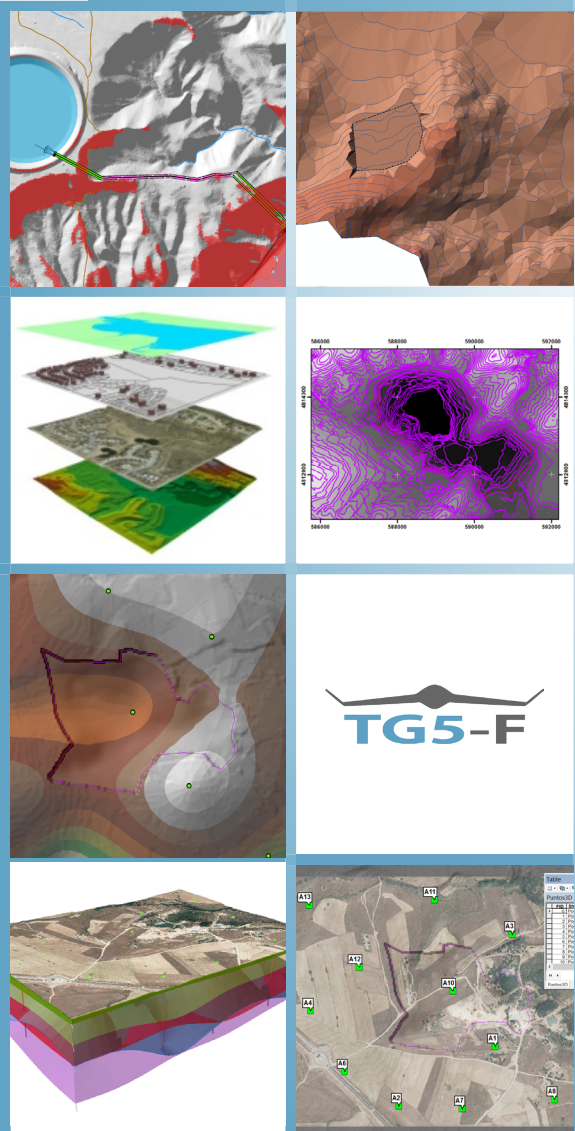
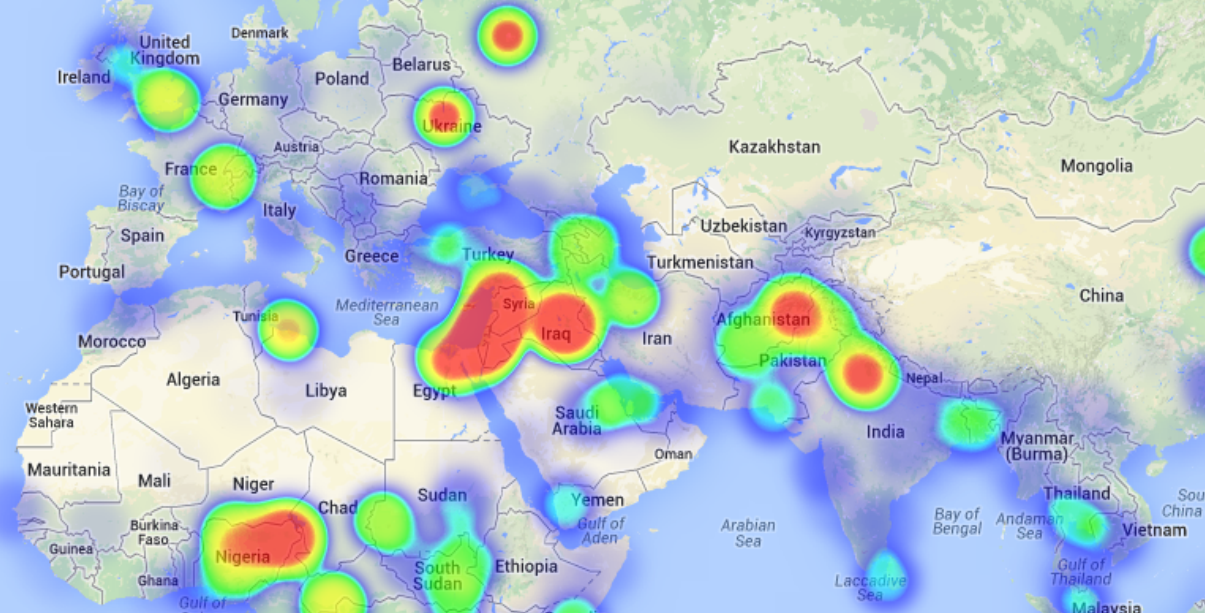
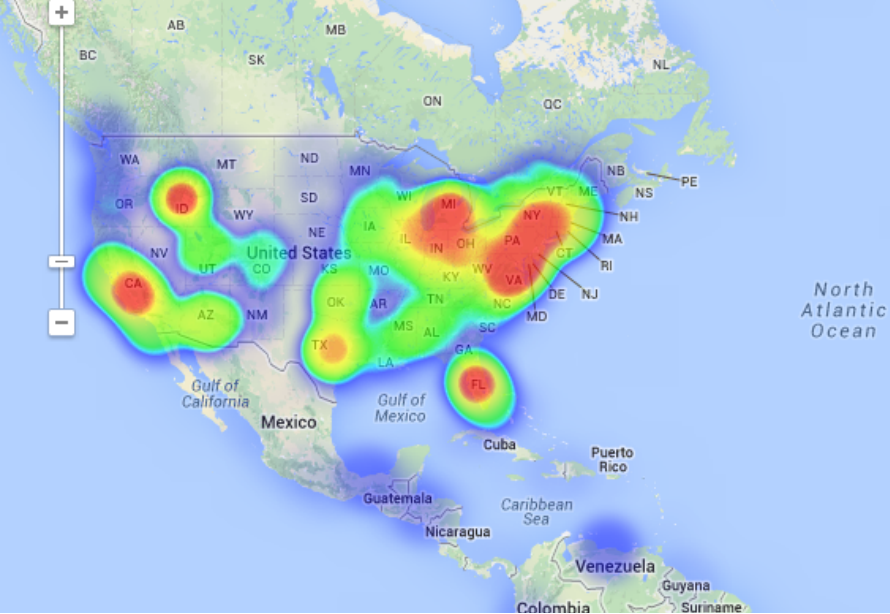


