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Choosing a Map Projection

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Appendix
Glossary of Map Projections

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All items are listed in the Glossary by alphabetical order. If an item consists of two or more words, the first is always a noun. For example: *Azimuthal projection* is listed as *projection, Azimuthal.* Comma means that the usual order of the word is inverted. The synonym in English is marked with *also*. The advantage is given to the first stated item. If there are synonyms in French and German, they are separated by a semicolon (;). See refers to the terms that were used in the definition of a certain item or are connected with them.

Almucantar

Also: parallel of altitude

Small circle on the surface of the Earth's globe along which all points are equally distant from a point on the globe that we consider a pole of a pseudo-geographic coordinate system.

Note: In astronomy, the circles on the celestial sphere parallel with the horizon.

Fr. parallèle de hauteur

Ger. Netzbreite; Höhenkreis

Aspect of the projection

The position of the projection axis in relation to the geographic sphere parameterization axis.

See: axis of the projections

Aspect, normal

The aspect of a projection in which the projection axis coincides with the geographic sphere parameterization axis.

See: projection, map; aspect of the projection, axis of the projection

Fr. projection directe

Ger. Abbildung, normalachsige

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Aspect, oblique

The aspect of a projection that is neither normal nor transverse.

Remark: In the group of perspective projections, these are the projections in which the developable surface axis or perpendicular to the projection plane falls onto the Earth's surface in any point between the geographic pole and the equator.

See: projection, map; surface, developable

Fr. projection oblique

Ger. Abbildung, schiefachsige

Aspect, transverse

The aspect of the projection in which the projection axis is perpendicular to the geographic sphere parameterization axis.

Remark: In the group of perspective projections, these are the projections in which the developable surface axis or the perpendicular to the projection plane is placed in the equator plane.

See: projection, map

Fr. projection transverse

Ger. Abbildung, querachsige

Axis of rotation

The straight line around which a sphere is created by the rotation of a semicircle, or a rotational ellipsoid is created by the rotation of a semiellipse.

Remark: A sphere and a rotational ellipsoid are surfaces by means of which the Earth's form is usualy approximated. The axis of rotation runs through the poles.

Fr. axe de rotation

Ger. Rotationsachse

Axis of the geographic parameterization of a sphere

The straight line intersecting the North and South Poles and the coordinate system origin and centre of the sphere; axis Z in the geographic parameterization of a sphere.

Axis of the projection

The axis of pseudogeographic parameterization of a sphere, based on which the basic equations of map projection are defined. If the basic equations of a map projection are given using geographic coordinates, then the projection axis is identical to the axis of geographic sphere parameterization.

Axis of the pseudogeographic parameterization of a sphere

The straight line intersecting the North and South Pseudopoles and the coordinate system origin and centre of the sphere; axis Z' in the pseudogeographic parameterization of a sphere.

Directions, principal

Also: directions, base

Two mutually perpendicular straight lines in a point on the ellipsoid or sphere and the appropriate mutually perpendicular straight lines in the plane of projection along which the linear scale has extreme values—maximum and minimum.

See: scale, linear
Fr. directions principales
Ger. Hauptverzerrungsrichtungen

Equations of map projection, basic

Map projection equations which define a map projection in a pseudogeographic system.

Note: The selection of basic equations for a map projection is a question of agreement and/or custom. By selecting the basic equations of a map projection, one of its aspects is implicitly or explicitly defined. For cylindrical projections, meridians are represented as parallel straight lines, while parallels are represented as parallel straight lines perpendicular to meridian images. For Robinson's or Winkel Tripel projections, they take the form conceived by their authors. In fact, if we have projection equations in a geographic coordinate system, then we obtain equations in the pseudogeographic system by formally replacing geographic coordinates with pseudogeographic coordinates. However, this still does not guarantee the basic equations of a map projection, because the equations of any projection in any aspect can be written in the geographic coordinate system.

