ASSESSMENT OF TOPOGRAPHIC VARIATION IN UMP GAMBANG CAMPUS USING DIGITAL ELEVATION MODEL (DEM) DATA

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Thesis submitted in fulfillment of the requirements
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ABSTRAK

Istilah topografi merujuk kepada mendokumentasikan dan memetakan kawasan perubahan ketinggian, tiga dimensi permukaan, dan klasifikasi pelbagai bentuk muka bumi. Untuk menggunakan istilah ini dalam erti kata moden, pengguna mesti menjana Digital Elevation Model (DEM). Perwakilan warna DEM boleh digabungkan dengan butiran topografi DEM. Ciri topografi termasuk cerun, dan terbitan cerun dan aspek, serta kawasan berlorek. Imej yang terhasil akan lebih berdasarkan resolusi imej, bentuk dan tekstur ciri topografi berbanding DEM sahaja. DEM biasanya digabungkan dengan imej kawasan berlorek untuk menyerlahkan topografi.

ABSTRACT

The term topographic refers to documenting and mapping out areas of elevation change, the three-dimensionality of the surface, and the classification of various landforms. To use this term in the modern sense, users must generate Digital Elevation Model data (DEM). The DEM's color representation can be combined with the DEM's topographic details. Topographical features include slope, and the derivatives of slope and aspect, as well as shaded relief. The output image is more based on the image resolution of the topographic features' shape and texture than the DEM alone. A color DEM is commonly combined with a shaded relief image to highlight the topography.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Topography is a branch of planetary science that studies the shape and properties of the Earth's surface and other observable astronomical objects, such as planets, moons, and asteroids. Topography is also an illustration of the shape and properties of such characters. Additionally, the topography of a region might refer to the surface's shape and qualities. In general, the topography is concerned with local particulars, such as relief but also natural and artificial characteristics, and local history and culture. This usage is less prevalent in the United States, where topographic maps with elevation contours corresponding to elevation contours have made topography identical to relief. However, Europe continues to utilize the ancient definition of topography as the study of place. Specifically, topography involves recording relief or terrain, the surface's three-dimensional nature, and identifying distinct landforms. Geomorphometry is a synonym for this. In contemporary usage, this involves producing elevation data in electronic format.

This study collects data in three ways to determine the variance topography of the UMP Gambang Campus. In this research, comparing the land survey approach, drone technology, and DEM data results allows this study to determine whether the satellite's topography is identical to UMP Gambang Campus. The digital elevation model (DEM) data will be more comprehensive. Using the Topographic Shader Tool, DEMs can have their colour representation of the DEM combined with topographic features. Shaded relief, slope, aspect, and the derivatives of slope and aspect are examples of topographic features. The final image provides a more accurate visual depiction of the shape and texture of topographic features than DEM alone. A typical use combines a colour DEM and a shaded relief image to create a hillshade image that emphasizes terrain relief. Lastly, we may compare the accuracy of the topography UMP Gambang Campus produced by technology using this research.

1.2 Problem Statement

The UMP Gambang Campus should have a current topographical map. Topography mapping can have the most significant impact on water flow and also development planning. UMP Campus Gambang has various elevations, and this research will determine how different the elevation of the Campus is. The topography mapping also allows imagining what is inside the Campus, such as size, shape, distance, height and others. Other than that, topography mapping also helps plan roads and road connections because the map provides information about the existence, collation, and distance between features on the earth's surface. So that all data can be obtained from the map topography, and we can plan based on the information available.

This research will aid in various areas of UMP Gambang Campus, including making development planning easier. This study will inform us how many hectares of land we may utilize if we wish to construct something new, like a cafe, gym, or student residence on the UMP Campus Gambang. It will also be necessary for evaluating expenses. With this study's aid, the land's slope, which influences the water flow, may also be determined. If the problem with this water reservoir still needs to be resolved, the floods that occurred in 2021 could reoccur. The disaster will disrupt students' activities on campus. Regarding the amount of data that can be obtained, the research may illustrate the superiority of the conventional method, which is a land survey and the modern approach like DEM.

Lastly, the collection of DEM data relies entirely on the technology of the QGIS software package. This software will make obtaining data on the earth's surface much easier, as it is necessary to carry out field activities such as land surveys to gather the data. In addition, the collection of data regarding the land surface of a location will require a significant amount of time. However, if there is no QGIS software, an organization will probably have to spend considerable money collecting data from other software. This is in contrast to the fact that there will be no charge for using QGIS. Next, it's important to note that not all software is accessible through various laptop operating systems like Mac, Windows, Android, etc. However, all kinds of processors can easily access and download the QGIS software.

1.3 Objective

This study is based on two main objectives:

i. To determine the elevation of the topographic at UMP Gambang Campus.

ii. To compare the topographic variation between DEM and conventional method in the UMP Gambang Campus.

1.4 Scope of Study

Land surveying involves costs, the exact amount of which may be difficult to determine once the surveyor has completed the work. Because unforeseen circumstances, such as missing corners, may happen. However, a quote can provide a somewhat accurate cost estimate. A broader and more exhaustive survey will be more expensive than a simple survey of a single borderline. Consider offering tens of thousands or perhaps hundreds of thousands of ringgits to individuals who conduct their first survey. In addition, topography measurements require research. The surveyor will survey the location specified by the company that hired him. The organization must take the time to hire the most qualified land surveyor for its purposes. The organization must verify that land surveyors possess the relevant credentials and continually upgrade them to reflect technological advancements. Additionally, ensure the land surveyor has experience measuring land for the required type of project.

Traditional aero planes are less susceptible to the effects of the elements than drones. For instance, if the weather is terrible, the drone will not be able to operate appropriately, nor will it be able to collect reliable data or imagery. However, there are drones available that are more stable and can successfully survive gusts of wind. These drones are accessible. In addition, to acquire data of an accurate and high quality, one needs to possess the necessary skill set. These specs will often be viewed by the typical farmer who is required to undergo extensive training or utilize the services of a thirdparty drone provider to acquire, process, and analyses data about agricultural operations. Because there are now more people working in the sector as drone pilots, the price of drones and the resource costs that come along with them will continue to rise as the technology behind them advances. So, drone technology requires a high expense and knowledge and skill to conduct it.

Compared to other conventional approaches, such as land surveys, the quality of the data that digital elevation models provide is not very good, which means that the accuracy of these models is a key focus of the research that goes into improving them. In addition, DEM has a close relationship with point density, which affects the accuracy and quality of the DEM generated as a result. The lesser the resolution, the more widely spaced the generated points (Zainurin et al., 2014). When such an event occurs, the precision and quality of the DEM are decreased to their lowest possible level. Conversely, a low-resolution reading indicates the highest level of accuracy and quality, limiting the capacity to explore the software in greater depth. Besides that, there is software for which you must pay a license to use it. Lastly, according to the University of Southampton articles, DEM lacks information in flat locations, such as problems accurately displaying slope fractions. In addition, the data's irregularity makes further examination of slope and aspect derivations more time-consuming than other DEM variants.

1.5 Significant of Study

As with any endeavour, geography enthusiasts benefit from having as much background knowledge as possible before getting started. The usability of your land depends heavily on its elevation. Therefore, any mistakes there could be disastrous. However, if problems are identified in time, basic fixes like relocating buildings, installing drainage systems, levelling the land, etc., are usually possible. An accurate topographic survey is helpful in any situation, but there are times when it's crucial. Topographical surveys have several positive outcomes. As a first step, having an exact and complete map of land is essential to avoid making any expensive blunders due to unknowns further down the road. If someone is looking to buy some land, a topographical survey is the best way to learn about the area and how it's changed over time. Before making any alterations to the ground, it can give the necessary information. Engineers and architects can use this data to construct designs considering the property's specifics. Finally, it provides the final as-built data to ensure the site was built according to the approved methods.

There are several benefits to drone surveying. First, compared to more conventional human surveying methods, employing a modern drone can significantly reduce risk while saving money. Drones can do surveys and inspections of land and structures as precisely as human inspectors but much more quickly. They are, therefore, handy for any topographical survey. Then, let's examine the main advantages of drone surveys. First, using drones, surveyors may now investigate regions that were previously off-limits. It could be a section of land or a building floor inaccessible to pedestrians or vehicles. Second, drones can be used to conduct surveys of a wide variety of structures, including roofs, utilities, the underside of a bridge, and railways. Third, drones help survey various terrain types, including dense forests and quarry sites. Old-fashioned surveying techniques take too long to complete in remote places. Using drones to conduct surveys of inaccessible areas has the added benefit of minimizing disruption to nearby residents and business owners.

