



Geographic Information System

Intro. to GIS & Overview

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Outline

- What is GIS?
- GIS File Elements
- Types of GIS
- Download Geo-Datasets
- An Overview of ArcGIS Pro
- References



What is GIS?

- GIS is a computer system or software that may create, manage, analyze, and illustrate map data that is attached to unique locations.
- It could be a platform that enables users to capture, store, manipulate, analyze, and present spatial or geographic data.
- The location data, along with all associated information, provide a foundation for mapping and analysis used in virtually every field.

What is GIS?

- With the advancement in technology, a GIS map is dynamic, means that the map can be modified in a very little time, and can be stored, displayed, and printed out quickly and efficiently.
- GIS is a new methodology in science and applications; it is a new profession and a new business.

What is GIS?

GIS refers to three integrated parts:

1. Geographic:

The geographical location of the real world (coordinate system)

2. Information:

The geo-based database, e.g., attributes and labels

3. Systems:

The hardware, software, or any kind of applications.

What is GIS?

[1/2] From Oxford Bibliographies (2017)...

- A GIS (Geographic Information System) is a computer- based tool that helps us visualize information with patterns and relationships that are not otherwise apparent.
- The ability to ask complex questions about data analyze many features at once and then instantly see the results on a map is what makes GIS a powerful tool for creating information.

What is GIS?

[2/2] From Oxford Bibliographies (2017)...

- GIS can be used in many disciplines, such as resource management, criminology, urban planning, marketing, and transportation.
- GIS is a useful tool for researchers and scientists, and it plays a vital role in scientific research, such as in environmental science, earth sciences, and other fields.

What Can a GIS Do?

- 1. Capture data:** You can add data from many sources to a GIS, and you can also create your own data from local directory. You will learn about getting data into a GIS.
- 2. Store data:** You can store and manage information about the real world in ways that make sense for your application. You will learn about organizing data.
- 3. Query data:** You can ask complex questions about features based on their attributes or their location and get quick results. You will gain experience with querying.

What Can a GIS Do?

- 4. Analyze data:** You can integrate multiple datasets to find features that meet specific criteria and create information useful for problem solving.
- 5. Display data:** You can display features based on their attributes, a powerful feature you will come to appreciate. You will learn how to symbolize features in different ways.
- 6. Present data:** You can create and distribute high-quality maps, graphs, and reports to present your analysis results in a compelling way to your audience. You will learn how to create a report and how to design an effective map.

GIS Infrastructure (5 Key Components)

- **Hardware:** The machine where the GIS can be run (computer, digitizer, plotter, printer).
- **Software:** The program needed to run the GIS (ArcGIS and its extensions)
- **Data:** The digital and database (information)
- **Organization & People:** This is the most important part of the GIS structure. GIS is too important and so costly that it cannot be considered just equipment. **It requires organization and staff to utilize this technology.**

GIS Principles

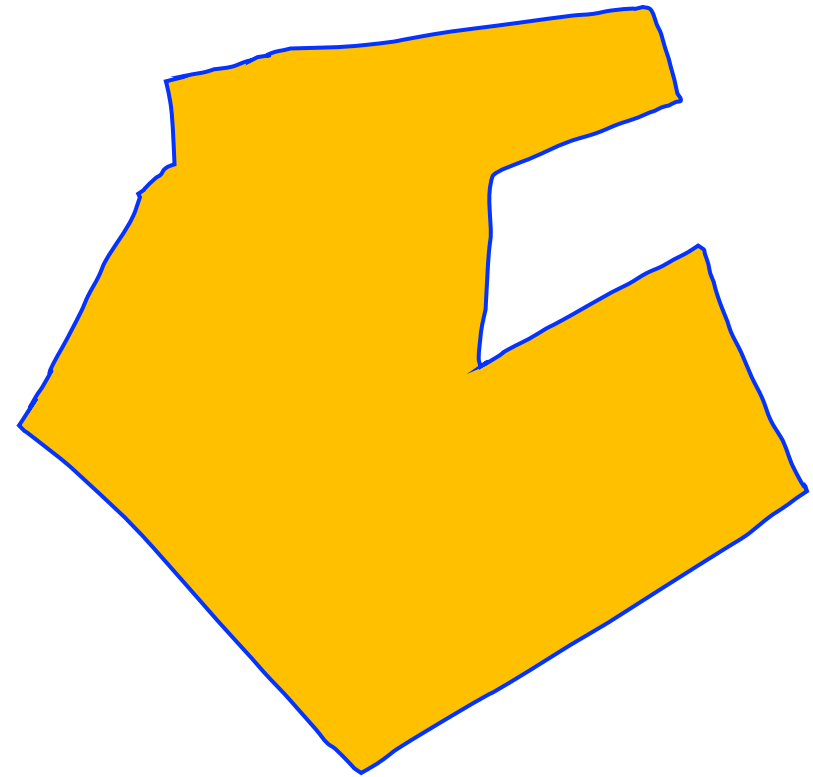
- The computer is an unavoidable technology in our time (**But...**). We are living in the digital age, which has become an important element in nearly all professions.
- Computer training in most scientific disciplines is essential.
- GIS is an inevitable technology that will be used in all scientific fields. GIS has become the accepted and standard means of using spatial data.

GIS Principles

- GIS is more accurate, flexible, object efficient, and rapid fun than the traditional method of spatial data inventory.
- GIS is replacing traditional cartography. Much of the traditional “pen & ink” cartography performed by skilled drafts persons and artists is being replaced by GIS.
- GIS is opening new horizons. New modes of analysis and applications are constantly being discovered.

GIS File Elements

- Basically, the geographic datasets could be classified into two types: vector data and raster data.
- All of them have at least three elements: coordination system, georeferencing, and shape.
- Usually, these datasets have several information as shown in attribute table.



Types of GIS

- **Conventional GIS software:**

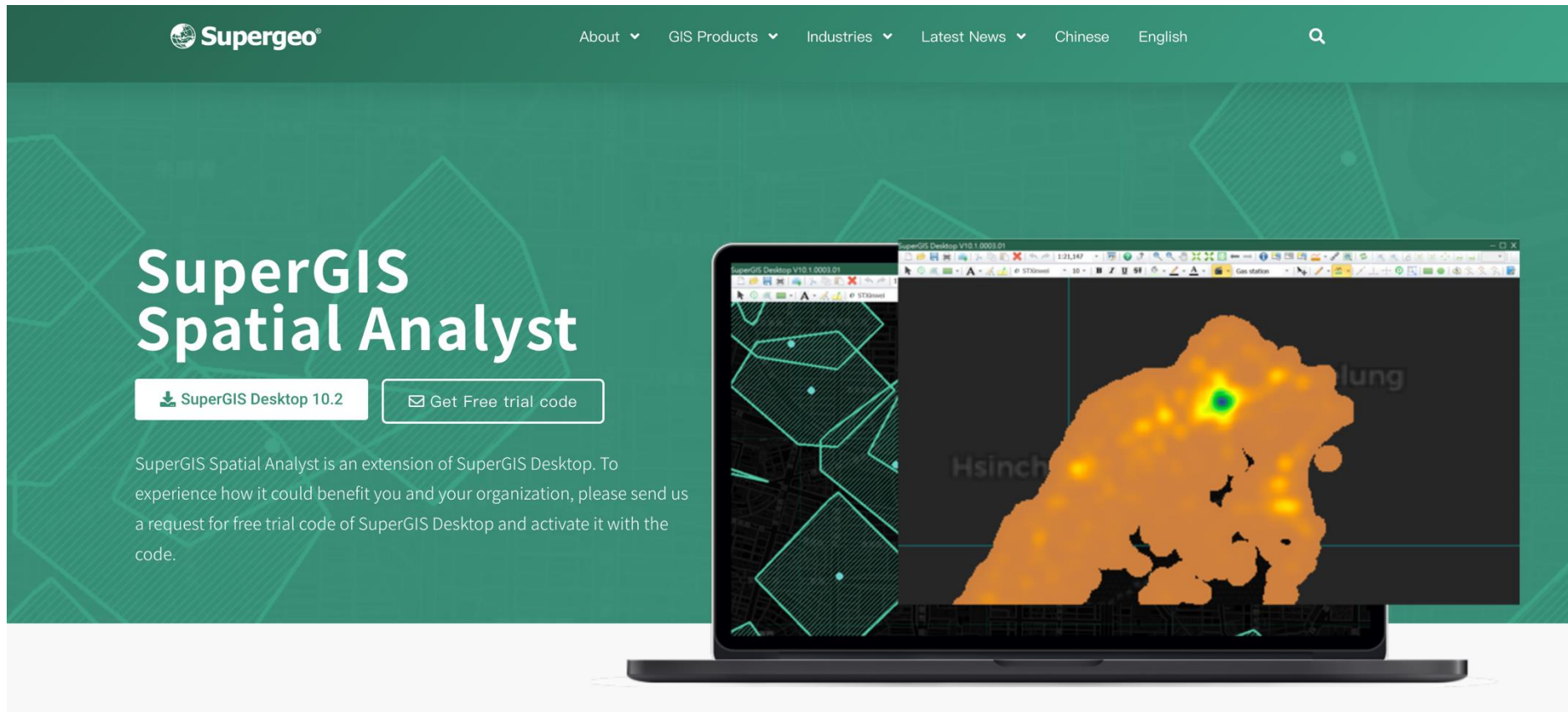
As abovementioned, the conventional GIS usually refers to a system or software to store, analyze, and illustrate map data and geo-information.

- **Web GIS:**

Story map, website-like web dashboard ...
See the following examples...

Types of GIS – Conventional

- Taiwan version – SuperGIS



Types of GIS – Conventional

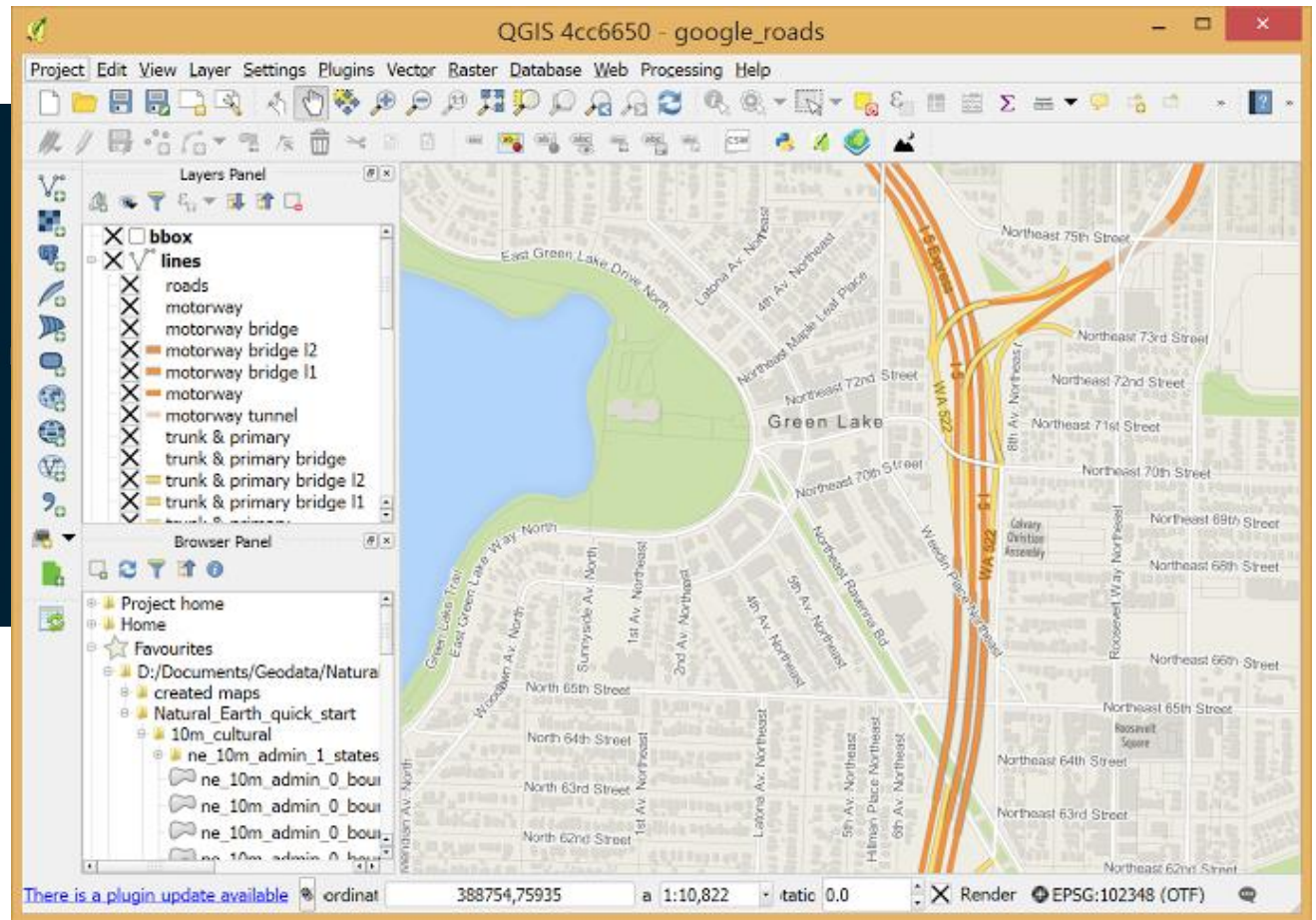
- Quantum GIS

Free and open source

QGIS overview

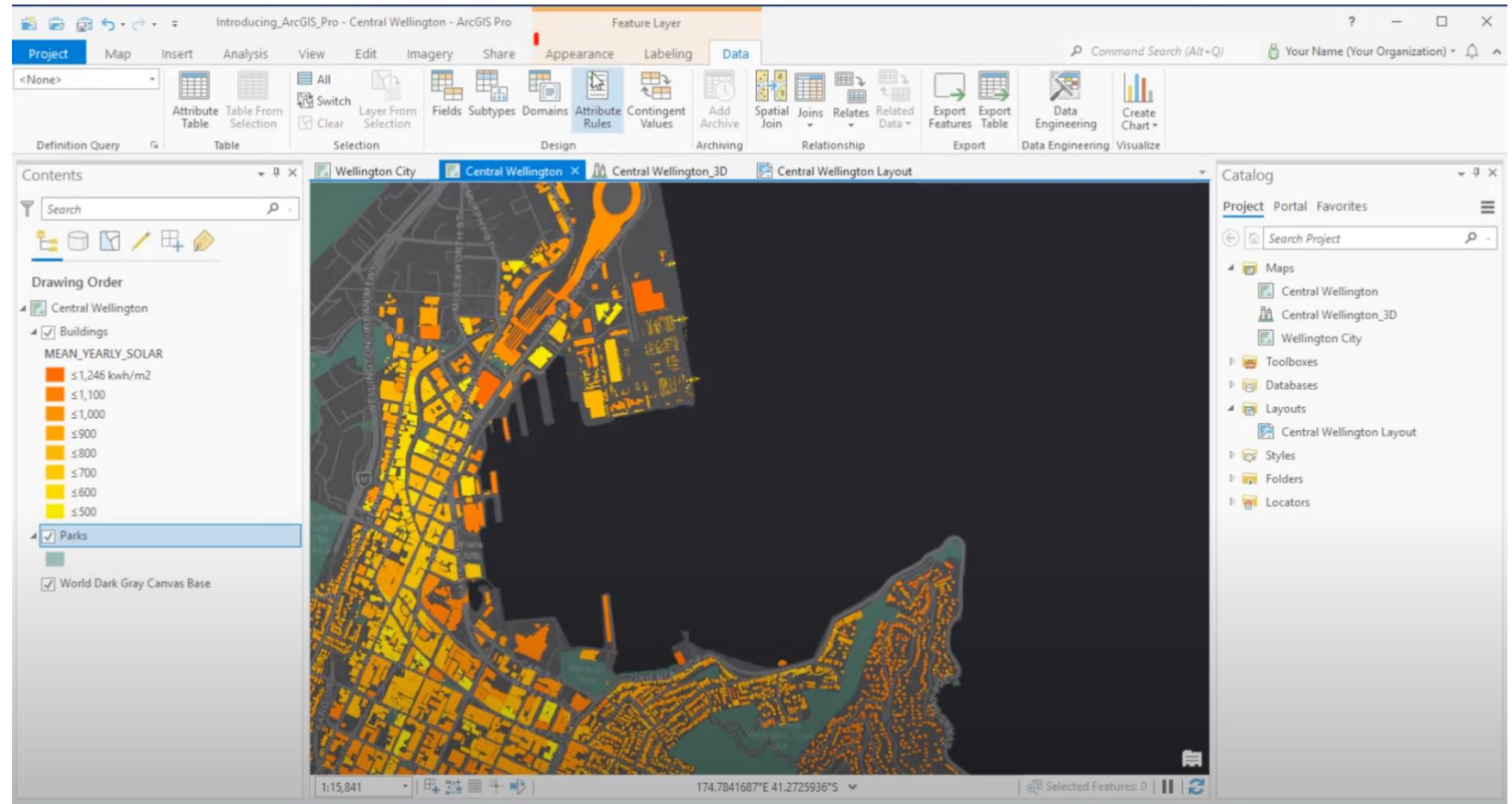
Giving the power of spatial visualization and decision everyone

