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Theme :

GIS-based Multi-criteria model as decision support tool for managing road maintenance

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Dedication

This study is dedicated sincerely to my beloved mother and father Who inspired me and gave me strength. with their prayers, guidance and sacrifices when I thought About surrender. To my brother Mohammed, who shared his advice with me.To my brothers and sisters.To all my friends.

Ikram DRICHE

Acknowledgements

First of all, we would like to thank ALLAH the merciful for giving us the strength, luck and patience to complete this modest work.We express our gratitude to Mr. Sofiane SAGGAI and Mr. Ali BOUAMRAN For the trust they've given us. And on his advice, his seriousness.We also thankespeciallyMr.OualideMELOUAHWe also thank all teachers without forgetting the management team From the Department of Irrigation and Indian Civil University of Wargla, which Participate directly or indirectly in our training during our studyFinally, we thank our friends for having supported andencouraged us during all theseyears

Abstract

This note identifies a new approach to technical management, evaluation and road maintenance planning, so the need for an information system is critical, as it provides comprehensive, clear and effective solutions and helps in decision-making. This work contains an overview and understanding of GIS concepts, then we conducted a brief study of the geographical location of the region and finally the modeling part that we implemented and the design of the system with illustrations and model presentation .

Keywords: geographic information system, spatial databases, road network

résumé

Cette note identifie une nouvelle approche de la gestion technique, de l'évaluation et de la planification de l'entretien des routes, de sorte que le besoin d'un système d'information est essentiel, car il fournit des solutions complètes, claires et efficaces et aide à la prise de décision. Ce travail contient une vue d'ensemble et une compréhension des concepts SIG, puis nous avons mené une brève étude de la situation géographique de la région et enfin la partie modélisation que nous avons mise en œuvre et la conception du système avec des illustrations et une présentation du modèle.

Mots-clés : système d'information géographique, bases de données spatiales, réseau routier

ملخص :

تحدد هذه المذكرة نهجا جديدا للإدارة الفنية والتقييم وتخطيط صيانة الطرق ، وبالتالي فإن الحاجة إلى نظام معلومات أمر بالغ الأهمية ، لأنه يوفر حلولا شاملة وواضحة وفعالة ويساعد في صنع القرار.يحتوي هذا العمل على نظرة عامة وفهم لمفاهيم نظم المعلومات الجغرافية ، ثم أجرينا دراسة موجزة للموقع الجغرافي للمنطقة وأخيرا جزء النمذجة الذي قمنا بتنفيذه وتصميم النظام مع الرسوم التوضيحية وعرض النموذج.

الكلمات المفتاحية: نظام المعلومات الجغرافية، قواعد البيانات المكانية، شبكة الطرق

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List of abbreviations :

GIS : Geographic Information System.

ESRI: Institute of Environmental Systems Research

KML : Keyhole Markup Language

UTM : Universal Transverse Mercator

WGS84 : World Geodetic System (WGS84)

GC : Good condition.

BC : Bad condition.

KP :kilometric point.

RN : National road

RC :communeRoad

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GENERAL INTRODUCTION

The road network is an important part of any city that directly affects the lives of the population (Berdica,K 2002) the development of infrastructure networks such as roads and streets is of paramount importance to understanding the development of urban systems (Perret,et all 2015)

Given the important role played by road networks, it is necessary to follow up and maintain damage periodically. These problems and damage include road life and extreme weather conditions. Algeria has not survived these difficulties, and lack of data and difficulty in managing are an obstacle. The main purpose of this research is to develop and assassinate the predictive ability of two multi-standard models for managing road maintenance problems using GIS platforms and a range of environmental geo-causative factors. This programme has been widely used in public works, for example, to manage traffic lights. (Al-Zeitani, Mohammed AbdulLawi, A, 2020), Bridge Management (J. Awad et al., 1999)...

Our dissertation is organized as follows:

Chapter I: We provided a definition and overview of GIS, its components and functions, as well as examples of some areas of use.

ChapterII: We presented arcgis concepts, functions, components and uses

ChapterIII :System design and modeling phase. We have provided the means and tools to create the system model and exploit the geospatial information of the of Ouarglacity .We've created layers and entered data to get a spatial database that helps manage road maintenance.

ChapterI

Geographic Information System

Overview

Introduction :

Geographic Information System is a system for organizing and displaying data collected from different sources to help make decisions and to exploit or improve descriptive rules as we have to achieve effective and practical road maintenance.(Malczewski, J. 2004).

I.1. Definition :

Over the past half century, through continuous development, Geographic Information System(GIS) has contributed to many geographic research and applications and has shown its benefits in many related areas such as Earth Sciences (Goodchild2010, 2018; Egenhoferet al. 2015; Longley et al. 2015). There are many definitions of GIS. Here we adopt a comprehensive definition based on an information system designed to interact with geographical, spatial or geospatial data for use in geographical search(Lü, Guonian, et al. 2019). It is a geographical term that refers to "a scientific field dedicated to the study of land, archaeology, population and terrestrial phenomena". (American Heritage Dictionary 2006)Geographic information systems have evolved from computer mapping to data analysis, problem solving and decision-making (Mark et al.1999).

I.2. Why usingGeographic information systems:

Maps were used as a gps and direction planning tool, and as mapping techniques such as longitude, latitude and abstract symbols evolved, maps were able to communicate spatial data and geographical features of humans (Crone, et all , 2009). To understand the geographical world, there are three stages: the first is to obtain information, secondly to study geographical organisms (their forms, distribution and relationships), and thirdly to analyse geographical phenomena (Mark et al., 1999) And to meet these different requirements accordingly.Fig.1
Here, the role of GIS has emerged as it is used for three main roles: a reference database, a visualization tool and an analysis tool(Gregory et al. 2001). The spatial database allows us to answer questions such as "What is on this site?" Where are these features?" It also allows data to be integrated from different sources, For example, to study hospital data in an area, we use census data surrounding each hospital, and other data such as the water system can be added to determine water quality, in this way many information can be collected from different sources and linked together. (Gregory, Ian N.2003).

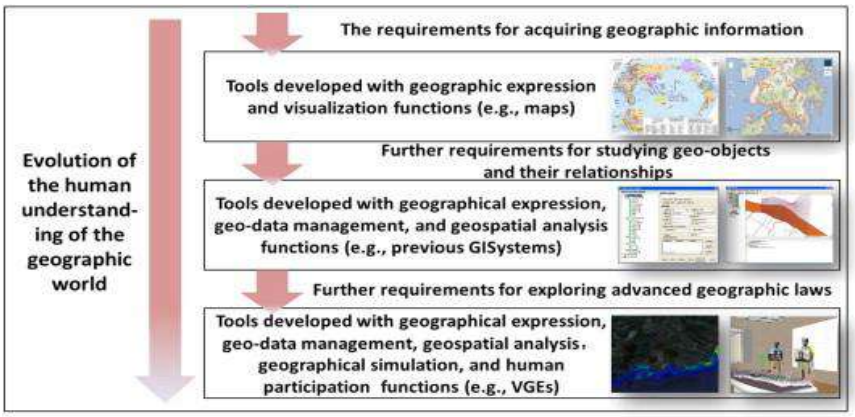

Fig.II.1. The development of tools according to the evolution of human understanding of the geographic world.

I.3. GIS Components :

A geographic information system consists of five major components:

- **program**: A program that provides the following five basic functions:
- Acquisition: Capture, integrate and share geographic information in digitaldata
- Archiving: Structuring geographic information and storing it in digital form.
- Analysis: Manipulating and querying geographical data.
- View: Represent and format data in map form.
- Abstraction: Representing the real world.
- **Data**: The most important part of GIS, consisting of:
- Attribute data: Describes a geographical object:Type of trees, type of building, population of a place ...
- Geographical objects: they are organized into layers. Each layer indicates a subjectFor example, vegetation, water system, road network.There are three types of geographical entities:

  - ✓ Point (x,y).Example hospital, school.
  - ✓ Line (x1, y1)... (xn,yn)). Example: water system, road network.
  - ✓ Polygon. Example: Cities and gardens...

There are two ways to act:

- Vector (vector format): Objects are represented by points, lines, and polygons.

- Point data format: This is an image, plan, or image that is scanned and displayed in GIS as a picture.

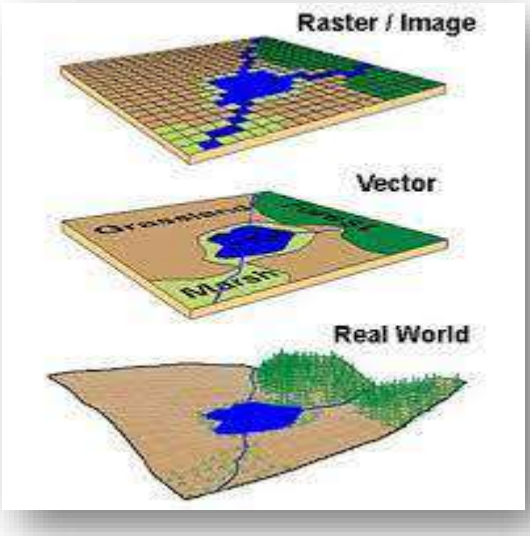

Fig.I.2. Modes of representation of a GIS.

GIS's geo-coordinate system allows objects to be collected in layers, each layer collecting information related to the same subject(Slimani-2012) .

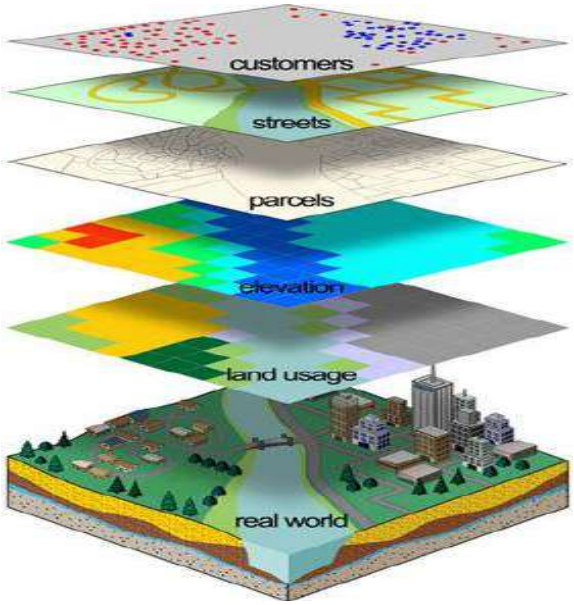

Fig .I.3.Geographic Information System Layer.

- Metadata: GIS processes data from different sources and attaches it to information about the same source, i.e. data on data.

- **Devices:** Data is processed using computer software to facilitate the dissemination of GIS results.
- **Know-how:** GIS requires knowledge and know-how in many fields geography, mapping, data analysis and processes, computer science, urban planning, hydrology , This system requires the cooperation of experts from different fields.
- **Users:** In order to ensure a good quality of interpreting the results of data analysis usually the level of skill of the user is great, and is usually assigned to an engineer who has good knowledge of the data that is dealt with(Slimani.2012).

I.4. Functionality of a GIS:

GIS can be created to meet different demands. Although different systems have the same shared functions grouped into 5 families under the term "5A": abstraction, acquisition, archiving, viewing, analysis, and expectation.

I.4.1. Abstraction:

GIS is used to obtain information to solve a problem and contain information representing existing elements and phenomena, these representations are used to reproduce reality with great accuracy in a way that is understandable to the user and use this data to achieve certain objectives.So the necessary elements and their nature must be identified and integrated with the maps of the region, which contain selected elements according to their nature and specifications crisis to meet the needs of the user, It is drawn to facilitate understanding of the reading of cards for a greater number of information, and the options relate to the nature of the information to be accessed, the elements of the territory to be determined and the way they are drawn and the characteristics and criteria to be known according to the objectives to be reached and the problems to be solved, and so we can determine the content of the system.

I.4.2. Acquisition of geographic data :

After creating the conceptual model and identifying the necessary engineering information and data, we can identify the items that will be included in the system, after which the data that must reach quality requirements must be integrated to reach the goals to be reached.

There are four different types of data depending on the associated geometry: point data, vector data networks, or NTMs, and data without geometry and must be converted into a computer format before using paper data and this step is called digitization.

I.4.3. Archiving :

GIS collects information for use to access different data and has the ability to process the engineering component and enables us to work on searches based on engineering standards. Some computer systems can manage engineering data and support data, and some systems separate them from each other because they do not have the same processing capabilities, Geographic information publishes databases in several locations and creates a link by servers, and information is collected from different sources so it must be formatted to be able to exploit it

I.4.4. analysis :

GIS describes the terrain, thus making it possible to understand the events that can occur and use data to solve problems enhances the value of information systems, engineering information provides the relationship between translated objects and certain characteristics and since objects have features that reflect some non-engineering characteristics, classic information systems analyses (without the use of engineering functions) can be achieved and thus use geometric and semantic characteristics to conduct a full analysis.Spatial analysis is the most commonly used in GIS where accurate spatial analysis can be performed by integrating data into different layers of information, often requiring reference analysis with digital alphabetical information such as topographical composition of terrain .

I.4.5. Display :

In GIS, the feature of translated and engineering information is manipulated, often describing a complete or partial territory that is conceivable.Computer engines provide high-resolution and fast-track tools. allowing the selection of certain objects to follow thematic approaches depicted by GIS according to different criteria, visual information has an important place in today's society. GIS provides tools to visualize a region quickly and in many different ways according to selected topics and on an adapted scale. allowing the immediate availability of data in the system to permanently reuse data, Semantic mapping rules apply to products derived from GIS (Tomlind,D .1999) .