Digital Elevation Models (DEM) are excellent for contouring topography and relief maps at larger geographical scales. They are modelling water flow or mass movements, creating physical models such as relief maps, correcting aerial photography or satellite imagery and using physical geography and geomorphology to analyses terrain (Marwaha & Duffy, 2021). Digital elevation models (DEM) are crucial topographic inputs for correctly modelling floodplain hydrodynamics (Demir et al., 2016). Digital elevation models (DEMs) are 3D digital representations of a terrain's surface, including the x, y, and z coordinates of points. Depending on the required spatial precision, these locations are obtained from a GPS receiver, survey instruments, or aerial or satellite stereo photography. The algorithms in GIS software utilize these digital files of x, y, and z coordinates to generate either three-dimensional surfaces or elevation contours. This spatial information is utilized by GIS software (Aviratdhodare, 2020). The output of these algorithms is used for additional calculations and analysis. To calculate cut and fill off of the land under study, 3D terrain visualization, watershed and viewshed analyses, and many other civil engineering, infrastructure, architectural, and even video game, defense, and intelligence-related applications and uses, a Civil Engineer is essential today.

Lastly, this study supports SDG 9 Industries, Innovation, Infrastructure, and SDG 11 Sustainable Cities and Communities. The initiative would ensure that the campus develops quality, reliable, sustainable, and resilient infrastructure. Also, to ensure campus life and environmental health are in balance. Furthermore, this study will help the university determine which parts of campus are suitable for constructing new buildings, allowing them to make more environmentally friendly facilities. This study also can notice concerned parties about the water disaster in the UMP Gambang Campus so the concerned parties can do something to ensure the campus is not affected by any disaster, especially the water disaster.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The literature review investigates the numerous research endeavours undertaken on the subject. This chapter provides information on various topics, including Over Internet Regional Mapping with Google Maps, Drones for improving topographical mapping, Evaluation in Malaysia, Digital Elevation Models (DEMs), and the type of DEM data. The analysis of the works contributes to the process of determining the topographic changes that are present in a specific region. In addition, various methodological approaches were carried out to evaluate the precision of the topography in the region under investigation. Moreover, this chapter focuses on theoretically based elevation measurements, such as drones, satellite sensors, and land surveys. Additionally, the chapter on elevation discusses numerous tools. In summary, this chapter elaborates on all pertinent ground elevation mapping-related discussions.

2.2 Topographic Survey Helped Build Larger Topographic Maps

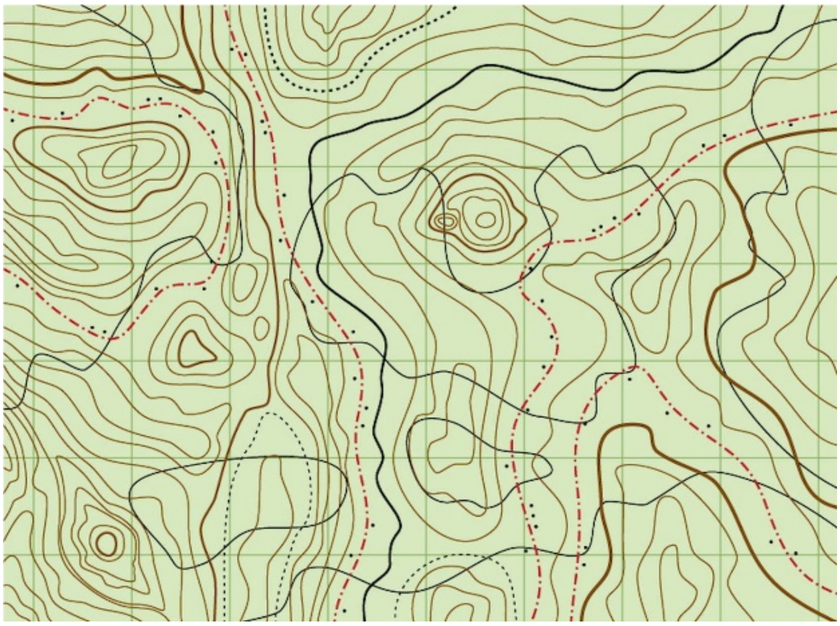


Figure 2.1 Example of Contour Line in Maps

Source: Nasim et al (2015)

Maps are vital for transportation and communication planning because they depict the relationship between locations and distances. In addition, the map depicts information on the plant life on Earth, including its different shapes and heights. Aerial photographs of the area to be mapped are taken using specialized mapping equipment. Here is an illustration of aerial photography. A stereoscopic projector is used to create three-dimensional images from aerial photographs. It is possible to compute the study area's elevation and sketch contour lines, rivers, roads, and other features from the study site. Land surveys are conducted for numerous purposes, including determining names and locations. The National Mapping Department is a federal agency that creates and distributes official maps to the proper people and organisations. Before the topographic maps may be made available for purchase, several safety standards must be satisfied. Only trained specialists should have access to topographical maps, as their ownership poses a significant security risk. In addition, there may be national security risks. Consequently, sensitive information, such as military locations and other strategically significant places, must be removed from the map.

To give a basis for more precise topographic maps, this is why topographic surveys were done in the first place. These exhaustive surveys were conducted so that previously undetected topographical characteristic may be disclosed. The Carte géomatique de la France, the first comprehensive set of topographic maps for France, is a significant publication (1789). Subsequently, topographical surveys were utilized for military and infrastructure initiatives. In the 1980s, computerized databases became the norm once paper topo maps had primarily been phased out. In the middle of the 1990s, database designers combined information from these topographic maps with data from other sources to create the tools we use to navigate online maps today. Today, topographic maps apply to numerous disciplines, including geography, earth sciences, and civil engineering. Using a survey-grade global positioning system (GPS) receiver and an electronic distance measurement (EDM) total station theodolite, the locations of the features represented on the plan are calculated (TST). In addition, topographic maps can indicate whether a specific road or trail is ascending or descending.

2.3 Over the Internet Regional Mapping with Google Maps

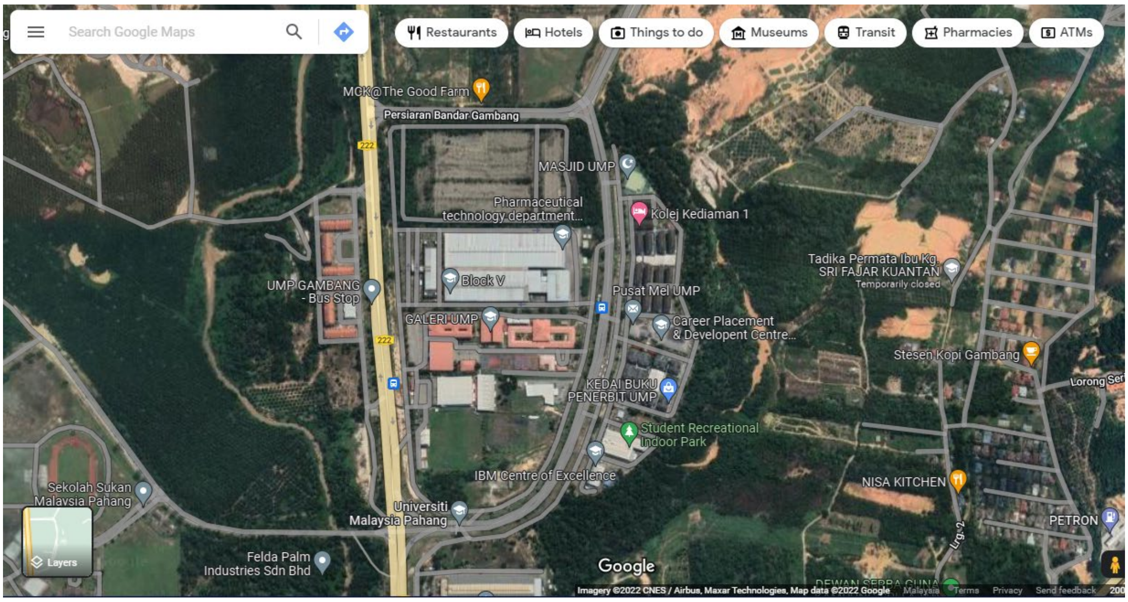


Figure 2.2 UMP Campus Gambang maps

Source: Google Maps

Google Maps combines the most significant characteristics of a desktop mapping application and a web service. Access satellite imagery, aerial views, road maps, 360-degree interactive panoramas of the streets, real-time traffic updates, and directions for travelling on foot, by car, by bike, by plane, or by public transportation. One billion people every month will use Google Maps by 2020. The satellite view in Google Maps provides a bird's-eye view of the ground from above. Most satellite images and planes flying between 800 and 1,500 feet are employed to provide high-resolution images of the city. In 2011, the average age of a satellite image was discovered to be less than three years.

To provide Google Earth and Google Maps users with a clearer image of the ground below, Google engineers developed a method to remove clouds from satellite images a few years ago. This approach is now being developed by the company using the latest, higher-resolution NASA and USGS Landsat 8 satellite images (Parez, 2016). Numerous experts contacted for this study concur that Google Maps' success can be attributed to the company's meticulous data curation and attention to detail. They have published research findings in The Manifest to support this notion. For example, it has been shown that at least 25% of navigation app users and their preferred apps deliver upgraded directions. In addition, 36% of navigation app users receive directions before departing, 34% receive them halfway through the journey, and 30% receive them the entire distance (Williams, 2018).

