Global Scale Hydrologic Fluxes

Evapotranspiration dominates the terrestrial hydrologic annual hydrologic budget accounting for up to 70% of total precipitation input into New England and globally.

The remaining 30% of the incoming precipitation is distributed to shallow groundwater, soil moisture, and surface runoff.

Groundwater discharge to streams accounts for up to 2/3 of the water in streams, and from 50% (uplands) to 100% (Cape Cod and the Islands) of the water budget of streams in New England.

How is stream flow generated?

Prior to a precipitation event, water in the ground moves slowly to the stream generating streamflow along a topographic gradient. (SSF). New precipitation infiltrates the soil and moves vertically to the water table where it pushes water molecules already in the ground down hydraulic gradient to the stream increasing the amount of water reaching stream. As precipitation continues the water table will reach surface creating larger stream area (SOF).

Shanley et al., 2015 Hydrological Processes

Yearly Hydrologic Budget

Why does it always feel dry in August? Well, trees suck a lot of water! Despite the fact that on average each month receives an equal amount of precipitation (See top plot in blue lines – dashed is 1 standard deviation), there is strong seasonal fluctuation in groundwater levels and streamflow. Seasonal changes in evapotranspiration (PET – red lines in top plot) controls this and impacts water availability throughout the year. This is so pronounced that streamflow and groundwater levels in October and November actually increase when the leaves fall off the trees!

Where does the drinking water for UMass and Amherst come from?

Atkins Reservoir (SW)  Pelham Reservoirs (SW)

The town of Amherst, MA has surface water reservoirs (made by damming streams) that account for 60% of the annual water consumption (Atkins and Pelham reservoirs). These reservoirs run low in the later summer months (see blue bars above) just when students begin arriving in Amherst. Total water use is actually lower in summer – opposite of every town in the state! In 1980, classes were cancelled and students sent home due to lack of water. To supplement the surface water reservoir sources, the town taps the Lawrence Swamp Aquifer in South Amherst (see more below). Groundwater accounts for 40% of the annual water usage and is reliable source of water in times of drought.
How do Aquifers Work?

An aquifer is a water-bearing geologic formation that is conductive enough to supply water at an economically beneficial rate. The geologic structure of the subsurface determines where aquifers are and the quality of the water contained within. Water is stored in small pores and cracks connected to the surface and moved by gradients in hydraulic potential (much like the water pipes in your house).

Lawrence Swamp Aquifer System in South Amherst

The Lawrence Swamp Aquifer is a primary source of water for UMass and the town of Amherst. The two figures at left depict a west-to-east cross section from the lowest part of Lawrence Swamp to the Pelham hills. Water infiltrates at higher elevations and flows down towards and underneath geologic formations where it is captured by the town’s 6 production wells. The water quality is great and requires minimal treatment.