



Geographic Information System

Digitalization

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Outline

- Usage of Digitalization
- Digitalization Lab



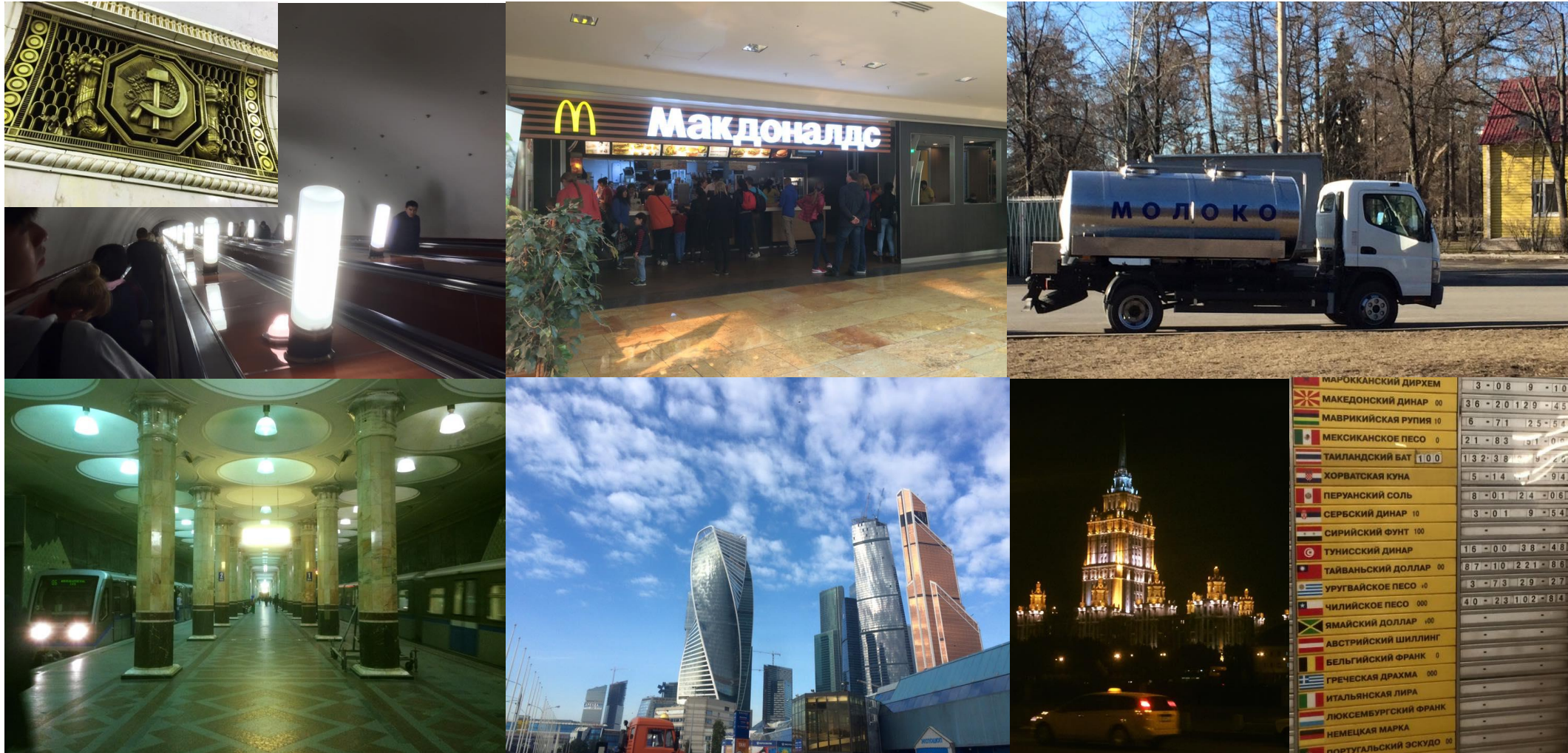
Usage of Digitalization

- In most cases, we have ESRI shapefile, Google KML or KMZ, GeoJSON, or any other geocoding file.
- However, we do not have some data that could be utilized for any kind of analysis; therefore, we have to digitalize a raster data (image) to a vector data (shapefile).
- This approach is widely adopted in both industrial and digital humanities, such as Ancient Taipei City Map.
- Two steps :: Georeferencing → Editing

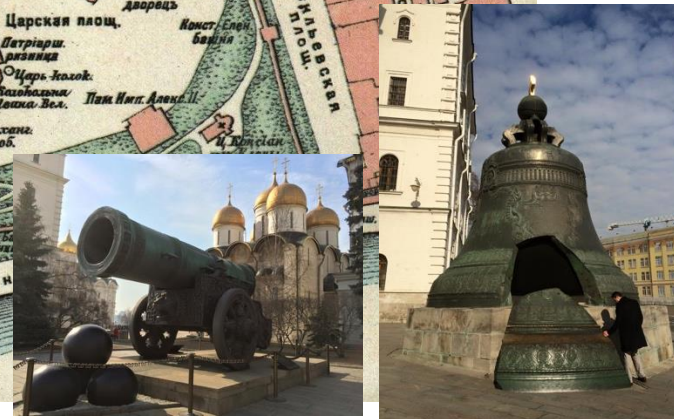
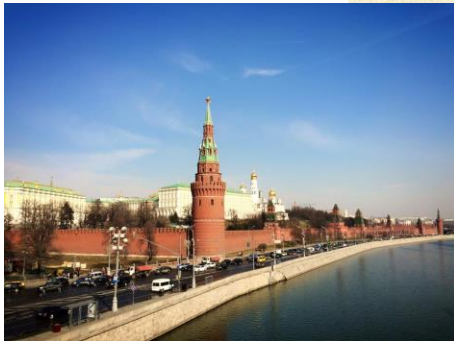
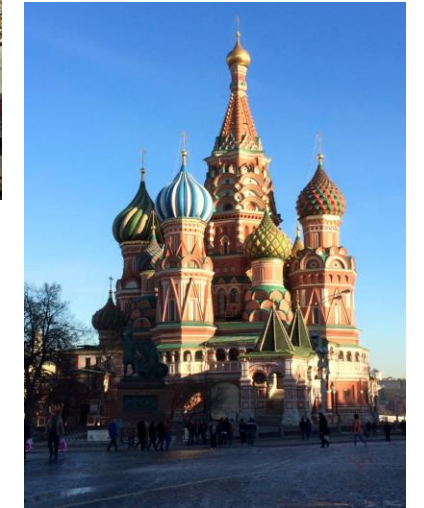
Digitalization Lab

- Today, we have to digitalize an ancient map of Kremlin in Moscow, Russian Federation.
- Here is the link of dataset:
<https://download.geofabrik.de/russia/central-fed-district.html>
- Two shapefiles will be used in this Lab:
 - gis_osm_roads_free_1.shp
 - gis_osm_buildings_a_free_1.shp