2.4 Drone for Advancement Topographic Mapping

Figure 2.3 DJI MAVIC Air 2
Source: DJI (2020)

Frequently, drone technology is utilized by surveyors and project managers. It ushers in a new era of topographical surveying by enabling the recording of comprehensive site maps, including contours and topography, at a fraction of the time and expense of conventional methods (Aero, 2017). Drones' sensors obtain diverse acceptable data points, including georeferenced elevation data and colour samples, when flown at various angles. Once collected, these points can be incorporated into a 3D Point Cloud, which can then be utilized to present a comprehensive overview of the project to the surveyor or client (Garnett, 2021). Advik (2022) asserts that the DJI Mavic Air 2 is one of the most effective field-survey drones. Given that the drone's 1/2.3-inch CMOS sensor can shoot 48MP photographs, his suggestion is persuasive. The DJI Mavic Air 2 is the best drone for land surveying due to its high-quality camera.

Figure 2.4 Controler DJI MAVIC Air 2

Source: DJI (2020)

FocusTrack, Hyperlapse, and QuickShots are a few of the capabilities of the Mavic Air 2 drone. One of the incredible automated flight sequences, QuickShots, can be initiated with a single button touch. The aesthetic purpose of Hyperlapse is to demonstrate the passage of time and the motion of an object in a single image. FocusTrack is an innovative tracking toolbox that facilitates the production of high-quality cinematic footage. The most recent OcuSync 2.0 drone controller features dual 2.4 GHz and 5.8 GHz radio frequencies. It can broadcast up to 10 kilometers away, has enhanced interference resistance due to automatic frequency switching, and enables smoother image transmission using H.265 encoding.

2.5 Elevation in Malaysia

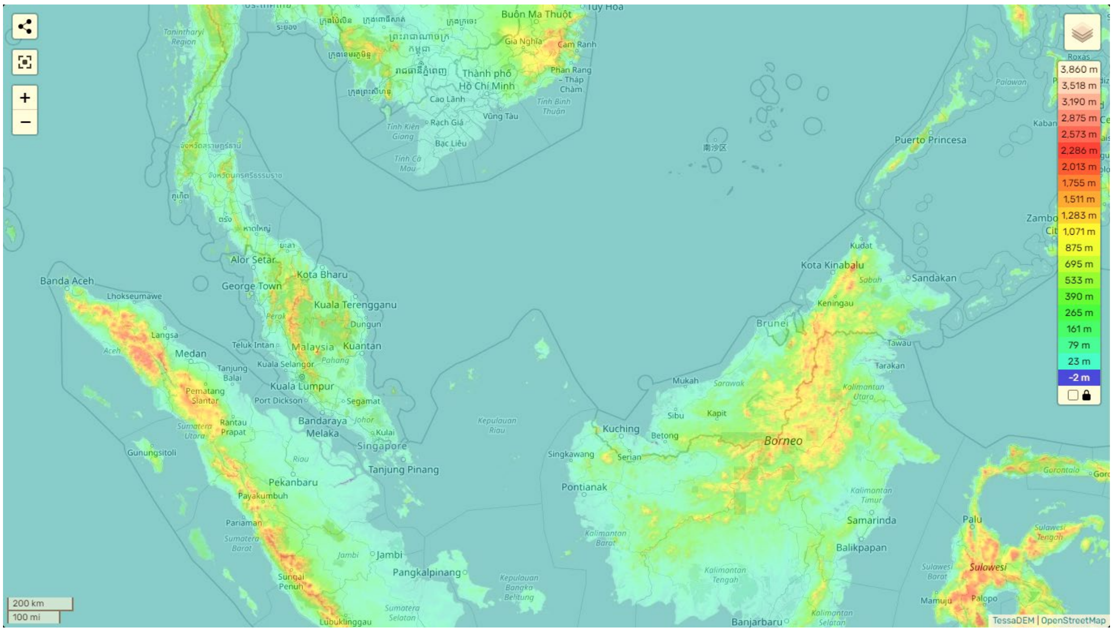


Figure 2.5 Malaysia Elevation maps

Source: Google Maps

Peninsular and East Malaysia, divided by the South China Sea, possess hilly interiors and low-lying coastal plains. Peninsular Malaysia comprises 40 per cent of Malaysia's total geographical area, measuring 740 kilometers in length and 320 kilometers in width. Mount Korb in the Titiwangsa Mountains is 2,183 meters tall and separates the country's East and West coasts. Mount Korbu is situated in the heart of the mountainous peninsula, which is dominated by several mountain ranges. In these mountains, dense trees blanket the granite and other igneous rocks. It has been so severely eroded that a karst landscape now dominates the region. These mountains are the origin of several rivers that flow into Peninsular Malaysia. The western side of the peninsula is the only one with harbors, with a total shoreline length of around 1,931 kilometers and a maximum width of up to 50 kilometers.

As of 2007, approximately two-thirds of Malaysia was covered with forest, and some trees were 130 million years old. Dipterocarps dominate the ecosystem of the forest.

East Malaysia was once covered with lowland rainforest, supported by the region's hot and humid environment. Lowland forests include areas below 760 meters. There are around 14,500 distinct species of trees and blooming plants. In addition to its rainforests, Malaysia is home to a substantial peat forest and about 1,425 km2 of mangroves. Higher in the landscape, oaks, chestnuts, and rhododendrons replace dipterocarps. Peninsular Malaysia is home to an estimated 8,500 species of vascular plants, while the East is home to 15,000 more. With 240 tree species per hectare, the East Malaysian forests are one of the most biodiverse regions, with an estimated 2,000 tree species. Rafflesia blossoms, with a maximum diameter of 1 meter, are the world's giant flowers.

2.6 Shuttle Radar Topography Mission (SRTM) Measure the Earth Elevation

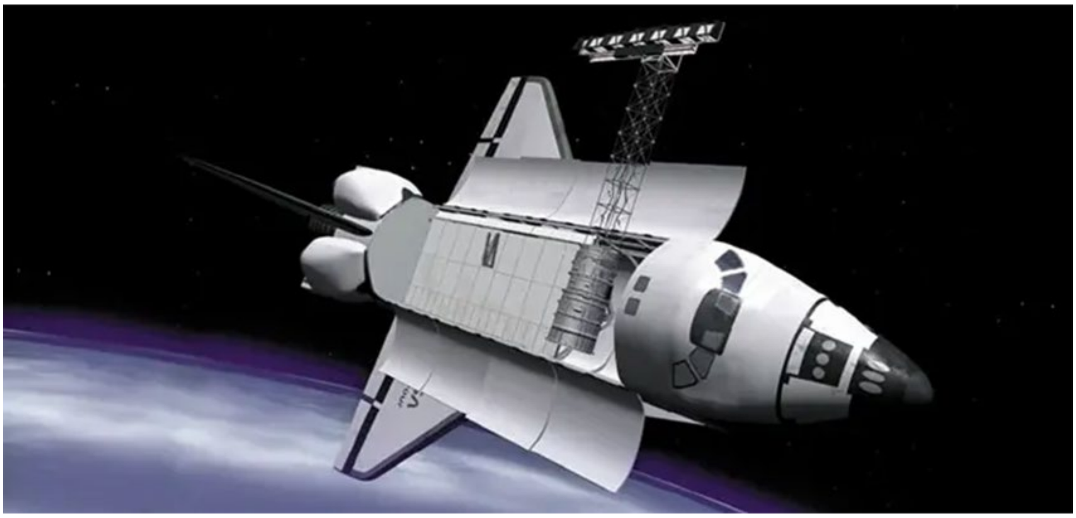


Figure 2.6 Space Shuttle Endeavour
Source: GISGeography (2022)

Before the 2009 release of the ASTER GDEM, the Shuttle Radar Topography Mission (SRTM) attempted to compile Earth's most comprehensive high-resolution digital topographic record. Its data set contained virtually global-scale digital elevation models acquired between 56°S and 60°N. In February 2000, as part of its 11-day STS-99 mission, the Space Shuttle Endeavour carried the upgraded radar system SRTM. To deploy the SRTM satellite, a specialized payload compartment was constructed for the Space Shuttle Endeavour. The Shuttle Radar Topography Mission (SRTM) utilizes InSAR and two antennas to survey the topography of the Earth. Interferometric synthetic aperture radar produced a digital elevation model by integrating signals from two radar antennas during a single pass (Cris, 2017). NASA decided to begin collecting topography because scientists use such data in climate models and because terrain affects air and water flow, among other factors. The topography also reveals landforms and tectonic activity. According to GIS Geology (2022), precise land topography is required to design infrastructures such as cell towers and hydropower dams. The scientific community as a whole stand to gain much from this voyage, which includes contributions from the German and Italian space agencies.

