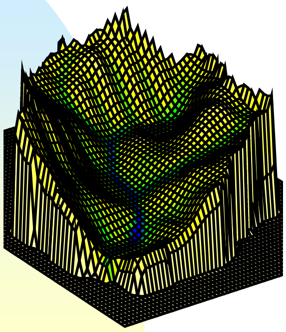
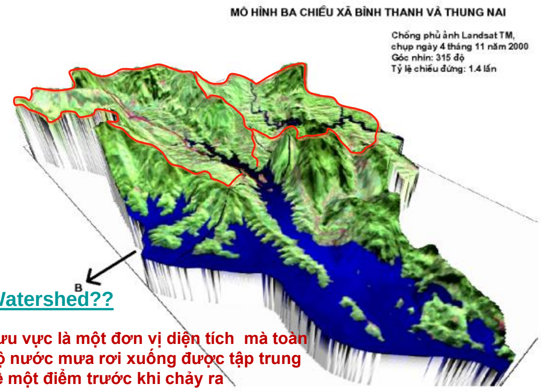
Digital Elevation Model (DEM) Processing for Watershed Delineation

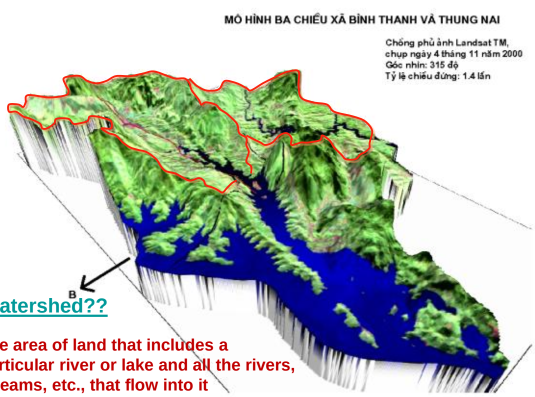


Lab 2



Watershed??

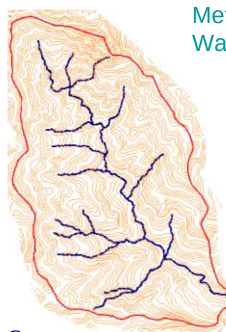
Lưu vực là một đơn vị diện tích mà toàn bộ nước mưa rơi xuống được tập trung về một điểm trước khi chảy ra



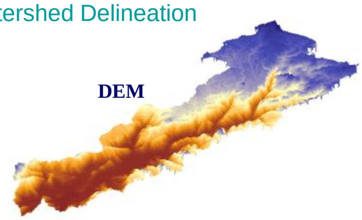
Watershed??

The area of land that includes a particular river or lake and all the rivers, streams, etc., that flow into it

