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Article:

Fundamentals of Geo-Positioning Reference Frames, Map Projections and Their Applications

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1.Abstract:

A map is defined as a miniature drawing of the Earth's surface or part of it. The designation was based on many projections used to transmit information from reality to the map, and this would be in the processing of geospatial information. The maps were developed by Greek and Roman circa 2300 BC, and were preserved on Babylonian clay tablets. Since that, it has been adopted to transfer the natural data to a map but it is necessary to use the projection types of the map which including cylindrical projection, conical projection and flat or azimuth projection. These three types are illustrated by explanation and some images of detailed explanation of each species. As such, there are still flaws in the map forecast and reference system, but they must be used strictly to overcome these defects and produce a correct map to use.

Keywords: Geo-positioning, Reference System, Reference frame and Map projections.

2-The research problem:

The study problem illustrated the lack of awareness of the effective role of geographic information systems and its various programs in designing digital maps and being satisfied with relying on algorithmic calculations and merging positioning with map design using projections in geographic information systems, in addition to the lack of nationally approved standards for geographical reference, reference system and metadata. There is a noticeable decrease in the use of digital technologies for the production of maps, and the necessity of establishing stable and complete digital databases in spatial analysis, a prediction and map reference system, and a special coordinate reference system to be available to all users. In addition to the need to propose clear strategies for users of geographic data and to give special consideration to the “geocoding” system as it is the point of connection between demographic information and its location on the ground, in addition to the need to raise awareness of the responsible authorities in national statistical offices supporting geographical initiatives, to provide technical and methodological information that helps in Utilizing the power of geographic information systems and other geospatial technologies in updating projection processes and determining the best approved technical strategy for selecting projections and determining the scope of geographic reference use in coordinate transfers, changing projections, and obtaining better results and analyzes to develop databases for geographical features in order to create an integrated and stable base for digital maps "

3-The purpose of the research:

1- Knowing the meaning of the projection, its types, and the aims of its using to recourse a geographical result that can be relied upon in other geographical studies.
2- The projection requires familiarity with the geographical and astronomical location of the diameter to be drawn and projecting its map with the appearance of acceptable distortions in

the cartoon work, and knowledge of the coordinates used in the work to reach the completion of the work.

3- Mastering the use of known (cartesian or polar) coordinates and the degree of accuracy by applying mathematical relationships related to that projection and the degree of representation of coordinates on the map

4- The relationship between the axes of planar coordinates and geographical coordinates and their rotation in order to determine the location of any point on the surface of the Earth that has a spherical shape.

5- The small scale maps and works that require high accuracy, identify large scale maps and find out the reasons why geographical coordinates are insufficient for this.

4-The research methods:

Historical method:

Some references were used to present what is related to the history of previous geographical studies and the beginnings of their establishment, from the beginnings of manual drawing of some of the areas they visited, and then creating paper maps based on the projections.

Descriptive method:

The basic approach in the research, which was used to describe the basic projections of the maps that the geographers relied on, which they used to create paper maps and compare their three types, is considered the best for producing the map and the importance of the prediction and reference system for the map and the coordinate reference system.

5-The importance of research:

This study is one of the important studies that benefit the learner of geography, especially the study of maps and their projections, which are useful in identifying the difference between the types of projections, as well as the reference system and reference for the events on which the map depends, whether digital or paper.

6-Research sources:

Many of the references that were mentioned at the end of the research, which were the main source for obtaining the required information that the researcher reported in writing this research.

7-Previous studies:

- **Foreign Studies**

1- Lapaine and User (2014), a projection aspect is the appearance and position of a graticule image in the projection plane. Aspects can be polar, equatorial, normal, transverse and oblique

2-Richard Patrillo's study (1999) deals with analyzing and critiquing the cartographic representation of Spanish atlases and their impact on mental images formed about Spanish influence in the world.

3-Verna Nesses study (1998) The study deals with the use of atlases and maps in the classroom and their role in developing the skills of geographical analysis, reading and cartography.

4-A study of the cartography by Ciaran Birnam (1993) dealing with the role of multimedia in the cartographic presentation of the educational atlas and its importance in geographic self-education

5- A study of cartography Imhof (1948) on the Swiss school atlas of general education, which is a study, criticism, and analysis of the atlas and comparing it to educational atlases in Germany, the United Kingdom and France.

- **Arabic studies**

1-Nasser Muhammad Salma's study (1998) on the importance of the school atlas in teaching geography in general education stages

2-Ismail Youssef's study (1999), design and analysis of atlases, where he included samples of some questionnaires used in analyzing atlases and traditional tests

3-Al-Ta'i Subhan Arab Hamadeh's study (1992) on distortion in projections and their coordinate systems. The study was conducted to limit the distortions resulting from the projection

process on the flat surface of the natural surface and the emergence of the required map.