Digitalization Lab

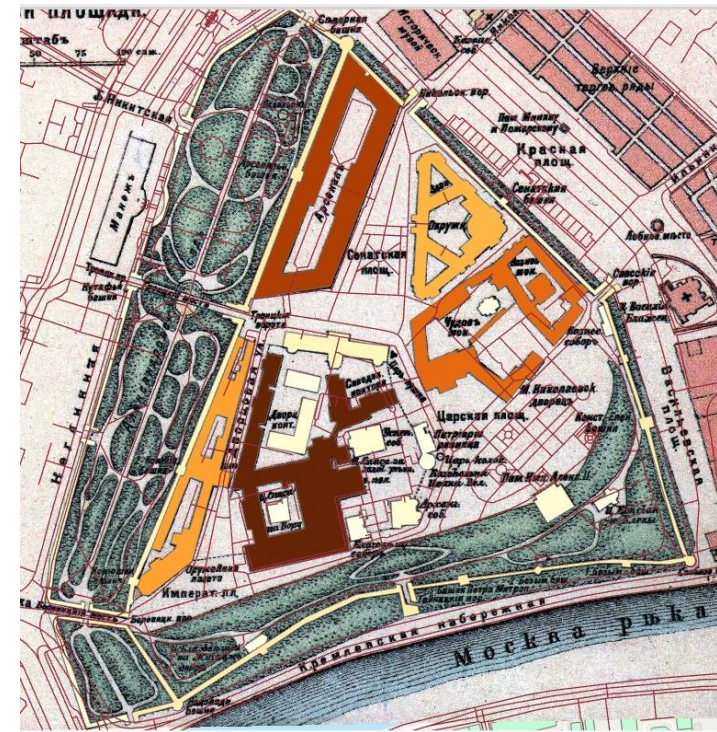


Digitalization Lab

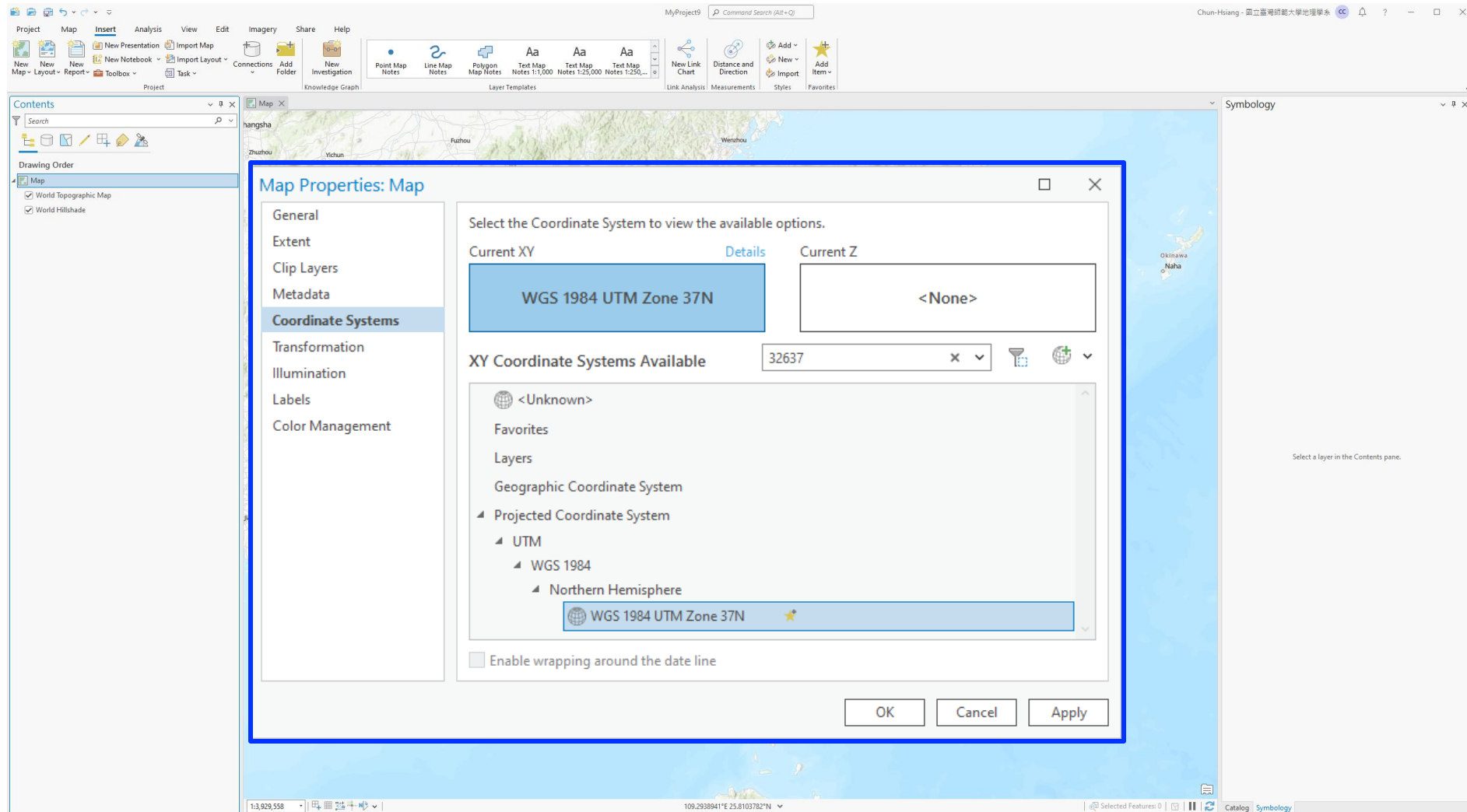


Digitalization Lab

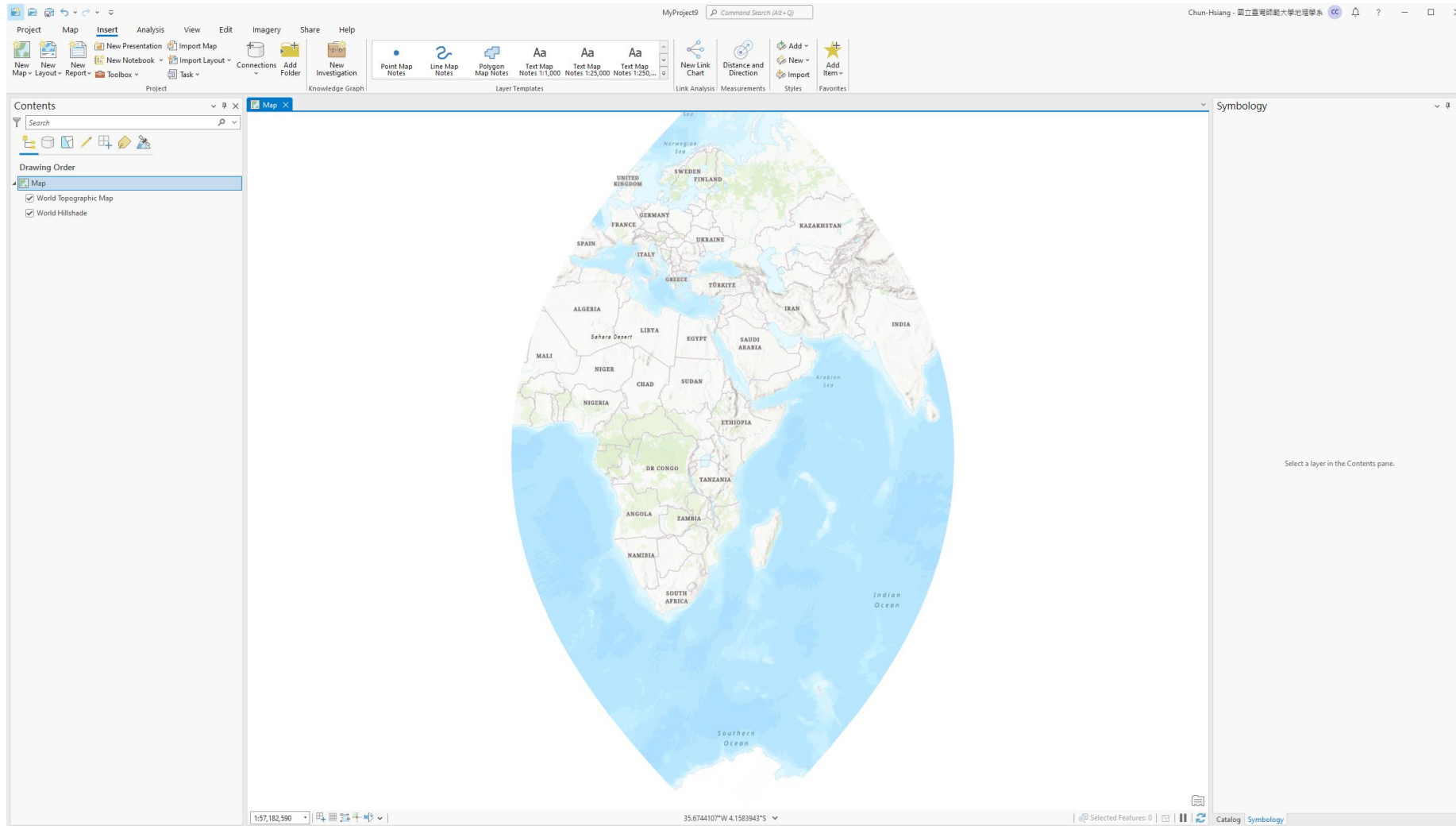
- 1) Set **PCS** for targeting area
- 2) **Create a Feature Class** (Shapefile)
- 3) **Georeferencing**
- 4) **Fit to Display**
- 5) **Add Control Points**
- 6) Show **Control Point Table** and **Save** it
- 7) **Edit :: Create** → start to digitalizing all Kremlin buildings
- 8) **Create a Feature Class** (Shapefile) for Erasing the overlapped areas
- 9) **Erase** the overlapped areas
- 10) **Create a Feature Class**(Shapefile) for adding the overlapped areas
- 11) **Union** the added areas
- 12) **Calculate Geometry** :: Perimeter and Area
- 13) **Symbology** with Area values



