INTERNSHIP TRAINING REPORT

INTER UNIVERSITY CENTRE FOR GEOSPATIAL INFORMATION SCIENCES AND TECHNOLOGY, UNIVERSITY OF KERALA, KARYAVATTOM CAMPUS

MEGHA KENNADY
6151100012

Submitted to the University of Kerala in partial fulfilment of

the requirement for the degree of

Master of Science in Environmental Sciences

RESEARCH CENTRE AND POST GRADUATE DEPARTMENT OF ENVIRONMENTAL SCIENCES

ALL SAINTS' COLLEGE

UNIVERSITY OF KERALA

THIRUVANANTHAPURAM

CERTIFICATE

This is to certify that **Ms. Megha Kennady**, Second year MSc Environmental Sciences student, All Saints' College, Trivandrum has done a one month long internship programme under my guidance at the Inter University Centre for Geospatial Information Science and Technology (IUCGIST), Kariavattom Campus, University of Kerala during the period from 25th April 2022 to 25th May 2022.

5/9/2023

Prof. (Dr.) Rajesh Reghunath
Director, IUCGIST
University of Kerala

INTER UNIVERSITY CENTRE FOR GEOSPATIAL INFORMATION SCIENCE AND TECHNOLOGY ★ UNIVERSITY OF KERALA ★ KARIAVATTOM CAMPUS, TVPM-695 581

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DECLARATION

I hereby declare that this internship training entitled " GIS Essentials: Mapping and Spatial Analysis Training" is a record is a record of work carried out by me in partial fulfillment of the requirement for the degree of Master of Science in Environmental Sciences and that no part of this work has previously been presented for any other degree or diploma in any university.

September 2022

Thiruvananthapuram   Megha Kennady

ACKNOWLEDGEMENT

I bow down before the God almighty for having blessed me with such an opponunity, strength and confidence for completing the Study.

I extend' my profound gratitude to the Head of the Department of Environmental Sciences, Dr. Reshma J K, All Saint's College for helping in completing the study.

I deeply indebted to Dr. Rajesh Reghunath, Director, IUCGIST University of Kerala for his scholarly advice and suggestions, as well as for allowing me to use the lab facilities needed for this work's geospatial analysis. The help and support provided by Mrs.Vineetha P, a faculty member of the IUCGIST University of Kerala, is also thankfully acknowledged

I am also thankful to our teachers and our friends who helped me directly or indirectly in the completion of the internship work.

Last but not the least I am greatly indebted to my parents, other family members, friends, and well-wishers for their love, encouragement, and moral support.

CONTENTS

INTRODUCTION

Geographic Information System (GIS) captures, stores, analyses, manages and presents data, which is linked to locations or having spatial distribution. It is a computer – based system with four sets of tools for managing georeferenced information.

These includes,

Data capture: graphic data (digitized, converted from existing data) and attribute data (Keyed in, loaded from existing data files)

Data storage and manipulation: file management and editing.

Data analysis: Database query, spatial analysis and modelling.

Data display: maps and reports

GIS is run on all spectrums of computer systems ranging from personal computers to multi – user supercomputers, and are available in a wide variety of software languages. GIS is a useful tool for data integration, automated mapping and information analysis. Large volume of data is directly and conveniently accessible using the powerful GIS software, tools in problem – oriented systems. They can show and interpret the data in a way that is directly understandable and helpful for decision – making processes, supporting their interactive analysis. Different data kinds that are located in the same geographic area can be managed by a GIS. The main benefit of GIS is that it makes it simple to read, analyse, and determine the spatial relationships between many layers of spatial data presented as maps and satellite pictures. The goal of GIS is to supports and make decisions for the management and efficient conservation of natural resources more confidently.

Remote sensing (RS) technology was created much earlier than geographic information systems (GIS). RS gathers data about physical objects via measurements taken at a distance, without actually coming into contact with the object. Three phases of remote sensing technology can be identified: (i) gathering data from a sensor deployed on a platform, such as a satellite; and (ii) managing the data: (iii) data interpretation that results in the creation of thematic maps of the surfaces under investigation. A source, interactions with the earth's surface, interactions with the atmosphere, and a sensor make up an electromagnetic radiation-based remote sensing system. The sun’s reflected light and the earth’s heat are examples of natural sources of electromagnetic radiation, while microwave radar is an artificial one. The features of the objects affect the earth’s surface interaction, which determines the quantity and nature of radiation emitted or reflected from the earth's surface. A sensor, like a radiometer or camera, records the electromagnetic radiation that has interacted with the atmosphere and the earth's surface. Electromagnetic energy travelling through the atmosphere is bent and scattered, and this phenomenon is referred to as atmospheric interaction.

