Misunderstanding Map Projections

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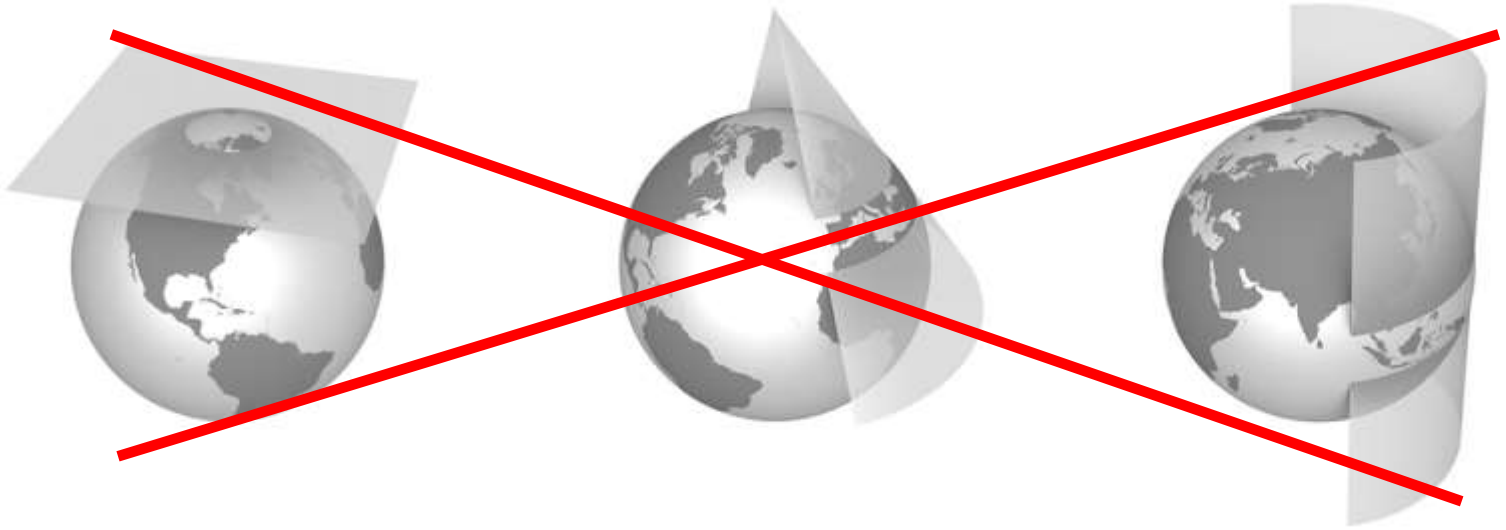
Understanding Map Projections by Melita Kenedy, published by ESRI in 1994, 1997, 1999 and 2000, and a book of the same title by Melita Kenedy and Steve Kopp, published again by ESRI in 2001.

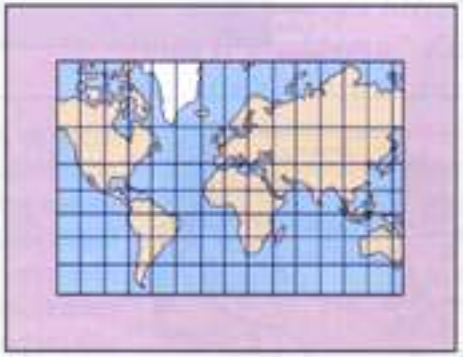
The same ‘understanding map projection’ is found in *Open Source GIS: A GRASS GIS Approach* by Markus Neteler and Helena Mitasova, the third edition of which was published in 2008 by Springer.

And in almost all books, e-books, lecture-notes or articles …

3 misunderstandings

1st misunderstanding:
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 distortion (tearing or stretching).



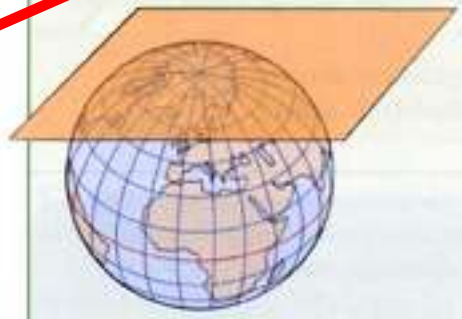


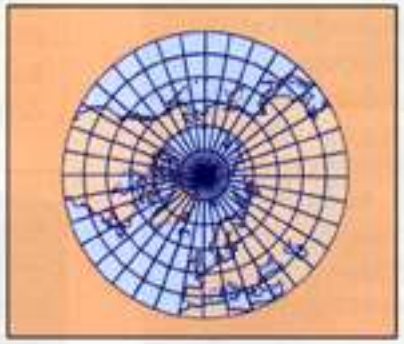
Valjkasta projekcija

Valjak dodiruje globus na ekvatoru. Tamo su površine najvjernije, a na polovima su najizobličenije.

Stožasta projekcija

Stožac dodiruje globus na jednoj paraleli. Tu su površine najtočnije prikazane. Dijelovi stošca koji su više odvojeni od globusa, više su i izobličeni.





Horizontalna projekcija

Ravna ploha dodiruje globus u jednoj točki. Što su površine udaljenije od te središnje točke, to su izobličenije.

Map projections are mathematical procedures that enable the mapping of the earth's or other celestial bodies' curved surface to a plane.

The theory of map projections is often referred to as the mathematic cartography.

The goal of studying map projections is the creation of mathematical basis for making maps and solving theoretic and practical problems in cartography, geodesy, geography, astronomy, navigation and other related sciences.

http://ica-proj.kartografija.hr/home.en.html

Some projections of the azimuthal, cylindrical and conic families have a direct geometric interpretation as light rays projected from a source intercept the Earth and, according to laws of perspective, "draw" its features on a surface. The latter may be a plane, yielding the map itself, or an intermediate shape like a cylindrical or conical shell.

http://www.progonos.com/furuti/MapProj/

On the other hand, many projections are only distantly inspired by geometric principles. For instance, Mercator's cylindrical projection can't be visualized as a perspective process unless:

- light rays don't follow straight trajectories, or
- the light source is not a point or straight line, or
- the projection surface is not a simple tube

In all three cases the complexity negates the usefulness of a perspective model. Indeed, many projections have simply no geometric or physical interpretation, and are described purely by mathematical formulae. I.e., the cartographer devises a spherical-to-flat mapping according to some desirable but arbitrary property or constraint.

