Case for a Qualitative Geospatial Revolution

ASPRS is currently requesting feedback from the membership and outside organizations on the final draft of the proposed ASPRS Positional Accuracy Standards for Digital Geospatial Data (see http://www.asprs.org/a/society/divisions/pad/Accuracy/ASPRS_Positional_Accuracy_Standards_for_Digital_Geospatial_Data_Draft_Rev5_V1.pdf). ***Comments should be e-mailed by Sept. 15, 2014*** to the Map Accuracy Standards Working Group at the following e-mail address: AccuracyStandard@asprs.org .

Historic Perspective on Soil Allocation, Measurement and Geospatial Data Quality

On the eve of The Imaging and Geospatial Information Society -- ASPRS adopting new positional accuracy guidelines, I feel some discussions of quality are in order. To understand quality is to understand error. Let's leave room for professional judgment, interpretation and critical examination of data gathered. Mapping professionals, and for that matter, national governments, have been concerned with spatial quality measures for centuries, if not millennia. Interestingly, Herodotus (c. 484 to c. 425 B.C.), the noted Greek historian and geographer, documented a very early, if not the first, division of "soil" and tax assessment in the form of a rent paid year by year. Lots were divided into squares and values were adjusted if flooding or significant erosion occurred. The Egyptian King Sesostris, who ruled almost 2000 years before Christ, is credited by Herodotus with instituting this land tenure system, a systematic use of land measurement and the first application of geometry (surveying) for subdividing "soil" (land). In the case of the United States, our founding planters and surveyors like George Washington and Thomas Jefferson were keen on accurate land surveys for both political and personal reasons. Both lived full lives and enjoyed comfortable living conditions on relatively expansive estates as the result of their personal achievements and economic status tied in no small part to their successful land management. Both, however, dealt with geospatial error and the need for a standard framework for measuring the earth and resulting economically motivated land transactions. In Washington's case, in 1791 he called upon Congress to establish a scientific basis for measures and weights (see Linklater, 2002). Jefferson was very much a measures and weights reformer, so much so that he became a metric advocate and supported the "Latitude of Paris" in 1791.

George Washington's Mount Vernon (photo by J. M. Young)

Thomas Jefferson's Monticello (photo by J. M. Young)

Ever-present Error

Even with all the recent advances in Geospatial Information science, surveying and engineering, error remains ever present, particularly macro-geospatial errors related to land settlement in flood-prone areas, earthquake zones, exposure of the built environment to extreme meteorological and climatic occurrences; wasteful use and inefficient distribution of water; environmental contamination, and generally our inability to inhabit safe geographies. Colorado is a great example of what can happen in any given season, such as the recent forest fires and flooding events. Preston James also characterizes the persistence of error in geographic research (James, 1966) which undoubtedly introduces error and bias into research conclusions. James does offer a set of conditions where avoidable errors in geographic research can occur:

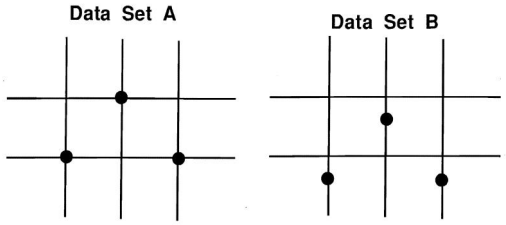
1. Inexact use of words
2. Uncritical use of statistical data
3. Failure to indicate the reliability of data
4. Failure to distinguish among different kinds of spatial distributions

The history of geospatial error and error reduction over time lends itself to many worthy research topics. Immanuel Kant (1724 – 1804), a regular lecturer on Physical Geography who lived in the same time period as Washington and Jefferson, wrote extensively about the "universal principle of right and the linked notion of "What is Truth." Kant wrote of the cognitive faculties of understanding, judgment and reason. In his *Critique of Judgment*, Kant further described judgment as a middle term between understanding and reason (Kant, 1790). Perhaps with all of our technological advances to measure and monitor the earth we have lost touch with applying judgment through achieving understanding of the world around us and reasoning accurate models to describe the current state and what might happen in the future … sea level changes, droughts, slope failures, high volume precipitation events … and on and on.

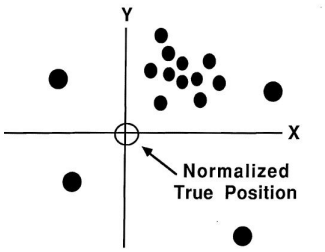
A Quality Model for the Qualitative Geospatial Revolution

Early in my career, under an EPA Research contract assignment, I was directed to follow a laboratory oriented QA methodology (see Young and others, 1985). After some intellectual struggle, I adopted the following Quality Model. The Model has survived the test of time and remains quite relevant today. I will review the *ASPRS Positional Accuracy Standards for Digital Geospatial Data Draft Rev5 V1* with this quality framework in mind:

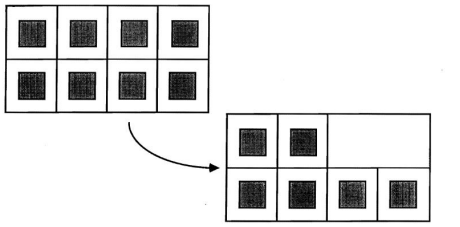
- Precision – Agreement between data sets, methods and or technologies



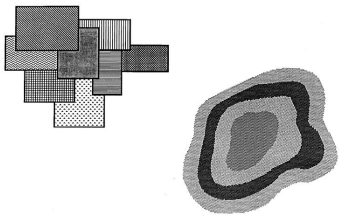
- Accuracy – Conformity to a correct value or set of values



- Completeness -– Measure of the transformation and/or capture omissions of a set of points, lines or areas



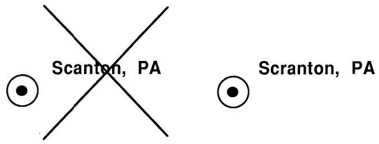
- Representativeness -– measure of a subset of data which is statistically representative of an area, feature or condition



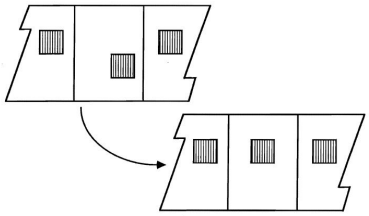
- Comparability –- Measure of factual, temporal, positional or areal sampling interval agreement

Error Diagnosis encompasses consideration of both systematic and random error types and bias, including the following:

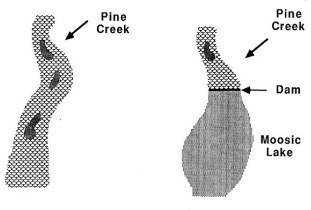
- Factual



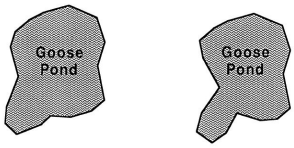
- Positional



- Temporal



- Areal



- Compound –- a combination of any of the errors described above
- Conceptual -- errors related to generalization of position, location or subjective descriptions of place

Remember that according to the Romans, one foot equals 16 fingers, so why are we all so confused (Linklater, 2002)? Indeed, it is time for a Qualitative Geospatial Revolution. As always, I welcome your questions and comments.

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