Geodesic

Also: line, geodesic; line, geodetic

Geometrically interpreted, it is the shortest line connecting two points of a not too large area on a surface.

See: orthodrome
Fr. ligne géodésique
Ger. Linie, geodätische

Graticule

Image of coordinate lines in a plane of projection.

Note: The graticule presented by the lines of meridians and parallels is called the basic graticule.

Ger. Kartennetz

Latitude, geographic

(1) Generic (general) term for geodetic and astronomical latitude. (2) The angle between the equatorial plane and the direction of the normal to the Earth's sphere through the given point; regarded as positive Northwards. (3) The parameter φ in the geographic parameterization.

Remark: The geographic latitude for an ellipsoid can be defined analogously.
Fr. latitude géographique
Ger. Breite, geographische

Line, rhumb

Also: line of constant bearing; loxodrome

A line on the rotational surface intersecting all meridians at the same angle.

Remark: Ships sail along the rhumb line when sailing continuously in the same course on their way between two positions.

See: meridian
Fr. loxodromie
Ger. Loxodrome

Longitude, geographic
(1) Generic (general) term for geodetic or astronomic longitude. (2) The angle between the plane of the prime meridian and the plane of the meridian through the given point; it is considered positive Eastward. (3) The parameter λ in the geographic parameterization.
Fr. longitude géographique
Ger. Länge, geographische

Loxodrome
See: line, rhumb

Meridian
(1) Generic (general) term for astronomic and geodetic meridian. (2) A line on the Earth's sphere obtained by the intersection of the sphere with the half-plane with the boundary straightline coinciding with the sphere rotational axis. (3) The parametric curves (semicircles) $\lambda = const.$ connecting the North and South Poles in the geographic parameterization of a sphere.
Remark: The meridian on an ellipsoid can be defined analogously.
See: longitude, geographic
Fr. méridien
Ger. Meridian

Orthodrome
Geodesic on a sphere.
Note: On a sphere, the orthodromes are the arcs of great circles.
See: geodesic
Fr. orthodrome
Ger. Orthodrome

Parallel, geographic
(1) Generic (general) term for astronomic and geodetic parallel. (2) The line on the Earth's sphere obtained by the intersection of the sphere with the plane perpendicular to the rotational axis of the sphere. (3) The parametric curve (circle) $\varphi = const.$ in a plane perpendicular to the Z axis of the geographic parameterization of a sphere.
See: latitude, geographic
Fr. parallèle de latitude
Ger. Breitenkreis; Parallelkreis

Parameterization of a sphere, geographic
Mapping $(\varphi, \lambda) \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right] \times [-\pi, \pi] \to (X, Y, Z)$ given with the formulae $X = R \cos\varphi \cos\lambda$, $Y = R \cos\varphi \sin\lambda$, $Z = R \sin\varphi$, where R is the given radius.

Parameterization of a sphere, pseudogeographic

The generalization of geographic parameterization of the same sphere obtained by rotation around the origin. The geographic latitude and longitude are transformed into the pseudogeographic latitude and longitude. The two corresponding 3D rectangular coordinate systems X, Y, Z and X', Y', Z' have a mutual origin (0, 0, 0), their coordinate axes are generally going to be placed at certain angles, and the relation between the two systems can be described using a rotation matrix:

$$\begin{bmatrix} X' \\ Y' \\ Z' \end{bmatrix} = \begin{bmatrix} l_1 & m_1 & n_1 \\ l_2 & m_2 & n_2 \\ l_3 & m_3 & n_3 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix},$$

where $l_i, m_i, n_i,\ i = 1, 2, 3$, are cosines of directions of the new axes in relation to the old axes. The connection between pseudogeographic and geographic parameterizations is given by three independent parameters. If the rotation is identity, then the pseudogeographic parameterization and geographic parameterization are identical.

Plane, equatorial

The plane containing the equator.