8. Introduction:

A projection aspect is usually defined in references as the relation to the so-called auxiliary surface. However, such surfaces do not usually exist in map projection theory, which raises the issue of defining projection aspects without reference to auxiliary surfaces .Nowadays, map becomes one of the most important methods which represent the earth in order to identify the human where they are. The map can be defined as a miniature 'picture' represents the earth as the scale of model of spatial objects including an area of land or sea with physical features such as roads, rivers, cities etc. It could be the most important part of human day-to-day because it assimilates the world in a small picture which for example used as a tourist guide. Additionally, from the Greek and Roman era the maps have been developed through they were maintained on Babylonian clay tablets about 2300 B.C. Since then, the spherical concept of civilizations land by scientists Greeks and rather a period of Aristotle and this was during 350 B.C. After that, the people started to make drawings of the geography of the desired areas on flat surfaces used several methods for drawing such as stones or on woods. Then the developing of the map can be printed on the paper to be easy using and carrying.

Figure 1: Ptolemy's World Map

A 15th-century manuscript copy of the Ptolemy world map, reconstituted from Ptolemy's *Geographia* (circa 150), indicating the

countries of "Serica" and "Sinae" (China) at the extreme east, beyond the island of "Taprobane" (Sri Lanka, oversized) and the "Aurea Chersonesus" (Malay Peninsula). (http://en.wikipedia.org/wiki/Map_projections)

A mathematician, astronomer, geographer, astrologer, and poet named Claudius Ptolemy for about five centuries later (AD 90 – AD 168) developed the projection principles. In geography Ptolemy's basic work known as *Geographia* that related to the collections of the world's geography during Roman Empire through 2nd century (Wikipedia, Ptolemy, 2011). However, the coordinates were illustrated in Ptolemy's Geographia which represented the entire place and the geographic features that were known for Ptolemy in a grid extended over the world. Measurements of latitude were carried out from the equator putting the meridian of 00 longitude at the most western land accessible. In this time, Ptolemy's Geographia started to be printed with engraved maps, and many studies were conducted later on to give improvement to its quality in the 15th century. At the end of the 18th century, the highly precise longitude could be achieved. Therefore, the map accuracy was increased to be more factual from the Mercator's time which is using extensively in navigation charts as well as the universal maps to around 19th century. On the other hand, the ground observation and remote sensing both are modern technologies which using in order to capture images to make maps. Also, Geo-positioning is one of the most important methods of commissioning a point on the terrestrial surface or in the celestial sphere a specific location (a set of coordinates). Although maps become most popular in these days, most of the people identify little information about the world or none of them know any idea. Thus, the map in this world, the human cannot be dispensed without it especially for traveling which becomes much easier than before. This essay outlines the reference system, the implementation of reference system, celestial and terrestrial reference frame, cartestian coordinate transformation, reference frames in geodesy and map projections.

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Figure 2: Stock photo: -World Map-From Wikipedia, the free encyclopedia

9. Reference system

Initially, there is several differences knowledge about the earth's shape started from circular Pythagoras 6th Century BC to smooth mythically in the middle Ages and finally to our ideas, the main understanding through our what we know about the Earth, it is spheroid shape and also its irregular surface. However, the common shape of the Earth has been arranged in more recent centuries. In order to know the general shape for the Earth, first require for coordinate reference system all coordinates, which defied as a set of system that explain how a certain point or object will be appoint a set of coordinates (Junkins & Garrard, 1998). By beginning the zero point for the system an origin agree to measurement of linear distances. Reference system can be defined as a set of prescriptions and conventions together with the modeling required to define at any time a triad of coordinate axes. Through the origin the axes are used to identify reference lines on the reference frame and pass it. Thus, objects position could be described by distances from the origin and matching angular displacements from the reference lines or axes. These conventions consent to the axes of the

coordinate reference system and the origin to be fixed to the accepted mathematical model which can be used for any applications. The reference can achieve by a reference ellipsoid. As a result, there are two types of coordinates one is Cartesian (x, y) and the other will be spherical coordinates (r, Ø) which are a great example related to the transformation (NIMA, 2000).

$$r = \sqrt{x^2 + y^2} \quad (1)$$

$$\theta = \sin^{-1}\left(\frac{z}{\sqrt{x^2 + y^2 + z^2}}\right) \quad (2)$$

$$\theta' = \arctan\left|\frac{y}{x}\right| \quad (3)$$

For instance, regard as two dimensional in order to draw point on the paper should use Cartesian coordinate system. The two axes will be the x- and y-axes which are drawn at right angles to each other in order to identify the origin, the point of junction with the x- and y-axes (Junkins & Garrard, 1998).

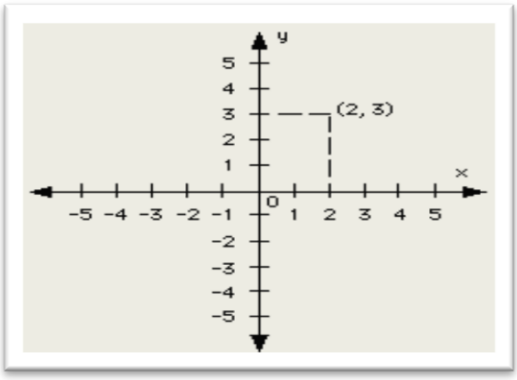

Figure 3: 2D Cartesian coordinate system

It is clear that the figure above illustrate the two-dimensional coordinate systems for Cartesian coordinate system, a point is graphed depend on its location along overlap via the vertical and the horizontal axes which representing as axes x and y.

