Q&A Session for Hydro Seminar Series - Session 6

David Tarboton Q&A:

Q: Where does the stream cross section geometry shape come from?

A: In the height above stream approach to obtain hydraulic parameters reach average stream shape quantified by cross sectional area, wetted perimeter and hydraulic radius is determined from the digital elevation model.

Q: How do we get the TauDEM tool in Arc GIS?

A: http://hydrology.usu.edu/taudem. Once you have installed the software you can add the TauDEM tools toolbox to Arc Toolbox.

Q: Have you tried estimating channel hydraulic properties in different stream environments?

A: We have not yet systematically applied this across different stream environments.

Q: Any comments on the potential differences [in hydraulic geometry] between arid and humid environments?

A: Quantification of hydraulic geometry depends on the digital elevation model (DEM) representing the stream bathymetry, that is the underwater ground or river bed elevations. In humid environments DEMs that represent the water surface will not produce fully representative hydraulic geometry. In arid environments for dry or ephemeral streams the DEM is more likely to reflect the river bed.

Q: It can be argued that roads are all first-order streams that conduct water into the natural hydrography. Should we account for that in our models?

A: Yes, it is important to consider roads as hydrologic pathways. The GRAIP approach that I briefly illustrated (http://www.fs.fed.us/GRAIP/) uses a road inventory to quantify stream sediment inputs from road erosion. It is a special case of the general approach to modeling I am advocating that takes advantage of additional spatially distributed information to improve model predictions. However, you mentioned considering roads as first order streams. Roads are roads. They are different from streams. I think models should recognize this, and I would not treat them the same way as first order streams.

Q: How do your models perform using 10m NED DEMs v. 2m LiDAR derived DEMS? Have you found benefits in using 1m DEM's over 3m DEM's (resampled from 1m) for hydrologic analyses?

A: Model performance for different scale DEMs has not yet been systematically evaluated. Fully quantifying the advantages of higher resolution data still needs work.

Q: Do you have a workflow available using ArcGIS and TauDEM tools to rapidly delineate floods using stream height?

A: Yes. See https://www.hydroshare.org/resource/f1d1d9b5b70f4174b650c899168f632a/. The README.txt file in this resource describes the Workflow. Some of the initial steps to determine stream sources are manual.

Q: How do we account for the differences in stream extents between wet/dry times and places?

A: The hydraulic geometry approach takes stream extent as an input. Model sensitivity to the extent of streams in wet times still needs to be evaluated.

Q: Do you have a publication describing what you have done so far with this?

A: Not yet for the height above stream approach to hydraulic geometry. The general method as part of TauDEM is described by Tesfa, T. K., D. G. Tarboton, D. W. Watson, K. A. T. Schreuders, M. E. Baker and R. M. Wallace, (2011), "Extraction of hydrological proximity measures from DEMs using parallel processing," Environmental Modelling & Software, 26(12): 1696-1709, http://dx.doi.org/10.1016/j.envsoft.2011.07.018.
There are also papers by Nobre et al. that give the idea of using height above stream for flooding. Nobre, A. D., L. A. Cuartas, M. R. Momo, D. L. Severo, A. Pinheiro and C. A. Nobre, (2015), "HAND contour: a new proxy predictor of inundation extent," Hydrological Processes, http://dx.doi.org/10.1002/hyp.10581.

Q: In an elevation-driven model, opposed to a channel, vector-driven model swamps are an area, a sink. How should the wetlands modeled?

A: As we get to more detailed spatially distributed models, I think they need to start using objects to represent different elements on the landscape that behave differently. So wetlands, lakes and reservoirs need to be explicitly identified and modeled. There is however always a

trade off in not being able to represent all detail for small wetlands and here I would accept the approximation of a hydrologically conditioned DEM (pits filled) as good enough for most needs. At some point we need to get to models that allow the terrain to fill and spill naturally. GSSHA (http://www.gsshawiki.com/) I believe does this, but these are not common yet.

Q: For determining reach scale properties, would this be assuming one is NOT using a DEM product where streams have been "burned in" or any other hydrologic conditioning has been done by the vendor?

A: In general yes. Burning in or hydrologic conditioning alters the information about the topography near streams. However, you should really ask what is the most reliable source of elevation information in the vicinity of the streams, and if the Hydrography is good, that is it has been carefully mapped and has good elevation information associated with it, and the DEM is poor, then imposing the Hydrography adds value. This really speaks to the need to have consistent DEM and Hydrography information and for elevation and Hydrography teams to coordinate in doing this.

Q: How would you handle flow from Legal drains?

A: This is a bit beyond what I addressed in the talk. In general, a model is better if it takes advantage of all information, so to the extent that information about drains and the areas where they receive their input can be quantified, this information should be represented in drain objects in a model. If they are surface drains they may be manifested in the DEM, but if they are subsurface, then whatever information is available for them needs to be assimilated. Unfortunately, automated ways to do this at large scale are limited. Standard representations of drain data need to be developed to advance this area.

Q: Did you use 10-meter DEMs?

A: Yes

Q: Where could I get more information on “where streams begin?”

