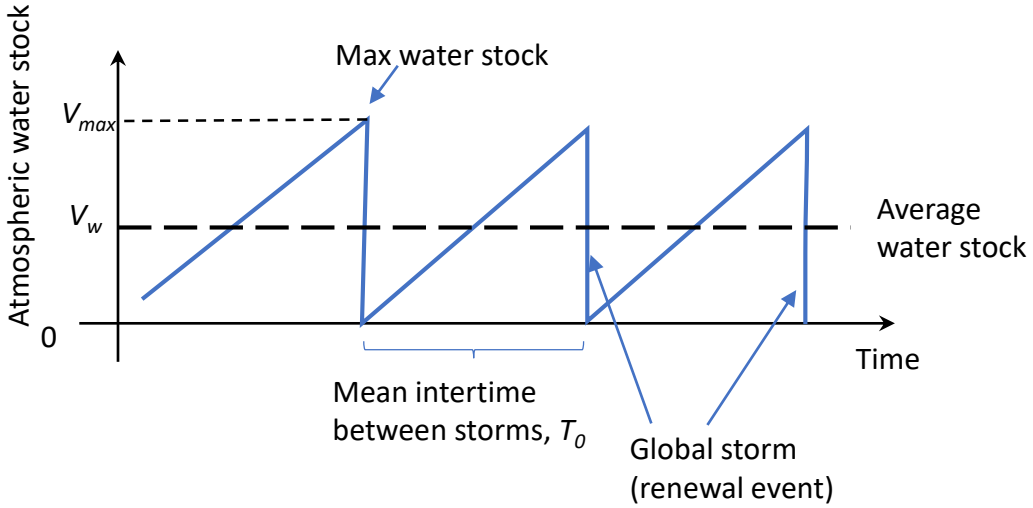
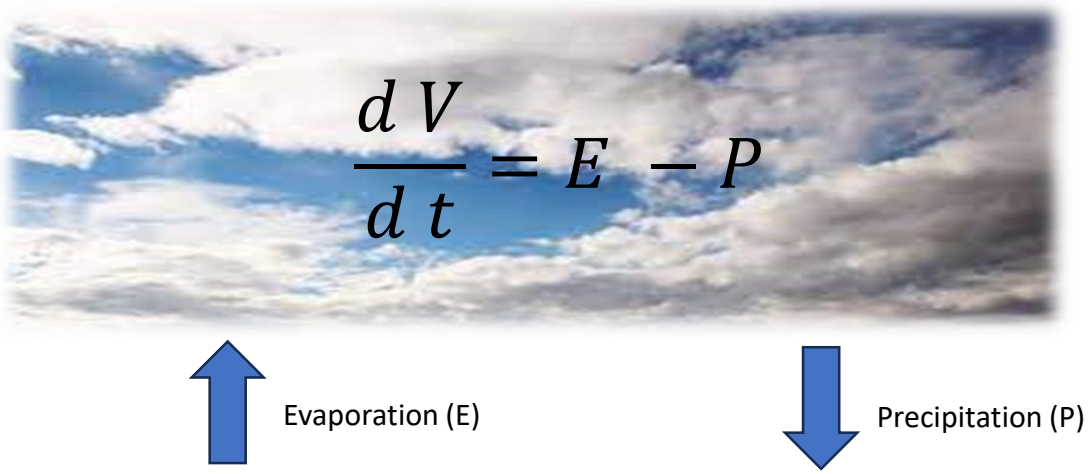
Water Resources Engineering and Management

Exercises Lecture 2: global circulation; groundwater dynamics

24/02/2025

Exercise 1. Assess the mean period for the renewal of water in the atmosphere (residence time)





QUESTION

- The residence time, T_W
- The relationship between T_W and T_0

Exercise 2. Where would all the water go?