I.5. Uses of GIS :

After 30 years of the development of GIS, its use has become widespread in several different fields (Lakhoua,et al .2007):agricultural engineering, water management, environment....etc. Here we mention some of them.

I.5.1. GIS in agronomy :

GIS has been widely used in land use, natural resource management and agricultural planning(Wu, Wei, et al.2011) It can also access and understand differences in crops within fields and can be used to gather information such as soil nutrients, topography and moisture to produce a map to show the factors affecting crops. (Oshunsanya, S., and O. Aliku.2016).Examples of GIS applications in agricultural engineering : GIS was used to solve the environmental, economic and social impacts of land management and water use in agriculture(Riquelme, F. J., & Ramos, A. B.2005).Research the characteristics of forest distribution using GIS using landscape and topographic data in Japan(Sano, M.,et al .2009) , Study of water quality and water pollution Soil mapping and easy processing and analysis of soil data using arcGis(MamillapalliS,et al.1996).

I.5.2. GIS in ecology :

Upadhyay (2009) stated that "Geographical Information Systems is an information technology that has been used in public policy making for environmental and forest planning and decision making over the past two decades".

I.5.2.1. GIS in forest management:

GIS enables forest workers to maintain, analyses records and make decisions and can provide resource information and facilitate resource planning and management, for example, landscape assessment and planning(Upadhyay M .2009)GIS can be used to include a range of administrative concerns such as habitat conservation and timber production(Wulder MA, Franklin SE .2007)

(Wulder MA, Franklin SE.2007)GIS is a good tool for forest management as it answers the following questions:

• Location: What is at?

Location of forest resources in the land in different ways such as place name, mail, zip code or geographical references

• Trends: What has changed since?

We can see what has changed within the study of forests or land use in an area over time

• Patterns: What spatial patterns exist?

Determine whether there is a landslide in the forest area

• Modeling: What if?

What happens if we add a road network to the forest?

GIS has a role to play in post-fire recovery operations, where forest managers used it to map meteorology and fire risk classifications.

(Chuvieco,E. 1989) explained "that fire behavior models have been developed from fuel models to predict the fire intensitybased on factors such as slope, elevation, site exposure, wind speed, relative humidity, cloudcover, temperature, and live and dead fuel moisture".

I.5.2.2. GIS in water resources :

Water resource modelling requires a number of time-consuming steps before actual simulation, including spatial data collection, storage, retrieval and processing, and GIS can change the way engineers deal with water resource modelling(Denning, J.: 1993),GIS has evolved into a sophisticated database management system for storing the big data required in hydrological modelling(Bhaskar et al., 1992; Vieux et al., 1989).GIS helps manage land use within a drainage basin (Stuart and Stocks, 1993).

I.5.3. GIS in Road maintenance :

GIS has been developed as a road maintenance management tool and can help make decisions regarding priority for road network maintenance(Shrestha, P., Nipesh .2009).

Conclusion :

In this chapter, we saw an overview and some basic concepts of GIS, and then why we use GIS and its functions to meet different demands, and finally the uses of GIS.

Chapter II

Generalities about ArcGIS

Introduction:

ArcGIS is a geographic information system to work with maps and geographic information held by the Institute for Environmental Systems Research.[1]

II.1. What is ArcGIS ?

ArcGIS is a family of client software, server software, and online geographic information system (GIS) services developed and maintained by Esri. ArcGIS was first released in 1999 and originally was released as ARC/INFO, a command line based GIS system for manipulating data. ARC/INFO was later merged into ArcGIS Desktop, which was eventually superseded by ArcGIS Pro in 2015.[2] ArcGIS Pro works in 2D and 3D for cartography and visualization, and includes Artificial Intelligence (AI)..[3]

Fig.II.1.ArcGIS logo

II.2. How Does it Work?

Like many GIS software, ArcGIS creates maps that require categories organized as layers. Each layer is registered spatially so that when they're overlaid one on top of another, the program lines them up properly to create a complex data map. The base layer is almost always a geographical map, pulled out of a range of sources depending upon the visualization needed (satellite, road map, etc). This program has a lot of them available to users and also contains live feed layers including traffic details.

The first three layers are called feature or vector layers, each containing individual functions distinguished through the platform. These are:

- **points** (like landmarks, buildings)
- **lines** (like roads and other 1D schemata)
- **polygons** (like political information and geographical census, called 2D data)
- **raster images** (a base vector layer like an aerial picture)

Data can be correlated with at least one of these spatial layers and can be both mapped and analyzed, be it through features like demographic changes, or via data tables.

II.3. ArcGIS Desktop :

II.3.1. Product levels :

ArcGIS Desktop is available at different product levels, with increasing functionality.

- **ArcReader** (freeware, viewer) is a basic data viewer for maps and GIS data published in the proprietary Esri format using ArcGIS Publisher. The software also provides some basic tools for map viewing, printing and querying of spatial data. ArcReader is included with any of the ArcGIS suite of products, and is also available for free to download. ArcReader only works with pre-authored published map files, created with ArcGIS Publisher.[4]
- **ArcGIS Desktop Basic**, formerly known as ArcView,[5] is the entry level of ArcGIS licensing. With ArcView, one is able to view and edit GIS data held in flat files, or view data stored in a relational database management system by accessing it through ArcSDE. One can also create layered maps and perform basic spatial analysis.
- **ArcGIS Desktop Standard,** formerly known as ArcEditor, is the midlevel software suite designed for advanced editing of spatial data in shapefiles and geodatabases. It provides tools for the creation of map and spatial data used in GIS, including the ability of editing geodatabase files and data, multiuser geodatabase editing, versioning, raster data editing and vectorization, advanced vector data editing, managing coverages, coordinate geometry, and editing geometric networks. ArcEditor is not intended for advanced spatial analysis.[6]
- **ArcGIS Desktop Advanced**, formerly known as ArcInfo, allows users the most flexibility and control in "all aspects of data building, modeling, analysis, and map display."[7] ArcInfo includes increased capability in the areas of spatial analysis, geoprocessing, data management, and others.[6]

Other desktop GIS software include ArcGIS Explorer and ArcGIS Engine. ArcGIS Explorer is a GIS viewer which can work as a client for ArcGIS Server, ArcIMS, ArcWeb Services and Web Map Service (WMS).

- **ArcGIS Online**[8] is a web application allowing sharing and search of geographic information, as well as content published by Esri, ArcGIS users, and other authoritative data providers. It allows users to create and join groups, and control access to items shared publicly or within groups.
- **ArcGIS Web Mapping APIs** are APIs for several languages, allowing users to build and deploy applications that include GIS functionality and Web services from ArcGIS Online and ArcGIS Server. Adobe Flex, JavaScript and Microsoft Silverlight are supported for applications that can be embedded in web pages or launched as stand-alone Web applications. Flex, Adobe Air and Windows Presentation Foundation (WPF) are supported for desktop applications.

II.3.2. Components :

ArcGIS Desktop consists of several integrated applications, including ArcMap, ArcCatalog, ArcToolbox, ArcScene, ArcGlobe, and ArcGIS Pro. ArcCatalog is the data management application, used to browse datasets and files on one's computer, database, or other sources. In addition to showing what data is available, ArcCatalog also allows users to preview the data on a map. ArcCatalog also provides the ability to view and manage metadata for spatial datasets.[9] ArcMap is the application used to view, edit and query geospatial data, and create maps.The ArcMap interface has two main sections, including a table of contents on the left and the data frames which display the map. Items in the table of contents correspond with layers on the map.[10] ArcToolbox contains geo-processing, data conversion, and analysis tools, along with much of the functionality in ArcInfo. It is also possible to use batch processing with ArcToolbox, for frequently repeated tasks.[11] ArcScene is an application which allows the user to view their GIS data in 3-D and is available with the 3D Analyst License.[12] In the layer properties of ArcScene there is an Extrusion function which allows the user to exaggerate features three dimension-ally.[13] ArcGlobe is another one of ArcGIS's 3D visualization applications available with the 3D Analyst License. ArcGlobe is a 3D visualization application that allows you to view large amounts of GIS data on a globe surface.The ArcGIS Pro application was added to ArcGIS Desktop in 2015 February.[14] It had the combined capabilities of the other integrated applications and was built as a fully 64-bit software application.[15] ArcGIS Pro has ArcPy Python scripting for database programming.[16]

II.3.3. Extensions :

There are a number of software extensions that can be added to ArcGIS Desktop that provide added functionality, including 3D Analyst, Spatial Analyst, Network Analyst, Survey Analyst, Tracking Analyst, and Geo-statistical Analyst. Advanced map labeling is available with the Maplex extension, as an add-on to ArcView and ArcEditor and is bundled with ArcInfo. Numerous extensions have also been developed by third parties, such as the MapSpeller spell-checker, ST-Links PgMap, XTools Pro and MAP2PDF for creating geo-referenced pdfs (Geo-PDF),[17] ERDAS' Image Analysis and StereoAnalyst for ArcGIS, and ISM'sPurVIEW, which converts Arc- desktops into precise stereo-viewing windows to work with geo-referenced stereoscopic image models for accurate geo-database-direct editing or feature digitizing.

II.3.4. Address locator :

An address locator is a dataset in ArcGIS that stores the address attributes, associated indexes, and rules that define the process for translating nonspatial descriptions of places, such as street addresses, into spatial data that can be displayed as features on a map. An address locator contains a snapshot of the reference data used for geocoding, and parameters for standardizing addresses, searching for match locations, and creating output. Address locator files have a .loc file extension. In ArcGIS 8.3 and previous versions, an address locator was called a geocoding service.[18]

Conclusion:

In this chapter we saw the definition of ArcGIS system and some basic concepts and the way it works and its components and functions

ChapterIII

Design and implementation

Introduction :

After learning about GIS concepts and ArcGIS concepts, we design and implement an application in this chapter that will be useful for management and decision-making.

III.1. Data sources :

- A recent map of the city of Ouargla with a 1:100 scale imported from Google erth.
  Its projection system: WGS_1984 ZONE 31.
  Its coordinate system: UTM.

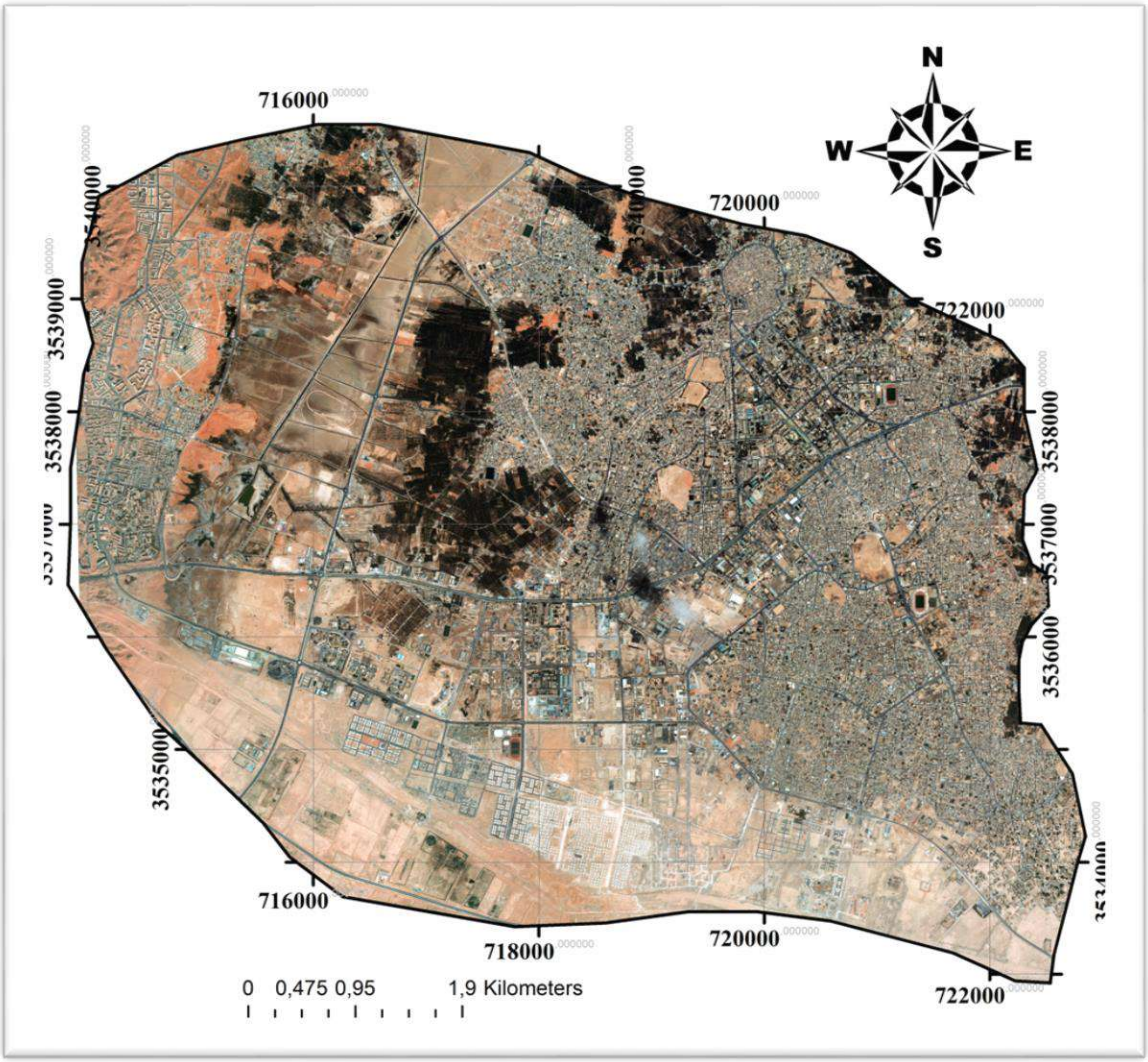

Fig.III.1.Map of Ouargla city

Table.Ⅲ. 1:consistency of municipal road classified up to 31/12/2021

Commune	CC	KP begin	KP end	Long	Larg	begin	end
Ouargla	10	0+000	8+600	8,6	7	RN 49 PK158+100	Rabea Adaouia School
	11	0+000	2+500	2,5	7	Dual Way Cité Nacer	Cité Nacer Dual Way
	12	0+000	4+800	4,8	7	CW 206 PK 2+120	RN 49 PK 162+300
	13	0+000	4+500	4,5	7	Cité sidi omrane	Tomb of the marabout Sidi Berjel
	14	0+000	2+000	2	7	Bab Azi El Kacer	RN 49 PK 164+350
	15	0+000	4+500	4,5	7	Dual Way Said Otba	Mendas area
	16	0+000	3+200	3,2	7	RN 49 Pk 156+550	Dual Way cité nacer

It's the blue-colored roads we're going to study.