2.7 Digital Elevation Model (DEM)

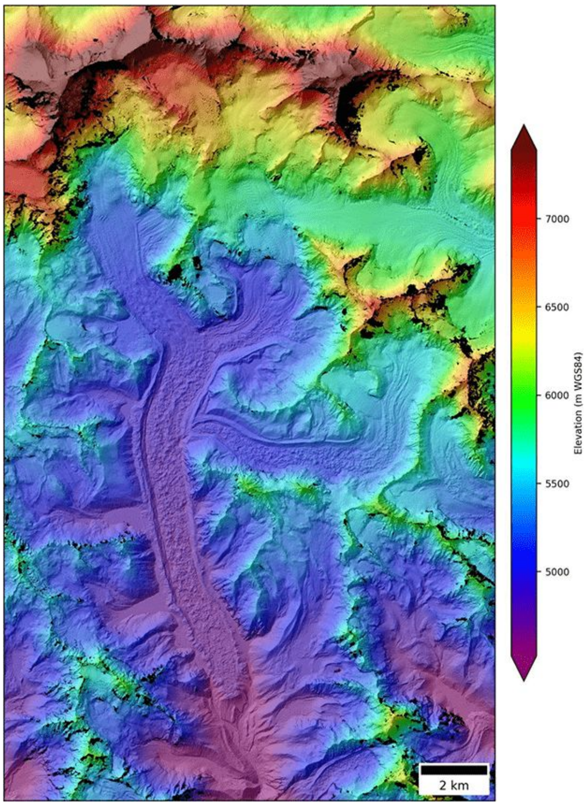


Figure 2.7 Example of DEM capture

Source: Marwaha & Duffy (2021)

According to Marwaha and Duffy (2021), DEMs are typically derived from remotely sensed data from satellites, drones, and aircraft. This diversity of DEM source data enables the filling of data gaps, for instance, in rural places where few data are accessible. Automatic DEM extraction from stereo satellite scenes enables data from satellite sensors like SPOT-5 (5-10m resolution). SAR interferometry, Stereo

Photogrammetry, DGPS readings, and ground survey are all remote sensing techniques for producing DEM surfaces.

They are raster grids of the Earth's surface that are referenced to the vertical datum, the surface of zero elevation to which scientists, insurers, and geodesists refer when measuring heights. A generic term such as DEM can be used at most sizes and in most settings because the distinction between bare-earth and surface objects is not significant, and DEMs often have spatial resolutions of 20 m or higher. The more detailed the information within a DEM data file, the smaller the grid cells. Therefore, choose a short grid spacing (or small cell size) if we want to model with great detail.

Table 2.1 DEM sources for different applications at different scales
Source: Charim.net

Application	**Mapping scale**	**Specification**	**EO S**	**EO sources**	**Remarks**
		Horizontal (resolution)	Vertical (Accuracy)		
- Topographic mapping	1:200.000	30 m.	1 m.	SRTM, ASTER	Free download
	1:50.000	10-15 m.	1 m.	WorldDEM / Terra SAR-x, SPOT 5	DEM Derivatives : • Hill-shading • Contour lines / spot heights
	1:10.000	5 m. or <	1 m.	Aerial photo, LiDAR WorldView2 / GeoEye2	
	1:5.000 or larger	1 m.	1 - 0.5 m.	Aerial photo, LiDAR	
- Flood modelling	1: 5.000 or larger	0.5 - 1 m.	0.5 m or <	LiDAR DTM/ DSM	DEM Derivatives: • Slope aspect • Slope form / length • 3-D Visualization
• Landslide mapping	1:2.000 or larger	0.5 m. or <	0.5 m. or <	LiDAR DTM	
• **Coastal** mapping	1:2.000 or larger	0.5 m. or <	0.5 m. or <	LiDAR DTM	
• Other detailed hazard mapping	1:2.000 or larger	0.5 m. or <	0.5 m. or <	LiDAR DTM	
- Elements at risk mapping	1:2.000 or larger	0.5 m. or <	0.5 m. or <	LiDAR DSM	DEM Derivatives: • Height & volume of buildings • 3-D Visualization

Table 2.1 summarises suggested DEM resolutions and Earth Observation sources for topographical mapping and assessing hazards and at-risk objects. If clouds are present in the top portions of the terrain, use radar sources such as the freely accessible SRTM (30 m resolution) or the more expensive WorldDEM data collected by the Terra-SAR-x radar sensor (12 m. resolution). In cloudless, lower-lying terrains, optical EO, such as SPOT 5, WorldView-2, and GeoEye-2, and stereoscopic aerial-photo derived digital

elevation models (DEMs) or pointed data from an active LiDAR system, may be employed.

2.7.1 Type of DEM

There are two distinct DEMs which are digital surface models (DSMs) and digital terrain models (DTMs) (DTMs). Defining Elevation Models (DEMs) use a grid of columns and rows to represent elevation data, a space-saving way to store massive amounts of data. However, vector-based formats are also suitable. Data sets known as triangulated irregular networks (TINs) employ a variable point location method to pin down elevations at known points.

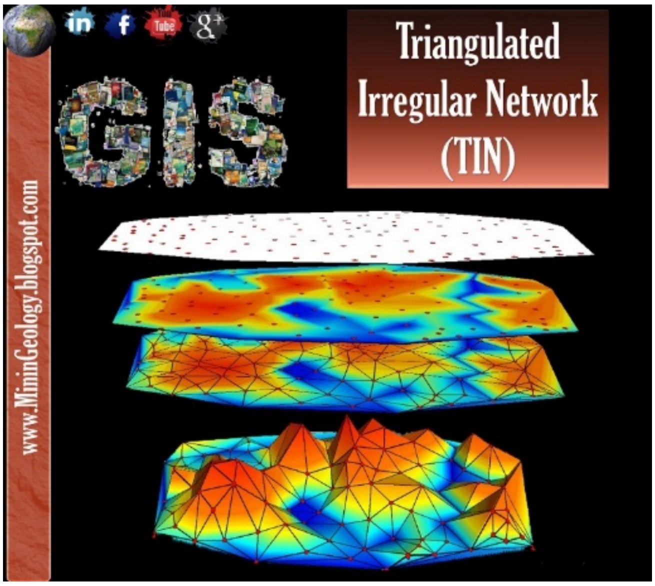


Figure 2.8 Triangulated Irregular Network

Source: Minin Geology

2.7.1.1 Digital Surface Model (DSM)

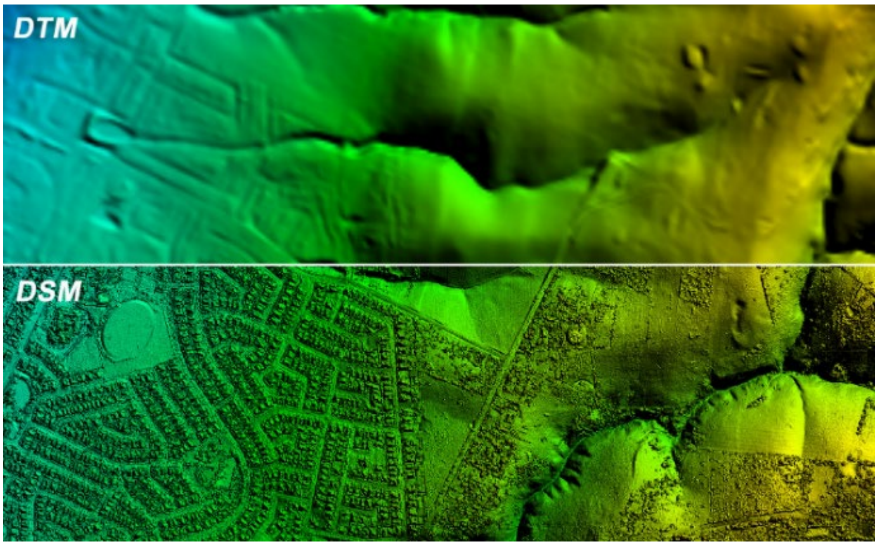


Figure 2.9 Example image for DTM and DSM
Source: Marwaha & Duddy (2021)

A DSM is a digital depiction of an entire surface, including all-natural and manufactured elements, such as vegetation and structures. DSMs depict the observable properties of the Earth's surface. They contribute significantly to urban planning. As urban surroundings change over time due to urbanization, 3D surface models can substantially enhance the understanding and explanation of complex urban circumstances. For example, in aviation and urban planning, DSMs help determine if a planned development will obstruct the view from a runway approach zone. DSMs have also been utilized in visualization, disaster management, navigation, vegetation management, and decision-making, in addition to their typical applications.

