To 3-D or not to 3-D

Ishpeveeshiv! In my native language that means "Great Day to you all". It's great to be here and actually get to see and speak to all you GEO Geeks. I am Darryl Sanchez, enrolled member of the Northern Cheyenne Tribe, a federal worker for the Bureau of Indian Affairs. It's been nearly 22 years since the beginning of my evolutionary journey working with ESRI GIS software and following our great leader, Jack Dangermond.

I would especially like to thank Jack for what he has done for me. Thank you Jack! It has been a great run.

My ancestors navigated by the stars and today we navigate by satellites moving around our mother earth. You know it took Jack all these years to convince me that the world was flat again. However, the truth of this matter roving this sacred land of ours made me believe that the only thing flat was my feet. But I am not here to talk about my flat feet I am here to talk to you about in general how important it is to imagine again and share with you a vision what I see in this next evolutionary period for GIS or more appropriately 3D GIS.

In the next 2-5 years surveyors will be sending you survey data in digital format for road construction, floodplain management, rights-of-way, subdivision plats, GLO plats, recovered PLSS corners, partitioned metes and bounds parcels from Geodetic grade multi-frequency GPS receivers. How to bring this geodetic controlled data into a GIS (Geographic Information System) system properly will require a new 3-D spatial GIS.

For this topic was extremely confusing to me at first and after reading dozen of articles and literature on this subject matter it became mildly confusing. However, I do not claim to be an expert on this subject matter but bear with me I have done my best to explain how best to bring this highly technical data into your GIS. So keep an open mind a continue keep up the research in the subject matter because it is constantly changing and maybe someday one of you people can better explain this highly technical subject matter.

Surveyors using single-frequency GPS devices using OPUS-RT (On-line Positioning User Service-Rapid Static) widely known as post-process differential GPS, also using a reference station to correct these positions are key to sub-meter or sub-foot-level accuracies

also a widely known real-time process as DGPS (Differential GPS). All to be the thing of the past.

Getting higher accuracy in real-time requires capturing rover positions from dual or multi-frequency carrier phase observations will be the thing of the future. This process is beginning to be widely known as RTK (real-time kinematic). RTK systems are limited due to the distance factor in the order of 10 kilometers, whereas DGPS systems with positioning accuracy of sub-meter or sub-foot are not as limited to the short distance factor for RTK, which has a distance factor a few hundred kilometers.

With network RTK, the differential errors caused by ionospheric and tropospheric refraction, and satellite orbit errors are precisely estimated based on dual-frequency carrier phase observations of a local or regional network of reference stations. Correction model parameters are determined to allow the prediction of the differential errors for the baseline between a master reference station and the user's position. Applying these corrections to code and carrier phase observations of the master reference station, VRS

measurements are generated for RTK positioning of the rover receiver.

Currently, no standardized data format exists for broadcasting of correction model parameters. Furthermore, there is not even an agreement on the parameterization of the correction models. Therefore, the most common form of network RTK nowadays uses VRS measurements to be relayed to the users. The advantages are obvious: using the VRS technique, existing standardized data formats and standard off-the-shelf receivers are capable to work in network RTK mode.

However, the currently used network RTK format also has some disadvantages. First, two-way communication links are required, since the users have to transmit their approximate positions to the processing center which in return sends the users the observations or corrections of an individual VRS. Second, the baseline processing software inside the rover receiver is not able to notice that it processes virtual reference data. It considers the data to originate from a single reference station located very close to the rover position and thus in some cases it may not come to optimal decisions

in the baseline processing. Nevertheless, as long as no standardized network RTK format exists, transferring VRS observations will stay the preferred method of providing pre-processed network information to the users.

Now comes the good part, if we know how to correct GPS positions down to sub-decimeter or centimeter accurate, what map projection can most accurately reflect its position on a map. We all know that the most accurate distorted map projection on a 2-D system is State Plane NAD 83. However, this map system has a major flaw that for every 1 mile of distance surveyed there is the 6 inch infamous error associated with it. The question is; How do we address it? Answer, according to Micheal Dennis of NGS, (National Geodetic Survey) LDP (Low-distortion projection). What good is having 4 centimeter accurate (ellipsoid) height combined with 2 centimeter accurate horizontal data when we all know that this data transformed back to a flat-plane system in order to bring this data up into GIS. This data is supposed to be the most accurate that can be captured using RTN (Real-time Networks) according to William Henning in his article title "NGS expands its role in real-time network positioning."

I will go on record that there is a more accurate way to capture 3-D and bring this data into a coordinated system that is three-dimensional by using LDP. If an LDP is created for the project area than that projection can be created in GIS, used in GPS and reference stations within a project area.

Once all this equipment is standardized using one projection the world of GIS becomes super simple again. Then the GPS data is ready to be accepted into GIS as positions. So, now if a survey is sent, you have the ability to quality check the traverses in your system, by opening editor connecting the dots (positions) by your pencil tool. Once the line is created you can choose the line and push edit vertices in order to activate the description screen in the traverse tool. Right-click in the white space area and left-click "Load Traverse from Sketch", in order to paste the quadrant bearings and distances of the traverse produced by the surveyor.

This is the only way I know for you GIS people to check the validity of the surveyors work.

Well that ends my presentation any questions?

No further questions I would like to thank each and everyone here today for having me to speak with you and hope that your evolutionary journey in 3-D GIS is not so difficult as I had it in the 2-D GIS.