The earliest kind of remote sensing was aerial photography, which is still the most popular form of remote sensing even in the era of satellites and electronic scanners. Aerial photography is the process of taking pictures of the earth's surface using a camera mounted on an aeroplane or balloon. These images are quite helpful for creating large-scale maps. Radar is used to gather aerial sensor imageries. Remote sensing by satellite is a modern invention. The design of remote sensing satellites is based on the intended use, such as the analysis of the earth's resources, meteorology, communication, or military objectives.

The Landsat series from the United States, the SPOT satellite series from France, and the IRS series from India are the most frequently used earth resource satellites. These contain a variety of scanners, including Multispectral Scanner (MSS). Topical Mapper (TM). Scanner that is panchromatic (PAN). scanner with high resolution visible (HRV). Wide Field Scanner (WIFS), Linear Imaging and Self Scanning (LISS) technology, etc. The most popular meteorological satellites are NOAA, NIMBUS, GOES Meteos, and Himawari. The satellite company or its designated receiving stations are where the user countries can purchase satellite data in digital or graphical format directly. GIS tools can digitise and analyse remote sensing data to produce exact outputs in a variety of formats. Land use planning and management, natural resource management (land, water, agricultural, and fishery), forestry and wildlife management, soil degradation studies, and enumeration area mapping are the main applications for GIS and RS. Natural hazard mapping, disaster forecasting and management, environmental impact studies, mineral exploration, etc. Globally, the use of GIS and RS for resource planning and management, both of natural and artificial resources, is rising quickly.

Internship is an integral platform for anyone to gain experience in an actual workplace. An internship was done at Inter University Centre for Geospatial Information Sciences and Technology, University of Kerala, Karyavattom Campus during the period 22nd April 2022 to 10th June 2022 on Remote Sensing and GIS. GIS is a computer – based tool for mapping and analysing features and events on earth. It integrates common database operations, such a query and statistical analysis, with maps. On the other hand, remote sensing is the science of collecting data regarding an object or a phenomenon without any physical contact with the object. The data collected through remote sensing is integrated into GIS. It was a good opportunity for us to improve our general research and GIS research skills, to prepare and use data for GIS analysis and to present the analysis. The internship was significant and beneficial because it developed skills that are marketable, required in the workplace, and increased critical thinking skills.

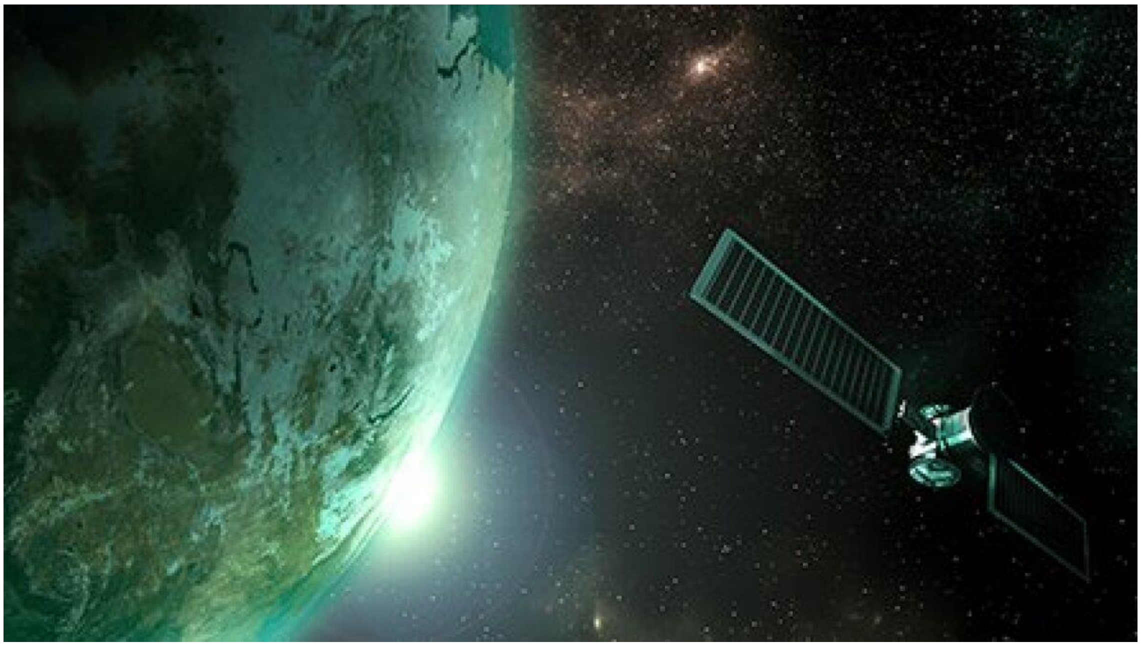
The theory sections of the internship help us to learn about the concept of GIS and Remote Sensing. During the later sessions, we learned about the ArcGIS software and their operational features which allows the storage, handling and analysis of the geographical information. ERDAS Imagine software was used to learn about the classification of the Land Use/ Land Cover classes and for the LULC map creations. Several other operations are also learned related to our researches like georeferencing, LULC map creation, LST calculation, Vegetation Indices calculation, Shore line fluctuation analysis, Buffer map creation etc.

