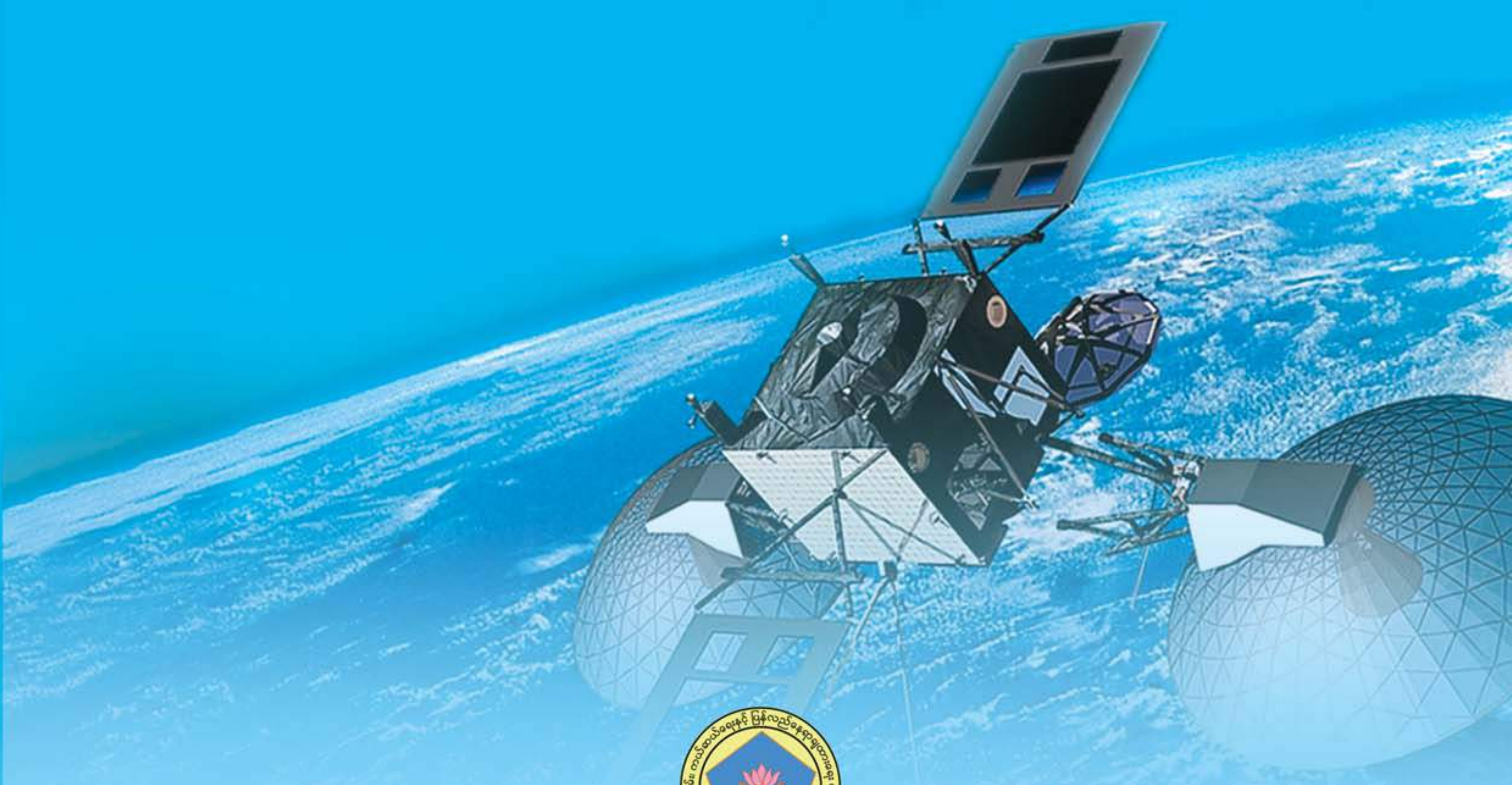


Ministry of Social Welfare, Relief and Resettlement

Relief and Resettlement Department

Geo-informatics Applications in Disaster Management (Facilitator's Guide)

USAID
FROM THE AMERICAN PEOPLE

MCCDDM

This module carries pre-training entry level assessment as well as hands on exercise manual on Geographic Information Systems, Remote Sensing, Geographic Positioning System (GPS) and some applications of these technologies on Disaster Risk Management (DRM) especially for hazard mapping, monitoring and risk assessment module as well as the damage assessment module. Practical manual developed using open source products like Quantum GIS , RStudio, Google Earth Pro and Google Earth Engine.

This module can also can be used by other training facilitators, non-technical professionals and self-learners as well. However, it is strongly recommended that training participants and self-learners already have some basic knowledge of Computer Basic, Geoinformatics and disaster management.

Each module also contains Learning Units with suggested training methods and exercises based on that module's content. The modules are developed using training material from technical international and local workshop as well as training as references. The exercises enhanced the skill of participants to new concepts and current practices on applications of Geo-informatic on Disaster Risk Management. The training activities include interactive lectures, presentation, review sessions, guided hands on exercises, group exercises and presentations. The training can be facilitated by staff officers of Relief and Resettlement Department as well as related departments, Faculty members of Universities and so on. Facilitators should have some background in both geo-informatics and disaster management in order to be most effective delivery of the course, so they are able to answer the technical questions which may arise from the participants.

We hope the information presented in this module would enable participants on how the Geo-informatic technology can be used to solve the problems faced by people and make their lives easy. And also, participants have been improving capability to acquire knowledge and basic skills of effectively utilizing Geoinformatics in managing disasters.

Kyaw Zaya Htun

Acknowledgement

The author would like to express his very special thanks are extended to Ministry of Social Welfare, Relief and Resettlement and Mandalay Technological University for giving a chance as a member of technical advisory group of Myanmar Consortium for Capacity Development on Disaster Management (MCCDDM) and participating in developing curriculum. The module has been developed in consultation with many experts at national as well as at international level and revised some exercise using national data set. The author acknowledges the significant contributions from Remote Sensing Department, Mandalay Technical University in developing the module. Inputs material received from organizations at national and international including Remote Sensing Department, Mandalay Technological University, Geoinformatic Center, Asian Institute of Technology, Asian Disaster Properness Center (ADPC), ITC, the Netherlands and International Centre for Integrated Mountain Development (ICIMOD) for improving the contents and design of the module and the practical manual. Author is grateful to all whose support has made the effort turn into a successful publication particularly authorized persons from Ministry of Social Welfare, Relief and Resettlement and Mandalay Technological University. The author also extend his thank to Ma Thiri Maung from Relief and Resettlement Department, Dr. Sreeja S. Nair (UNHABITAT)) and U Min Thein Htike (UNHABITAT) for their kindness support, suggestion and kindly make edition on this module.

List of Acronyms

AVHRR	Advanced Very High Resolution Radiometer
DIP	Digital Image Processing
DMIS	Disaster Management Information System
DMP	Disaster Management Plan
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DSS	Decision Support Systems
EMR	Electro Magnetic Radiation
FCC	False Color Composite
GAD	General Administrative Department
GEE	Goggle Earth Engine
GIS	Geographical Information System
GNSS	Global Navigation Satellite Systems
GPS	Global Positioning Systems
ICIMOD	International Centre for Integrated Mountain Development
KML	Keyhole Markup Language
NDVI	Normalized Difference Vegetation Index
QGIS	Quantum GIS
ROI	Region of Interest
RRD	Relief and Resettlement Department
RS	Remote Sensing
SBI	Space Based Information
SCP	Semi-automatic Classification Plugin
SDRN	State Disaster Resource Network
SPOT	Système Pour l'Observation de la Terre
STRM	Shuttle Radar Topography Mission
UAV	Unmanned Aerial Vehicle
UN	United Nations
UNSPIDER	United Nations Platform for Space-based Information for Disaster Management and Emergency Response
VCI	Vegetation condition Index

1.0 Salient features of the Module

Name : Geoinformatics Applications in Disaster Management

Total Number of modules : 4

Target Group: Technical Professionals, Subject specialists (Geologist, Environment, Agricultural Specialist, Watershed Professional and so on) Trainers and Administrators working on Disaster Management.

Duration: 7 days training depending upon the target groups and their training needs.

Infrastructure Requirements

- Geoinformatics lab with high end computers (it is advisable to have PCs with RAM of 2 GB or more with more than 50 GB unused disk space)
- GIS and Image Processing Software Quantum GIS., google earth pro, and Microsoft excel also may be required for hazard specific programs.
- Number of trainers required is minimum 4-5 for each course. A technical assistant for handling GIS and Remote Sensing Lab is also needed.
- Sitting arrangement is Class Room Type (U shape table is better if possible)
- Training materials include data in desired format, hand-outs and Practical Manuals
- High speed internet connectivity

2.0 INTRODUCTION TO THE MODULE

1. Introduction

There is an increasing trend in disasters both in frequency as well as in the damage caused in terms of human casualties, economy and environment. In Myanmar, as of 15 August, according to the National Natural Disaster Management Committee (NNDMC), a total of 1,615,335 people has been affected (including 264 people in Tanintharyi); cumulatively, 333,178 households have been displaced and 110 people have died. The basic information for disaster reduction (technical studies, geographical data, etc.) are very important for damage assessments and humanitarian response activities. There is an urgent need to share the data and information required for DRR with local authorities and other stakeholders for better decision-making. With the use of GIS and remote sensing the possible effects of natural phenomena like floods, drought, earthquakes, landslides, volcanic eruptions and forest fires on buildings, population, infrastructure etc. can be modelled and made visible in a spatial and interactive manner. GIS and remote sensing can be used as a powerful tool for analysis of hazard, vulnerability and risk, resulting in the development of different scenarios and concrete measures for disaster prevention. Simple, low-cost GIS systems allow local authorities to properly plan the areas under their jurisdiction, and to incorporate the local knowledge and ensure community participation, combined with modeling results from experts. To achieve this, professionals needs to be trained in the application of GIS and remote sensing for disaster management.

2. Title of the Module

Training Module on Geoinformatics Applications in Disaster Management

3. Target Group

- Officials from RRD, GAD and other departments involved in DRR and Emergency Response.
- Technical Professionals from ministry of education and faculty members of Universities (for Master Trainers).

4. Aims and Objectives

Aim of the course is to develop a pool of trainers who can train the officials to make use of spatial data and Geoinformatics for Disaster Risk Reduction as well as emergency response.

The key objectives are

- Develop skills for training delivery with special focus on software demonstration skills
- To enhance the knowledge on the basic concepts and terminologies on Disaster Management with special focus on Myanmar and utilization of spaced based new technologies.

- To introduce various sources of data required for disaster management, the sources of data and how to apply these spatial and non-spatial information on DRM.
- To develop skills on generating or creating of map or monitoring, analysis of hazard vulnerability, risk assessment, monitoring, emergency response, early warning and damage assessment.
- To improve the skills in implementing functionalities of Remote Sensing & GIS software for disaster management through hands on training and demonstrations.
- To make continue contribution and sharing knowledge and experience on Applications of these new technologies among the respective organizations.

5. Course Content

- Disaster Management Terminologies and Concepts
- Introduction to Geographic Information Systems, Remote Sensing, GPS and Searching, Exploring and Gathering Geospatial Data from the Web for Emergency Response Mapping
- Geoinformatics for Mapping and monitoring of Hazards, Vulnerability and Risk Assessment
- Geoinformatics for Disaster Management Planning and Emergency Response

6. Course Duration

- 1 day on Basic Disaster Management
- 7 days programme (technical skill development)
- 2 days on Training for Instructors (Developing training delivery skills

7. Number of candidates – 30 participants (max)

8. Methods of teaching – Lecture, Presentation, Hands on Exercise, field survey

9. Assessment during the course – Pre and post training questionnaire, question answer session, presentation by participants.

3.0
HOW TO USE THE MODULE

This module is meant for use by Course Coordinators and the trainers identified by him / her. Although the module is self-explanatory the trainers are advised to undergo ToT training before using it for delivering such training programmes. Before starting the training programme they must thoroughly familiarise themselves with the module.

The module is having the following details

- Title of the modules and Learning units : This identifies the topics of the session. Each session should begin with a brief outline of the topic.
- Learning Objective : This describes what the participants will be able to gain in terms of knowledge, skill or attitude by the end of each session. The facilitator / trainer may explain the objectives before commencing each session.
- Methodology : Methodology to be adopted for each session is given. However, the resources persons can choose own methods to make the session more interactive and participatory.
- Duration: This shows the duration of each of the learning unit. The resource persons should be told to complete the session within the allotted time. Any deviation will upset the training schedule.
- Content: The contents to be covered in each session are given. The resource persons should go through these and ensure that all items are covered in the session.

Guidelines to course facilitator:

These are instructions to resource persons or facilitators for handling the sessions effectively.

- The course facilitator of programme should adequately equip him/herself by reading the relevant literature on the subject and preferably by attending similar training programmes.
- Course Director/ Coordinator should make sure that the profile (i.e., computer proficiency) of the participants is relatively uniform. Since Geoinformatics is a technical programme and it involves lot of hands-on exercise. Mixed (technical and non technical) group is not very successful since the needs of different target groups are extremely different.
- Though it may be necessary to bring in outside experts as guest faculty, it is essential that the available faculty members from the training center i.e. DMTC and RRD are involved as far possible for providing continuity to the training and to support and facilitate the learning process.
- The reading material provided is for the Resource persons as well as the participants. The resource persons should also read it before starting the programme so that he/she gains a thorough knowledge in the subject area. It is desirable that the reading materials are supplied to them well in advance or at least on day one of the course.

- The suggested timings of the programme are from 9.00 am to 5.00 pm with 60 minutes for each lecture session followed by practical exercise. This is required for adequate coverage of all sessions in a day. It is better to make the programme a residential one. This will enable the participants to spend the evening hours in studying cases, go through the reading material, and exchange their views and so on.
- Each session has to be participatory and experiential. The participants may be encouraged to ask questions, seek clarifications, share their personal experience and express their views freely.
- The reading material provides specific case studies on the Role of Geoinformation in Disaster Management. However, the resource persons should present district and state level data relating to the respective state on various topics and discuss the same. This way the participants will gain more insight into the issues closer to home.
- Case studies depicting the local situation may be prepared in advance for use in the hands on sessions. Course director can suggest participants to bring own data sets. This will help them in understanding the data needs, source, updating and applications.
- The course has to be sufficiently flexible, in terms of time allotted to each session and content, to accommodate the requirements of the participants.

4.0 DESIGN BRIEF

Module	Session	Target Group/ Course	Duration
1. Disaster Management Terminologies and Concepts	**1.1 Disaster terminology** 1.2 Disaster management concepts and DM cycle 1.3 DRM in Myanmar & Hazard profile in Myanmar (Meteorological, Hydrological, Geological, Biological) **Exercise 1.1** Terminology of DRM	All participants and courses	2 hours
2. Introduction to Geographic Information Systems, Remote Sensing, GPS and Searching, Exploring &Gathering Geospatial Data from the Web for Emergency Response Mapping	**2.1 (A)-Introduction to Geographic Information Systems (GIS)** • What is GIS? GIS Definitions • Purpose of GIS & GIS in everyday life • What can we do with GIS? • Describe about the various components of GIS • Data Types • Projection, Datum, Coordinate System & Scale • Explain the functions of GIS • Prepare of thematic maps • Application of GIS for DRM 2.1 (B)- Introduction to Quantum GIS Software • Introduction to GUI Interface of QGIS • Displaying data • Projection, Datum & Coordinate • Querying • Manipulation and updating • Map composer • GeoReferencing • Generation Data • Vector Analysis **Exercise 2.1** Hand on Exercise (QGIS Practical Session)	All participants and courses	1 hours 5 hours

Module	Session	Target Group/ Course	Duration
	2.2 Introduction to Remote Sensing • Definition of Remote Sensing • Advantages of Satellite Remote Sensing • Basic Components of Remote Sensing Systems • Electromagnetic Spectrum • Interaction of objects with EMR and Spectral Reflectance Curve • Active and Passive Remote Sensing • Scale and Resolution, Spectral, Spatial, Temporal and Radiometric • Remote Sensing Platforms and Sensors • Remote Sensing data and applications	All participants and courses	1 hour
	Exercise 2.2 Performing Supervised Image Classification Using the Semi-Automatic Classification Plugin in QGIS		2 hours
	2.3 Introduction to GPS and field data collection techniques • What is GPS? • Components/ segments of GPS, Space Segment, Control Segment and user Segment • Why GPS? What are the advantages? • How does a GPS Work? • Existing GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS) • Applications (in brief) • Practical on GPS data collection and integrate to GIS • GPS data and integration with Google earth		1 hours
	Field Exercise 2.3 Collecting way points, paths, GPS data to Map - Representing on Google Map		3.5 hours
	2.4 Using Google Earth Engine (GEE) to Map Changes on the Landscape		1 hours
	Exercise 2.4 Using Google Earth Engine (GEE) to Map Changes on the Landscape		3 hours

Module	Session	Target Group/ Course	Duration
3. Geoinformatics for Mapping and monitoring of Hazards, Vulnerability and Risk Assessment	**3.1. Introduction to earthquake** Exercise 3.1 Preparation of Earthquake Hazard Map for Chauk, Myanmar 3.2 Introduction to food Exercise 3.2 Flood Monitoring and Identification of Flood Affected Area Using Pre and Post Flood Images 3.3. Introduction to Landslide Exercise 3.3 Landslide Hazard Mapping 3.4 Introduction to Drought Exercise 3.4 Drought Assessment and Monitoring Using Landsat Image 3.5 Introduction to Strom Surge Exercise 3.5 Storm Surge Hazard Mapping	All participants and courses	1 hr 2 hr 1 hr 2 hr 1 hr 5 hr 1 hr 2 hr 1 hr 2hr
4. Geoinformatics for Disaster Management Planning and Emergency Response	**4.1 Geoinformatics for Disaster Management Planning and Emergency Response** Exercise 4.1 Flood Preliminary Damage Assessment (Nagris 2008) 4.2-Searching, exploring and gathering geospatial data from the web for emergency response mapping • Searching, exploring and downloading Landsat imagery • Searching, exploring and downloading Baseline Data (Open Street Map) • Searching and downloading Global Population Data • Searching and downloading Precipitation data • Searching and downloading Tropical Storm data • Searching and downloading earthquake peak ground acceleration data • Searching, exploring and downloading near real time MODIS imagery • Searching, exploring and downloading very high resolution browsing imagery **Exercise 4.2** Searching, exploring and gathering geospatial data from the web for emergency response mapping	All participants and courses	1 hr 2 hr 3 hr

Module	Session	Target Group/ Course	Duration
	4.3- How to export JAxa image to KML 4.4 Application of UAV on Emergency Response in DRM **Filed Execirse 4. 6** How to acquired Aerial Photo Using UAV/ Drone	All participants and courses	1 hr 5 hr

5.0
Proposed Training Schedule

Training of Trainers Programme on Geoinformatics Applications in Disaster Management

Day	08:30-09:15	09:15 09:20	09:20-10:05	10:05 10:15	10:15-11:00	11:00 11:05	11:05-11:50	11:50 12:50	12:50-13:35	13:35 13:40	13:40-14:25	14:25 14:45	14:45-1530	15:30 15:35	15:35-16:20
1 13 Feb	Opening ceremony	Break time	Course Introduction & Expecta-tion check M 1.1 Pretest	Tea break	Introduction to training and approaches to adult learning (ADPC/ UNH)	Break time	Introduction to training and approaches to adult learning (ADPC/ UNH)	Lunch time	1.1 Disaster Management terminology Concepts and DM Cycle DMTC	Break time	1.2 Hazards and Disasters in Myanmar DMTC	Tea break	1.3 Introduction to DM System in Myanmar	Break time	1.3 Group Work for Terminol-ogies and concepts
2 14 Feb	2.1 Introduc-tion to GIS		Exercise on QGIS		Exercise on QGIS		Exercise on QGIS		Exercise on QGIS		Exercise on QGIS		Exercise on QGIS		Exercise on QGIS
3 15 Feb	2.2 Introduction to Remote Sensing		Exercise on Q GIS Image Analysis Plugin		_ Exercise on Q GIS Image Analysis Plugin		Exercise on Q GIS Image Analysis Plugin		2.3 Introduction to GPS		Field Exercise on spatial data collection using AGPS		Field Exercise on spatial data collection using AGPS -		Field Exercise on spatial data collection using AGPS -
4 14 Feb	Practical exercise on GPS data import of QGIS		Practical exercise on GPS data import of QGIS		2.4 Introduction to Google Engine		Exercise		Exercise		Exercise		Exercise		Exercise

Day	08:30-09:15	09:15 09:20	09:20-10:05	10:05 10:15	10:15-11:00	11:00 11:05	11:05-11:50	11:50 12:50	12:50-13:35	13:35 13:40	13:40-14:25	14:25 14:45	14:45-1530	15:30 15:35	15:35-16:20
5 15 Feb	3.1 Earthquake Hazard Mapping	Break time	3.1 Exercise	Tea break	3.1 Exercise	Break time	3.1 Exercise	Lunch time	3.2 Flood Monitoring and Damage Assessment	Break time	3.2 Exercise	Break time	3.2 Exercise	Break time	3.2 Exercise
6 16 Feb	3.3 Landslide Hazards		3.3 Landslide Hazard Mapping Exercise		3.3 Landslide Hazard Mapping Exercise		3.3 Landslide Hazard Mapping Exercise		3.3 Landslide Hazard Mapping Exercise		3.3 Landslide Hazard Mapping Exercise		3.3 Landslide Hazard Mapping Exercise		3.3 Landslide Hazard Mapping Exercise
7 17 Feb	3.4 Drought Assessment and Monitoring		Drought Assessment Exercise		- Drought Assessment Exercise		Drought Assessment Exercise -		3-5 -Strom Surge Hazard Mapping		Strom Surge Hazard Mapping Exercise		Strom Surge Hazard Mapping Exercise		Strom Surge Hazard Mapping Exercise
8 18 Feb	4.1 Geo-infor-matics for Disaster Management Planning and Emergency Response		4.1 Flood Preliminary Damage Assessment Exercise		Flood Preliminary Damage Assessment Exercise		Flood Preliminary Damage Assessment Exercise		4.2 Emergency Response Mapping		4.2 Emergency Response Mapping		4.2 Emergency Response Mapping		4.2 Emergency Response Mapping
9 19 Feb	Introduction and Applications of UAV in DM		Exercise		Exercise		Exercise		Exercise		Exercise		Exercise		Exercise
10 4 Feb	TFI to develop Session		TFI to develop Session		TFI to develop Demonstra-tion on Software		TFI to develop Demonstra-tion on Software		Developing a Practical exercise		Post Test Closing Ceremony				

Module 1 :
DISASTER MANAGEMENT TERMINOLO-GIES AND CONCEPTS

Description

This module is intended to introduce the basic concepts, definitions and terminologies used in disaster management. i.e. Hazard Vulnerability, Risk and Disaster Management Cycle. Besides this will cover a brief introduction to the institutional and legal framework for disaster management in Myanmar. This is relevant because participants are mainly from technical background and not having understanding about the basic DM Concepts and institutional framework for disaster management in the country.

Learning Objectives

Towards the end of this module participants will be able to

- Define the various terminologies used in Disaster Management
- Distinguish between terms e.g. hazard and disaster, vulnerability and risk etc.
- Enumerate various disasters
- Classify based on origin and scale
- Describe various phases of Disaster Management Cycle
- Introduce to DRM in Myanmar

Methodology

- Power Point Presentation
- Question, Discussion & Answer

Duration

2 hour

Teaching and Performance Aids

- Lecture Note on DM Concepts
- Handout of Presentation

Contents

- Definitions and Terminologies : Hazard, Vulnerability, Risk and Disaster
- Phases of Disaster Management Cycle
- Legal and Institutional Framework for DRM in Myanmar

Instruction for the Trainer

The trainer should be knowing about the profile of the participants and should make a presentation suitable for participants from technical background having very little or no knowledge on Disaster Management. Presentation should be made in such a manner to grab attention from participants of Geoinformatics background. Less text and more pictures and photographs is advisable for the group. Instruction shall be given to the participants to observe the presentation carefully and note down the observations and test the disaster terminologies to all participants.

A picture analysis

Facilitator may conduct a group activity/ exercise with this session. Methodology followed will be picture analysis. The course team will provide photographs illustrating different terminologies on disaster management. The participants group have to match the photo with the terminology. All the photos and terms will be displayed on the wall.

Module 2 :

INTRODUCTION TO GIS, REMOTE SENSING, GPS AND FREE DATA SOURCE & OPEN SOURCE SOFTWARE

Learning Unit 2.1: Geographic Information Systems (GIS)

Description

This session will introduce the definition, components and functions of Geographic Information Systems (GIS).

Learning Objectives

Towards the end of this module participants will be able to know

- Definition of Geographic Information Systems
- Purpose of GIS & GIS in everyday life
- What we can do with GIS
- Basic knowledge about Projection, Datum, Coordinate System & Scale
- Functions of GIS
- How to prepare of thematic maps
- How to use GIS Software (Quantum GIS) to perform the basic GIS functions and generate a desired output.
- Application of GIS on DRM

Methodology

- Lecture and Power Point Presentation
- Demo on GIS Software (Quantum GIS)
- Hands on Exercise

Duration

4 hours (lecture + Demo) + 13.5 hours for Hands on Training.

Teaching and Performance Aids

- Lecture Note (Components and Functions of Geographic Information Systems)
- Handout of Presentation
- Practical Manual

Contents

(A) Introduction to GIS

- What is GIS?
- Purpose of GIS & GIS in everyday life
- What we can do with GIS
- Components of GIS
- Data types
- Projection, Datum, Coordinate System & Scale
- GIS Functions
- Prepare of thematic maps
- Application of GIS for DRM

(B) Introduction to QGIS Software

1. Introduction to GUI Interface of QGIS
2. Displaying data
3. Projection, Datum & Coordinate
4. Querying
5. Manipulation and updating
6. Map composer
7. GeoReferencing
8. Generation Data
9. Vector Analysis

Practical Exercise on Quantum GIS will be done to develop skills on performing the GIS basic tools and generation of final output map .

Instruction for the Trainer

The trainer should give more emphasis on demonstration of the GIS Functions and data integration & creation and analysis in GIS. The exercise should be designed and conducted in such a way that all the basic functions to be introduced after performing the hands on exercise. Since it is important to learn the basic functions, make sure that participant already acquired basic skills of performing GIS functions

Learning Unit 2.2: Remote Sensing

Description

This unit is intended to introduce the basic principles and terminologies used in Remote Sensing. Introduction to the various remote sensing data and their importance in Disaster Management also will be included in this unit.

Learning Objectives

Towards the end of this module participants will be able to

- Understand Principle of Remote Sensing
- Understand Various Remote Sensing Satellite System/ Data and Characteristics
- Understand Advantage and limitation of Remote Sensing for Applications
- Understand Basic Remote Sensing Image Processing

Methodology

- Power Point Presentation
- Demo

Duration

5 hour Lecture+Demo & 13 hours for Hands on Training.

Teaching and Performance Aids

- Power point presentation
- Handout of Presentation

Contents

- Definition of Remote Sensing
- Advantages of Satellite Remote Sensing
- Basic Components of Remote Sensing Systems

- Electromagnetic Spectrum
- Interaction of objects with EMR and Spectral Reflectance Curve
- Active and Passive Remote Sensing
- Scale and Resolution, Spectral, Spatial, Temporal and Radiometric
- Remote Sensing Platforms and Sensors
- Remote Sensing data and applications

Practical Exercise on QGIS software to be made as a part of the Session to introduce basic remote sensing image preprocessing & classification for technical professionals.

Instruction for the Trainer

The trainer should give more emphasis on demonstration of the principle of Remote Sensing technology, sensors, data and basic image processing. The exercise should be designed and conducted in preforming basic remote sensing image processing. Semi-automatic classification plugin will be used in QGIS software for image preprocessing and classification.

Learning Unit 2.3:

INTRODUCTION TO GPS AND FIELD DATA COLLECTION TECHNIQUES

Description

In this unit the participants will be introduced to the concepts and functions of Global Positioning System (GPS) and Global Navigation Satellite Systems (GNSS) and applications in Disaster management.

Learning Objectives

Towards the end of this module participants will be able to

- Define GPS
- Enumerate the advantages & disadvantages of GPS
- Describe about the various Segments of GPS
- Explain how a GPS system works?
- Explain about the existing GNSS?
- Specify the different types of errors in GPS Systems?
- Explain about Differential GPS and advantages
- Capture data in GPS and integrate in GIS using android GPS software and connecting to Google Earth.
- Examples of GPS applications in Disaster Management.

Methodology

- Lecture and Power Point Presentation
- Demo on GPS
- Field Survey to collect data
- Hands on Exercise to integrate data in GIS

Duration

- Total – 3 hours lecture +Demo+10 hour practical on GPS data collection and integrate to GIS

Teaching and Performance Aids

- Lecture Note Global Positioning Systems
- Handout of Presentation

Contents

- What is GPS?
- Components/ segments of GPS, Space Segment, Control Segment and user Segment
- Why GPS? What are the advantages?
- How does a GPS Work?
- Existing Global Navigation Satellite System (GNSS)
- Applications (in brief)
- Practical on GPS data collection and integrate to GIS
- GPS data and integration with Google earth

Instruction for the Trainer

The trainer should give more emphasis on demonstration of the GPS instrument and data collection and integration in GIS. It is also important to explain about the limitations and advantages of using the GPS.

Learning Unit 2.4

USING GOOGLE EARTH ENGINE TO MAP CHANGES ON THE LANDSCAPE

Description

This session will introduce you to Google Earth Engine (GEE) and its basic functionality, including exploring the Data Catalog, viewing datasets and Land Cover Classification in the Workspace.

Learning Objectives

- To explore the Data Catalog, viewing and sharing datasets in the Workspace of GEE
- To perform Land Cover Mapping using Random Forest Classification method and other calculation on image index in workspace of Google Earth Engine

Methodology

- Power Point Presentation on concepts
- Demo
- Guided Hands on Practice

Duration

- 1.5 hours including 30 minutes demonstration.

Teaching and Performance Aids

- Training Manual demonstrating the steps. Exercise on introduction of Google Earth Engine (GEE) and introduction to Random Forest Classification method for Land cover mapping using time series dataset of Landsat image in GEE.

Contents

- Exploring the Data Catalog and viewing datasets in the Workspace of GEE.
- Image Classification of time series dataset of Landsat images using Random Forest method.
- Downloading the output of classification.

Instruction for the Trainer

The trainer has to introduce Google Earth Engine and its basic functionality, including exploring the Data Catalog, viewing datasets, creating ROI, classification methods, sharing workspace and how to download the result in the Workspace.

Module 3 :

GEOINFORMATICS FOR MAPPING AND MONITORING OF HAZARDS, VULNERABILITY AND RISK ASSESSMENT

Objective of the Module 3 is intended to develop skills on applications of Spatial and non Spatial data and Geo-informatics tools for Hazard and Vulnerability Mapping, Monitoring and Risk Assessment.

This module includes various natural hazards like drought, landslides, floods, storm surge and earthquake hazards. There are 7units in this module (3.1- 3.7) with to address the interests of various target groups. Each of this module can be used as add on module to ongoing hazard specific programmes and also for the Hazard Vulnerability and Risk Assessment programme.

Learning Unit 3.1

PREPARATION OF EARTHQUAKE HAZARD MAP FOR CHAUK, MYANMAR

Description

This exercise will show how to prepare an Earthquake hazard map based on spatial information from USGS web site and calculate the affected population using global population dataset.

Learning Objectives

- The objective of this exercise is how to download and use the free data sets for shake map & global population data, how to calculate the affected location and people and generating output for the earthquake hazard mapping.

Methodology

- Power Point Presentation on concepts
- Demo

Duration

- 1.5 hours including 30 minutes demonstration.

Teaching and Performance Aids

- Training Manual demonstrating the steps. Exercise on downloading shake map from USGS web site & global population dataset and calculation the affected people and area in the training manual.

Contents

- Modified Mercalli Intensity Scale and peak ground acceleration
- Calculation the affected population, districts and townships in earthquake prone area.

Instruction for the Trainer

The concept of earthquake and Modified Mercalli Intensity Scale and peak ground acceleration be explained clearly to the participants before doing the exercise. QGIS software is been used for doing this exercise. (Refer to Exercise number 3.1 in the practical manual)

Learning Unit 3.2

FLOOD MONITORING AND IDENTIFI CATION OF FLOOD AFFECTED AREAS USING PRE AND POST FLOOD IMAGES

Description

This module is going to classify two images acquired in 2014 and 2015 in Kalay township in Myanmar for damage assessment; in July 2015, the heavy seasonal rains were followed by the Cyclone Komen causing flood and landslide across 12 states and regions in Myanmar, affecting more than a million people.

Learning Objectives

- To perform satellite based flood extraction method (Extract flood layer or identify flood affected areas based on preflood and post flood satellite imageries)
- To estimate impact .on population and facilities assets such as settlements and transportation.

Methodology

- Power Point Presentation on concepts
- Demo
- Guided Hands on Practice

Duration

- 2 hours including 30 minutes' demonstration.

Teaching and Performance Aids

- Training Manual demonstrating the steps. Exercise on classify Water defining a classification threshold and assessment for Exposure or Not exposer in the training manual.

Contents

- Flood prone area identification
- Extract the spatial information from before flood image (Digitizing)
- Assessment for Exposure.

Instruction for the Trainer

The trainer should explain how to classify the image and setting threshold value for the pixel for the flood affected area in order to identify only those pixels which are in the flood affected area. The identification of the pixels is based on the spectral signatures and this needs to be explained clearly to the participants before doing the exercise. QGIS software semi-automatic classification plugin is has been used for doing this exercise. (Please refer to exercise number 3.2)

Learning Unit 3.3

LANDSLIDE HAZARD MAPPING

Description

This module will give a detailed description of the data sets and methodology used for regional scale Landslide hazard mapping and comparison with the land slide inventory map generated using the field data. The exercise for this module is based on the methodology and data used in the preparation of Landslide Vulnerability Atlas, Developed by Deo Raj Gurung, international Centre for Integrated Mountain Development (ICIMOD)

Learning Objectives

Towards the end of this module participants will be able to

- To develop landslide inventory using Google Earth
- To generate landslide hazard map using 8 independent variables (geology, river network, road network, land cover/use, etc.) based on logistic regression method

Methodology

- Power Point Presentation
- Demo on the software
- Guided Hands on Practice

Duration

- 6.5 hours including 45 minutes lecture/ presentation

Teaching and Performance Aids

- Handouts and Lecture notes
- Training Manual demonstrating the steps

Contents

- Data requirements for Regional scale landslide hazard mapping
- Method to prepare a regional level landslide hazard map
- Preparation inventory of the landslide location map using Google Earth Pro
- Preparation of various thematic layers for the land slide hazard mapping
- Generating the regional level landslide hazard Zonation map based on 8 independent variables (geology, river network, road network, land cover/use, etc.)
- Developing the final hazard prone areas. map

Instruction for the Trainer

The concept of logistic regressive method with advantages and limitation should be explained clearly to the participants. And also, need to clearly explain eight parameters for landslide hazard mapping. QGIS and RStudio software is been used for doing this exercise. (Refer to Exercise number 3.3 in the practical manual)

Learning Unit 3.4

DROUGHT ASSESSMENT AND MONITORING USING LANDSAT IMAGE

Description

This unit will be an introduction to the concept of Agricultural Drought Monitoring using time series remote sensing data.

Learning Objectives

- The aim of the exercise is to monitor crop conditions for early warning and assessment of agricultural drought using multi-date satellite imageries. This exercise will increase the skills of the participants in using QGIS software for performing various tasks like clipping image, image enhancement, generating NDVI, creating NDVI difference images and spatial statistics.

Methodology

- Power Point Presentation on concepts
- Demo
- Guided Hands on Practice

Duration

- 3 hours including 30 minutes lecture/ presentation

Teaching and Performance Aids

- Handouts and Point Presentation on the concepts of Agricultural drought monitoring
- Training Manual demonstrating the steps. Exercise on Drought Monitoring in the training manual.

Data:

- Freely downloadable Landsat data

Contents

- Introduction to drought and drought monitoring
- About NDVI
- Downloading data from Landsat website
- Image preprocessing
- Spatial Subset
- Creating NDVI
- Representing NDVI as pseudocolors
- Selecting multi-date data for a normal and drought year
- Creating NDVI difference images (drought year – normal year)
- Classify based on the NDVI difference values
- Overlaying vector data and Generating Region of Interest
- Spatial Statistics
- Calculating the percentage variation from normal for each region of interest i.e. at district, block or mandal level
- Classifying the vegetation condition of the districts/ townships are normal, watch and alert based on the deviation from normal.

Instruction for the Trainer

The concept of Agricultural drought monitoring and advantages and limitation should be explained clearly to the participants before doing the exercise. QGIS software is been used for doing this exercise since the software is having advanced functions for data processing and spatial statistics and is very user friendly. (Refer to Exercise number 3.4 in the practical manual)

Learning Unit 3.5

STORM SURGE HAZARD MAPPING

Description

The modules cover the data requirements and methods to prepare a storm surge hazard map for cyclone for a particular location and vulnerability assessment based on the population density. Exercise is covered surge mapping and vulnerability mapping.

Learning Objectives

Towards the end of this module participants will be able to

- Identify the various data sets to be used for Storm Surge Mapping
- Download data from various sources
- Create Distance layers for calculations, Calculate decay coefficient, surge height calculation for different zones.
- To know the way and use of GIS for Cyclone Surge Hazard Map, Vulnerability Map and Risk Map by storm surge modelling method.

Methodology

- Power Point Presentation
- Demo and Hands on Practice

Duration

- 2.5 hours including 30 minutes lecture/ presentation

Teaching and Performance Aids

- PowerPoint presentation
- Training Manual demonstrating the steps

Data:

- Digital Elevation Model (DEM)
- Coastal line
- Population
- Administrative boundary

Contents

- Downloading DEM & global population data
- Creation of Distance Layer from coastal line
- Calculation of surge decay coefficient
- Surge Depths identification
- Population vulnerability analysis (coastal flooding due to surge)

Instruction for the Trainer

Open source Quantum GIS is used. Trainer have to explain about concept of surge decaying coefficient and how to identification the storm surge depth. Vulnerability analysis can be done only on population density to make the exercise more useful and applicable to real situations. (Refer to Exercise number 3.5 in the practical manual)

Module 4 :

GEOINFORMATICS FOR DISASTER MANAGEMENT PLANNING AND EMERGENCY RESPONSE

Learning Unit 4.1

GEOINFORMATICS FOR DISASTER MANAGEMENT PLANNING AND EMERGENCY RESPONSE

Description

The modules will demonstrate examples of development and implantation of Geoinformatics based Disaster management plans and emergency response. Applications of UAV will introduce and also introduce to how acquired aerial photo using UAV for Decision Support Systems, DM plans, contingency and Emergency Response Plans developed in Myanmar.

Learning Objectives

Towards the end of this module participants will be able to

- How Geo-informatic technology can be apply on Disaster Management Planning and Emergency Response
- Apply UAV on Emergency Response in DRM

Methodology

- Power Point Presentation
- Demo

Duration

- 1.5 hour

Teaching and Performance Aids

- Handouts
- Lecture notes

Contents

- Geoinformatics for Disaster Management Planning and Emergency Response
- Application of UAV on Emergency Response in DRM

Instruction for the Trainer

The trainer should show demonstration of Geoinformatics for Disaster Management Planning and Emergency Response. The trainer also demonstrate how to fly UAV and acquired the information for DRM.

Learning Unit 4.2

FLOOD PRELIMINARY DAMAGE ASSESSMENT (NAGRIS 2008)

Description

In this unit the participant will be introduced to the concept of preliminary flood damage assessment using pre and post flood satellite imageries and applying change detection method.

Learning Objectives

Towards the end of this module participants will be able to

- Perform building damage assessment using pre and post disaster aerial and satellite images (visual interpretation)
- Generate a building damage intensity interpolated raster for assessed areas and categorizing the damage levels.

Methodology

- Power Point Presentation on concepts
- Demo
- Guided Hands on Practice

Duration

- 3 hours including 30 minutes presentation

Teaching and Performance Aids

- Handouts notes on the concepts of damage assessment based on pre-and post-satellite image
- Training Manual demonstrating the steps. Exercise on Damage Assessment in the training manual.

Data:

- Pre and post disaster satellite images

Contents

- Create building point layer using pre disaster satellite image
- Damage assessment by visualization method only using pre-and post-satellite images
- Classify the damage level and use interpolation method to categorize the damage level

Instruction for the Trainer

The concept of using pre and post disaster image for visual damage assessment be explained clearly to the participants before doing the exercise. And also demonstrate creating point vector layer and how to classify building damage level and input damage percent value to attribute table in QGIS software.

Learning Unit 4.3

SEARCHING, EXPLORING AND GATHERING GEOSPATIAL DATA FROM THE WEB FOR EMERGENCY RESPONSE MAPPING

Description

This session is aimed at introducing to various sources of spatial and non-spatial data sets and open source software which are freely available on website.

Learning Objectives

Towards the end of this module participants will be able to

1) Get familiar with some geodata web portals and how to access
2) Search and downloading rainfall accumulation data (TRMM) and Tropical Strom data
3) Searching, exploring and downloading earthquake peak ground acceleration data
4) Searching, exploring and downloading baseline vector data (OSM)
5) Searching, exploring and downloading satellite imagery SPOT Vegetation, NOVA AVHRR, SRTM, ASTER, LANDSAT TM etc
6) How to use Google earth pro and google earth engine

Duration

- 1-hour Lecture+Demo & 1.5 hours for Hands on Training.

Contents

- Searching, exploring and downloading Landsat imagery
- Searching, exploring and downloading Baseline Data (Open Street Map)
- Searching and downloading Global Population Data
- Searching and downloading Precipitation data
- Searching and downloading Tropical Storm data
- Searching and downloading earthquake peak ground acceleration data
- Searching, exploring and downloading near real time MODIS imagery
- Searching, exploring and downloading very high resolution browsing imagery

Teaching and Performance Aids

1. Handout of Presentation
2. Hand on exercise
3. Computer with internet connectivity

Instruction for the Trainer

The trainer should make some demo about how to download different types of datasets, how input to QGIS software and analysis on these datasets.

Group Exercise

Description

Objective of the module is to assess the leanings and skills acquired during the 7 days of training. This session shall be dedicated to the presentation of the applications, analysis and outputs developed by the participants. This will help the participants in using the skills developed during the training in the working environment. This will also help in understanding the further training needs.

Tasks for the course coordinator/trainer

1. Inform in advance regarding the course schedule and group work module to the participants.
2. Request the participants to bring sample data for doing the group exercise which can be implemented at their workplace. E.g. data for hazard mapping, risk assessment, damage assessment etc.
3. Brief about the group exercise/ topics and data sources to the participants.

4. Divide participants into 4 groups (5 each) and assign a task on day 1.
5. Gentle reminder to the participants to check the progress.
6. Presentation Session on day 7 before the valedictory

Tasks for Participants

1. Finalize theme for group exercise- Hazard mapping, risk assessment, damage assessment or any other theme.
2. Identify a group lead. Assign task to each member. i.e. digitizing/ modifying a map, downloading satellite imagery, census data, generating a scenario etc
3. Collection, compilation and collation of data available amongst the team members and other sources
4. Data processing and generating a sample exercise
5. Presenting (ppt stration demo)

EXERCISE 1.1

TERMINOLOGY OF DISASTER RISK MANAGEMENT

Learning Objective:

- Become familiar with terminology and disaster Management concepts

#	Terminology	Attempt	Answer	Marks
1	Disaster			
2	Hazard			
3	Element at risk			
4	Vulnerability			
5	Exposure			
6	Capacity			
7	Response			
8	Resilience			
9	Mitigation			
10	Prevention			
11	Preparedness			
12	Recovery			
13	Disaster Risk			
14	Disaster Risk Management			
15	Disaster Risk Reduction			
16	Climate Change			
17	Adaptation			
Total				

(*Reference*: Power Point)

Exercise 2.1
INTRODUCTION TO QGIS

An Overview of the Interface

Quantum GIS is an open source Geographic Information System that supports most geospatial vector and raster file types and database formats. Unlike many other open source GIS programs, QGIS is available for a number of operating systems, including both Windows and Mac OSX. There are five reasons to start using QGIS:

1. QGIS is free
2. Q GIS is Cross Platform
3. The Use of Open Source GIS is Growing
4. Plenty of QGIS Support and Tutorial
5. Resume Builder

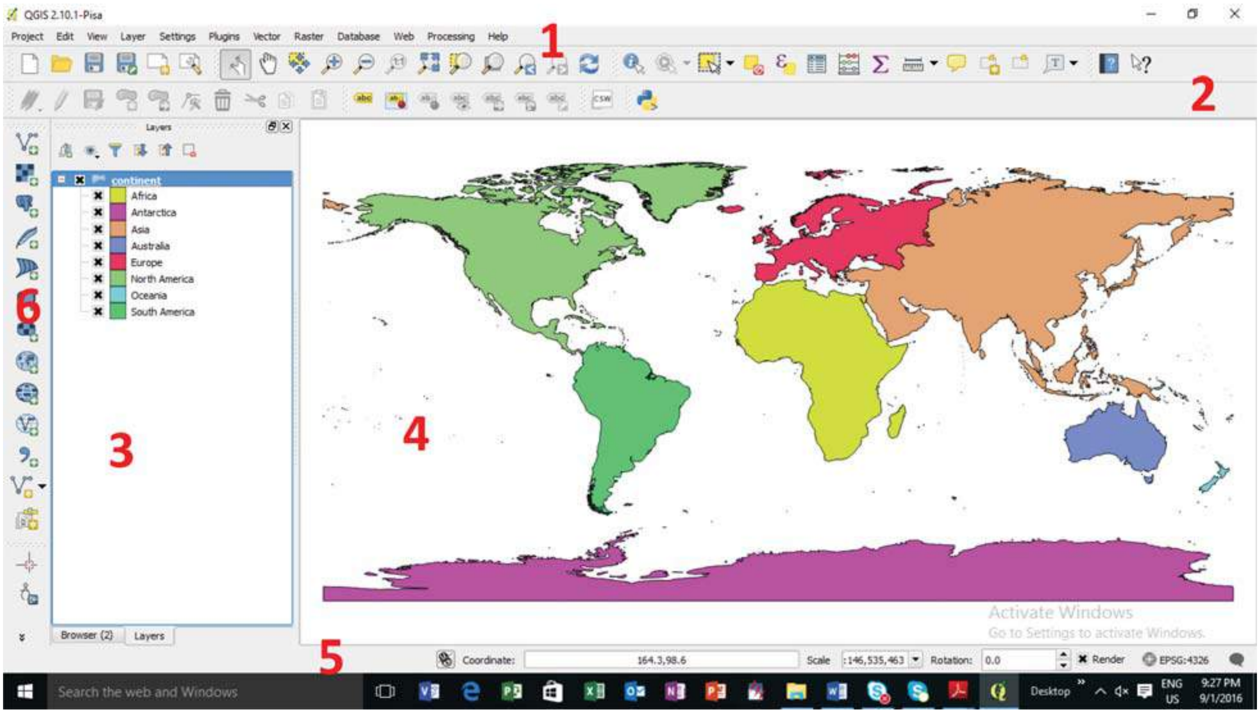
Learning Objective:

- Become familiar with some basic tools and functionalities of QGIS and create new dataset from satellite images and existing analog data for your own study.

Data Used: Data provided in Exe_2_1 folder.

2.1.1. Introduction to GUI Interface of QGIS

When QGIS starts, you are presented with the GUI as shown in the figure (the numbers 1 through 5 in yellow circles are discussed below).



The QGIS GUI is divided into five areas:

1. Menu Bar

2. Toolbars
3. Panels
4. Map View
5. Status Bar
6. Manage Layers

These six components of the QGIS interface are described in more detail in the following sections. Two more sections present keyboard shortcuts and context help.

Menu Bar

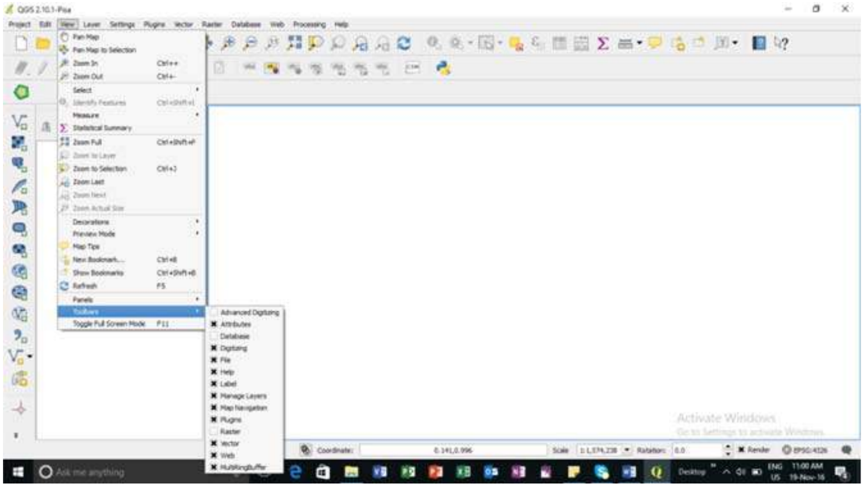
The menu bar provides access to various QGIS features using a standard hierarchical menu. The top-level menus and a summary of some of the menu options are listed below, together with the associated icons as they appear on the toolbar, and keyboard shortcuts. The shortcuts presented in this section are the defaults; however, keyboard shortcuts can also be configured manually using the *Configure shortcuts* dialog, opened from Settings ▸ *Configure Shortcuts*....

Although most menu options have a corresponding tool and vice-versa, the menus are not organized exactly like the toolbars. The toolbar containing the tool is listed after each menu option as a checkbox entry. Some menu options only appear if the corresponding plugin is loaded.

Toolbars

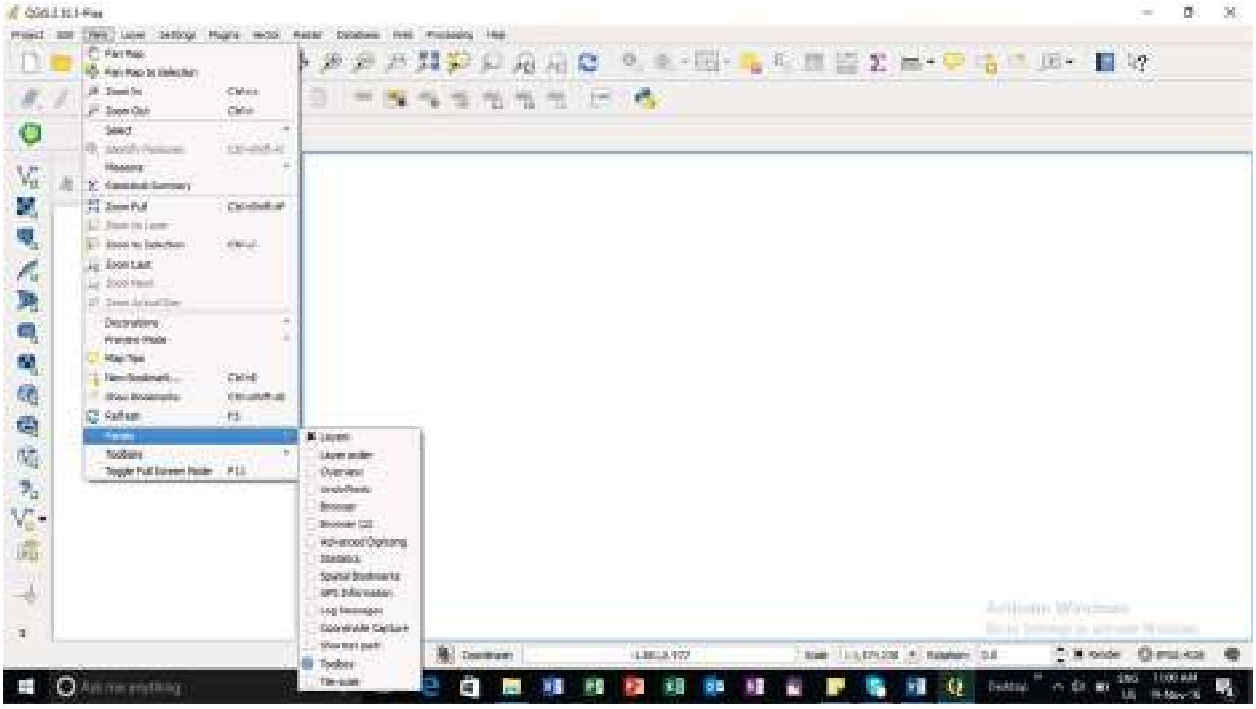
The toolbar provides access to most of the same functions as the menus, plus additional tools for interacting with the map. Each toolbar item has pop-up help available. Hold your mouse over the item and a short description of the tool's purpose will be displayed.

Every toolbar can be moved around according to your needs. Additionally, they can be switched off using the right mouse button context menu, or by holding the mouse over the toolbars.



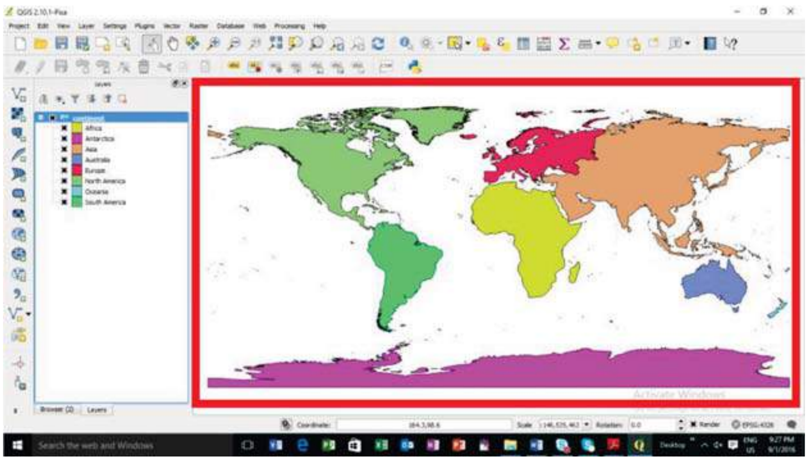
Panels

QGIS provides by default many panels to work with.



Map View

Also called Map canvas— maps are displayed in this area. The map displayed in this window will depend on the vector and raster layers you have chosen to load. The map view can be panned, shifting the focus of the map display to another region, and it can be zoomed in and out. Various other operations can be performed on the map. The map view and the legend are tightly bound to each other — the maps in view reflect changes you make in the legend area.



Status Bar

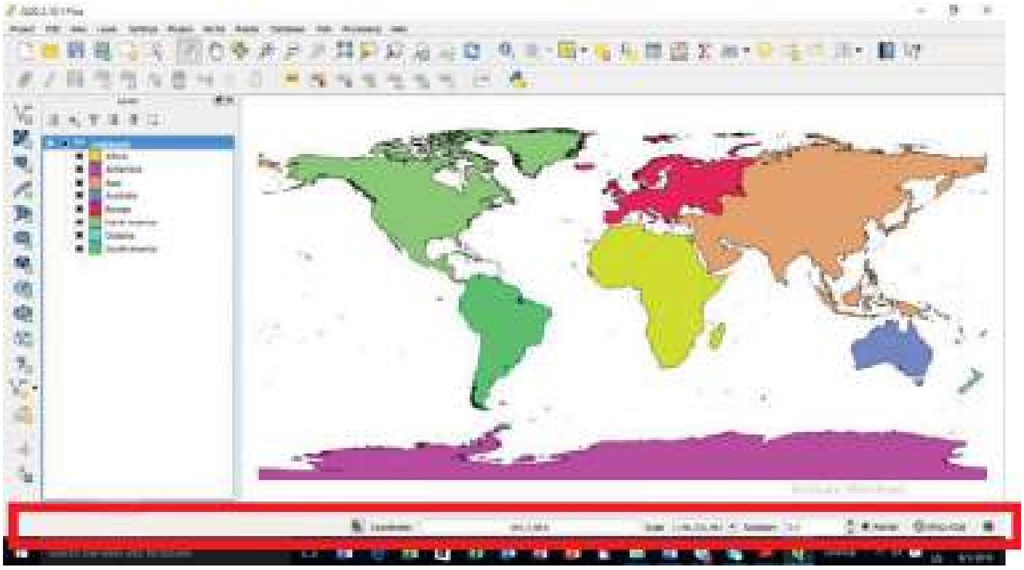
The status bar provides you with general information about the map view, and actions processed or available and offers you tools to manage the map view.

The  Coordinate option shows the current position of the mouse, following it while moving across the map view. You can set the unit (and precision) to use in the project properties, General tab. Click on the small button at the left of the textbox to toggle between the Coordinate option and the Extents option that displays in map units, the coordinates of the current lower leftmost and upper rightmost points of the map view, as you pan and zoom in and out.

Next to the coordinate display you will find the Scale display. It shows the scale of the map view. If you zoom in or out, QGIS shows you the current scale. There is a scale selector, which allows you to choose among predefined and custom scales to assign to the map view.

To the right of the scale display you can define a current clockwise rotation for your map view in degrees.

On the right side of the status bar, there is a small checkbox which can be used to temporarily prevent layers being rendered to the map view.



2.1.2. Displaying Vector and Raster Data

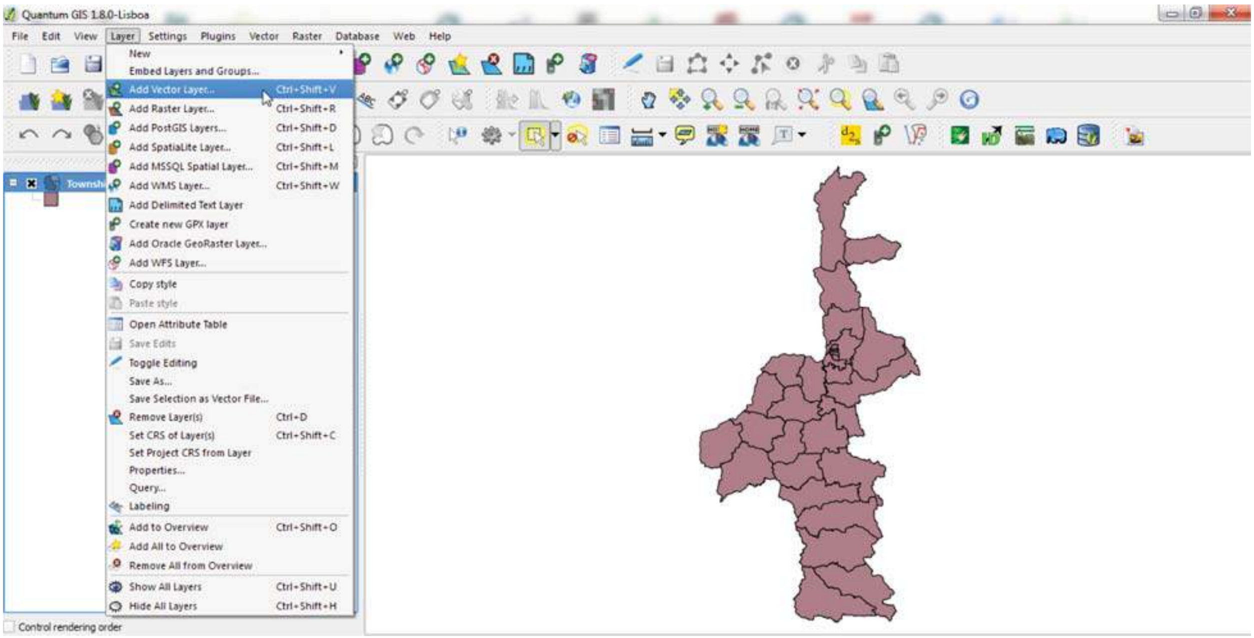
Step 1

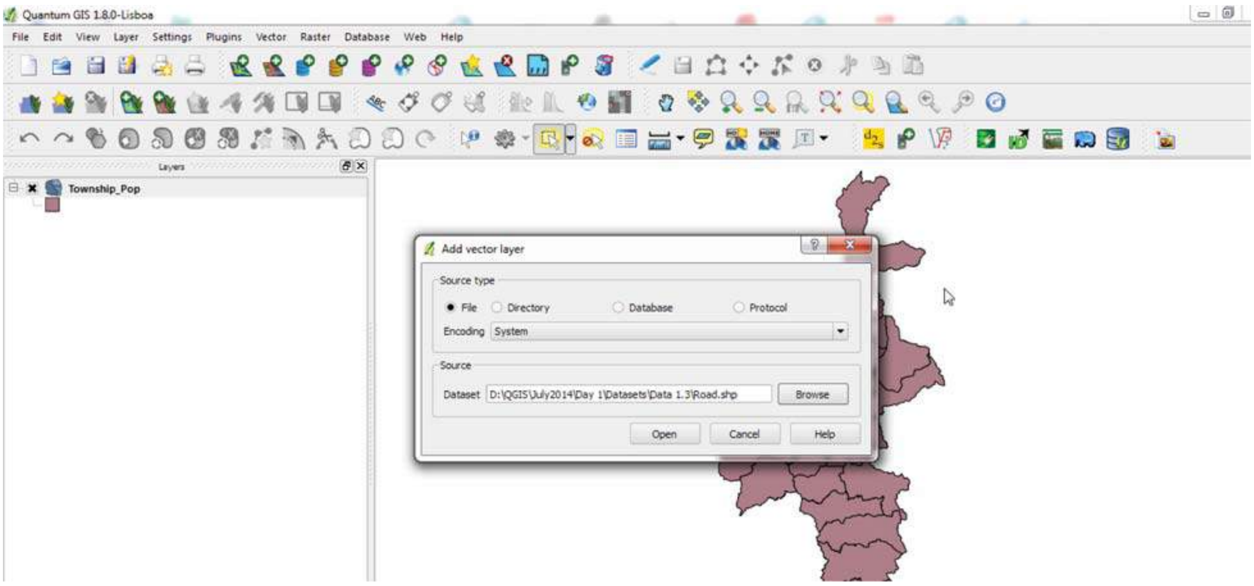
Begin by starting a new document in Q-GIS. Below, is are the basic icons and commands that are commonly used in Q-GIS:

......add vector layer	......new print composer
......add raster layer	..... composer manager
.......new project	.......new shapefile layer
.......open new project	......save project

Step 2

Add the Township_Pop Shapefile. This can be done by adding a Vector Layer on the Toolbar or from the layer tab in the Menu Bar. What type of Shapefile is this?



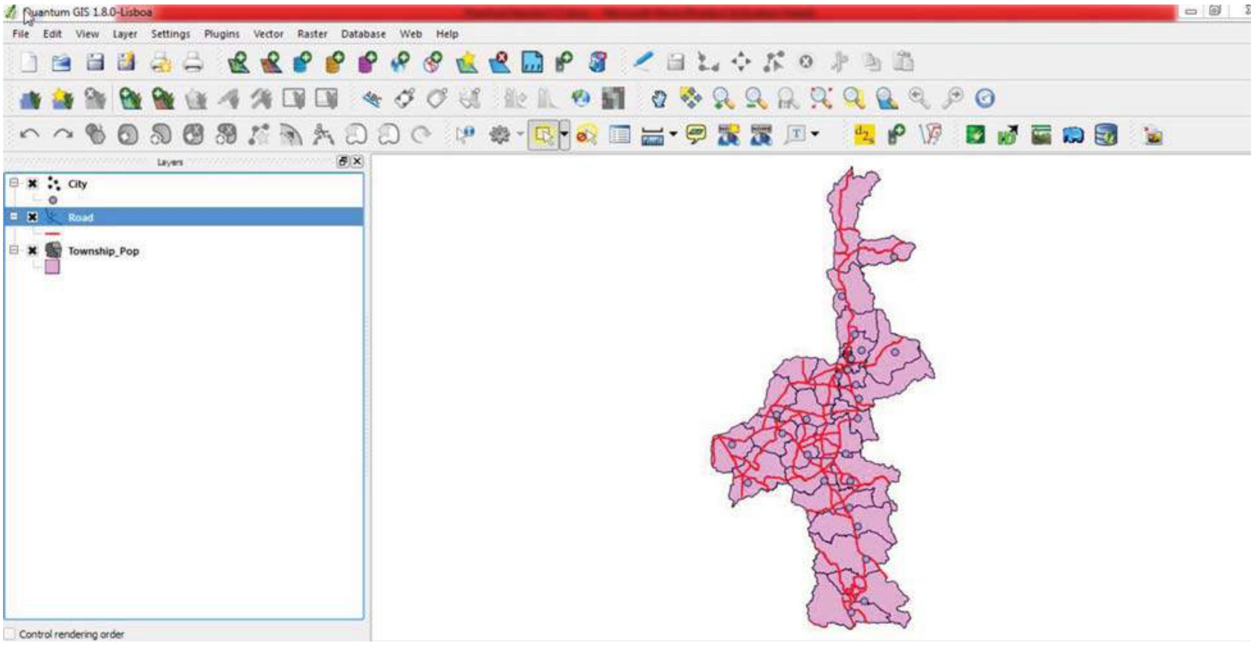


Step 3

Add the Road Shapefile. This can be done by adding a Vector Layer on the Toolbar or from the layer tab in the Menu Bar. What type of Shapefile is this?

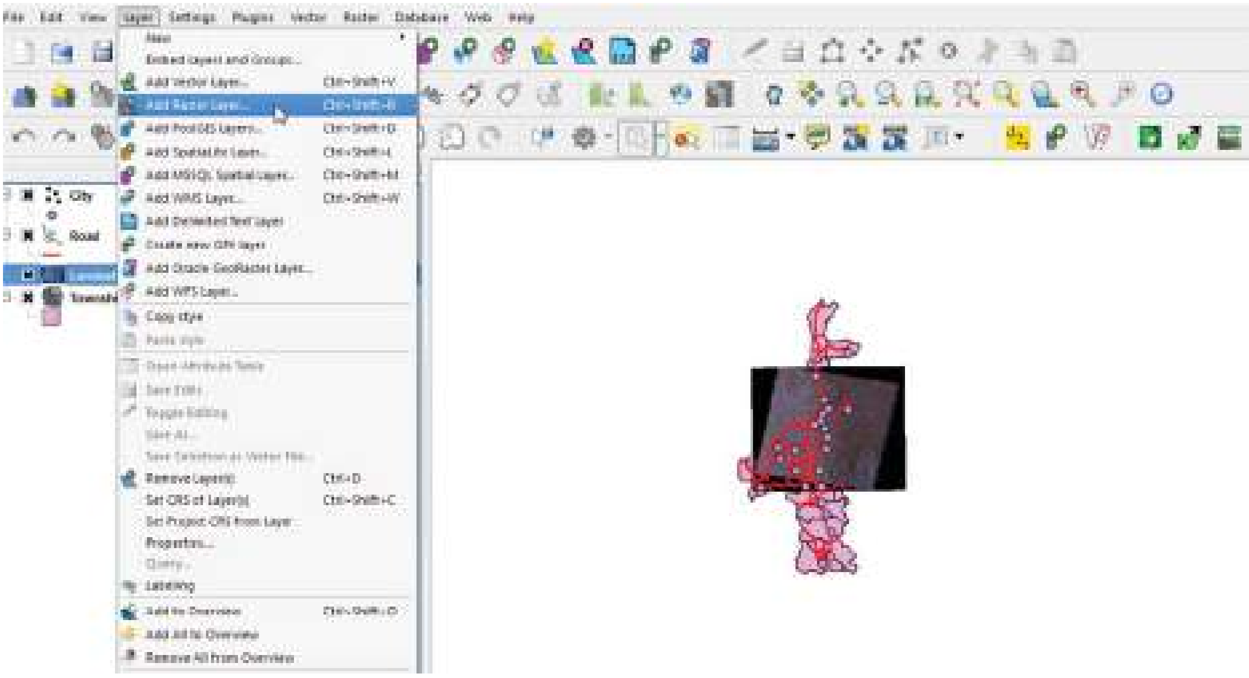
Step 4

Add the city Shapefile. This can be done by adding a Vector Layer on the Toolbar or from the layer tab in the Menu Bar. What type of Shapefile is this?



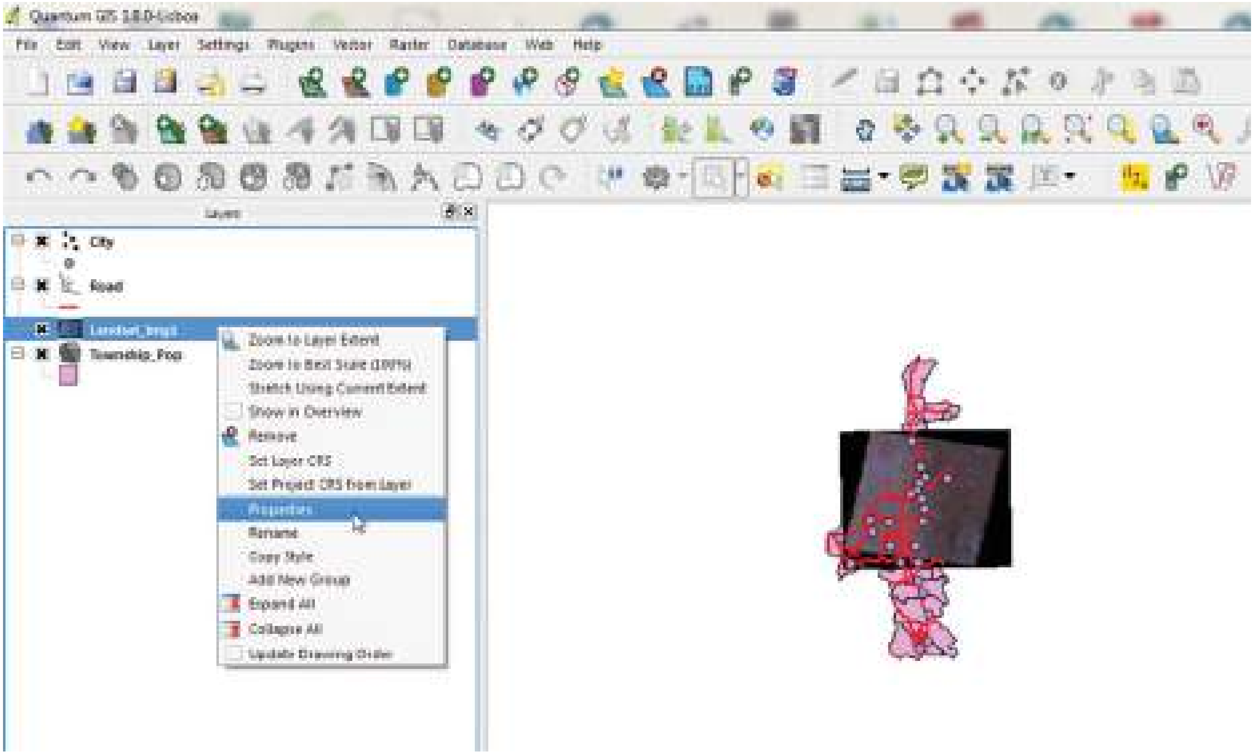
Step 5

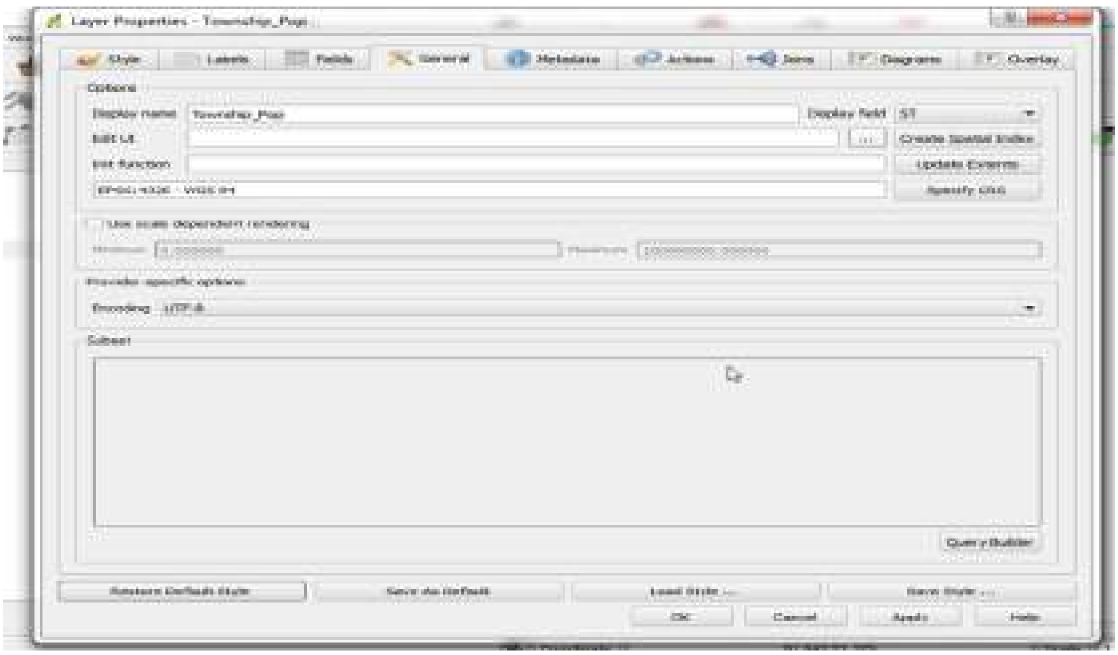
Add the Landsat_Img Raster file. This can be done by adding a Raster Layer on the Toolbar or from the layer tab in the Menu Bar.



Step 6

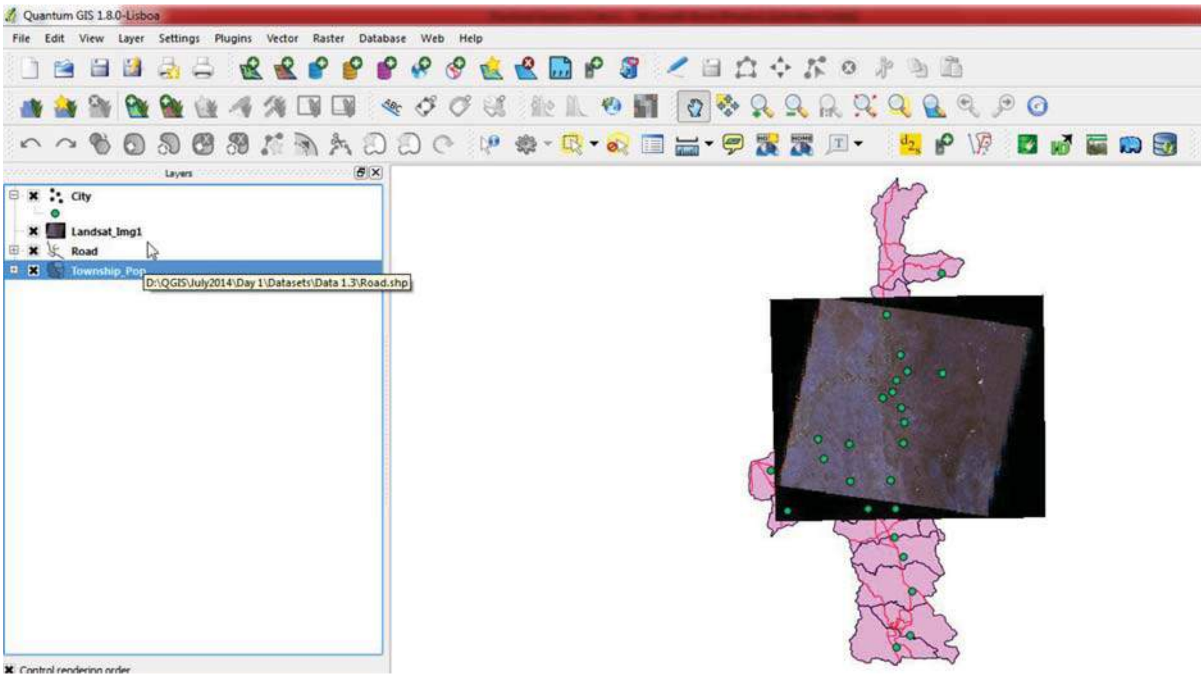
Make sure that all of the layers are on the same projection. Look up the projection type for each layer. This is done by rick clicking on the layer name in the Map Legend (Layers Panel). Click on Properties, then General. Under the General Tab, there will be information about the projection type. If the projection types to do match, this how you can also change the projection.

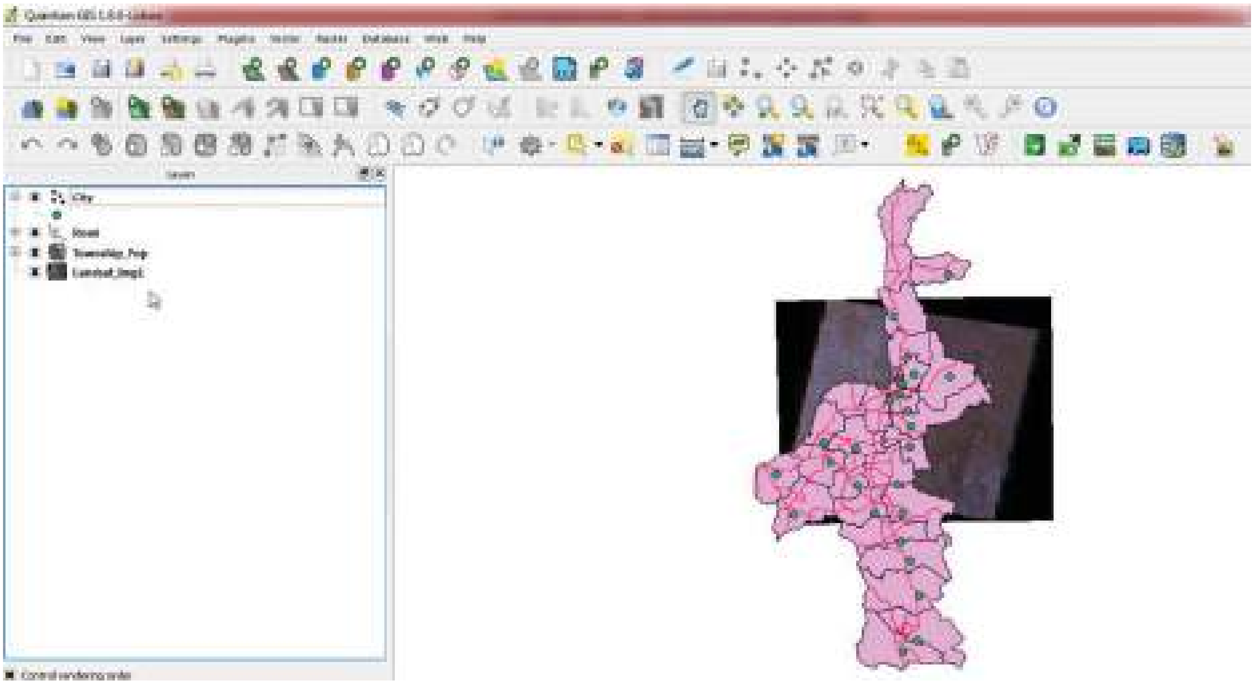




Step 7

Arrange the layers so that the city and road shapefiles appear on top of the satellite image. This is done in the Map Legend (Layers Panel). Simply, click on the city shapefile, and move it above the Landsat_Img. Do the same for the road shapefile.





2.1.3. Spatial Referencing

All GIS dataset require a specific reference system (i.e. datum, coordinate system and map projection) to integrate, combine and display spatial data (which defines location, shape and extent of geographic objects).

To effectively use a GIS it is important to understand how map projections are define and coordinates are measured.

Shape of the earth plays an important role on how the coordinates are going to be measured. Humans since early in the history have long speculated on its size and shape.

Datum

What is a coordinate system?

A coordinate system is a reference system used to represent the locations of geographic features, imagery, and observations such as GPS locations within a common geographic framework. Each coordinate system is defined by:

- Its measurement framework which is either geographic (in which spherical coordinates are measured from the earth's center) or planimetric (in which the earth's coordinates are projected onto a two-dimensional planar surface).
- Unit of measurement (typically feet or meters for projected coordinate systems or decimal degrees for latitude–longitude).

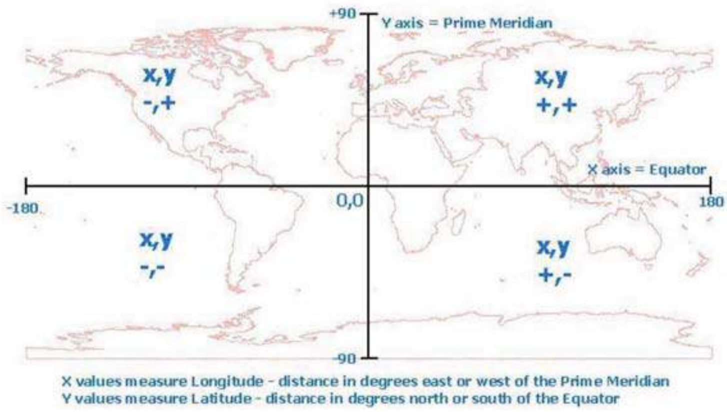
- The definition of the map projection for projected coordinate systems.
- Other measurement system properties such as a spheroid of reference, a datum, andprojection parameters like one or more standard parallels, a central meridian, and possible shifts in the x- and y-directions.

Types of coordinate systems

There are two common types of coordinate systems used in GIS:

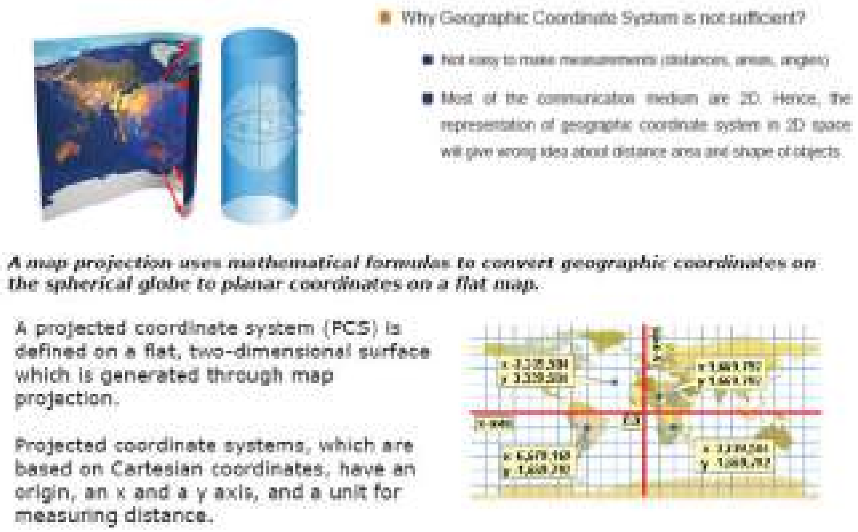
- A global or spherical coordinate system such as latitude–longitude. These are often referred to as *geographic coordinate systems.*
- A projected coordinate system based on a map projection such as transverse Mercator, Albers equal area, or Robinson, all of which (along with numerous other map projection models) provide various mechanisms to project maps of the earth's spherical surface onto a two-dimensional Cartesian coordinate plane. Projected coordinate systems are sometimes referred to as *map projections*.

Geographic Coordinate Systems



- Use Decimal Degrees (angles), 3 digits or less
- North America:
- West of the Prime Meridian, so Longitude (X) is negative
- North of the Equator, so Latitude (Y) is positive

Projected Coordinate Systems



Projection

A Projection is a series of transformations which convert the location of points on a curved surface (the reference surface or datum) to locations on flat plane (ie transforms coordinates from one coordinate reference system to another).

Creation of a Map Projection

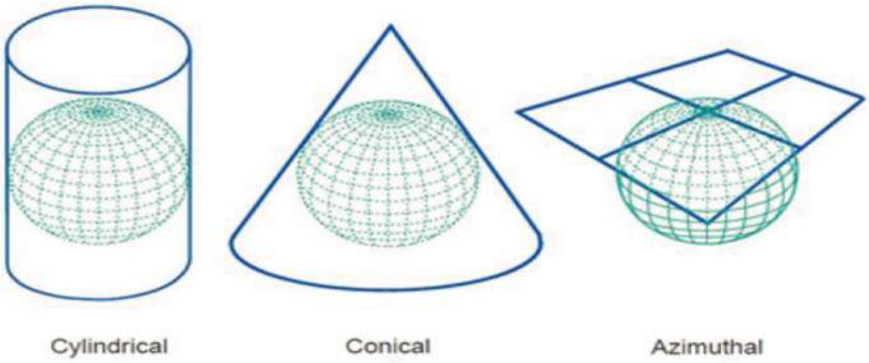
The creation of a map projection involves three steps in which information is lost in each step:

1. selection of a model for the shape of the earth or round body (choosing between a sphere or ellipsoid)
2. transform geographic coordinates (longitude and latitude) to plane coordinates (eastings and northings).
3. reduce the scale (in manual cartography this step came second, in digital cartography it comes last)

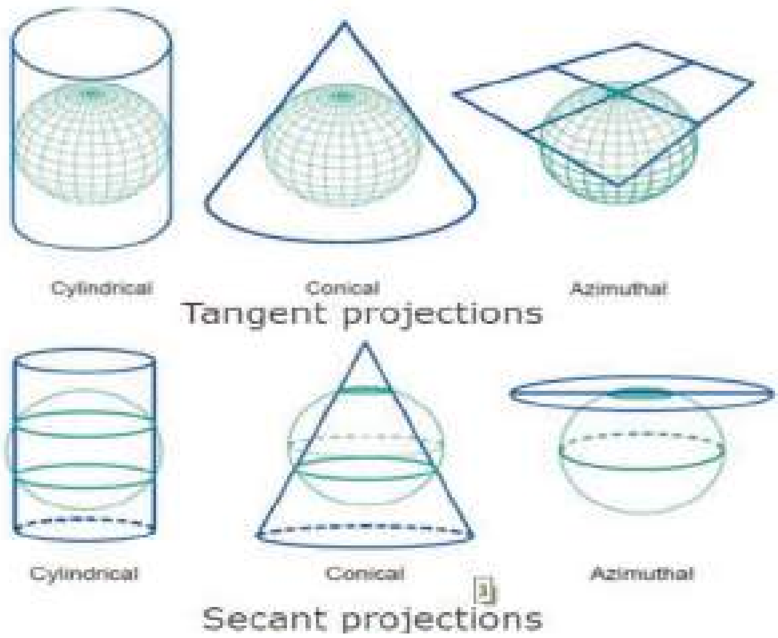
There are several different types of projections that aim to accomplish different goals while losing data in other areas through distortion.

- Area preserving projection – equal area or equivalent projection
- Shape preserving – conformal, orthomorphic
- Direction preserving – conformal, orthomorphic, azimuthal (only from a the central point)
- Distance preserving – equidistant (shows the true distance between one or two points and every other point)

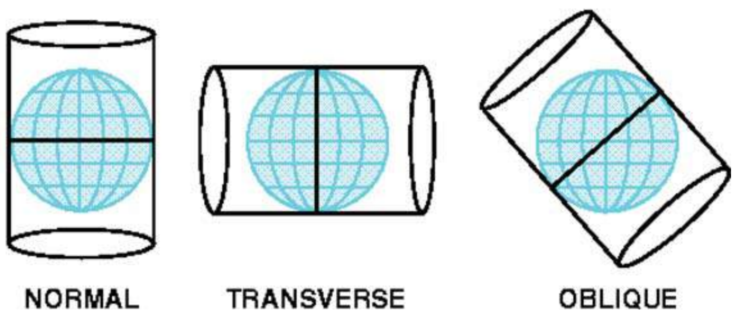
Based on Projection Surface



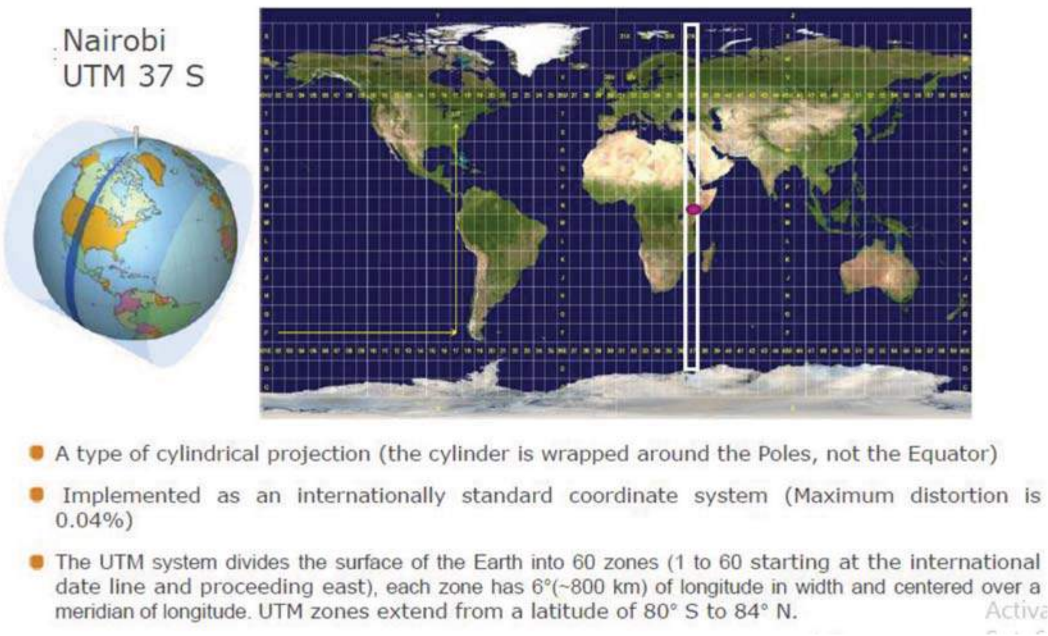
Based on Point of Secancy



Based on Orientation of Projection Plane



Universal Transversal Mercator (UTM) Coordinate System



2.1.4. Querying in QGIS

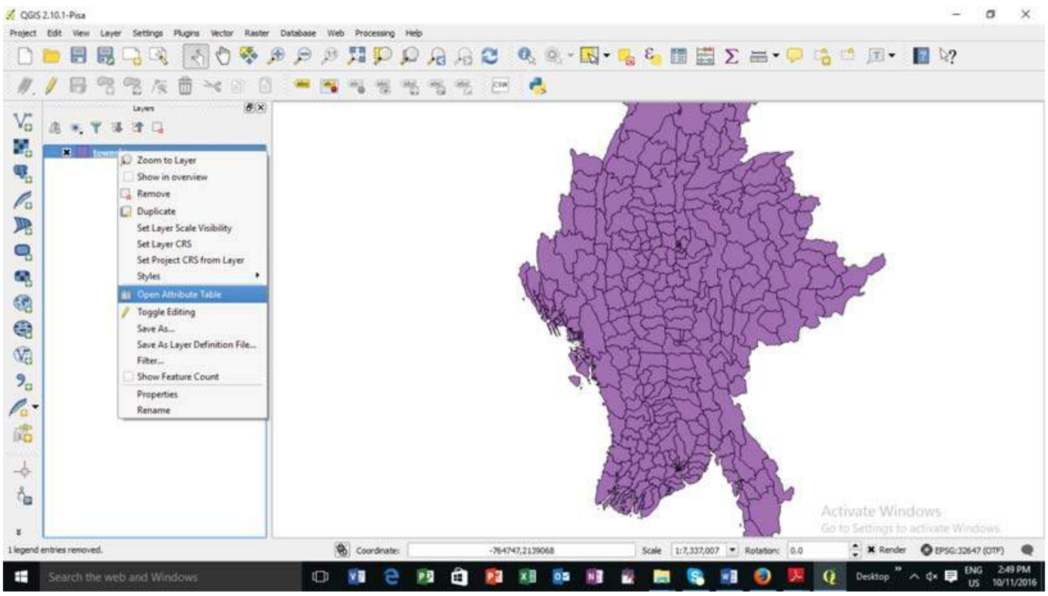
A query is a request for information (selective information) from the attribute table in QGIS based on SQL command or expression. QGIS has some support for analyzing of SQL-like expressions.

1) Select features using an expression (attribute query)

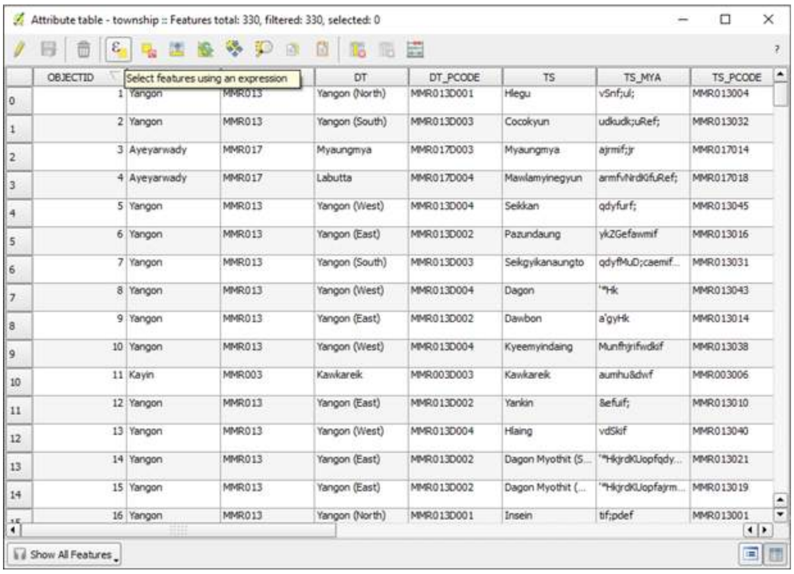
One method to select features in a layer is to select features using an attribute query:-

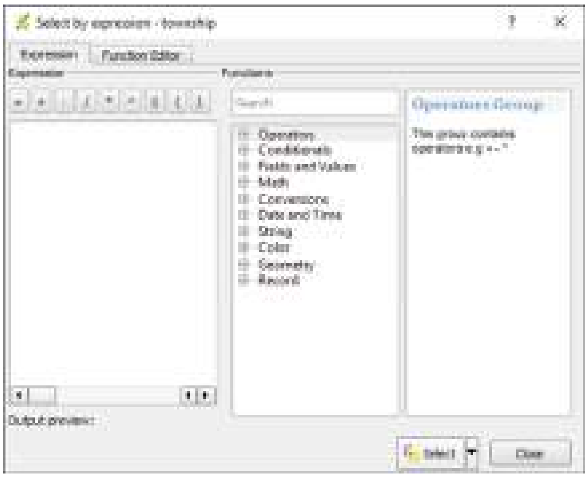
To query a layer by its attribute data,

1. Right click on the layer's name in the Layer Panel and select the open attribute table



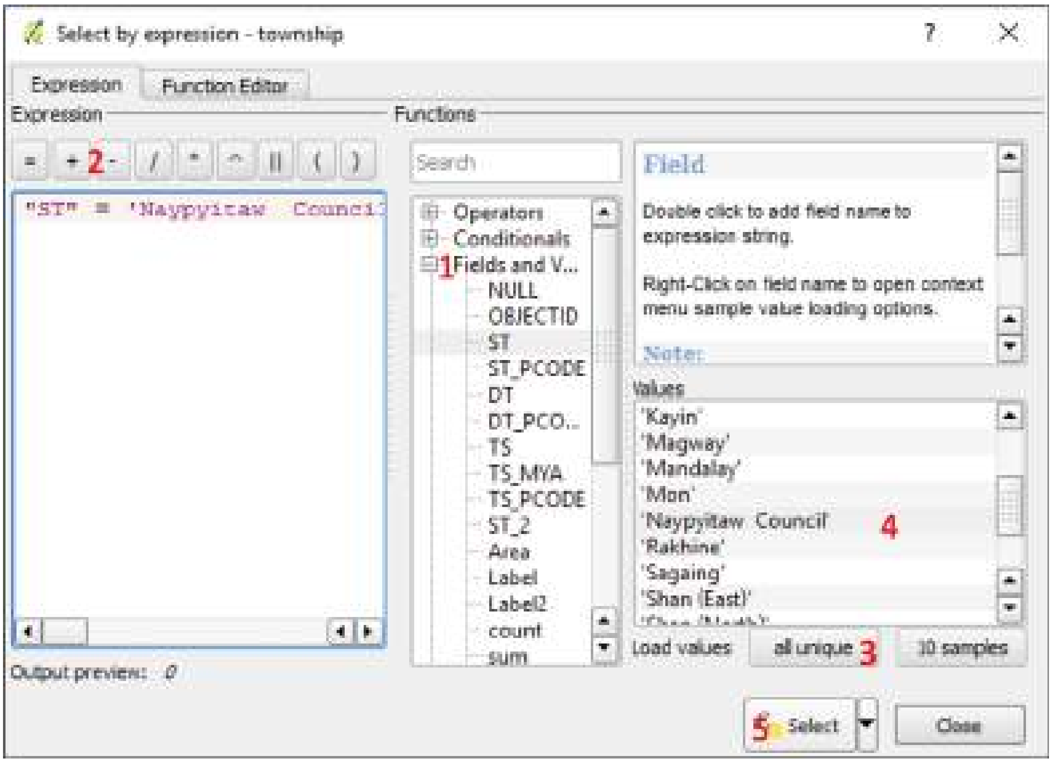
2. Then Select features using an expression in attribute table to type the expression.



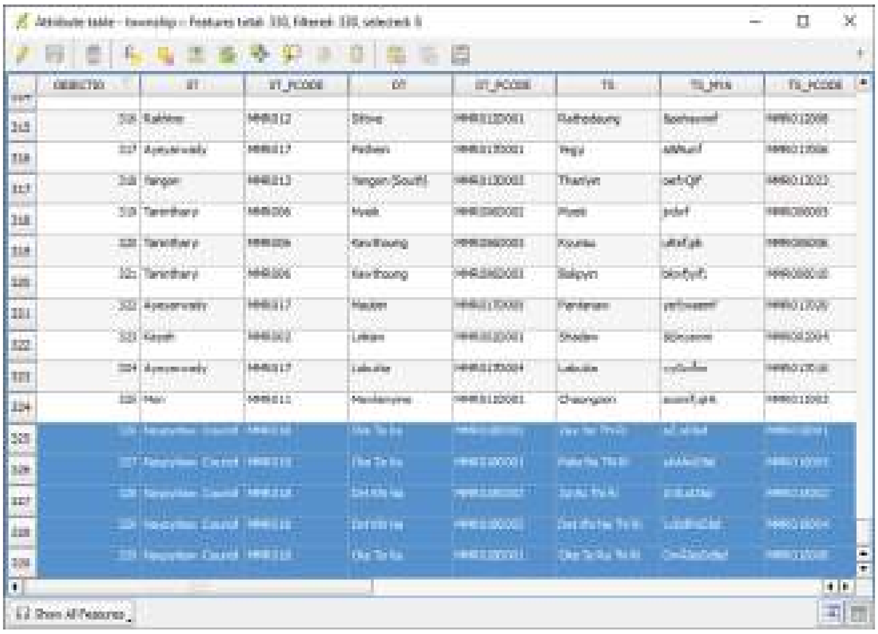


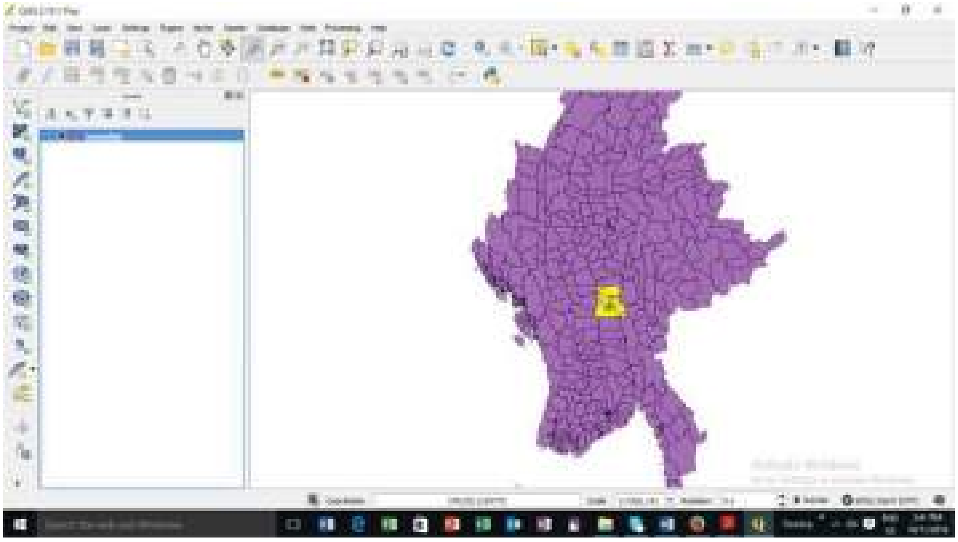
It is possible to type the SQL query into the SQL where clause box. Alternatively:-

1. Click the Field that contains the attributes you wish to base the query on
2. Select the operator
3. Press the All unique under the values box to list all the available values
4. Double click the value that you wish to select
5. You will see the query being built in the SQL where clauses box.



Selected values (records) can be seen in the attribute table:





Some operators used in where clause:

Operator	Description
=	Equal
<>	Not equal. **Note:** In some versions of SQL this operator may be written as !=
>	Greater than
<	Less than
>=	Greater than or equal
<=	Less than or equal
BETWEEN	Between an inclusive range
LIKE	Search for a pattern

And Operator

SELECT * FROM Customers WHERE Country='Germany'AND City='Berlin';

OR Operator

SELECT * FROM Customers WHERE City='Berlin'OR City='München';

AND and OR Operator

SELECT * FROM Customers WHERE Country='Germany' AND (City='Berlin' OR City='München');

Note: The values in column of attribute table is text, you need to use single quote ' ' in expression but for number case no need to add this.

SELECT * FROM Customers WHERE Country='Mexico';

SELECT * FROM Customers WHERE CustomerID=1;

LIKE Operator

SELECT column_name(s) FROM table_name WHERE column_name LIKE pattern;

LIKE Operator and % Wildcard in Text field

SELECT * FROM Customers WHERE City LIKE 'ber%';

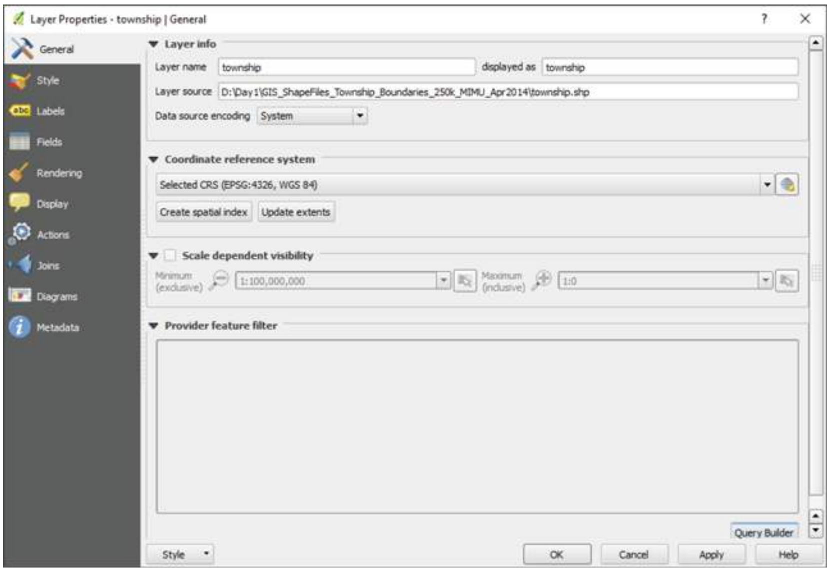
SELECT * FROM Customers WHERE City LIKE '%es%'; SELECT * FROM Customers WHERE City LIKE '_er-lin';

More detail : please check http://www.w3schools.com/sql/

(2) Filtering values Using Query Builder

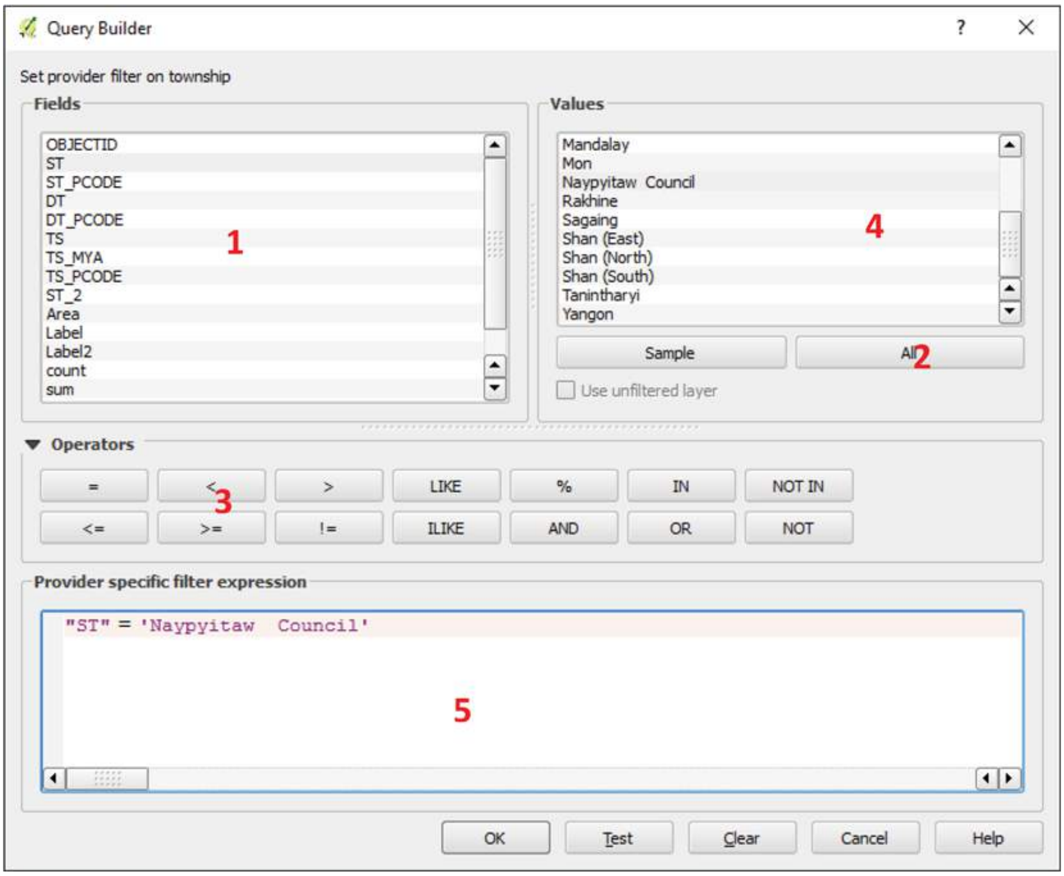
The Query Builder allows you to define a subset of a table using a SQL-like WHERE clause and display the result in the main window. The query result then can be saved as a new vector layer. Once you set the definition query, the map is redrawn and displays the subset of features that are selected using your query. The layer continues to be drawn with this feature subset each time the map is refreshed.

Open the Query Builder by opening the Layer Properties and go to the General menu. Under Feature subset click on the [Query Builder] button to open the Query builder.

