Type of the Paper (Data Descriptor)

Interactive 3d models and animations for understanding earth's coordinate systems

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Abstract: This work presents datasets that can be used for getting a good understanding of an essential geoscience content knowledge that describe earth's coordinate systems. This include coordinate system used for spherical/spheroidal earth with latitudes and longitudes and their subsequent transformations to 2d maps on a variety of media (paper as well as digital) using the process of map projections. The datasets include PDF documents that are embedded with 3d models, animations and mathematical equations. The dataset has separate PDF documents for geographic (for spherical earth) and projected (2d) coordinate systems. Additionally, the data set include individual 3d models that can be used in various digital systems (including apps) and the animations in mp4 format that can be watched on most of the modern digital devices.

Dataset: http://dx.doi.org/10.4227/39/5a77c1220483a

Dataset License: Data with this article is public repository under a Creative Commons Attribution 4.0 International License. Data is available from USC Research Bank through the following link: http://dx.doi.org/10.4227/39/5a77c1220483a
Keywords: Map projections; coordinate systems; earth's 3d models; earth's 2d representation

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1. Summary

The use and collection of geographic data as well as application of geospatial technologies across diverse disciplinary areas has increased manifold (Srivastava & Tait, 2012). A pre-requisite for using modern geospatial technologies as well as geodatabases is to have a good understanding of the models that represent that represent information from the curved surface of spherical/spheroidal earth on a 2d media. Use of geospatial information without a good understanding has been noticed in many recent studies [1-4]. These digital resources will provide opportunity for educators as well as users of geospatial data to get deeper understanding about the appropriateness of the spatial data for various uses and representations.

The process of representing information from curved 3d surface of the earth to 2d media using several types of map projection began more than two thousand years ago [5-7]. Since then, various map projection methods have been proposed, and there are plenty of literature describing the process [8-11]. The datasets presented in this publication has utilized knowledge from literature and used modern software tools together with available digital data for creating 3d models and subsequent animations to demonstrate diverse ways to represent earth surface information on 2d media. Detailed methods for creating these data sets is described in a separate publication [12].

2. Data Description

This section provides details of datasets which shared through this article.

2.1. Type of data

Interactive 3d models and animations embedded in PDF documents, individual animations and 3d models.

How data was acquired

Datasets were created from freely available world maps in digital format. These maps were subsequently used for created 3d models of the earth. The 3d earth models were eventually transformed into 2d maps, and animations were created for this process. Global maps were created from geographic datasets and modified using a combination of software packages that included ArcGIS, Autodesk Maya, GIMP, Meshlab and Adobe Acrobat, Microsoft Word, VirtualDub, and VidCoder.

Data format

PDF documents, mp4 movies, and 3d models as u3d.

Experimental factors

An understanding of relevant geoscience content area.

Experimental features

3d models and animations are created using theoretical knowledge about earth's representation on 2d media using modern software tools.

Data source location

Research repository website of University of the Sunshine Coast, Queensland, Australia

Data accessibility

Data with this article is public repository under a Creative Commons Attribution 4.0 International License.

Data is available from USC Research Bank through the following link:

http://dx.doi.org/10.4227/39/5a77c1220483a

3. Methods

Methods used for creating 3d models and animations was published in the following publication:

> Srivastava, S., Techniques for developing resources to understand geographic and projected coordinate systems. Journal of Spatial Science, 2014. 59(1): p. 167-176.

The datasets include the following:

1. PDF documents on selected topics (Figure A). This include:

a. 3d models for spherical earth's coordinate system. This coordinate system is referred as geographic coordinate system and uses latitude and longitude values.

b. 3d models, animations, and mathematical equations for coordinate systems of 2d earth (Table 1). This coordinate system is referred as projected coordinate system and uses distance units (metre, feet, etc.) on X and Y axes.