[Download](#) Available on Windows, Mac, Linux



Types of GIS – Conventional

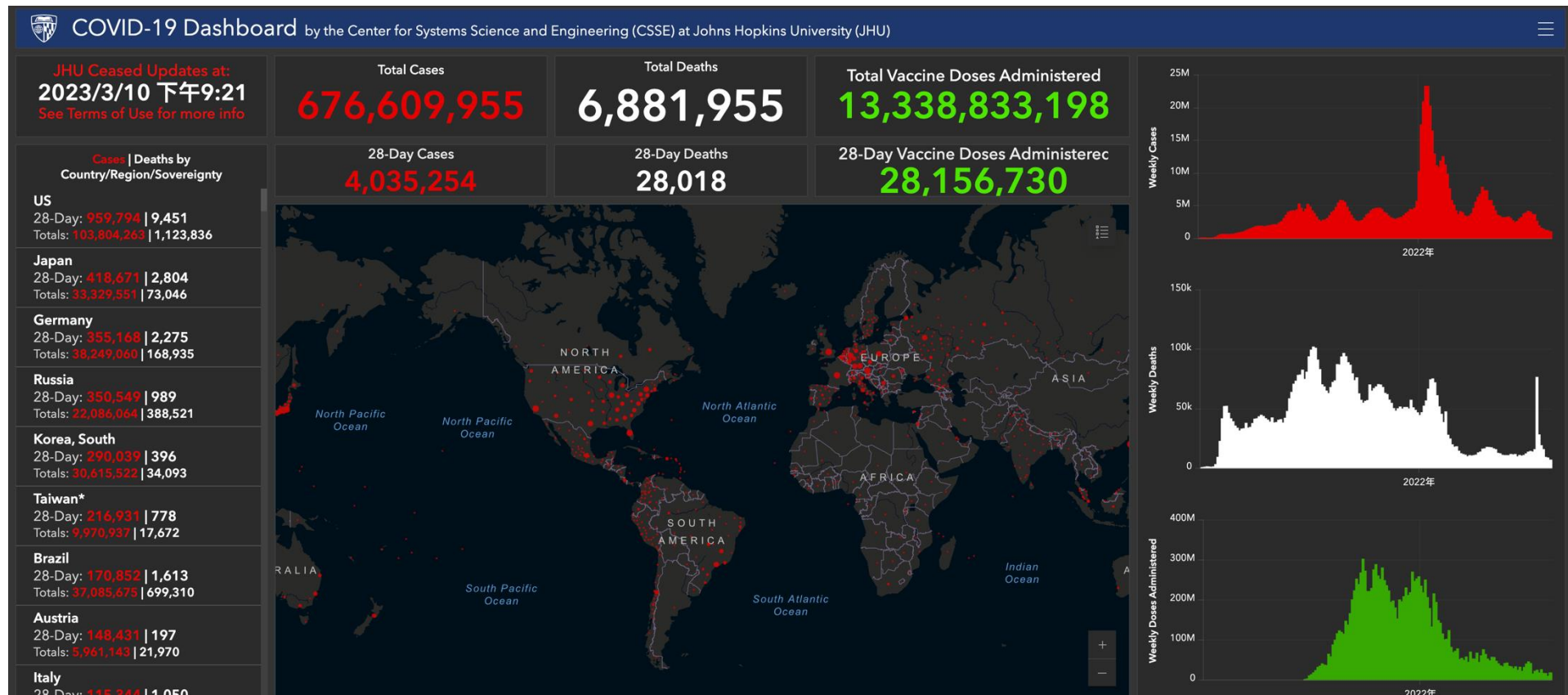
- ArcGIS Pro



Source: https://www.youtube.com/watch?v=1YhdQToyPg4&ab_channel=ArcGIS

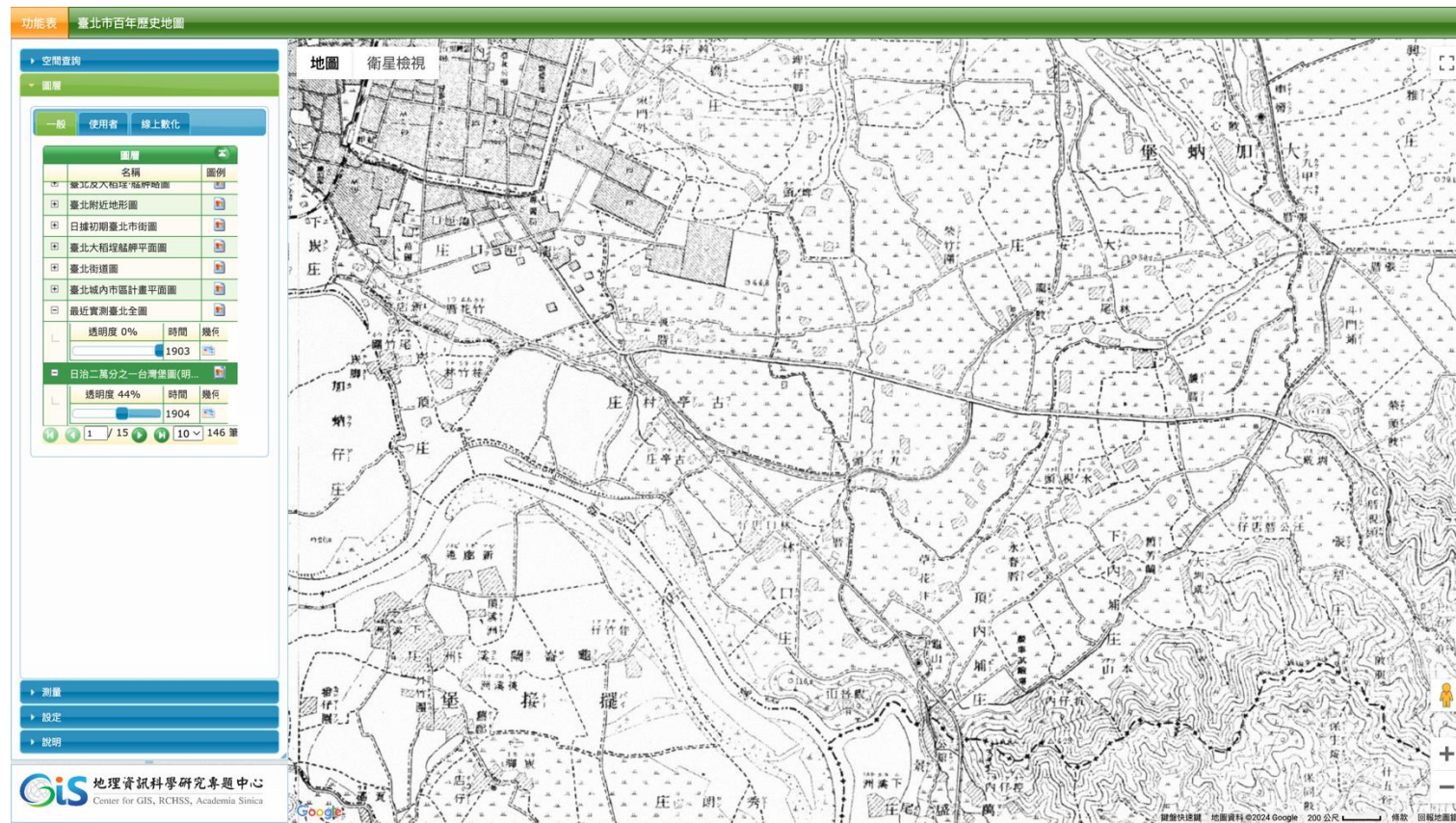
Types of GIS – Web GIS

- COVID dashboard
- <https://coronavirus.jhu.edu/map.html>



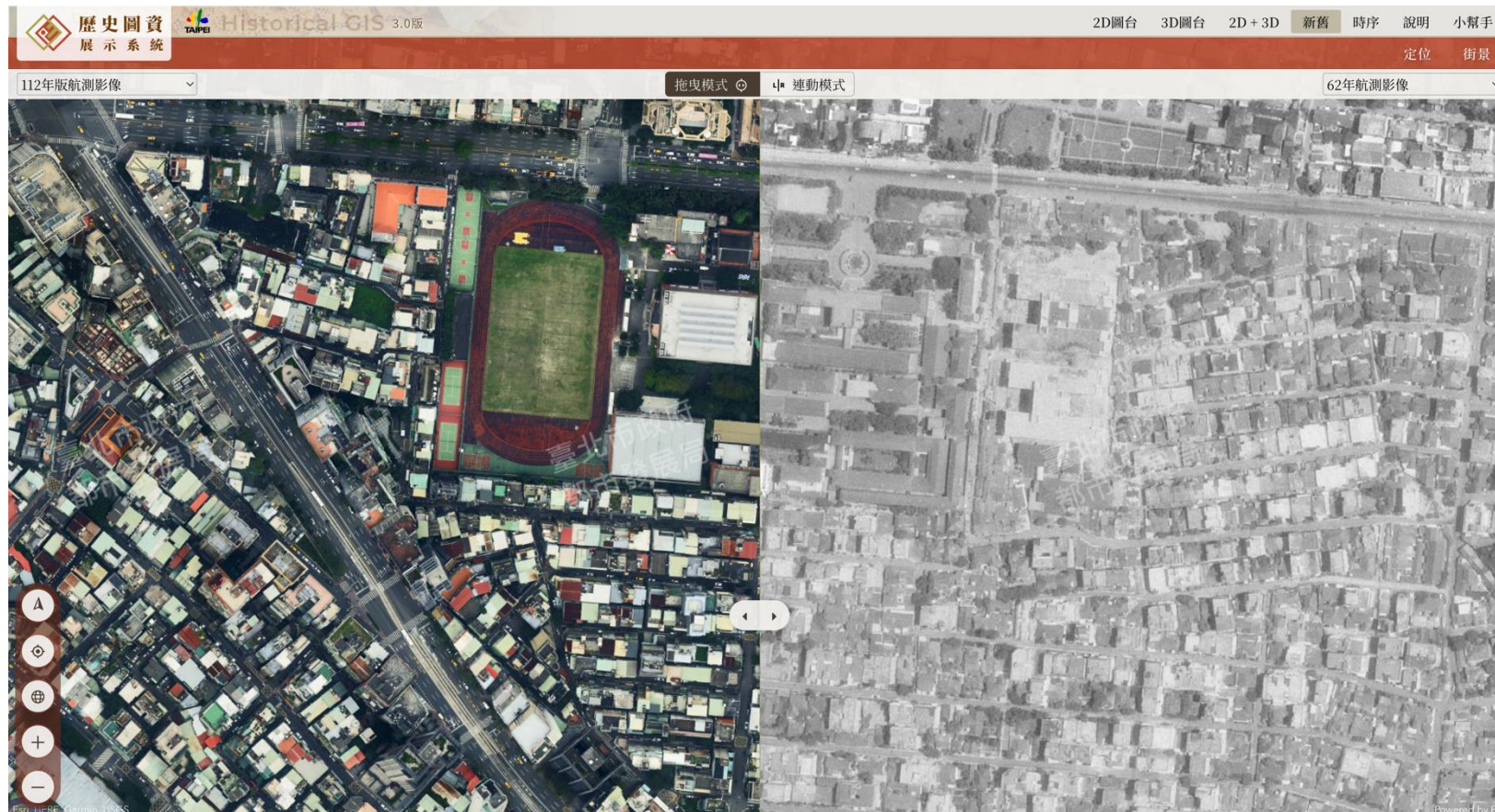
Types of GIS – Web GIS

- 臺灣百年歷史地圖
- <https://gissrv4.sinica.edu.tw/gis/twhgis/>



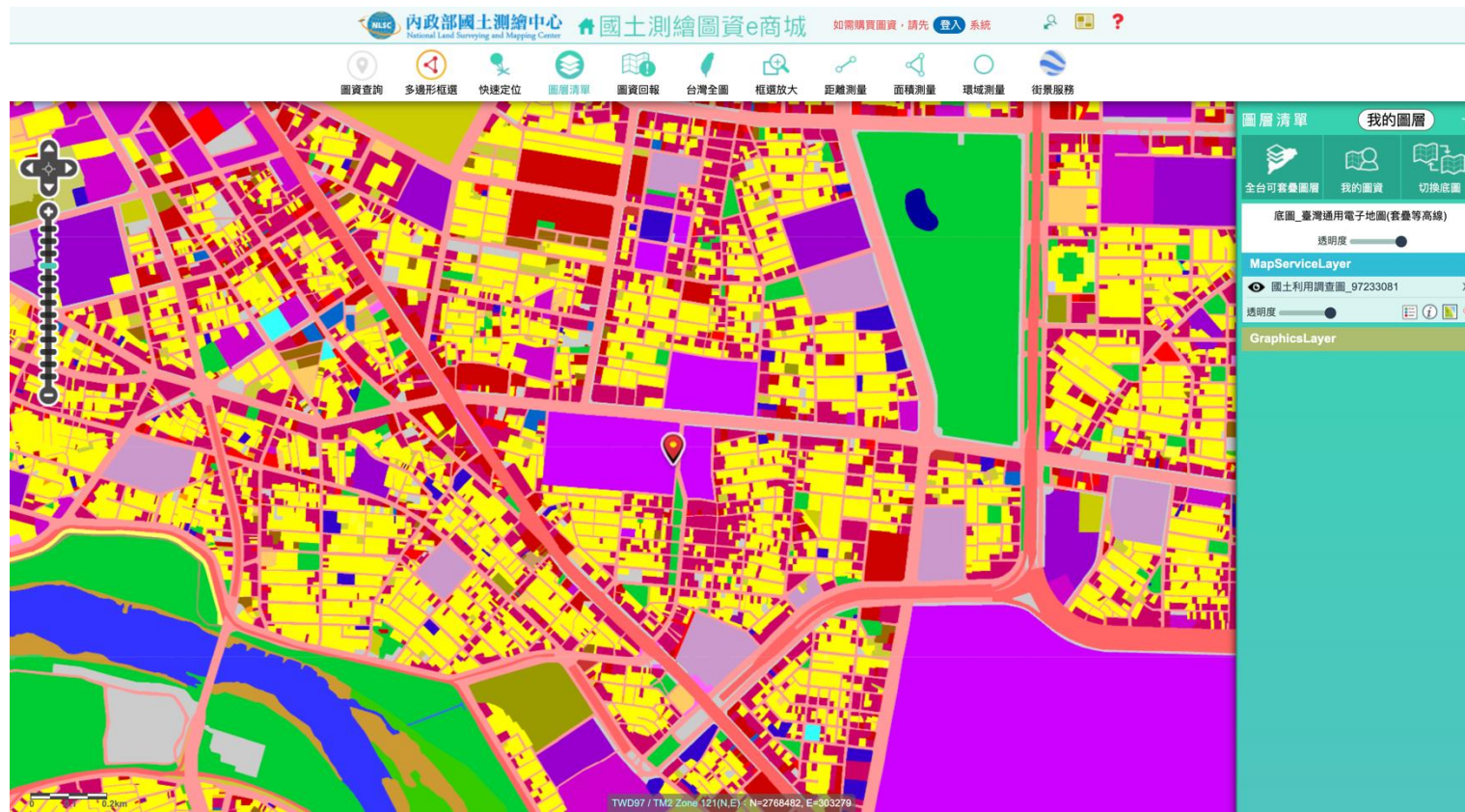
Types of GIS – Web GIS

- 台北市歷史地圖 <https://www.historygis.udd.gov.taipei/urban/>



Types of GIS – Web GIS

- 國土利用現況調查
- <https://whgis-nlsc.moi.gov.tw/GisMap/NLSCGisMap.aspx>



Simple Lab Practice

- Please use the above-mentioned web GIS platforms to observe the historical changes in the location of NTNU's main campus.
- You may make a screenshot to record the changes and highlight the critical timestamps that exist in significant constructions.

