USING LIDAR AND OTHER ANCILLARY DATA TO ANSWER WATER RESOURCE QUESTIONS

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Anecdotal observations suggest that many groups working within the Mohawk don't realize that terrain elevation Lidar data is out there, and how it might be used. This is an attempt to provide pointers and encouragement to work with it. There is much we can learn from the dense and precise characterization of the terrain, its vegetative cover and its built infrastructure.

There is available Lidar Data in all Mohawk watershed, with the exceptions of:

- West Canada Creek and Delta Reservoir catchments.
- Disconnect between the Mohawk and the lower Schoharie Creek.
- No data on the Saratoga County side of the lower Mohawk.

Data ingestion

- LAStools: converting, filtering, viewing, processing, and compressing LIDAR data in LAS format, http://www.cs.unc.edu/~isenburg/lastools. E.g. to interpolate ground points from *mohawak.las* and store DEM in GeoTIFF: > las2dem -i mohawk.las –o mohawk.tif -keep_class 2
- ArcGIS: LAS → multipoint dataset → terrain → DEM/TIN. GeoCue's LP360 add on allows direct LAS manipulation, www.geocue.com/lidar/qcoherent/lp360arcgis.html
- AutoCAD/MicroStation: need thinning of point cloud. Terrasolid's TerraScan add-on for direct LAS manipulation - www.terrasolid.fi
- libLAS: http://liblas.org, start here if you plan to write LAS manipulation code.

Lidar Derived DEM analysis

- ESRI implemented a collection of tools as its ArcHydro toolset, some of them are for raster analysis.
- The above and additional raster analysis functionality, in open source license, from USU's Hydrology group TauDEM toolset.
- GDAL - Geospatial Data Abstraction Library format conversion, grid algebra, www.gdal.org/
- Tool catalog in OpenTopography's Tool Registry. If you write code, look there for building blocks, //opentopo.sdsc.edu/gridsphere/gridsphere?cid=contributeframeportlet&gs_action=listTools

Hydrologic Analysis TauDEM functions

Functions for:

- Pit removal by flooding to ensure hydraulic connectivity within the watershed.
- Computation of flow directions and slopes using single and multiple flow direction methods.
- Contributing area using single and multiple flow direction methods.
- Multiple methods for the delineation of channel networks including geomorphology-based methods sensitive to spatially variable drainage density.
- Objective methods for determination of the channel network delineation threshold based on stream drop analysis.
- Delineation of watersheds and subwatersheds draining to each stream segment and association between watershed and segment attributes for setting up hydrologic models.

D8 vs. D-infinity flow

- D8 Flow Direction Coding: 1 - East, 2 - Northeast, 3 - North, 4 - Northwest , 5 - West, 6 - Southwest, 7 - South, 8 – Southeast
- D-infinity Flow direction is encoded as an angle in radians counter-clockwise from east as a continuous (floating point) quantity between 0 and 2pi. Important for diffuse flow analysis.

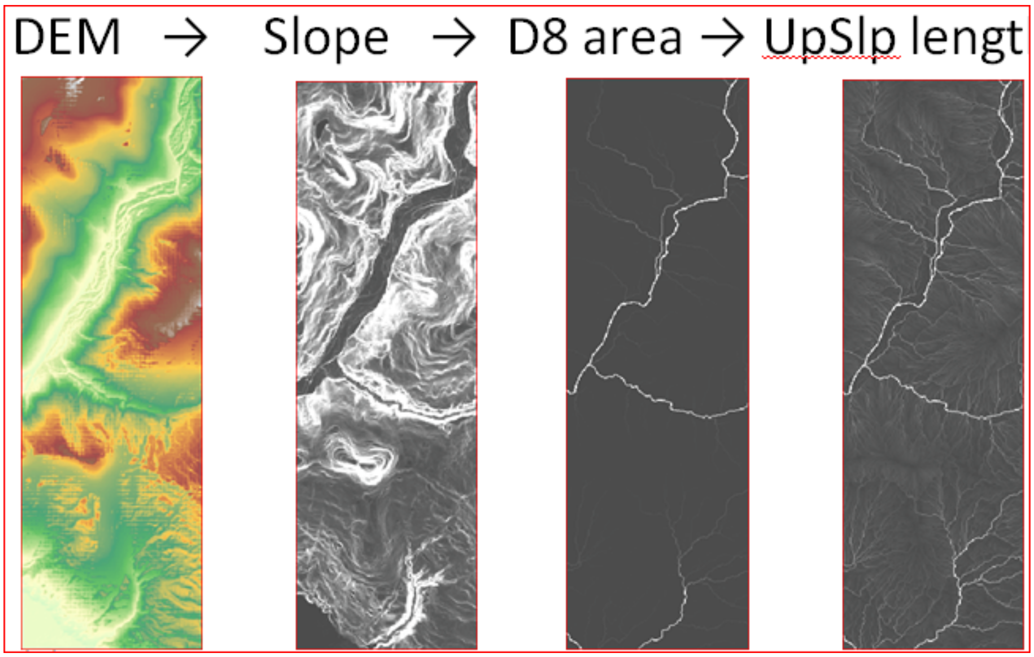
E.g., we can obtain Slope, contributing area and upslope length for every cell in the DEM:

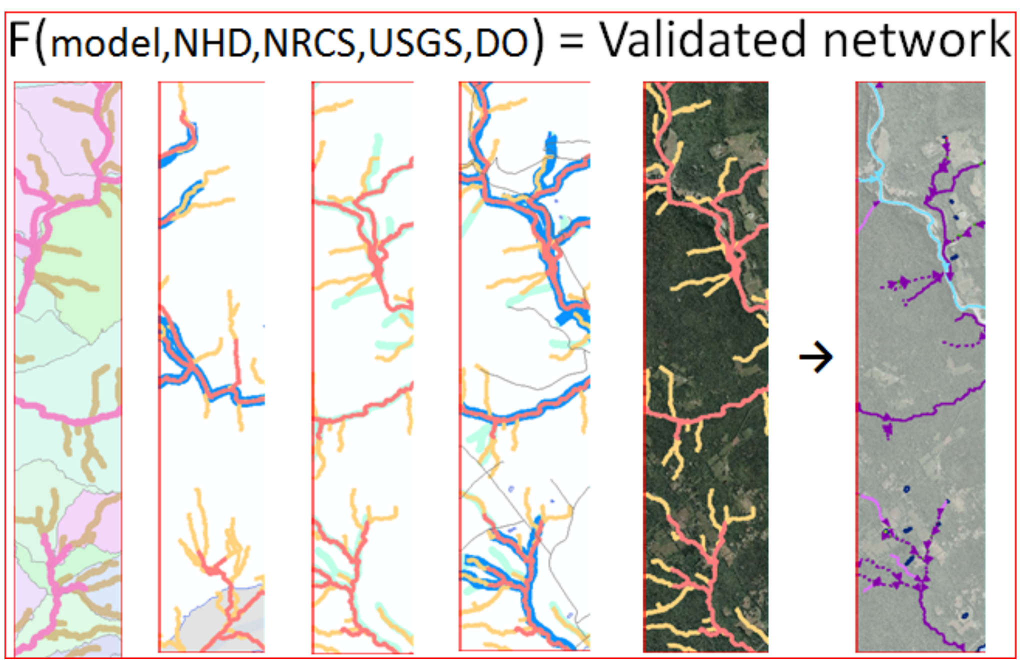
Some of the stream network functions are:

- PeukerDouglas: I interpret it as a landscape 'concavity' index.
- DropAnalysis: objective selection of stream delineation threshold.
- Threshold: Input, any grid. Output an indicator (1,0) grid of cells that have values ≥ threshold.

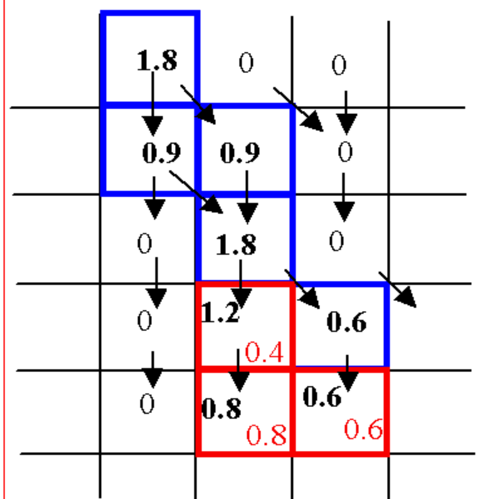
- StreamNet: Produces vector network from a stream raster grid and corresponding subwatersheds draining to each stream network link.

Stringing them together appropriately allows the extraction of a stream network based in a geomorphology statistical analysis of channel network characteristics, sensitive to the characteristics of each specific catchment. By comparing the model results with ancillary data –USGS hydrography and hydrologic study data for the area, NRCS soil maps, transportation infrastructure, aerial photography, etc., we can then extract a validated new stream network. Then it is an exercise in network parameter differences to see how the new information compares with that previously held –stream network length, sinuosity, etc changes.





Terrain Analysis TauDEM functions
There are functions for Slope over specific catchment area ratio, which is the inverse of the wetness index; Upslope dependence function to map the locations upslope where activities have an effect on a downslope location; Decaying accumulation that evaluates upslope contribution subject to decay or attenuation; etc. For example, the D-Infinity Reverse Accumulation function allows evaluation and map of the hazard due to activities that may have an effect downslope, e.g. land management activities that increase runoff. If runoff could trigger debris flows, the weight grid can be read as a terrain stability map.



Reverse accumulation of field weights indicated in red

Resources – Tools

- Martin Isenburg at UNC LAStools: http://www.cs.unc.edu/~isenburg/lastools/
- David Tarboton et al. at USU TauDEM 5: http://hydrology.usu.edu/taudem/taudem5.0/
- ArcGIS
    - ArcHydro toolset works with ESRI grids
    - TauDEM 5 (v. 9 only) works with TIFF grids
- Grid conversion:
    - GDAL_Translate utility: http://www.gdal.org/gdal_translate.html
      > gdal_translate -ot Float32 -of GTiff -a_nodata -9999 Mohawk.flt Mohawk.tif
    - ArcGIS → Data → Export.

Resources – Datasets
NYS lidar data collections: call the NYS Office of Cyber Security, 518-474-5212

Resources – Bibliography

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