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GIS for Foresters

Snapping a Pour Point for Watershed Delineation in ArcGIS Hydrologic Analysis

By Yanli Zhang, Matthew McBroom, Jason Grogan, and I-Kuai Hung

A watershed, catchment, or drainage basin is the natural hydrologic unit enclosed by a drainage divide lying upslope from a specified outlet, or “pour point.” This defined area is the basic watershed management unit, analogous to a stand in silviculture. Establishing accurate watershed boundaries is important for many facets of natural resources management, including hydrologic analysis, watershed modeling, watershed protection planning, endangered species conservation, and total maximum daily load (TMDL) development. Historically, watershed boundaries were established, delineated, or “line traced,” from contour maps. However, this method relies on the accuracy of the contour map and the delineator’s experience, and can be time-consuming for multiple delineations and subsequent analysis of drainage-basin or stream-channel characteristics.

GIS has greatly expedited the process of watershed delineation and analysis. By using a digital elevation model (DEM) and establishing the watershed outlet, or pour point, GIS users can quickly and accurately conduct watershed delineations. DEMs are available from the US Geological Survey (http://seamless.usgs.gov/) with 30- or 10-meter resolutions. The general watershed delineation procedure in ArcGIS is illustrated in Figure 1.

The overall procedure is straightforward, but there are additional steps that require special attention. One of these is snapping the pour point, as illustrated in Figure 2. This is how Esri explains the process: “Search within a snap distance around the specified pour points for the cell of highest accumulated flow and move the pour point to that location.” This explanation may not adequately describe the process for non-GIS professionals, so the following practical example of a stream-crossing study will help to illustrate this issue.

To manage stream crossings, it is necessary to determine the appropriate design flow, both for the structure to perform properly and to prevent failures. The peak flow of a stream crossing is determined by the 26-meter resolution DEM. After the contribution area is only one cell (26 meters by 26 meters), the pour point is the outlet of the watershed in the true location. This explanation may not precisely match with vector data. Other potential reasons for the slight location difference between the original georeference and the raster resolution. In this case, one DEM cell has 26-by-26-meter (676 square meter) coverage and its height is the average value within that area. Raster data at this resolution may not overlay each other. The possible reasons for this could be the difference between the original georeference and the raster resolution. In this case, one DEM cell has 26-by-26-meter (676 square meter) coverage and its height is the average value within that area. Raster data at this resolution may not match with vector data. Other potential reasons for the slight location difference between the pour point and the true outlet of the watershed include, but are not limited to, the accuracy differences in GIS data, accuracy of GPS unit, and terrain changes.

In summary, snapping a pour point is needed for watershed delineation, and a snap distance is the search radius for finding the point that has the highest accumulated flow. For different data sets, a suitable snap distance should be set based on trial tests. However, a global snap distance may not be appropriate in some cases. For example, a stream crossing may be located on a tributary and near the point where the tributary joins the main stream. If the snap distance is too long, the calculated pour point could be the confluence of the tributary and the main stream. In this case, the contributing area of the main stream above the confluence will be delineated instead of the contributing area of the stream crossing. In future articles we will further discuss the watershed delineation process and practical applications using ArcGIS.

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**Figure 1.** The general watershed delineation process using ArcGIS.

**Figure 2.** User interface of Snap Pour Point function in ArcGIS.

**Figure 3.** Snap distance illustration (to delineate the contribution area of the stream crossing, a snap distance is required to find the point having the highest accumulated flow).

**Figure 4.** Flow accumulation raster and vector stream comparison.