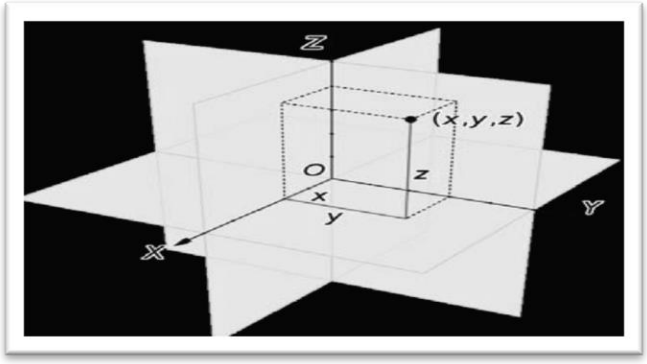

Figure 4: 3D Cartesian coordinate system

In the Cartesian coordinate system with the three dimensional, the coordinate must have three points involve axes (x,y and z) with the horizontal reference having the x and y axes and a vertical reference having the z axis.

The reference system is limiting as algorithms, models, conventions and a collection of geometric principles in order to concern with coordinate system. Thus, this could be helpful for understand how the coordinate has the complete specification format. On the other hand, this coordinate method may is not accessible to any users (Meuller, 1985). In order to generate special a coordinate reference system to be available for all the users, a coordinate frame system have to create identical coordinate reference system (Meuller, 1985).

A reference frame can be defined as realizes the system by coordinate clearly points that could be accessed to them directly by observation. Because of the earth is irregular surface, the coordinate frame is used in order to cover the ellipse and it also called a datum. Therefore, the simple way for understanding the coordinate reference system, related to the lecture about the reference system (Wang, J. 2013 lecture 3) it is defined by:

- Location of the origin.
- Orientation of the fundamental plane (e.g. X,Y-plane)
- The principal direction (e.g. X or Z-axis), and

- Geometric principles or rules (e.g. orthogonal Cartesian)

An example for frame system is a group of points that divide on the world coordinate with numbers in the reference system. That is, a frame system related to physical coordinate system describes the real coordinate values of the real points which could be accessible for all users. Other example which more popular adapted from the coordinate is WGS84 Coordinate System, this system known as World Geodetic System 1984 (WGS84) which is used as the Global Positioning System (GPS) by a large number of people around the world.

10. Reference Frame (Datum)

Reference Frame may refer to a coordinate system used to represent and measure properties of objects such as their position and orientation or it could be a system that uses coordinates to establish position. An example is a set of distribution points with their coordinates system which include the numbers related to the reference system. It is known that the frame is the realization of physical system recognizes by the coordinates values of real points that could be accessible to anyone. Also, it cannot obtain without a system as well as the system value will not define without a frame so it related to each other. Reference frame is usually needed because the earth is neither a perfect sphere nor an ellipsoid and this type can be used if it has be realized the geodetic Reference frame or Datum. Reference Frame can describe via several major properties such as an origin, reference lines and reference planes. For the origin In order to be useful for measuring linear distances, a reference frame must have a reference point of origin that set up the zero point for the frame. In addition, reference lines should be found in order to provide the great meaning and a zero reference to angular numbers. Beside the reference lines, angular measurements need to find out the description of planes in which angles are to be measured. On the other hand, a moving frame is referring to reference frame that moves with body and it can translate and/or

rotate. A reference frame is fixed or moving with a constant velocity, whereas it is an inertial frame.

For making an accurate map should defined a real datum for the points that collect on the earth surface. The coordinate of the datum defined the reference system by identify the horizontal and vertical datum. As is well known, from the equator the world is bigger than the poles and the datum in the modern ideology is defined by create an ellipsoid and major reference point. For example, North American Datum of 1927 uses the Clarke 1886 ellipsoid to represent the major reference point, and the subsequent (NAD 83) that a geocentric origin is used in North America. On the other hand, the (OSGB36) which refers to Ordnance Survey Great Britain of 1936 depend on the Airy 1830 ellipsoid, while in the United Kingdom the International Ellipsoid (1924) datums use and the European Data of 1950 (ED50) depend on it. (WGS 84) is known as World Geodetic System in 1984 which global datum uses a geocentric origin depend on the GRS 80 ellipsoid and Doppler satellite imagery.
GIS refer to Geographical Information Systems and (SIS) refer to Spatial Information Systems which are described both systems related to the object's spatial coordinates to its properties which using a relational data base. Moreover, both systems are used spatial coordinates resulting from geodetic datum to take back linked information from a database. However, the GIS data represents real world objects which may be cataloged into moreover separate features as roads. The known about the data in Geographic Information system is represented the information by using vectors in order to display geographic features using geometric shapes.