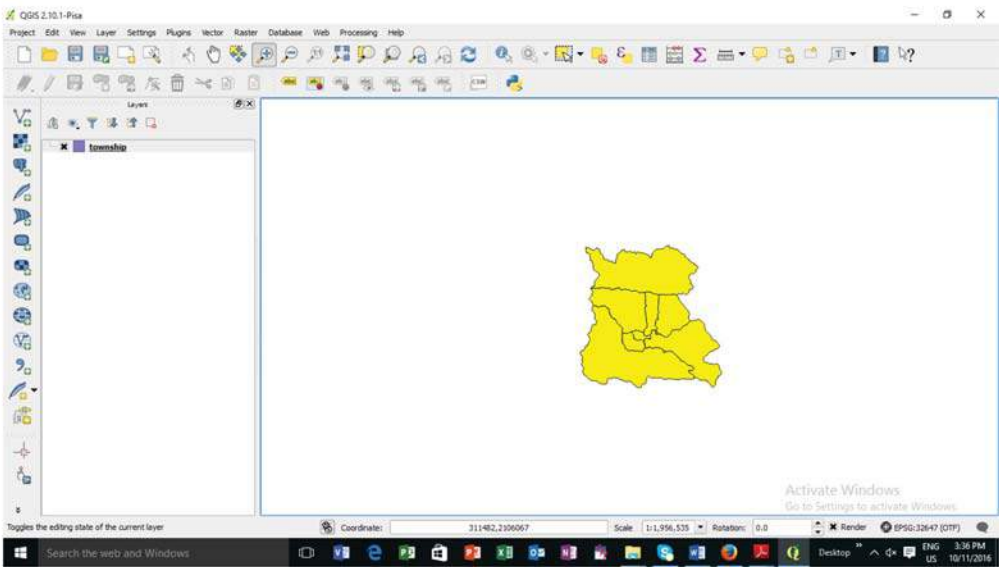


For example, if you have a township layer with a ST (state) field you could select only state that is "Naypyitaw Council" in the Provider specific filter expression box of the Query builder.

The Fields, Values and Operators sections help the user to construct the SQL-like query like the previous ecample.



The result of query will be as follow:



Question:

What difference between Query Builder and Select Features by Using an Expression?

Save selected features as new layer

The selected features can be saved as any OGR supported vector format and also transformed into another Coordinate Reference System (CRS). Just open the right mouse menu of the layer and click on Save selection as to define the name of the output file, its format and CRS. It is also possible to specify OGR creation options within the dialog.

(3) Spatial Query

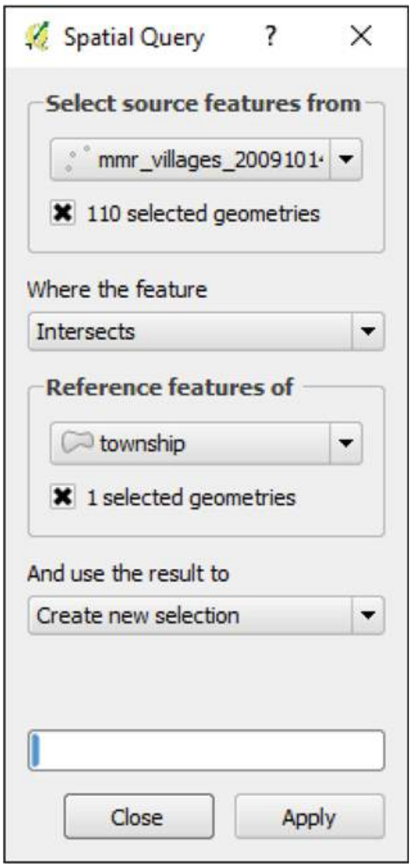
The Spatial Query Plugin allows you to make a spatial query (i.e., select features) in a target layer with reference to another layer. The functionality is based on the GEOS library and depends on the selected source feature layer.

Possible operators are:

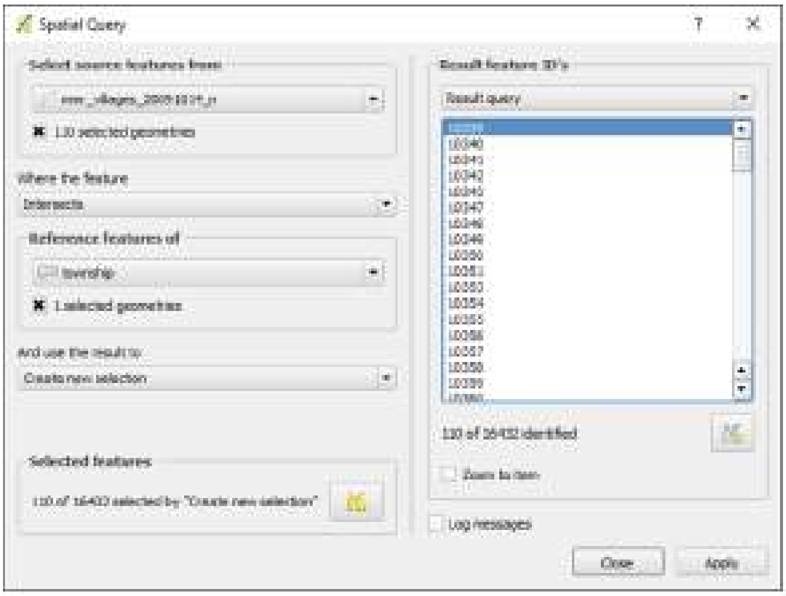
- Contains
- Equals
- Overlap
- Crosses
- Intersects
- Is disjoint
- Touches
- Within

As an example, we want to find villages in Kyauk township. The following steps are necessary:

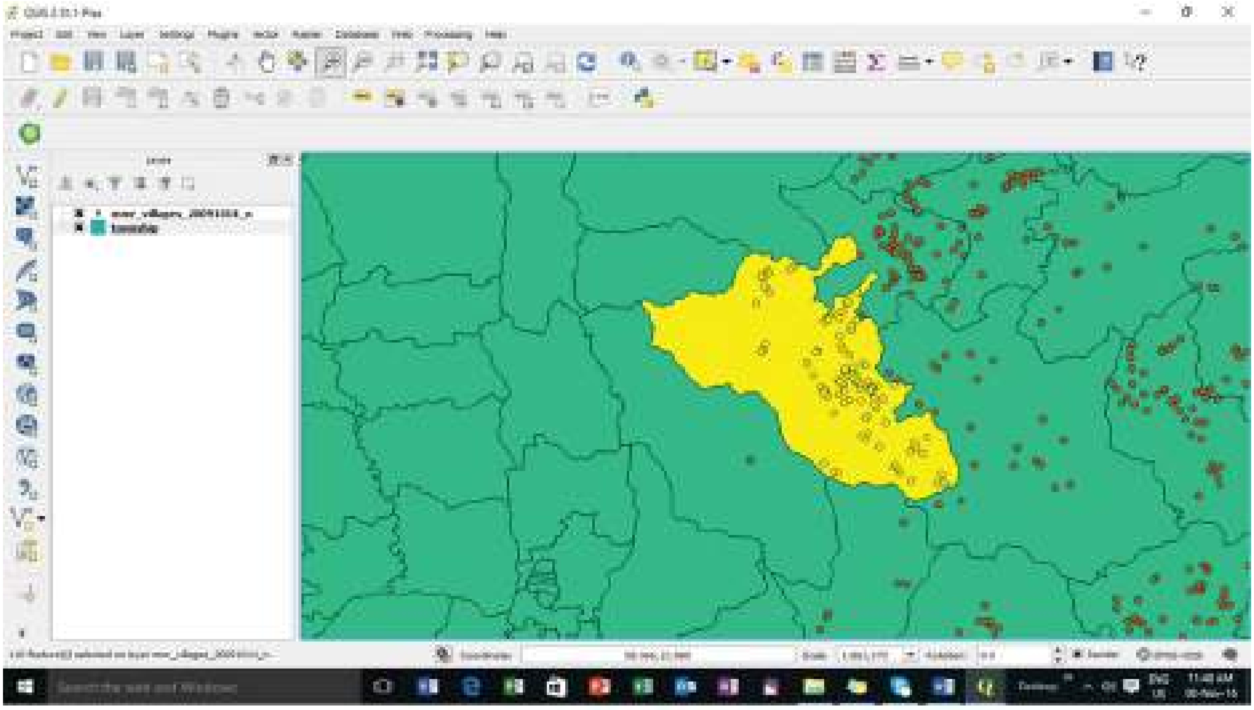
1. Start QGIS and load the vector layers villages.shp and township.shp.
2. Select “Kyaukme” township from township layer using expression method.
3. Click on the Spatial Query icon, which appears in the QGIS toolbar menu.
4. Select the layer villages as the source layer and township as the reference feature layer.
5. Select ‘Intersect’ as the operator and click [Apply].



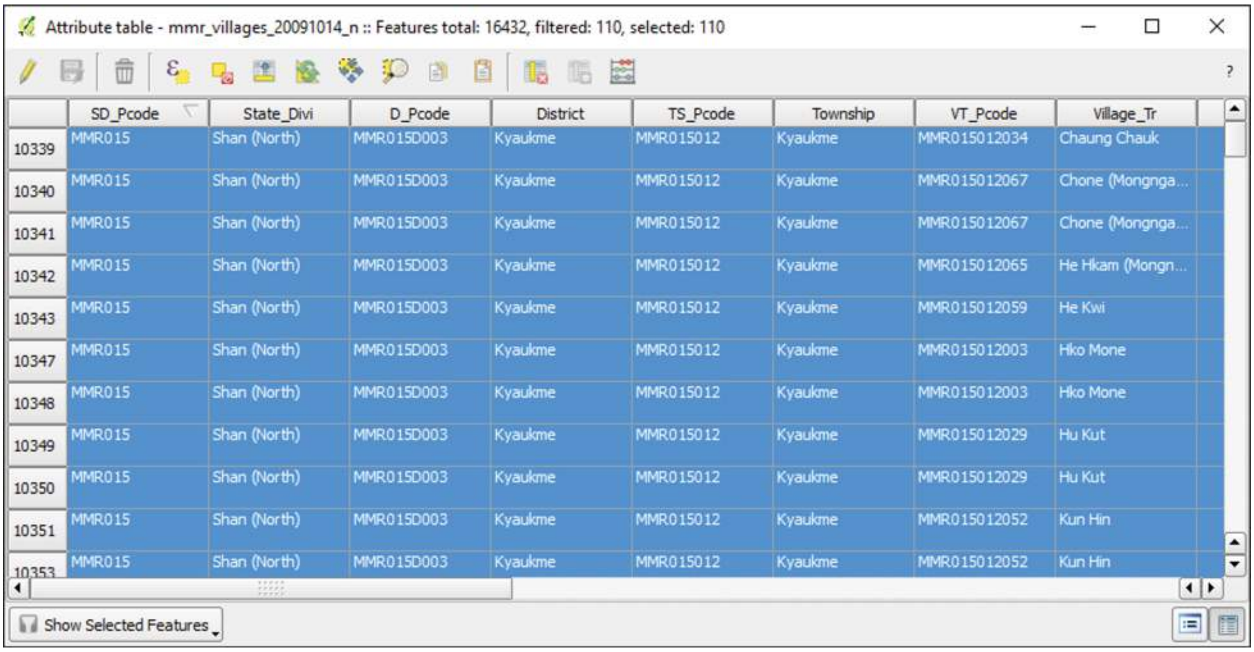
Then click “Apply”. Now you get a list of feature IDs from the query and you have several options, as shown in figure.



Click “Close” button and you will see the selected villages inside the Kyaukme township.



And also check the attribute table of Village layer.

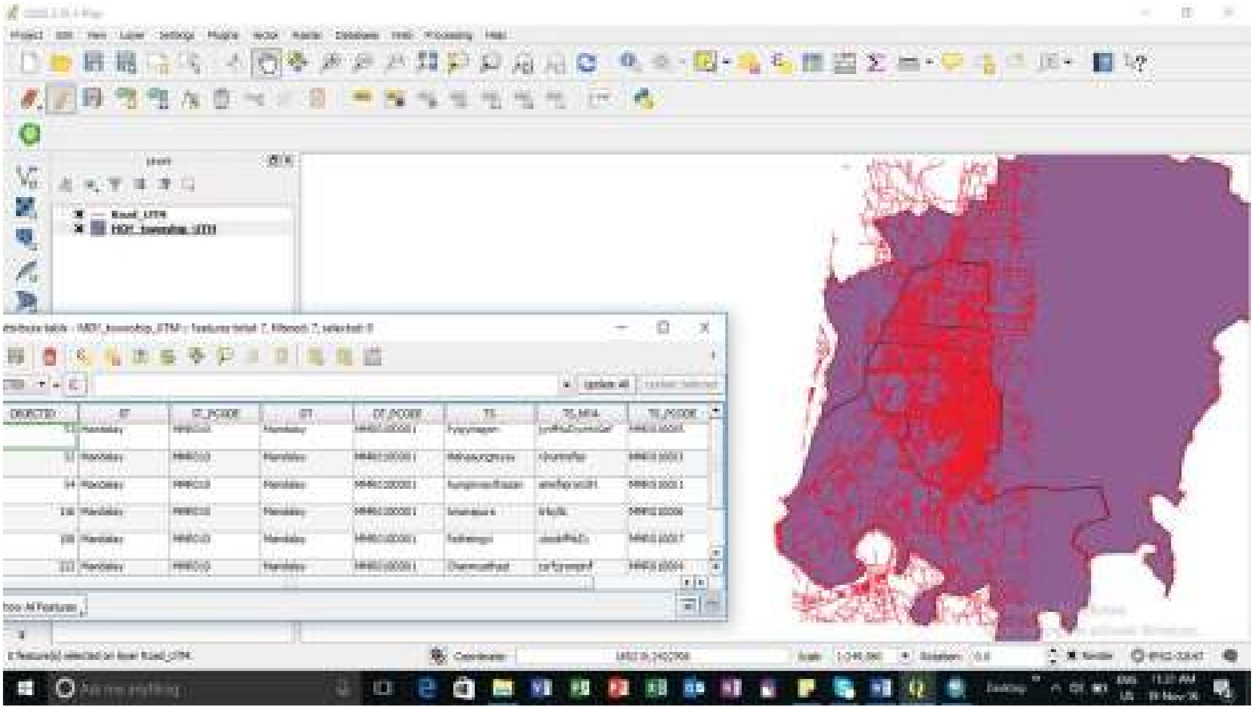


	SD_Pcode	State_Divi	D_Pcode	District	TS_Pcode	Township	VT_Pcode	Village_Tr
10339	MMR015	Shan (North)	MMR015D003	Kyaukme	MMR015012	Kyaukme	MMR015012034	Chaung Chauk
10340	MMR015	Shan (North)	MMR015D003	Kyaukme	MMR015012	Kyaukme	MMR015012067	Chone (Mongnga...
10341	MMR015	Shan (North)	MMR015D003	Kyaukme	MMR015012	Kyaukme	MMR015012067	Chone (Mongnga...
10342	MMR015	Shan (North)	MMR015D003	Kyaukme	MMR015012	Kyaukme	MMR015012065	He Hkam (Mongn...
10343	MMR015	Shan (North)	MMR015D003	Kyaukme	MMR015012	Kyaukme	MMR015012059	He Kwi
10347	MMR015	Shan (North)	MMR015D003	Kyaukme	MMR015012	Kyaukme	MMR015012003	Hko Mone
10348	MMR015	Shan (North)	MMR015D003	Kyaukme	MMR015012	Kyaukme	MMR015012003	Hko Mone
10349	MMR015	Shan (North)	MMR015D003	Kyaukme	MMR015012	Kyaukme	MMR015012029	Hu Kut
10350	MMR015	Shan (North)	MMR015D003	Kyaukme	MMR015012	Kyaukme	MMR015012029	Hu Kut
10351	MMR015	Shan (North)	MMR015D003	Kyaukme	MMR015012	Kyaukme	MMR015012052	Kun Hin
10353	MMR015	Shan (North)	MMR015D003	Kyaukme	MMR015012	Kyaukme	MMR015012052	Kun Hin

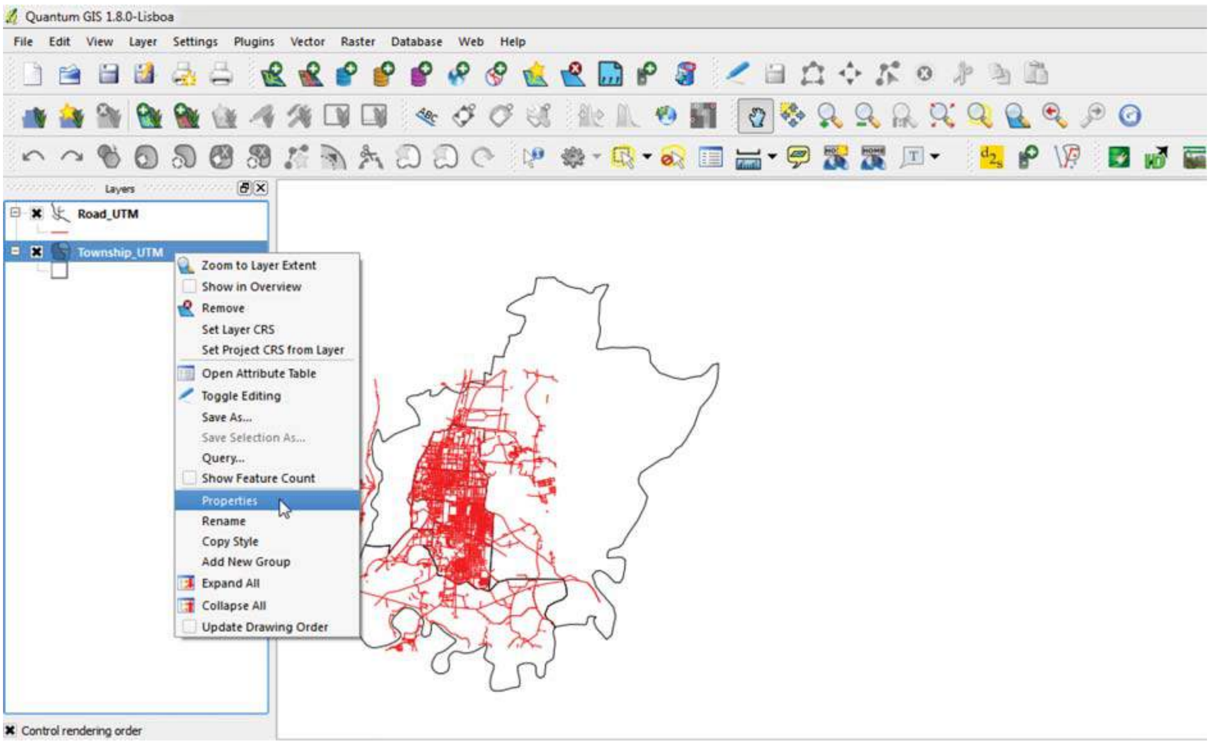
2.1.5. Manipulation and updating

Preparing data and join to GIS database

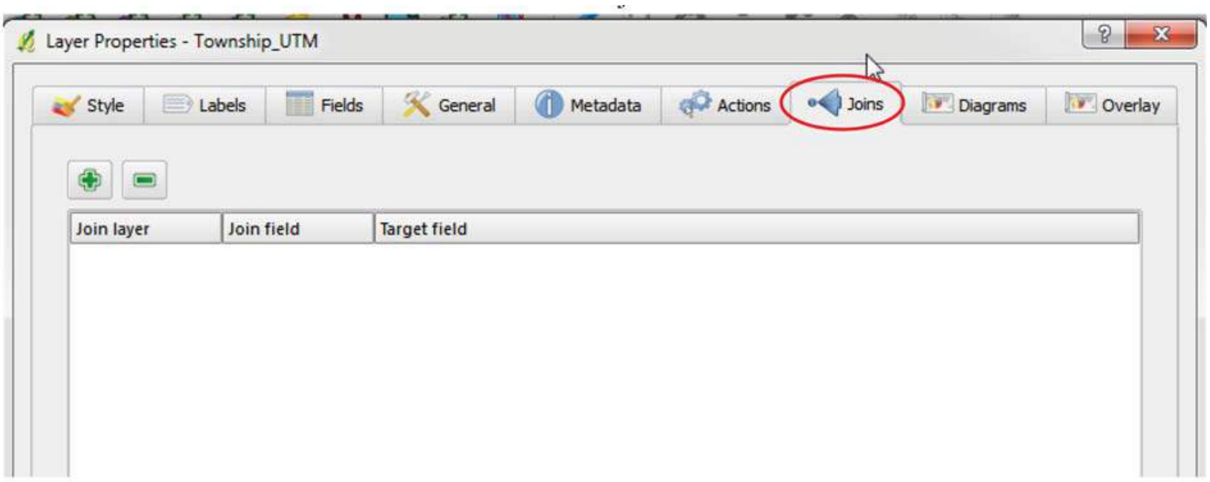
- Start QGIS and add file “MDY_Township_UTM” and “Road_UTM”



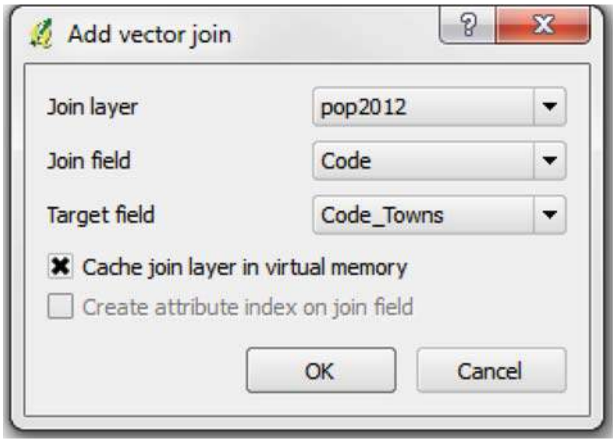
- Open attribute of MDY_Township_UTM you will see there are 7 records of the name for each township. And also see code of township as “Code_Township” containing same code value like in Pop2012.csv in order to join the attribute table of MDY_Township_UTM and Pop2012.csv excel table.
- Add Pop2012.csv to QGIS, then open the attribute you will see population and code for each township
- Join pop2012.scv to attribute data of “MDY_Township_UTM” by right click on layer of “MDY_Township_UTM” then select “Properties”



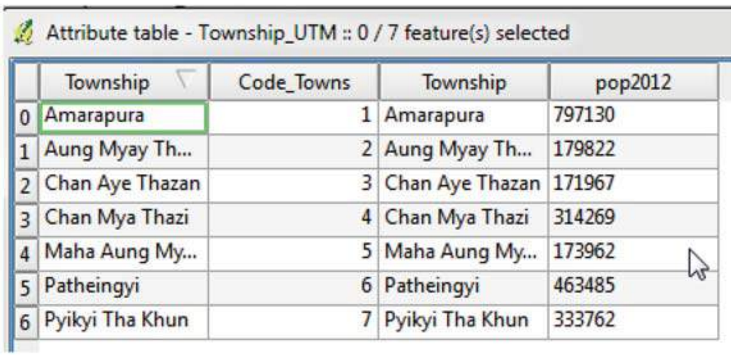
- Choose the tab "Joins" then click on  to start join the csv file to the GIS data.



- Select "pop2012" for Join layer, "Code" for Join field and "Code_Township" for Target field. Then click OK

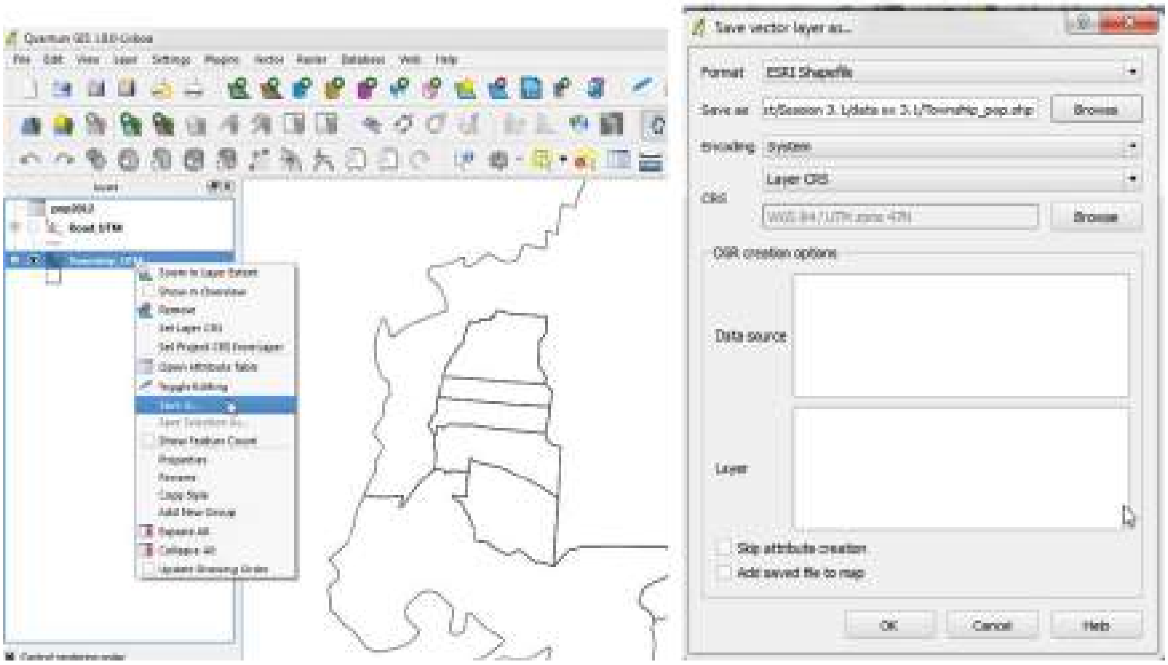


- Now you will be able to see the population in the MDY_Township_UTM attribute already.


Attribute table - Township_UTM :: 0 / 7 feature(s) selected

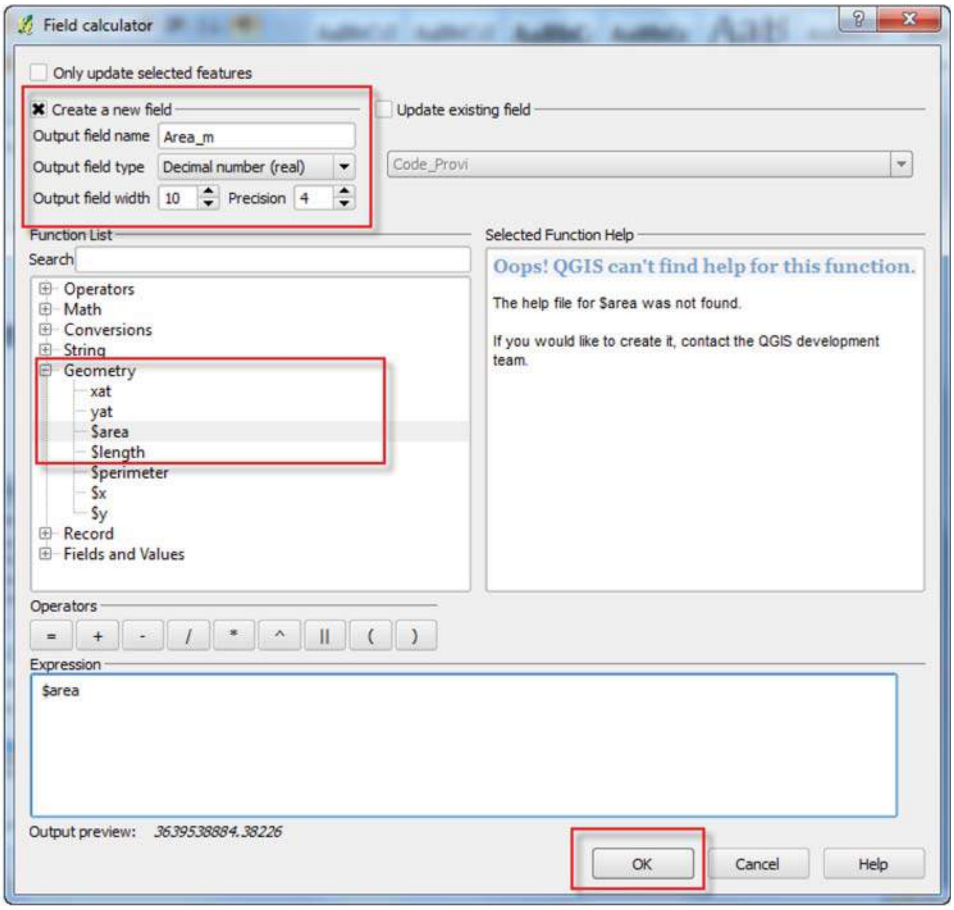
	Township	Code_Towns	Township	pop2012
0	Amarapura	1	Amarapura	797130
1	Aung Myay Th...	2	Aung Myay Th...	179822
2	Chan Aye Thazan	3	Chan Aye Thazan	171967
3	Chan Mya Thazi	4	Chan Mya Thazi	314269
4	Maha Aung My...	5	Maha Aung My...	173962
5	Patheingyi	6	Patheingyi	463485
6	Pyikyi Tha Khun	7	Pyikyi Tha Khun	333762

- Save as to be a new shapefile. Give a name as "Township_pop"

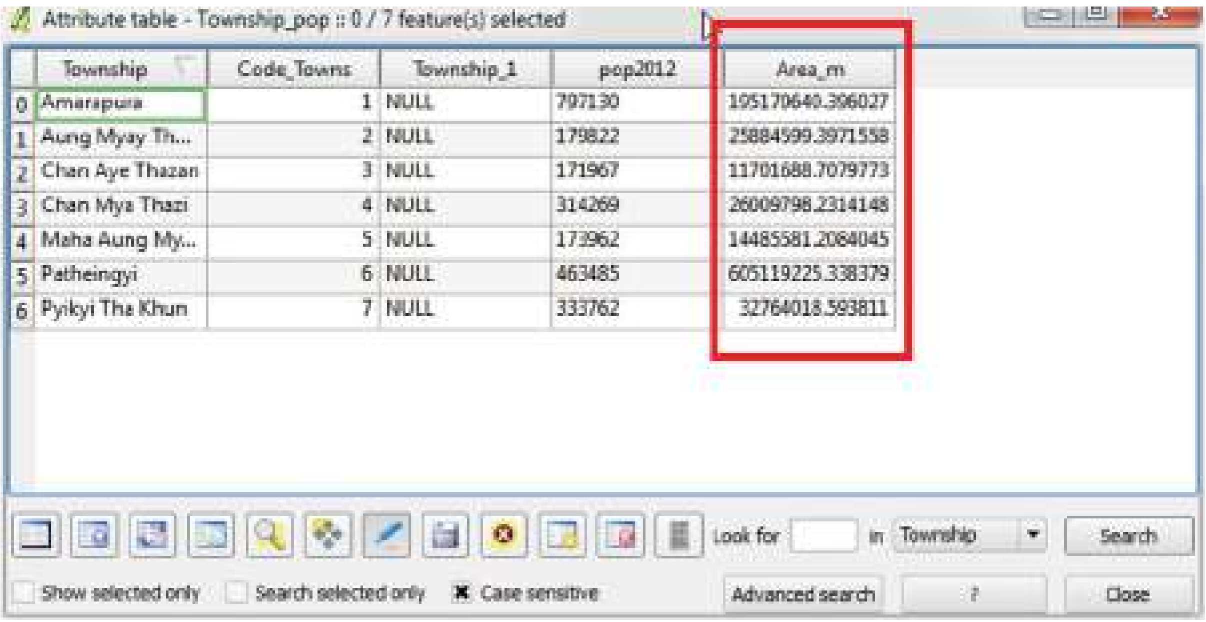


Area calculation in QGIS

- Add layer of "Township_pop.shp"to QGIS
- Open attribute table and start editing mode by click on 
- Click on field calculator icon  and the calculator box will appears.
    - o Check on "Create a new field"
    - o Assign Output field name as "Area_m"
    - o Assign Output field type as "Decimal Number (Real)"
    - o Assign Output field width as "10" precision as "4"
    - o Double click on $Area in Geometry
    - o Click OK



- You will see the result of area calculation in the attribute (in unit of meter)

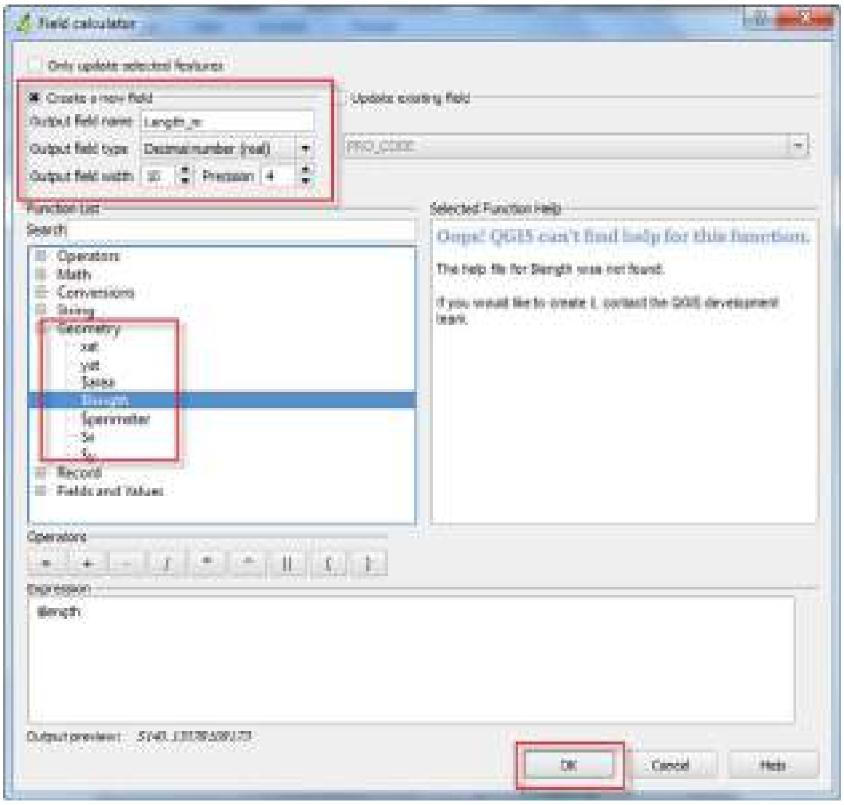


- Once the calculation is done, click on  again to save and finish editing mode.

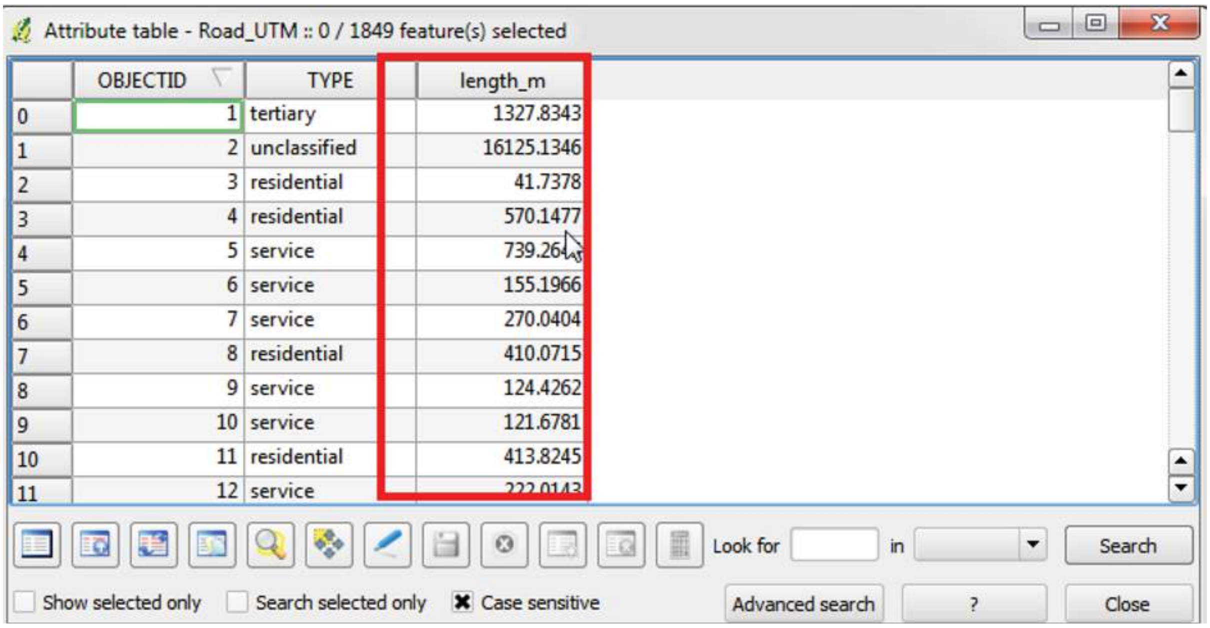
Question: Please calculate area in square kilometer.

Length calculation in QGIS

- Open attribute table of "Road_UTM" and start editing mode by click on 
- Click on field calculator icon  and the calculator box will appears.
    - o Check on "Create a new field"
    - o Assign Output field name as "length_m"
    - o Assign Output field type as "Decimal Number (Real)"
    - o Assign Output field width as "10" precision as "4"
    - o Double click on $Length in Geometry
    - o Click OK



- You will see the result of length calculation in the attribute



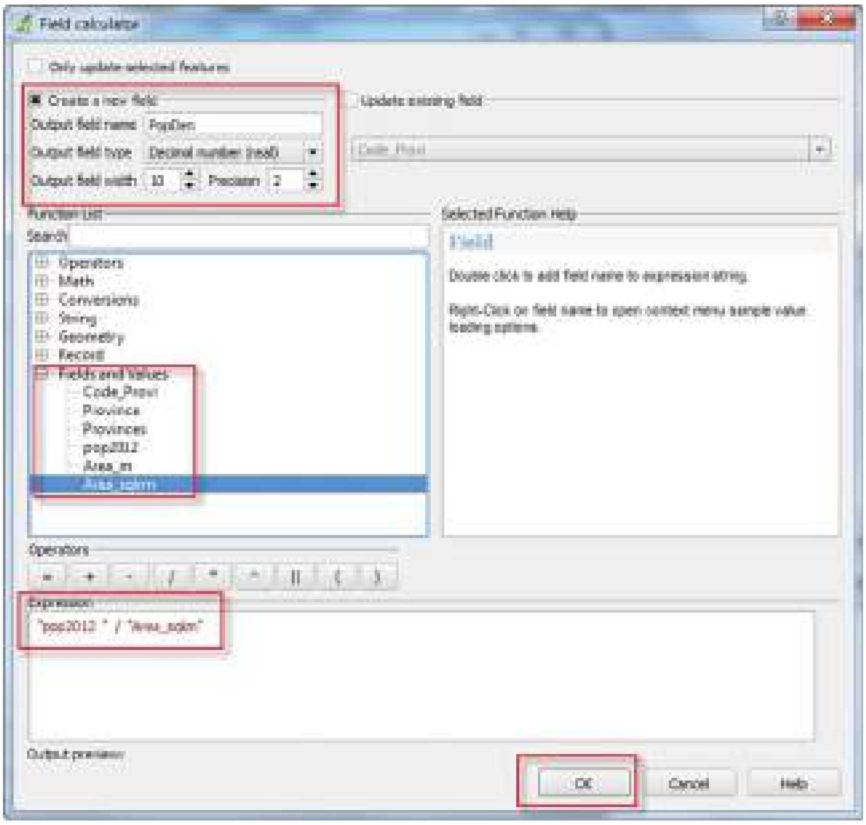
- Once the calculation is done, click on [edit icon] again to save and finish editing mode.
- **Please calculate length in kilometer**

Population density calculation

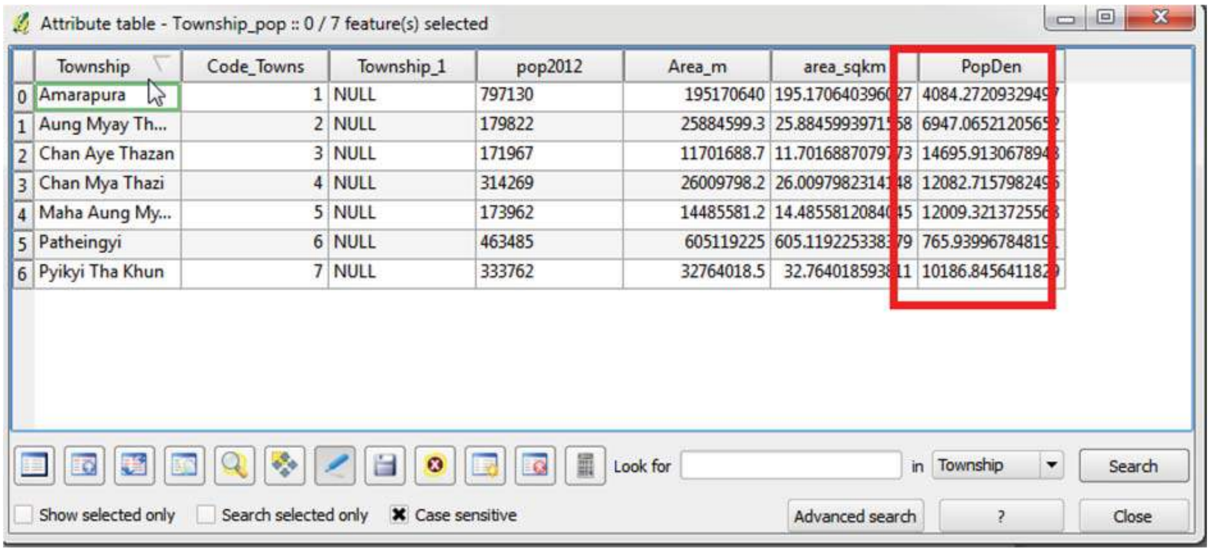
Back to "Township_pop.shp "shapefile again. Now, we have number of population and area already. The equation of population density is:

$$\text{Population density} = \frac{\text{Number of population}}{\text{Area}}$$

- Open attribute table and start editing mode by click on [edit icon]
- Click on field calculator icon [calculator icon] and the calculator box will appears.
  - Check on "Create a new field"
  - Assign Output field name as "PopDen"
  - Assign Output field type as "Decimal Number (Real)"
  - Assign Output field width as "10" precision as "4"
  - Select fields in "Fields and Values" and required operator also select from operator list to be put in expression box
  - Click OK



- You will see the result in the field "PopDen"



Calculation number of male and female in each province

- Assuming that number of male is 45% of population
- Please calculate number of male and female by using the attribute in the layer of Province_pop" based on the above assumption.

Questions?

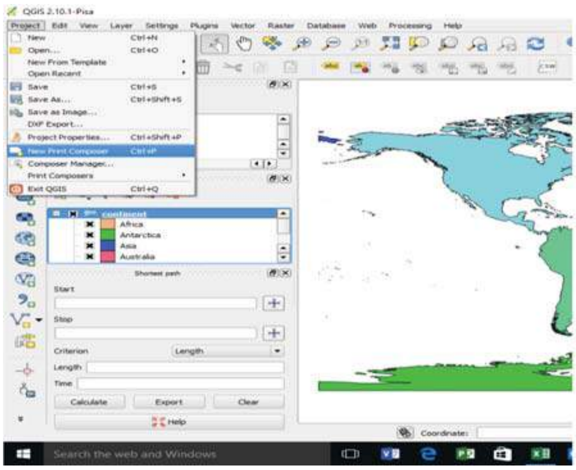
1. Which province has the biggest area?
2. Which province has the highest density of population?
3. Which province has the least number of female?

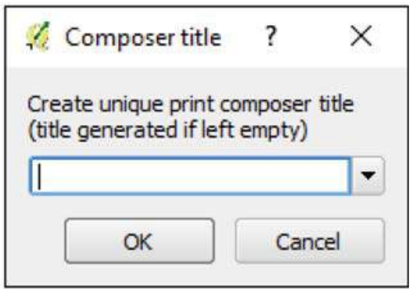
2.1.6. Map Composer

Now that you've got a map, you need to be able to print it or to export it to a document. The reason is, a GIS map file is not an image. Rather, it saves the state of the GIS program, with references to all the layers, their labels, colors, etc. So for someone who doesn't have the data or the same GIS program (such as QGIS), the map file will be useless. Luckily, QGIS can export its map file to a format that anyone's computer can read, as well as printing out the map if you have a printer connected. Both exporting and printing is handled via the Map Composer.

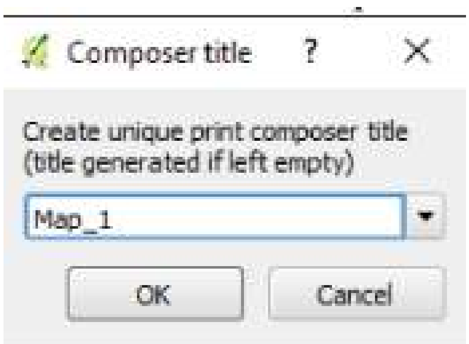
QGIS allows you to create multiple maps using the same map file. For this reason, it has a tool called the Composer Manager.

• Click on the Project ⟶ Select New Print Composer. Then you'll see a Composer title dialog appear.

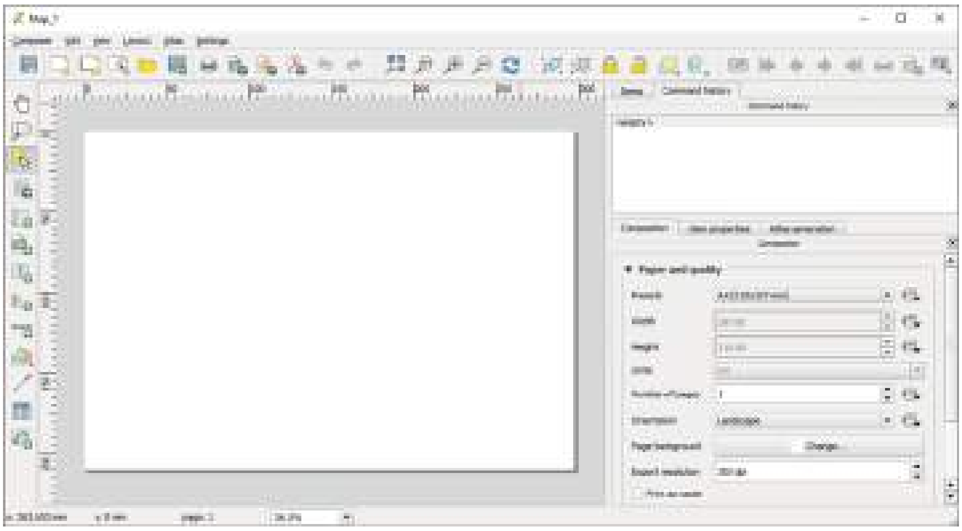




• GIVE THE NEW COMPOSER THE NAME OF MAP_1.

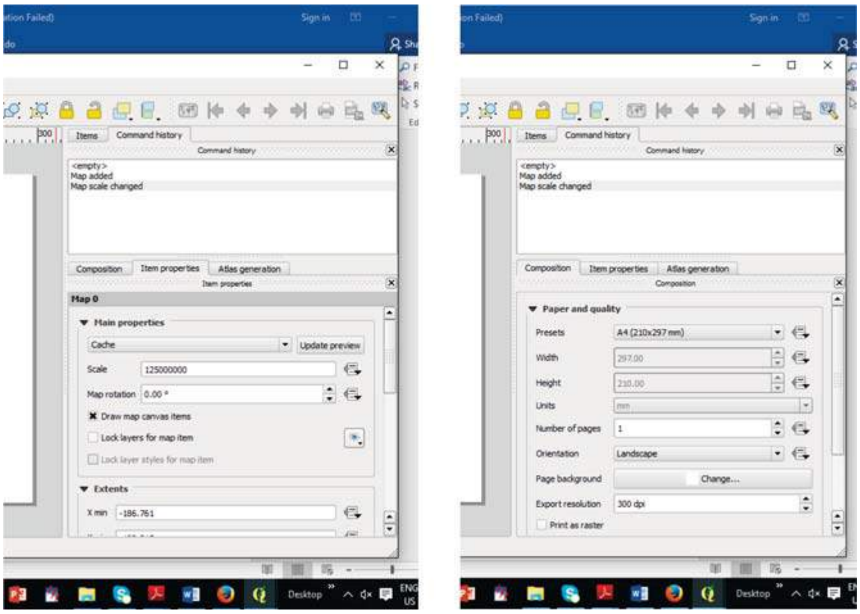


• CLICK OK. THEN YOU WILL SEE THE BANK MAP COMPOSER DIALOG WILL APPEAR.

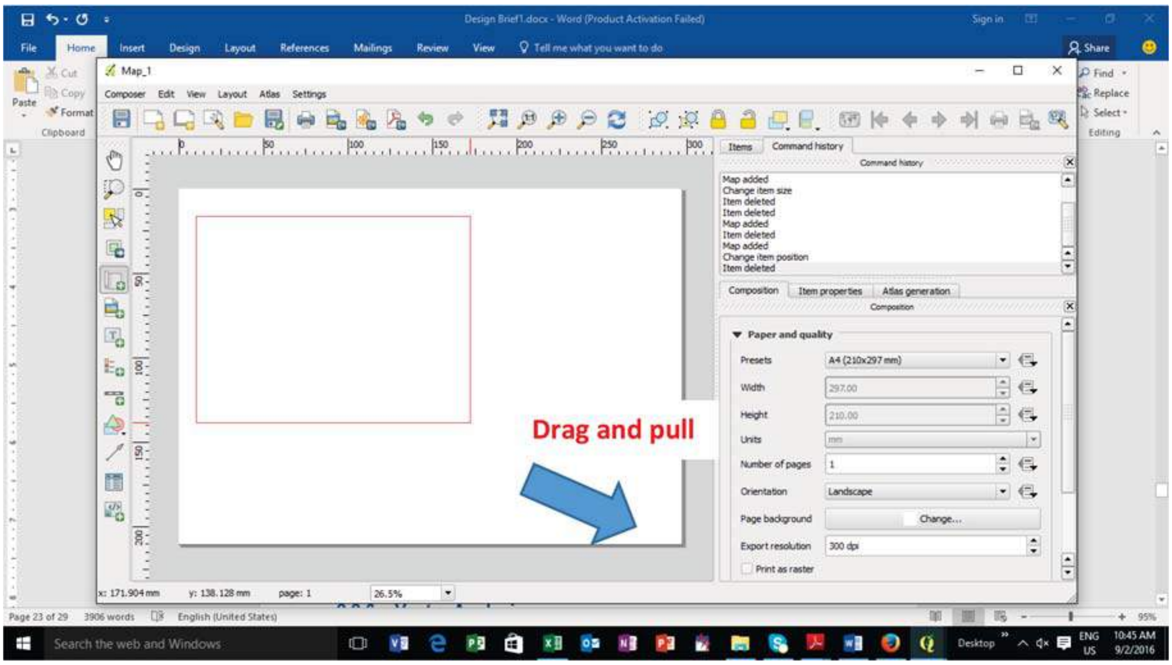


Basic Map Composition

1. Define the map scale and then select the paper size, Orientation and Quality (export resolution) according to fit with your map scale and paper size.



2. Click on the Add New Map button . And click and drag a box on the blank page. The map will appear on the page.



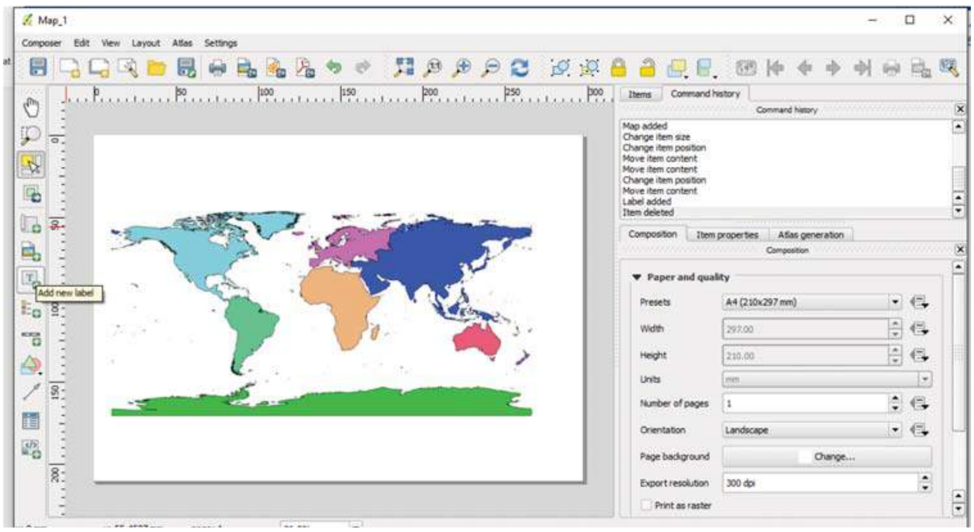
3. You can also move the map (the box) using Move item .

4. Zoom and pan the map in the main QGIS window. You can also pan the map using the Move item content in the fix frame (in the box).

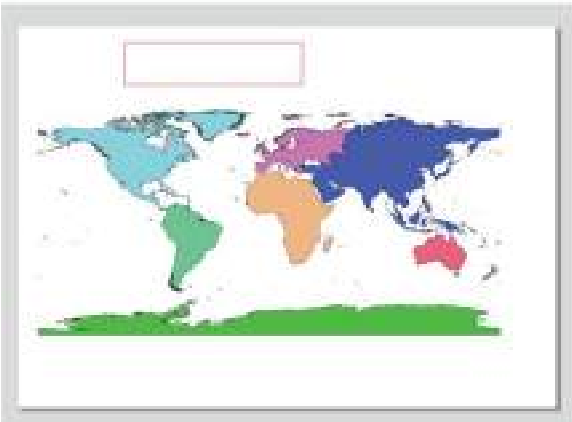
5. Map elements

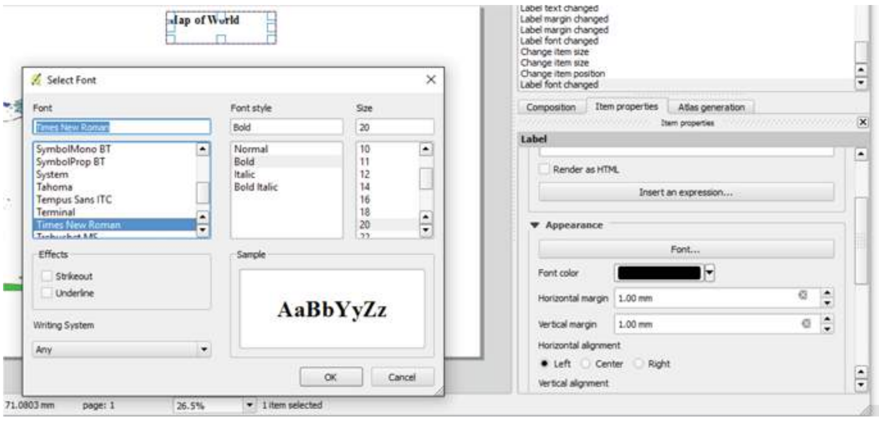
(a) Map Title

- Click on this button to add the title of map and drag above the map, and a label will appear at the top of the map. Resize it and place it in the top center of the page. It can be resized and moved in the same way that you resized and moved the map.



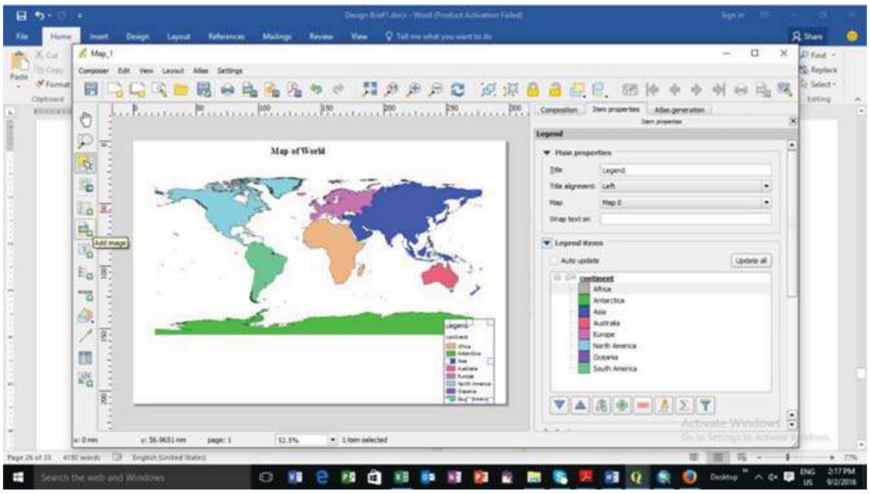
- Select the label by clicking on it.
- Click on the Item Properties tab in the side panel of the Composer window.
- Change the text of the label to “Map of World”:
- Use this interface to set the font and alignment options:



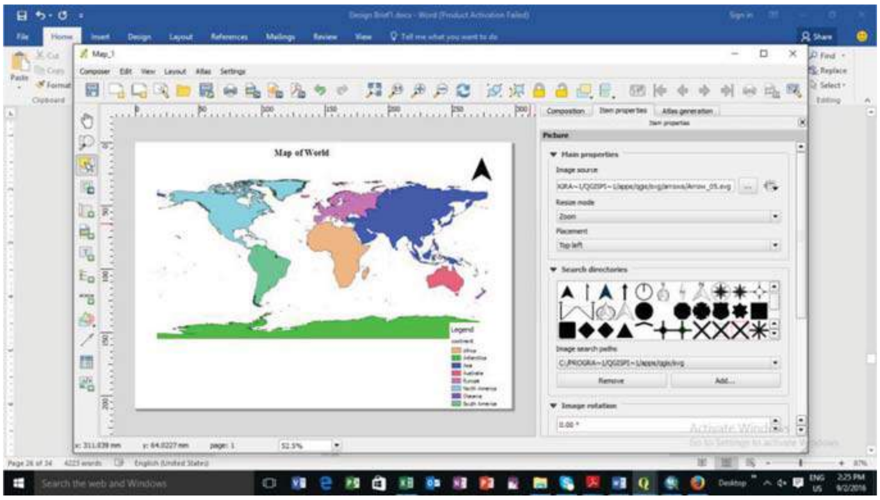


(b) North Arrow

- Click on the button  (add image) to add a north arrow and drag on the page.

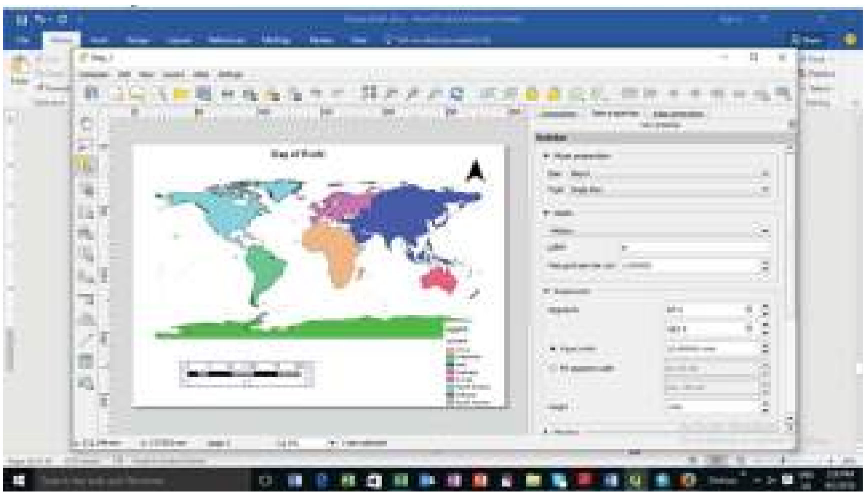


• In the Item Properties tab, you'll find search directories panel and select the desired icon.



(c) Scale Bar

- Click on the button  to add a scale bar and drag on the page. And also change the setting of scale bar.

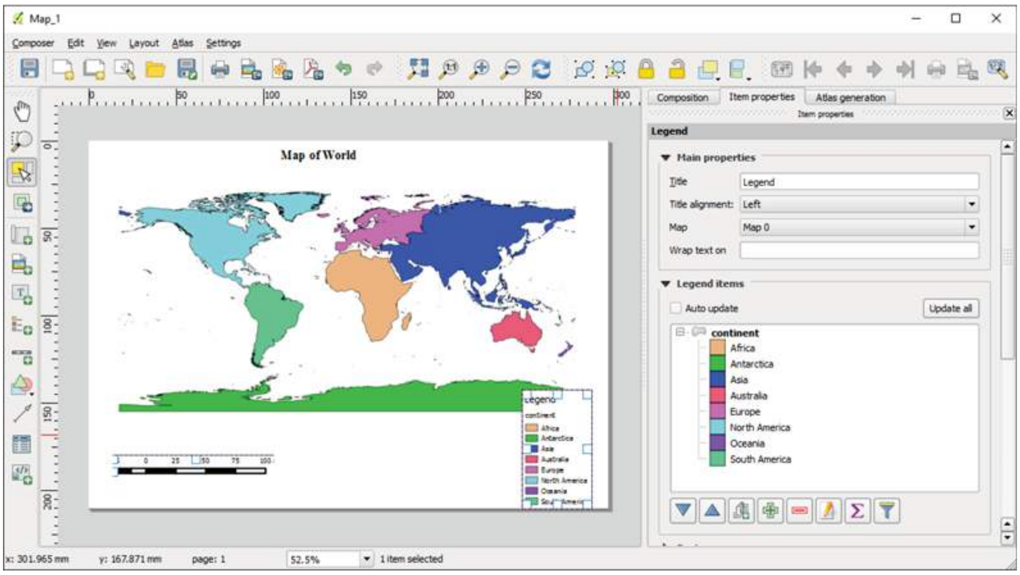


(d) Legend

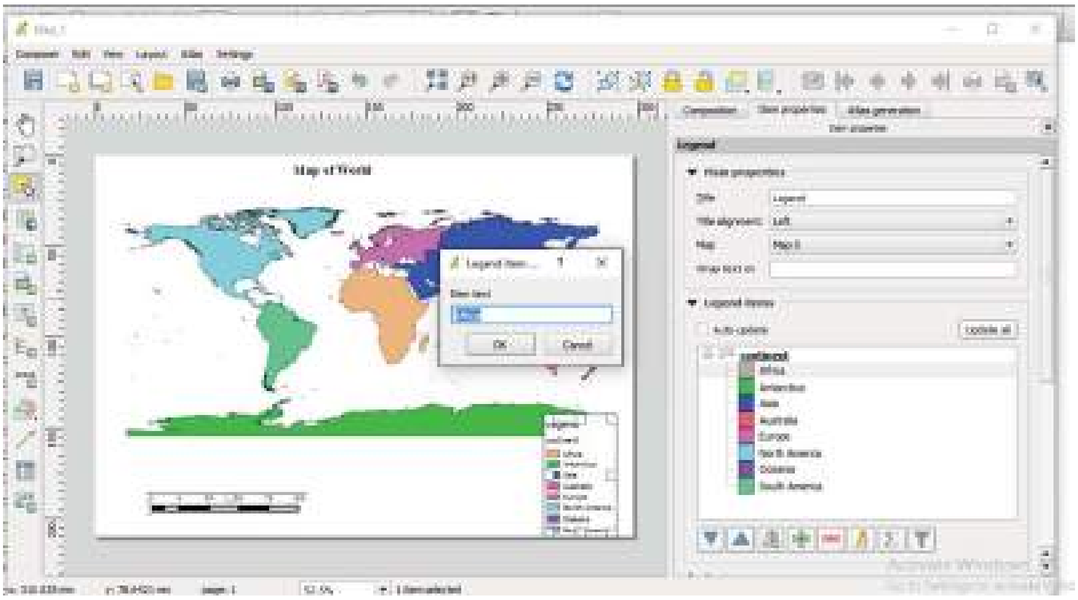
- Click on this button  (add new legend) to add the Legend. And drag on the page to place the legend, and move it to where you want it:

Customizing Legend Items

- In the Item Properties tab, you'll find the Legend items panel.
- Unselect the Auto Update and then some icons are active below the Legend item.



- Delete it from the legend by clicking the minus button:  .
- Select a layer from the same list. Click the Edit button  ;



6. Finally the map is ready for export You'll see the export buttons near the top left corner of the Composer window:

   The other three buttons allow you to export the map page to a file. There are three export formats to choose from: 

• Export as Image

• Export as SVG

• Export as PDF

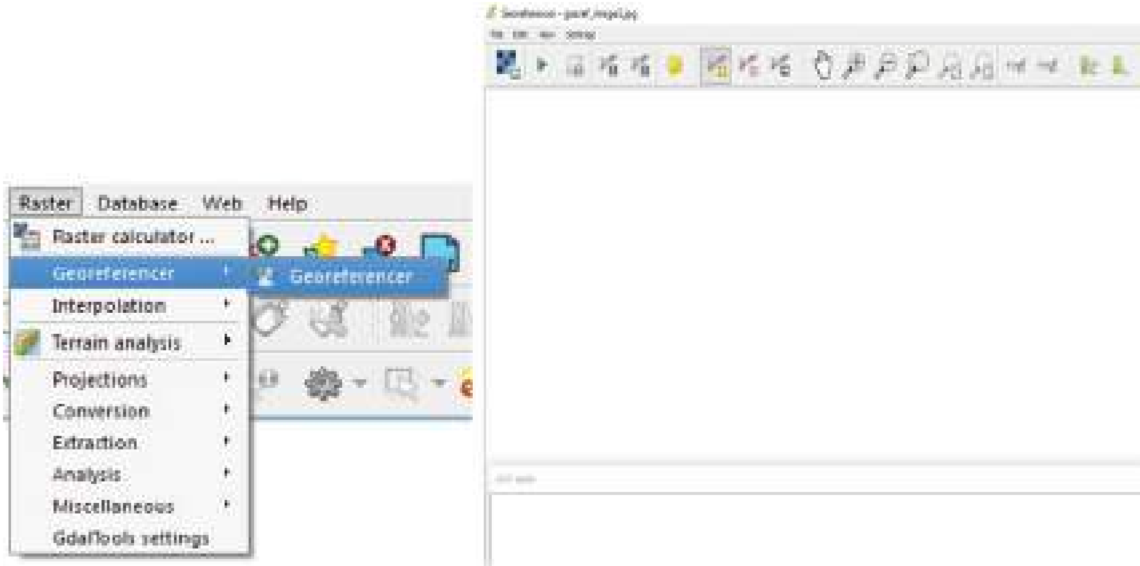
2.1.7. Georeferencing

In this exercise we will be using Google satellite image (extracted image) of Mandalay to be rectify. You will need at least four (4) reference points or corners with valid coordinates.

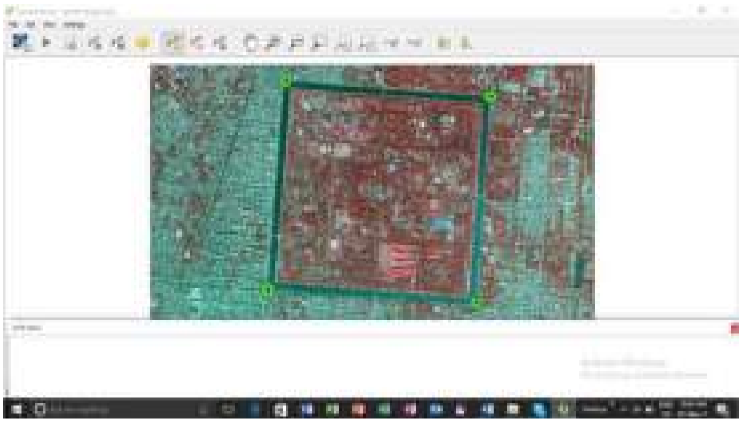
Given Coordinate

	Lat			Lon		
GCP_ID	Deg	Min	Sec	Deg	Min	Sec
1	22	0	13.5	96	5	9.208
2	22	0	11.2	96	6	28.9
3	21	58	55.5	96	6	23.5
4	21	58	59.8	96	5	3.277

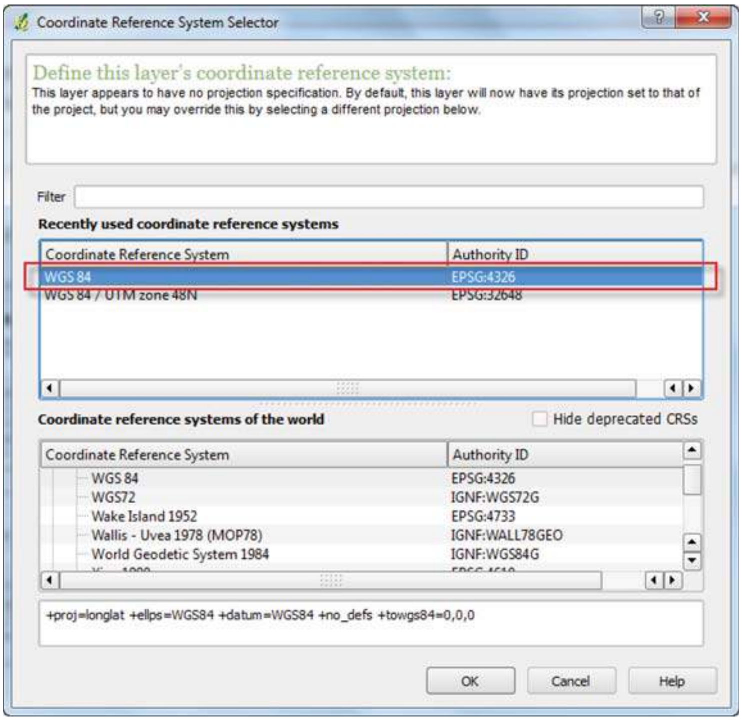
1. Open QGIS
2. In the main menu tab select 'Raster' and scroll down then select 'Georeferencer'
3. Georeferencer window will appear



4. Load your raster data or satellite image by selecting the 'Open raster'  button and locate your file at your training directory
5. Select the image called 'georef_image3.jpg' highlight the file and click 'Open'



6. The CRSS (Coordinates Reference System Selector) will appear asking you to select or input the desired coordinate system would you apply to the image.
7. Locate and choose the 'WGS84 then click 'Ok' button



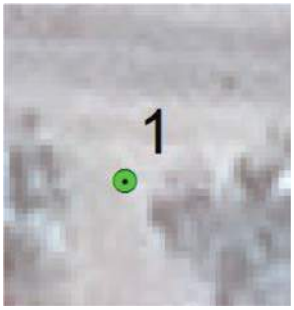
WGS84

The World Geodetic System is a standard for use in cartography, geodesy, and navigation. It comprises a standard coordinate frame for the Earth, a standard spheroidal reference surface (the datum or reference ellipsoid) for raw altitude data, and a gravitational equipotential surface (the geoid) that defines the nominal sea level. (source: wikipedea.org)

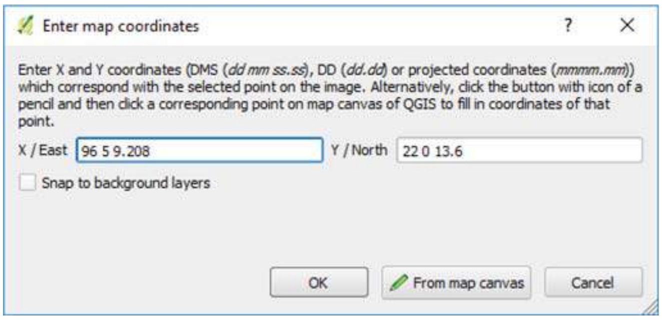
UTM Zone 47N & 48N Projected CRS used in World - N hemisphere - 96°E to 102°E - by country

WGS 84 / UTM zone 47N is a projected CRS last revised on 08/25/2006 and is suitable for use in Between 96°E and 102°E, northern hemisphere between equator and 84°N, onshore and offshore. China. Indonesia. Laos. Malaysia - West Malaysia. Mongolia. Myanmar (Burma). Russian Federation. Thailand. WGS 84 / UTM zone 48N uses the WGS 84 geographic 2D CRS as its base CRS and the UTM zone 48N (Transverse Mercator) as its projection. WGS 84 / UTM zone 48N is a CRS for Large and medium scale topographic mapping and engineering survey. (source: Wikipedia.org)

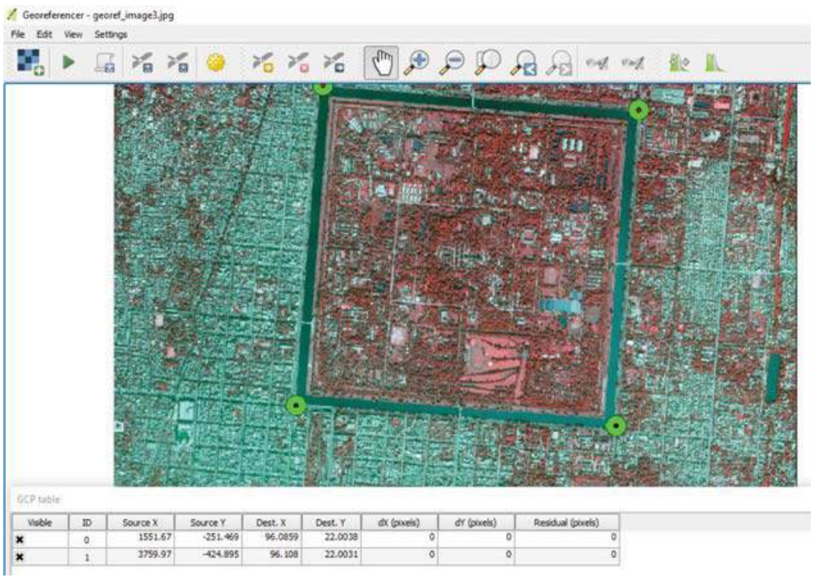
8. After pressing ‘OK’ button your image will be automatically loaded in your Georeferencer window
9. It is not rectified yet you’ve just specify the CRS of the image. It needs a reference point in order to do that. Please refer to the given coordinates above.
10. Inputting the four given coordinate points as GCP
11. Zoom to the point1 in the upper left corner of your satellite image. Use the pan, zoom in and zoom out tool 
12. Click the ‘Add point’ button 
13. After clicking the add point button your cursor will changed to plus symbol.

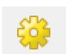


14. Input the map coordinates of point1 (the X and Y value)
15. Please take note the Y = Northing / Latitude,   X = Easting / Longitude

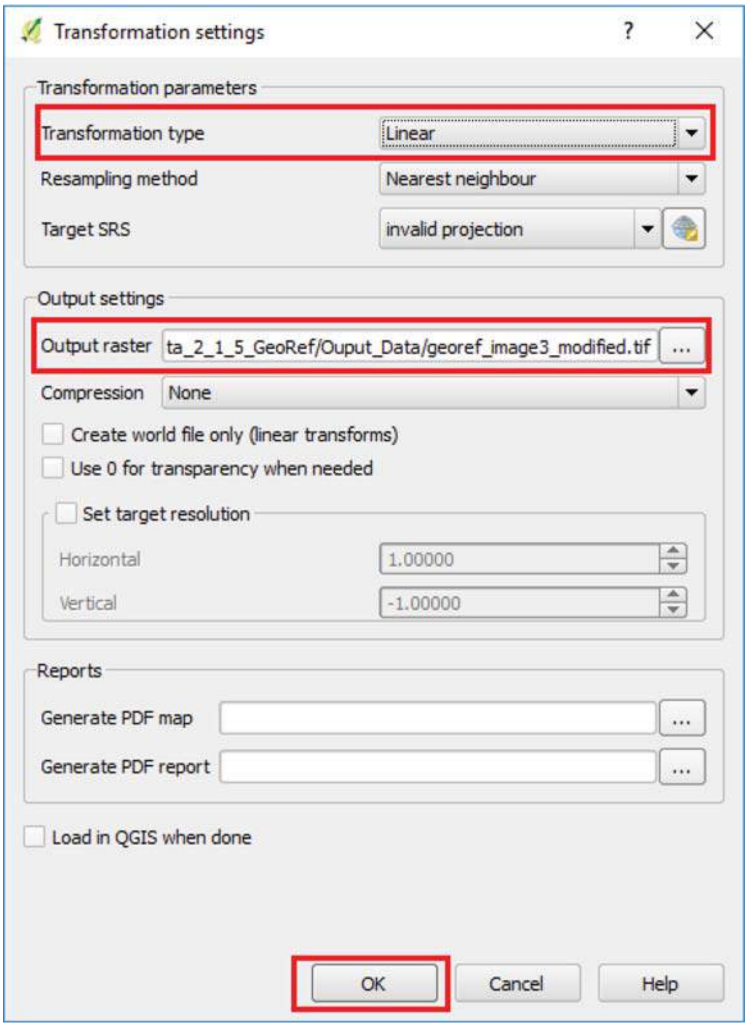


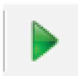
16. In the Enter map coordinates window the value of the point1 is already plotted and press 'OK' button
17. Repeat the process no. 12 to 16 do this for the rest three points the 2, 3 and 4
18. Your window will look like the figure below



19. Save the GCP points by pressing this button 
20. Save it to your working directory and name it 'georef_gcp'
21. Click on Transformation setting  and input information below
    - o Transformation type: Linear

   - o Resampling: Nearest neighbor
   - o Compression: LZW
- o Output raster: georef_image_modified
- o Check on the small box saying 'Load in QGIS when done'



22. Press 'OK' button then click on the start Georeferencing button 
23. CRS window will appear. Just select the 'WGS84 ... then click 'Ok' button
24. It will load automatically to your QGIS map canvas.

2.1.8. Creating Vector Data

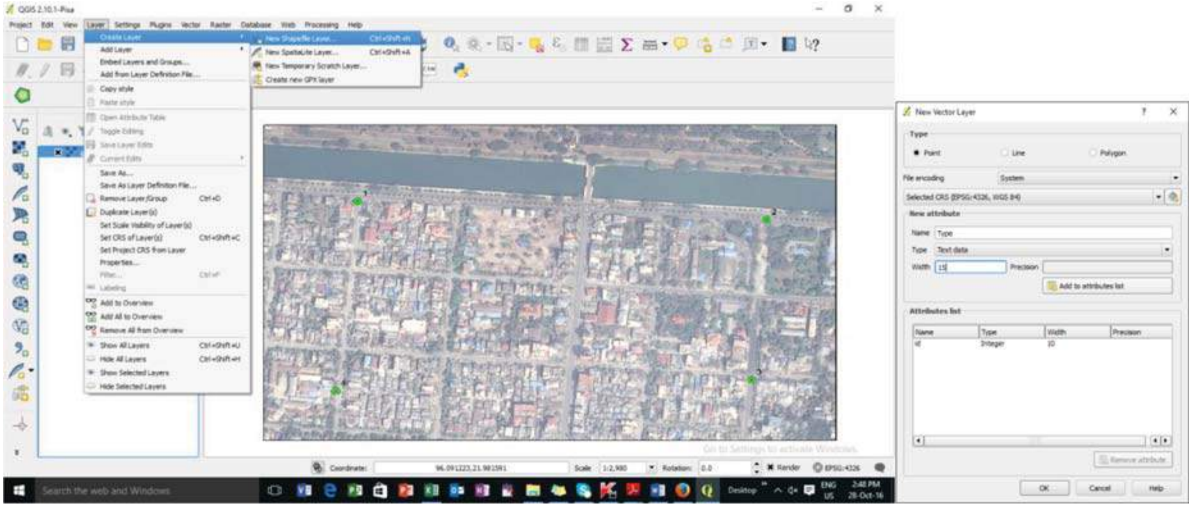
Before you can add new vector data, you need a raster dataset to add it to. In our case, you'll begin by creating new data entirely, rather than editing an existing dataset. Therefore, you'll need to define your own new dataset first. This time you can use the previous geo-referenced image as the background image for creating vector or digitizing

You'll need to open the New Vector Layer dialog that will allow you to define a new layer.

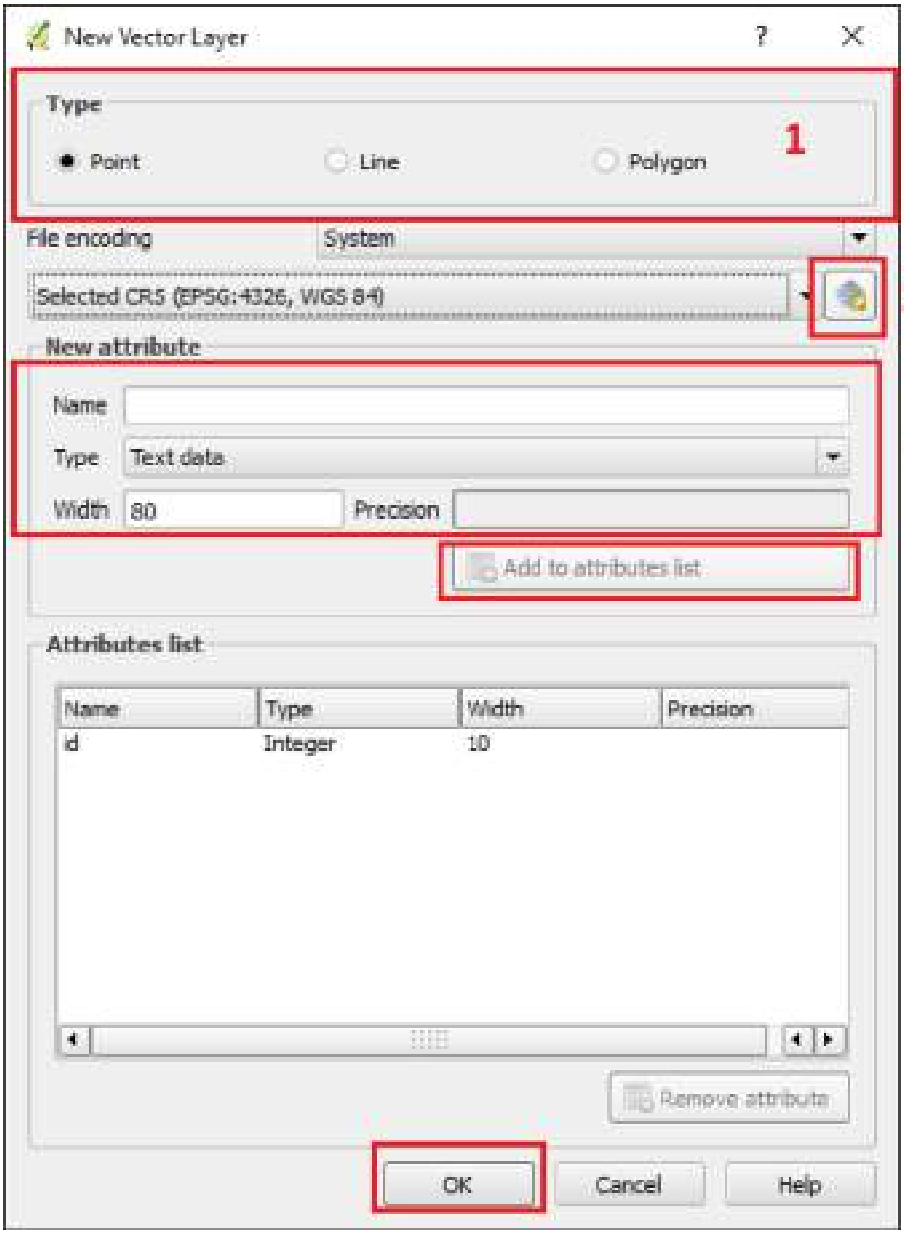
Creating Point Layer

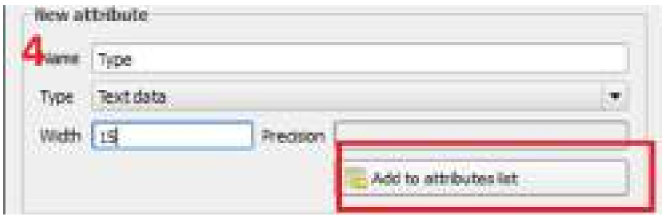
Step 1

• Navigate to and click on the menu entry Layer New New Shapefile Layer.

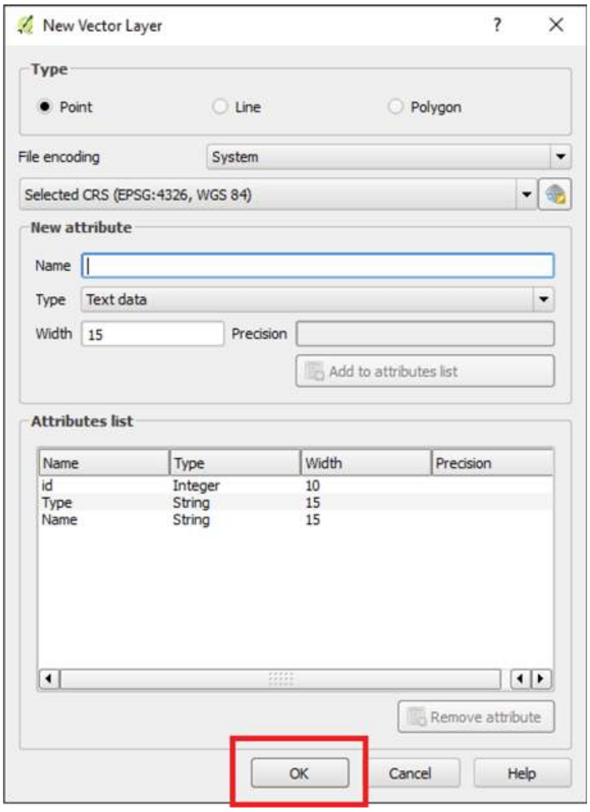


1. Click on the Point radio button
2. The next field allows you to specify the Coordinate Reference System, or CRS. A CRS specifies how to describe a point on Earth in terms of coordinates, and because there are many different ways to do this, there are many different CRSs. The CRS of this project is WGS84, so it's already correct by default:
3. Next there is a collection of fields grouped under New attribute. By default, a new layer has only one attribute, the id field (which you should see in the Attributes list) below. However, in order for the data you create to be useful, you actually need to say something about the features you'll be creating in this new layer. For our current purposes, it will be enough to add two field called Type and Name.
4. Replicate the setup below, then click the Add to attributes list button:

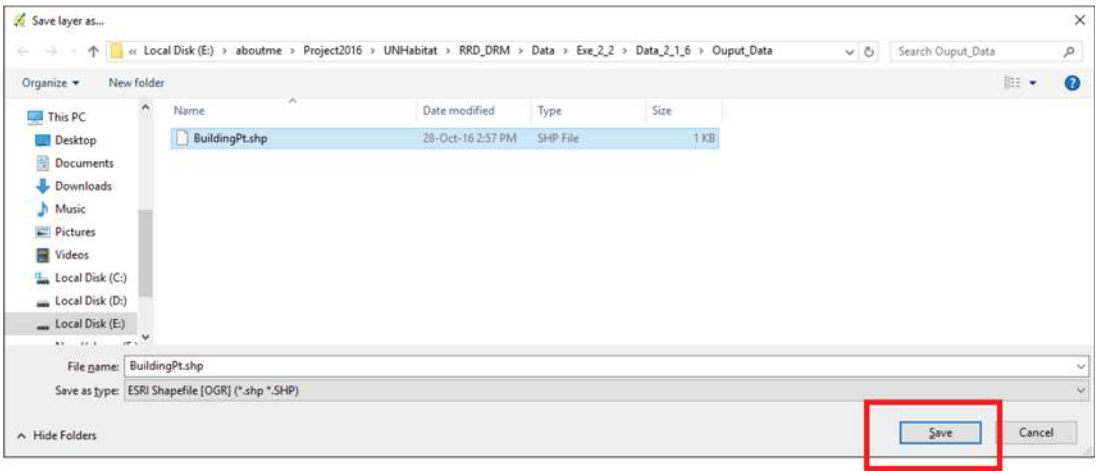




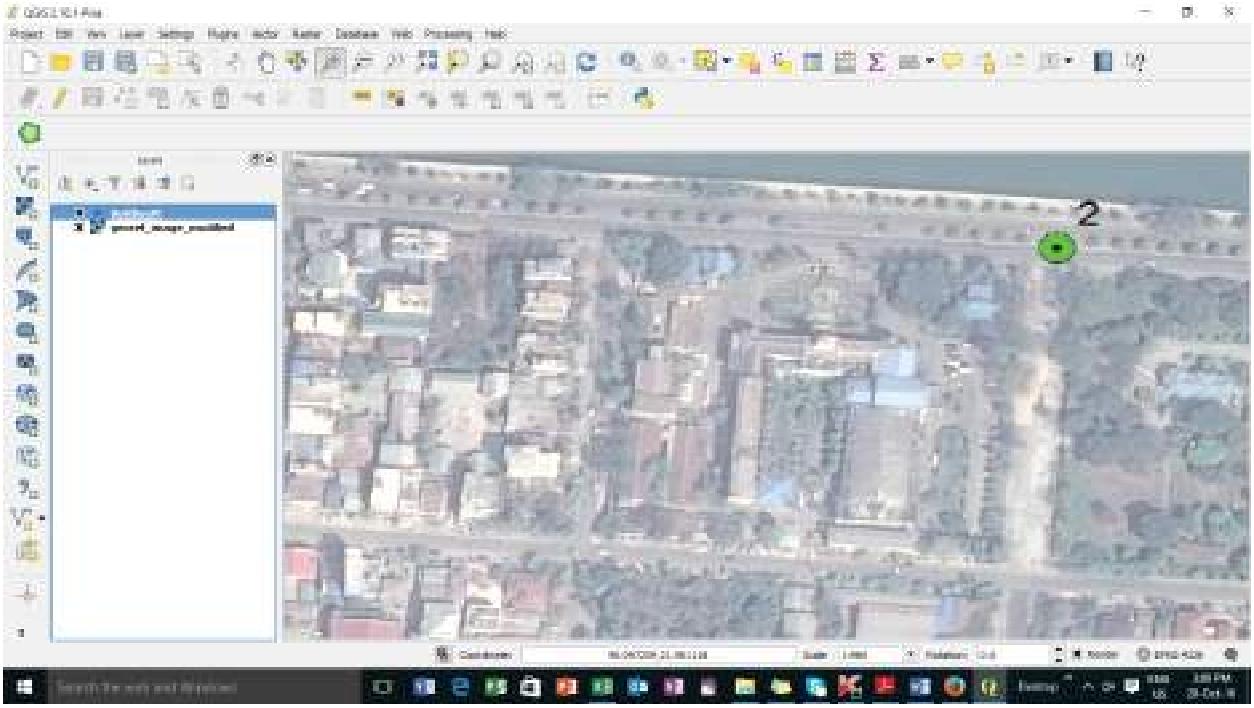
- Click OK. A save dialog will appear.



- Navigate to the your desired directory. (e.g. E:\aboutme\Project2016\UNHabitat\RRD_DRM\Data\Exe_2_2\Data_2_1_6\Ouput_Data\....)
- Save your new layer as BuildingPt.shp.

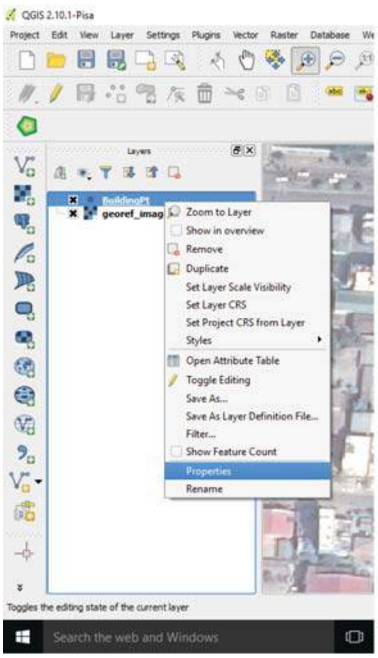


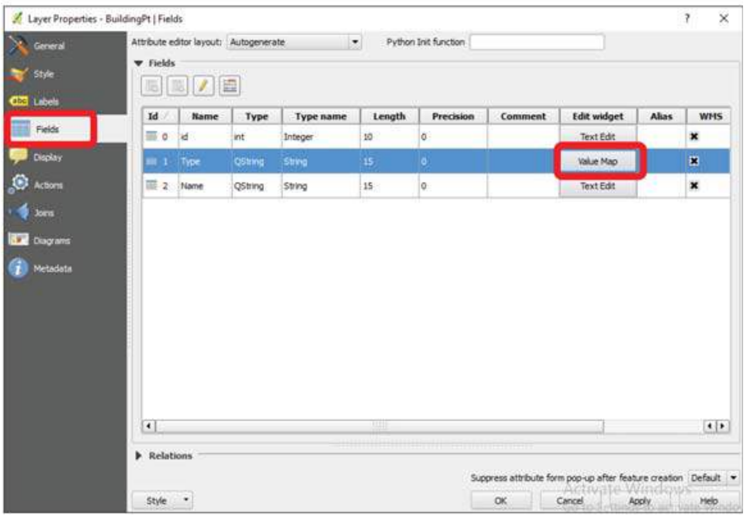
The new layer should appear in your Layers list.



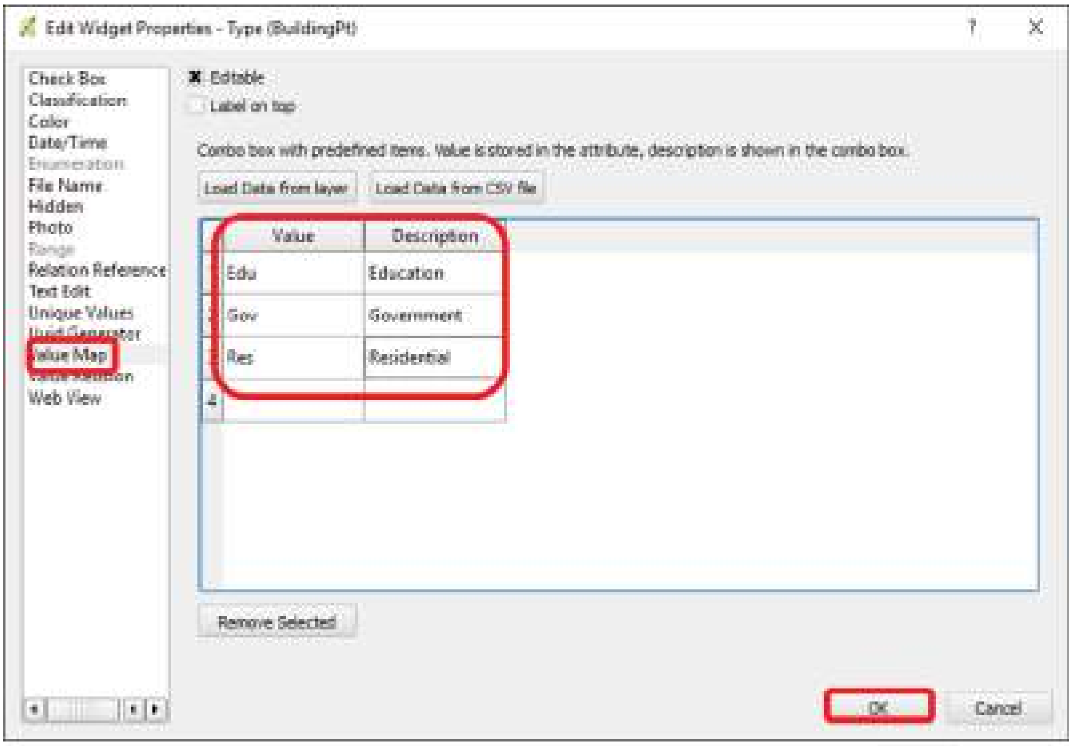
Step 2

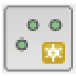
- We will digitize the buildings from geo-reference image by categorizing as Gov, Res, Edu and etc. So firstly
- Right click the "BuildingPt" layer and select the property and then click the Field tab from panel and select View Map from Edit widget.

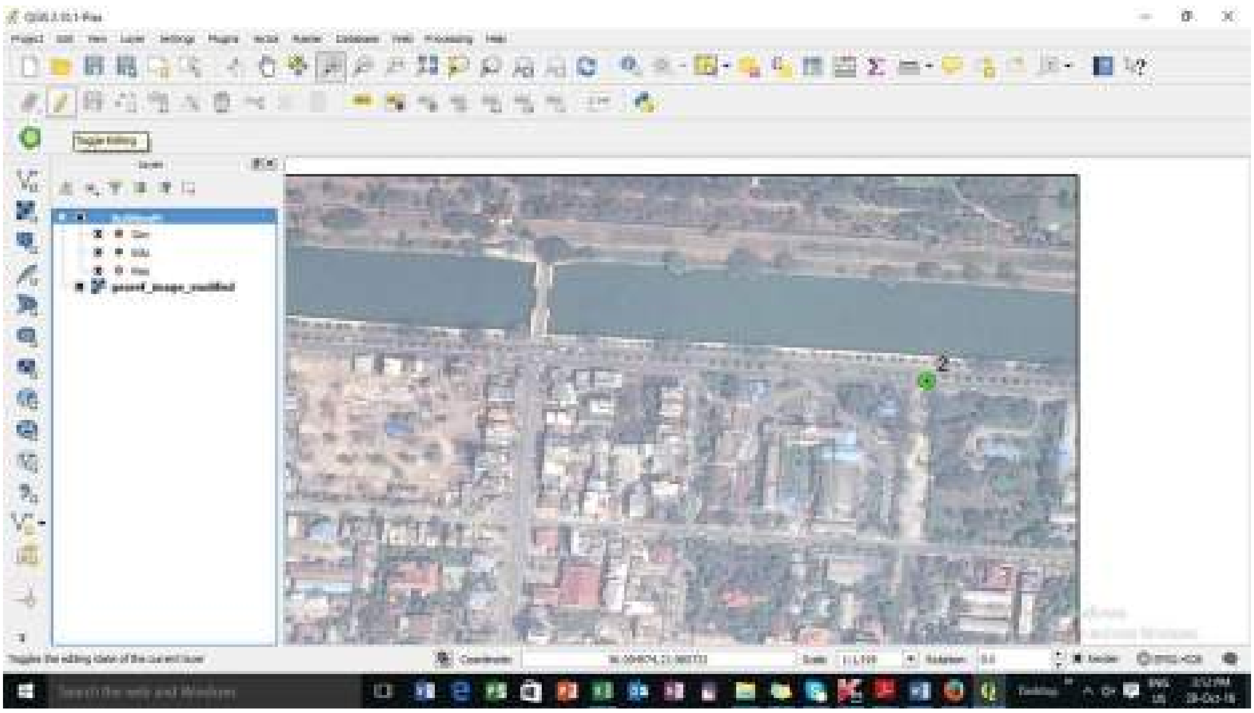




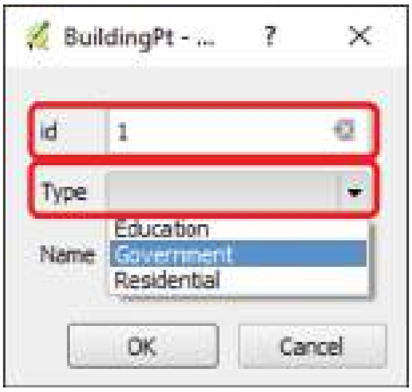
- Then type value and description for three categories as Edu, Gov and Res. Then click OK.

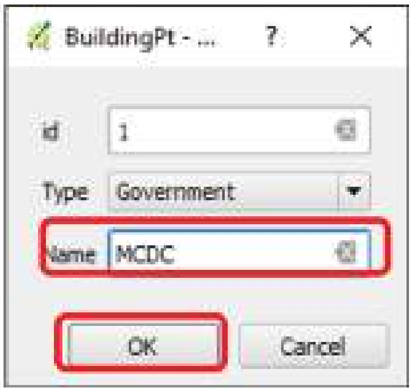


- Clcik  Toggle Editing tool to start digitizing. Then click  . Add Feature tool to start drawing the buildings as point features from background layer.

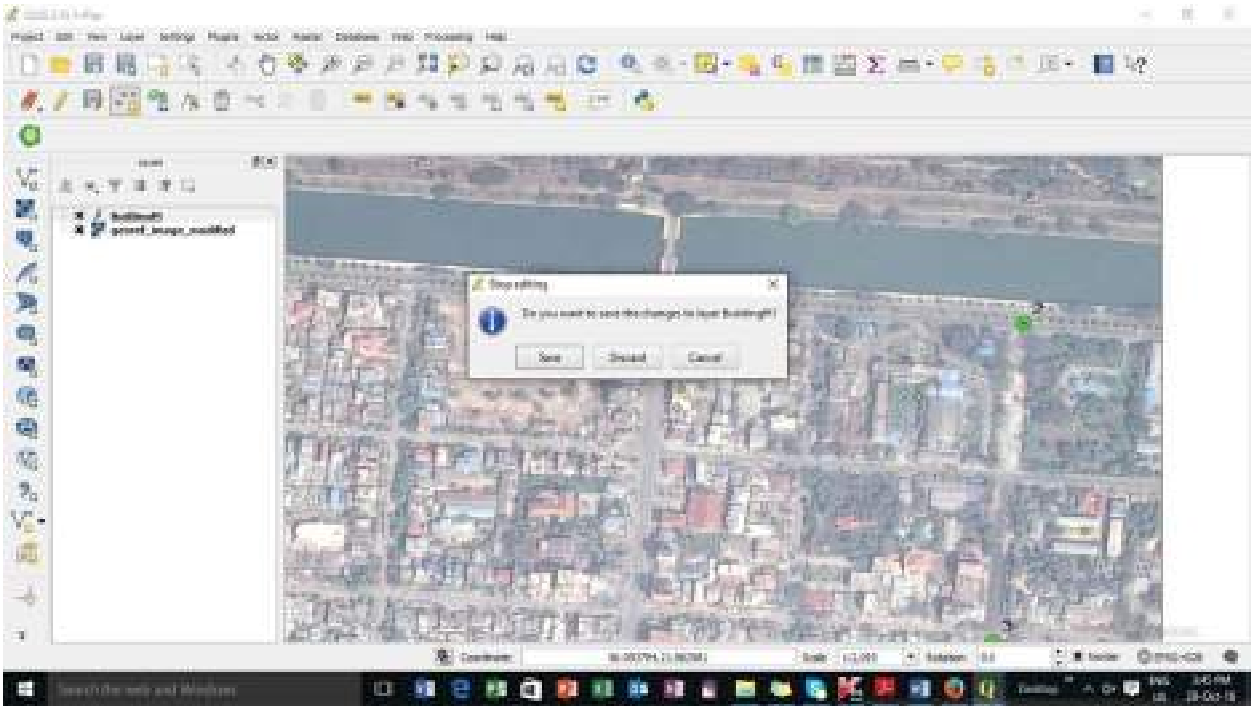


- Click the point in the middle of one building compound and type 1 in ID and select “Government” from Type and give the name as MCDC. Then click OK.

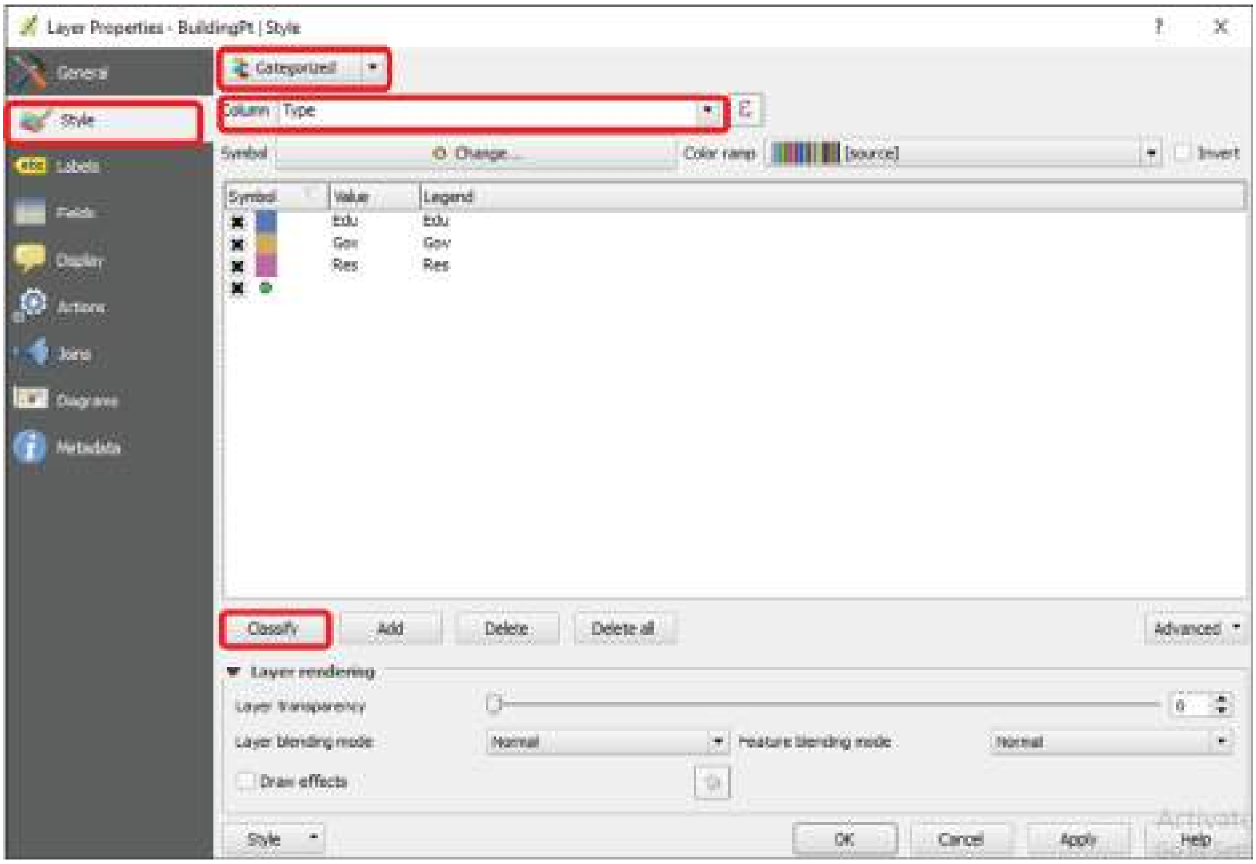




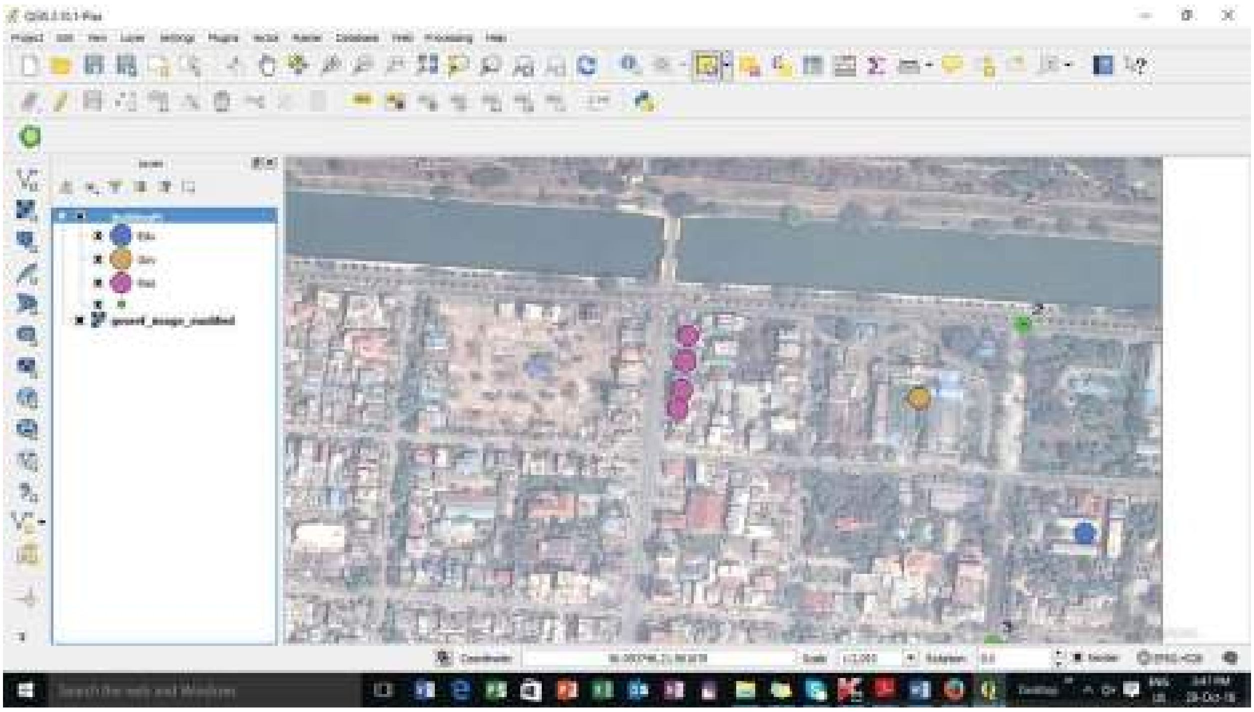
- Then digitizing the other buildings like government, residential and education. Then  editing tool to stop digitizing and save the layer as BuildingPt.



