

What analyses do hydrologists do with streamflow data?

Part 1

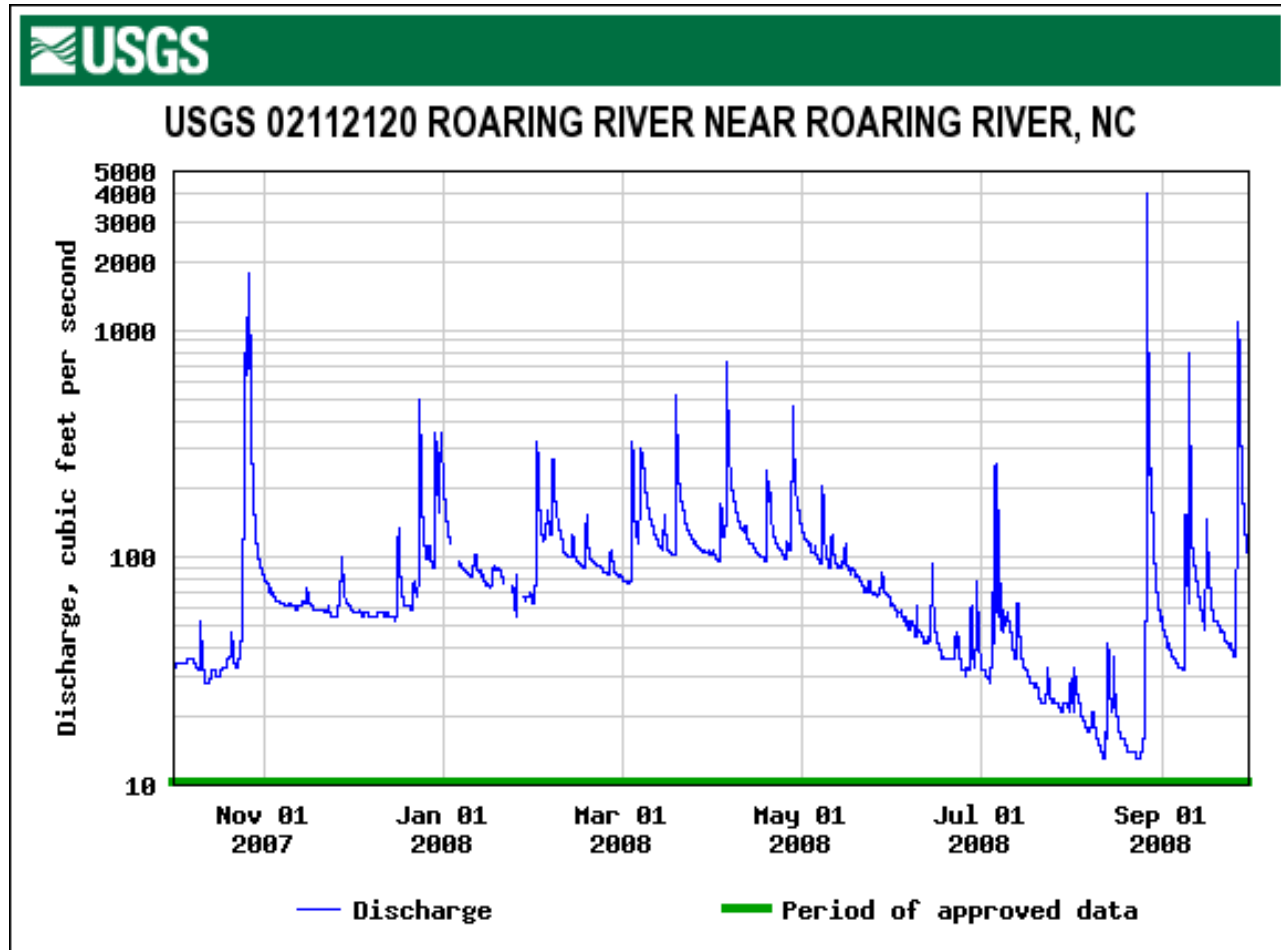
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Watershed Hydrology
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(Credit: Jeff Conaway, USGS, Alaska Science Center. Public domain.)

What can you do with streamflow data?