# ARCGIS COURSE, APPLIED TO GEOLOGY AND MINING





## TRAINING OVERVIEW



This course will qualify students in ArcGIS Desktop 10.x and, in particular, in ArcMap, ArcCatalog and ArcToolBox, for the development of projects related to geology, hydrogeology and mining.

Students will gain advanced knowledge in ArcGIS 10 tools, useful for the design of geologic and hydrologic studies, such as georeferencing and digitizing of geological maps, generating DTMs, 3D cuts, estimating piezometric levels, drainage networks, multivariable analysis for the location of mining exploitations, and landscape and topographic studies.

## STUDENT PROFILES



This course is aimed at students and professionals related to geology, engineering, topography, geography and environmental sciences interested in the use of Geographic Information Systems for their professional activities.

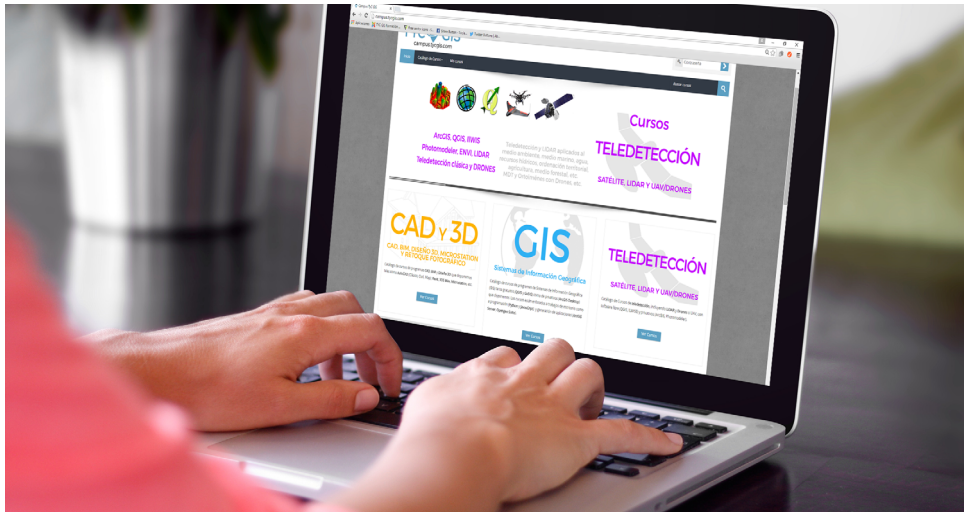
**Important note: this course requires previous ArcGIS Desktop knowledge.**

## GOALS



- Demonstrate the importance and usefulness of GIS in studying and working with geology, hydrogeology and mining variables.
- Facilitate the understanding of all the essential concepts needed for an advanced use of ArcGIS Desktop and GIS in general, but more specifically, for its use in geology and mining.
- Use GIS key tools for the correct management of raster and vector data models, the creation of high quality cartography and developing complex spatial analysis.
- Study the existing difficulties in the design of geological studies with GIS and their resolution through exercises.
- Learn how to prepare, layout and deliver high-quality mapping for environmental impact studies, etc

**Some of the skills acquired by the students will be:** creation of field sampling spatial databases, geochemical mapping, erosion studies, hydrologic studies, multivariable analysis for the correct geological position of infrastructures, location of surface geological deposits, generation of 3D geological cuts, etc.