Download Geo-Datasets

- 政府資料開放平臺 <https://data.gov.tw/>



資料集服務分類



Download Geo-Datasets

- 內政部社會經濟資料服務平台
- <https://segis.moi.gov.tw/STATCloud/QueryInterface>



SEGIS 社會經濟資料服務平台

關於平台 ▾ 資料集 ▾ 應用服務 ▾ 推動成果 ▾ 登入

資料集查詢下載

查詢條件

類別：

空間範圍：

資料時間： 不限 今年 近三年 年度範圍

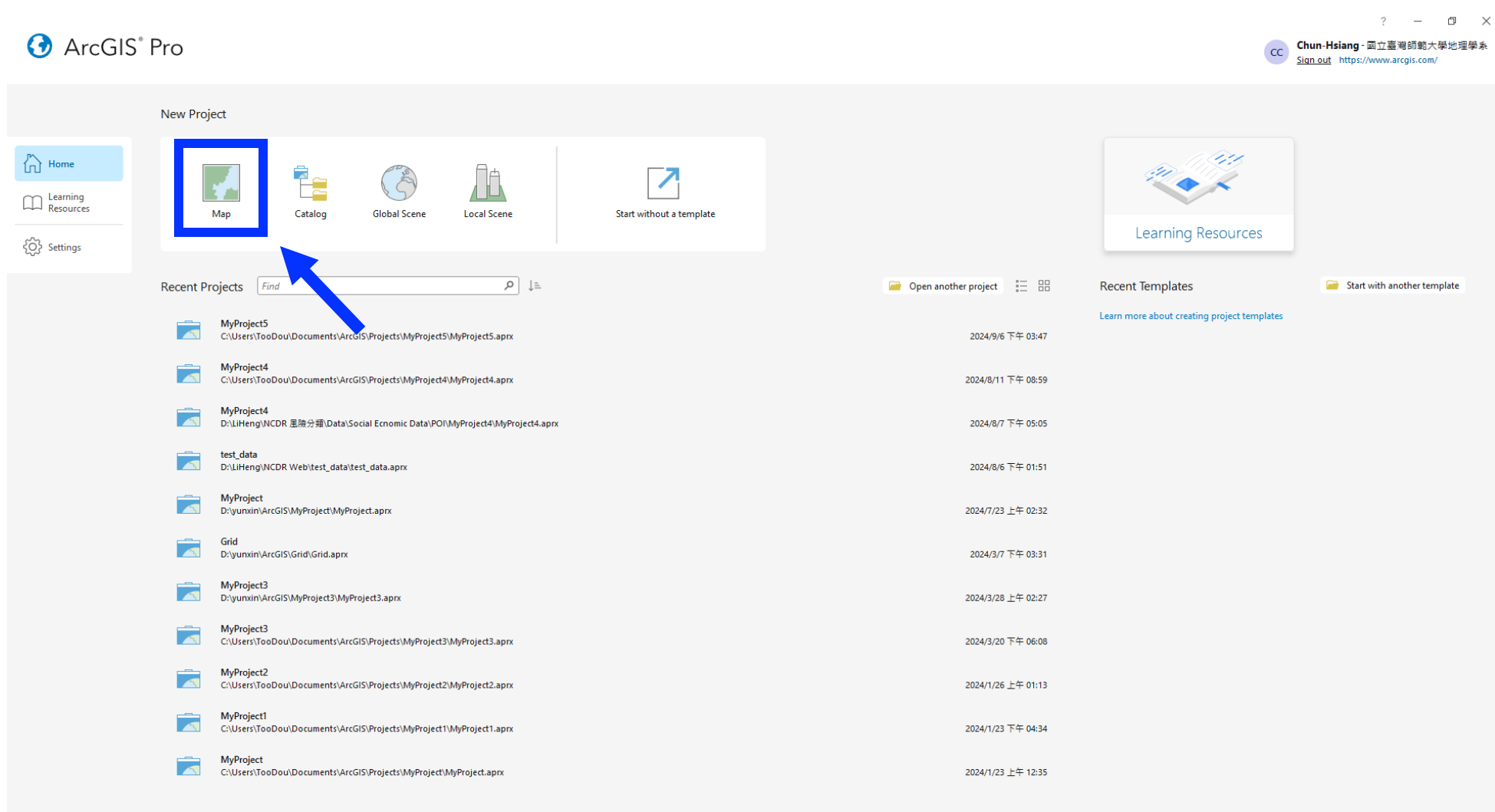
空間統計單元：

開放程度： 開放資料 須申請資料

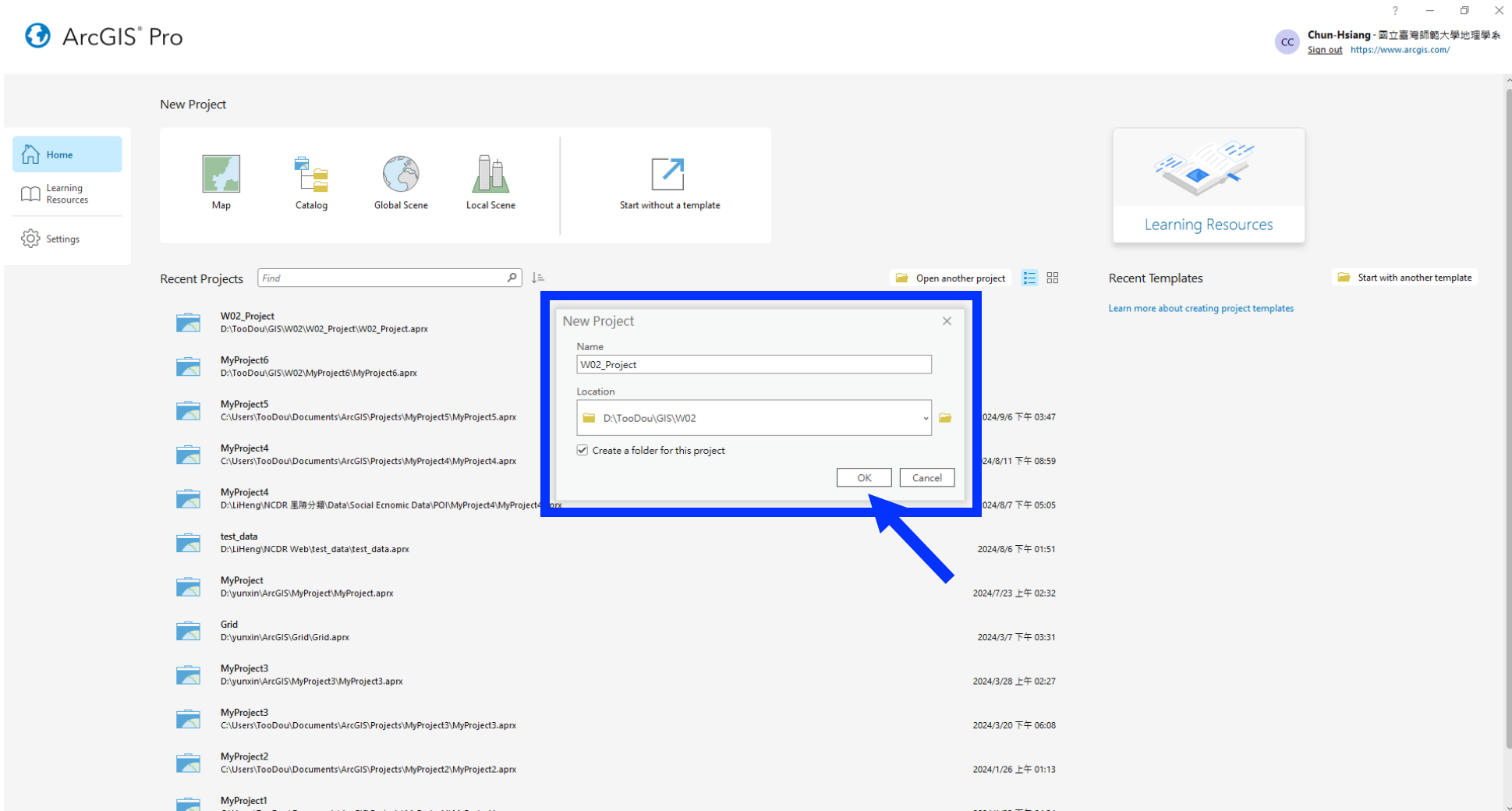
關鍵字：

查詢

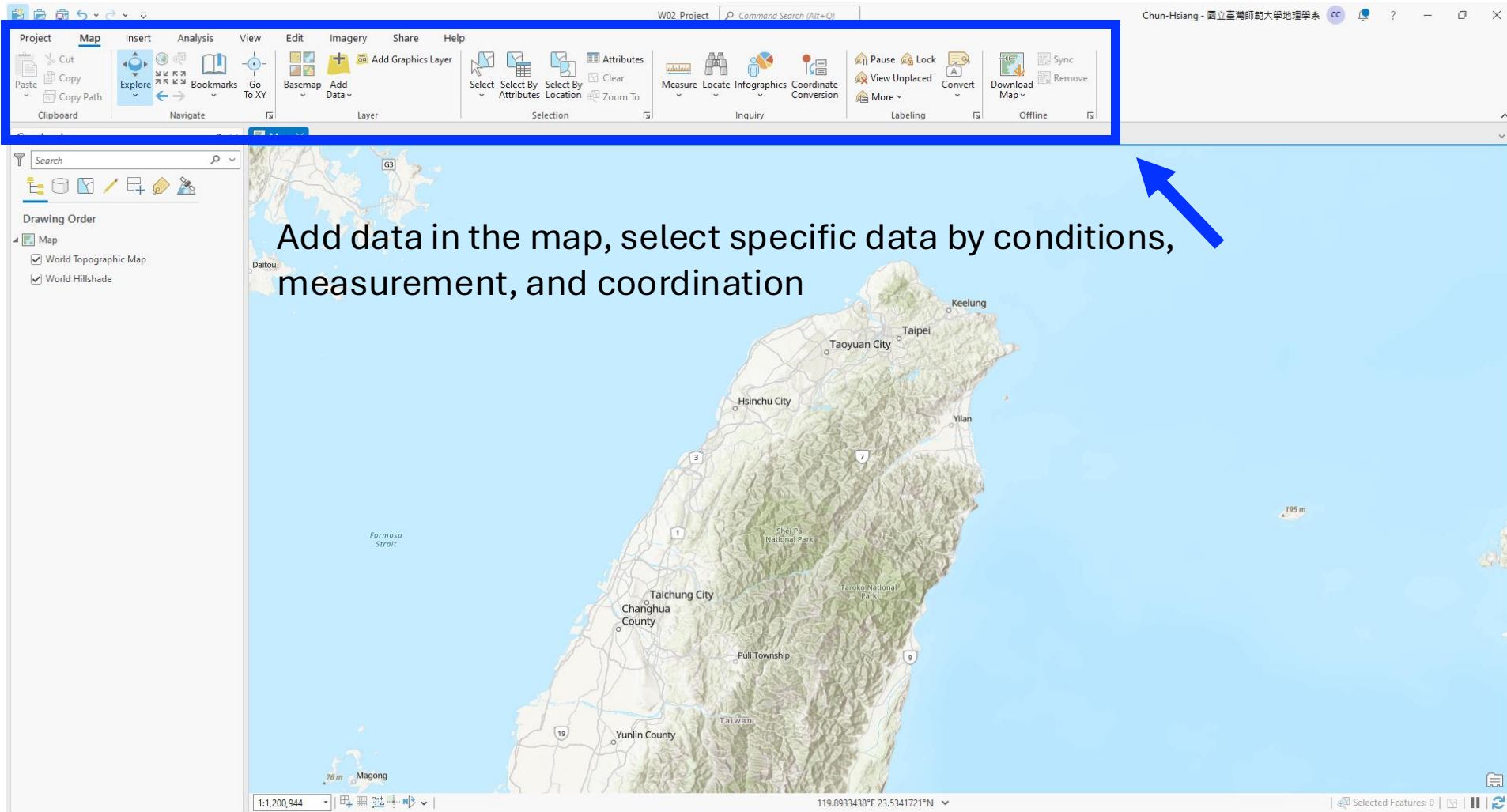
