

**HARAMAYA UNIVERSITY**

**COLLEGE OF COMPUTING AND INFORMATICS**

**DEPARTMENT OF INFORMATION SYSTEMS**

**GEOGRAPHICAL INFROMATION SYSTEMS GROUP ASSIGNMENT**

**NAME ID**

1. DAWIT TADELE 3081/13

2. MUBAREK KEMAL 2065/13

3. SAMUEL MAMIRU 2361/13

4. EYOB ELEFACHEW 1035/13

**Submitted to: Dr. Kassaye Hussien**

**Submission Date: Friday, March, 2024**

Table of Contents

[**I**. **Describe the advantages of maps over globes** 1](#_Toc161360927)

[**II. What is Datum?** 2](#_Toc161360928)

[**III**. **Elucidate the differences between local and global datum?** 3](#_Toc161360929)

[**IV**. **Explain the difference between GCS and PCS** 4](#_Toc161360930)

[**V**. **Explain UTM?** 5](#_Toc161360931)

[**VI**. **There are places where GPS does not function. List some of these places.** 6](#_Toc161360932)

[**VII**. **At which UTM Zone Ethiopia is located? If there are more than one UTM zones, list all of them with the corresponding cardinal directions of the country?** 7](#_Toc161360933)

[**VIII**. **Describe the importance of coordinate system in GIS.** 8](#_Toc161360934)

[**Reference** 10](#_Toc161360935)

## **I. Describe the advantages of maps over globes**

Advantages of maps over globes include their portability, ease of storage, and ability to display detailed information on a flat surface. Maps are also more versatile for different types of projections, making them suitable for various purposes such as navigation, urban planning, and thematic mapping.

One source that highlights these advantages is "Understanding Maps: A Systematic History of Their Use and Development" by Joseph E. Schwartzberg. Schwartzberg explains that maps offer the advantage of being easily transportable and storable compared to globes, which are bulkier and more cumbersome. Maps can be folded, rolled, or stacked, allowing for convenient storage and transportation. Additionally, maps can provide more detailed information due to their ability to represent features at varying scales and projections. This versatility makes maps valuable tools for a wide range of applications, from illustrating geopolitical boundaries to depicting topographical features.

In addition to the portability and detailed information advantages, maps also offer greater flexibility in terms of customization and presentation. Unlike globes, which are limited to a spherical shape, maps can be created in various shapes and sizes to suit specific needs. This adaptability allows cartographers to emphasize certain features or areas, adjust scales, and choose different projections to best represent the data they wish to convey.

Furthermore, maps can be easily updated to reflect changes in geographical or political boundaries, infrastructure development, or other relevant information. This dynamic nature ensures that maps remain current and accurate, making them indispensable tools for decision-making processes in fields such as urban planning, emergency response, and resource management.

Moreover, maps are more accessible for educational purposes. They can be reproduced at a lower cost, allowing for wider distribution and use in classrooms, textbooks, and online resources. Additionally, maps can be annotated with labels, symbols, and colors to highlight specific points of interest or convey additional information, enhancing their educational value and usability.

In summary, while globes have their own merits in representing the Earth's spherical shape accurately, maps offer several practical advantages in terms of portability, detail, customization, and accessibility. These advantages make maps essential tools for a diverse range of applications, from everyday navigation to complex spatial analysis and planning.

## **II. What is Datum?**

A datum refers to a mathematical model that defines the shape, size, and orientation of the Earth's surface in a specific area of interest. It provides a framework for accurately representing spatial data by establishing a reference point from which coordinates are measured.

According to "Geographic Information Systems and Science" by Paul A. Longley, Michael F. Good child, David J. Maguire, and David W. Rhind, a datum in GIS is defined as "a set of reference points on the Earth's surface against which position measurements are made, and an associated coordinate system" (Longley et al., 2015).

In GIS, datums are essential for ensuring the accurate alignment of geographic data layers and facilitating spatial analysis. Different regions may adopt different datums to account for variations in the Earth's shape and size, leading to datums specific to certain countries or regions. Common datums include WGS84 (World Geodetic System 1984) and NAD83 (North American Datum 1983).

When working with GIS, it's crucial to use the appropriate datum to avoid spatial inaccuracies and inconsistencies in data analysis and visualization. GIS software often provides tools for transforming data between different datums to ensure compatibility and accuracy in spatial referencing.

