Mercator Museum

History of cartography

ENGLISH

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The world on a map - an insoluble problem?

Since time immemorial, man has been dealing with visualisation of his surroundings. Images of the environment followed by maps developed simultaneously with the evolution of technology and man's spatial understanding. It was not until the 16th century that the globe came into regular use for showing us our world – even though it is the only correct representation.

The reality of a round Earth burdened cartographers with an insoluble problem. It is just as difficult to represent a spherical Earth correctly on map, as it is to press a ball flat on a table without deforming its surface – impossible in fact.

In the past, there were numerous proposals of methods for reducing that deformation as much as possible. We call these cartographic images or map projections. The most important question remains: what does one want to show on a map? Every cartographic image will be a compromised representation.

Projection

Map projections are representational maps – i.e. each mathematical method that allows display of a curved surface of a celestial body or part of it on a flat surface.

Depiction of parts of the earth's surface on a map without distortion is only possible for small areas. In the first instance, the purpose of the map determines the choice of a particular type of projection. Does one want to show directions as accurately as possible, to compare surface area or determine distances accurately?

Among other criteria, we can group cartographic projections based on the shape of their grid. The most common are the azimuthal, conical (or conic) and cylindrical projections, so named because their grids give the impression of the projection of the sphere on a plane, a cone or a cylinder, respectively.

Azimuthal projection

The Earth's surface is displayed on a flat surface that usually centres on the poles or another point on Earth that one wants to place at the centre of the map. The parallels are concentric circles around the central point of contact. Radial distortion gets greater as the distance from the centre increases. The meridians or longitude lines run in straight lines away from the centre. The azimuth projection is usual used when mapping the poles.

Conical projection

The image of the Earth's surface is within a conical surface that touches the globe along a pre-selected circle of latitude, the so-called standard parallel. The Earth's and the cone's axis coincide. This shows the areas around the standard parallel accurately. The lines of latitude (parallels) are parallel conical curves. The further the area is from the standard parallel the greater the distortion. The meridians show as radial straight lines coming from the start point. The usual use of cone projections is for elongated areas with an east-west orientation.

Cylindrical projection

Depiction of the Earth's surface is within a cylindrical surface that touches at the Equator. Latitude and longitude circles appear perpendicular to each other forming a rectangular grid. Cylinder projections show an enormous east to west stretching towards the poles because all the parallels are the same length as the equator. Deformation only stays limited in areas around the equator.

The most famous cylinder projection is the Mercator projection – one of great importance for seafarers. Thanks to the Mercator world map (1569), the compass course a navigator takes on the earth's surface is no longer a curve but a straight line that consistently intersects the meridians at a right angle. We call this line a rhumb line (or loxodrome). This made navigation at sea a lot simpler. It suffices to draw a line with a ruler, determine the wind direction and continue sailing further on the same compass course.

Scale

Scale on a map is the ratio between the distance on the map and the corresponding distance in reality. Reference to the scale is usually indicated on the edge of the map in the form of a numerical or graphic scale. The larger the scale of the map, the more details it will show. The smaller the scale of the map, the more one must simplify or generalize.

Numerical scale: is the scale of the map displayed by numbers, usually in the form of a fraction. For example 1:10 000.

Graphic scale: is the depiction of the scale using a graphical representation such as a scale bar or a scale diagram.

A scale bar: is a line or thin bar marked with the distances in reality on a specific scale.

Geographic coordinates

To determine the absolute location of a place we use the network of meridians and parallels, with which we can establish the precise longitude and latitude – i.e. the geographic coordinates.

Meridians or lines of longitude are half circles that run from pole to pole and cross the equator perpendicularly. All meridians are the same length and run from north to south. The standard or Prime Meridian (0^0) is the Greenwich Meridian – it divides the Earth into the western and eastern hemispheres.

Parallels or lines of latitude are circles that follow a west-to-east direction and are parallel to each other. The Equator is the standard parallel (0^0) – it divides the Earth into northern and southern hemispheres.

The longitude of a place is its distance from the prime meridian, measured along the parallel in degrees minutes and seconds (°, ' and "), the latitude of a place is its distance from the equator, measured along the meridian in degrees minutes and
seconds (°, ' and ").

In addition to the longitude and latitude, we also measure the elevation of a place and map it based on contour lines. By levelling, one calculates the location relative to the reference plane or Mean Sea Level. This is the average low tide level in Ostend (Ostend level) and is 0 meters.

Triangulation

Surveyors use the triangulation method to measure territories. They divide the land into triangles. For any triangle, if the length of one side and the two adjacent angles are measured, one can calculate the length of the other two sides and the angle between them. As a basis for making maps, there is a network of so-called geodetic points throughout the territory of Belgium – these have accurately known relative positions. Originally, mostly high towers visible from a great distance were the choice for these points.

The history of Mercator

Since time immemorial, we have shown data with spatial characteristics on plans or maps. It is an elementary form of communication. The aim is to collect or share information about the appearance location of observed elements. In this way, the user of the map can find out where something is located, how and by which route one can get there, how it looks and what is located nearby.

We recommend those who want to understand and interpret Mercator's work in its historical context to first to take a long look at some milestones in cartography, centuries before Mercator people attempted to map their world.

To draw a map is a matter of knowledge and the ability to find an answer to these questions: What is the extent of the known world? How far have explorers already been?
How to portray the globe on a flat surface and what methods are available for that?
Examples of maps from the Babylonian, Greek, Roman and medieval periods show that the worldview and cartographic techniques have been through all kinds of evolutions during the course of history.