An overview of ArcGIS Pro



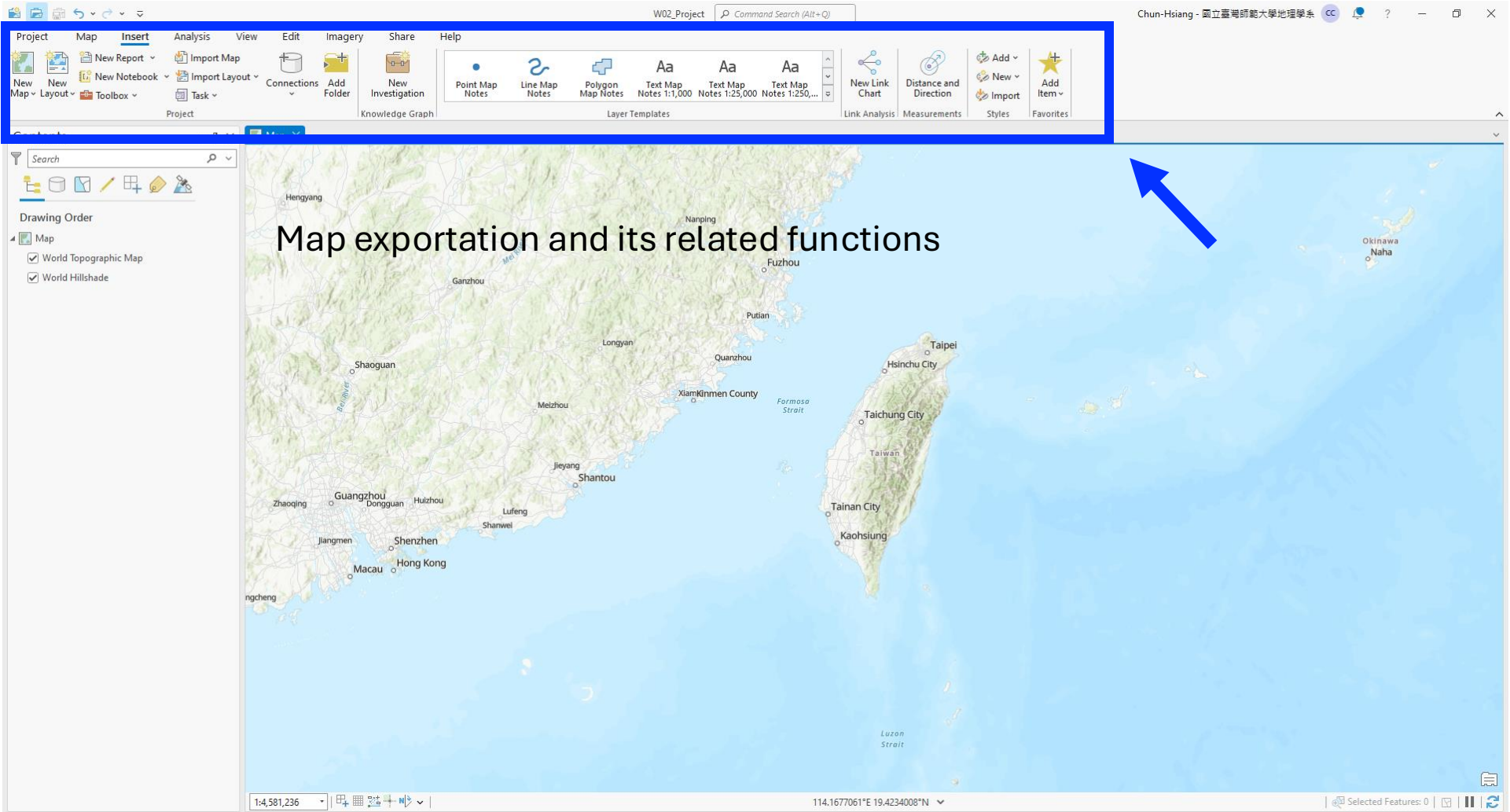
An overview of ArcGIS Pro



An overview of ArcGIS Pro

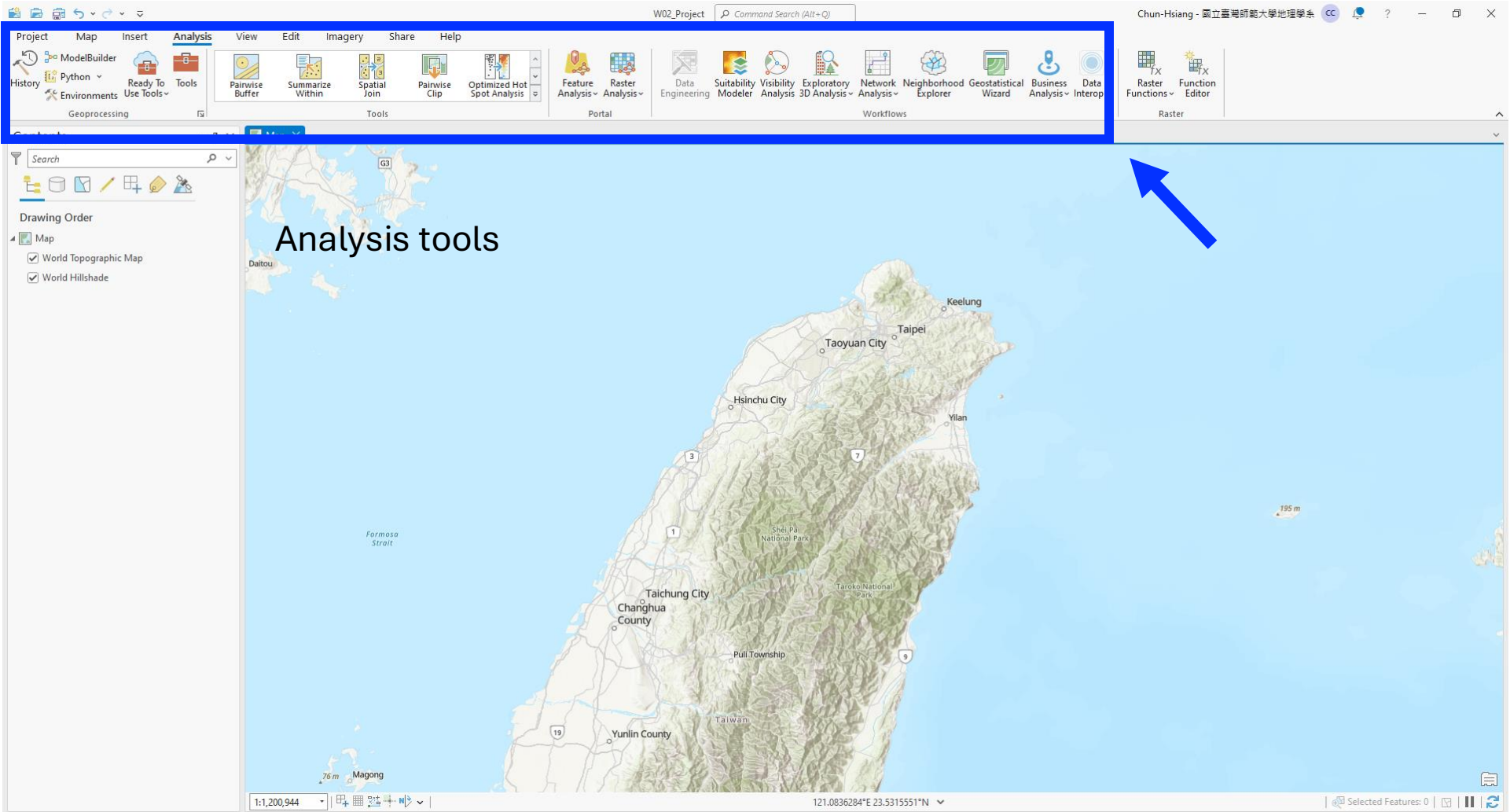


An overview of ArcGIS Pro

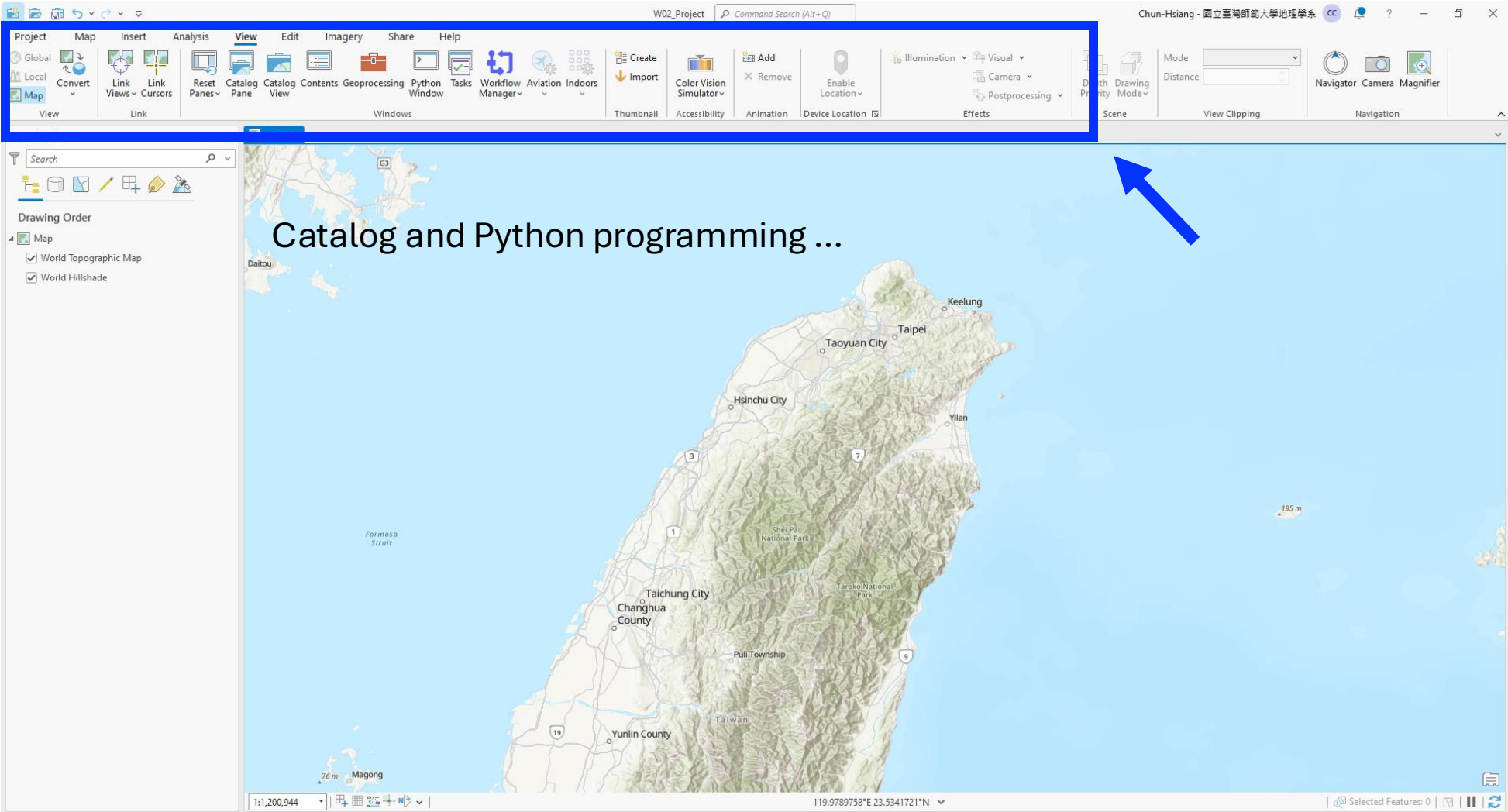


Map exportation and its related functions

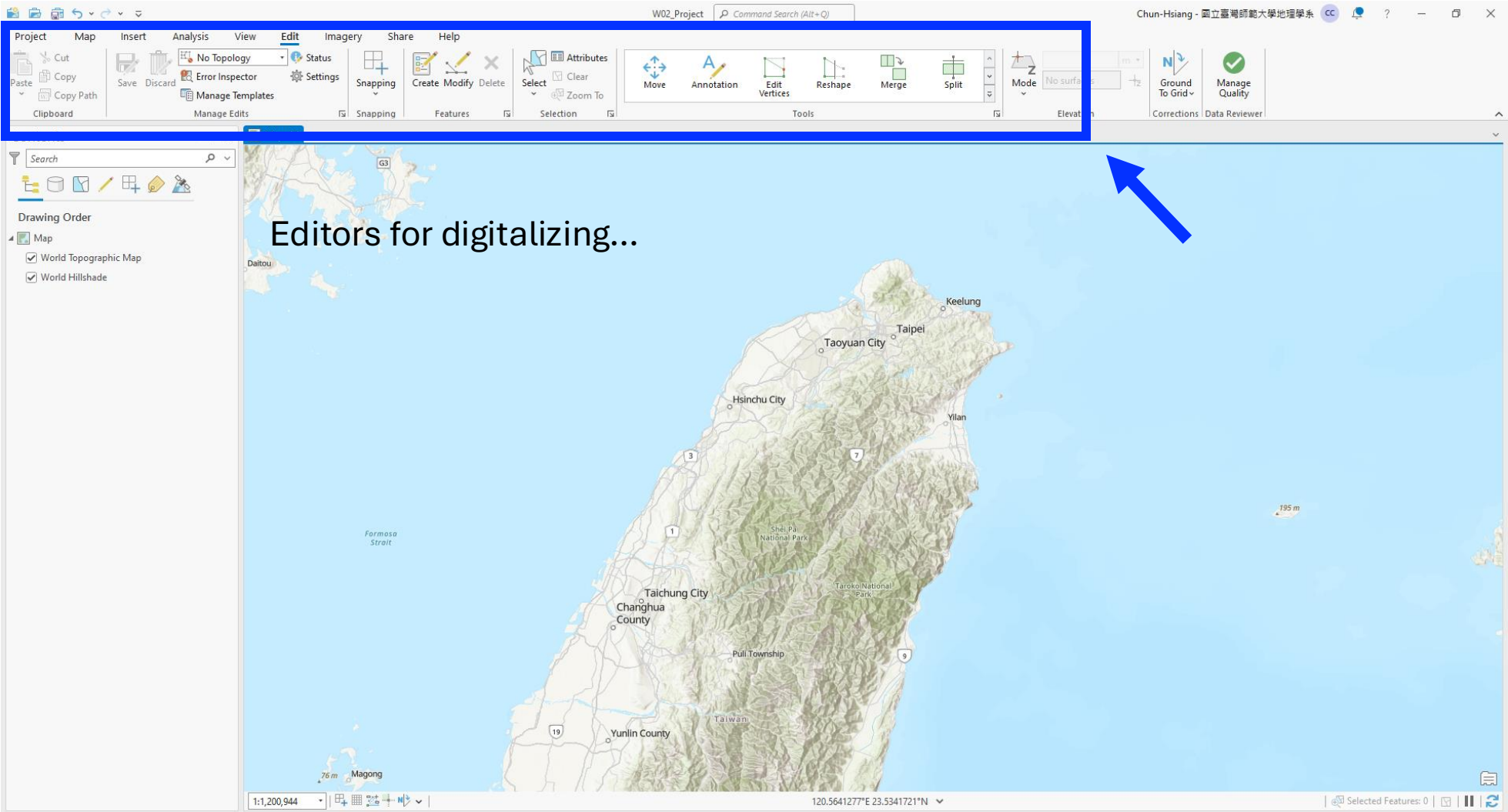
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An overview of ArcGIS Pro

