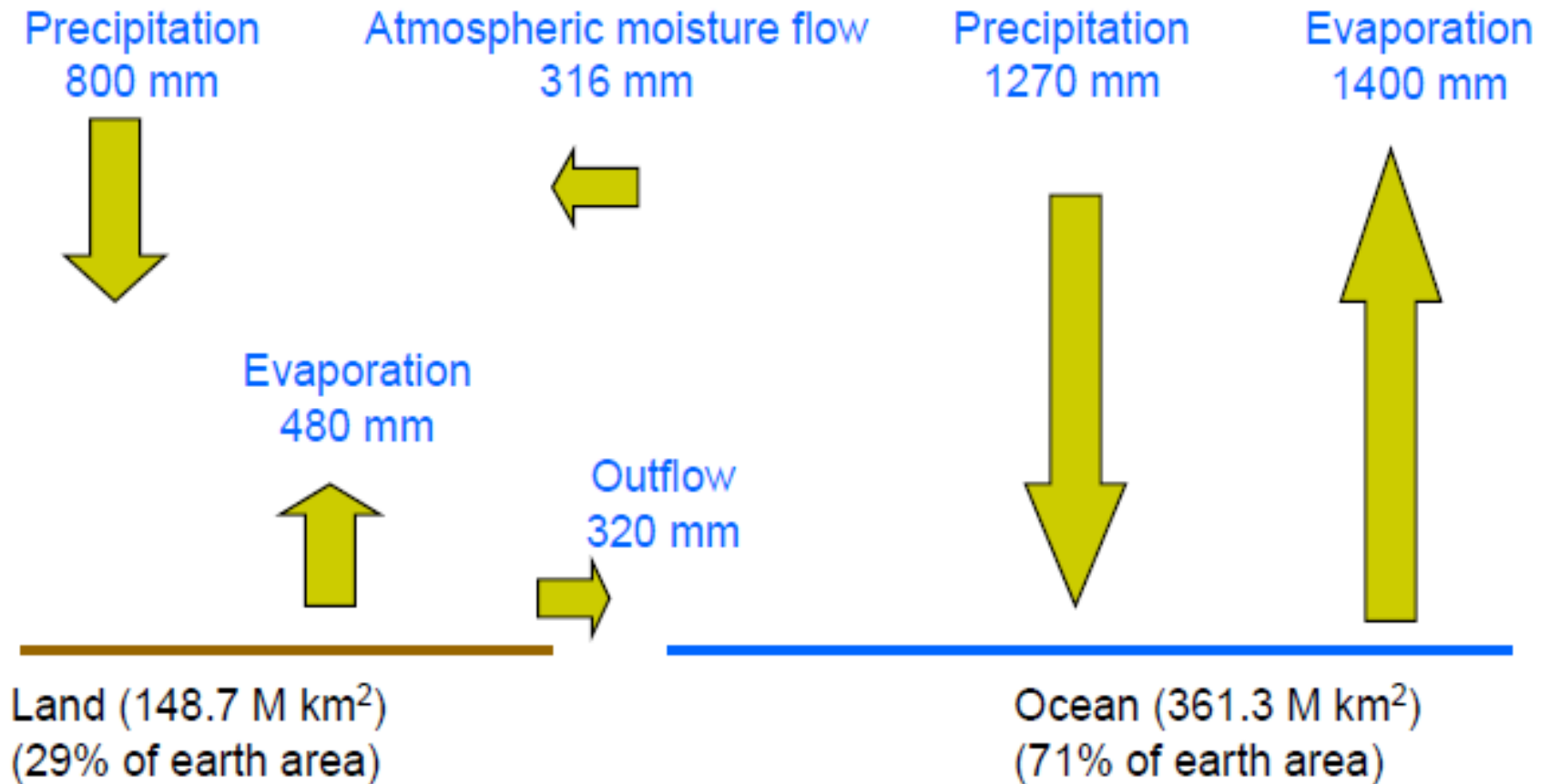
## **Introduction of Water Resources and Hydrology**