The internship was a continual process of learning and evaluation. We learned about GIS program, GIS analysis tools, and how to utilize GIS and Remote Sensing capabilities in our research were also learned. The internship was a constant progression of learning and evaluation, that was supported by critical thinking.

ABOUT THE HOST INSTITUTE

The Inter University Centre for Geo-spatial Information Science and Technology (earlier it is known as Centre for Geo-Information Science and Technology) was established in 2008 as a joint venture of the University of Kerala, the Department of Science and Technology, Govt. of India and the Kerala State Council for Science, Technology and Environment. This inter-institutional, inter-disciplinary centre envisages geo-information management and capacity building in geo-spatial information infrastructure. Hon'ble Chief Minister of Kerala Sri. V. S. Achuthanandan inaugurated the centre on 17th March 2008. The centre has already developed a pilot-scale scalable architecture for well-enabled spatial data management and has launched map services.

The centre has a post-masters PG Diploma programme in Geo-Information Science and Technology, a full-time two-semester course consisting of specialized training in remote sensing, photogrammetry and GIS. In addition to this, the centre conducts short term training programmes and training workshops for the researchers, officials and end-users.



LEARNING OUTCOMES

During the first week, we had a theory section on GIS and remote sensing by Vineetha P, Lecturer at Inter University Centre for Geospatial Information and Technology. It really helps us a lot to understand about the concept of GIS and remote sensing. Remote sensing is one of the methods commonly used for collecting physical data to be integrated into GIS. Remote sensors collect data from objects on the earth without any direct contact. They do this by detecting energy reflected from the earth, and are typically mounted on satellites or aircraft.

Then we were introduced to ArcGIS software and its operational features. ArcGIS is a geographical information system (GIS) software that allows handling and analysing geographical information by visualizing geographical statistics through layer building maps like climate data or trade flows. In ArcGIS, we had learnt how to georeference toposheets. Georeferencing is a process of establishing a mathematical relationship between the image coordinate system and the real-world spatial coordinate system.

To perform image to image georeferencing first add a topographic map and then right-click Table of Contents, select a target layer (the referenced dataset), and click Zoom to Layer. Then on the Georeferencing toolbar, click the Layer drop-down arrow, and select the raster layer to be georeferenced. Click Georeferencing > Fit to Display. This displays the raster dataset in the same area as the reference layer.

Click the Control Points tool to add control points. To add a link, click on a known location on the raster dataset and on a known location on the referenced data. Notice the image shift with each control point added. Add as many controls as needed until the data are aligned correctly. Click Georeferencing > Update Georeferencing to save the transformation information with the raster dataset. This creates a new file with the same name as the raster dataset, but with an AUX file extension. It also creates a world file for TIFF and IMG files.

Calculation of vegetation indices using raster calculator were also done using ArcGIS. The Normalized Difference Vegetation Index (NDVI) measures the greenness and the density of the vegetation captured in a satellite image. Healthy vegetation has a very characteristic spectral reflectance curve which we can benefit from by calculating the difference between two bands – visible red and near-infrared.

During the following days, we were also taught about bubble map and how to create it. Bubble Map is all about symbolizing layers to represent quantity, as it mostly works in the same way as quantity map. Bubble map uses range of coloured bubbles of different sizes in visualization of data and is also known as a “graduated marker map”. A bubble map shows circular markers for points, lines, and polygon features of different size. The bubble sizes are based on a selected numerical attribute value from user’s uploaded layer.

Towards the last days of our internship, we learned about the creation of a Land Use/Land Cover (LULC) map. The term Land Use/ Land Cover is used together but each term has got different meanings. Land cover refers to the surface cover on the ground like vegetation, urban infrastructure, water, bare soil, etc. Identification of land cover establishes the baseline information for activities like thematic mapping and change detection analysis. Land use refers to the purpose the land serves, for example, recreation, wildlife habitat, or agriculture. Land Use Land Cover (LULC) maps of an area provide information to help users to understand the current landscape.