2nd misunderstanding:
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).

Map Projections

Map Projection Classes: Introduction

Introduction | Earth's Graticule | Map Projection Properties | Map Projection Classes | Using Map Projections

Introduction | Cylindrical Projections | Planar Projections | Conic Projections | Pseudocylindrical (Oval) Projections

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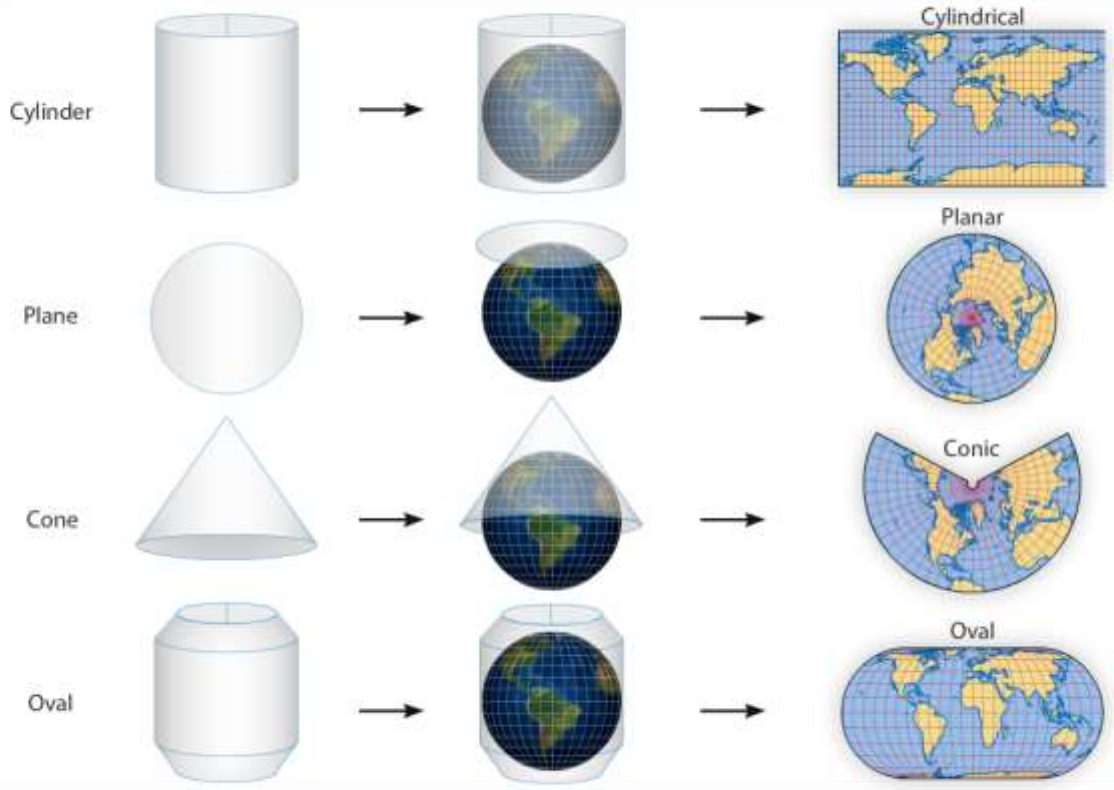

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DES KÖNIGLICH PREUSZISCHEN GEODÄTISCHEN INSTITUTES
NEUE FOLGE. № 52

KONFORME ABBILDUNG DES ERDELLIPSOIDS IN DER EBENE

VON

PROF. DR. L. KRÜGER
ASSISTENZ-HILFSARBEITER AM KÖNIGL. PREUSSISCHEN GEODÄTISCHEN INSTITUT

POTSDAM

DRUCK UND VERLAG VON B. G. TEUBNER IN LEIPZIG
1912

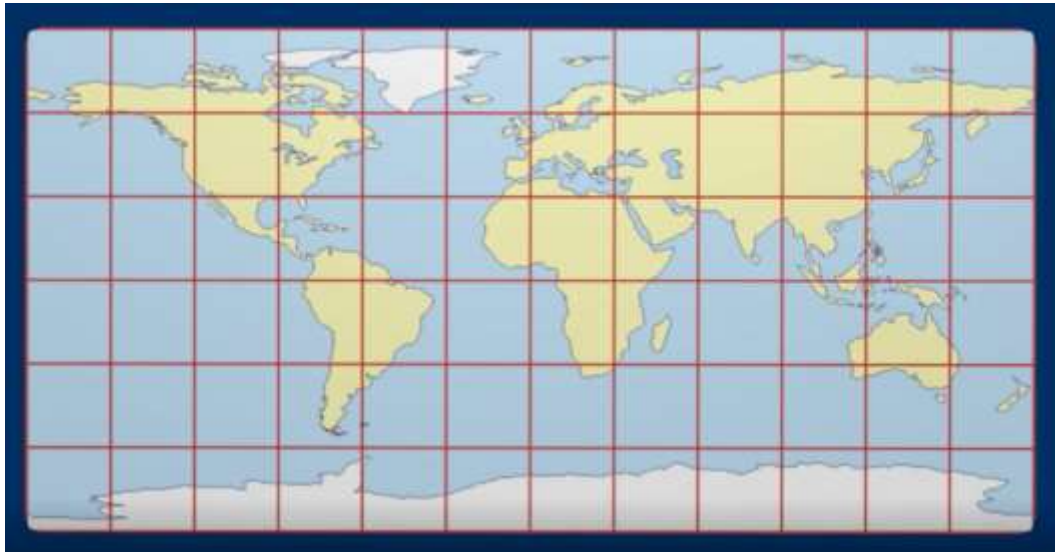
Lee, L. P. (1944): The Nomenclature and Classification of Map Projections, Empire Survey Review, No. 51, Vol. VII, 190–200.