2.7.1.2 Digital Terrain Model (DTM)

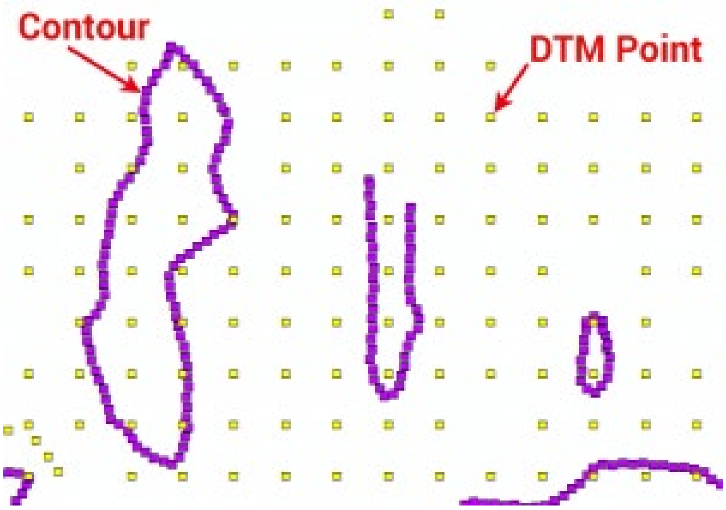


Figure 2.10 Contour and DTM Point
Source: GISGeology

Different terrain mapping (DTM) and digital elevation modelling (DEM) are interchangeable in some regions. DTMs are elevation surfaces that describe the ground level relative to a standard vertical reference datum. However, a DTM has a slightly different meaning in the United States and other nations. A Digital Terrain Model (DTM) is a vector data collection that displays topographical features such as ridges, brake lines and regularly spaced points. A DTM improves the DEM since it accounts for the straight parts of the raw landscape. Digital terrain models (DTMs) can be constructed in several ways, including digitized contours and digital surface models (DSMs), by estimating the difference in height between individual trees and structures and their immediate surroundings. DTMs can be generated using the same techniques as DSMs, including LiDAR, stereo photogrammetry, SAR, DGPS, and ground surveying, with variable degrees of detail.

CHAPTER 3

METHODOLOGY

3.1 Introduction

According to the case topographical variance on the UMP Gambang Campus utilising data from digital elevation models, the process will be carried out in two steps. The first phase will involve the pre-processing of satellite data collecting using QGIS. Then, in Phase 2, the data will be processed, and any required modifications will be applied to guarantee that the final data is accurate. Figure 3.1 show the methodology flowchart.

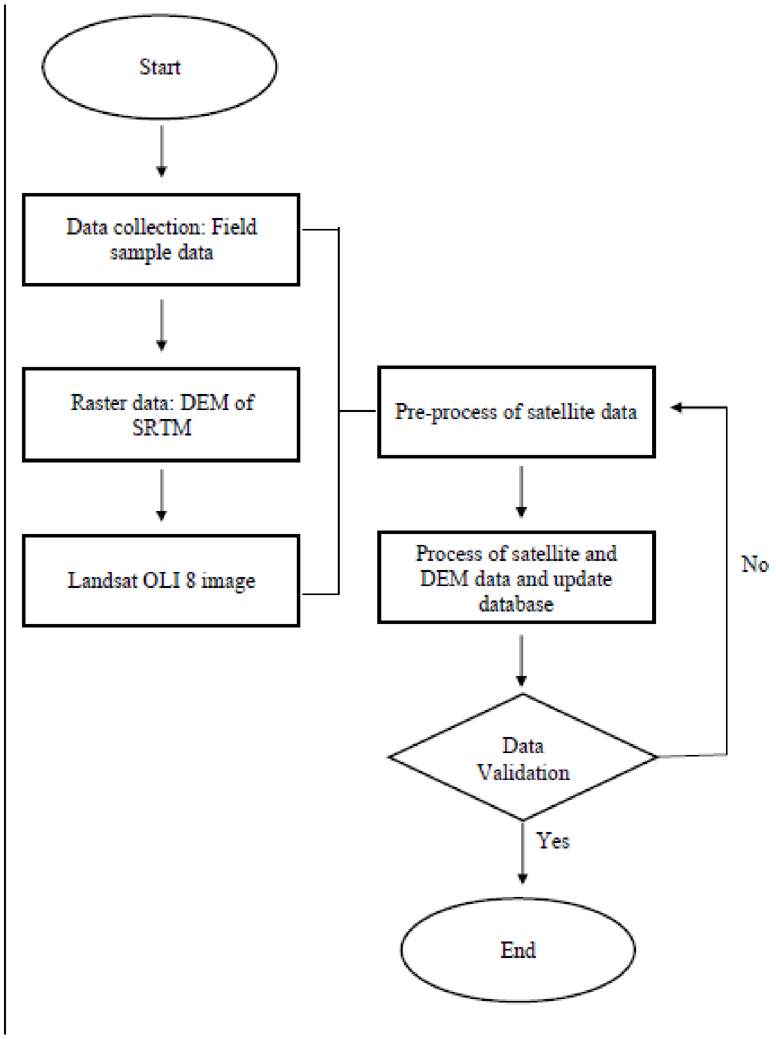


Figure 3.1 Methodology Flowchart

3.2 Raster Data Image

A raster comprises a matrix of pixels or cells arranged in rows and columns or a grid, each containing a value representing some data, like the temperature. Rasters might be digital photographs, satellite photos, or scanned maps. Raster data illustrate physical phenomena such as Thematic data, also known as discrete data, which can be used to represent characteristics such as land use and soils. Next, Continuous data replaces temperature, altitude, and spectral data from sources like satellite and aerial photography. Images include photographs of buildings and digitized maps or drawings. Although thematic and continuous rasters can be seen on a map as data layers alongside other types of geographic information, they are typically used as the basis for spatial analysis performed using the ArcGIS Spatial Analyst extension. Since image rasters can be presented alongside geographic data, they are widely used as characteristics in tables, where they are used to provide additional information about map elements.

