Problem: *Water Cycle Climatology for a Watershed*

Statement:

Using water balance concepts and historical observations, assess the "climatology" of water cycle variables (precipitation and streamflow) for a watershed. As part of this exercise, you will also learn about some available online sources for hydrologic data.

The National Weather Service (NWS) uses 30-year averages to define climate "normal" (or the climatology) for weather variables. The latest climate normal period is from 1981 to 2010. Use coincident observations of precipitation and streamflow for this period for your assessment.

Do the following steps in your analysis:

a. Pick a USGS stream-gage somewhere in the United States to define the outlet of a watershed. Report the USGS stream-gage number and the watershed drainage area (in mi^2). **Do not** select a watershed that does not have *Monthly Statistics* for the years 1981 to 2010. Report the station name and USGS ID number. Also report (verbatim) the REMARKS from the *Water-Year Summary* for a recent year. (If the remarks say that **flows are regulated**, choose another stream-gage).

   Note: To find a stream-gage, I recommend looking at the USGS Current Water Data for the Nation real-time data. Click on the State you are interested in on the map, and then click on the *Statewide Streamflow Current Conditions Table* for a list of real-time operating stream-gages. Follow the link to your chosen stream-gage. Under the Available data for this site pulldown menu, select *Location Map* (to get drainage area), select *Monthly Statistics* (to verify that there are monthly data for the 30-year period), and select Water-Year Summary (to get the REMARKS). The watershed you choose is up to you, but I suggest a watershed that is in the range of 10s to 1000s of square miles (HUC-8 size or smaller).

b. Create a table showing the average monthly discharge (in cfs) and the average monthly discharge depth (in inches) for the stream-gage you selected.

   Note: You will need to copy and paste the monthly mean discharge for 1981 to 2010 into a spreadsheet. Find the average of the 30-years for your table. You can compute the average monthly depth (volume/area) by first computing the volume (average discharge rate × time) and then dividing by the drainage area (keep track of units!).

c. Create a table showing the average monthly precipitation (in inches) for the watershed.

   Note: This step will be an approximation (with more time we could estimate the mean areal precipitation of the watershed more accurately). Go to the NOAA Climate Data Online Site and choose the *Mapping Tool*. From the Surface Maps tab choose *Normals*. From the Layers tab choose *Monthly Climate Normals*, and then zoom in to your selected watershed. Find the station that is closest to your watershed drainage area (within the watershed would be ideal,

but that might not be possible). Use the tools (see wrench icon) to select the station. Add it to your cart and *Continue* with the defaults to submit your order. From the PDF download, you can retrieve the monthly precipitation means (these are for 1981 to 2010).

d. Plot the average monthly precipitation (in inches) and the average monthly discharge (in inches) versus month (on one graph).

e. Compute the average annual precipitation (in inches).

f. Compute the average annual discharge (in inches).

g. Compute the average annual evapotranspiration (in inches) using the long-term water budget assumption.

h. Compute the runoff coefficient (i.e., annual discharge as a fraction of precipitation) (in %).

Note: It is common in hydrology to consider the partitioning of precipitation (over long time scales) into (1) the portion that becomes discharge (or runoff), and (2) the portion returned to the atmosphere by evapotranspiration. Part h) asks you to determine the percentage of precipitation that becomes discharge.

Suggestion: After selecting a stream-gage in part a), it would be helpful to have a map of the watershed (especially for part c). Unfortunately, this is not provided with the stream-gage information. I suggest that you use the USGS StreamStats 4 application to create a watershed map.

Solution: