Earth's Geography

Mapping Earth 101

Maps are essential tools for depicting the Earth's surface on two-dimensional mediums, such as paper or digital screens. Yet, the challenge lies in the Earth's inherent three-dimensionality; transferring its surface to a flat format inevitably introduces compromises or distortions. This necessity has birthed the field of map projections, a set of techniques designed to represent the globe on flat surfaces with as little distortion as possible.

Critics of the spherical Earth model, notably Flat Earthers, often disregard this fundamental aspect of cartography. They overlook the fact that no large-scale terrestrial, aerial, or marine navigation system relies on a flat, scale representation of the Earth. This oversight is crucial because the geometry involved in mapping a three-dimensional object onto a two-dimensional plane naturally results in distortions. For instance, the commonly used Mercator projection maintains accurate compass bearings but distorts the size and shape of landmasses as they approach the poles. This is apparent when comparing the size of Greenland to Africa on a Mercator map, where Greenland appears significantly larger than its actual size relative to Africa.

The Folly of Challenging the Globe

To challenge the conventional understanding of Earth's shape, one would need to prove that world maps used in practice across various industries are fundamentally flawed or that there exists a hidden, perfectly flat, accurately scaled map of Earth used in secret by these industries. Both propositions are practically implausible. The global reliance on existing maps, such as those used in GPS technology, aviation, and maritime navigation, underlines their practical and tested accuracy. The GPS system, for example, operates on the principle that the Earth is a sphere, using satellites in orbit to provide precise location information—a process that would not be feasible if the Earth were flat.

In essence, the argument against a flat Earth is grounded in practical evidence and the basic principles of geometry. The widespread use of spherical Earth maps in navigation and industry worldwide is not just a matter of convenience but a testament to their accuracy and reliability.

Here are examples of interactive maps with real time flight and marine positioning data. All of these represent the spherical shape of the earth using the Mercator Projection. Feel free to experiment with each map's built in masurment tool to see the difference in scale at different latitudes on earth.

VesselFinder displays real time ship positions and marine traffic detected by global AIS network

Flightradar24: Live Flight Tracker - Real-Time Flight Tracker Map

Map Projections

A map projection is a systematic method of transferring the Earth's curved surface onto a flat surface. All map projections distort the Earth's surface in some way, as it's mathematically impossible to flatten a sphere without stretching or compressing its surface. The types of distortions include changes in area, shape, distance, and direction. Cartographers select projections based on the purpose of the map, choosing the type of distortion they find most acceptable for the map's use.

Why All World Maps are Wrong

https://www.youtube.com/embed/kIID5FDi2JQ?si=LAd03tMWBYNXpG8L

Types of Distortion

- Area distortion occurs when the size of landmasses is either enlarged or reduced.
- Shape distortion happens when landmasses do not retain their true shape on the map.
- Distance distortion affects the accuracy of distances between points on the map.
- Direction distortion can alter the angle between landmarks or destinations.

Euclidean Geometry

Euclidean geometry, named after the ancient Greek mathematician Euclid, is a mathematical system that describes the properties and relations of points, lines, angles, surfaces, and solids in a flat, two-dimensional space. It's based on five postulates, which include notions as simple as "a straight line can be drawn connecting any two points" and as fundamental as the parallel postulate, stating that through a point not on a given line, there is exactly one line parallel to the given line.

Euclidean geometry forms the basis of our understanding of shapes, angles, and distances in the spaces we encounter in everyday life. It's used extensively in architecture, engineering, and design, where the surfaces worked with are flat and the principles of straight lines and angles apply directly.

Non-Euclidean Geometry

Non-Euclidean geometry arises from either relaxing or altering Euclid's fifth postulate, the parallel postulate, leading to geometries that deal with curved spaces. There are two main types of non-Euclidean geometry:

Hyperbolic Geometry: This geometry assumes that through a point not on a given line, more than one line can be drawn parallel to the given line. It deals with the geometry of saddle-shaped surfaces, where the angles of a triangle add up to less than 180 degrees.

Spherical Geometry: This geometry deals with the properties of shapes on the surface of a sphere. Unlike flat surfaces, the shortest path between two points on a sphere is not a straight line but an arc known as a great circle. In spherical geometry, the angles of a triangle add up to more than 180 degrees, and there are no parallel lines since all great circles (the equivalents of lines in spherical geometry) intersect.

Representing the Geometry of the Globe on a Flat Map

When mapping the globe, cartographers confront the challenge of projecting the Earth's curved surface (which follows spherical geometry) onto a flat plane (which follows Euclidean geometry). This process inherently involves distortion, as the properties of spherical surfaces cannot be perfectly translated into flat surfaces.

Preserving Properties: Different map projections prioritize preserving different properties (e.g., area, shape, distance, direction). No single projection can preserve all these properties due to the fundamental differences between Euclidean and non-Euclidean geometries.

Choosing Projections: The choice of a map projection reflects a balance between the type of distortion the cartographer is willing to accept and the map's intended use. For instance, the Mercator projection preserves angles and shapes at the expense of distorting area, making it useful for navigation, while the Robinson projection aims to balance the distortion of various properties, making it visually appealing for world maps.

Mercator Projection

https://www.youtube.com/embed/CPQZ7NcQ6YQ?si=J-t4m7VBYVzfw3ct

Implications for Understanding the Globe

The transition from Euclidean to non-Euclidean geometry in mapping the globe highlights the complexity of representing our three-dimensional world on two-dimensional surfaces. It underscores the importance of choosing the right projection for specific purposes and the need to understand the limitations and distortions inherent in different map projections. The study of geometries—both Euclidean and non-Euclidean—provides essential insights into how we visualize and navigate our world, emphasizing that the geometry we learn in school is just the beginning of understanding the vast and varied nature of space itself.

Modern Cartography

With the advent of satellite technology and geographic information systems (GIS), modern cartography has reached unprecedented levels of accuracy. Satellites can measure the Earth's surface with incredible precision, allowing cartographers to create maps that are more accurate than ever before. These technologies also enable the updating of maps in real time to reflect changes in the Earth's surface.

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