1. Create **hydrographs** – streamflow magnitude and variability over time.

- m^3/s
- Often a log y-axis

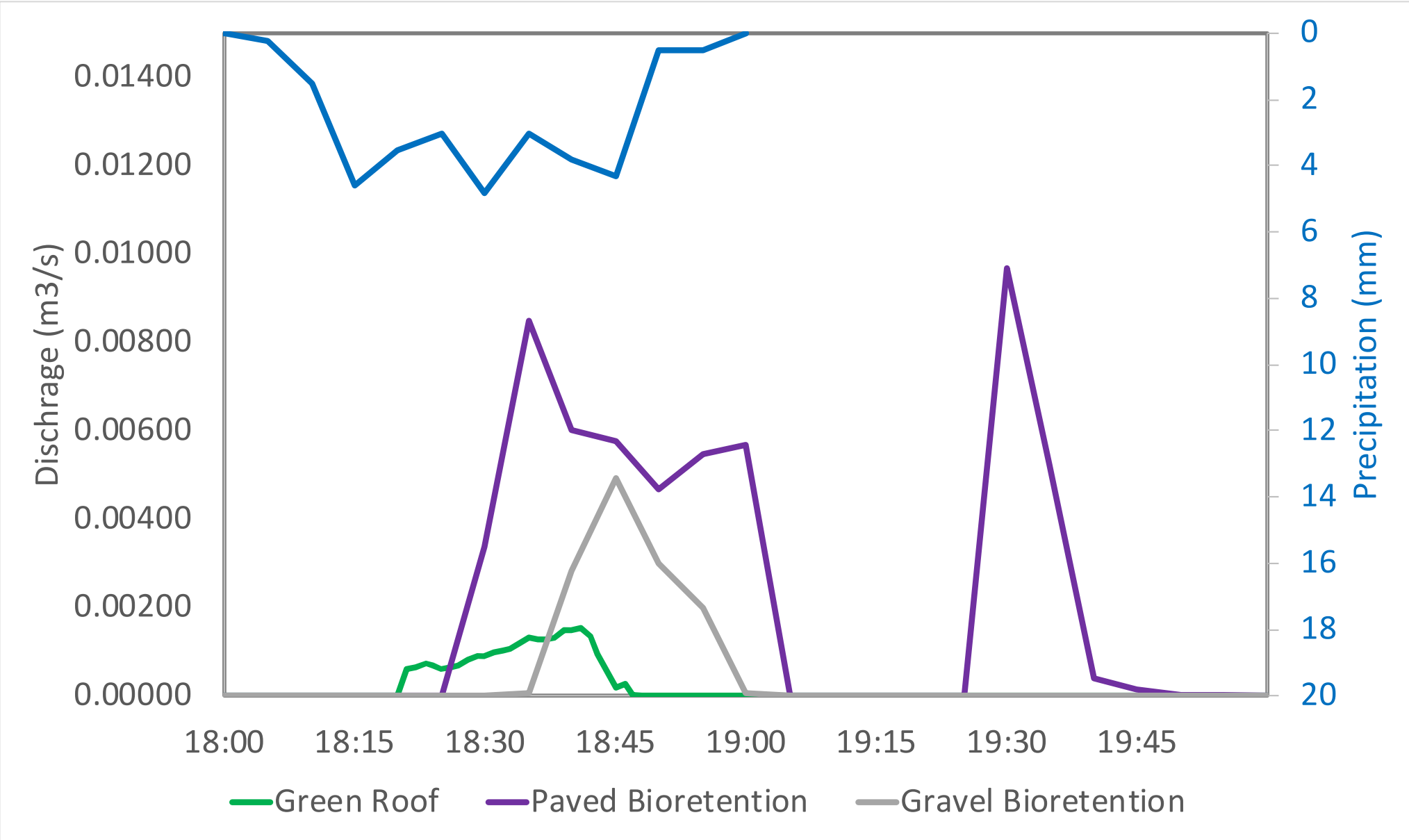


What can you do with streamflow data?

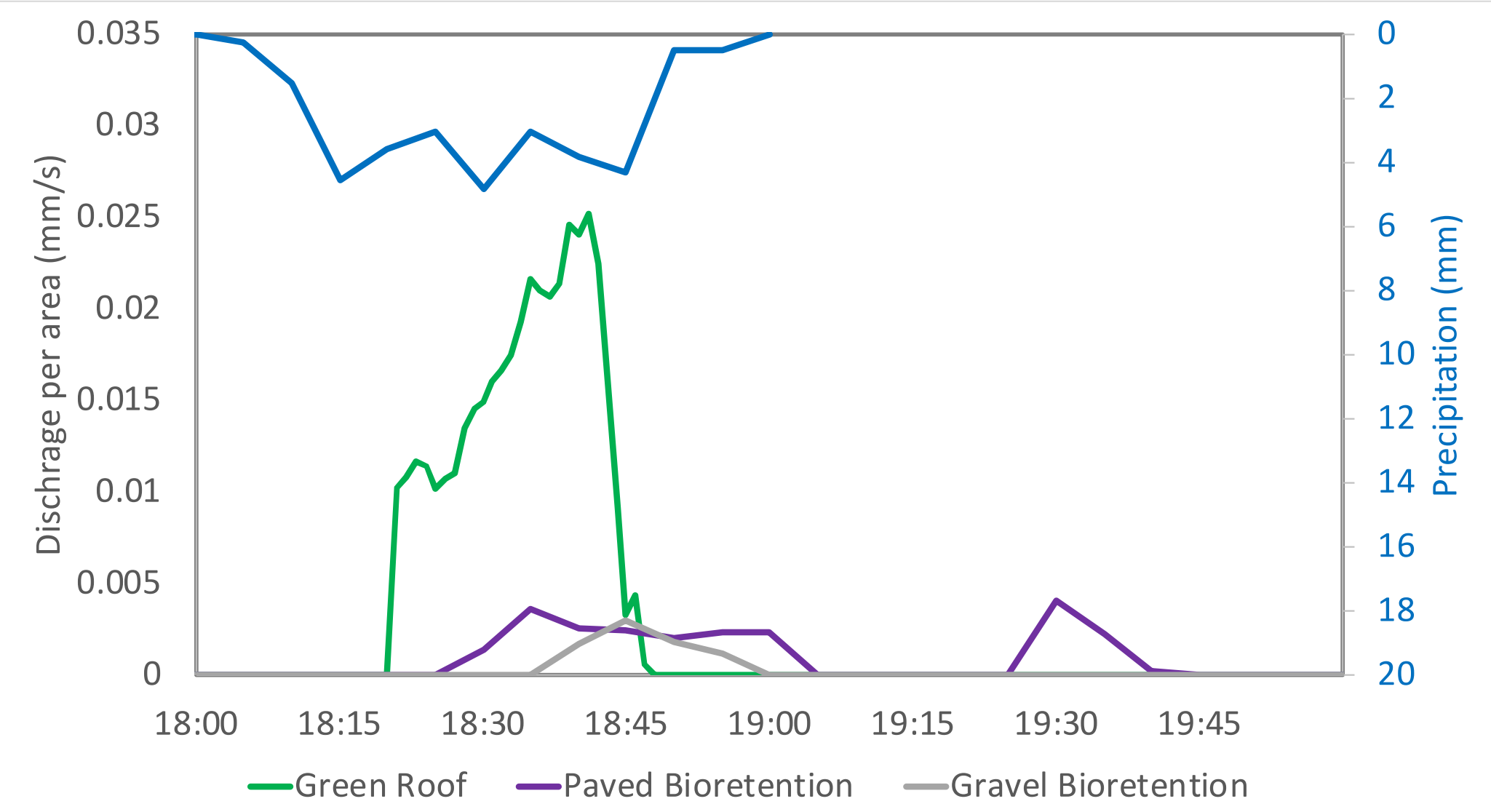
2. Create **unit hydrographs** –divide streamflow by watershed area

- $\text{m}^3/\text{s}/\text{km}^2$ <- lets you see easily that discharge is divided
- mm/hr or ... <- simplifies to the fraction to a rate, comparable to rainfall
- Useful to compare streamflow in 2 or more watersheds.

