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Selection of a Suitable Cartographic Projection for the State Area

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Abstract:

Choosing a cartographic projection is one of the first tasks a cartographer undertakes when creating a map. The need to map the world has been ingrained in humanity for thousands of years, and selecting the appropriate cartographic projection is essential for creating an accurate map. There are countless types of these projections, and all cartographic projections can be adjusted using constants. This offers us almost unlimited options for choosing a projection.

Every projection of the world or a part of it involves some degree of distortion. It is possible to create projections that do not distort angles, areas, or lengths in certain directions. However, it is impossible to achieve a projection that does not distort any of these measurements. The Earth's sphere simply cannot be unfolded onto a plane without deformation. But which projection is ideal for which part of the Earth's surface? And which one should a cartographer choose when creating a map of, say, a specific country?

There are many guidelines and established rules for choosing a projection, e.g. Talhofer (2022). For some purposes, cartographic projections are also mandated by law. Often, a cartographer knows what properties they expect from a projection. However, multiple options will meet their criteria. The question, then, is how to choose the right one.

The solution to this problem is to create an application that, based on clearly specified requirements, offers the user a list of suitable projections. The user simply selects the state area for which they need to create a map. Next, they select requirements for individual types of distortion—maximum angular, areal, and linear distortion, represented by the value of the Airy variation criterion. The program then calculates which part of the selected territory meets the set requirements. Based on this value, the 15 available simple cartographic projections are ranked. The user can then select the desired variant. For each type of projection, a definition file for that projection can be downloaded for use in standard GIS software.

This approach is unique among the available programs. It uses mathematical criteria to compare different projections. Other publicly available applications offer a choice of map projections based solely on the size, shape, and location of the area. They then take into account only the type of distortion that needs to be minimized.

Each of the available cartographic projections is designed to minimize length distortion at the edges of a specific country's territory. This requirement is addressed by calculating the ideal values of undistorted parallels, prime meridians, or projection centres.

The created application (SSCProj – Selection of a Suitable Cartographic Projection for the State Area) is not intended to determine the best possible cartographic projection; such a conclusion can never be definitively established. Using different algorithms would certainly result in differences. However, it is intended to serve as a potential aid to cartographers in selecting a suitable projection for a given area based on specified distortion requirements. The final choice of cartographic projection, however, always remains with the cartographer.

The SSCProj runs as a desktop application with its own graphical user interface. The SSCProj was tested among colleagues at the Czech Technical University in Prague. Since the winter semester of 2025, it has also been incorporated into the mathematical cartography curriculum. It serves as a source of information for students on the optimal cartographic projection of a given area.

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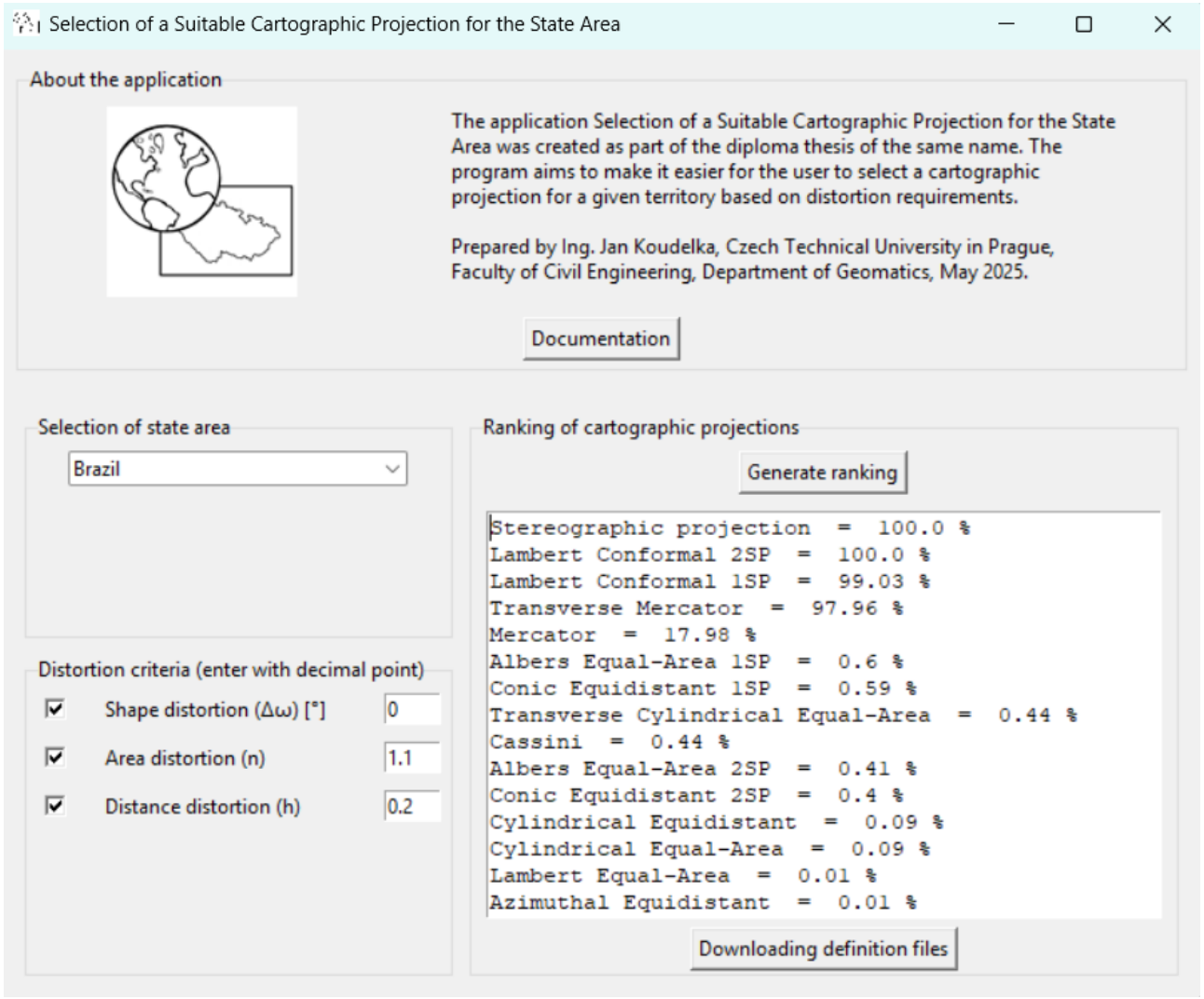

Figure 1. Sample of the created application.

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