# Global Water Resources



105,000 km<sup>3</sup> or  
0.0076% of total  
water

# Global Water Balance



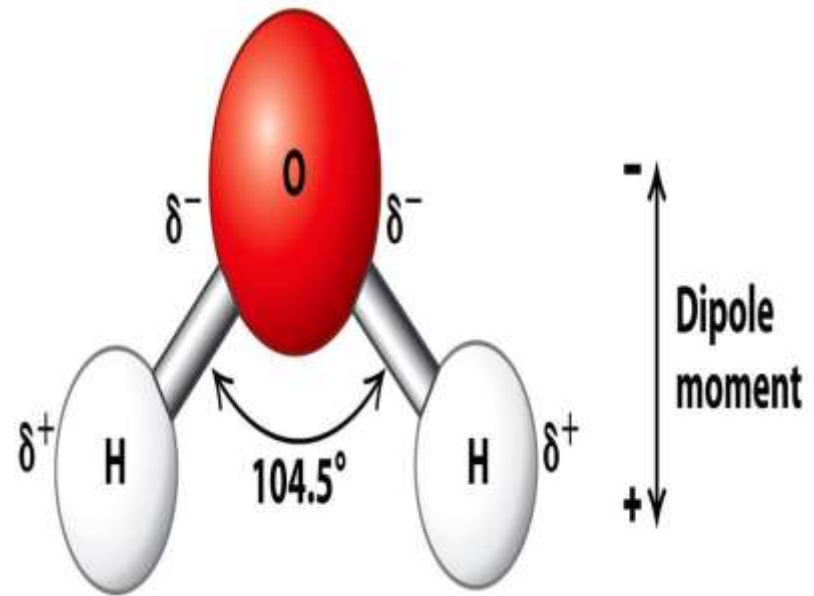
# What is hydrology?

☞ Sum of two terms:

