What is the IDEA whose time has come?

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The idea being promoted is that spatial data can be handled more efficiently in terms of the global spatial data model (GSDM) that accommodates both the geometry and statistical characteristics of 3-D digital geospatial data – the term "geospatial" carries implicit reference to earth-based spatial data. It is left to the user to discriminate between the terms spatial and geospatial. There are cases (for example relative to the moon or planets) in which such discrimination can and should be made.

The GSDM is used to perform computations in three-dimensional space and is predicated on:

1. The assumption of a single origin for 3-D spatial data – earth's center of mass.
2. Using the rectangular earth-centered earth-fixed (ECEF) coordinate system defined by the U.S. DoD for operation of the NAVSTAR GPS satellite positioning system.
3. Performing computations according to rules of solid geometry as formulated by Rene Descartes in the 1600s – the functional model component.
4. Using standard deviation to describe spatial data accuracy – the stochastic model component. Standard deviations are derived from proven error propagation procedures governed by the matrix formulation given as $\Sigma_{yy} = J_{YX}\,\Sigma_{XX}\,J_{XY}^{t}$. For example, see Mikhail's 1976 book, Observations and Least Squares. Many other authors also derive and use the same formulation.

The integrity of the GSDM has been vetted and acknowledged by reputable spatial data professionals.

For context, consider the fundamental differences between spatial data models used extensively in surveying, mapping, engineering, remote sensing, photogrammetry, and navigation.

1. The geodetic coordinate system model of latitude, longitude, and height also covers the entire earth. Characteristics include:

    - Computations are performed on and relative to the mathematical ellipsoid.
    - Units are mixed-mode – curvilinear for latitude and longitude and meters for height.
    - Classical equations for geometrical geodesy are highly developed, comprehensive, and used worldwide. Those geodesy equations involve complexity that is a challenge for many.
    - But, those equations have been programmed to run on ever faster computers and the efficiency of most spatial data users is rarely compromised by not understanding the equations.

2. The local coordinate system model is applicable to small areas for which a flat-earth can be safely assumed. Within those curved-earth limitations, both two- and three-dimensional computations can be performed with geometrical integrity according to rules of solid geometry. Many projects and applications have been completed successfully using local coordinates. But, the fact remains, the earth is not flat. The emergence of modern measurement systems and computer storage of spatial data has forced many flat-earth users to confront various technical/logistical challenges.

3. Map projections are a model designed to "flatten the earth" and simplify computations. The U.S. military (and others) has used the universal transverse Mercator (UTM) projection world-wide since WWII and zones in the state plane coordinate (SPC) system have been used successfully throughout the U.S. since the 1930s. With a number of trade-offs, map projections support the use of "flat earth" plane coordinates for routine surveying, mapping, and related computations. Those trade-offs include:

    - Due to unavoidable distortion, given by the grid scale factor, a distance on the map differs from the distance on the ellipsoid by an amount that may or may not be acceptable.
    - In an effort to control the allowable distortion, a given map projection will cover a limited geographical area.
    - In areas where elevation is appreciable, the geographical area that can be covered by a given level of distortion is further limited by an elevation factor which converts an ellipsoid distance to a ground-level horizontal distance.
    - With those restrictions on distortion, the geographical coverage becomes somewhat restricted – resulting in the proliferation of "small" projections needed to preserve 2-D geometrical integrity.

By contrast, the GSDM models computations in 3-D space while the geodetic model requires measurements be reduced to the ellipsoid and the map projection model suffers inherent distortions of measurements in an effort to "flatten the earth."

Advantages - the GSDM:

1. Is already defined and one set of equations is applicable worldwide – no zones.
2. Does not distort physical measurements.
3. Uses equations that are much less complicated than geodesy or cartography equations.
4. Enjoys global uniqueness enjoyed by geodetic coordinates.
5. Allows the user to display results in other systems – geodetic, UTM, SPC, etc.
6. Permits the user to work with local flat-earth coordinate differences, $\Delta e/\Delta n/\Delta u$.
7. Accommodates the characteristics of 3-D digital spatial data.
8. Includes both functional (geometry) and stochastic (error propagation) model components.
9. Involves no projection constants, grid scale factors, elevation factors, or combined factors.
10. References directions to the true meridian through any point selected by the user.
11. Is compatible with "cloud" storage of spatial data.
12. Is not unique to any given discipline. Interoperability rules!