Methods of Processing for Watershed Delineation

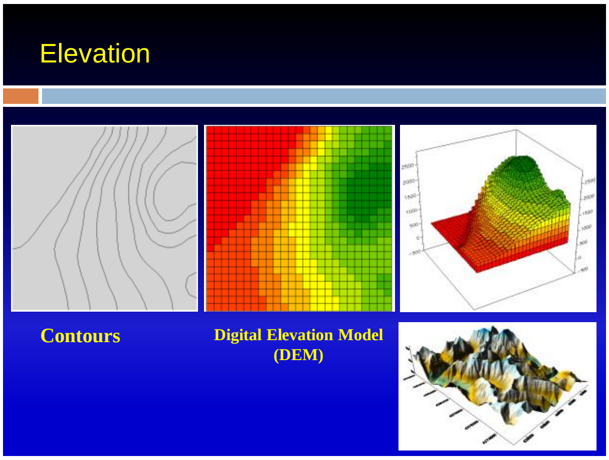


Contours



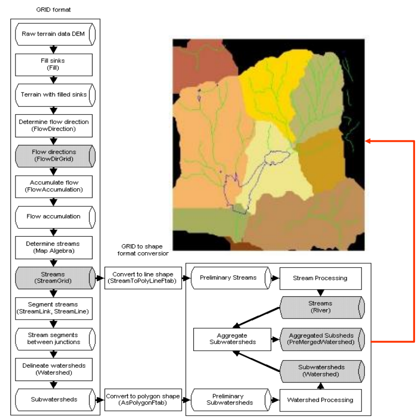
DEM

Hand Digitizing VS. GIS Digitizing

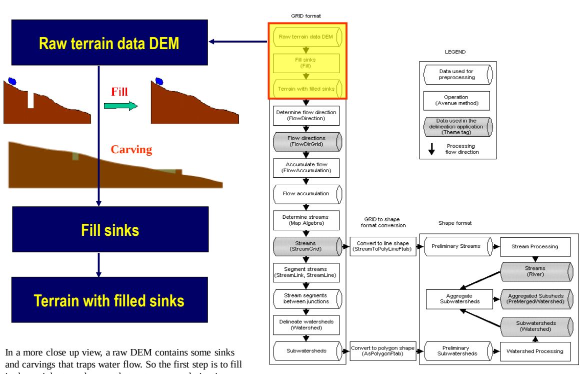


Processing flow for Watershed Delineation

This diagram presents a processing process for subwatershed delineation. As you can see (it is a little bit small!) the first input data is a DEM and it is in grid format. The last output is a map of watersheds delineated.



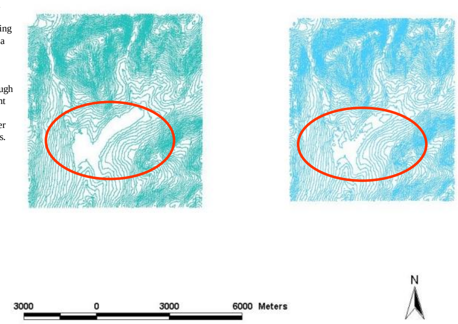
Processing flow for Watershed Delineation



In a more close up view, a raw DEM contains some sinks and carvings that traps water flow. So the first step is to fill in those sinks to make sure that water accumulation in proper process downstream in later steps.

Pits in IDW Surface of DEM

This diagram shows the effects of filling in the pits of a DEM on contours interpolation. The left is rough while the right is much smoother after filling the pits.

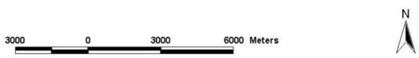


Pits in IDW Surface of DEM

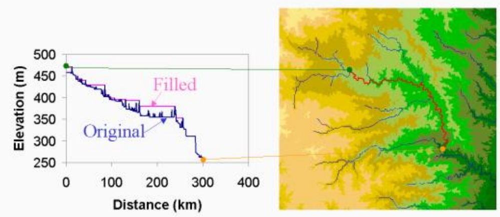
This diagram shows the effects of filling in the pits of a DEM on contours interpolation. The left is rough while the right is much smoother after filling the pits.

Contours after filling the pits

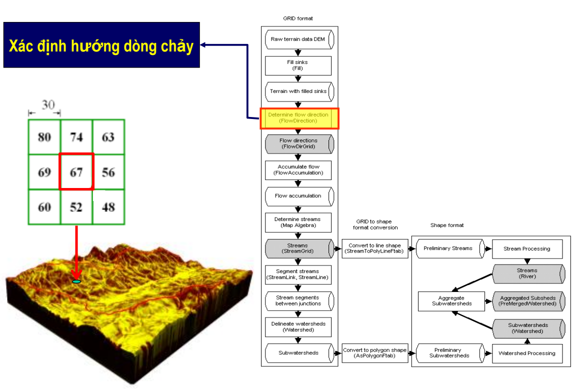
Contours before filling the pits



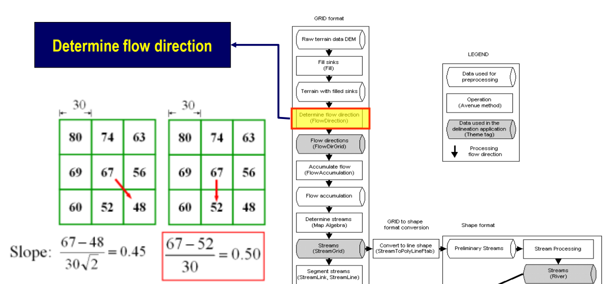
Effect of Pit Filling on Elevation



Processing flow for Watershed Delineation

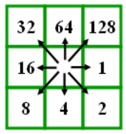


Processing flow for Watershed Delineation

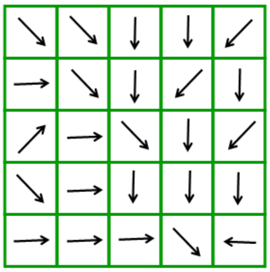


The next step is to determine flow direction. Water flows from higher elevation to lower one. To determine this, we need to calculate slope. As you can see, the slope from cell 67 to cell 52 is bigger than to cell 48, therefore, water flows from cell 67 to cell 52. The direction for this case is digitized as a number of 4, why? Let's go to next step.

