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State Plane Coordinate System of 2022

Quarter 3, 2018 Article

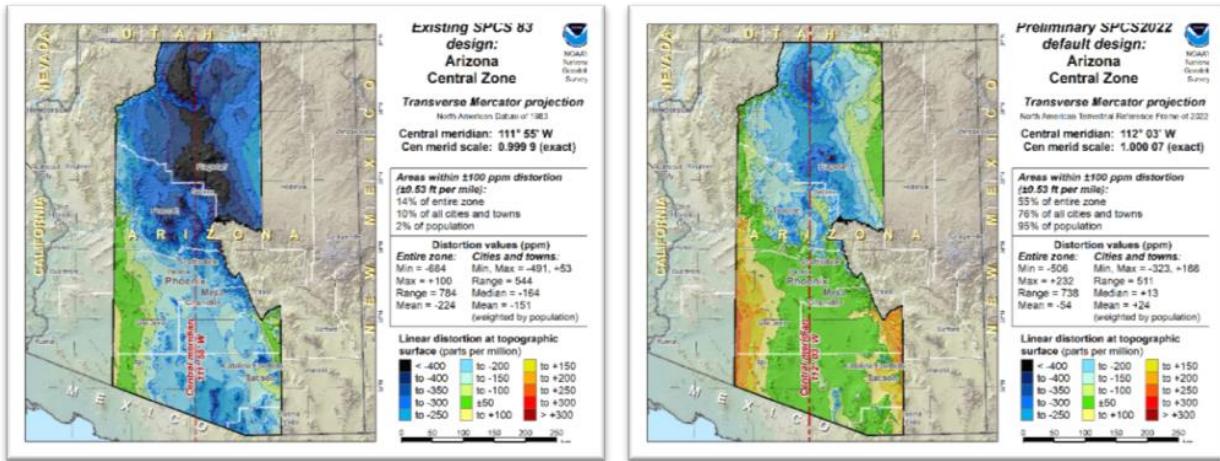
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An update of the State Plane Coordinate System (SPCS) is part of the transition from the North American Datum of 1983 (NAD 83) to the 2022 Terrestrial Reference Frames. To this end, the National Geodetic Survey (NGS) will establish the State Plane Coordinate System of 2022 (SPCS2022), which will replace SPCS 83, the version referenced to NAD 83.

SPCS is a system of large-scale conformal map projections originally created in the 1930s to support surveying, engineering, and mapping activities throughout the U.S. and its territories. As a reminder, a map projection is a systematic transformation of the latitudes and longitudes of locations on the surface of a sphere or ellipsoid representing the Earth to grid coordinates (x, y or easting, northing values) on a plane. This is where the curvilinear or round system of measurements meets the 'flat earth' of plane geometry. Think of the 2D space you work in for CAD, BIM and GIS mapping

The characteristics and usage of SPCS have varied considerably over its long history. Details of the history and evolution of SPCS, as well as its current status and possible future changes are given in [NOAA Special Publication NOS NGS 13, "The State Plane Coordinate System: History, Policy, and Future Directions."](#) This report also includes the defining parameters for every SPCS zone ever created by NGS, as well as the current status of U.S. state and territory SPCS 83 legislation and adopted version of the foot.

The figure below is a comparison between SPCS 83 and a preliminary SPCS2022 design for the Arizona Central Zone.



This is one possible scenario for Arizona and is what NGS is currently calling a default approach. There is an opportunity to perform something different from the default upgrade for SPCS2022. This will be discussed below.