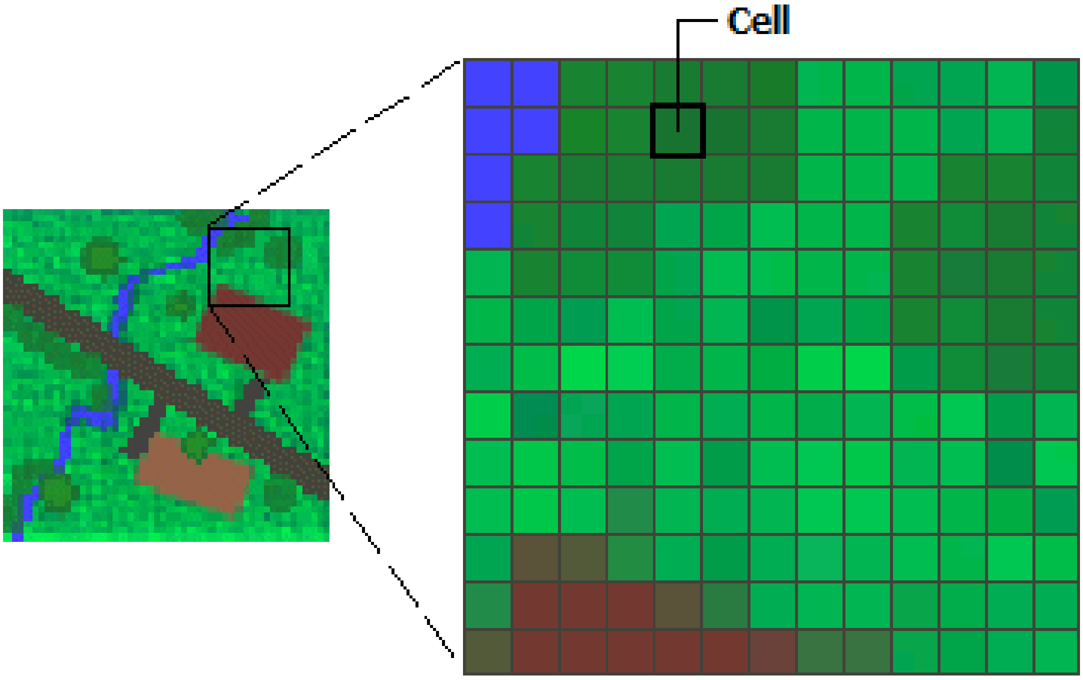


Figure 3.2 Raster data example

Source: ArcGIS.com

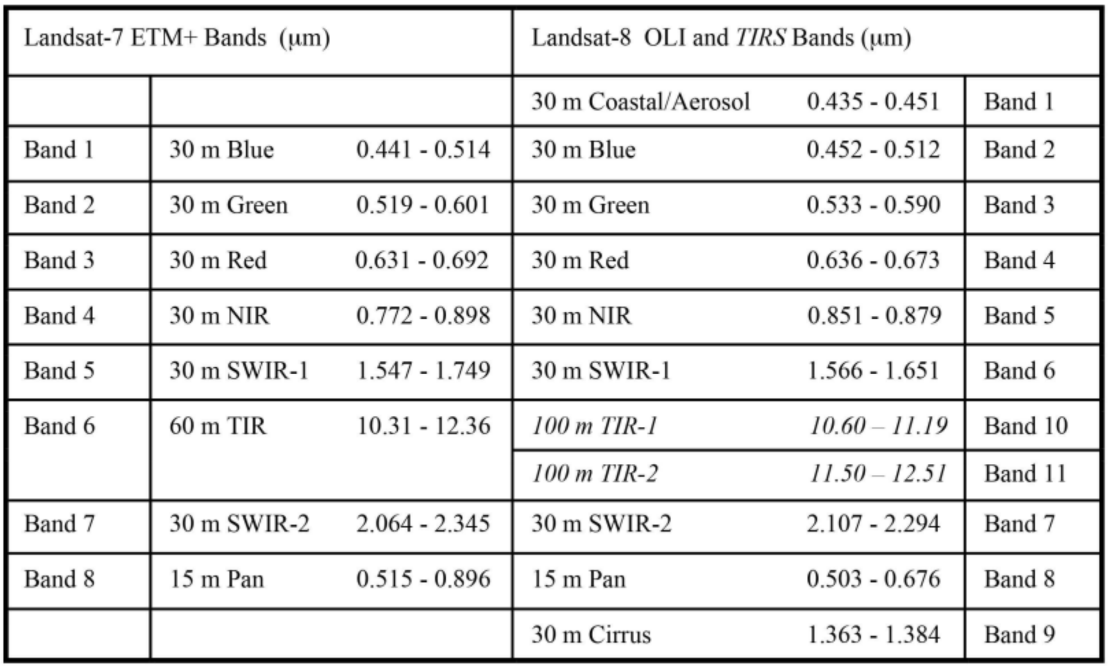
Raster data is frequently displayed underneath other feature layers in a GIS. For instance, including orthophotos as a base map layer gives the map user more information and assurance that the underlying map layers are properly spatially aligned and accurately represent their intended subject matter. Orthophotos from aerial photography, satellite imagery, and scanned maps are the primary inputs used to create raster base maps. Here is a road network raster for use as a foundational map layer. Aside from that, continual data changes throughout a landscape lend themselves well to representation in Rasters (surface). Their surface-based continuity storage solution is highly efficient. A standard grid pattern is also provided to depict surfaces. Surface maps are often used to display elevation data collected from the Earth's surface. Still, other values such as precipitation, temperature, concentration, and population density can also be used to define surfaces that can be examined spatially. Below is an elevation raster, with green cells representing lower elevations and red, pink, and white cells representing higher elevations.

3.3 Raster Data Image

Ball Aerospace & Technologies constructed the Operational Land Imager (OLI) for use on Landsat 8 as a remote sensing device. The next-generation satellite Landsat 8 was put into orbit on February 11, 2013, to replace Landsat 7. The instruments used in Landsat 8 are a significant step forward in technology. Incorporating the technical approach shown by a sensor aboard NASA's experimental EO-1 satellite, OLI is an upgrade to previous Landsat sensors. The OLI sensor is a push-broom type that uses a four-mirror telescope with 12-bit quantization. OLI gathers information over panchromatic, visible, near infrared, and short-wave infrared spectral regions. A five-year lifespan was assumed in its design. The following diagram contrasts the OLI spectral bands with the ETM+ bands found on Landsat 7. With OLI, you may take advantage of two new spectral bands, one optimized for spotting cirrus clouds and another for monitoring the coast.

Table 3.1 Landsat OLI Spectral Bands

Source: B. Markham (July, 2013)



Landsat-7 ETM+ Bands (μm)			Landsat-8 OLI and *TIRS* Bands (μm)		
			30 m Coastal/Aerosol	0.435 - 0.451	Band 1
Band 1	30 m Blue	0.441 - 0.514	30 m Blue	0.452 - 0.512	Band 2
Band 2	30 m Green	0.519 - 0.601	30 m Green	0.533 - 0.590	Band 3
Band 3	30 m Red	0.631 - 0.692	30 m Red	0.636 - 0.673	Band 4
Band 4	30 m NIR	0.772 - 0.898	30 m NIR	0.851 - 0.879	Band 5
Band 5	30 m SWIR-1	1.547 - 1.749	30 m SWIR-1	1.566 - 1.651	Band 6
Band 6	60 m TIR	10.31 - 12.36	*100 m TIR-1*	*10.60 – 11.19*	Band 10
			100 m TIR-2	*11.50 – 12.51*	Band 11
Band 7	30 m SWIR-2	2.064 - 2.345	30 m SWIR-2	2.107 - 2.294	Band 7
Band 8	15 m Pan	0.515 - 0.896	15 m Pan	0.503 - 0.676	Band 8
			30 m Cirrus	1.363 - 1.384	Band 9

TIRS gathers information for two additional small spectral bands in the thermal area, previously covered by a single broad spectral band on Landsat 4-7. With the OLI data as a reference, the 100 m TIRS data is registered to provide radiometrically, geometrically, and terrain-corrected 12-bit data products. In comparison to the 250 scenes every day that Landsat 7 is supposed to acquire for the USGS data archive, Landsat 8 must return 400. Daily scene acquisition rates have been stabling at 725 for Landsat 8 and 438 for Landsat 7. This improves the likelihood of photographing land masses worldwide that are not obscured by clouds. The Landsat 8 picture size is 185 kilometres across and 180 kilometres in length. The standard operating height of the spaceship is 705 kilometres. Data products from Landsat 8 must meet or exceed a cartographic accuracy of 12 m, considering terrain impacts.

3.4 Working with DEM with ArcGIS

The elevation values in a digital elevation model (DEM) are sampled on a regular, rectangular grid, making it a type of geographical dataset. They have several uses in hydrological modelling, 3D visualizations, and terrain analysis. Although DEMs can be stored in various forms, many operations require that they be converted to a raster dataset. While the DEM on your map does depict the topography, it might not be easy to conceptualize at times. This is because it has all the data you need about the topography in three dimensions, but it looks like something other than a three-dimensional thing. A hillside is a raster that maps the terrain using light and shadow to generate a 3D-looking image, and it can be calculated to gain a better look at the landscape.

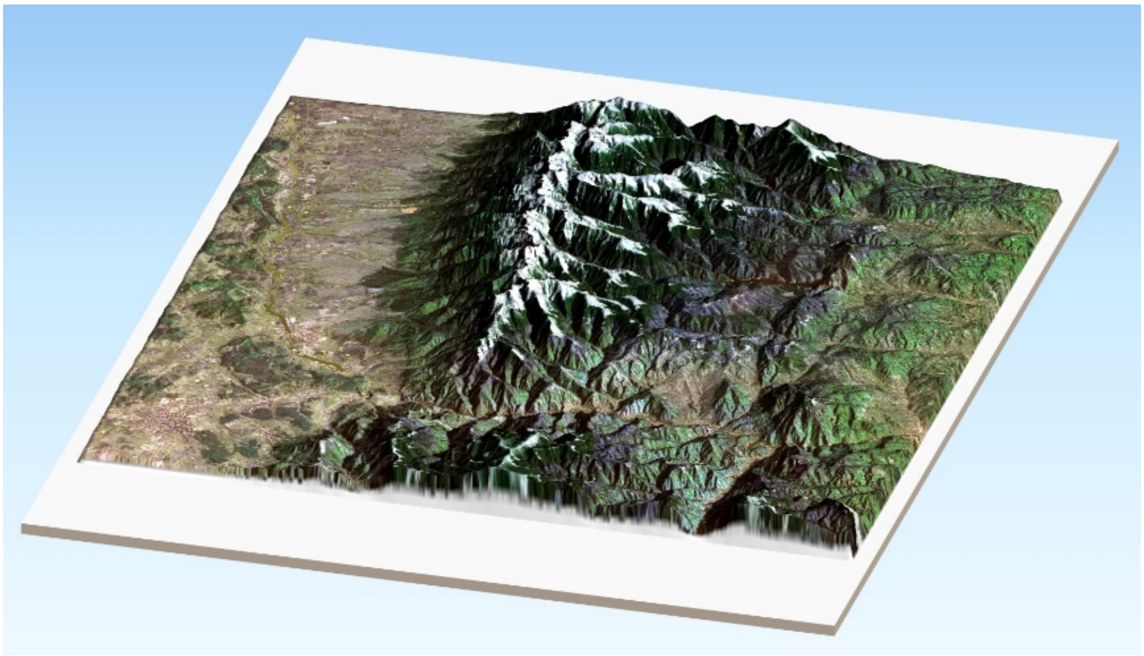


Figure 3.3 3D DEM image

Source: Cimpianu (March 2020)

DEMs and their derivatives can be easily generated using imagery files that include height information in ArcGIS Pro. When a new 3D Scene is created in ArcGIS Pro, the World Elevation Services is made available as a potential data source for presenting topographic information. Additionally, it is possible to import different-resolution elevation data. DEMs from the USGS 3D Elevation Program and the National Elevation Dataset (NED) are two good examples (3DEP).

To produce a DEM, you can drape a 2D raster file over Esri's elevation data in a 3D Scene. For example, let's say you have a multi-band raster image in jpeg format that has been geotagged and covers a particular area. To do this in ArcGIS Pro, create a new folder in the Catalog window. Then, select "Insert" from the menu bar to make a brand-new map. If you open the Catalog window, find the file containing the orthophoto, and then click Add to a new project, you'll have the option to include it in your map. Both the map window and the Contents pane should now display the satellite picture. Including a base, the map will help put the image in its proper spatial context.