A: Not a short answer. Some of the papers on my website start addressing this in terms of objective threshold determination, but automated mapping of this is still an open question. I suggest looking at
Tarboton, D. G. and D. P. Ames, (2001),"Advances in the mapping of flow networks from digital elevation data," in World Water and Environmental Resources Congress, Orlando, Florida, May 20-24, ASCE. http://www.neng.usu.edu/cee/faculty/dtarb/asce2001.pdf

Tarboton, D. G., R. L. Bras and I. Rodriguez-Iturbe, (1992), "A physical basis for drainage density," Geomorphology, 5(1/2): 59-76.
Tarboton, D. G., R. L. Bras and I. Rodriguez-Iturbe, (1991), "On the Extraction of Channel Networks from Digital Elevation Data," Hydrologic Processes, 5(1): 81-100.
Passalacqua, P., P. Tarolli and E. Foufoula-Georgiou, (2010), "Testing space-scale methodologies for automatic geomorphic feature extraction from lidar in a complex mountainous landscape," Water Resour. Res., 46(11): W11535, http://dx.doi.org/10.1029/2009WR008812.

Q: you mentioned SPRNT available on GitHub - can you give the URL?

A: https://github.com/frank-y-liu/SPRNT

Q: What vertical resolutions (accuracy) can be attained with current DEM technology? Vertical errors of 1 meter for example would have a large influence on inundation area in low relief basins.

A: Lidar is claimed to get to 5 to 10 cm, but yes a 1 m error is problematic

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Q: So does TauDEM replace the need for a land survey of the stream (e.g., cross-sections of the stream bed)?

A: Taudem is only as good as the data it gets input. I'd prefer surveys to refine the DEM that TauDEM can use. I think that a DEM surface that has assimilated in surveyed information about streams is likely to be better than one derived purely from aerial photography or Lidar, and this better DEM will result in better TauDEM output. This is consistent with my suggestion for integrating information, to achieve consistency across all data sources.

HR NHDPlus Q&A

Q: Will the vector data be available in Geopackage or Spatialite formats as well as File Geodatabase?

A: We currently plan to release the data in File Geodatabase format for the vector data and TIFF for rasters. We will consider doing other formats, and would be interested in hearing feedback from the user community regarding what other formats are most useful.

Q: Is there a plan for the HR build/refresh tools to be made available to local partners/stewards?

A: We plan to release the Build/Refresh tools as open source, but we do not plan to support them as an application for partners/stewards. We plan to run the tools in house for refreshes. The initial run to produce Beta datasets will be done by Horizon Systems under contract.

Q: How are you reconciling the location of the NHD 24K vector streams with the 10m flow accumulation which may not align with the vector hydrography?

A: The NHD High Resolution lines (from whatever source scale they are) are enforced by "burning" them into the elevation surface. As a result the flow accumulation will agree very well with the vector NHD flowlines. See the NHDPlus V2 User Guide Appendix A for details. We're using the same process.

Q: What are plans for Alaska on the national mapping efforts? Is there a plan for a HR pilot project in Alaska?

A: USGS has been investing heavily in high-resolution elevation data for Alaska in recent years. We have been working with the Alaska Hydrography Technical Working Group, and a significant amount of new high-resolution hydrography data is being developed. While we don't currently have a pilot project in work, once we get our process more fully developed and more Alaska data become available, we will look at a pilot project in Alaska.

Q: What scale DEM were you using?

A: We are using the ⅓-arc-second seamless elevation data from the 3DEP program. This is a best-available dataset. It was derived from 10-meter resolution or better data everywhere. A significant amount now is resampled from higher-resolution lidar data. We project the ⅓-arc-second data to an Albers Equal Area projection at 10 meters resolution.

Q: Has any work been done to look at the differences in outcomes from using NHDPlus V2 versus the high resolution NHDPlus? How does it make a difference in the end?

A: We plan to develop an automated means of comparing the NHDPlusHR to NHDPlus Version 2 as part of the QC process. As partners begin the QC review we hope to be able to provide a complete comparison for every Version 2 catchment/flowline. This should identify anyplace the network and drainage areas are significantly different.

Q: Can you show us a NHDPlusHR production schedule?

A: Not yet. Once we have gotten a few regions processed, we hope to be able to estimate how long it will take to complete the work. Then we should be able to say approximately when we will be working on each region. The map in the presentation shows the priority order we've determined based on feedback from several partners. The first six are pretty firmly set. The order of the remaining regions is subject to change.

Q: Will the edits/updates to the NHD be run first through the "base" HR NHD and then imported into HR NHDPlus?

A: Yes, the intent is for all updates to both NHD and WBD to be done through the stewardship process to the primary datasets. The changes will be reflected in NHDPlusHR when the next refresh is run.

Q: Would you object to someone taking the open source methodology and translating it to the GRASS vector model?

A: No, we would not object. In fact, we would welcome such a development. We wouldn't have the expertise or resources to provide much support for this, however.

Q: Will the hydrologic vectors be 2d or 3d?

A: Currently the NHD schema is a 3D schema (Z values are defined in the schema,) however the Z values have never been populated. We have been doing a research project to populate the Z values from the DEM, and early results look good. If you would like to look at some sample data, let us know. We need more eyes looking at the results.

Q: If we identify a waterbody not in NHD or that needs to be edited, what is the process of getting them into NHD? Do we report these to the state NHD steward?

A: For a small number of edits, you can report them via this web page. For more extensive edits, we encourage you to contact the steward directly. You can find contact information here: http://nhd.usgs.gov/stewardship/#.VqRXZPkrJpg.

Q: Are the beta tests going to be exclusive in-house or can outside entities test too?

A: We plan to release the beta data publicly. Outside entities would be welcome to participate in the QC review, but we would like to formalize the process. Let us know if you would like to be involved.