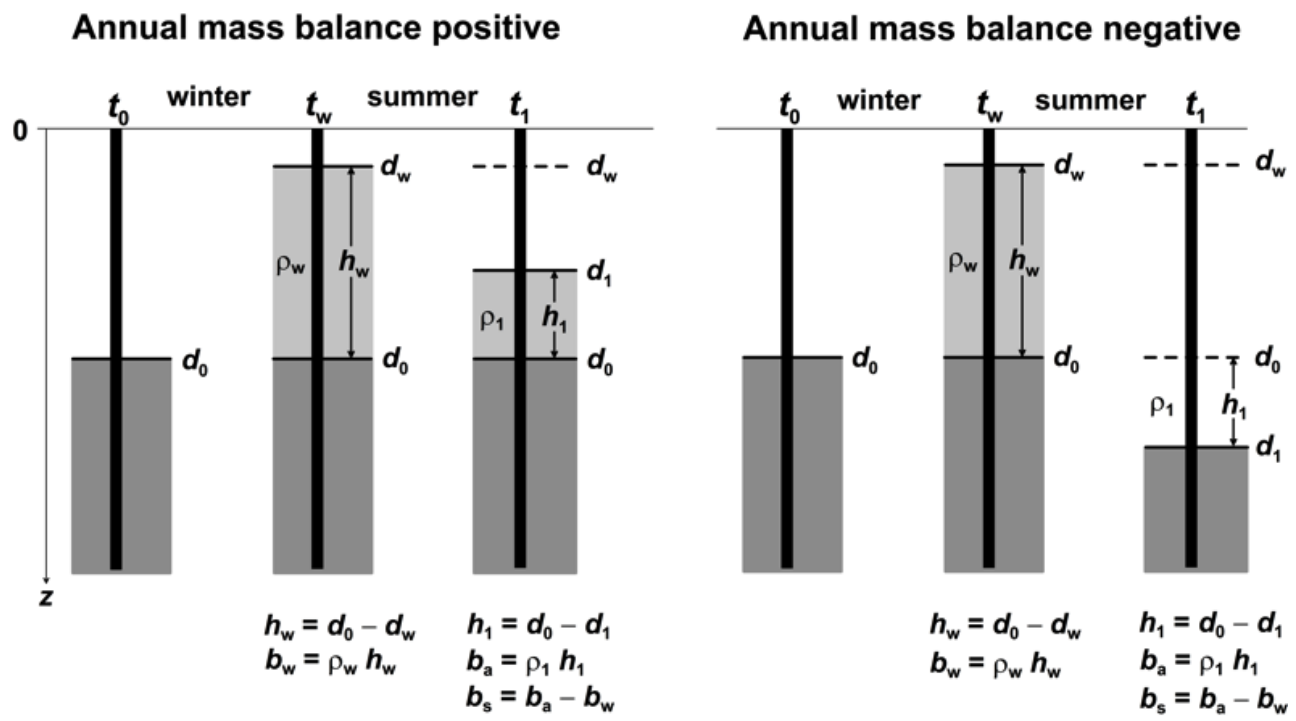
Single stake mass balance

Credit: Notation is from Cogley et al., 2011

Supplemental info on board:

Diagram of stakes A (left) and stake B (right)



Add these length details:

Both stakes were installed at (t_0) with 2.5m sticking out of the ice. At the end of the following winter (t_w), both stakes were sticking out of the snow by 0.5m. At the end of subsequent summer (t_1) the exposed length of stake A was 2.0m, and stake B was 3.0m.

Add these definitions:

t_0 = end of the summer (ablation season)

t_w = end of the winter (accumulation season)

t_1 = end of the mass-balance year

b_w = winter balance (change of mass between t_0 and t_w)

b_s = summer balance (change of mass between t_w and t_1)

End of winter snow density (ρ_w) *= 400 kg m^{-3}*

End of summer snow density (ρ_s) *= 500 kg m^{-3}*

Density of ice (ρ_i) *= 900 kg m^{-3}*

Density of water (ρ_{water}) *= 1000 kg m^{-3}*

Tell students that:

- to convert a snow or ice depth into water equivalent units the depth must be multiplied by the ratio of the snow or ice density to the density of water
- the vertical coordinate is positive downwards, measured from the origin z = 0 at the top of the stake
- light shading represents snow; dark shading represents firn or glacier ice

Questions:

1. Which of stake A or B is in the accumulation or ablation area?
2. Using the definitions from the figure above, and the densities given, compute the
    a. winter,
    b. summer and
    c. annual mass balance (b_a) balances at each stake in water equivalent units.

HINT: First compute the winter balance then the annual and then the summer balance as described in the equations given on the board.