Tabel.III.2: Municipal roads in Ouargla

Stat	Total road length
Ouarlag	30.1 klm
Ain Beida	36.2 klm
N'Goussa	42.6 klm
Rouissat	7.6 klm
Sidi khouied	6 klm
Hassi ben Abdellah	12 klm

III.2. Implementation:

III.2.1. Production tools :

- One PC CORE(TM) I5 2.27 GHz.
- Memory (Ram) 4GB.
- 64-bit operating system x64 processure .
- Windows 10
- ArcGis 10.8 Desktop

III.2.2. The tools for achieving :

We chose ArcGis 10.8 Descktop,an integrated set of GIS applications in three products :Arcview , Arceditor and Arcinfo .This product includes the following applications

- **ArcMap** is the main component of arcGIS's range of geospatial processing software, and is primarily used to display, edit, create and analyze geospatial data. ArcMap allows the user to explore data within a data set and feature code accordingly and create maps.

- **ArcCatalog** helps organize and manage the different types of geographic information .
- **ArctoolBox** includes a set of projection management , etc.
- **ModelBuilder** allows you to create new tools from existing tools.
- **Global Mapper 15** Vector, raster, and elevation data can be exported in virtually every common file format as well as many proprietary types. During export, data can be tiled into smaller or more manageable files, or the export area can be cropped to a defined area or to the extent of the current screen view.

III.3. Description of the main interface :

- **1** Menu (contains the default ArcMap options).
- **2** Research and exploration tools.
- **3** Table of contents (for view tracking).
- **4**Processing area (area of the display of maps and documents).

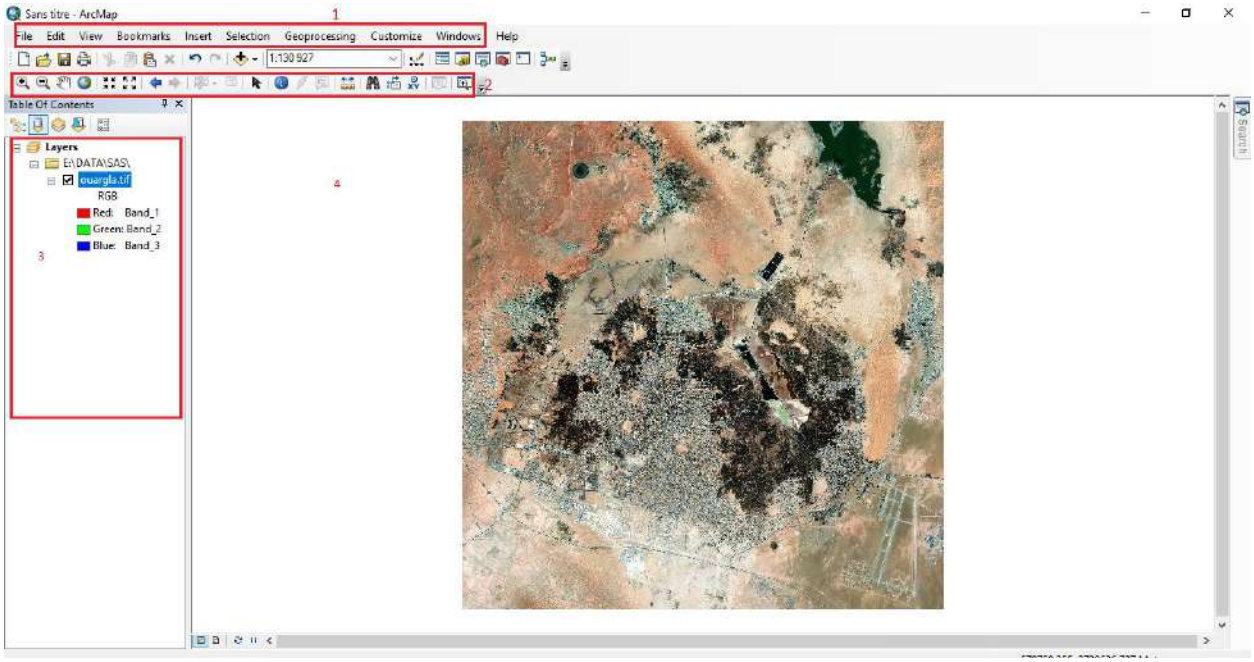

Fig.III.2.The Main façade of ArcMap

III.4. Custom menu description :

➢ Road drawing

At this point,we've identified the roads on google erth

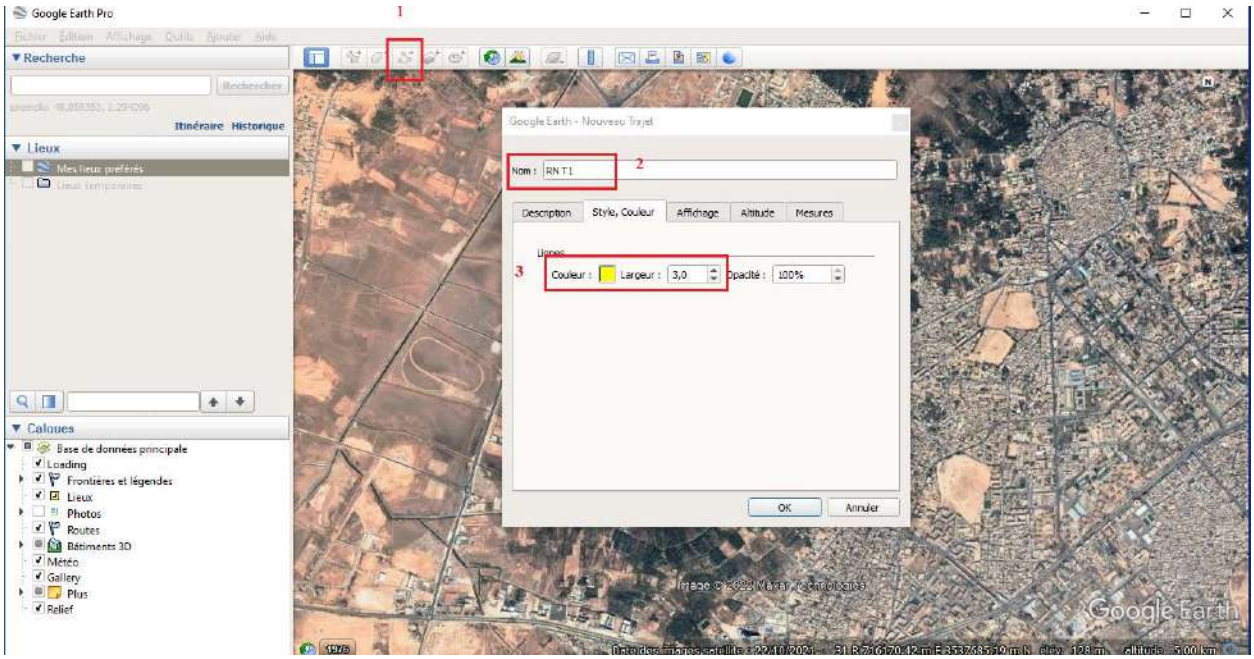

Fig.III.3.Road drawing(Specify the name, color and thickness of the line)

- The first step to charting the road is to press the icon to draw a line, and then determine the name and color, Here we chose RN as the name of the national road.

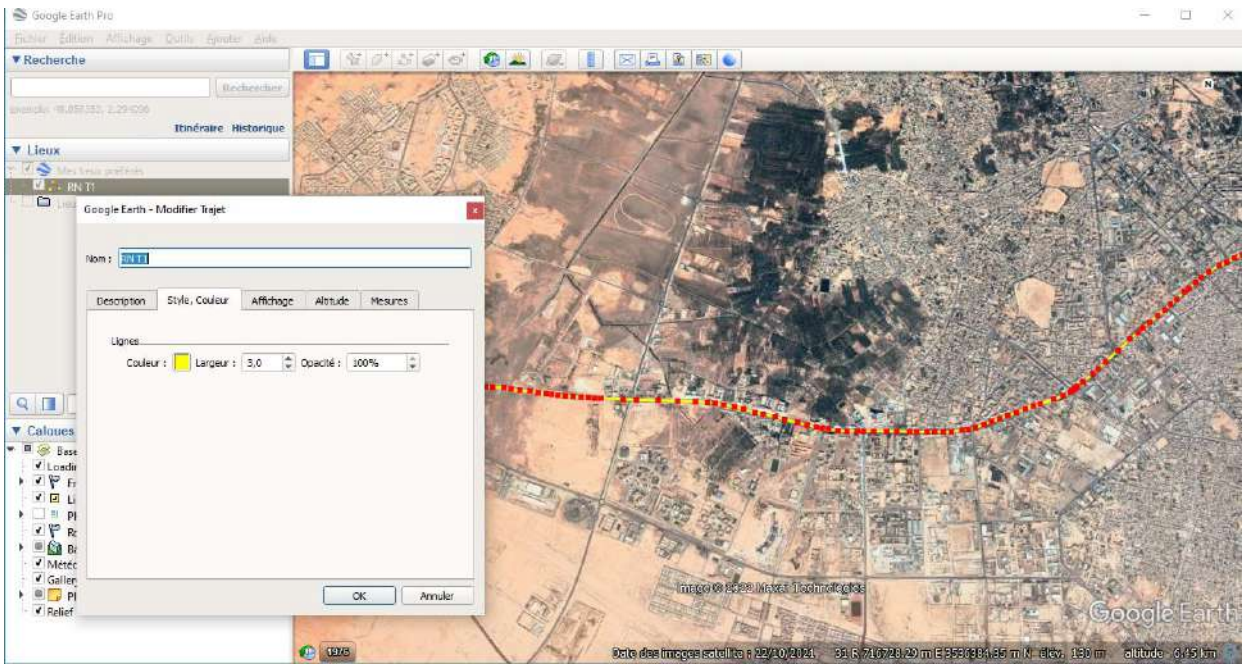

Fig.III.4.Road drawing(Draw the road on the map)

- Here we draw the national road in the form of points connected to each other.

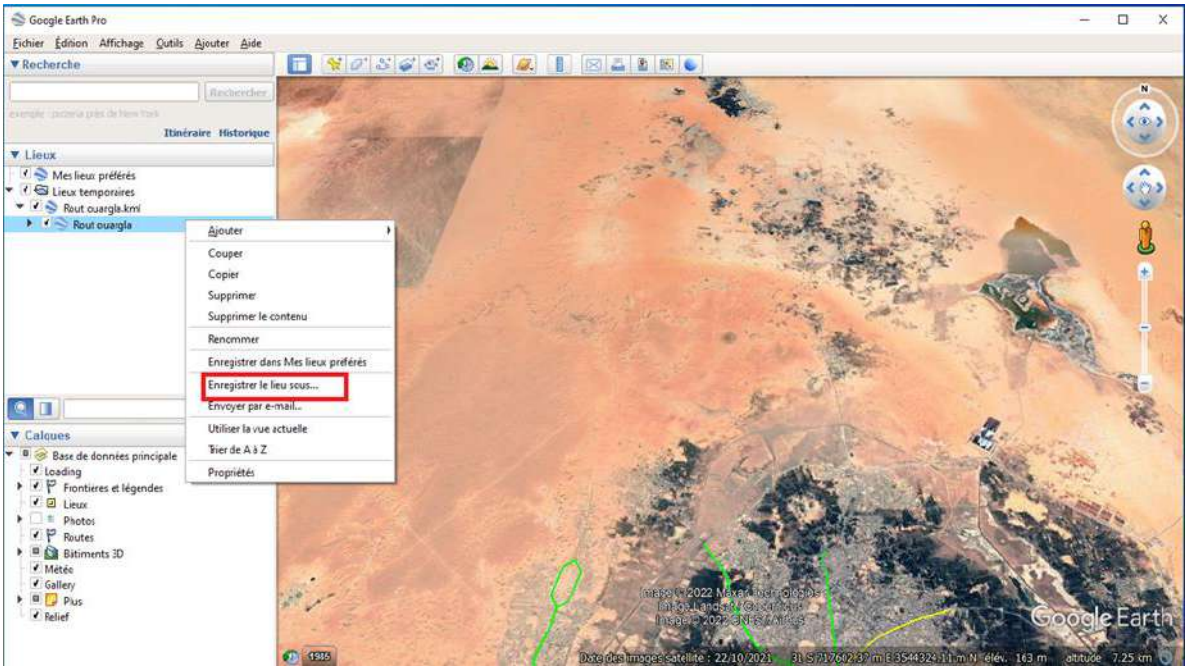

Fig.III.5.Save the link

- Then we save the link To reuse it in the system.

