Global COGO, Inc.
(3-D Coordinate Geometry)
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August 16, 2018

NGS Feedback
- Juliana Blackwell, NGS Director
- Michael Dennis, Project Manager

NOAA/NOS/National Geodetic Survey
1315 East-West Highway, Rm 9340 N/NGS1
Silver Spring, MD 20910

RE: SPCS22 Redefinition

These comments are submitted in response to the Federal Register Notice of April 18, 2018 inviting feedback. Thank you for the opportunity to share my input.

1. I have "followed" progress of the NGS 10-year Strategic Plan. I commend you for establishing such a plan and for the diligent efforts by many dedicated persons for meeting the plan. The user community, both present and future, is indebted to you for accomplishing same.

2. I owe my interest in state plane coordinates to my mentor, Ralph Moore Berry, Geodetic Engineering Professor at the University of Michigan. I graduated in 1973 and was employed by Commonwealth Associates, Inc. of Jackson, Michigan. Among others, I was assigned to perform control survey computations for mapping high-voltage transmission lines in various states. One project was 93 miles of 765 kV powerline in the area north of Detroit (the survey was completed but the lines were never built). The project was based on the Lambert Conic Conformal Michigan State Plane Coordinate System computed on the 800-foot reference elevation surface.

   We used the elevated system quite successfully but ran into discrepancies when interacting with vendors and other users. There was also an issue with consistency in NGS publications on computation and use of the Michigan scale factor. If handled correctly, the discrepancy was of no consequence. Details of same are reported at http://www.globalcogo.com/MichGSF80.pdf.

3. My 1980 MS thesis at Purdue University is titled "A Metric Map Projection for the State of Michigan" and included transformation equations designed to meet the 0.1 mm criterion for integrity as stipulated by NGS. Given "scale factor confusion" in the user community and availability of software for using state plane coordinates, the thesis proposed moving the reference surface back to the ellipsoid for the NAD 83. Professor Berry was Deputy Director of NGS at the time and traveled to Purdue University to be present at the defense of my thesis. He concurred with moving the reference surface back to the ellipsoid.

4. Incidentally, 298.257 is the value for eccentricity squared used in the thesis. That was premature but based on written correspondence from NGS. That mistake was subsequently "corrected" in the following article http://www.globalcogo.com/Parameters_GRS80.pdf.

5. I worked at NGS in Rockville, MD, during the summer of 1983 and was privileged to work on NAD 83 mapping transformations - my participation is acknowledged on page iv of NOS NGS 5. I mention

this because I was directed to use a desktop computer (not a PC) capable of 12 significant digits. In working through the mapping equations, I discovered that 12 digits were not sufficient to meet the 0.1 mm criterion for the transformations. I was then allowed to stand in line to use the mainframe computer in "chasing those digits." The final equations for SPC transformations to be included in NOS NGS 5 were listed by T. Vincenty in a document dated 1984.08.31. The Vincenty equations are slightly different than the ones used in my thesis. Subsequent papers and programs that I wrote for SPC transformations use the Vincenty equations.

6. Nancy von Meyer wrote a paper, "County Coordinate Systems" published in the June 1990 issue of the ACSM Bulletin. That paper lays out arguments for what is now called "low distortion projections." Because the von Meyer article did not contain algorithms for making the mapping transformations, I wrote a paper, "Design of a local coordinate system for surveying, engineering, and LIS/GIS" published in SaLIS, Vol. 53, No. 1, pp 29-40 - http://www.globalcogo.com/localcor.pdf.

   Two important features of that paper include:

   a. The transformation equations are based on the Vincenty equations from NOS, NGS 5.
   b. The ellipsoid for the elevated reference surface was determined in the same manner as NGS did for the Michigan 800-foot elevation reference surface. That is, the location of the reference surface is obtained by adding a "user selected" value to the ellipsoid semi-major axis. That approach has been subsequently replaced by a more rigorous procedure that retains the ellipsoid definition but modifies the central scale factor in the design of the current low distortion projections (LDPs).

7. NGS is currently considering modifications to existing state plane coordinate zones to be compatible with the 2022 datum definitions. The Federal Register Notice invites comments on the proposed procedures for same.

8. In my opinion, given how we got to where we are, NGS is doing what needs to be done and is to be commended for being quite through in the process. One possible improvement comes to mind – I suggest that it would be appropriate for NGS to include a provision for formal adoption and use of the global spatial data model (GSDM) as the basis for user applications of 3-D digital spatial data in a given jurisdiction. Perhaps the most compelling reason for using the GSDM is that spatial data are (not counting time) three dimensional while map projection models accommodate only two dimensions. The "best" model is one that is simple and adequate. The GSDM already exists and meets requirements of both those who want a single system and those wanting a LDP.

9. The GSDM is described in both the first and second editions of "The 3-D Global Spatial Data Model" published by CRC Press, a Taylor & Francis group. A "Google" search provides links to sources.

10. Thought-provoking (somewhat abstract) arguments in favor of using the GSDM include:

    a. Arguments in favor of broadening the surveying curriculum at NMSU – http://www.globalcogo.com/setepaper.pdf
    b. Information for the "scientific" community – http://www.globalcogo.com/gsdm-eos.pdf
    c. Efforts to include "spatial reasoning" considerations – http://www.globalcogo.com/GIS-GSDM-Bridge.pdf
    d. Comments on the COGO Report Card on the U.S. National Spatial Data Infrastructure – http://www.globalcogo.com/APA-ASCE-Spatial.pdf

e. Looking to 2022, the following poster was presented at 2016 AGU Fall Meeting – http://www.globalcogo.com/poster.pdf

11. Fundamental definitions include:

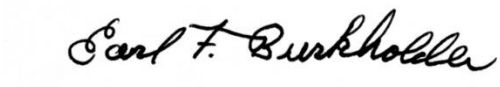
    a. Defining document on file with U.S. Copyright Office - http://www.globalcogo.com/gsdmdefn.pdf
    b. "First" proposed application of the GSDM – http://www.sewrpc.org/SEWRPCFiles/Publications/ppr/definition_three-dimensional_spatial_data_model_for_wi.pdf
    c. Peer-reviewed article on spatial data accuracy - http://www.globalcogo.com/accuracy.pdf
    d. More comprehensive article on "Fundamentals of Spatial Data Accuracy and the GSDM" – http://www.globalcogo.com/fsdagsdm.pdf
    e. Summary of evolution meaning of terms, network accuracy and local accuracy - http://www.globalcogo.com/appendixE.pdf

12. Other technical considerations include:

    a. The GSDM eliminates the grid to ground dilemma - http://www.globalcogo.com/3DGPS.pdf
    b. The equations are all public domain and "simple" to implement - http://www.globalcogo.com/psgsdm.pdf
    c. Example - the GSDM handles spatial data accuracy standards – both network and local - http://www.globalcogo.com/EFB-SaGES-ALTA-NSPS.pdf
    d. BIG DATA challenges can be met with the GSDM – http://www.globalcogo.com/BIGDATA.html
    e. Refutes argument that GSDM does not provide rigorous estimate of local accuracy - http://www.globalcogo.com/StdDevLocalNetwork.pdf
    f. Example showing that map projection models are inappropriate for underground mapping - http://globalcogo.com/underground-mapping.pdf
    g. Summarizes efforts to promote use of the GSDM – http://www.globalcogo.com/3D-future.pdf

13. There are many other items posted on the Global COGO, Inc. web site – www.globalcogo.com. Since the "genie" will never go back into the bottle, a reasonable approach might be to look for the best way for NGS to fulfill its mission with regard to the NSRS while accommodating a forward-looking vision for eventual wholesale use of an integrated 3-D spatial data model.

Submitted with utmost regard for work being done on the 2022 datums.



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