In GIS, the choice of datum impacts the accuracy and reliability of spatial data analysis and interpretation. Datums serve as the reference framework for aligning different layers of geographic information, such as satellite imagery, maps, and survey data. They establish a common ground for measuring distances, determining directions, and representing features on the Earth's surface.

Moreover, datums in GIS are not static but may evolve over time due to advancements in geodesy and changes in the Earth's surface. For example, improvements in satellite technology may lead to the refinement of datum parameters, resulting in updated versions of existing datums to enhance positional accuracy.

Furthermore, understanding the relationship between different datums is crucial when working with spatial data from diverse sources. GIS professionals often need to transform data between different datums to ensure compatibility and consistency across projects or when integrating data from global or regional datasets.

Additionally, the choice of datum can have significant implications for specific applications within GIS, such as navigation, land surveying, and environmental modeling. Different datums may be optimized for specific purposes, taking into account factors such as local terrain variations, geoid models, and coordinate precision requirements.

In summary, datums play a foundational role in Geographic Information Systems, providing the reference framework for accurately representing and analyzing spatial data. Their proper selection and understanding are essential for ensuring the reliability and integrity of GIS projects and applications.

## **III**. **Elucidate the differences between local and global datum?**

Local and global datums serve as reference frameworks for measuring and representing the Earth's surface, but they differ in their scope, accuracy, and regional applicability.

1. **Global Datum**

* **Scope:** Global datums aim to provide a reference framework that covers the entire Earth's surface uniformly.
* **Accuracy:** Global datums often employ sophisticated mathematical models to represent the Earth's shape, size, and orientation accurately on a global scale.
* **Applicability:** Global datums, such as WGS84 (World Geodetic System 1984) and ETRS89 (European Terrestrial Reference System 1989), are widely used for global positioning, satellite navigation, and international mapping projects.
* **Consistency:** Global datums ensure consistency and compatibility across different regions, facilitating seamless integration of spatial data from diverse sources worldwide.
* **Examples:** WGS84, which is widely adopted for GPS navigation and global mapping projects, provides a consistent reference framework for positioning and spatial analysis on a global scale.

1. **Local Datum**

* **Scope:** Local datums are designed to provide a reference framework tailored to specific regions or countries, accounting for regional variations in the Earth's shape and size.
* **Accuracy:** Local datums may offer higher accuracy and precision within their designated regions compared to global datums, as they are customized to fit local terrain and geoid characteristics more closely.
* **Applicability:** Local datums are commonly used for national mapping projects, cadastral surveys, and engineering applications where precise local positioning is essential.
* **Regional Specificity:** Local datums are tailored to account for regional geodetic parameters, such as ellipsoid dimensions, coordinate origins, and projection methods, optimizing accuracy for specific geographic areas.
* **Examples:** NAD83 (North American Datum 1983) and GDA94 (Geocentric Datum of Australia 1994) are examples of local datums used in North America and Australia, respectively, to provide accurate positioning and mapping capabilities within these regions.

In summary, while global datums offer a standardized reference framework for global positioning and mapping, local datums provide customized solutions tailored to specific regions, offering higher accuracy and precision for local applications. Understanding the differences between these datums is crucial for ensuring the accuracy and reliability of spatial data analysis and interpretation across different geographic scales.

## **IV**. **Explain the difference between GCS and PCS**

In geographic information systems (GIS), Geographic Coordinate Systems (GCS) and Projected Coordinate Systems (PCS) serve distinct purposes, reflecting the underlying principles of spatial referencing and representation. GCS establishes a framework for defining locations on the Earth's surface using latitude and longitude coordinates, typically based on a spherical or ellipsoidal model of the Earth (ESRI, n.d.). It enables the representation of global or regional data and is commonly used for tasks such as mapping, navigation, and spatial analysis.

Projected Coordinate Systems, on the other hand, involve transforming the coordinates from a GCS onto a two-dimensional Cartesian coordinate plane, providing a flat, planar representation of the Earth's curved surface (ESRI, n.d.). PCS is tailored for specific regions or areas and employs map projections to minimize distortions in distance, area, direction, or shape. This transformation is necessary to create maps and visualizations for local or regional areas while preserving spatial relationships.