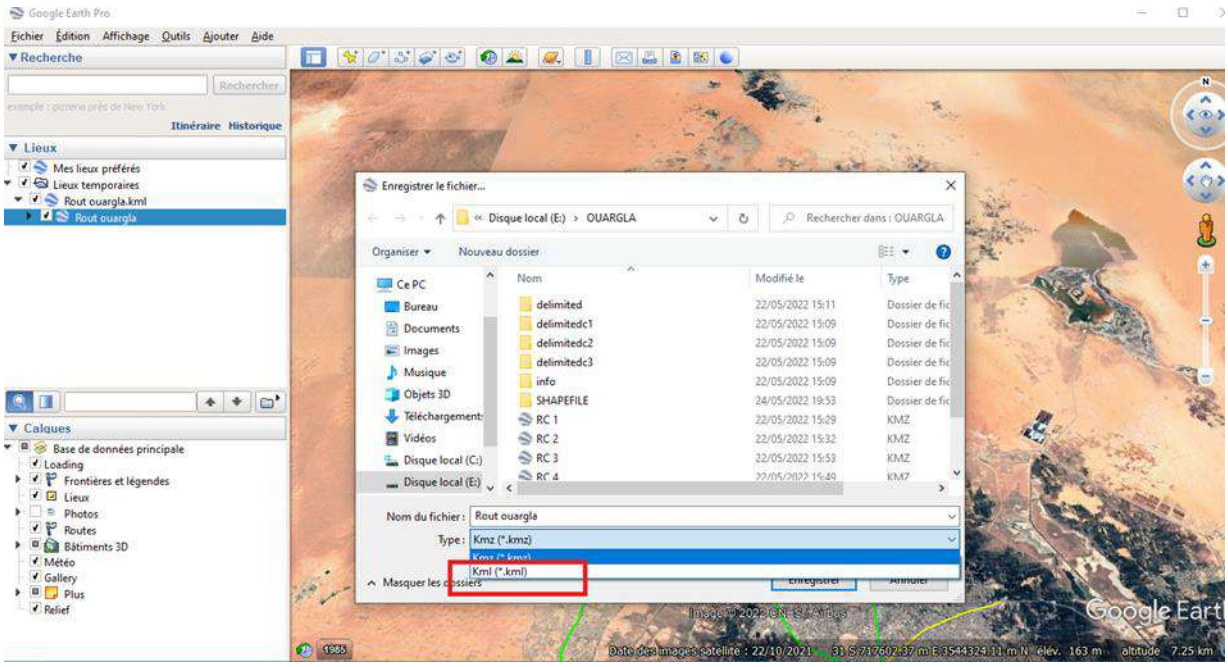

Fig.III.6.Save the link

- Her we Save the link in KML forma To view geographic data in Google Earth.

- **Global Mapper :**

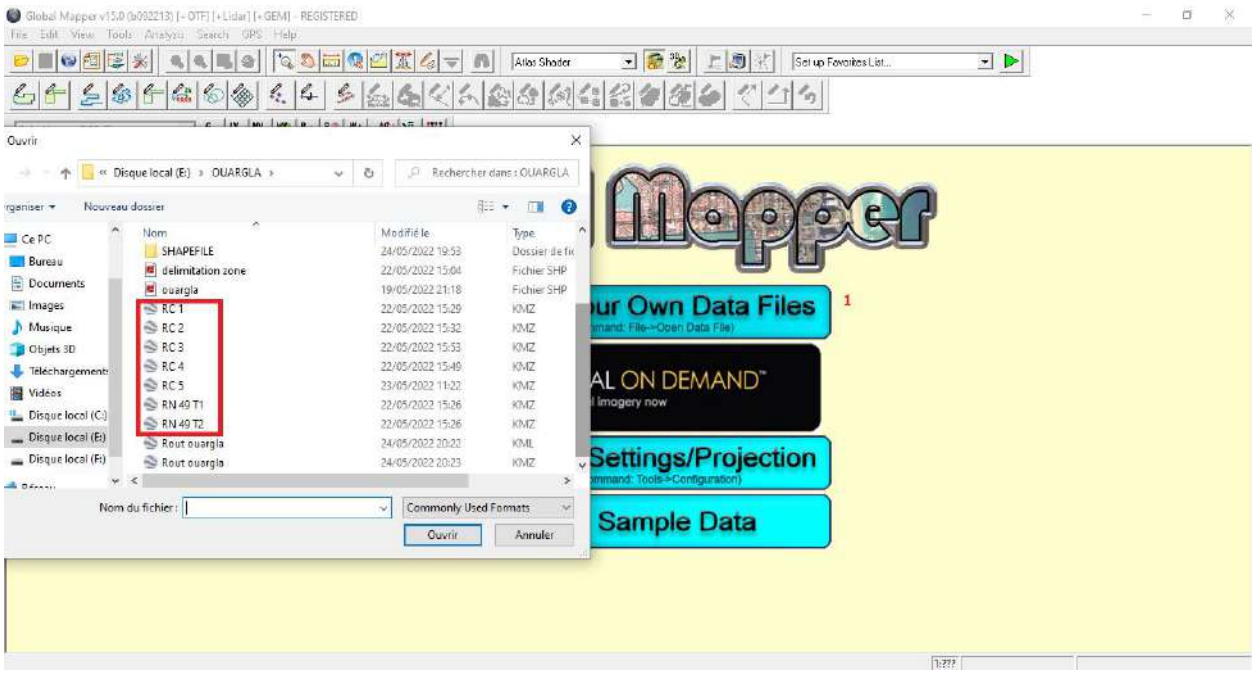

Fig.III.7.Export data to Global Mapper.

- In this program we bring data (the road link that we drew in googl erth), we choose a name for itthen click on the(open) icon.

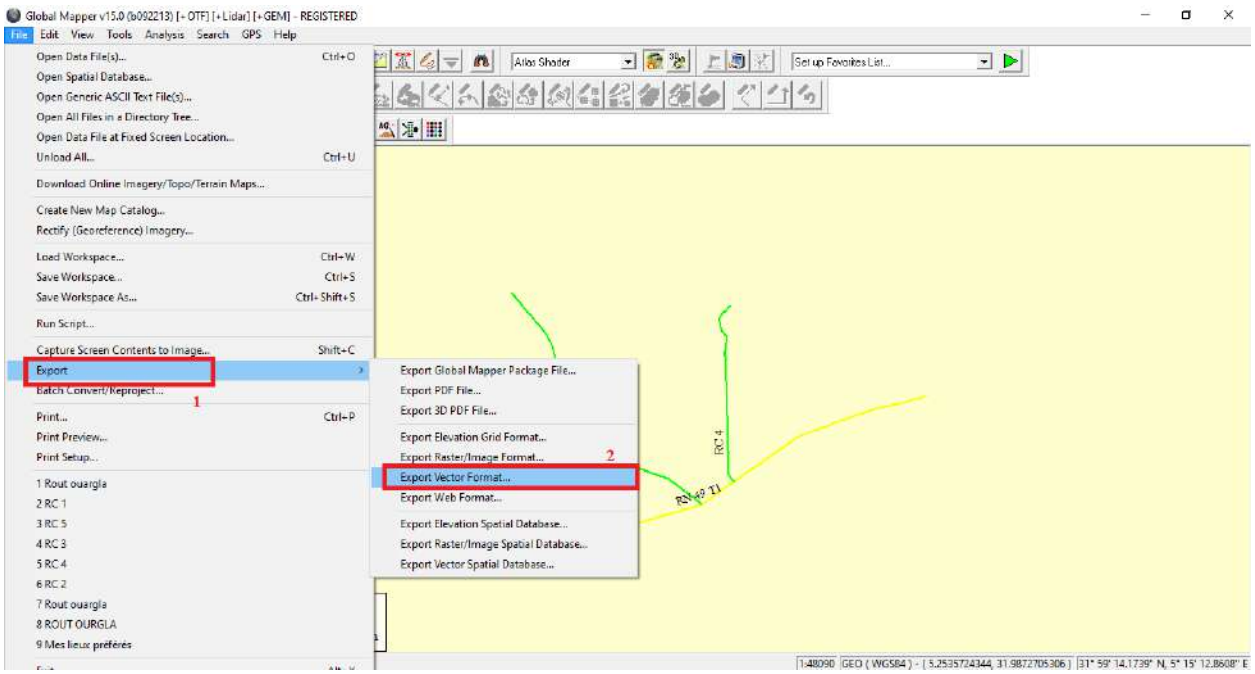

Fig.III.8.Export Vector Format

- In this step we Change format to vector format, so we Click onExport then choose Export Vector Format

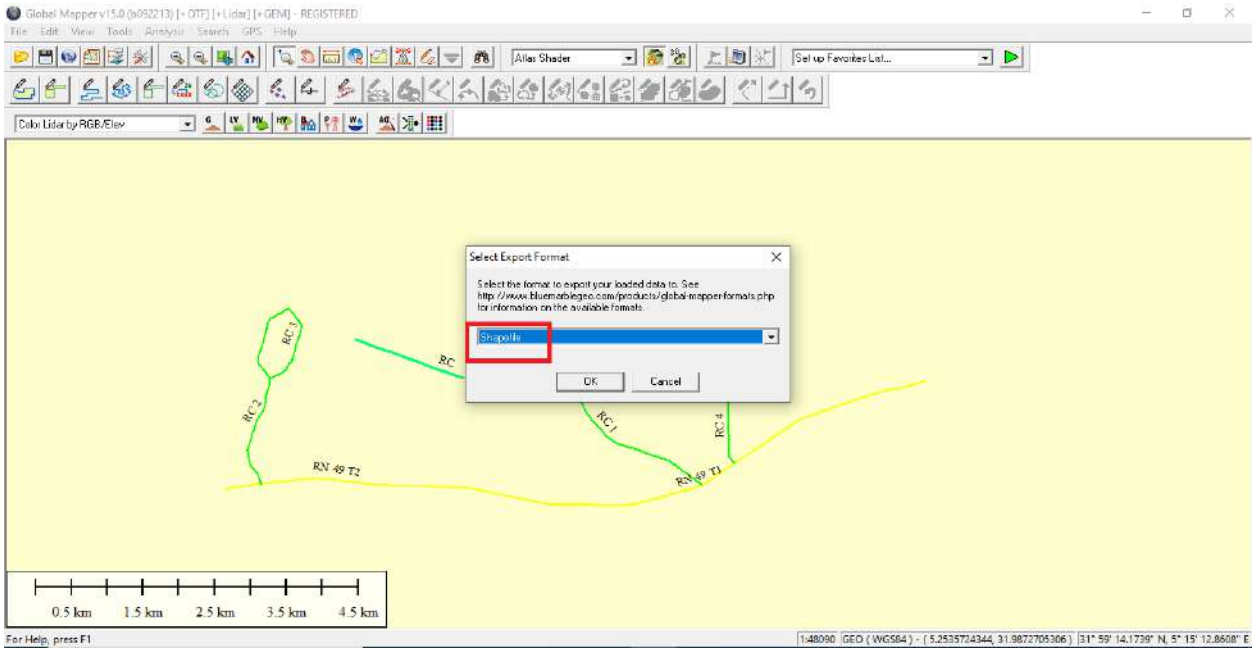

Fig.III.9.Select Export Format

- We choose shapefile (The Esri vector data storage format is to store the location, shape and features of geographical features. It is stored as a set of relevant files and has a single feature category.)

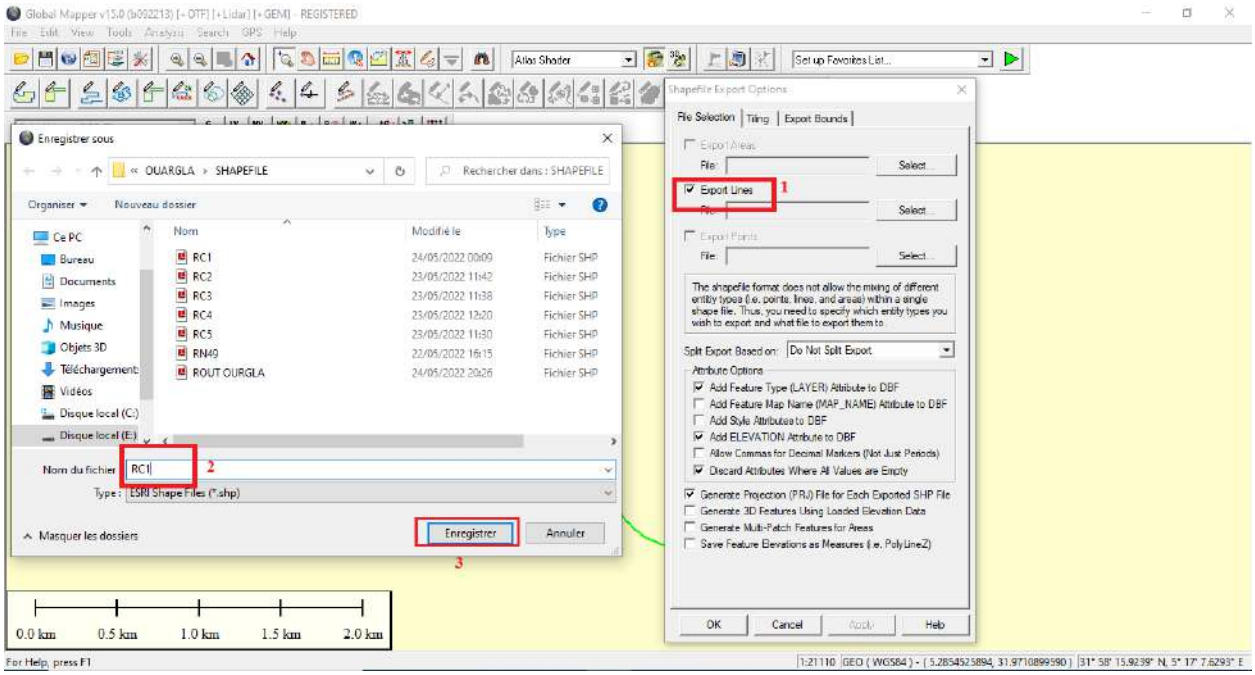

Fig.III.10.Export format (Save)

- Here we click on export lines, then we come up with shapefils, we name them, and then we save,Then it shows us the road map on the show.