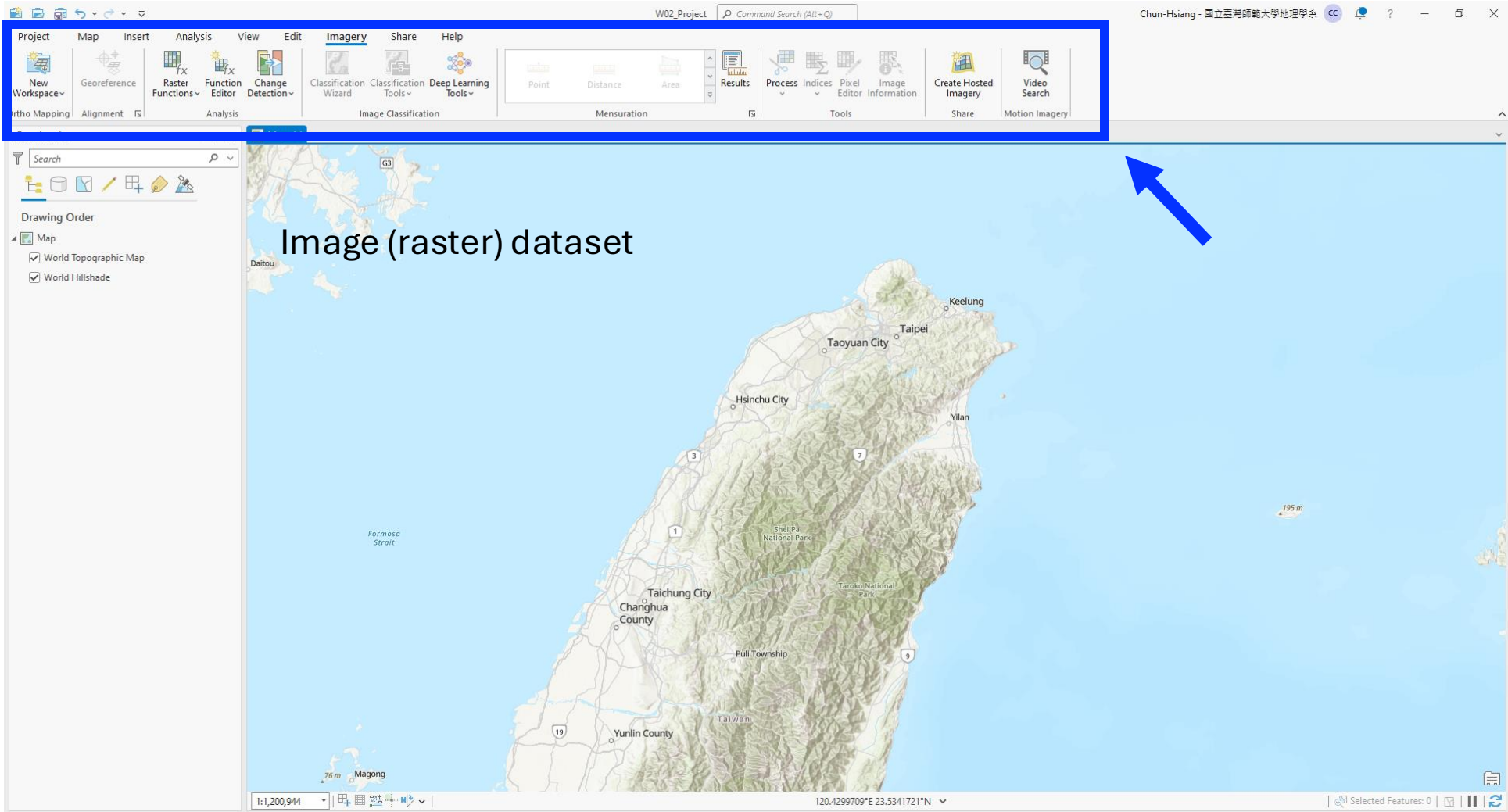


An overview of ArcGIS Pro

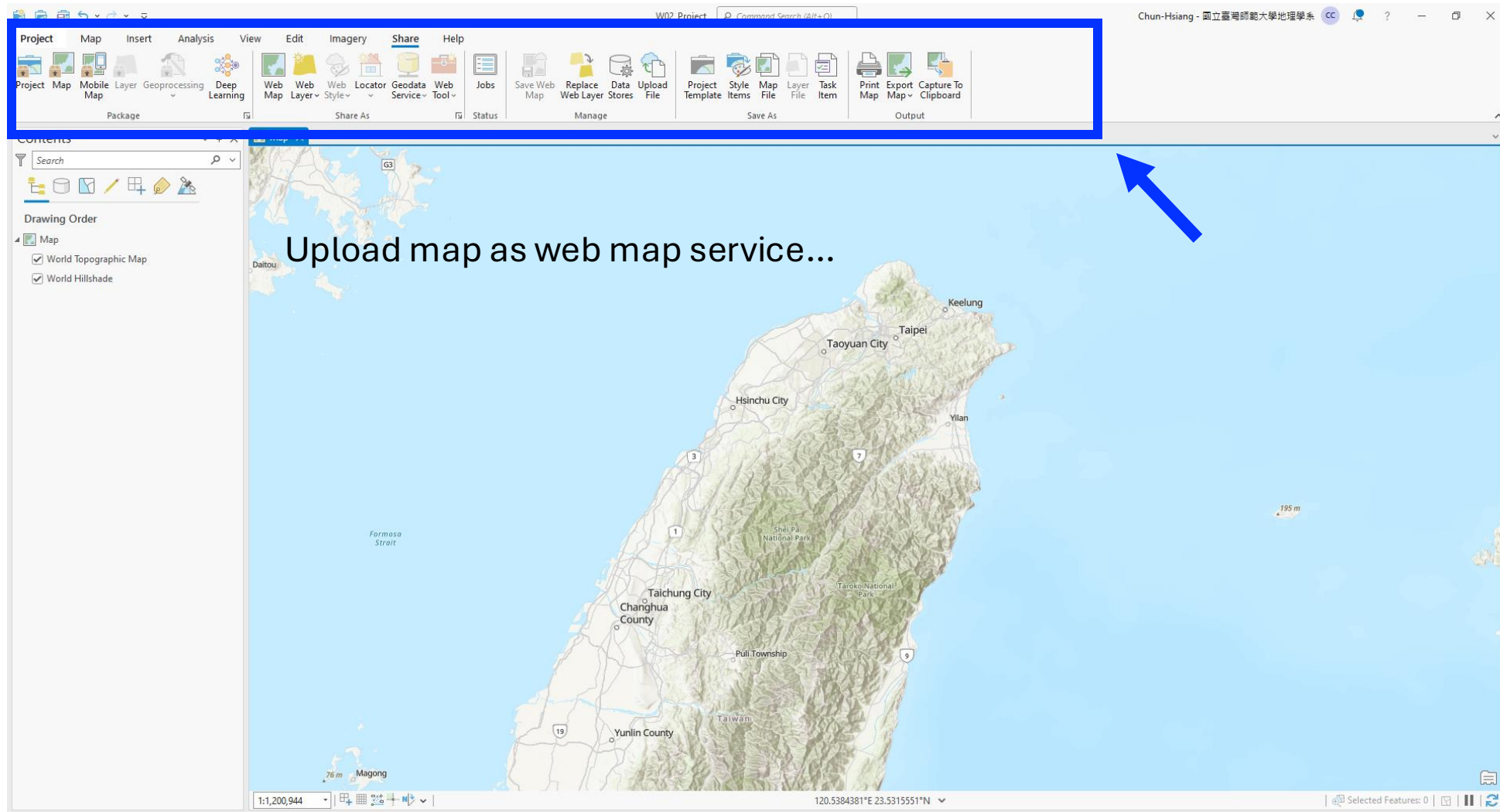


Editors for digitalizing...

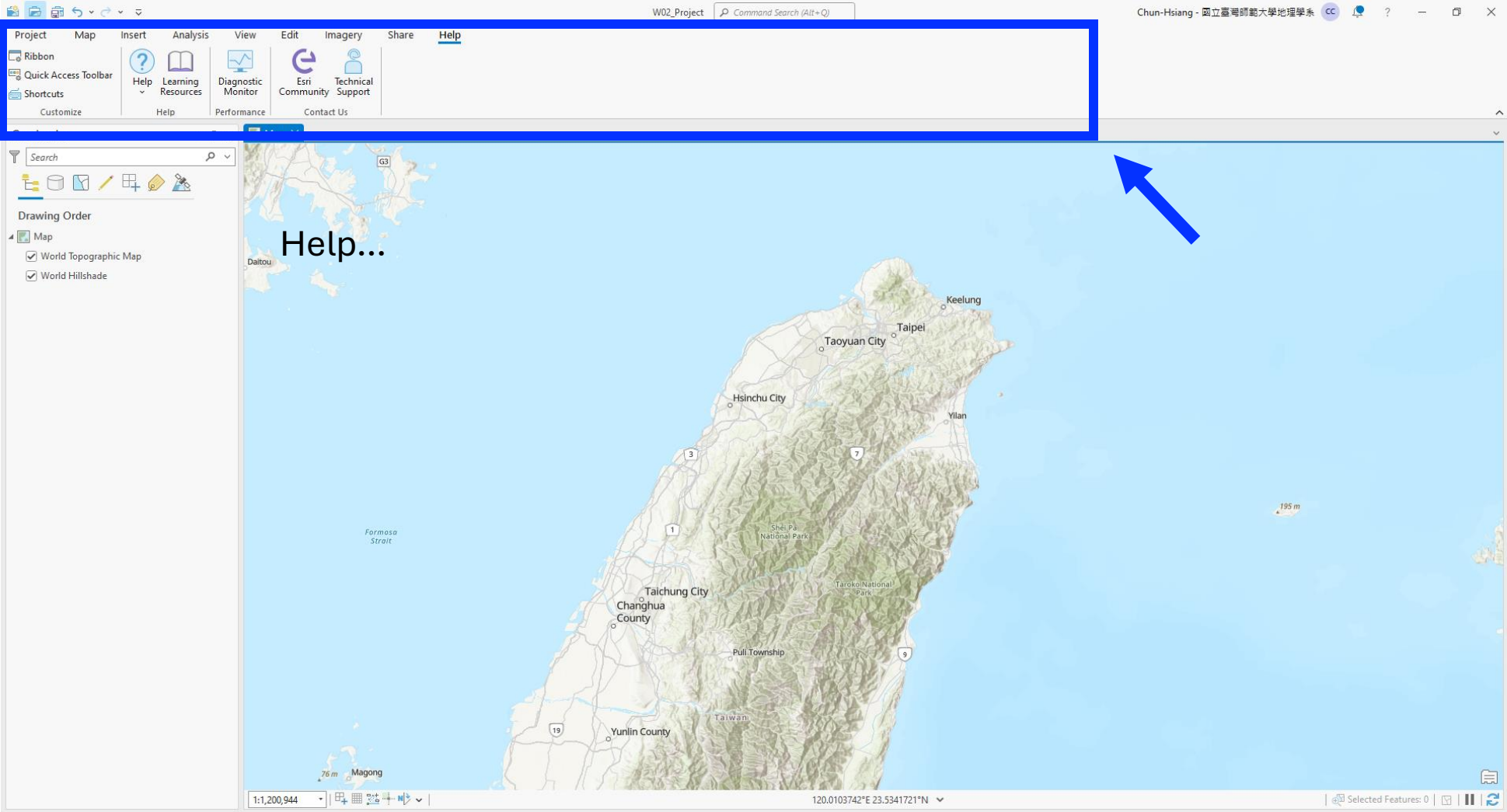
An overview of ArcGIS Pro



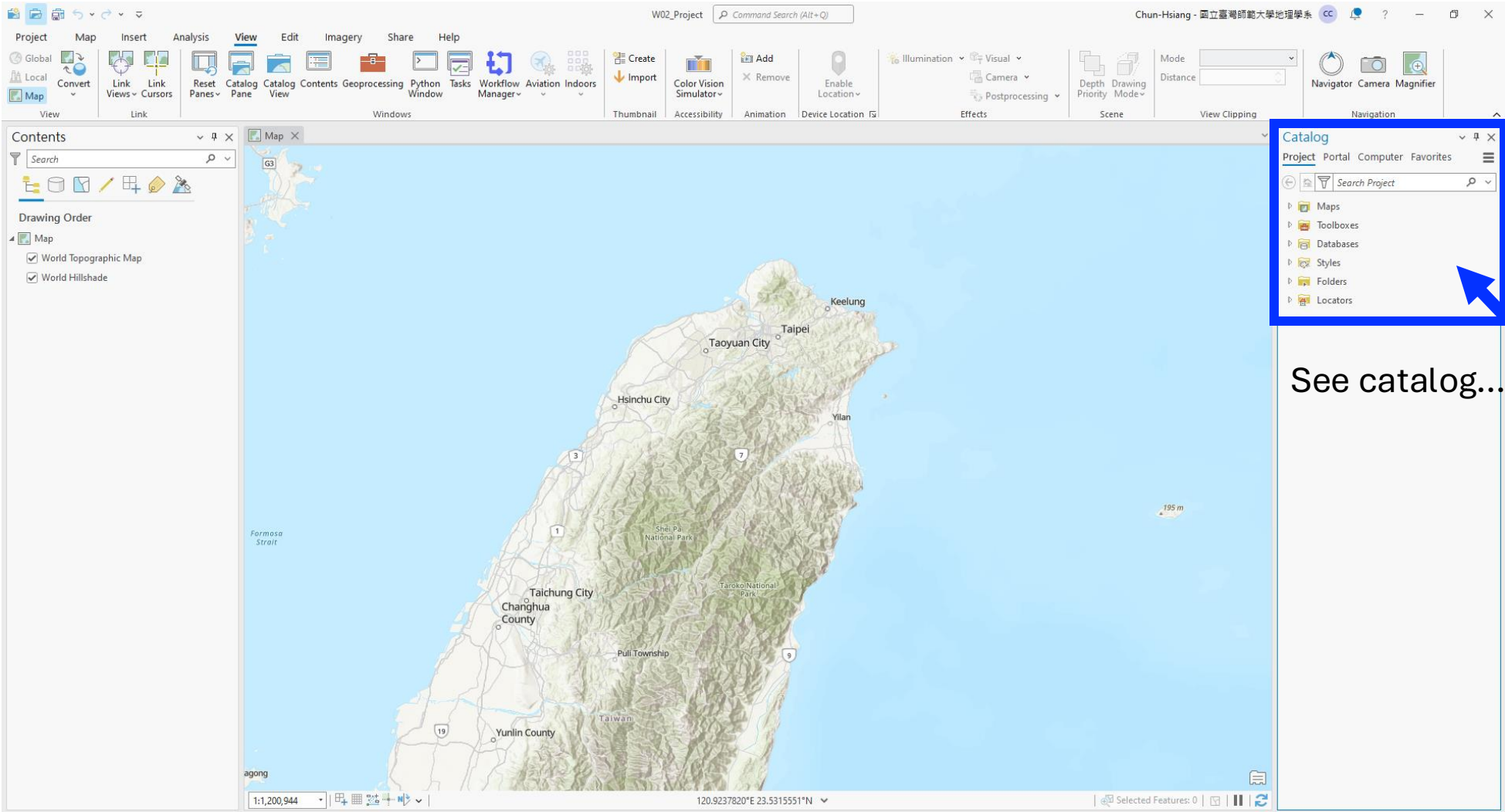
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An overview of ArcGIS Pro

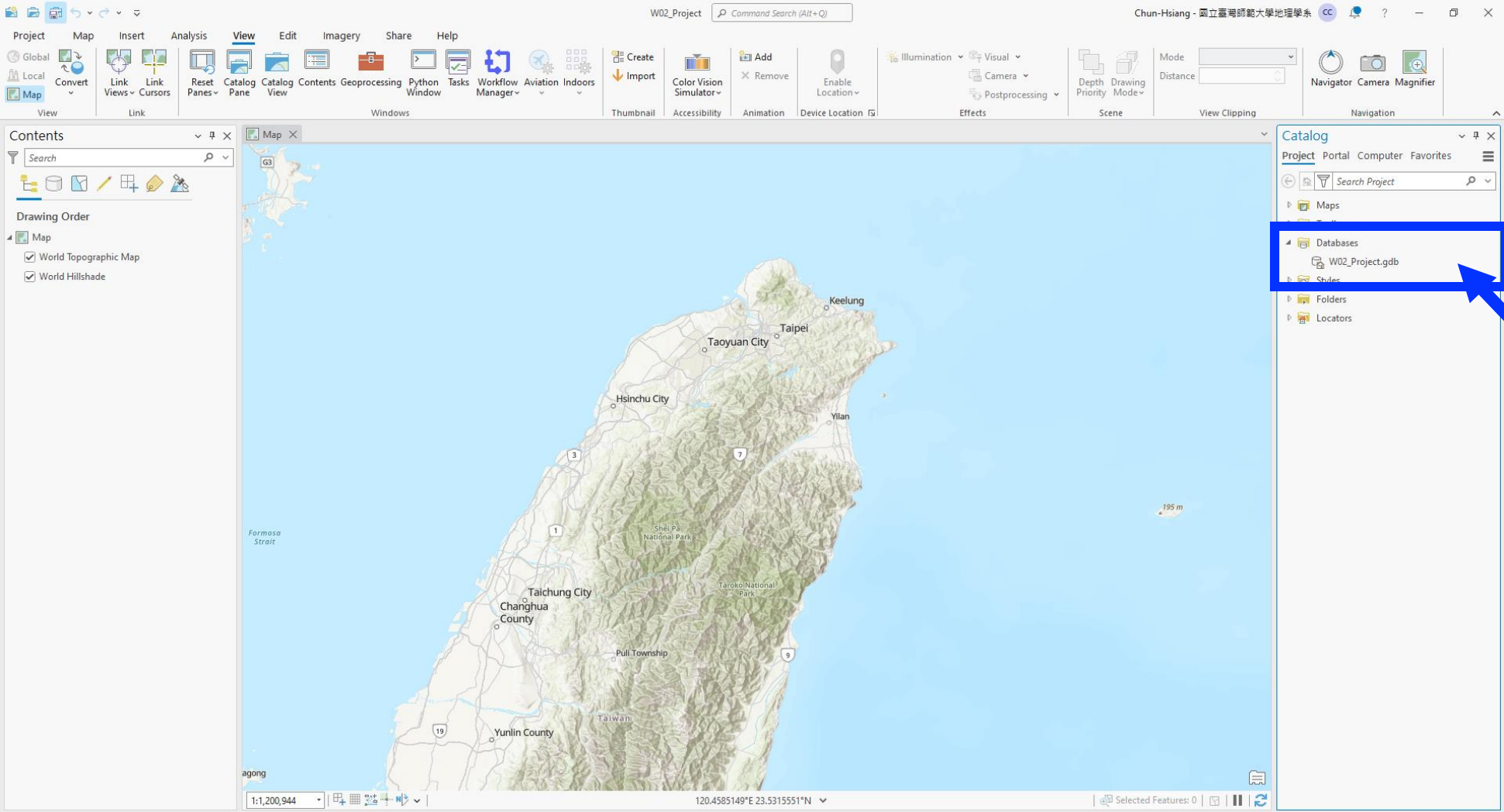


An overview of ArcGIS Pro

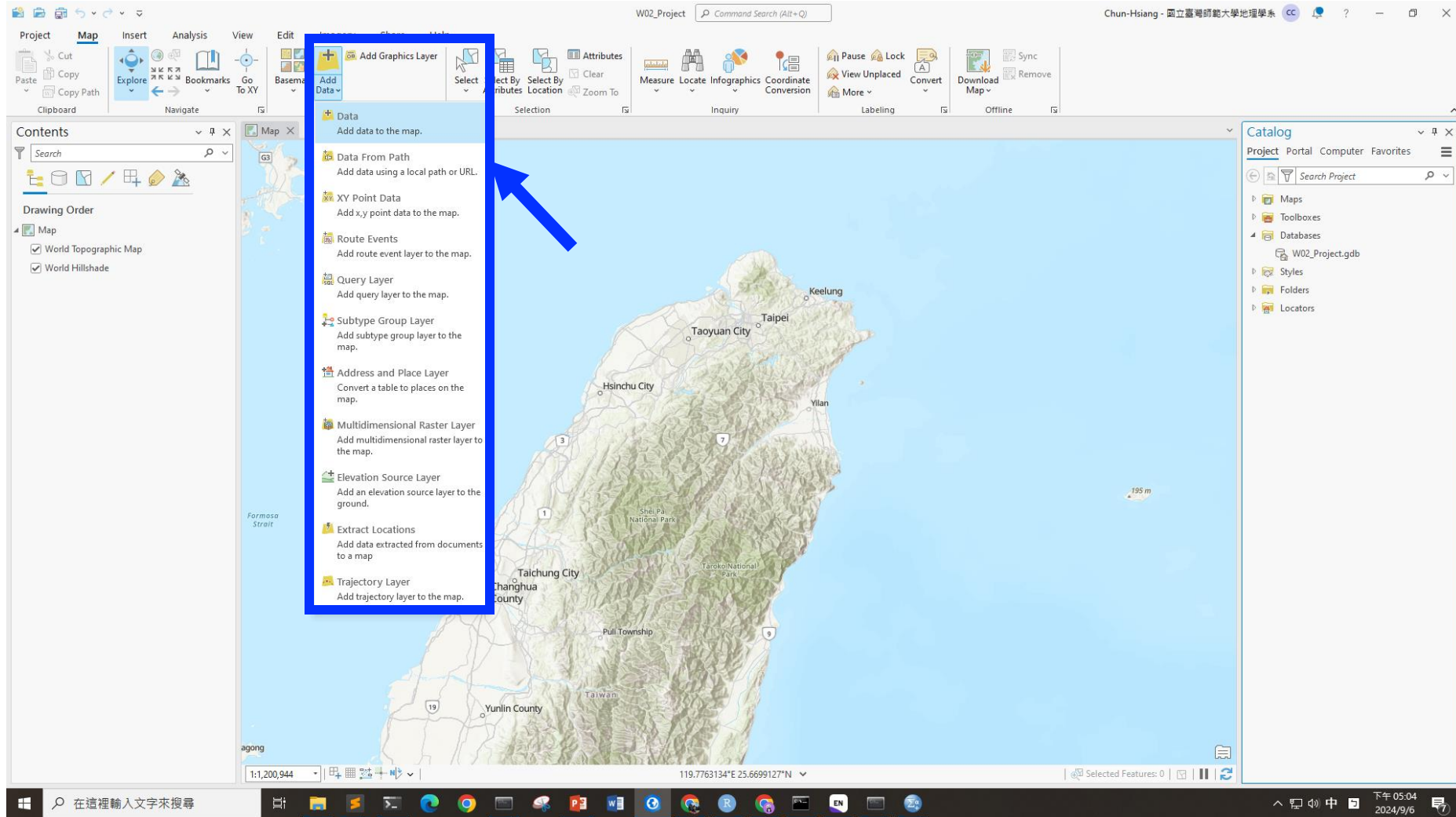


See catalog...