Hydrograph: Which GI has highest outflow?

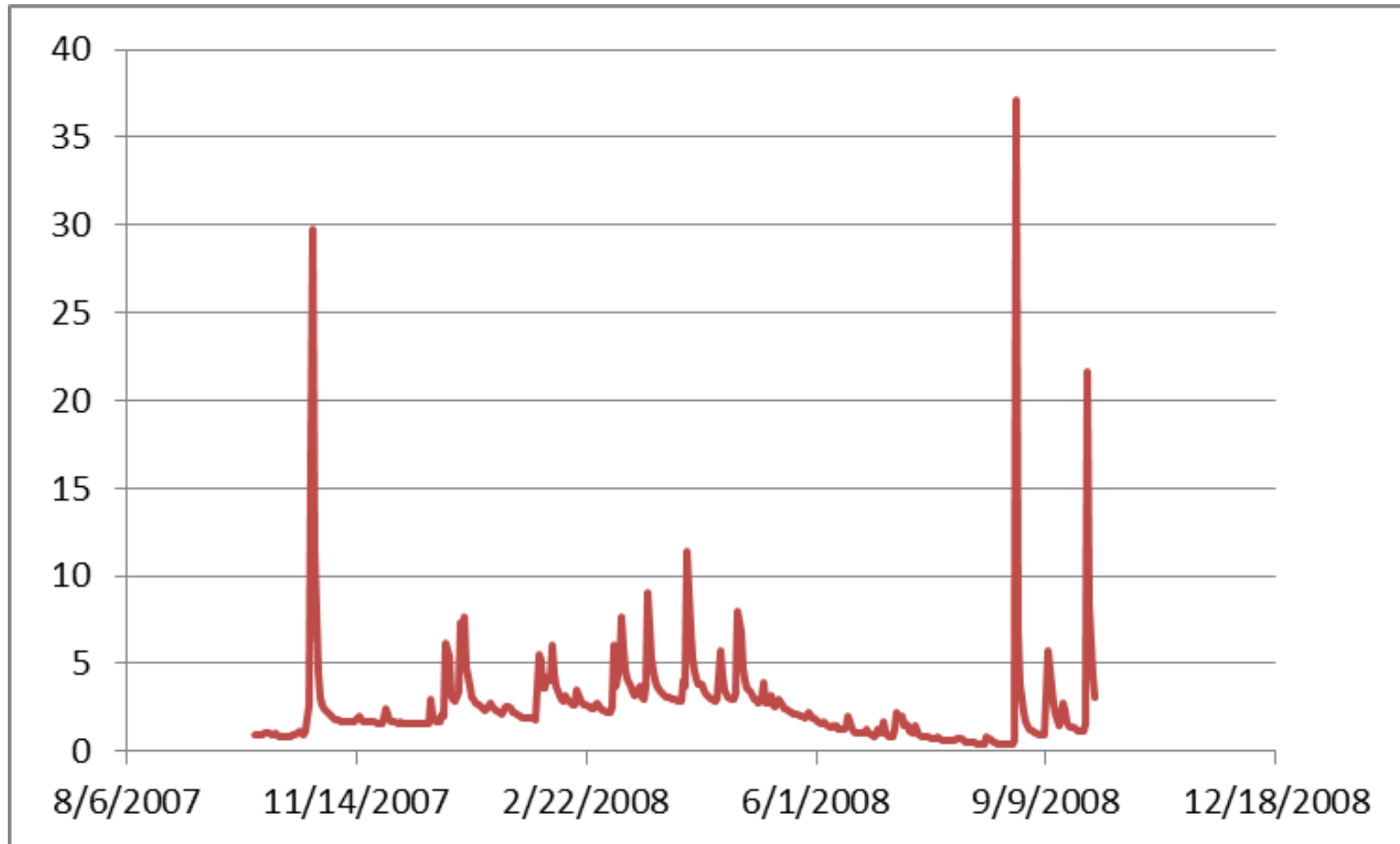


Unit hydrograph: Which GI is least effective at retaining stormwater?

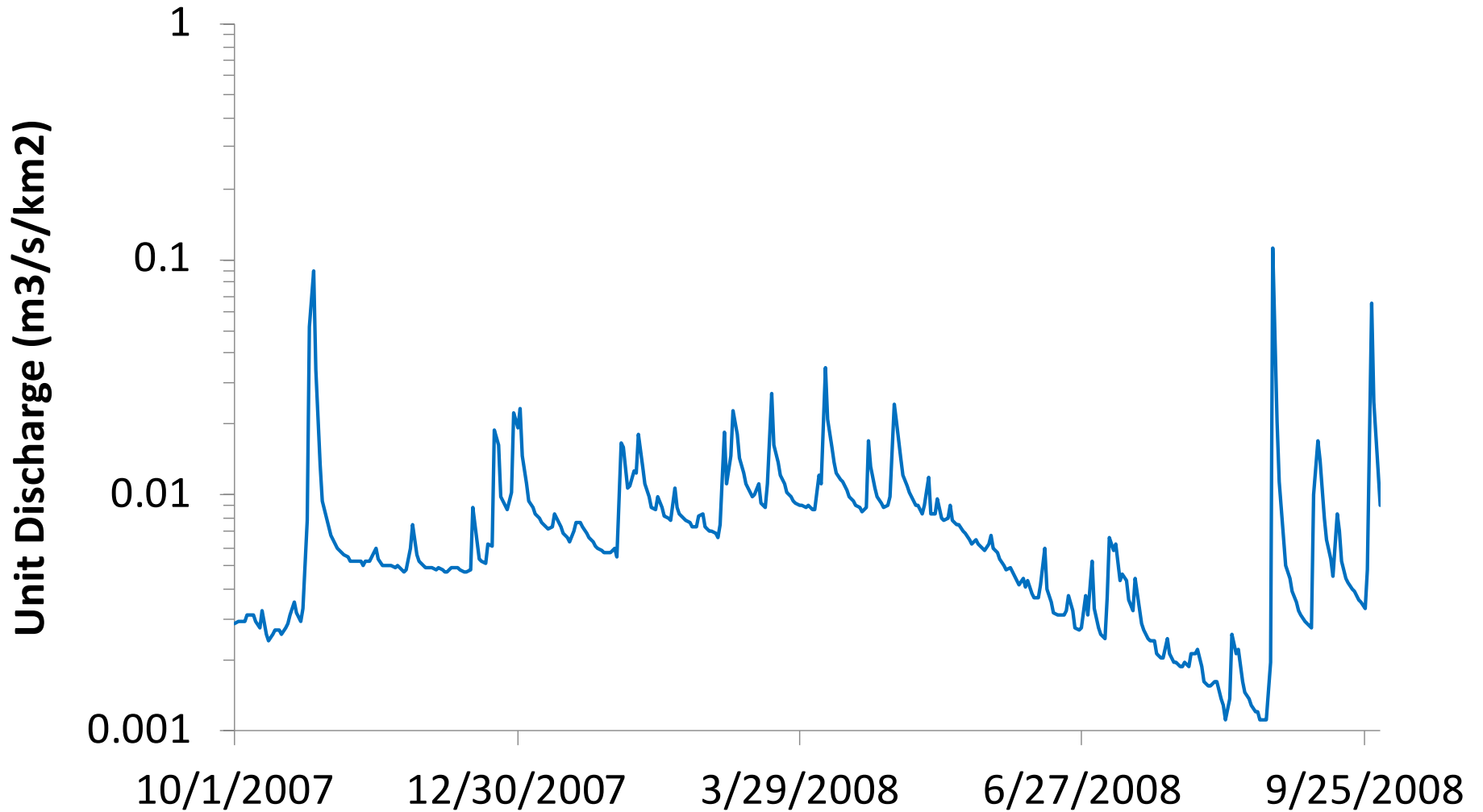


A bit of an aside on the graphics of hydrographs

Why is this hydrograph terribly designed?

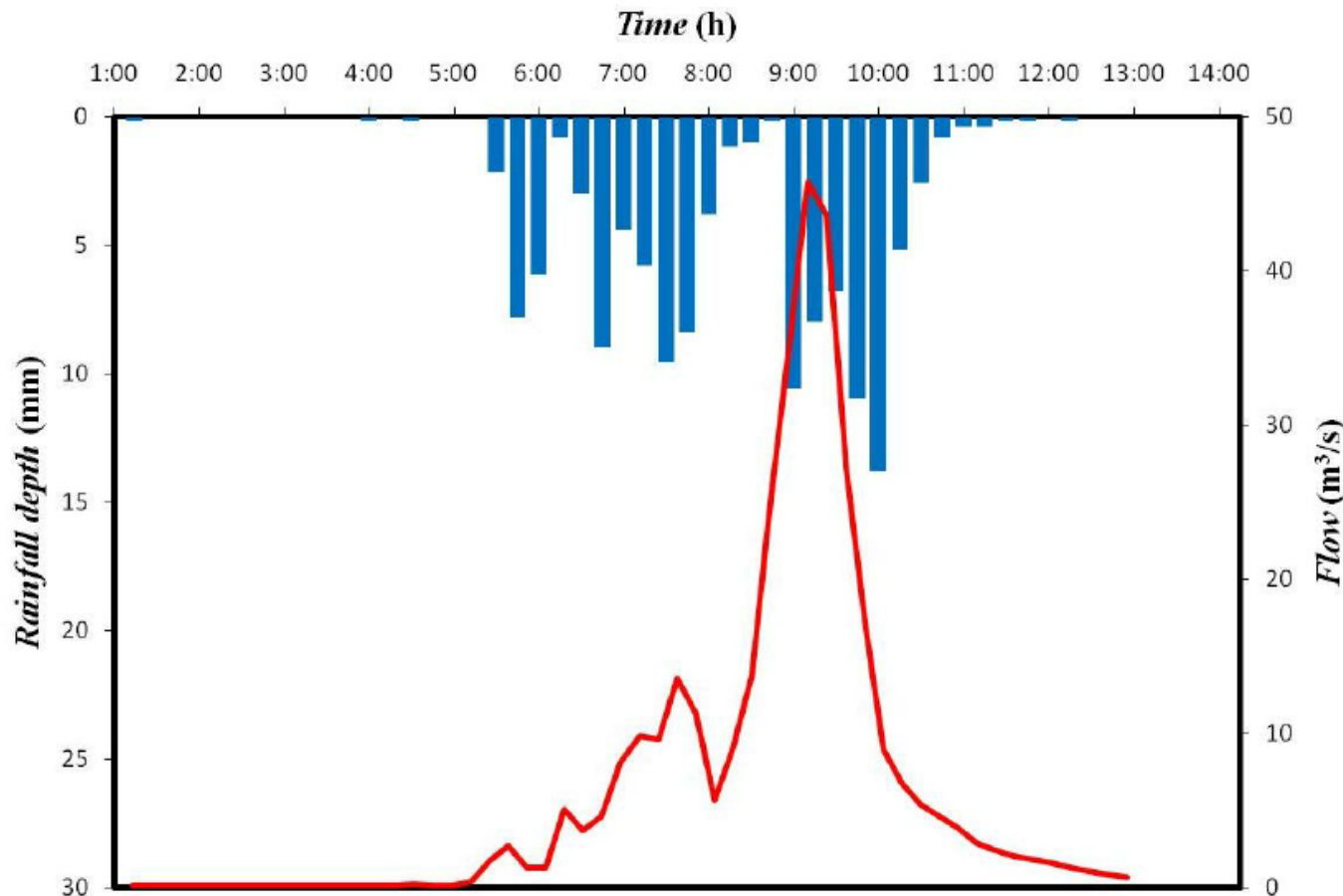


Good unit hydrograph



What can you do with streamflow data?