- Then right click the layer of BulidigPt and select the property. Then go to Style tab. Then select the Categorized and also select Type in column. Click the Classify button.



- Then we can see the different types of buildings as different color in BuildingPt layer.

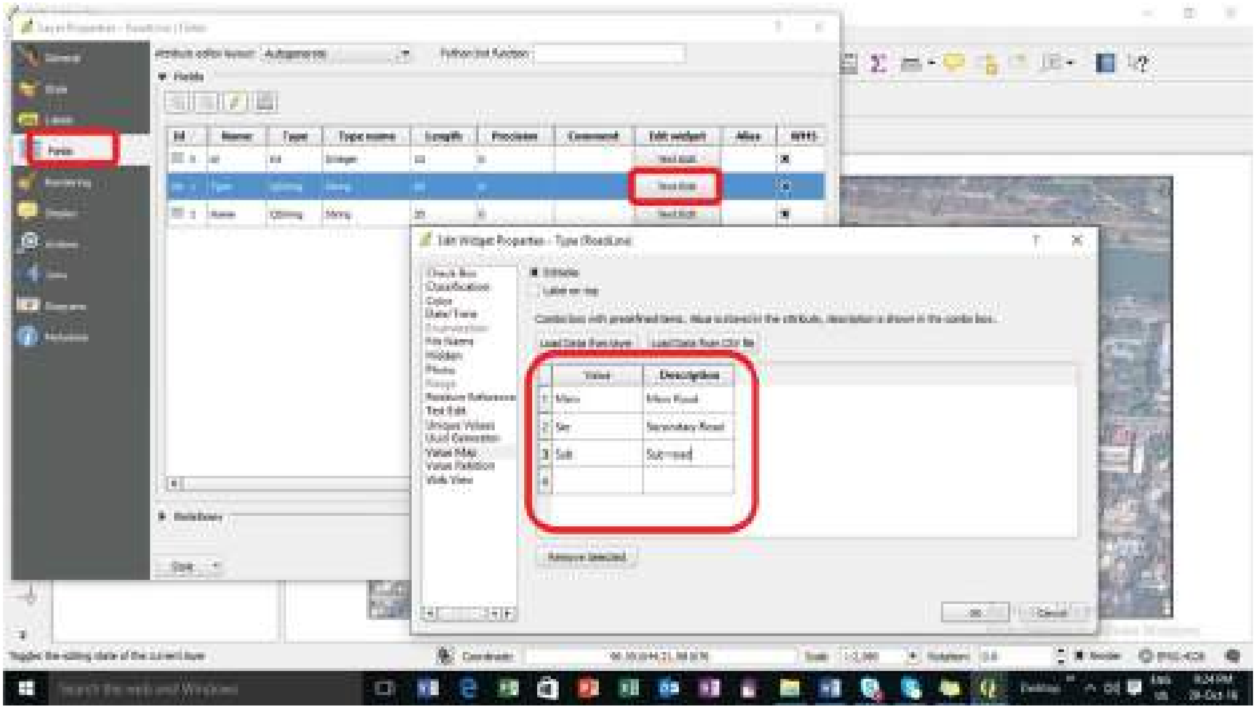


Creating Line Layer

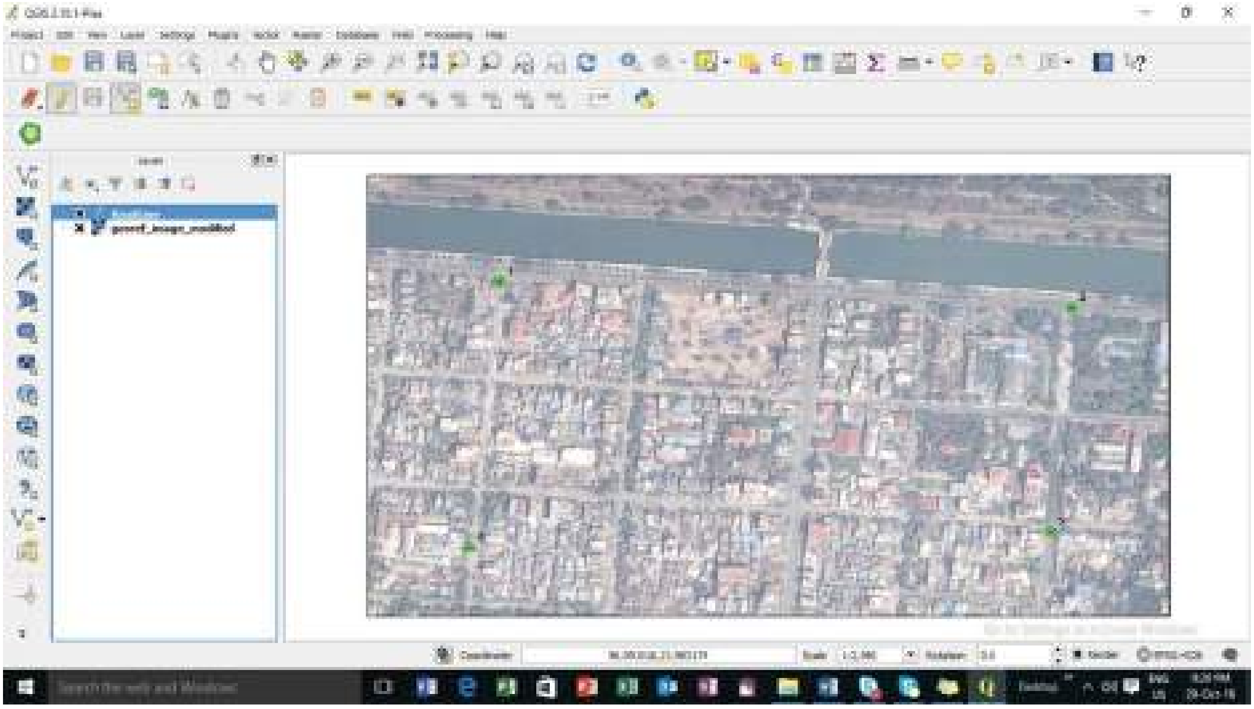
- Please repeat the previous step 1 and choose Line option in New Vector Layer Panel. And then Saved as RoadLine.shp.

- We will digitize the road from geo-reference image by categorizing as Main, Secondary, Sub-road and etc.

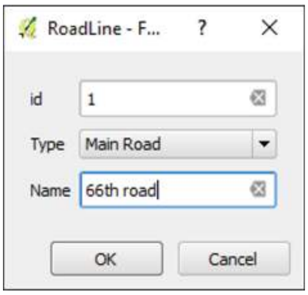
- So firstly Right click the "RoadLine" layer and select the property and then click the Field tab from panel and select View Map from Edit widget. Then type value and description for three categories as Main, Sec and Sub. Then click OK.



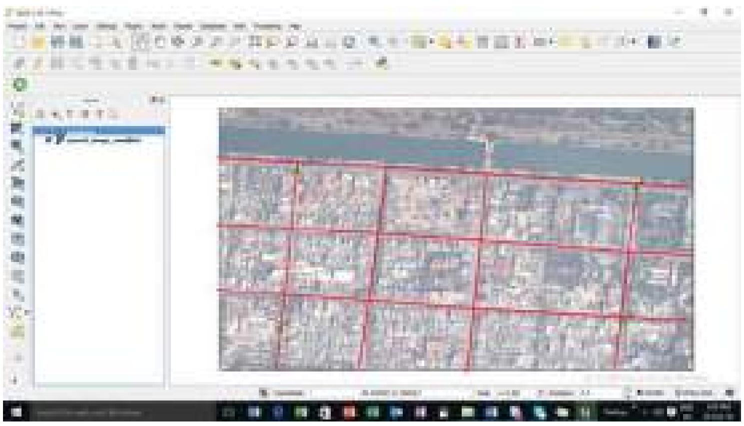
- Clcik  Toggle Editing tool to start digitizing. Then click  Add Feature tool to start drawing the road as line features from background layer.



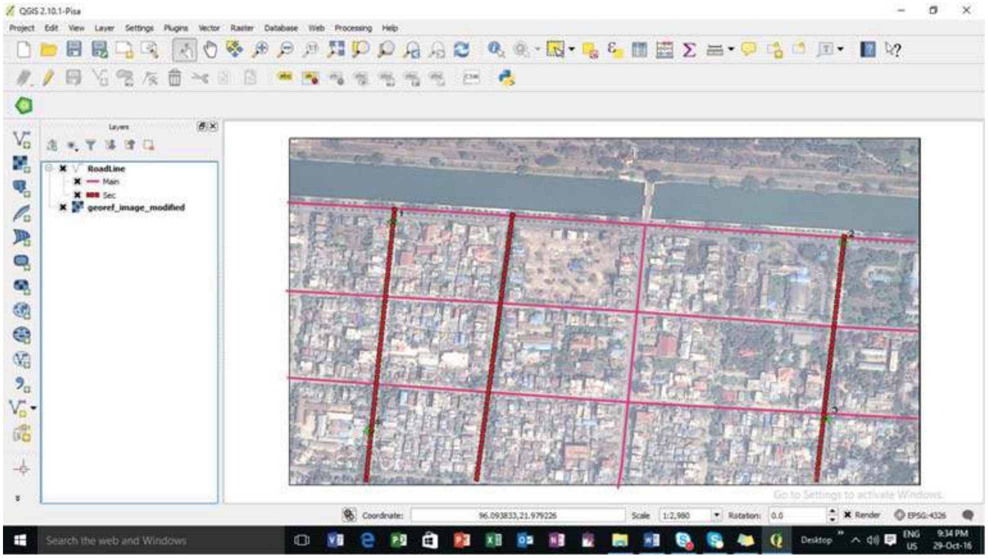
Click the add line feature in the middle of Road. Then right click and type 1 in ID and select "Main" from Type and give the name as 66th road. Then click OK.



Then digitizing the other line features like secondary road and sub road. Then editing tool to stop digitizing and save the layer as RoadLine.



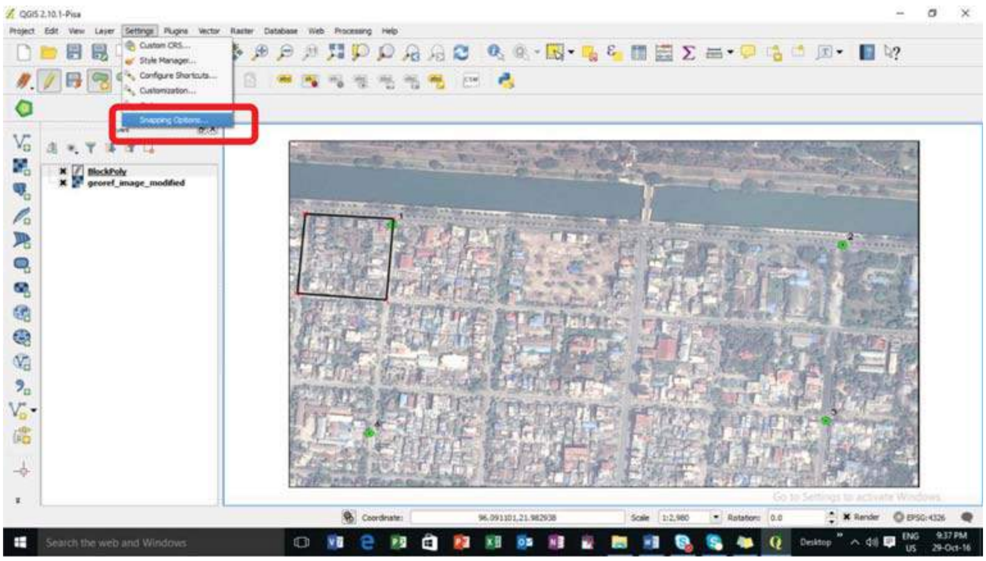
Then right click the layer of RoadLine and go to Style tab. Then select the Categorized and also select Type in column. Click the Classify button. Then we can see the different types of road as different color in RoadLine la yer.



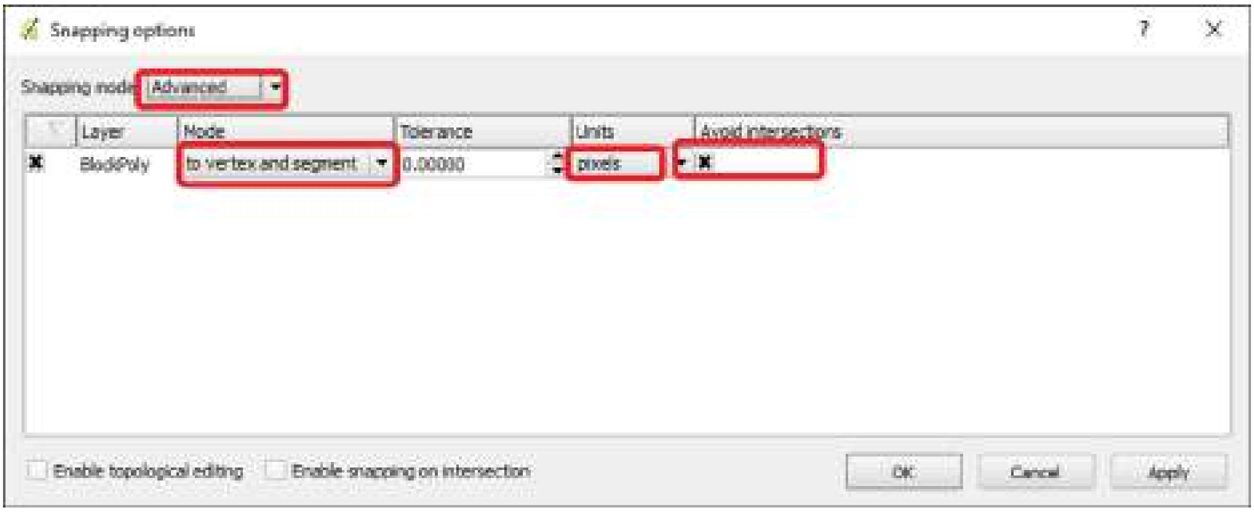
Polygon Lyaer

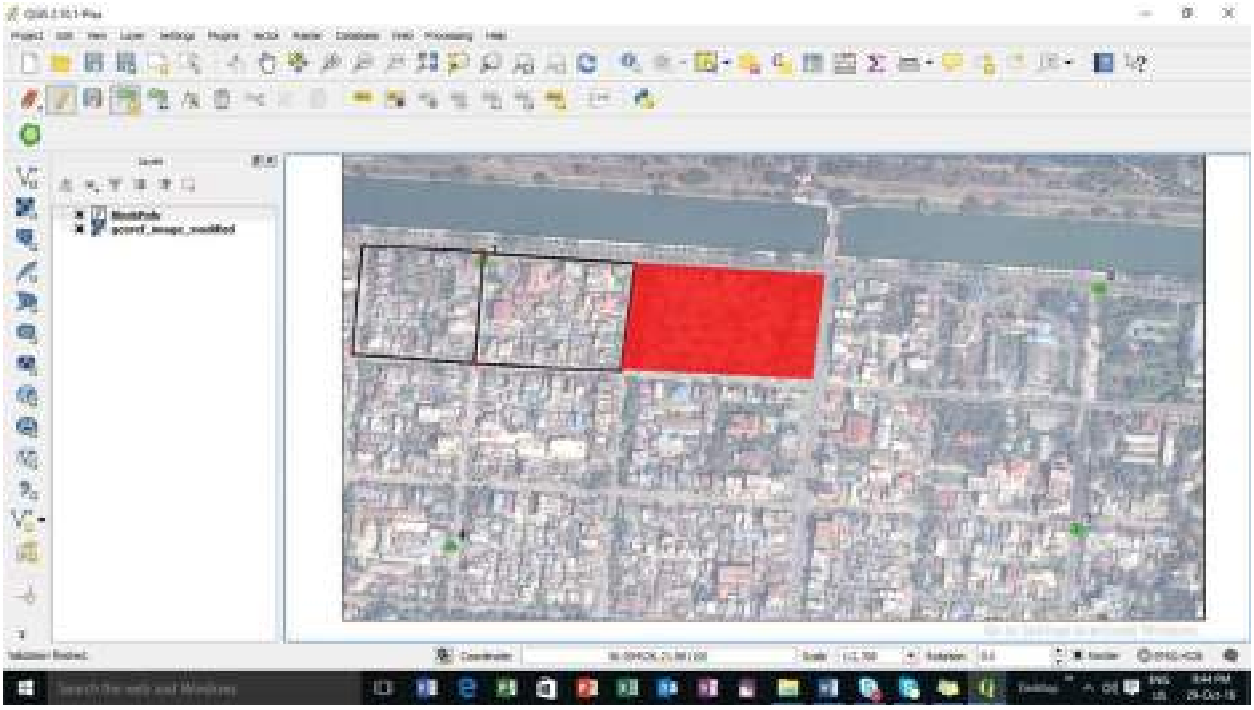
Please repeat the previous step for Polygon layer for block and save the layer as “BlockPoly.shp”.

Remark: go to snapping Option in Setting sub menu from Main Menu. Then change the Snapping Option as below.



By chaning snapping option like previous step, you can avoid the intersect area when you draw the adjacent polygons (silver polygons). We can also classify the types of buildings like the previous steps in point and line.





2.1.9. Spatial Analysis (geoprocessing)

There are 971 buildings in the Smart City classify into 3 categories based on the size of the building as define as:

Type of Building	Area (m_2)	Relocation Cost (USD)
Small Building	< 100	5,000
Medium Building	100– 300	10,000
Large Building	>300	25,000

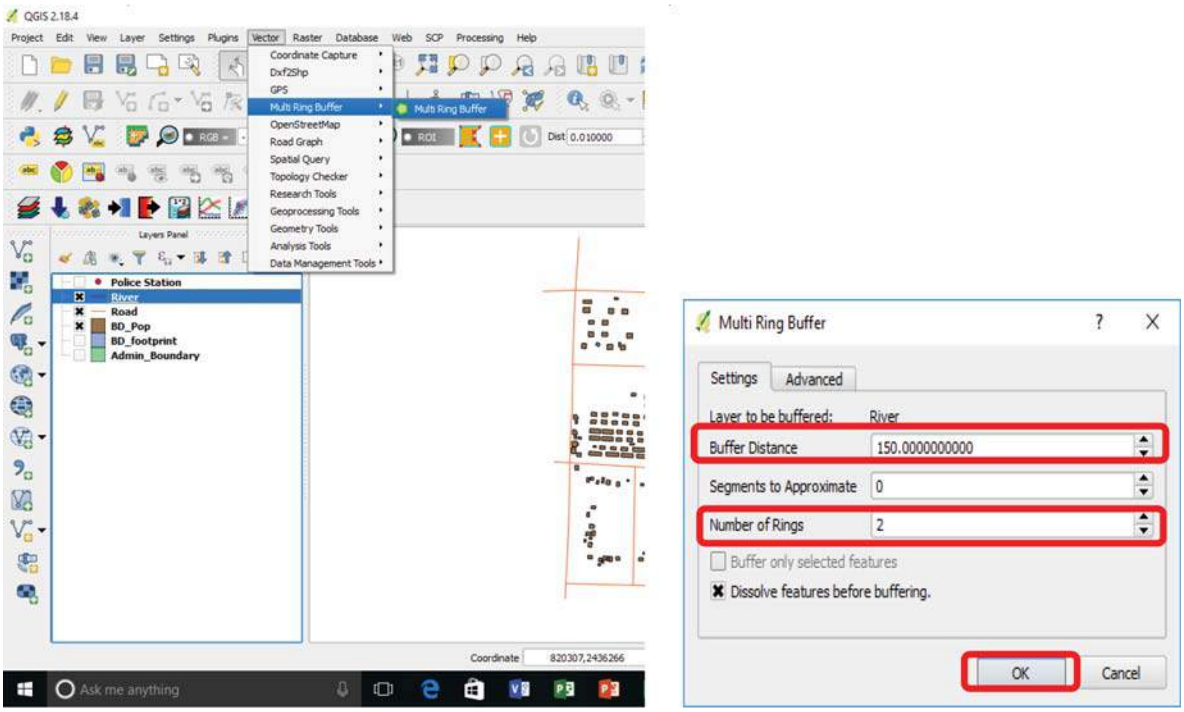
There was a big flood event in year 2010 and the lots of damage were occurred. Finally, the government came up with the flood risk zone. It divided into two risk zones (high and low zone)

-High risk zone of the flood inundated 150 meter from the center line of the river - Low risk zone of the flood inundated 300 meter from the center line of the river.

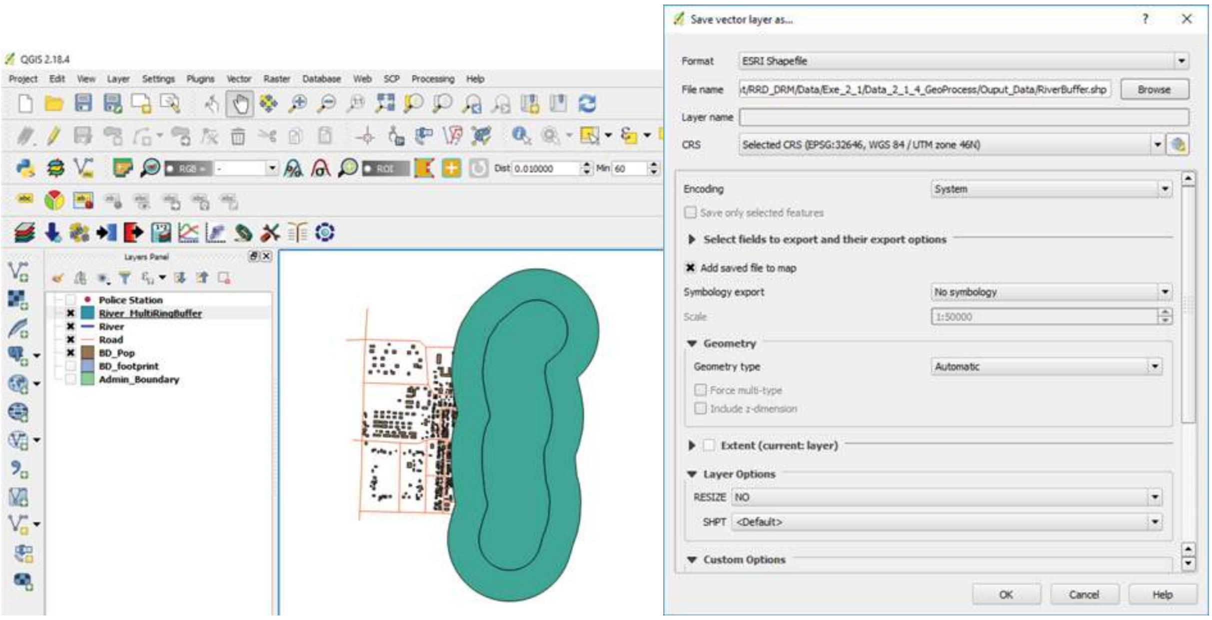
1. Open the layers from exercise folder. (police station, road, river, bd_footprint and admin boundary layer)

Creating Buffer Zone for Risk Zones

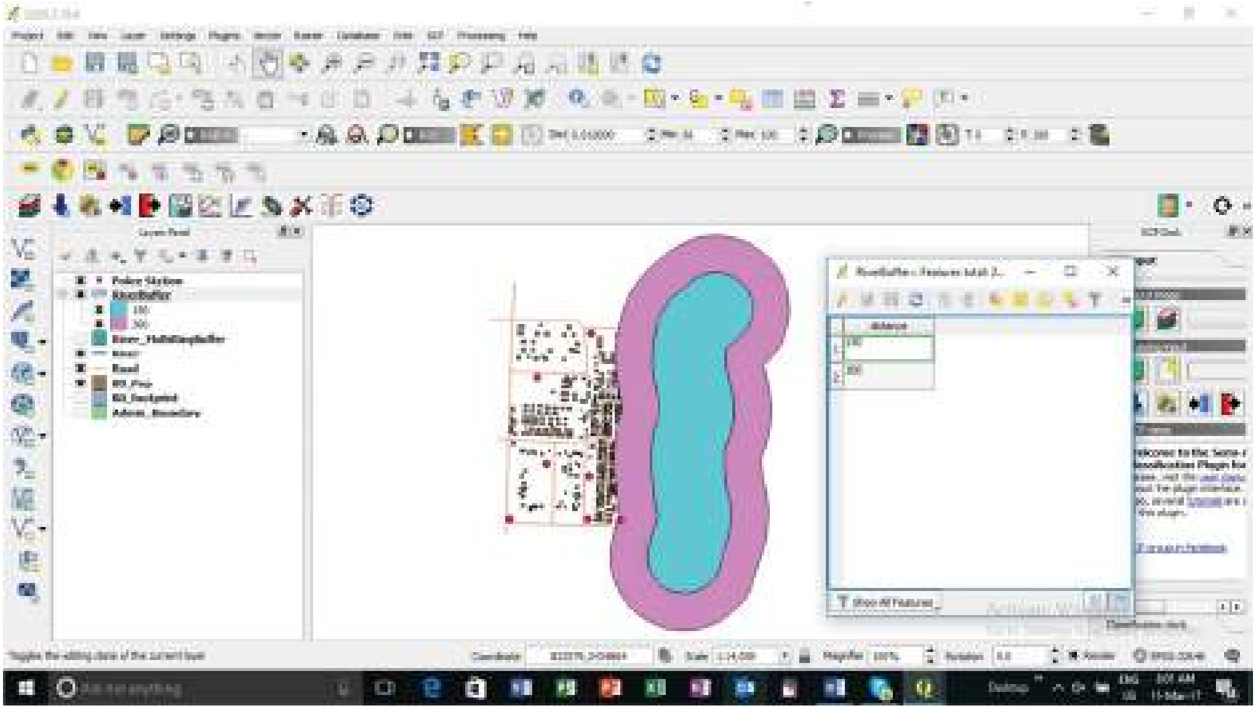
2. Open the 'Multi Ring Buffer' tool from 'Geoprocessing Tool' in 'Vector' main menu. And input file as "River" layer and create the buffer distance for 150m and 300m. Don't forget to select the river.shp (the desired layer to create multi ring buffers).



The result will be seen as follow and this is the temporary file. Then please right click the result layer and click "Saved as" to keep in you desired location.

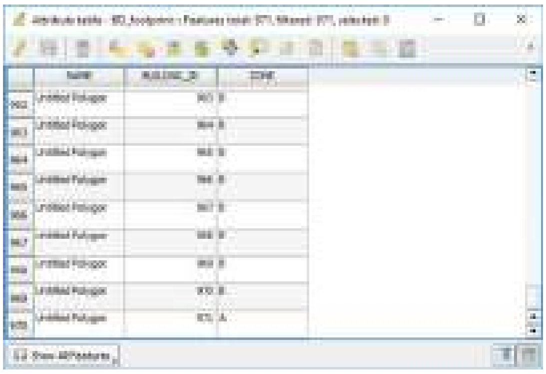


You can also check the buffer distance in attribute table of this layer.

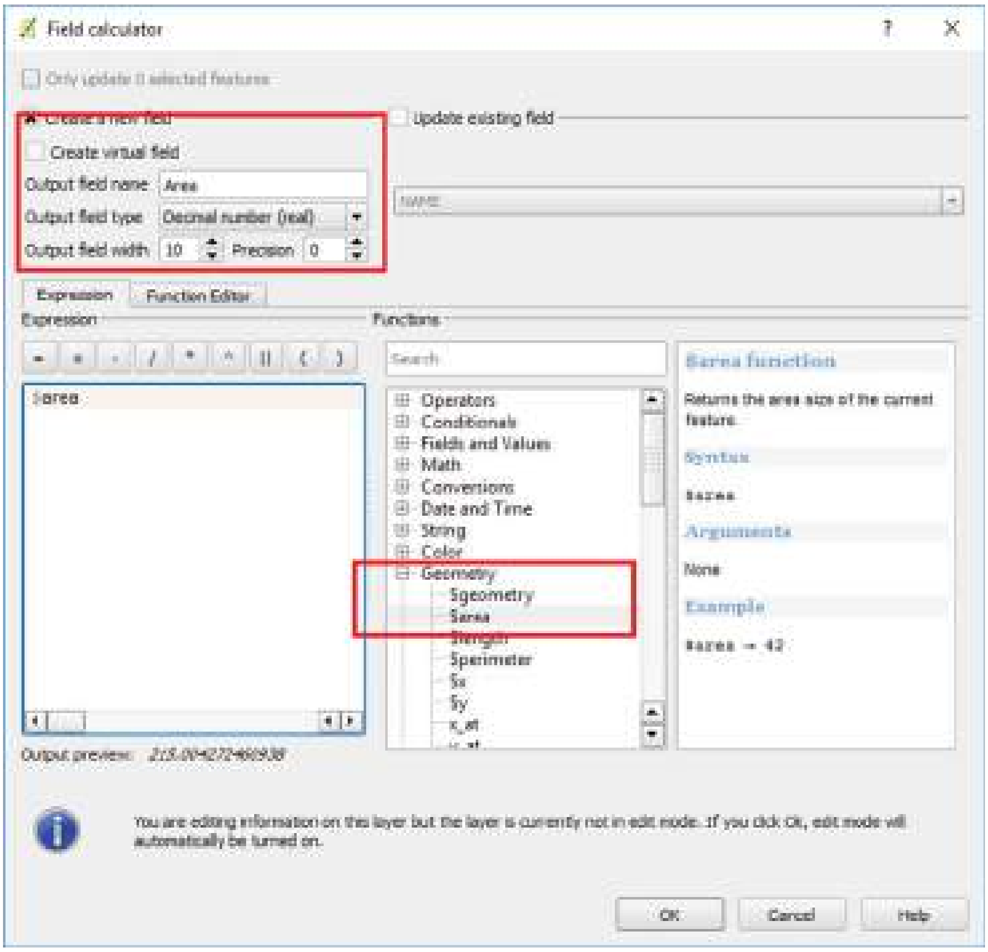


Calculating Area of Each building

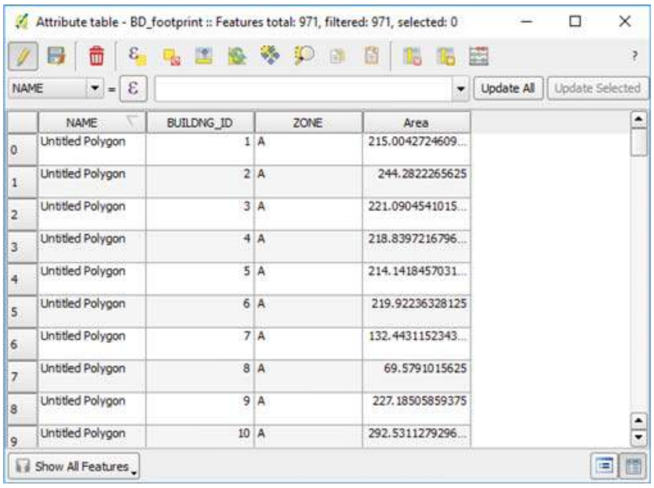
3. Open the attribute table of “BD_footprint” to categorize the building types. So firstly we will calculate the area of each building.



- Click the filed calculator  and check the create a new filed. Give output field name : "Area", type: "Decimal number". Then click the "Geometry" in function and click the "$area" to calculate the area of buildings. Then click "Ok".

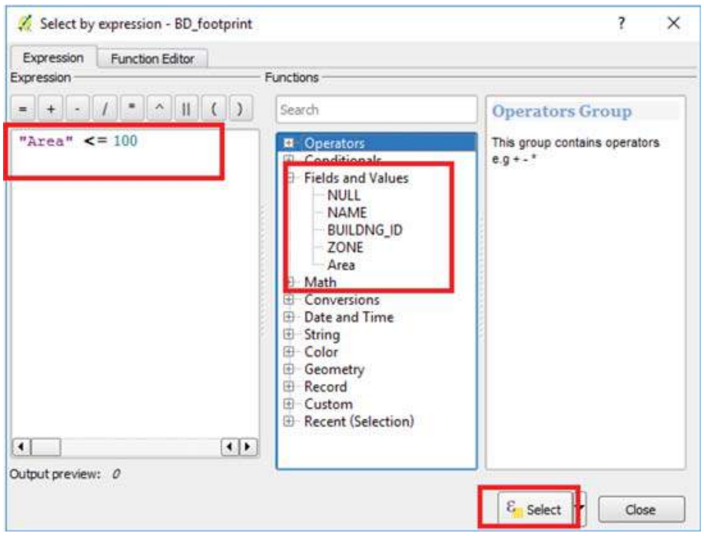


- You will see the result as follow:



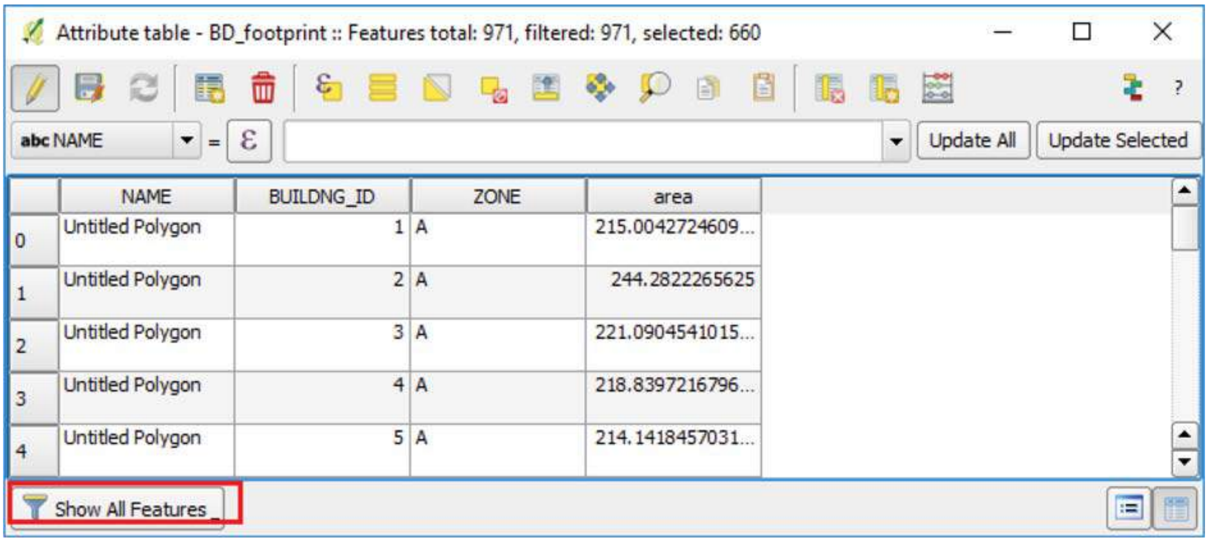
Categorize the Building Types according to their Area

4. To categorize the building types: open the attribute table of this layer again and click the expression tool and type the expression “Area” <=100 for small building type. Then the buildings which have area less than or equal to 100 sqm will be selected.

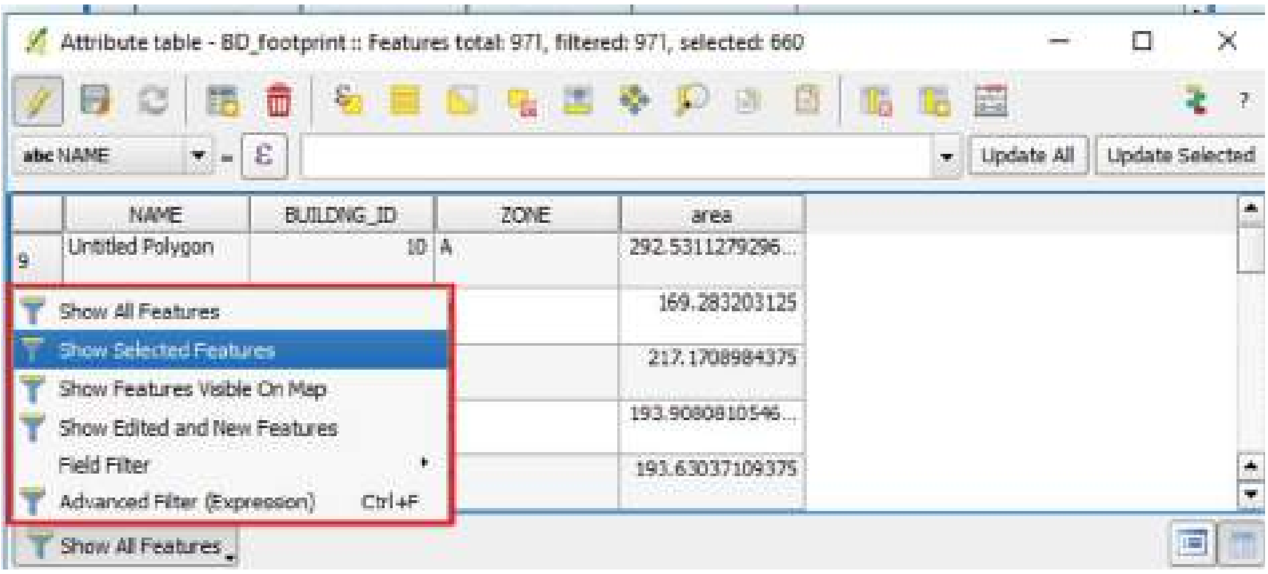


Showing the Selected Feature in Attribute Table

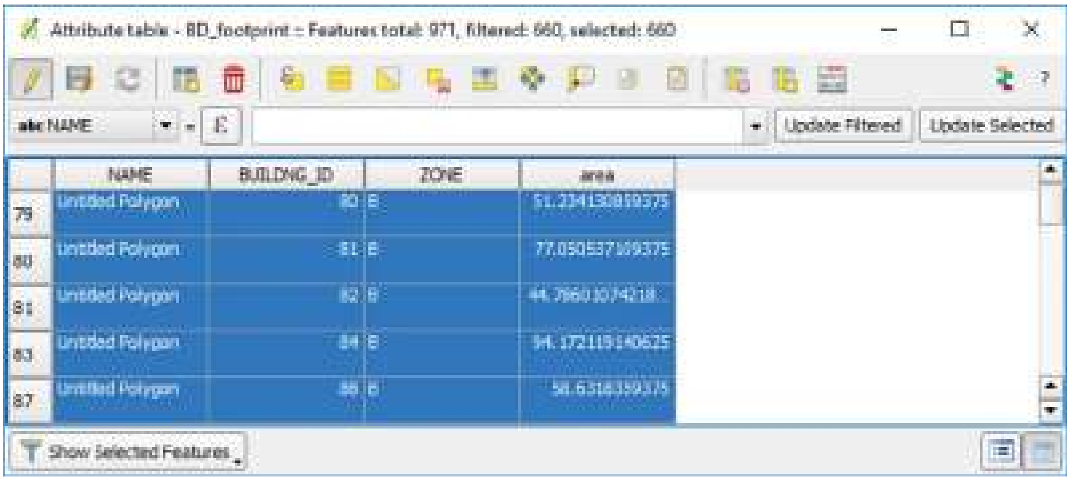
- Then open the attribute table of “BD_footprint” and click the “Show All Features”.



Then choose " Show Selected Features".

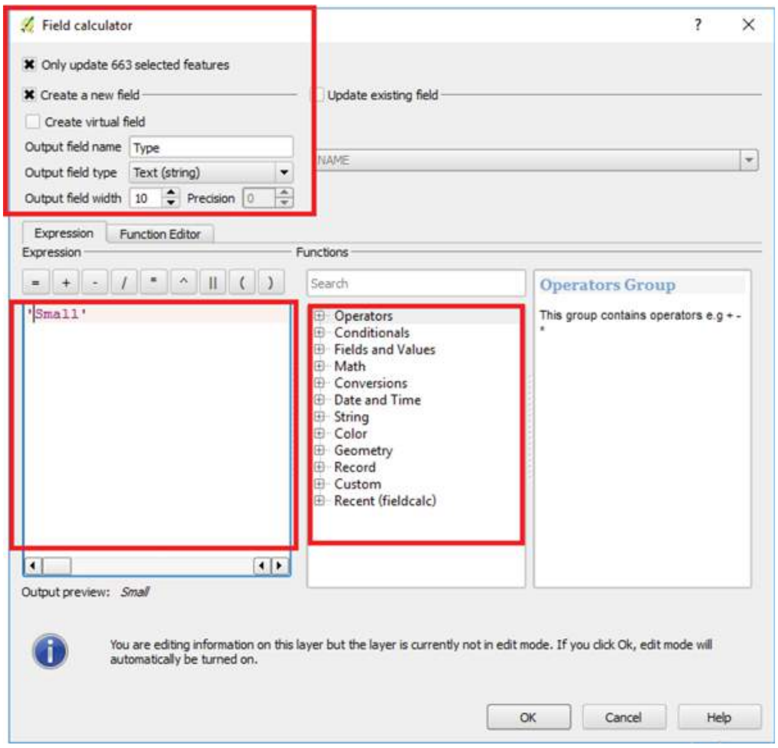


• Then you will see the selected features as below.

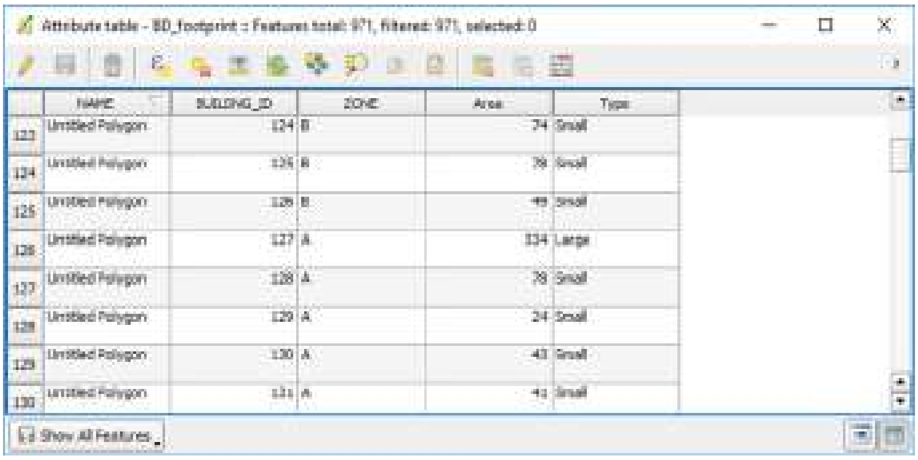


Adding the Categorize Type in New Column

- Then using the filed calculator and create the new column "Type" and give the value as "small" for selected buildings in attribute table.



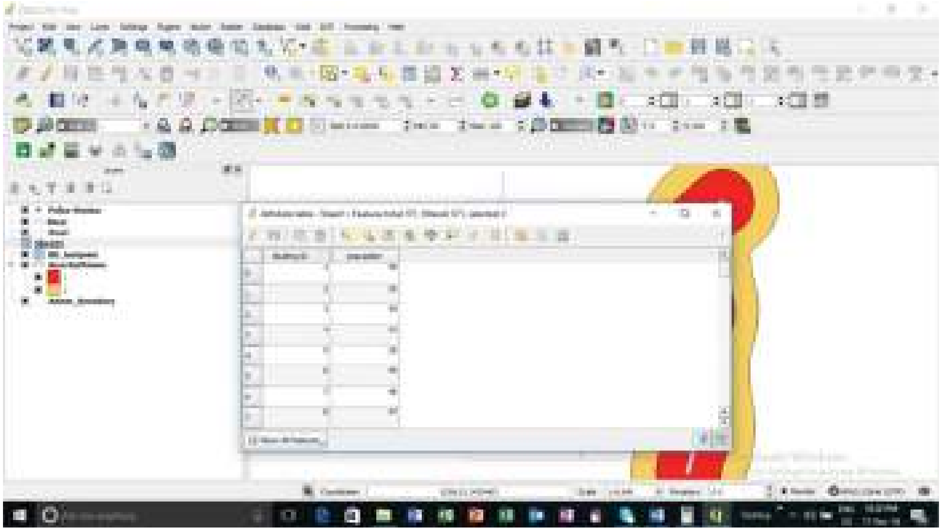
- After adding the type of building as "small , you will see as follow in the attribute table of thie layer.



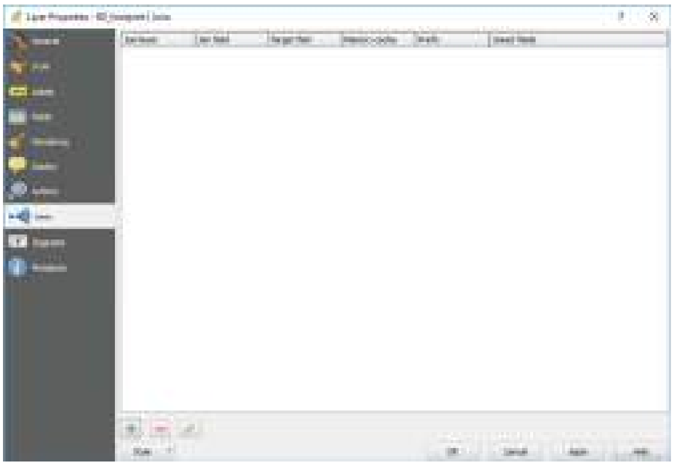
- Repeat the same process for "medium" and "large" building using expression tool and field calculator. Then you can see the result as follow.

Joining Attribute Table of BD_footprint with Excel File

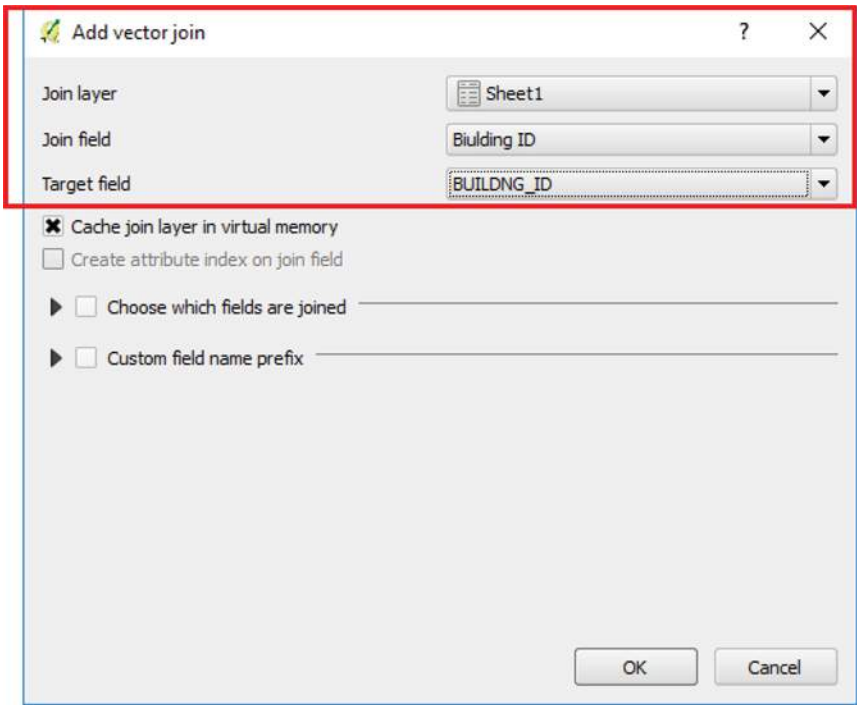
5. Open the population data excel file using add vector layer tool. And then open the attribute table of this file.



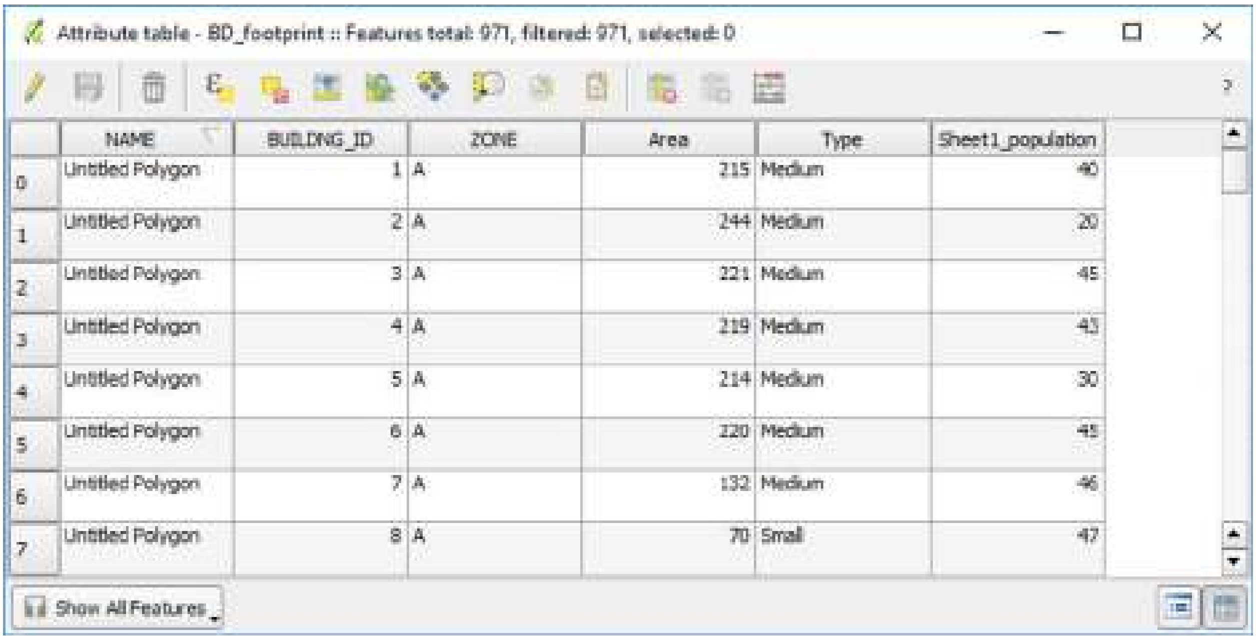
- Then right click the building layer and select the "Join" from property.



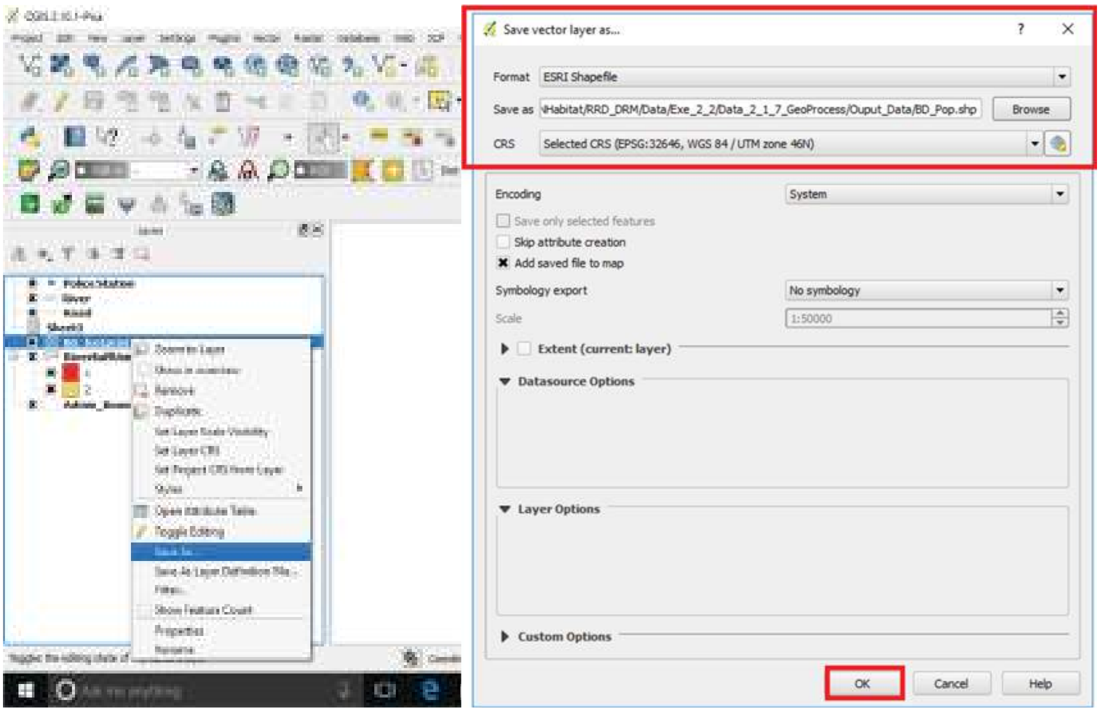
- Add the join layer as "sheet1" and select join field as "BuildingID" from excel file. Select target filed as also "BuildingID" from building layer.



- After clicking ok button, you will see the result of joining building layer and excel table using Building_ID as primary key.

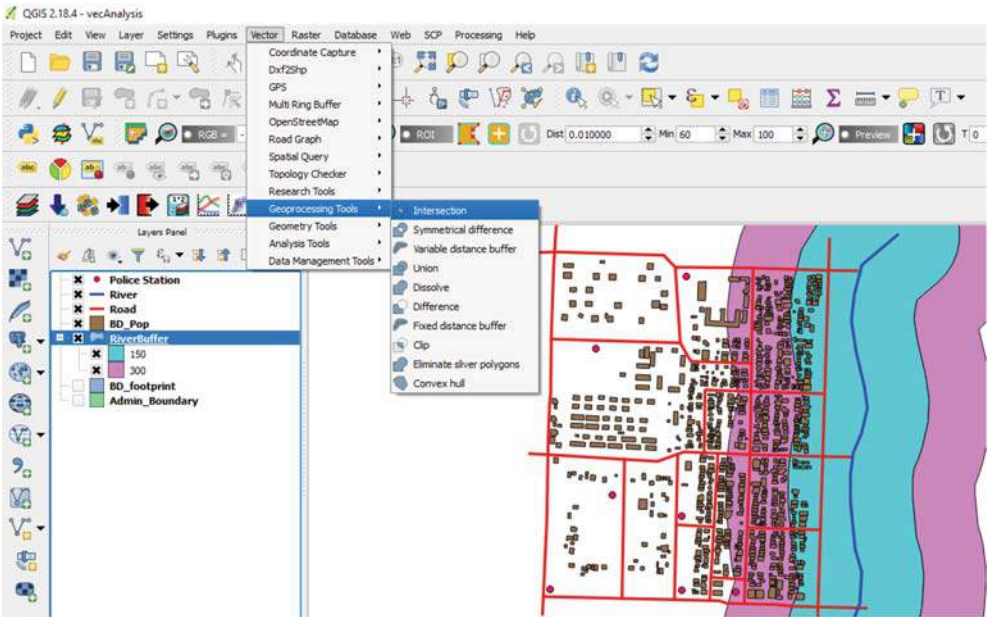


- Right click the building layer and select the “Save as” and give the location of output file and filename.

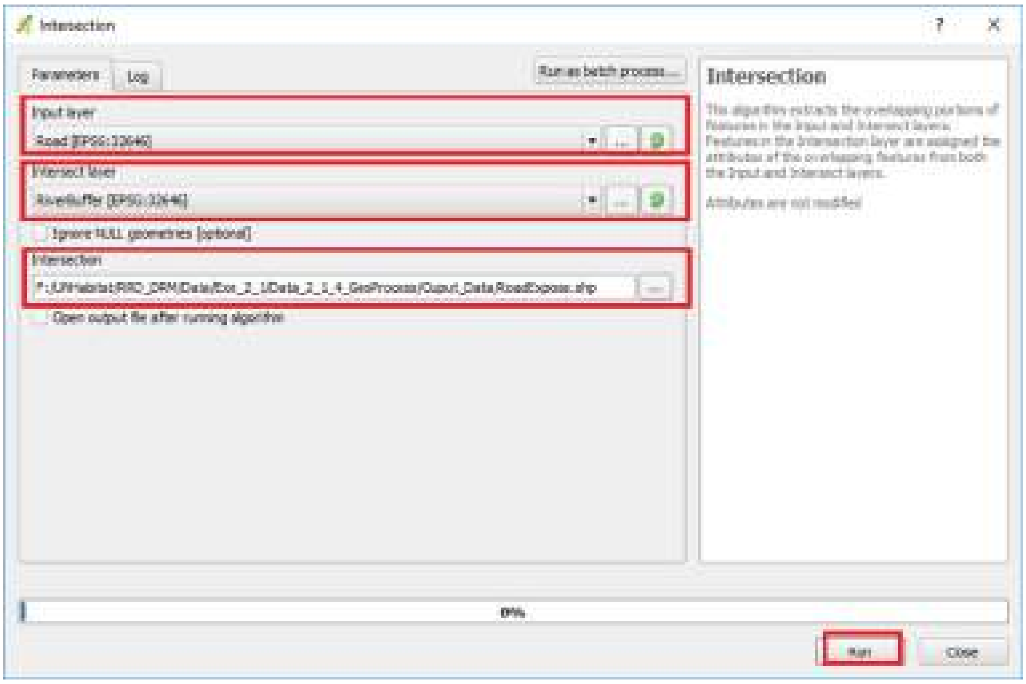


Extraction the Exposed Area of the Flood Zone

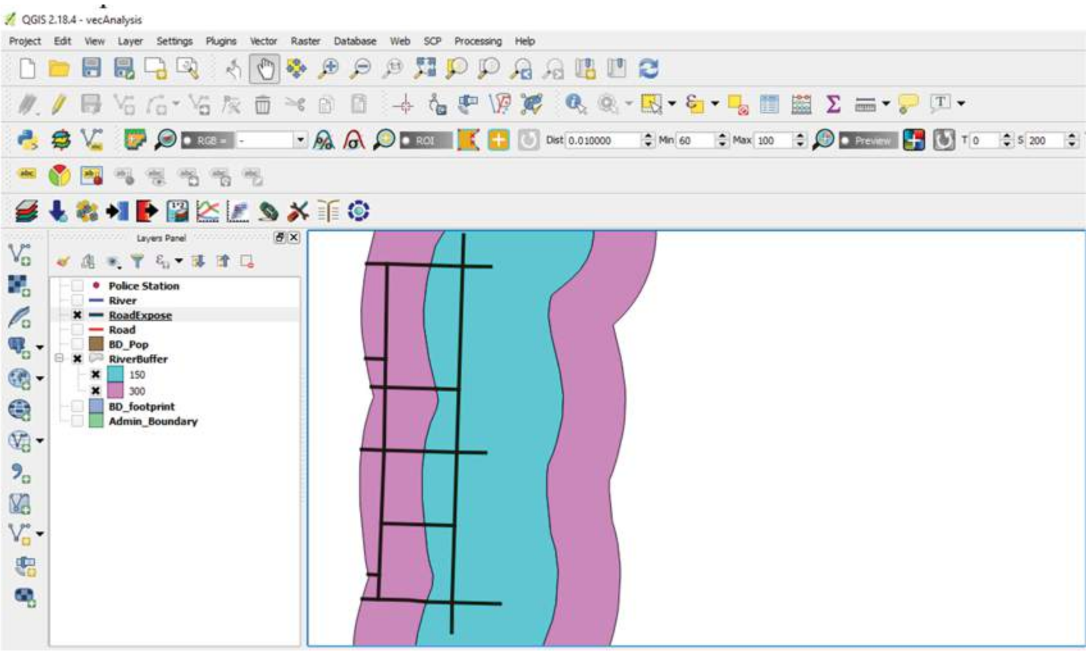
- Open the “Intersection” from “Geoprocessing Tool” in Vector Main Menu to identify the expose area of road in flood zone.



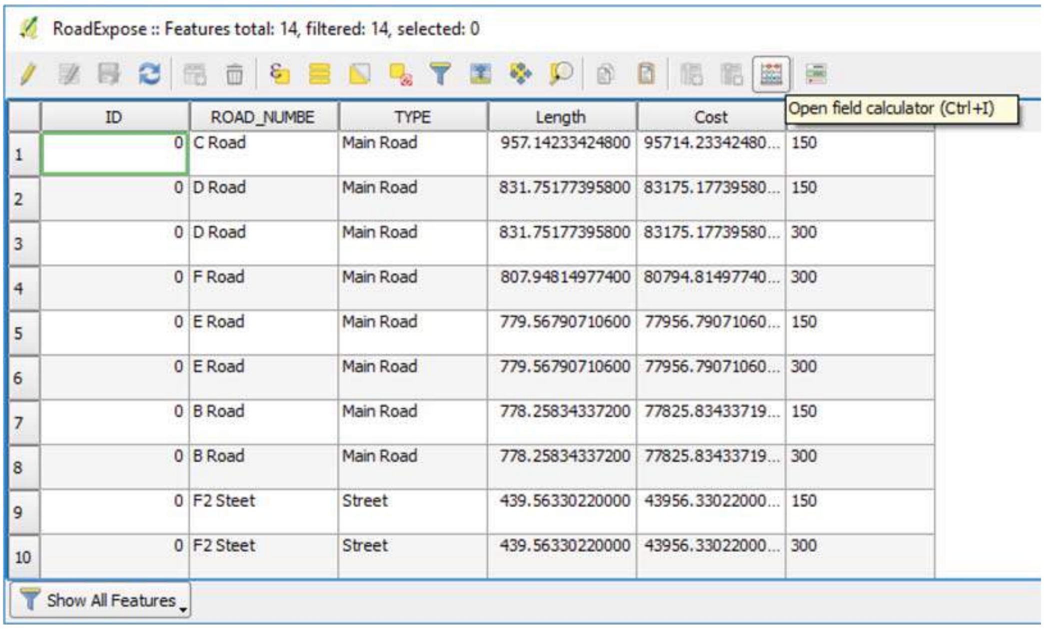
- Input layer: road.shp
- Intersect layer: RiverBuffer
- Then save the output file to your desired location as “RoadExpose.shp.”



- The expose area of road can be seen as follow.

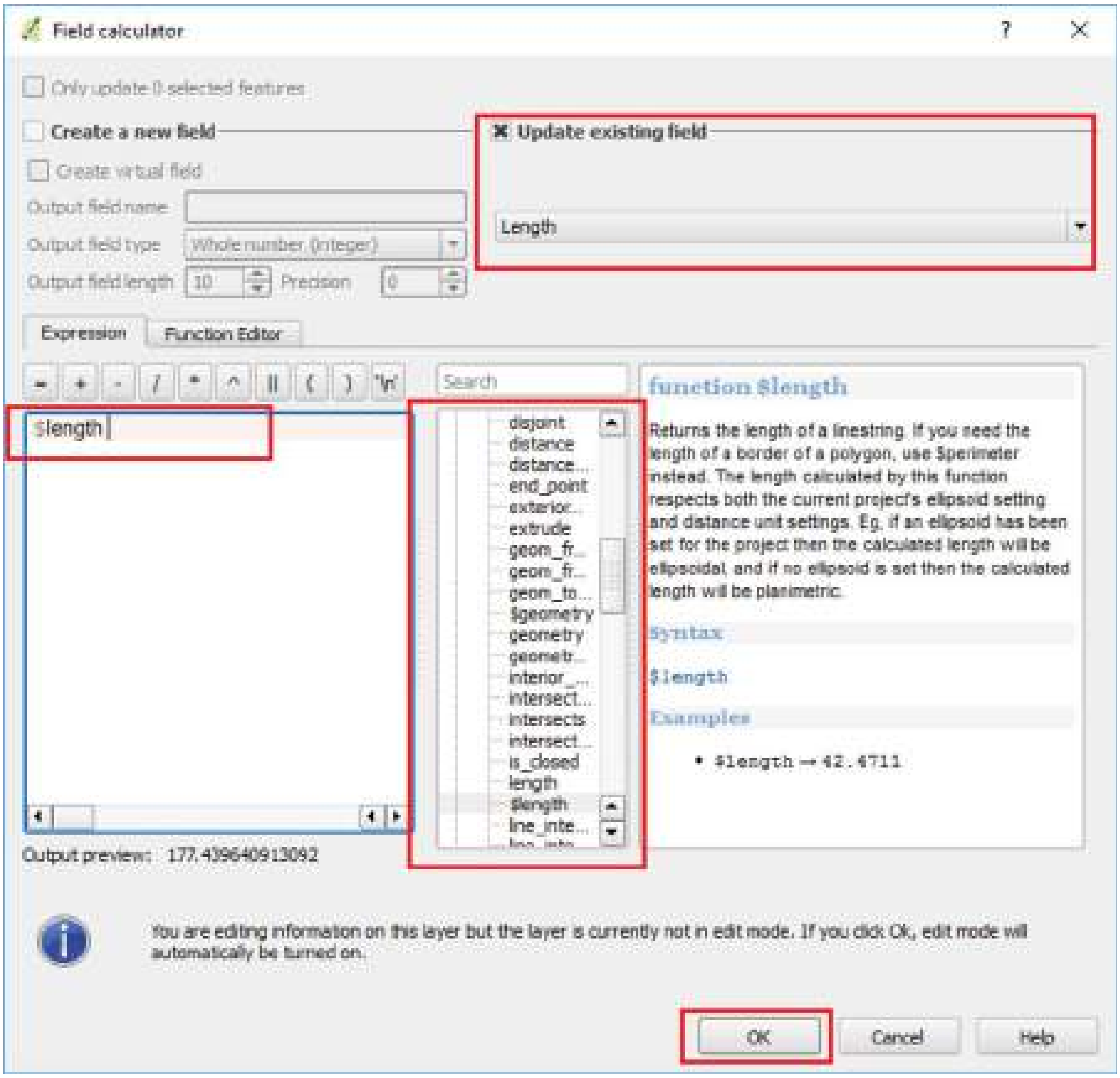


- Right click the output file and open the attribute table to calculate the length of the road again.

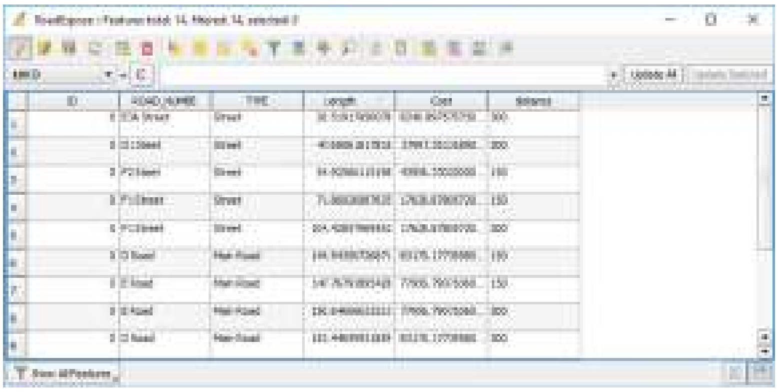


	ID	ROAD_NUMBE	TYPE	Length	Cost	
1	0	C Road	Main Road	957.14233424800	95714.23342480...	150
2	0	D Road	Main Road	831.75177395800	83175.17739580...	150
3	0	D Road	Main Road	831.75177395800	83175.17739580...	300
4	0	F Road	Main Road	807.94814977400	80794.81497740...	300
5	0	E Road	Main Road	779.56790710600	77956.79071060...	150
6	0	E Road	Main Road	779.56790710600	77956.79071060...	300
7	0	B Road	Main Road	778.25834337200	77825.83433719...	150
8	0	B Road	Main Road	778.25834337200	77825.83433719...	300
9	0	F2 Steet	Street	439.56330220000	43956.33022000...	150
10	0	F2 Steet	Street	439.56330220000	43956.33022000...	300

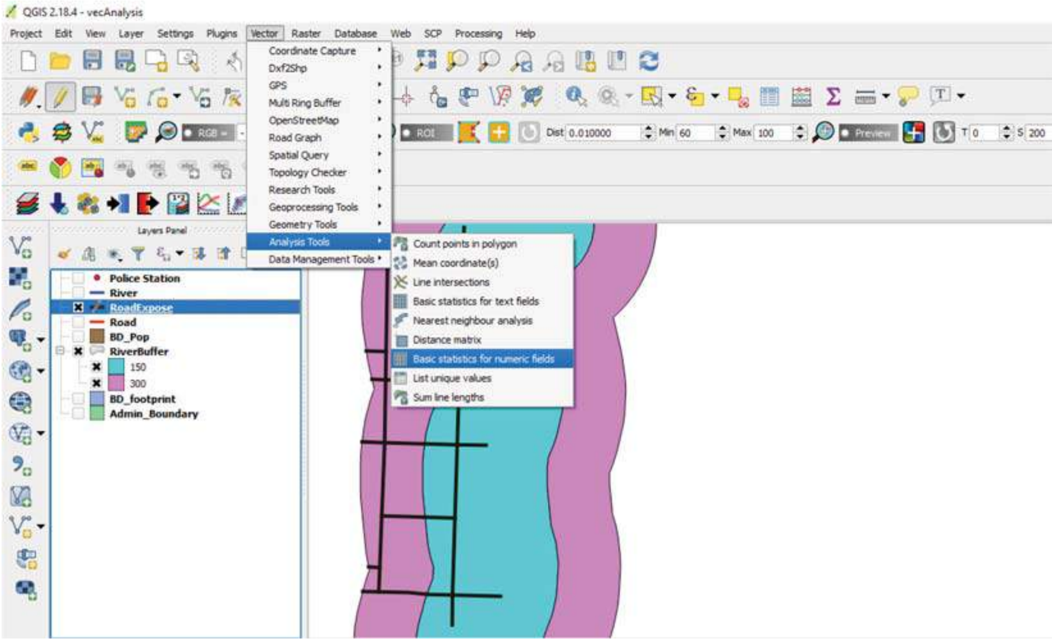
• Right click the output file and open the attribute table to calculate the length of the road again.



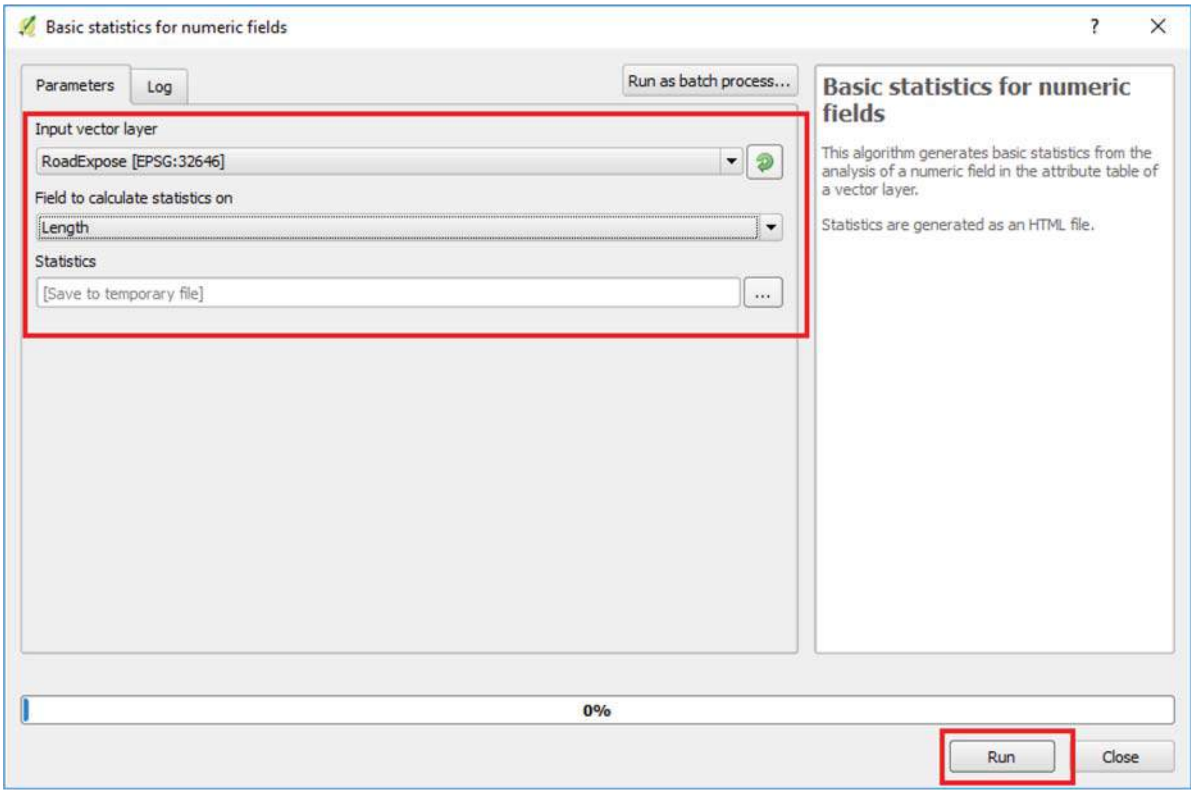
- The length calculation result will be seen as follow



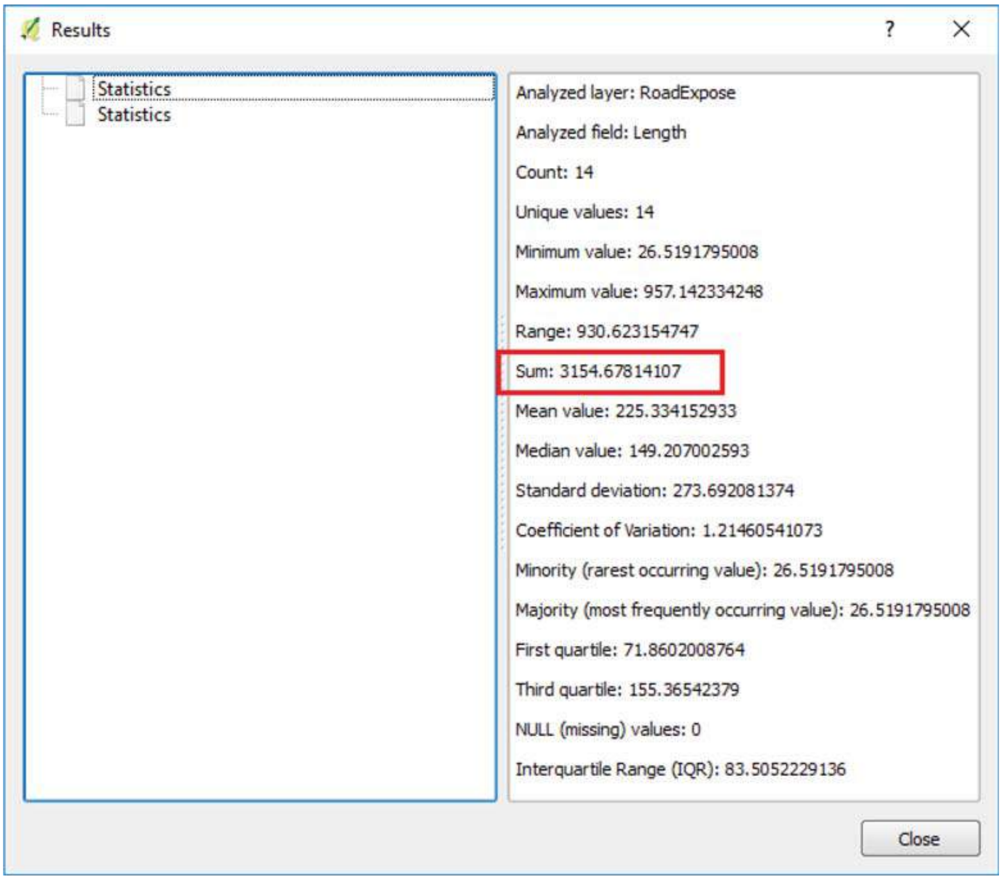
To calculate the total exposer road length, go to the “basic statistics” tool from “Analysis Tools” in “Vector” main menu.



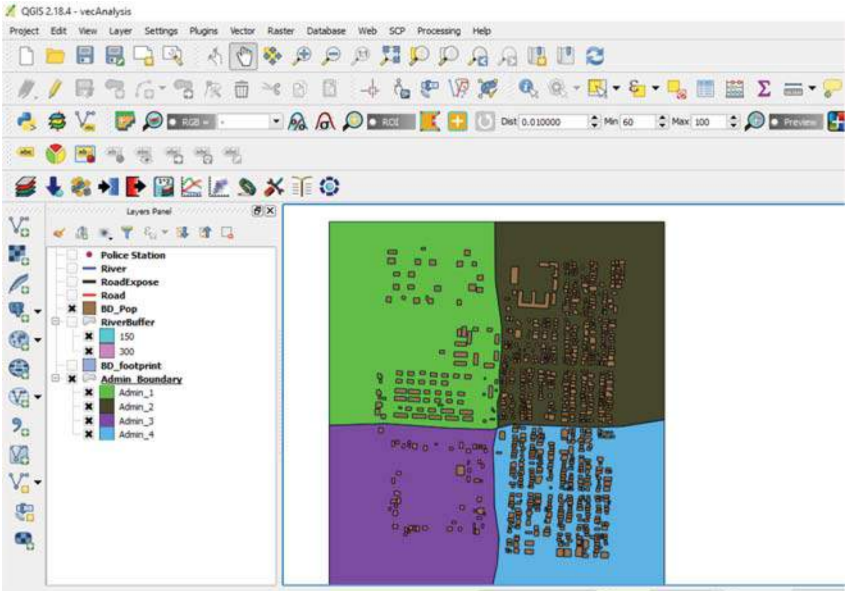
- Input vector layer: “RoadExpose.shp”
- Field to calculate statistics : “Length”



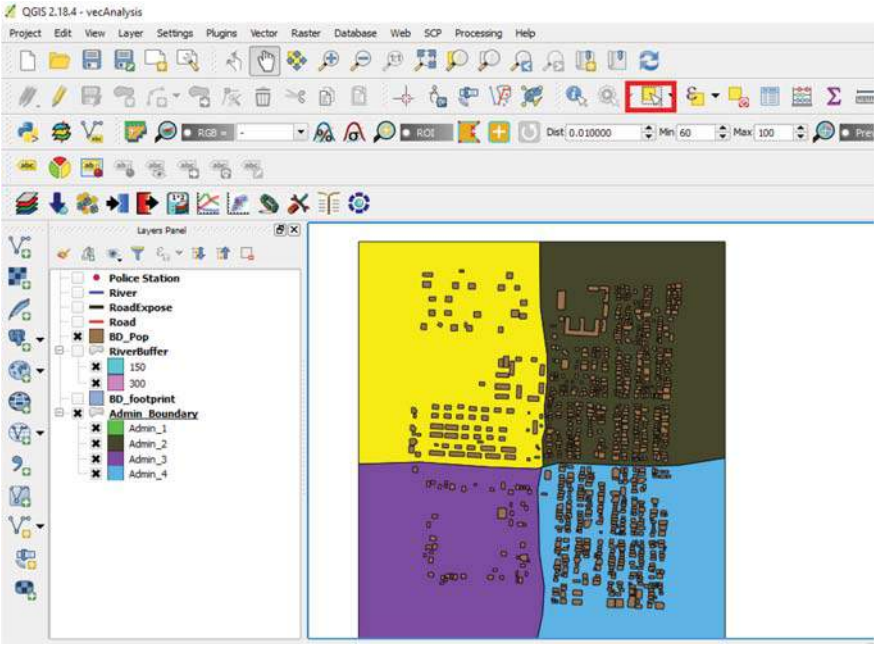
- You can check the summarize length of exposed road can be seen in Result window.



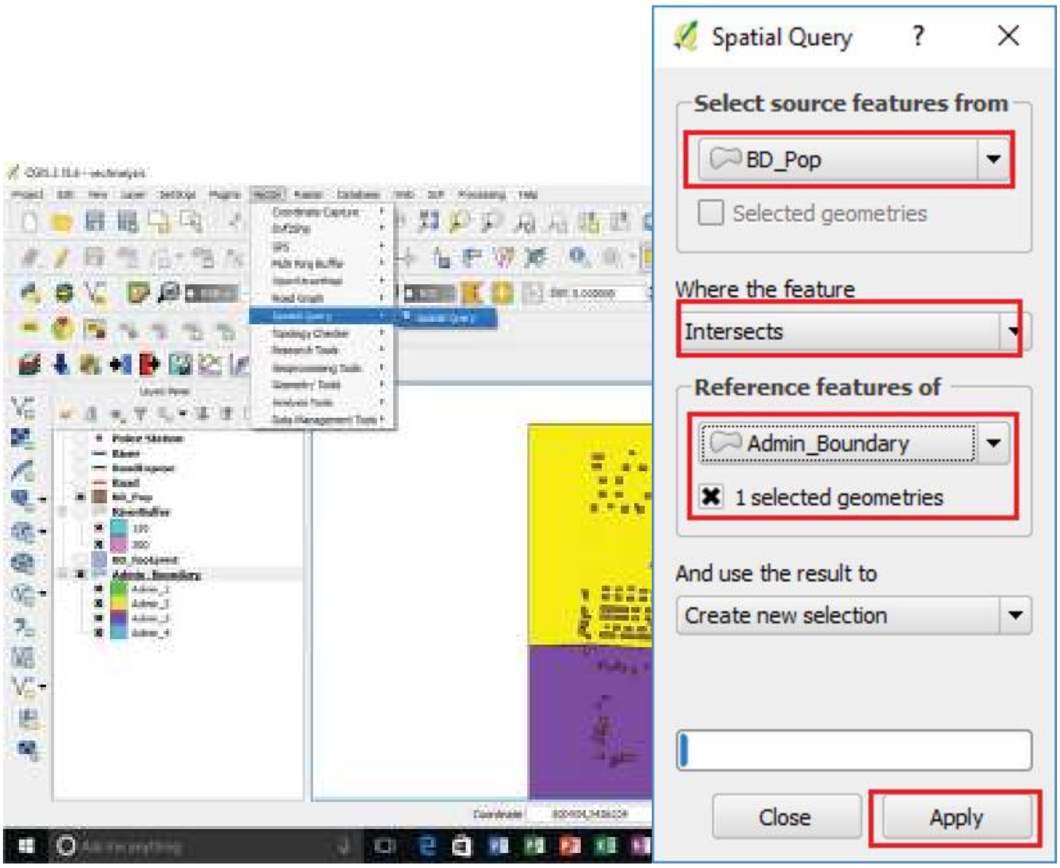
- Add the building layer which has already joined with population excel file to identify the building and population in each administrative boundary.



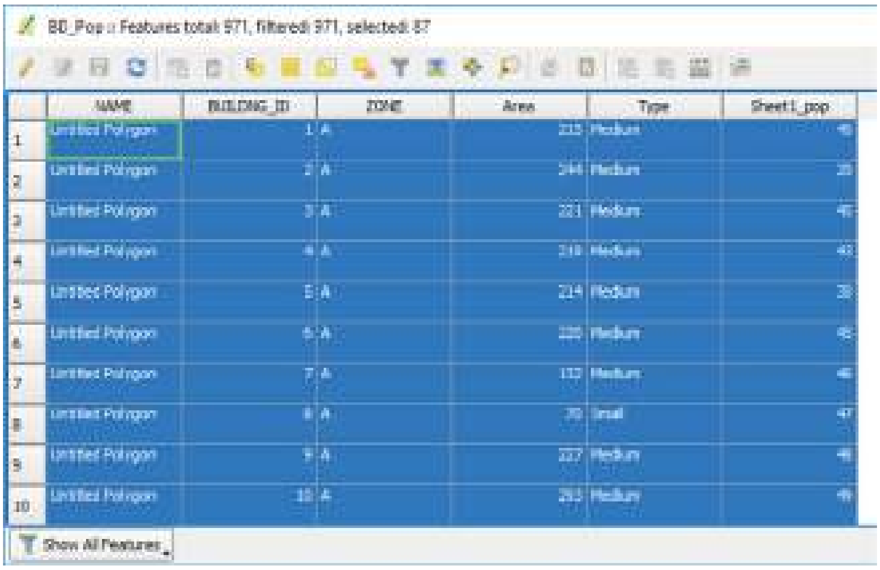
- Select the admin_1 area+ using “Select Feature” tool from “Attribute Tool bar”.



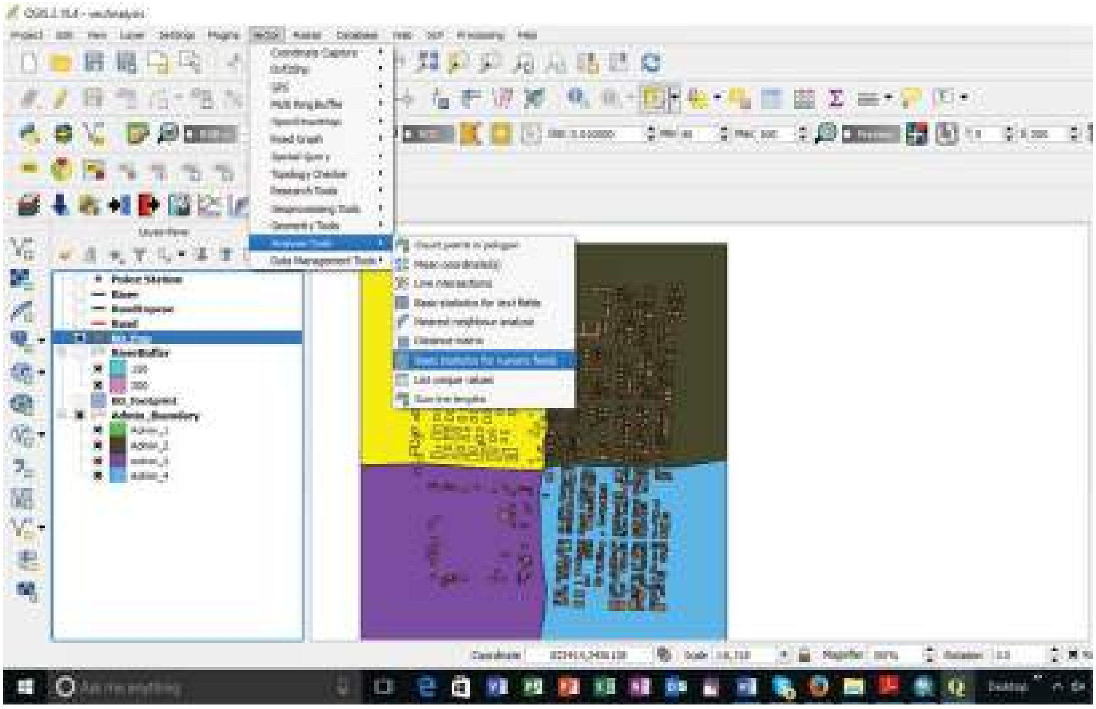
- Using “Spatial Query” from “Vector” Main Menu to identify the number of buildings in selected administrative boundary.



• The result can be checked in attribute table of building layer.

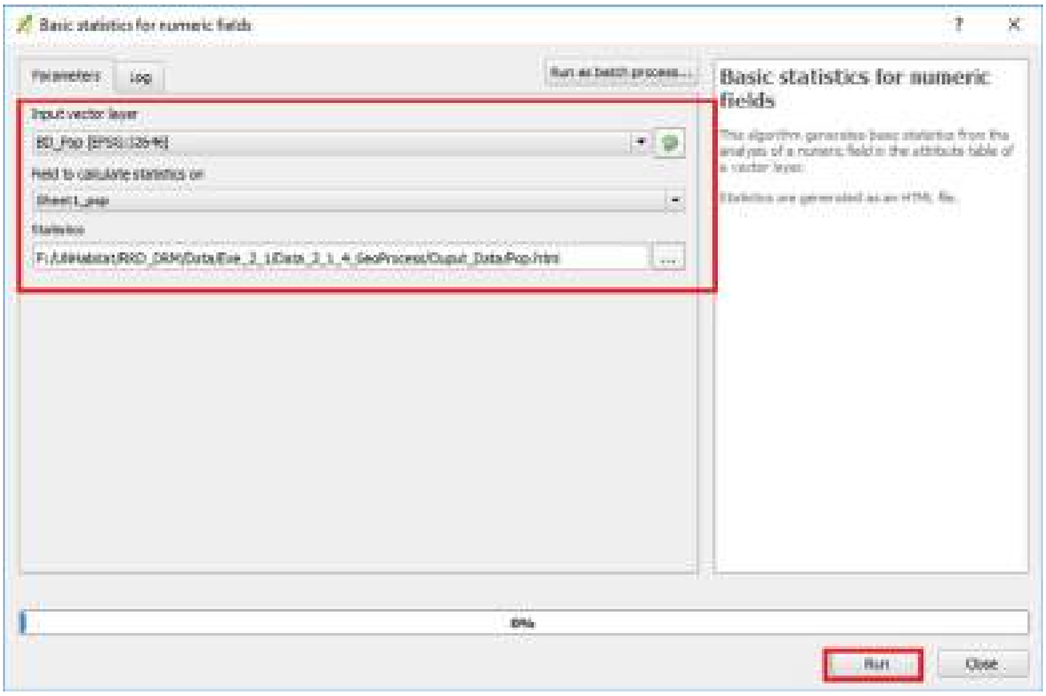


To calculate the total population, go to the “basic statistics” tool from “Analysis Tools” in “Vector” main menu.

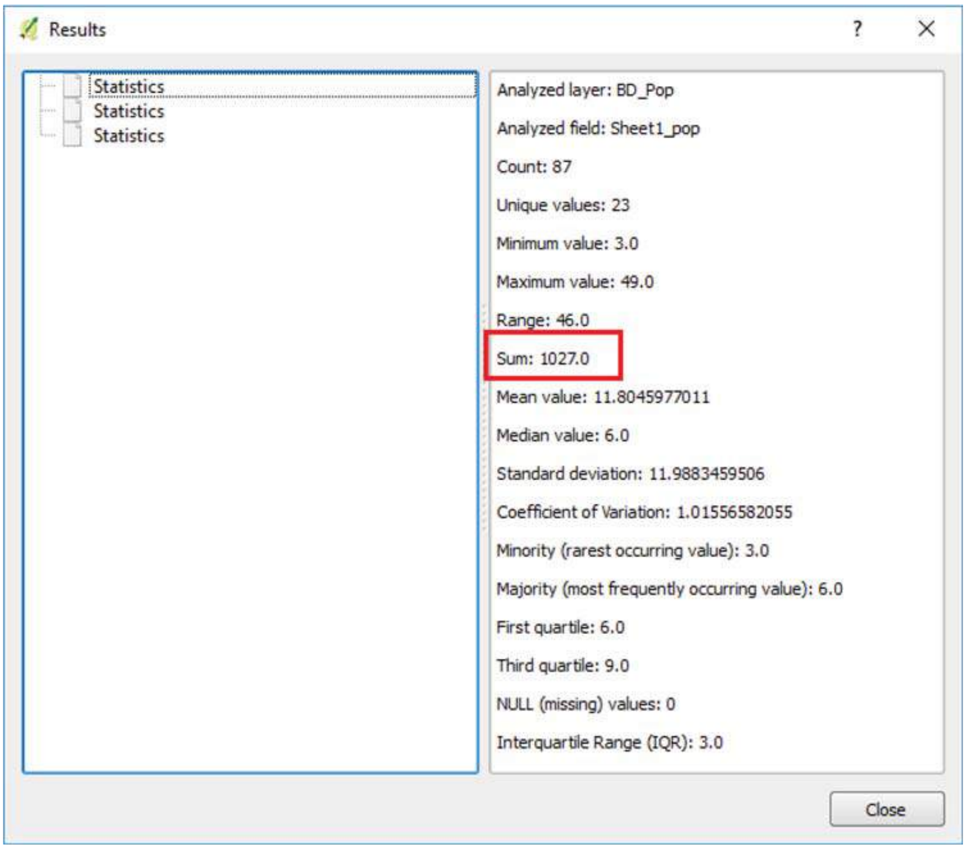


• Input vector layer: "BD_Pop.shp"

• Field to calculate statistics : "pop"



• You can check the total population in selected admin boundary can be seen in Result window.



• Please repeat the processing for other steps same procedure as above.

Questions

1. What is the total length of the road which exposed into the flood zone?

   ....

2. How many Building Density and population density in each admin boundary?

Admin Boundary	Building Density	Pop Density
Admin_1		
Admin_2		
Admin_3		
Admin_4		

3. How many buildings exposed to the flood in high zone?

   ....

4. How many buildings exposed to the flood in low zone?

   ....

5. What is the total population exposed to flood in high zone?

   ....

6. What is the total population exposed to flood in low zone?

   ……………………………………………………………………

7. If the government needs to relocate all building in high risk of flood zone, how much the government has to allocate budget (in USD) for relocate those building?

   ……………………………………………………………………

8. Please find the suitable area to construct the new government complex by using the follow condition

   - The complex must close to the main road (not more than 30 meter)

   - The complex must close to the Police Station (not more than 50 meter)

   - The complex must not locate in flood zone

9. How many Large Buildings exist in study area?

   ……………………………………………………………………

EXERCISE 2.2

PERFORMING SUPERVISED IMAGE CLASSIFICATION USING THE SEMI-AUTOMATIC CLASSIFICATION PLUGIN IN QGIS

This exercise will introduce the pre -image processing and image classification in Remote Sensing. This will be useful in Land Cover / Land Use Mapping for disaster risk management. In order to perform an image classification, we must first decide on how to categorize the landscape. SCP uses both classes and macroclasses. A number of classes may be nested within the macroclass. For example, we may have multiple forest types within the macroclass of 'forest'. You may also need different class values for different spectral types within the same land cover category. For example, you may have a class for light water and a class for medium and dark water. These are not separate land cover categories, but they are necessary for the classification because statistically they will have different spectral values in the imagery.

Land cover class typology

Macroclass	MC ID	Class	C ID	Vegetation or Land Cover Type
Open Forest	1	Open/sparse	10	Pinyon/Juniper
Closed Forest	2	Closed, light	20	Ponderosa Pine
Closed Forest	2	Closed, medium	21	Ponderosa Pine
Closed Forest	2	Closed, dark	22	Ponderosa Pine
Shrub/scrub	3	sparse, light soil	30	Sagebrush, rabbitbrush or other shrubs
Shrub/scrub	3	medium	31	Sagebrush, rabbitbrush or other shrubs
Shrub/scrub	3	Dense, dark	32	Sagebrush, rabbitbrush or other shrubs
wetland	4	Dark, with water signal	40	Emergent marsh
wetland	4	Medium, stronger vegetation signal	41	Wet meadow
water	5	Light	50	Water, shallow or with silt
water	5	Medium	51	Water, typical
water	5	Dark	52	Water, deep lake
bare	6	Light soil	60	Bare ground
bare	6	Dark soil, lava	61	rock/soil
Herbaceous	7	Light	70	Cheat grass or other herbs
Herbaceous	7	dark	71	Cheat grass or other herbs
Agriculture	8	New growth, very strong signal	80	Agricultural fields, irrigated
Agriculture	8	Medium signal	81	Agricultural fields, irrigated
Agriculture	8	Dry, fallow	82	Agricultural fields, non-irrigated
Developed	9	Medium	90	Roads, buildings, etc.

Learning Objective:

- Understand Basic Remote Sensing Image Processing
- Understand the types of Image Classification in Remote Sensing

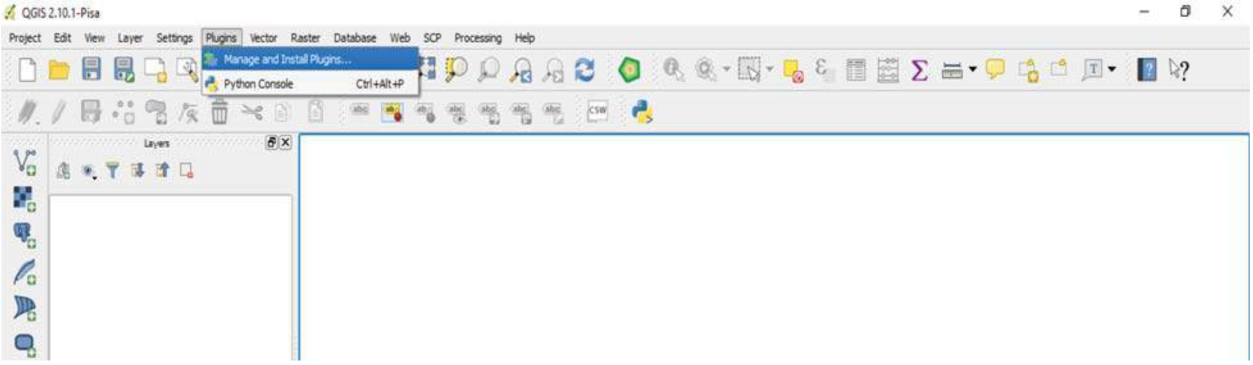
Data Use:

- Landsat Image

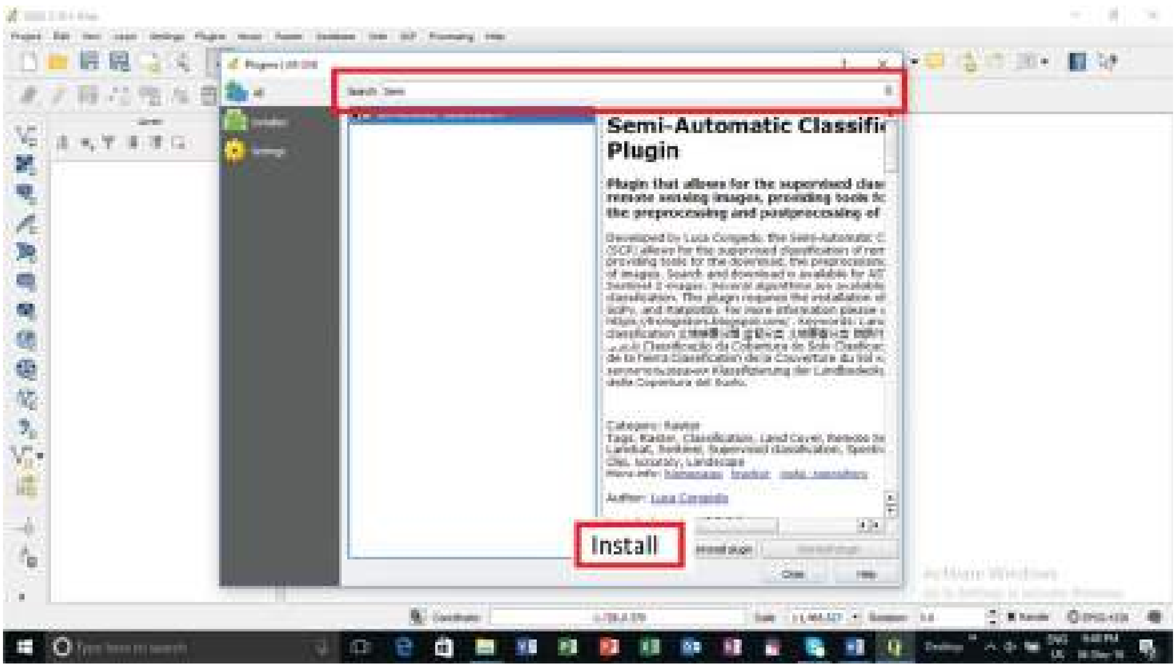
Steps:

1. Plug in installation

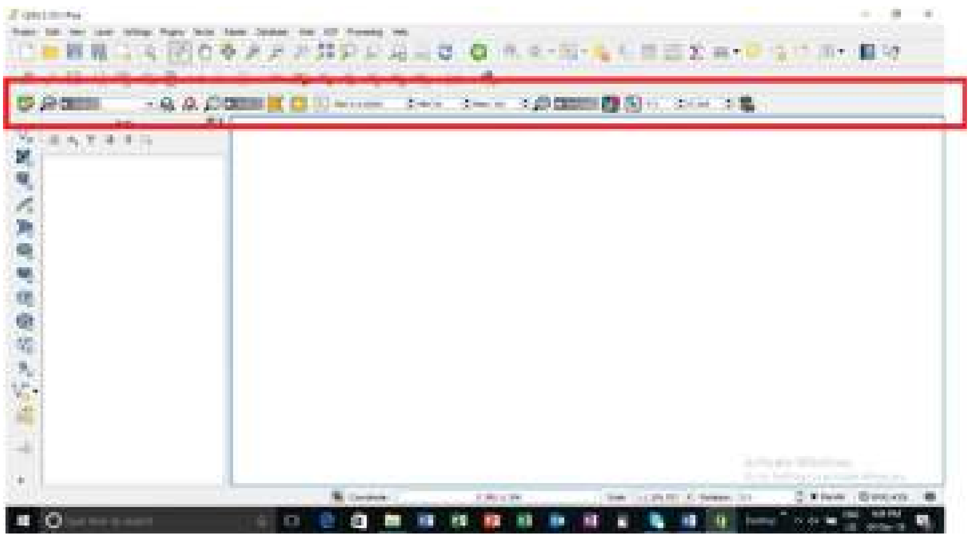
Go to 'Plugin' from Main Menu and select ' manage and install plugin'.



Then type 'Semi....' in text box of search and press install button.

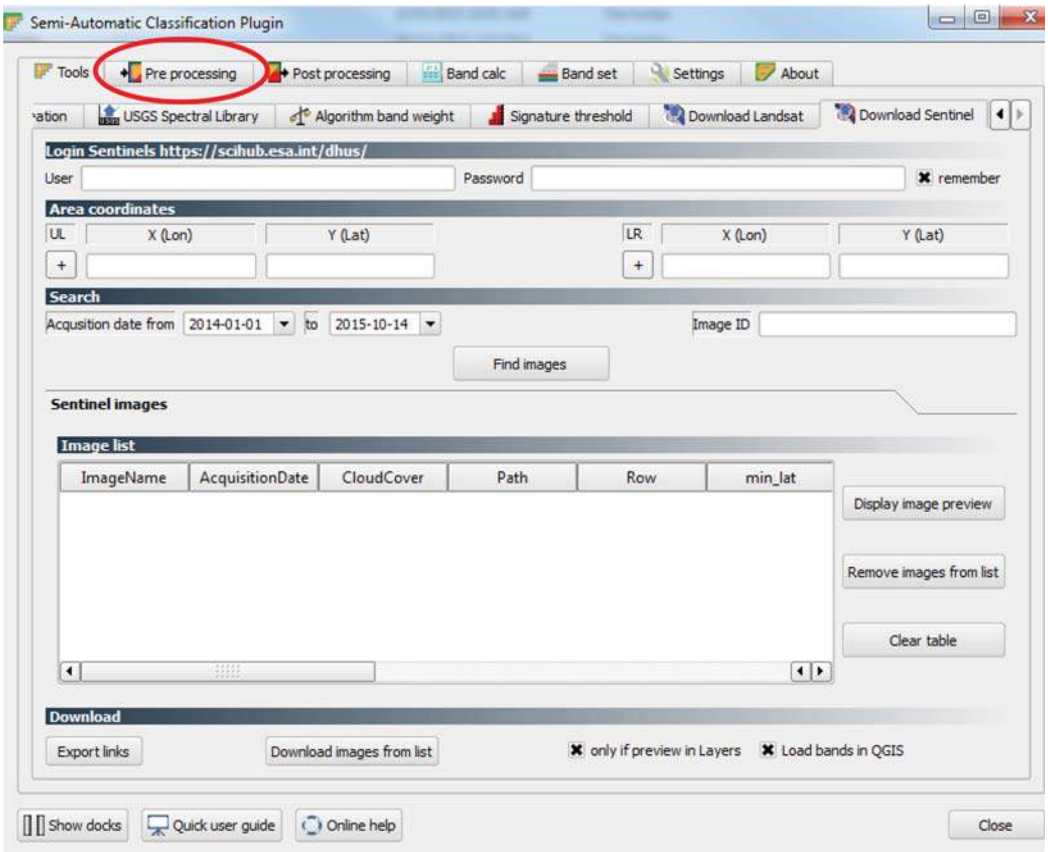


Then you will see 'Semi-automatic classification plugin' will appear in your window.

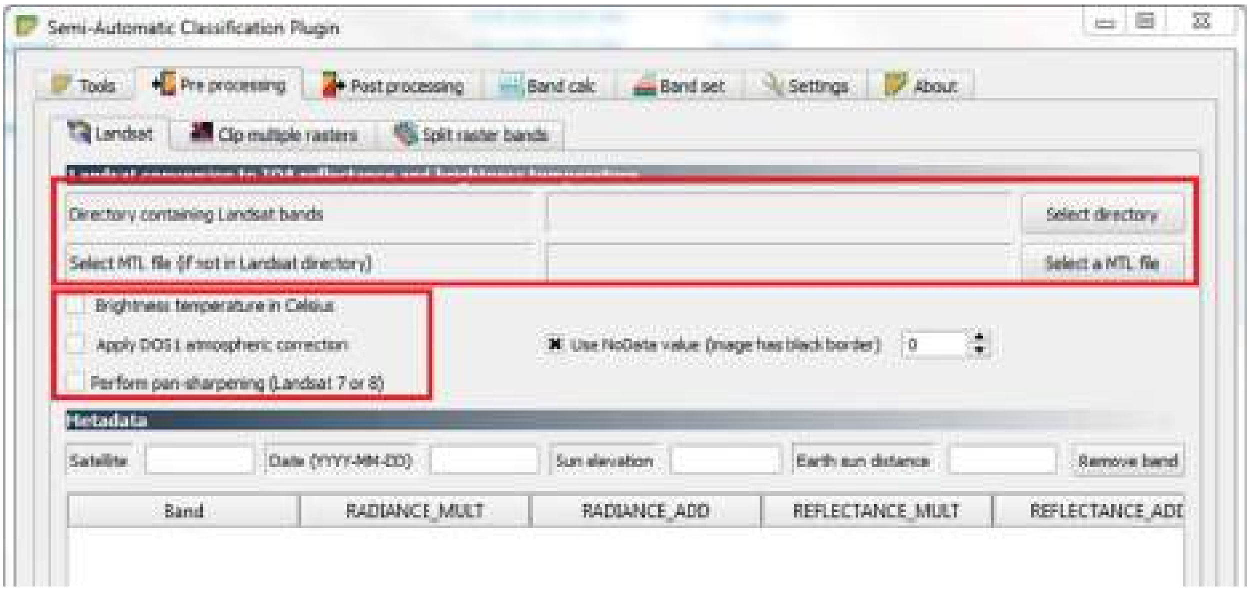


2. Conversion of raster bands from DN to Reflectance for the images

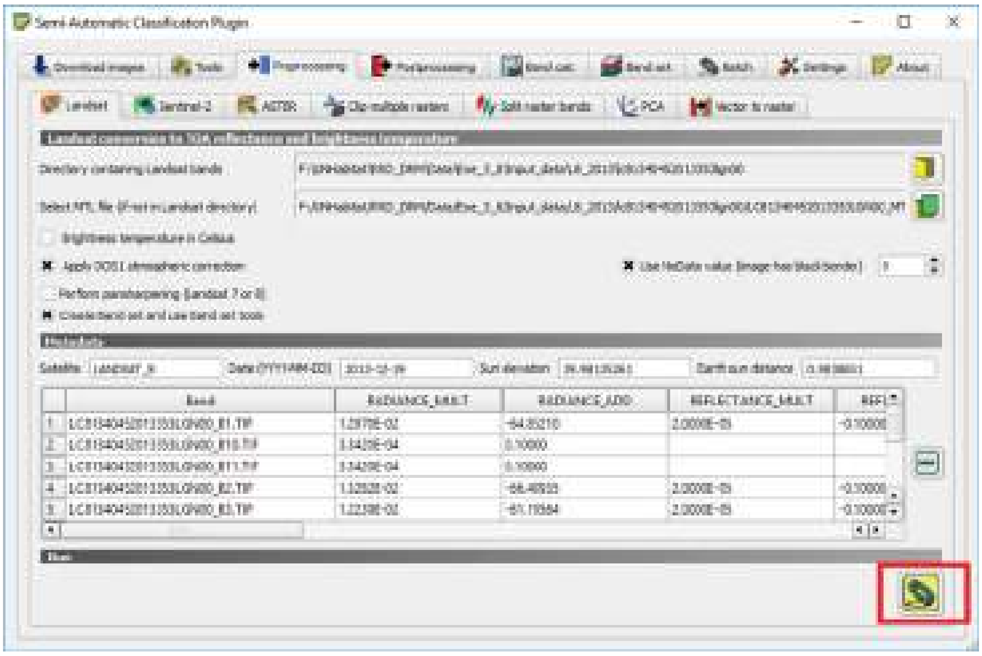
We will use the Semi-Automatic Classification Plugin (SCP) tool in QGIS to convert to top-of-atmosphere (TOA) reflectance. Open QGIS. Turn on the SCP tools if not already active. To do this, right click and check the box next to 'SCP Toolbar'. Click on the button to activate the SCP interface. Once the SCP window opens, click on 'Pre-processing'



Select the directory with the Landsat bands to process. The MTL file should be in that folder already. This is the file with the gain and offset values that will be used to convert the digital numbers to TOA reflectance. At this stage, you can also select to use a dark object subtraction for atmospheric correction if you want, and you can pan-sharpen the bands to use for later steps in the classification process. Note that pan-sharpening will add considerably more time to the process.

