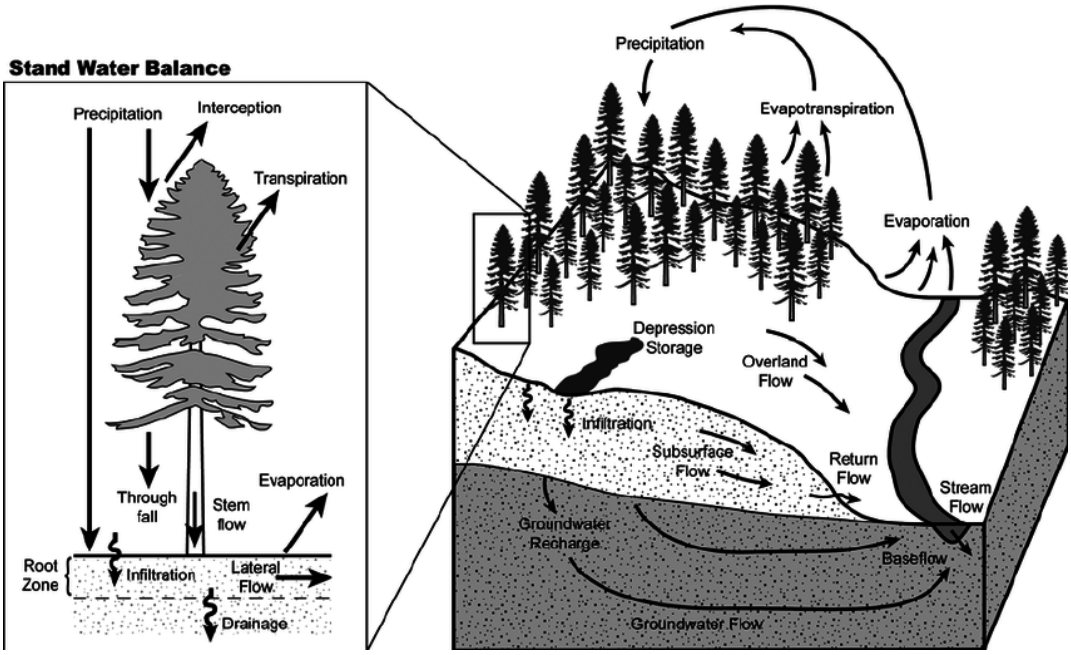
Unit 18 Physical Hydrometeorology

1. Undergraduate students: In Interior Alaska, spruce forests typically occupy north-facing slopes, with birch forests on the south-facing slopes.
    a. Redo the example in box 6.6 using the regression equation for spruce–fir–hemlock from table 6.6 using cross rainfall values of 100 mm to 400 mm in steps of 100 mm and numbers of storms form n=10 to n=60. Hint: This calculation will be a busy task unless you solve it in excel or use a programming software to scrunch the numbers.
    b. Create plots cross rainfall vs. net rainfall and cross rainfall vs. the ratio of net to cross rainfall like seen in the book to see how the percentage changes. Then compare your results with figure 6.18. How does interception of birch and spruce differ?
    c. Typically spruce grows on north, while birch on southern slope. Discuss the runoff-producing potential of north- versus south-facing slopes in this region.

2. All students: Set up the stand water balance equations for the zoomed figure below.



From: https://www.researchgate.net/figure/Hillslope-hydrologic-cycle-and-stand-water-balance-The-loss-of-forest-canopy-influences_fig1_259042489

3. Graduate students: Rain of 2.25 cm/h falls over 20 km^2 watershed that is covered by a homogeneous forest. During this event only water losses due to interception occur. Calculate the volume of water that leaves the basin as storm runoff for a 30-min and a 105-min rainfall using the models whose equations are given below. Here K is 1.5, S is 0.2 cm and the evaporation rate E is 0.05 cm/h.

$$L_i = \begin{cases} P \; if \; P \leq S \\ S + K \; E \; t \; otherwise \end{cases}$$

Here L_i and P are the interception volume and the storm depth per unit area and t is time since onset of the storm.

$$L_i = S\left(1 - e^{\frac{-P}{S}}\right) + K\ E\ t$$

Determine the runoff ratio for both conditions.