Hydrology and the Environment
BEE 371

Thiessen Polygons (see also: Dingman p. 121-125; or Dunne & Leopold p. 38; Ward & Trimble pp. 43-44)

Often we need to determine the average amount of precipitation over an area, e.g., a watershed, and it is not always clear how to get the most representative value. The advent of geographic information systems (GIS) has greatly streamlined the problem of determining spatial statistics, but sometimes it is not practical to use GIS. The Thiessen Polygon approach is probably the most common method used in hydrometeorology for determining average precipitation (or snow) over an area when there is more than one measurement. The basic concept is to divide the watershed into several polygons, each one around a measurement point, and then take a weighted average of the measurements based on the size of each one's polygon, i.e., measurements within large polygons are given more weight than measurements within small polygons. The weighted average is calculated by:

$$\overline{P} = \frac{P_1A_1 + P_2A_2 + P_3A_3 + ... + P_nA_n}{A_1 + A_2 + A_3 + ... + A_n} = \frac{\sum_{i=1}^{n} P_iA_i}{\sum_{i=1}^{n} A_i}$$

where $\overline{P}$ is the weighted average, P's are measurements, and A's are areas of each polygon.

The figure below shows an example of how Thiessen Polygons are made. First connect all of the measurement points, the dots in the figure are measurement points and they have been connected with dashed lines. Second, perpendicularly bisect each of the "connecting" lines and extend the bisecting lines until the either intersect the watershed boundary or another bisecting line. In the figure there are four polygons; note that measurements made at point 4 will be contribute less to the final average than, say, the measurements at point 2.