11. Implementing Referencing systems and Reference frame

As described above the reference frame is a particular application by observation. The analysis of the theory of reference frames in physics came before coordinate systems. In this case, if the defining a particular point on the earth surface such as our location in

order to obtain the details, it should process this information and the position of reference which is concerned position at a particular point in particular time too. The collection of point is described by a database of geometric horizontal and elevation positions make available accurate calculation to be made.

In fact, the reference system cannot be used to extract the information to define the real location in the world but in order to apply; it has been realized datum or reference frame. There are several differences between the reference system and reference frame:

I. The reference system is known as mathematical system famous for the positions and velocity, while the reference frame the positions can be observed via using physical sites.
II. The reference frame apply the coordinate system in order to assist the users using to access to the points in real measurements time.
III. A coordinate system is simply a plot which helps to picture the vectors well. Reference frames assists to analysis the vector and solve the kinematics.
IV. Coordinate transformation in the reference systems can be helpful for the geographic data users in order to obtain the understanding of thematic data.
V. The reference system provides the reference frame for the term used in the model.

The creation has outdoor coordinate system which is thought of and assumed to have no rotation or is fixed while we have that orbits and rotates (Forbus, 1999). Of particular note, the Reference System is known as the ideal which has remained constant, however, the Reference Frame is known as the realized form that has evolved.

12. Terrestrial and Celestial reference frames

The reference system and reference frame normally used such as WGS84 which related to world geodetic system, for instant NAD

related to North American Datum is represent as 83(NAD83), and Geocentric Datum of Australia 1994 (GDA94) are in a cluster called Terrestrial Reference System and reference Frame (TRS) and (TRF). Both of the ITRS/F and ICRS/F are maintaining by the International Earth Rotation Service (IERS). A Terrestrial Reference System '(TRS) is a spatial reference system which refers to the Earth fixed. (TRS) and (TRF) are fixed the Earth rotation providing constantly unchanging coordinates for all locations. A Terrestrial Reference frame provides a set of coordinates of some points located on the Earth's surface. Also it called Earth Centre Earth-Fixed (ECEF) involves a mathematical model for a physical earth for each point in each position. The best reason for using the ITRF, it could be because it provides the most accurate global reference frame available and precise GPS orbits (from IGS) use it.

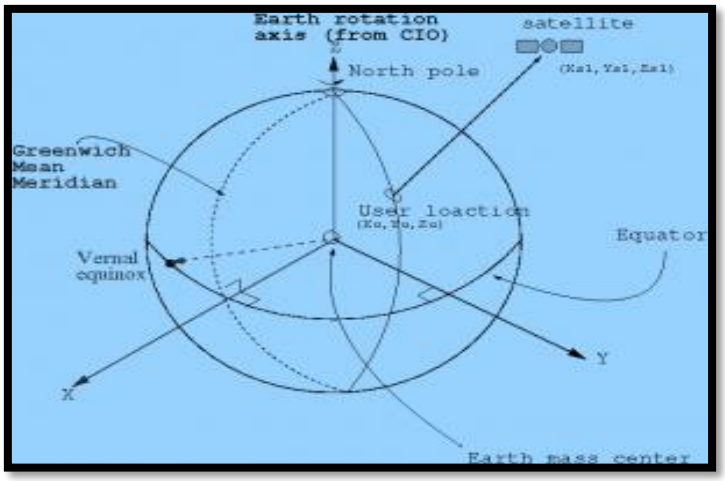

Figure 5: Terrestrial Reference System

On the other hand, the other form is related to reference system and reference frame that called the Celestial Reference system (CRS) and Celestial Reference Frame (CRF). CTS is determined from a set of precise coordinates of extragalactic radio sources, for example, it is fixed with respect to distant objects of the universe. The best Celestial Reference System (CRS) should keep in touch with the geocentric space coordinates of Bar Centric Celestial Reference System (CCRS). Now days, the International

Celestial Reference Frame (ICRF) identify by coordinates of a small point of at a half quasar and which of their position is the best. The rotation which is measured with respect to a frame tied to stellar objects, called a celestial reference frame. Components the ICRF a catalogue of 608 equatorial coordinates of extragalactic radio references fetched from around 1.6 million observations accumulated by worldwide network (Jonathan & Roger, 2008).

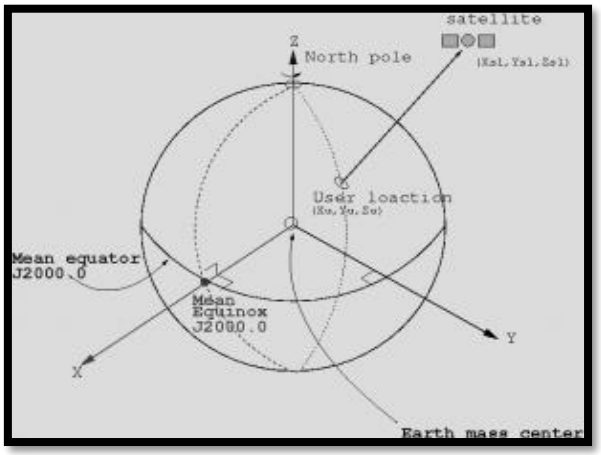

Figure 6: Celestial Reference System

According to the definitional of the IERS, the transformation model is given by:

$$\boldsymbol{x}_{\text{to}} = \boldsymbol{T} + (1 + D)\, R^{\text{T}}\, \boldsymbol{x}_{\text{from}} , \qquad (4)$$

where x is the coordinate vector of a point in the fram being transferred to of that same point in the fram being transferred from. the translation between frames is given by T and the difference D. the rotation represented by R^T which introduce the rotation from the new frame to the old frame. If the rotaition angles which refer to R_1, R_2 and R_3 are too small form will be as:

$$R^{\text{T}} = R_1^{\text{T}}(R1)\; R_2^{\text{T}}(R2)\; R_3^{\text{T}}(R3) \approx \begin{pmatrix} 1 & -R3 & R2 \\ R3 & 1 & -R1 \\ -R2 & R1 & 1 \end{pmatrix} , \qquad (5)$$

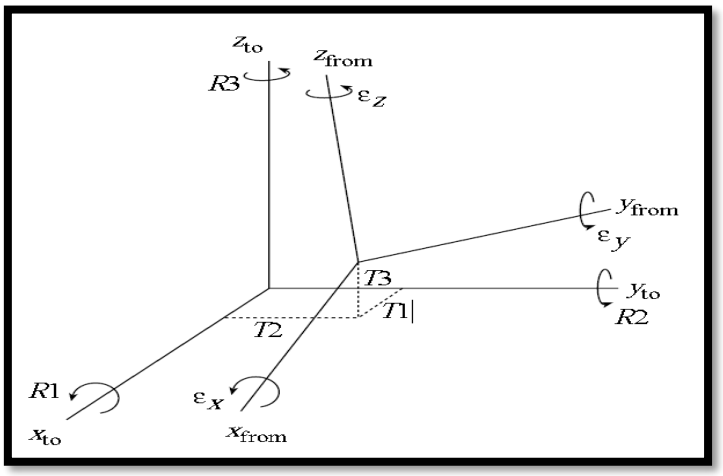

Figure 7: the transformation of IERS

13. Cartesian coordinate Transformation:

The coordinate transformation is used in order to transform coordinates in one system to coordinates in another system and get many form this include rotation, scaling and translation, using a GPS is a great example which receiver several datum more than other such as WGS84 [Marsden 2009]. In the same way, cartographers usually create transformations without repeat their surveying; however, a geodetic transformation outline translation of mathematical that change the coordinates of one coordinate system for one point in order to obtain point's coordinate in different system. At the inverse transformation which used to regress for the basic coordinate system to but the coordinate in the second. To achieve this type more than a few mathematical translations should need. Therefore, the geodetic transformation could not identify whichever specific formula. For achieving the result, the equations must be used in order to connect between the Cartesian coordinates which adapted from GPS to the impact of their velocities this could be via the changing of the coordinate's reference frame and their period.

Examples of transformations at one side of the axis, the geographical coordinates transform the map projections longitude and

latitude on ellipsoid to Cartesian coordinate on plane. The transformation of the two dimensional 2D occurs when the coordinate of the point in one triangular system (x, y) the transformation will be to another triangular system (X, Y). On the other hand, the transformation impact on a group of points via change place, orientation and scale. The types in 2 dimensions of transformations involve translations, scaling, rotation and shearing and these are main types of transformations which can be combined in order to obtain more complex transformations.

Projection representativeness of three-dimensional (3D projection), which is a drop my appreciation for the body three-dimensional form drawing two-dimensional, which is a means used newly mapping three-dimensional, and because most of the tools available to display graphical data in computer graphics is the means of two-dimensional, represents the three-dimensional graphics special coordinates display with shadow effects and others to make them see the trilogy. There are many ways in which the transformations occur. These transformations include local geocentric terrestrial (the center of the earth) and local geodetic frame.

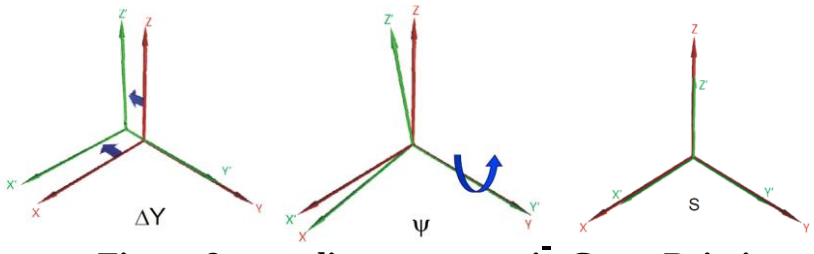

Figure 8: coordinate systems in Great Britain

As the figure above shown, the guide to coordinate systems in Great Britain (n.d), the Helmert transformation is a linear formula which operates on the basis that rotations about any axes is of a few degrees, uses vector notation to determine coordinates of each point in a new reference system B from those in an original reference system A by:

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix}_B = \begin{bmatrix} x \\ y \\ z \end{bmatrix}_A + \begin{bmatrix} \Delta x \\ \Delta y \\ \Delta z \end{bmatrix} + \begin{bmatrix} \Delta s & \omega & \psi \\ -\omega & \Delta s & \varepsilon \\ \psi & -\varepsilon & \Delta s \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix}_A \quad (6)$$

Where $\{ \Delta x, \Delta y, \Delta z \}$ represent translations along the x, y and z axes, $\{ \varepsilon, \psi, \omega \}$ represent rotations about the x, y and z axes and s is a scaling factor. Three-parameter (translation only or rotation only), four parameter (translation or rotation with scaling) or six-parameter (translation and rotation only) transformations may occasionally be required.

14. Map Projections

A medieval depiction of the Ecumene (1482, Johannes Schnitzer, engraver), constructed after the coordinates in Ptolemy's Geography and using his second map projection

A map projection is referring to method which used in cartography to show a two-dimensional curved surface of the Earth level.

Maps Flat cannot appear without the projection process and it could be more useful than spherical. Projection on the Earth in many cases such as is smaller and the possibility of storing easier, can be compatible with a large area of standards and the possibility to show on the computer screen easier. Scientists have invented them cartographer through the ages a lot of projections until today we have a few hundred of map projections. It cannot find a map drawn on a flat surface, the surface of the paper realized where all the elements of space, shape, the direction and distance correct its map.

Displaying curved features on a plane surface usually introduces distortions and therefore cartographers have developed a large number of projections that reserve the diverse properties of the physical realm (Graaf, 2003, p. 42). There are different properties of the real world that are using in different applications, the most important one is the conformal which related to the size of the point on the map be the same in any direction, and maintain the shape locally. The second is maintaining on the distance from the centre of the projection to any other location on the map and this known as equidistant.

The third will be about the area on the earth should be proportionate with the same area on the map. From one point on a line to any point on the map, the azimuthally angle should be maintained. As it known, the map projections properties include the map that the areas on it maintain the correct proportion to areas on the earth and this known as equivalency, and then this map also has contain the true scales in order to get true distance which called equidistance. In the same case, the shape must be the same as to the earth's shape and this could be related to conformity (Wang, J. 2013 lecture 6). It should be also includes the directions and bearing.

In general, the most important types of projections and the most widely used: Cylindrical projection, Cone Projection and Azimuthal or planar. The below points illustrate the three types:

❖ **Cylindrical projection:**

The map in this type can be drowning with longitude in vertical lines which can be created in the mind by think about Cylinder axis synchronization with the axis of Earth's rotation. This cylinder should be encapsulated from all corners around the earth which is projected. The classification of geometry describe the cylindrical projection is stretched the distances from east to west. The mapping of meridians to vertical lines can be visualized by imagining a cylinder whose axis coincides with the Earth's axis of rotation. This cylinder is wrapped around the Earth, projected onto, and then unrolled. As the figure below illustrates the Mercator projection appears the cylindrical projection shape.

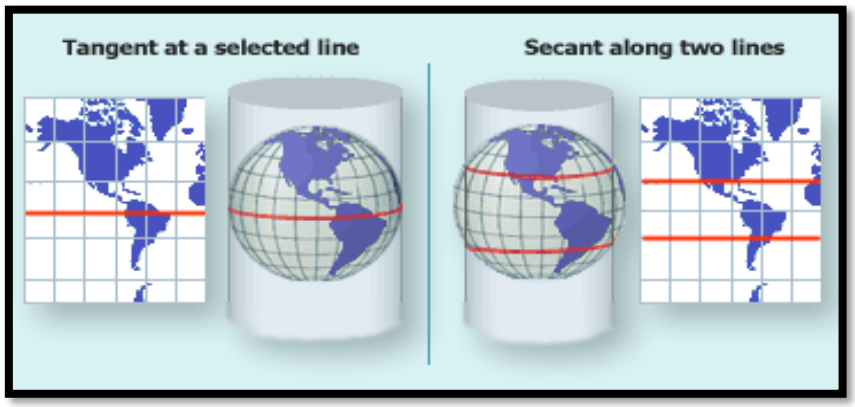

Figure 9: Cylindrical projection shape

❖ **Cone projection:**

Arises projected cone developed cone-shaped paper hat on the globe above a polar or south, and as a light into the ground to reflect the image of the inner surface of the cone, and draw lines land and features on the surface open cone, then simplifies to a map. This projected often used in mapping areas at mid-latitudes and low longitudinal direction such as Africa or North America.