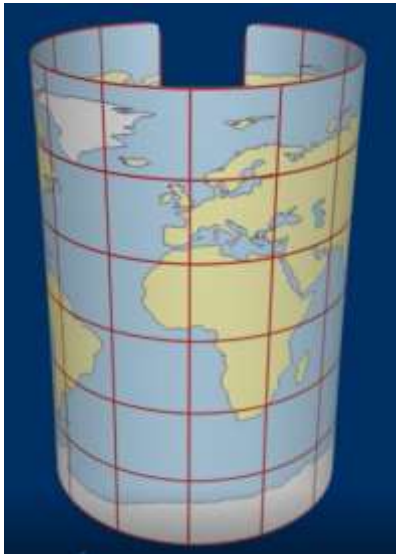
Cylindric: projections in which the meridians are represented as a system of equidistant parallel straight lines, and the parallels by a system of parallel straight lines at right angles to the meridians.

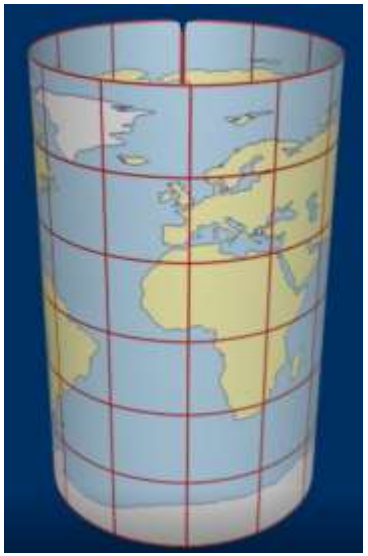
Conic: projections in which the meridians are represented as ...

Azimuthal: projections in which the meridians are represented as ...

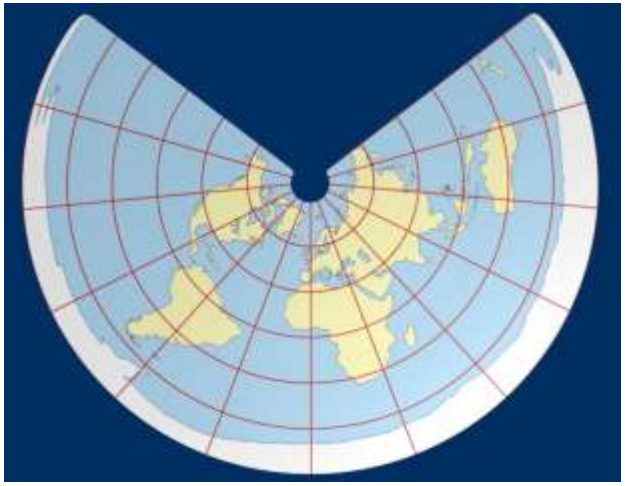
No cylinders, no cones, ... ?!

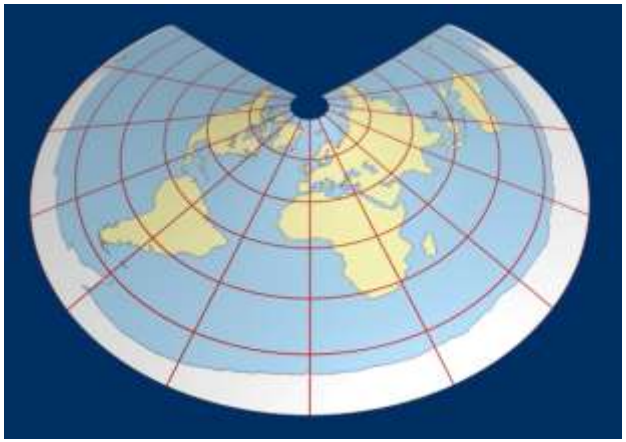


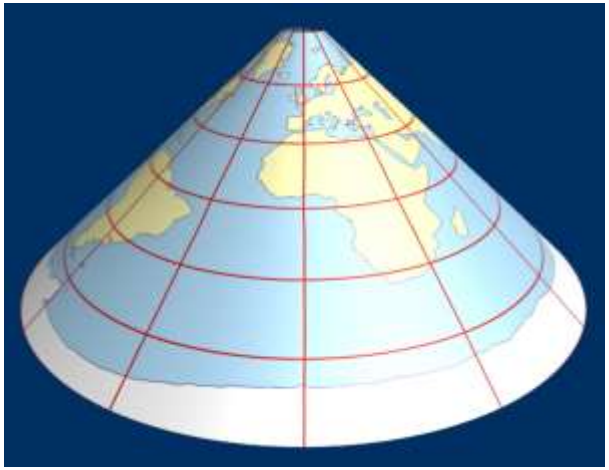




Contributions to the Use of Mathematics and its Applications







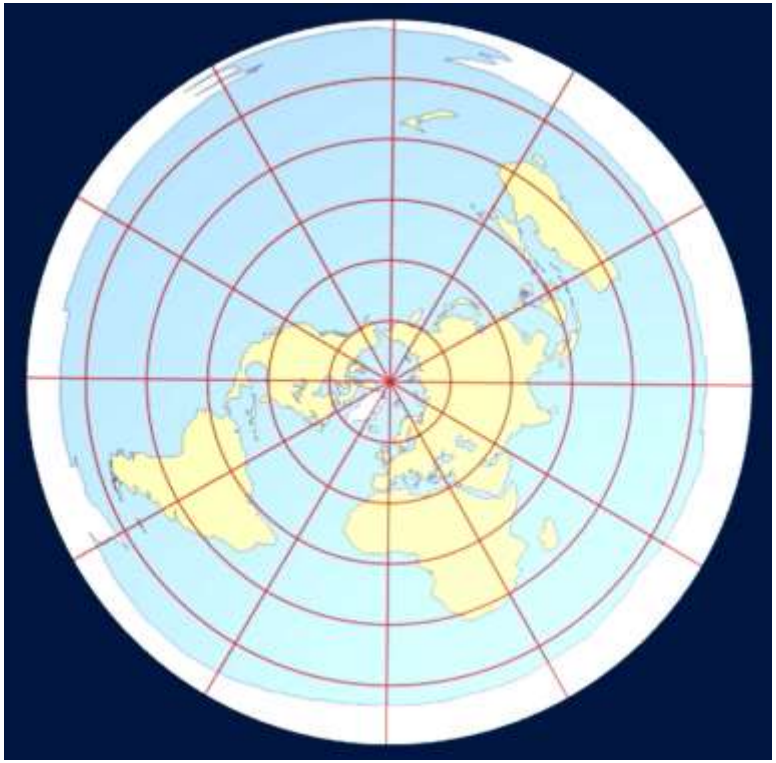
Close, C. F. and Clarke, A. R., (1911): Map projections:
Encyclopaedia Britannica, 11th ed., v. 17, p. 653-663, reprintings to 1960

Conical projections are those in which the parallels are represented by concentric circles and the meridians by equally spaced radii. There is no necessary connexion between a conical projection and any touching or secant cone.

The name conical is given to the group embraced by the above definition, because, as is obvious, a projection so drawn can be round to form a cone.

"No reference has been made in the above definitions to cylinders, cones or planes. The projections are termed cylindric or conic because they can be regarded as developed on a cylinder or cone, as the case may be, but it is as well to dispense with picturing cylinders and cones, since they have given rise to much misunderstanding.

Particularly is this so with regards to the conic projections with two standard parallels: they may be regarded as developed on cones, but they are cones which bear no simple relationship to the sphere."



Developable surface?

Prof. Dr. of the Faculty of Electrical Engineering and Computing (Zagreb):

„In addition to cylindrical surface, projections can be obtained by using conical surface, pseudocylindrical and sinusoidal surfaces, and planes.”

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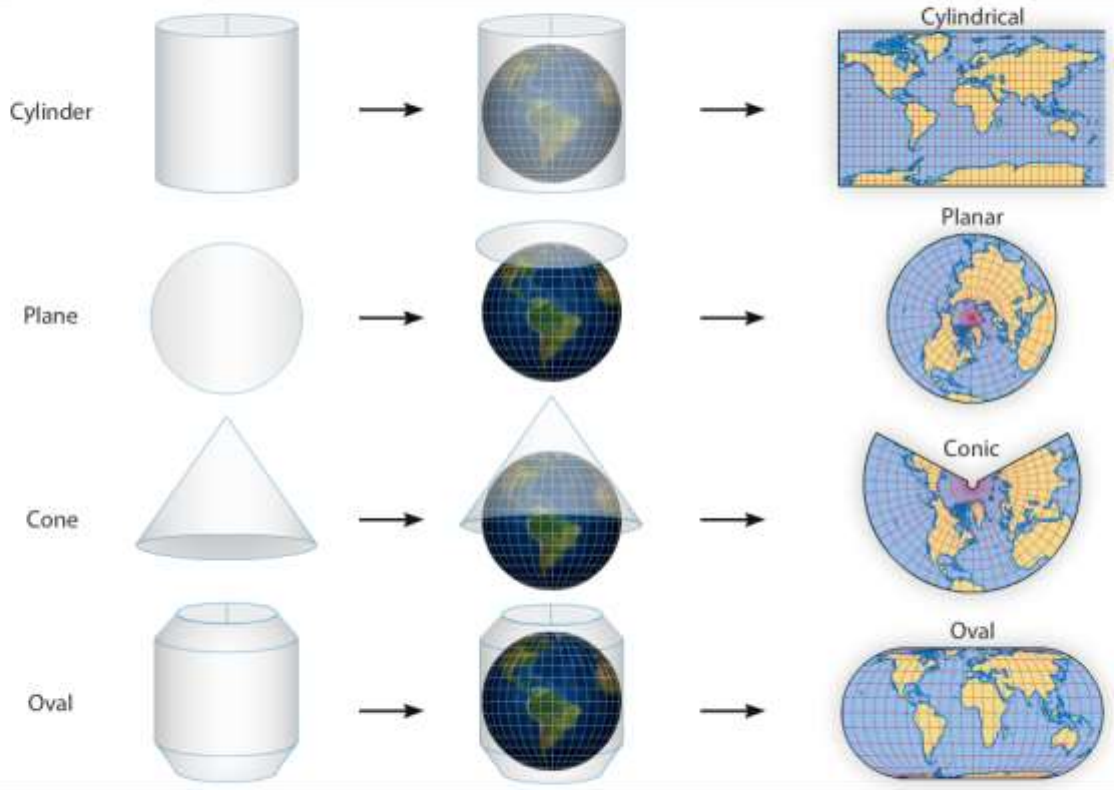

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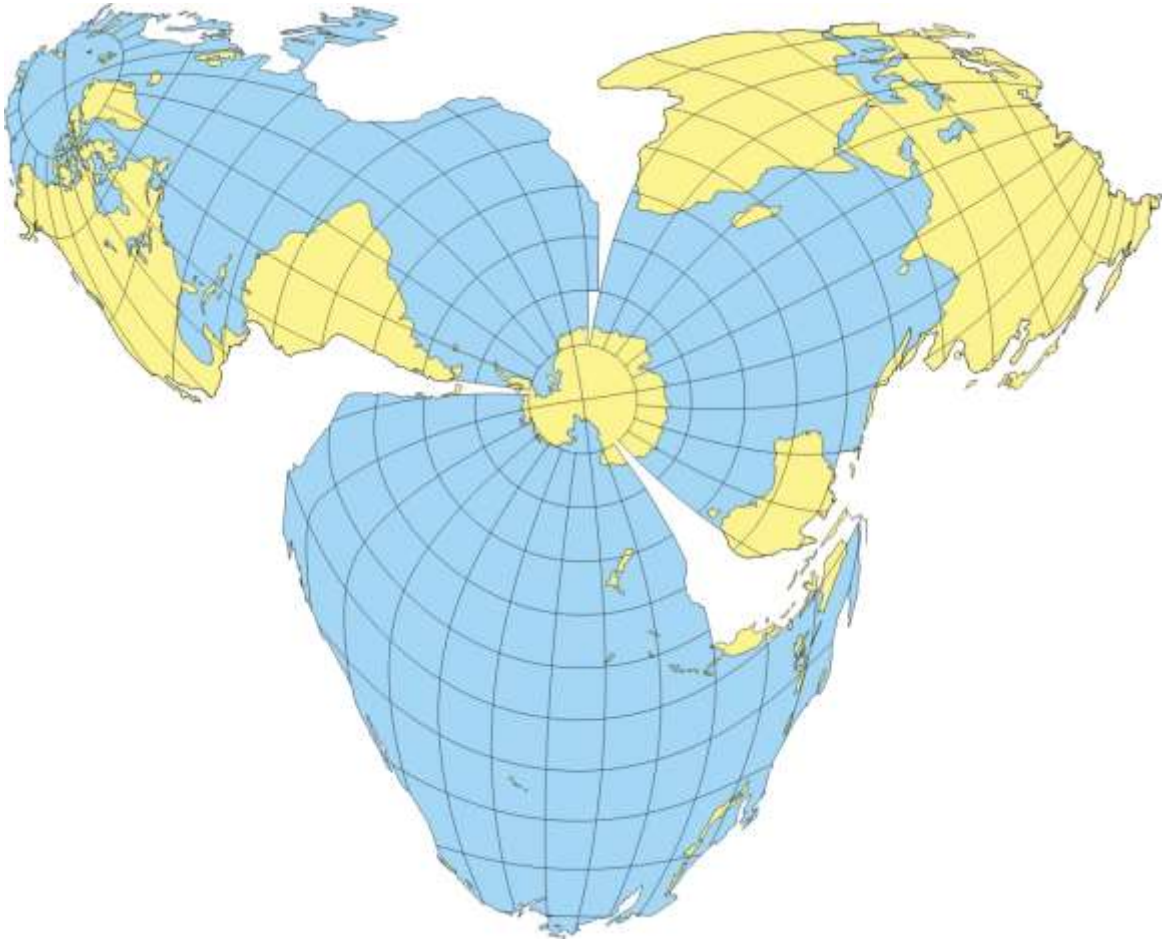
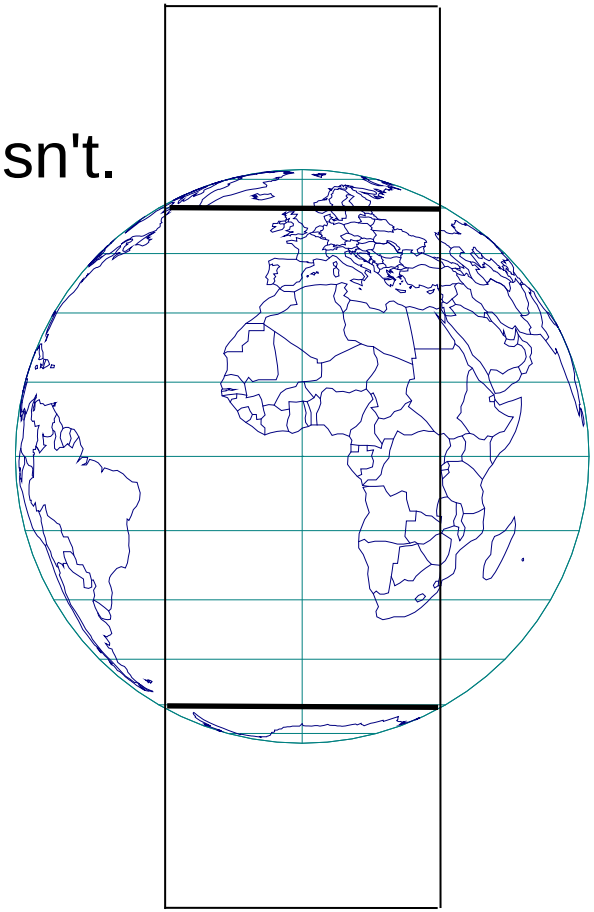


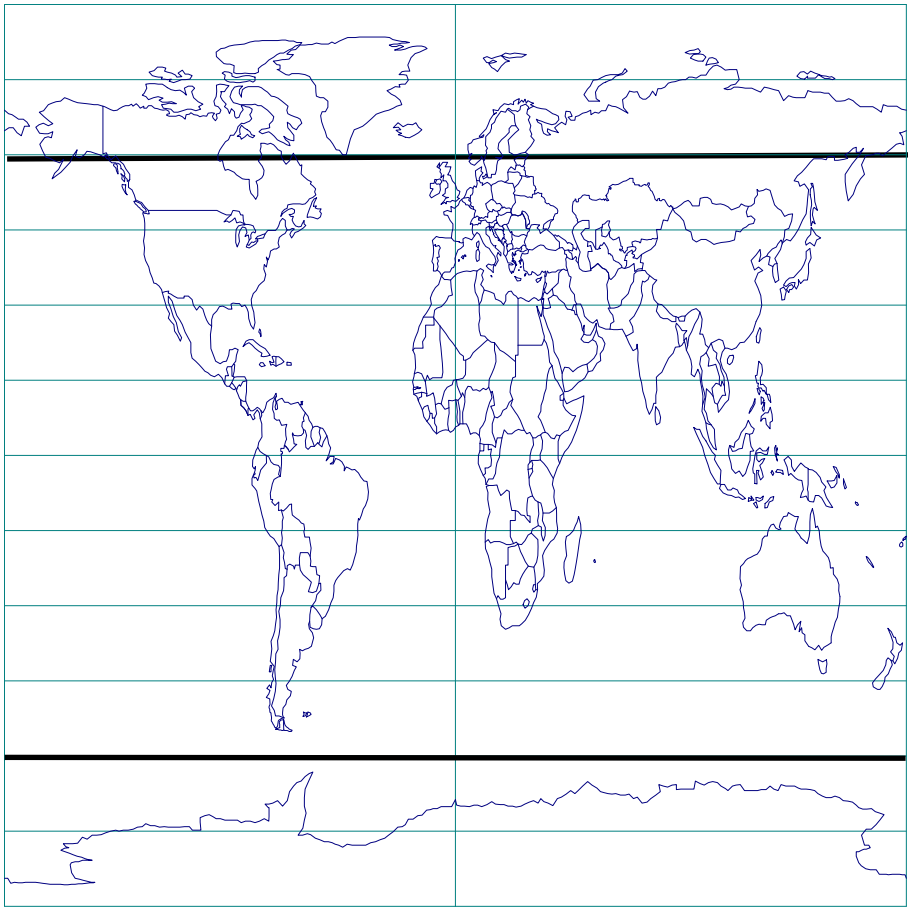
Pseudosomething ...

