Assignment#6: Hydrograph separation (3/17)

The purpose of this assignment is to separate hydrograph data using a variety of techniques.

1) The first part of this assignment is to simply apply and compare 3 different hydrograph separation methods: constant recession time, linear reservoir, and chemical separation. I have provided discharge and stream chloride data for Reedy Creek, VA (Eshleman, et al. 1993. Water Resour. Res. 29(10)). This is a hydrograph from a 5.2 cm rainfall event. The watershed is 45.1 km², 20 ha of which is perennial open water and 200 ha is mapped as wetland. The specific tasks required for this assignment are below- display results in graphical form:

- Separate a storm hydrograph into "new" and "old" water based on the hydrochemical technique. (NOTE: precipitation for this storm has a Cl⁻ concentration of about 4 μeq/L)
- Separate baseflow and quickflow using the “recession duration” method to determine when storm runoff ends and use straight-line separation.
- Separate a storm hydrograph into baseflow and quickflow using a linear reservoir approach; assume a linear reservoir coefficient of 0.0074 hr⁻¹ (the value of the coefficient is commonly between 0.0007 and 0.001 hr⁻¹ for large watersheds)
- Compare the results among the different techniques. Are any particularly unique? Why?

2) The second part of this assignment is to apply the Boussinesq-based (a.k.a. linear reservoir) technique to Fall Creek (we investigated this watershed in earlier assignments) and infer the extent of saturation. We’ll use 1990 Fall Creek data.

- First, find a good recession coefficient by isolating several (at least 3) hydrograph recession limbs that are in recession for at least 5 consecutive days. Plot these recessions as ln(Q) vs time and find the slopes of the relationships. You may want to experiment with removing the highest point or two to see if regressions improve.
- Using an average slope (i.e., average recession constant) from above, find a well behaved spring hydrograph and separate the baseflow from the “runoff.” Note, the data will be “noisy.” Estimate the “runoff” volume (i.e., the area between your separation line and the streamflow in units of m³).
- Assuming the runoff between 4/10 and 4/14/1990 is due to saturation excess runoff from the most recent measured rain (~2.34 cm), estimate the area of saturation (rain X saturated area = volume of runoff). What fraction of the watershed was saturated?

EXTRA CREDIT: Carry-out a more extensive analysis of any watershed of choice using data over the past several decades. Are there any trends, e.g., does the recession constant change seasonally or with climate changes, does the fraction of discharge that is baseflow change, etc.? This could become the basis for a final project.