Using Arc Hydro to study stream morphology in the Oregon coast range

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for Geog 592 - GIS II
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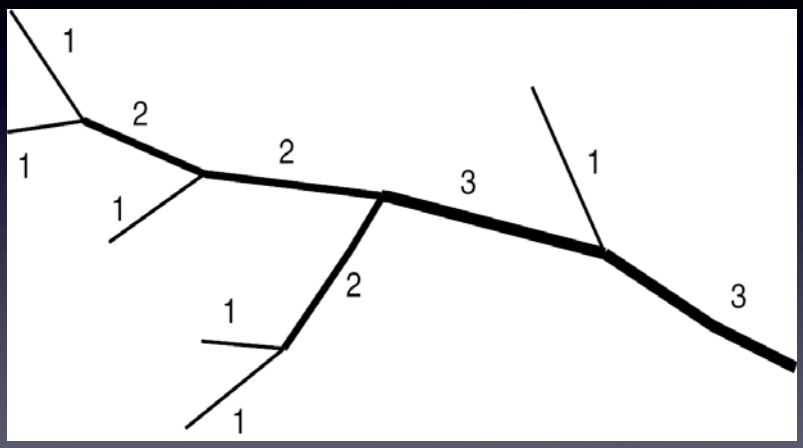
project objectives

- gain experience using Arc Hydro in water resource analysis for future projects.
- successfully define basins and streams using DEM.
- apply morphometric calculations to quantify basins and associated streams.

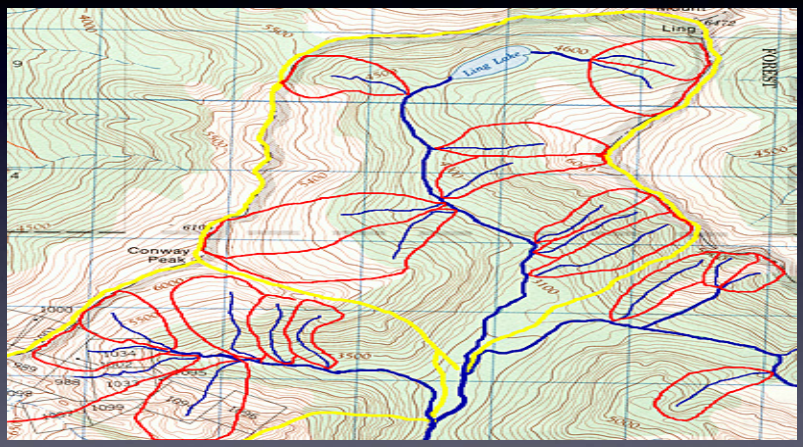
inputs

- 10 meter DEMs for western Oregon.
- 7.5 minute quad topo maps and water course shapefile for Oregon used as references.

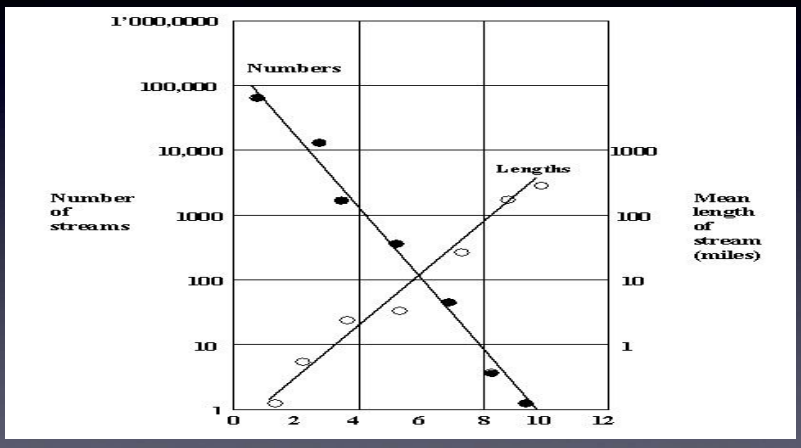
strahler stream ordering system



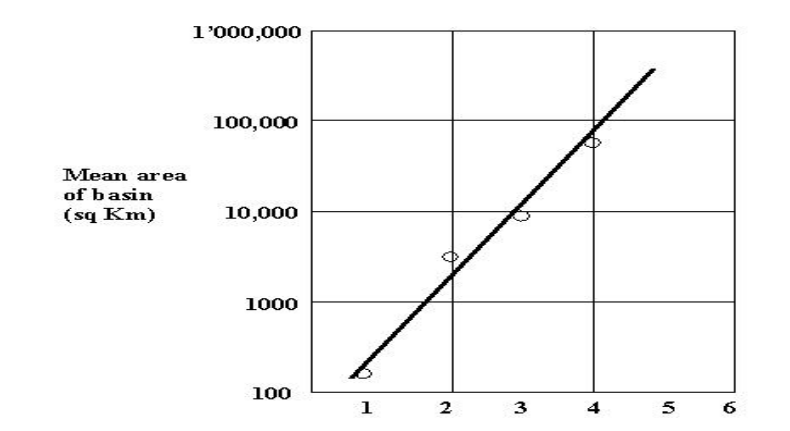
basins with first order streams



stream length increases with order while numbers decrease



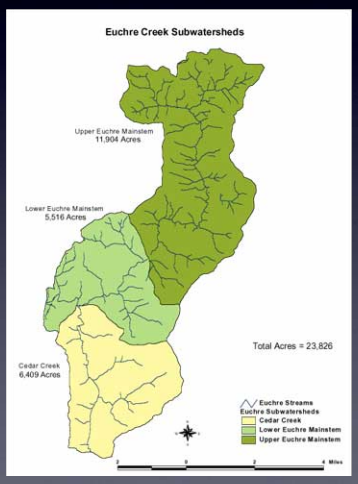
stream order increases with basin size



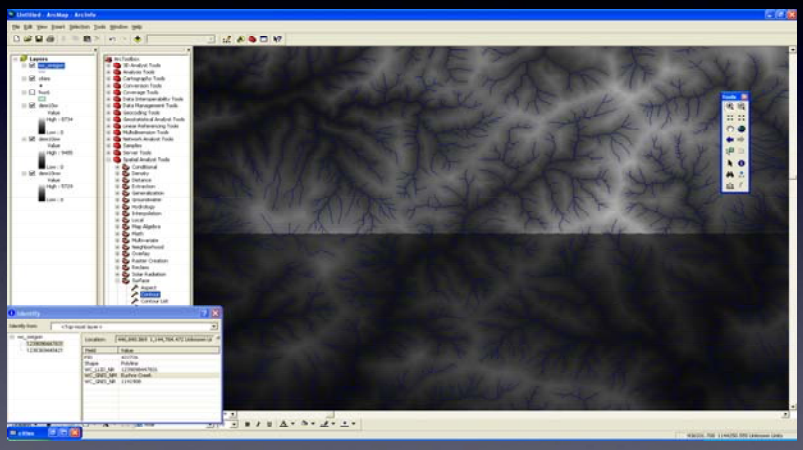
Areal Morphometry

- drainage density = sum of stream lengths divided by area of basin
- quantifies landscape dissection and runoff potential.

Stream morphology deals with changes to form from sedimentation and erosion.



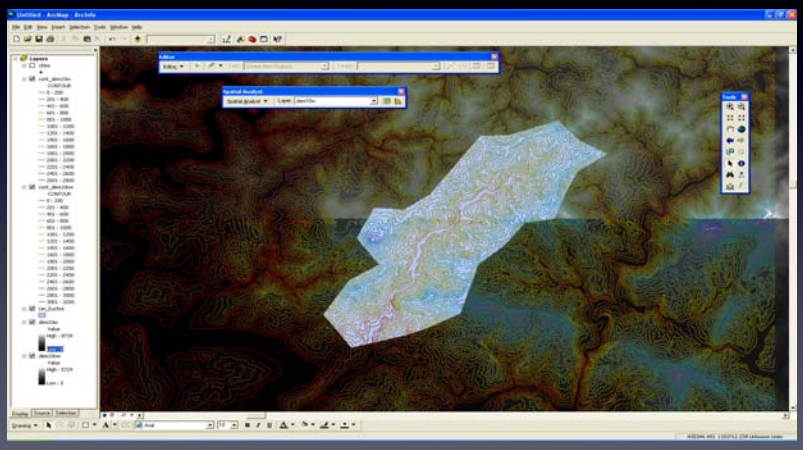
DEM with water course dataset superimposed



some initial prep

- create empty shapefiles in Arc Catalog with same coordinate system of DEM.

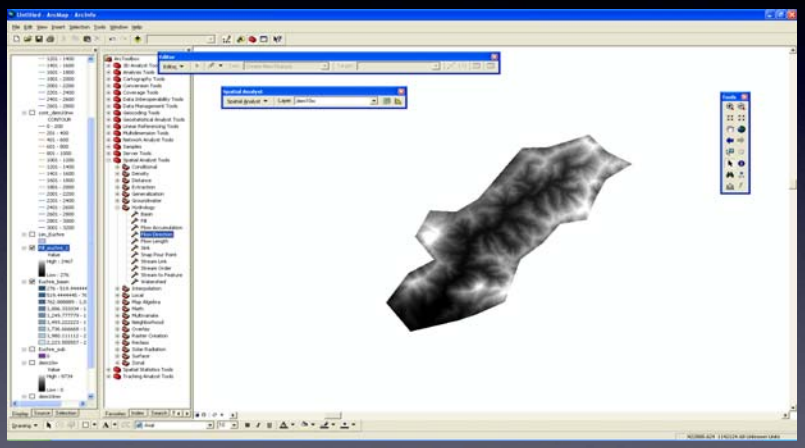
using contours for hand digitizing analysis extent



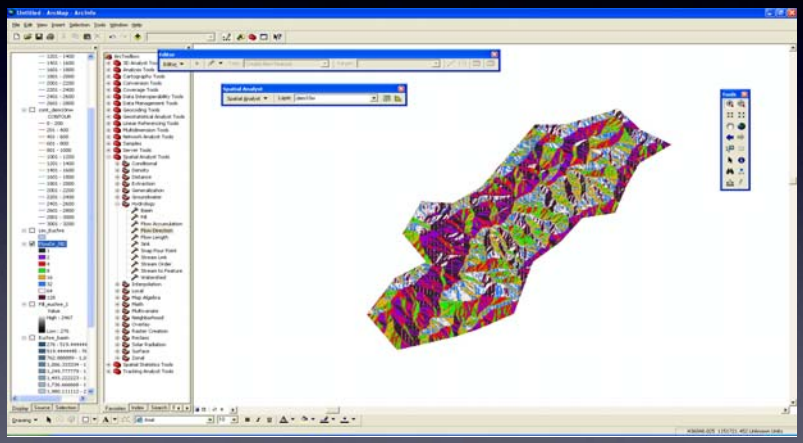
more prep

- as this basin will span across two DEMs, the raster calculator will be used later to mosaic them together.
- with delineated (clipped) DEMs created the inputs can be tossed, this will improve processing time .
- next steps involve using the Arc Hydro - Terrain preprocessor.

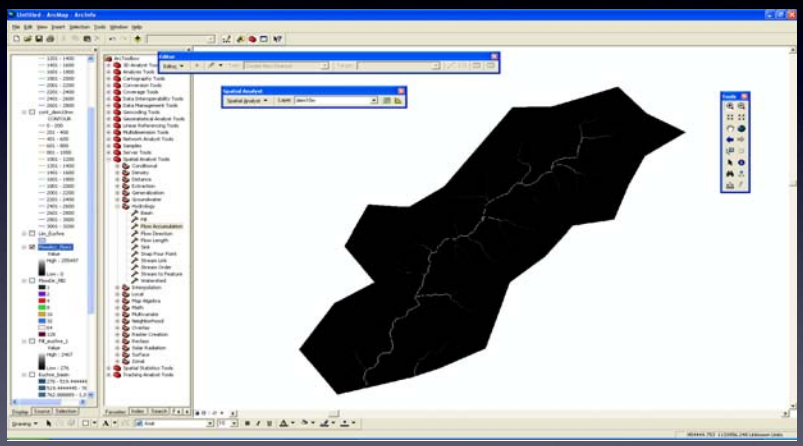
“fill sinks” or obstructions, but watch out for legitimate sinks like those in karst landscapes



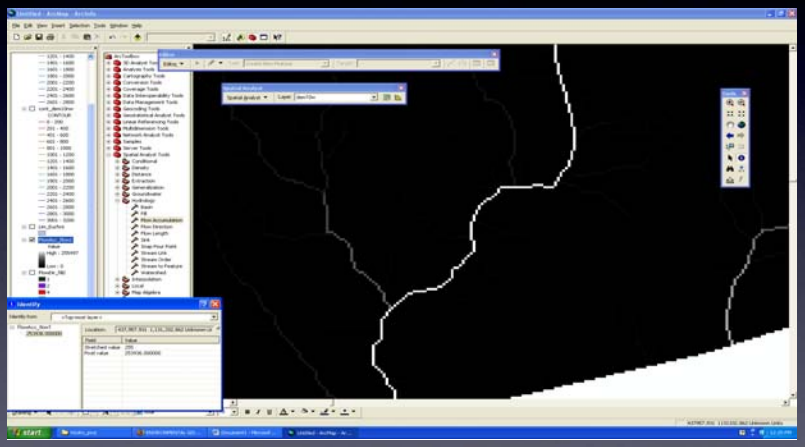
establish hydrologic “flow direction”



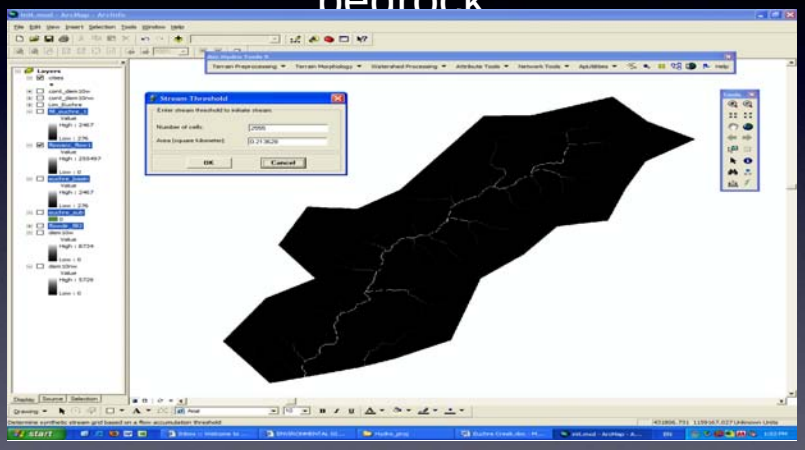
create “flow accumulation”, cumulative increase of contributing cells going downstream



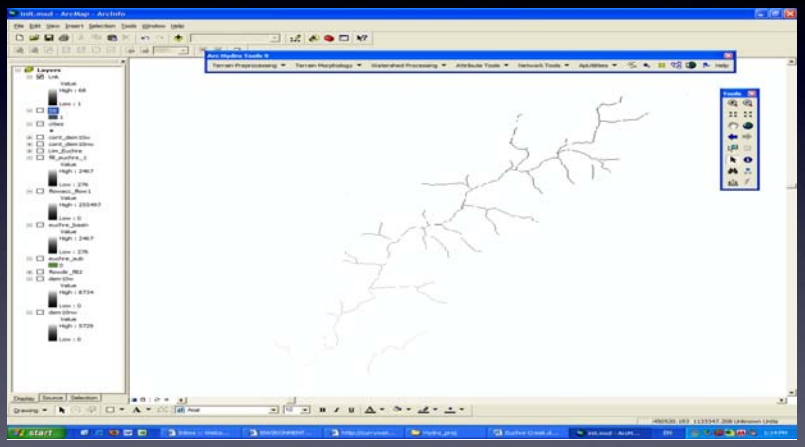
flow accumulation shown at mouth of stream



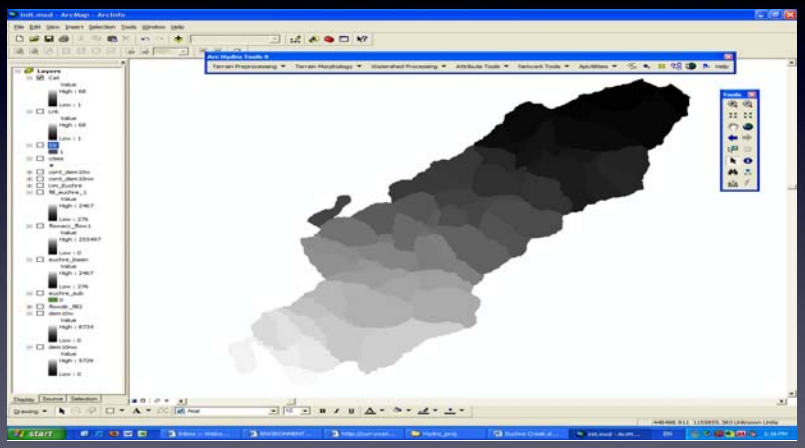
“stream definition” delineate drainage network, important: # cells (area) required for incision of bedrock



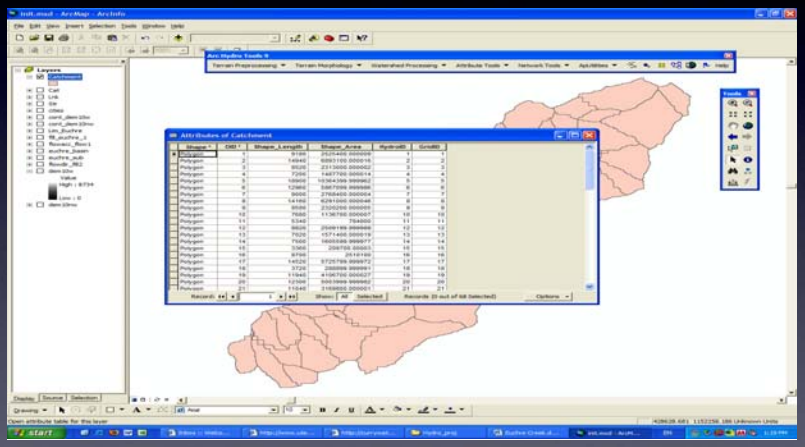
“stream segmentation” gives unique values to each segment



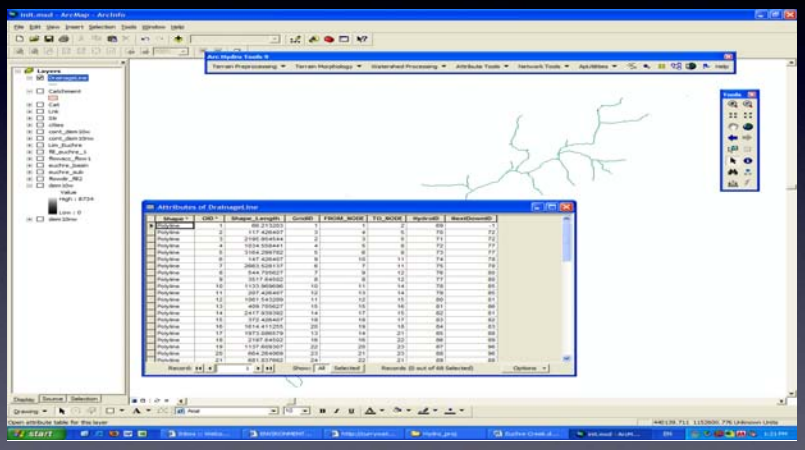
“catchment grid delineation” provides catchment for every stream segment



“catchment polygon processing” creates shapefile with area attributes



“drainage line processing” creates shapefile with length attributes



drainage density is low since low order streams were not generated

h_order	Cnt_h_orde	Sum_Shape_	length (mi)	Sum_Shape1	area sq (mi)	Dd
1	72	94,890.16	17.972	158,558,400.00	5.687	3.16
2	22	24,625.65	4.664	26,420,400.00	0.948	4.92
3	15	19,687.19	3.729	24,227,100.00	0.869	4.29
4	18	15,707.19	2.975	20,742,300.00	0.744	4.00
			29.339		8.248	3.56

final results with stream order added to attribute table

lessons learned

- it looks like no 1st and maybe even 2nd order streams were generated by Arc Hydro.
- 10 meter DEMs are probably not precise enough for this task, these are usually just scanned topos.
- were algorithms in Arc Hydro suitable for this analysis?

Literature referenced

- Hydrologic and Hydraulic Modeling Support with GIS, Maidment, D., Djokic, D.
- A View of the River, Leopold, L.B.
- Fluvial Processes in Geomorphology, Leopold, L.B., Wolman, M.G, and Miller, J.P.