Hydro + Logus

Hydro = Water

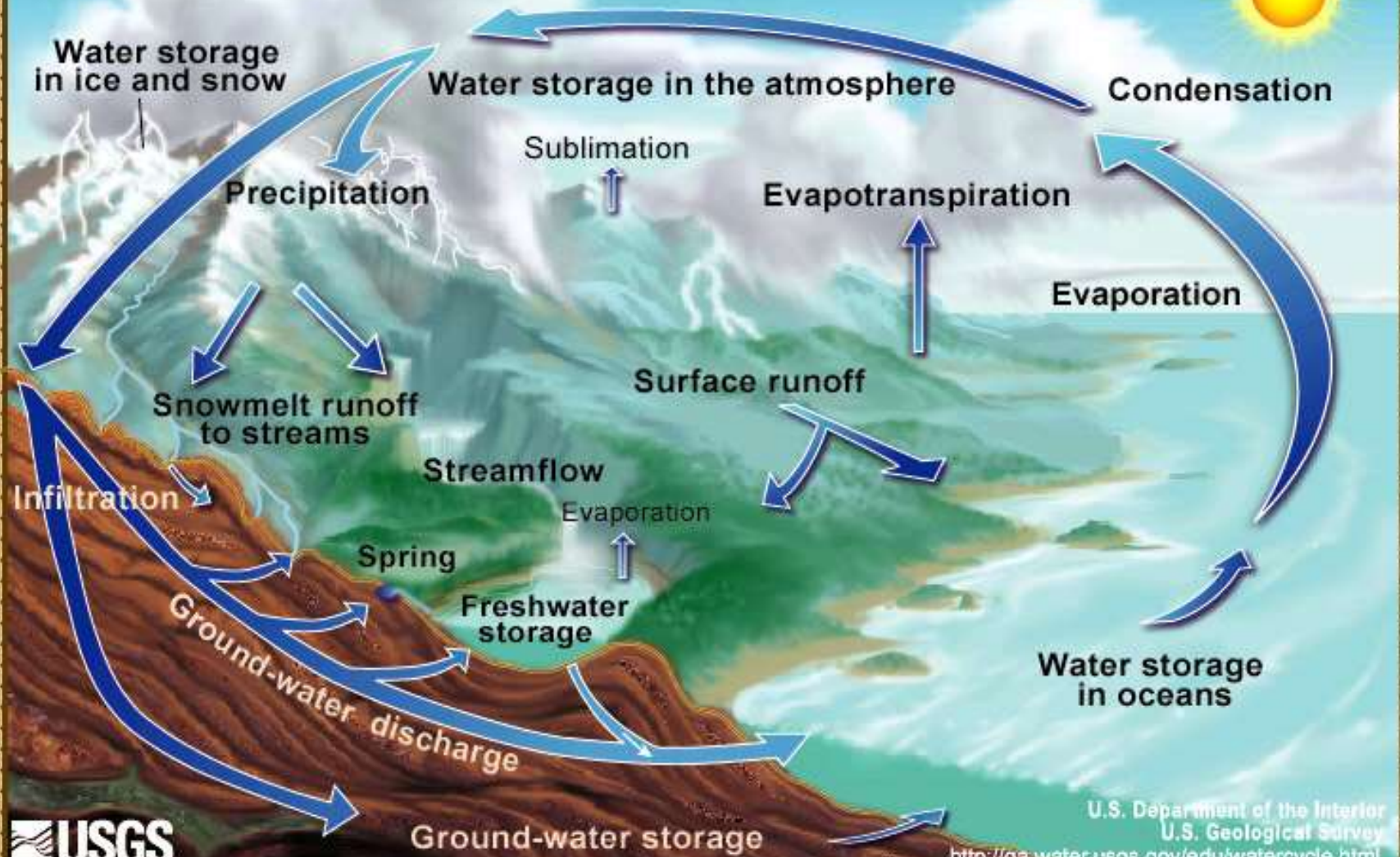
Logus = Study



☞ In a broad sense:

**HYDROLOGY** can be defined as the **STUDY OF WATER** – its occurrence, distribution, movement, and properties of all the waters of the earth and its atmosphere.

# The Water Cycle



# HYDROLOGY | classification

Customarily, **Hydrology** is partitioned into



## **Surface-Water Hydrology:**

Relation between **water** and the **surface** of the earth



## **Groundwater Hydrology:**

Relation between **water** and **lithosphere** (subsurface portion of the earth)



## **Potamology:**

It is the scientific studies of **rivers**.