1. Georeferencing

In ArcGIS, we had learnt how to georeference toposheets. Georeferencing is a process of establishing a mathematical relationship between the image coordinate system and the real-world spatial coordinate system.

a) Image To Image Georeferencing

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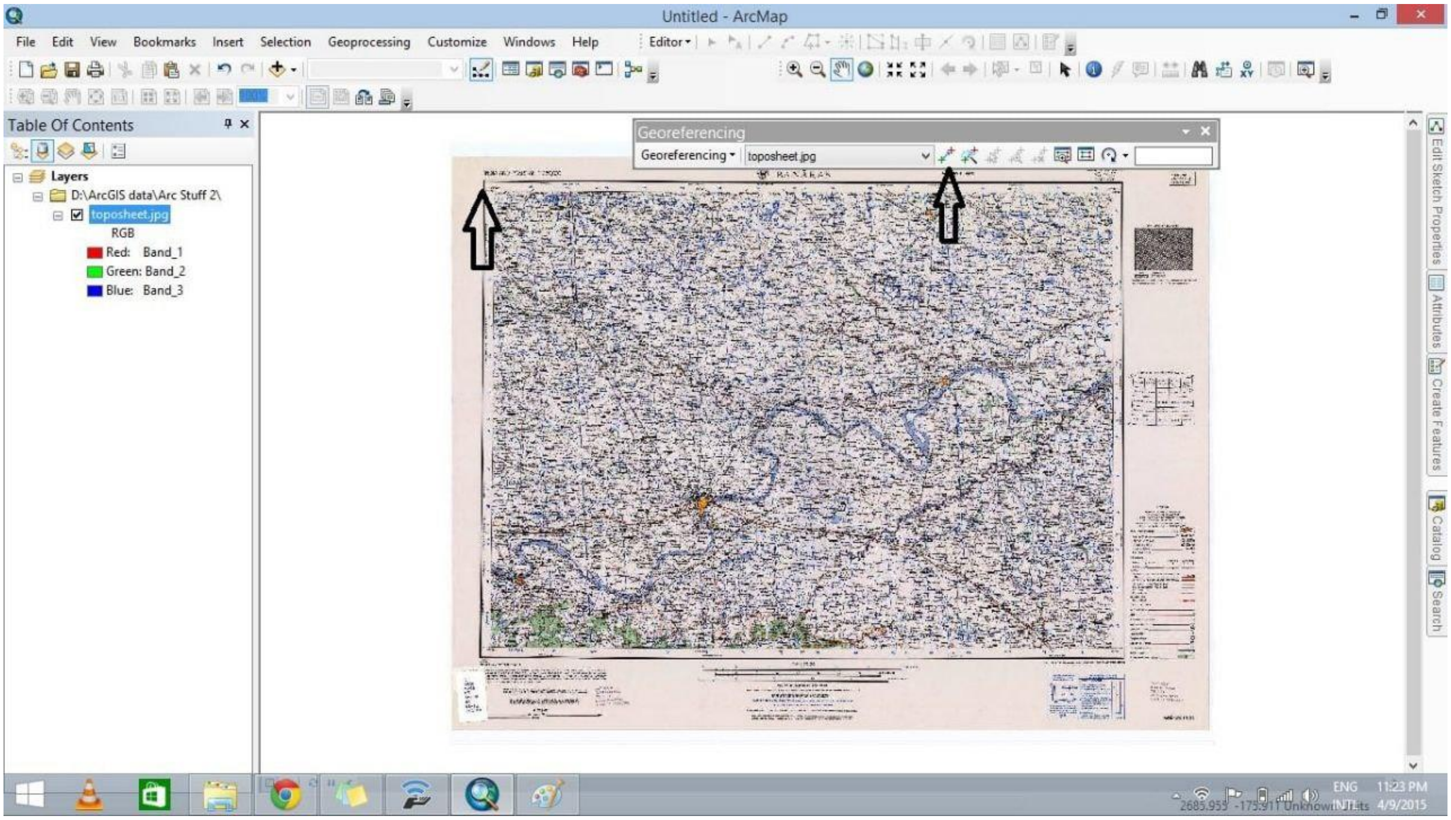
- This creates a new file with the same name as the raster dataset, but with an AUX file extension. It also creates a world file for TIFF and IMG files.

b) Ground To Image Georeferencing

- To perform ground to image georeferencing, from the right-side Catalog window, drag the unrectified image to the map.
- Then Click the Add Control Points tool, click anyone cross point of this unreferenced image to add the source coordinate of the 1st link.
- Click the right button of the mouse and select Input X and Y option from the pop-up window.
- Coordinates dialog box appears, enter the longitude(X) and latitude(Y) value. Then click OK, follow the same technique and add additional three links for the other three cross points.

- Click the View Link Table(i) to evaluate the transformation. Input any wrong point or value choose select link(ii), select a point, and then press the delete button on your keyboard
- Select the Georeferencing dropdown menu and click Rectify. Save as window is appears, change the output location and also change name and file format, and click save
- Select the unreferenced image from the TOC (Table of Content) window and remove it. Now Save changes to the existing map window is open, click No button. Because now you don’t need to save this map.
- Before adding the rectified image in the catalog window select rectified image, click the right button to choose Properties.
- Scroll down the Raster Dataset Properties window, on the Spatial Reference Section, click Edit button.