Flow Direction Grid



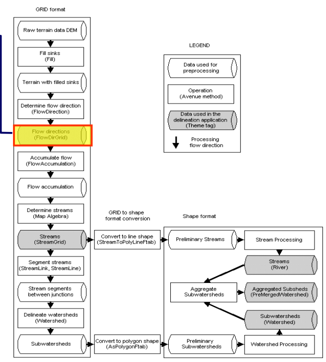
The 9 square boxes in the top right corner present digital numbers of flow direction. For example, to the east is 1 (equals to 2^0) , to the west is 16 (equals to 2^4), etc. This is the way to make it fits to the binary algorithm of the computer. Any other reasons more than that, we don't know!



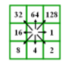
2	2	4	4	8
1	2	4	8	4
128	1	2	4	8
2	1	4	4	4
1	1	1	2	16

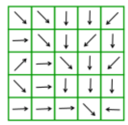
Processing flow for Watershed Delineation

Flow direction



Flow Direction Grid



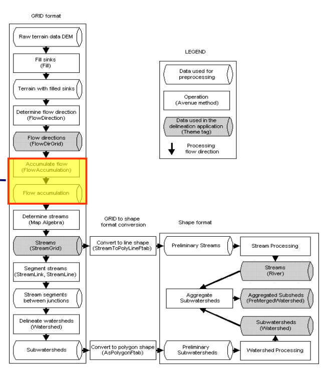


2	2	4	4	8
1	2	4	8	4
128	1	2	4	8
2	1	4	4	4
1	1	1	2	16

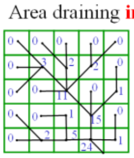
From slope calculation, flow direction then assigned by digital numbers.

Processing flow for Watershed Delineation

Accumulate flow



Flow Accumulation Grid.
Area draining **in** to a grid cell

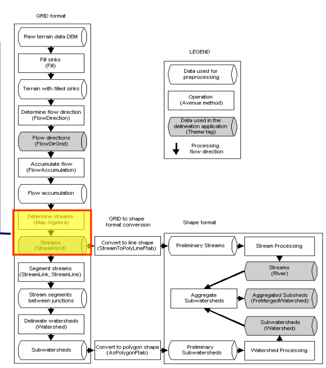


0	0	0	0	0
0	3	2	2	0
0	0	11	0	1
0	0	1	15	0
0	2	5	24	1

Flow accumulation is calculated based on the network of contributing cells above a certain cell. The number 3 for example, is made up of the three cell above it (not include itself).

Processing flow for Watershed Delineation

Determine Stream



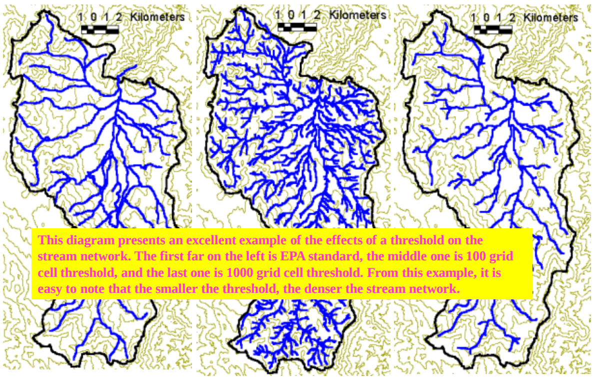
Flow Accumulation
> 5 Cell Threshold

0	0	0	0	0
0	3	2	2	0
0	0	11	0	1
0	0	1	15	0
0	2	5	24	1

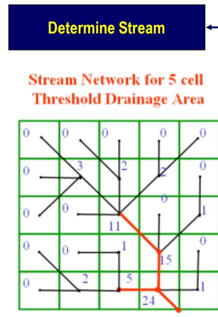
The next step is to determine a threshold for the stream network. In this case, for example, only cell accumulated from 5 cell or more is considered a stream cell.