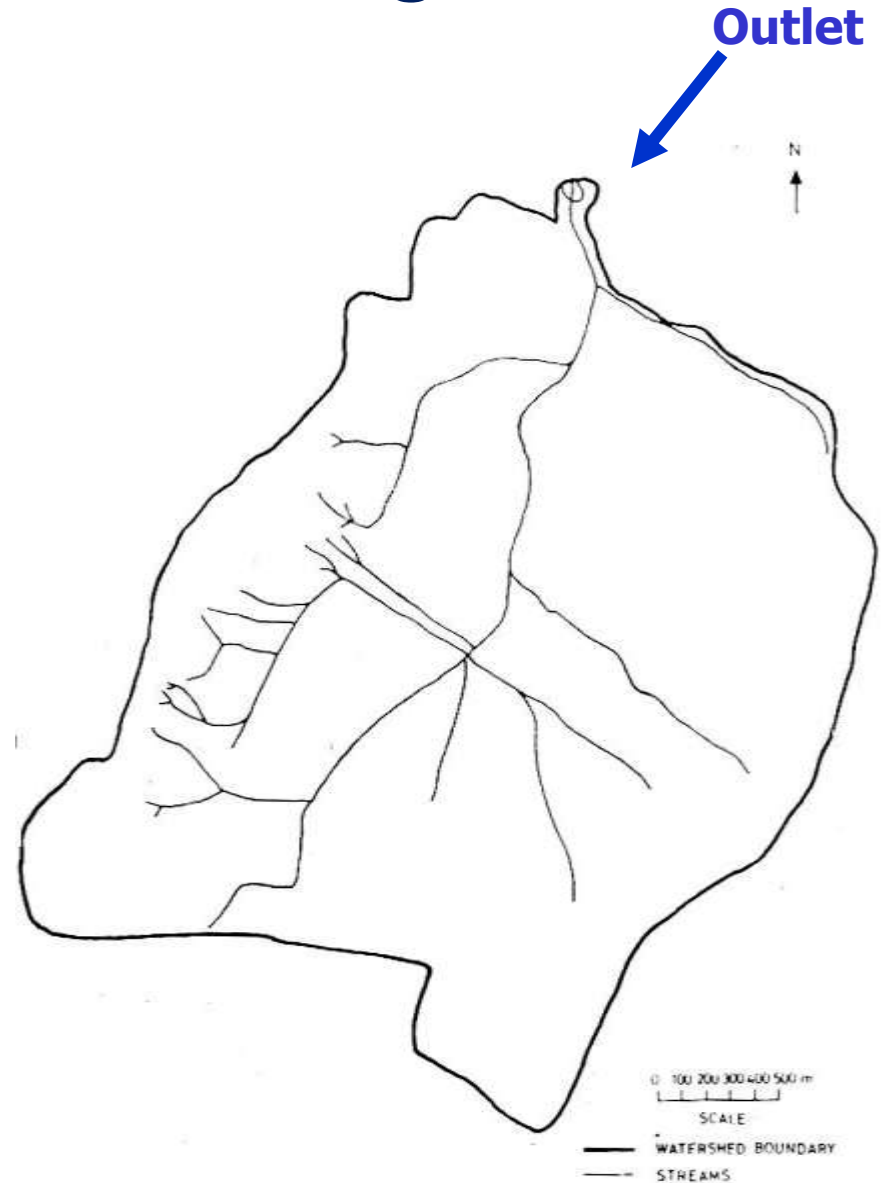


## **Limnology:**