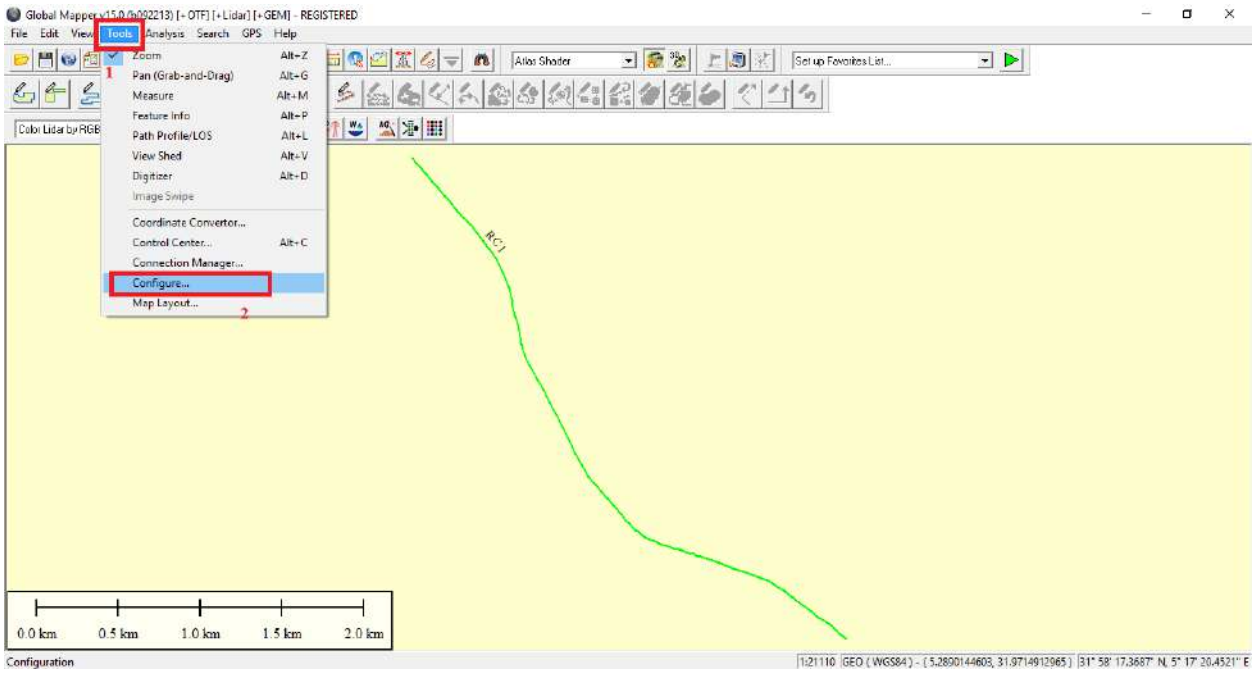

Fig .III.11.Configure

- To change theConfiguration we click on (tools) then click on (configure).

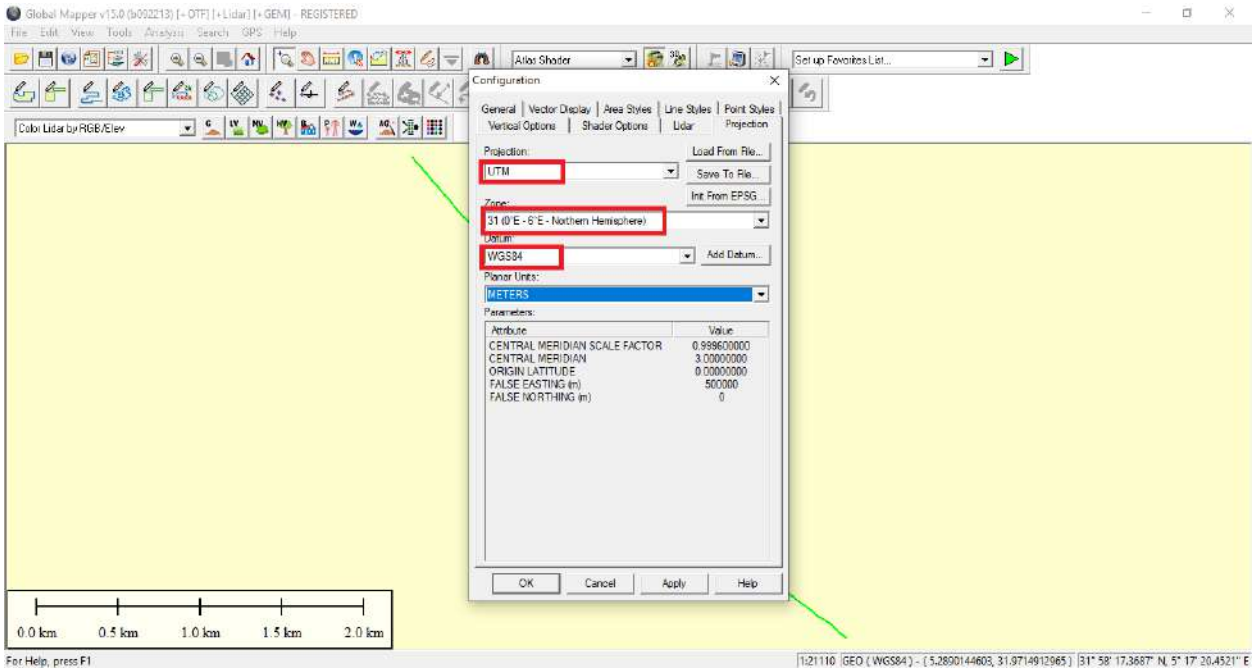

Fig.III.12.Determiningcoordinates

- Here to change the Configuration we choose :
  - Projection (UTM)
  - Zone (31(o°E-Northem Hemisphere))
  - Datum (WGS84)

➢ ArcMap :

❖ First Layer : Map of Ouargla

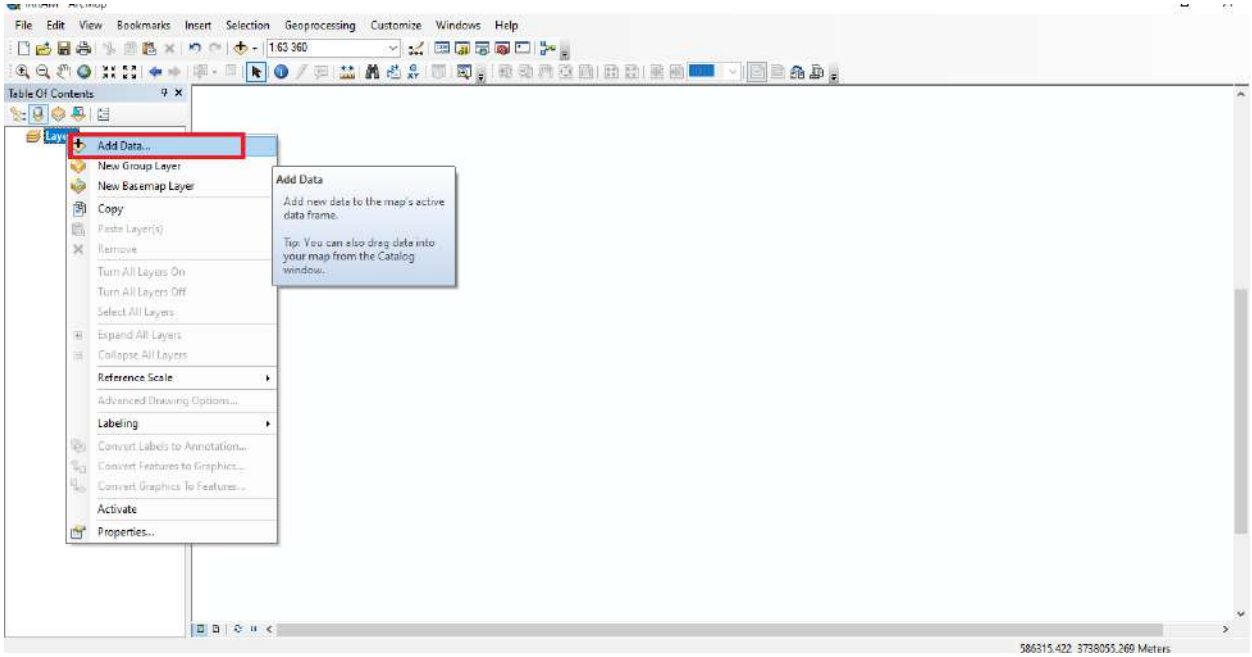

Fig.III.13.Add Data

To create the first layer on ArcGIS, we take the next steps

- The first step is : Click on an icon(layer)To add the first layer

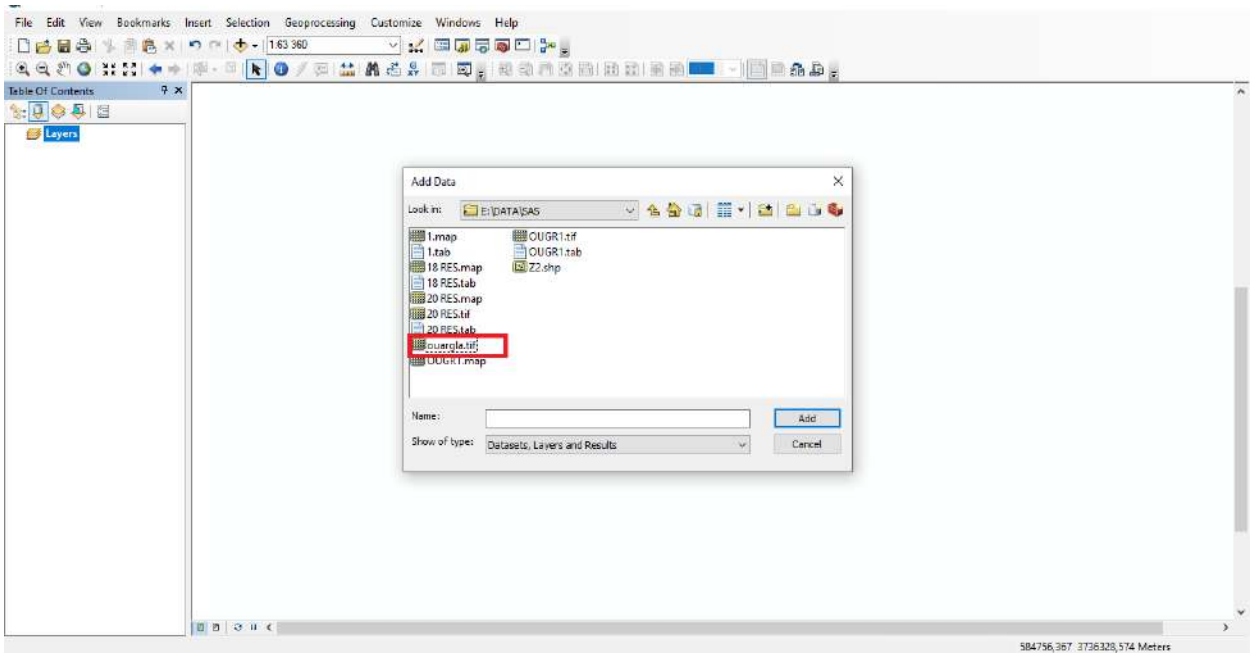

Fig.III.14.Add Data(Ouargla.tif)