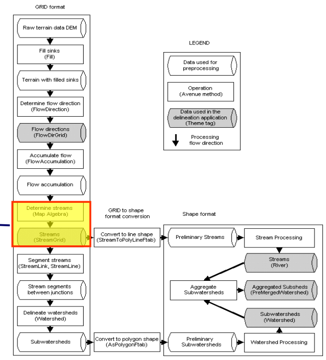
Drainage Density for Different Support Area Thresholds

EPA Reach Files | 100 grid cell threshold | 1000 grid cell threshold



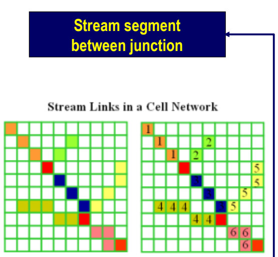
Processing flow for Watershed Delineation

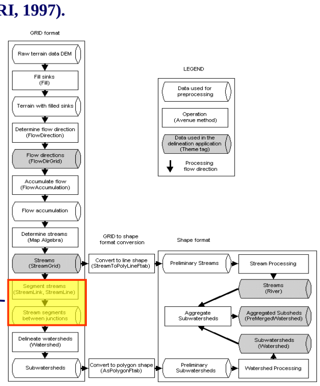




Again, this is the stream network for 5 cell threshold drainage area.

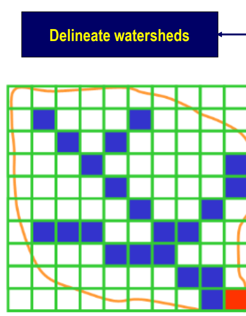
Processing flow for initial, arbitrary subwatershed delineation (from ESRI, 1997).

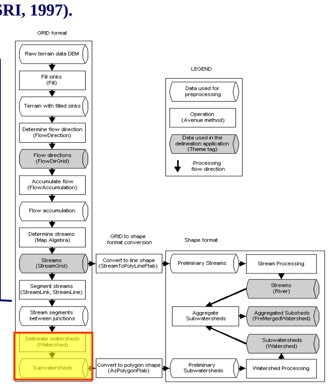




The stream segments are connected by stream junctions (point to the junctions on the diagram)

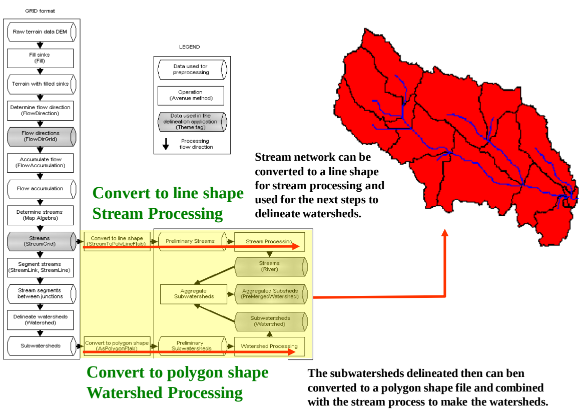
Processing flow for initial, arbitrary subwatershed delineation (from ESRI, 1997).