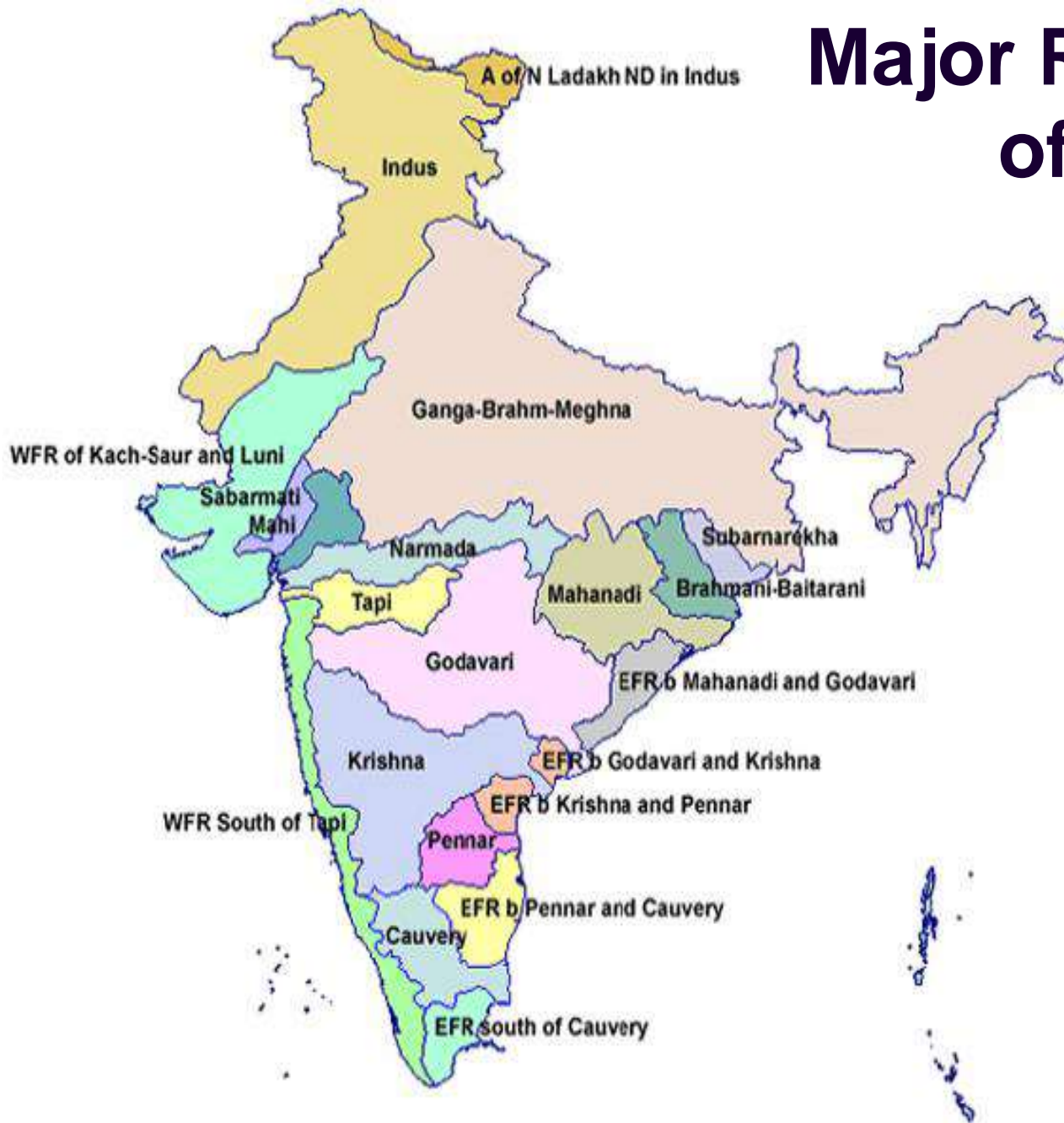
It is the study of **inland waters**.