- Here we Bring the map of Ouargla city

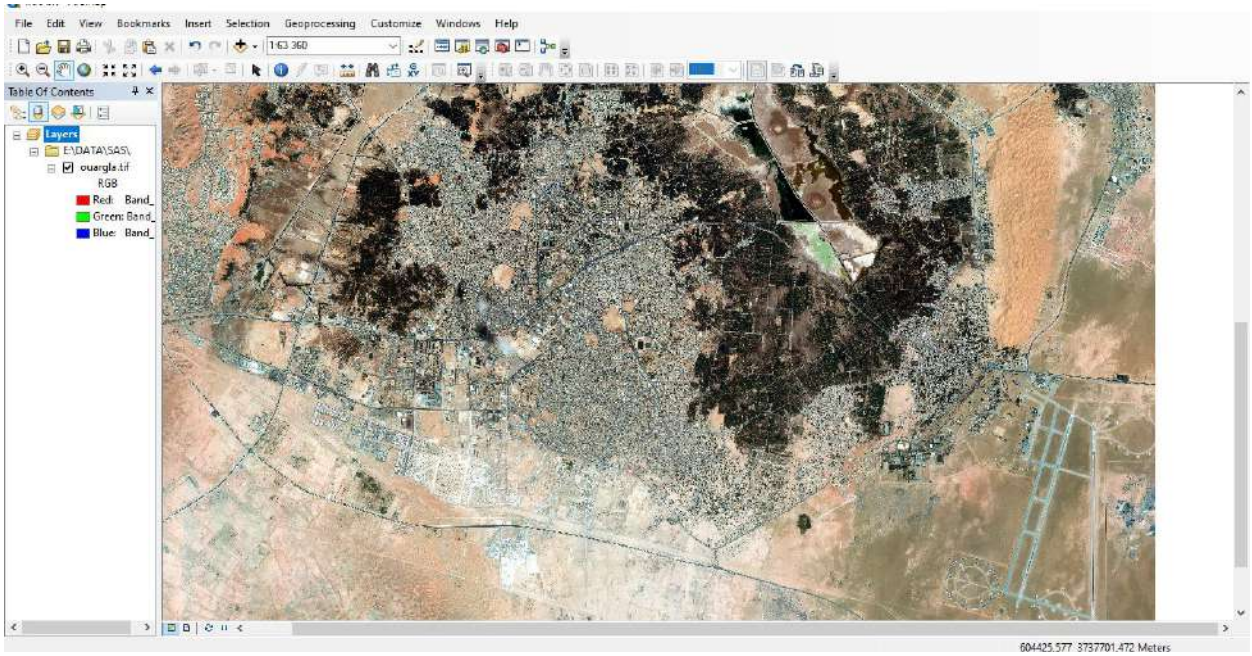

Fig.III.15.Ouargla map

- **Second layer :** Roads

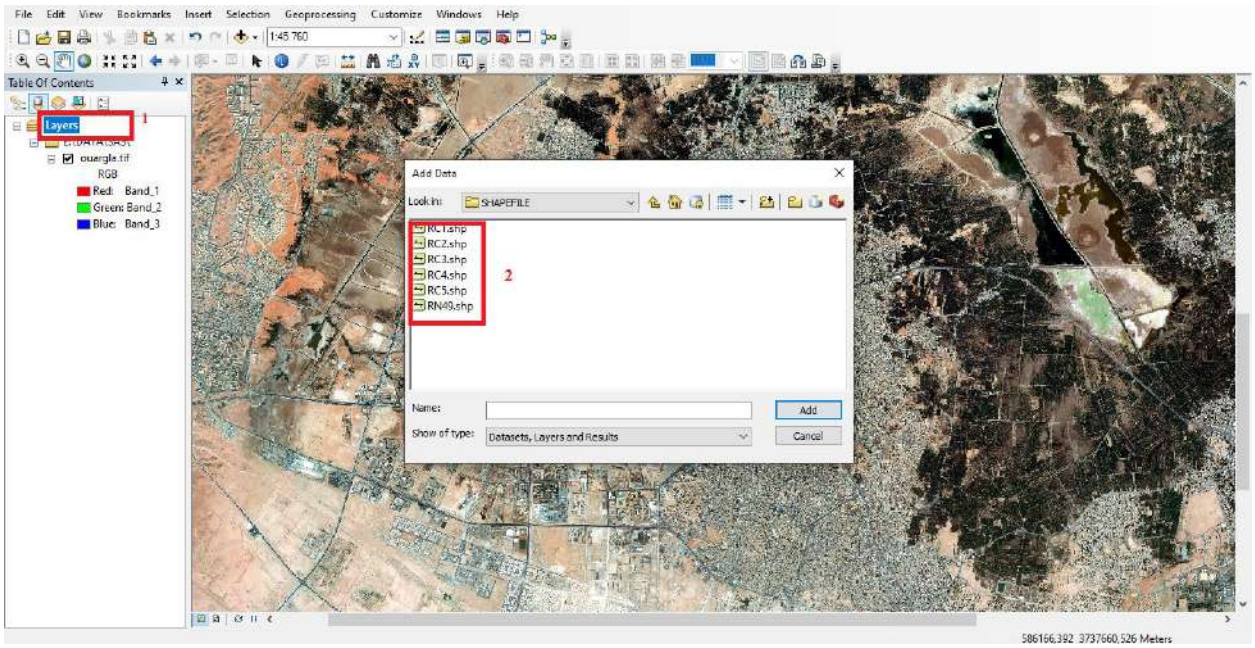

Fig.III.16.Second layer (Roads)

- To add the Second layer we Click on Layer.and Bring shepefile data one by one.

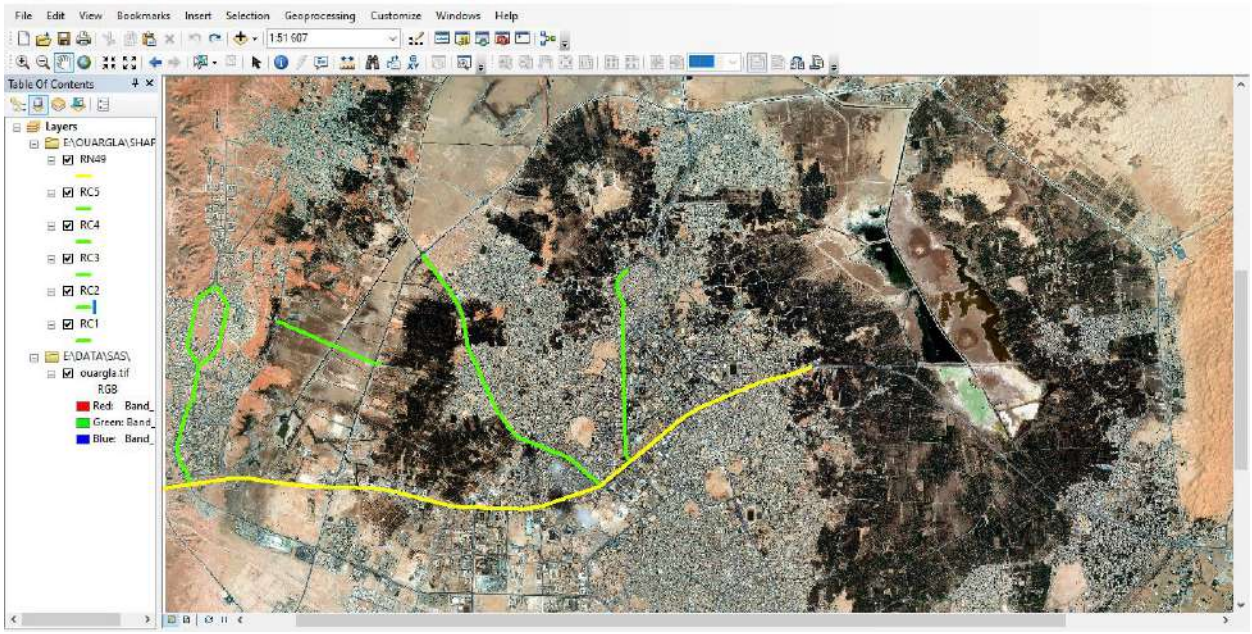

Fig.III.17.Rouds

- In this document we see the map layer and the road layer.

❖ Enter road data :

At this point, we're going to set up a road database.

- **Length :**

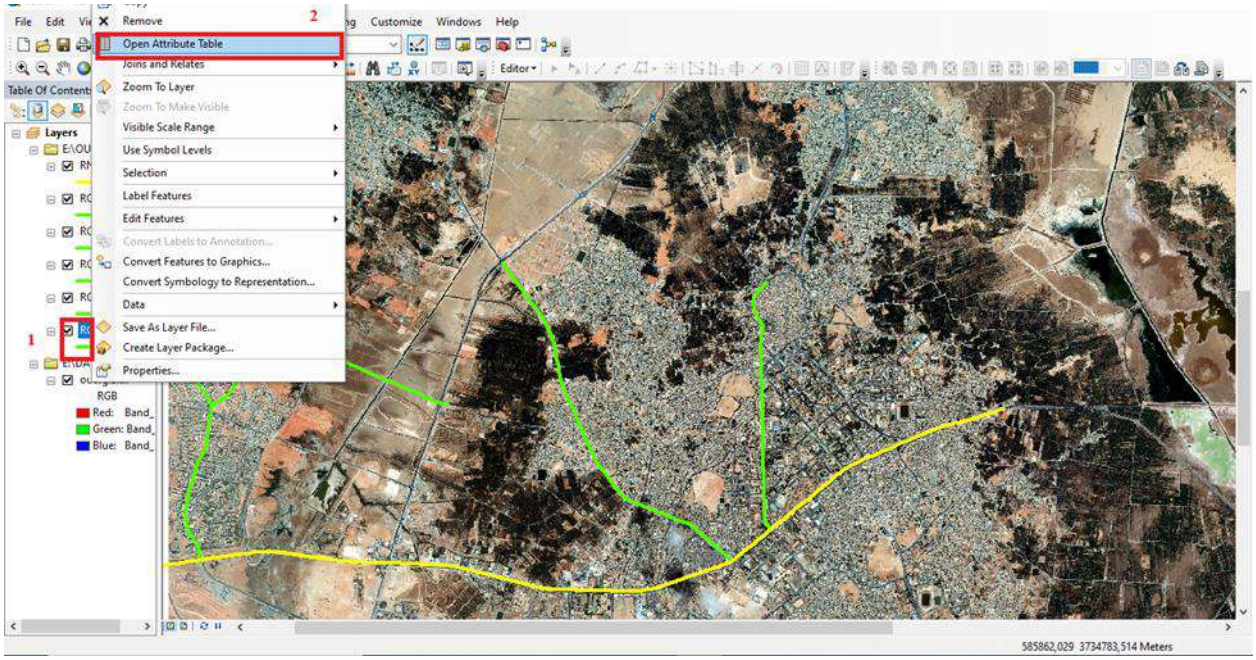

Fig.III.18.Road data(attribut table)

To add data to the road layer, follow the following steps:

- Click the right mouse on the layer to add its data.
- Click (Open atrebut tabel).

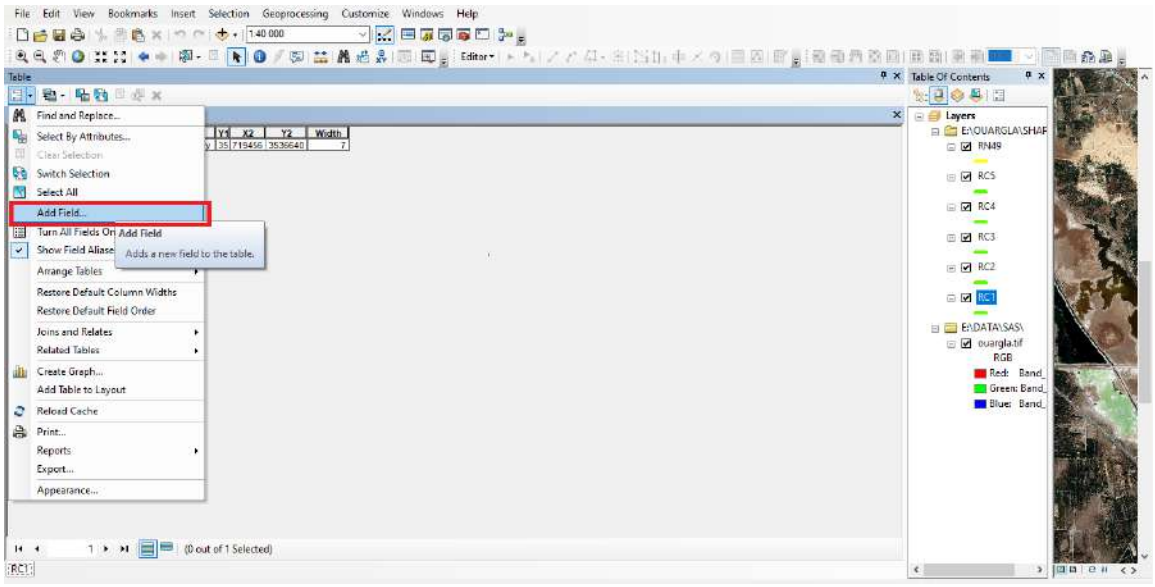

Fig.III.19.Add Field

We click on the econ (add field) to add the first data .

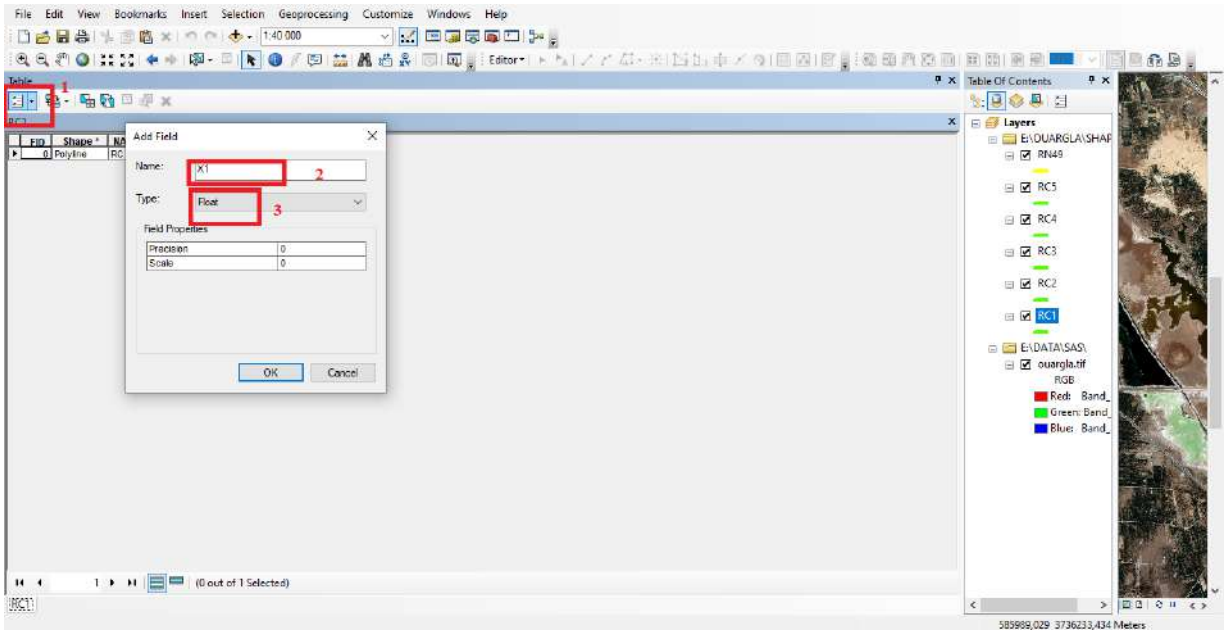

Fig.III.20.Add coordinates

We set coordinates beginning and end of the road.