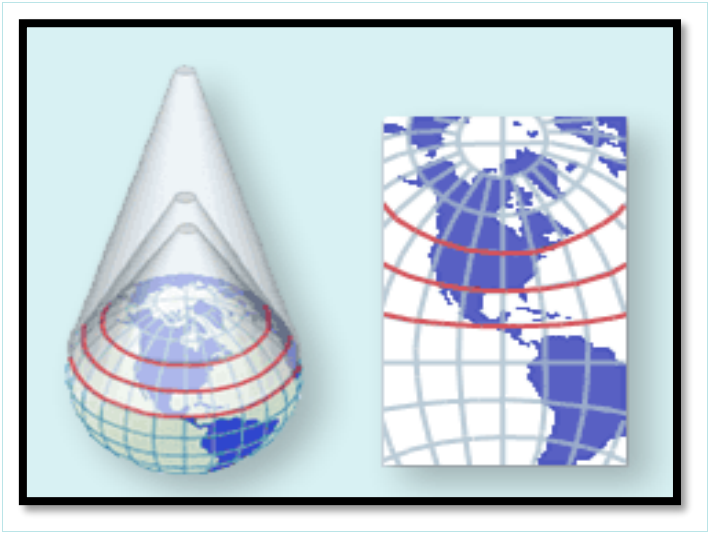

Figure 10: Cone projection shape

- **Azimuthal or planar projection:**

Arises azimuthal or planar projection on a flat surface in front of the Earth (likened not really), and is usually at the point of the North Pole or points south pole, and after dropping lines land and features on this surface, we get a map with lines along in the form of straight lines converge at a point pole and circles display full circles pole position. This projection used in mapping the Polar Regions or maps of the tropics.

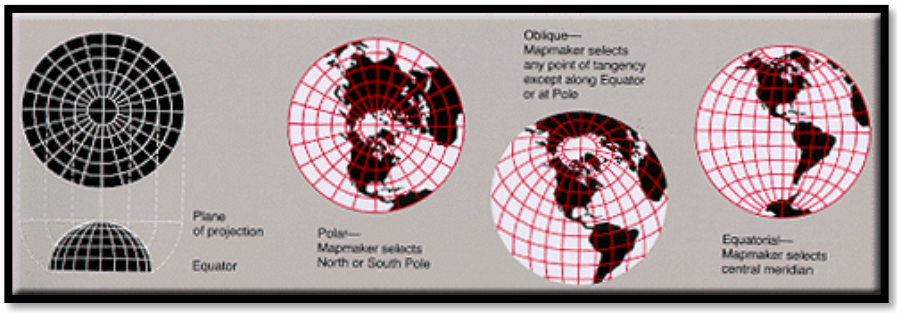

Figure 11: azimuthal projection shape

The classification is the method which used in order to improve the projections for the three types of the map projections. The

projection of cylindrical departure could be represented their projections as the conic. Although, the cylindrical projection of geometric surface is made to longitude, the parallels are organized by the mathematical projections. In this case, the sharp of the suitable longitude may useful to reduce the cylindrical projection. The latitude rose spacing to near to the poles, in contrast, the longitude has the same spacing. The projection map of the planar is on the flat surface and the result of this projection is named azimuthal projections. Latitudes appear concentric circle connecting with pole being their centrals; in contrast, longitudes are interconnecting at the pole keeping their angles. The focal point is further aspect which contains the planar project at 90^0 angles.

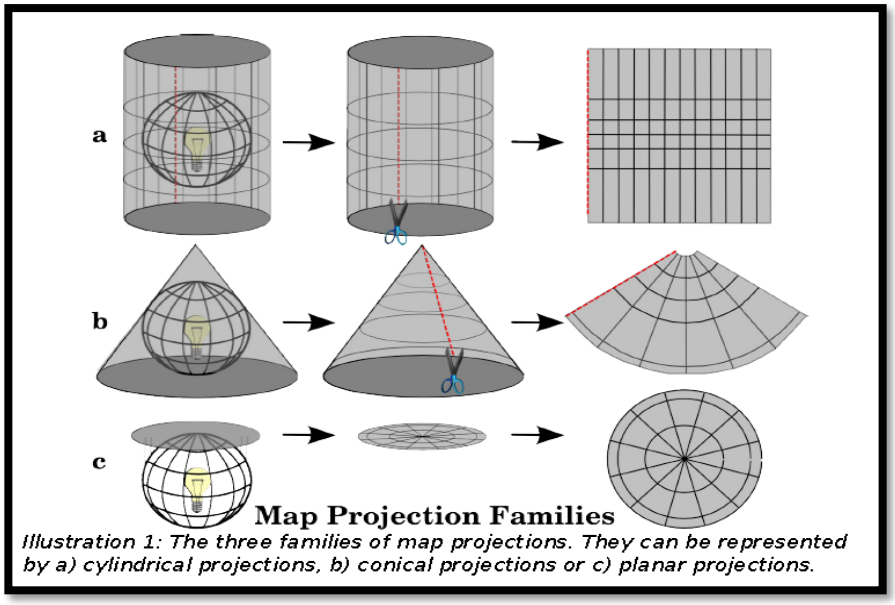

Illustration 1: The three families of map projections. They can be represented by a) cylindrical projections, b) conical projections or c) planar projections.