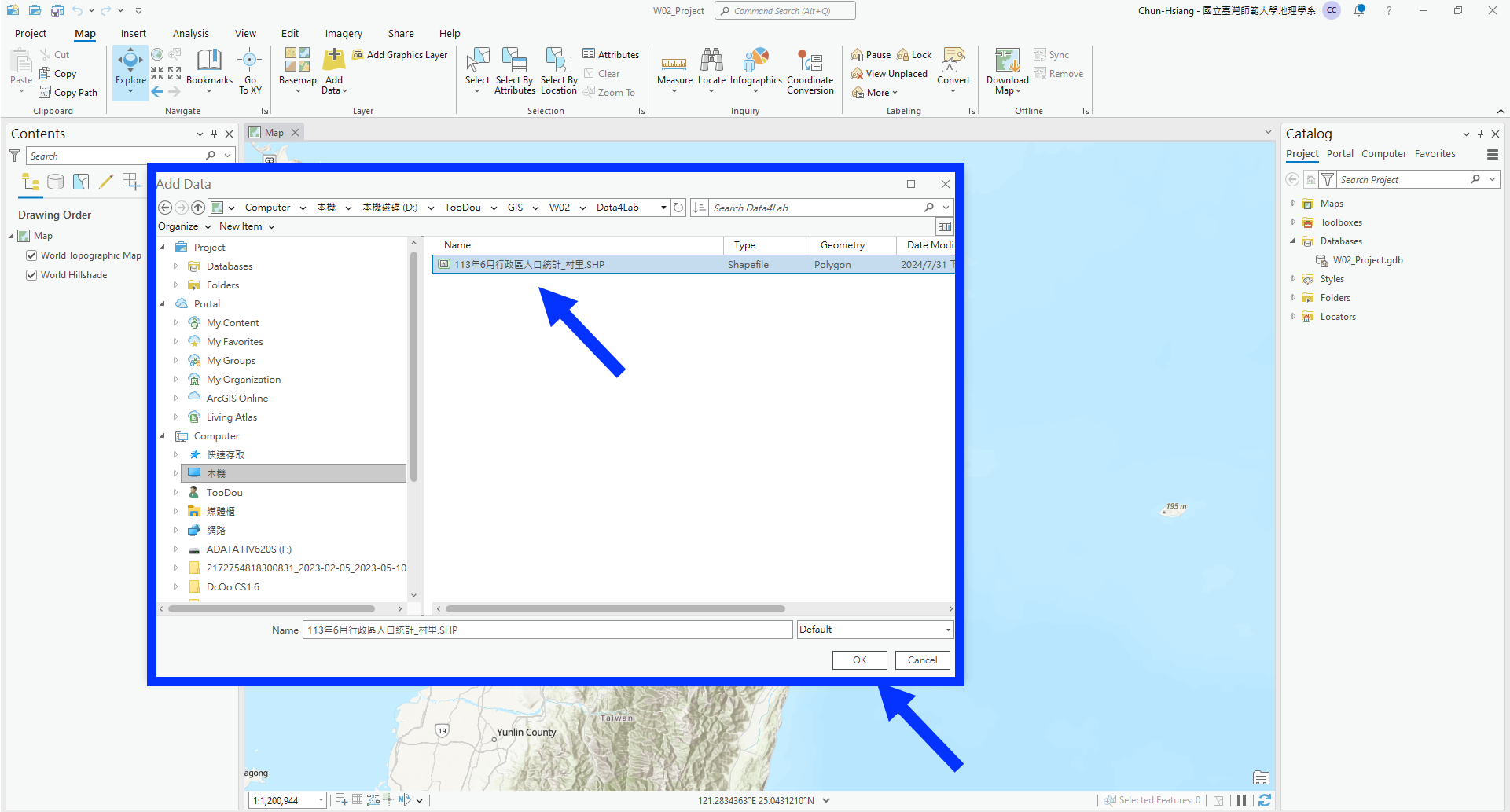
An overview of ArcGIS Pro



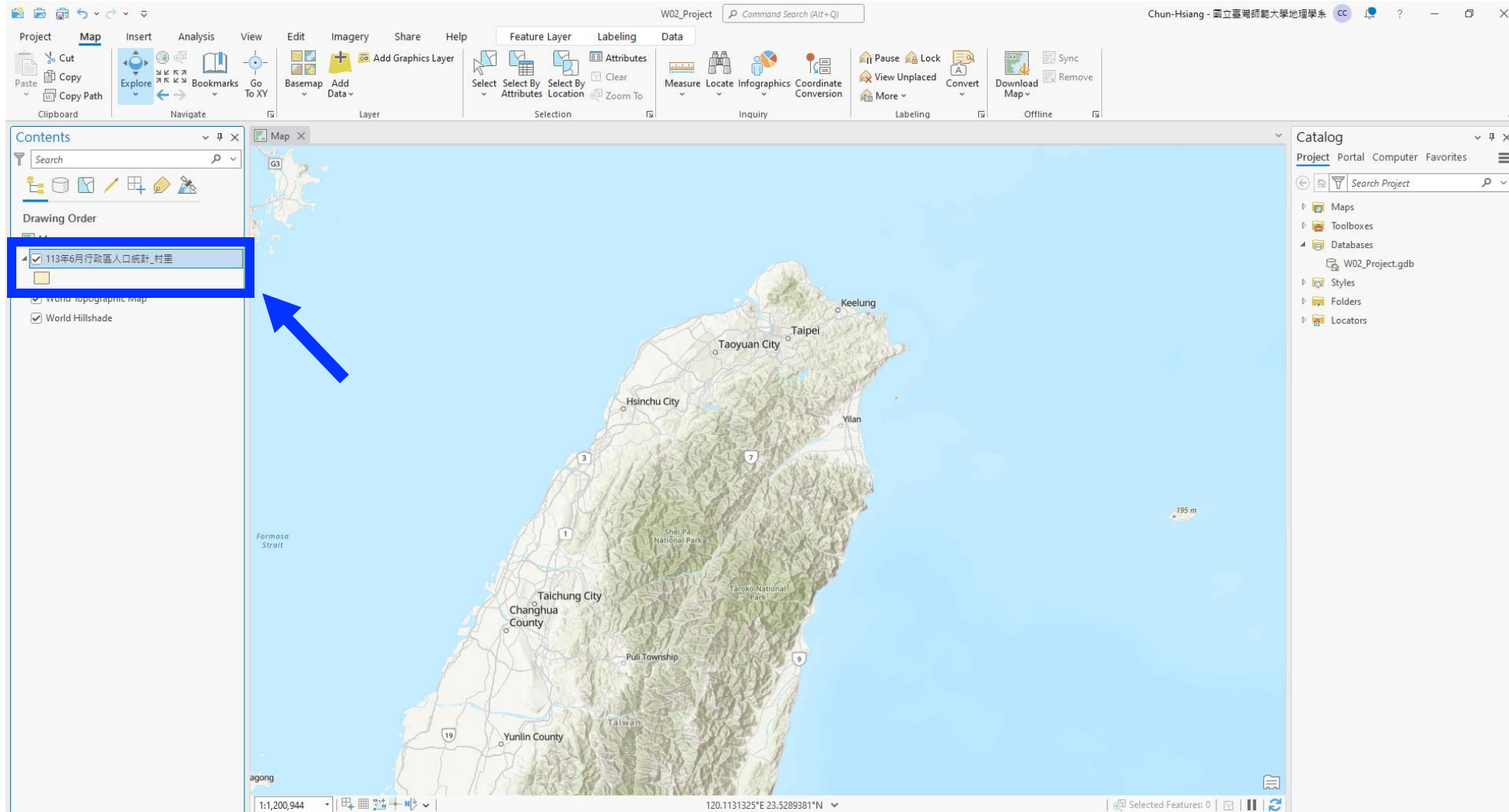
An overview of ArcGIS Pro



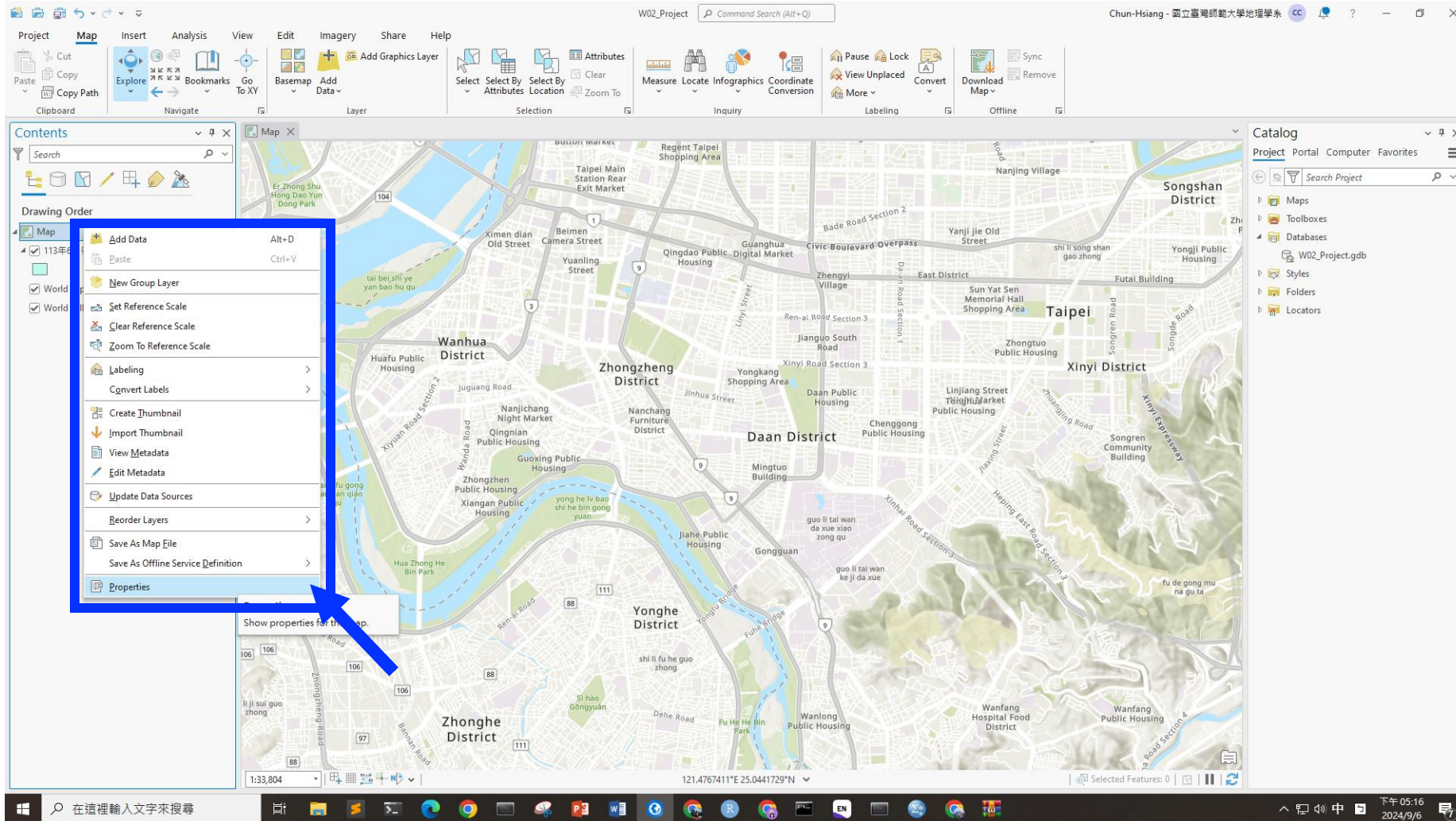
An overview of ArcGIS Pro



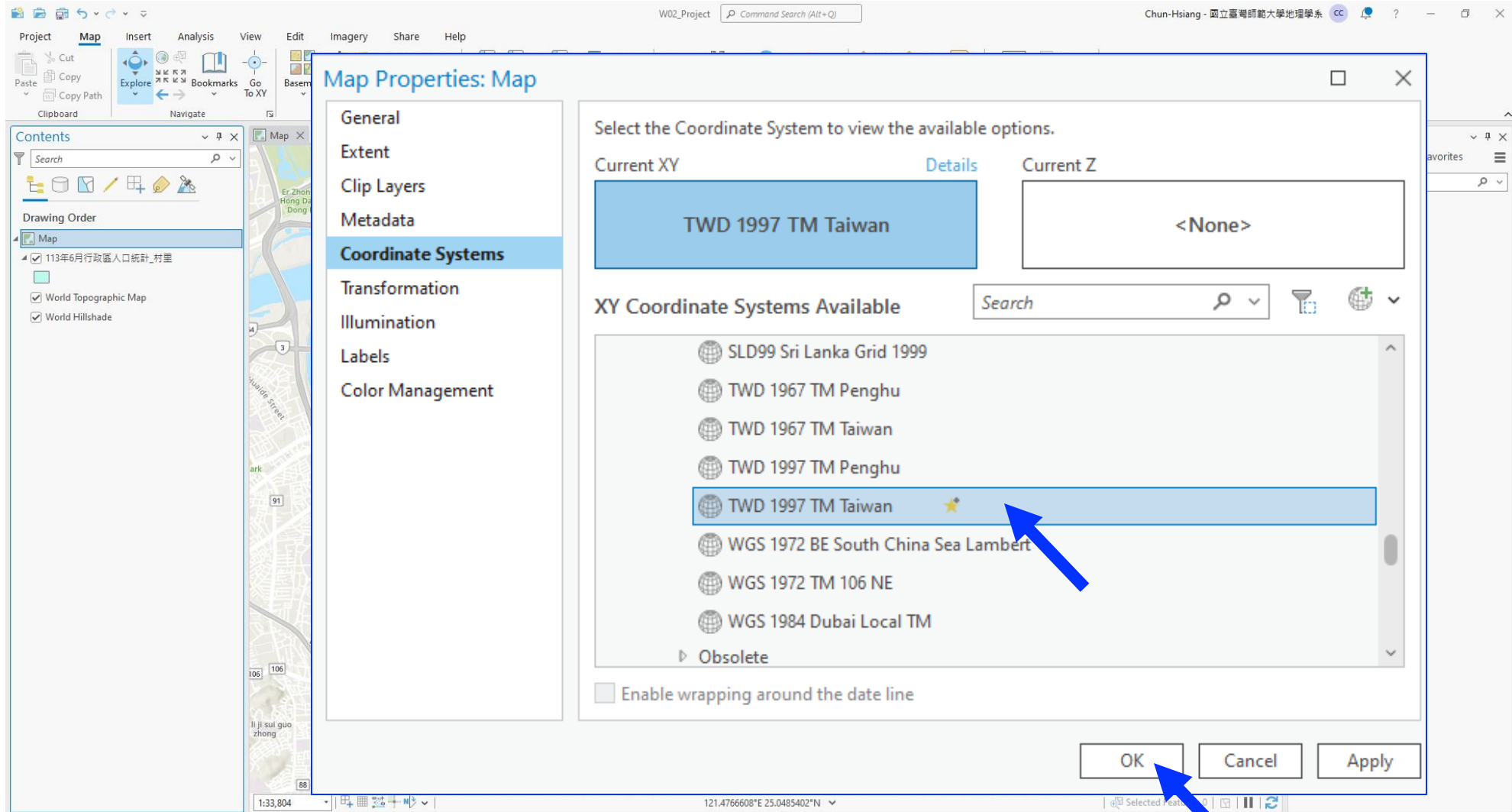
An overview of ArcGIS Pro



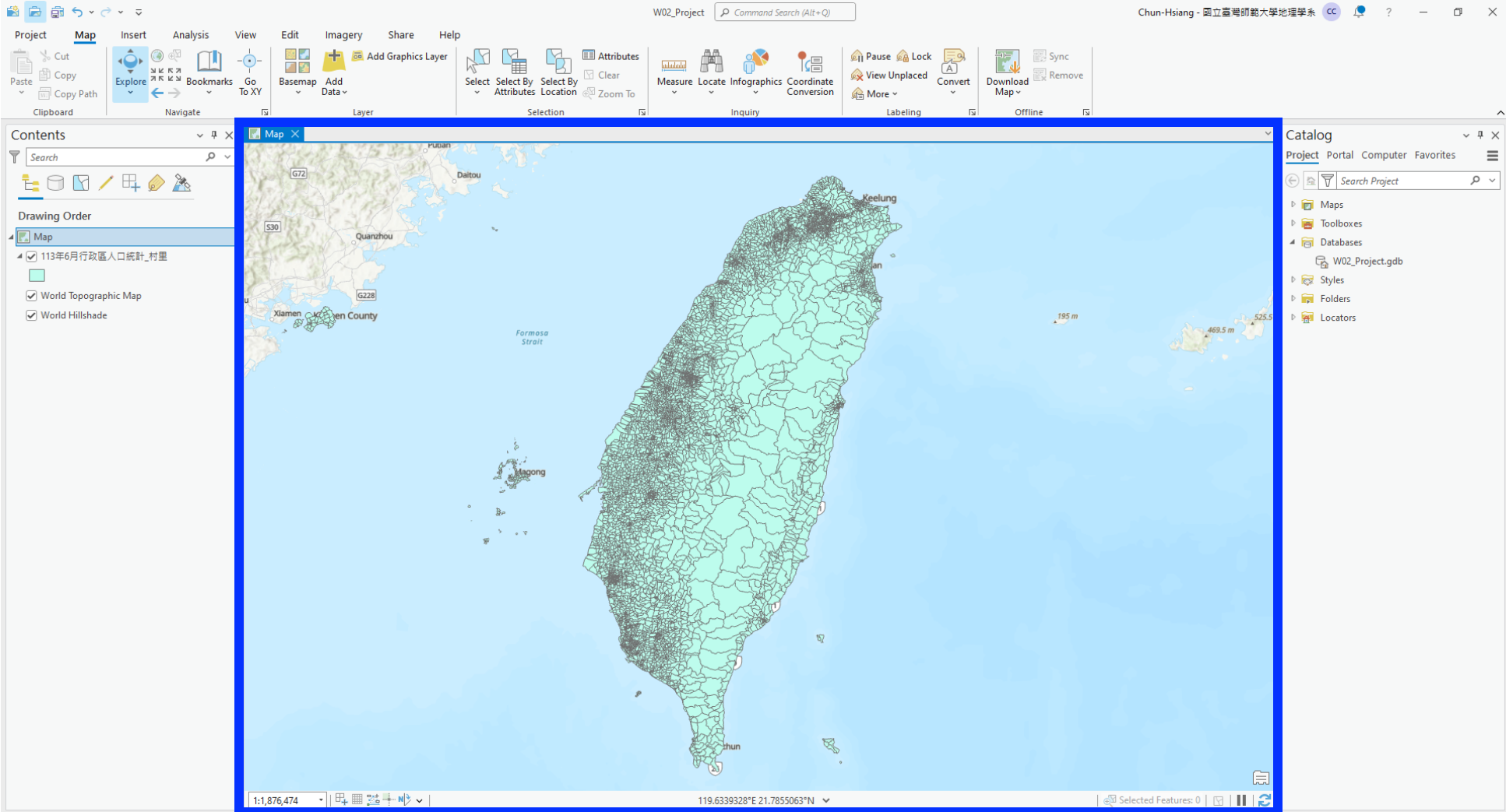
An overview of ArcGIS Pro



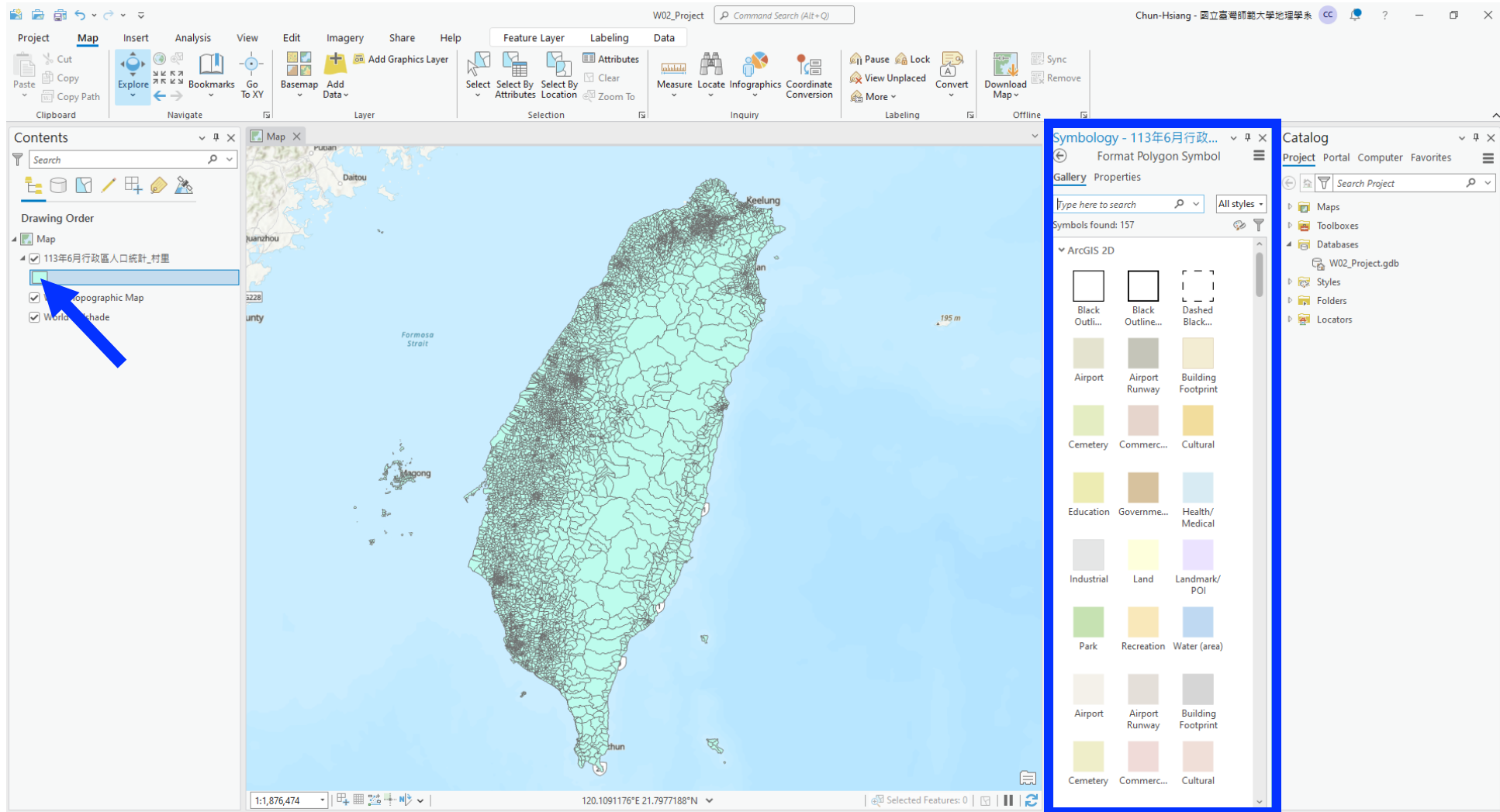
An overview of ArcGIS Pro



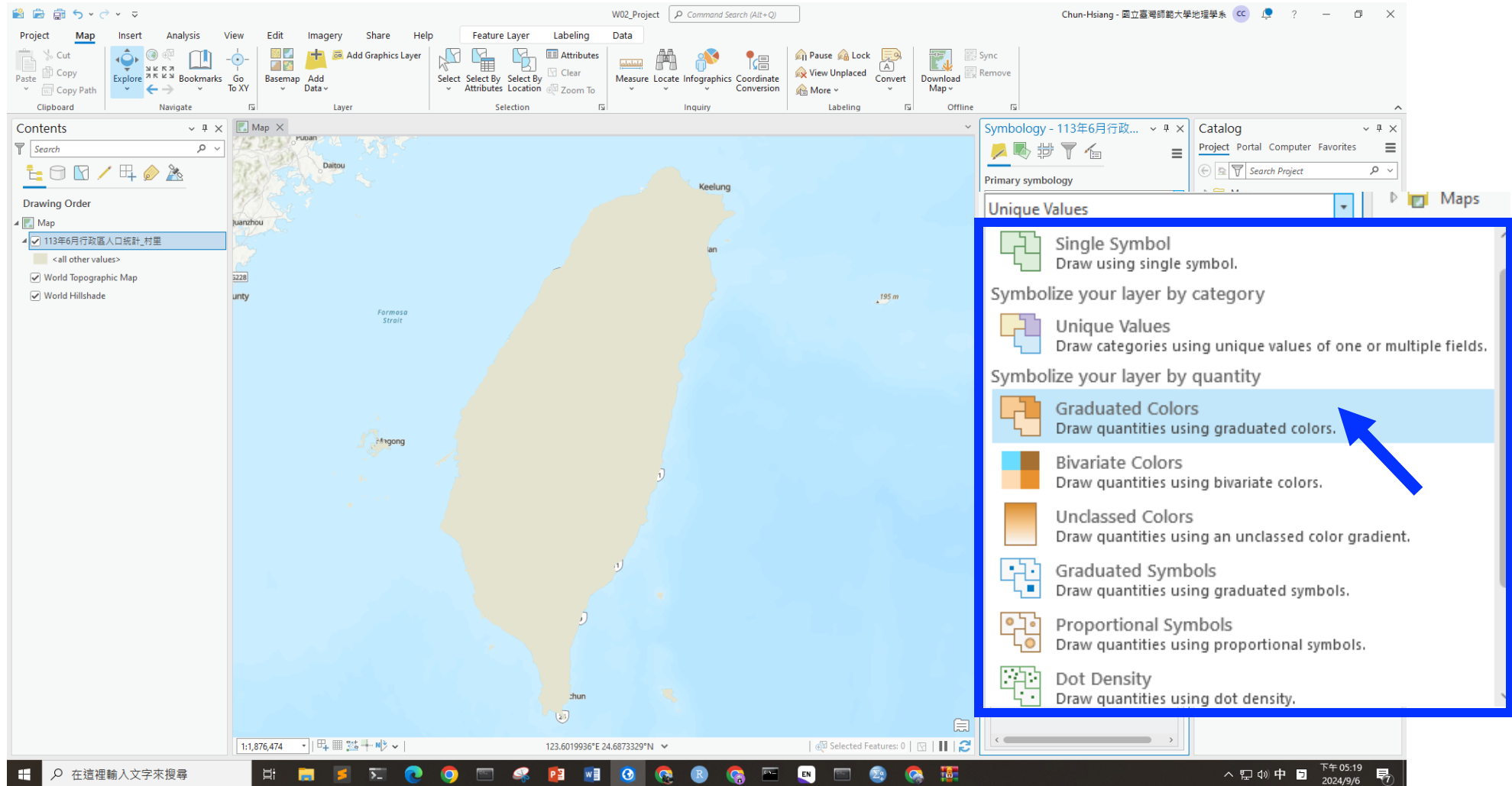
An overview of ArcGIS Pro



An overview of ArcGIS Pro



An overview of ArcGIS Pro



An overview of ArcGIS Pro

The screenshot displays the ArcGIS Pro interface. The main map shows a population density layer for June 2024 (113年6月行政區人口統計_村里) over Taiwan. The Symbology pane is open, showing the layer's symbology settings. The layer is named 'H_CNT' and uses a graduated color scheme with 5 classes. The color scheme is a yellow-to-red gradient. The Symbology pane also shows a histogram and a table of classes.

Symbology - 113年6月行政...

Primary symbology

Graduated Colors

Field: H_CNT

Normalization: <None>

Method: Natural Breaks (Jenks)

Classes: 5

Color scheme: [Yellow to Red Gradient]

Classes | Histogram | Scales

Symbol	Upper value	Label
[Yellow]	≤ 871	0.000000 - 8...
[Light Orange]	≤ 1836	871.000001 - ...
[Orange]	≤ 3250	1836.000001...
[Red-Orange]	≤ 7694	3250.000001...
[Red]	≤ 18183	7694.000001...

An overview of ArcGIS Pro

The screenshot displays the ArcGIS Pro interface. The main map shows a choropleth map of Taiwan, with population density represented by a color gradient from yellow (low density) to red (high density). The legend on the left, titled '113年6月行政區人口統計_村里', lists population ranges for various administrative areas. The symbology panel on the right, titled 'Symbology - 113年6月行政...', shows the 'Graduated Colors' method with 20 classes. A blue arrow points to the 'Natural Breaks (Jenks)' method in the symbology panel.