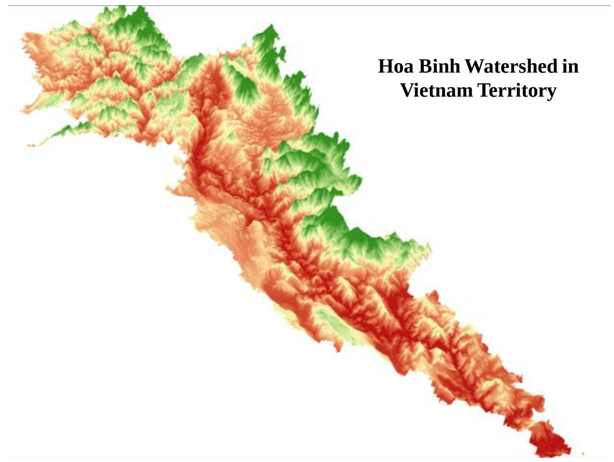


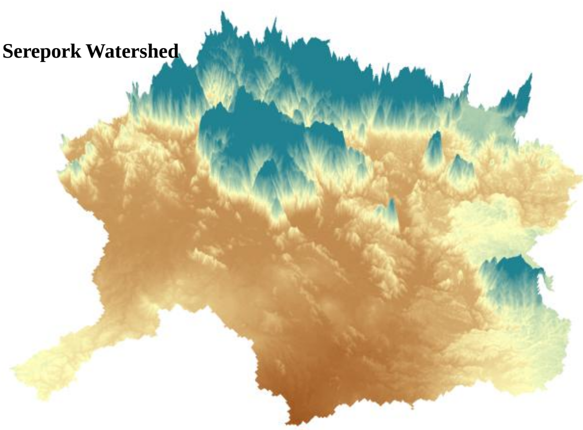


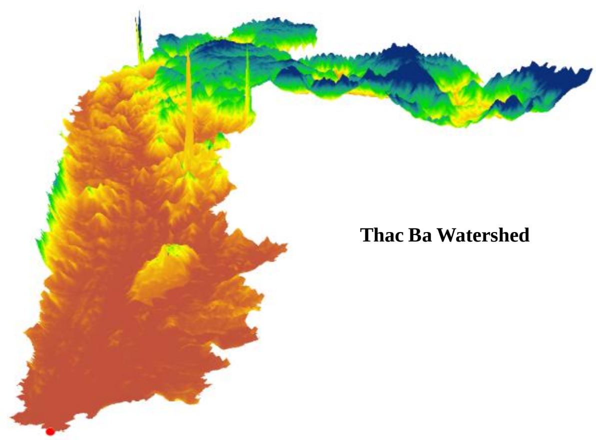
This a scratch of the watershed delineated from the stream network mentioned in the previous step. The red cell is the outlet. It is not easy to make. Fortunately, we do not have to do it by hand, the program (ArcHydro) makes it!

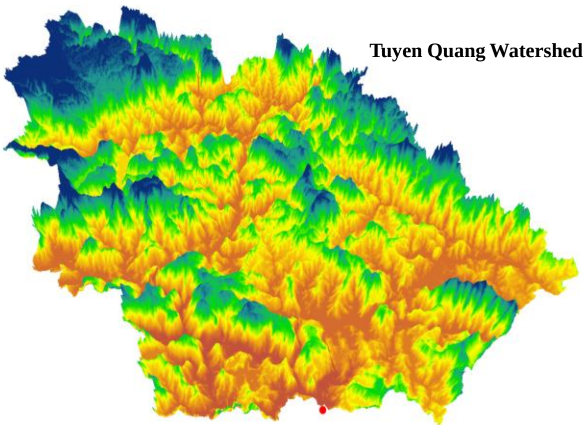
Processing flow for Watershed Delineation



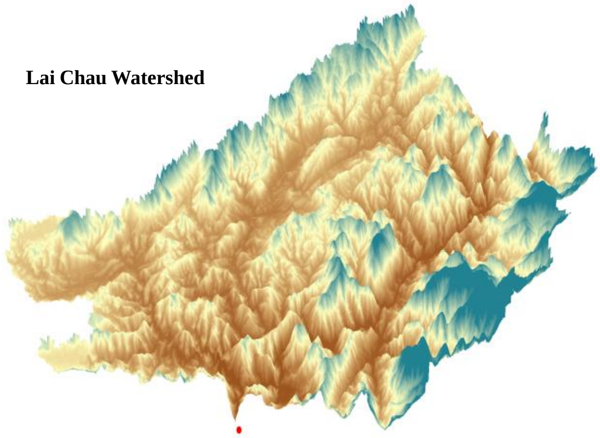




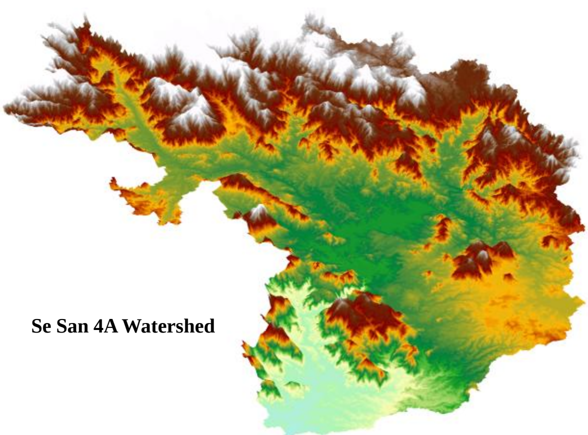




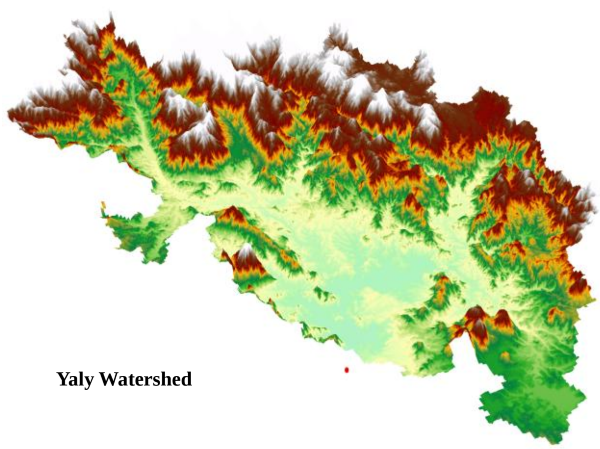
Tuyen Quang Watershed



Lai Chau Watershed



Se San 4A Watershed



Yaly Watershed