- Click at Tabel option
- Set coordinates

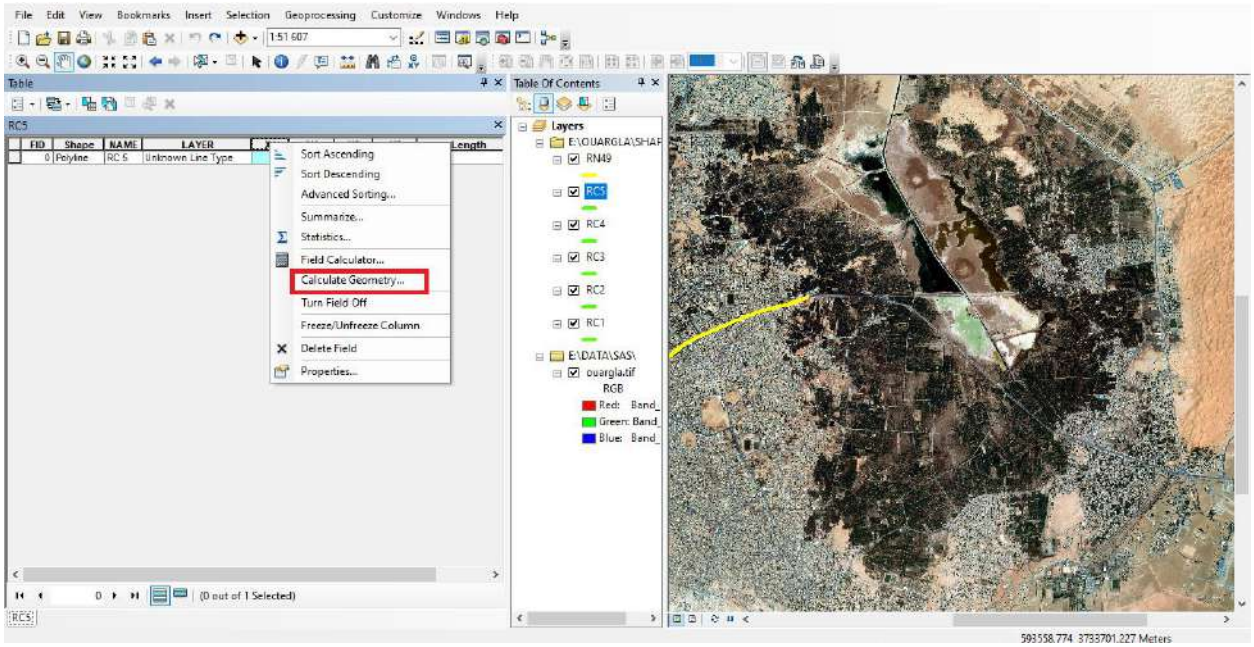

Fig.III.21.CalculatGeometry

To calculate the lengths :

- Click at (Calculat Geometry)

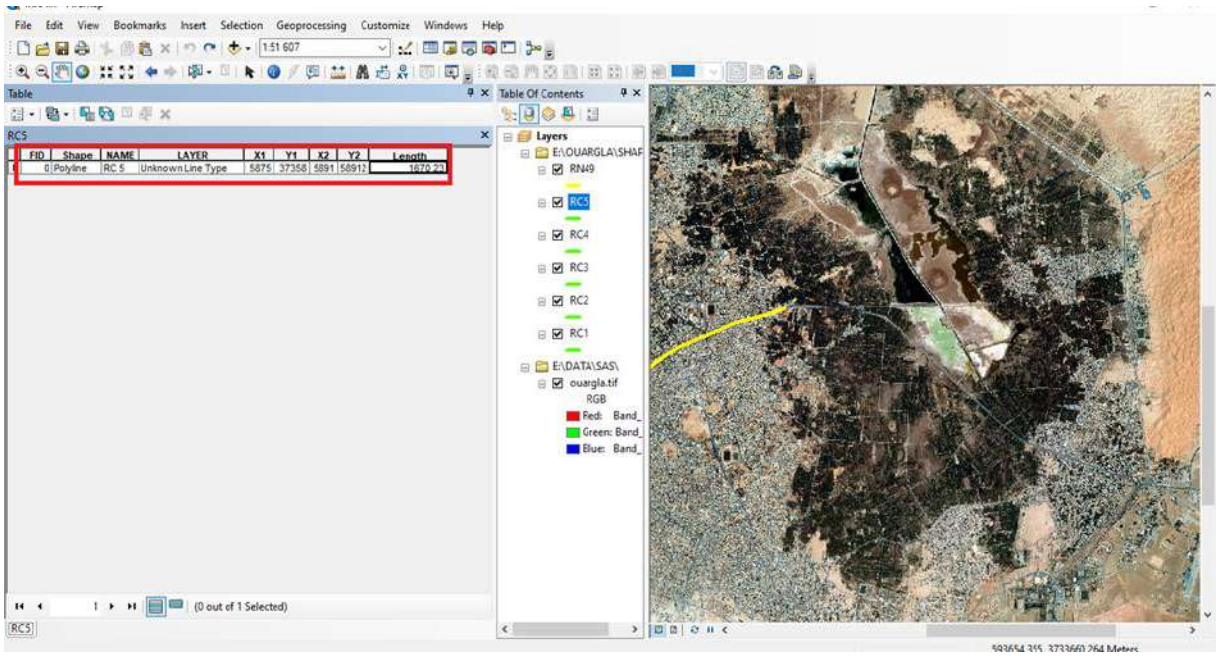

Fig.III.22.Coordinate and length schedule

We get a table with coordinates, the beginning, the end of the road, and the length of the road.

Table.III.3 :The road length

	X1	Y1	X2	Y2	Length
RN T1	722096	3538200	716093	3536560	6556.66
RN T2	716095	3536560	713824	3536460	2294.27
RC 1	717140	3539530	719456	3536640	3879.91
RC 2	714313	353806	714248	353654	1597.75
RC 3	714317	3538070	714312	3538070	2354.97
RC 4	719739	3539400	719832	3536970	2517.81
RC 5	715311	3538640	716630	3538130	1418.62

X1,Y1 :The starting point coordnates

X2,y2 : The endpoint coordnates

Length : Road Length

- **Width :**

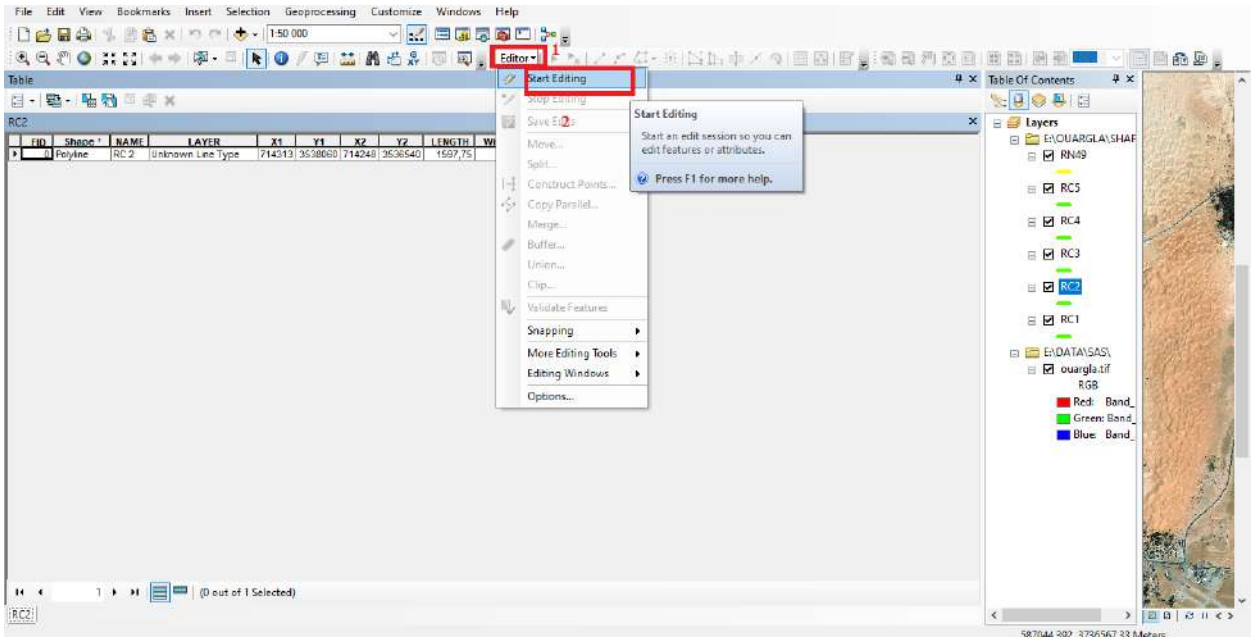

Fig.III.23.Editing

To add the rest of the data, we take the next steps.

- Click on Editor
- Click on Start Editor

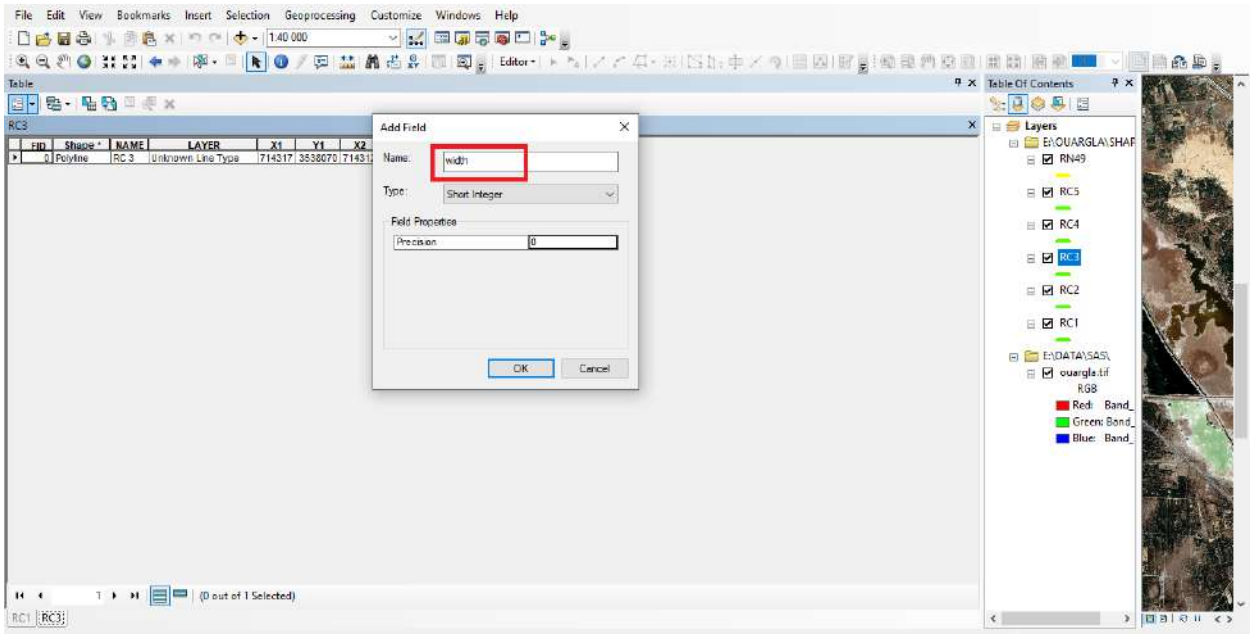

Fig.III.24.Editing(Name ,Type)

- Then select the name and type ,Here we added road view data.