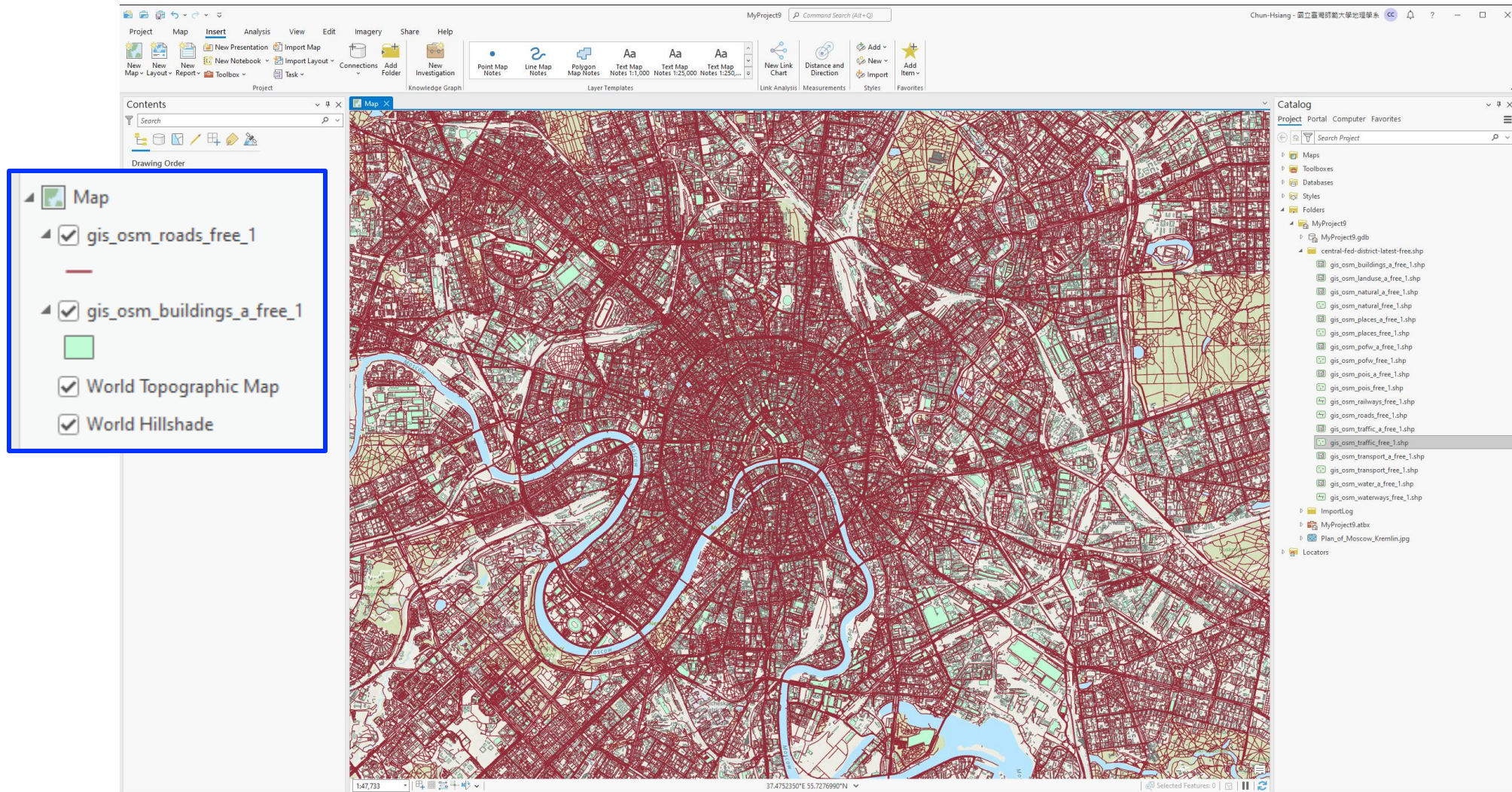
PCS Settings for Moscow



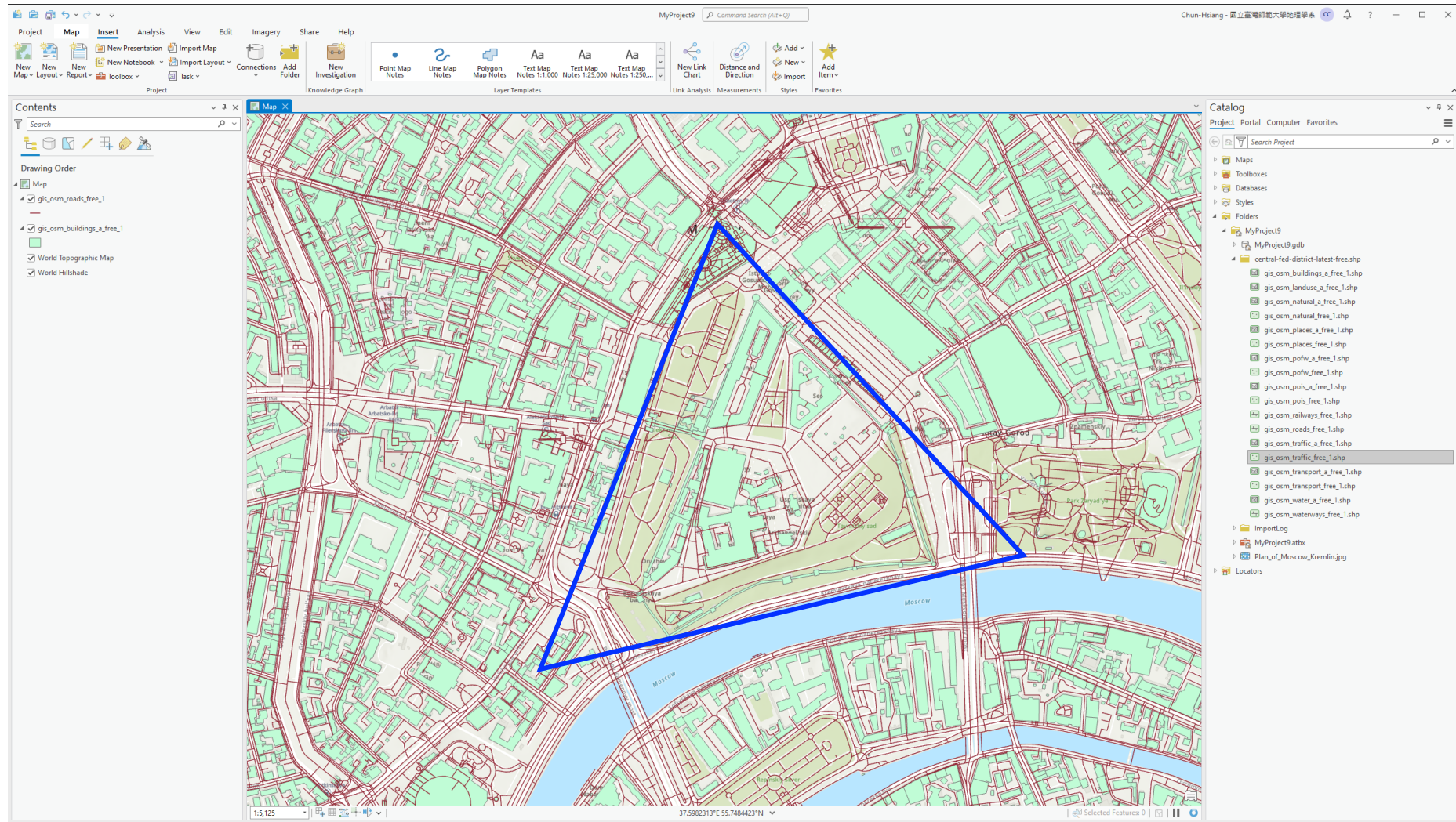
PCS Settings for Moscow



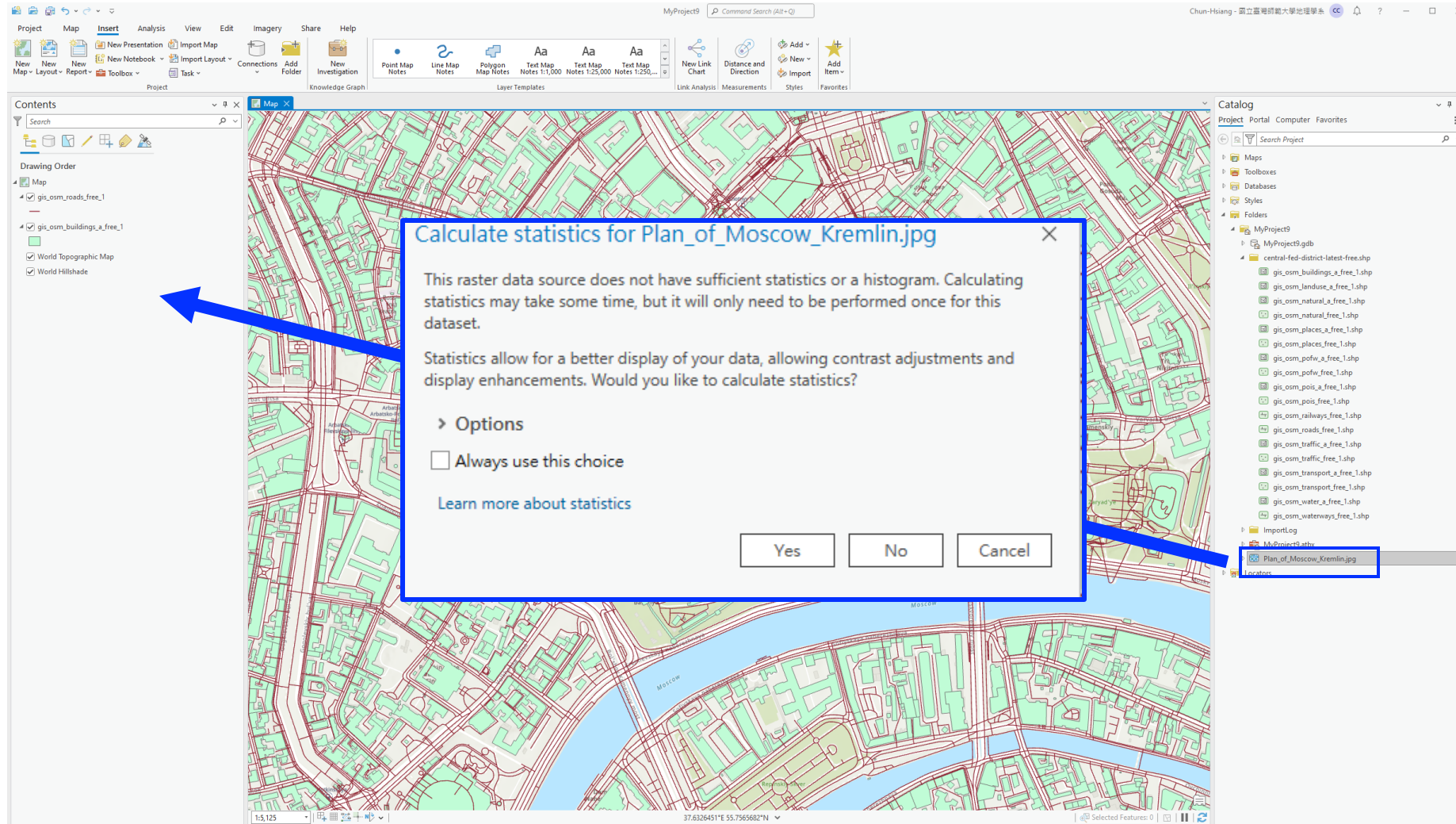
OSM Datasets



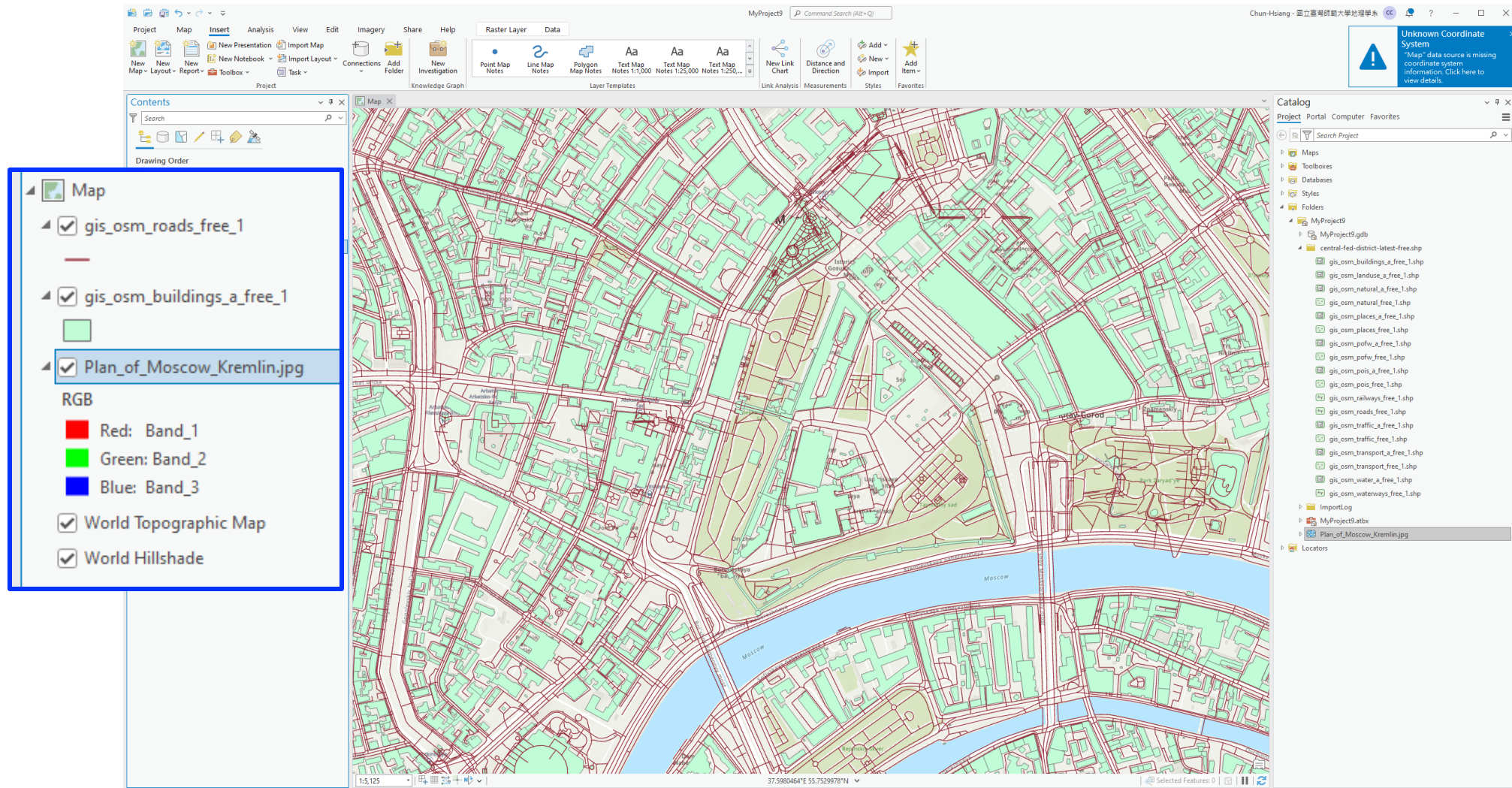
Zoom to Kremlin



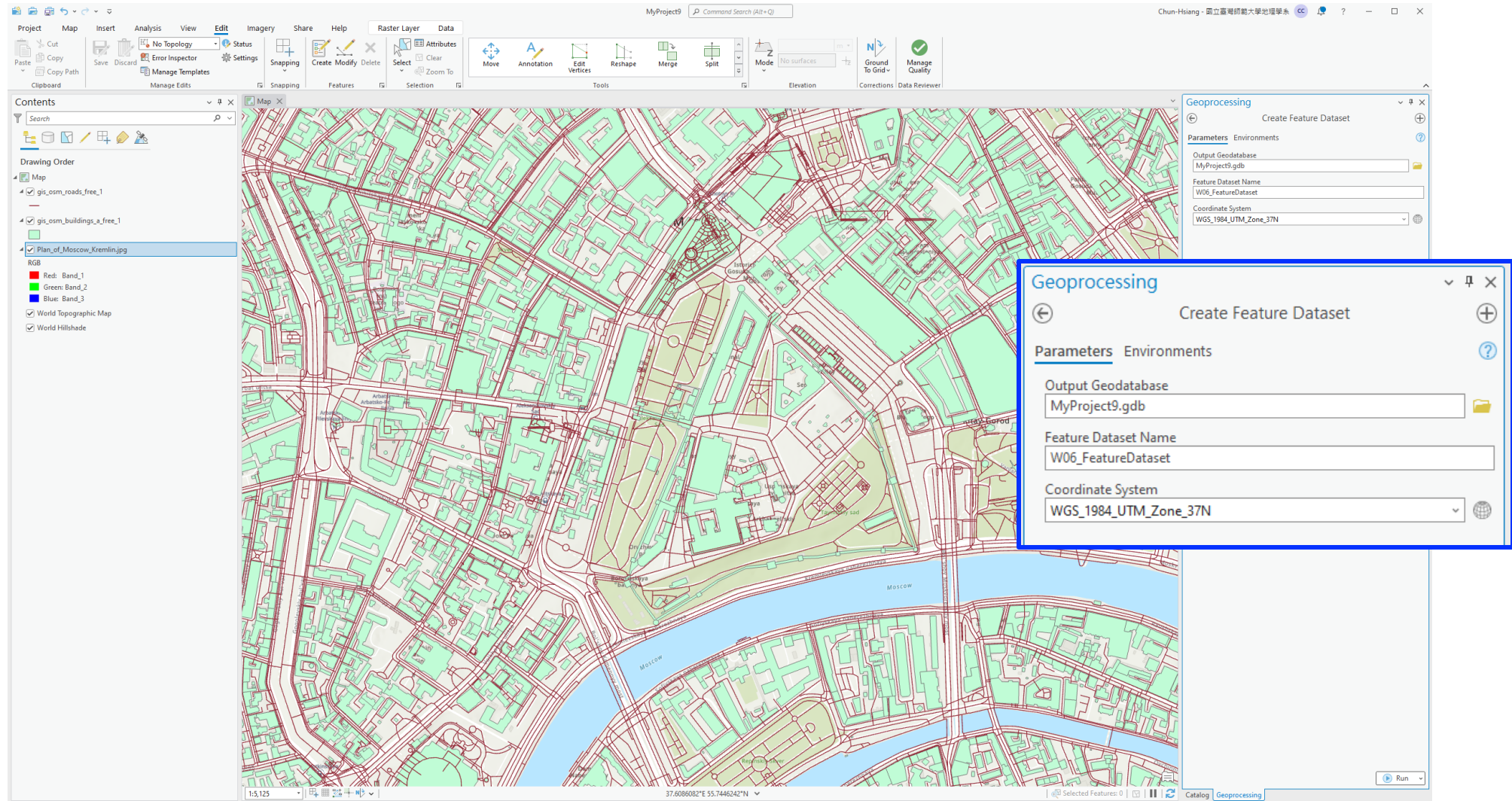
Load the Ancient Map



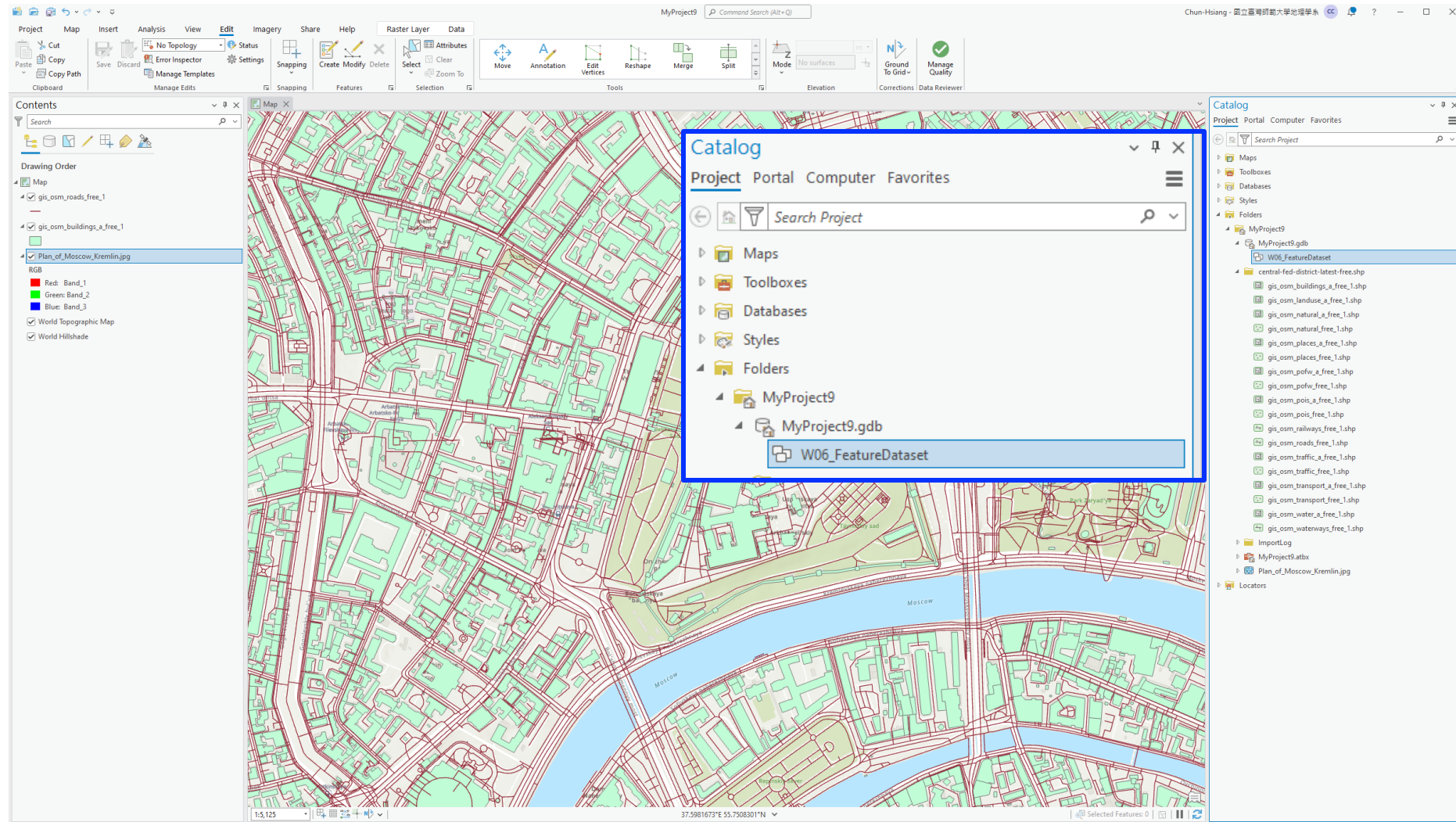
Loaded the Ancient Map