2. Raw animation files in mp4 format.
3. Raw 3d models in u3d format which is also available in individual PDF documents

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Table 1: List of datasets, their formats and possible uses

	Dataset	Format	Uses
1.	Cylindrical Map Projection	PDF	A combination of resources is included for each map projection types. Resources include interactive 3d models, animations, mathematical equations, and resulting 2d map of the world.
2.	Conical Projection		
3.	Geographic Coordinate System		
4.	Gnomonic Planar Projection		
5.	Oblate Cylindrical Projection		
6.	Orthographic Planar Projection		
7.	Traverse Cylindrical Map Projection		
8.	Projections on Polyhedrons and Pseudocylinder		
9.	Projections on Polyhedrons		
10	Various aminations	Mp4	Animations can be played on a diverse range of digital devices or can be embedded into customized apps.
11	Various 3d models	U3d	Universal 3d models can be inserted into PDF documents where uses can interact with it. Additionally, after converting to different file formats of 3d models, they can be used in a diverse range of visualization media. For example, after their conversion to FBX file format, we are using these models for real 3d visualization inside CAVE2 virtual reality system.

All the datasets are available at the following website: http://dx.doi.org/10.4227/39/5a77c1220483a

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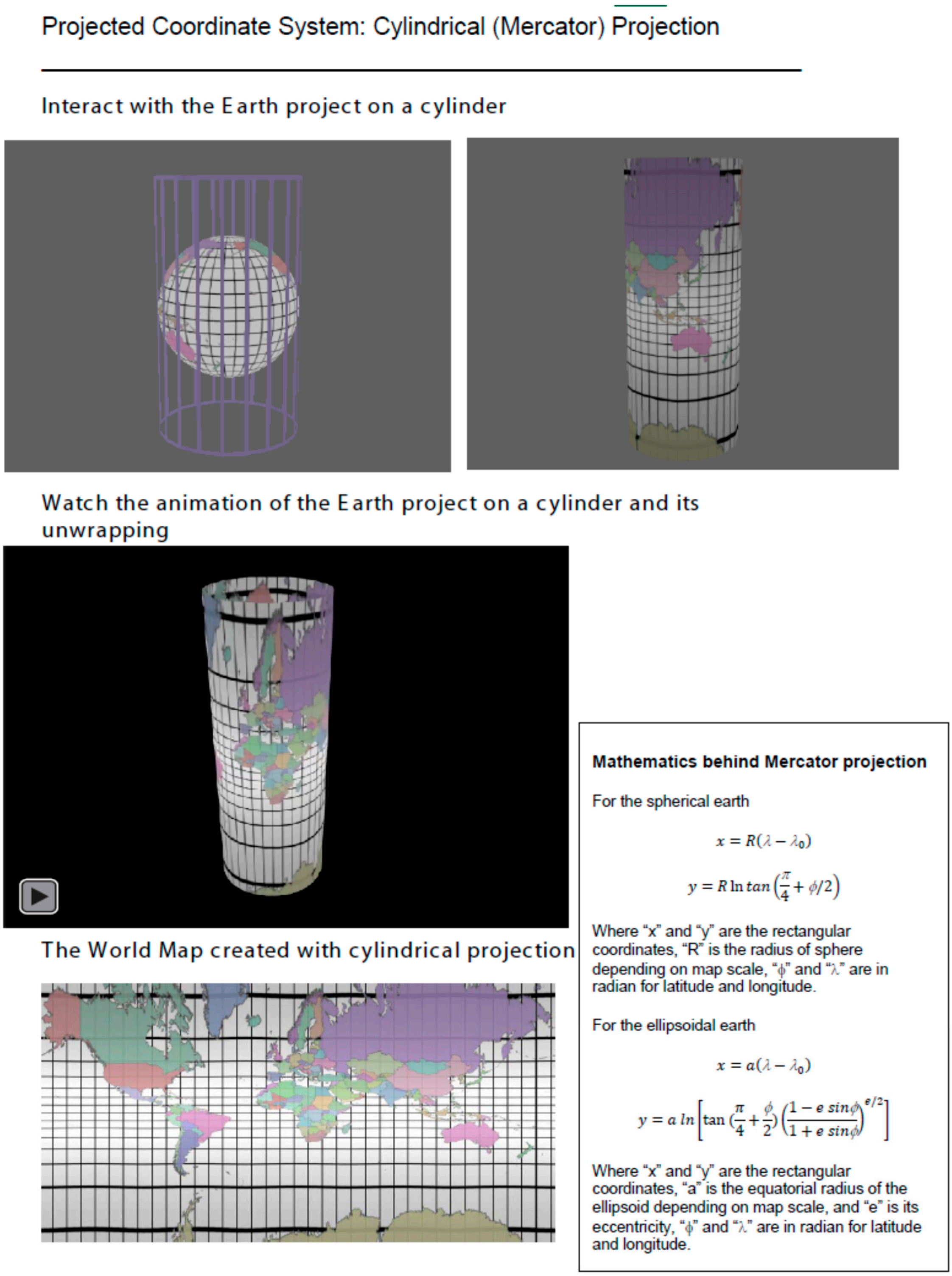