Legend Data:

Population Range	Color
0.000000 - 226.000000	Lightest Yellow
226.000001 - 586.000000	Light Yellow
586.000001 - 879.000000	Yellow
879.000001 - 1192.000000	Light Orange
1192.000001 - 1553.000000	Orange
1553.000001 - 1956.000000	Light Red
1956.000001 - 2403.000000	Orange-Red
2403.000001 - 2918.000000	Red-Orange
2918.000001 - 3491.000000	Red
3491.000001 - 4086.000000	Dark Red
4086.000001 - 4730.000000	Dark Red-Orange
4730.000001 - 5428.000000	Dark Red
5428.000001 - 6190.000000	Dark Red
6190.000001 - 7093.000000	Dark Red
7093.000001 - 8286.000000	Dark Red
8286.000001 - 9753.000000	Dark Red
9753.000001 - 11615.000000	Dark Red
11615.000001 - 15165.000000	Dark Red
15165.000001 - 23147.000000	Dark Red
23147.000001 - 45308.000000	Dark Red

Symbology Panel Data:

Symbol	Upper value	Label
Lightest Yellow	≤ 226	0.000000 -
Light Yellow	≤ 586	226.000001
Yellow	≤ 879	586.000001
Light Orange	≤ 1192	879.000001
Orange	≤ 1553	1192.000001
Light Red	≤ 1956	1553.000001
Orange-Red	≤ 2403	1956.000001
Red-Orange	≤ 2918	2403.000001
Red	≤ 3491	2918.000001
Dark Red	≤ 4086	3491.000001
Dark Red-Orange	≤ 4730	4086.000001
Dark Red	≤ 5428	4730.000001
Dark Red	≤ 6190	5428.000001
Dark Red	≤ 7093	6190.000001
Dark Red	≤ 8286	7093.000001
Dark Red	≤ 9753	8286.000001
Dark Red	≤ 11615	9753.000001

An overview of ArcGIS Pro

The screenshot displays the ArcGIS Pro interface. The main map shows a choropleth map of Taiwan, with a legend on the left titled "113年6月行政區人口統計_村里". The legend lists population ranges for various administrative areas, color-coded from yellow (low density) to red (high density). The Symbology panel on the right is open, showing the "Natural Breaks (Jenks)" method selected for the "P_CNT" field. A blue arrow points to the "Natural Breaks (Jenks)" option in the Symbology panel.