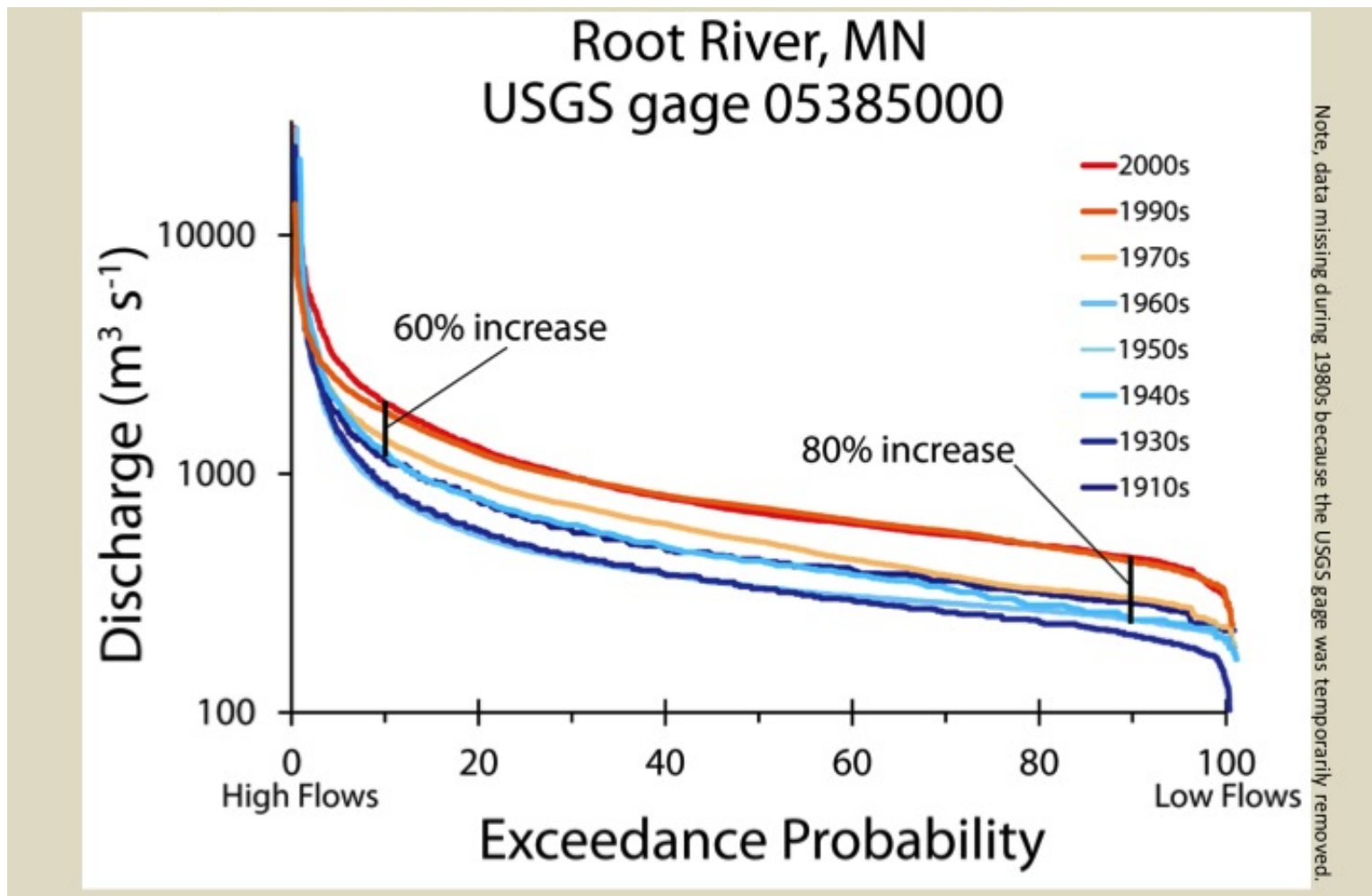
3. Create **hyeto-hydrographs** – compare rainfall to discharge to look at rainfall-runoff response.



Anything we can make as a graph, we can also calculate statistics for...

What can you do with streamflow data?

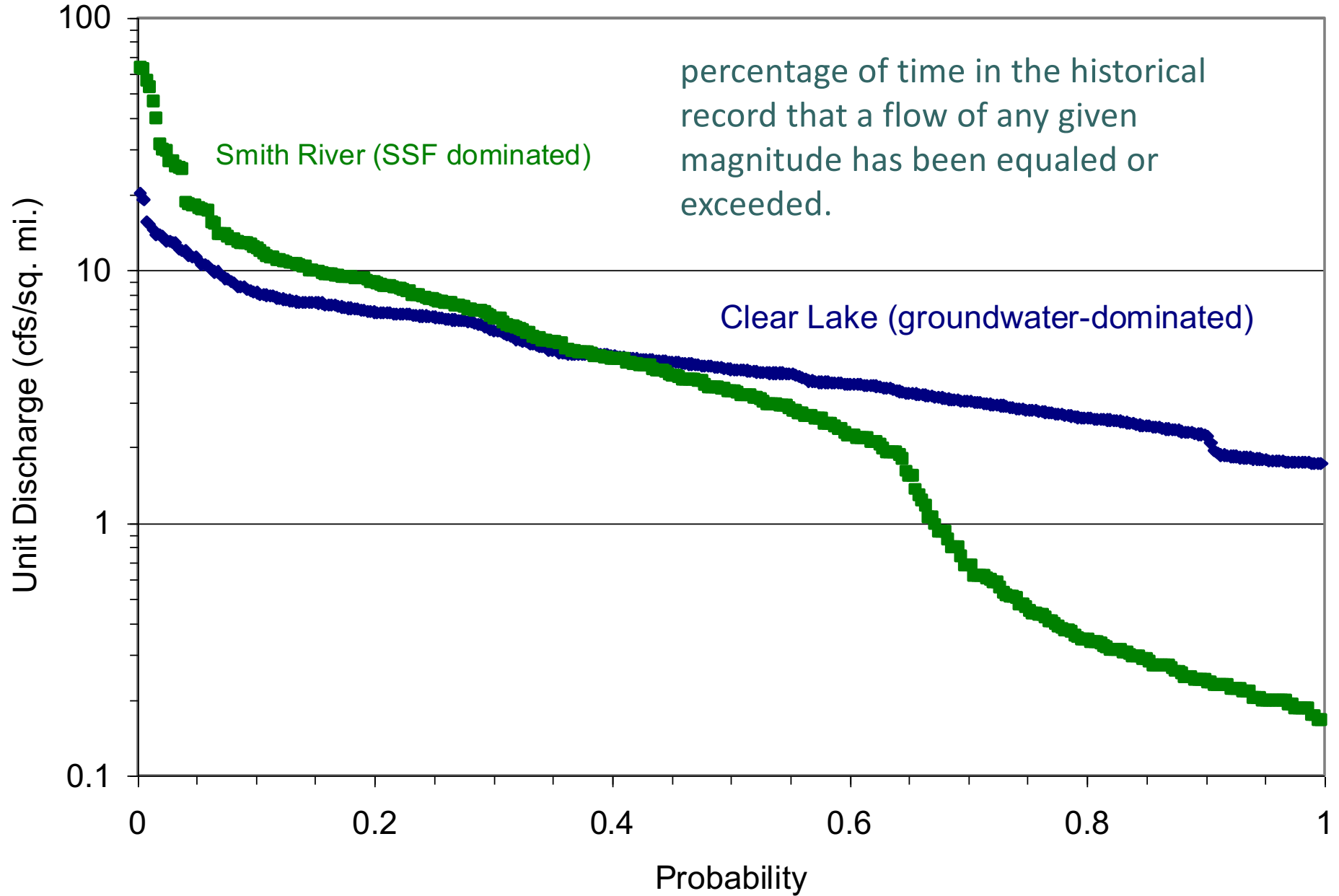
4. Create **flow duration curves** – show probability that a given flow will be exceeded