Create a Feature Dataset

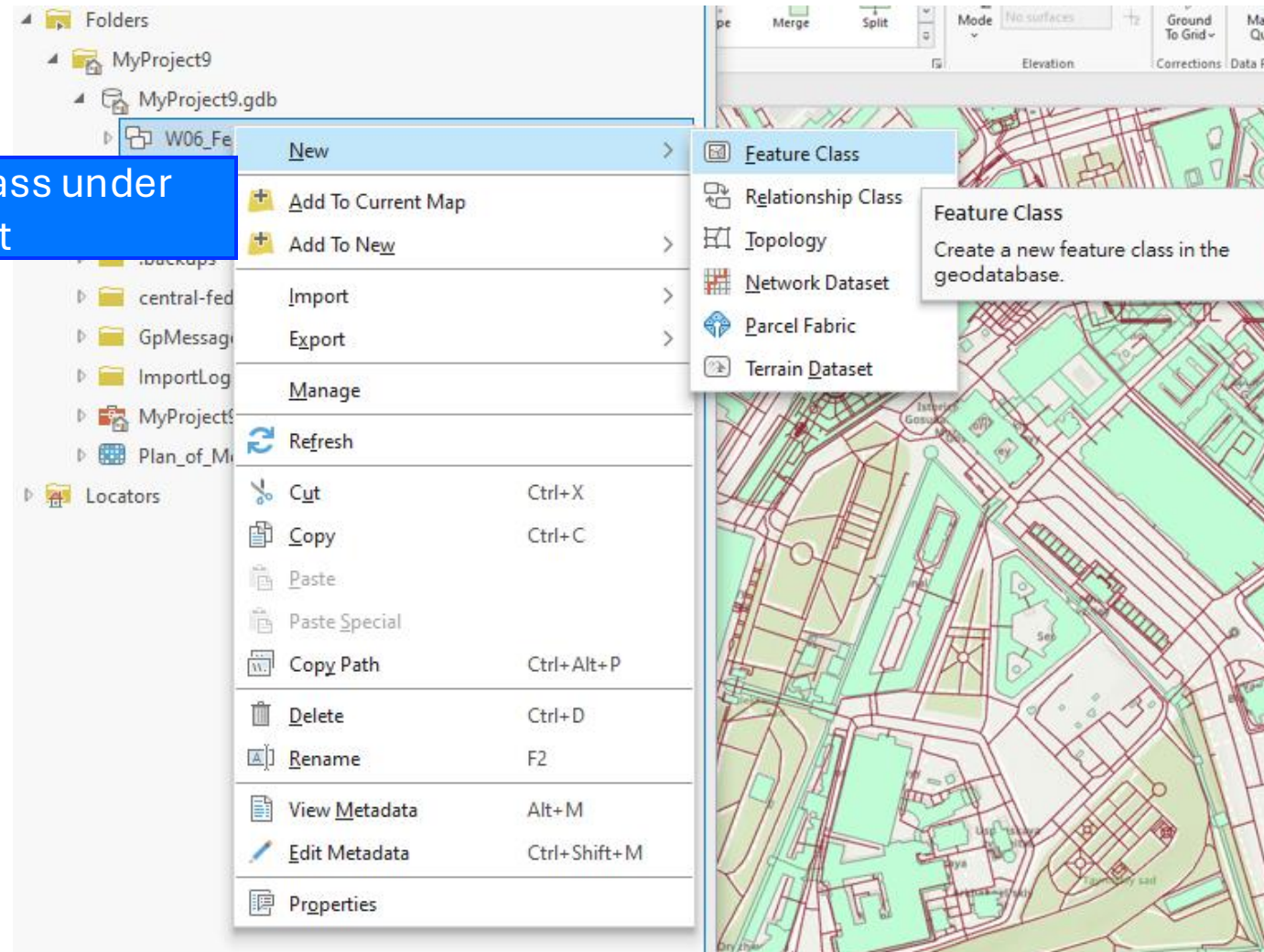


Created a Feature Dataset

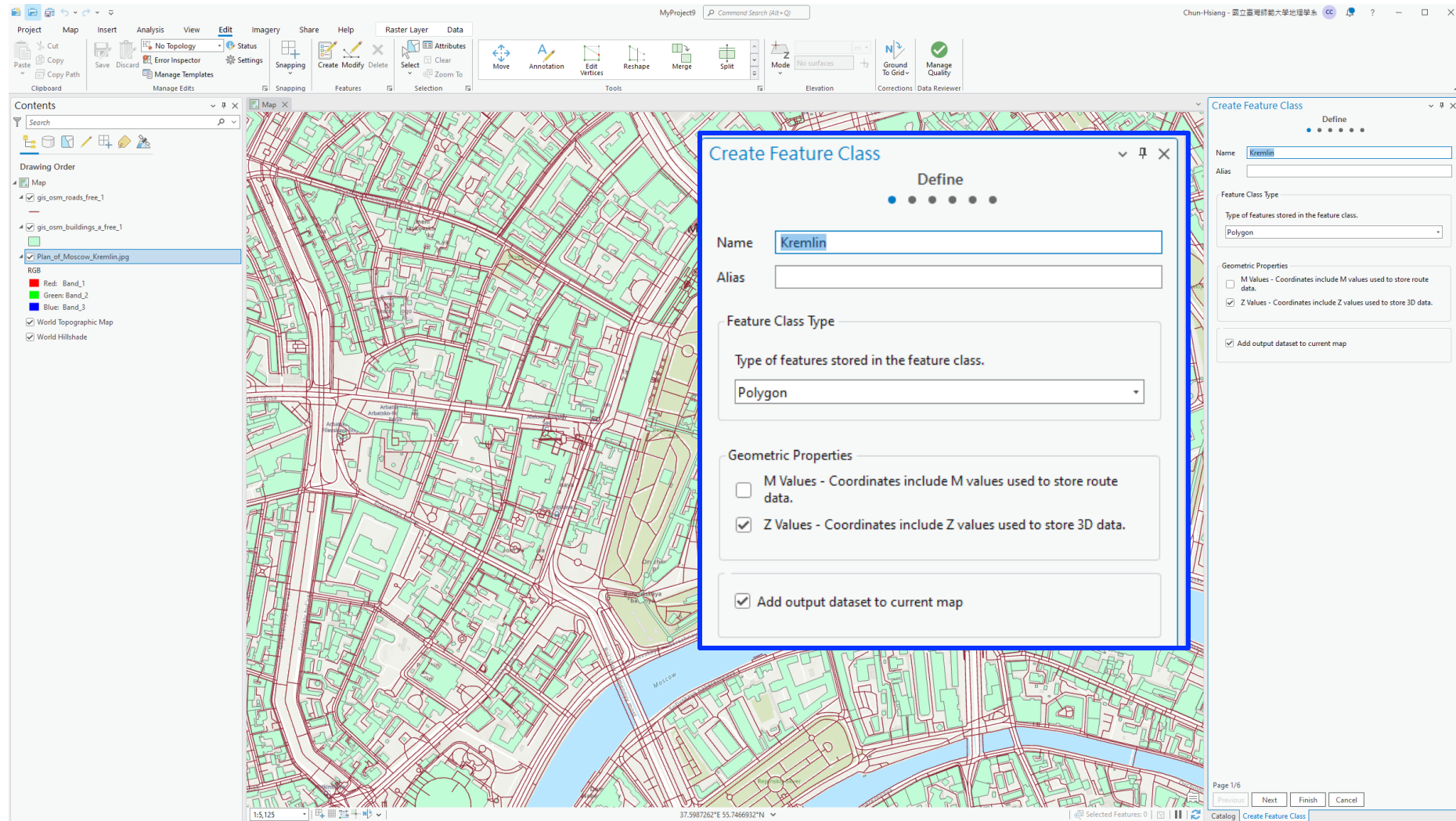


Create a Feature Class for Digitalization