3rd misunderstanding:
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)

Is the normal aspect of equidistant cylindrical projection with two standard parallels a secant projection?

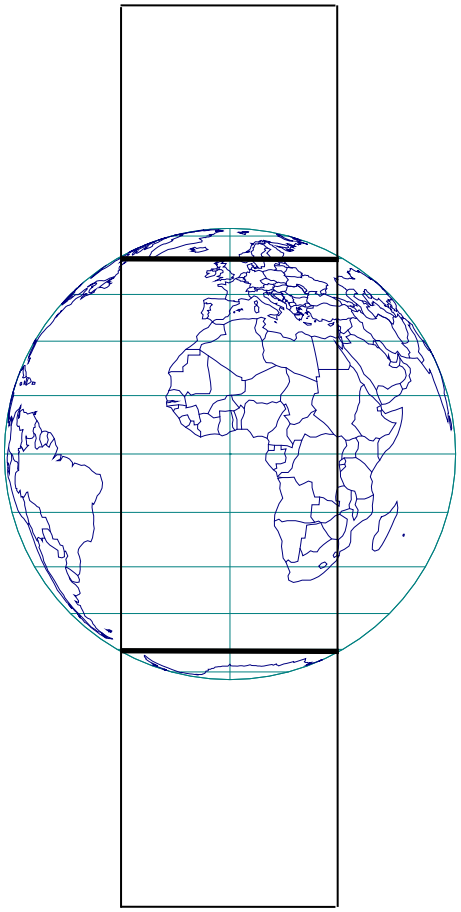
No, it isn't.

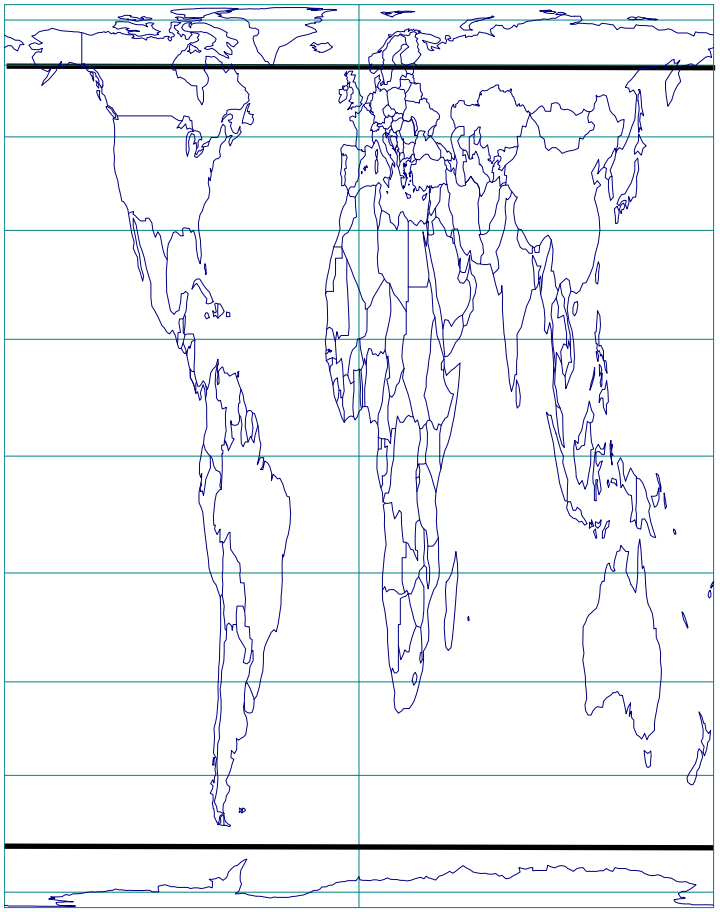




Is the normal aspect of equal-area cylindrical projection with two standard parallels a secant projection?