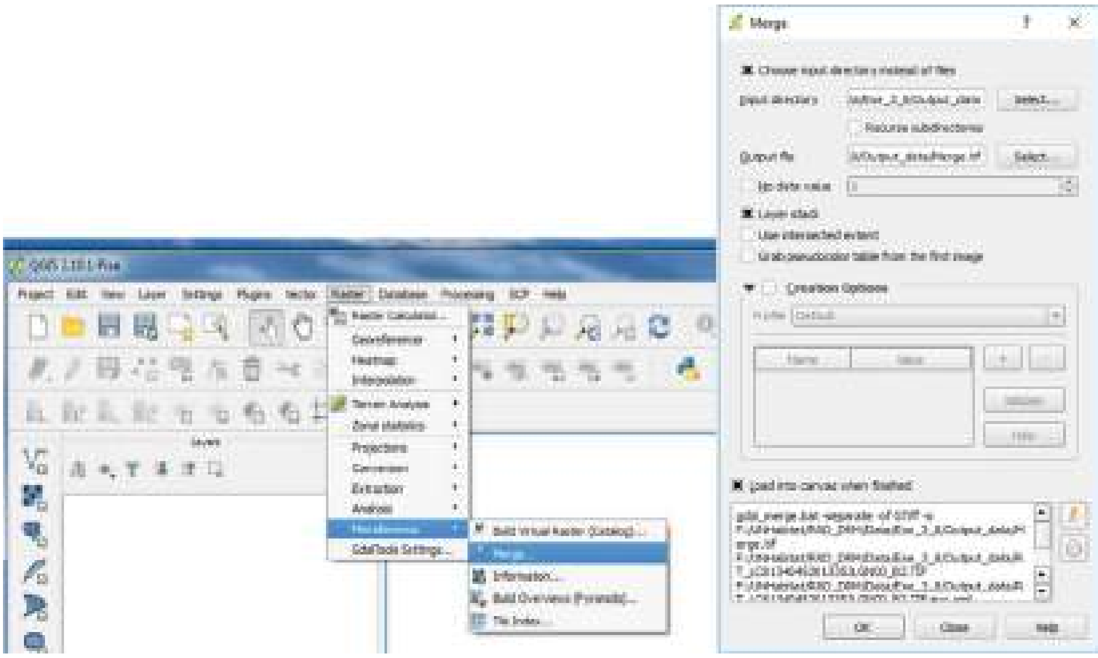


Then select "run". A window will pop up asking where to put the processed files. It is best to create a new folder for these. Select that location and then continue.

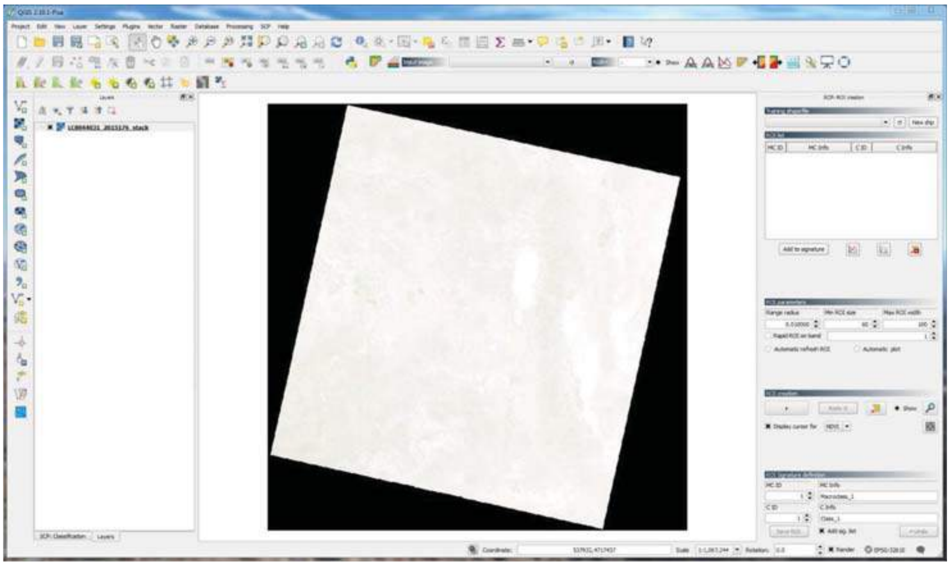


3. Stack the bands

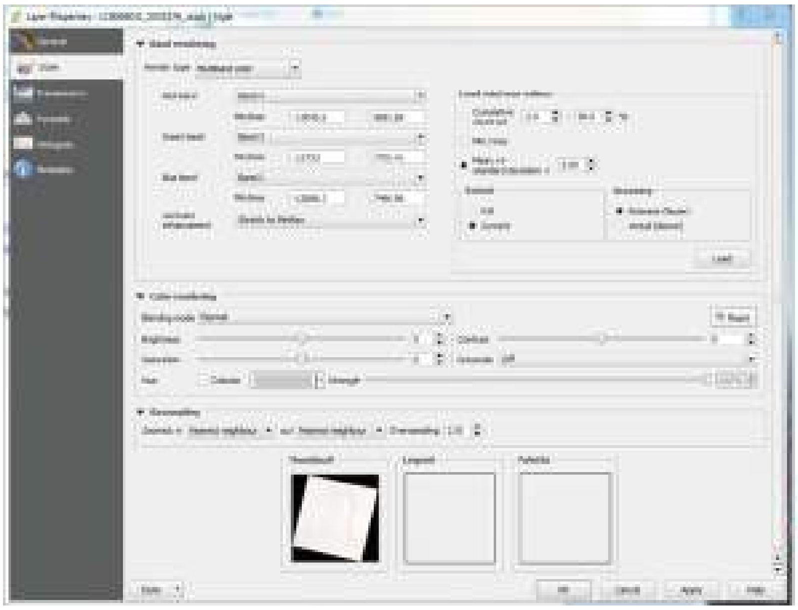
To do the layer stacking in QGIS, however, it is best to have each image in its own folder. You then select the folder with the bands, remove the bands that you don't want in the final image and run the command. The command that we will use is called 'Merge' and it is available under the Raster toolset, in 'Miscellaneous'.

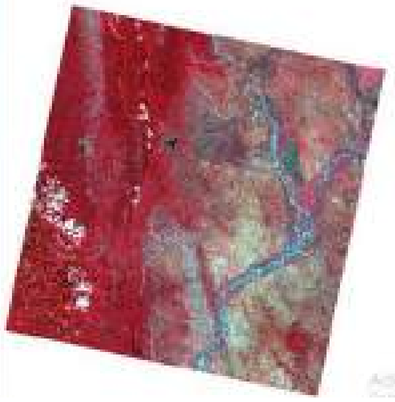


In the Merge function, select the input directory containing the bands to stack. Then create the output file, select the no data value (I usually use -9 or -10) and check the 'Layer stack' button. You window should look something like this:



Zoom into an interior portion of the image, check the ‘Mean +/- standard deviation’ button, set the extent to ‘Current’, then click on ‘Apply’. Also, set the layers to display as 5,4,3 as shown here.



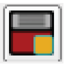


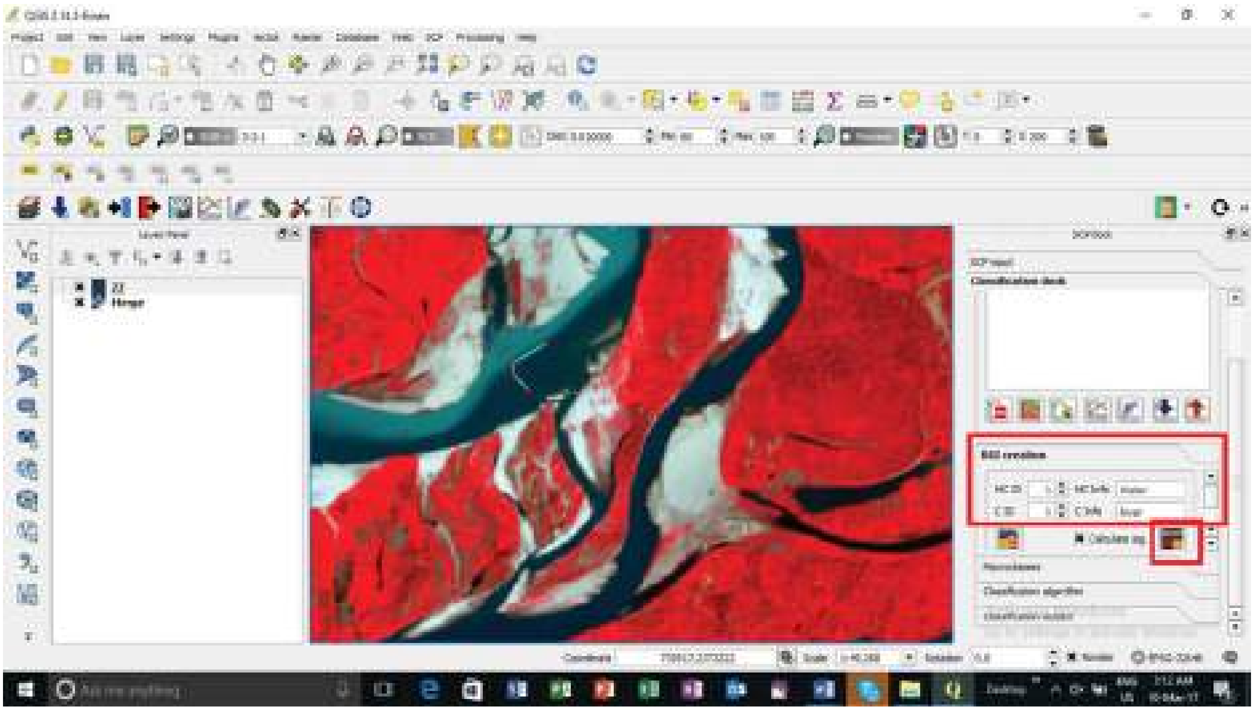
4. Digitizing Training Regions

• Select the image from the dropdown list in the SCP toolbar. If you don’t see the image in the dropdown in red box , click the refresh button.

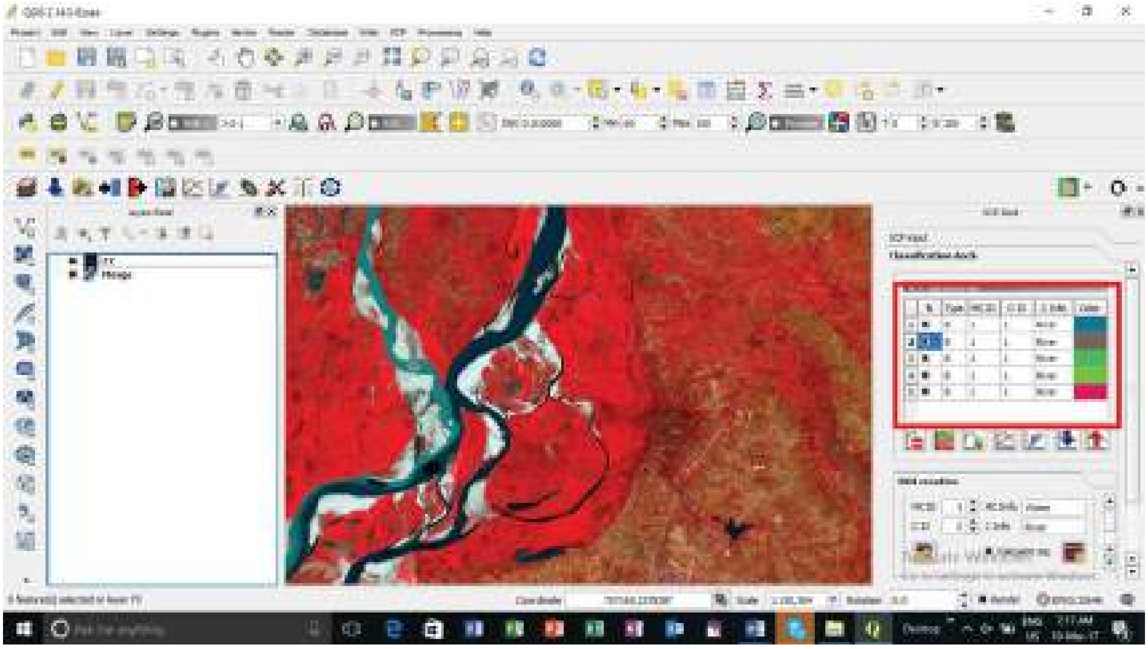
- Create a shapefile to store the training regions, or 'ROIs' in "Classification Dick". In ROI creation, you can give the main class ID in MC ID and sub class in C ID.

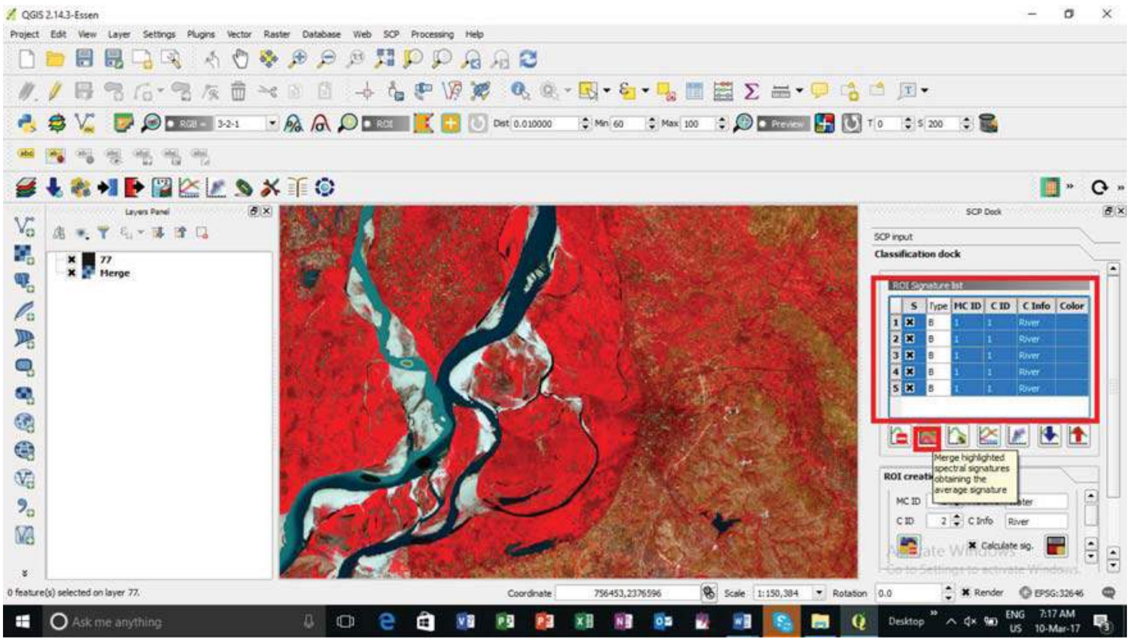
e.g	MC ID =1 (water)	MC ID =1 (water)
	C ID =1 (river water)	C ID =2 (lake water)

- Then Click the  button for temporary save for each class.

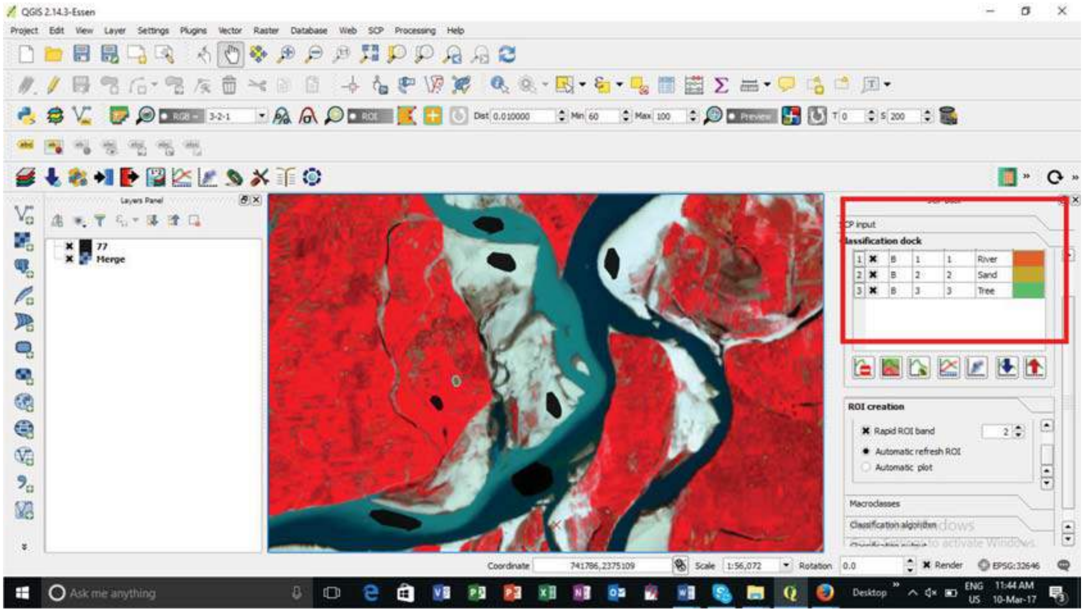


- Then select the same type of ROI and click merge  button to keep same types of ROI as one feature.



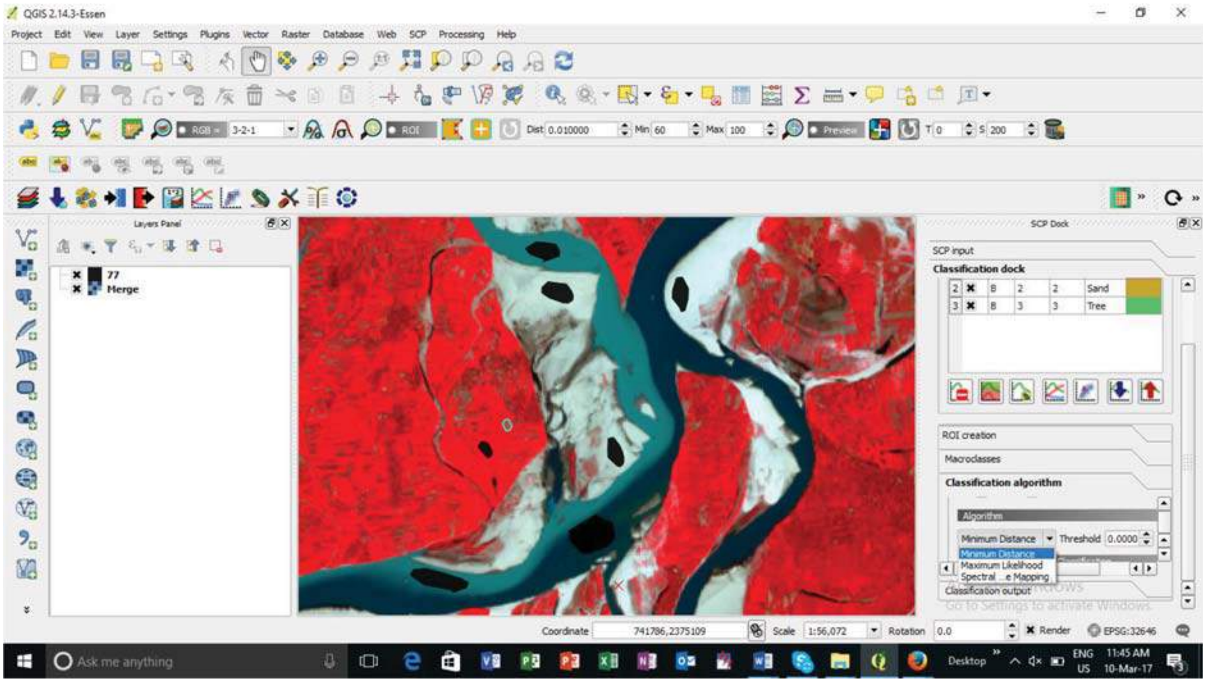


- After merging, the result will be seen like below.



5. Run the Classification Algorithm

- Select the algorithm to use (Maximum Likelihood is recommended). Apply a threshold if you choose. Any pixels that do not fall within the statistically significant threshold of that value will be left unclassified. Therefore, you will have to classify them through some other means, if you change that value to non-zero.



- Then, click on 'Perform classification' and a window will open directly you to enter the output name and directory.

6. Review the Output and Repeat Steps 4-5 if Necessary

FIELD EXERCISE 2.3

COLLECTING WAY POINTS, PATHS, GPS DATA TO MAP AND REPRESENTING ON GOOGLE MAP

Introduction

Global Positioning System (GPS) satellite-based technology is being widely used for surveying throughout the world. It offers a relatively inexpensive alternative to conventional surveying for many uses. GIS users in increasing numbers are incorporating GPS into the data collection phase of their projects. Interfaces between GIS and GPS are being developed, and experiences gained are leading to increased and improved integration of GIS and GPS. When a GPS Unit receives a signal from GPS satellites, it computes a position. The position computations are stored as coordinates. points, lines and polygons are collections of positions. Some GPS units can only collect individual positions, and require additional post processing or editing in the office to create lines or polygons. Most mapping grade GPS units have the capability to output the collected positions into either a point, line or polygon feature. If your GPS unit has the capability of using a data dictionary or a form to collect attributes, these tools can help guide you in determining whether to collect features as points, lines or polygons.

• Points and waypoints are best used for individual feature with only one geographic location (i.e., a sign). If you are collecting data as Points or waypoints it is advisable to collect multiple positions. The logging interval you select for collecting the positions can have an impact on accuracy. Collecting data at the point location for a longer time and then averaging positions, yields better results than collecting data at the point location for a shorter time.

• Track logs, lines and polygons are best used for linear or multi-dimensional features (i.e., collect roads as lines and wetland area as a polygon). If you are collecting data as Track logs, lines or polygons, the GPS receiver automatically records a positions along a path at either an interval determined by time or distance traveled.

Learning Objective:

- To get familiar with filed collecting data with GPS and how to export/ import GPS data to/from QGIS

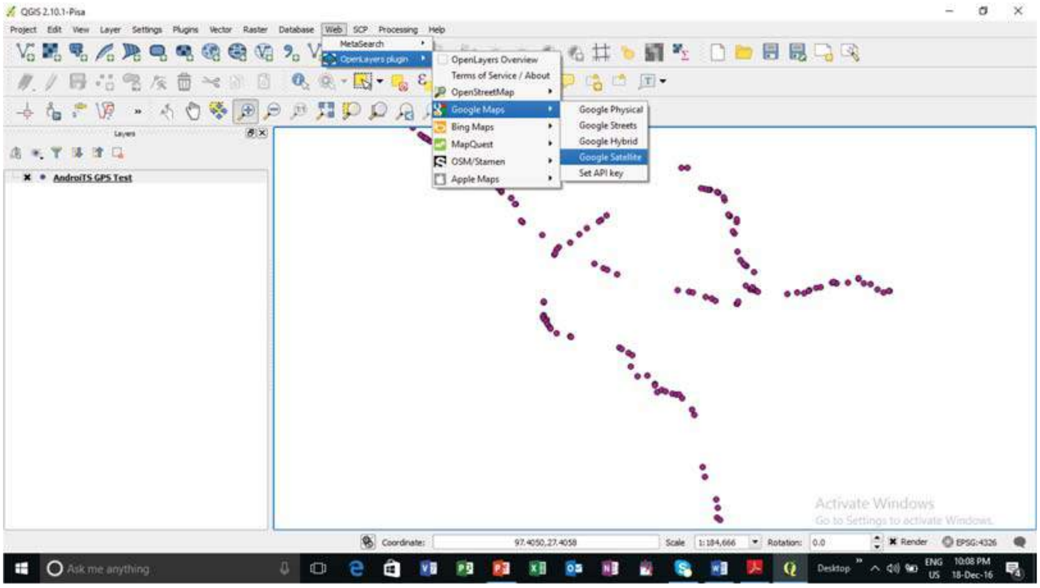
Data Use:

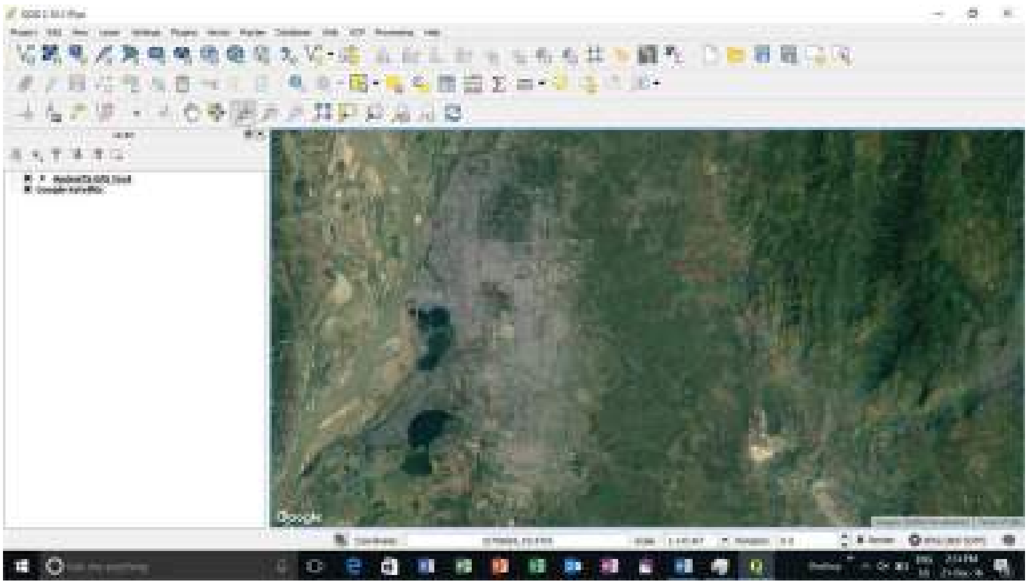
- GPS Data

Exporting GPS Data (Collective Data) to QGIS

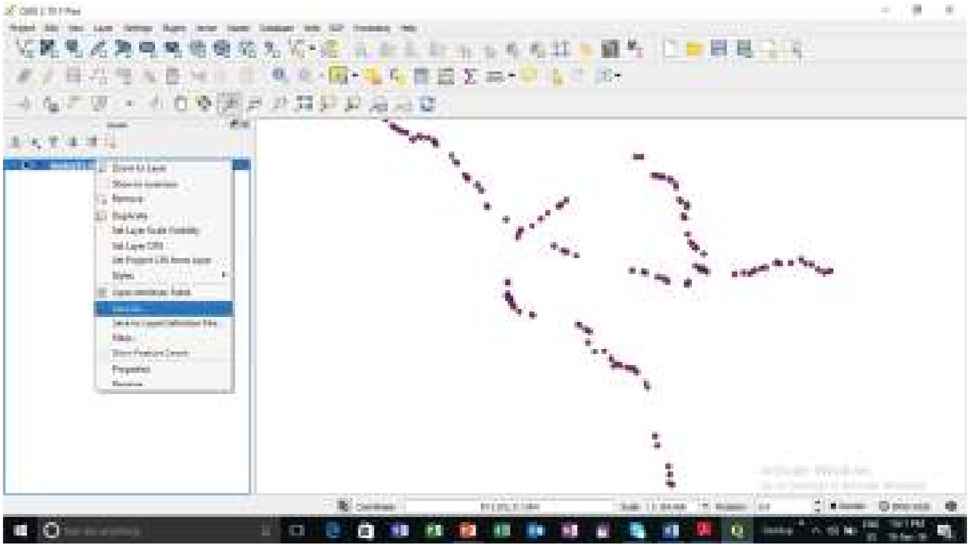
1. Copy the KML file exported from AndriodGPSTest Software to your desktop desired folder.

2. Open this KML layer from QGIS using open Vector file tool from Manage Layer panel. And you can also use google earth as your background.



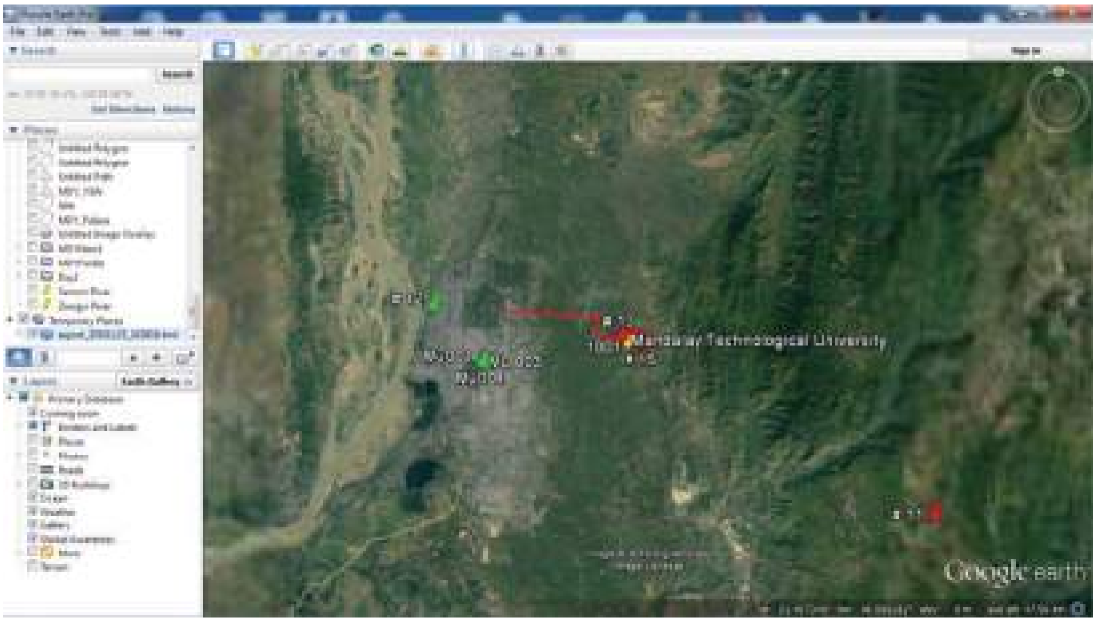


3. Right click the KML layer to save as your shape file format for further processing.



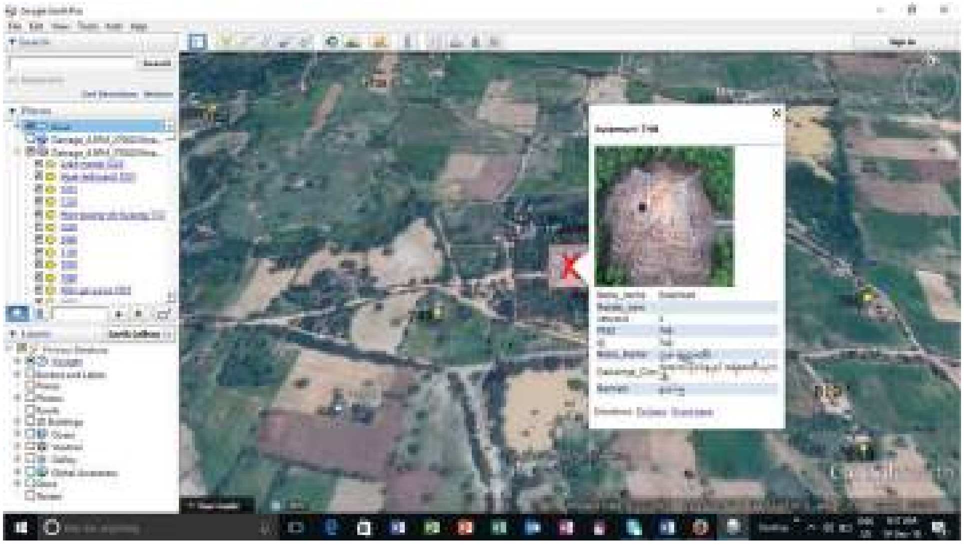
Exporting GPS Data (Collective Data) to Google Earth

1. Open Google earth pro and open your GPS KML file. You will see your GPS waypoints in Google Earth.



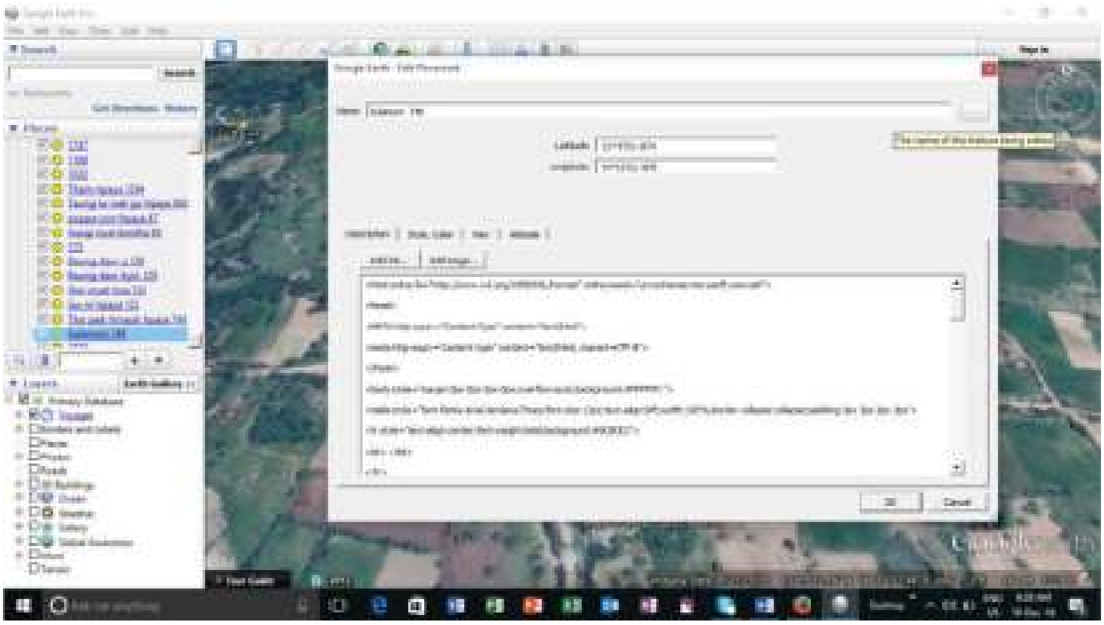
Linking field photos with GPS Waypoints

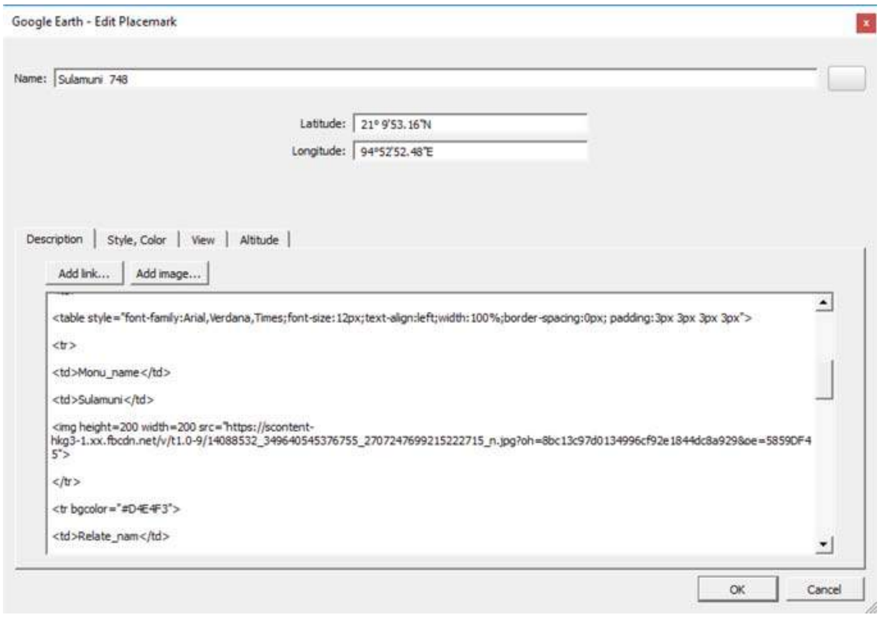
1. You can also link the field photo with your GPS waypoint using html code in property of place mark. So right click the one place mark from “Places” panel.



In description tab of the property of place mark, you can type the image source as follow:

<img height=200 width=200 src="https://scontent-hkg3-1.xx.fbcdn.net/v/t1.0-9/14088532_349640545376755_2707247699215222715_n.jpg?oh=8bc13c97d0134996cf92e1844d-c8a929&oe=5859DF45">

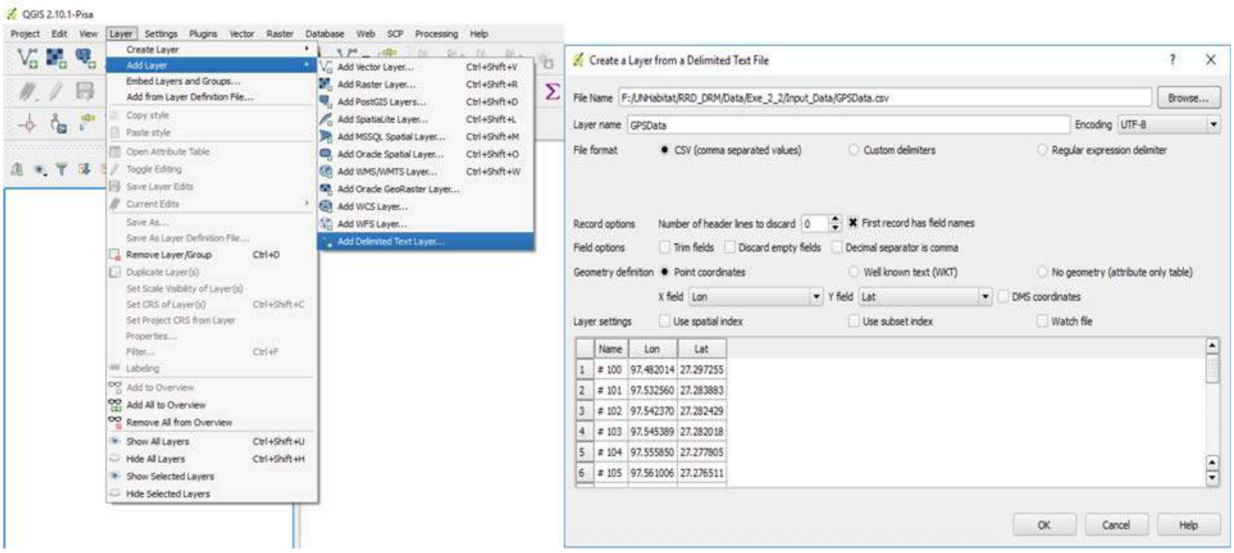




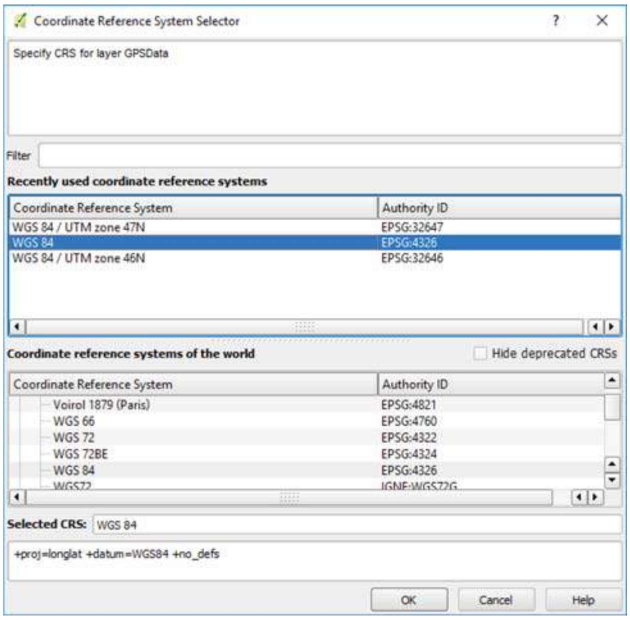
Note: You need to upload and share your photo to public at your google drive or website.

Importing Excel file GPS Way Point Data to QGIS

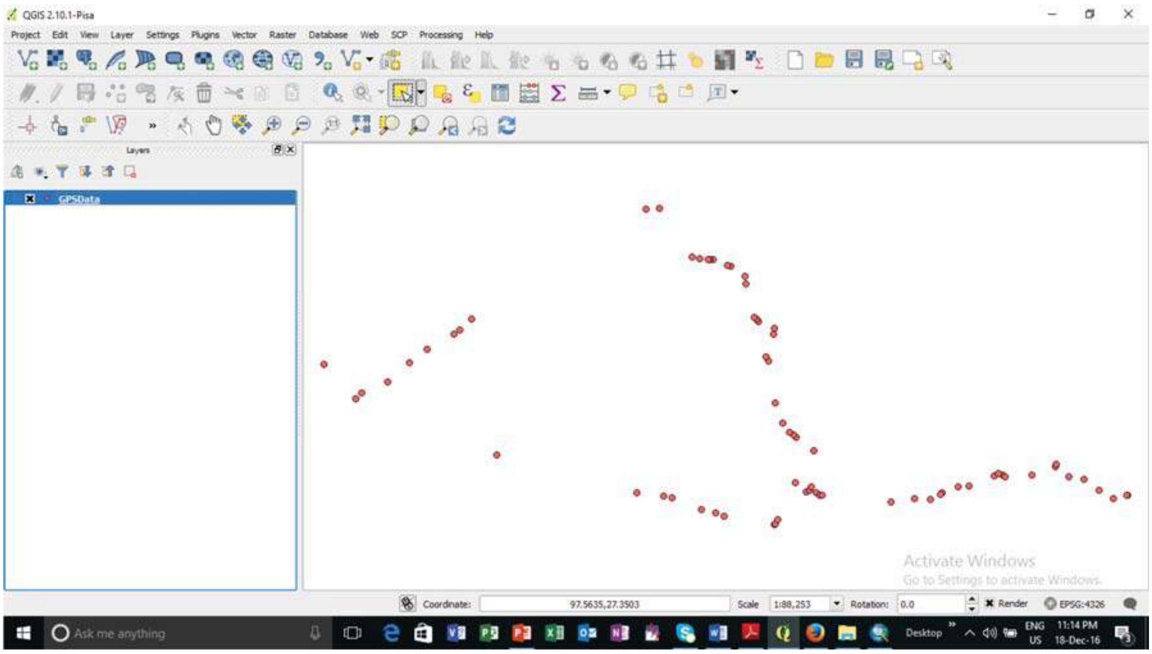
1. Import file must be CSV format file and open this CSV file using "Add Delimited Text Layer..." tool from "Layer" main menu. Navigate the your csv file location and choose csv as your file format and select X field as Lon and Y field as Lat.



2. Then select the WGS 84 (EPSG:4326) as your reference coordinate system.



3. The output file will be seen as below. Then saved your file as GIS shape file format in your desired folder for further processing.`



Question

2. Create a map layout using your GPS data and use satellite image as your background.

EXERCISE 2.4

USING GOOGLE EARTH ENGINE TO MAP CHANGES ON THE LANDSCAPE

Google Earth Engine is a planetary-scale platform for environmental data analysis. It brings together over 40 years of historical and current global satellite imagery, and provides the tools and computational power necessary to analyze and mine that vast data warehouse. Current applications include: detecting deforestation, classifying land cover and land cover change, estimating forest biomass and carbon, and mapping the world's roadless areas.

This exercise will introduce you to Google Earth Engine and its basic functionality, including exploring the Data Catalog and viewing datasets in the Workspace.

Learning Objective:

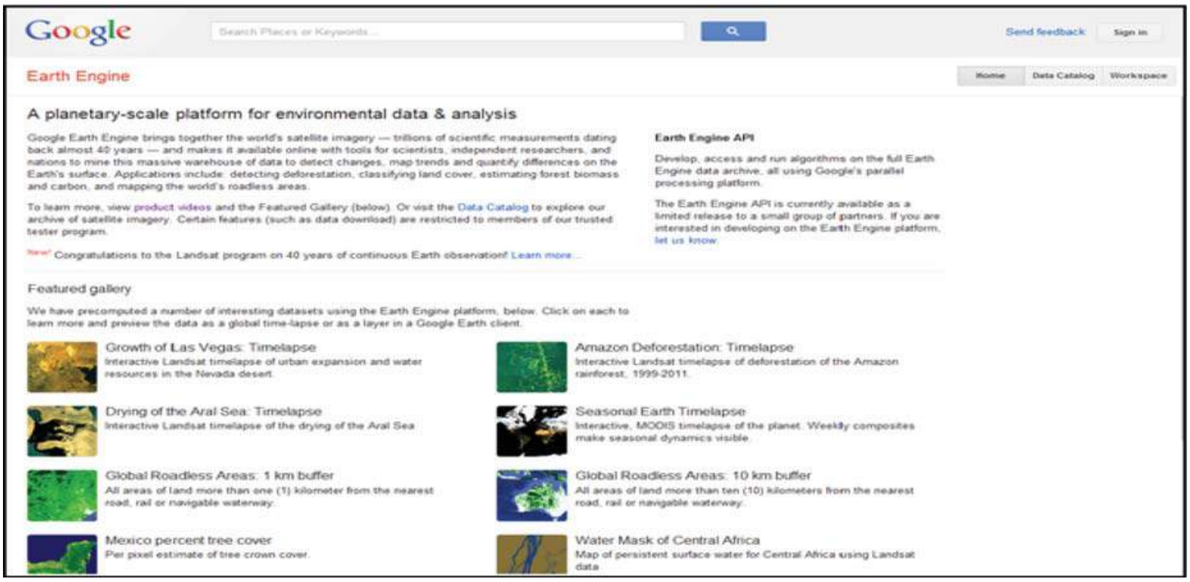
- To explore the Data Catalog and viewing datasets in the Workspace of GEE
- To perform Land Cover Mapping using Random Forest Classification method and other calculation on image index in workspace of Google Earth Engine

Home page

The Home page is where you will start when you first access Google Earth Engine. There you will see introductory text, a gallery of featured maps, and links to other important Earth Engine pages.

Let's explore the Home page and find out a bit of what Earth Engine can do.

- Open your browser and go to http://earthengine.google.org. You will see the page below.



Reference : https://www.google.com/earth/outreach/tutorials/eartheng_gettingstarted.html

At the top of the page is a search bar, where you can search for places or datasets. For example, entering "Landsat" brings up datasets with Landsat in their name, description, or tags, while entering "Myanmar" brings up locations with Myanmar in their name. In the top right, there is a Sign in button, where Earth Engine trust user can sign in.

Below the Sign in button are three buttons: Home (the page you're on), Data Catalog, and Workspace. We'll explore the latter two in the sections below.

The introductory text on the Home page gives an overview of Earth Engine as "a planetary-scale platform for environmental data and analysis." It also provides links to product videos, news items, and other resources.

Featured Gallery

Below the introductory text is the Featured gallery, where you can quickly find examples of some of the best and latest analysis products produced by Google Earth Engine and the organizations using it. These include links to view massive datasets using the Google Earth plugin (available for Windows and Mac).

- Click on Global Roadless Areas: 1 km buffer to see the map shown below.

Reference : https://www.google.com/earth/outreach/tutorials/eartheng_gettingstarted.html

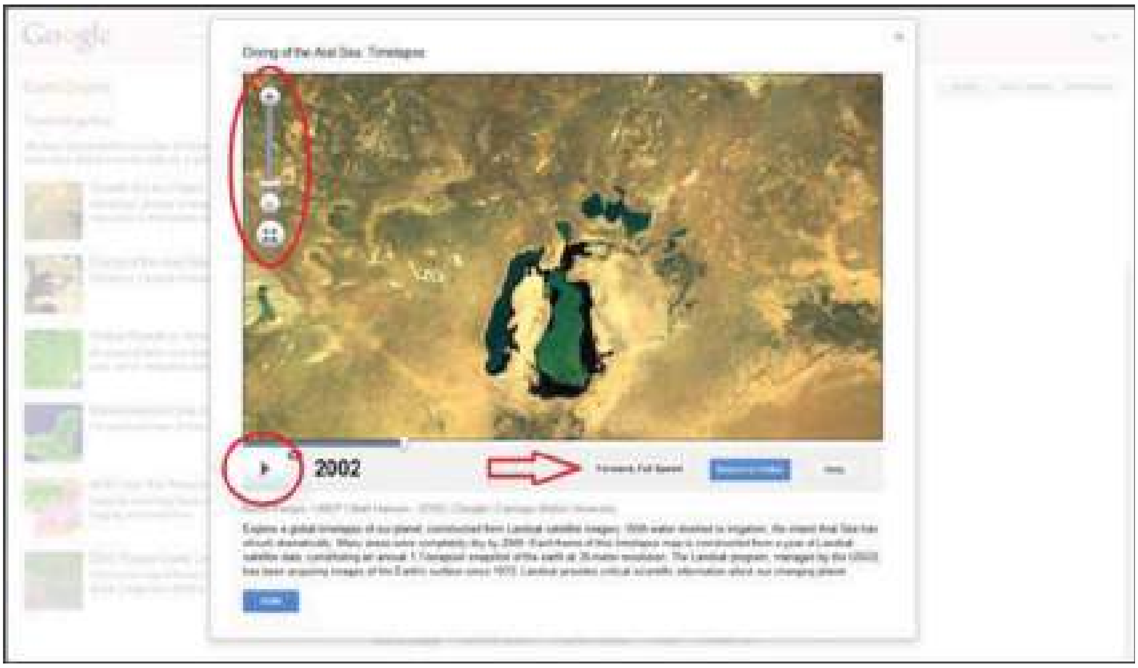
Explore the map by panning and zooming Google Earth. You can use the controls in the upper right, or use your mouse to pan, and your mouse's scroll wheel to zoom.

When you have finished exploring, click the blue Done button to return to the home page.

Other links in the Featured gallery will display timelapses of environmental change on massive scales. For most of the timelapses, clicking the link will show you an introductory video, like the one for the Drying of the Aral Sea shown below.

To explore the timelapse map, click the "Explore Map" button indicated above and you'll see the zoomable, timelapse map shown below. On the timelapse maps, you can zoom in, pan the map, pause the timelapse, and select the playback speed, as indicated below.

Reference : https://www.google.com/earth/outreach/tutorials/eartheng_gettingstarted.html



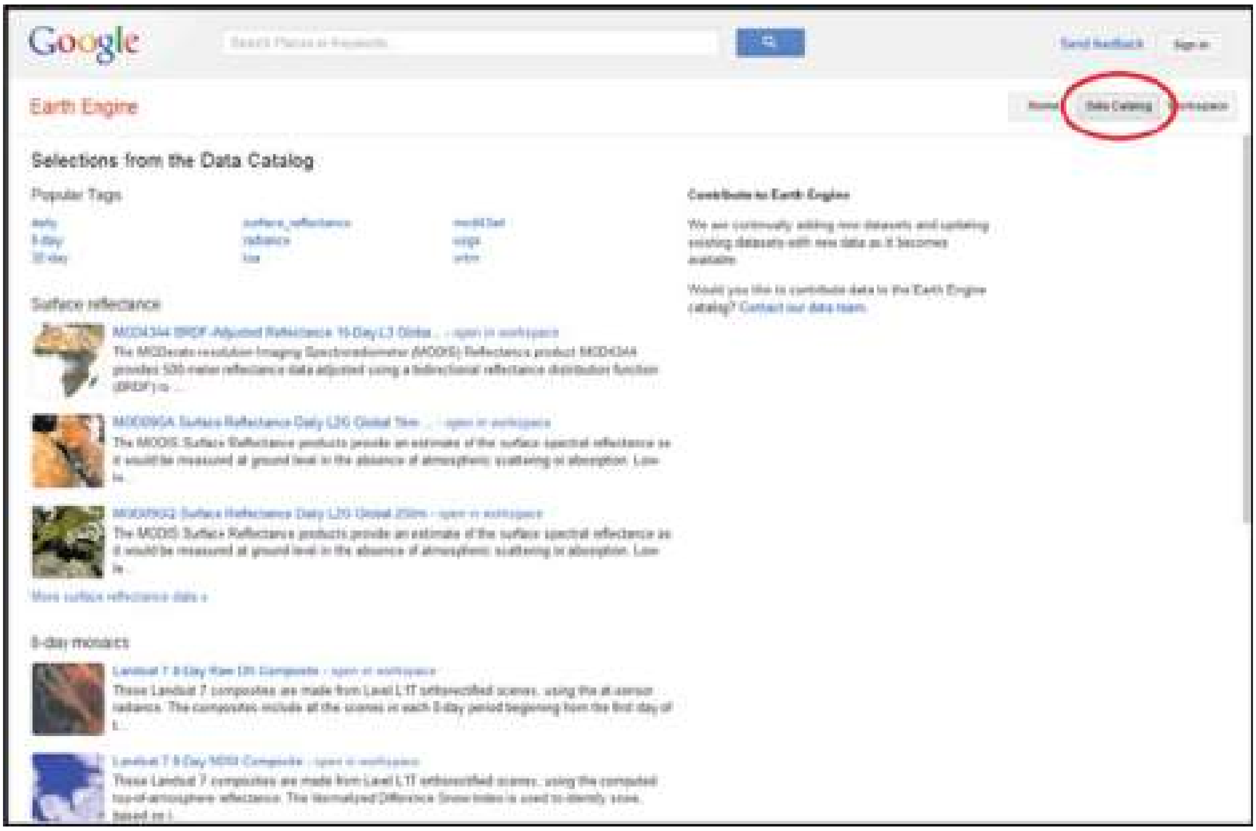
When you have finished exploring, click the blue Done button to return to the home page.

Data Catalog

The Data Catalog lists the datasets available for viewing and analysis in Google Earth Engine.

1) Click on the Data Catalog button in the upper right of any Google Earth Engine page.

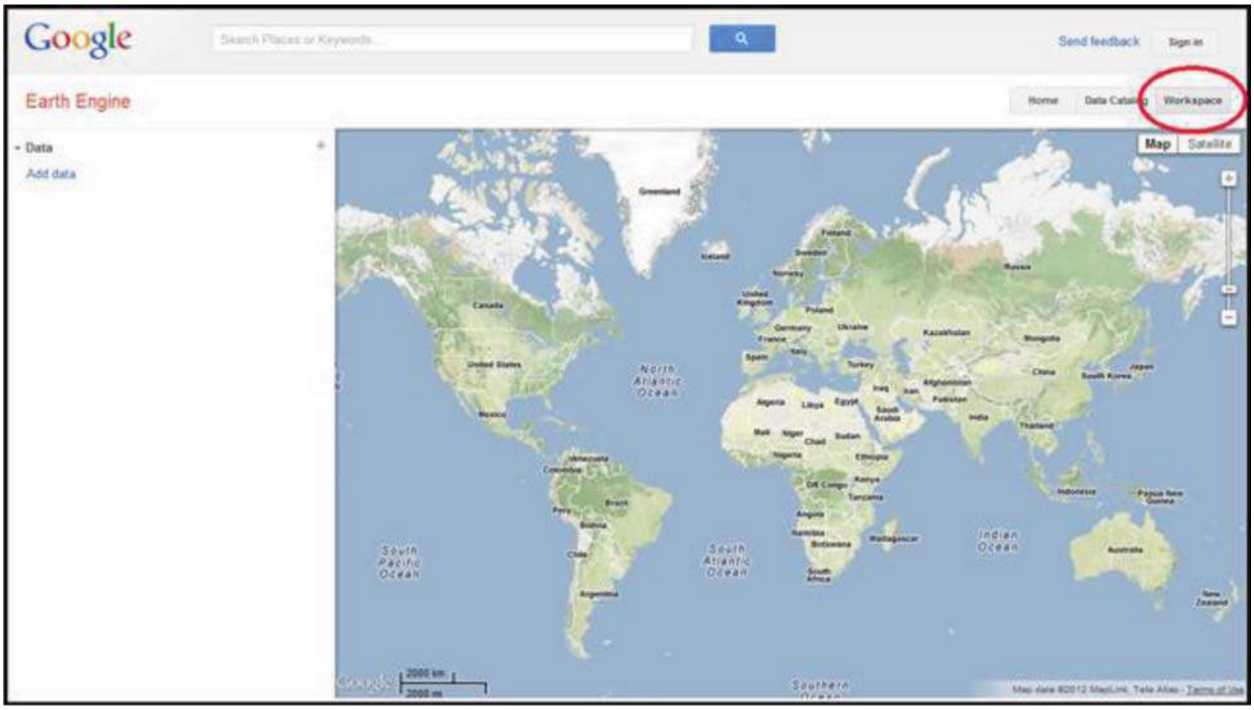
Reference : https://www.google.com/earth/outreach/tutorials/eartheng_gettingstarted.html



On the Data Catalog page you will see a list of Popular Tags, linking to datasets that have those tags applied. Below that is a list of various datatypes and multi-day mosaics, including brief descriptions of, and direct links to, a handful of the available datasets. These lists show or link to most of the datasets and mosaics available in Google Earth Engine. To access ALL available datasets, use the search bar at the top of the page.

Workspace

The Workspace is where you manage, analyze, and visualize datasets in Google Earth Engine. Click on the Workspace button in the upper right of any Google Earth Engine page.

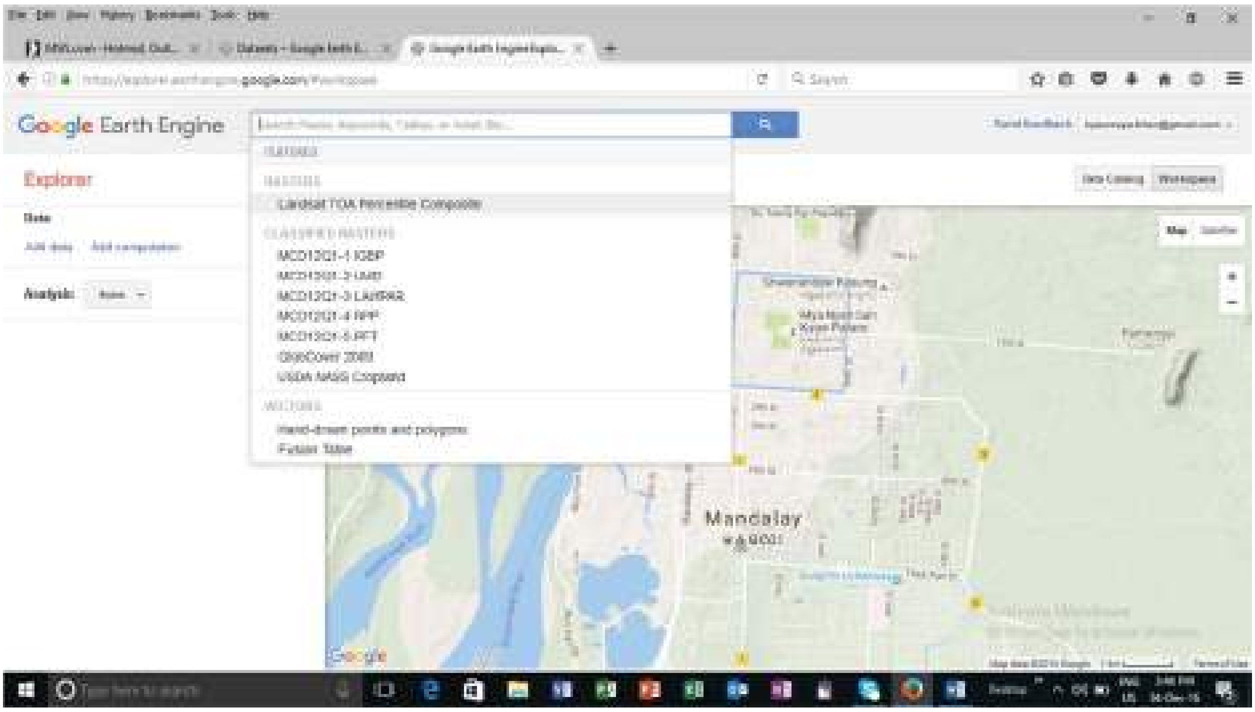


On the Workspace page, you will see a map on the right, and space for a list of data layers on the left.

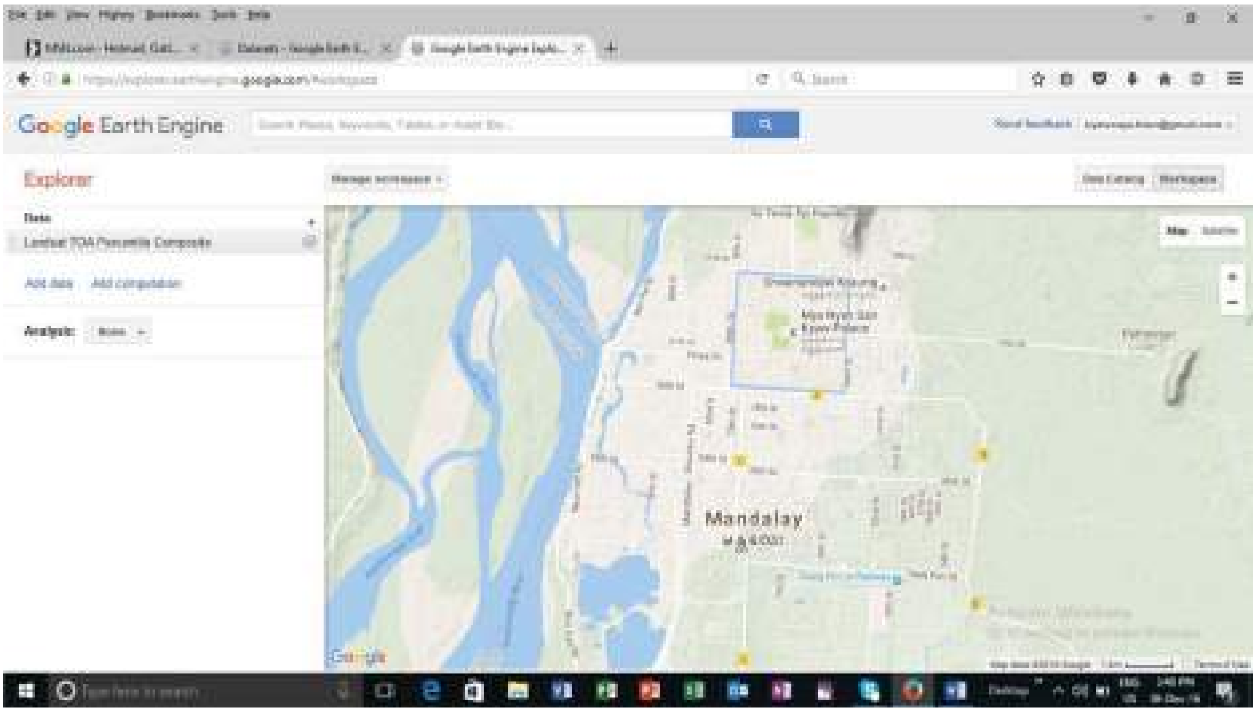
You can move (pan) around the map by clicking and dragging anywhere on the map. To zoom in and out there are several techniques. You can always use the [+] and [-] zoom buttons and the zoom slider on the map to zoom in and out. You can also double-click anywhere on the map to zoom in. If your pointing device (mouse or track pad) has a right button, you can double-right-click on the map to zoom out. If you have a touch-screen device, you may be able to zoom with a pinch gesture, and if you have a mouse with a scroll wheel, the easiest way to zoom is to simply turn the wheel. To change the map background use the buttons in the upper right of the map to select either Map view or Satellite view.

Adding a dataset to the Workspace

- Click the Data Catalog button to return to the Data Catalog page.
- Click to select MCD43A4 BRDF-Adjusted Reflectance 16-Day L3 Global 500m (currently at the top of the list under "Surface reflectance"). This is a MODIS derived layer that shows the color of the land surface over each 16 day period.
- On the dataset details page, click the blue "Open in Workspace" button. This will bring you to the Workspace, with the dataset visible as a layer.
- Alternatively, you can skip the details page and open the layer in your workspace directly from the Data Catalog by clicking the "open in workspace" link next to the dataset name.

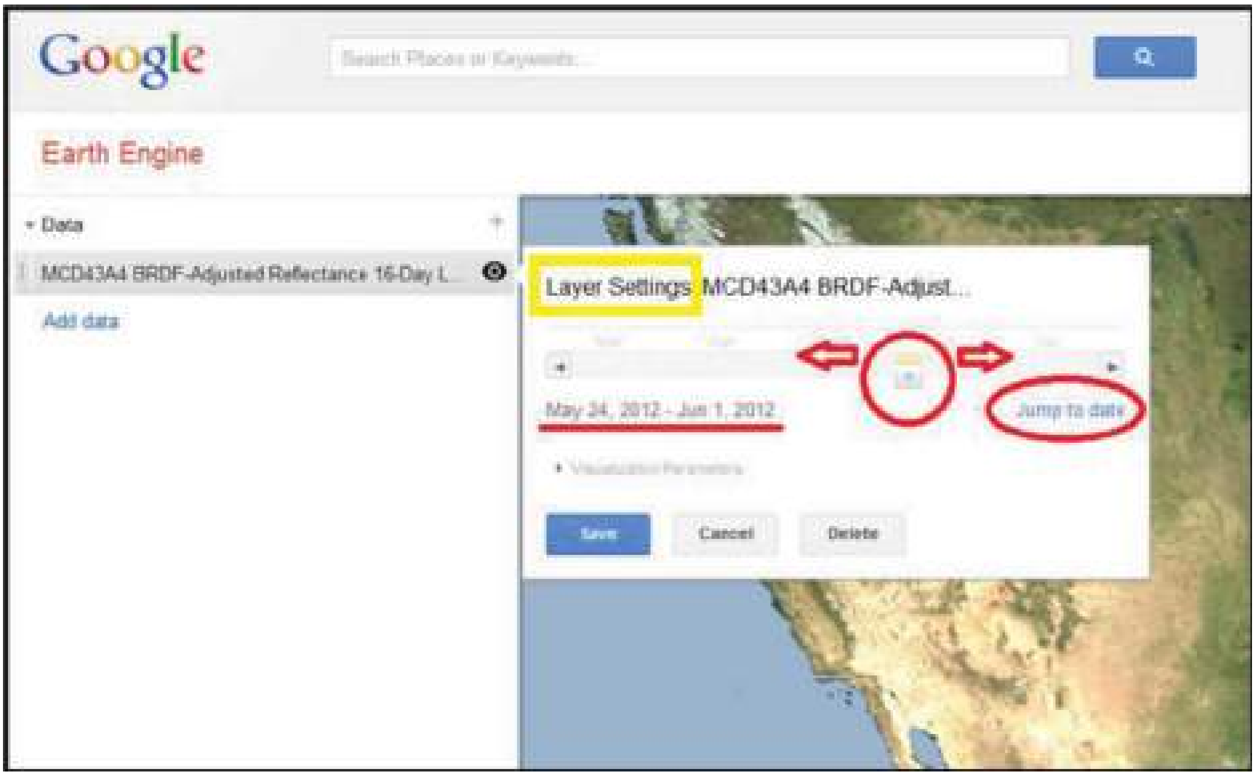


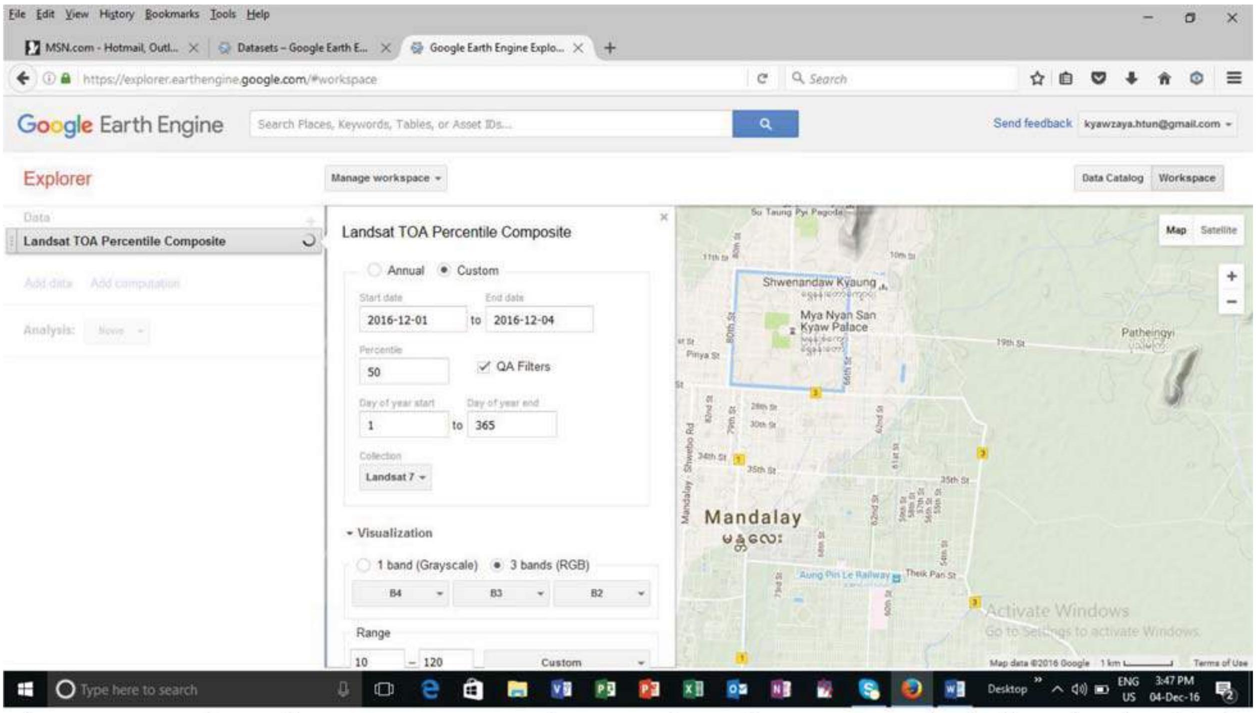
- You will see that the dataset is listed (MCD43A4...) in the Data layer list in the left-hand panel, and that the data is visible on the map.
- For visibility of the data layer by clicking the visibility button (eye icon) to the left of the data layer name (see below). Click the visibility button (eye icon) again to make the data layer visible on the map again.



Adjusting the layer settings

- Click on the Data layer name in the left-hand panel to bring up the Layer Settings, as shown below.

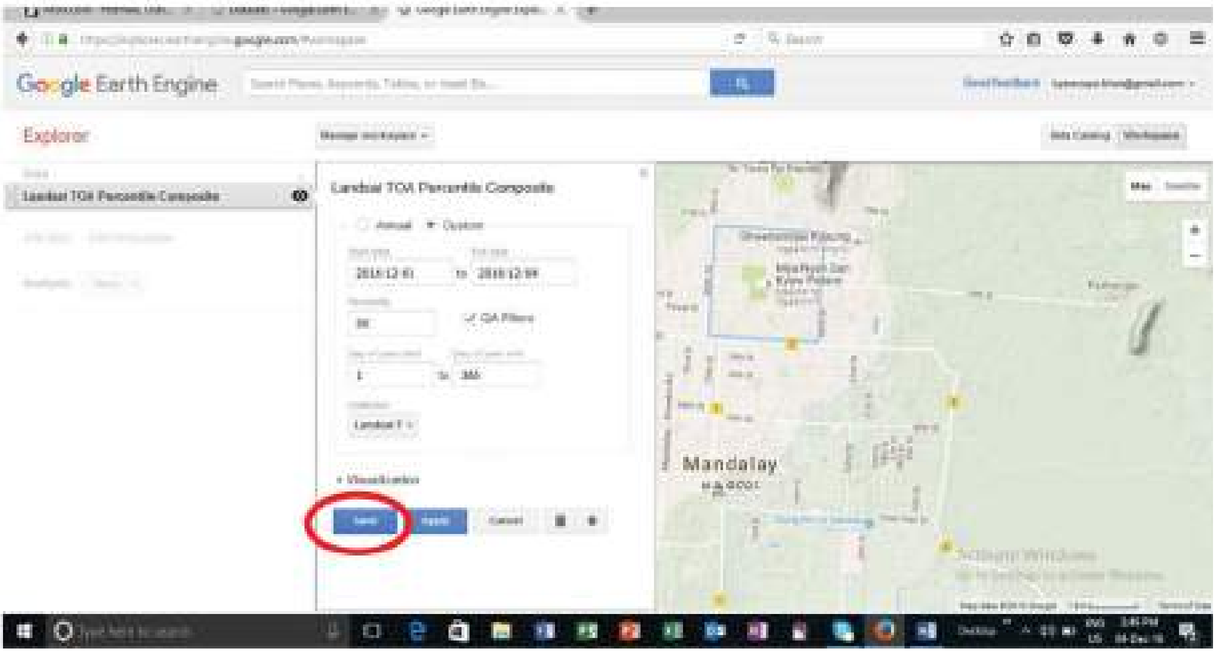




The Layer Settings allow you to customize a variety of parameters, including the date(s) for which data is shown.

- Look at the time slider and find the date range listed just below it. Note that the dates shown are the most recent 16 day period available. At the time of this writing, it listed "Jul 19, 2012 - Jul 26, 2012." This means that the data on the map are a visualization of 16 days of BRDF-adjusted surface reflectance data (in this case, just 3 of the many bands).
- Change the time setting by dragging the time slider towards the left, and watch the data on the map change. If you drag the slider to an opposite season (e.g., Summer to Winter), you will see more obvious changes.
- The time slider indicates which time period you have selected, and the orange highlight on the slider bar indicates which date range is currently visible on the map (it sometimes takes a moment to catch up with the slider).
- To go farther back in time, or to select a specific date range, click on the Jump to date link below the time slider and use the calendar interface to select a date.
- When you have selected the date range you wish to show, click the Save button to save the Layer Settings. If you wish to return to your previous settings, click the Cancel button instead.

Note: For "Classified Raster" type data layers, the settings required are different. See the Viewing Classified Rasters section below.



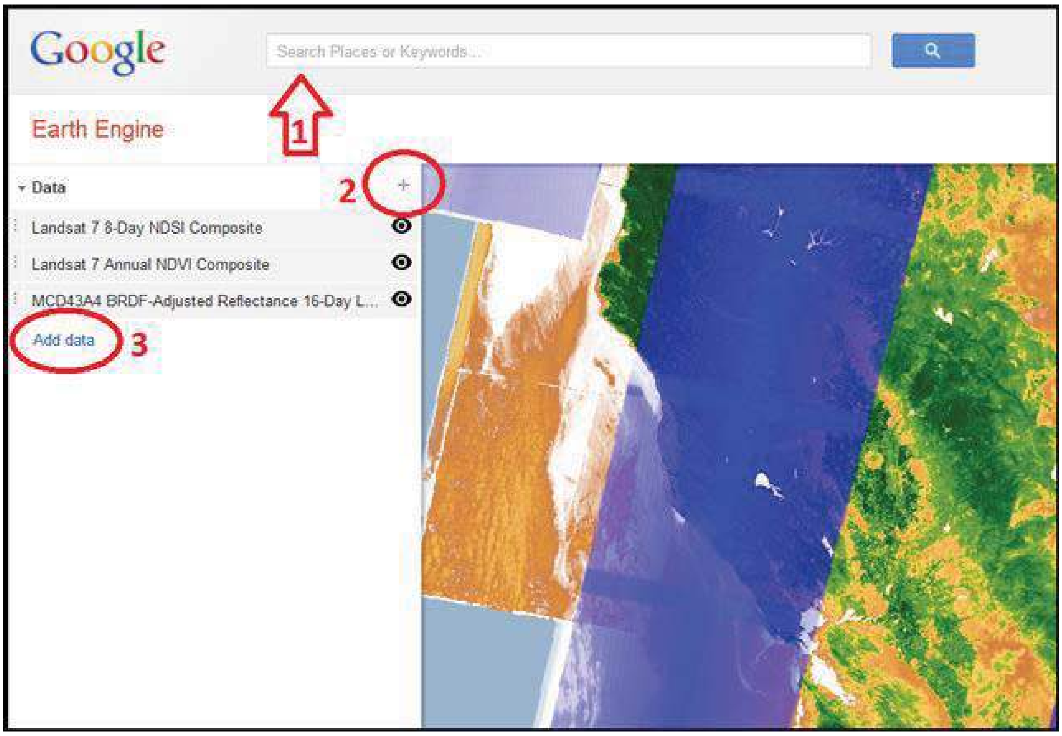
Adding more layers

You can view multiple data layers on your map at once by adding additional datasets.

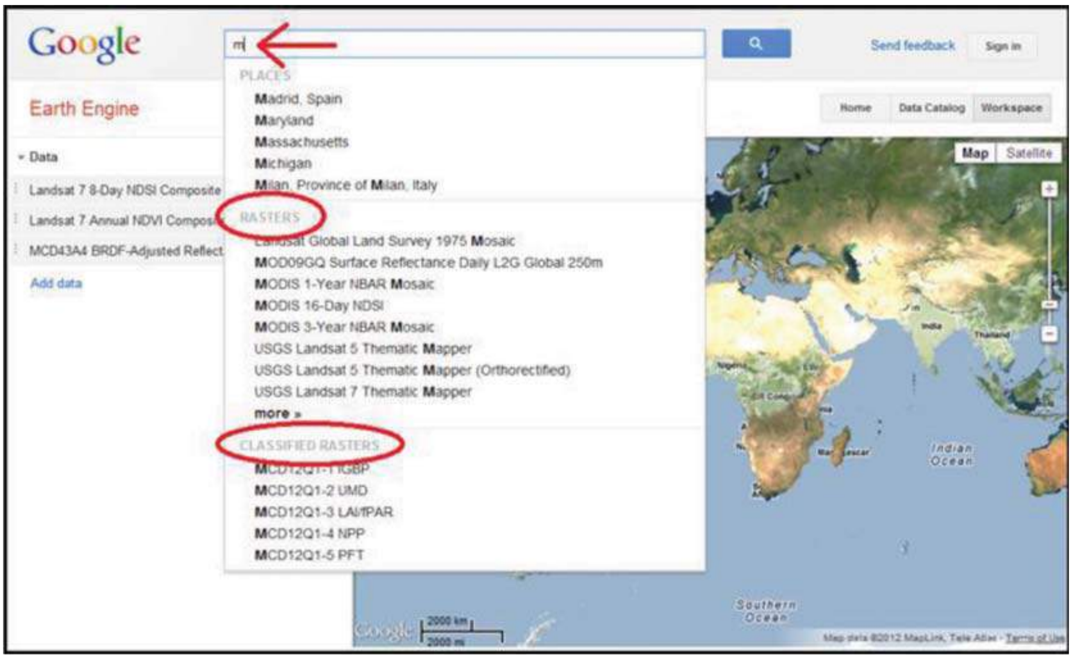
There are several ways to add additional data layers in your Workspace. The first method is to return to the Data catalog, select another dataset, and use its Open in Workspace button. This will add the dataset to your workspace, as a layer above your current data layer(s). Note that the new layer will show on top of the previous layers on your map. See below for changing the order of the layers. Another way to add additional datasets is directly from the search bar your Workspace. To start searching for a dataset to add, do one of the options below:

- Click in the Search bar
- Click the "+" button at the top right of your data layer list, or
- Click the Add data link at the bottom of your data layer list.

All three of these options will allow you to type your query in the Search bar, and select a dataset to add as a layer.



When you add a new layer to your Workspace, "Raster" type datasets will come in as a simple layer, but "Classified Raster" type datasets require a bit of set up before you can view them (see the Viewing Classified Rasters section below). The screenshot below shows both types of datasets as results for the search "m".

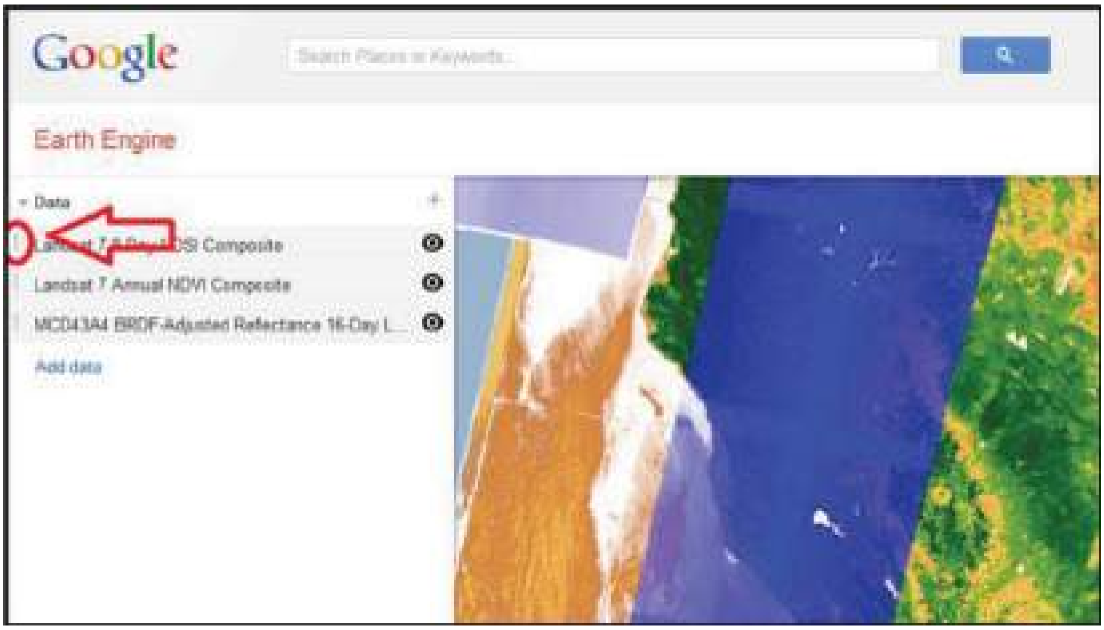


Duplicate Datasets

You can also add the same dataset twice, as two separate layers in your Workspace. One reason to do this would be to view two different time slices of the same dataset, to view change over time. For more on this, see the "Visualizing change over time" section below.

Re-ordering layers

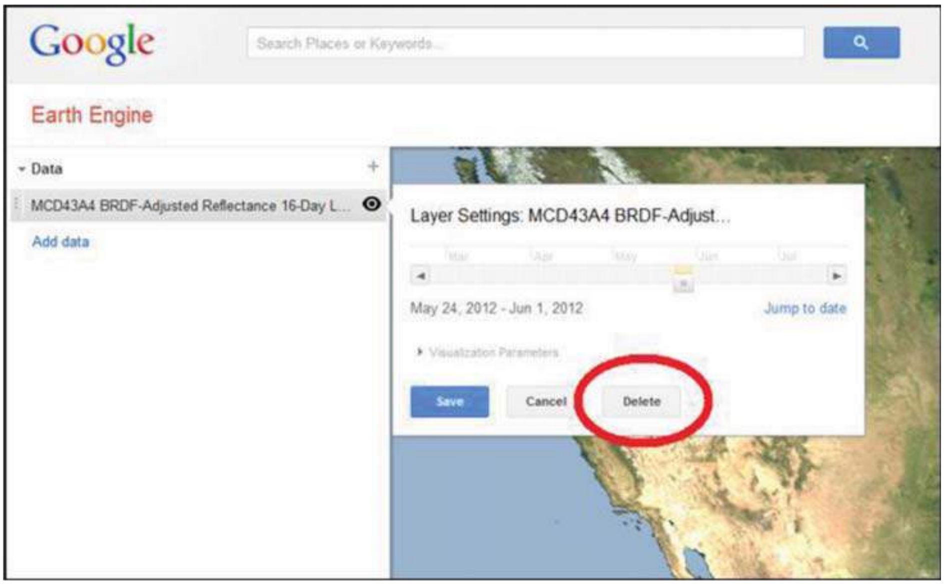
When you have more than one dataset visible on your map, the one listed at the top of the Data layers list will be drawn on top of those below it. To change the ordering, use your mouse to click on the drag point to the left of the dataset name in the list, and drag it up or down in the list.



Removing a layer from the Workspace

If you wish to remove a data layer from your Workspace...

- Click on the data layer name in the Data list to bring up the Layer Settings dialog.
- Click the Delete button and the layer will be removed from your Data list and from the map.
- Note: If you want to turn off the layer to remove it from the map, but leave it in the Data list, click the visibility button (eye icon) next to the Data layer name.



Now that you know the basics, let's explore a few of the more powerful things you can do in the Google Earth Engine workspace. In the sections below we'll show you how to setting up and view classified rasters, adjust a layer's visualization parameters, and visualize change over time.

Advanced - Viewing Classified Rasters

Classified Raster type data layers require a little more setup in order to view them. You will need to select the year to show, and set up classes with names and colors to represent each class. For example, the MCD12Q1 classified rasters represent 5 different systems for classifying land cover type. Each of these datasets is annual (ranging from 2001 to 2009), and divides the Earth into different land cover classes. More information about each of these classification systems may be found on the USGS Distributed Archive site.

Let's set up a Classified Raster data layer...

Add a classified Raster

- Search for "MCD" and see under the Classified Rasters results section, there are several datasets listed.
- Select any one of them to add to your workspace. We'll use MCD12Q1-1 IGBP for this example.
- When the layer is added to your workspace, the Layer Settings dialog should open automatically. If not, click on the layer name to open it.

Select a year to display

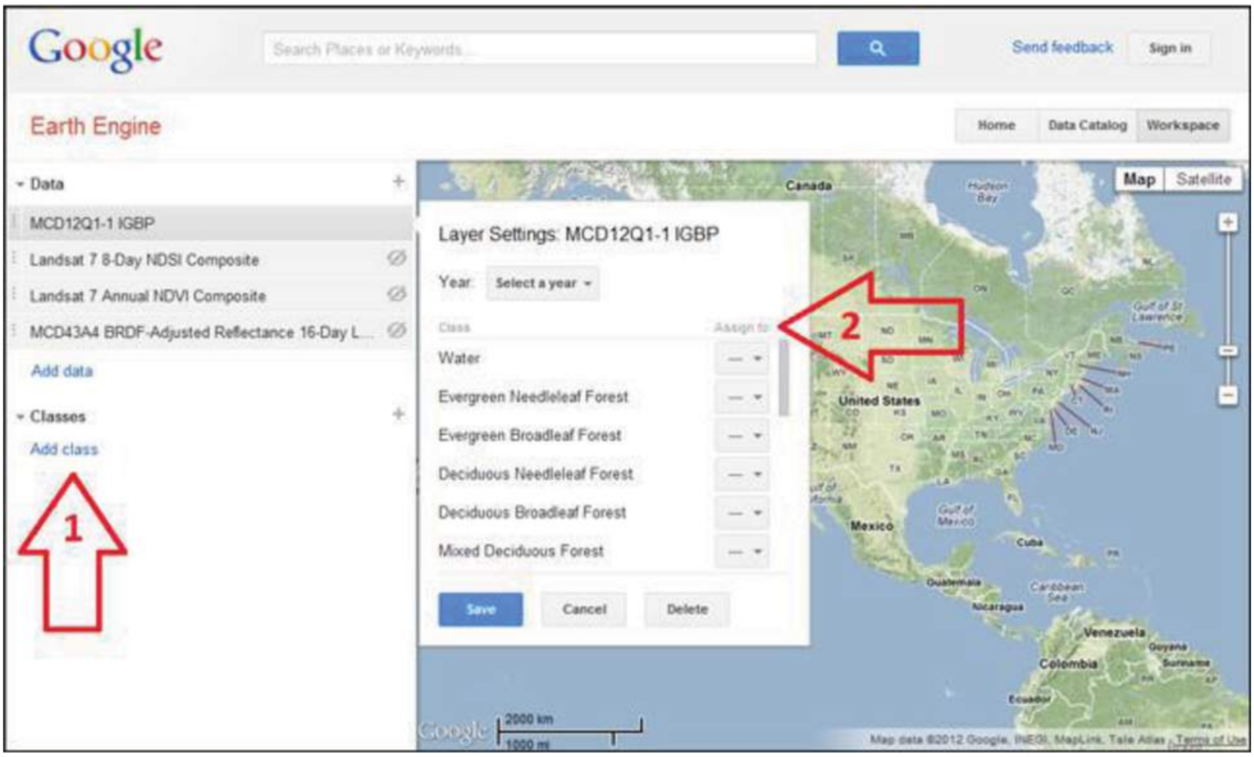
- In the Layer Settings dialog, select a year from the Year: dropdown.

Add classes to display

When you add the classified raster, a Classes section appeared in the left-hand panel. You can use this to add classes and assign colors and names, or you can do it in the Layer Settings dialog for the classified raster layer. These two techniques are described in the instructions and image below.

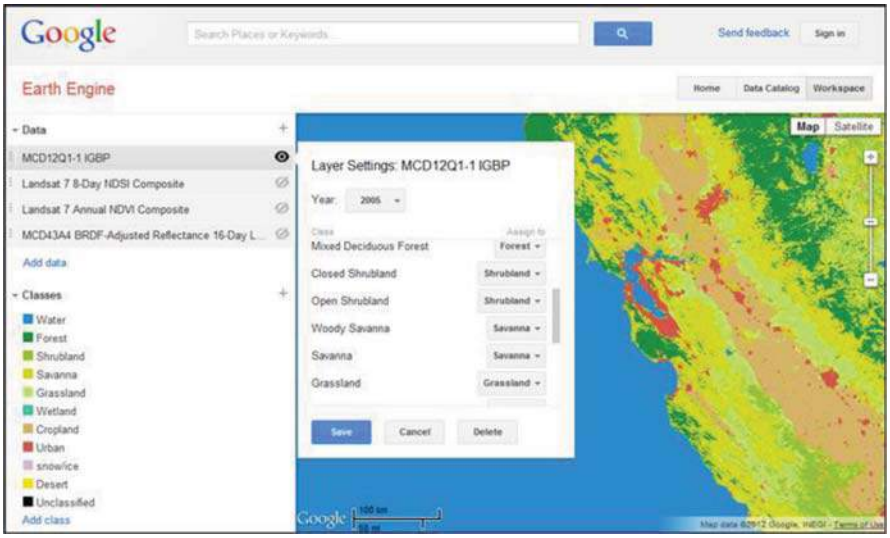
1. Use the Layer Settings dialog to add classes.
    1. Click on the name of the Classified Raster layer in your Data layers list, to open its Layer Settings dialog.
    2. In the Layer Settings, click the pulldown menu next to one of the listed classes, for example "Water", and choosing Add new class.
    3. The new class will appear in the Classes section of your left hand panel.
    4. Set the color of the class by clicking on the color square next to it.
    5. Set the name of the class by clicking on the text next to it.
    6. Repeat for the other classes in the classified raster.

2. Use the Classes area in your left hand panel to add classes.
    1. Click on the Add class link, or the "+" symbol to add a new class.
    2. Set the color of the class by clicking on the color square next to it.
    3. Set the name of the class by clicking on the text next to it.
    4. Click on the classified raster layer's name to open the Layer Settings dialog.
    5. Assign the classes you created to the classes in the raster using the dropdowns next to each class name.



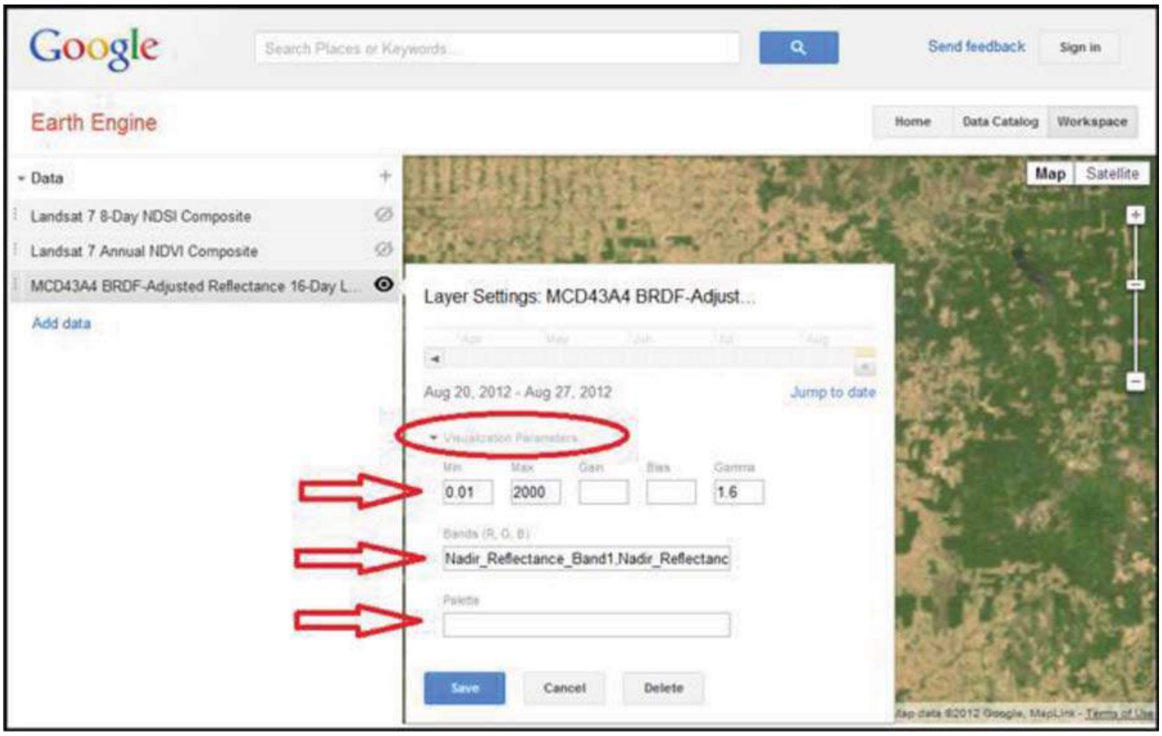
Classes that have not been assigned colors will not appear on the image. Classes may be removed from the image by clicking the X that appears next to a Class when you move your mouse over the class name.

Once you add classes to your workspace for each of the classes in the raster dataset, it will look something like this:



Advanced - Setting Visualization Parameters

In the Layer Settings dialog for most data layers, you will see a "Visualization Parameters" link. Click on it to reveal a number of advanced visualization settings. Each dataset has different default values, which are shown when you first click the link, but you can modify them to change how you visualize the dataset.



Min, Max, Gain, Bias and Gamma

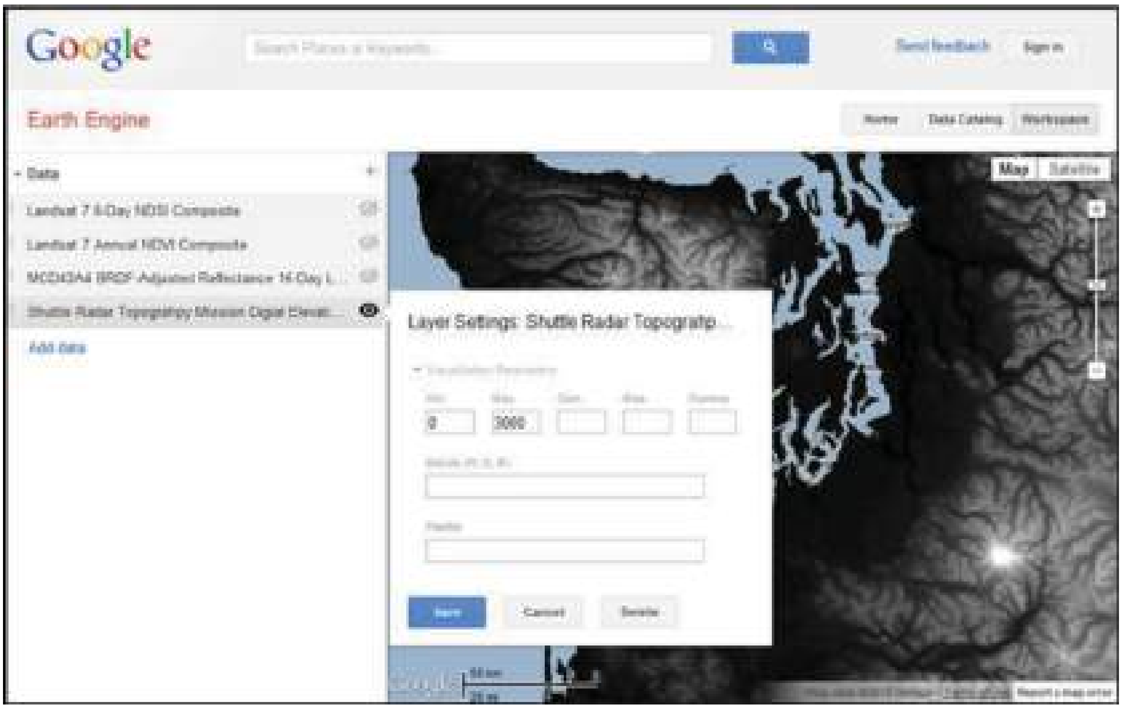
The first row of parameters are Min, Max, Gain, Bias, and Gamma. These parameters let you modify how data values are visualized. You may either set Min and Max, or you may set Gain and/or Bias.

Min and Max

Min represents the value to represent as decimal value 0 and Max represents the value to represent as decimal value 255. The values below Min will also be drawn with value 0, and the values above Max will also be drawn with value 255. Values between Min and Max will be scaled linearly, so that the middle of the range will be assigned value 122.

For example, the Shuttle Radar Topography Mission (SRTM) dataset contains values that represent elevation in meters, from -425 m to 8806 m. To visualize the dataset with a good detail in most parts of the world, you might want to represent 0 meters as black and represent 3000 meters and above as white, so set the Min to 0 and Max to 3000. To pick out mountains, or better see variation in high elevation areas above 3000 meters, you can set the Min to 3000 and the Max to 8806.

The image below shows the SRTM dataset with Min = 0 and Max = 3000, showing Puget Sound and highlighting Mount Rainier (4,392 m tall) as the white spot



Gain and Bias

An alternative way to alter how the values in a dataset map onto visualization values is the change the gain and bias. Each value is multiplied by the gain, and increased by the bias. For example, the SRTM values, which range between -415.0 and 8806 can be compressed to between 0 and 255 by multiplying by 0.02765 (set the gain to 0.02765) and adding 11.47 (set the bias to 11.47).

Gamma

Gamma represents the relationship between a value and the luminance used to represent it. Roughly speaking, increasing gamma increases the intensity of values in the middle of the visualization range.

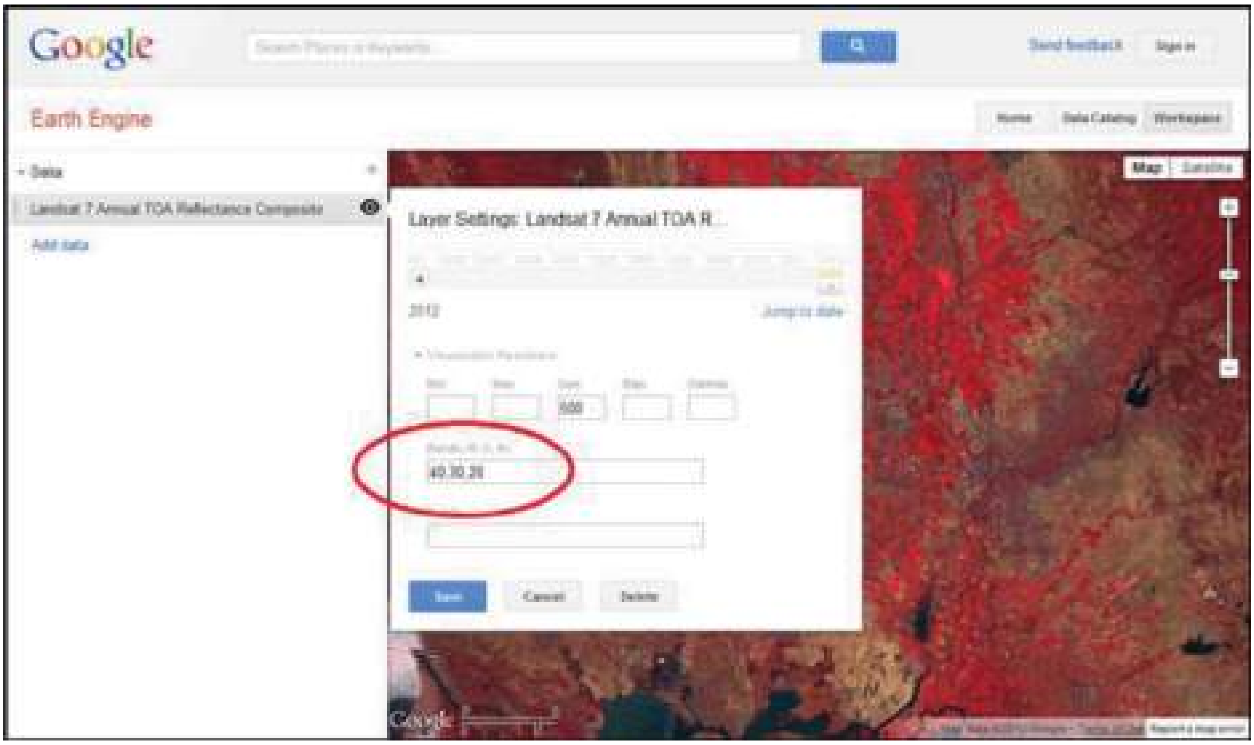
Bands (R, G, B)

When you see an image on the web, you are generally seeing a combination of red, green, and blue pixels (RGB). In Earth Engine, these are separated into "bands": the red band contains the red values for each pixel, the blue band contains the blue values for each pixel, and the green band contains the green values for each pixel. These bands are then combined to form the image you see on the screen.

Many Earth Engine datasets include more than three bands. For example, Landsat 7 images have 8 bands. Three bands roughly match red, green, and blue, and others represent infrared light, or thermal energy. Each band has a name. In the case of Landsat, the blue band is named 10, the green band is named 20, and the red band is named 30. To see an image that looks like how we typically see the aerial imagery, Earth Engine maps bands 30, 20, 10 onto R,G, B, respectively.

However, mapping different bands onto R, G, and B can create some interesting and useful effects. For example, mapping bands 40, 30, and 20 onto R, G, and B creates a "false color" image in which vegetation is highlighted and displayed in red.

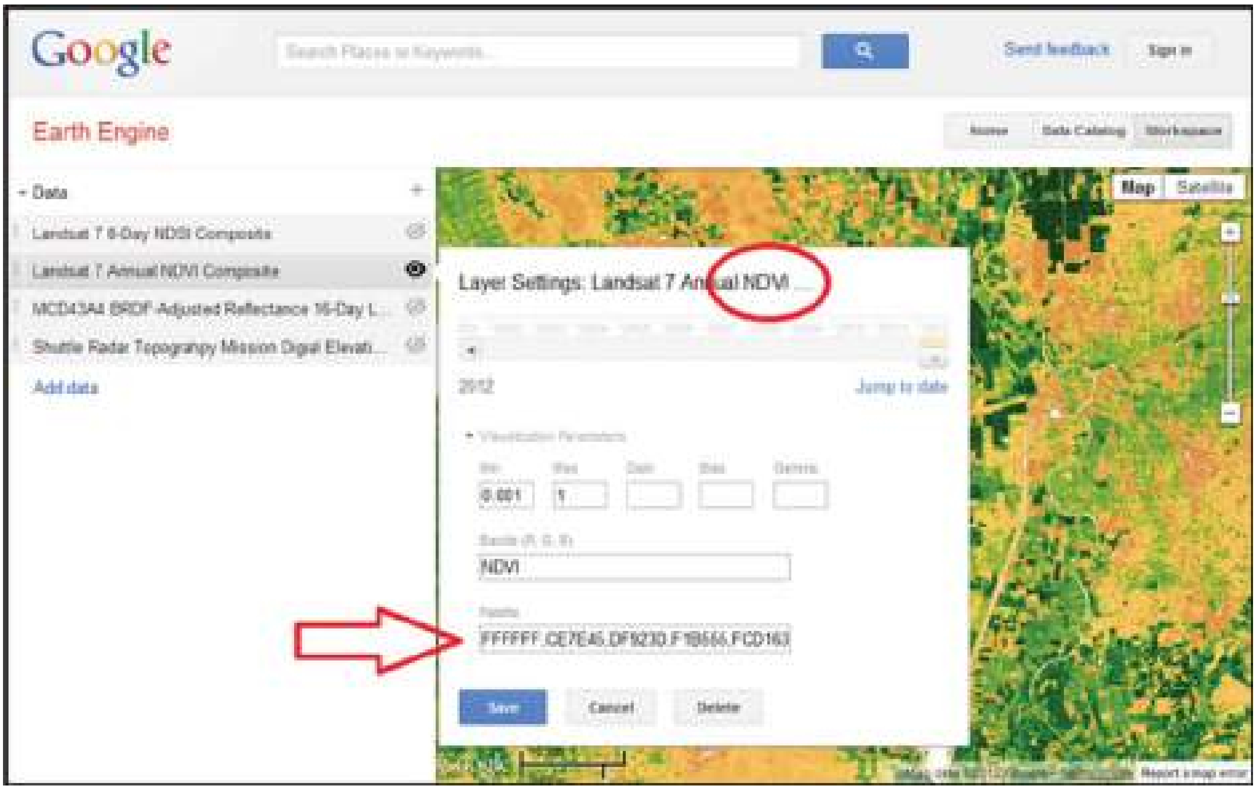
The Bands input field provides a place where you can tell Earth Engine which bands of a dataset you would like to represent as red, green, and blue. To do this, list the band names in the RGB order, separated by commas. For example, to see a false color image, type 40, 30, 20 into the Bands (R, G, B) input field, as shown below:



Palette

A palette allows you to assign colors to the range of values in a dataset. A palette is a series of comma separated hexidecimal color values. Providing two values sets the color of the lowest value and highest value of the dataset. For example the SRTM digital elevation model is displayed in shades of gray by default. To display it in shades of red instead, where the lowest elevation points are black, and the highest elevation points are dark red, enter 000000,FF0000 into the palette box (it looks better if you set Min to 0 and Max to 3000). FF0000 is the hexidecimal value that is high (FF) on red and low (00) on green and blue. The 000000 value is low on red, green, and blue. To make the low elevations white instead, use the palette FFFFFF,FF0000.