## ONLINE FORMAT METHODOLOGY

The online format uses the online learning and technological platform Moodle, a telematics tool that works through the internet. It is a learning platform that provides students access to the training course content, fulfill the practical cases and consult the teaching staff, as well as availability to the resources and help at any moment.

The platform is available 24 hours a day, through which the student will be able to ask for help at any given moment. Instructors will reinforce the student's autonomy during its training process, supporting and clarifying any possible doubts that may arise along the course.

Therefore, the course is carried out through different areas available on the online platform and where the student can search for training material, download information, complete the practical exercises and take assessments to verify the assimilated knowledge. The teachers will offer progressively the basic information needed to work towards the completion of a final practical case.

## INSTRUCTOR



### Santiago Pardini Herranz

With a Bachelor's degree in Environmental Sciences and a Specialist certificate in Geographic Information Systems from the Universidad Politecnica de Madrid (Spain), Santiago has more than 5 years experience as a GIS Consultant / Technician.



He has experience in the development of GIS studies for diverse types of projects: hydraulic infrastructures, lineal structures, wind and photovoltaic installations, mining activities, land use zoning, fauna studies, etc.

### Mario Iglesias Martínez

Bachelor's degree in Geological Sciences from the Universidad Complutense de Madrid and Hydrogeologist at the Universidad Politecnica de Catalunya, with a Master in Regional Geology and Geological Cartography at the Universidad Federal de Minas Gerais/ Brasil. With experience in geological cartography, hydrogeology and mining exploration in Spain, Brasil and sub-saharan Africa, he develops his work as a geologist in public organizations (Spanish Geological and Mining Institute), volunteering projects (World Geologists in Burkina Faso) and in different Engineering and Environmental Management consulting companies (MDGeo, CRN, etc).



He currently is the Geologist - Project Manager of the mining exploitation authorizations that the Spanish company Cratón del Congo Exploraciones SL holds in Gabon and Mozambique



## 1 - INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEMS

Introduction.

Definition and basic concepts.

Uses of Geographic Information Systems.

Geographic information: vector data models, raster data models and other

data models (CAD, TIN, etc.). Main features of each data module, advantages and disadvantages.

Introduction to ArcGIS Desktop: ArcMap, ArcCatalog, ArcToolbox, ArcScene and ArcGlobe.

Arcmap interface, extensions and tools.

## 2 - VECTOR DATA MODEL. INFORMATION DISPLAY

Information layers: how to add layers, features and attribute tables.

Data tools: search and queries.

Selection tools: selection per feature, selection by spatial location and information capture.

Layer symbology: basic symbology, by category, by quantity and through graphics.

Other display options: labelling and transparencies.

## 3 - COORDINATE SYSTEMS, PROJECTIONS AND GEOREFERENCING

Introduction to Coordinate systems and projections.

Defining Coordinate Systems.

Coordinate system transformation. Reprojection of ED50 or ETRS89 geographic databases.

Image, layer and CAD files georeferencing.

## 4 - VECTOR DATA MODEL. EDITING AND CREATING INFORMATION

Creation and editing of spatial data.:

- Creating spatial data: Editing toolbar. Digitization techniques.

- Creating layers from CAD files.

- Modifying existing layers.

- Creating layers from coordinates and GPS data.

Creation and editing of data in attribute tables:

- Structure of an Attribute table.

- Types of data included in an Attribute table.

- Modify information from an Attribute table.

- Calculate geometric information (Surface, perimeter, length, etc.).

- Creation of statistics from the table.

- Export tables to Excel and other formats.

Report and graph creation.

## 5 - DATABASE AND SPATIAL DATABASE MANAGEMENT (GEODATABASE)

Designing databases.

Joining and relating databases.

Spatial joins. Obtain statistics from database information and spatial position of elements in a layer.

Geodatabase: advantages. Properties.

Loading data to the geodatabase. Subtypes and domains.

**Guided Exercise 1 (GIS database): Creation digital cartography from field data.**

## 6 - SPATIAL ANALYSIS USING VECTOR DATA

Extract (Clip, Split), overlay (intersect, union) and proximity (buffer analysis, Thiessen polygons) toolsets.

Obtaining field grids.

Multi-criteria analysis. Obtaining optimum areas according to several criteria.

**Guided Exercise 2 (data analysis): Creation of grid fields and combining them with field data applied to geology.**

## 7 - SPATIAL ANALYSIS USING RASTER DATA

File conversion tools. File format conversion from vector to raster, and viceversa.

ASCII or html files, and exporting files to KML (Google Earth) as well as CAD.