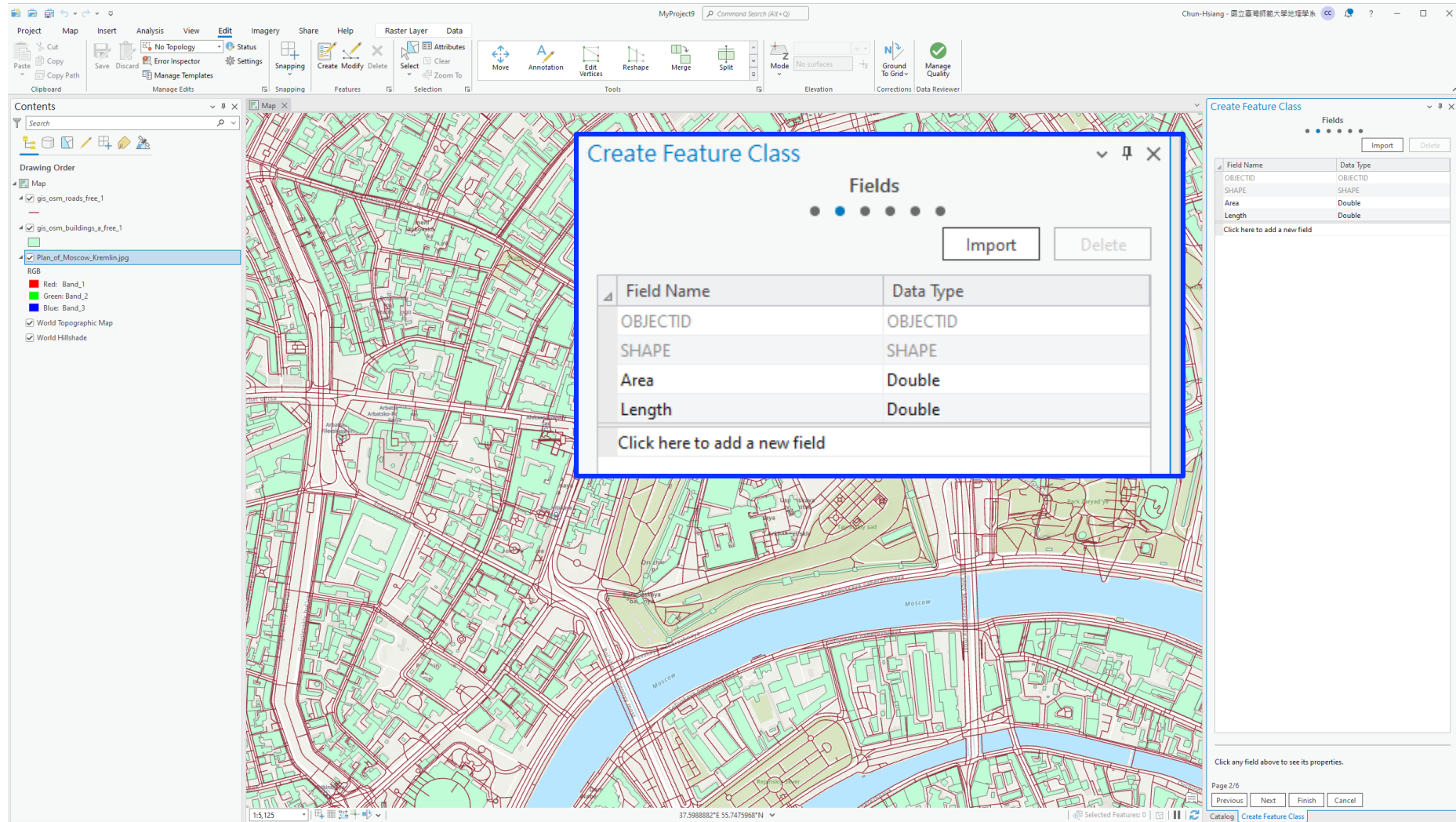
Create a feature class under the Feature Dataset



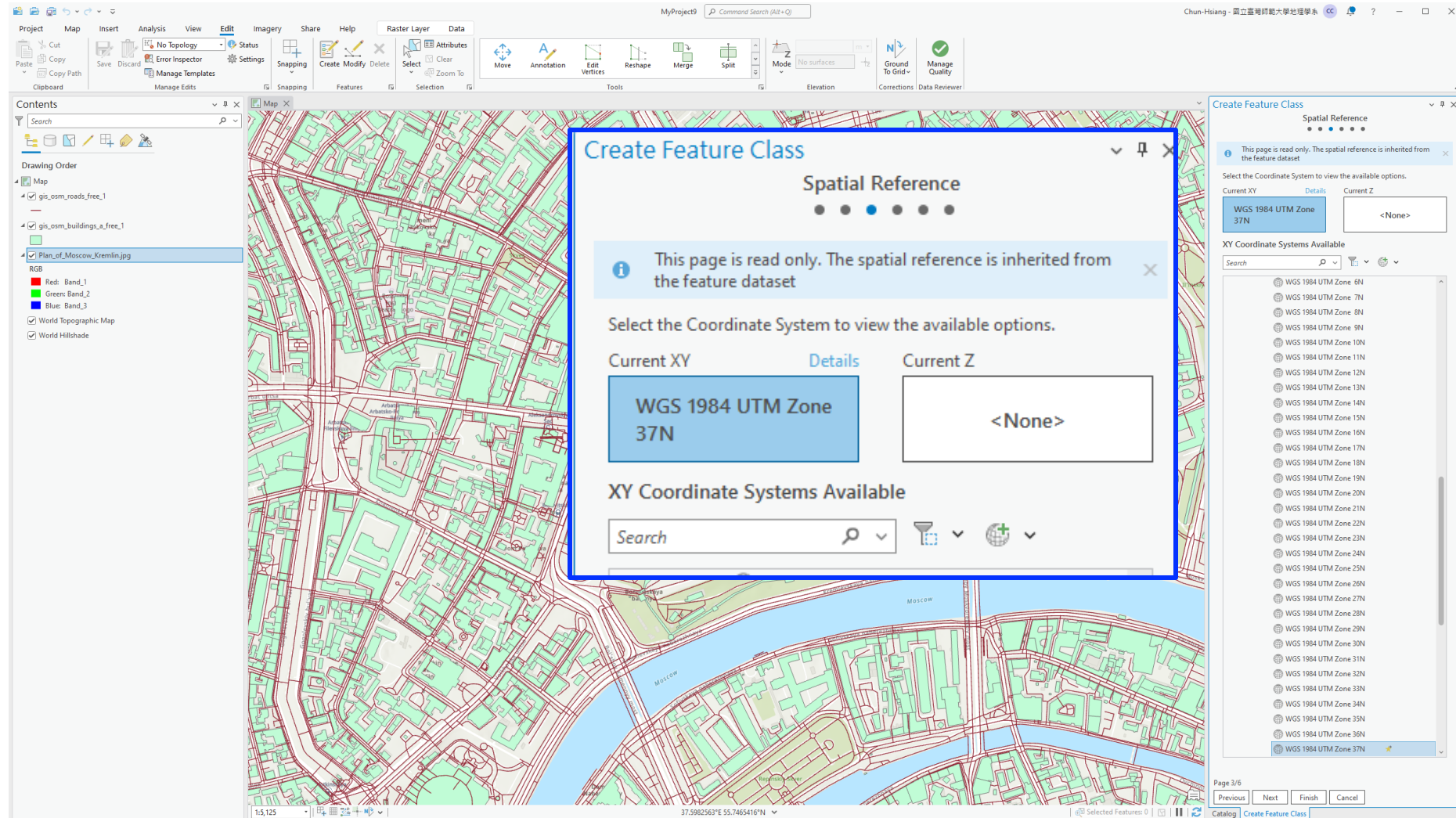
Create a Feature Class for Digitalization