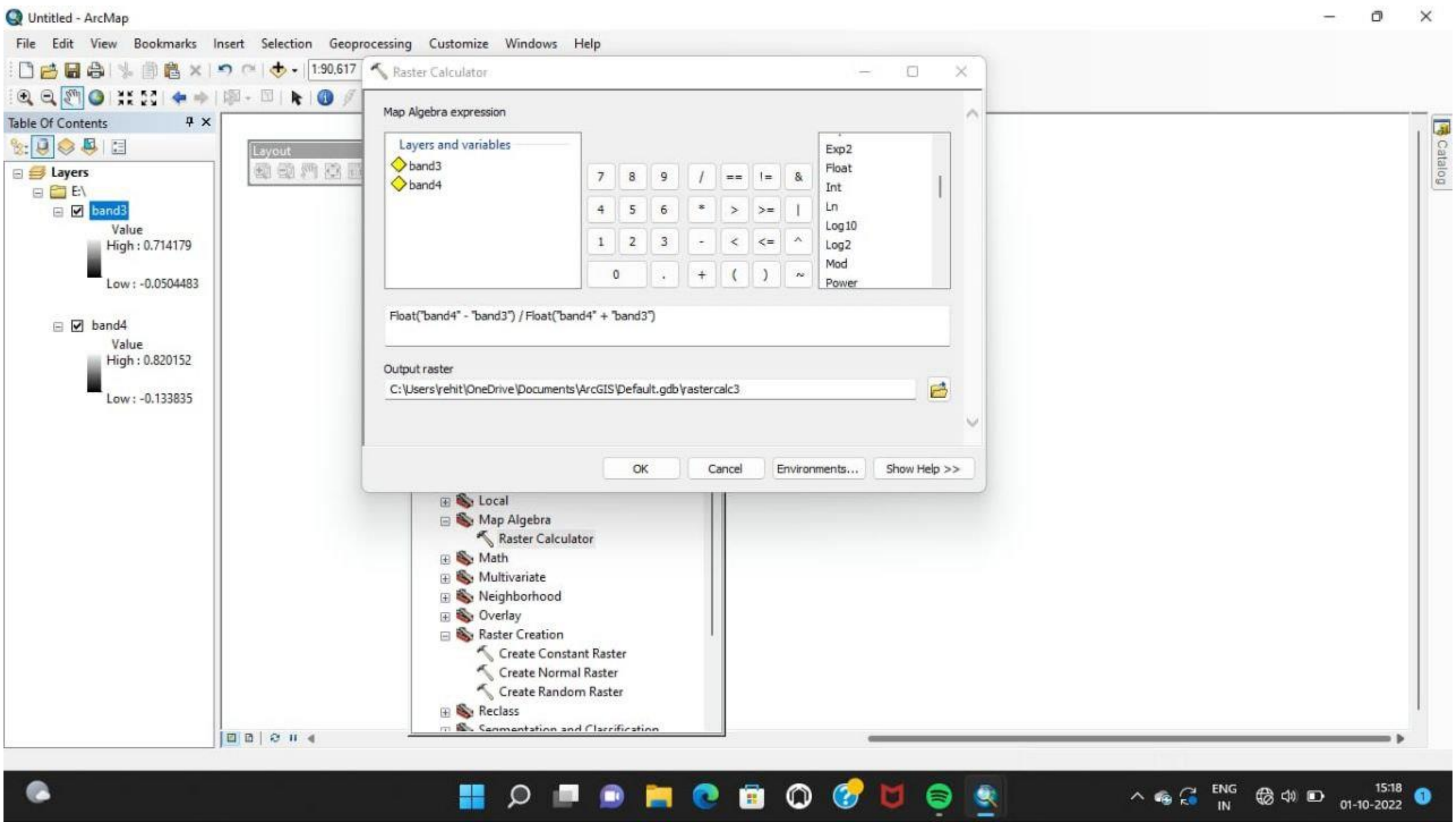
Georeferencing of a toposheet

2. Vegetation Indices Calculation

Calculation of vegetation indices using raster calculator were also done using ArcGIS. Vegetation indices (Vis) are the quantitative measure of biomass or vegetation vigour that is usually formed by adding, dividing, or multiplying the values of several spectral bands to get a single value that represents the amount or vigour of vegetation. Vegetation indices are a staple remote sensing product and the normalized difference vegetation index (NDVI) may be the most widely used vegetation index. To calculate NDVI you simply need appropriate imagery and a program that allows you to interact with the image data

Steps involved in the calculation of NDVI are the following.

- Open ArcMap and add satellite images band 4 and band 5 for calculating NDVI.
- Open Arc toolbox in ArcMap
- From the Arc toolbox open Raster calculator (Arc toolbox >Spatial Analyst tool > Map Algebra tool > Raster Calculator tool)
- When the raster calculator has finished running the resulting NDVI layer will be added to the ArcGIS interface. NDVI will be displayed as a grayscale image.