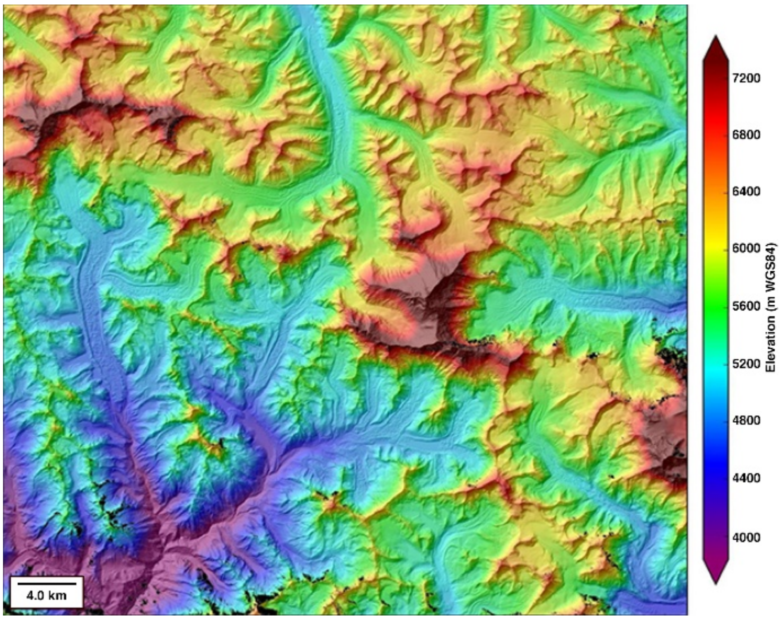


Figure 3.4 2D DEM image

Source: nsidc.org

After that, you may utilize the DEM raster to construct a 3D scene on the 2D map window. Insert to New Map to New Local Scene. In this section, you'll be able to drape the satellite image over any elevation data set you like and examine the resulting image from various perspectives. Dropping the georeferenced picture file from the Catalog window onto the map window causes it to be draped automatically over Esri's elevation data. A DEM is produced, which displays the elevation changes of the ground in three dimensions. Zoom in and spin the graphics to see details.

The Esri elevation data source automatically used when building a 3D Scene is mentioned as Elevation Surfaces, Ground, WorldElevation3D/Terrain3D at the bottom of the Contents pane of the 3D Scene. By selecting "Remove" in the Contents pane of ArcMap, you can use your elevation data, such as a Geo TIFF containing elevation data from the United States Geological Survey. In addition, you can bring back the 3D surface you saw before by clicking Add elevation source under Elevation Surfaces in the Contents pane.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter will explain the results obtained by using QGIS software. In addition, this chapter also contains an explanation of the topography in the study area, which is at UMP Gambang Campus. In this chapter, we will also compare the data obtained using the conventional method. This data comparison will also show how valid the data is. This chapter will end with the conclusion of the chapter.

4.2 Raster Data in GIS Software

Raster data is the most excellent solution for a Geographic Information System (GIS) when showing information that spans a large area. However, it cannot be neatly split down into vector characteristics. The point, polyline, and polygon features can correctly represent certain parts of this terrain, such as trees, roads, and building footprints. However, specific landscape components are more difficult to define with vector characteristics. For example, in the shown meadows, there are a variety of colours and amounts of cover. Creating a single polygon around each grassland region is simple, but this simplification leads to a substantial data loss. Because changing the value of an attribute in a vector feature impacts the entire feature, vectors are not optimal for representing features with various degrees of homogeneity. Another alternative is building polygons for each different grass and ground cover colour. The problem with this technique is the colossal amount of work required to generate a quality vector dataset. Figure 4.1 depicts raster data explicitly created for the UMP Gambang Campus.

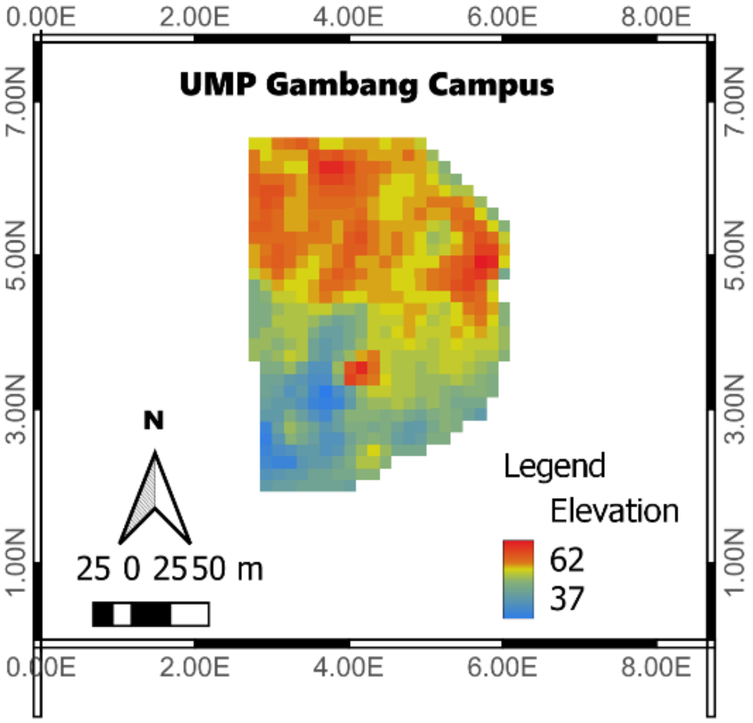


Figure 4.1 Raster data of UMP Gambang Campus

There is a widespread practice of placing raster data beneath a vector layer to provide context for the latter. Due to the human eye's superior picture-interpretation skills, the vector layer's underlying image is utilised to create a more informative map. The figure above shows us red, yellow, and blue, the incline of the terrain, and each has a different value to the elevation. When applied to topography, the colour red indicates an elevated position. The yellow colour is a nearly slopy area but for blue colour is a flat area. While this may sound like a lot, the distance between each area of the pixel is relatively small when you see the final numbers.

4.3 Raster Data in GIS Software

Using the raster data, I could categorise the area into seven distinct types, each representing a specific type of topography. Classes include nearly flat, gently sloping, gently sloping, strongly sloping, moderately sloping, and very sloping. Each pixel's size in the raster data is considered while determining the total area. The area measured in hectors comes out to 123.0 hectors, according to my estimates. Table 4.1 details the whole area for each classification.

Table 4.1 Area of Topographic Category

Topographic Category	Estimated Area (ha)
Nearly Level (Flat)	26.65
Gently sloping	32.82
Moderately sloping	24.62
Strongly sloping	19.32
Moderately steep	12.97
Steep	4.50
Very steep	2.12
Total area (UMP Gambang Campus)	**123.00**

In Table 4.1, you'll find the results of my labours processing DEM data across seven categories. After analysing the terrain, I can confidently declare that the UMP Gambang Campus features a large amount of flat and gradually sloping terrain. This information demonstrates that the UMP Gambang Campus has a favourable topographic elevation since it allows for additional development without considering the topography. Saving money on soil-layering costs means less money is spent on new construction. Based on the data in table 4.1, the topography of the UMP Gambang Campus is relatively low due to the area's lower elevation. However, it is still not particularly hazardous because the slope is barely below 45 degrees.

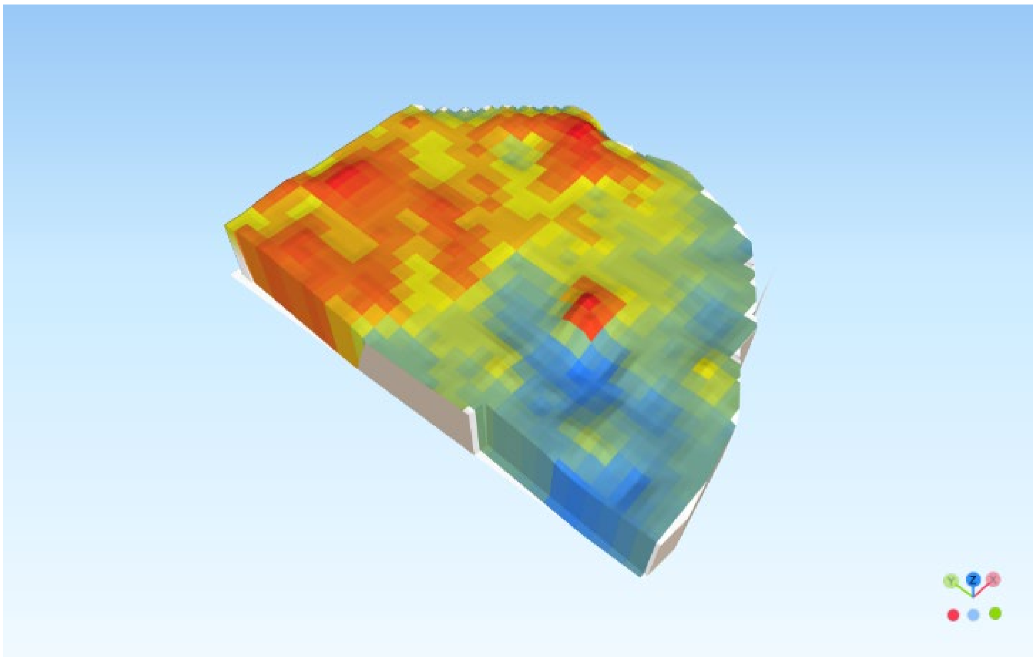


Figure 4.2 3D images of DEM data

Moreover, a review of figure 4.2 reveals that the UMP Gambang Campus topography is not overly steep, as it does not depict such high ground and instead portrays the area as gently sloping. This confirms the raster data analysis I conducted using QGIS and yielded the results shown in table 4.1. In conclusion, the UMP Gambang Campus can create a new infrastructure where everyone can access sustainable, resilient resources to construct a safe for alligend with SGD 9: Industry, Innovation and Infrastructure.

