Lecture 21a--Instantaneous Unit Hydrographs

When we talked about making unit hydrographs using the S-curve method, we talked mostly about *how*, and not describing using math. What you're doing when you lag an S-curve is this:

$$Q_t\left(\Delta t - hrUH\right) = \frac{\Delta Q}{I\Delta t}$$

Where Δ*t* is the time lag you made between them, Δ*Q* is the discharge difference between the two lagged S-curves, and *I* is the intensity of rainfall (basically, this is 1/*D*, where *D* is the duration of the unit hydrograph you summed to get the curves. A 1-hour UH is, by definition, 1 inch of rain per hour, so *I*=1, a 2-hour UH is ½, so *I*=0.5, etc.) Soooooo, what happens if you want to make an *infinitely small* time lag between them? If you make the change small enough….you know what happens next. The Δ*t* and Δ*Q* become d*t* and d*Q*!

$$Q_t\left(IUH\right) = \frac{1}{I}\frac{dQ}{dt}$$

Where *IUH* just means that the resulting hydrograph is *instantaneous* (it's the Instantaneous Unit Hydrograph, get it?). This equation is just another way of saying that the ordinates of the IUH are proportional to the *slope* of the S-curve! So. To make an IUH, you make an S-curve, just like we did before, and you determine the *slope* of the S-curve to get the IUH! Let's try it out.

Now, if you *have* an IUH, you can directly make UH of any duration—all you do is lag the IUH by the duration of the UH you'd like to make, and then *averaging* (instead of subtracting) the values for each time interval. Let me show you.