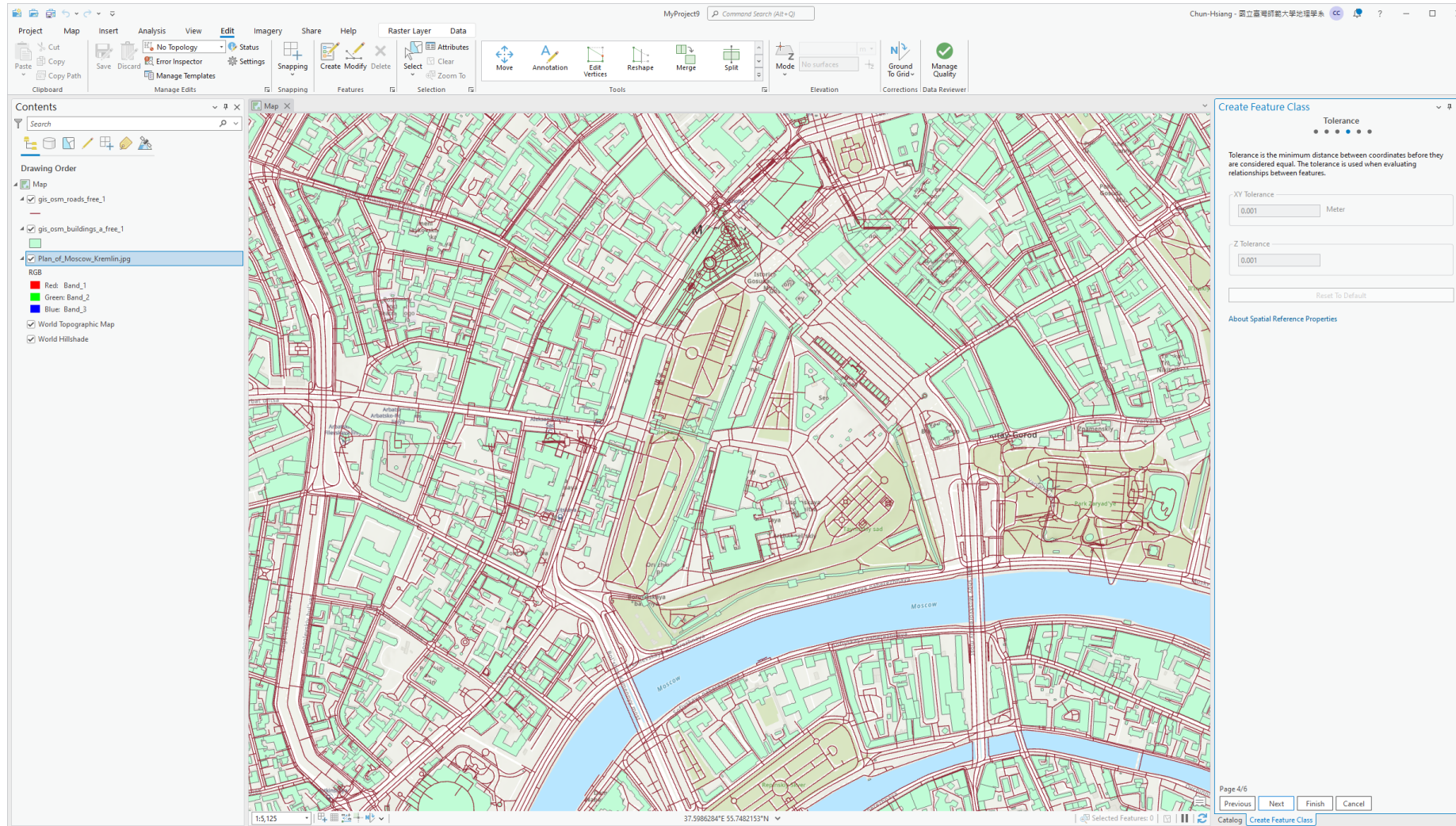
Create a Feature Class for Digitalization



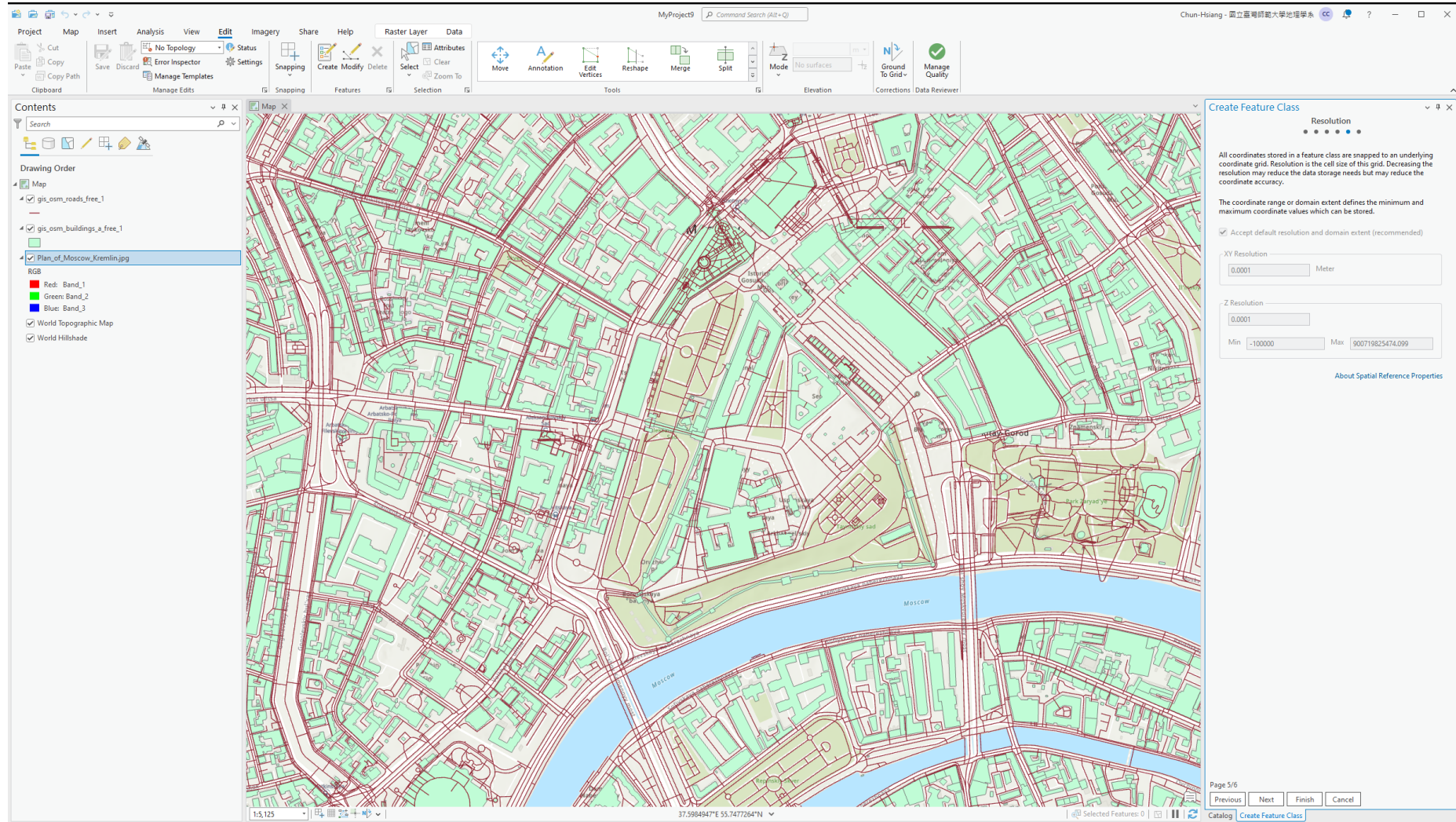
Create a Feature Class for Digitalization



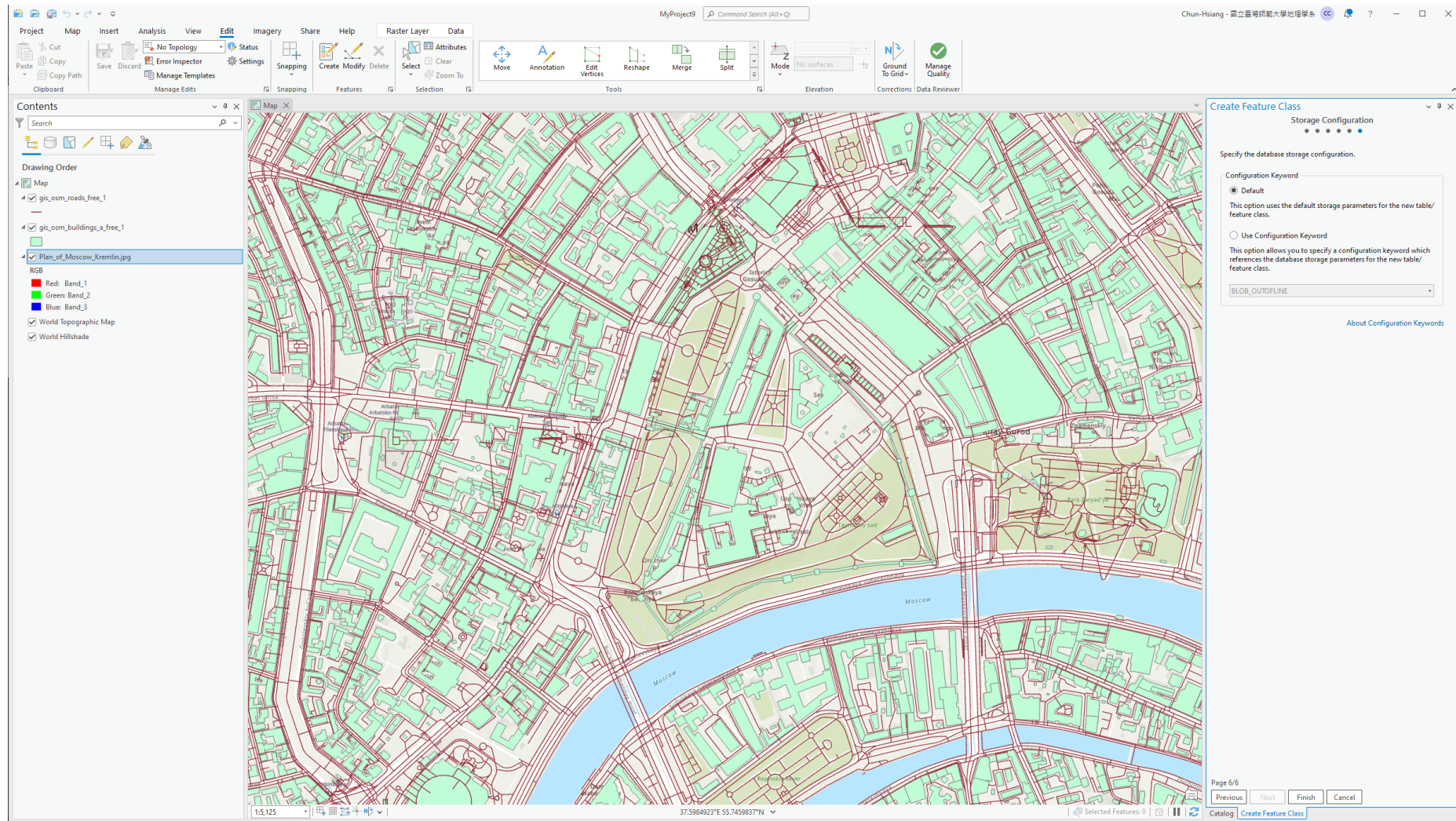
Create a Feature Class for Digitalization