While GCS maintains accuracy in measuring angles and distances across the globe, PCS introduces distortions due to the inherent limitations of map projections, which vary based on the projection method and geographic extent (ESRI, n.d.). As such, GCS is suitable for analyzing spatial relationships at a global or continental scale, where distortions are minimal and precise geographic referencing is crucial.

Conversely, PCS is preferred for local mapping projects, engineering designs, and land surveying, where precise measurements and spatial referencing within a limited area are essential (ESRI, n.d.). The choice of coordinate system depends on factors such as the geographic extent of the study area, the purpose of analysis, and the level of accuracy required.

Understanding the distinction between GCS and PCS is fundamental in GIS applications, as it influences the choice of coordinate systems, data visualization techniques, and spatial analysis methods tailored to specific project requirements and geographic contexts (ESRI, n.d.).

## **V**. **Explain UTM?**

The Universal Transverse Mercator (UTM) system is a widely used map projection and coordinate system designed to provide accurate representations of the Earth's surface, particularly for large-scale mapping and navigation purposes. Developed by the United States Army Corps of Engineers in the mid-20th century, UTM divides the Earth into a series of zones, each spanning 6 degrees of longitude. The system employs a cylindrical map projection, specifically the Transverse Mercator projection, which minimizes distortion within each individual zone.

UTM coordinates are expressed in meters and consist of two components: easting and northing. Easting represents the distance, in meters, eastward from the central meridian of the zone, while northing represents the distance, in meters, northward from the equator. Each zone has its own central meridian, which serves as a reference line for measuring easting values. Additionally, a false easting value is often added to eliminate negative numbers and ensure that all coordinates within the zone are positive.

One of the key advantages of the UTM system is its ability to provide accurate distance and area measurements within each zone, making it well-suited for local and regional mapping applications. Furthermore, UTM coordinates are relatively simple to interpret and work with, as they are expressed in a linear metric scale.

However, UTM does have limitations, particularly with regard to its applicability for global mapping. Since each zone covers only 6 degrees of longitude, distortion increases towards the zone boundaries, which can affect the accuracy of measurements near the edges of zones. Additionally, the UTM system is not well-suited for representing features that span multiple zones, such as large-scale international mapping projects.

Overall, the UTM system provides a practical and efficient means of representing geographic locations and measuring distances on maps, particularly for applications that require detailed spatial accuracy within specific regions.

## **VI**. **There are places where GPS does not function. List some of these places.**

While GPS (Global Positioning System) is a widely used and reliable navigation tool, there are certain situations or locations where GPS signals may be obstructed or unavailable. Some examples include:

* **Indoor Environments:** GPS signals have difficulty penetrating through building structures, resulting in poor reception or complete signal loss indoors, such as within shopping malls, underground parking garages, or dense urban areas with skyscrapers.
* **Underground Tunnels and Caves:** GPS signals cannot penetrate through solid rock, making them ineffective for navigation in underground tunnels, caves, or subway systems where line-of-sight to satellites is obstructed.
* **Deep Valleys and Canyons:** GPS signals may be weak or completely obstructed in deep valleys, canyons, or areas surrounded by tall mountains, where the line-of-sight to satellites is limited.
* **Urban Canyons:** Tall buildings in urban areas can create "urban canyons," where GPS signals are obstructed or reflected, leading to multipath errors and inaccuracies in positioning.
* **Thick Forests and Jungles:** Dense vegetation can attenuate GPS signals, resulting in reduced signal strength and accuracy in forested areas or dense jungles.
* **Polar Regions:** Near the Earth's poles, GPS satellite coverage is limited due to the orbital configuration of the GPS satellite constellation, leading to reduced accuracy and intermittent signal reception in polar regions.
* **Nearby Obstructions:** GPS signals can be temporarily obstructed by nearby objects such as tall buildings, mountains, or large vehicles, causing momentary signal loss or inaccuracies in positioning.
* **Electronic Interference:** GPS signals can be disrupted by electronic interference from sources such as radio frequency (RF) interference, jamming devices, or electromagnetic interference (EMI) from nearby electronic equipment.

While GPS is highly reliable in most outdoor environments, understanding its limitations can help users navigate effectively and recognize situations where alternative navigation methods may be necessary.