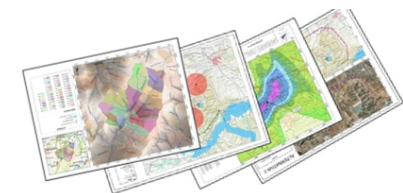
Create Digital Elevation Models from vector data, ASCII and TIN files.

Extracting information from raster files by query, mask, entity and / or joining raster files.

Contour lines, slope calculation, hillshade maps, orientation and visibility studies.

**Guided Exercise 3 (digital terrain model): Generating DTMs from vector and field data. Modifying DTMs.**

**Guided Exercise 4 (landscape): Creating a visibility study through viewsheds from high precision digital terrain models, defining specific views and project elements.**





## 8 - ADVANCED SPATIAL ANALYSIS.

Data interpolation. Different interpolation methodologies (IDW, kriging, natural neighbour).

**Guided Exercise 5 (Geochemical Maps): Generating geochemical maps depending on the spatial variability of chemical elements or compounds to detect anomalies (geological exploration), halo of contaminated soils, etc.**

Use in hydrology: obtaining a drainage system, flow direction, outlets, and identification of drainage basins.

**Guided exercise 6 (hydrology): Obtain the drainage network, the main flow direction,**

accumulation areas and hydrographic basins, sub basins and micro basins.

## 9 - ADVANCED SPATIAL ANALYSIS II

Reclassifying raster files. Euclidean distances, building Boolean layers, adding values to intervals or categories, and data conversion.

Map algebra (raster calculator), math calculations between raster layers, field statistics.

**Guided exercise 7 (slope stability): Risk analysis for landslides according to several variables like slope, type of substrate, presence of vegetation, etc.**

Volume calculation.

Raster multi criteria analysis. Basic concepts and weightings. Weighted overlay. Non-compensatory analysis.

**Guided exercise 8 (selection of alternatives): Multicriteria analysis to position a mine, including its sterile batteries.**

## 10 - 3D DATA DISPLAY (ARCSCENE)

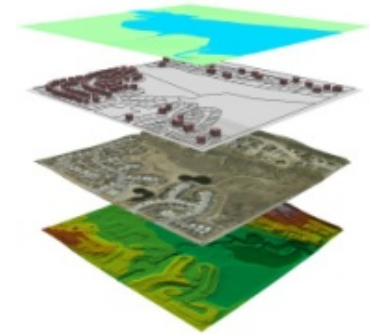
Converting vector files from 2D to 3D.

Vector and raster layers display in 3D.

Generation of 3D figures in ArcGIS.

Guided exercise 9 a (3D geological cuts): Generating 3D geological cuts from interpolated data collected on field.

**Guided exercise 9 b (3D piezometric level): Generating piezometric level 3D views from interpolated data of soundings.**



## 11 - WEB INFORMATION SOURCES AND RESOURCES

Downloading digital maps (IGN) and using WMS cartographic servers.

Regional, European and international spatial data web platforms.

Arcgis Online services.

## 12- MAP CREATION

Sheet configuration.

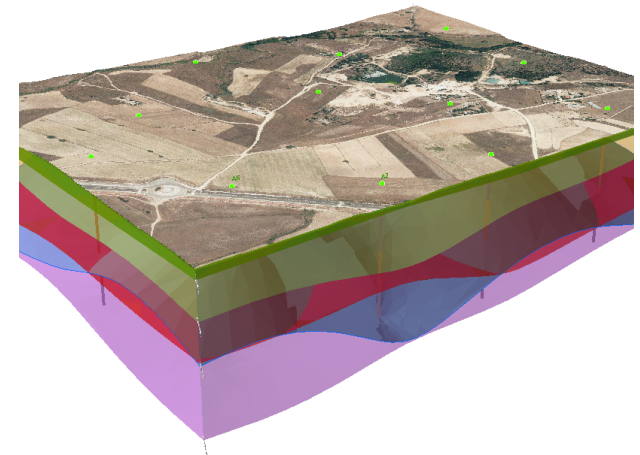
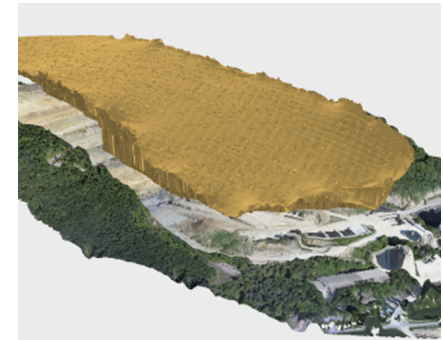
Inserting basic elements (north, scale bar, numeric scale, map legend, etc.)

Add UTM coordinates grid, composition with several "Data frames", images, excel tables, etc.

Save maps as templates. Create a document based on the template.

Printing options.

**Guided exercise 10 (map composition): creating quality mapping focused on environmental studies according to the INSPIRE directive.**





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