Q&A Session for Hydro Seminar Series - Session 8

Date: Thursday, May 19, 2016

1. Will hydro-enforced DEM become a standard requirement and a standard product for 3DEP projects in the near future?
   A: This question has been answered verbally. Please see the video transcript.

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2. Can you explain what point spacing means?
   A: This question has been answered verbally. Please see the video transcript.

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3. Might there be any plans for using lidar for karst hydrology modeling (surface to groundwater or other)? (I came in late, so this might have already been addressed...)
   A: This question has been answered verbally. Please see the video transcript.

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4. For the future work of incorporating the breaklines with the NHD, what is the anticipated/targeted scale? NHD medium or high resolution? Is there any effort to extend flowlines beyond current NHD extents?
   A: This question has been answered verbally. Please see the video transcript.

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5. Will a certificate of attendance be distributed to attendees?
   A: We aren't set up to do certification for these seminars.

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6. How can you delimitate the coast with LIDAR considering is always dynamic?
   A: This question has been answered verbally. Please see the video transcript.

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7. Any insights into particular issues in karst terranes?
   A: This question has been answered verbally. Please see the video transcript.

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8. What is the transform between NHD Resolution (100K , 24K) and the Lidar derived hydro surface?
   A: I am unclear on the meaning of the question. Bob, please feel free to contact Karl Heidemann directly and we can get this answered for the group.

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9. Have you tried using elevation data from IFSAR? Is it useful?
   A: Specifically, no, simply because the relatively coarse resolution and lower accuracy of IfSAR data makes it less useful in most CONUS locations. In addition, IfSAR data is inherently raster; the processes by which breaklines are integrated with lidar are TIN-based, that is, lidar points (as masspoints) plus breaklines. Integrating breaklines with raster source data (instead of points) mostly leads back to burning-in features on an existing DEM – the very process we would like to move away from. That said, there certainly are areas where using IfSAR would be sensible.

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10. Where do you typically get the culvert information?

A: Usually, the culverts are identified during the collection of the breaklines, as a manual digitization effort. Basically, an analyst digitizes a stream; when they encounter a road fill, they stop the stream line and change to a culvert line, place the culvert, then change back and carry on.
If a spatially-enabled source for culverts is available (City or County Engineer, DOT, or other agency) it can be used to guide the analyst, but often the accuracy is insufficient to match the lidar-referenced hydrography. It is usually faster and easier to just draw the new line (usually just 2 vertices), using the culvert database as a reference.

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11. How would you imagine that your hydro-conditioning efforts would differentiate between true natural depressions (potholes) that belong in the DEM as landscape features...and those artifacts that would be removed by hydro conditioning?
    A: This casts back to the type of DEM and its intended use and purpose. Recall that a hydro-conditioned DEM is a modeling tool, and that there are multiple "flavors". True depressions would remain in a Topographic DEM, and even in a hydro-enforced DEM. But in a hydro-conditioned DEM, the goal is to fill depressions, including the natural ones. A lot of H&H modeling software does not handle internal drainage areas very well.
    Depending on the application of the DEM, an engineer or hydrologist may have more specific requirements, e.g., only filling small depressions (less than x pixels); these variations are usually handled in the raster software.

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12. In these surfaces, why are there breaks in the highways?
    A: Some of the breaks across the highways are at culvert locations, and only appear in the hydrologic surfaces, not the topographic DEMs. This is because the breaks allow water to flow across the surface, as (in the real world) it would flow through the culvert.
    The breaks that appear in both the hydrologic and the topographic DEMs are at bridges, because in most typical DEMs, bridges are always removed. This is because a bridge (deck) is not part of the landscape or bare-earth surface. It is a man-made structure that spans across and above the landscape.
    There also are some cases, usually in transportation applications, where the DEM user may want the bridges to remain in the surface, so the continuity of the travelways is maintained. We now require lidar points on bridge decks to be classified as such, and presently advocate (will require in the future) the outline of the bridge deck to be collected as a breakline. This provides us with the data needed to produce these transportation DEMs as well as the topographic and hydrologic flavors.

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13. Is NHDPlus v2 hydro-conditioned or hydro-flattened?
    A: The elevation data used to produce NHDPlus catchments is hydro enforced by burning with a snapshot of the NHD medium resolution flowlines and walling with a snapshot of the WBD.

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14. Do you have an automated method or tool for identifying culverts and creating the culvert breaklines or is this a manual process
    A: Identifying culverts is primarily a manual process.

    Techniques have been developed to locate (likely) culvert locations, and these have proven useful, but they produce omission and commission errors. They seem to work best on large, deep culverts.

    Sandra Poppenga here at EROS has done a bit of research on this topic;
    http://pubs.usgs.gov/sir/2010/5059/ might be a good place to start investigating.

Culverts can also be identified from an engineering database when available, but in virtually all cases, each structure representation has to be checked for connectivity to the stream network (breaklines) anyway.

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15. How will the new 1.3 breaklines migrate to current NHD database

    A: **The goal is to configure the Ele-Hydro Data Dictionary such that the collected linework can be (all but) directly used by both Elevation and Hydrography teams. Some minor adjustments may be required by one or the other group when topology requirements differ, i.e., NHD would need to dissolve out culvert segments, converting them into the same type as the adjoining flowline feature; Elevation would need to cookie-cutter out waterbody segments beneath bridge decks.**

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16. Hi Karl - for those states such as Illinois which has provided USGS our state-produced lidar, what sorts of hydrographic breakline enhancement is being applied to the US Topo maps?

    A: **I'm not aware of any treatments specifically being used on Illinois data, but in general the only thing that is being done at present is ensuring that water bodies are properly hydro-flattened. On occasion, the Elevation team finds a need to rework water body surfaces.**

    The National Map US Topo team may make adjustments to surfaces or breaklines to guide the behavior and appearance of topographic contours (or adjust the contours themselves); I am not an authority on TNM procedures.

    Please note that we are still in a developmental stage with the Ele-Hydro Breakline effort. There is much to be developed and finalized.

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17. How will the new 1.3 breaklines migrate to current NHD database

    A: **[duplicate question; see above from 1:52 PM]**

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18. Is the process used to hydro flatten rivers using the artificial path (centerline) described and avail

    A: **To my knowledge, nobody has published this in any detail. I would be happy to explain it in minute detail, but it would become a class unto itself. Briefly summarized:**

    The banks of the river are digitized. I do these as polygons, but the mechanics work with polylines just as well.

    Then the approximate centerlines is digitized, from upstream to downstream.

    All of the lines are densified to a high level, as the vertices needed to define a line laterally may not (probably won't) fall in the locations needed to define the line vertically.

    The centerline vertices are then assigned elevations based on the nearest/lowest lidar point. There are numerous considerations to accomplishing this, with specific search strategies and algorithms for different types of terrain, land cover, point density, etc. Monotonic downhill flow is imposed on the line, either during the conflation stage, or after the fact.

    As for the banks, once the centerline is finalized, each vertex in the bank polygon (or lines) finds the nearest vertex in the centerline and copies its Z-value. Because all of the lines have been heavily densified, the vector between the bank vertex and the nearest centerline vertex will almost always be perpendicular

to the centerline. Thus, opposing vertices of the banks will capture the same Z-value.

In tightly twisting streams/rivers, and very complex lakes/reservoirs, the "near" function can grab the wrong centerline vertex – this is why the "flattener" lines are used to always provide the bank lines with an appropriate "centerline".

I realize this response, while kinda long, barely begins to answer the question. It is a very complex process. I hope it helps – if you have further questions, I would be happy to answer them if I can. Feel free to contact me directly. The folks at QCoherent (LP360) might have a white paper or documentation that could provide more information.

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19. Why are there no point/pulse reflections off water? is this explained by EM spectrum characteristics?

    A: **Most of the topographic lidar systems use a laser operating in the near-infrared range, typically 1064nm. This wavelength is heavily absorbed by water.**

    However, turbid water, suspended particulates, floating debris or algae, or similar can produce very good returns from "water". Similarly, specular reflections from the water surface will also produce returns – this can be quite confused if the water is choppy or wavy, and the frequent transitions between specular reflections and NIR absorption can cause significant ranging errors in the lidar system.

    In general, when there are returns from water bodies, they should be considered suspect and unreliable.

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20. What are the method(s) used for breakline collection?

    A: **Several different methods can be used. Many vendors use "lidargrammetry", where lidar intensity images are created as stereo pairs and breaklines are collected via traditional stereo photogrammetric compilation. Some COTS software (e.g., LP360) has tools that marry manual digitization and automatic elevation conflation into a single task, while offering a variety of different elevation assignment algorithms. Another approach is to manually digitize the features in 2D against imagery and hillshaded lidar TINs or DEMs, then run subsequent processes to conflate elevation values to all the feature vertices and impose additional constraints, e.g., monotonic flow.**

    An important point to note is that one cannot simply digitize 2D lines and then drape them on the lidar TIN or DEM: this adds no useful elevation information to the surface, and the breaklines will simply reflect the vertically uneven edge of the waterbody – the very problem we are trying to overcome. Elevations must be intelligently extracted from the lidar point cloud and applied to the vertices.

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21. How are ephemeral streams and rivers treated where the river may meet the nominal 30m width requirement but are dry 90% of the year?

    A: **Good question. To some degree, it depends on whether the stream is wet at the time of collection. Lidar data producers are not hydrography experts; they can only deal with what's in front of them.**

    Depending on the size of the channel and the geometry of the banks, it may be possible to delineate top bank lines, but these may be of limited utility: We would not want to "flatten" a dry channel when there is valid (and useful!!) topography already there. And determining the normal WSEL and thus, the width of the "river", is not something anybody wants an untrained lidar technician to do.

On the Elevation side, we are satisfied with mapping the dry riverbed. The more bare-earth, the merrier!

On the NHD side (and speaking out of turn here), the lidar might support updating the existing NHD linework for ephemeral streams in some cases, but that would likely need to be done by experienced NHD and Elevation analysts, probably in-house.

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22. Are there any Federal standards for accepting locally or regionally produced hydrologically conditioned DEMs?

    A: Not to my knowledge. USGS presently does not produce or distribute an hydro-treated DEMs, so a standard (at USGS) would have no real utility - yet. That said, these are products we are definitely investigating with keen interest.

    One approach that has been proposed is to have a "base" DEM (likely traditional topographic), and sets of update overlays. So for example, you have a topographic DEM and a hydro-enforced raster that contains only the pixels that are different between the two. A full hydro-enforced DEM can easily be produced simply by merging the two, with the hydro–enforced pixels overwriting the topographic pixels. This is a very storage-efficient technique, both for USGS and for end users.

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23. What type of effort is underway to integrate bathymetric lidar with surface lidar in final products?

    A: I am not aware of any NHD-specific efforts in this direction. It is being pursued on the 3DEP Elevation side of the family. Dean Gesch and Jeff Danielson, both here at EROS, have worked extensively on "topobathy" and techniques and have produced several seamless datasets (CoNED - Coastal NED).

    3DEP and The National Map have begun integrating the available and suitable bathymetric datasets into their elevation products; I do not know the status of that effort or when distribution can be expected. Jason Stoker or Jeff Danielson might be more helpful contacts. I suggest this site for further information: http://topotools.cr.usgs.gov/coned/