On the other hand, Universal Transverse Mercator **(**UTM) is referring to a projected, planer coordinate system. A planer coordinate system is contained whether two-dimensional or flat and it includes two axes that are straight perpendicular to each other, and intersect at the origin of the coordinate system grid. Planner coordinates are located according to their distance from the origin. Also, the planer coordinate system vs the projection, the grid of

the planer coordinate system more than the grid of a projection, therefore, allow coordinates on the planer grid to be converted to GCS coordinates.

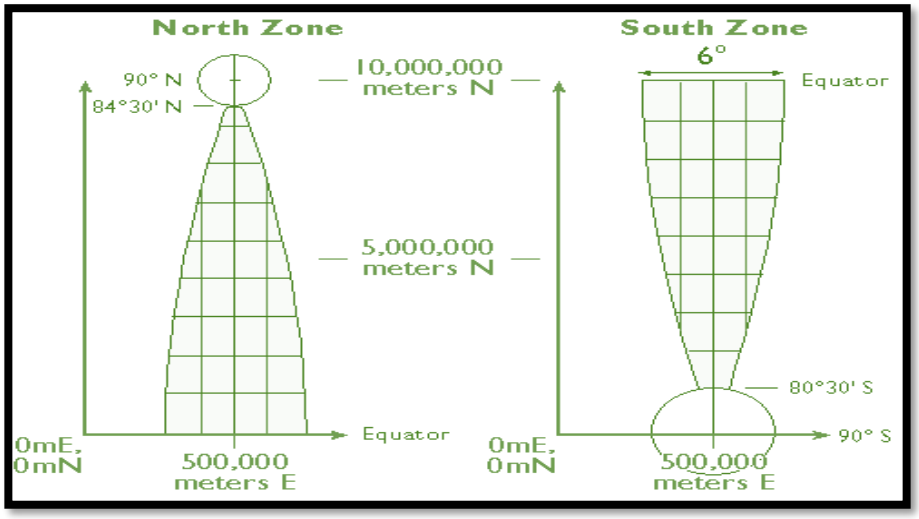

Figure 12. Characteristics of UTM Zone Coordinate Grids.
Source: David (2006)

According to the figure above which illustrate the UTM with the two planer coordinate system grids. It is clear that, the south zone and the north zone origin's easting value is zero meters, and is located 500,000 meters east of the central meridian. With regard to the south zone it is clear that the origin's northing value is zero meters and is located 10,000,000 meters south of the equator. In contrast with the north zone, the origin's northing value is zero meters, and is located at the equator. The areas of the 6° wide zone of the globe is projected onto the two-dimensional planer grids. It can see that the origins of the grids are outside of the geographic range of the zone to which they belong. Therefore, they are measured to be made-up origins. Points on the grid are located according to their distance in northing-easting meters from the origin.

The map projection associated with GDA94 is the Map Grid of Australia, 1994 (MGA94), a transverse Mercator projection, which conforms to the internationally accepted Universal Transverse Mercator Grid system (UTMGS). Australia using the

projection in order to maintain the Geodetic Datum of it, which realized by the coordinate. Also, Australia wants to determine the methods of the sea and other navigation conditions. On the other hand, the important applications of projections are Political boundary purpose, Topography and Census or calculation the number of the population and this can via select the area that have a large number to identify where it is. Additionally, Australia applies the map projection in, the ocean for geology, energy exploration, minerals and tectonics. The GDA has been signed a treaty to use map projection across Australia by Inter-Governmental Committee on survey and mapping with all states and regions.

15. Remarks and conclusion:

This research provides the simple information including the International Reference System and Frame with simple explanation of Terrestrial and Celestial. In addition, both of Terrestrial and Celestial Reference S/F are maintaining by International Earth Rotation System (IERS). The IERS defines a reference system as a collection of conventions and recommendation identifiable in forms that are stable in defining a coordinate axes triad at any given time. Thus, the most perfect reference system cannot be identified.

On the other hand, there are a number of coordinates of the center of the earth which cannot be confined within certain so as to be associated with the definition of IERS. The using of new observation techniques will be more accuracy and develop to determine the earth orientation. The summary of Terrestrial Reference System (TRS): is Mathematical definition of the reference in which positions and velocities will be expressed. Therefore it can be invariable but inaccessible to users in practice. On the other hand, Terrestrial Reference Frame (TRF): is Physical materialization of the reference system by way of geodetic sites. Therefore, it could be accessible but perfectible.

In addition, Cartesian coordinate transformation illustrates the important benefit of using it in the transformation of the

coordinates. The knowledge of the transformation is mathematical method usages which include the calculation in order to transfer the coordinate axis.

Finally, map projections have been developed navigation. However, there are several disadvantages of the both map projections and reference system but they can be improved their usage.

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