Figure A: An example of PDF resource about a map projection type with interactive 3d model, animation and mathematical equation

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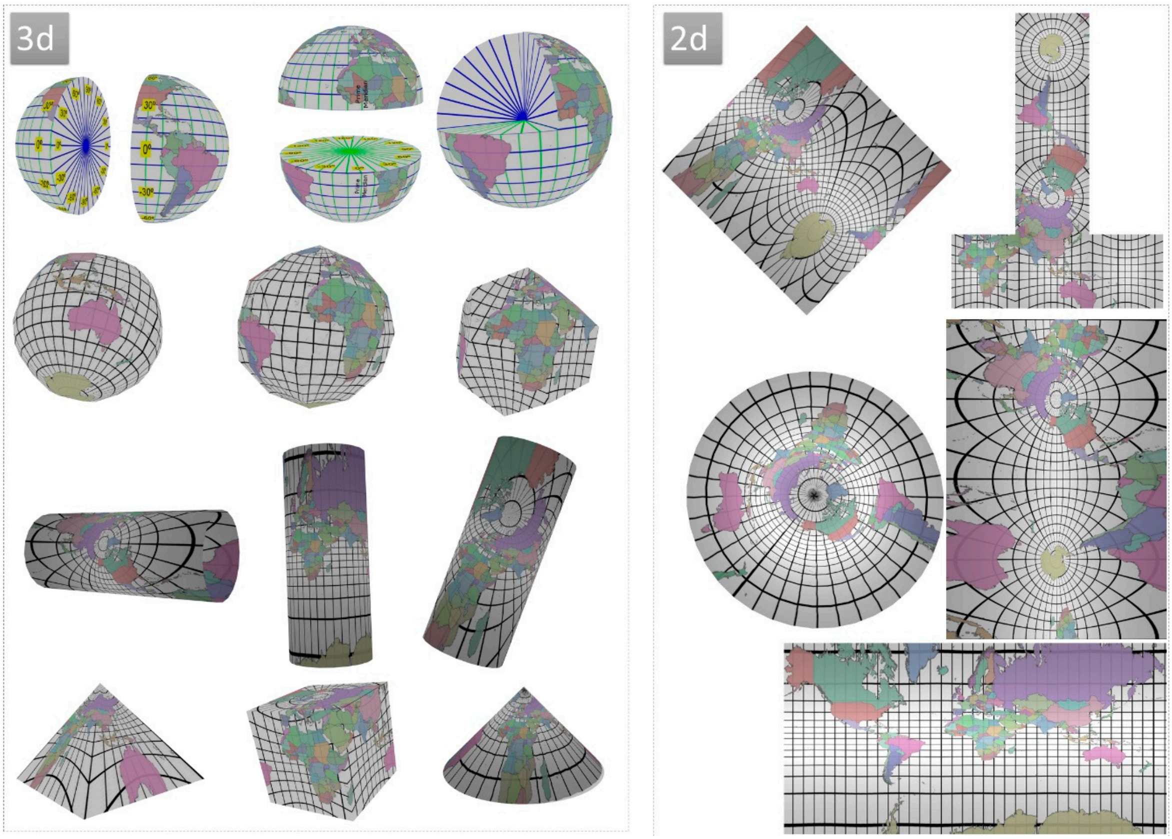

Figure-B: Examples of 3d models representing projection of spherical/spheroidal earth on different surfaces before creating 2d maps

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Conflicts of Interest: The author declares no conflict of interest.

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