Fr. plan d'équateur

Ger. Äquatorebene

Plane of projection

The plane into which the surface of the Earth or a celestial body, assumed to be an ellipsoid or sphere, is mapped (projected).

Fr. plan de projection

Ger. Abbildungsebene

Pole, North

The point with coordinates (0, 0, R) in the geographic parametrization of a sphere.

Pole, South

The point with coordinates (0, 0, $-R$) in the geographic parametrization of a sphere.

Projection, Arbitrary

Map projection that is neither equivalent, nor conformal, nor equidistant. In this projection the surface of the Earth's ellipsoid or sphere is mapped into the plane under some special conditions.

See: projection, map; projection, conformal; projection, equivalent; projection, equidistant

Fr. projection aphylactique

Ger. Abbildung, vermittelnde

Projection, Azimuthal

Also: projection, zenithal

Projection in which pseudomeridians are represented as straight lines intersecting at a certain point and forming an angle equal to the difference of corresponding pseudogeographic latitudes, while parallels are concentric circles with a common centre at the point of intersecting pseudomeridians. Azimuthal projection equations in a polar coordinate system in the plane by using the pseudogeographic system are: $\rho = \rho(\varphi'), \delta = \lambda'$.

Remark: Perspective azimuthal projection—special type of azimuthal projection in which the Earth is considered to be a sphere, and the points from the sphere are projected following the laws of linear perspective from the point of view to a projection plane. The projection plane is perpendicular to the line connecting the point of view with the globe centre.

See: projection, map; pseudomeridian; pseudoparallel; system, pseudogeographic coordinate

Fr. projection azimutale

Ger. Azimutalabbildung

Projection, Conformal

Also: projection, orthomorphic

Map projection preserving angles.

Remark: Map projection in which there are no angular distortions. In conformal projection the linear scale in every point is equal in all directions, so in these projection the similarity of infinitesimal parts of the representation is preserved.

See. projection, map; scale, linear

Fr. projection conforme

Ger. Abbildung, konforme; Abbildung, winkeltreue

Projection, Conic

Also: projection, conical

Projections in which pseudomeridians are represented as straight lines intersecting at a certain point, while pseudoparallels are represented as concentric circle arcs, with the angle between any two pseudomeridians being lesser than the corresponding difference of the corresponding pseudogeographic latitudes. Conical projection equations in a polar coordinate system in the plane by using the pseudogeographic system are: $\rho = \rho(\varphi')$, $\delta = k\lambda'$, $0 < k < 1$.

Remark: Perspective conic projection—perspective projection in which the cone is used as a developable surface.

See: projection, map; projection, perspective; pseudomeridian; pseudoparallel; system, pseudogeographic coordinate

Fr. projection conique

Ger. Kegelabbildung

Projection, Cylindrical

Projection in which pseudomeridians are represented as parallel straight lines and pseudoparallels are represented as parallel straight lines perpendicular to meridian images. Cylindrical projection equations in a Cartesian coordinate system

in the plane by using the pseudogeographic system are: $y = y(\varphi')$, $x = k\lambda'$, $0 < k \leq 1$.

Remark: Perspective cylindrical projections—perspective projection in which the cylinder is used as a developable surface.

See: projection, perspective; pseudomeridian; pseudoparallel; system, pseudogeographic coordinate

Fr. projection cylindrique

Ger. Zylinderabbildung

Projection, Equidistant

Map projection preserving distances in a particular direction.

Remark: Map projection on which the linear scale along one principal direction is equal to the unit, i.e. in any point there exists a direction with no linear distortion along it.

See: scale, linear; directions, principal

Fr. projection équidistante

Ger. Abbildung, abstandstreue

Projection, Equivalent

Also: projection, equal-area; projection, authalic

Map projection preserving areas.

Remark: An equivalent map projection has the property that in any point the area scale is equal to 1, i.e. there are no area distortions in any point.