Symbology - 113年6月行政...

Primary symbology
Graduated Colors

Field: P_CNT
Normalization: <None>
Method: Quantile

Classes

Color scheme

Natural Breaks (Jenks)
Numerical values of ranked data are examined to account for non-uniform distributions, giving an unequal class width with varying frequency of observations per class.

Quantile
Distributes the observations equally across the class interval, giving unequal class widths but the same frequency of observations per class.

Equal Interval
The data range of each class is held constant, giving an equal class width with varying frequency of observations per class.

Defined Interval
Specify an interval size to define equal class widths with varying frequency of observations per class.

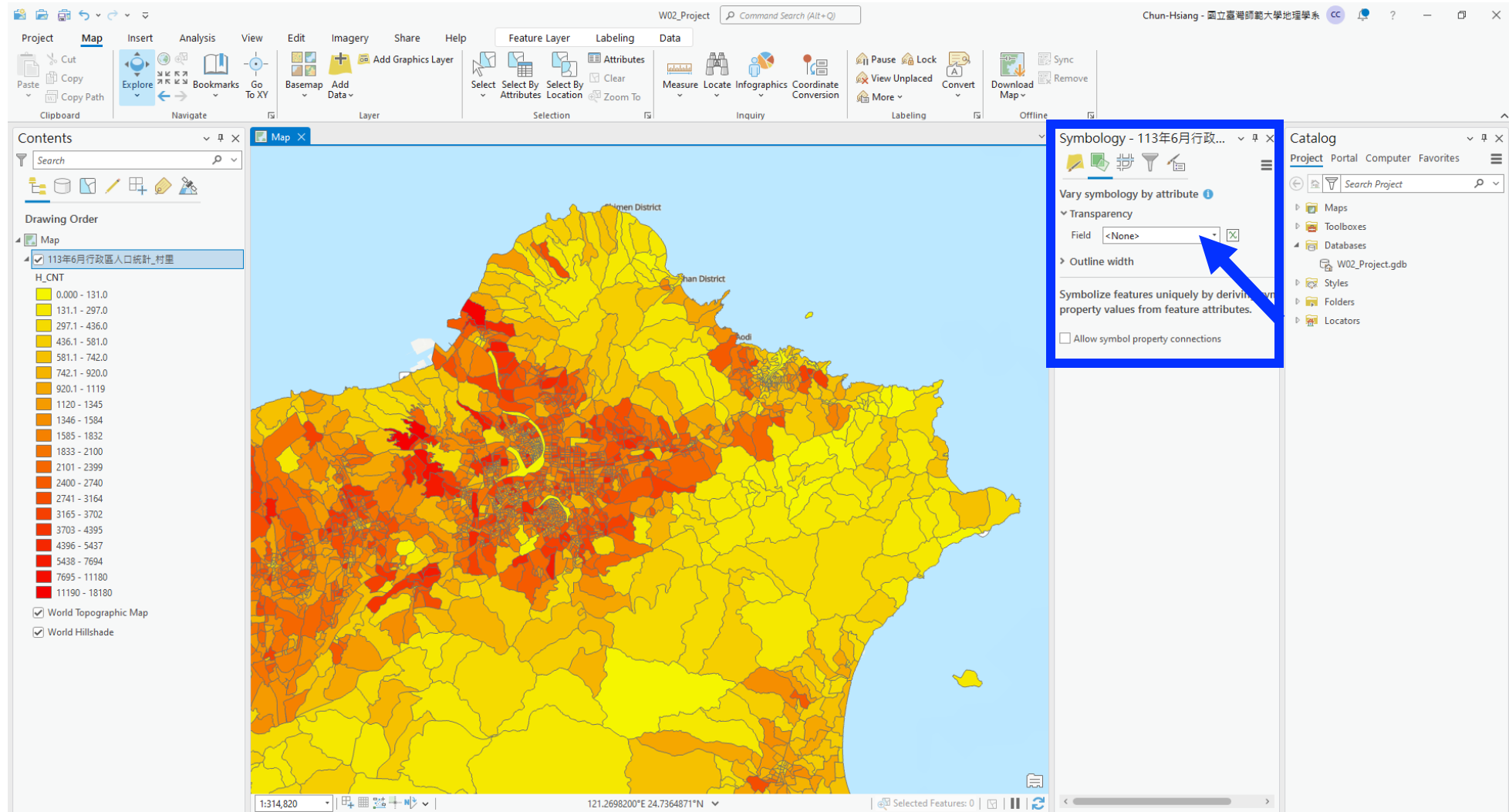
Manual Interval
Create class breaks manually or modify one of the preset classification methods appropriate for your data.

Geometric Interval
Mathematically defined class widths based on a geometric series, giving an approximately equal class width and consistent frequency of observations per class.

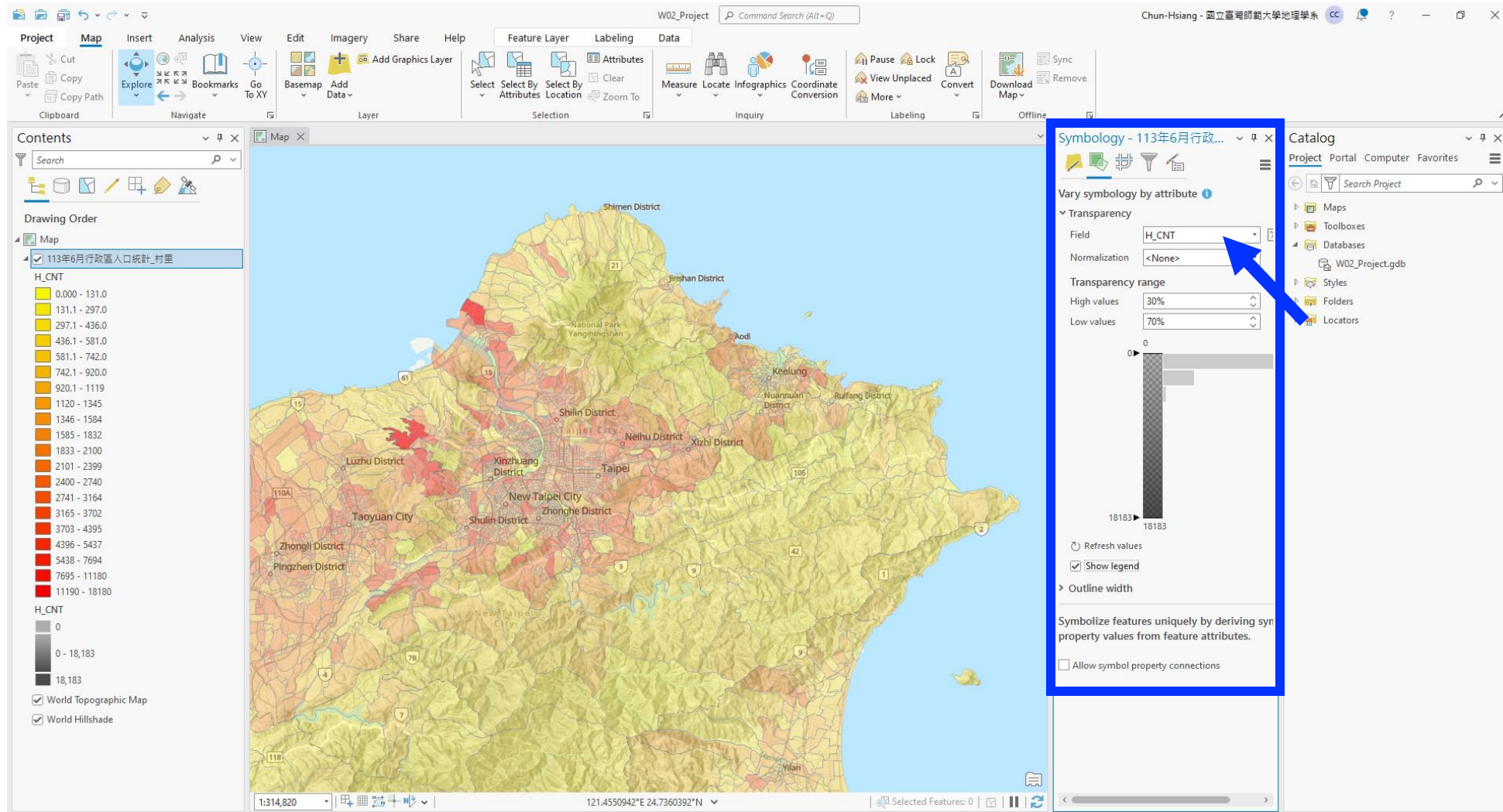
Standard Deviation
For normally distributed data, class widths are defined using standard deviations from the mean of the data array, giving an equal class width and varying frequency of observations per class.

Symbol	Value	Color
□	0.0000001 - 390.000000	Yellow
□	390.0000001 - 614.000000	Light Yellow
□	614.0000001 - 778.000000	Yellow-Orange
□	778.0000001 - 924.000000	Orange
□	924.0000001 - 1076.000000	Light Orange
□	1076.0000001 - 1241.000000	Orange
□	1241.0000001 - 1432.000000	Light Orange
□	1432.0000001 - 1642.000000	Orange
□	1642.0000001 - 1879.000000	Light Orange
□	1879.0000001 - 2151.000000	Orange
□	2151.0000001 - 2464.000000	Light Orange
□	2464.0000001 - 2817.000000	Orange
□	2817.0000001 - 3239.000000	Light Orange
□	3239.0000001 - 3686.000000	Orange
□	3686.0000001 - 4160.000000	Light Orange
□	4160.0000001 - 4705.000000	Orange
□	4705.0000001 - 5360.000000	Light Orange
□	5360.0000001 - 6216.000000	Orange
□	6216.0000001 - 7675.000000	Light Orange
□	7675.0000001 - 45308.000000	Red

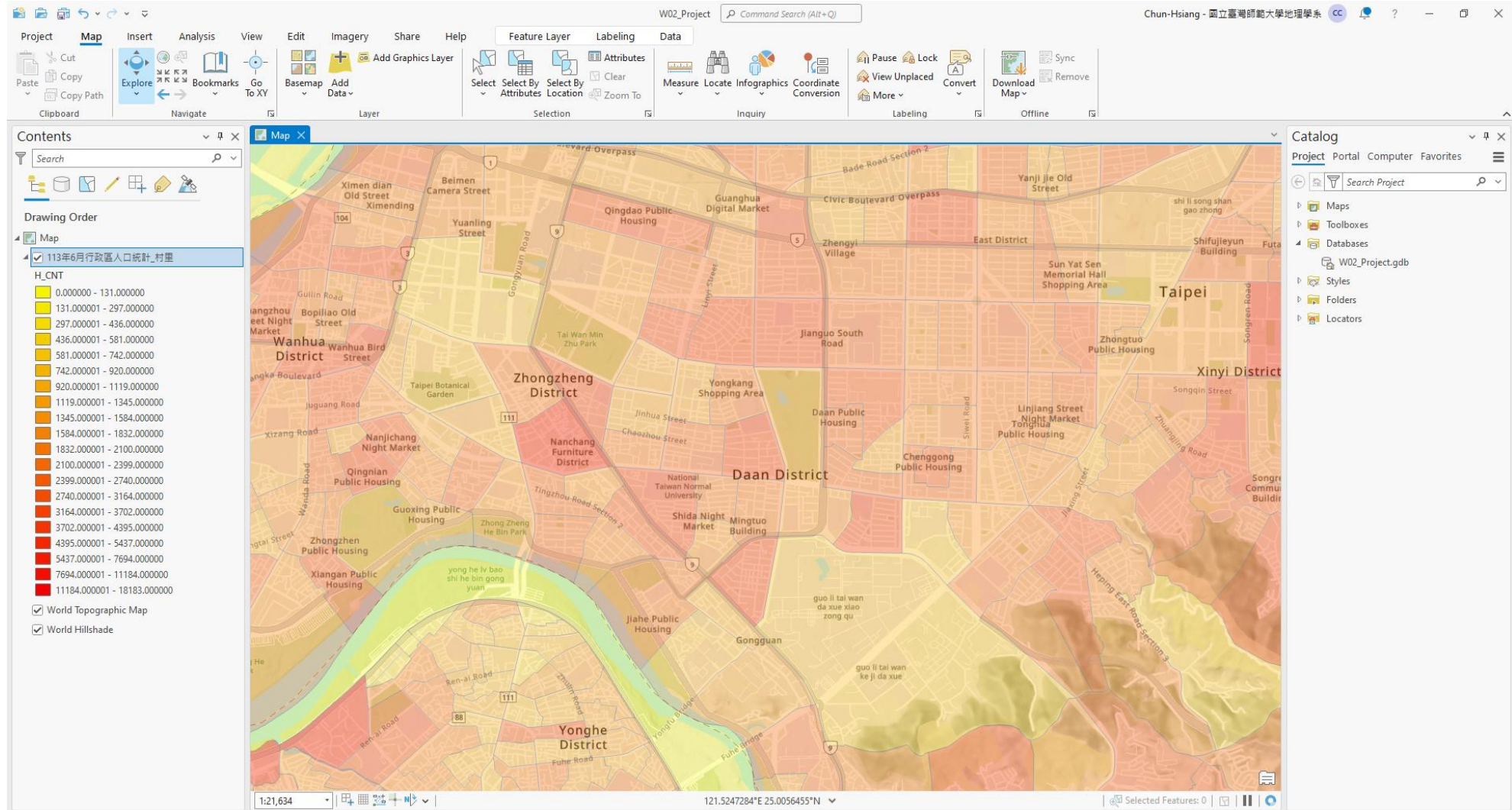
An overview of ArcGIS Pro



An overview of ArcGIS Pro

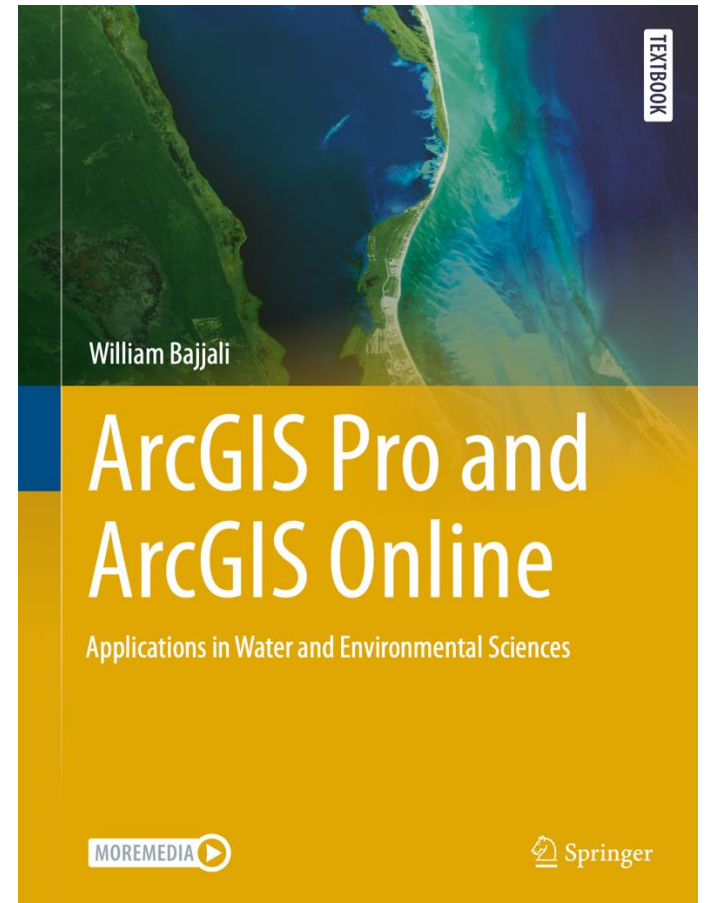


An overview of ArcGIS Pro



References

- William Bajjali (2023) ArcGIS Pro and ArcGIS Online. Springer.
- SuperGeo
- Quantum GIS
- ...





The End

Thank you for your attention!

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