# **Watershed/Catchment/Drainage Basin:**

It is defined as the land area which contributes surface runoff to a specific discharge point (i.e., outlet). It is outlined by **surface water divides** (also called 'topographic divides').



# Major River Basin of India






# Hydrologic Cycle

 From a **global perspective**, Hydrological cycle may be considered to be comprised of **three major systems**:

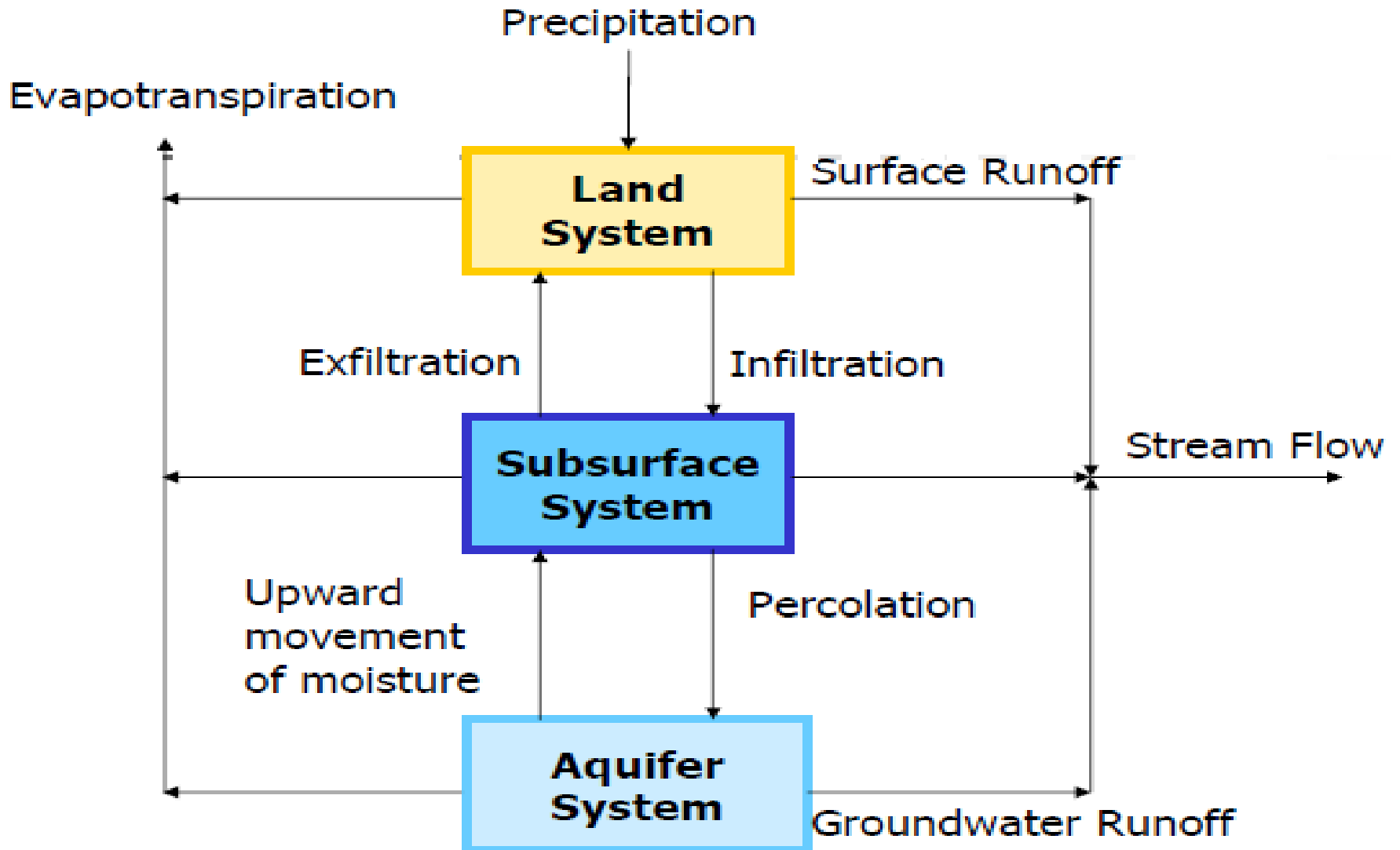
**The Oceans** – as the major **source of water**