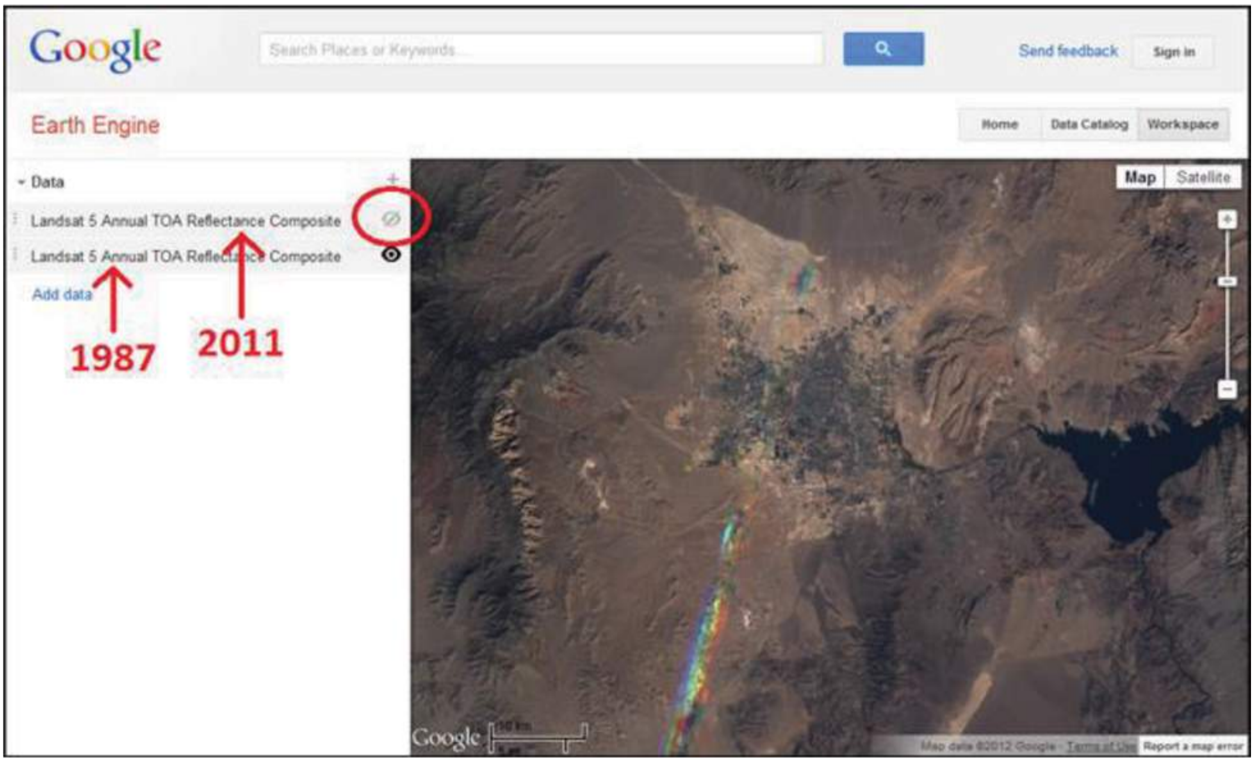
Adding an additional color values to the palette will divide the color range into two areas: beginning to midpoint, and midpoint to end. The colors in these ranges will be scaled from the beginning of each range to its end. Adding more colors will increase the number of color ranges. Try visualizing SRTM with the palette FFFFFF,00FF00,FF0000. To see a complicated palette, open an NDVI dataset (type NDVI into the search field) and open its Visualization Parameters. The image below shows NDVI around Sacramento, California.



Advanced - Visualizing change over time

One of the interesting things you can do in Google Earth Engine is to visualize changes over time. To do this, you will need to add the same dataset to your Workspace as two separate layers, but set them to show different time slices. The example below will show you how to visualize the rapid urban expansion of Las Vegas, Nevada.

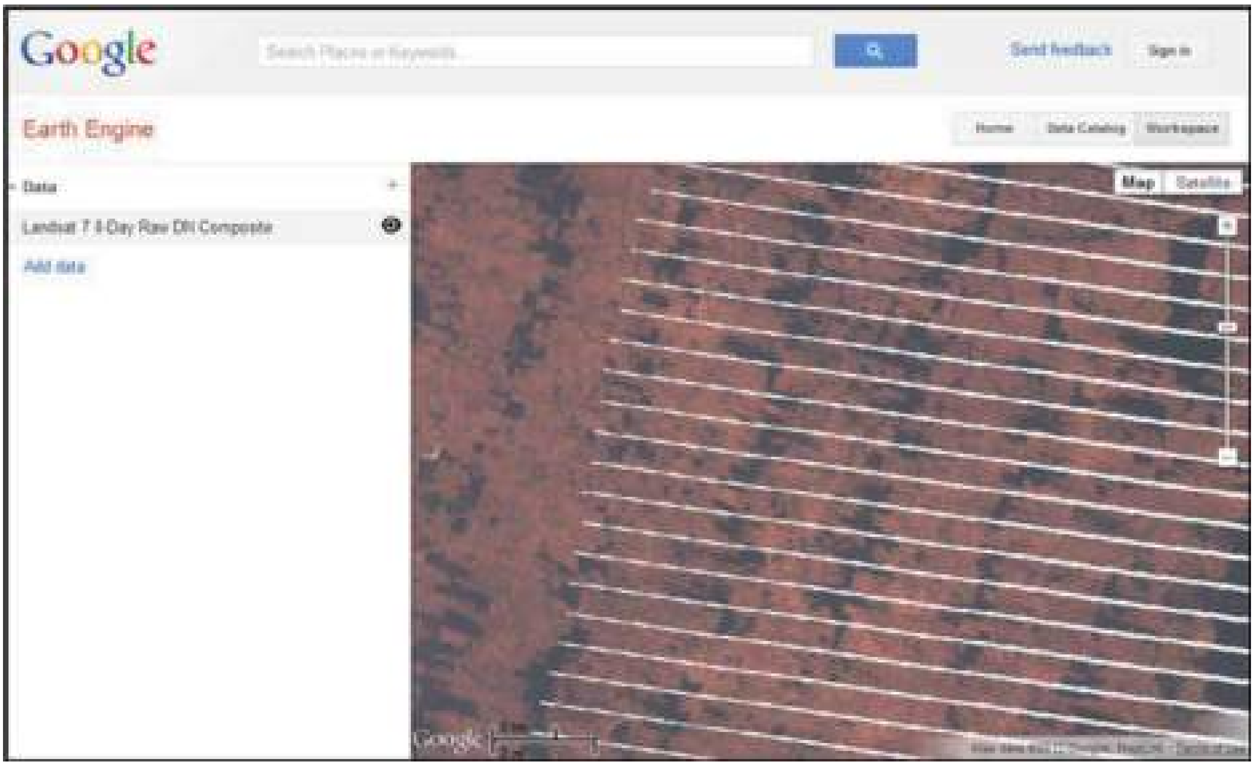
- Go to your Workspace, search for “Las Vegas, NV”, and zoom to it.
- Remove (or turn off) all the layers from your Data list.
- Add the “Landsat 5 Annual TOA Reflectance Composite” dataset to your workspace.
- Now, add it again, as a second, identical layer.
- Using the Layer Settings, set the top one to 2011, and the bottom one to 1987.
- Toggle the visibility of the top layer on and off, and will let you see the growth of the city over those 14 years.



Things to look out for

There are a number of things to look out for and be aware of as you explore the data in Google Earth Engine, some related to the way Earth Engine works, and some implicit in the datasets. Below are some of the more common things you may run into.

- Landsat imagery cannot be viewed globally; you must zoom in a few levels. If the image isn't appearing on the map, look for the yellow bar at the top of the page indicating that you need to zoom in.
- Each dataset comes from a satellite that functions (or functioned) over a specific time frame. Landsat 5, for example, stopped sending data in November, 2011. The Landsat 7 and MODIS satellites are still functioning.
- Different satellites visit the same spot on the Earth with different frequency. MODIS imagery covers the entire globe every day. Landsat only visits the same spot every 16 days, but in return it provides higher resolution. In addition, there are spots on the Earth that are missing data for some satellites. Landsat 5 data is missing in many places.
- Missing data is rendered as transparent - you can see through to the Google Maps basemap.
- Some places are cloudy all the time, and accordingly have no clear imagery. Certain datasets will show these areas as having missing data.
- Landsat 7 had a partial failure of its imaging system on May 31, 2003, which results in long stripes of missing data in every Landsat 7 scene taken since then, as visible in the image below. These
- can be corrected for by using a Landsat Composite dataset which combines multiple scenes over time and therefore can fill in the missing gaps.



What next?

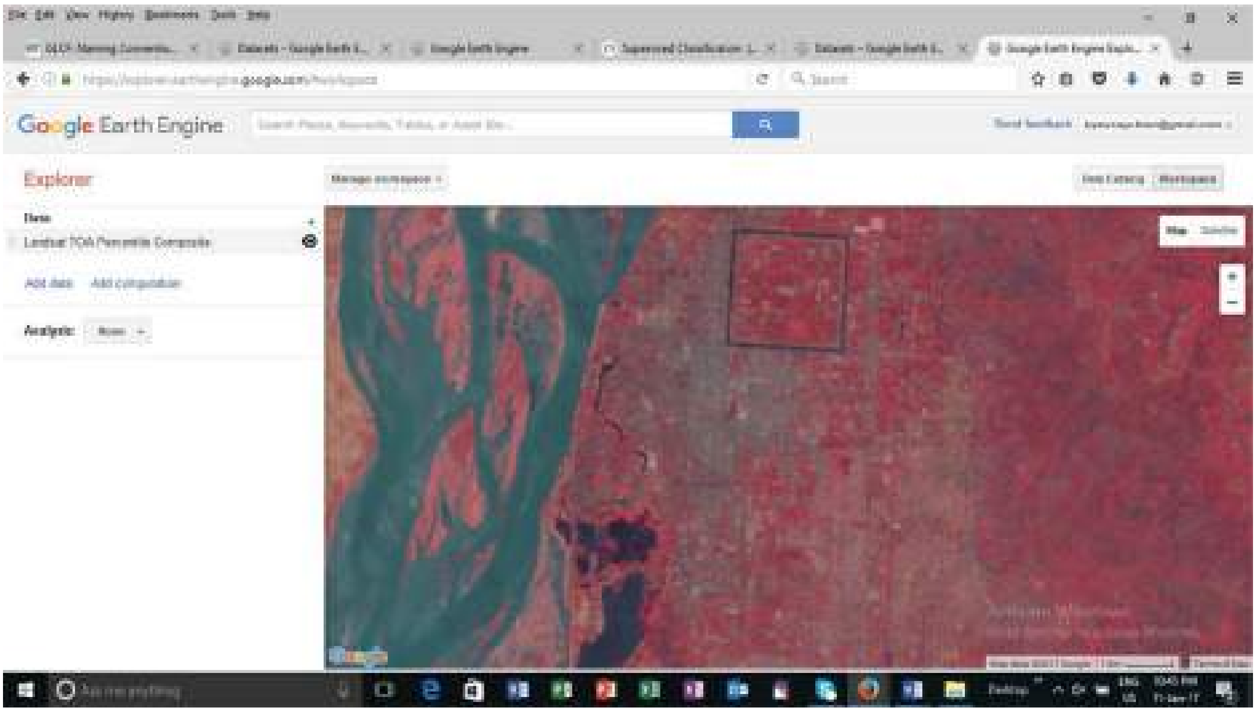
Google Earth Engine has more advanced features such as classifying land cover, downloading datasets, and the ability to build your own data analysis algorithms. If you are interested in these features you will need to sign in, which is currently limited to organizations in the Trusted Tester program. To apply to be a trusted tester, please send a brief description of your organization and how you would like to use Google Earth Engine to: earthengine-beta@google.com. Once you are a trusted tester, you will be able to access additional tutorials.

Supervise Image Classification

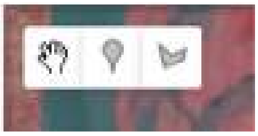
The Classifier package handles supervised classification in Earth Engine. The general workflow for classification is:

1. Collect training data. Assemble features which have a property that stores the known class label and properties storing numeric values for the predictors.
2. Instantiate a classifier. Set its parameters if necessary.
3. Train the classifier using the training data.
4. Classify an image or feature collection.
5. Estimate classification error with independent validation data.

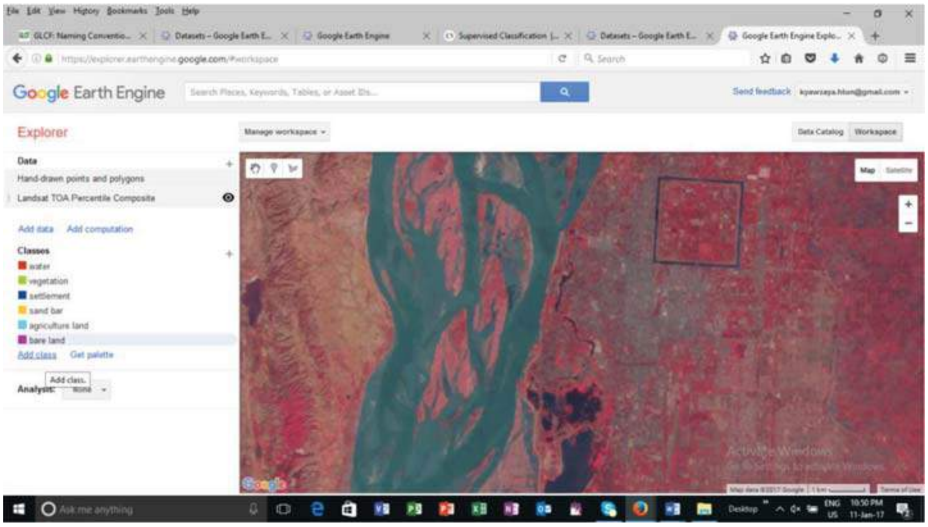
Open the workspace of the google earth engine and navigate your interested area. Then add the Landsat 7 image for 2000 Feb using "Add layer" in left panel of workspace and define the color composite, false color composite (RGB: 432), for image classification.



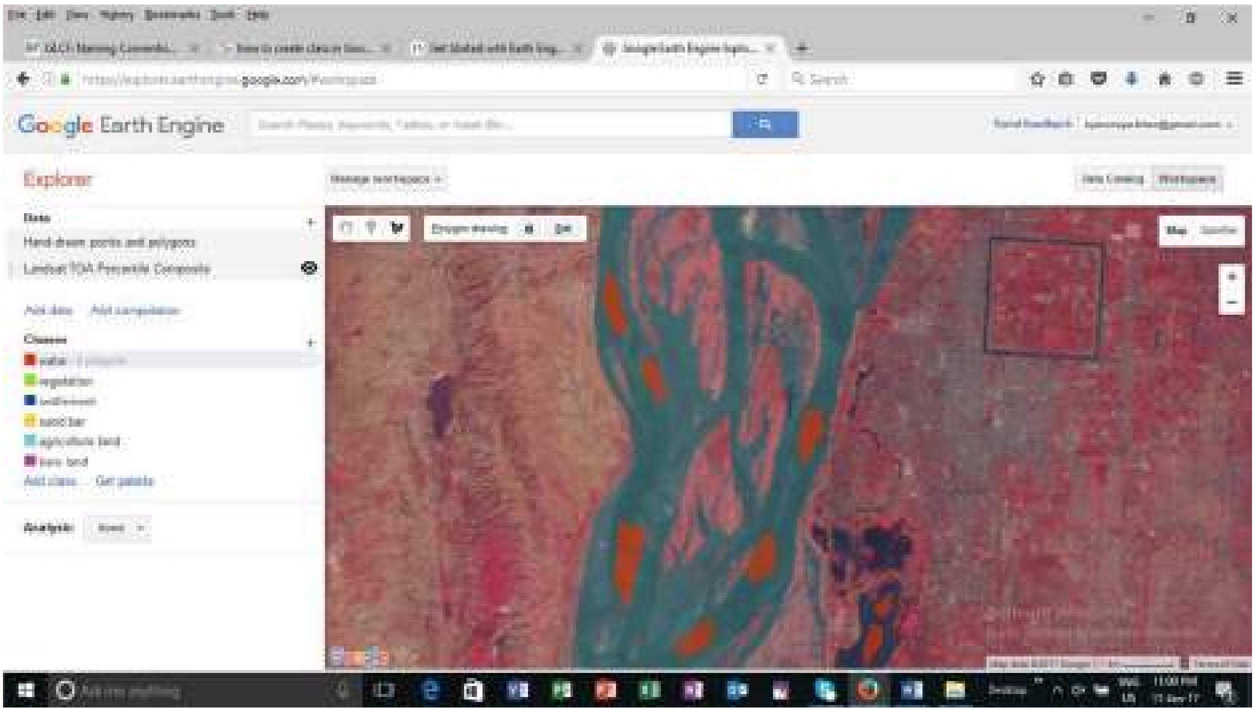
Select the “Hand-drawn points and polygons” from Add data of the workspace in order to create region of interest (ROI) for different land cover.



Using “Add Class” to define the class types for your area.



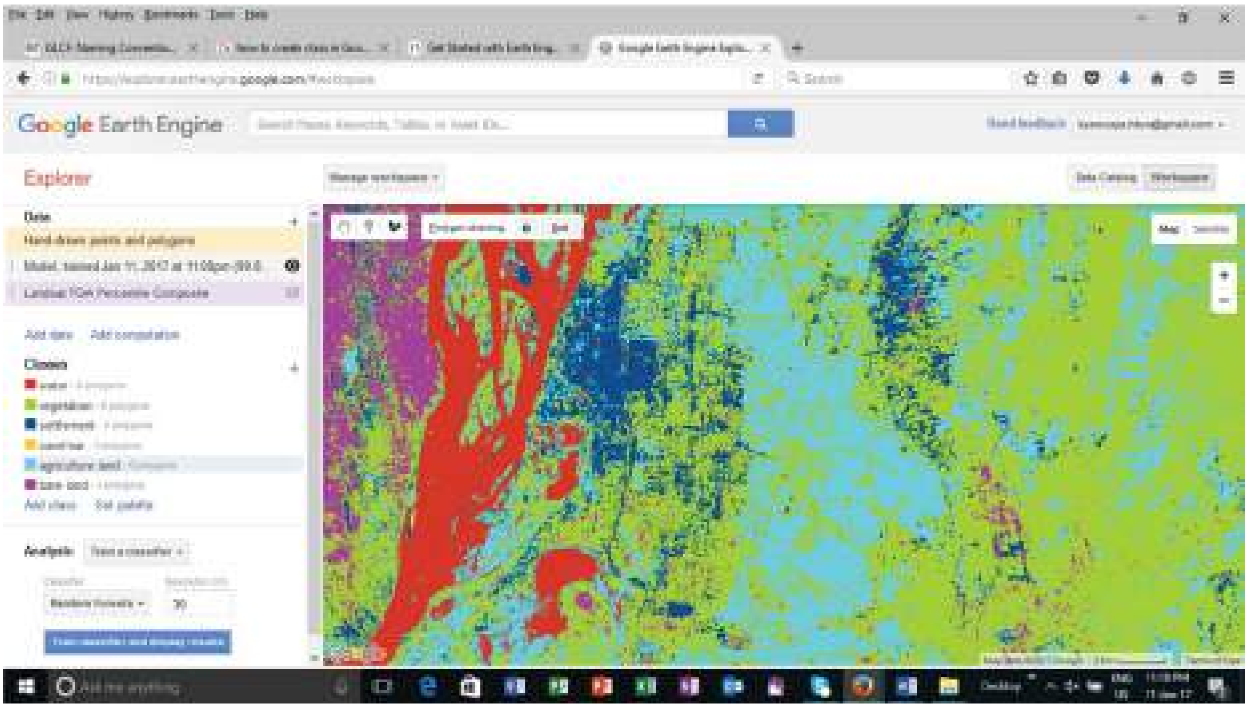
Firstly, select the “water” class to draw the ROI and zoom the image to water body area to see more clear. Draw the polygon using “Draw a shape” inside the water body area. Different waterbodies have different signatures and so collect the ROIs for different signature of waterbody.



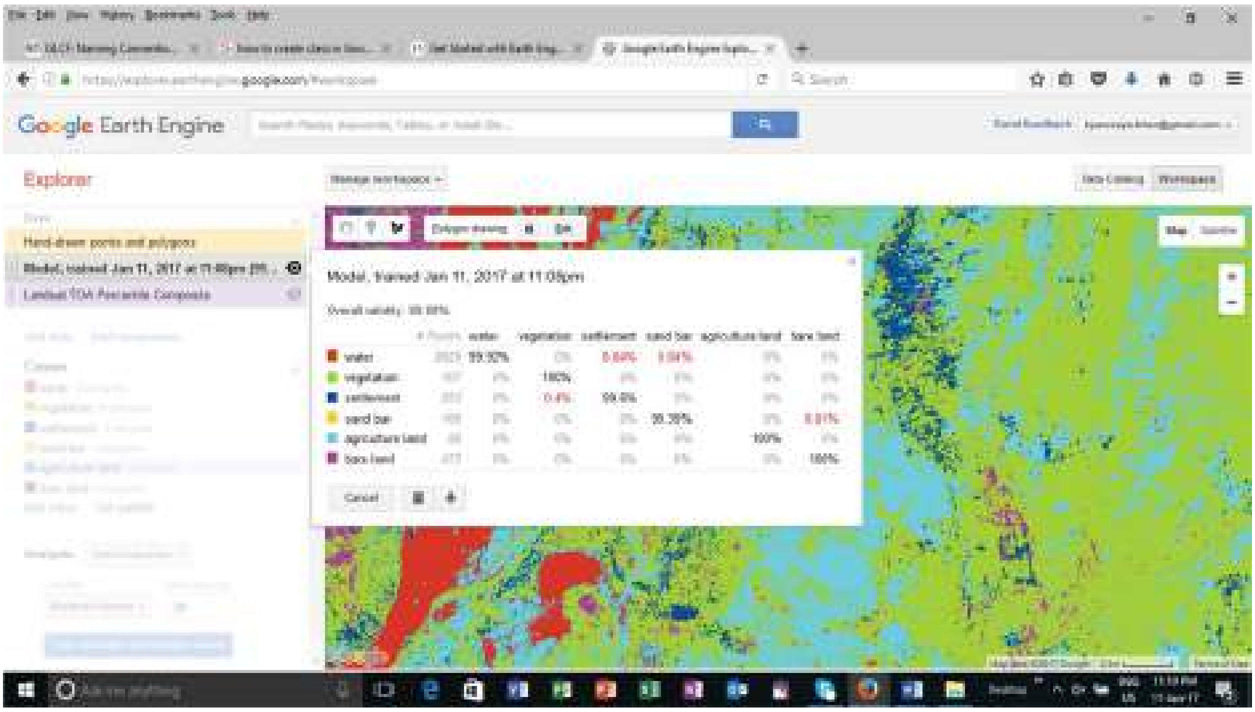
Repeat the same process for other land cover classes : vegetation, settlement, sand bar, agricultural land and bare land.

After that, select “Train a clssifier” from Analysis and then select “Random forests” as classifier and type “30” for resolution (m). Then press the “Train classifier and display results” button for image processing.

The new layer, “Model, trained as ….” Layer will appear in left panel of workspace.

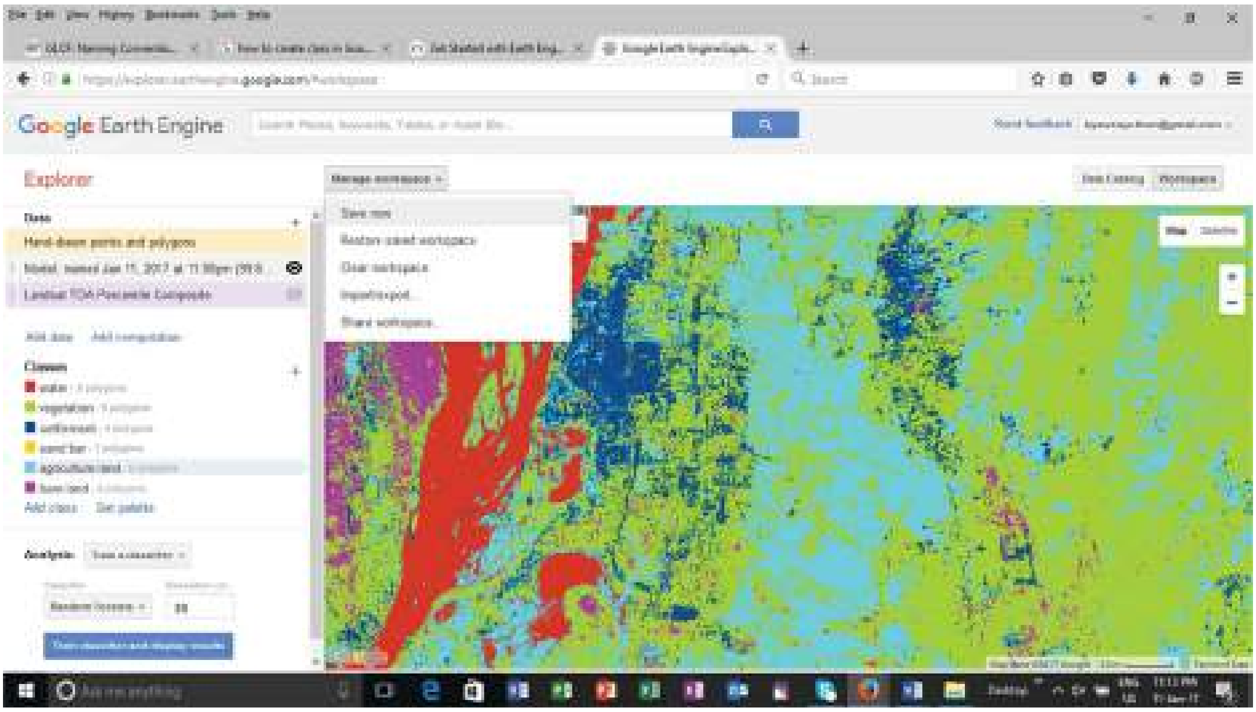


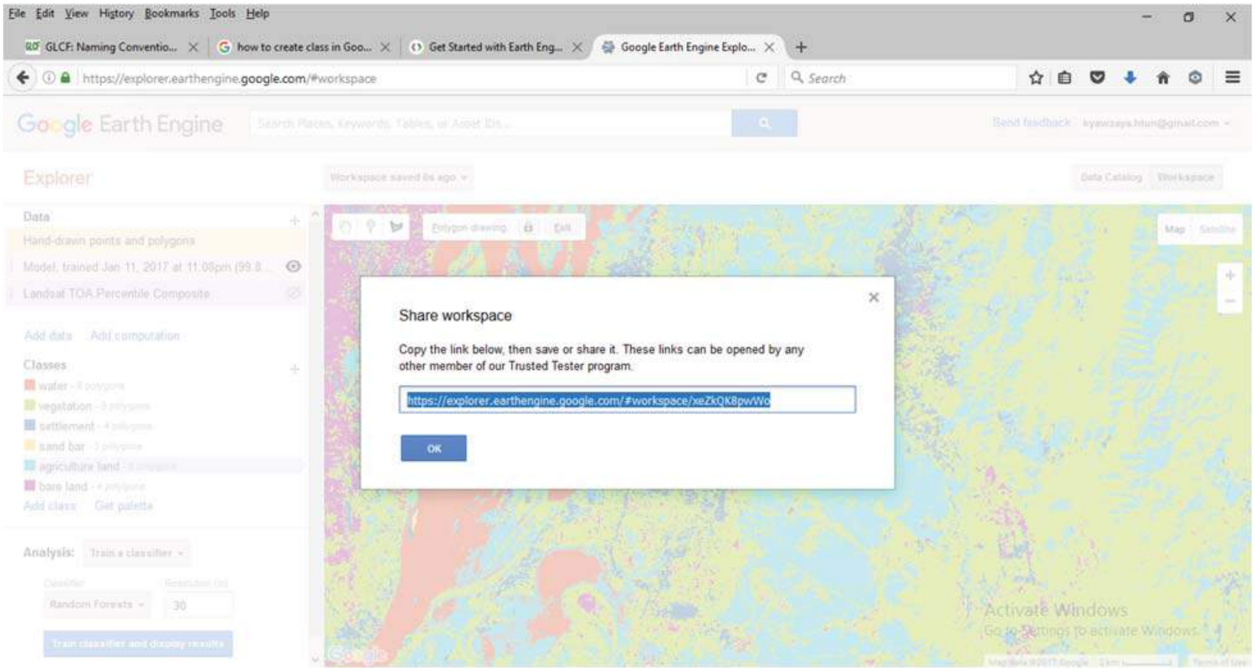
We can also check the overall validity for classification result by clicking this result layer. If you want to download this classification result, you can click the down arrow and select the file format for result and desired resolution.



Manage Workspace

You can also save your workspace to continue your work when you open the GEE again. And also you can share your workspace to other using share workspace and copy the link from pop up window and send this link https://explorer.earthengine.google.com/#workspace/xeZkQK8pwWo to other. Then he or she can continue your work by saving time.




Share workspace
Copy the link below, then save or share it. These links can be opened by any other member of our Trusted Tester program.
https://explorer.earthengine.google.com/#workspace/xeZkQK8pwWo
OK

EXERCISE 3.1

PREPARATION OF EARTHQUAKE HAZARD MAP FOR CHAUK, MYANMAR

This exercise will show you, how to prepare an Earthquake hazard map based on spatial information from USGS web site. During this exercise, you will learn the basics i.e how to download the spatial information from online and how to use this information for visual earthquake assessment and hazard mapping using different type of layers i.e. Point, line and polygon, various thematic layers, editing of table and maps etc.

After every significant earthquake event USGS publishes near-real-time maps of ground motion and shaking intensity as a product called shakemap. These maps can be used by federal, state, and local organizations, both publish and private, for post-earthquake response and recovery, public and scientific information, as well as for preparedness exercises and disaster planning. In previous exercise of data gathering we have learnt from USGS website (http://earthquake.usgs.gov/earthquakes/shakemap/list.php?y=2016). Now in this exercise you are going to use that shakemap to calculate preliminary GIS based impact analysis, which can be used for post-earthquake response and recovery planning. Here you are going to use MMI (Modified Mercalli Intensity) scale intensity map downloaded from USGS website.

Modified Mercalli Intensity Scale:

The Modified Mercalli Intensity scale is a seismic scale used for measuring the intensity of an earthquake or how measurement of intensity at site. It measures the effects of an earthquake, and is distinct from the moment magnitude usually reported for an earthquake (sometimes described as tbe obsolete Richter magnitude), which is a measure of the energy released. To get a better understanding of Modified Mercalli Intensity following is an abbreviated description of the 12 level of Modified Mercalli intensity.

A ShakeMap is a representation of ground shaking produced by an earthquake. The information it presents is different from the earthquake magnitude and epicenter that are released after an earthquake because ShakeMap focuses on the ground shaking produced by the earthquake, rather than the parameters describing the earthquake source. So, while an earthquake has one magnitude and one epicenter, it produces a range of ground shaking levels at sites throughout the region depending on distance from the earthquake, the rock and soil conditions at sites, and variations in the propagation of seismic waves from the earthquake due to complexities in the structure of the Earth's crust.

I. Instrumental	Generally not felt by people unless in favorable conditions.
II. Weak	Felt only by a few people at rest, especially on the upper floors of buildings. Delicately suspended objects (including chandeliers) may swing slightly.
III. Slight	Felt quite noticeably by people indoors, especially on the upper floors of buildings. Many do not recognize it as an earthquake. Standing automobiles may rock slightly. Vibration similar to the passing of a truck. Duration can be estimated. Indoor objects (including chandeliers) may shake.
IV. Moderate	Felt indoors by many to all people, and outdoors by few people. Some awakened. Dishes, windows, and doors disturbed, and walls make cracking sounds. Chandeliers and indoor objects shake noticeably. The sensation is more like a heavy truck striking building. Standing automobiles rock noticeably. Dishes and windows rattle alarmingly. Damage none.
V. Rather Strong	Felt inside by most, may not be felt by some outside in non-favorable conditions. Dishes and windows may break and bells will ring. Vibrations are more like a large train passing close to a house. Possible slight damage to buildings. Liquids may spill out of glasses or open containers. None to a few people are frightened and run outdoors.
VI. Strong	Felt by everyone, outside or inside; many frightened and run outdoors, walk unsteadily. Windows, dishes, glassware broken; books fall off shelves; some heavy furniture moved or overturned; a few instances of fallen plaster. Damage slight to moderate to poorly designed buildings, all others receive none to slight damage.
VII. Very Strong	Difficult to stand. Furniture broken. Damage light in building of good design and construction; slight to moderate in ordinarily built structures; considerable damage in poorly built or badly designed structures; some chimneys broken. Noticed by people driving automobiles.
VIII. Destructive	Damage slight in structures of good design, considerable in normal buildings with a possible partial collapse. Damage great in poorly built structures. Brick buildings easily receive moderate to extremely heavy damage. Possible fall of chimneys, factory stacks, columns, monuments, walls, etc. Heavy furniture moved.
IX. Violent	General panic. Damage slight to moderate (possibly heavy) in well-designed structures. Well-designed structures thrown out of plumb. Damage moderate to great in substantial buildings, with a possible partial collapse. Some buildings may be shifted off foundations. Walls can fall down or collapse.
X. Intense	Many well-built structures destroyed, collapsed, or moderately to severely damaged. Most other structures destroyed, possibly shifted off foundation. Large landslides.
XI. Extreme	Few, if any structures remain standing. Numerous landslides, cracks and deformation of the ground.
XII. Catastrophic	Total destruction - everything is destroyed. Lines of sight and level distorted. Objects thrown into the air. The ground moves in waves or ripples. Large amounts of rock move position. Landscape altered, or leveled by several meters. Even the routes of rivers can be changed.

Comparison of PGA and MMI scale:

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.05	0.3	2.8	6.2	12	22	40	75	>139
PEAK VEL.(cm/s)	<0.02	0.1	1.4	4.7	9.6	20	41	86	>178
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Worden et al. (2011)

Learning Objective:

- The objective of this exercise is to familiarize you with the basic GIS Functions like creating layers, overlaying layers, editing tables and maps, preparing thematic maps, performing queries and generating output and not about the hazard zonation mapping procedure.

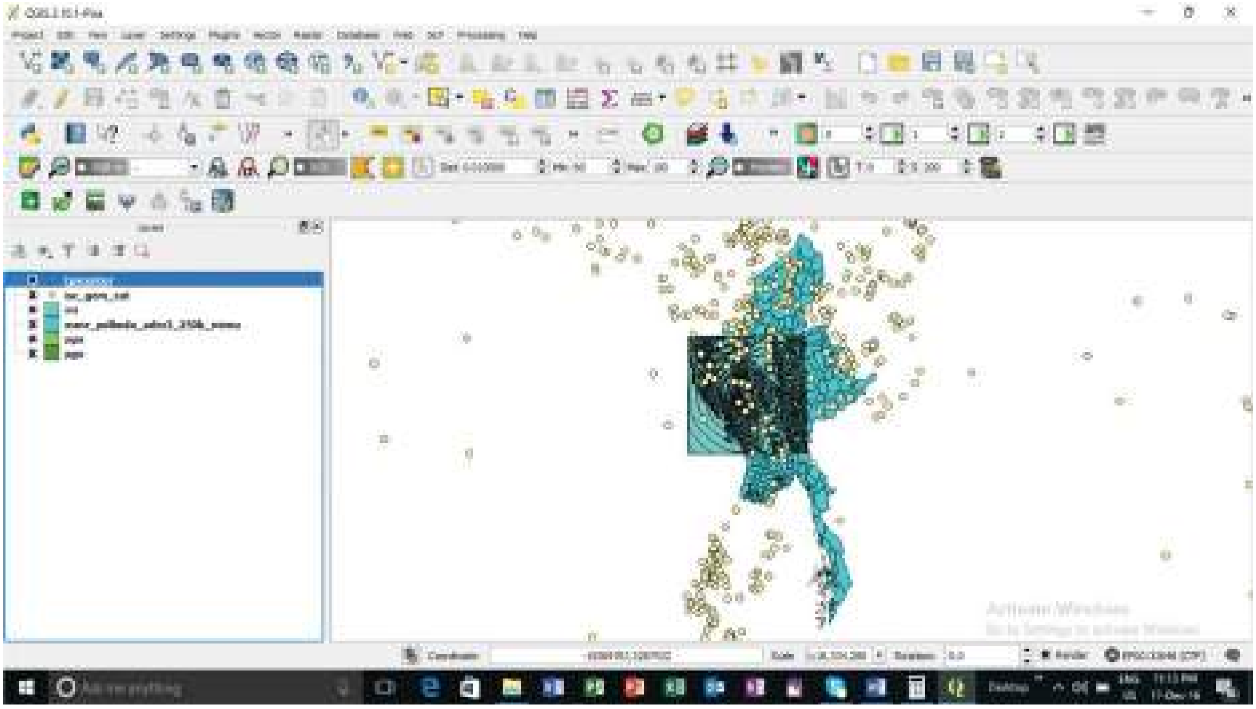
Input data:

1. Mi.shp (Modified Mercalli Intensity Scale Map)
2. Pga.shp (Peak Ground Acceleration Map)
3. Pgv.shp (Peak Ground Velocity Map)
4. Admin_boundart,shp (Administrative Boundary Map)
5. World Population Data

1. Download the earthquake information from following link and keep this download data in Input_Data sub-folder of Exe_3_1 folder.

http://earthquake.usgs.gov/earthquakes/shakemap/global/shake/c000dqqw/#download

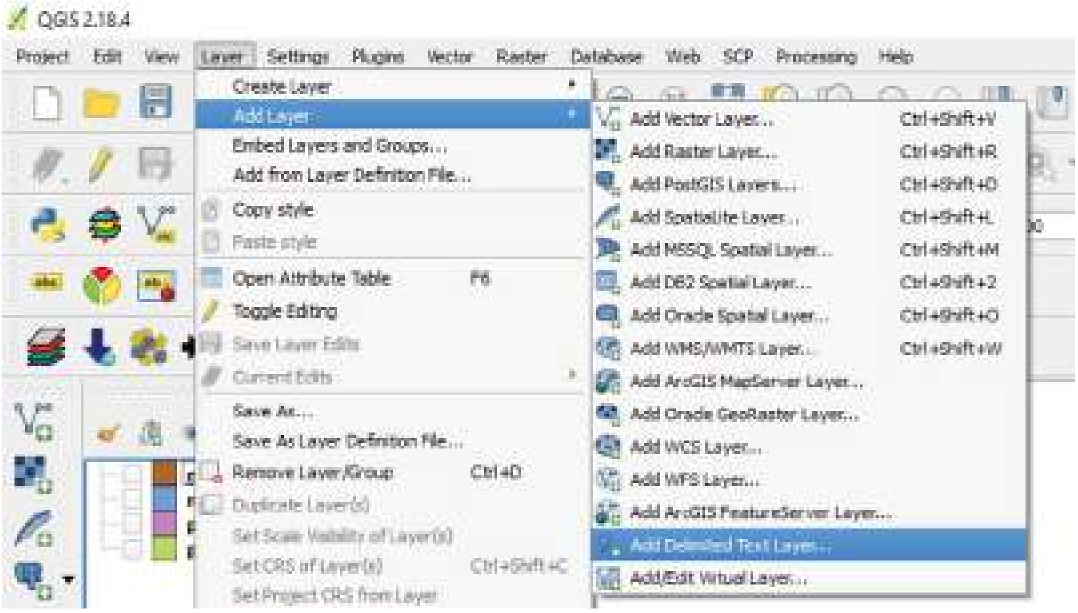
2. Open the all layers from Input_Data sub-folder of Exe_3_1 folder. (Mi.shp, Pga.shp, Pgv.shp and township admin boundary)



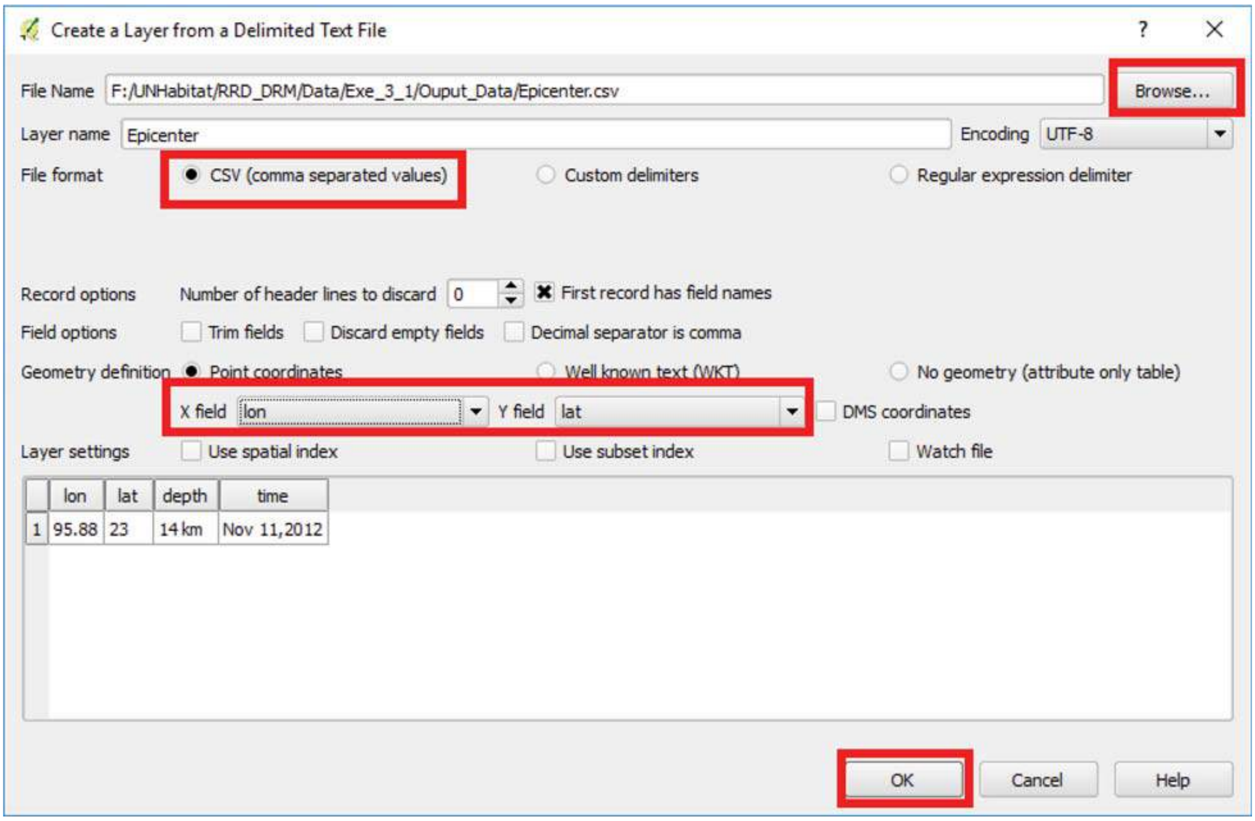
3. Then copy the Earthquake epicenter information to excel file from website and save as *.CSV format.

Lon	Lat	depth	time
95.88	23	14 km	Nov 11,2012

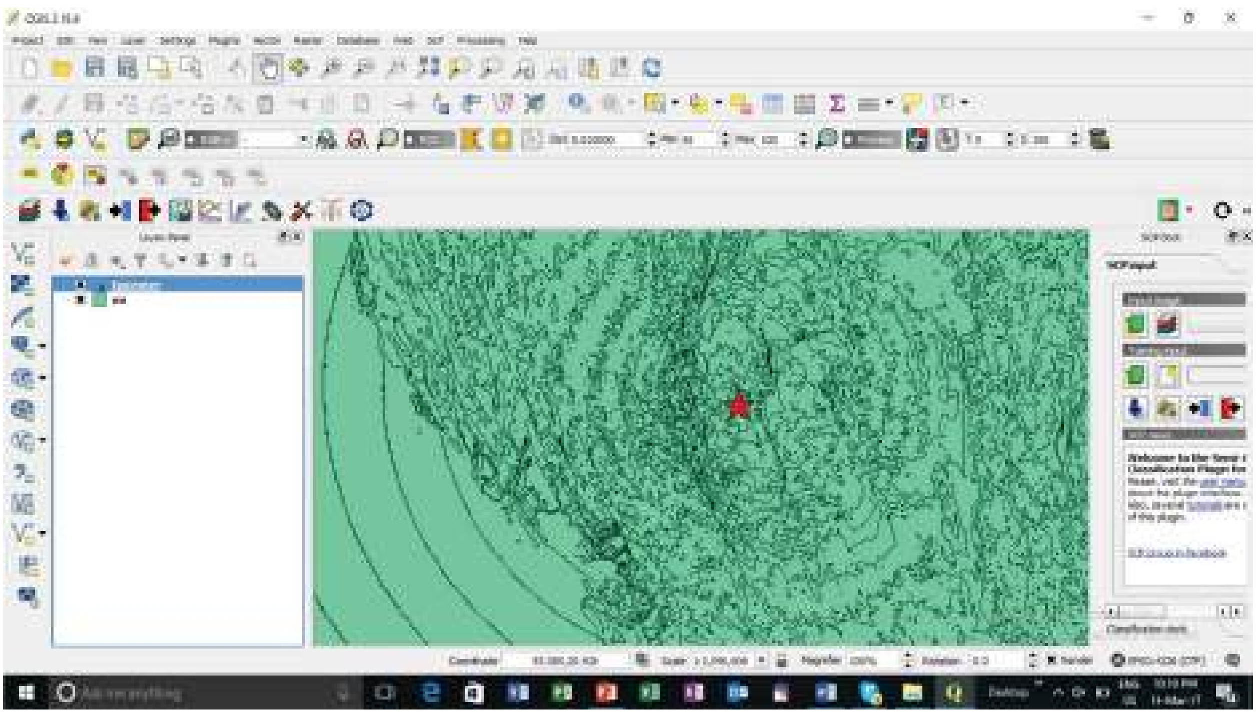
4. Open this CSV file using “Add delimited text layer” from “add layer”. From Layer main menu.



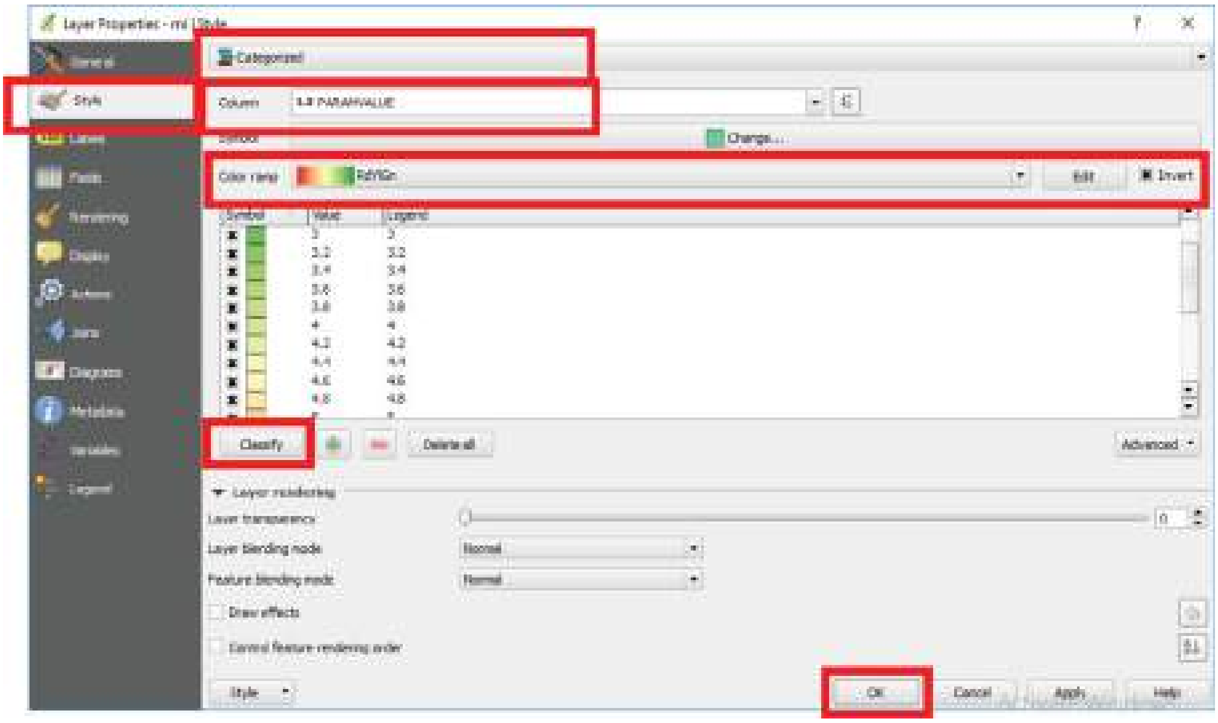
5. Navigate the location of CSV file in your exercise folder using “browse” and check for X field and Y field for Longitude and Latitude of the epicenter. Then click the “Ok” button.

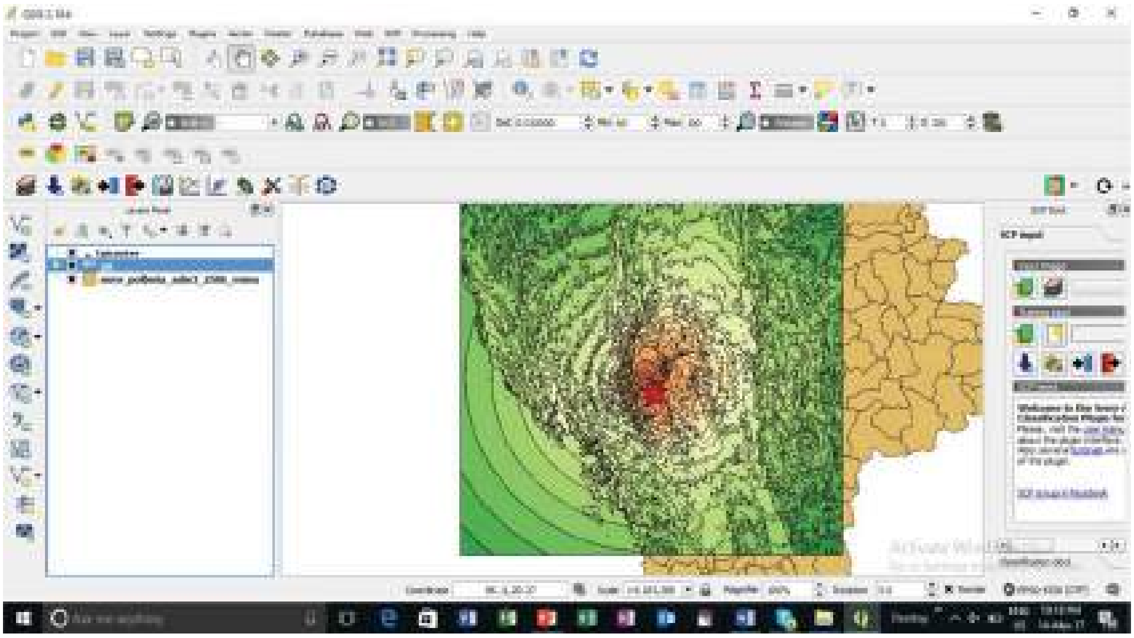


5. Then you will see the epicenter of Aug 2016, Chauk's earthquake layer as follow.



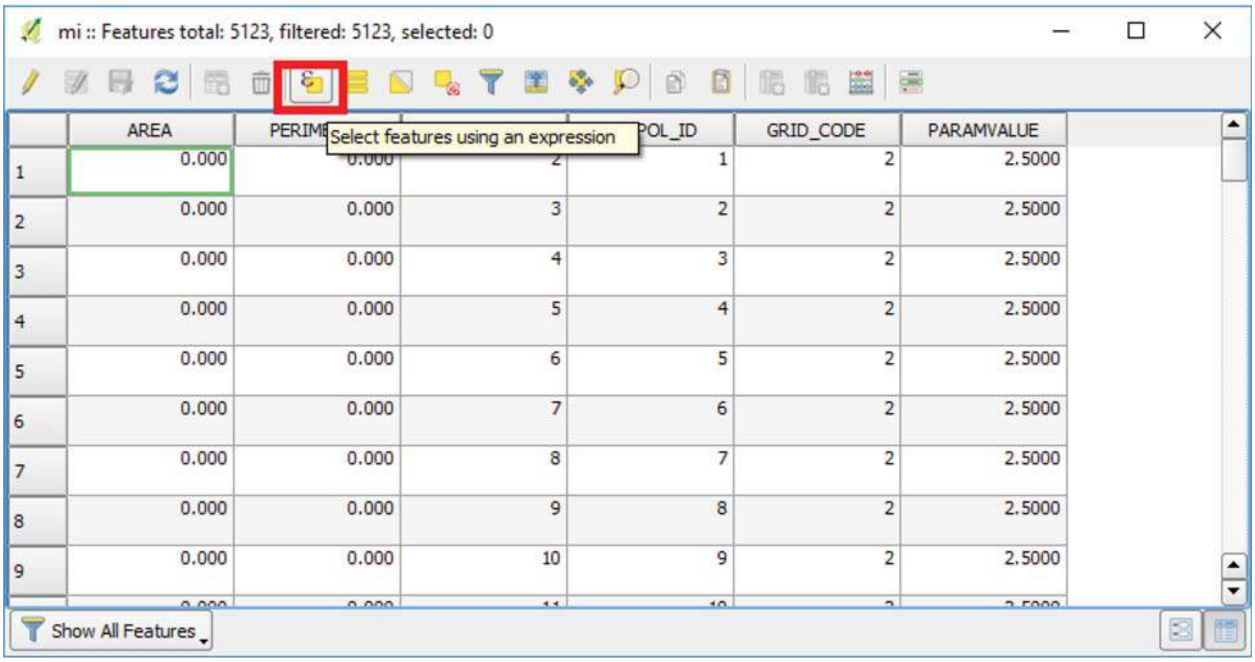
6. Categorize the "Mi" layer according to the Modified Mercalli Intensity scale using "Paramvalue" field in attribute table in style of the property of this layer.



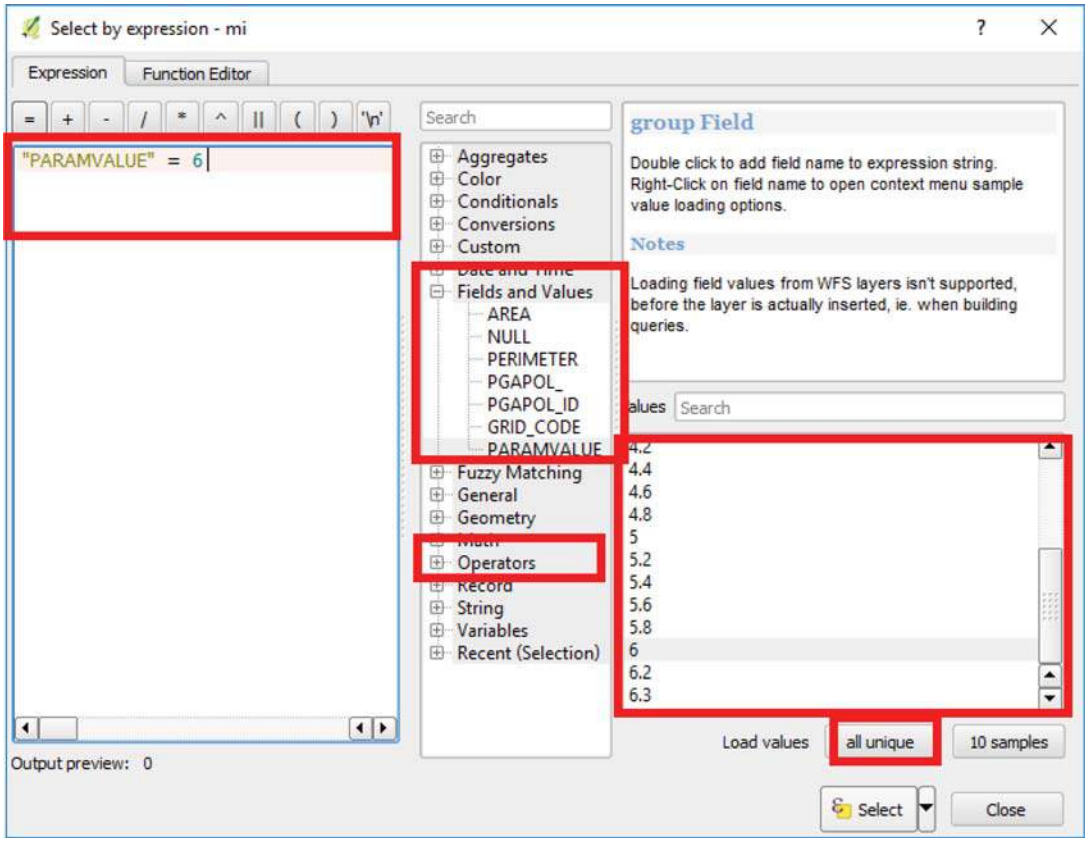


7. To calculate the affected people in MMI scale VI:

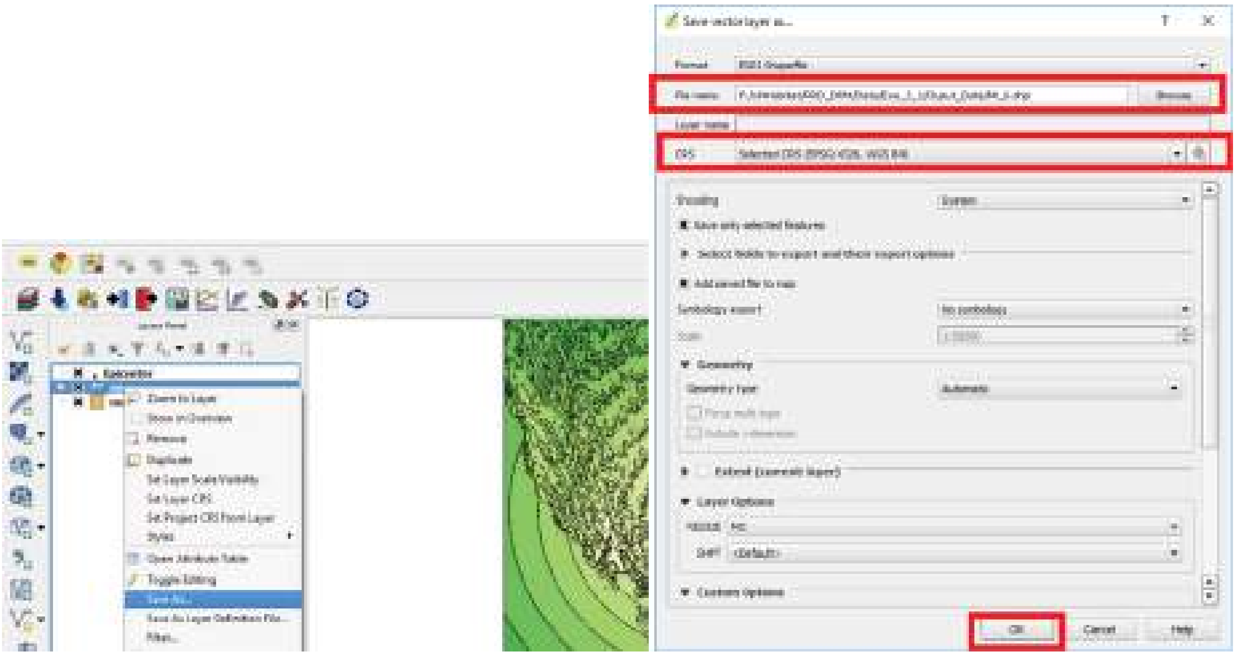
- Open the population layer and Mi.shp file.
- Then select the MMI=6 from attribute table of “MI.shp” layer using expression tool and saved as the selected data as “MI_6.shp”.



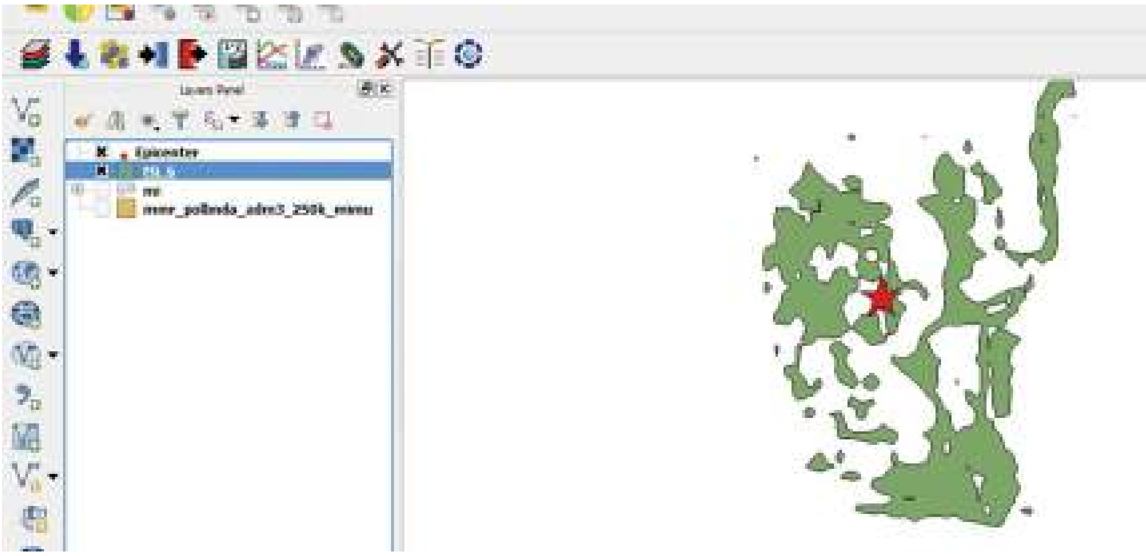
- In expression window, type the command like follow.



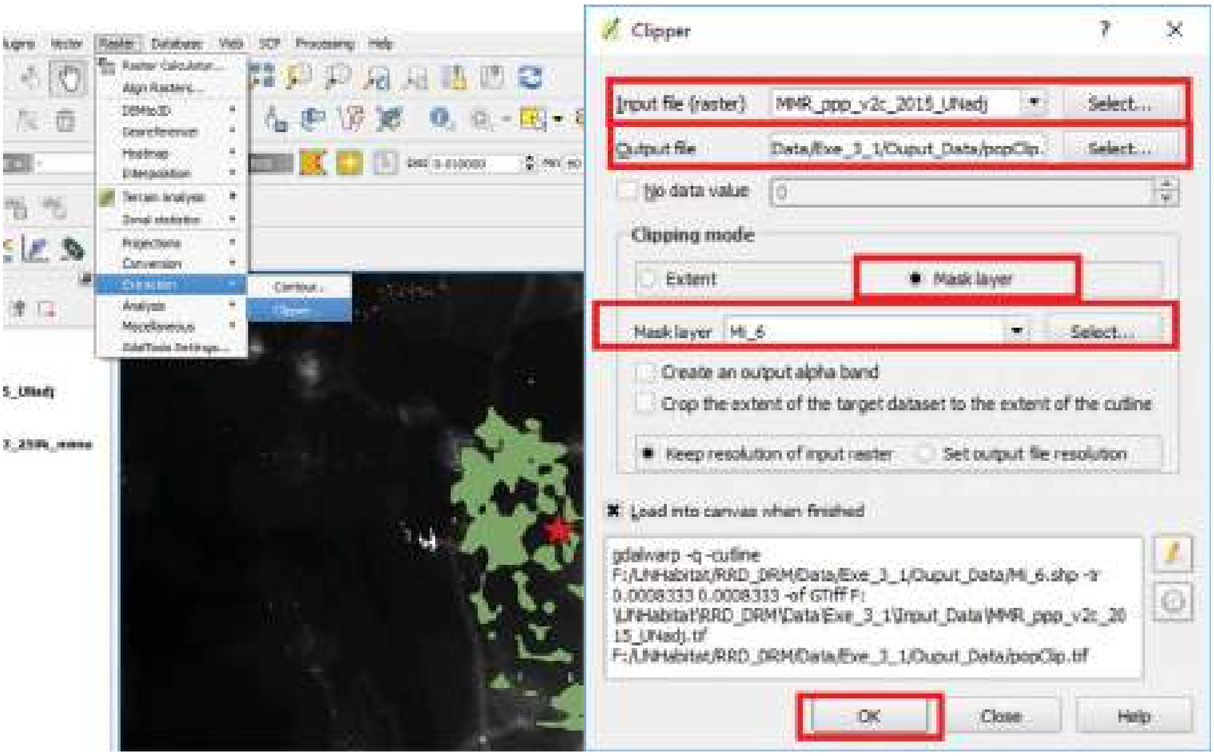
- Then right click the “Mi.shp” layer and save as “Mi_6.shp” in Output_data” folder of Exe_3_1.



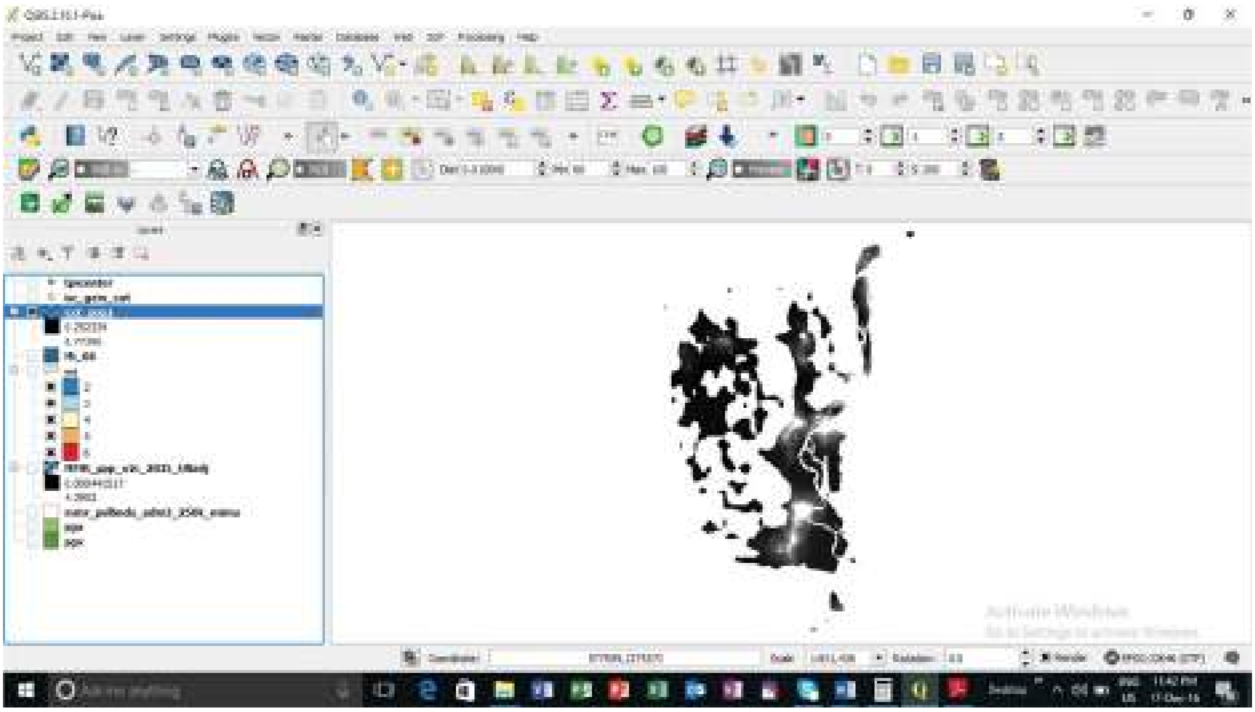
- The output file will be seen as below.



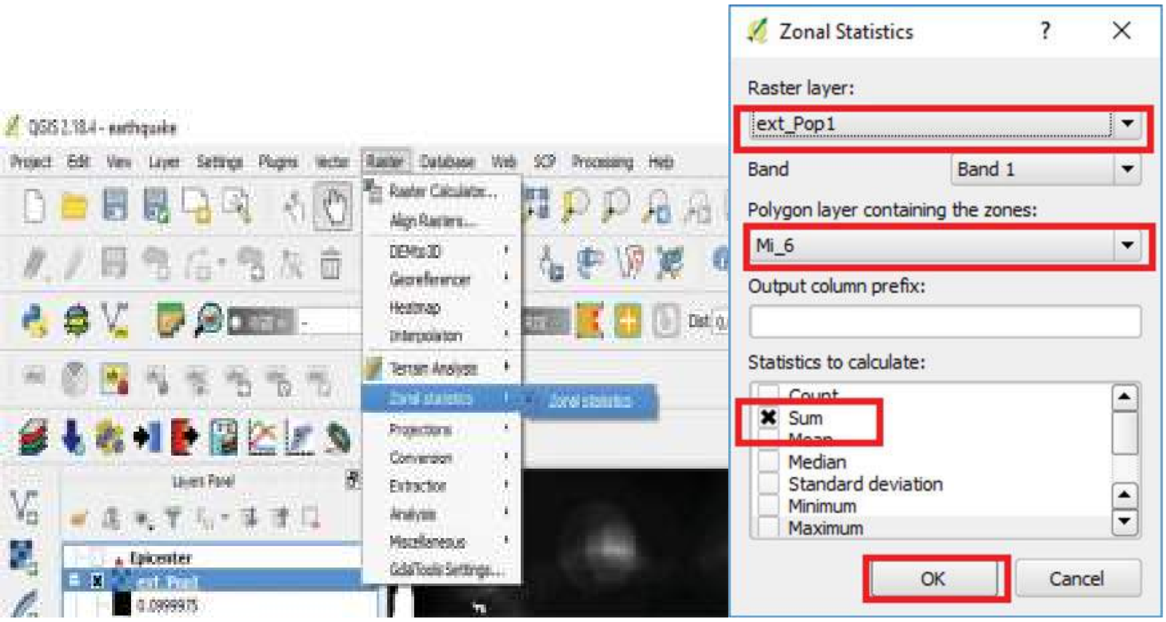
- Extract the population layer using selected "MI_6.shp" file using "Clipper" from "Extraction" tool from "Raster" main menu.



- The output file will be seen as below.



- To calculate the affected population, click the "Zonal statistics" from "Raster" main menu. "ext_pop1.tif": input raster layer and "Mi_6.shp": input zonal layer. The result can be check in the attribute table of "Mi_6.shp".



Question:

3. Identify the number of Districts in EQ Zones where the Modified Mercalli Intensity scale are V and IV.
4. Identify the number of Townships in EQ Zones where the Modified Mercalli Intensity scale are V and IV.
5. How much square km area in Magway Division is under severe shaking?
6. Fill out the following table to calculate of estimated affected population

Intensity	MMI	Population Exposed
Serve	VIII	
Very Strong	VII	
Strong	VI	

EXERCISE 3.2

FLOOD MONITORING AND IDENTIFICATION OF FLOOD AFFECTED AREA USING PRE AND POST FLOOD IMAGES

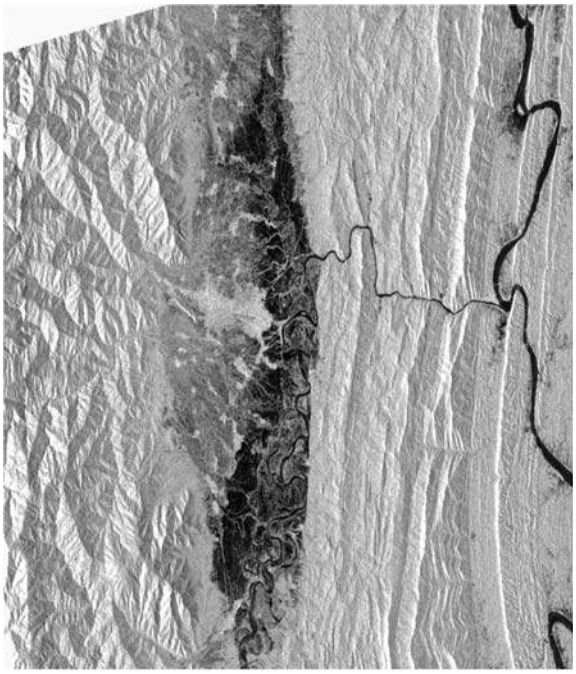
This tutorial illustrates how to monitor floods two Satellite Images: Spot (April,2014), before flood image and Sentinel-1(Aug, 2015), during flood image. In particular, we are trying to manual digitizing the settlement boundary and road line from Spot images acquired in 2014 in Kale region and also extract the flood prone area from Sentinel-1 in 2015, the heavy seasonal rains causing the flood along the Myitthar rivers, affecting more than a thousand of people in this area.

Learning Objective:

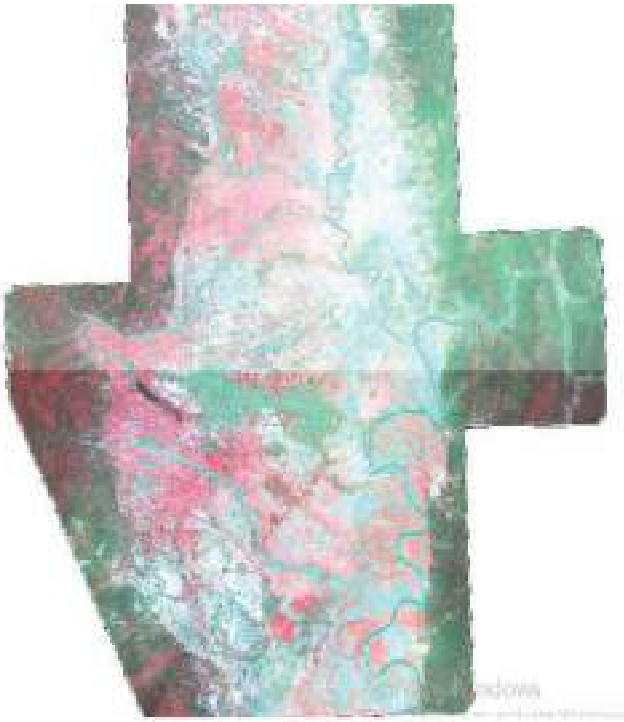
- To perform satellite based flood extraction method and estimate impact on population and facilities assets such as settlements and transportation.

Data Input:

Sentiel-1A Image (Aug, 2015) (during disaster period) and Spot Image(April,2014) (before disaster)



Sentiel-1A Image (Aug, 2015)



Spot Image(April,2014)

Sentinel 1A image

SAR images are often used for monitoring ship traffic, oil spills, and conditions at sea, because they can see through clouds and darkness, and the waves a SAR satellite like Sentinel-1 emits, can be used to detect small objects and oil spills, while covering a large area. In this tutorial, we'll be extracting information from Sentinel-1. The tutorial describes how to extract information on ships in a Sentinel-1A image, but you can use the same method to find oil spills, and estimate wind speed and direction at sea at the time the image was taken. Here we will extract the flood prone area from this sentinel 1 image.

Question: Find the Spot satellite image information from internet and fill the following table:

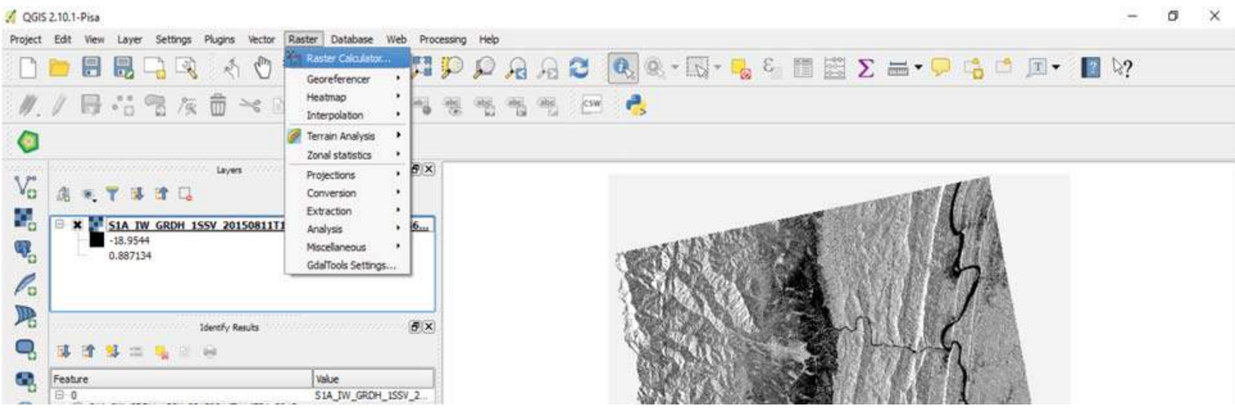
Spot Image

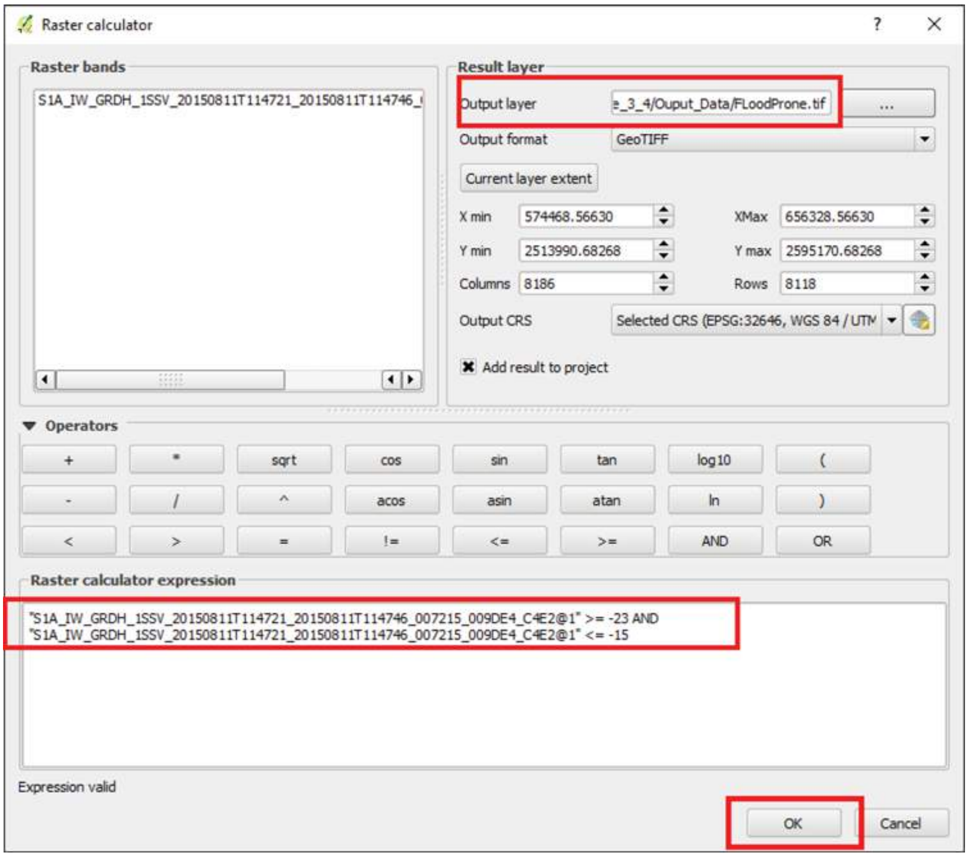
Band ID	Spot Image Band Number	Spectral Range
1		
2		
3		
4		

Flood Prone Area Identification

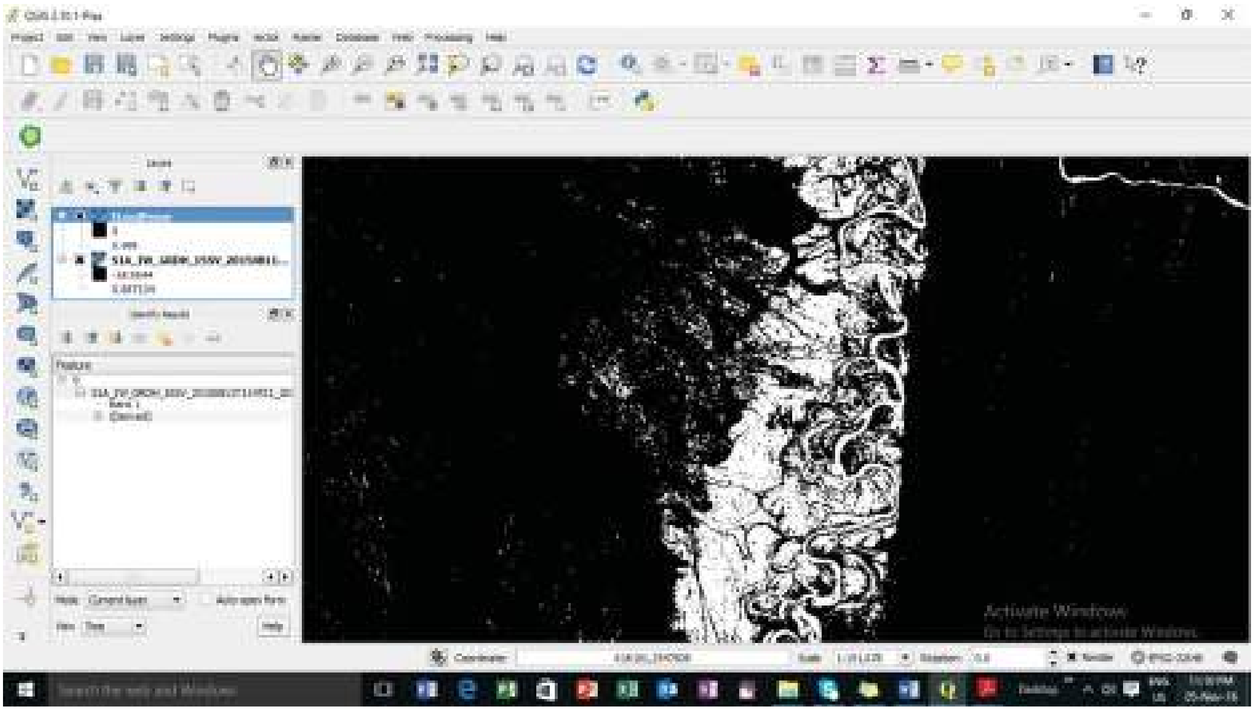
The main approach is to extract Water defining a classification threshold in order to identify only those pixels that are very similar to collected spectral signatures from Sentinel-1 image. Then extract the water body using the threshold by writing expression in Raster Calculator as follow:

- One of the methods used in GIS for satellite base flood extraction is a pixel-based classification technique called thresholding. Using  identify tool to define the threshold for waterbody in different location of the image and extract the maximum and minimum pixel value of the water area in the image.
- After getting the threshold value of the water, e.g. the pixel value of water is between -23 and -15, we can extract the water body area using raster calculator.
- Using Raster Calculator from Raster Menu to extract the waterbody from satellite image like below. Then save the output layer as FloodProne.tif.

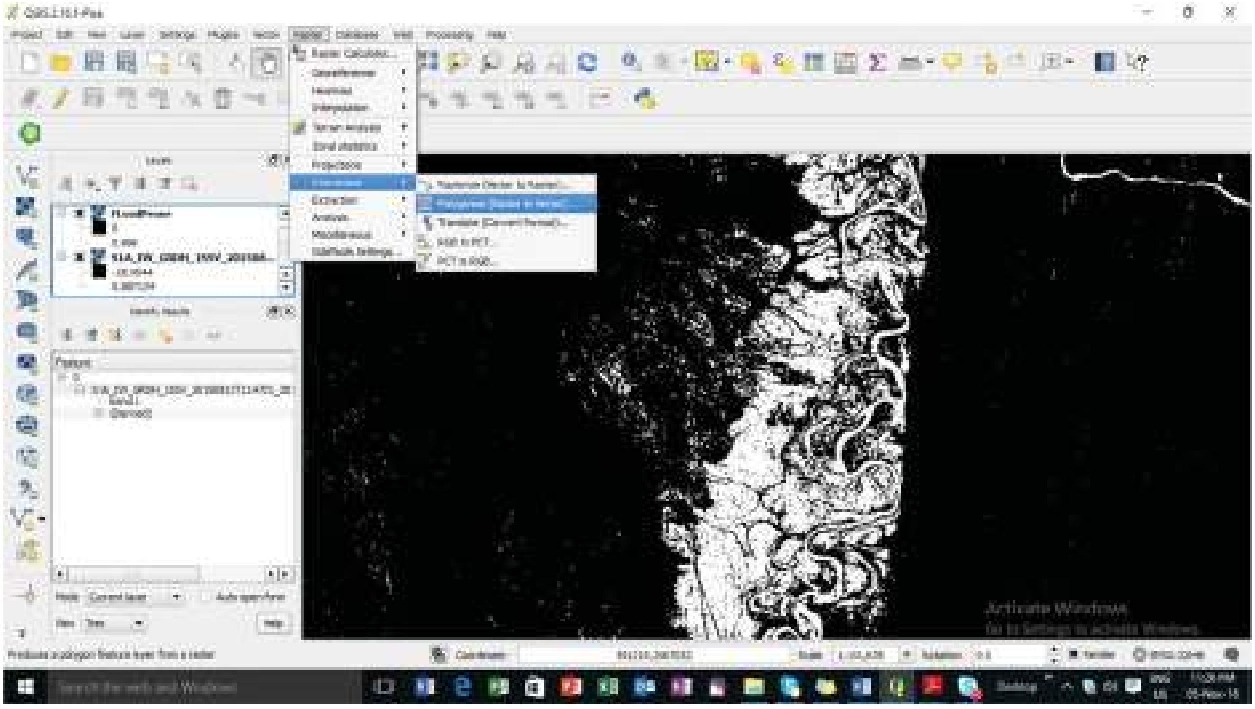




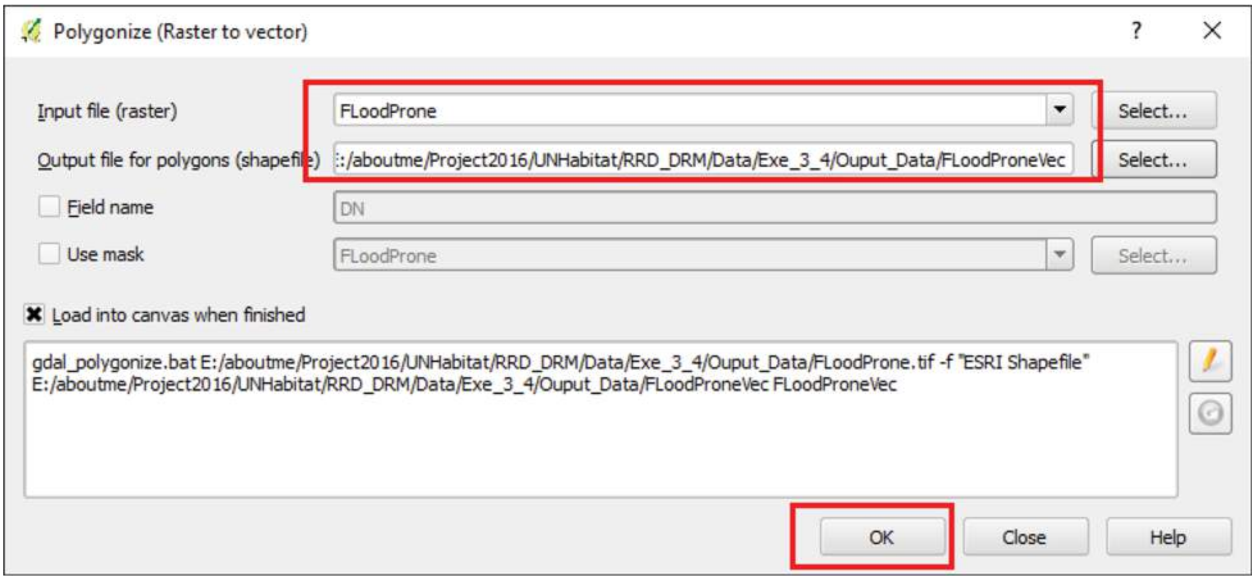
- In “FloodProne.tif” layer, we could see only both 0 (not waterbody) and 1 (waterbody).



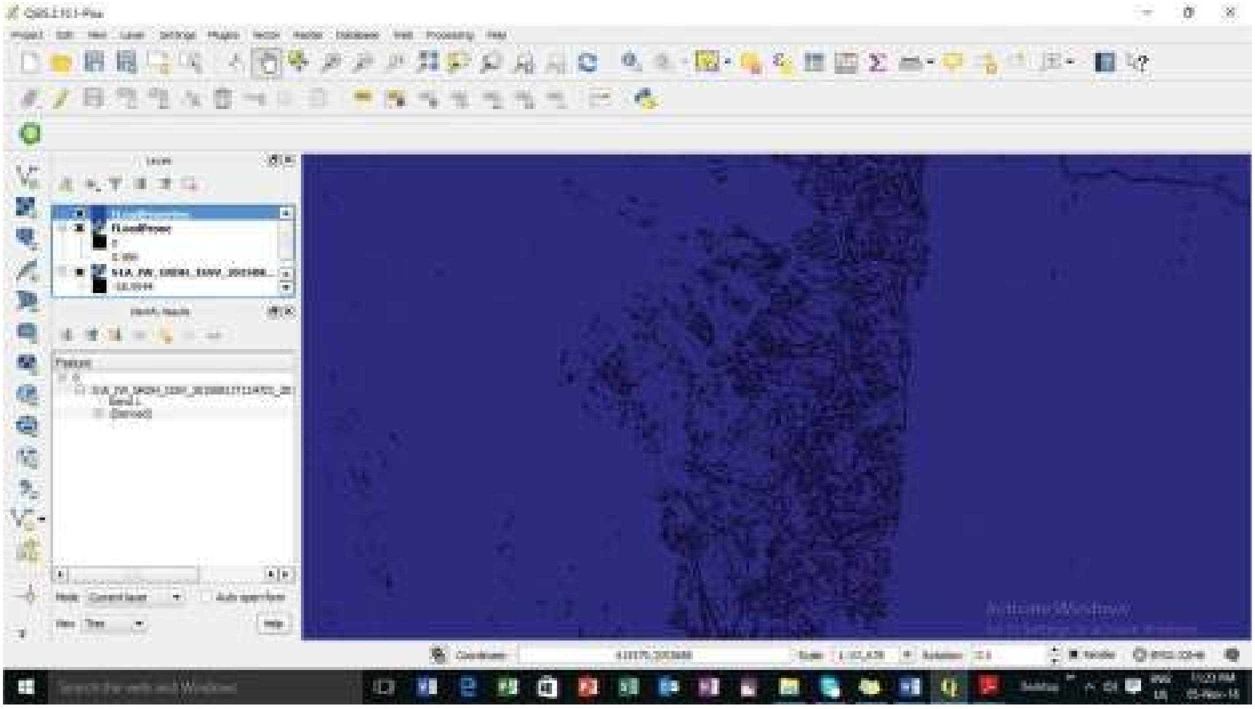
- Then Click Conversion tool from Raster menu and select the Polygonize (Raster to Polygon) to convert the raster to vector file.



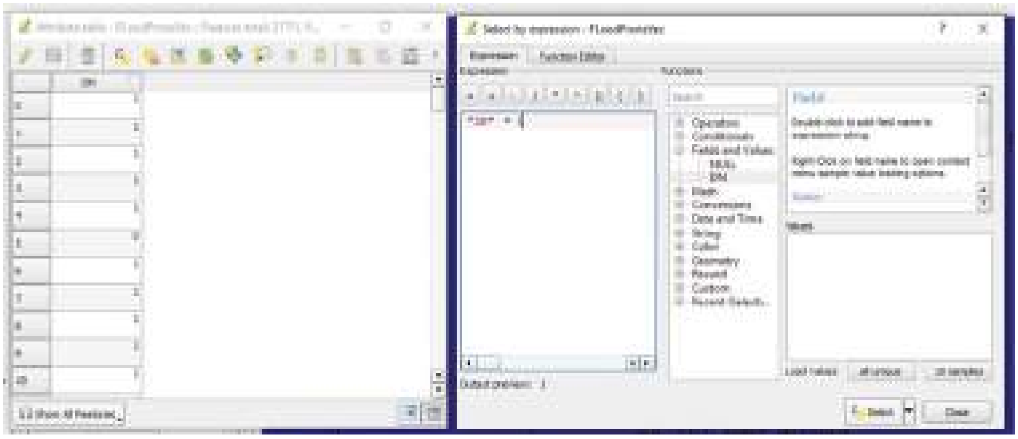
- Select the input file which is convert to vector file and define the location of output file in appear window of Polygonize.



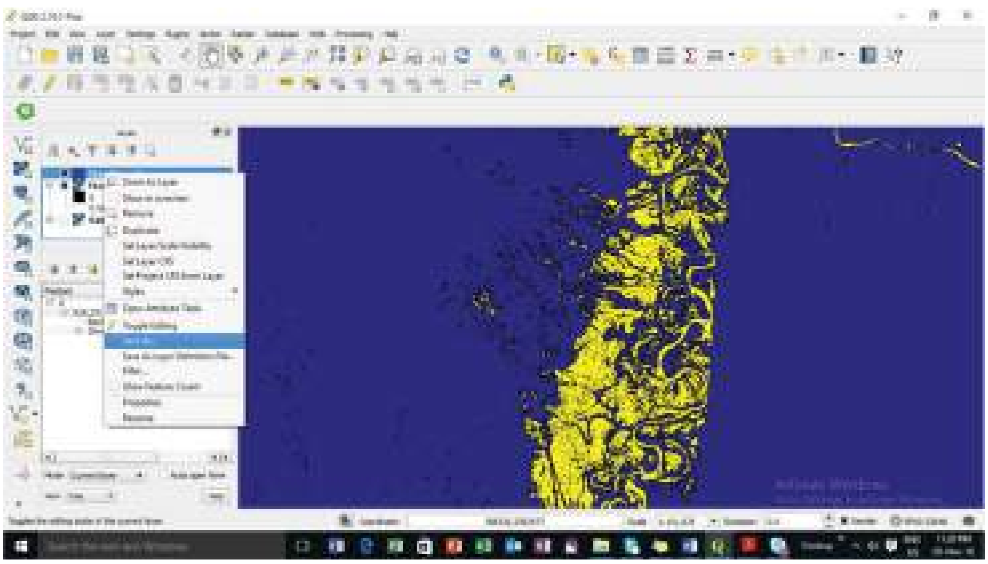
- The result will be seen as below.

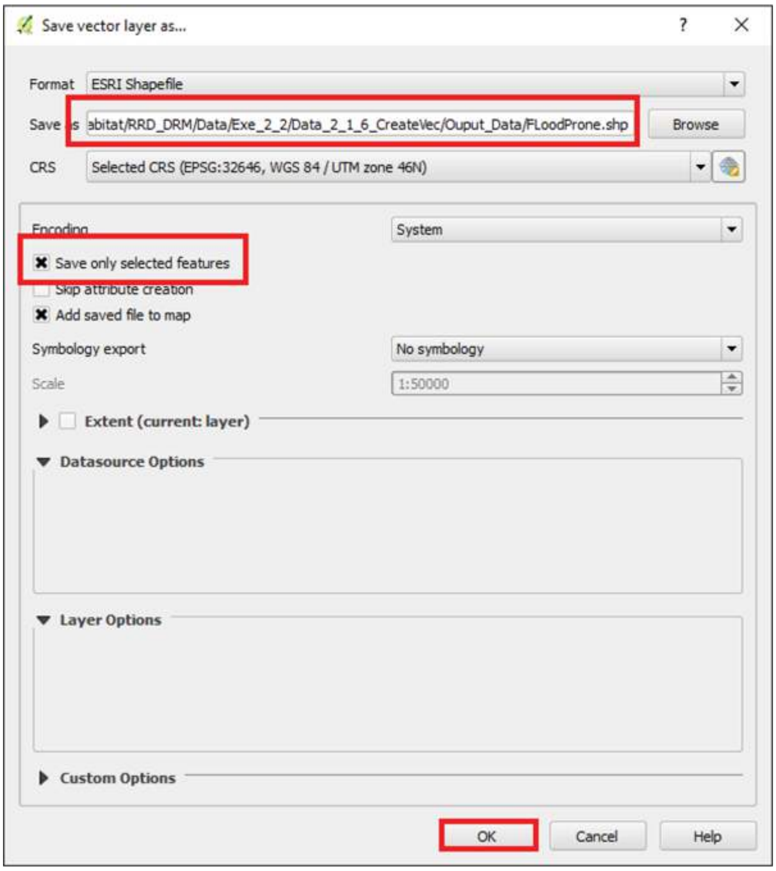


- Opent the attribute table of FloodProne layer and select the records which has DN value 1 using expression like the previous exercise.



- Then Right Click this layer and saved the layer as Flood Prone.shp. Don’t forget to select Saved Only Selected Features. Then click “Ok” button. The flood prone area map will be appeared.



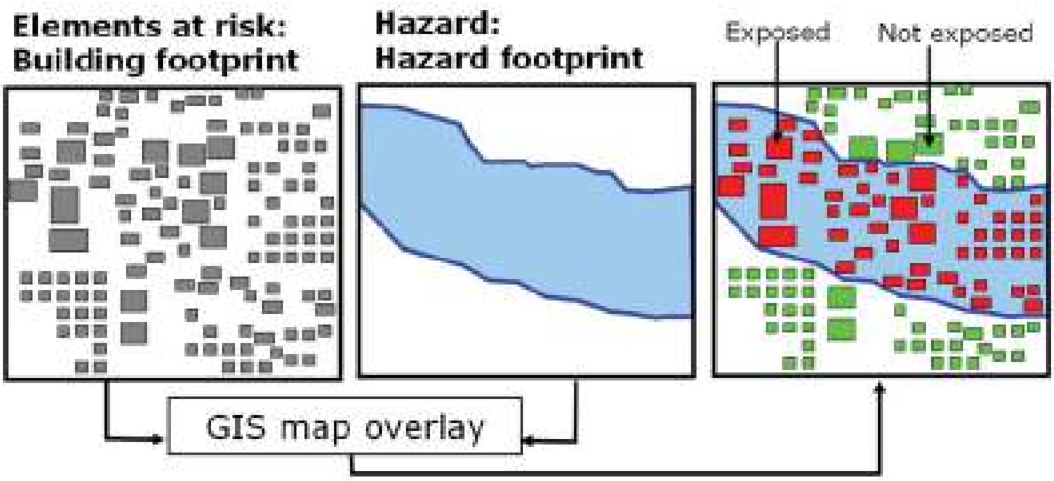


Extract the spatial information from before flood image (Digitizing)

- Open the Spot Satellite Image "IMG_SPOT6_PMS_201404060408069_ORT_1402532101_R1C1.JP2 " and used as background image for digitizing.
- Click on the menu entry Layer New New Shapefile Layer to create the polygon layer according to 2.1.6 and saved the file as "Village_bond".
- Create the new column and name as "Vil_Name". Clcik  Toggle Editing tool to start digitizing. Then click  Add Feature tool to start drawing the village boundary as polygon features from background layer.
- And also download the open street map layer using the link: http://www.openstreetmap.org/ (or) http://extract.bbbike.org/ (please check EXERCISE 4.2 of Module 4).
- You can also do the Land Cover / Land Use classification according to exercise 2.2 and do the assessment that which percentage of each land cover type is under water. (please use geo-processing tool like the exercise of Spatial Analysis in previous module)

Assessment for Exposure or Not exposer

The interaction of elements at risk and hazard defines the exposure and the vulnerability of the elements-at-risk. Exposure indicates the degree to which the elements at risk are exposed to a particular hazard. The spatial interaction between the elements at risk and the hazard footprints are depicted in a GIS by simple map overlaying of the hazard map with the elements at risk map.



- Overlay with Flood Prone area Map and digitized layer to identify the exposer or not for risk assessment and try to answer the following questions.

Question:

1. How many percent of the settlement area is in the flood prone area in 2015?
2. How many buildings are exposed to a particular flood hazard in 2015?
3. How many percent of the road is in the flood prone area in 2015?

EXERCISE 3.3

LANDSLIDE HAZARD MAPPING USING LOGISTIC REGRESSION

This module will give a detailed description of the data sets and methodology used for regional scale Landslide hazard mapping and comparison with the land slide inventory map generated using the field data. The exercise for this module is based on the methodology and data used in the preparation of Landslide Vulnerability Atlas, Developed by Deo Raj Gurung, nternational Centre for Integrated Mountain Development (ICIMOD)

Learning Objective:

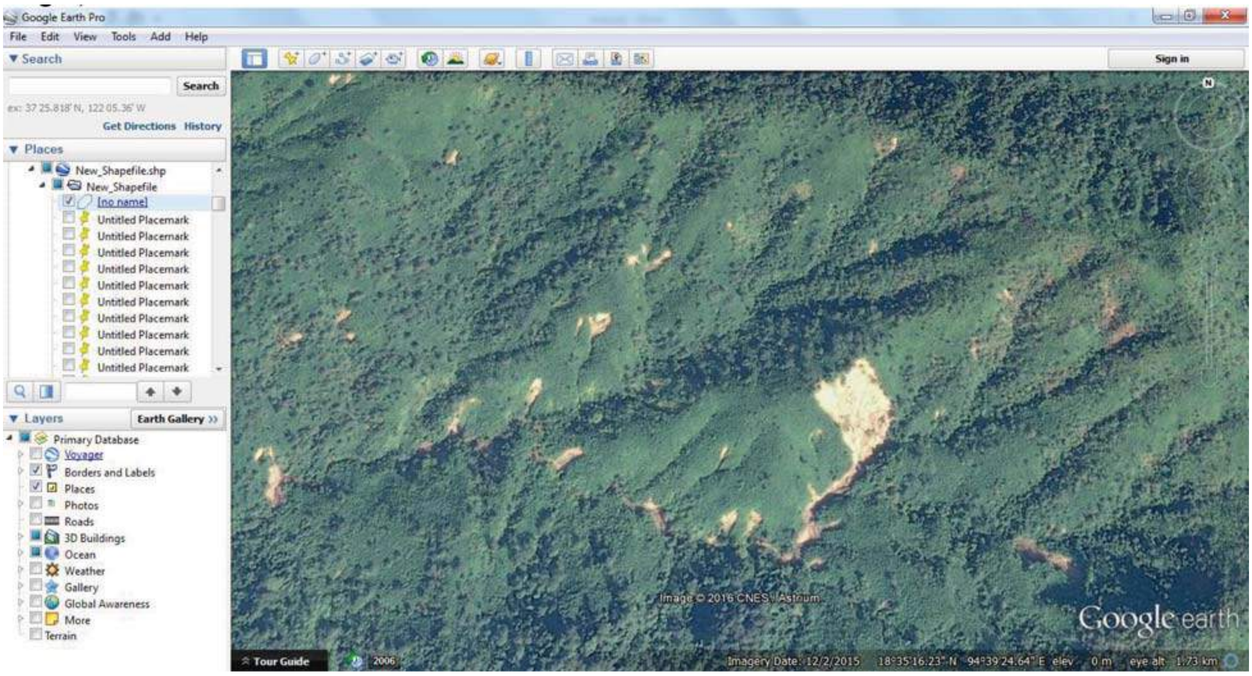
- To develop landslide inventory using Google Earth
- To generate landslide hazard map using 8 independent variables (geology, river network, road network, landcover/use, etc.) based on logistic regression method

Data Use:

- DEM, Fault line, Geology map, Land cover map, river, road

We will develop landslide inventory using Google Earth

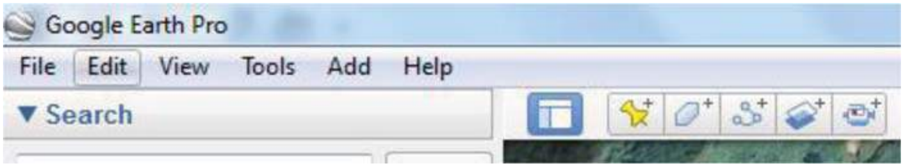
1. Double click on Google Earth icon to start Google Earth application.
2. Zoom into your area of interest (AOI) and look for landslide (fresh landslide will appear bright).



3. Activate 3D view by clicking on Terrain under Layers. 3D view will give you better impression of reality and help increase accuracy of the landslide inventory database.

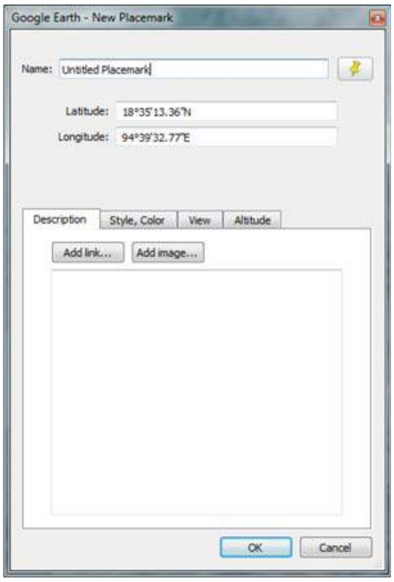
Soruce : National Training on “Exploring the use of Earth observation data and modelling in disaster risk mapping” prepared by Deo Raj Gurung, ICIMOD

4. Click on Add Placemark to mark landslide.

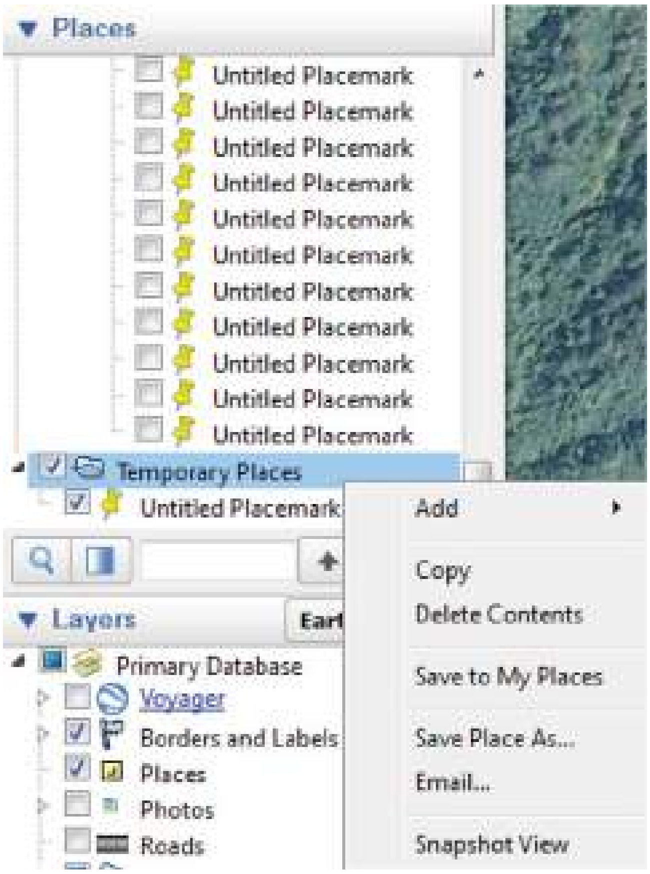


5. Place the placemark at the center of the landslide feature.

6. Once the place mark is on correct position click on Ok to register the placemark. Add few more placemarks for practice.