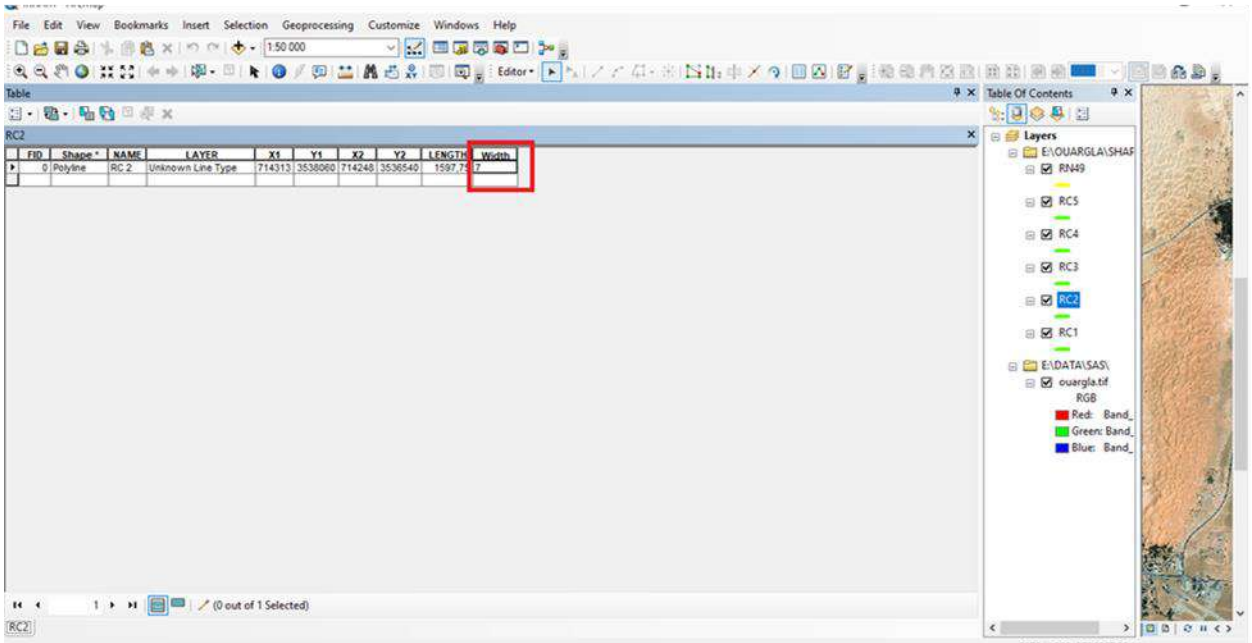

Fig.III.25.Editing(Width)

- We determine the width of theroad

- **Road condition :**

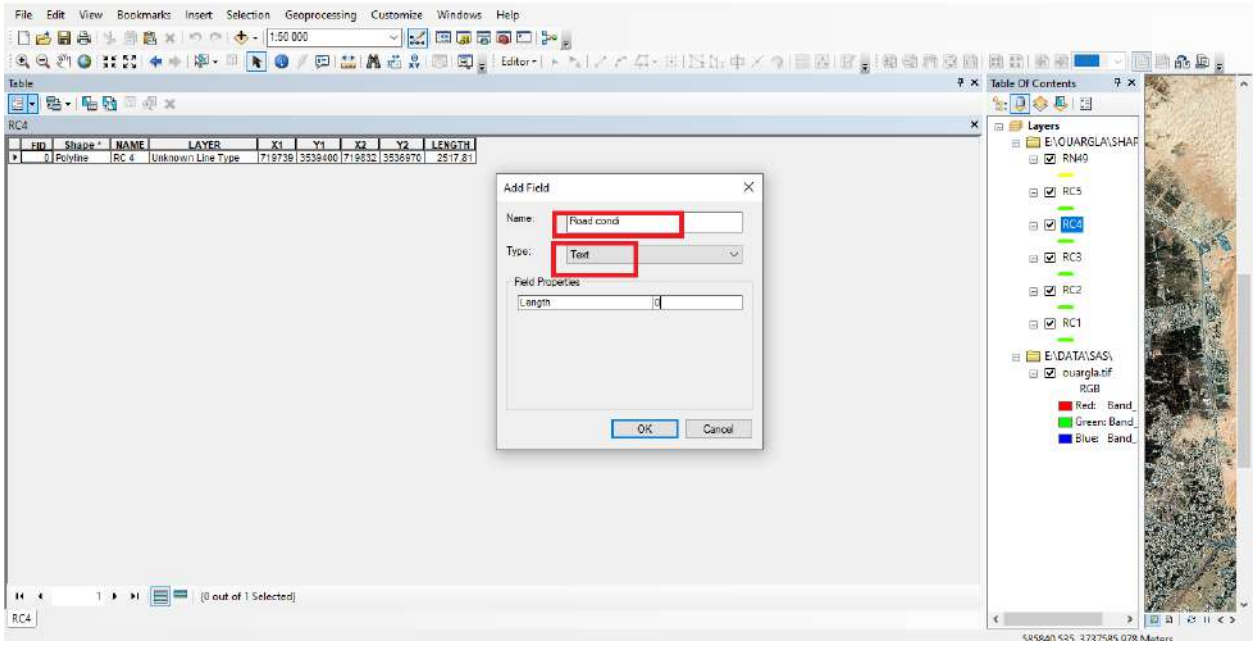

Fig.III.26.Editing(Name,Type)

We're doing the same steps as before.but in the type we choose (text).

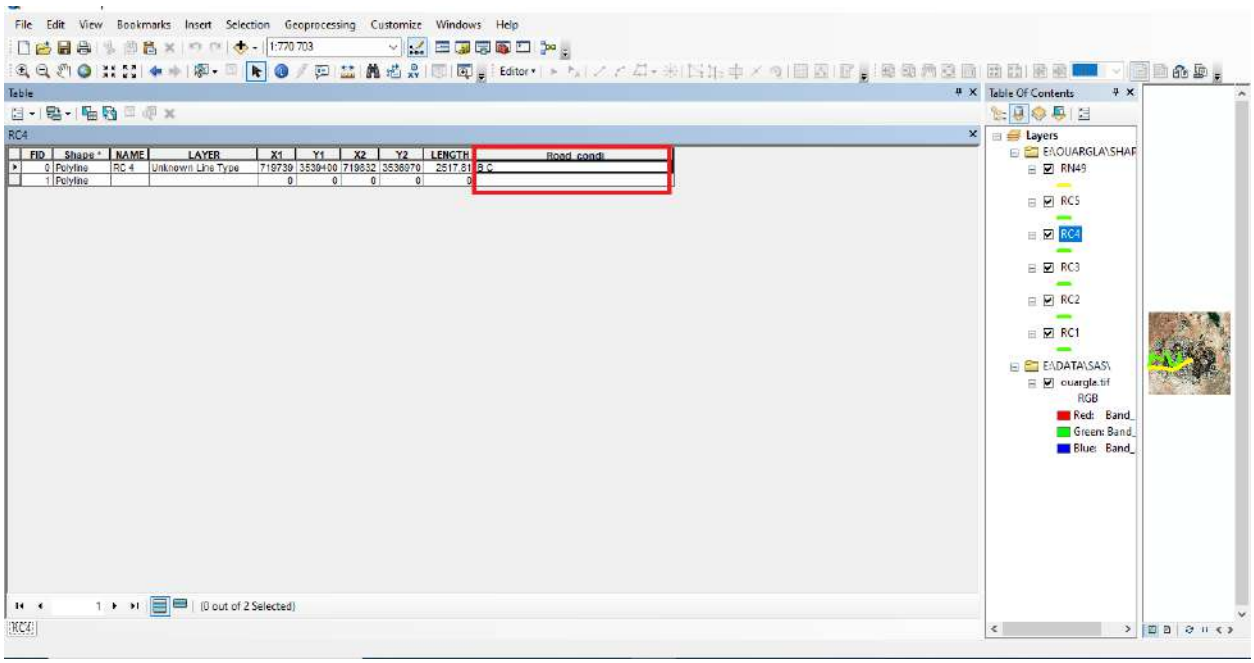

Fig.III.27.Determining the status of the road

ThenWe determine the specifics of the road.

G C : Good condition**.**

B C : Bad condition.

Atthe end, we'll get an accessible database just by clicking the road as shown in the figure below.

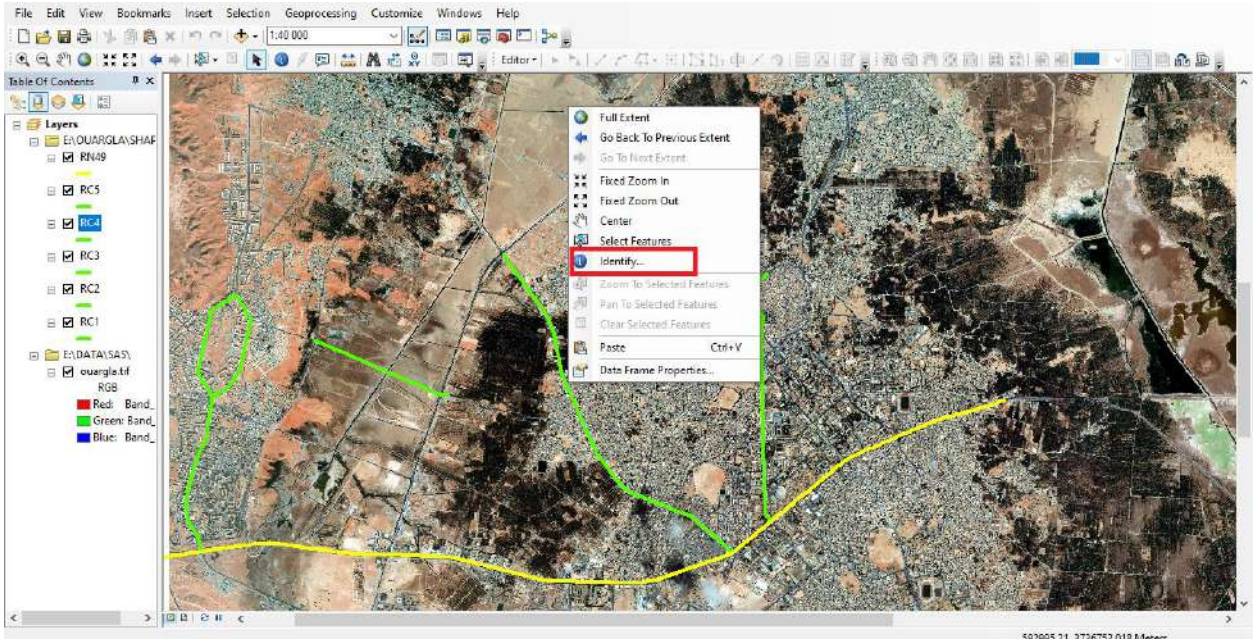

Fig.III.28.Show data

- Clicking the right button of the mouse and then (Identify).

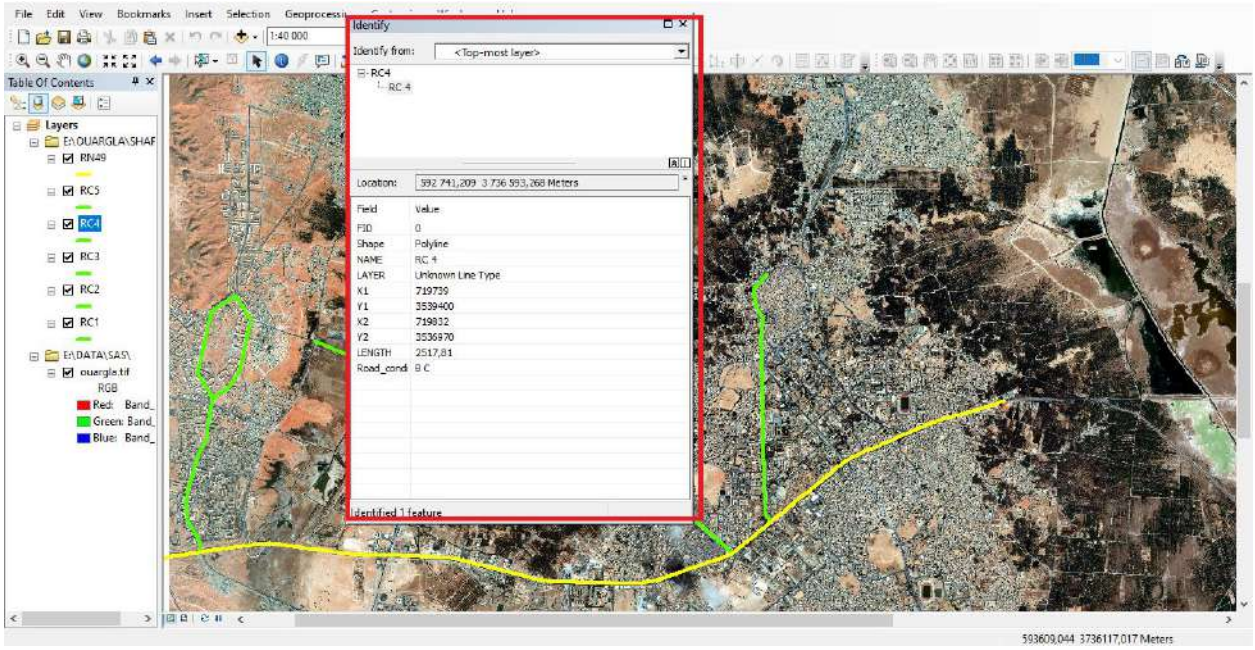

Fig.III.29.Show data

- Here we see the road spreadsheet.

Conclusion :

In this chapter we explained the data sources and provided the tools and programs used to implement the application by revealing its various components and functions that allow the development of the system, in addition to seeing the functions of our proposed model with

illustrations of all steps. We created several layers, a layer for the study area map, then a road layer, andthen weentered the data for each road.

GENERAL CONCLUSION

Roads are an important part of the city's structure and have an impact on the economic and social field, and its collapse is a major problem, and one of the reasons for these problems is climatic factors, road age and poor management, so we need to follow up, monitor and maintain.

In Ouargla which is one of the most important cities in Algeria, road network is very dense. This road network in Ouargla has experienced rapid expansion in recent years, which has allowed a rapid development of agricultural, industrial and commercial activities. Due to severe weather conditions (rather large thermal amplitude, and hot-dry winds) and local conditions (water upwelling and intense traffic), the road network in Ouargla and over time has suffered degradation in several sections. The citizens and in particular the drivers in Ouargla denounce the absence of the maintenance of the degraded sections and the local authorities have marked the lack of means of monitoring and control of road networks which does not stop widening.

In this research, we suggested a method to help with the follow-up and monitoring process, we relied on GIS where it allows its functions, components and application services to manage data, and monitor the state of the road.

To do this, we used the ArcGIS software, which is based in its operation on the introduction of several pieces of information in the form of layers. Each layer represents a piece of data.

At the end of this work, we were able to establish a road database for the city of Ouargla containing several layers:

The first layer is the map layer. The second layer, the road layer, we drew the road network in the system.The third layer is the data layer where we have introduced data for the road network.

We finally get a geographic card with spatial data that can be obtained by clicking only on the road.Wesee it helps with follow-up, surveillance and decision-making.

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