## **VII**. **At which UTM Zone Ethiopia is located? If there are more than one UTM zones, list all of them with the corresponding cardinal directions of the country?**

Ethiopia is primarily located within UTM (Universal Transverse Mercator) Zone 37, which covers the majority of the country. However, due to its geographical extent, parts of Ethiopia also extend into adjacent UTM zones. These zones include:

* UTM Zone 36: This zone covers the western part of Ethiopia.
* UTM Zone 37: This zone covers the central and eastern parts of Ethiopia.
* UTM Zone 38: This zone covers the easternmost part of Ethiopia.

**In summary:**

* Ethiopia is primarily located within UTM Zone 37.
* Western Ethiopia extends into UTM Zone 36.
* Eastern Ethiopia extends into UTM Zone 38.

## **VIII**. **Describe the importance of coordinate system in GIS.**

The coordinate system is a fundamental component of Geographic Information Systems (GIS), playing a crucial role in accurately representing, analyzing, and visualizing spatial data. The importance of the coordinate system in GIS can be understood through several key aspects:

* **Spatial Referencing:** The coordinate system provides a standardized framework for referencing geographic locations on the Earth's surface. By assigning unique coordinates to each point or feature, GIS enables precise spatial referencing and identification, facilitating data integration and interoperability across diverse datasets.
* **Data Integration:** GIS allows users to integrate spatial data from various sources, such as satellite imagery, maps, surveys, and demographic data. A consistent coordinate system ensures that spatial data layers align correctly, enabling seamless integration and analysis of spatial relationships, patterns, and trends.
* **Geospatial Analysis:** GIS enables sophisticated spatial analysis techniques, such as buffering, overlay analysis, proximity analysis, and spatial interpolation. These analyses rely on accurate coordinate referencing to compute distances, areas, and relationships between geographic features, supporting decision-making processes in diverse fields such as urban planning, environmental management, and public health.
* **Map Production:** Coordinate systems are essential for producing maps and visualizations in GIS. By projecting geographic data onto a two-dimensional map surface, GIS allows users to create maps that accurately represent spatial patterns, distributions, and phenomena. Different map projections and coordinate systems may be selected based on the purpose of the map and the geographic extent of the area being represented.
* **Navigation and Routing:** GIS-based navigation systems rely on accurate coordinate referencing to provide real-time routing and directions to users. By incorporating geographic coordinates into mapping applications, GIS facilitates efficient route planning, navigation, and location-based services for transportation, logistics, and emergency response purposes.
* **Data Sharing and Collaboration:** Standardized coordinate systems enable seamless data sharing and collaboration among GIS users and organizations. By adhering to common coordinate referencing standards, GIS datasets can be easily exchanged, shared, and integrated across different platforms and applications, fostering collaboration and interoperability in spatial data infrastructure initiatives.

In summary, the coordinate system is a foundational element of GIS that underpins spatial referencing, data integration, analysis, map production, navigation, and collaboration. Its importance lies in enabling accurate and meaningful representation of geographic data, supporting informed decision-making and problem-solving in a wide range of applications and industries.

# **Reference**

Berry, R.M. 1976. "History of Geodetic Leveling in the United States." Surveying and Mapping, vol. 36, no. 2, pp. 137-153.

Carrera, G. 1984. "Heights on a Deforming Earth." Department of Surveying Engineering Technical Report No. 107, University of New Brunswick, Fredericton, New Brunswick, Canada.

Carrera, G., P. Vanicek, and M.R. Craymer. 1990. "The Map of Recent Vertical Crustal Movement in Canada." Department of Surveying Engineering Technical Report, University of New Brunswick, Fredericton, New Brunswick/ Canada.

Cartwright, D. 1984. Communication to Working Group on Vertical Datum of the United States. Washington, D.C.: NAS Committee on Geodesy.

J.E. ALBERDA: Report on the Adjustment of the United European Levelling Net and Related Computations, Netherlands Geodetic Commission, New Series, 1, 2, 1963.

W. BAARDA: A Connection Between Geometric and Gravimetric Geodesy, A First Sketch. NGC, New Series, 6, 4, 1979.

E.I. BALAZS : Local Mean Sea Level in Relation to Geodetic Levelling Along the United States Coastlines, National Geodetic Survey, Rockville, Md., 1973.

O.L. COLOMBO : A World Vertical Network, Dept. Geodetic Science, 296, The Ohio State University, Columbus, 1980.

[Globe and Map - Differences, Similarities and Advantages (vedantu.com)](https://www.vedantu.com/geography/globe-and-map)