4.4 Comparison Data Collection

This study aims to examine the similarities and differences between the outcomes achieved using DEM data and those using the more traditional land survey methods and the more cutting-edge drone technology. These two approaches need to be compared with the data to measure how much more accurate the new approach is compared to the old one. Another explanation for the difference in the results of the three comparisons is that, as one might expect, the DEM was captured from space. In contrast, the topographic data from the land survey and drone at about ground level.

Table 4.2 Result Comparison with modern method and conventional method

Topographic Category	**Estimated Area (ha)**		
	Levelling Survey	**Drone Technology**	**DEM**
Nearly Level (Flat)	17.67	23.12	26.65
Gently sloping	31.83	31.98	32.82
Moderately sloping	36.21	30.15	24.62
Strongly sloping	26.70	22.45	19.32
Moderately steep	2.47	8.54	12.97
Steep	5.72	5.23	4.50
Very steep	5.13	4.35	2.12
Total area (UMP Gambang Campus)	**126.00**	**125.82**	**123.00**

Levelling survey, drone technology, and digital elevation model (DEM) data are compared in Table 4.3. Our study location is the UMP Gambang Campus, and all three approaches aim to determine the current topographic conditions there. Since a location's terrain will always change with time and weather, studies using all three methodologies over the same time frame have produced results that are not far different. Therefore, to maximise our efficiency, we've decided to run simultaneously. A levelling survey has obtained a horizontal cross profile in the land survey method. Agisoft Metashape is used in drone technology to merge images into a 3D drone model. The photo shows the campus terrain of UMP Gambang Campus.

Table 4.3 shows that all approaches produce comparable results across all measure types. However, the vast distance achieved by these three techniques could be better. Based on the findings of the levelling study, the total area of the UMP Gambang Campus is 126 ha. While DEM was able to map out 123 ha of land, drone technology was able to map out 125.82 ha. But the levelling survey is the most precise because, logically speaking, we must visit the place to level it physically. From this point of view, we may determine whether the terrain is inclined. Although the three approaches provide distinct outcomes, they are all usable because the gap between them is relatively small.

In conclusion, this data comparison reveals that the UMP Gambang Campus is situated on relatively level ground. Table 4.3 shows that regardless of which method is used, the resulting data indicates that the UMP Gambang Campus is located on very level ground. Data levelling findings indicate that the UMP Gambang Campus is moderately sloped, with a size of 36.21 ha. For drone technology and DEM, gently sloping data is the highest, with readings of 31.98 hectares and 32.82 hectares. The terrain at UMP Gambang Campus generally consists of gently sloping sections followed by level areas. As far as my eyes can tell, the UMP Gambang Campus is entirely covered by flat ground with a gentle slope.

CHAPTER 5

CONCLUSION

5.1 Introduction

The conclusion of the study result was reached in the previous chapter, which was Chapter 4. In this chapter, the conclusion was presented as an overall overview for the study to highlight the fact that the purpose had been accomplished. These recommendations are presented as potential enhancements to this research study.

5.2 Conclusion

In conclusion, this study achieved its goal by obtaining 2D and 3D DEM images. Using satellite imagery, we could classify the UMP Gambang Campus's topography into seven different topographic categories, ranging from relatively flat to very steep. Comparing data with levelling surveys or traditional methods yielded the same results for the second goal. Based on the findings of the comparison, it has also been determined that the conventional approach is more accurate than the modern way, including drone technology and digital elevation models. This is because we will need to visit the site to conduct the levelling survey method physically, and only then will we be able to assess the actual state of the land.

While the accuracy of the modern method is lower than that of the traditional one, this does not rule out its usage. However, due to its low cost and time-saving capabilities, anyone seeking topography data about a location still prefers the current approach. The traditional method is time-consuming and expensive because it calls for the services of a professional surveyor. Therefore, companies looking to cut costs have found that the current approach is the way to go. Finally, the conventional method, the levelling survey, delivers the most accurate results.

5.3 Recommendations

This research aims to create a topographic map of UMP's Gambang campus. QGIS was used extensively to calculate the UMP Gambang Campus's topographic elevation. It's suggested that another study implement various software like Earth Explorer to compare the data between software. To determine which software, perform better and are better suited to the study. One further suggestion is to use the largest area necessary. Since satellites had too far to get a good look at a limited area, the quality of the image it sent back would decrease, and the accuracy of the information would be affected. Therefore, if we take a larger, more representative sample, the results will be more accurate. This is because the higher-quality images produced by a larger selection will indicate the actual situation. Further study must identify more details about the transition from the relatively flat to the extremely steep terrain.

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APPENDICES

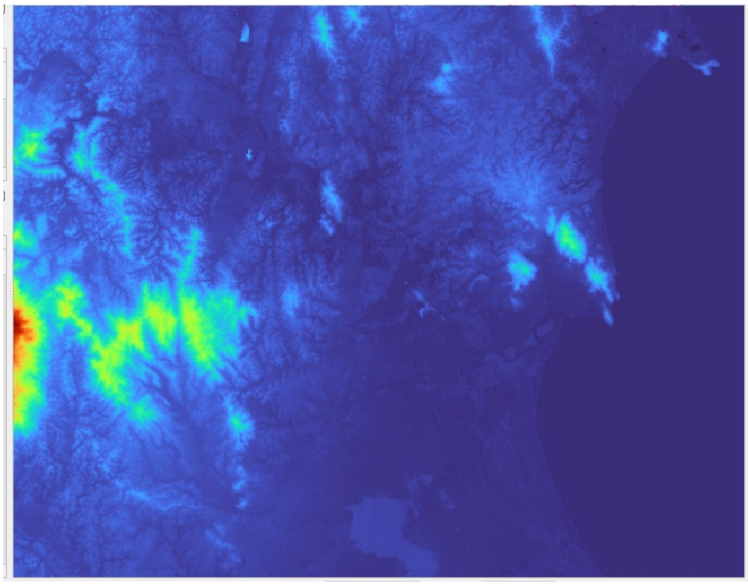
Appendix A :

Levelling Survey Fieldwork

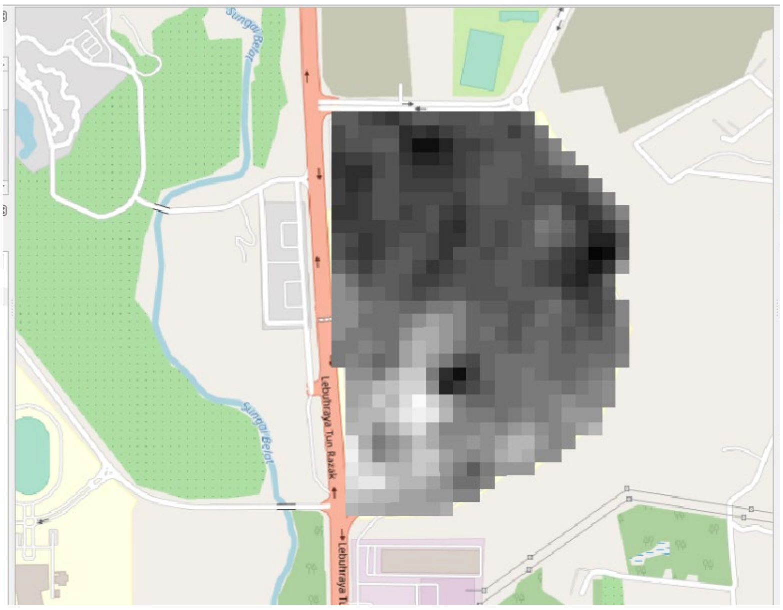
The above picture shows the levelling survey data collection in progress. It takes three weeks to finish levelling the area around UMP Gambang Campus. In the above image, you can see surveying taking measurements for the levelling procedure. It took three weeks to finish levelling the area around the UMP Gambang Campus.

Appendix B :

Raw data of DEM from GIS software



This figure shown the elevation of Kuantan. This is a raw map before proceeding to the clipping process that need to focus on Area of Interest (AOI).



This figure after done the clipping process. This figure shown the Area of Interest which is UMP Gambang Campus. After this process, this map can classified into few class of elevation in the area of the grey colour.