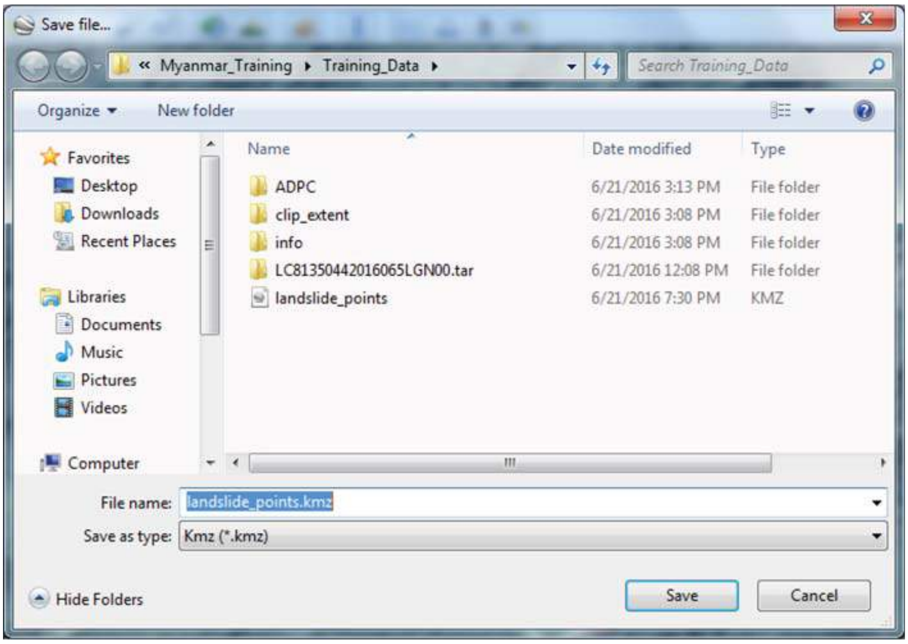


7. Right click on the folder (possibly Temporary Places) under Places. Click on Save Place As.

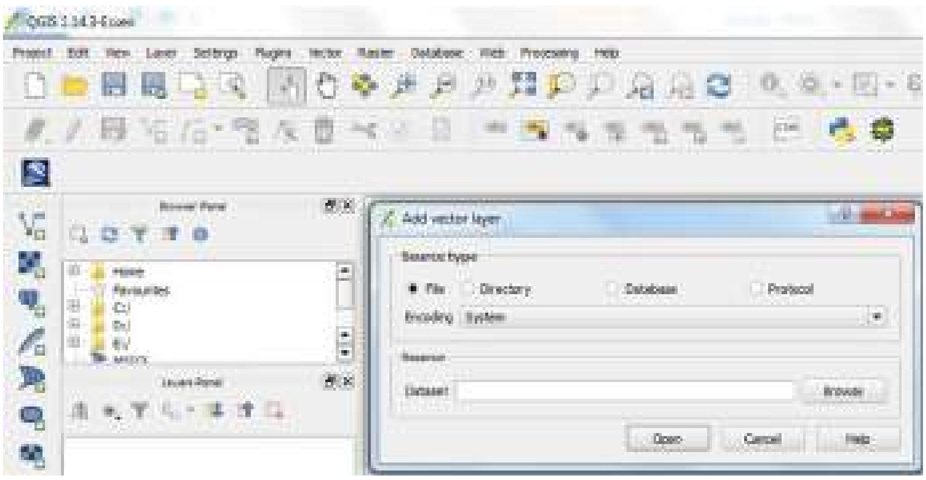


8. Browse to your training folder (F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Input_Data\) and name it landslide_points.kmz andclick on Save.

Soruce : National Training on "Exploring the use of Earth observation data and modelling in disaster risk mapping" prepared by Deo Raj Gurung, ICIMOD



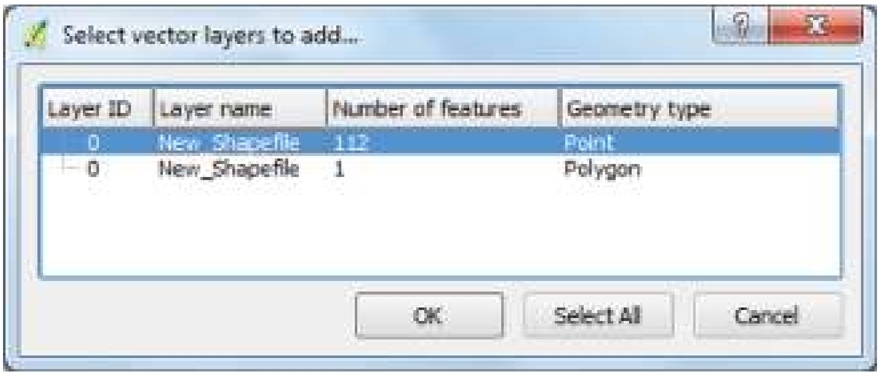
9. Open QGIS and click on Add Vector Layer. Look for landslide_points.kmz, the file you created in Google Earth (probably inside F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Input_Data\). Click on Open twice to open the .kmz file in QGIS.



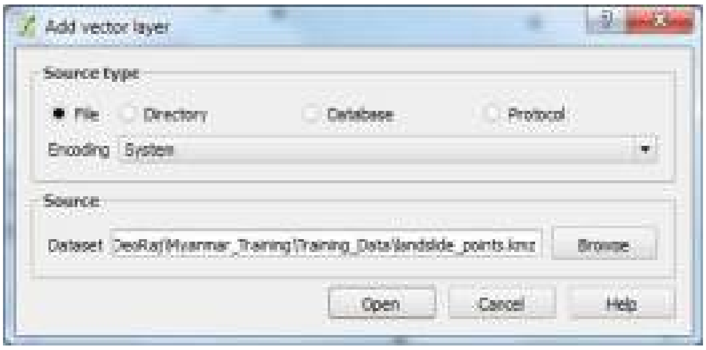
10. Against File name select Keyhole Markup Language to display .kmz or .kml files. Select landslide_points.kmz and click on Open.

Soruce : National Training on "Exploring the use of Earth observation data and modelling in disaster risk mapping" prepared by Deo Raj Gurung, ICIMOD

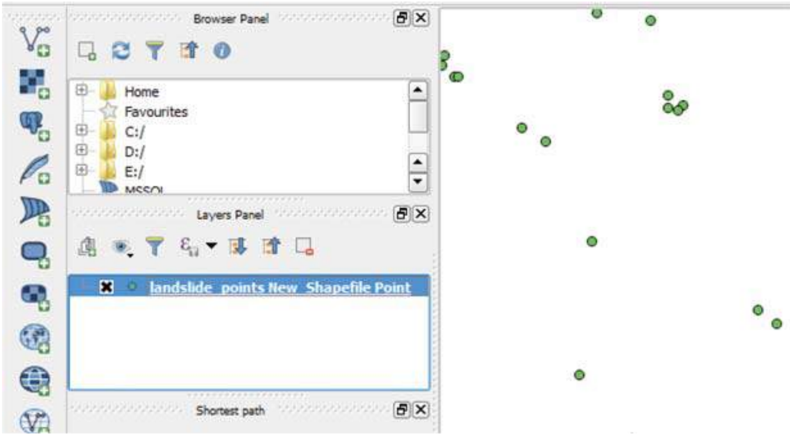
11. Click on Select All followed by Ok.



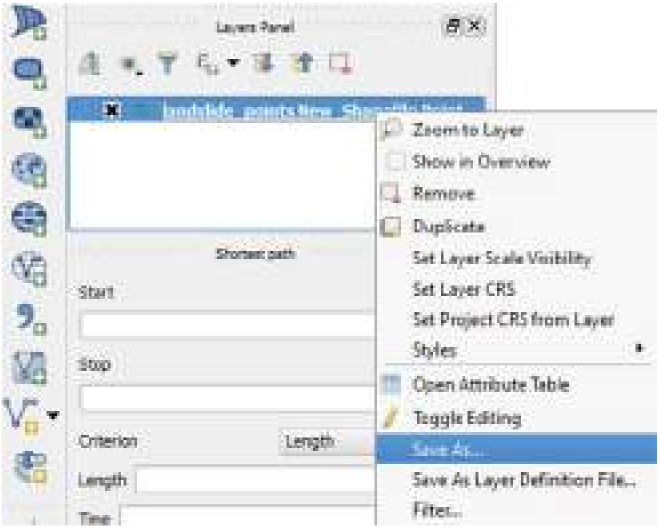
12. Click on Open to open the point file.



13. Notice that landslide_point file appears under Layers Panel while point are uploaded on map window.

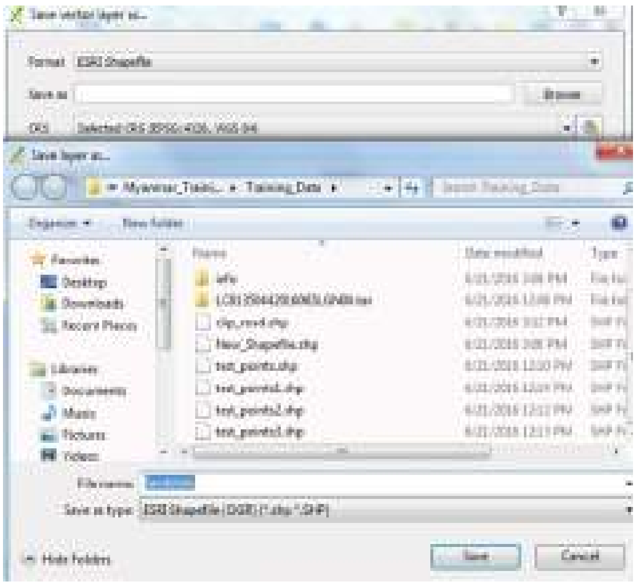


14. Right click on the landslide_pointsNew Shapefile Point and click on Save as.

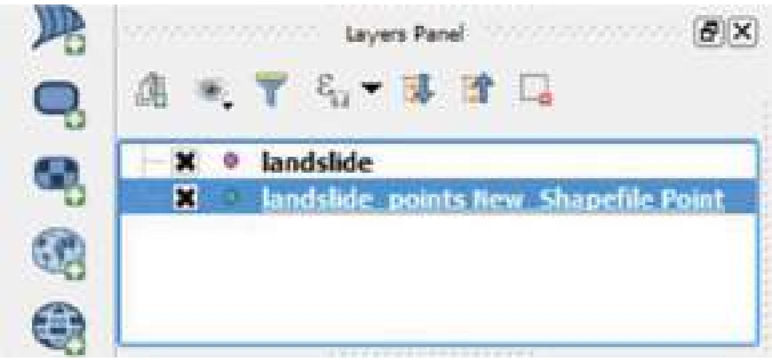


15. Click on Browse and navigate to folder to store the landslide file (F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Input_Data\).

Name the file as landslide and press Save followed by Ok.



16. Note that landslide has been added under Layer Panel. You may remove other file. To do so right click on the file name under Layer Panel and click on Remove.



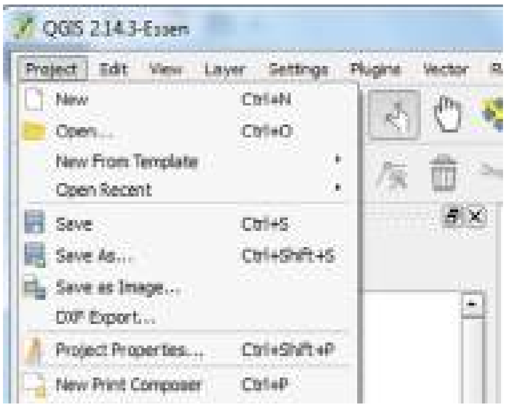
Landslide hazard mapping

Data preparation

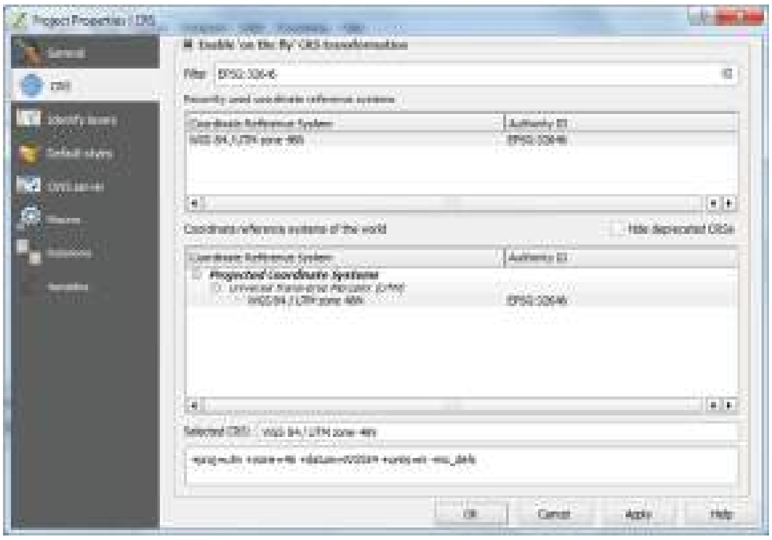
Input data can broadly categorized into two: independent and dependent variables. Independent variables are data representing causative factors like geology, river network, road network, landcover/use, etc. Dependent variable is landslide point database. For our exercise we will use 8 independent variables as below:

1. Geology
2. Road network
3. Drainage network
4. Slope
5. Aspect
6. Curvature
7. Fault lines
8. Landcover

1. Open QGIS and click on Project.

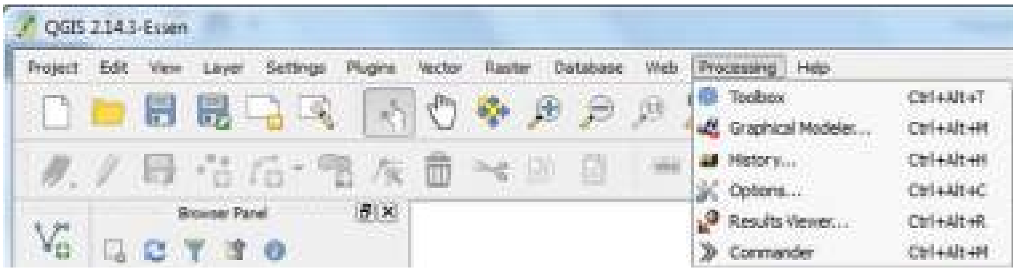


2. Check the box against ‘Enable on the fly’ CRS transformation and type EPSG:32646 in the Filter. You can also search for the same scrolling through list of coordinate systems. EPSG:32646 refers to WGS 84/UTM Zone 46N. Click on Apply to apply the setting. Click on Ok to close.

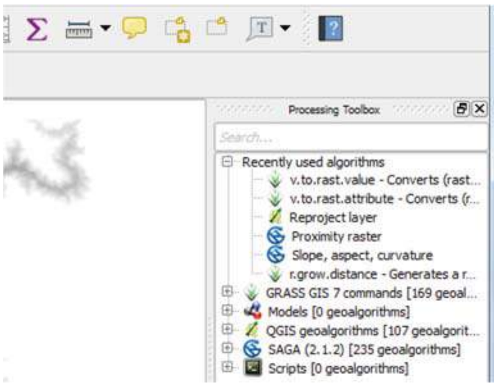


3. Click on Add Raster Layer and browse for digital elevation model (DEM) of the study area (F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Input_Data\ dem.tif). Click on Open to open the dem.tif in the map window.

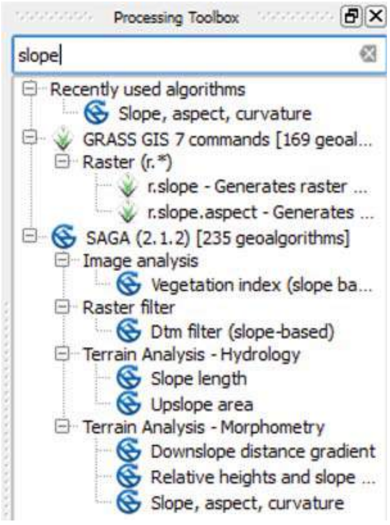
4. Click on Processing > Toolbox to invole tool box.



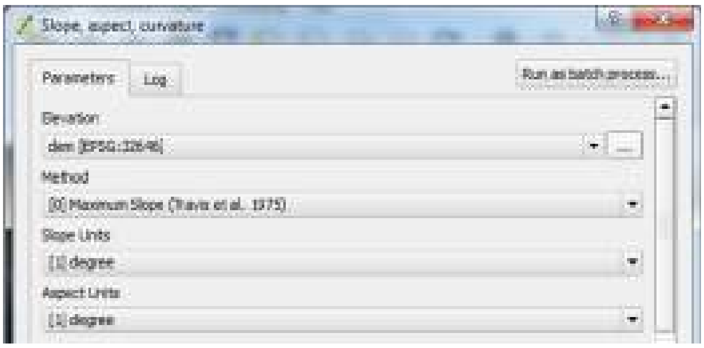
5. Processing Toolbox will be open on the left corner of QGIS interface.



6. Type slope to search the slope tool. Under SAGA and Terrain Analysis – Morphometry you will see Slope, aspect, curvature. Click on Slope, aspect, curvature.

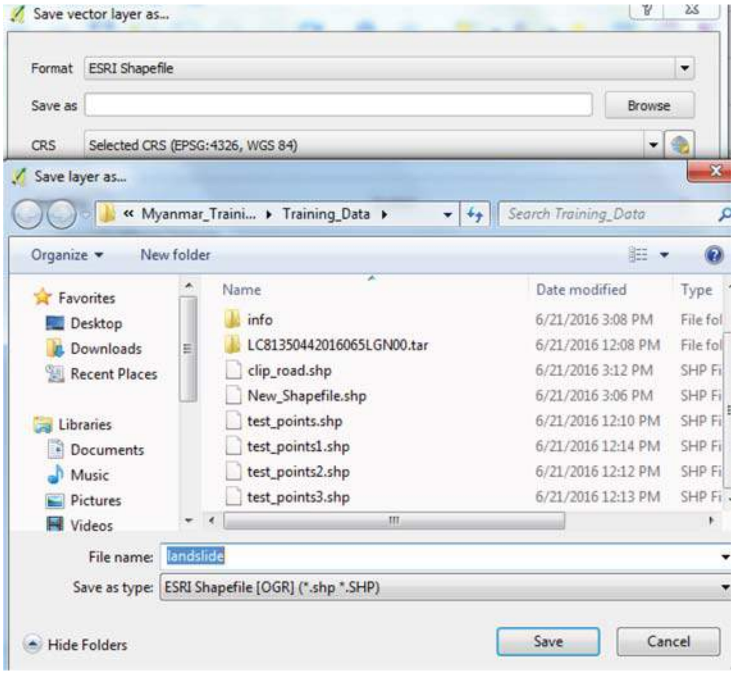


7. Specify dem (F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Input_Data\dem.tif) as Elevation file. Select Maximum Slope as method, and degree as measurement of Slope and Aspect.

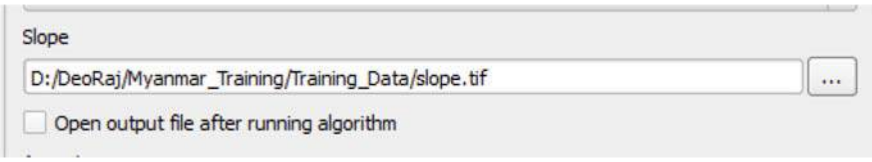


8. Click on the box beside Slope and click on Save to file....

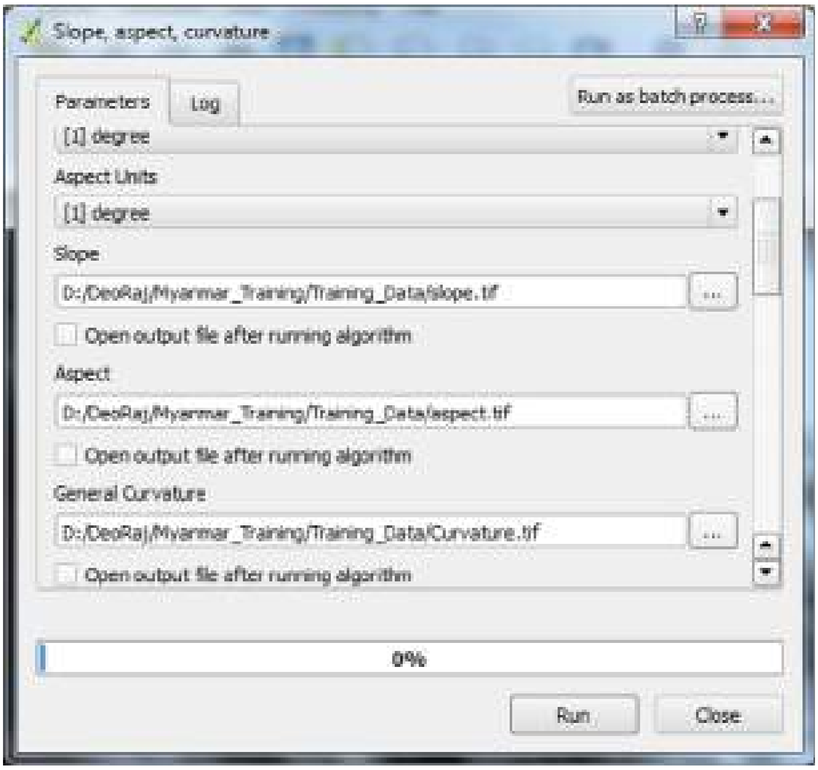
9. Browse to F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Input_Data\ and name the file as slope. Click on Save.



10. Check off "Open output file after running algorithm".

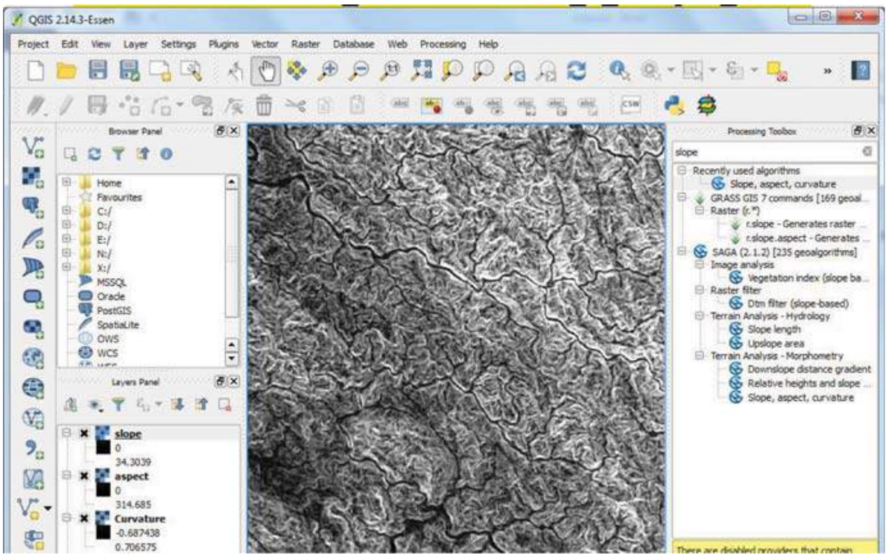


11. Repeat steps 8, 9 and 10 for Aspect and General Curvature also. Name the output files as aspect and curvature respectively. Once done click on Run to generate the slope, aspect and curvature from DEM.

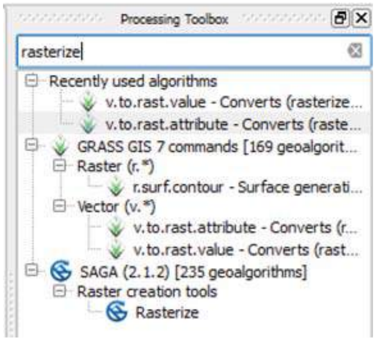


12. Once the process is completed click on Close.

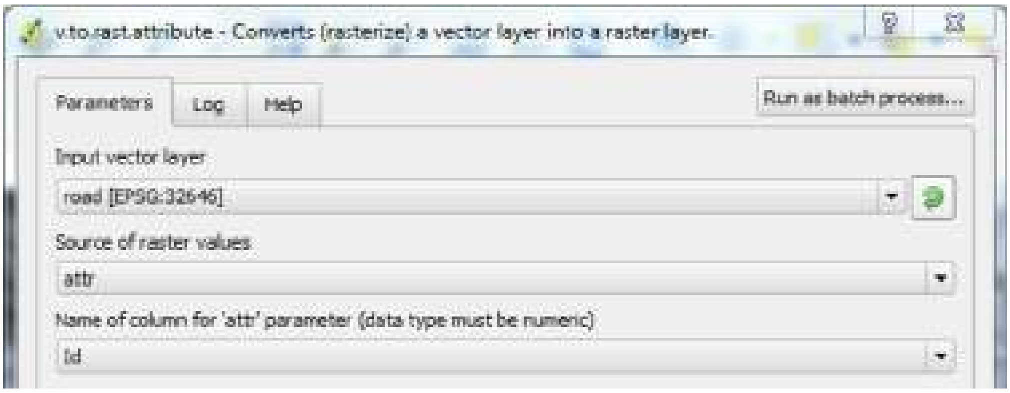
13. Click on Add Raster Layer and add newly generated files: slope, aspect and curvature from F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Input_Data\ folder.



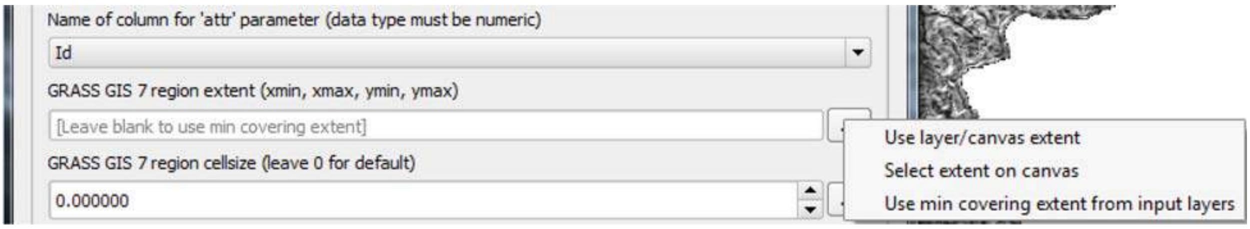
14. Add road data (F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Input_Data\road.shp). On the Processing Toolbar search bar type rasterize. Double click on v.to.rast.attribute.



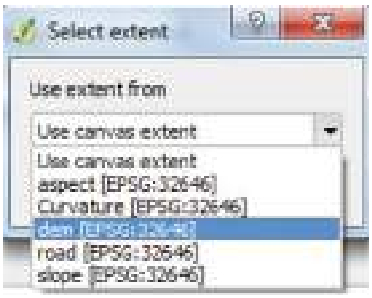
15. As input select road, attr, and Id for first three parameters.



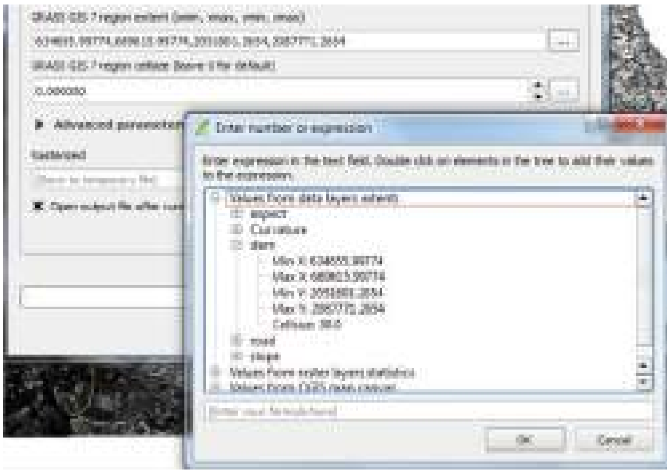
16. To set extent, click on box at the right end and select Use layer/canvas extent.



17. Select dem as reference to set the extent and click on Ok.



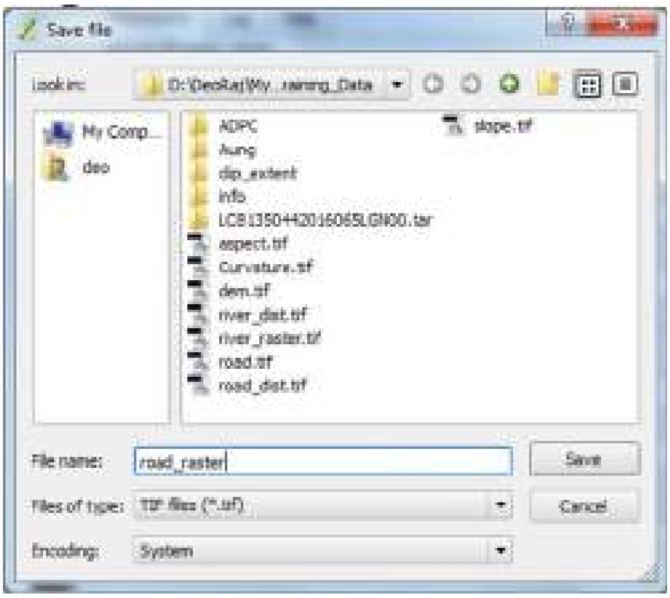
18. To set the cell size click on the box at the left corner and expand Values from data layers extents followed by dem. Double click on Cellsize. Click Ok.



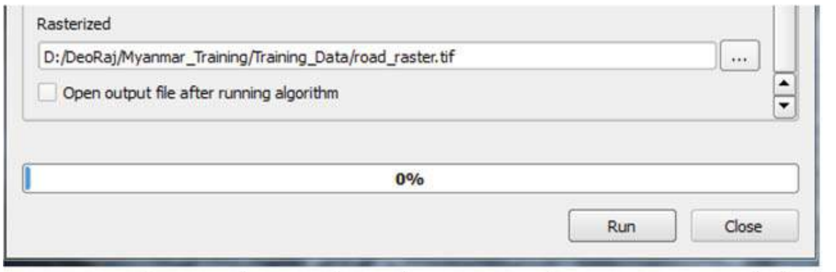
19. Scroll down and expand Advance parameters.

20. Under Rasterized click the box at the right end and followed by Save to file.

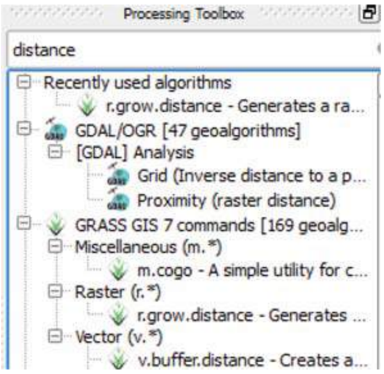
21. Brows to F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Input_Data\ and name the new file as road_raster and click on Save.



22. Click on Run. Once completed add road_raster.tif to map window.



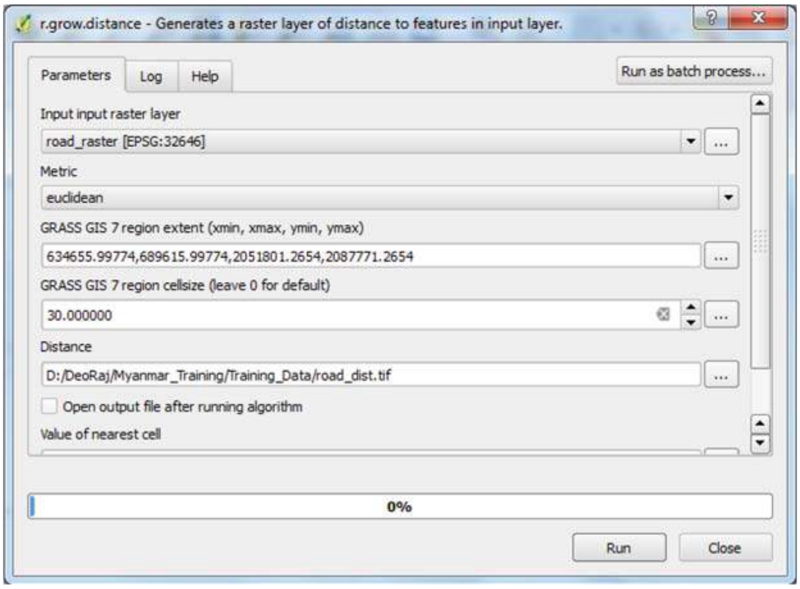
23. Type distancein search under Processing Toolbox and double click on r.grow.distance.



24. Select road_raster as Input input raster layer and euclidean under Metric. Check off "Open output file after running algorithm".

25. Click on the box at the right end against the Distance.

26. Name the file to be created road_dist and click on Run.



27. Repeat steps through 14 to 26 with river network to create distance from river, name it is river_dist. Once created, add the river_dist to map window.

28. Add geological map (F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Input_Data\geology.shp) of the area. Convert from feature to raster (the process is called rasterize). Name the output file geo_raster. Refer steps 14 to 20 if you need help.

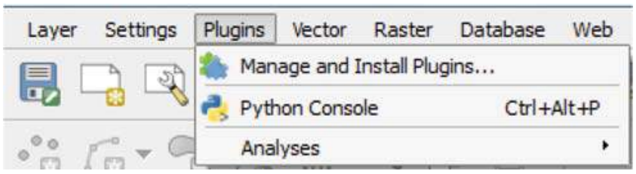
29. Add fault lines (F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Input_Data\fault.shp) or the area. Convert from feature to raster. Then create distance from fault map and name it fault_dist (refer step from 23 to 26 if you need help.

30. Add landcover (F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Input_Data\landcover.tif).

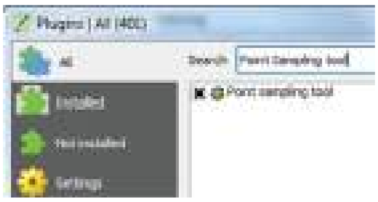
Hazard mapping

1. You should have all layers (landslide points, geology, distance from road, distance fromriver network, slope, aspect, landcover, distance from fault) opened up in map window.

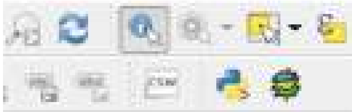
2. You need to install Point sampling tool from plugin. To do so click on



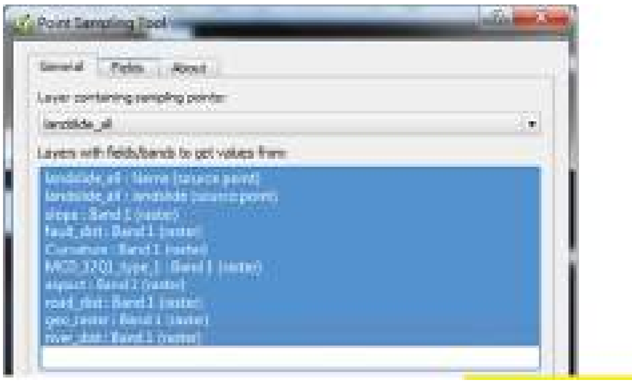
3. In Search bar type Point sampling tool.



4. Select the Point sampling tool and install click on Install plugin. Within a minute plugin should get installed.
5. Click on Point sampling tool icon on the tool bar.

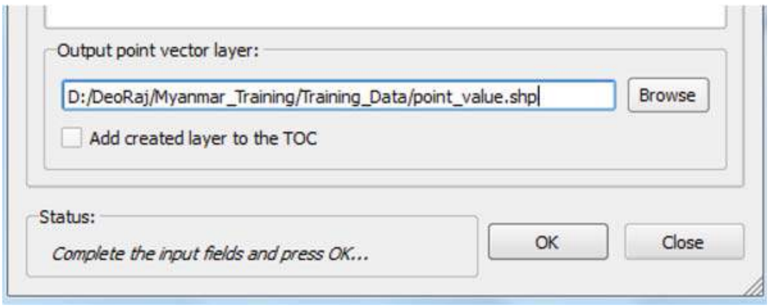


6. Select landslide_all to identify point layer, and select all the layers in the next box.

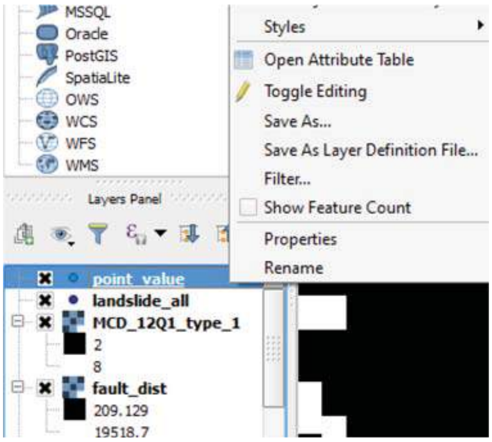


7. Click on Browse and navigate to F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Input_Data\ folder. Name the new file as point_value and click on Save.

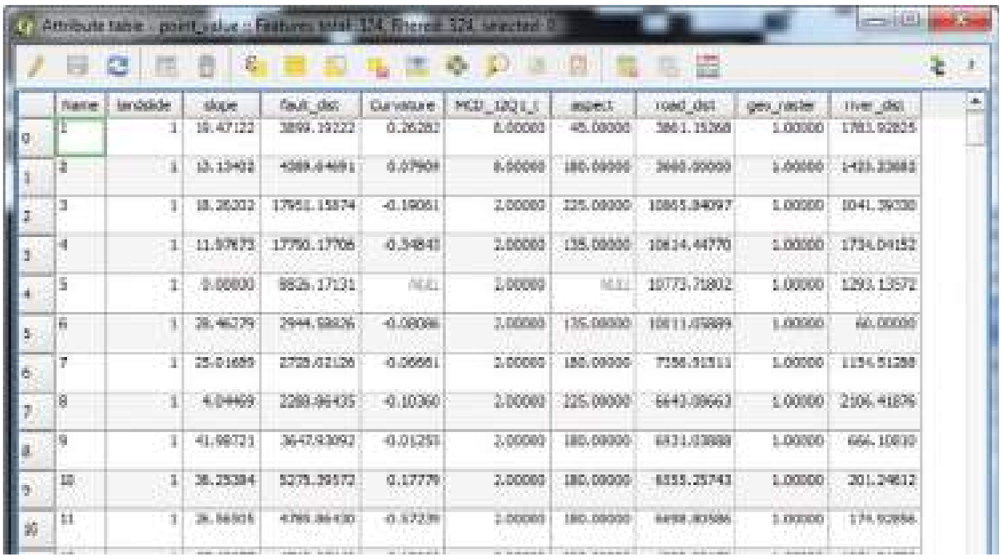
8. Check off the Add created layer to the TOC and then click on Ok. Once processing finished click on Close.



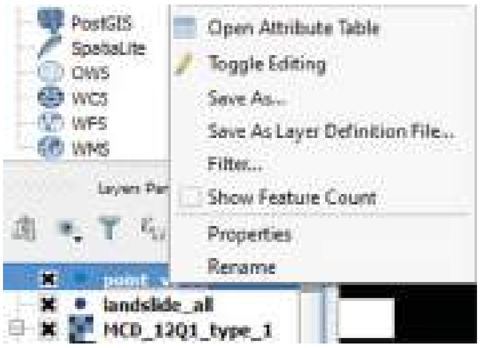
9. Add F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Input_Data\point_value.shp on map window. Under Layer panel right click on point_value and click on Open Attribute Table.



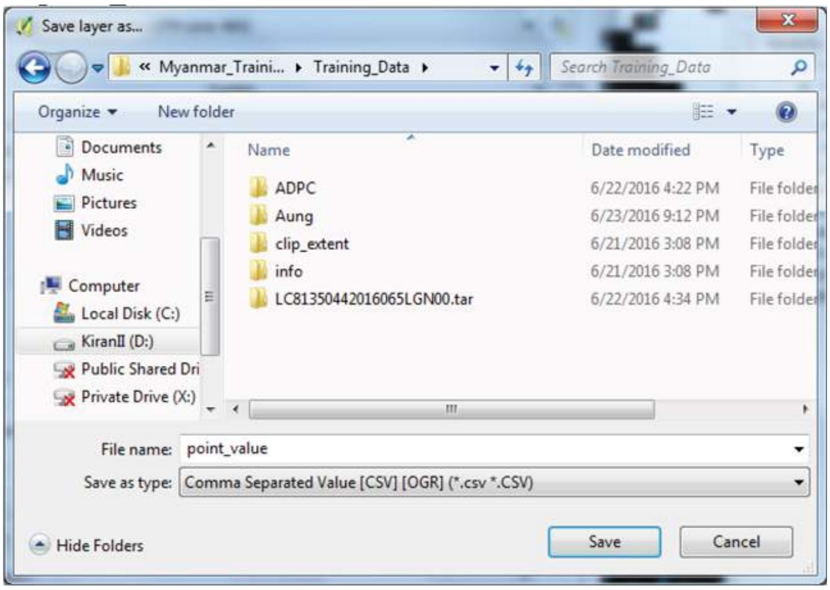
10. Value corresponding to each of the point for individual independent layers has been extracted.



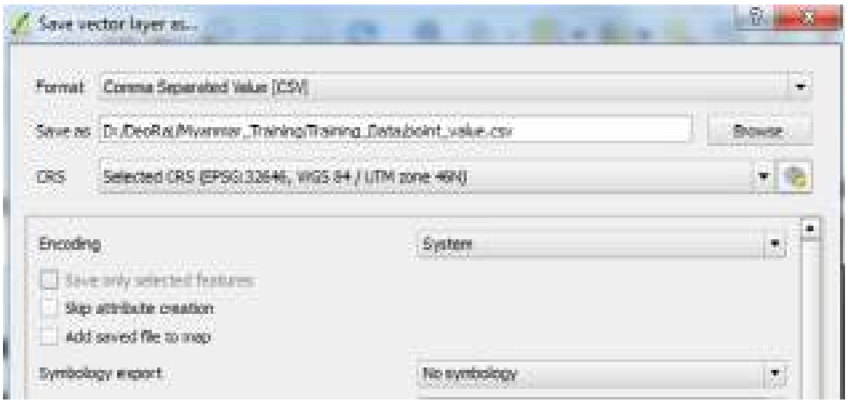
11. To export to .CSV file right click on point_value under Layer Panel and click on Save as...



12. Browse to F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Input_Data\ and name the .CSV file as point_value. Click on Save.



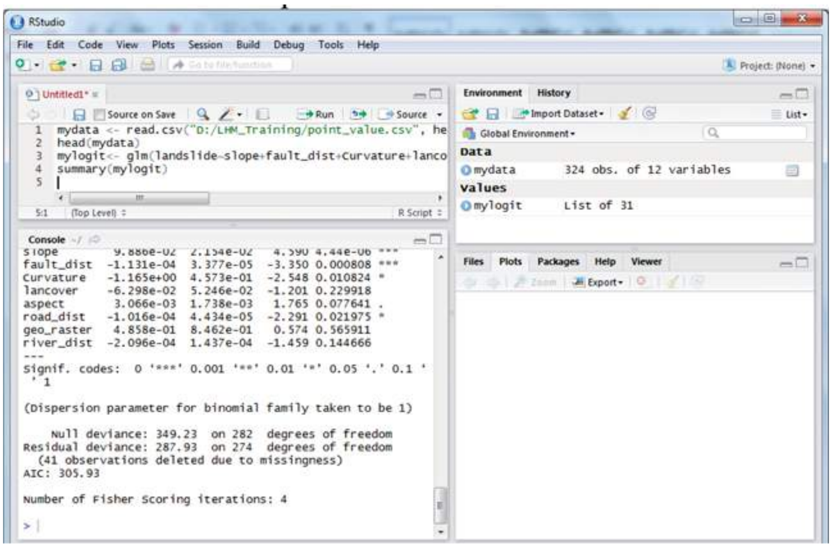
13. Uncheck Add saved file to map and click on Ok.



14. Browse for point_value.csv in F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Input_Data\ and open in Excel. Values for all layers at every landslide points has been derived. We will use this .csv data to run logistic regression

	A	B	C	D	E	F	G	H	I	J	K	L
1	X	Y	Name	landslide	slope	fault_dist	Curvature	lancover	aspect	road_dist	geo_raste	river_dist
2	635950.2	2080750	1	1	19.47122	3899.192	0.26282	5	45	3841.153	1	1783.928
3	635612.9	2081368	2	1	13.13403	4389.647	0.07909	5	180	3660	1	1425.237
4	653244.7	2054029	3	1	18.26202	17951.16	-0.19061	2	225	10865.84	1	1041.393
5	653043.4	2054759	4	1	11.97673	17796.18	-0.34843	2	135	10614.45	1	1734.042
6	663000.9	2054440	5	1	0	8826.171		2		10773.72	1	1293.136
7	669506.1	2052070	6	1	28.46279	2944.388	-0.08086	2	135	10011.06	1	60
8	675215.4	2052435	7	1	25.01689	2728.021	-0.06661	2	180	7356.915	1	1154.513
9	674612.5	2053239	8	1	4.04469	2288.864	-0.1036	2	225	6643.087	1	2106.419
10	676091.7	2052751	9	1	41.98721	3647.931	-0.01255	2	180	6911.039	1	666.1081

15. Click on to start up RStudio .

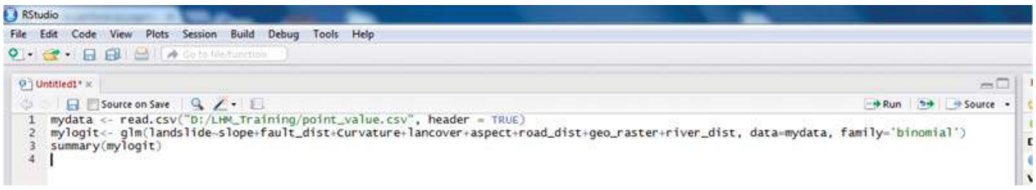


16. Enter following script in script window as shown below.

mydata <- read.csv("F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Input_Data\point_value.csv", header=TRUE)

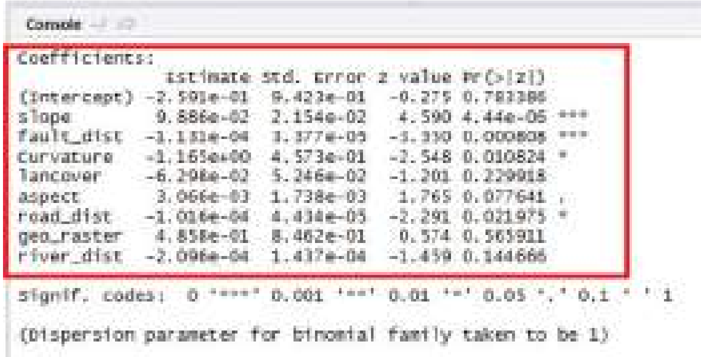
mylogit <- glm(landslide ~ slope + fault_dist + Curvature + landcover + aspect + road_dist + geo_raster + river_dist, data = mydata, family = "binomial")

summary(mylogit)



17. Select the script and click on Run to run logistic regression.

18. Result of the logistic regression is shown as below. We are interested in coefficient as for each independent variable as indicated by red box. These values are coefficient (□, □1, □2,.....) in Equation 2. We can now calculate Z.



```
Console
Coefficients:
              Estimate Std. Error z value Pr(>|z|)
(Intercept) -2.591e-01  9.423e-01  -0.275 0.783386
slope        9.886e-02  2.154e-02   4.590 4.44e-06 ***
fault_dist  -1.131e-04  3.377e-05  -3.350 0.000808 ***
curvature   -1.165e+00  4.573e-01  -2.548 0.010824 *
landcover   -6.298e-02  5.246e-02  -1.201 0.229918
aspect       3.066e-03  1.738e-03   1.765 0.077641 .
road_dist   -1.016e-04  4.434e-05  -2.291 0.021975 *
geo_raster   4.858e-01  8.462e-01   0.574 0.565911
river_dist  -2.096e-04  1.437e-04  -1.459 0.144666
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Dispersion parameter for binomial family taken to be 1)
```

$$P = \frac{e^{Z}}{1+e^{Z}} = \frac{1}{1+e^{-Z}} \qquad (1)$$

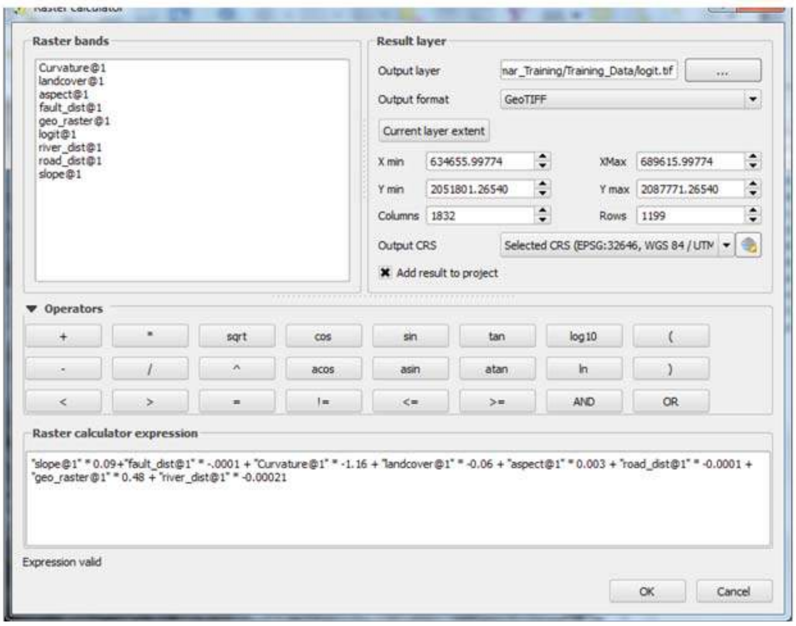
$$Z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n \qquad (2)$$

19. Open QGIS and click on Raster and Raster Calculator....

20. To implement Equation 2 (page 7) type below equation as shown below in Raster Calculator.

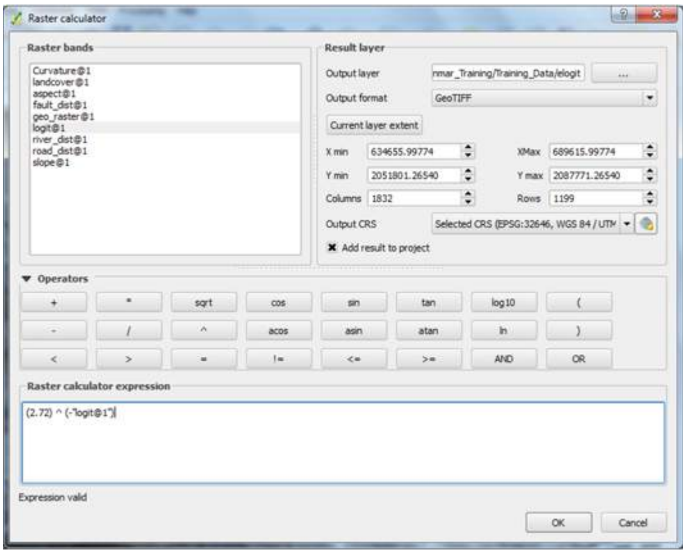
"slope@1" * 0.09+"fault_dist@1" * -.0001 + "Curvature@1" * -1.16 + "landcover@1" * -0.06 + "aspect@1" * 0.003 + "road_dist@1" * -0.0001 + "geo_raster@1" * 0.48 + "river_dist@1" * -0.00021

Name output layer as logit and format be GeoTIFF. Click on Current layer extent. Click on Ok.

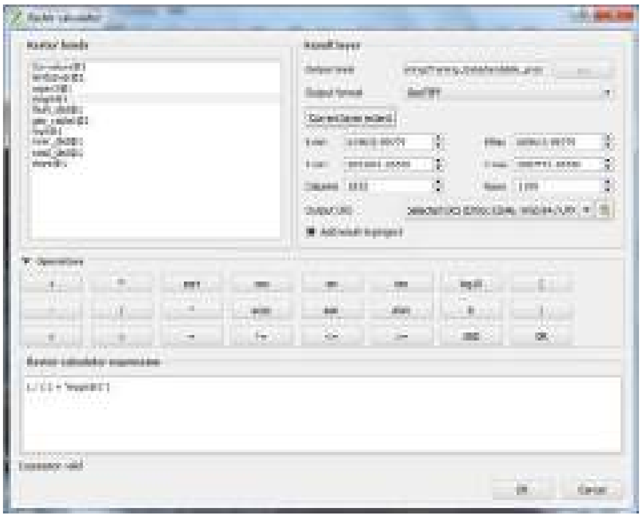


21. Now we have calculated Z layer and need to solve Equation 1, for which we will need to solve e-z first. To do so open Raster Calculator.

22. Enter shown as below in Raster calculator expression and save the output as elogit as GeoTIFF. Click Ok.



23. Now we need to solve Equation 1. To do so open Raster Calculator and enter expression as below in Raster calculator expression. Save the output layer as F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Output_Data\landslide_prob. Click on Ok.



24. The output layer landslide_prob is a landslide probability map which gives pixel based probability (to landslide) value. This is further re-coded into four classes: 1 as low, 2 as medium, 3 as high, and 4 as very high hazard zones using percentile approach as below:

Range New value Description

< 0.25 1 Low hazard

0.25-0.50 2 Mid hazard

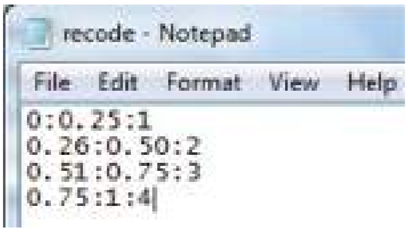
0.50-0.75 3 High hazard

> 0.75 4 Very high hazard

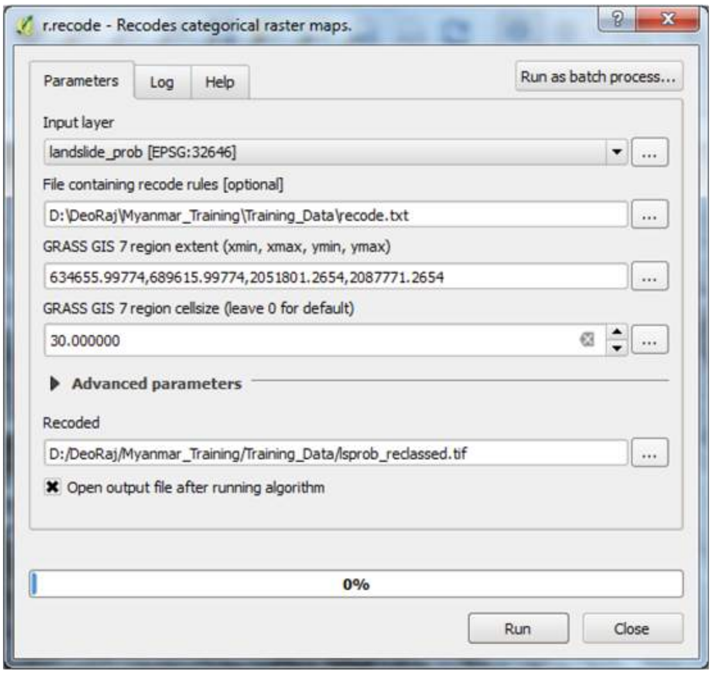
25. Open a Notepad and write as below. It means recode anything between 0 and 0.25 as 1; 0.26 and 0.50 as 2, and so on and so forth. Save it as recode in F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Output_Data\.

Range	New value	Description
<0.25	1	Low hazard
0.25-0.50	2	Mid hazard
0.50-0.75	3	High hazard
>0.75	4	Very high hazard

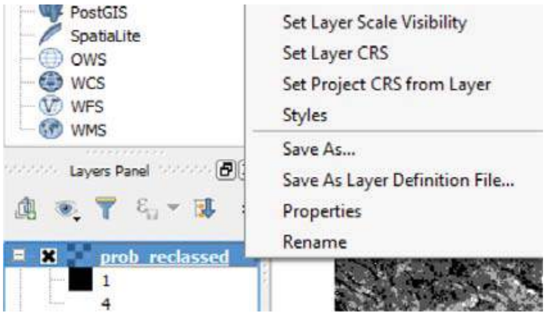
26. With the landslide_prob opened in map window, search for recode in Processing Toolbox. Double click on r.recode.



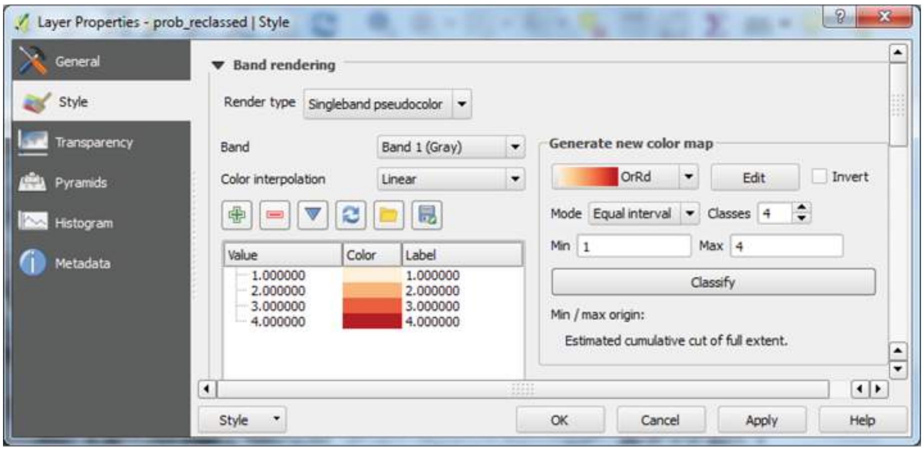
27. Identify landslide_prob as Input layer, navigate to F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Output_Data\recode.txt (Notepad file) as File containing recode rules. As GRASS GIS 7 region extent select landslide_prob, and for cellsize select landslide_prob and double click in 30. Name the recoded file as prob_reclassed.tif. Click on Run.



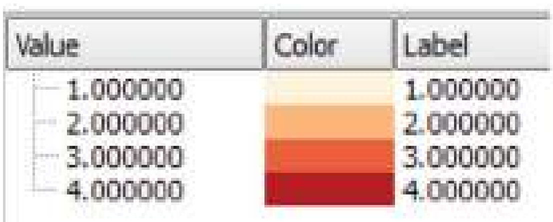
28. Under Layer Panel right click on prob_reclassed and click on Properties.

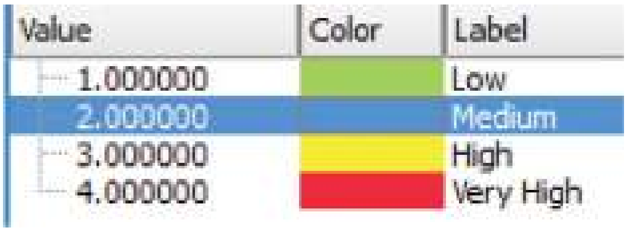


29. Select singleband pseudocolor as Render type, under Mode select Equal interval and make Classes to 4. Click on Classify.

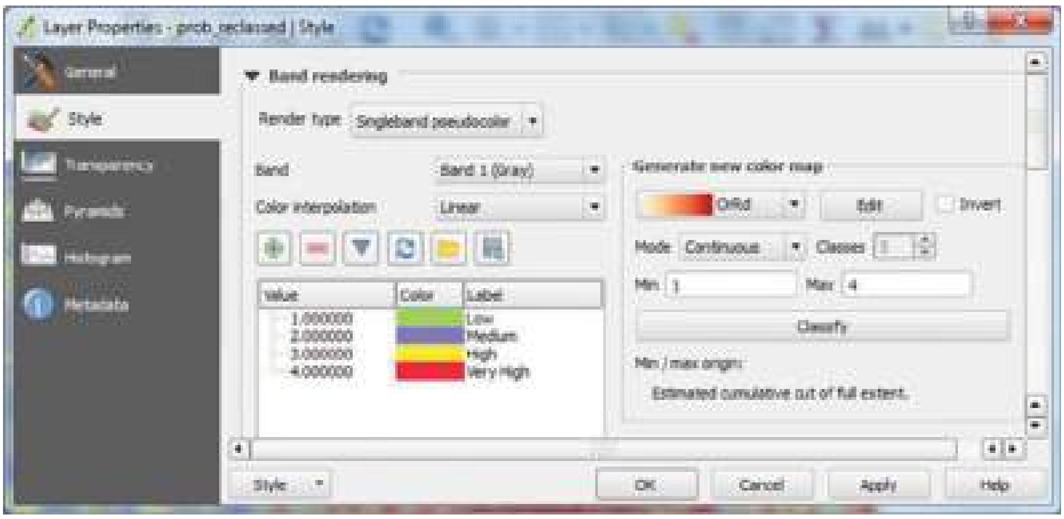


30. Double click on color bar and change the color to green, blue, yellow and red. Similarly change the Label as shown below.

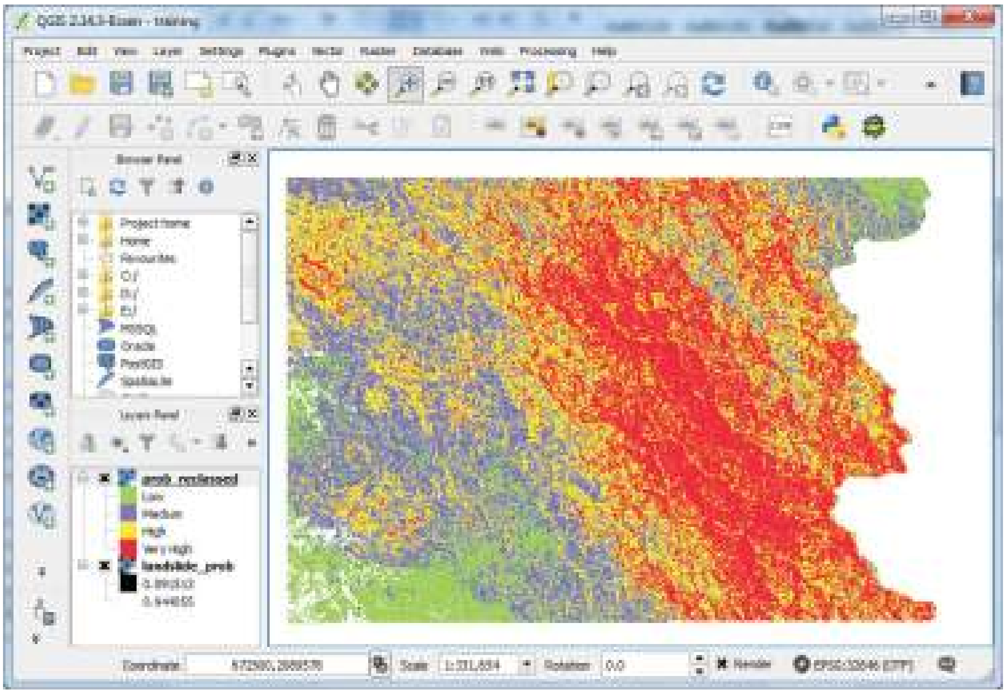




31. Click on Ok to apply the classification scheme in the map.



32. Hazard map is ready with color coded legend too. Click on Save and save it as hazard_map inside F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Output_Data\.



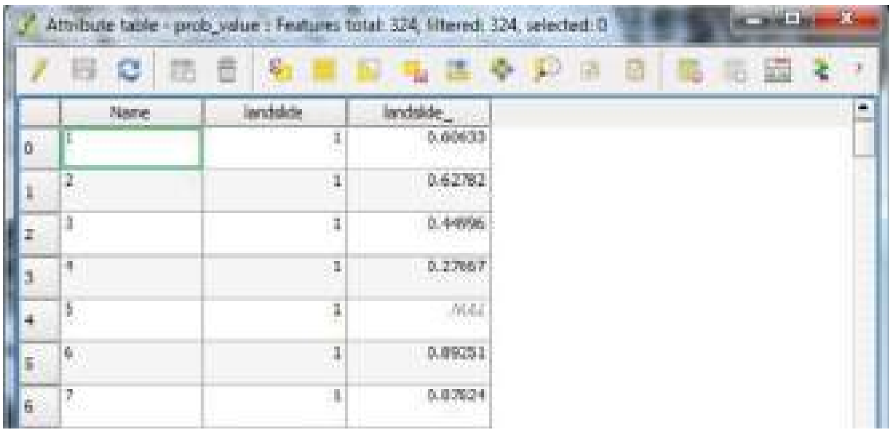
Accuracy assessment

There are many ways accuracy assessment are done but we will use ROC (Receiver Operating Characteristic) and Area Under Curve (AUC), using R software package. First we will need to generate probability value for all the landslide (and non-landslide) points using Point sampling tool.

1. Extract probability value (F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Output_Data\landslide_prob.tif) for each landslide points

   (F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Output_Data\landslide_all.shp).

2. The attribute table of the newly created prob_value point file should look like below where landslide indicates yes (1) or no (0) of landslide, and landslide_ indicates probability value.


Attribute table - prob_value :: Features total: 324, filtered: 324, selected: 0

	Name	landslide	landslide_
0	1	1	0.60633
1	2	1	0.62782
2	3	1	0.44896
3	4	1	0.27667
4	5	1	NULL
5	6	1	0.89251
6	7	1	0.87624

3. Export the attribute table to .CSV file and name it prob_value.csv.

4. Open the prob_value.csv in Excel. ROC is generated using this .csv file.

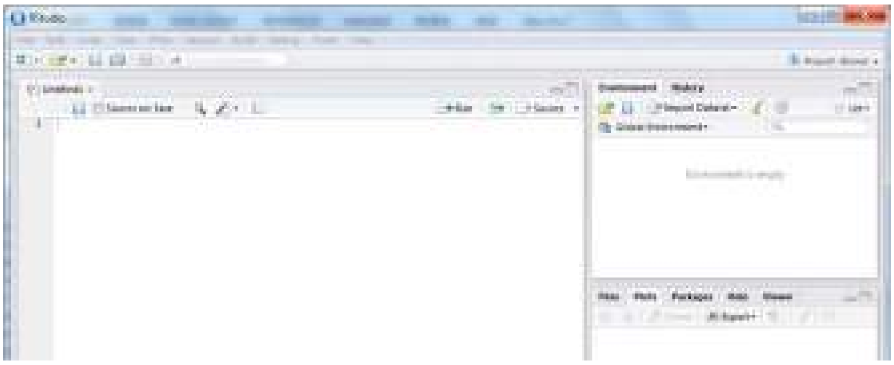
M9

	A	B	C	D
1	WKT	Name	landslide	landslide_
2	POINT (63	1	1	0.60633
3	POINT (63	2	1	0.62782
4	POINT (65	3	1	0.44996
5	POINT (65	4	1	0.27667
6	POINT (66	5	1	
7	POINT (66	6	1	0.89251
8	POINT (67	7	1	0.87824
9	POINT (67	8	1	0.5454
10	POINT (67	9	1	0.97066
11	POINT (67	10	1	0.93895
12	POINT (67	11	1	0.94109
13	POINT (67	12	1	0.91092

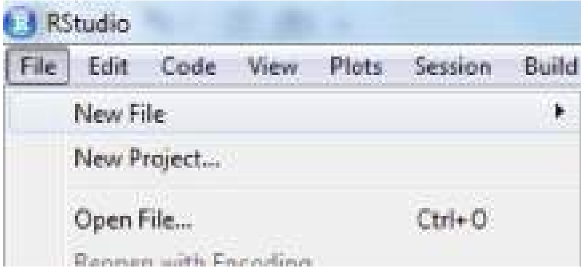
5. Delete column A and B and rename column D as prob. Save it and press Yes if prompted. It should look like below. Close the file.

	A	B
1	landslide	prob
2	1	0.60633
3	1	0.62782
4	1	0.44996
5	1	0.27667
6	1	
7	1	0.89251
8	1	0.87824
9	1	0.5454
10	1	0.97066
11	1	0.93895
12	1	0.94109
13	1	0.91092
14	1	0.78183
15	1	0.65983
16	1	0.95328

6. Open RStudio.

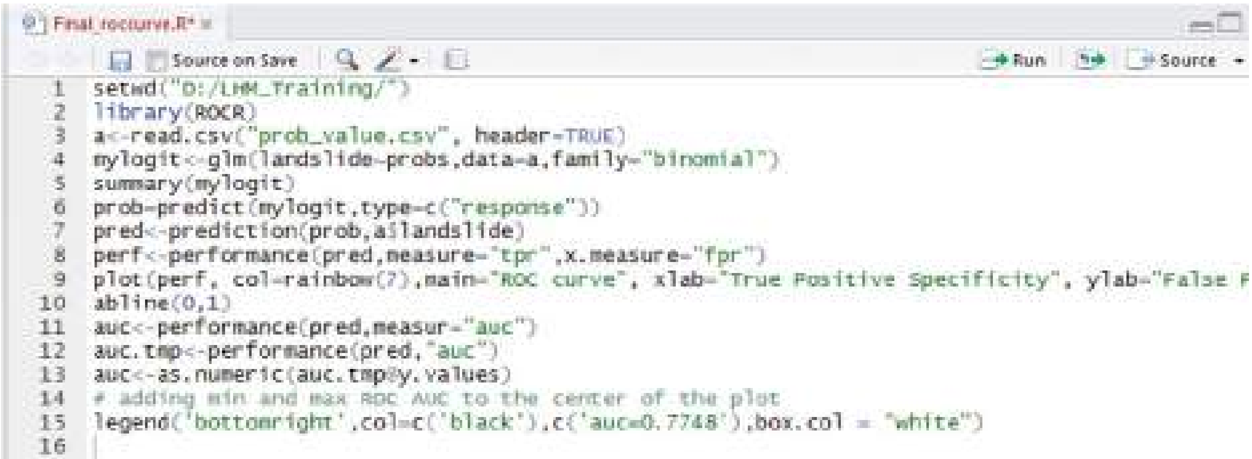


7. Click on File >> Open File.



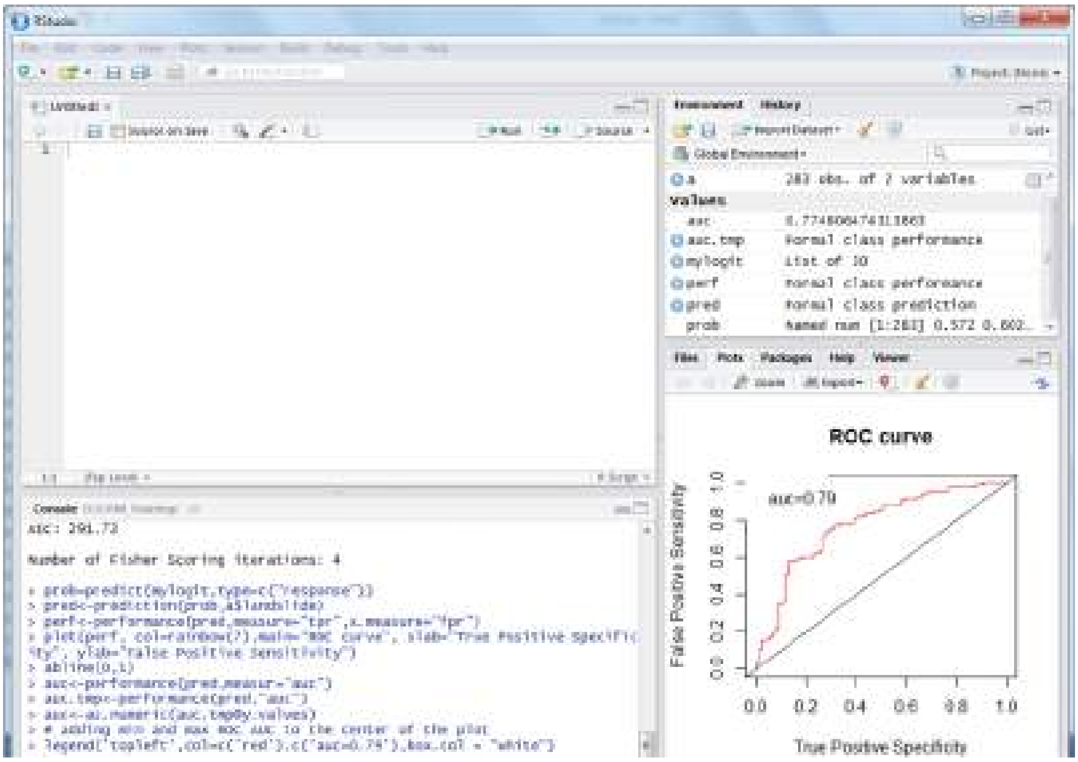
8. Browse for F:\UNHabitat\RRD_DRM\Data\Exe_3_3\Input_Data\roc.R.

9. roc.R is a script to perform ROC and AUC. One needs to configure the working directory, input .csv file and column to use for deriving ROC.

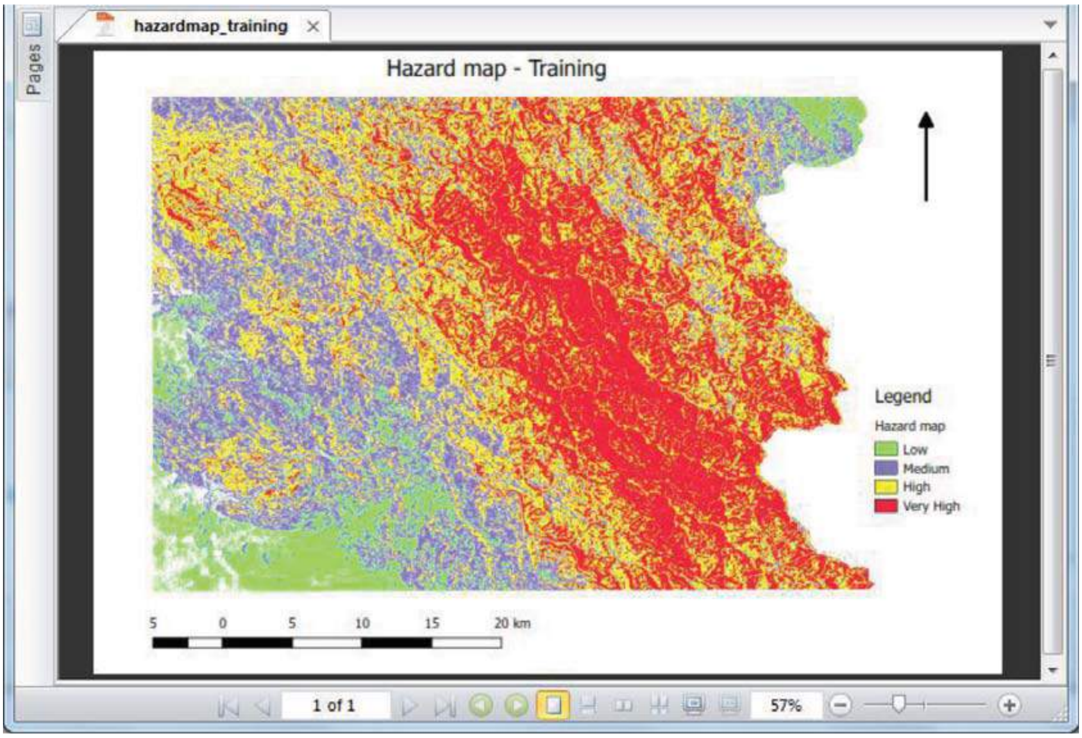


10. To run the script select entire script and click on Run.

11. On the right side of the R interface click on Plots where you will see ROC plotted. AUC isalso displayed on the plot. Higher the AUC better it is in terms of accuracy.



We are ready to prepare lay out of the hazard map for printing and use in reports.



EXERCISE 3.4

DROUGHT ASSESSMENT AND MONITORING USING SPOT VEGETATION DATA

The dry zone, central area of Myanmar is the area vulnerable to drought as compared to other parts of the country. Low rainfall, intense heat and degraded soil condition affect to social and economic situations of the local community in this area. In this exercise, we will compare the NDVI value between 2013 and 2015 to monitor crop conditions for early warning and assessment of agricultural drought using multi temporal Landsat satellite imageries.

Learning Objective:

- The aim of the exercise is to monitor crop conditions for early warning and assessment of agricultural drought using multi-date satellite imageries. This exercise will increase the skills of the participants in using QGIS software for performing various tasks like clipping image, image enhancement, generating NDVI, creating NDVI difference images and spatial statistics.

Data Used: Landsat images for 2013 (Normal Year) and 2015 (Drought Year)

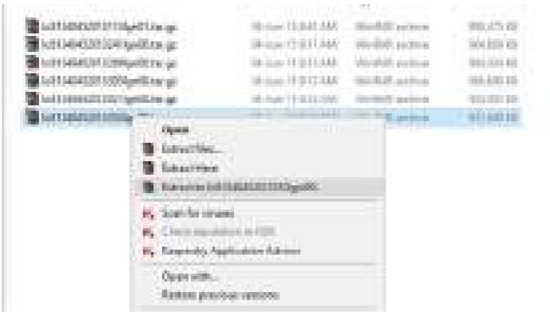
STEPS

(A) Data Preparation

1. Unzip the files

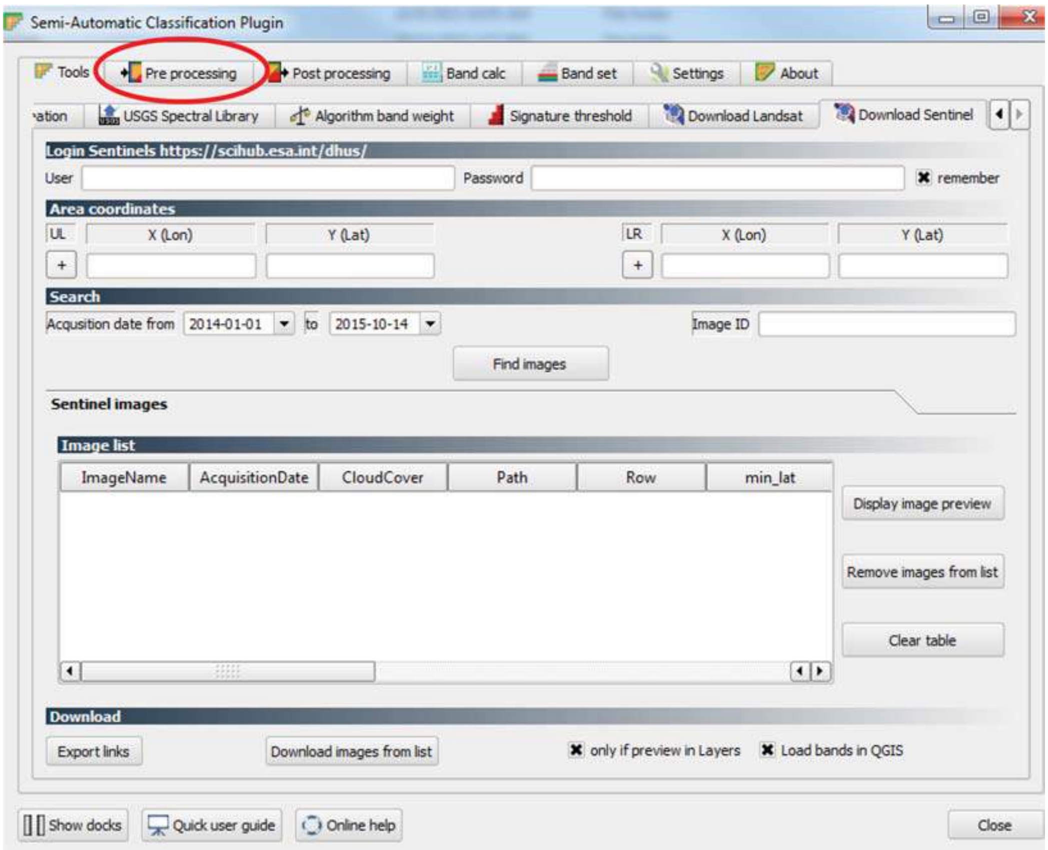
- You can manually unzip these files using 7 zip software. If you don't have 7 zip, you can download it here: www.7-zip.org

- Note: To unzip, simply right click and select 'Extract to.........'. You will now see this:

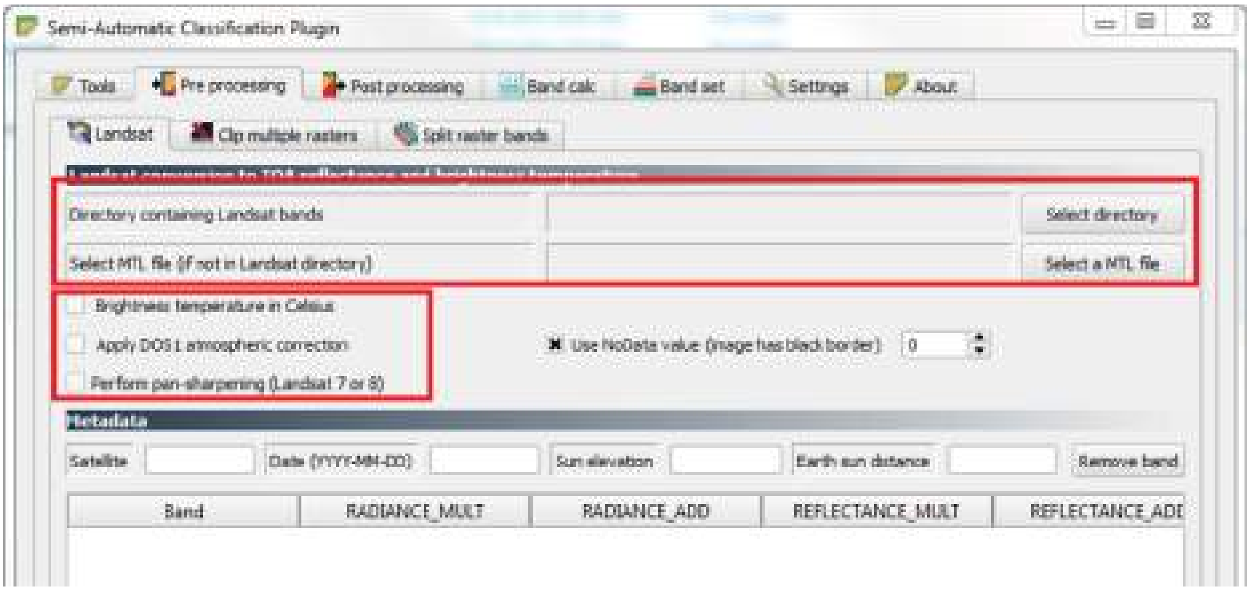


2. Conversion of raster bands from DN to Reflectance for the images using Semi-automatic classification plugin

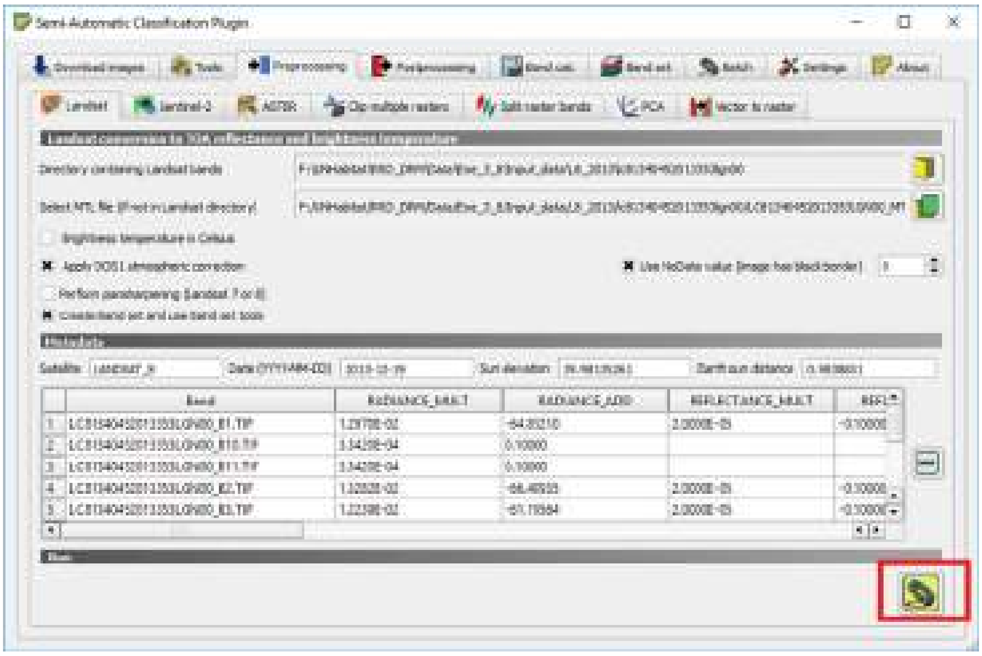
- We will use the Semi-Automatic Classification Plugin (SCP) tool in QGIS to convert to top-of-atmosphere (TOA) reflectance. Open QGIS. Turn on the SCP tools if not already active. To do this, right click and check the box next to 'SCP Toolbar'. Click on the button to activate the SCP interface. Once the SCP window opens, click on 'Pre-processing'



- Select the directory with the Landsat bands to process. The MTL file should be in that folder already. This is the file with the gain and offset values that will be used to convert the digital numbers to TOA reflectance. At this stage, you can also select to use a dark object subtraction for atmospheric correction if you want, and you can pan-sharpen the bands to use for later steps in the classification process. Note that pan-sharpening will add considerably more time to the process.

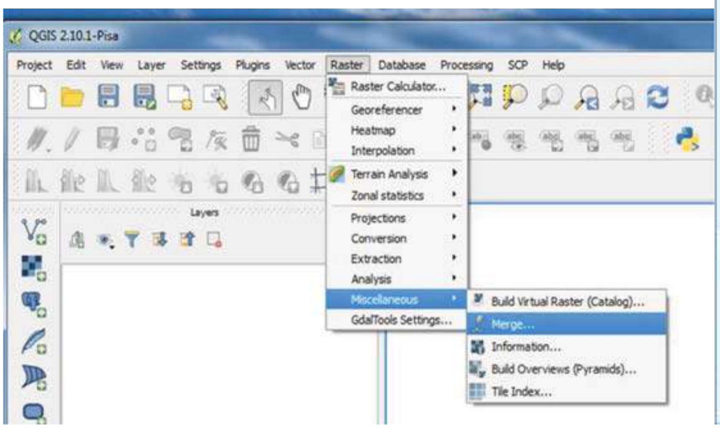


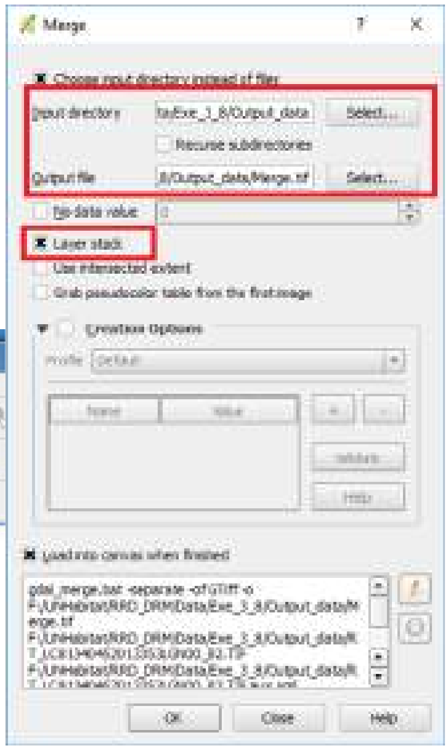
- Then select "run". A window will pop up asking where to put the processed files. It is best to create a new folder for these. Select that location and then continue.



3. Stack the bands

- To do the layer stacking in QGIS, however, it is best to have each image in its own folder. You then select the folder with the bands, remove the bands that you don't want in the final image and run the command. The command that we will use is called 'Merge' and it is available under the Raster toolset, in 'Miscellaneous'.

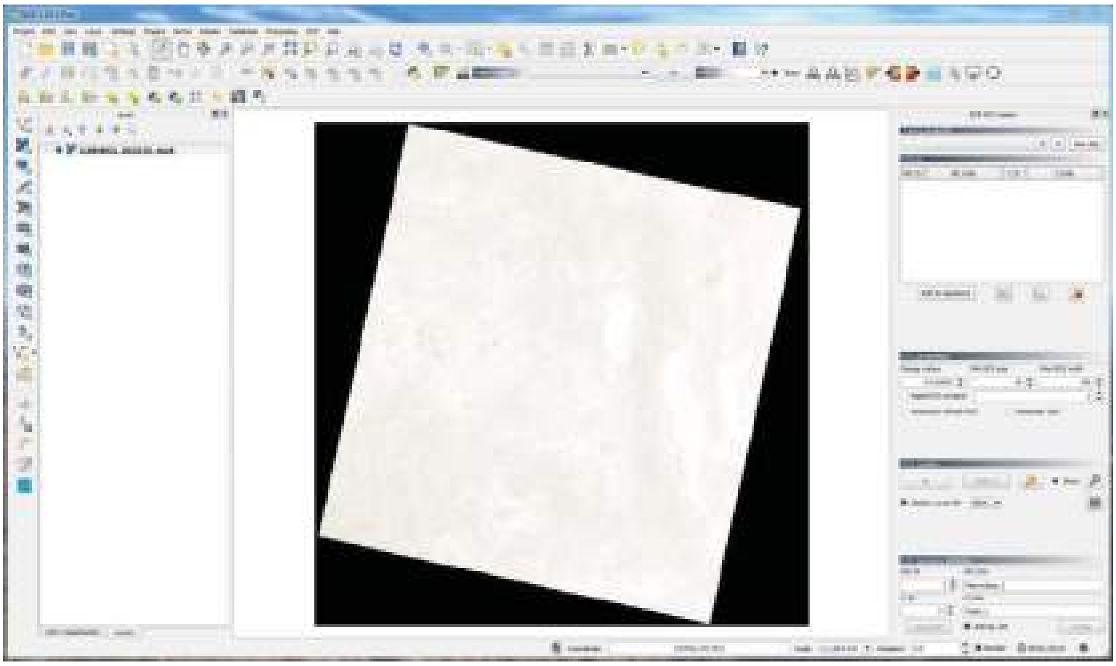




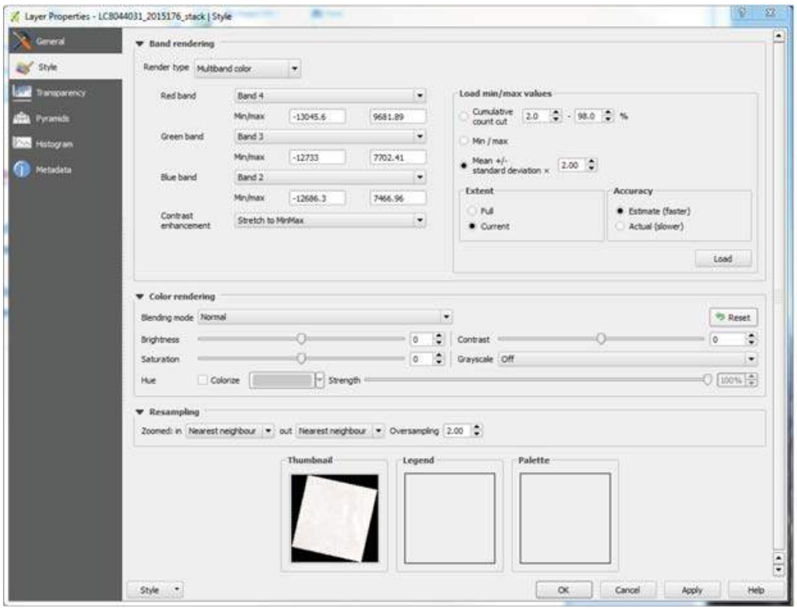
- In the Merge function, select the input directory containing the bands to stack. Then create the output file, select the no data value (I usually use -9 or -10) and check the 'Layer stack' button. You window should look something like this:

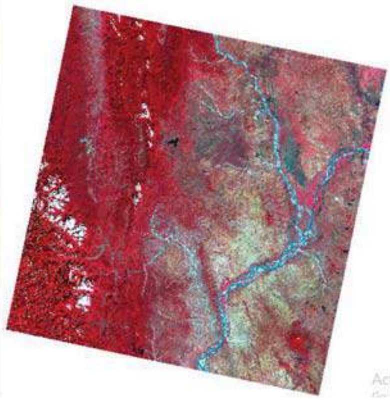
5. Subset the Image

- The image may look like this when you first view it. The no data values make the image appear very 'washed out'. We need to zoom into an area and then reset the statistics for drawing.

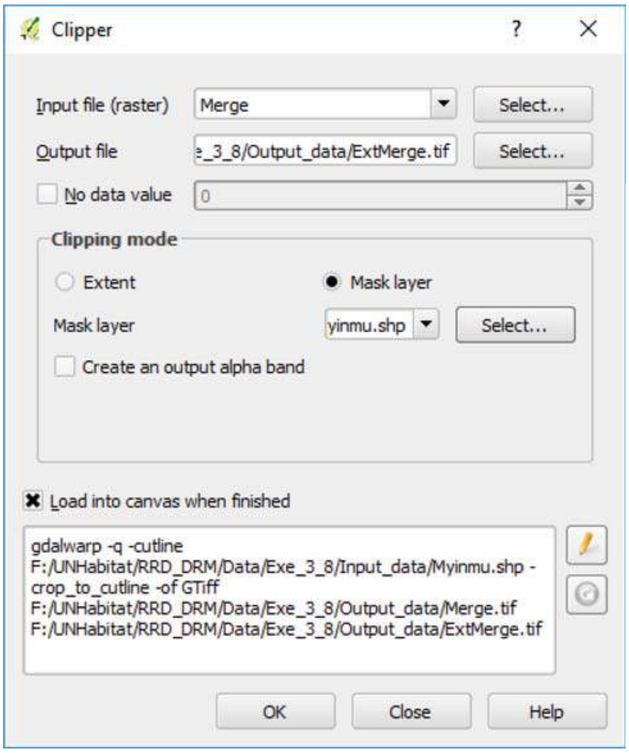


- Zoom into an interior portion of the image, check the 'Mean +/- standard deviation' button, set the extent to 'Current', then click on 'Apply'. Also, set the layers to display as 5,4,3 as shown here:



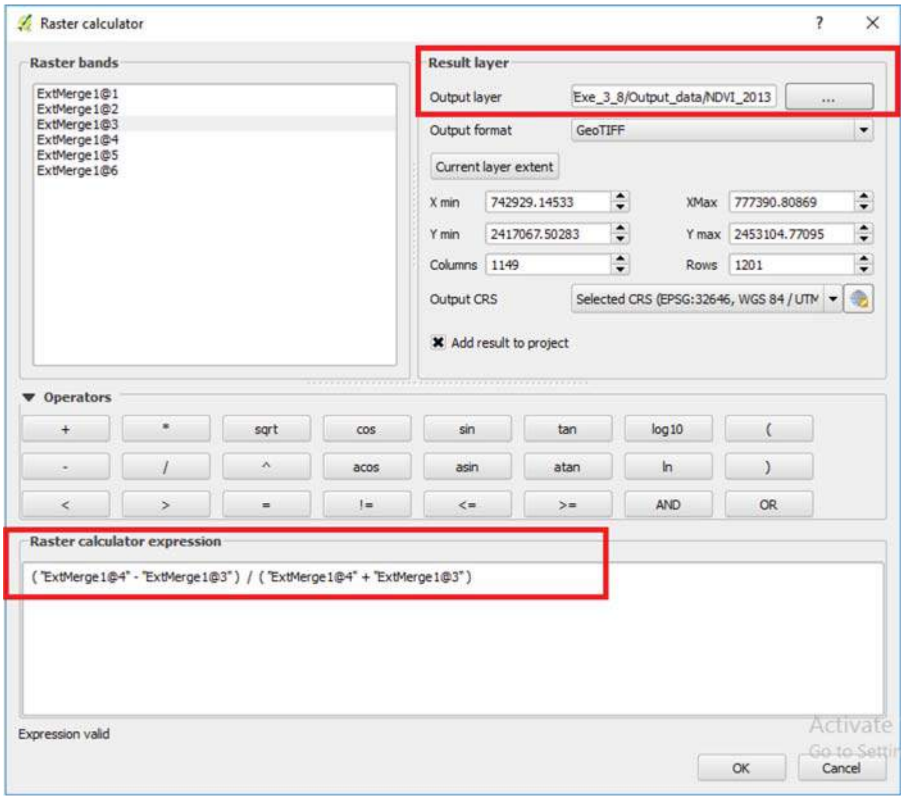


- To subset the image, you use the 'Clipper' tool. To access this, go to 'Raster' and then 'Extraction' and 'Clipper'. You can extract based on the current extent of the image inside of QGIS or you can use a mask layer, such as a polygon of a region of interest. Then the output file will be appeared like follow.

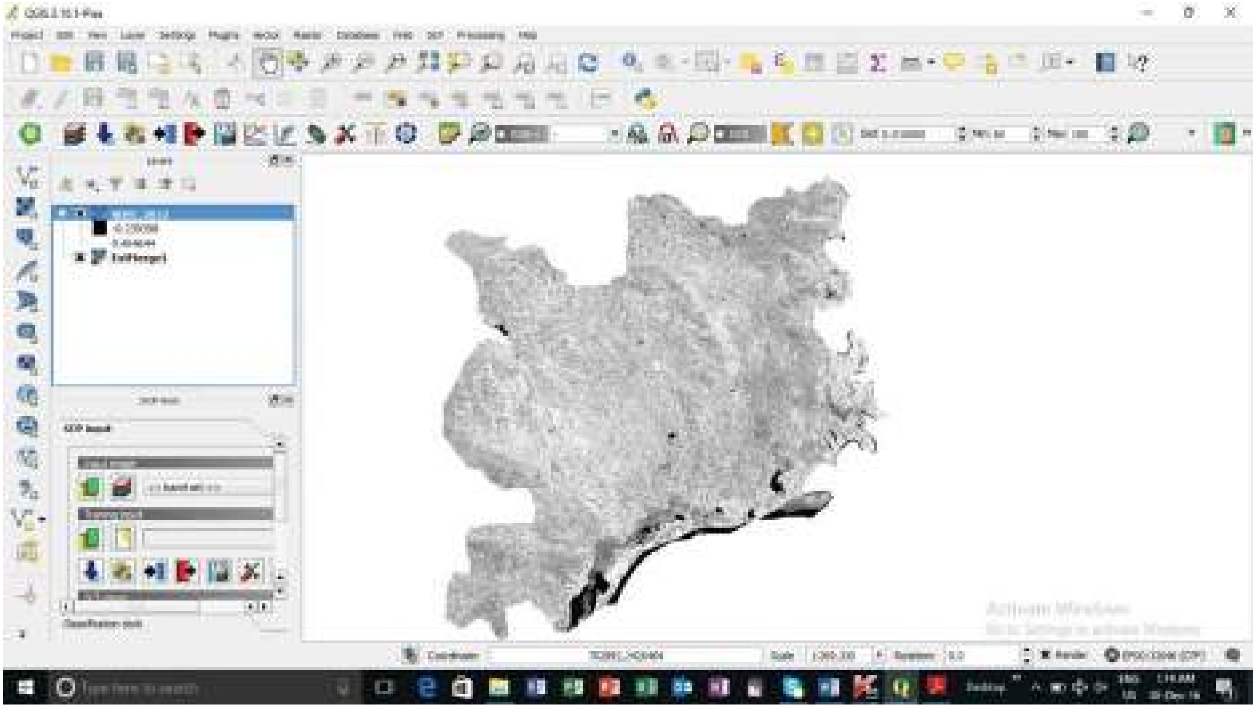


6. Compute NDVI

- To calculate the NDVI value we will use the command called 'Raster Calculator' under the Raster tool-set in Main Menu. Open the above clip image and type the expression in "Raster calculator expression" shown as below. Then click "Ok" button.



- The output file called NDVI image will be appeared as follow.
- Remark: The range of NDVI value is between -1.0 and +1.0.

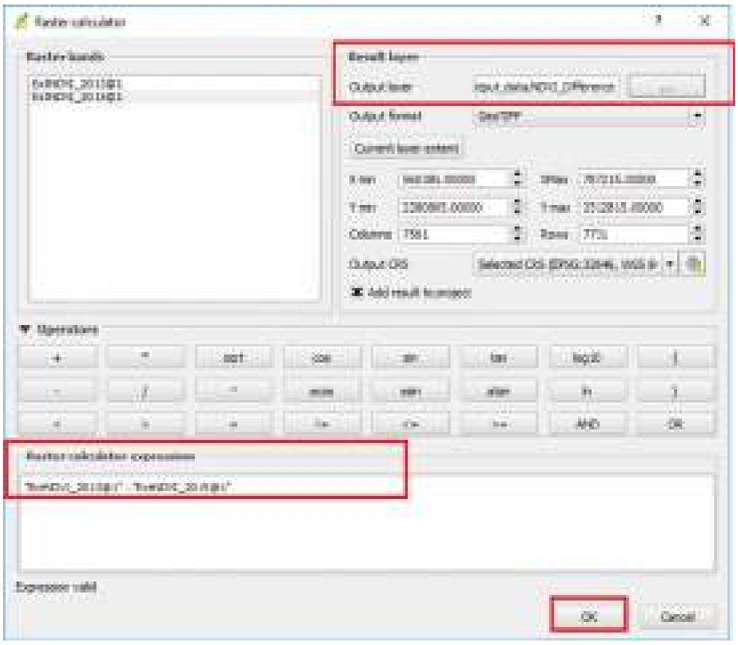


(B) CROP MONITORING & DROUGHT ASSESSMENT

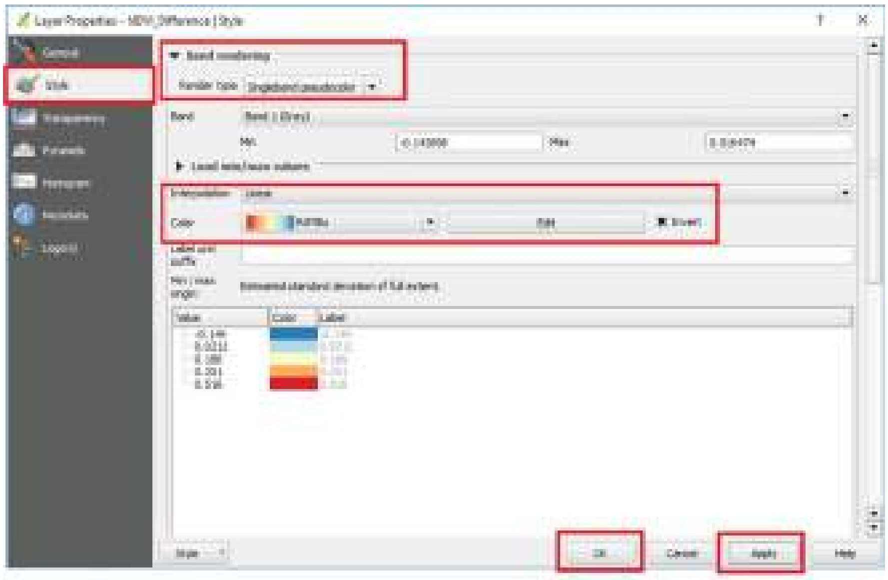
7. Repeat the step 6 to compute the NDVI for Landsat images 2013 and 2015 by using 'Raster Calculator' under the Raster toolset in Main Menu. (In reality, average NDVI should be calculate for one season)

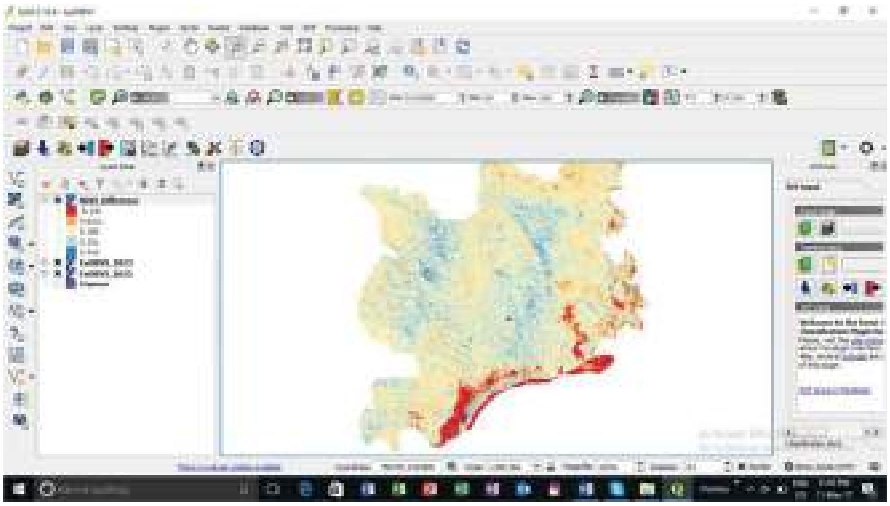
   The output file should be given as NDVI_2013.tif and NDVI_2015.tif.

8. NDVI Differencing: Use 'Raster Calculator' again to difference the NDVI value of satellite images 2013 & 2015 and give output file name as 'NDVI_Difference'.



9. Then load difference image and check for negative ranges and positive ranges. Positive value means: 2013 Vegetation is poorer than 2015. Negative Value mean: 2015 Vegetation is poorer than in 2013.





10. These NDVI Difference values are averaged over an administrative boundary and aggregated over growing season.

    a. NDVI Difference is > 10% but < 25% of normal: Watch

    b. NDVI Difference is > 25% of normal: ALert

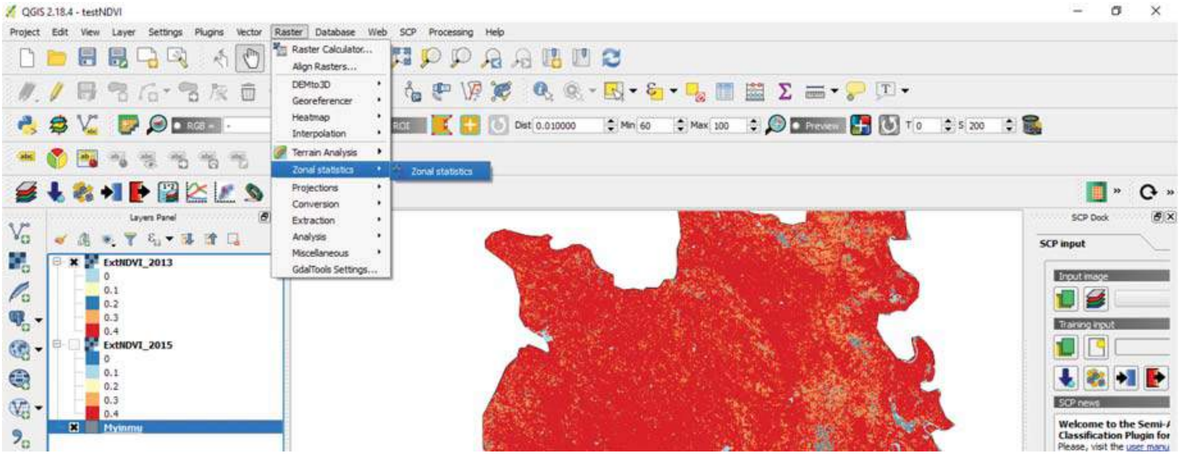
11. Use the formula for Drought Index

    a. Drought Index = (NDVI Drought year -NDVI Normal year)/ NDVI Normal year *100

    b. Decide Watch / Alert for this district for drought

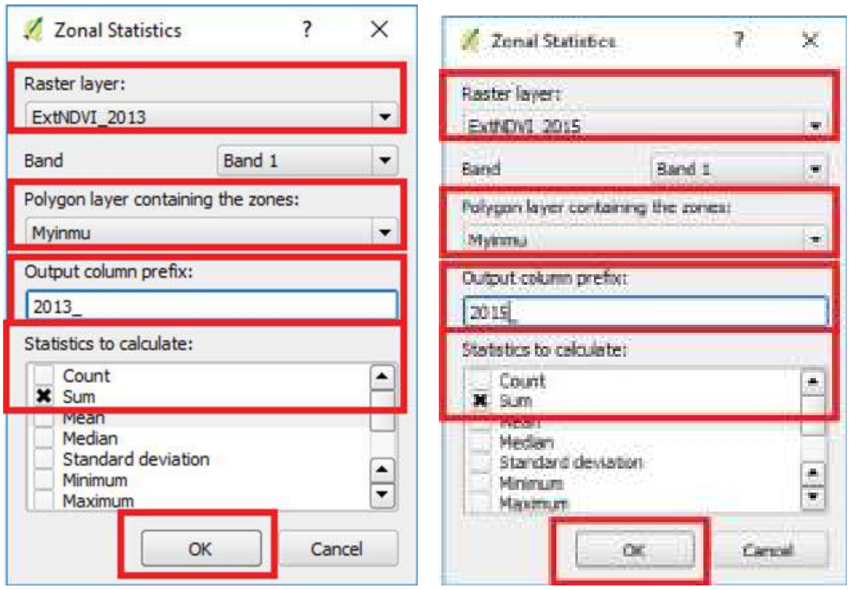
    c. Calculate index for other district

- Open “Zonal statistics” from “Raster” main menu and calculate the summarize of NDVI value in Myintmu township.