Calculation of Vegetation Indices

3. Bubble Map

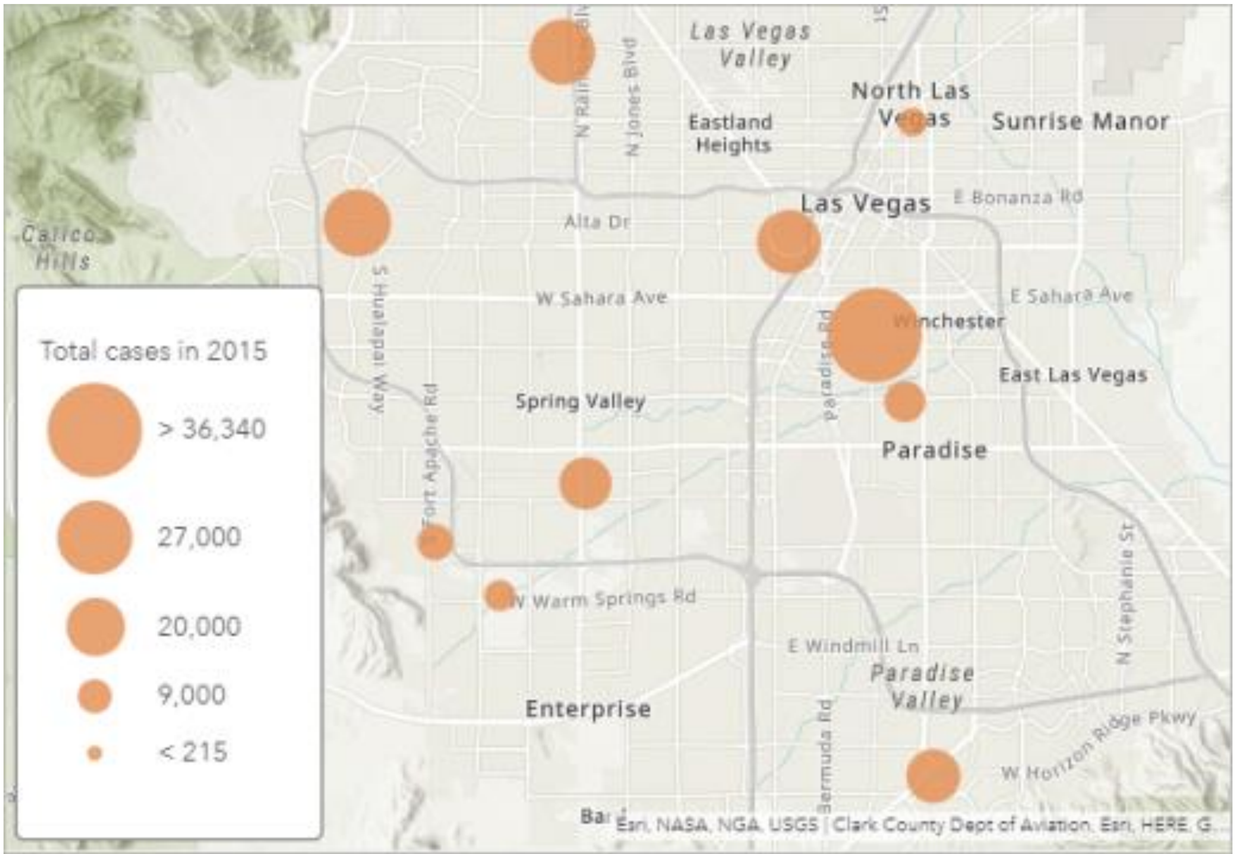
Bubble maps provide a means of graphically representing attributes and analyses associated with specific wells. Bubble maps are represented as layers within the GIS tab, and can be selectively enabled or disabled like other layers. To create these graphic representations, a coloured shape is overlaid on the entity. Both the colour and the shape reflect one of the properties associated with the entity. As the value of the property changes, the colour changes within a set range. In more complicated cases, multiple properties can be associated with different settings including variations in colour, size, angle, and shape, according to the scale you set.

The different steps involved in creating a bubble map the following:

- To add / create a bubble map, start by selecting wells for the bubble map. In the GIS Configuration pane, click the + icon and select Add Bubble Map Layer.
- Type a name for your bubble map layer and click Next. If you create a bubble map with the same name, a number is incrementally added to the name.
- Each tab in Preferences enables you to customize a different property that varies with well properties.
  - ➢ **Show in Legend** — select whether this property is displayed in the legend. If the property is using a variable colour setting, by default, the property is displayed in the legend.
  - ➢ **Fixed Colour / Size / Angle / Shape** — all wells show the same property, as set in the dialog box.
  - ➢ **Variable Colour / Size / Angle / Shape** — select an attribute or analysis result on which to vary the property. When selecting analysis results, an analysis name must also be selected.
  - ➢ **Parameter Type:**
  - ➢ **Ranged** — the colour, size, etc. displayed corresponds to a range of property values for each parameter.
  - ➢ **Set Point** — the colour, size, etc. displayed corresponds to a specific value for each parameter.
  - ➢ **Transparency** — use the slider to set the level of transparency / opacity for your bubbles.