**The Atmosphere** – as the **deliverer of water**

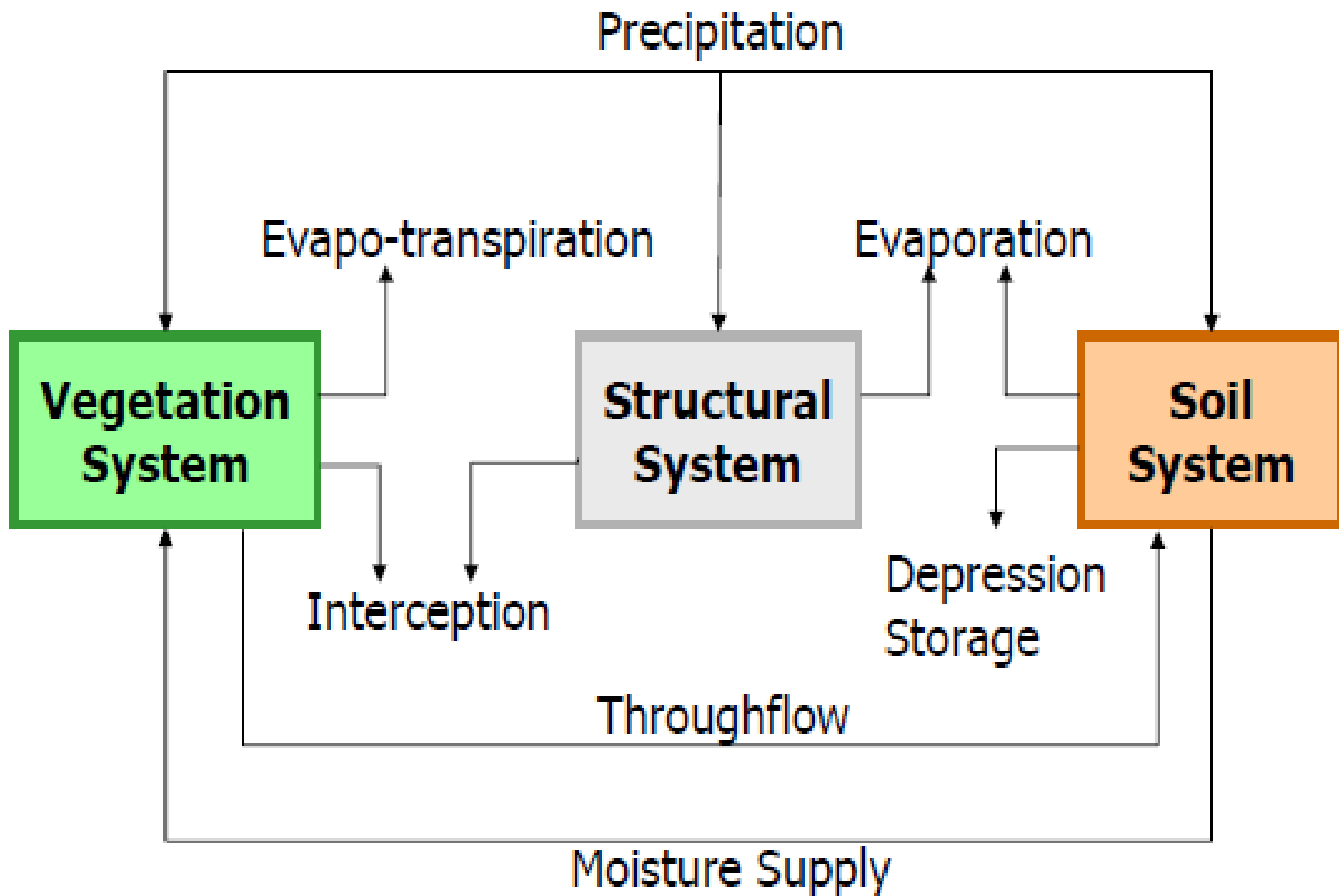
**The Land** – as the **user of water**

 **Principal processes** that transmit water from one system to other are **Precipitation, Runoff and Evaporation**

# The Earth System



# The Land System



# Hydrological budget

- 👉 Mathematical statement of Hydrological cycle



$$\frac{\Delta S}{\Delta t} = \bar{I} - \bar{O}$$

Change in storage over  $\Delta t$

Avg. inflow over  $\Delta t$

Avg. outflow over  $\Delta t$

**If  $I$  and  $O$  vary continuously with time**

$$\frac{ds(t)}{dt} = I(t) - O(t)$$

Any hydrological analyses must satisfy this Eq.

# Water Balance Equation

- In volumetric terms, it can be expressed as

$$S(t) - S(0) = V_I(t) - V_O(t)$$

- Including various components of hydrological cycle

$$S_s(t) - S_s(0) + S_m(t) - S_m(0) + S_g(t) - S_g(0) + S_i(t) - S_i(0) = P - V_Q - E - T - F$$

Surface

Soil moisture

Ground water

Interception

$E, T, F, S_i$  = Hydrological abstraction

$V_Q$  = Basin Yield

### Example 1.1

A lake had a water surface elevation of 103.200 m above datum at the beginning of a certain month. In that month, the lake received an average inflow of  $6.0 \text{ m}^3/\text{s}$  from surface runoff sources. In the same period, the outflow from the lake had an average value of  $6.5 \text{ m}^3/\text{s}$ . Further, in that month, the lake received a rainfall of 145 mm and the evaporation from the lake surface was estimated as 6.10 cm. Write the water-budget equation for the lake and calculate the water surface elevation of the lake at the end of the month. The average lake-surface area can be taken as 5000 ha. Assume that there is no contribution to or from the groundwater storage.