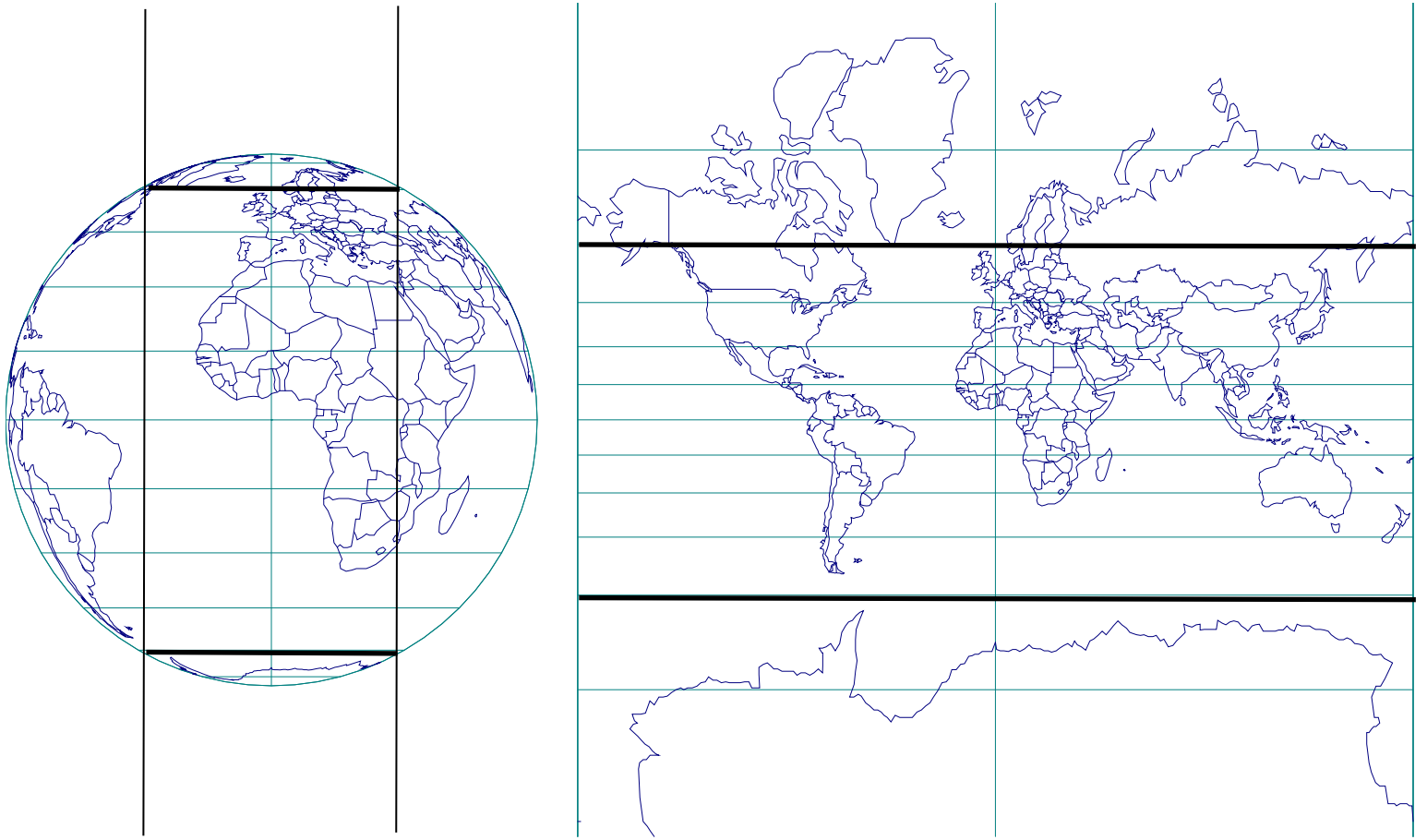
No, it isn't.

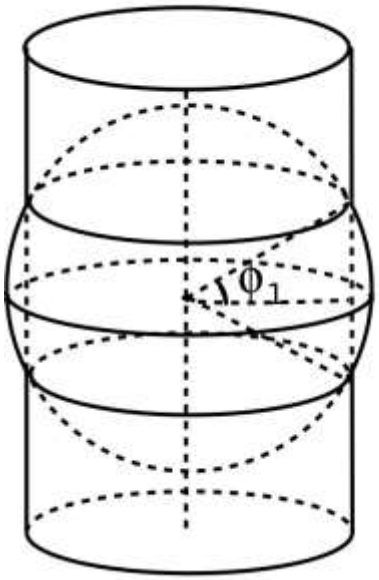


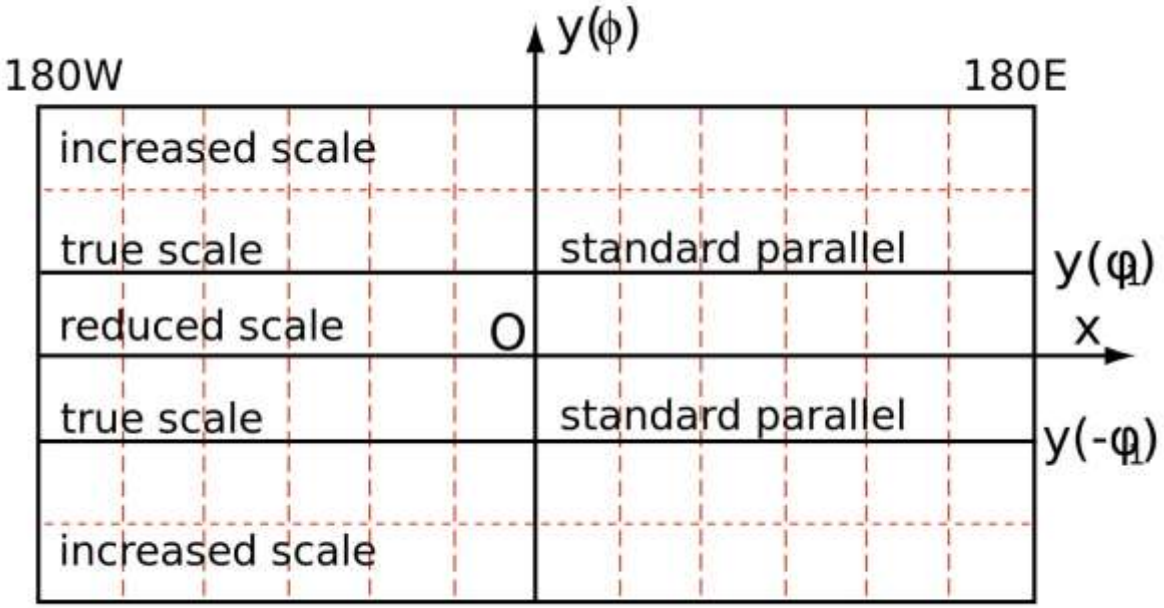


Is the normal aspect of Mercator projection with two standard parallels a secant projection?

No, it isn't.