Many entities within Arizona maintain a well-defined usage of the current SPCS 83, while several entities don't currently use SPCS 83 in its pure form (i.e., without some sort of modification), or don't use SPCS 83 at all. SPCS 83 modifications are not listed in the NGS 13 publication, and listing all the possible modifications for Arizona would be impractical. Data that are referenced to NAD 83 but are used in derivative coordinate systems can be summarized into a few general categories: created by modifications to an existing zone to change the distortion characteristics to better match project requirements (e.g., multiplying coordinate pairs by an average scale factor to scale the projected 'grid' coordinates to 'ground'); extension of a zone outside its original design boundary to cover a larger area (e.g., using SPCS 83 AZ Central zone for statewide coverage); and designing new zones using the SPCS 83 algorithms and detailed topographic surface information to result in better performing regional zones, such as Low Distortion Projection (LDP) zones. Additionally, some coordinate systems are poorly geodetically referenced, or not georeferenced at all. This final category includes everything from the assumed coordinate systems (5000, 5000 in the SW corner of a project and north up a section line), calibration/localization of RTK projects to site 3D planar control, and coordinate systems that are constrained to legacy information (plat, construction drawing or even a historic but superseded geodetic system, such as NAD 27). The above mentioned different ways that geospatial data are used in Arizona are summarized in the following list:

- Full use of NAD 83 & SPCS 83, as originally defined
- Use of NAD 83 geodetic coordinates with modified SPCS 83 (i.e., scaled to ground)
- Use of a single SPCS 83 zone for statewide coverage
- Use of NAD 83 geodetic coordinates & LDP or other non-SPCS 83 projected coordinate systems
- Use of arbitrary non-georeferenced coordinate systems

In short, there are presently several forms the positional components of geospatial data can take in Arizona. Part of this diversity can be attributed to advancements in measurement technologies (most notably GPS), and part of it is caused by the needs of data exceeding the original design of SPCS 83, which in Arizona, is virtually identical to the core design of SPCS 27. Addressing all of these cases for SPCS2022 is a great opportunity to organize geospatial data for users in Arizona.

So how will the NGS SPCS2022 apply to Arizona and how will we be able to move forward?

First, a general comment and observation about data users in Arizona. SPCS2022 gives us an opportunity to clean up the procedures of how we, as a geospatial community, document our newly collected data. We have an opportunity to create new zones that better meet all our contemporary coordinate system needs. If all of our future data can be directly categorized using a SPCS2022 zone, the need for subsequent modification can be eliminated for future projects. A simple transition to new SPCS2022 zones could be done by officially sanctioning the existing LDP coordinate systems that have been developed by various communities in Arizona. Another simple transition would be to optimally define a single State zone, for groups that require projected geospatial data with statewide coverage. Slightly more difficult is to address the practice of modifying coordinate systems to 'scale' them to a closer approximation of the topographic surface, for areas not presently covered by LDPs. Lastly is to address entities that currently do not geodetically reference their work to current control and do not use SPCS at all. It is entirely reasonable to say, with proper coordination, that the majority if not all geospatial professionals in Arizona could benefit from a well-planned implementation of SPCS2022.

This leads to the second point for moving forward. A work group has been formed at the State level under the Arizona Geographic Information Council (AGIC). The AGIC SPCS2022 work group will start the outreach to stakeholders within the State and develop a plan to move forward. Arizona's plan will be submitted to NGS for review and possible inclusion in SPCS2022 by the submission deadline: December 31, 2019. One of the NGS requirements is that we as a State speak with a common voice, and the AGIC work group can satisfy this very well.

Third, and within the AGIC work group, we will start to discuss the specific mechanics of moving forward. These will include:

- Determination of SPCS2022 zone characteristics within Arizona
- Selection of a linear unit
- Review and recommend updates to ARS 33-131 – 33-138, the statutes pertaining to NAD 83, international foot linear unit, and SPCS 83

The NGS draft policy and procedure documents for SPCS2022 are currently in a public review and comment period (ending Aug 31, 2018). Once the final guidelines are released for the project more specific direction can be given moving forward. An important step for right now is getting all the State stakeholders represented in the AGIC work group. Please contact Brian Fisher, the NGS State Geodetic Coordinator and the AGIC SPCS2022 Work Group chair for more information.



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