- **Auto Range** — for each ranged property, Harmony Enterprise automatically detects the appropriate range and division to separate values.
- **Reset Ranges** — reverts back to a previously saved range, or to the default values.
- **Change** — when you click this button, the <Colour> Attribute: a property dialog box opens.

- Select the attribute / result from the tree structure.
- To edit an existing bubble map, right-click it in the tree structure and select Options. If you click Variable Colour Settings, the Change button is enabled and you can set the <colour> for a specific attribute.
- To add wells to an existing bubble map, select the well, right-click it and select Bubble Map, Add to <bubble map name>.

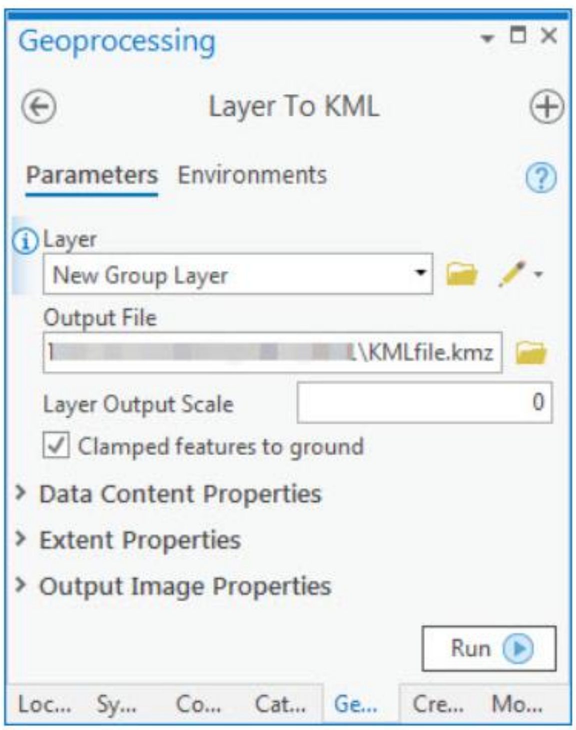


Representation of a Bubble Map

4. Conversion of Shapefiles to KML in ArcGIS

The major steps involved includes:

- In the Geoprocessing pane of ArcGIS, click Toolboxes, and navigate to Conversion Tools > KML > Layer To KML
- In the Layer drop-down list, select the shapefile or the layer group containing the shapefiles.
- Set a name and location for Output File.
- Set other parameters as desired, and click Run.
- The converted KML file is located in the specified output location with a .kmz extension (compressed or zipped KML files).
- On double clicking the file, it opens in Google Earth App.