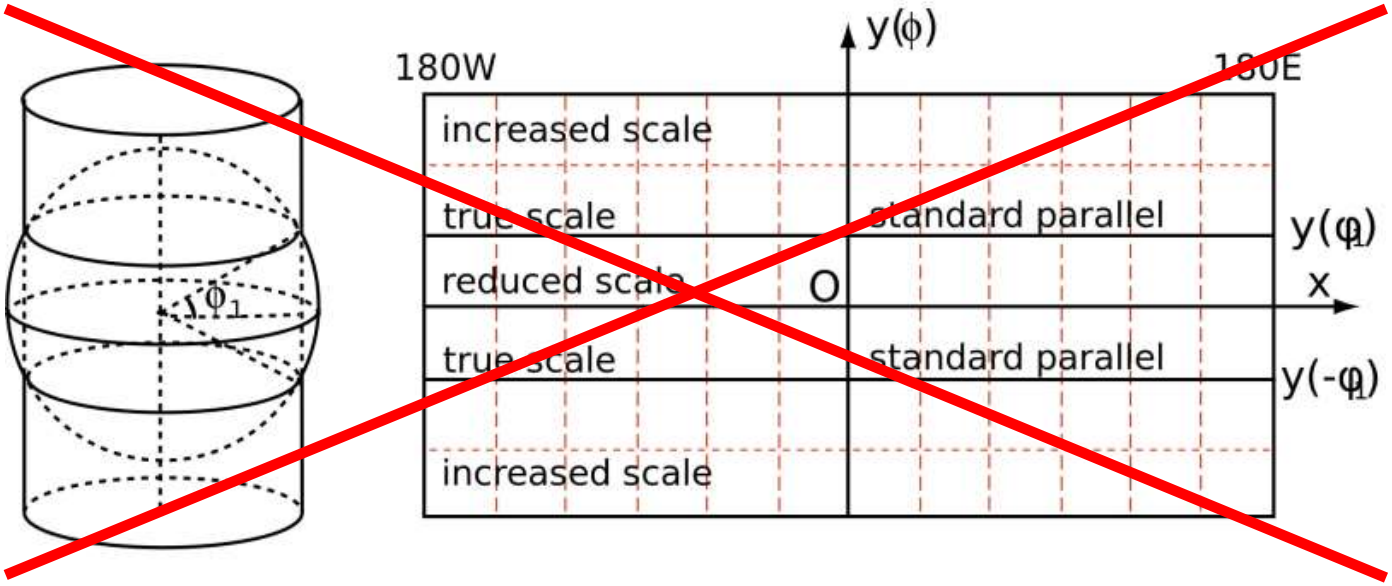






The usual erroneous illustration: standard parallel is at the same time secant parallel in normal aspect cylindrical projection. Source: Wikimedia commons (2016)

Please remember



Let us remember

It is not wise to use intermediate surfaces in the interpretation of map projections in general because:

- Most map projections in its definition do not have an auxiliary or developable surface
- The application of the auxiliary/intermediate surface can lead to the wrong conclusion about the distortion distribution (standard parallels)
- The application of a non-developing surface as an intermediate is out of question, because a spere is a non-developing surface!

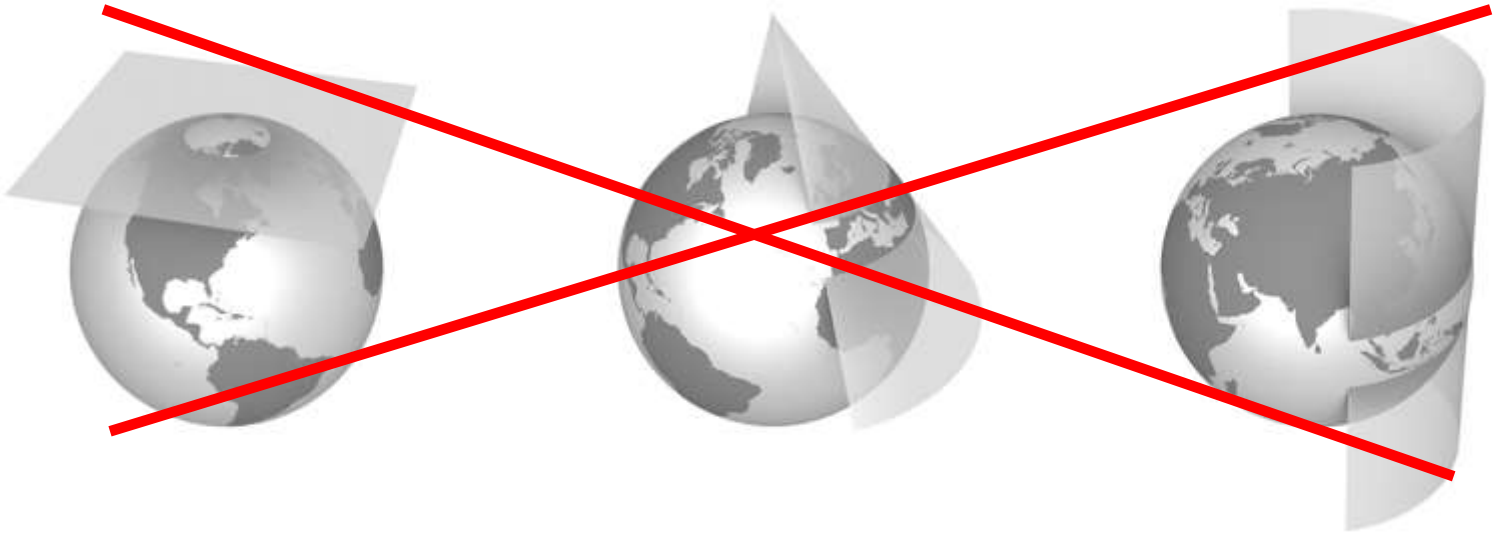
Conclusion

1. In the field of map projections, *we do not need* anything that not corresponds to the actual mathematical projection methods.

2. *We do not need* definitions that are conceptual and that not correspond to the reality, or that are not correct.

3. Generally speaking, secant cone, cylinder, and plane *should not be used* in map projections, because they usually give a wrong impression of what is really happening.

Thank you!



Critically think and never trust the professor!