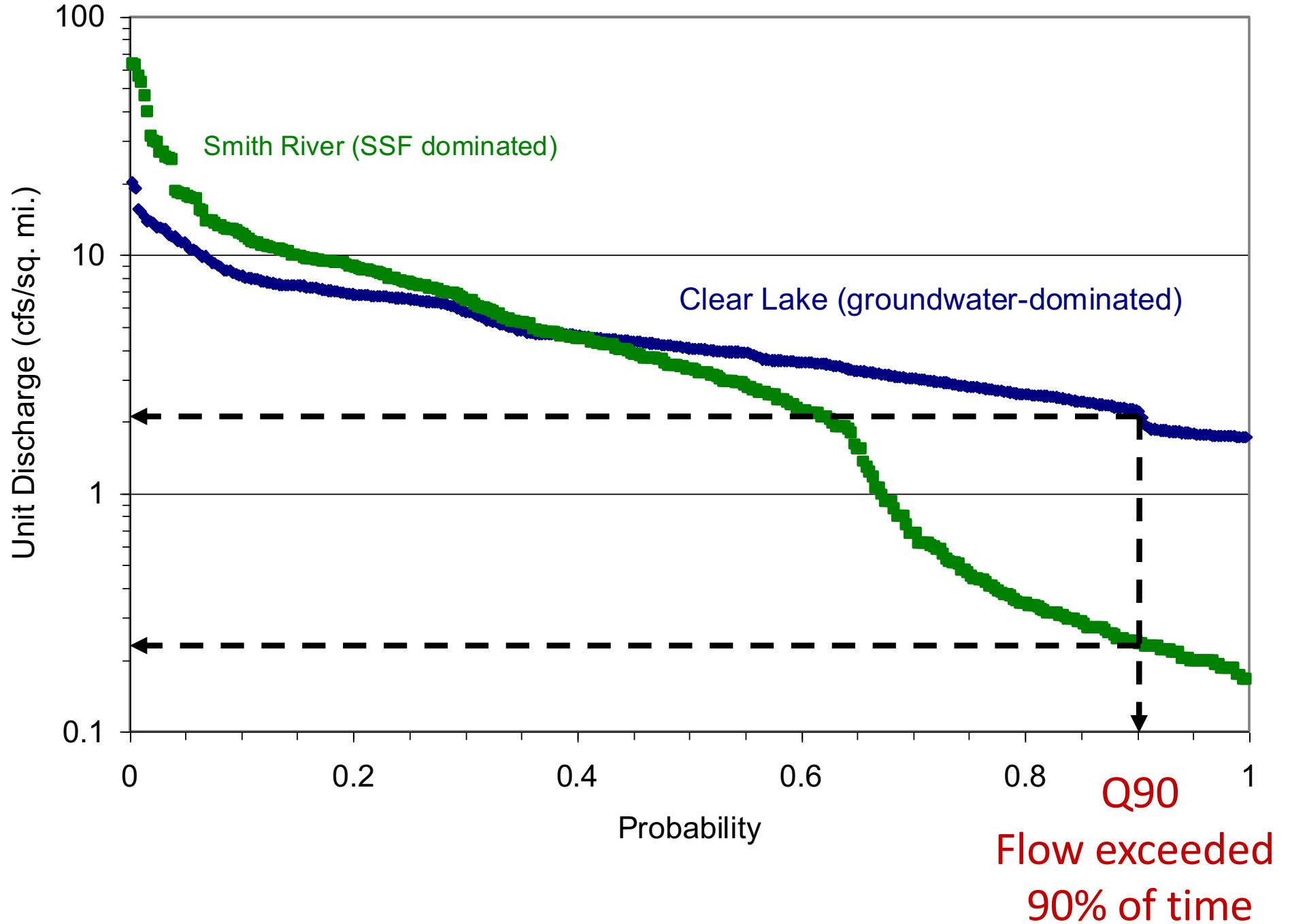
Anything we can make as a graph, we can also calculate statistics for...