Toolbox for creating a KML layer

Representation of a shapefile in Google Earth

5. Land Surface Temperature

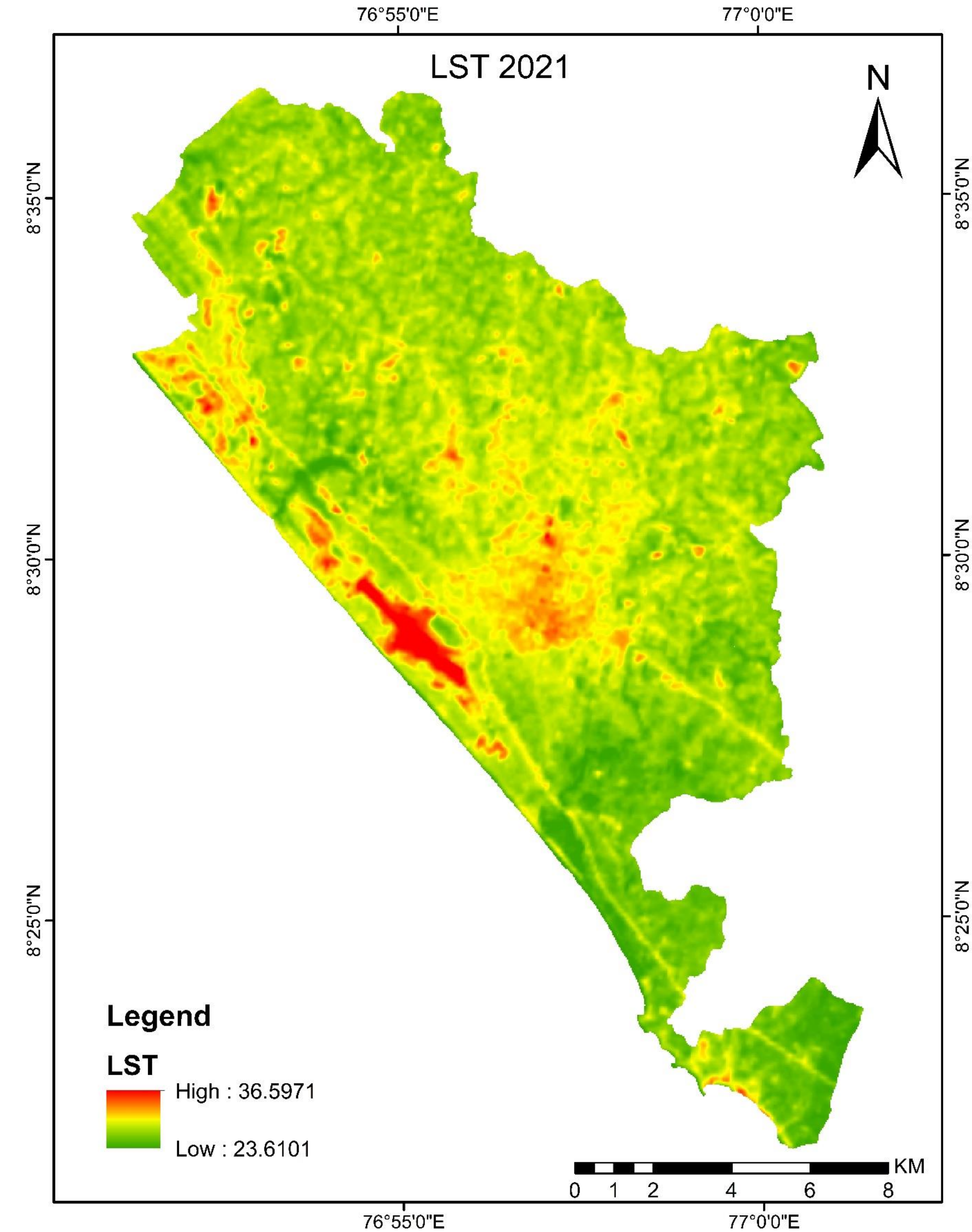
Remote Sensing (RS) and Geographic Information System (GIS) have found wide application areas in climate change analyses also this can be used for LST calculation. There are various sensor whose data is useful in generating LST such as advanced very high resolution radiometer (AVHRR), moderate resolution imaging spectroradiometer (MODIS), Landsat – 8 and many more.

The calculation of Land Surface Temperature using the Landsat 8 thermal bands are done using six steps:

- Calculation of Top of Atmospheric spectral radiance
- Top of Atmospheric spectral radiance to Brightness Temperature Conversion
- Calculation of Normalized Difference Vegetation Index
- Calculation of the proportion of vegetation
- Calculation of emissivity
- Calculation of Land Surface Temperature

The estimation of Land Surface Temperature using Landsat 5 thermal bands includes the following steps:

- Conversion of DN to Radiance
- Conversion of Radiance into Brightness Temperature in Kelvin
- Conversion of Degree Kelvin into Degree Celsius



Land Surface Temperature Map

CONCLUSION

The internship was a useful experience. We have learned many about Remote sensing techniques and GIS. We achieved many of our learning goals, such as prepare and use data for GIS analysis, and to present the analysis. There were many factors that helped as accomplish these goals.

Our guide Vineetha P, Lecturer at Inter University Centre for Geospatial Information and Technology, is extremely knowledgeable and passionate about the topic and finding ways to reduce it and solve our issues and gave us theory section on GIS and remote sensing. She is also very positive and helpful and is concerned with developing the intern's ability. To help researchers and interns, the institute has developed basic search and computer search strategies, a data collection process, and has established steps to follow in the research process. It really helps us a lot to understand about the concept of GIS and remote sensing. The time spent with her was extremely valuable for our project. Besides conducting georeferencing, calculation of vegetation indices, creating maps, point features, line features and polygon features, we also needed to know how to use QGIS. Being that the documentation and tutorials for QGIS are online, our skills were continually tested and improved. Characteristics of digital satellite image, processing of digital images, image enhancement, filtering and its classification were discussed. The application of remote sensing and GIS were also discussed. Not only did we gain practical skills but also had the opportunity of self-learning by reading articles and journals. The internship also involved taking part in and helped very lot to do our project works. In either case, discussions occurred between the participants and the tutor enhanced our learning experience. The experience of being a GIS and Remote sensing Intern was very beneficial for us.

The experience of being a GIS and remote sensing techniques learning were very beneficial for us. It improved and honed our skills in many ways. It increased our critical thinking ability. Therefore, the internship was valuable not only for learning "things," but also improved our basic knowledge on the usage of the different GIS applications. Overall, the internship at IUCGIST has been a success. We were able to gain practical skills, work in a fantastic environment, and make connections that will last a lifetime.