See: projection, map

En. projection, equivalent; projection, equal-area

Fr. projection équivalente

Ger. Abbildung, flächentreue

Projection, Gauss-Krüger

Also: projection, Transverse Mercator

Conformal transverse cylindrical projection with the property that the central meridian of the given area is mapped as a straight line and serves as the x axis of the rectangular coordinate system in the plane; the central meridian is mapped without linear distortions or the linear scale along this meridian is constant.

Remark: In English speaking area, the projection is known as the Transverse Mercator projection.

See: projection, conformal; aspect, transverse; projection, cylindrical

En. projection, Gauss-Krüger

Fr. projection de Gauss-Krüger

Ger. Gauss-Krüger-Abbildung

Projection, Geodetic

A map projection of an ellipsoid into a plane which is applied in state survey, numerical processing of geodetic networks, solving various practical geodetic problems and producing topographic maps and plans in larger scales.

Remark: Geodetic projections are usually conformal and most commonly used are the Gauss-Krüger or transverse Mercator projection, the Lambert conic conformal projection and the stereographic projection.

En. projection, geodetic

Fr. projection géodésiqu

Ger. Abbildung, geodätische

Projection, Gnomonic

Also: projection, central

Perspective azimuthal projection in which the point of view is in the globe centre.

Remark: In this projection, the orthodromes are represented as straight lines.

See: projection, azimuthal; orthodrome

Fr. projection gnomonique

Ger. Zentralprojektion; Abbildung, gnomonische

Projection, map

The method of representing the Earth or a celestial body, assumed to be an ellipsoid or sphere, in a plane. It is mostly defined by map projection equations $x = f_1(\varphi, \lambda)$, $y = f_2(\varphi, \lambda)$, where φ, λ are geographic coordinates on the ellipsoid or sphere, and x, y the coordinates in the projection plane. It can also be defined with the table of coordinates or the description of map graticule construction. According to the distortion characteristics, they are classified into conformal, equivalent, equidistant and arbitrary projections. Depending on the orientation of the axis of projection map projections can be divided into normal (direct), transverse and oblique aspects of the projections. According to the shape of the graticule, they are classified into conic, cylindrical, azimuthal, pseudoconic, pseudocylindrical, polyconic, and other projections. They are often named after their authors, e.g. Mercator, Sanson, Robinson. As a special group of map projections we separate geodetic projections, i.e. projections needed in state surveys.

See: graticule, normal; aspect, normal

Fr. projection cartographique

Ger. Abbildung, kartographische

Projection, Mercator

Conformal cylindrical projection.

Remark: Normal aspect has special importance in navigation, because the rhumb lines are represented as straight lines in this projection. Transverse aspect is used in many countries for official cartography. Universal Transverse Mercator (UTM) is used in military (NATO).

See: projection, cylindrical; projection, conformal; aspect, normal; aspect, transverse; line, rhumb; UTM

Fr. projection de Mercator

Ger. Mercatorabbildung

Projection, Orthographic

Perspective azimuthal projection in which the point of view is placed in infinity, so the projection rays are mutually parallel.

See: projection, azimuthal

Fr. projection orthographique

Ger. Abbildung, orthographische; Parallelprojektion

Projection, Perspective

Map projection in which the points from the ellipsoid or sphere are projected following the laws of linear perspective from the point of view into the projection plane or developable surface.

Remark: Of all perspective projections, the azimuthal projections are most often applied in practice, so the term perspective projection often denotes only this group of projections.

See: projection, map; plane, projection; surface, developable

Fr. projection perspective

Ger. Projection

Projection, Polyconic

Map projection on which the pseudomeridians are mapped as curves symmetrical about the straight central meridian, and pseudoparallels as nonconcentric circular arcs with centres on the central meridian.

