International Cartographic Association
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# Assessment of the methodology for defining the state plane coordinate reference system for topographic mapping, cadastre and engineering geodesy purposes

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**Keywords:** map projection, coordinate reference system (CRS), state plane CRS, accuracy, spatial data, distortions

**Abstract**:

The coordinate reference system is the mathematical basis for calculating the coordinates of objects and spatial phenomena in a given area. It is defined by the Earth ellipsoid and the map projection, the first for determining coordinates based on the Earth ellipsoid and the second for determining orthogonal coordinates in the plane. The coordinate reference system is now encoded in various international reference systems, one of which is the EPSG system.

High-precision field work such as those in geodetic networks, topographic mapping, engineering geodesy and cadastre, require a coordinate reference system in which lengths, areas and angles differences between the geometry of spatial data in nature and the plane must be within the accuracy frame. The very fact that coordinate reference systems are based only on the parameters of the Earth ellipsoid and the map projection, the mathematical relationship between the geometry of spatial data in the field and the plane is not part of the current models used to determine the most suitable state plane coordinate reference system.

Map projection is the final area that enables the calculation of orthogonal coordinates on the plane for the needs of state cartography, geodesy and cadastre. The current methodology for determining the most suitable map projection, in addition to the type of deformations and adaptation to the shape of the territory, is mainly based on the value of the map projection distortions. This methodology does not take into account the geometric differences between field and plane, but only the distortions between the ellipsoid and the plane, excluding from the mathematical model the physical surface of the Earth (relief) and the mean sea level (geoid).

In this paper will be presented performed analyses that demonstrate the need of including successively four layers (the relief, the geoid, the Earth ellipsoid and the map projection) parameters during the establishing of the state coordinate reference system, in order the successive differences between the geometry of objects in relief and the geometry calculated from orthogonal coordinates in the map projection to be within the accuracy frame for high-precision field work in geodetic networks, topographic mapping, engineering geodesy and cadastre. As research outcomes, several directions will be given as possible solutions for improving the methodology for the establishing of the state plane coordinate reference system, by adding new parameters to map projection.

Abstracts of the International Cartographic Association, 10, 118, 2025
32nd International Cartographic Conference (ICC 2025), 17–22 August 2025, Vancouver, Canada.
https://doi.org/10.5194/ica-abs-10-118-2025 