# Misunderstanding Map Projections

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## Abstract

The idea for this paper comes from the book Understanding Map Projections by Melita Kenedy, published by ESRI in 1994, 1997, 1999 and 2000, and a book of the same title by Melita Kenedy and Steve Kopp, published again by ESRI in 2001. The same 'understanding map projection' theme is found in Open Source GIS: A GRASS GIS Approach by Markus Neteler and Helena Mitasova, the third edition of which was published in 2008 by Springer. In fact, there are similar approaches in almost all books, e-books, lecture-notes or articles published on the web dealing with map projections.

Everyone knows that a map projection is used to transform a curved Earth surface into a plane (flat sheet of paper or computer screen). Direct projection of a spherical object onto a plane cannot be performed without distortion. The first misunderstanding in publications on map projections is that the most common approach is projecting the sphere or ellipsoid onto a developable surface such as a cylinder or a cone, which can be developed into a plane without deformation (tearing or stretching). The concept of developable surfaces is very common, but it does not correspond to reality, because only a few map projections are really mappings onto a developable surface. In general, map projection is the mapping of a curved surface, especially the sphere or ellipsoid, directly into a plane.

Many different projections have been designed with the aim of minimising distortion and preserving certain properties. Developable surfaces can either touch the sphere or ellipsoid (tangent case) or intersect it (secant case). Based on the geometry of the developable surface, projections can be divided into cylindrical, which transform the spherical surface to a tangent or secant cylinder, conic, which use the tangent or secant cone, and azimuthal, which use a tangent or secant plane (flat sheet). The last sentence is again a misunderstanding. Firstly, a map projection is not a projection onto a developable surface, in general. Secondly, is a plane a developable surface? How can azimuthal projections with several standard lines be explained by using a secant plane? Thirdly, what are the developable surfaces in pseudocylindrical, pseudoconic, or polyconic projections?

The points or lines where a developable surface touches or intersects the sphere or ellipsoid are called standard points and standard lines with zero distortion (e.g. standard parallel for a tangent cone or two standard parallels for a secant cone). This is the third misunderstanding. In general, the lines where a developable surface intersects the sphere or ellipsoid are not standard lines, i.e. lines with zero distortion.

Keywords: map projection, developable surface, standard line