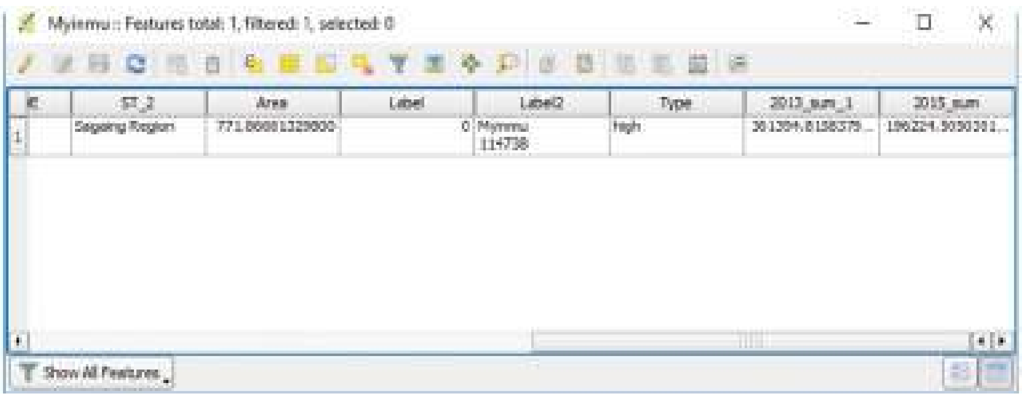


- In zonal statistic window, please fill the required information for 2013 and 2015 images as below:

Remark: The coordinate of the layers should be same coordinate system for zonal statistic



- After processing of zonal statistics, you can check the attribute table of township layer of “Myintmu. shp” for summarize of the NDVI in this township.



- Drought index of Myintmu township=[(196224.51-361394.82)/ 361394.82]*100

  = -45.70%

- So Drought index is > 25% of normal then this township status is "Alert"

Question:

1. Could you find the drought index map for each township in 2013 and 2015 using the above method? (Please use the entire image for processing)

EXERCISE 3.5

STORM SURGE HAZARD MAPPING

Delta region, southern west of Myanmar, is a low land area and naturally vulnerable to natural hazards associated with severe loss of lives and wealth. During the years from 1948 to 1994, Myanmar has been hit by 10 serve tropical cyclones. 'MALA' Cyclone(25/4/06), TORNADO (28/4/06) and Nargis (3/5/2008). Cyclone Nargis is the worst one and accompanied by storm surges. Cyclone hazard zonation is necessary to emphasize after the devastating cyclonic surge of May 2008 when about 150,000 people lost their lives along with other damages. This study used the Geographic Information Systems (GIS) together with Remote Sensing Technology for Disaster Risk Reduction. The Storm Surge Model was applied to generate different cyclone hazard zones which is helpful to mitigate the impact of cyclones and i

s essential for Disaster Prevention and Preparedness. Hazard zonation maps have been prepared taking into consideration storm surge depth, the geomorphological map and the Digital Terrain Model (DTM). Images of inundation for different surge heights will be generated by using the spread functions of GIS. Images of inundation depths were also produced using DTM and the Geomorphological map.

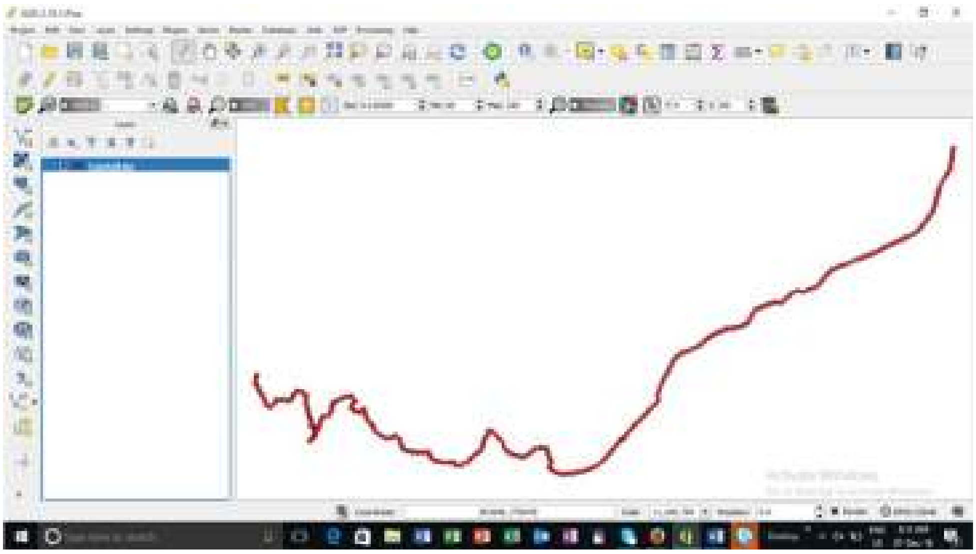
Learning Objective:

- Identify the various data sets to be used for Storm Surge Mapping
- Download data from various sources
- Create Distance layers for calculations, Calculate decay coefficient, surge height calculation for different zones.
- To know the way and use of GIS for Cyclone Surge Hazard Map, Vulnerability Map and Risk Map by storm surge modelling method.

Data Used: DEM, Coastal Line, Administrative boundary and population data

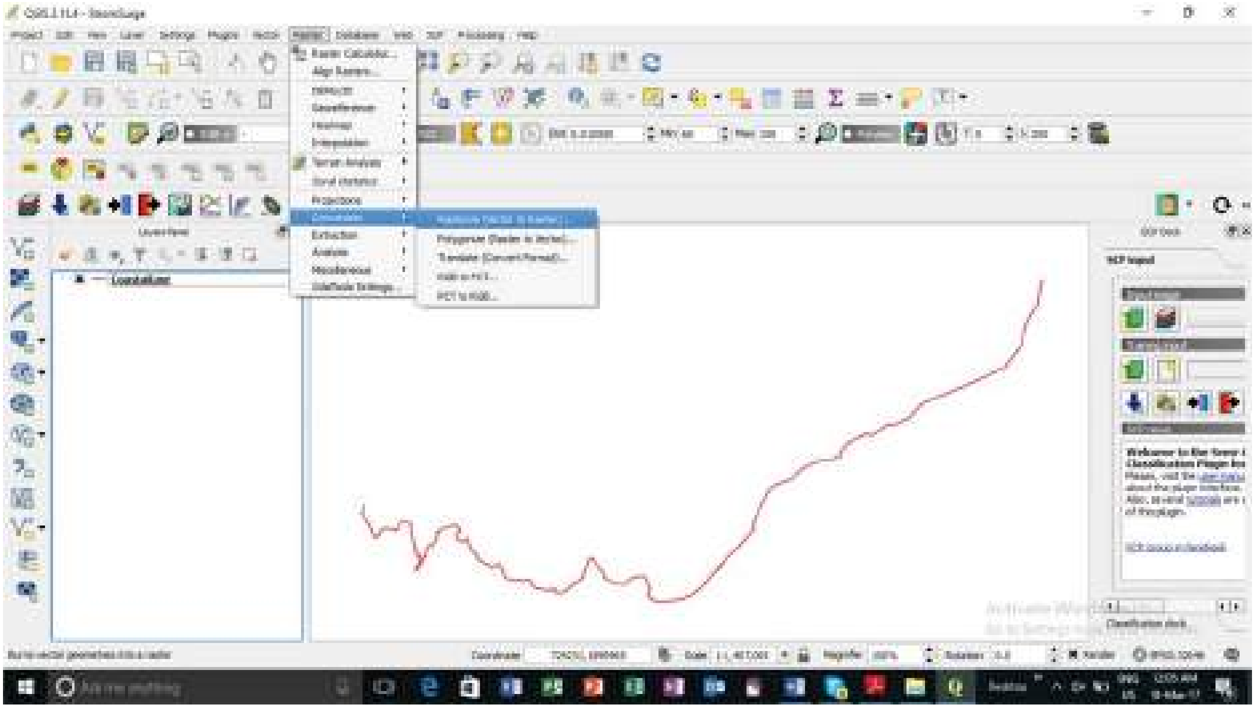
1. **Add Layer**

- Open the data like 'coastal line' layer from Exe_3.5 folder.

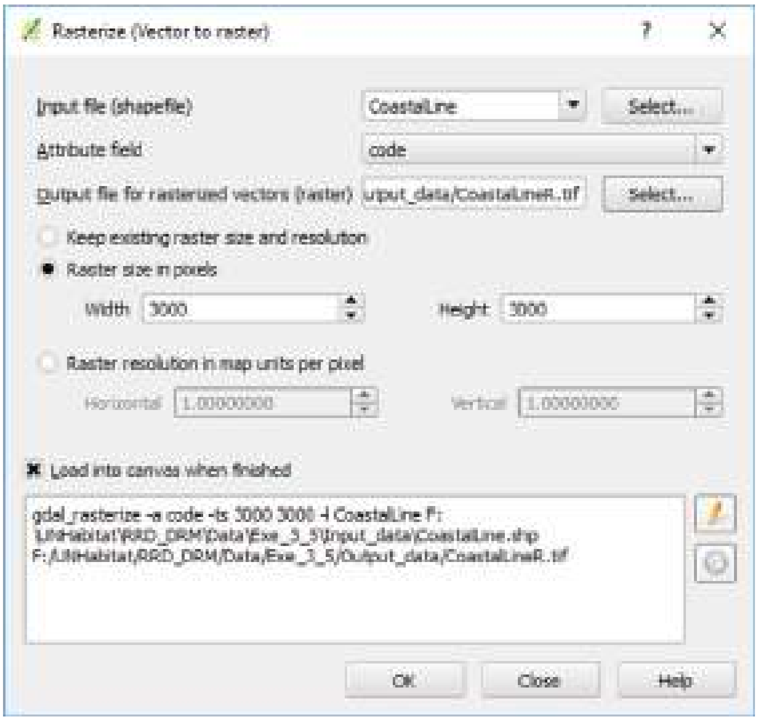


2. Creating of distance layer

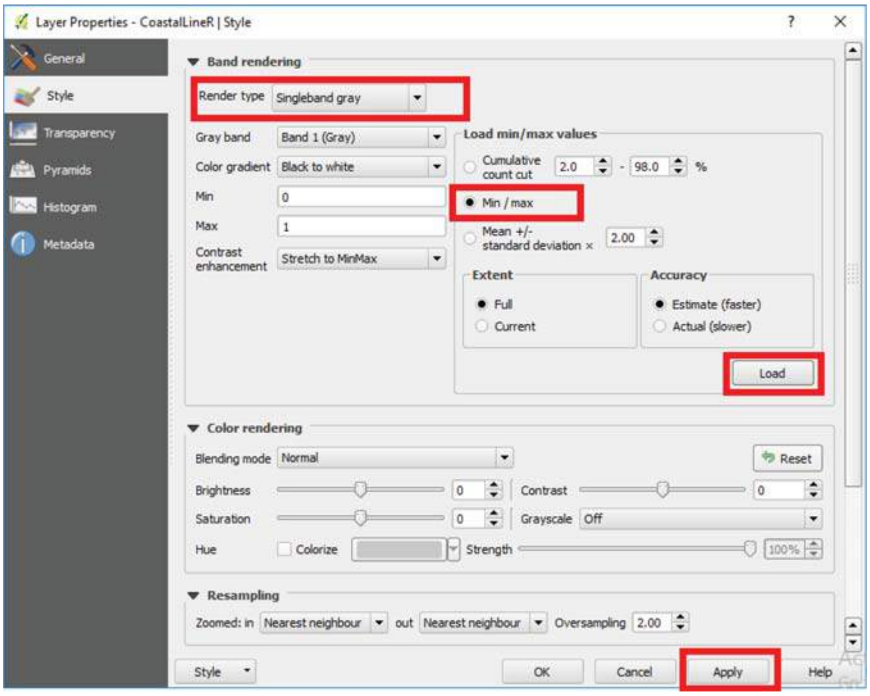
- Firstly, convert the vector layer of 'CoastalLine' to raster format using "Rasterize (vector to raster)" in "Conversion" sub-menu of Raster.



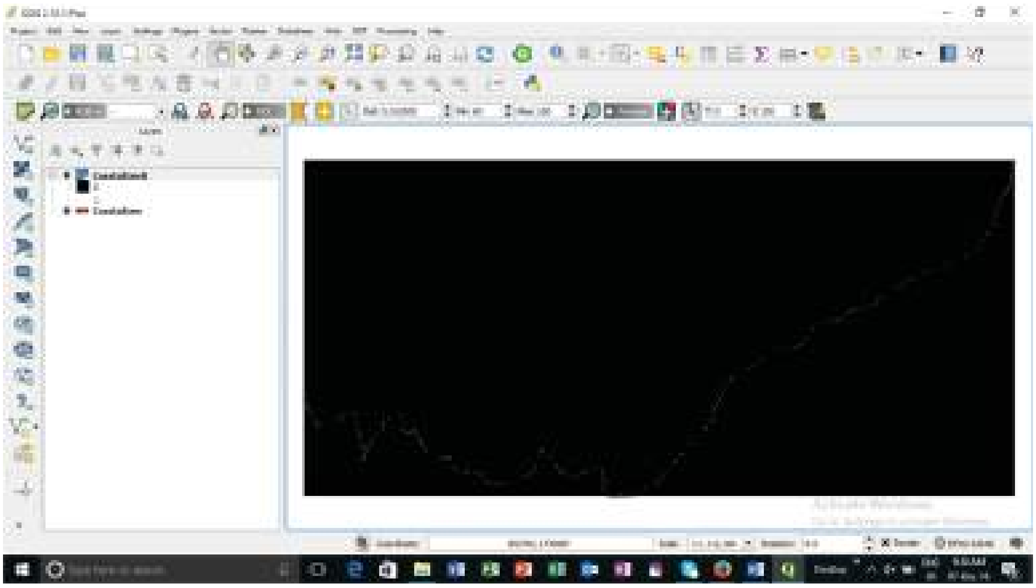
- Here you need to notice that before rasterization, you need to add 'code' filed in your 'CoastalLine' vector layer and give the value as '1' in this field. And give the output file name as 'CoastalLineR.tif'



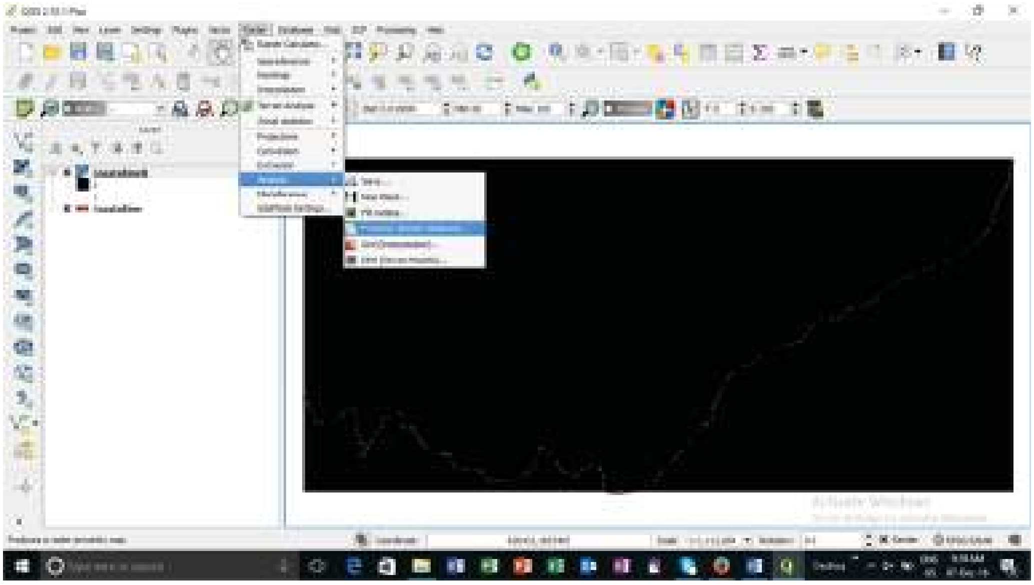
- After converting to raster format, right click the 'CoastalLineR.tif' layer and select the style tab. Then change the setting as mentioned below.



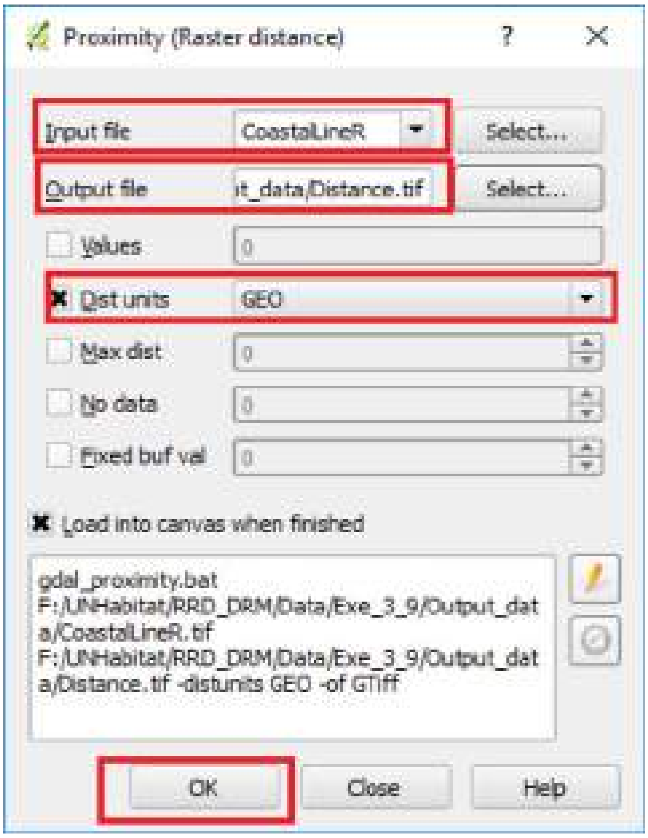
- Then you will see the 'CoastalLineR.tif' raster layer as follow.



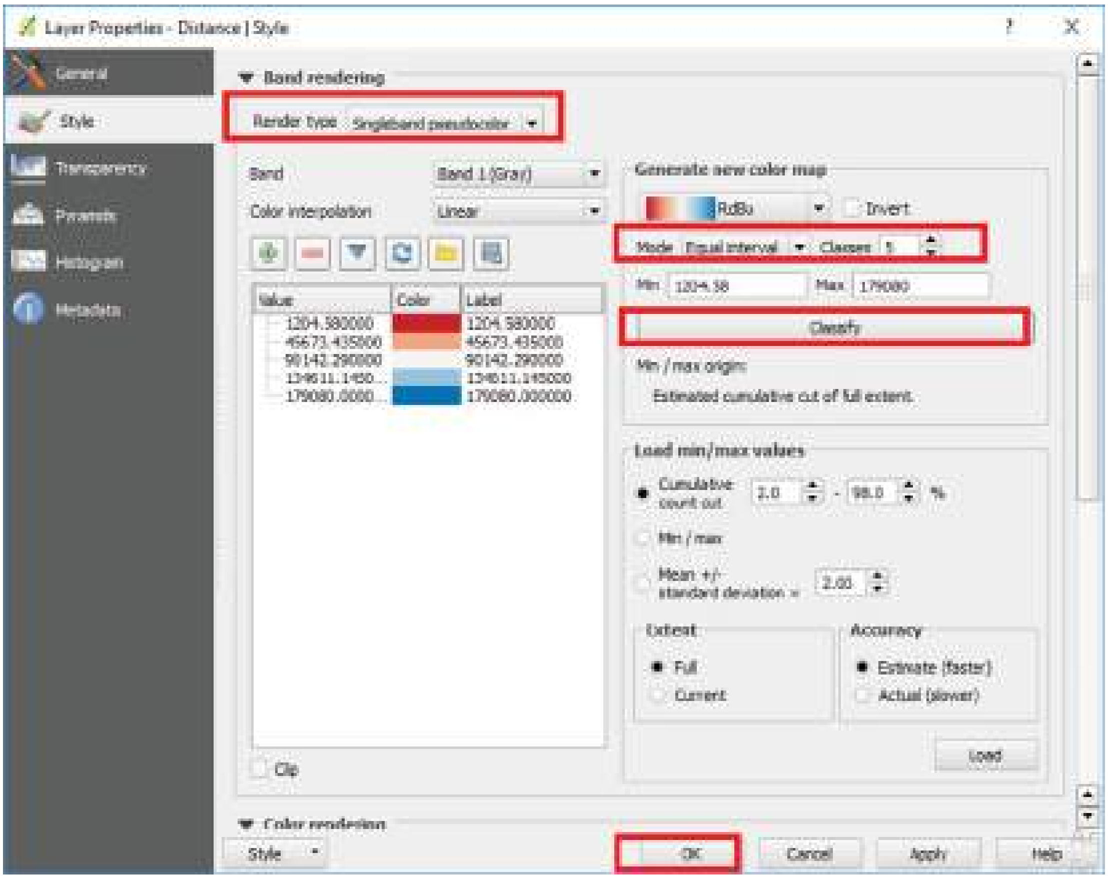
- Then using "Proximity (Raster Distance)" from "Analysis" sub-menu in "Raster" main menu to get the distance map using 'CoastalLineR.tif' raster layer.



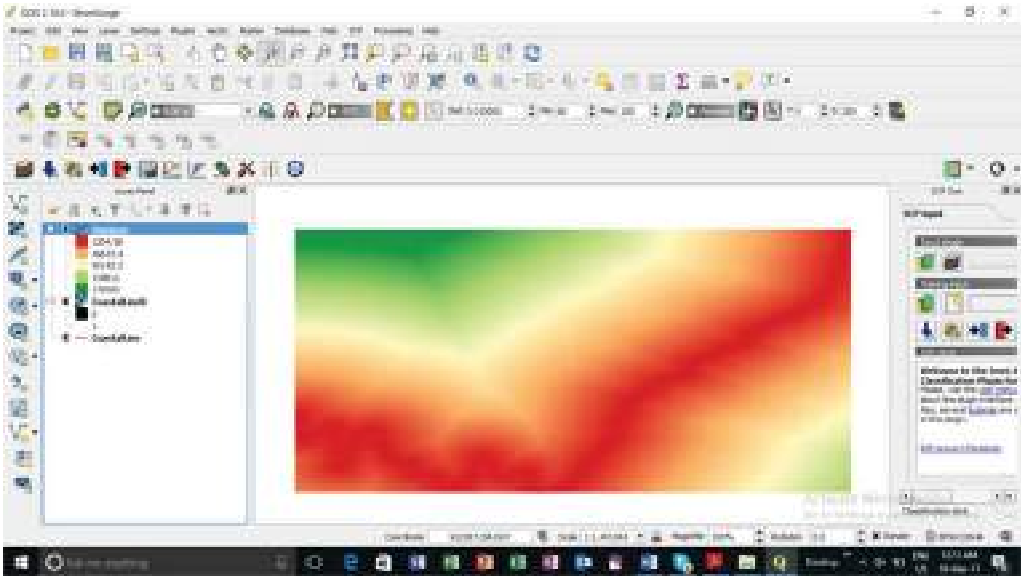
- Select the 'CoastalLineR.tif' raster layer as input file and saved the output file as 'Distance.tif'. And select "GEO" for distance units.



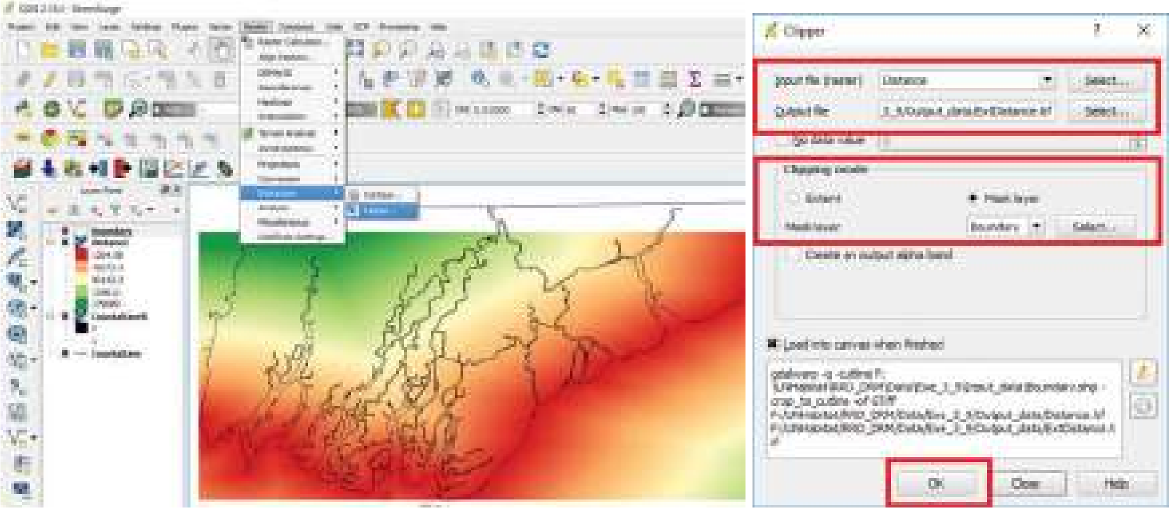
Right click the output file ('Distance.tif') and change the setting as follow in Style.



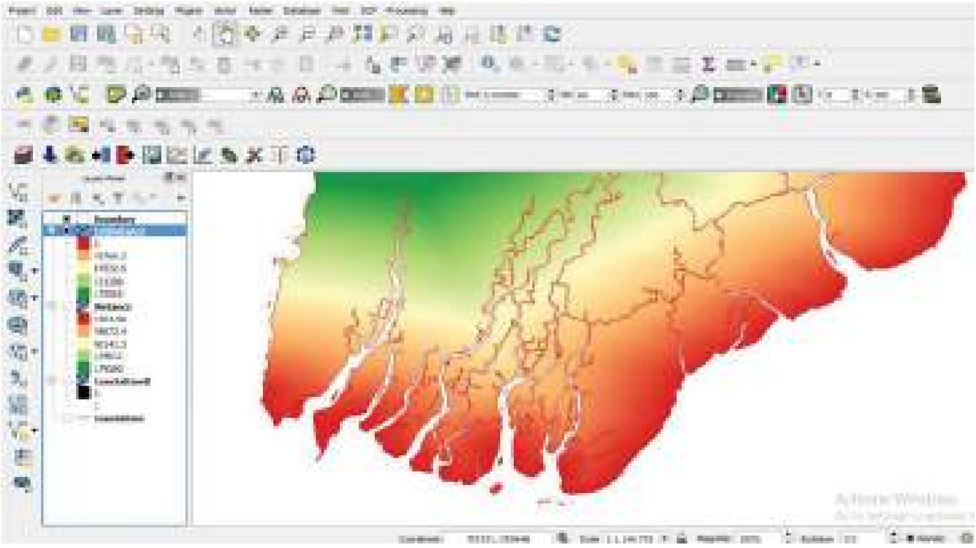
- You can see the 'Distance.tif' layer as follow. But we need to remove unnecessary area specially in water area.



- Add Ayeyarwaddy admin boundary to extract the distance map within admin boundary, we need to use “Clipper” tool from “Extraction” in Raster.



- The result file can be seen as follow.



- To reclassified the distance you can change the setting in style as follow.

3. Calculation of Surge Decay Coefficient (SDC)

Before preparing the surge inundation maps, we have to find out ‘how the surge depth decays in land’. This parameter is called Surge Decay Coefficient (SDC). The Surge Decay Coefficient (SDC) is a function of the friction caused by surface forms (morphology, embankments and elevated roads) and land cover (houses, rice fields, homestead gardens with trees, etc.). By that definition, the inundation maps will be developed assuming that the surge height decreases with SDC starting from the shore line to further inland depending mostly on the distance from the shoreline and elevation of the study area. For getting the relation between flood height and inundation from the coastline for the coast of Delta region, the following Table 1 is developed. For the modeling, the flood height of 7.5 m Nargis case with the total limit of inundation from the coastline as 60 km is taken. Constant surge depth in the first strip along the coast is taken as 4 km.

Table 1: Relation between Flood Height and Inundated Area

Flood height (distance from the coast in km)	Area under constant surge (distance from coast in m)	Total inundated area
7.5	4000	60

Surge Decay Coefficient (SDC) is calculated by this formula:

$$SDC = \frac{\text{Surge height - Avg elevation of the land at end of the surge}}{\text{Width total inundated area - Width area with constant surge}}$$

The calculated SDC value from the above formula is to be used for surge modeling on different inundation depths. For visualization, the following Figure (2) illustrates an example for a surge height of 7.5 m decay inland. The Nargis scenario map is developed based on the inundation map with decay from 4 km to 60 km using SDC value.

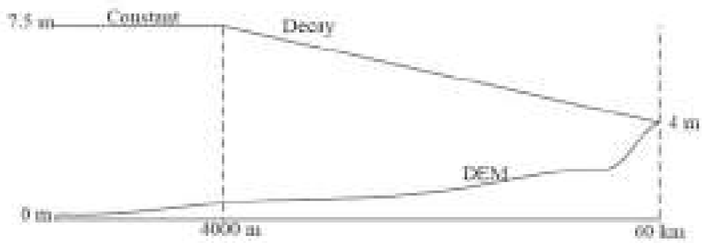
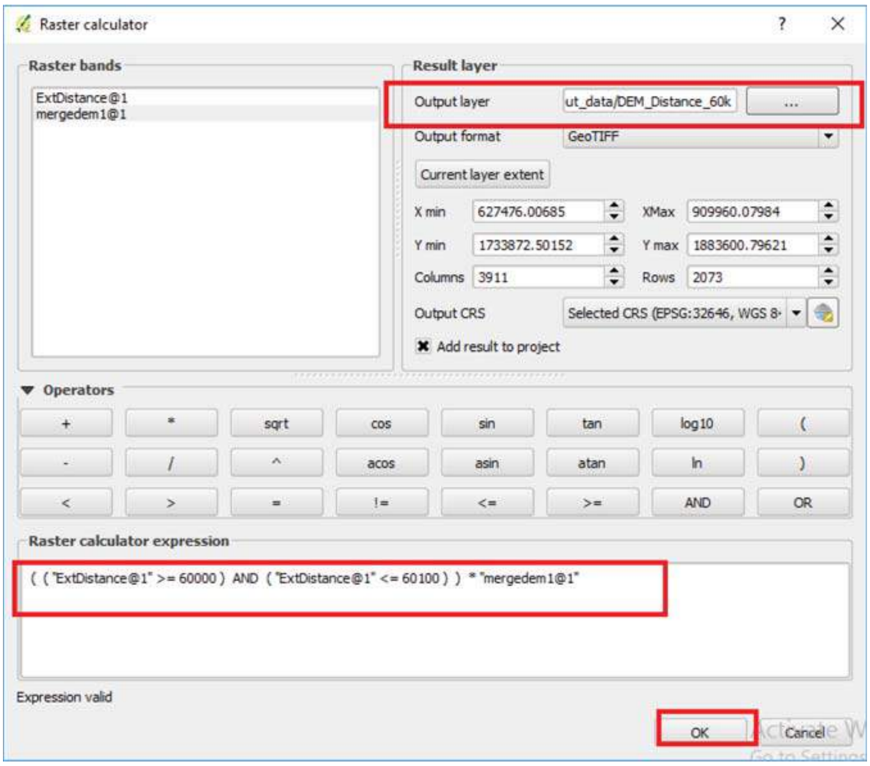
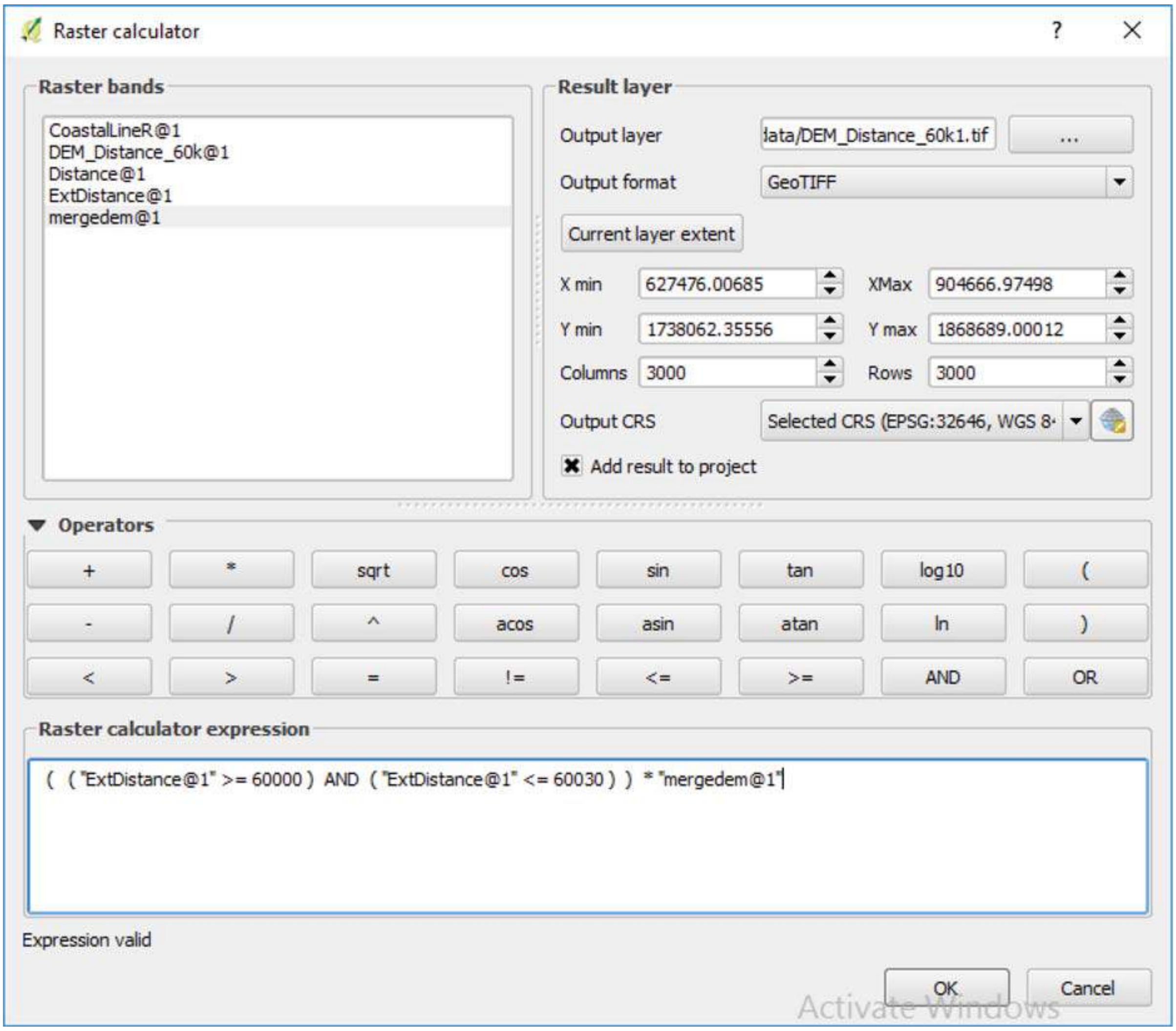


Illustration of 7.5 m Surge Height Decay in Land

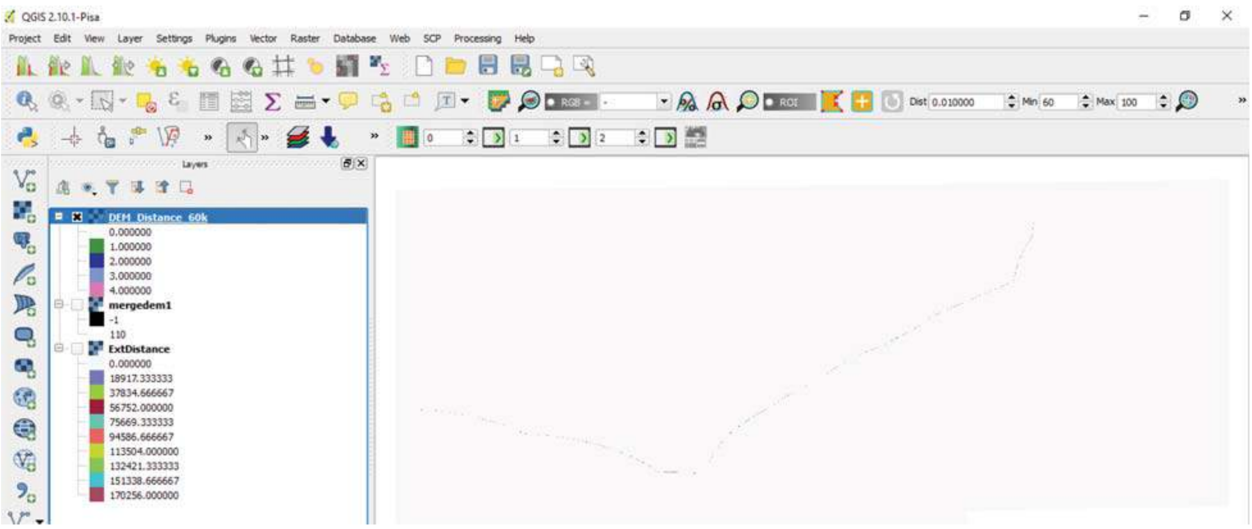
- To find the average elevation at the end of the surge (60000m away from coastal line), open the “raster calculator” from “Raster” main menu and type the command as below.



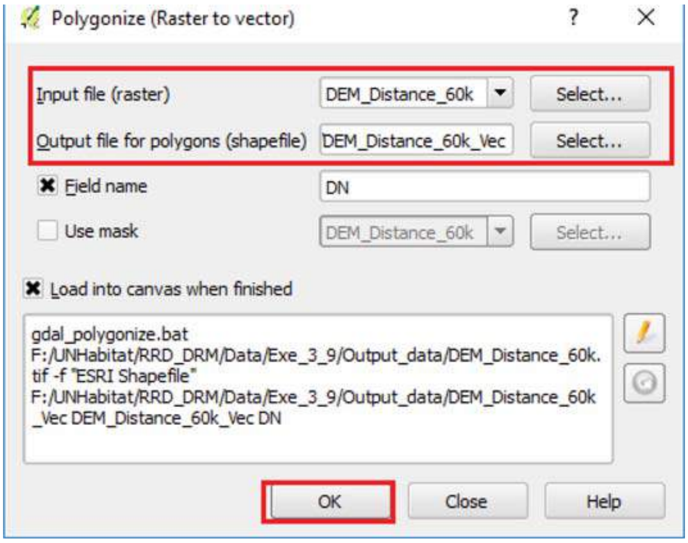


(("ExtDistance@1" >= 60000) AND ("ExtDistance@1" <= 60030)) * "mergedem@1"

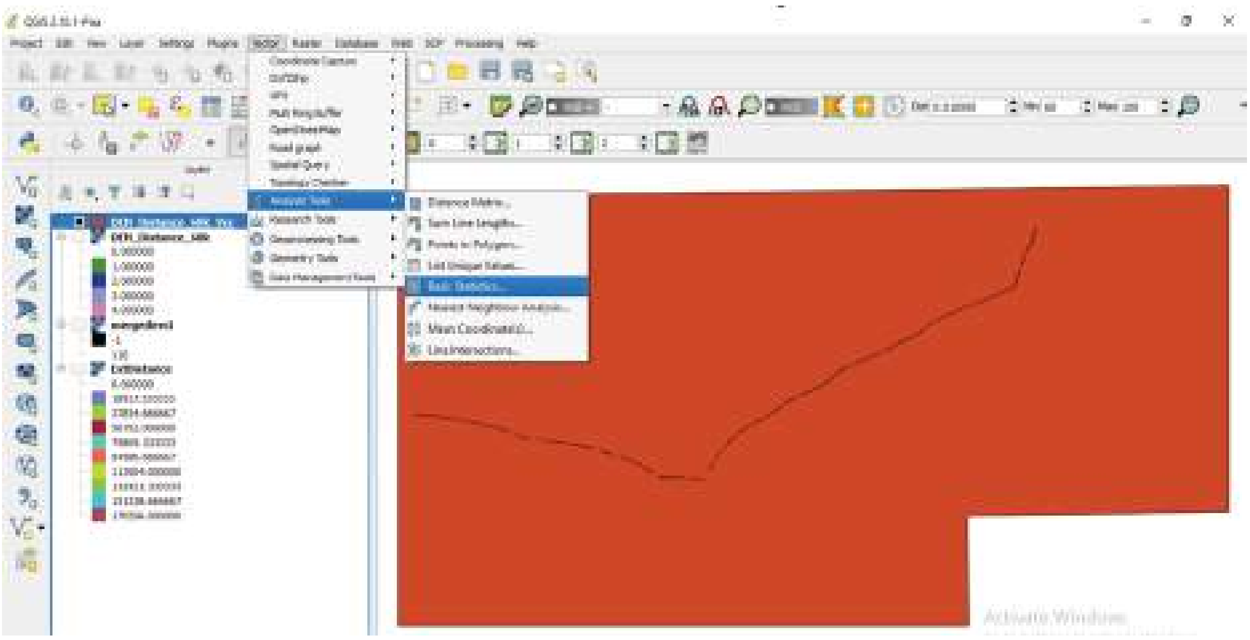
- The result will be seen as follow:



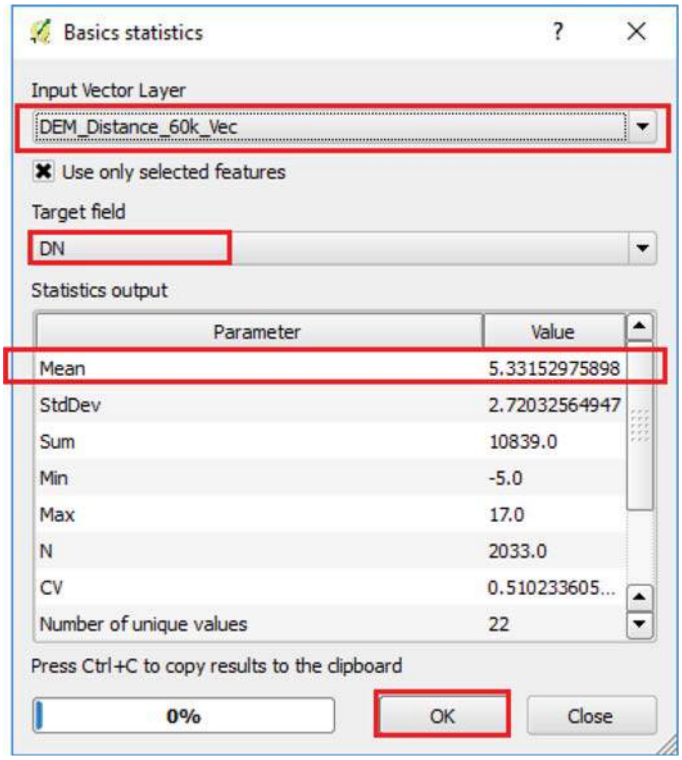
- To summarize the DEM value at the end of the surge, we need the result file to convert the raster file to vector file. Open “Polygonize (Raster to vector)” from “Raster” main menu.



- Then open “Basic Statistics” tool from “Analysis Tool” from “Vector” main menu to summarize the elevation value of the whole pixel.



- The total DEM value can be checked as below:



To calculate the SDC using the following equation:

$$SDC = \frac{\text{Surge height - Avg elevation of the land at end of the surge}}{\text{Width total inundated area - Width area with constant surge}}$$

Surge height =7.5,

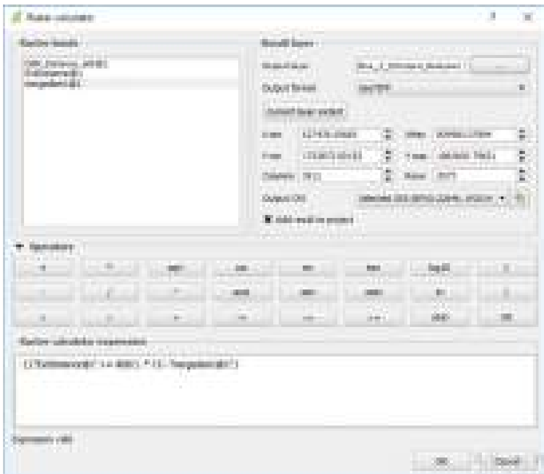
Avg Elevation at he land at end of the surge=5.33 m,

Width toal inundated area =60000 m,

Width area with constant surge=4000m

So, SDC=0.00004

(("ExtDistance@1" <= 4000) * 7.5 - "mergedem1@1")



4. Hazard Mapping

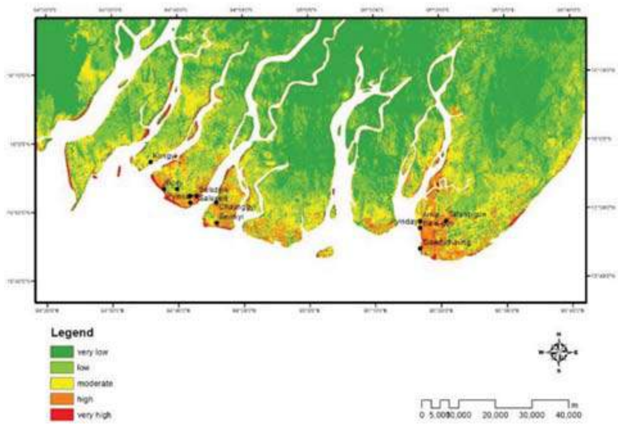
Following steps have been carried out to get Cyclone Surge hazard map of Delta region, Ayeyarwaddy Division, Myanmar, using Digital Elevation Model(DEM) as a primary input map.

(a) Distance buffer map was generated from the coastline

(b) Map calculation was done taking into consideration the distance map, the Digital Elevation Model, distance 4km from coastline where the surge depth remains constant (7.5m) and the surge decay coefficients for that particular surge height where distance is between 4 km and 60 km. The equation for calculating modified elevations per decay coefficient with respect to the original DEM data is as follows:

Modified DEM(m)= (inundation distance – constant surge depth distance) (m) X Decay coefficient (SDC) (m/m) + DEM (m) (Original)

(c) The final hazard map at the Nargis scenario will get subtracting the elevation map from Modified DEM.



5. Vulnerability Analysis to the Population

The vulnerability of the people to flooding is the degree of loss to the total population, or particular categories, resulting from flooding by a certain depth. It has to be expressed on a scale from 0 to 1. The vulnerability is increased linearly with the flood depth. Therefore, for calculating vulnerability to people at different flood depth, the relationship between flood depth and vulnerability is derived from the following assumptions:

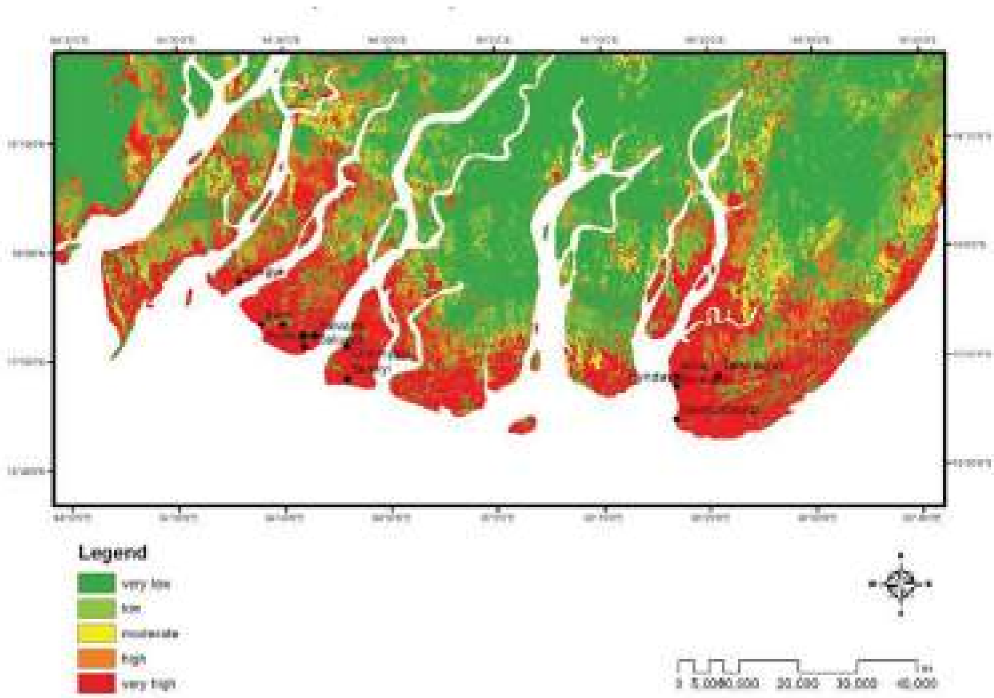
- Near the coast (15 km from the coast), the vulnerability is 0.7. Then calculate the average flood depth at 15 km by using surge inundation map and distance map started at the coastline.
- From the histogram of the 15 km flood depth map, it can be seen that the average flood depth at that distance is 2.5 m.
- At some further distance from the coast (~30 km from the shoreline), the vulnerability is less and assumed as 0.3. The average flood depth at that distance is 1.4 m.
- The vulnerability of 1 is reached at an arbitrary depth of 3.2 m flood level that occurred around 4 km from the coast.

  Based on the mentioned parameters, the vulnerability maps can be obtained by multiplying Vulnerability Coefficient (Vc) with flood depth values of hazard maps. In that case, Vc are calculated based on the assumption of flood depth and percentage of vulnerability. Calculated values of Vc derived from the relation of vulnerability and flood depth are summarized in Table.

Table 1: Vulnerability Coefficient Values

Distance from coast (km)	Flood depth (m)	Vulnerability	Vc
-	0.0	0	0.0000
30	1.4	0.3	0.21429
15	2.5	0.7	0.36364
4	3.2	1	0.42857

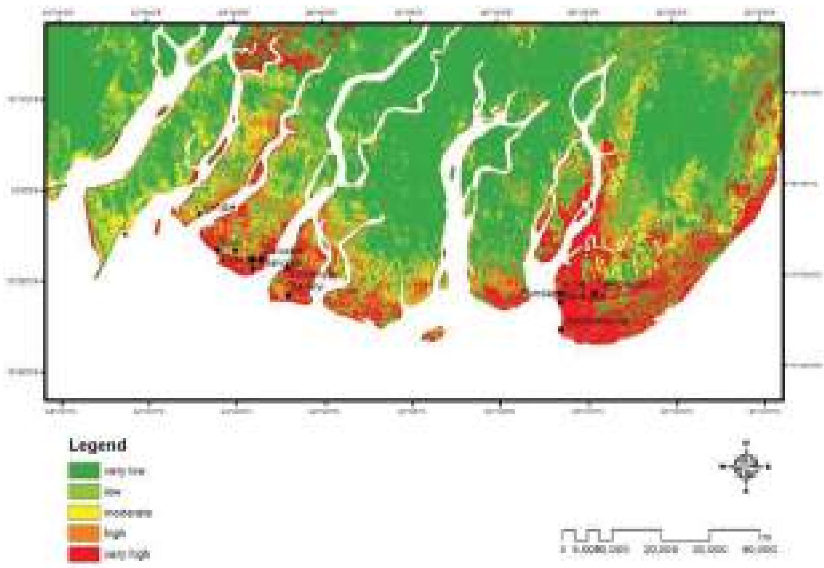
According to Vc Map, it can be seen that the Vc of 0.0 m flood depth is obviously '0.0000'. The Vc of flood depth between 0.0 m and 1.4 m is 0.21429 and between 1.4 m and 2.5 m is 0.36364. The highest Vc of 0.42857 reached between flood height of 2.5 m and 3.2 m. Above the flood depth of 3.2 m the vulnerability is always 1.



Vulnerability Map of the Delta Region, Myanmar

6. Casualty Analysis

After making the vulnerability maps, you can estimate the number of population at risk for a certain surge height over the affected area. Since the casualty is depend on the vulnerability and number of people living in the area, we first need to calculate population density over the certain area for a certain categories of people such as children, men, women and elderly. For the risk analysis on total population, assume that 16% of population has been moved to safer places by early warning prior to the cyclone event. Risk map can be generated from multiplication of hazard map, vulnerability maps and population density map. In the style tab in the property of the output risk map, setting the risk values interval as five class like very low, low, medium, high and very high. Then you will see as below.



EXERCISE 4.1

FLOOD PRELIMINARY DAMAGE ASSESSMENT (NAGRIS 2008)

after a disastrous event. An integrated remote sensing and GIS-based analysis approach can provide timely information on building damages. This preliminary analysis can help both national and international humanitarian actors to better coordinate and planning aid response as well as needs assessment operations.

Remote sensing based building damage assessment is generally performed using qualitative (e.g. photo-interpetation) or quantitative methods (e.g. image classification). Pre and post event satellite images once acquired can be analyzed and interpreted by expert analysts able to categorize assessed building according to different damage classes.

Objective

- Perform building damage assessment using pre and post disaster aerial and satellite images (visual interpretation)
- Generate a building damage intensity interpolated raster for affected areas

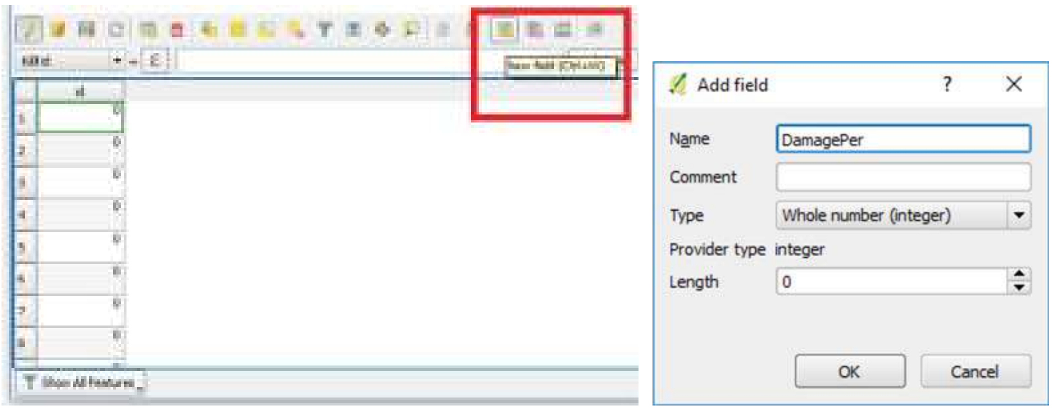
Data Use

1. QB_Kyuak_Kalat_20050117.img (pre disaster image)
2. WV1_Kyuak_Kalat_20080523.img (post disaster image)

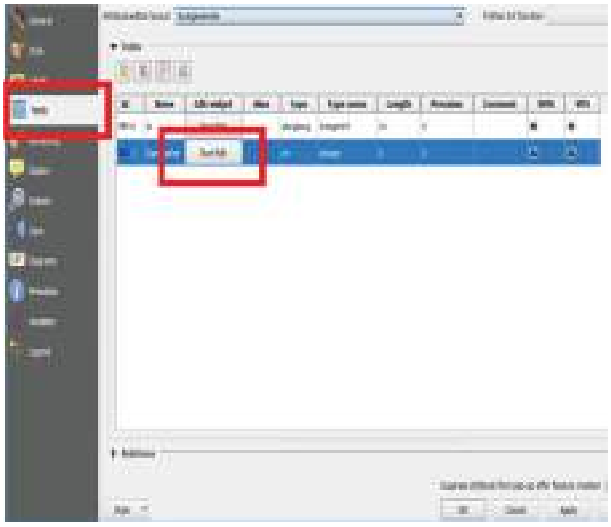
Creating Building point layer

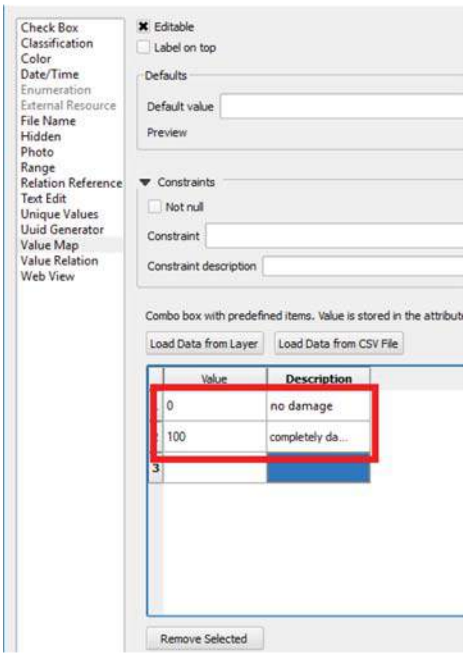
1. Create the point layer named as "Building" and select the projection type as WGS84/UTM zone 46 N. Then we will digitize the building as point using pre-disaster image as background image.
2. Open the attribute table of this building point layer and add the new field, named as Damageper" in attribute table using new field in the editing mode.

   Name: DamagePer Type: whole number (integer)



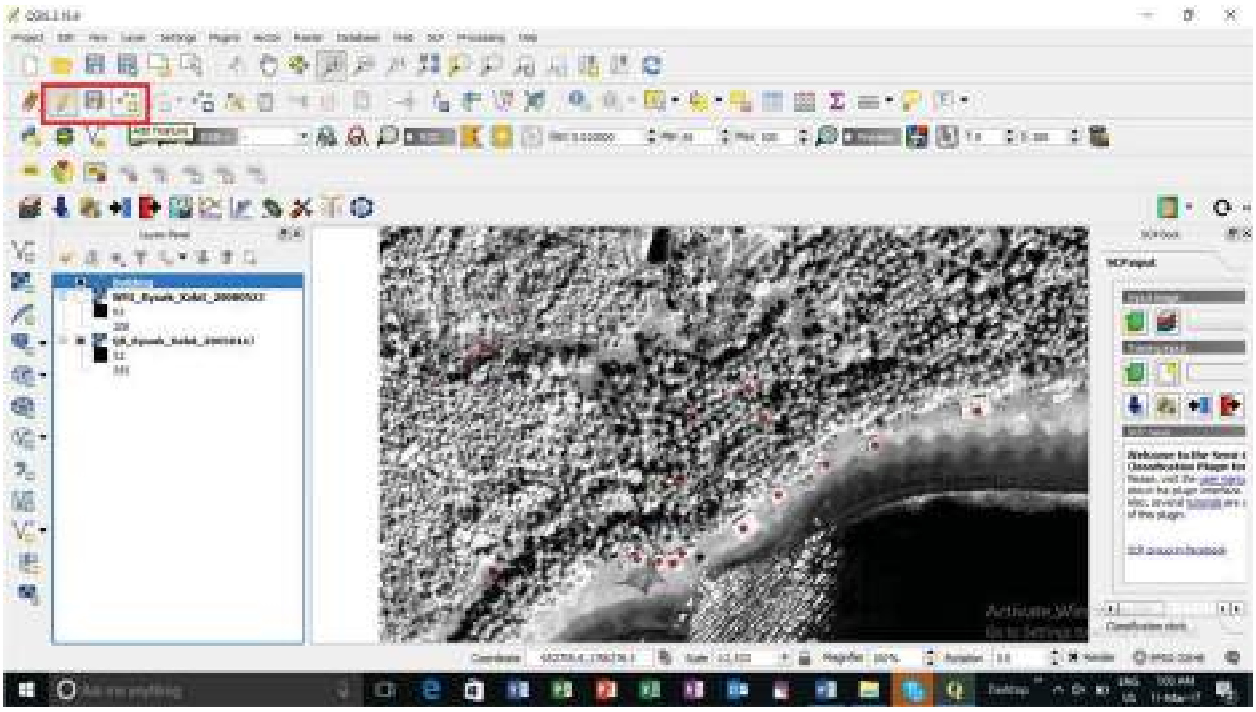
2. Then right click the building point layer and go to property. In field tab of the property, click the "Text Edit" and select the "Value Map" in right panel of text edit mode. Then add the two vales: 0 for No damage and 100 for Completely damage.

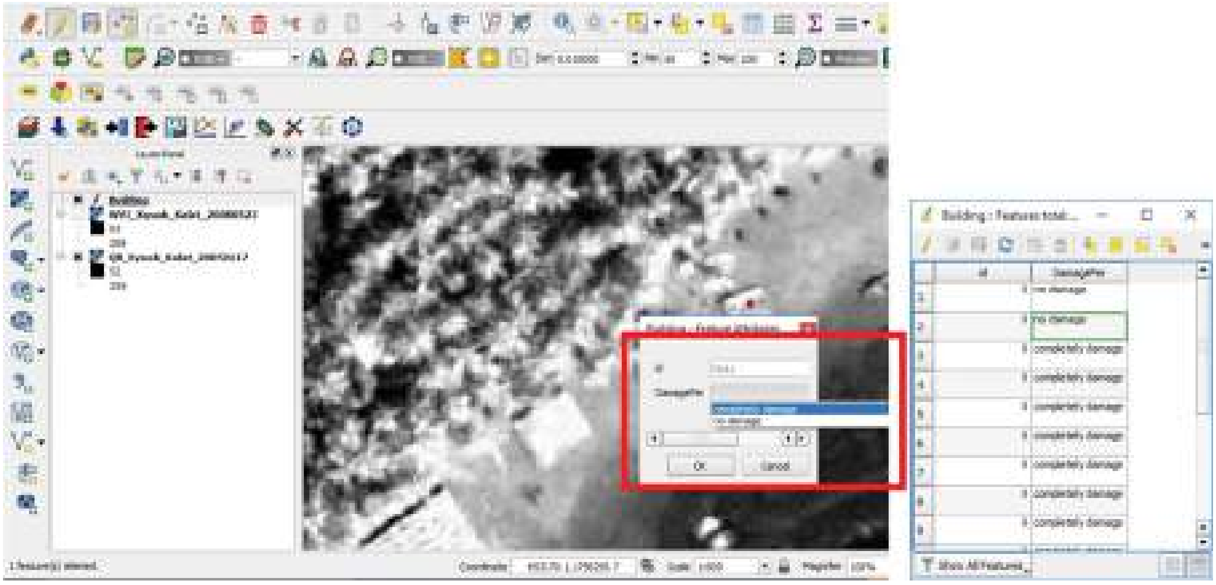




Identifying the Damage Level by Visual Interpretation

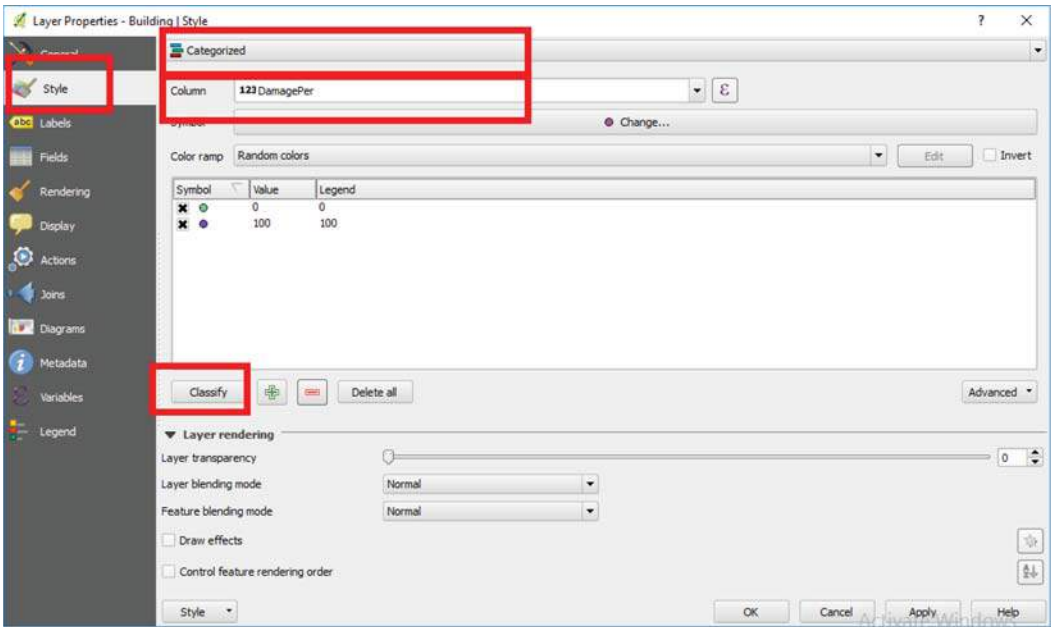
3. Then click the editing tool and digitize the buildings as points using "Add Feature" in editing mode and add "no damage" or "completely damage" in "DamagePer" column in attribute table of building point layer to classify the damage levels using pre and post images.

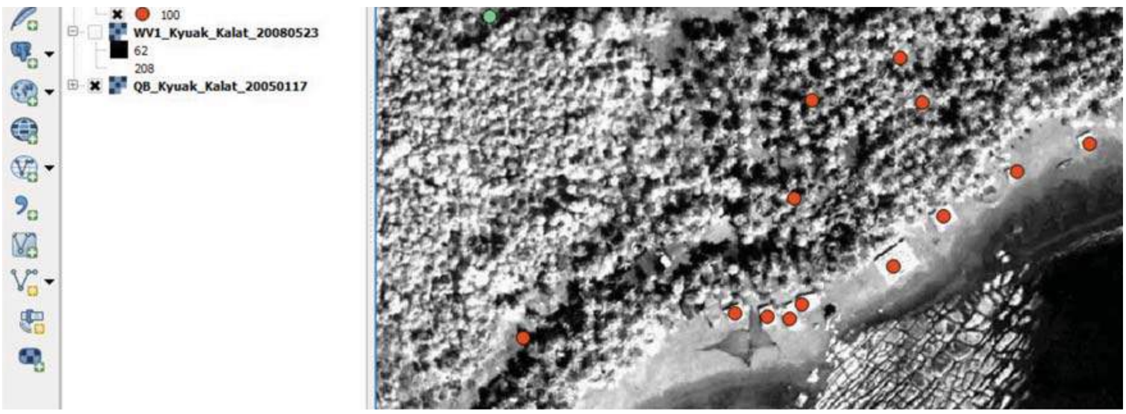




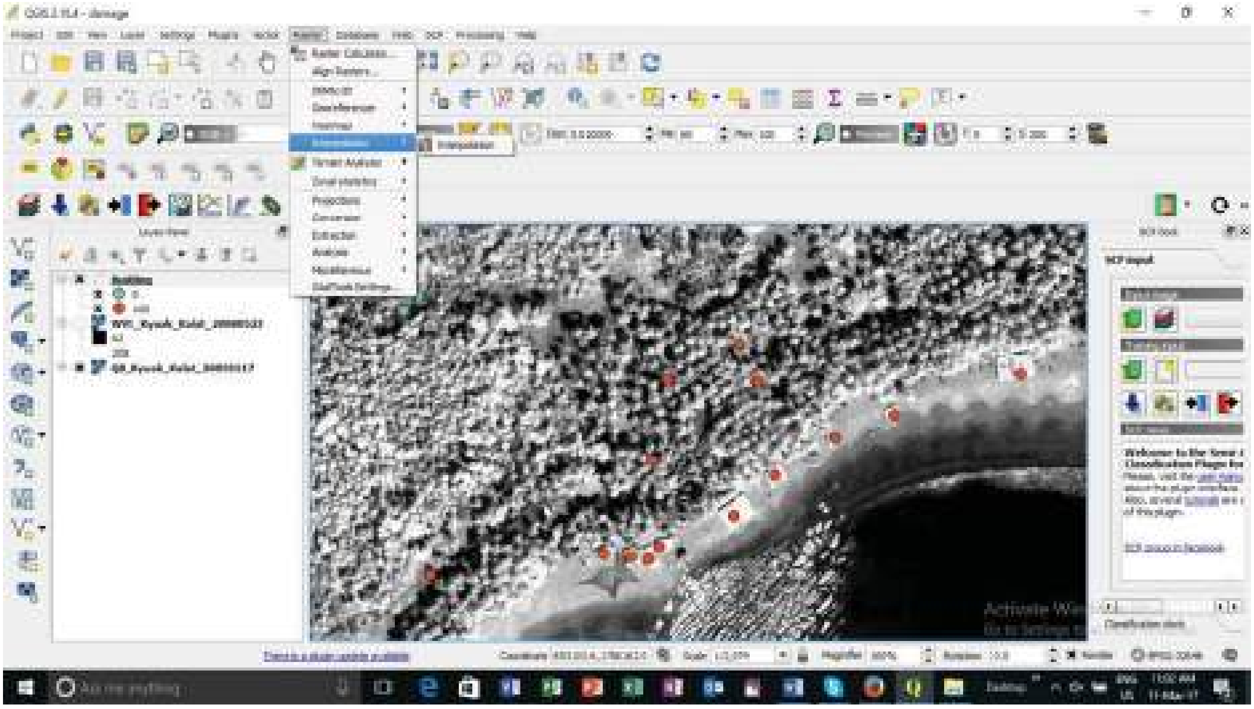
4. After we had finished the digitize the building as point and click "Toggle Editing" again to stop and save the digitizing task.

5. Then right click the building point layer and select the property. Then, categorized the building point layer according to percentage in "DamagePer" column.

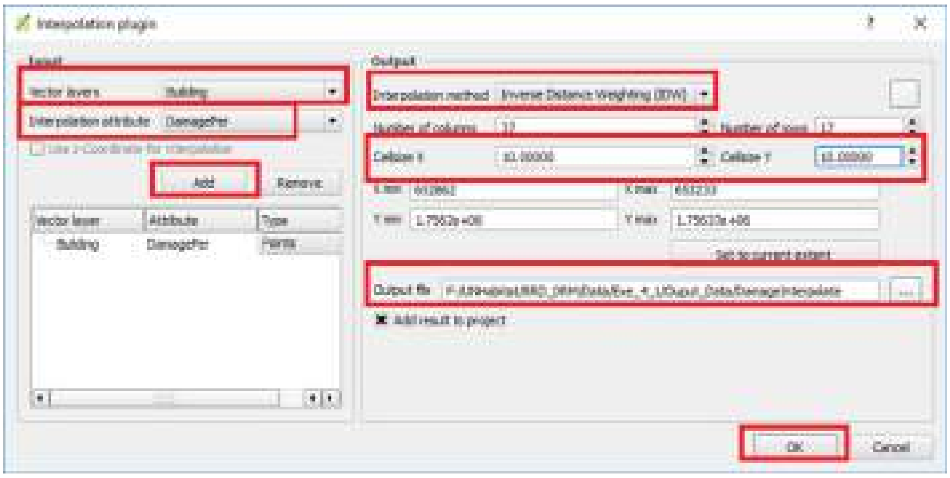




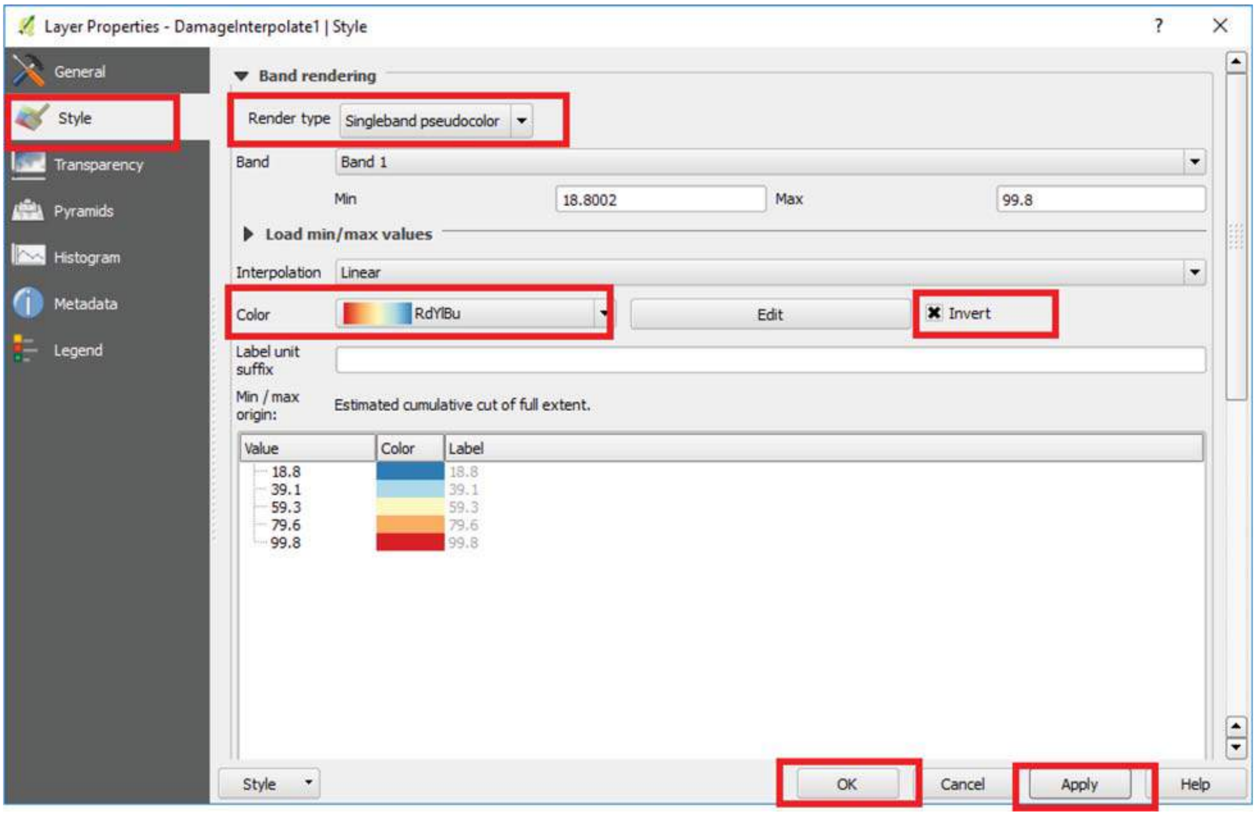
6. Then go to the “interpolation” in Raster main menu and select interpolation tool. Interpolation window/ form will appear.



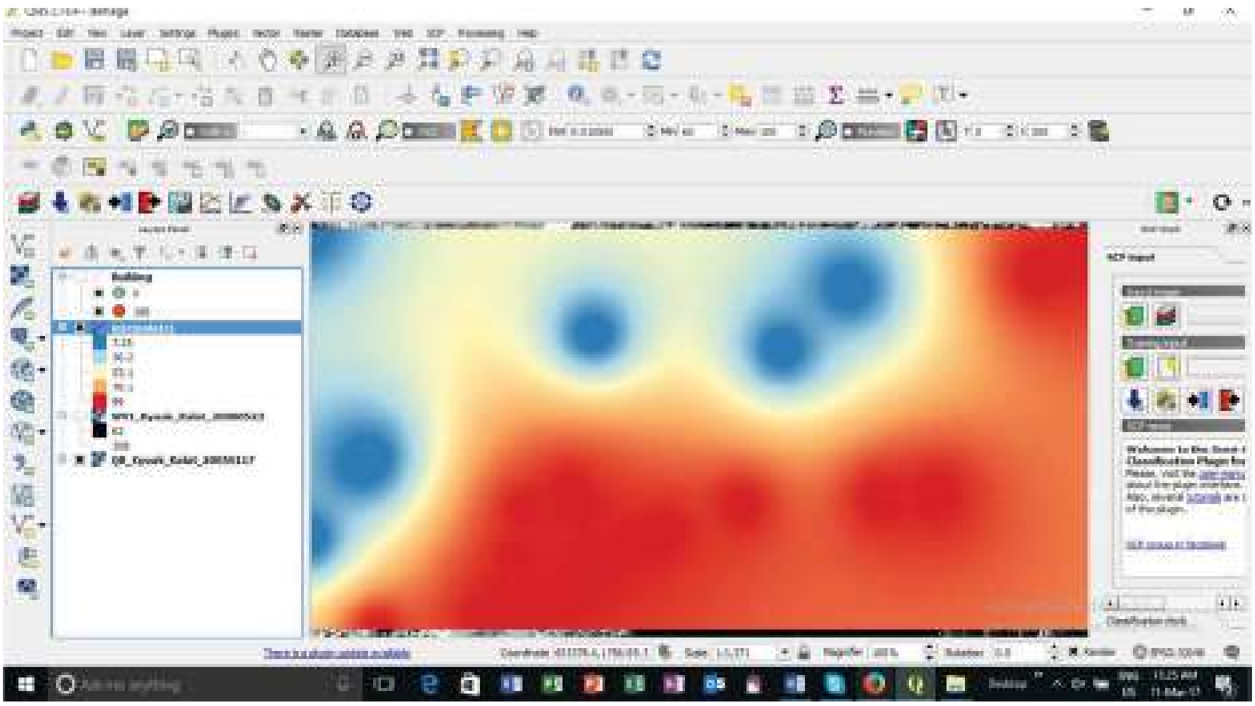
7. In this interpolation window, fill the required information as below. And save the ouput file as “DamageInterpolate.tif”.



8. Then right click the output file and select the property. In style of property window, choose “single-band pseudocolor” in Render type and choose the colour. Then click apply and ok button.



9. The interpolation result will be seen as follow. And please test with other interpolation methods.

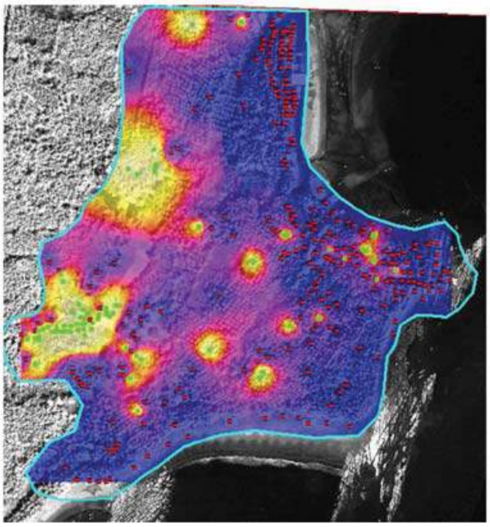


Question:

Q1. What is the resolution of pre and post disaster image? (spatial resolution)

Q2. Create the point layer for buildings in affected area. Classify the damage level and damage percentage.

Q3. Where would you say is the highest concentration of destroyed buildings based on the interpolation surface?



EXERCISE 4.2

SEARCHING, EXPLORING AND GATHERING GEOSPATIAL DATA FROM THE WEB FOR EMERGENCY RESPONSE MAPPING

When a disaster strike, one of the key tasks to perform before starting any GIS analysis is to review and to collect relevant disaster related information from media reports, OCHA SitReps, Government and Local Authorities to obtain an understanding of the type and magnitude of the disaster event. When a first review of available disaster related information is completed you can start searching and gathering relevant geospatial data (i,e, pre and post disaster satellite imagery and GIS baseline data) to be used for GIS analysis and mapping. In this exercise, you will search, explore and download some GIS and EO data by browsing different geospatial data portals which provide access to useful datasets for emergency response mapping.

Learning Objectives

- Get familiar with some geodata web portals and how to access
- Search and downloadin rainfall accumulation data (TRMM) and Tropical Strom data
- Searching, exploring and downloading earthquake information
- Searching, exploring and downloading baseline vector data (OSM)
- Searching, exploring and downloading satellite imagery SPOT Vegetation, NOVA AVHRR, SRTM, ASTER, LANDSAT TM etc
- To know useful of Google earth pro and google earth engine

Data will be acquired by browsing different geospatial data web portals

Web portal	Web Link	Data Type
USGS	Searching, exploring and downloading Landsat imagery	Raster/ Vector
Open Street Map OSM	http://extract.bbbike.org/	Vector
Global Population Data	http://www.worldpop.org.uk/	
	Raster	
Percipitaion data	Http://giovanni.gsfc.nasa.gov/giovanni/	
Unisys		
	http://weather,unisys.com/hurricane	
	Vector	
USGS	http://earthquake.usgs.gov/earthquakes/shakemap	
	Vector	
MODIS Rapid Response System	http://earthdata.nasa.gov/lance/rapid-response	
	Raster	

DigitalGlobe	http://www.digitalglobe.com	
	Raster	
AsterDEM	http://www.gdem.aster.ersdac.or.jp/	
	Raster	

1. Searching, exploring and downloading Landsat imagery

1. Identify the image to download using EarthExplorer (go to http://earthexplorer.usgs.gov/; note: you will need an account to order and download imagery)
2. Select the years and months of interest
3. Select the relevant dataset and the relevant Landsat mission (4,5,7,8). This will be based on the dates of interest.
    - For option 1, select surface reflectance
    - For option 2, select the standard product

4. Set the additional criteria such as day scenes only and minimum cloud cover

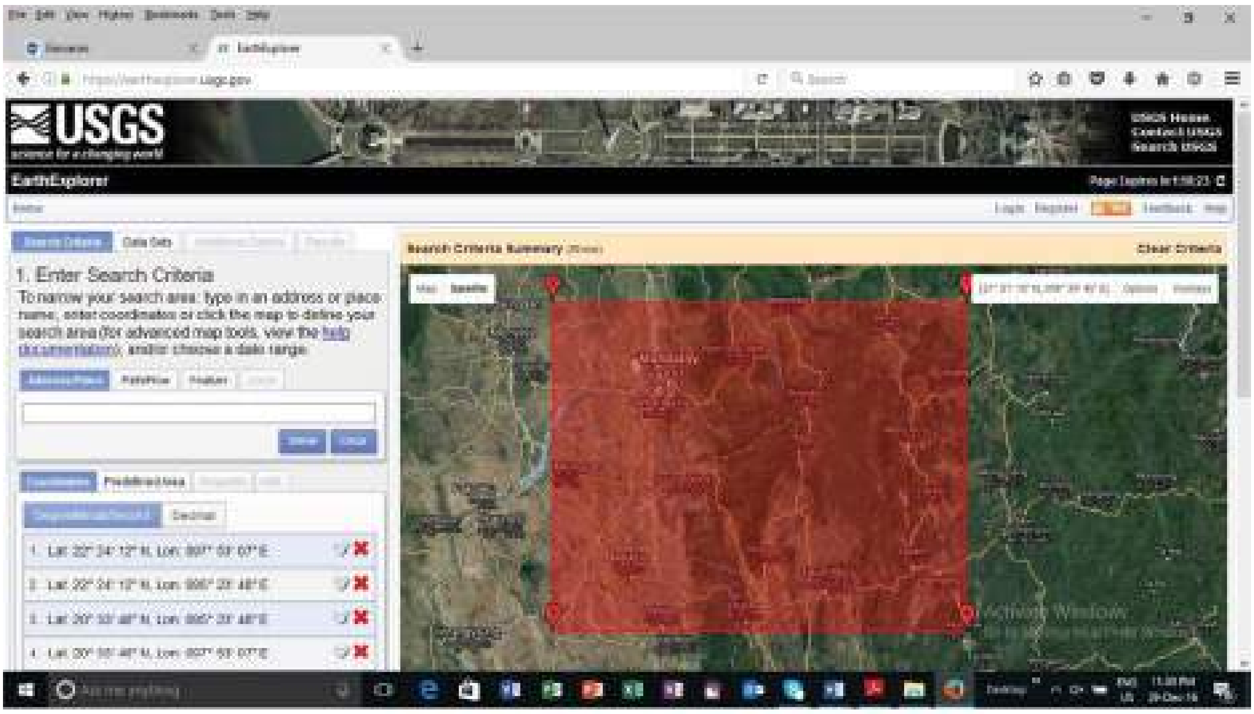
    Option 1: Order the imagery and wait for it to be processed.

    Option 2: download the imagery immediately

5. Unzip the files and put into a folder

Step 1 . Identify the path and row to download

You can also use Earth Explorer to find the appropriate path and row by browsing through their Google map to find your location of interest. There is a lot of overlap with Landsat scenes, so the area of interest may be covered by several Landsat scenes. If you zoom into an area and then select 'Use Map', a box will be drawn on the map and the search will use these coordinates.



Step 2: Select the years and months of interest to download

In the 'Search Criteria' tab, we will select the parameters for our search. For example, the best time of year to map land cover in Mandalay is summer.

Here is where you select the dates and you can specify individual months to search.

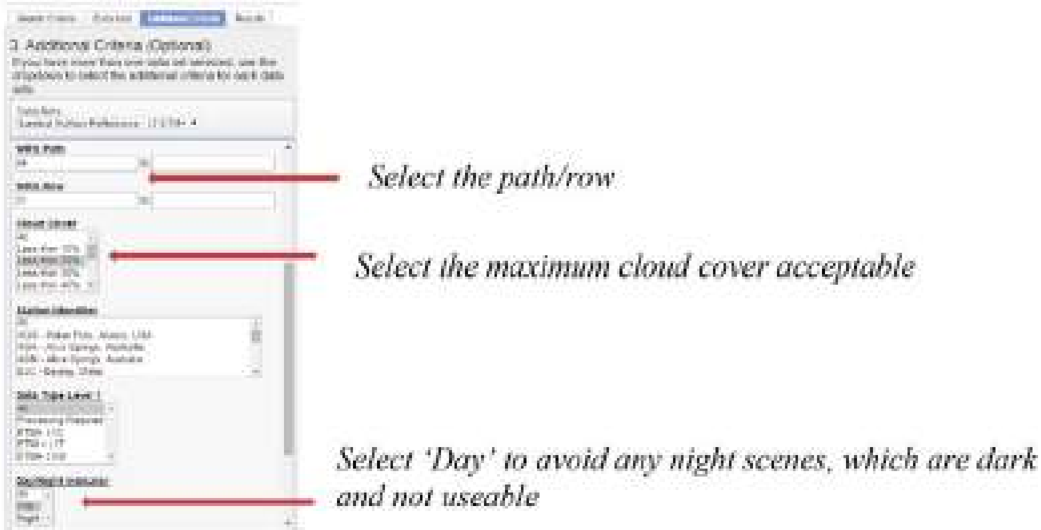
Step 3: Select the relevant dataset and Landsat mission

In 'Data Sets' tab, we will select the appropriate Landsat mission or missions. For this example, I am searching only for the 2000 image, and I want surface reflectance, so I select Landsat Surface Reflectance for the Landsat 4 and 5 missions.

For Option 1, you need to select the surface reflectance product in this step.

For Option 2, use the standard product.

Step 4: Set the Additional Criteria



Step 5: Order or download the Imagery

Once the images have been processed, you will receive an email notifying you that they are available for download. Simply click on the 'Download' button to download.

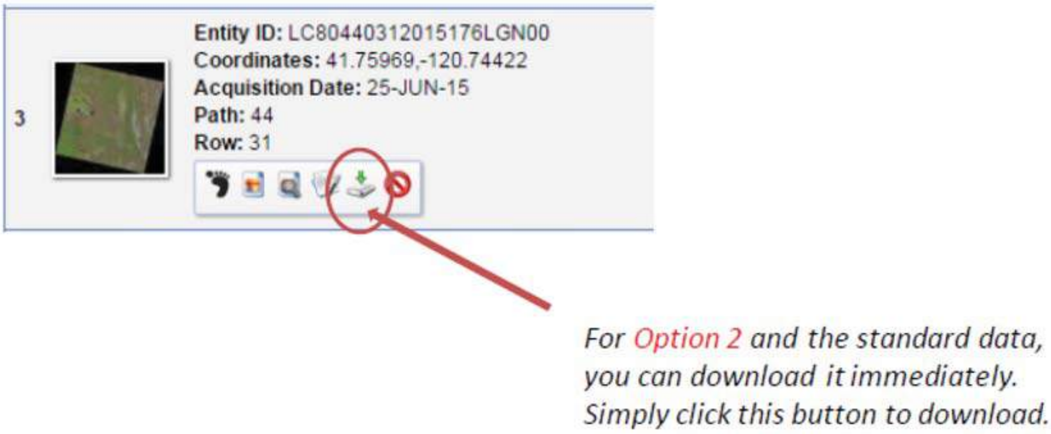
Requested: 3	Completed: 3	Open: 0	Waiting on data: 0

Order: justin_epting@fws.gov-0101510126894 **Date Ordered:** Oct. 12, 2015, 7 p.m.

Status: Complete **Date Completed:** Oct. 12, 2015, 7:35 p.m.

Requested Processing: surface reflectance, Output Format is geotiff

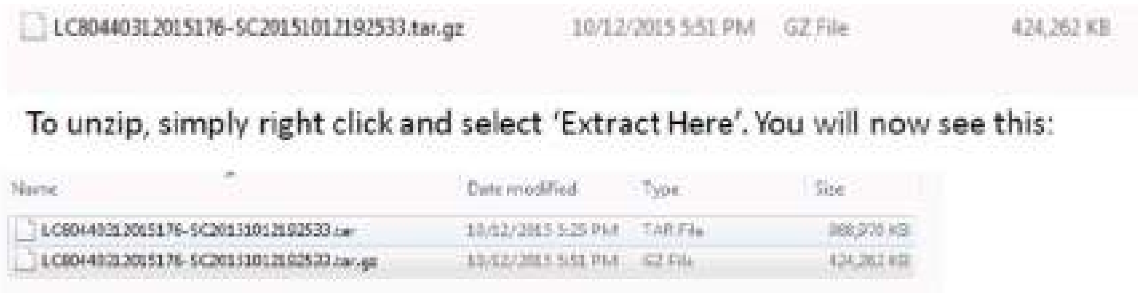
Product	Status	Product URL	Cksum URL	Note
LC80440312014157LGN00	Complete	Download	Checksum	
LC80440312013154LGN00	Complete	Download	Checksum	
LC80440312015176LGN00	Complete	Download	Checksum	



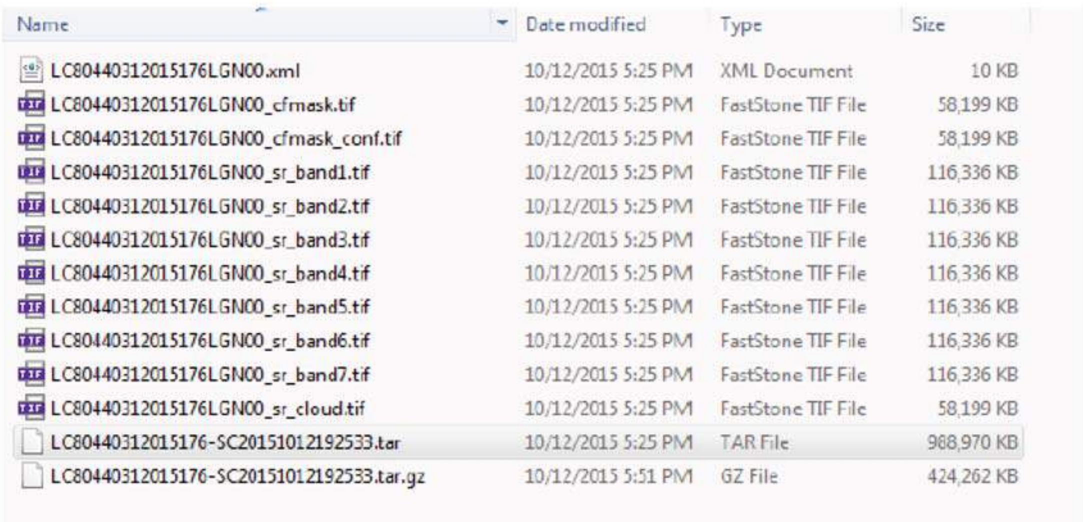
Step 6: Unzip the files

The Landsat data comes as individual bands and is compressed twice. One file is a tar file and the other is a gunzip file. You can manually unzip these files using 7 zip software. If you don't have 7 zip, you can download it here: www.7-zip.org

Note: also see the advanced lesson on how to unzip multiple files with a Python script



To unzip, simply right click and select 'Extract Here'. You will now see this:



Name	Date modified	Type	Size
LC80440312015176LGN00.xml	10/12/2015 5:25 PM	XML Document	10 KB
LC80440312015176LGN00_cfmask.tif	10/12/2015 5:25 PM	FastStone TIF File	58,199 KB
LC80440312015176LGN00_cfmask_conf.tif	10/12/2015 5:25 PM	FastStone TIF File	58,199 KB
LC80440312015176LGN00_sr_band1.tif	10/12/2015 5:25 PM	FastStone TIF File	116,336 KB
LC80440312015176LGN00_sr_band2.tif	10/12/2015 5:25 PM	FastStone TIF File	116,336 KB
LC80440312015176LGN00_sr_band3.tif	10/12/2015 5:25 PM	FastStone TIF File	116,336 KB
LC80440312015176LGN00_sr_band4.tif	10/12/2015 5:25 PM	FastStone TIF File	116,336 KB
LC80440312015176LGN00_sr_band5.tif	10/12/2015 5:25 PM	FastStone TIF File	116,336 KB
LC80440312015176LGN00_sr_band6.tif	10/12/2015 5:25 PM	FastStone TIF File	116,336 KB
LC80440312015176LGN00_sr_band7.tif	10/12/2015 5:25 PM	FastStone TIF File	116,336 KB
LC80440312015176LGN00_sr_cloud.tif	10/12/2015 5:25 PM	FastStone TIF File	58,199 KB
LC80440312015176-SC20151012192533.tar	10/12/2015 5:25 PM	TAR File	988,970 KB
LC80440312015176-SC20151012192533.tar.gz	10/12/2015 5:51 PM	GZ File	424,262 KB

2. Searching, exploring and downloading Baseline Data (Open Street Map)

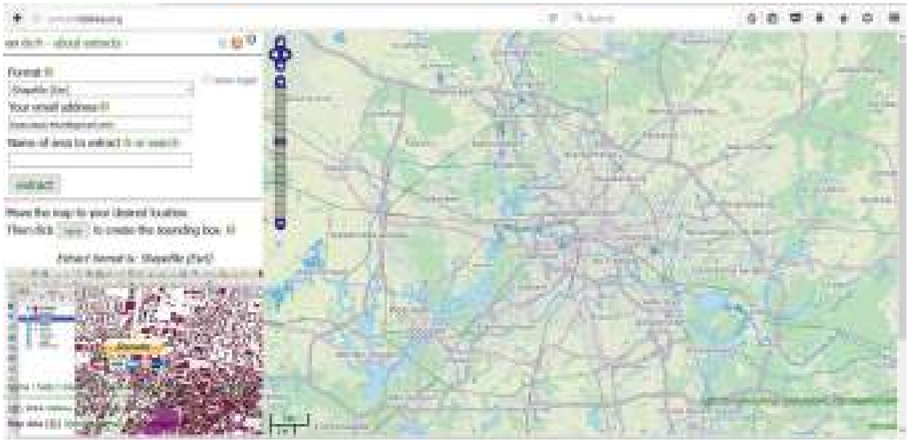
Everyone can contribute to the map by adding or correcting new roads or places of interest. With a GPS receiver and open source software you are ready to upload your GPS track to the web mapping service.

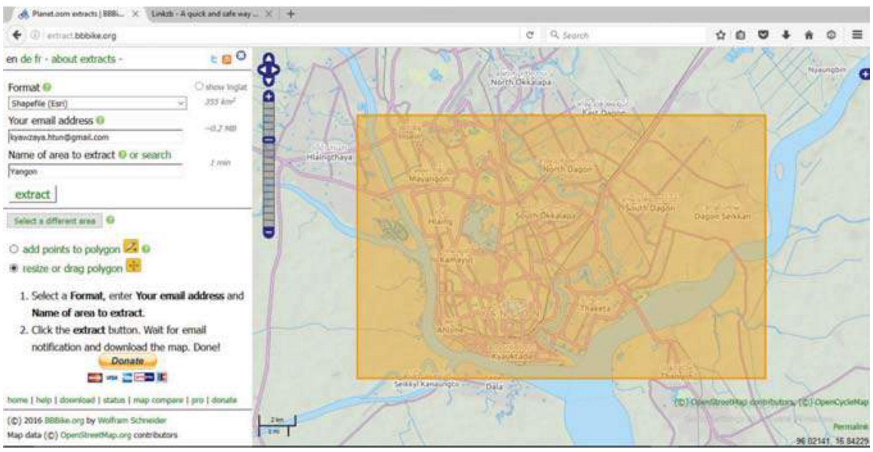
http://www.openstreetmap.org/ (or) http://extract.bbbike.org/

BBBike extracts allows you to extract areas from Planet.osm in OSM, PBF,o5m, Garmin,....,Esri shape file format. The maximum areasize is 24,000,000 sq km or 768 MB file size. It will take between 2-7 minutes to extract an area. The email filed is required, you will be notified by e-email if your extract is ready for download. Please use a meaningful name for the extract. For more information, please read the extract help page.

How to use the BBBike extract service:

4. Move the map to your desired location.
5. Then click to create the bounding box.
6. Move or resize the bounding box or add new points to the polygon.
7. Select a Format, enter Your email address and Name of area to extract.
8. Click the extract button. Wait for email notification and download the map.





Thanks - the input data looks good.

It takes between 2-7 minutes to extract an area from planet.osm, depending on the size of the area and the system load. You will be notified by e-mail if your extract is ready for download. Please follow the instruction in the email to proceed your request.

Area: 'Yangon' covers 356 square km
Coordinates: 96.0782,16.7597 x 96.299,16.8959
Format: Shapefile (Esri)

You can monitor the status of your request on the server status page.

Press the back button to get the same area in a different format, or to request a new area.

We appreciate any feedback, suggestions and a donation! You can support us via PayPal, Flattr or bank wire transfer.