See: projection, map; aspect, normal; pseudomeridian; pseudoparallel

Fr. projection policonique

Ger. Abbildung, polykonische

Projection, Polyhedric

Map projection in which the Earth's surface is divided by meridians and parallels into ellipsoidal trapeziums; each trapezium is mapped into the plane separately, providing that its sides are mapped as the parts of the straight lines. The lengths of trapezium bases are equal to the lengths of the arcs of the corresponding parallels, while the trapezium altitude or the trapezium legs are equal to the length of the meridian arc between the two parallels.

See: projection, map; meridian; parallel, geographic

Fr. projection polyedrique

Ger. Polyederabbildung

Projection, Pseudoconic

Projections in which pseudomeridians are represented as curves symmetrical to the central pseudomeridian, which is mapped as a straight line, while pseudoparallels are mapped as arcs of concentric circles. Pseudoconic projection equations in a polar coordinate system in the plane by using pseudogeographic system are: $\rho = \rho(\varphi')$, $\delta = \delta(\varphi', \lambda')$

See: pseudomeridian; pseudoparallel

Fr. projection mériconique

Ger. Abbildung, unechtkonische

Projection, Pseudocylindrical

Projection in which pseudomeridians are represented as curves symmetrical to the central pseudomeridian, which is mapped as a straight line, while pseudoparallels are represented as parallel straight lines perpendicular to the central pseudomeridian image. Pseudocylindrical projection equations in the Cartesian coordinate system in the plane by using pseudogeographic system are: $y = y(\varphi')$, $x = x(\varphi', \lambda')$.

See: pseudomeridian; pseudoparallel

Fr. projection méricylindrique

Ger. Abbildung, unechtzylindrische

Projection, Transverse Mercator

(1) Map projection that is a Mercator projection and in transverse aspect. (2) In the English speaking area it is the name for the Gauss-Krüger projection.

See: projection, Mercator; aspect, transverse; projection, Gauss-Krüger

Fr. projection transverse de Mercator

Ger. Mercatorabbildung, transversale

Pseudomeridian

The parametric curves (semicircles) $\lambda' = const.$ connecting the North and South Pseudopoles in the pseudogeographic parameterization of a sphere.

Pseudoparallel

The parametric curve (circle) $\varphi' = const.$ in a plane perpendicular to the Z' axis of the pseudogeographic parameterization of a sphere.

Scale, linear

Also: scale factor

The ratio of the differential of the arc length in the plane of projection and the corresponding differential on the surface of the Earth or a celestial body, assumed to be an ellipsoid or sphere.

Note: Linear scale varies from point to point on a map, and is different in every direction in any given point, which is why we differentiate: linear scale along the meridian, linear scale along the parallel, linear scale along principal directions. If at some point in a certain direction there are no linear distortions, the linear scale is equal to the unit.

See: directions, principal

Fr. échelle des longueurs

Ger. Längenmaβstab

Surface, developable

The surface that can be developed into the plane (cone and cylinder) into which the points are projected from the globe or ellipsoid surface in perspective conic and cylindrical projections.

See: projection, perspective

Fr. surface auxiliaire de projection

Ger. Hilfsabbildungsfläche

System, geographic coordinate

The coordinate system on a sphere defined by the geographic parameterization of a sphere.

System, pseudogeographic coordinate

The coordinate system on a sphere defined by the pseudogeographic parameterization of a sphere.

System, UTM (Universal Transverse Mercator) coordinate

Sixty systems of the transverse Mercator projection with each of them covering the area of six degrees of longitude. The point of origin in each system is in the intersection of the central meridian with the longitude 3°, 9°, 15° etc. and the equator. Linear scale along the central meridian is 0.9996.

See: projection, transverse Mercator

Fr. projection UTM

Ger. UTM-Abbildung

Vertical

Every great circle on the sphere passing through the pole of the adopted pseudogeographic coordinate system.

Remark: In astronomy, great circles on the sky sphere passing through zenith.

Fr. cercle vertical

Ger. Netzmeridian; Vertikalkreis

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