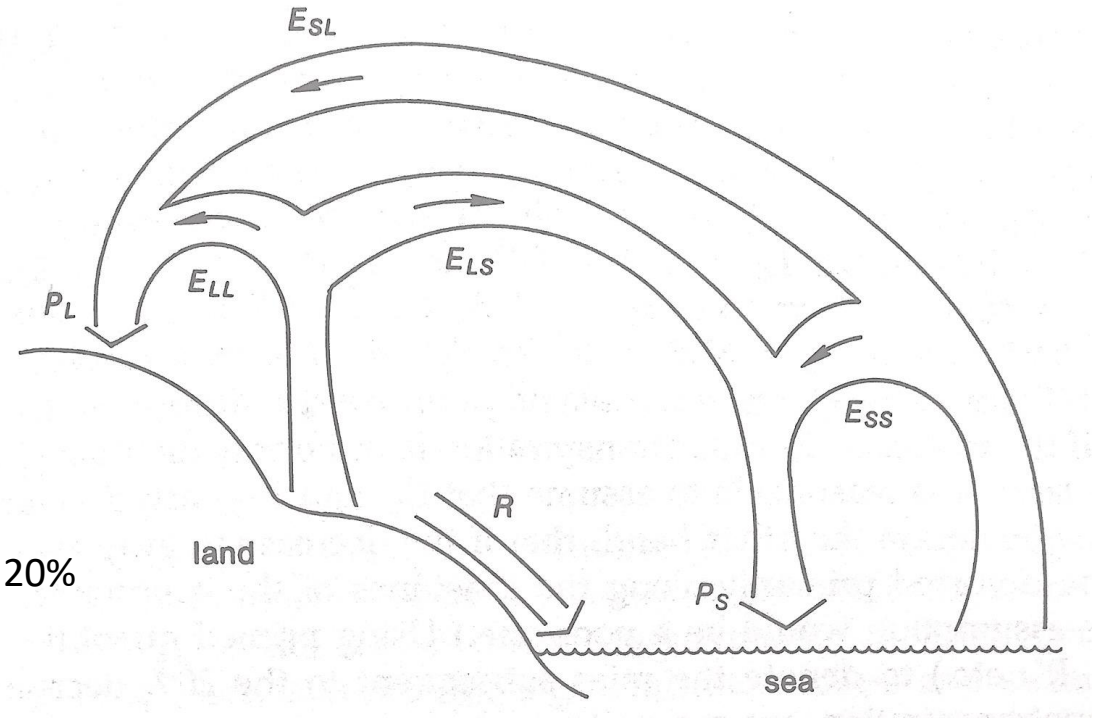
Assuming that evapotranspiration from the land surface decreases uniformly by 20% as a result of widespread deforestation, what changes would occur in global precipitation at the land surface and in average runoff from the land to the oceans?

This is not a residence time problem, but rather a box model problem

If you think that precipitation changes by 20%, you're wrong

QUESTION

- The fluxes at the current state
- The altered fluxes if evaporation from land diminishes by 20%



Source: John Harte. Consider a spherical cow. University Science Book, 1988

Exercise 3. Pumping test to define the soil conductivity, *K*

The average saturated hydraulic conductivity, *K*, of a given soil region is derived from field measurements. The following scheme is usually adopted for the phreatic groundwater flow.

DATA

- Pumped flow → q = 5 L/s
- Depth of impermeable bedrock → d_b= 32 ± 4.5 m
- Distance of 1st piezometric hole → r_1 = 20 m
- Distance of 2nd piezometric hole → r_2 = 55 m
- Water depth at 1st hole → d_1 = 4.82 m
- Water depth at 2nd hole → d_2 = 4.27 m
- Radius of the well → r_w = 0.5 m

HYPOTHESES

- Cylindrical simmetry
- Flow is horizontal (Dupuit-Forchmeier hypothesis)
- Suction above water table is ignored
- Free surface at water table and pressure here is 0 relative to atmospheric
- Hydraulic gradient constant at given radius dh/dr

QUESTIONS

- The hydraulic conductivity, *K*
- The uncertainty in the value of the hydraulic conductivity, ΔK
- The depth within the well, d_w