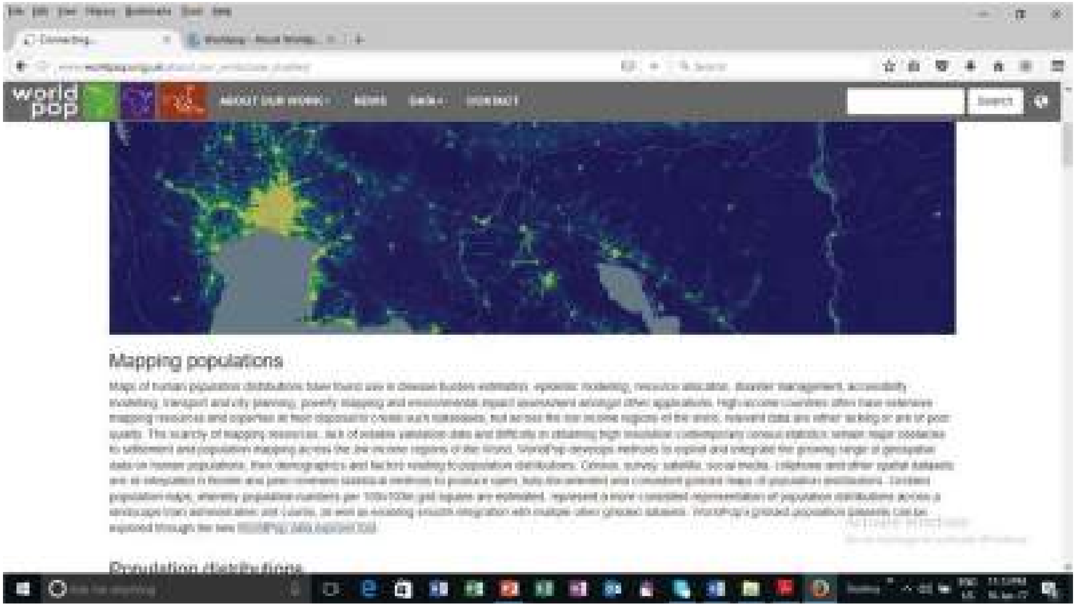
Donate

home | help | download | status | map compare | pro | donate

(C) 2016 BBBike.org by Wolfram Schneider
Map data (C) OpenStreetMap.org contributors

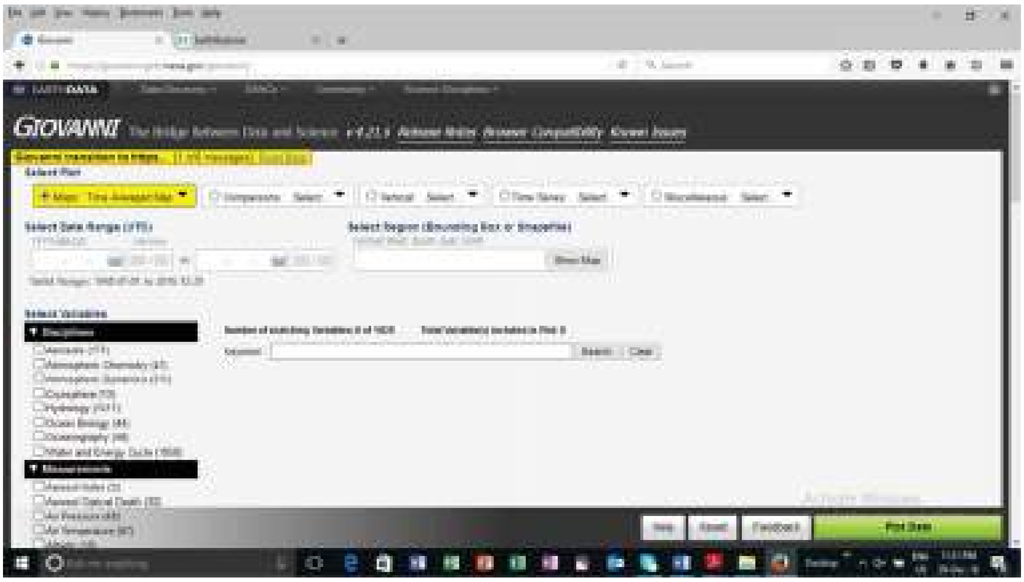
3. Searching and downloading Global Population Data

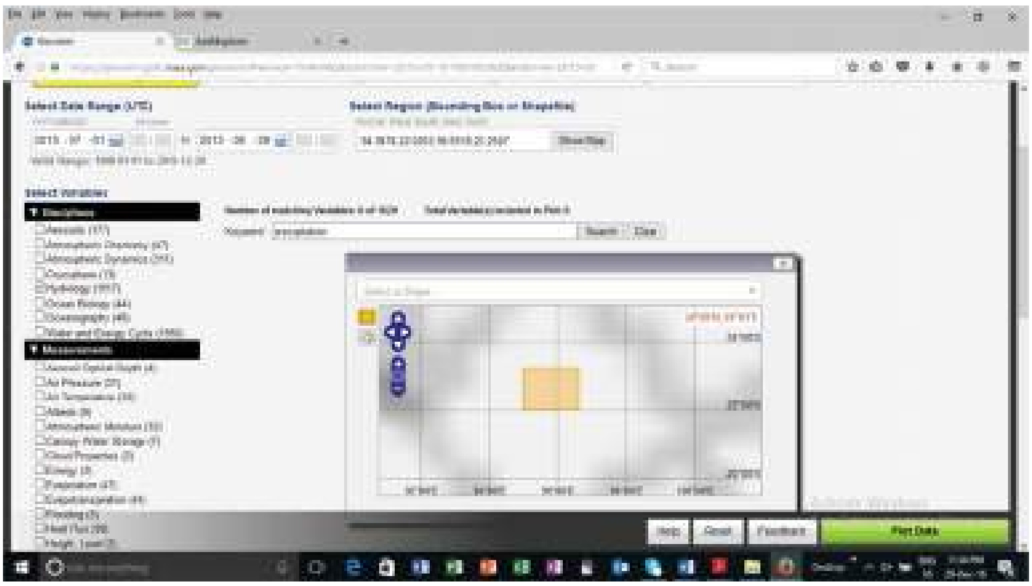
When a disaster occurs, the emergency response depends critically on the initial estimate of the affected population. However, retrieval of crucial and accurate statistics on population living within affected areas in many regions of the world can be time consuming and often very difficult to access. WorldPop population distribution model provides the finest resolution population distribution data available for the entire world at 100m resolution. WorldPop population dataset involves collection of the best available census counts (usually at sub-province level) for each country and four primary geospatial input datasets, namely land cover, roads, slope, and night time lights, that are key indicators of population distribution World-Pop shows the "ambient" population, where people are usually located at a set time of day, not just where the people live and this data is very useful to roughly estimate affected population when a major disaster occurs over a large region. More information about the data and download option can be access from the website below – http://www.worldpop.org.uk/

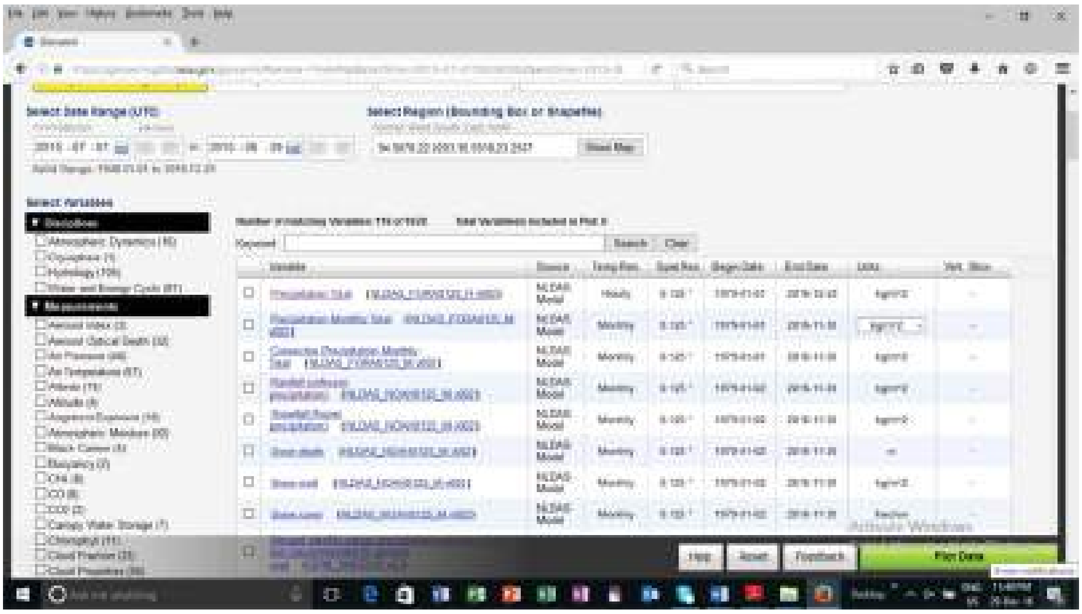


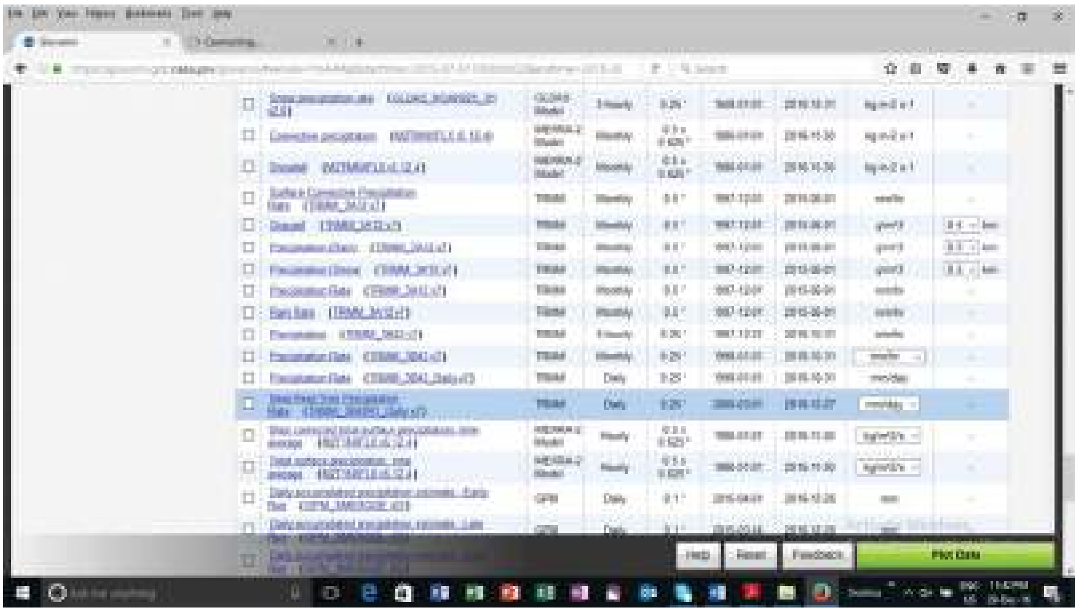
4. **Searching and downloading Precipitation data**

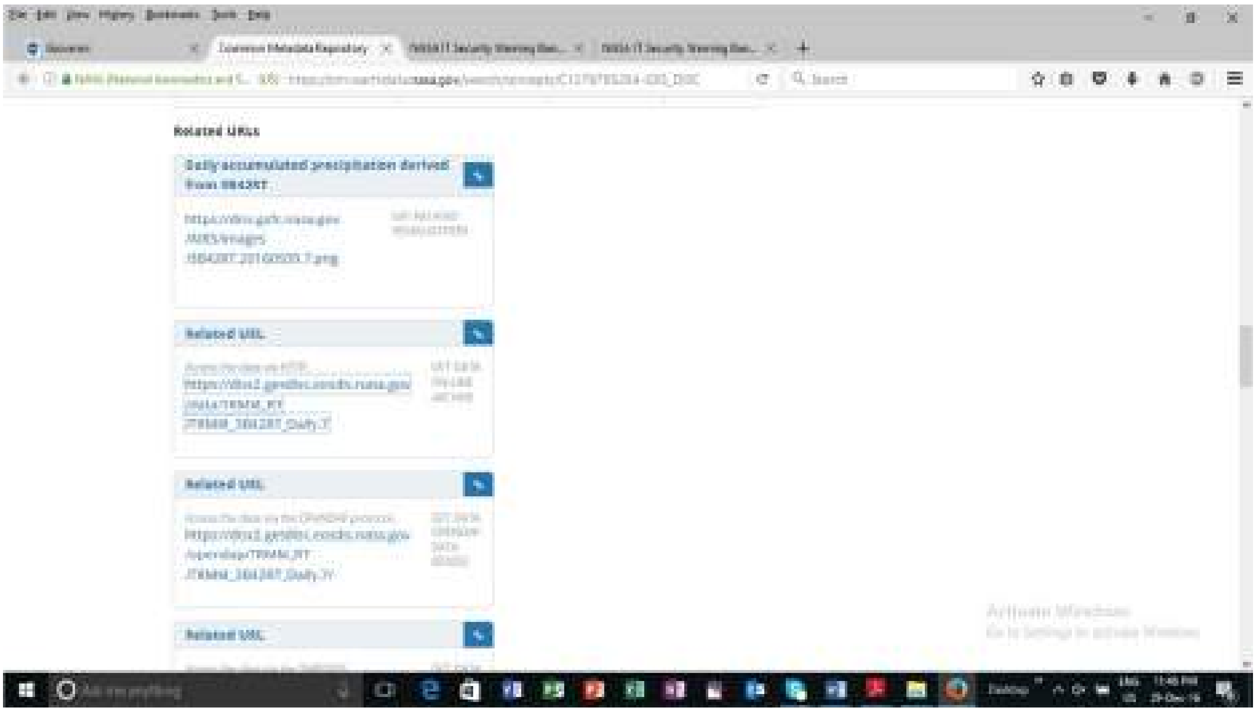
Http://giovanni.gsfc.nasa.gov/giovanni/

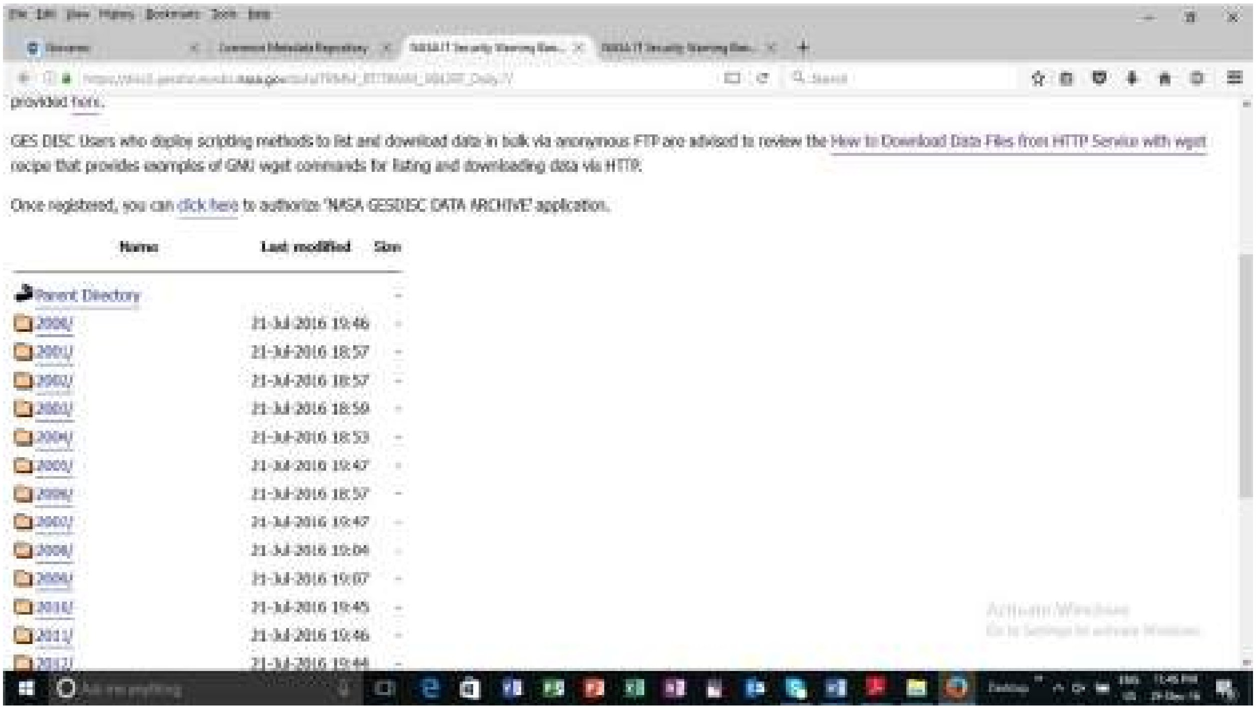




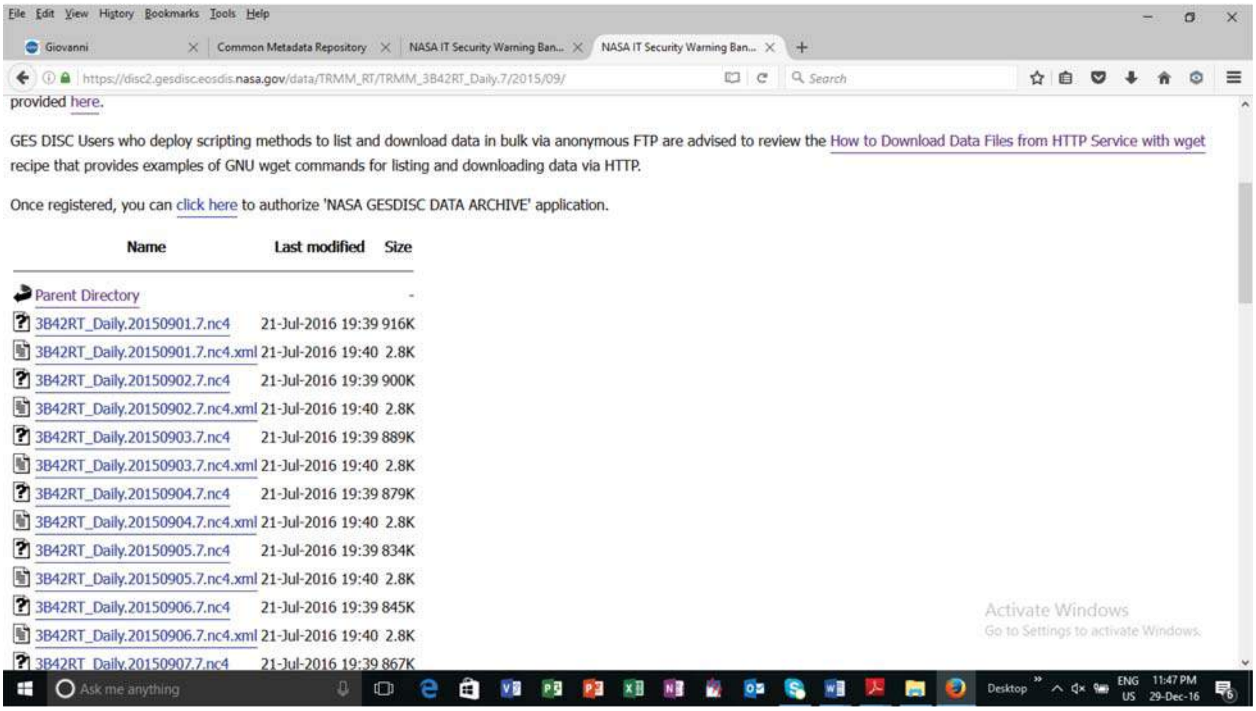

Select Date Range (UTC)
Select Region (Bounding Box or Shapefile)
Select Variables
Help
Reset
Feedback
Plot Data


Help
Reset
Feedback
Plot Data


Related URLs
Daily accumulated precipitation derived from 3B42RT
Related URL
Related URL
Related URL


provided here.
GES DISC Users who deploy scripting methods to list and download data in bulk via anonymous FTP are advised to review the How to Download Data Files from HTTP Service with wget recipe that provides examples of GNU wget commands for listing and downloading data via HTTP.
Once registered, you can click here to authorize "NASA GESDISC DATA ARCHIVE" application.
Name
Last modified
Size
Parent Directory

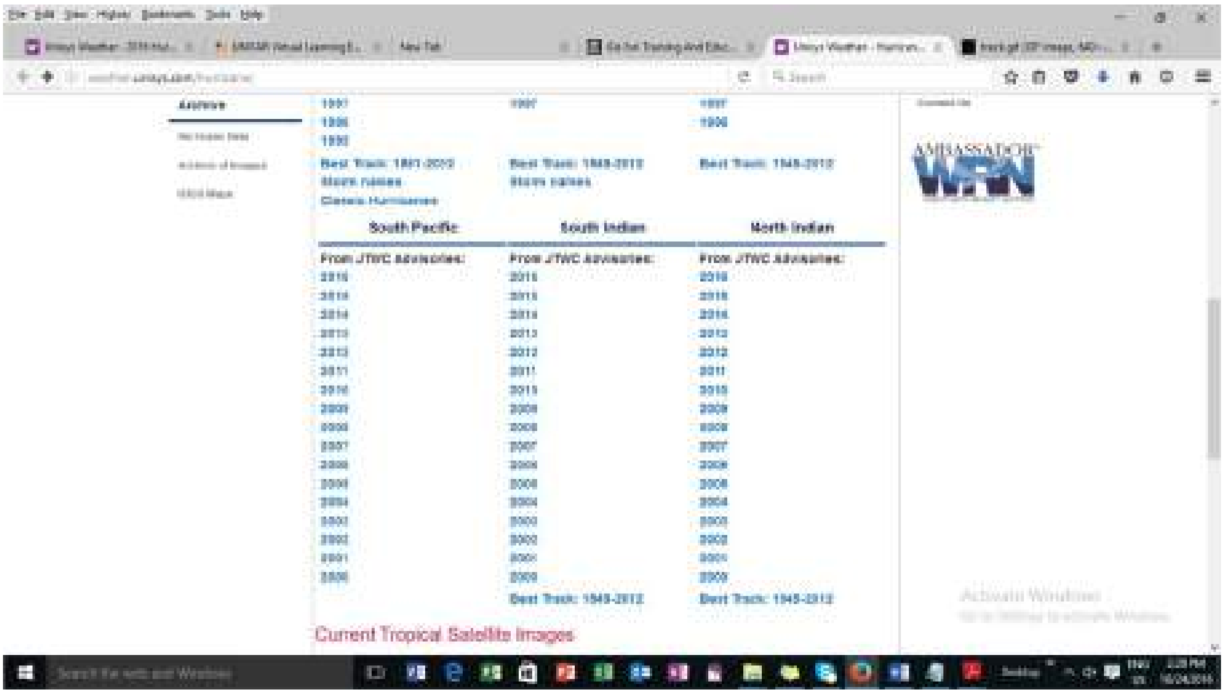

Once registered, you can click here to authorize 'NASA GESDISC DATA ARCHIVE' application.
Name Last modified Size
Parent Directory
01/ 21-Jul-2016 19:41
02/ 21-Jul-2016 19:41
03/ 21-Jul-2016 19:41
04/ 21-Jul-2016 19:41
05/ 21-Jul-2016 19:41
06/ 21-Jul-2016 19:41
07/ 21-Jul-2016 19:41
08/ 21-Jul-2016 19:41
09/ 21-Jul-2016 19:41
10/ 21-Jul-2016 19:41
11/ 21-Jul-2016 19:41
12/ 21-Jul-2016 19:41
NASA Web Privacy Policy and Important Notices

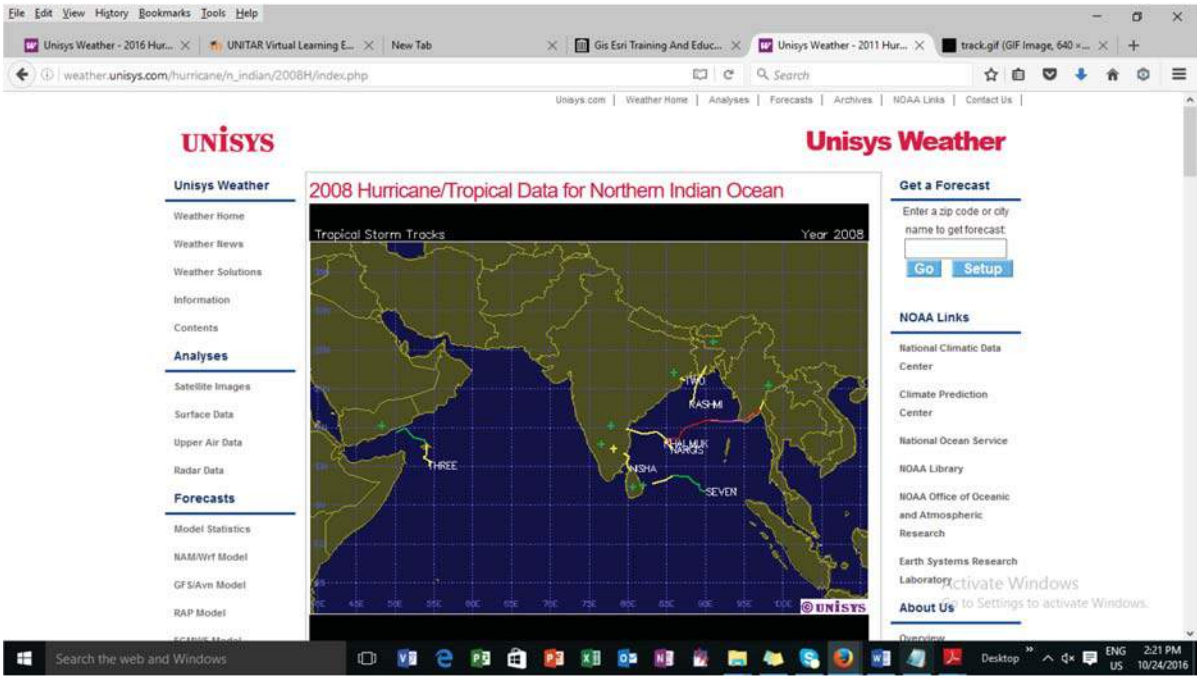

File Edit View History Bookmarks Tools Help
Giovanni
Common Metadata Repository
NASA IT Security Warning Ban...
NASA IT Security Warning Ban...
https://disc2.gesdisc.eosdis.nasa.gov/data/TRMM_RT/TRMM_3B42RT_Daily.7/2015/09/
Search
provided here.
GES DISC Users who deploy scripting methods to list and download data in bulk via anonymous FTP are advised to review the How to Download Data Files from HTTP Service with wget recipe that provides examples of GNU wget commands for listing and downloading data via HTTP.
Once registered, you can click here to authorize 'NASA GESDISC DATA ARCHIVE' application.
Name Last modified Size
Parent Directory -
3B42RT_Daily.20150901.7.nc4 21-Jul-2016 19:39 916K
3B42RT_Daily.20150901.7.nc4.xml 21-Jul-2016 19:40 2.8K
3B42RT_Daily.20150902.7.nc4 21-Jul-2016 19:39 900K
3B42RT_Daily.20150902.7.nc4.xml 21-Jul-2016 19:40 2.8K
3B42RT_Daily.20150903.7.nc4 21-Jul-2016 19:39 889K
3B42RT_Daily.20150903.7.nc4.xml 21-Jul-2016 19:40 2.8K
3B42RT_Daily.20150904.7.nc4 21-Jul-2016 19:39 879K
3B42RT_Daily.20150904.7.nc4.xml 21-Jul-2016 19:40 2.8K
3B42RT_Daily.20150905.7.nc4 21-Jul-2016 19:39 834K
3B42RT_Daily.20150905.7.nc4.xml 21-Jul-2016 19:40 2.8K
3B42RT_Daily.20150906.7.nc4 21-Jul-2016 19:39 845K
3B42RT_Daily.20150906.7.nc4.xml 21-Jul-2016 19:40 2.8K
3B42RT_Daily.20150907.7.nc4 21-Jul-2016 19:39 867K
Activate Windows
Go to Settings to activate Windows.
Ask me anything
Desktop
ENG US
11:47 PM 29-Dec-16

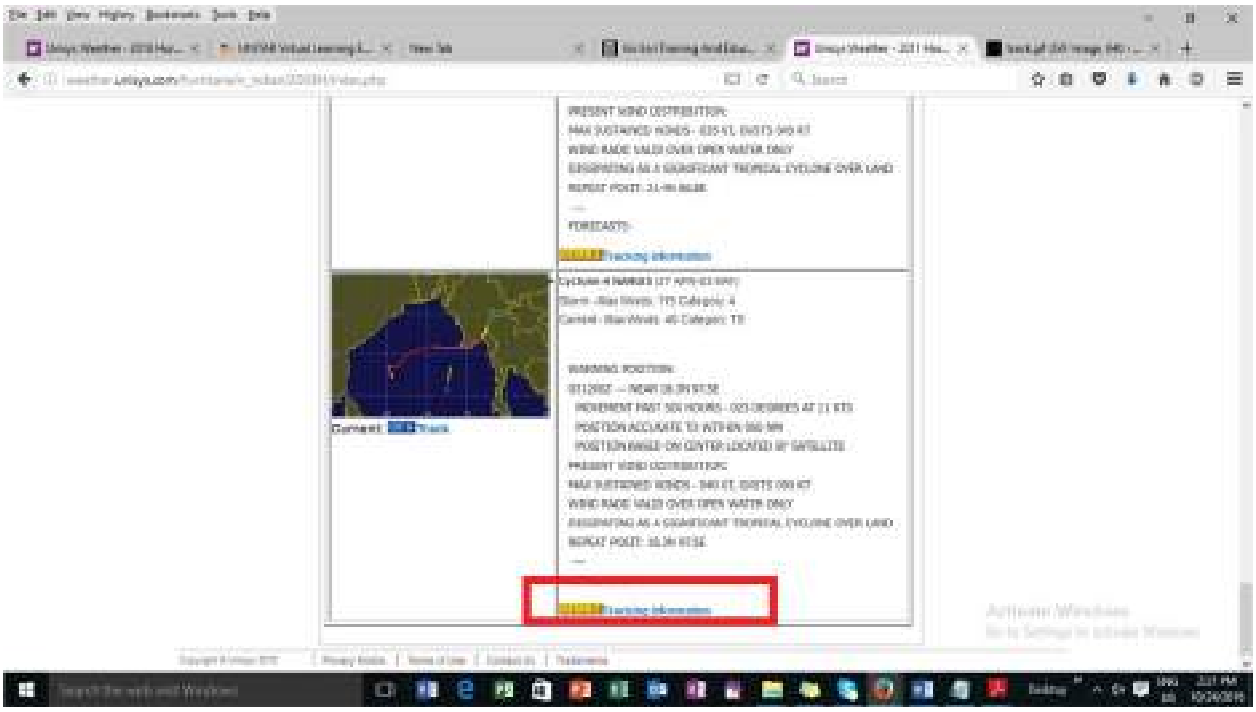
5. Searching and downloading Tropical Storm data

Real time and archive data about hurricane/ typhoon can download using the following web page:

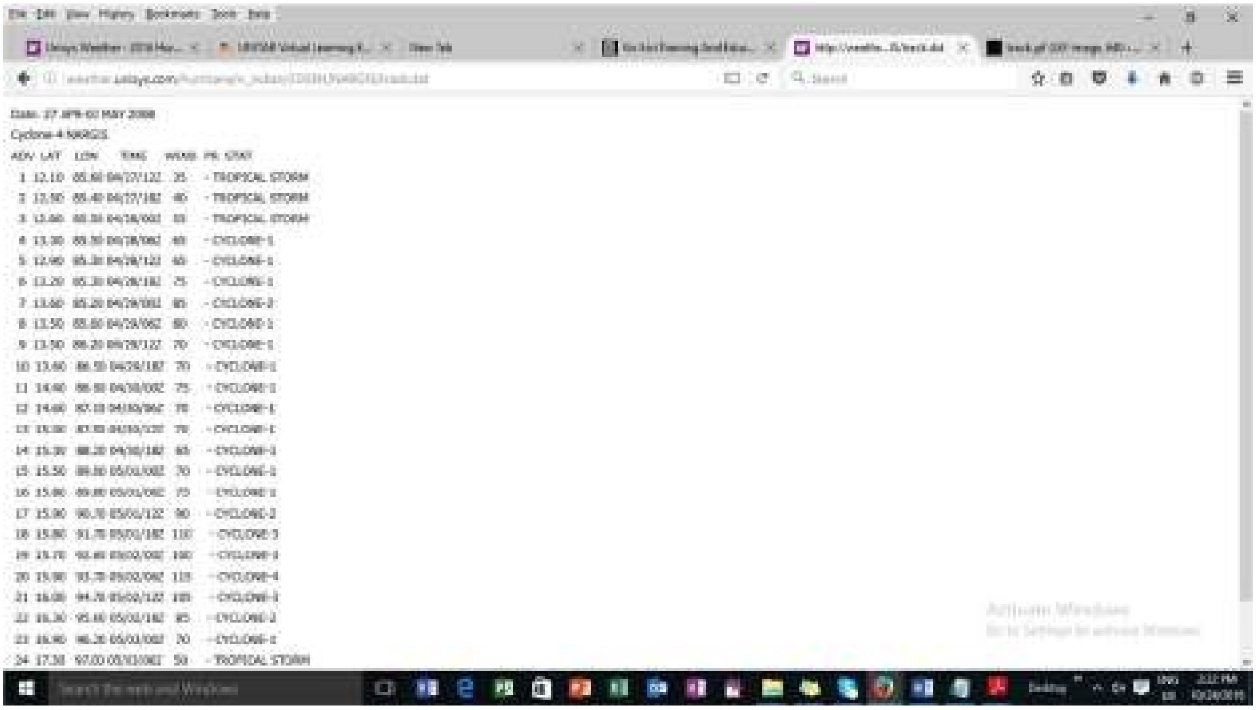
http://weather.unisys.com/hurricane/







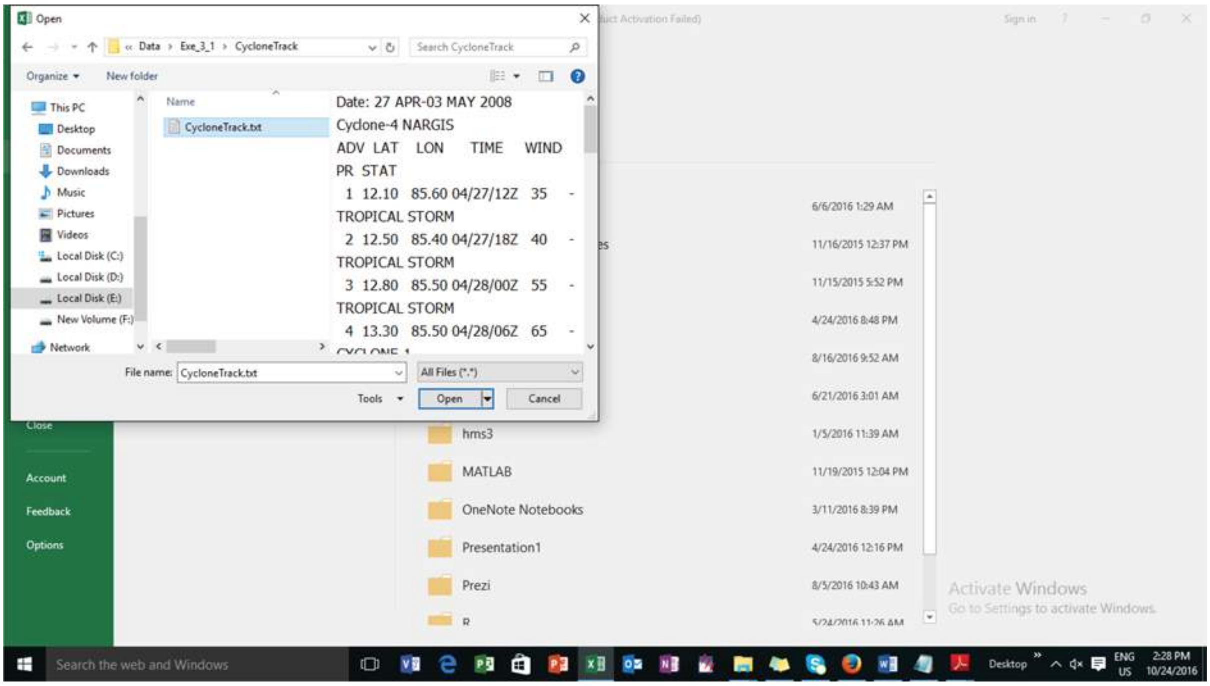
Scroll down to individual Storm details click on Tracking information for “Cyclone-4 NARGIS”

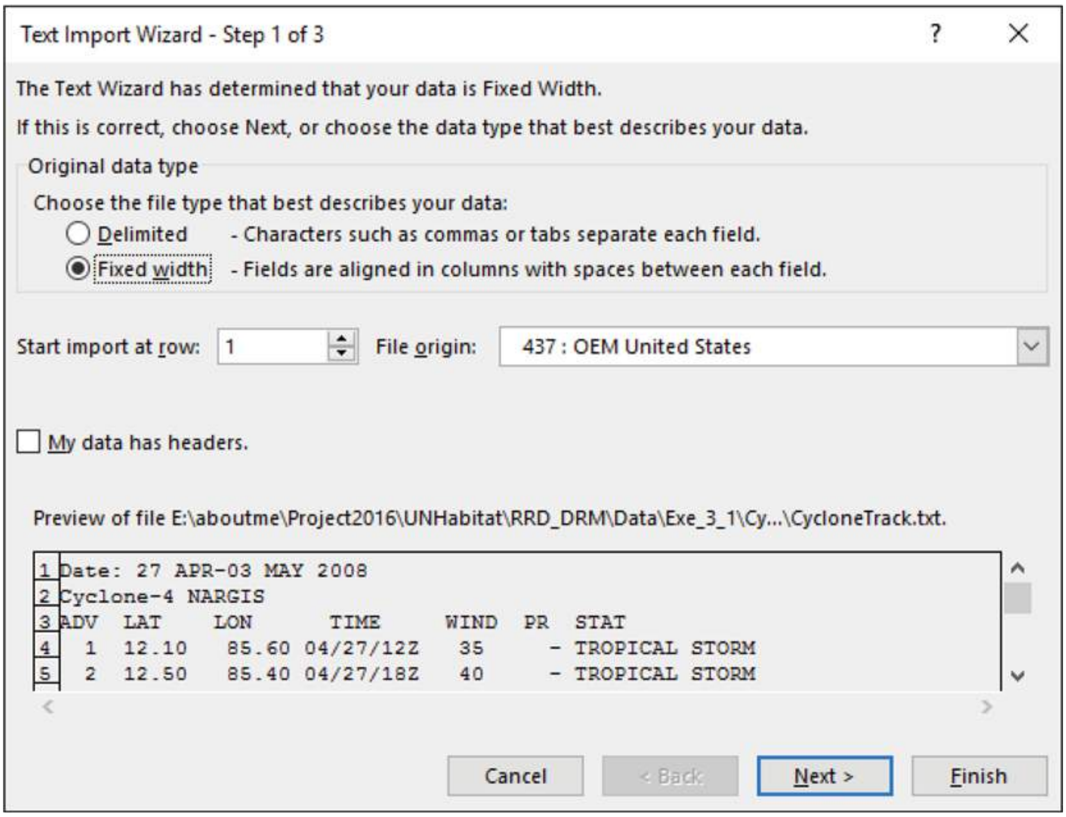


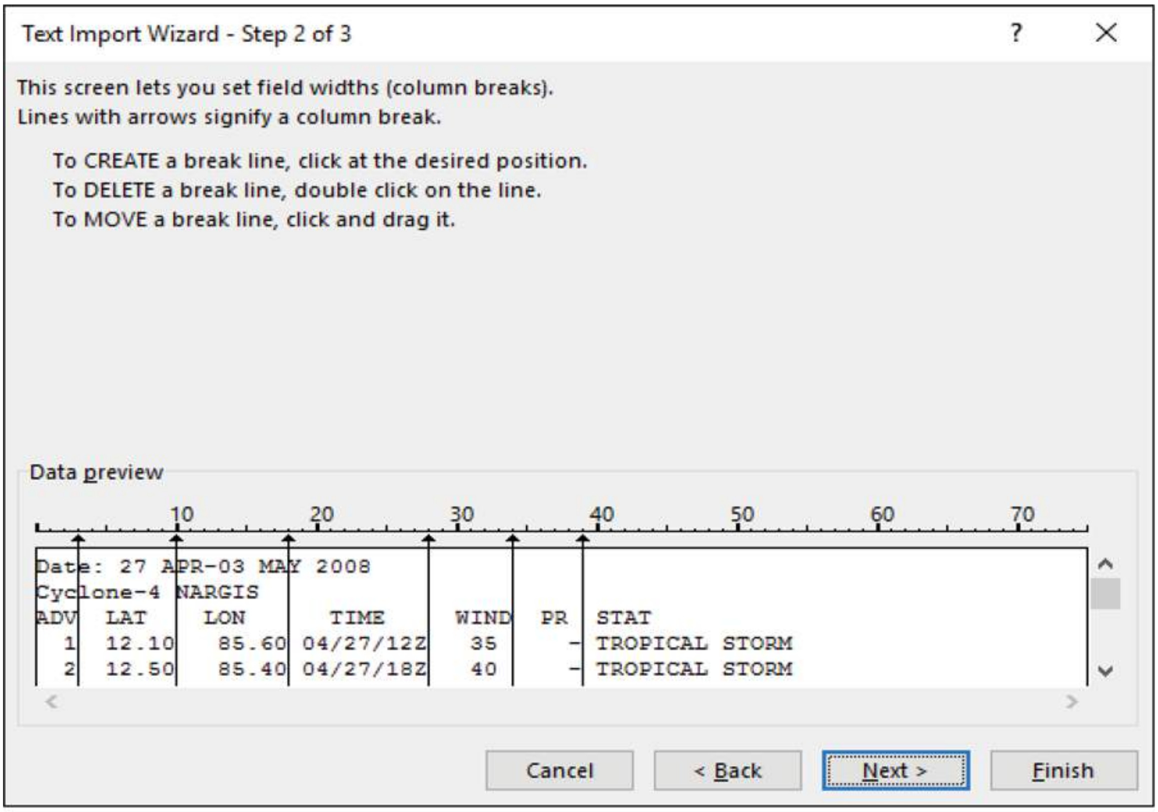
Repeat the steps in the previous exercise to convert text into a feature class (i.e. copy and paste data into a Word Pad, the load the data into excel.)

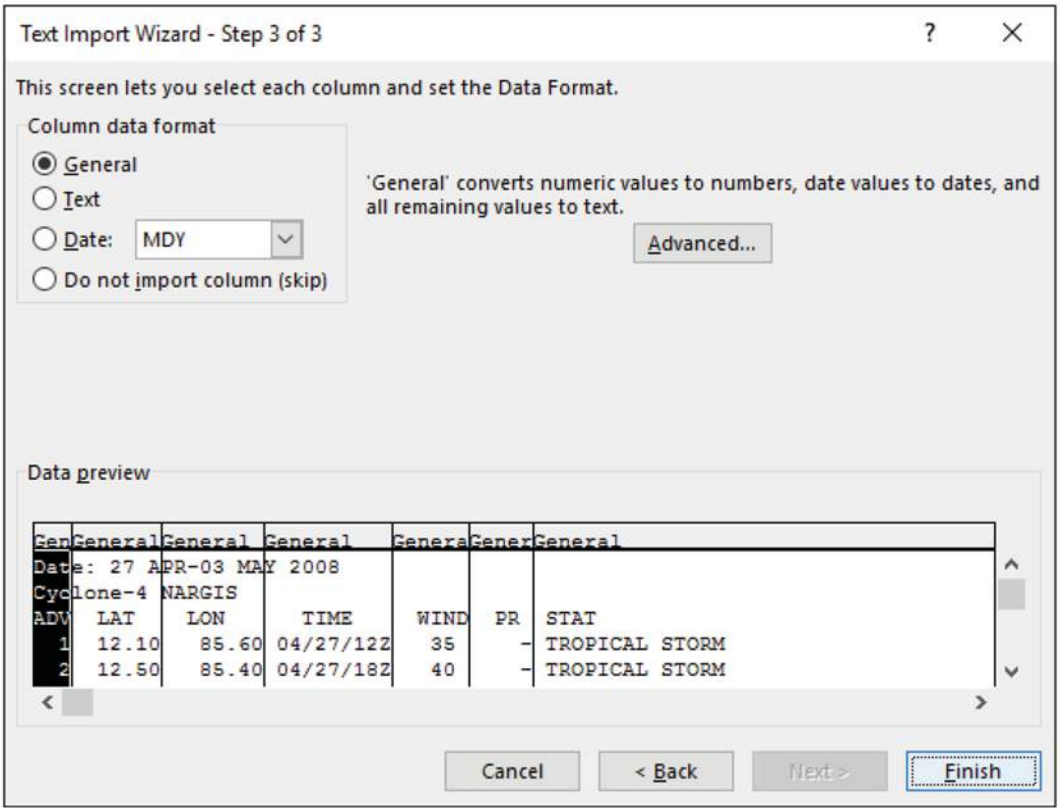
Open this note pad file from excel and delete the first two rows. And then save as TrackInfo.csv in your desired folder.

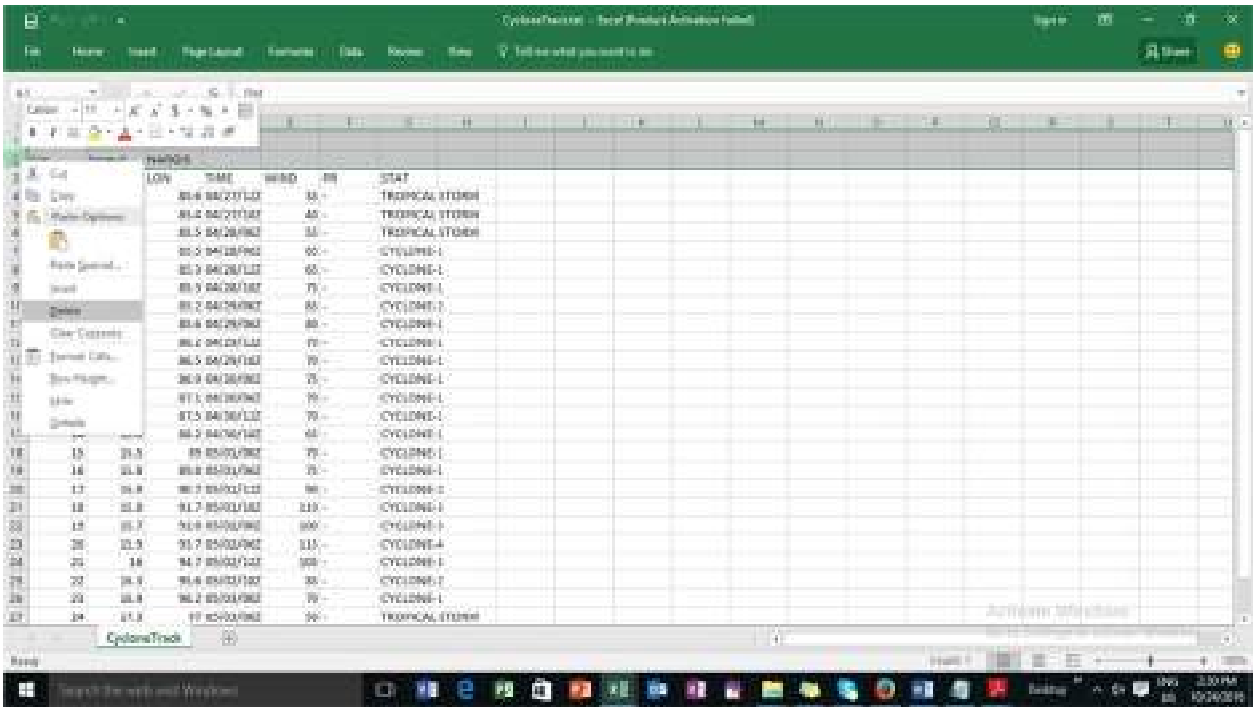
(e.g E:\aboutme\Project2016\UNHabitat\RRD_DRM\Data\Exe_3_1\CycloneTrack)

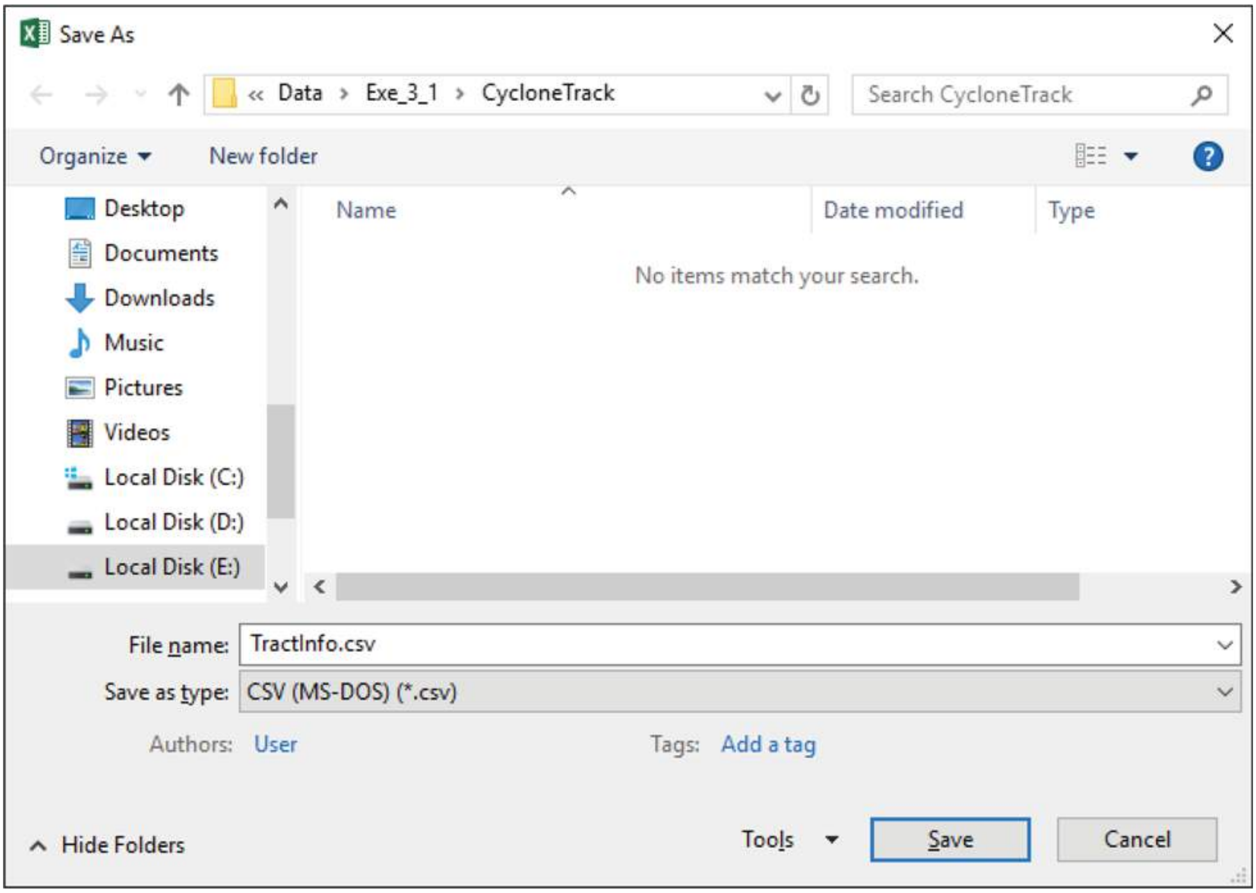

Open
Data › Exe_3_1 › CycloneTrack
Search CycloneTrack
Organize
New folder
This PC
Desktop
Documents
Downloads
Music
Pictures
Videos
Local Disk (C:)
Local Disk (D:)
Local Disk (E:)
New Volume (F:)
Network
Name
CycloneTrack.txt
Date: 27 APR-03 MAY 2008
Cyclone-4 NARGIS
ADV LAT LON TIME WIND
PR STAT
1 12.10 85.60 04/27/12Z 35 -
TROPICAL STORM
2 12.50 85.40 04/27/18Z 40 -
TROPICAL STORM
3 12.80 85.50 04/28/00Z 55 -
TROPICAL STORM
4 13.30 85.50 04/28/06Z 65 -
File name: CycloneTrack.txt
All Files (*.*)
Tools
Open
Cancel
Account
Feedback
Options
hms3
MATLAB
OneNote Notebooks
Presentation1
Prezi
Activate Windows
Go to Settings to activate Windows.
Search the web and Windows


Text Import Wizard - Step 1 of 3
The Text Wizard has determined that your data is Fixed Width.
If this is correct, choose Next, or choose the data type that best describes your data.
Original data type
Choose the file type that best describes your data:
Delimited - Characters such as commas or tabs separate each field.
Fixed width - Fields are aligned in columns with spaces between each field.
Start import at row: 1
File origin: 437 : OEM United States
My data has headers.
Preview of file E:\aboutme\Project2016\UNHabitat\RRD_DRM\Data\Exe_3_1\Cy...\CycloneTrack.txt.
1 Date: 27 APR-03 MAY 2008
2 Cyclone-4 NARGIS
3 ADV LAT LON TIME WIND PR STAT
4 1 12.10 85.60 04/27/12Z 35 - TROPICAL STORM
5 2 12.50 85.40 04/27/18Z 40 - TROPICAL STORM
Cancel
< Back
Next >
Finish

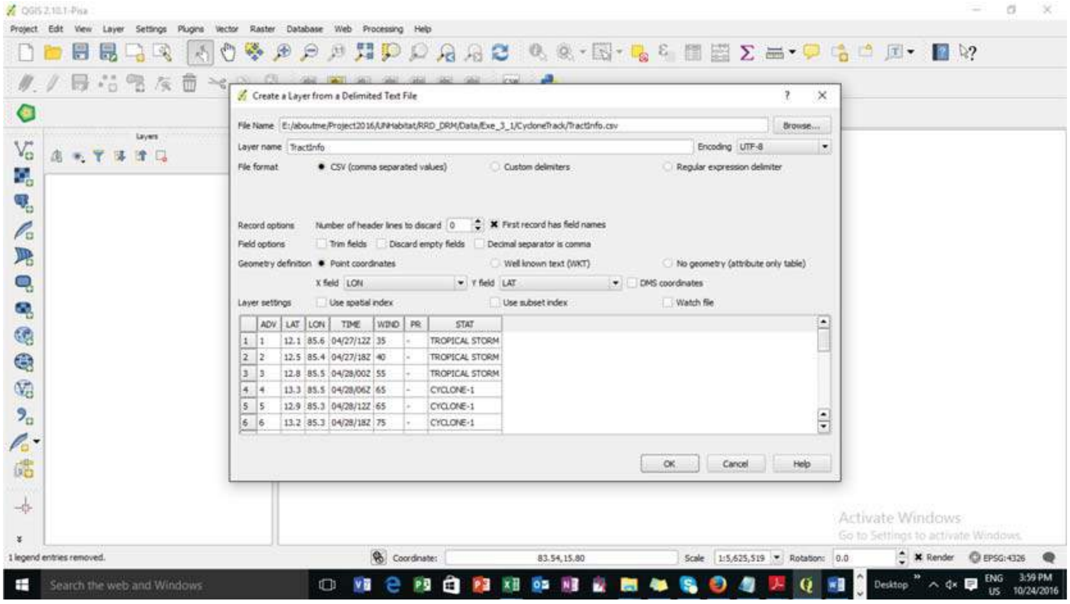

Text Import Wizard - Step 2 of 3
This screen lets you set field widths (column breaks).
Lines with arrows signify a column break.
To CREATE a break line, click at the desired position.
To DELETE a break line, double click on the line.
To MOVE a break line, click and drag it.
Data preview
10 20 30 40 50 60 70
Date: 27 APR-03 MAY 2008
Cyclone-4 NARGIS
ADV LAT LON TIME WIND PR STAT
1 12.10 85.60 04/27/12Z 35 - TROPICAL STORM
2 12.50 85.40 04/27/18Z 40 - TROPICAL STORM
Cancel
< Back
Next >
Finish


Text Import Wizard - Step 3 of 3
This screen lets you select each column and set the Data Format.
Column data format
General
Text
Date: MDY
Do not import column (skip)
'General' converts numeric values to numbers, date values to dates, and all remaining values to text.
Advanced...
Data preview
Date: 27 APR-03 MAY 2008
Cyclone-4 NARGIS
ADV LAT LON TIME WIND PR STAT
1 12.10 85.60 04/27/12Z 35 - TROPICAL STORM
2 12.50 85.40 04/27/18Z 40 - TROPICAL STORM
Cancel
< Back
Next >
Finish

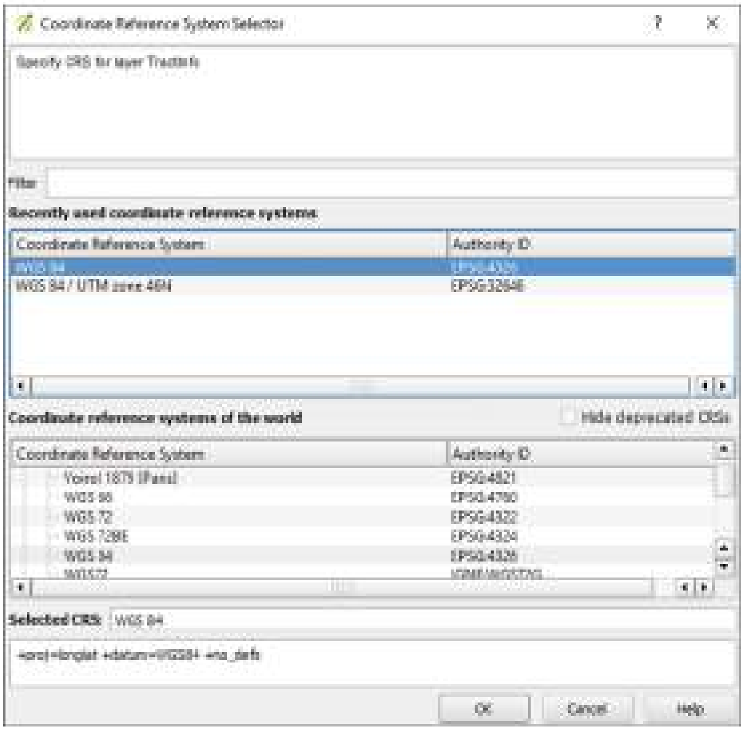




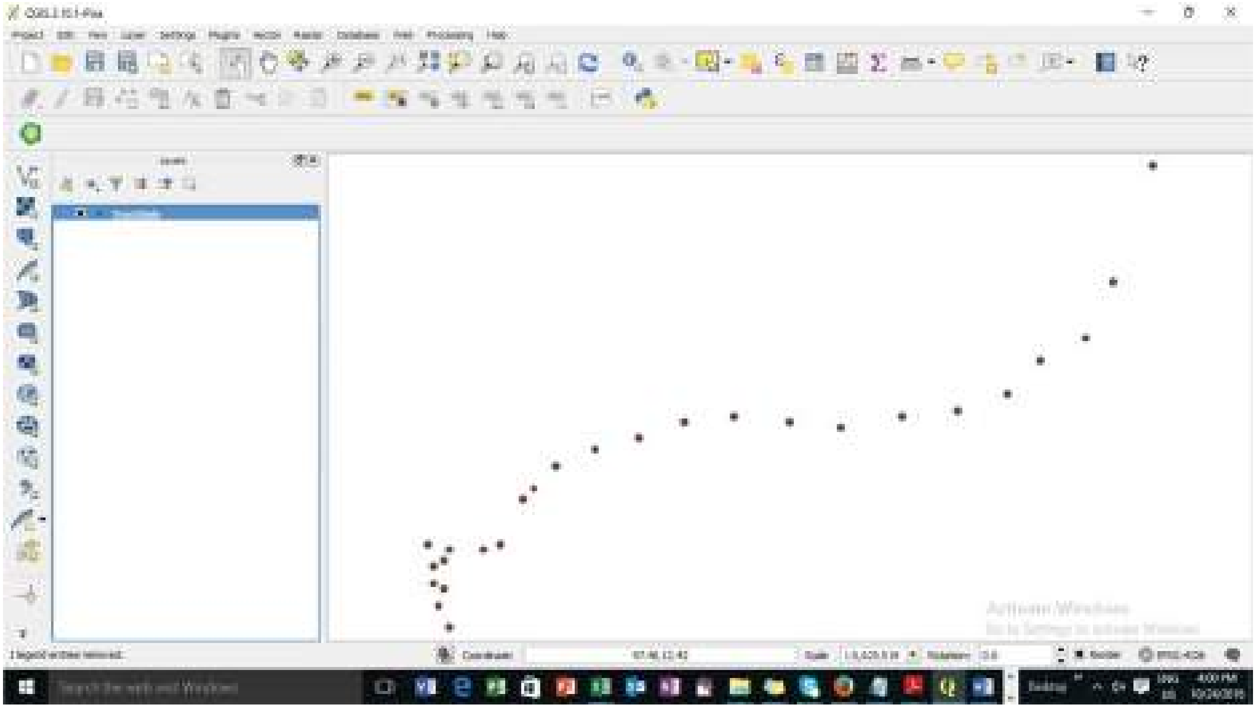
.Then add this csv file from Add delimited text layer tool in red box and open TractInfo.csv. Choose CSV from file format option. Then click Ok.



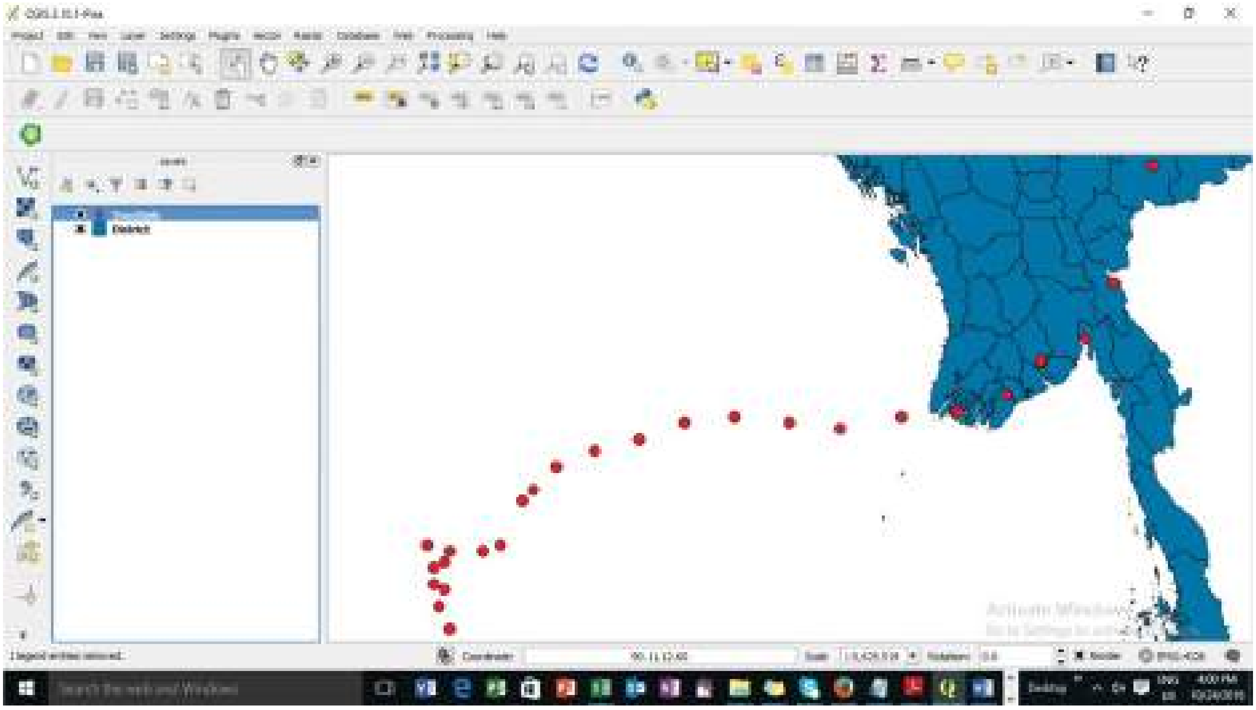
Then select the WGS 84 (EPSG.4326) from Coordinate Reference System. Then click Ok.



Finally you can see the tract of Nargis Cyclone.



Then add the District layer and overlay with TractInfo layer. You will see the tract information of NARGIS cyclone passed on which districts.



Other Ref : www.windytv.com/?pressure,21.514,91.868,5

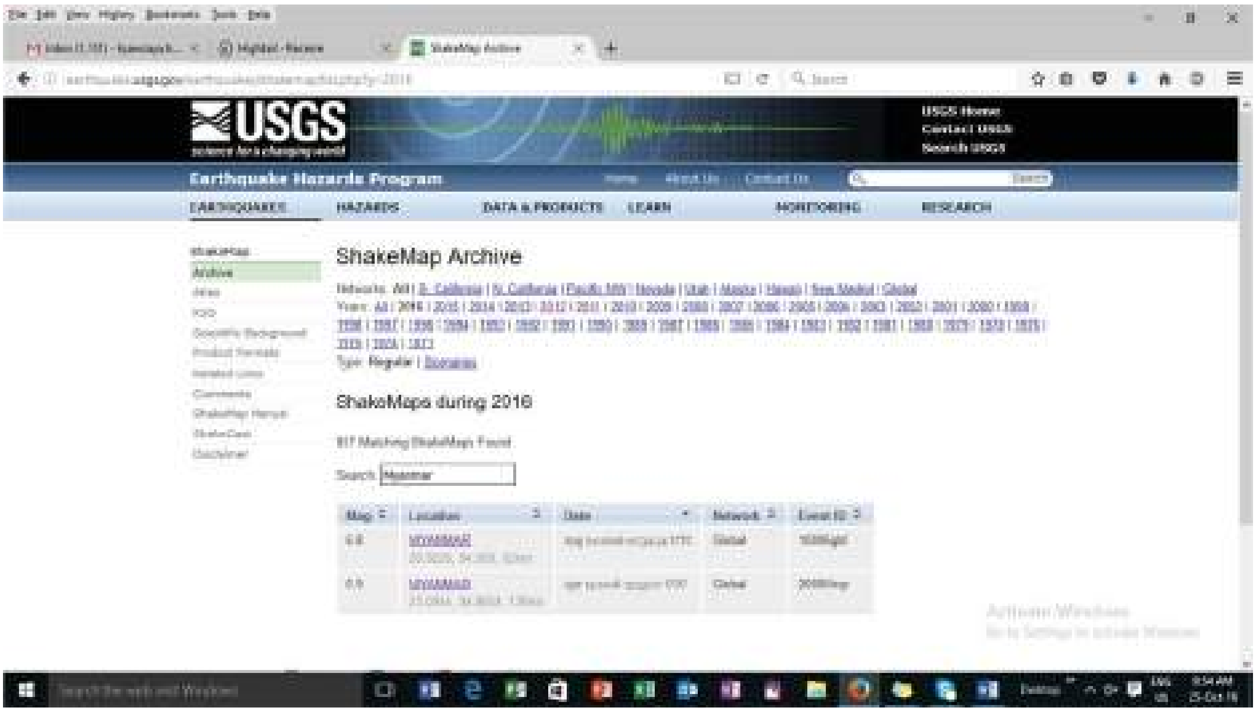
6. Searching and downloading earthquake peak ground acceleration data

USGS provides several alternative ways to obtain real-time earthquake data and information. Earthquake information is extracted from a merged catalog of earthquakes located by the USGS and contributing networks. Earthquake will be broadcast within a few minutes for California events and within 30 minutes for worldwide events: http://earthquake.usgs.gov/earthquakes/map/

For this exercise, you will download earthquake peak ground acceleration data (GIS format) relative to the earthquake occurred in Myanmar on the 24th Aug. 2016.

Browse to the following web page:

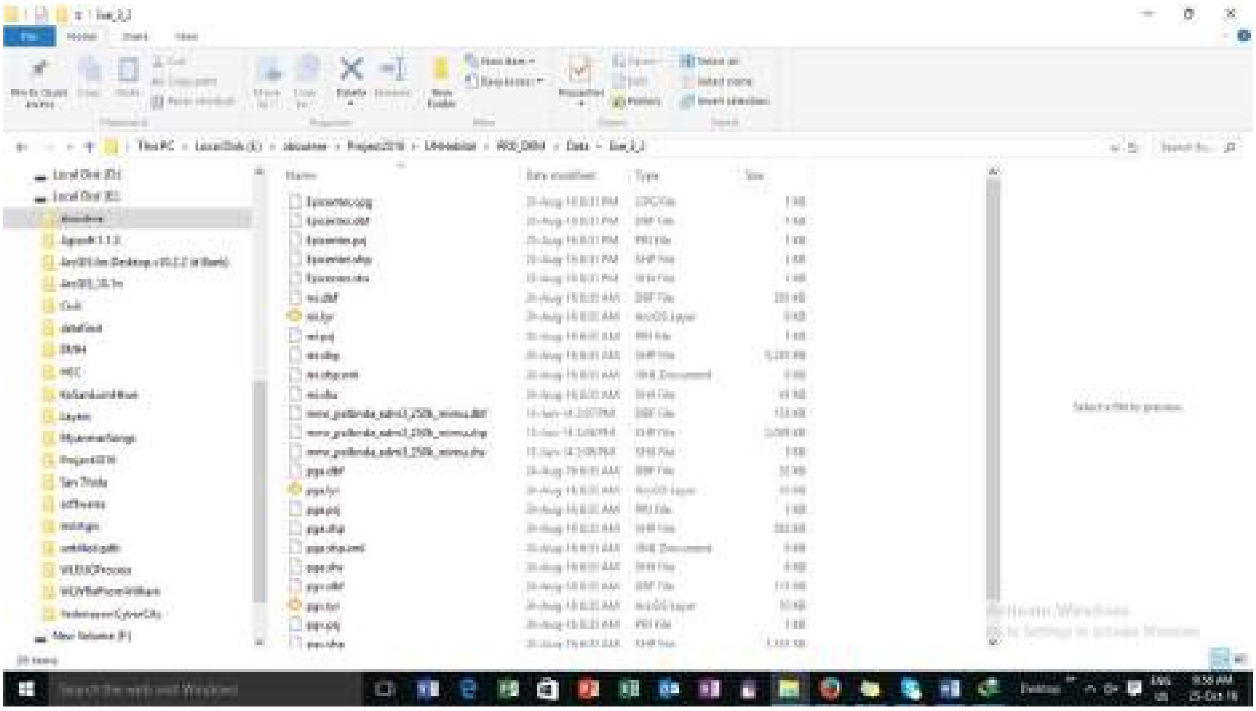
http://earthquake.usgs.gov/earthquakes/shakemap/global/shake/c000dqqw/#download

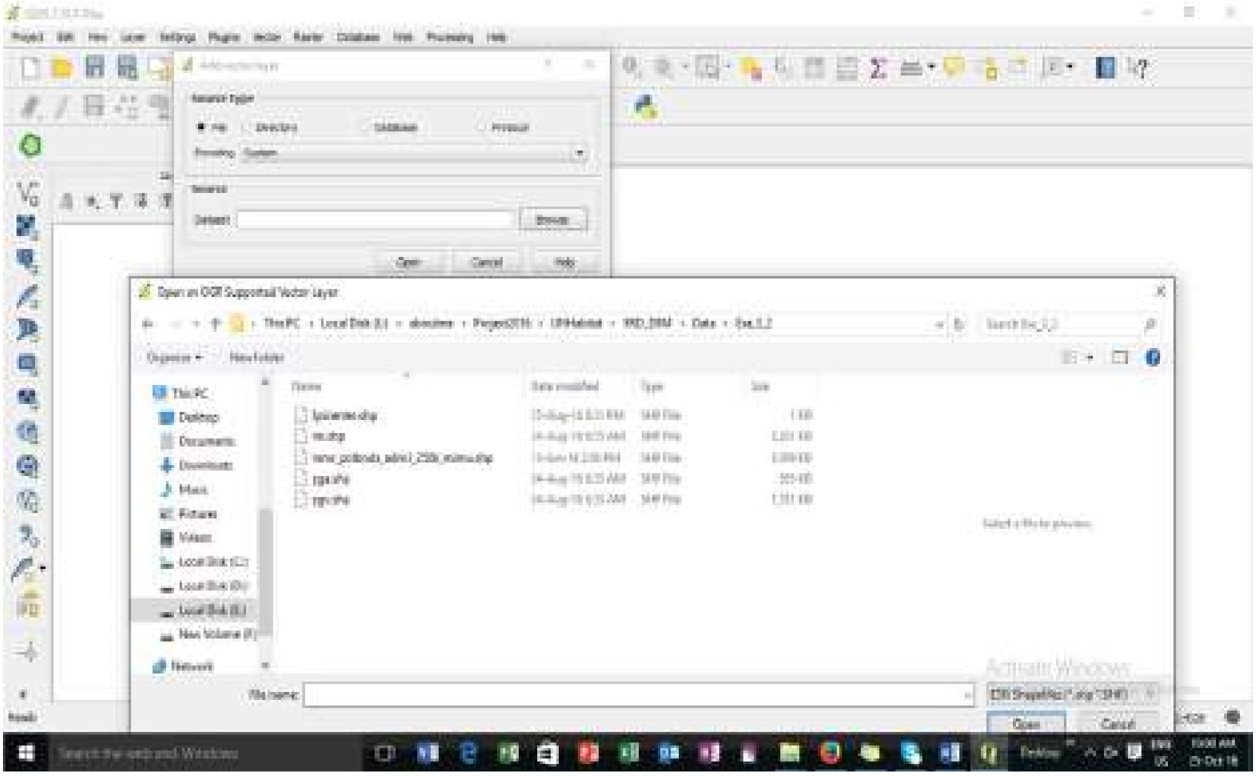


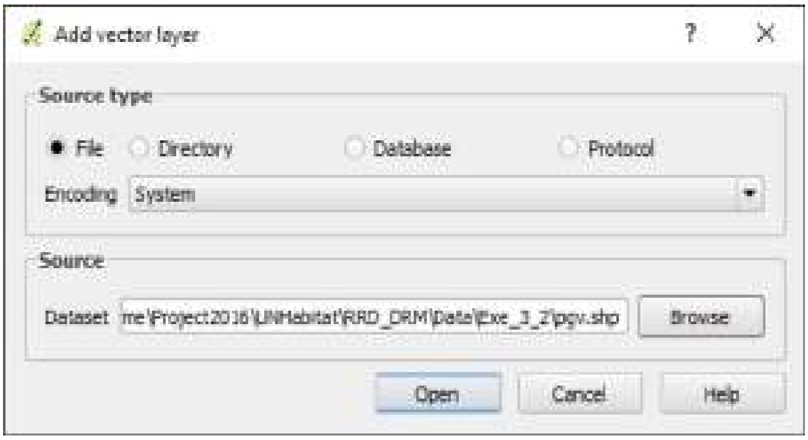

USGS
science for a changing world
USGS Home
Contact USGS
Search USGS
Earthquake Hazards Program
EARTHQUAKES
HAZARDS
DATA & PRODUCTS
LEARN
MONITORING
RESEARCH
Shakemap us10006gbf
Instrumental Intensity
USGS ShakeMap : MYANMAR

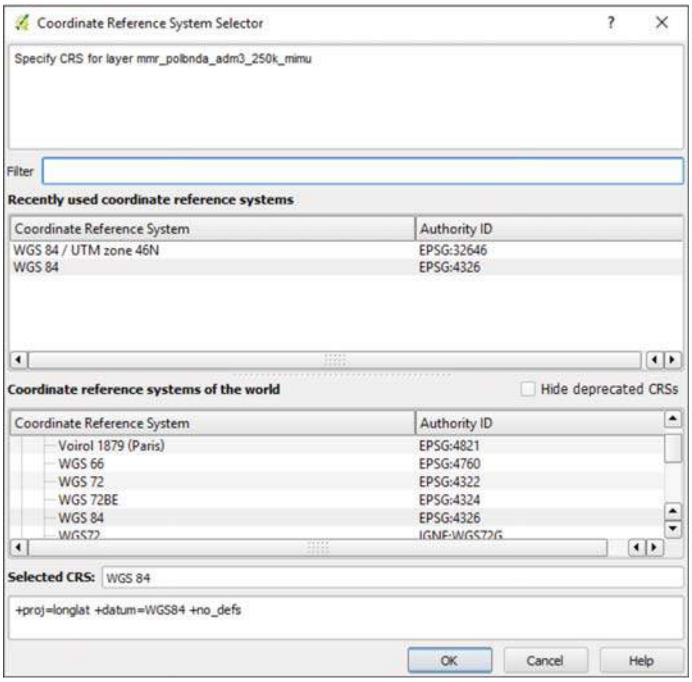

Downloads
Maps
Data
Instrumental Intensity
Raw Grids
Peak Ground Acceleration
GIS Files
Peak Ground Velocity
Station Lists
Uncertainty
Metadata
Spectral Response
0.3 sec Period
1.0 sec Period

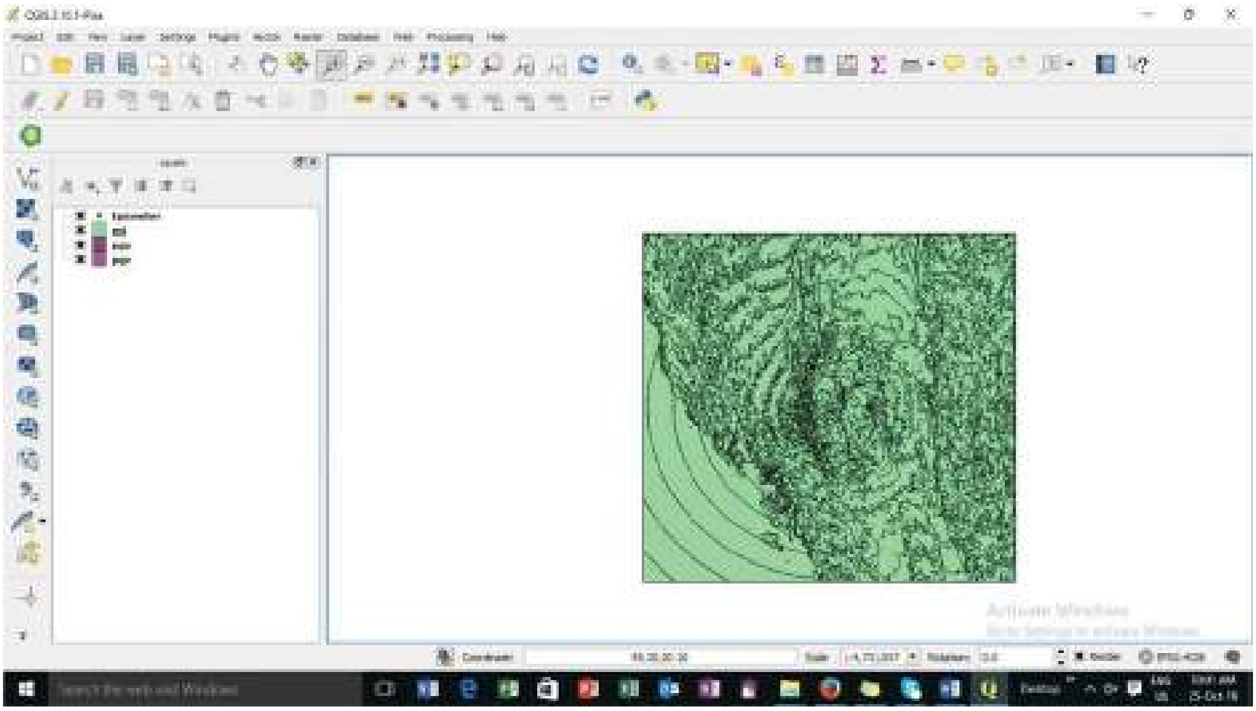

Downloads
Maps
Data
Instrumental Intensity
Raw Grids
Uncertainty
Metadata
Spectral Response
0.3 sec Period
1.0 sec Period
Download File Info
Start Download
Download Later
Cancel






Add vector layer
Source type
File
Directory
Database
Protocol
Encoding
System
Source
Dataset
me\Project2016\UNHabitat\RRD_DRM\Data\Exe_3_2\pgv.shp
Browse
Open
Cancel
Help



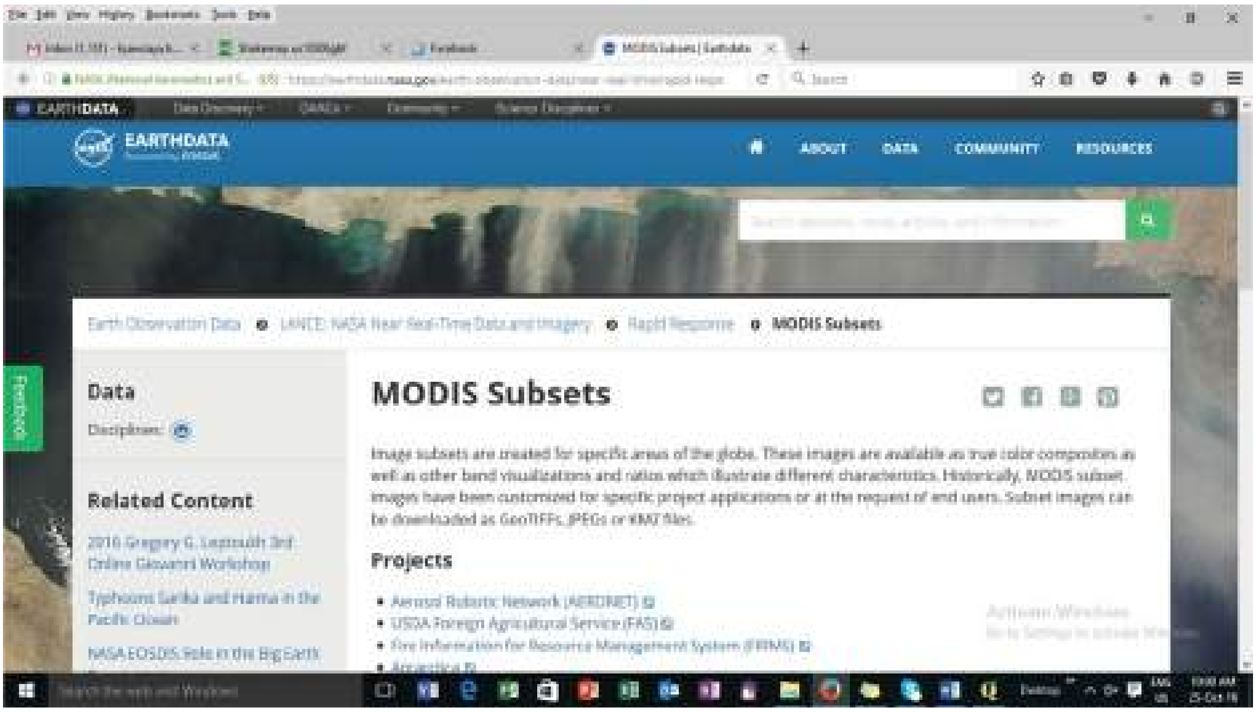


7. Searching, exploring and downloading near real time MODIS imagery

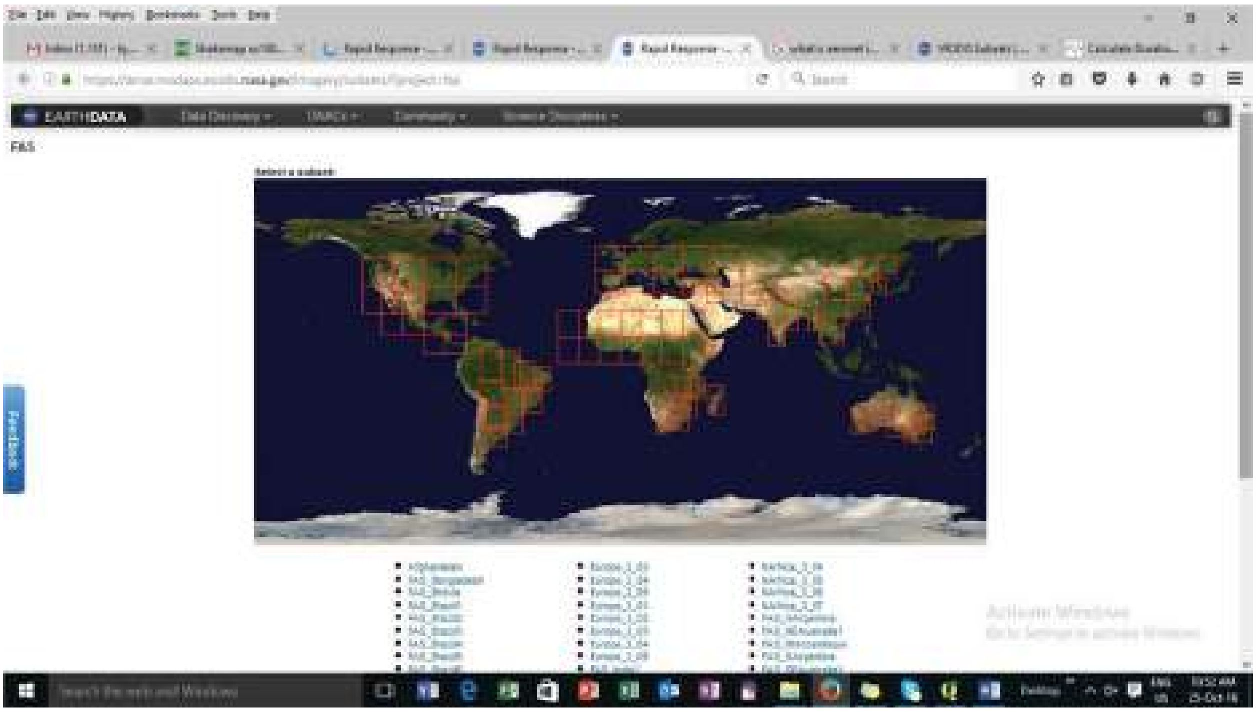
MODIS Rapid Respone System web portal was developed to provide daily satellite MODIS data (Moderate Resolution Imaging Spectroradiometer) acquired by NASA's Aqua and Terra satellite. True-color, photo like imagery and fase-color imagery are available at a spatial resolution of 250m within a few hours of being collected, making the MODIS Rapid Response System web portal valuable resource for searching and downloading MODIS data for emergency response mapping. A large number of user-specified, geo-referenced and geographically sub-setted images around the world are available in GIS-compatible format. Example include most of the AERONET sunphometer and the USDA Foreign Agriculture Service (FAS) sites:

http://eathdata.nasa.gov/lance/rapid-response

http://earthdata.nasa.gov/data/near-real-time-data/rapid-response/modis-subsets

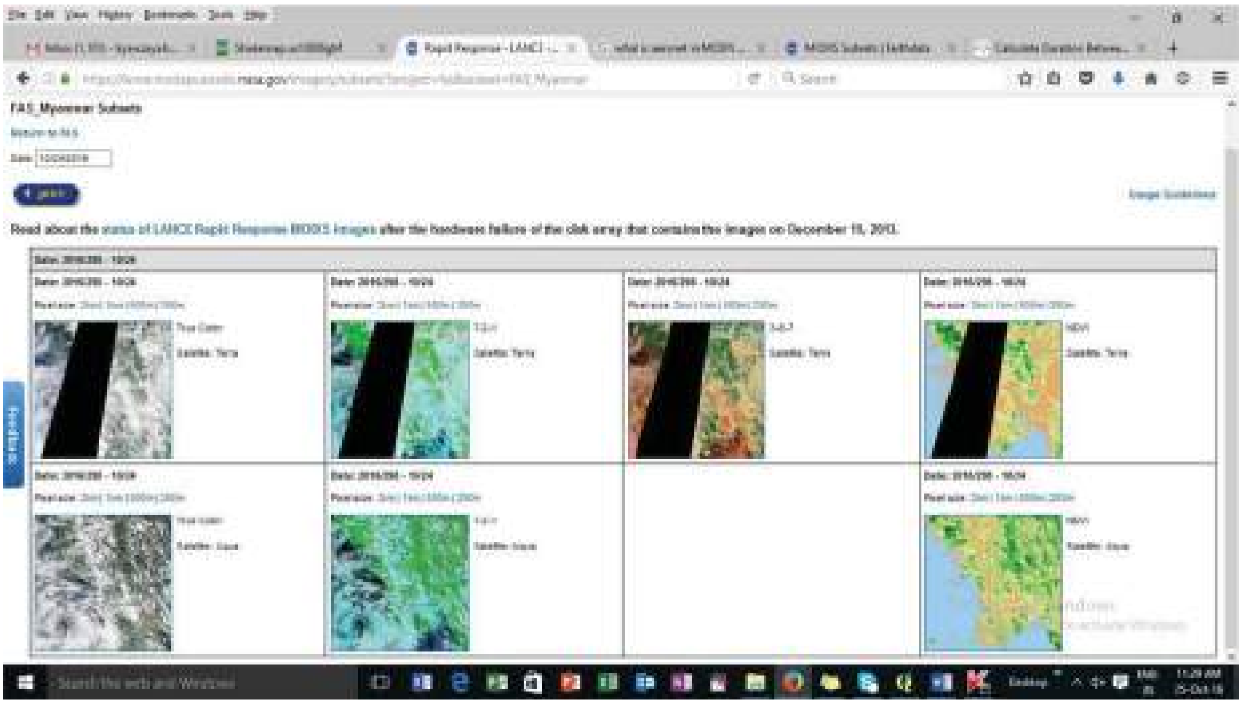


Select "FAS_Myanmar" subset and then search



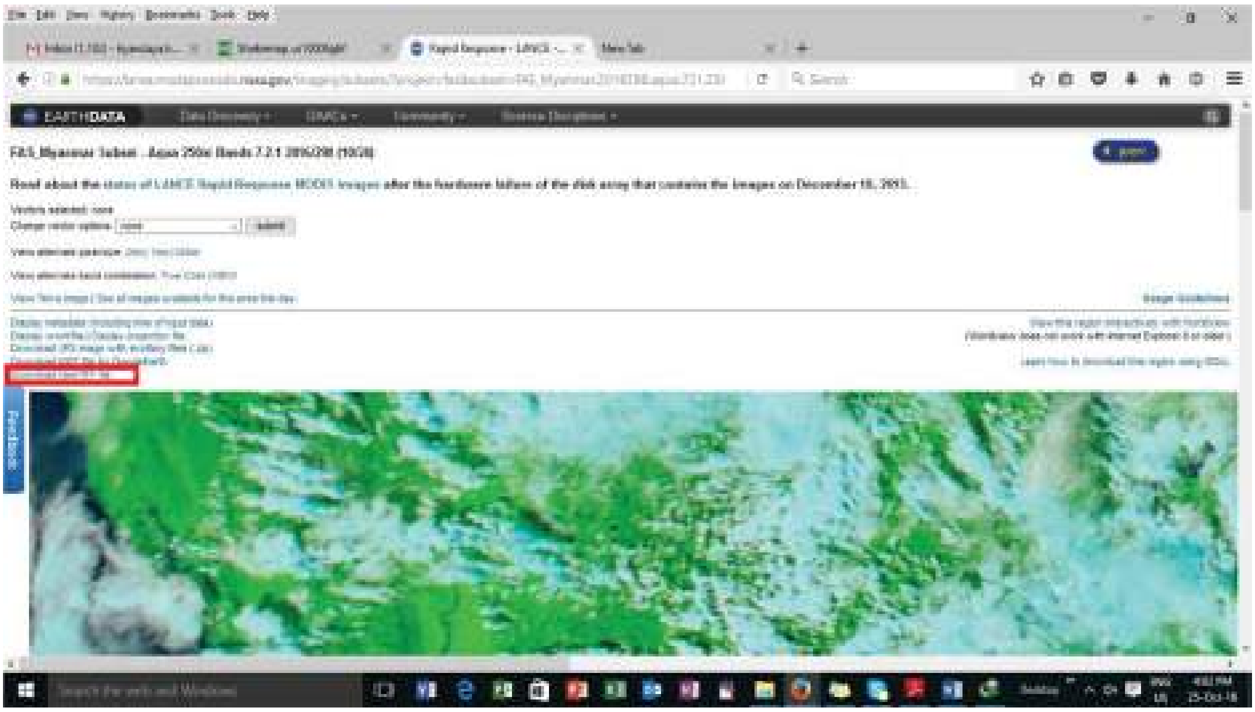
After a subset has been selected, you will get a preview of different band combinations (True Color, False Color and NDVI) of MODIS images (TERRA acquired around 10:30 UTC and AQUA acquired around 13:30 UTC):

You can download MODIS imagery different spatial resolutions (2km, 1km, 500m, 250m) and/or band combinations including the MODIS NDVI product



With the button for previous and next you will be able to navigate to other dates, but note that this system has dates as ISO-8601 Day of Year (increment number of the day in the year).

For this exercise: Click on the date box and from the calendar select 24 Oct 2016 as acquisition date



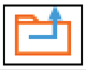
Select MODIS Terra True Color (250m) and save your image by clicking on “Download GeoTiff file” on:

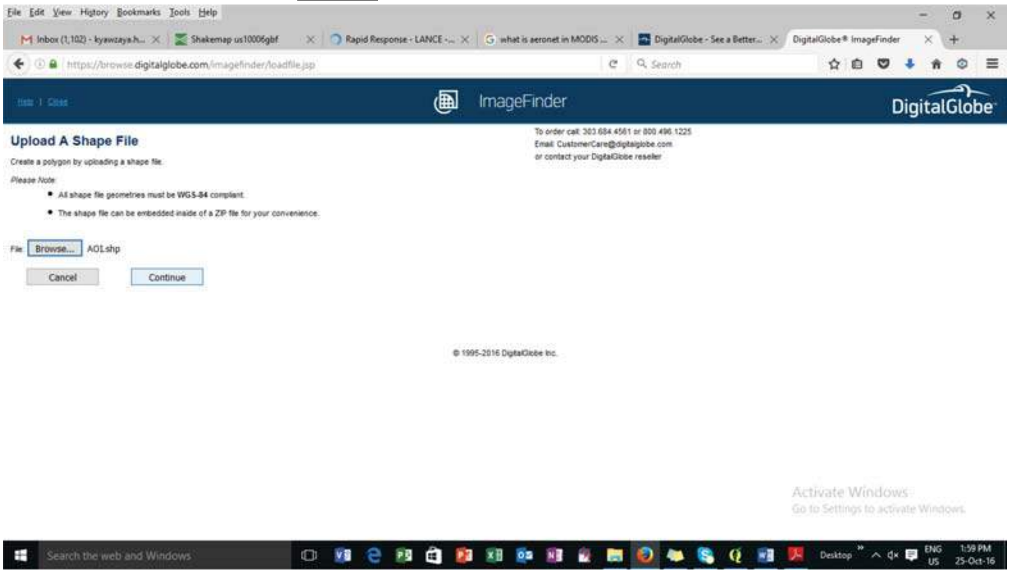
8. Searching, exploring and downloading very high resolution browsing imagery

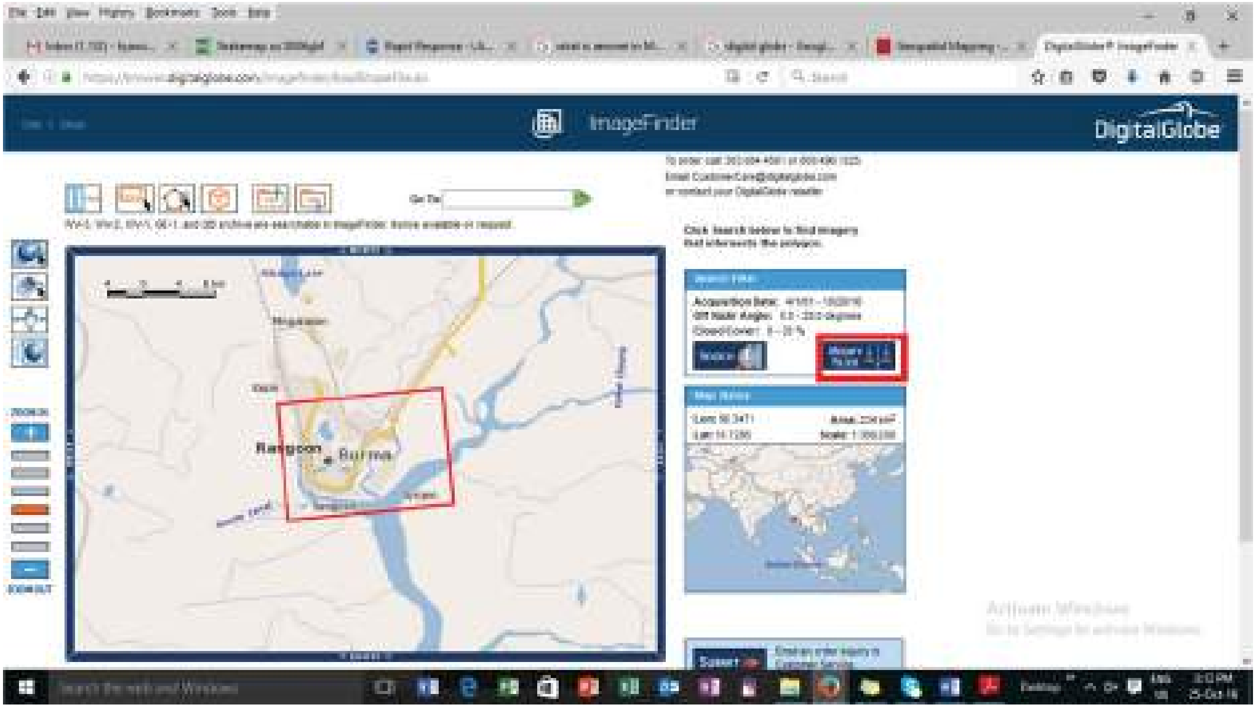
Availability of pre-and post disaster very high resolution imagery is very useful for planning emergency response activities in the field as well as for carrying out detailed damage assessment to physical assets such as transportation network and other critical facilities. Very high resolution imagery can be purchased from a number of different satellite imagery distributors but it also possible to obtain quick browse imagery at a lower resolution which might be useful for preliminary and quick evaluation of potential damages and losses.

DigitalGlobe is an American commercial vendor of space imagery and geospatial content, and operator of civilian remote sensing spacecraft. DigitalGlobe owns and operates a constellation of very high-resolution commercial earth imaging satellites: QuickBird, WorldView-1 and WorldView-2.

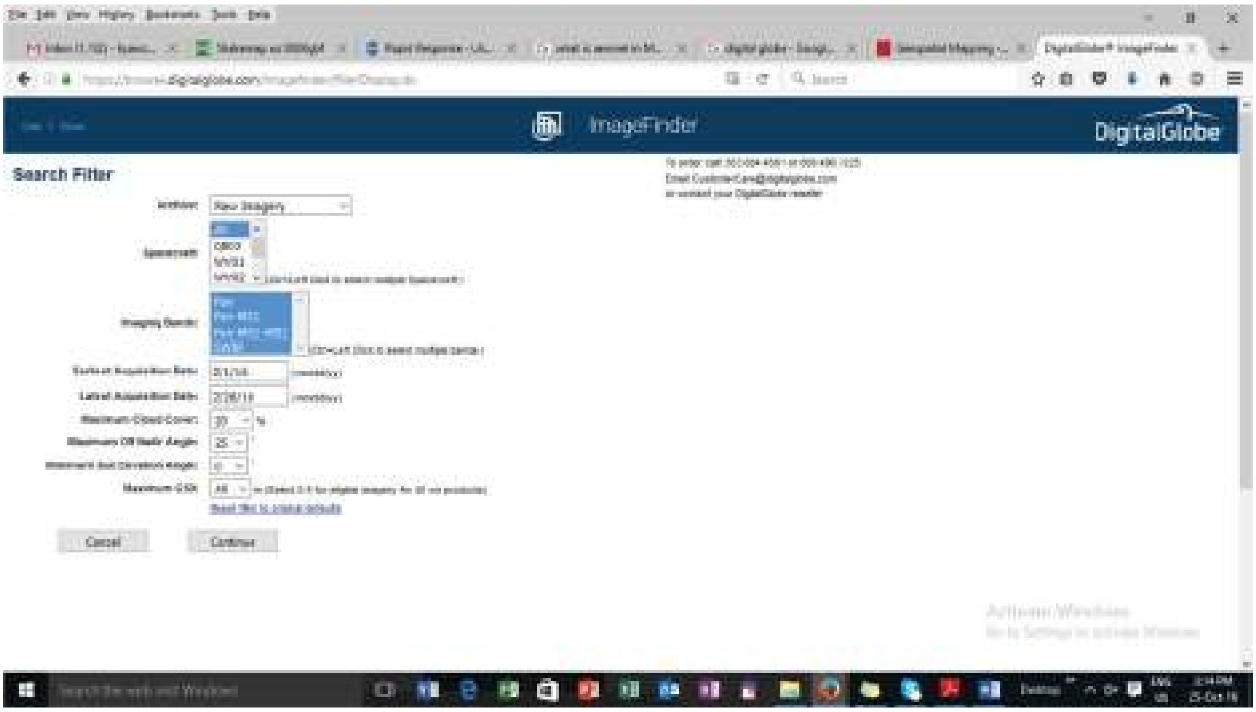
Browse to the image finder page: https://browse.digitalglobe.com

Click on the Upload Shapefile Icon  and browse to the created "AOI_1,shp"

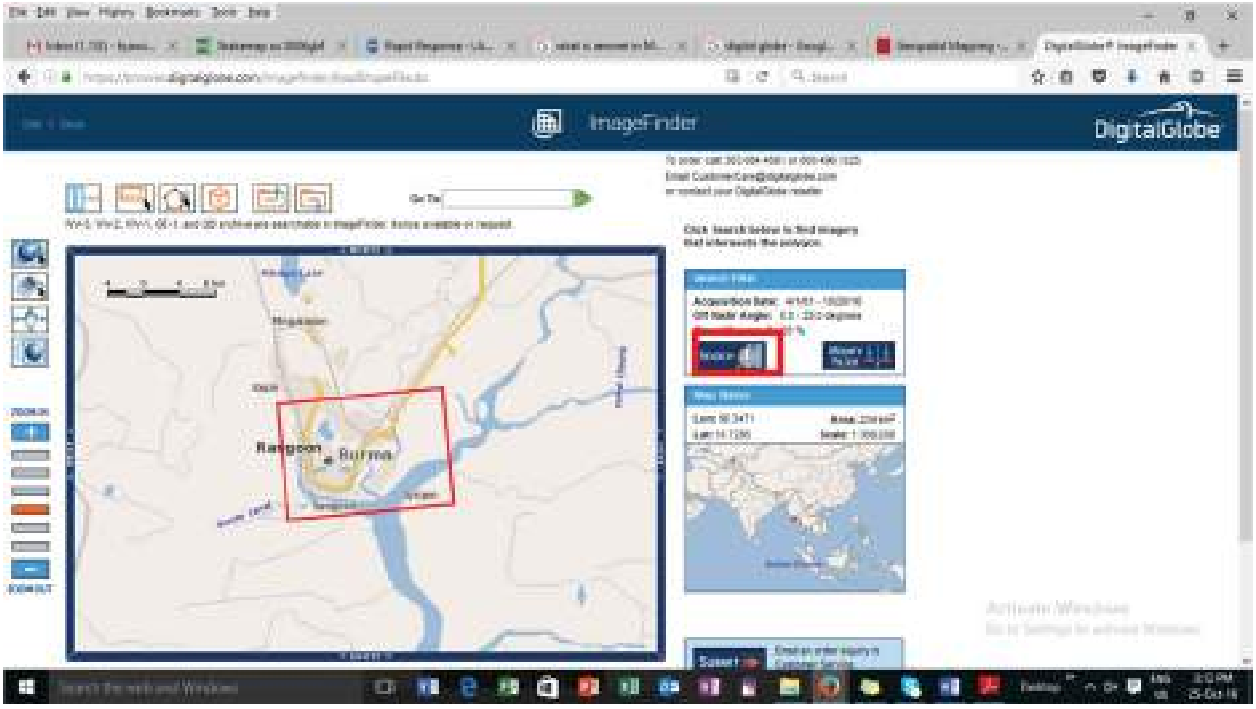




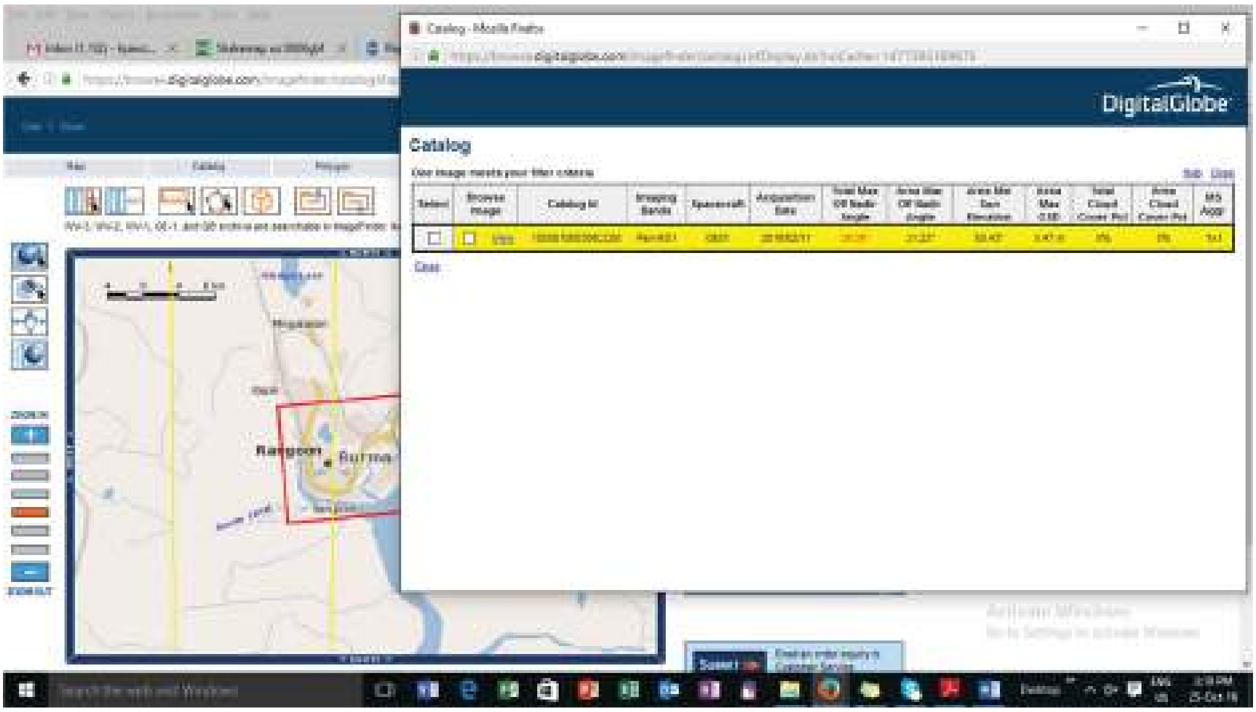
Click the Modify Filter button on the right side of the screen (red box) to set parameters for imagery search as shown below:



Click Continue button and then Click the Search button to display footprint of imagery in the map viewer and the list of available list of imagery catalog will appear.

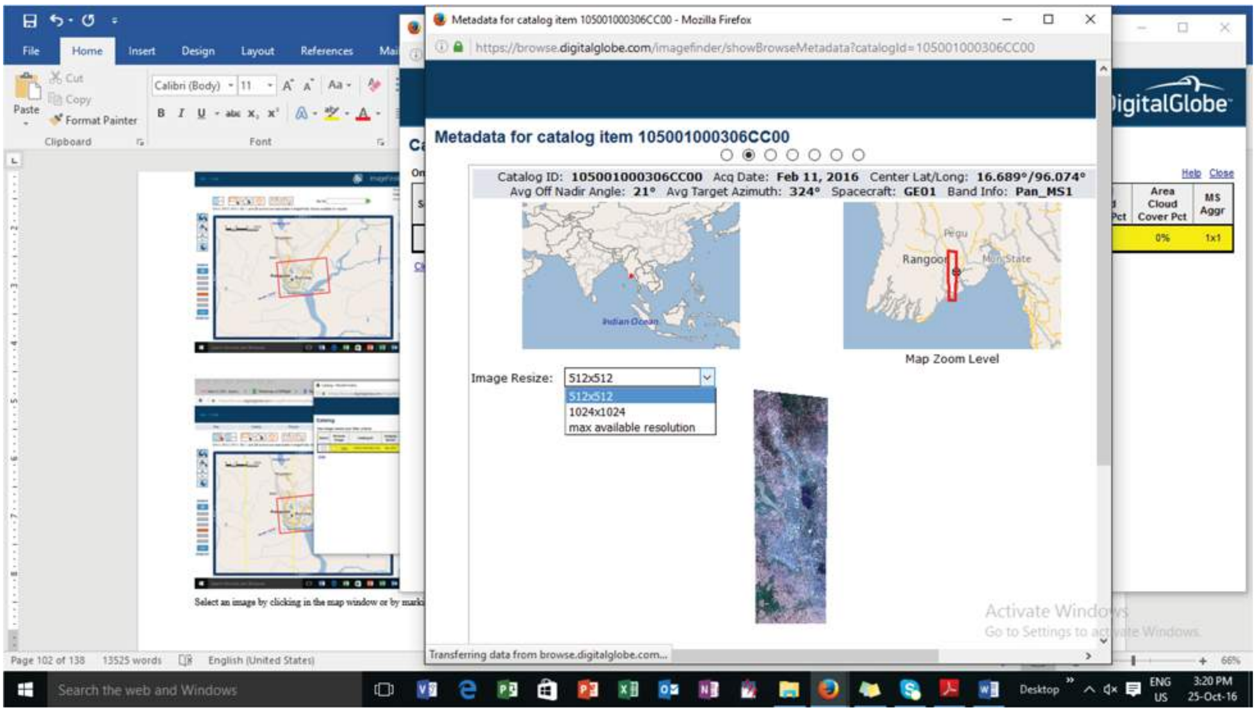


Clcik the view to see the image in appear window. Select an image by clicking in the map window or by marking the row in results.

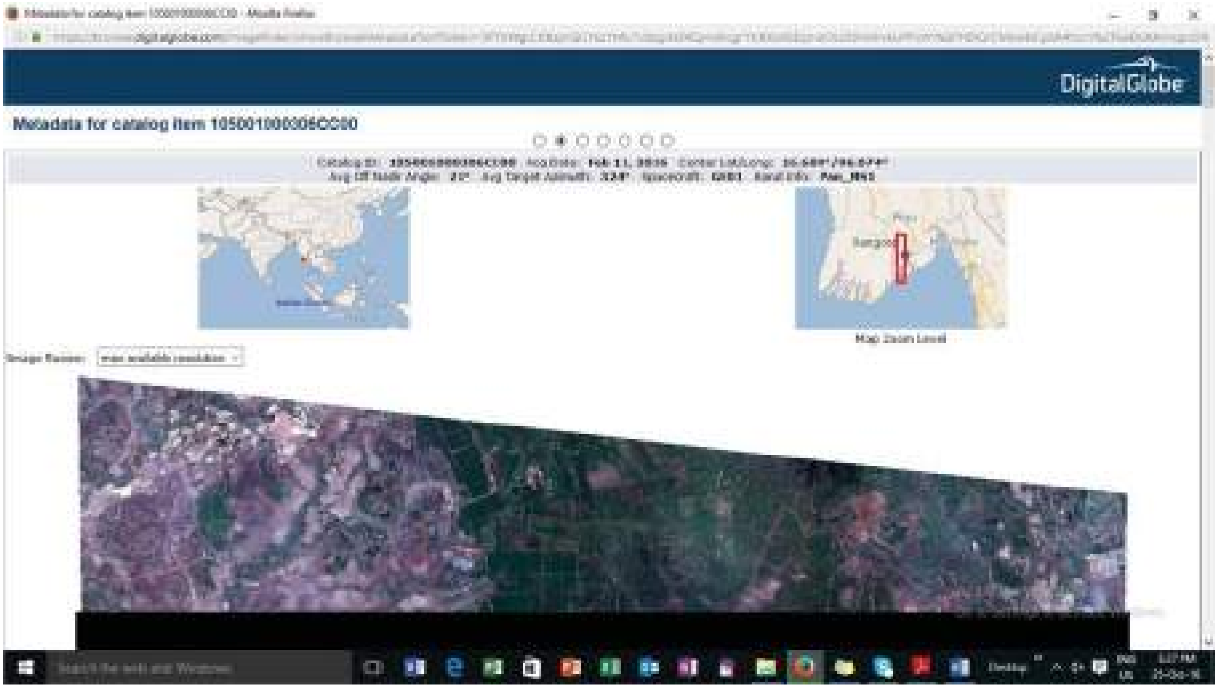


In appeared window, First column: select the product you want (check box), second column check box to see quick look in the map window.

Selected archived imagery in the catalog list can be display on the map viewer or on a new browse window with metadata information by clicking the View button. In the browse window selected image can be displayed using different pixel resolution:



To save the browse image: Right click on the image Save Picture as ...



Renamed the image as : "QB_3_3_2016" and Saved it on.

Annexures

Annexure I - Formats

Format I : Pre-training Assessment

1. Define the following terms
   a) Geographic Information Systems
   b) Remote Sensing
   c) Global Positioning Systems
2. What are components of GIS?
3. What functions of GIS can peform?
4. Define Remote Sensing?
5. What are the segments of GPS?
6. What do you mean by Resolution? types of resolution?
7. What is meant by Scale of a map?
8. What are different type of data sets used in GIS?
9. What is meant by spatial data? Describe the two data models?
10. What is vector data? Three types of vector data sets with examples?
11. What is meant by spatial resolution with respect to satellite data?
12. Define the following in your own words
    i. Hazard
    ii. Disaster
    iii. Risk
    iv. Vulnerability
    v. Disaster Management Cycle
13. Are you using spatial data/ maps for Disaster Management planning decision making? If yes, How?
14. Are you using digital maps? If yes what kind of digital maps you are using?
15. Are you familiar with Google earth and Maps of Myanmar? What is the difference between the two?
16. Are you using Geo-informatics Softwares ? (GIS or Image Processing)? Name the product you are using? (e.g. ARCGIS, ENVI, ERDAS, MAPINFO or any other)
17. Do you have prior experience is using GIS for Hazard Mapping, Modelling, Risk Assessment, damage assessment, emergency management or any other related applications? If yes please give brief details
18. Do you find the tools and spatial data useful? What are advantages of using the space based data and GIS as compared to conventional tools.
19. What are the challenges/ difficulties you faced which became a limiting factor for using Geoinformatics for disaster Management?

Annexure I: Formats

Format III: EVALUATION / FEEDBACK FORM

Name of the training programme :

Date and Venue:

Name of the Participant:

Organization:

Thank you in advance for giving your assessment. Just **encircle** the option that expresses you truly.

1. I think the structure and organization of the course fulfill the objectives of the training Workshop.

Very well	**Well**	**Moderate**	**Average**	**Unstructured**

2. I feel this training would be useful to me immediately in my job.

Very much	**Quite**	**Moderately**	**Limited use**	**Not at all**

3. I believe this will help me in my future job related Disaster Management

Strongly Agree	**Agree**	**Cannot say**	**Disagree**	**Strongly disagree**

4. Practical orientation of the Workshop / training course

Very high	**High**	**Uncertain**	**Limited**	**Very less**

5. I feel this inspires me to take up assignments related to disaster management

Very strongly	**Strongly**	**Cannot say**	**Low**	**Do not feel at all**

6. I have benefited from interaction with fellow participants in the course

Very much	**To a large extent**	**Not sure**	**Little extent**	**Not at all**

7. I found the course materials supplied to us to be

Very relevant	**Relevant**	**Cannot say**	**Little relevance**	**no relevance**

8. Your overall impression of the training Workshop

Excellent	**Very Good**	**Good**	**Fair**	**Poor**

9. As per the objectives of the training, any element that is left out of the Workshop in your view.
10. Which portion of the training you found least helpful
11. Any specific observation/ comments you wish to make.
12. Any suggestion regarding the training methods.
13. Any suggestion regarding topic and speakers.
14. Any particular faculty you have in mind, give the subject and session of that faculty
15. Your comments on administrative/logistic arrangements (Just encircle the option that expresses you truly):

Myanmar Consortium for Capacity Development on Disaster Management

မြန်မာ သဘာဝဘေးစီမံခန့်ခွဲမှု စွမ်းဆောင်ရည် ဖွံ့ဖြိုးတိုးတက်စေရေး ပူးပေါင်းအဖွဲ့