More on flow duration curves: <https://www.e-education.psu.edu/earth111/node/868>

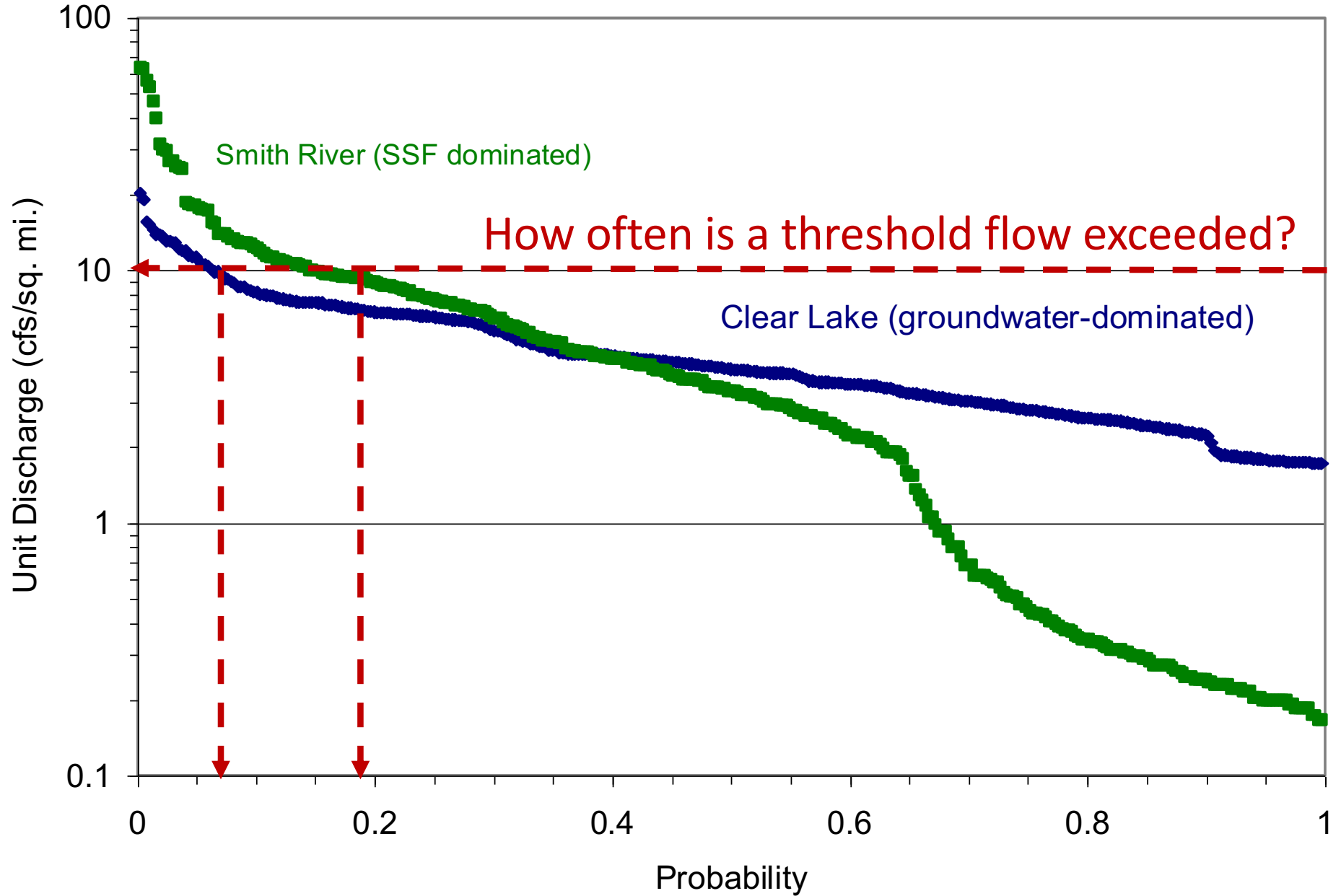
Flow duration curves



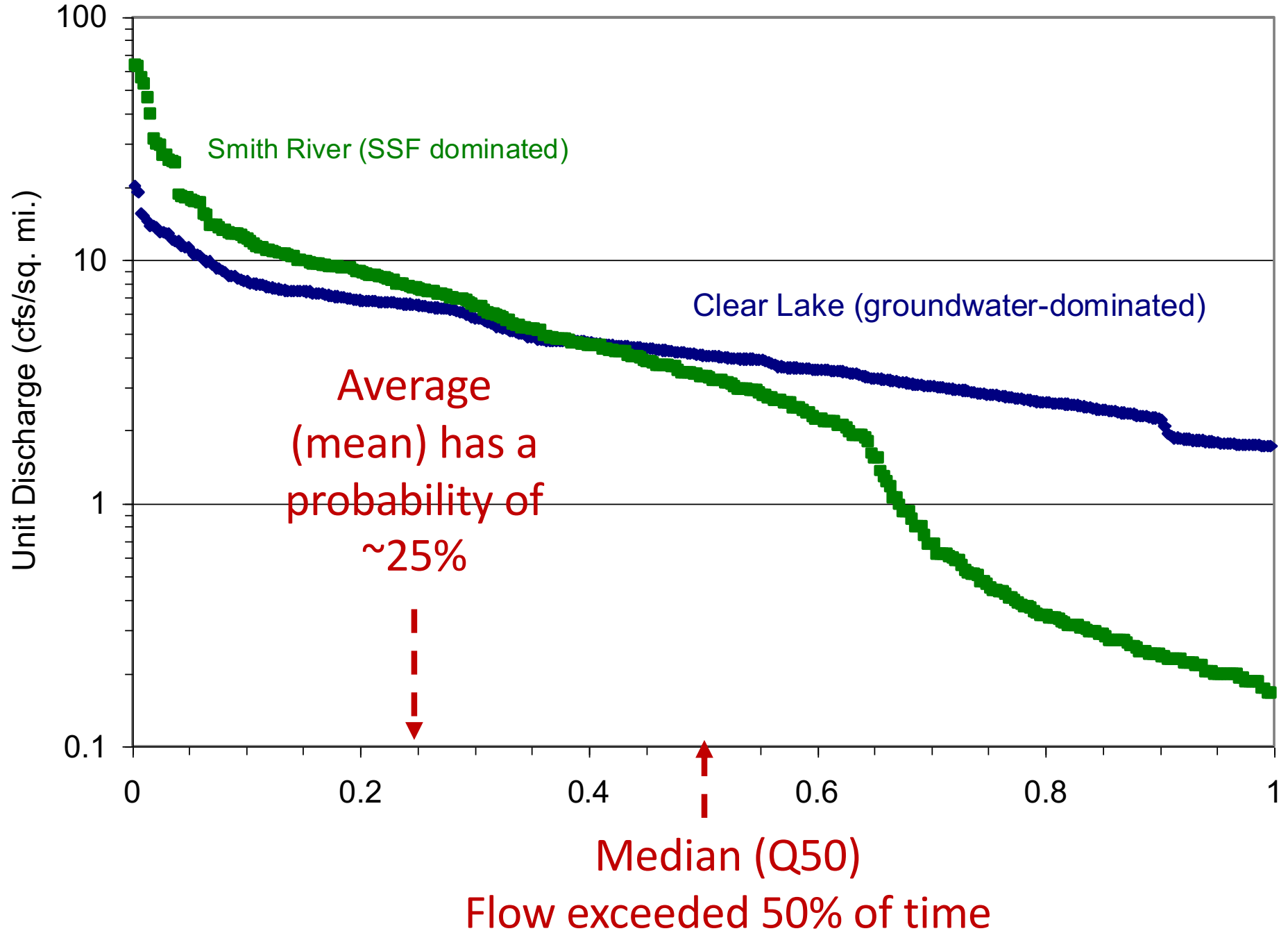
Flow duration curves



Flow duration curves



Flow duration curves



How to create your own flow duration curve

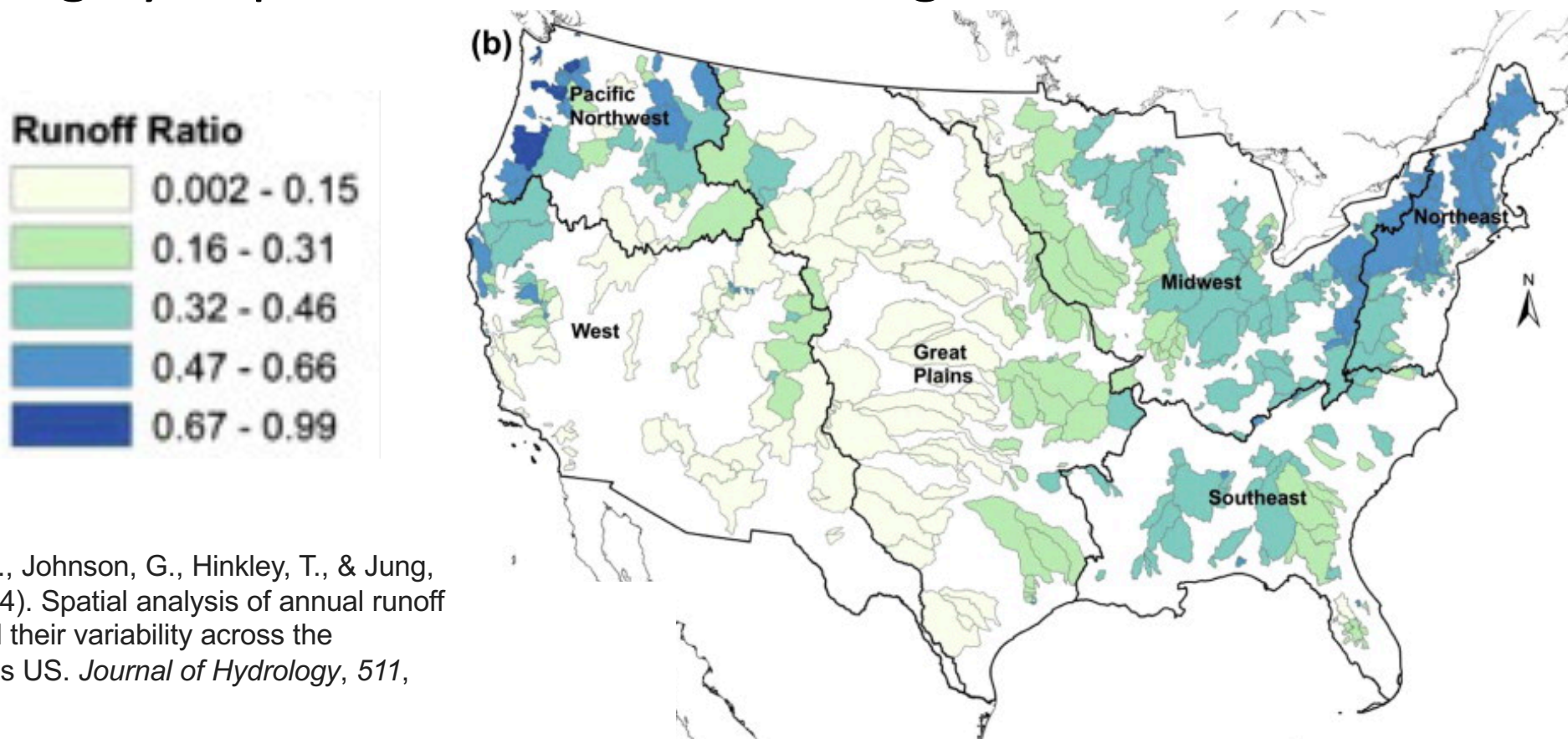
1. For your period of analysis, sort your data from largest to smallest. Rank the sorted data (biggest flow = 1).
 - *For my class: don't worry about ties.*
2. Apply formula $P = m / (n + 1)$, where rank is m, number of points in your analysis is n.
3. P = “exceedance probability” ← how likely is it get a flow to bigger than a given discharge
4. *(same idea as a flood frequency graph analysis)*
5. Make graph in excel with a log y-axis and linear x-axis.

For more help, there is a tutorial here:

<https://streamflow.engr.oregonstate.edu/analysis/flow/tutorial.htm>

5a. Calculate hydrologic response on annual or seasonal time scales

- **Runoff ratio = Annual Streamflow (or seasonal) / Annual Precipitation**
- Largely depends on climate and vegetation



Chang, H., Johnson, G., Hinkley, T., & Jung, I. W. (2014). Spatial analysis of annual runoff ratios and their variability across the contiguous US. *Journal of Hydrology*, 511, 387-402.

Hydrographs and flow duration curves are incredibly powerful tools for understanding streamflow regimes and watershed hydrology.

- *If you just want to do basic analyses (like for the problem set 10 due for my class), you can **stop here**.*
- *But you can do more...*