A pair of globes

In 1541, Gerard Mercator made a world globe. He was the first to include rhumb lines (loxodromes) on a globe. These are lines that the ships could easily follow, using a compass. The main use of globes was by geographers and other scholars to illustrate the results of exploration. Princes and nobles desired a globe – as a prestigious object.

With this globe, Mercator managed to improve numerous details in the existing cartographic image of the world. Its success helped him to win major commissions, allowing him to live very well. Through his contact with powerful patrons, he acquired interesting geographical information. That helped him to keep his maps up-to-date.

In April 1551, Mercator completed a celestial globe, the counterpart of his terrestrial globe of ten years earlier. This globe is the tangible proof that Mercator, as a scientist, was actively involved with cosmography, the description of heaven and earth. Mercator had an ambition to create an all-encompassing description of the cosmos. In this, he wanted to merge time and space, cosmology, geography and history into one.

In Mercator's era, astrology had different status than it does today. The general view was not one of a superstition but rather a form of applied astronomy. The practice of astrology was a serious science of great practical value. The premise was that planets and stars could affect human events.

Mercator's knowledge of the stars and planets is purely book learning. There is no question of real systematic astronomical observations. Mercator did not follow the heliocentric arrangement of Copernicus, because he suggested that the earth is the centre of the 'world' and that the firmament moved.

Digital atlases

Each original Mercator atlas - a book of about 400 years old - is an impressive looking piece. Beautiful coloured, with highly ornamented title cartouches, rich in detail, with clearly written place names. Unfortunately, we cannot let you as visitor simply browse through them. While an atlas in a closed museum display can show only one map, here you get the chance to browse through digital versions of some books of maps.
From left to right:

- Cl. Ptolemy atlas Ptolemaei Alexandrini Geographiae libri octo (1584)

- Mercator's atlas '*Gerarde Mercatore Rupelmundano 'Atlas sive cosmographicae'* (1595)

- The Mercator-Hondius atlas '*Atlas sive cosmographicae meditationes de fabrica mvndi et fabricati figvra*' (1607)

Map of Flanders

In 1539, Gerard Mercator gets a commission, from some Ghent citizens, to draw a map of the county of Flanders, exalting Ghent less than that of Pieter van der Beke. The map, made up of nine leaves, was a present to Emperor Charles V in 1540 as a reconciliation gift from the rebellious city of Ghent.

The print proof hangs in the Museum Plantin-Moretus in Antwerp. In 2011, it gained recognition by the Flemish Community as a masterpiece.

On the map of Flanders, there are six selected areas on which you can click through from 1540 to 2010 or 2011. Maps and areal photos show how the landscape changes.

Following a course

Mercator used a cylinder projection for his world map of 1569, known as 'Mercator projection' after him. This projection found an important application in seafaring that was undergoing enormous growth during the period of discoveries in the 16th century. Until this day, use of the Mercator projection is the basis for navigation both at sea and in the air.

Narration – film clip
The Atlantic, eighty two million square kilometres of water. This is the last frontier separating navigators from the new world, which they bumped into on their way to find a shorter route to the Far East, with its precious spices and minerals. He who would cross this frontier must be brave and sail fearlessly toward a horizon filled with sea monsters, storms and dangerous currents. And at journey's end, only 'terra incognita' awaited - uncharted territory.

Expeditions are expensive. The water supply on board is small and has limited shelf life. Diseases such as scurvy plague the crews. During prolonged becalming, the risk of mutiny is real. Yet the greatest challenge lies in the navigation. Because how can you sail on a round surface, without losing your direction? How do you navigate when you are far from home on the West African coast and lose visual contact with the pole star?

In the 16th century, this issue held the new maritime nations Spain, Portugal, England and Holland spellbound because their new empires stood or fell with the supply of herbs, spices and other valuable goods. That supply must be delivered quickly and safely, hence the feverish search for the best possible sea route. The shortest route between two points on earth is in reality a curve on the sphere – a route that describes a 'Great Circle' on the globe, also known as an orthodrome.

For the explorers, it was impossible to follow these shortest routes. The orthodrome makes a different angle at every meridian. If a seafarer sails folllowing an orthodrome, he must recalculate his course constantly. He must constantly change direction and adjust his sails – a hopeless enterprise!

It is much easier to hold the same wind direction and keep a constant course, using a compass – but if you constantly follow a compass course, you sail over the globe in a spiral curve toward the poles.
The solution came in 1569 with Mercator's second world map, which he designed especially for sea.

Mercator increased the distance between the latitudes towards the poles so that the meridians presented as parallel lines on the map. With this, he achieved the result that today still forms the basis of modern charts, namely that the map presentation has consistent angles.

Thanks to the Mercator map, the compass course a navigator takes on the earth's surface is no longer a curve but a straight line that consistently intersects the meridians at a right angle. We call this line a rhumb line (or loxodrome). This made navigation at sea a lot simpler. It suffices to draw a straight line with a ruler, determine the wind direction and to continue sailing further on the same compass course.
However, no projection can display the round earth on a flat surface without a distorted image. On a globe, we see clearly that the meridians meet at the poles but are further away from each other around the equator. On the Mercator map, on the other hand, the distance between the meridians is constant – so inevitably there is distortion of the surface area. The farther from the equator, the larger areas appear to be – at the poles, this magnification is infinite. On the Mercator map, Greenland is about as large as the continent of Africa – while it is about 17 times smaller in reality.

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