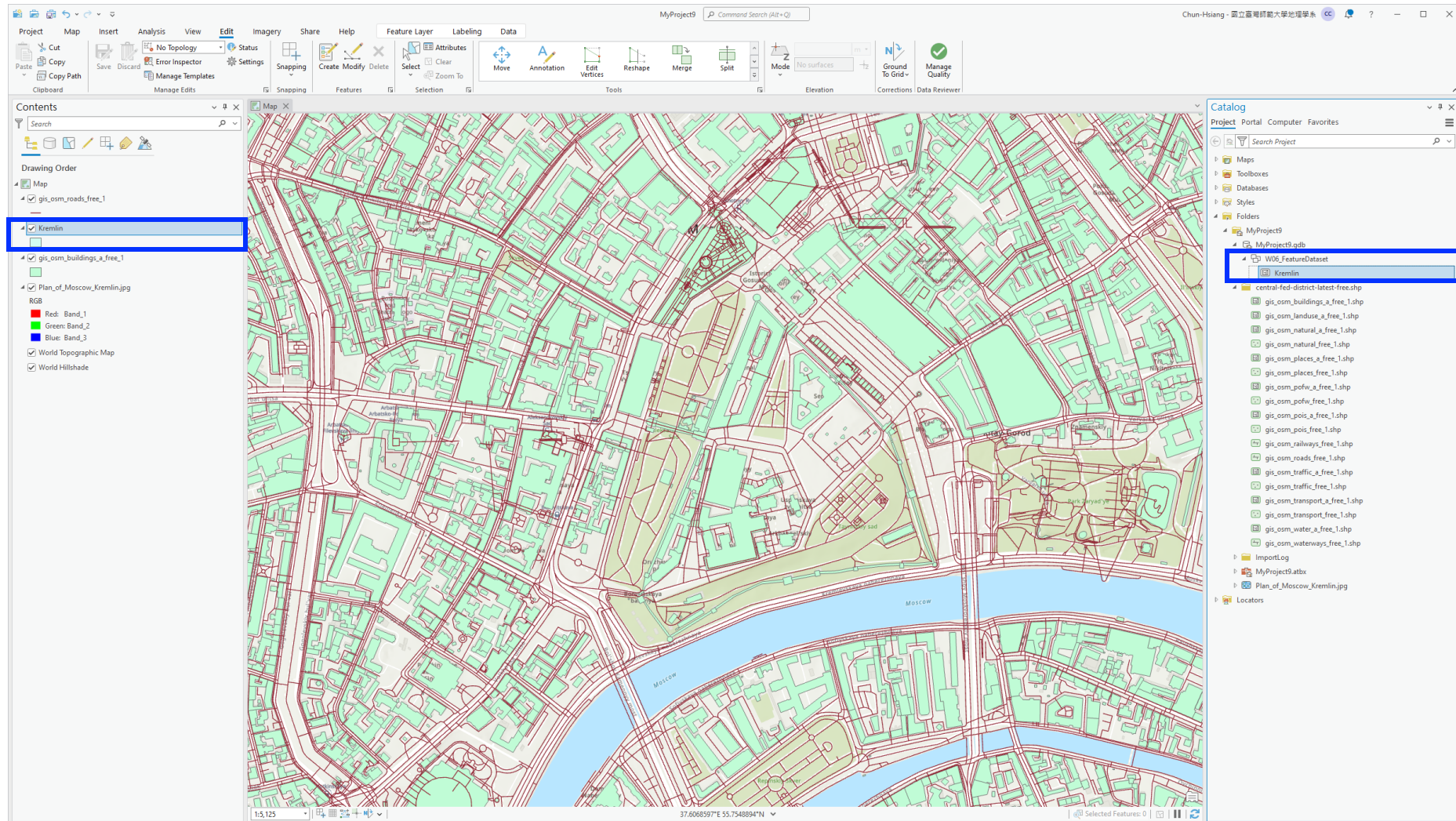
Create a Feature Class for Digitalization



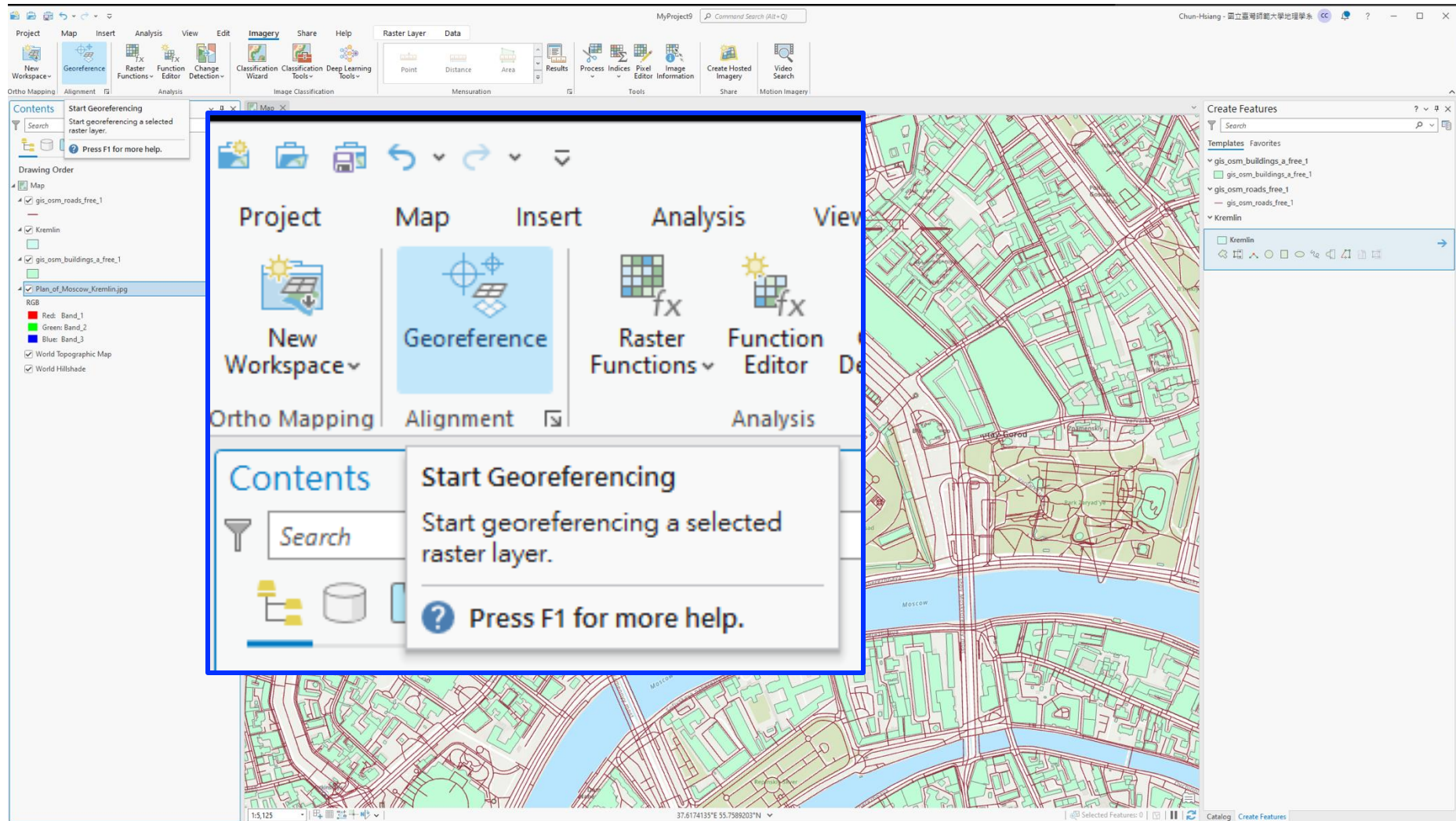
Create a Feature Class for Digitalization



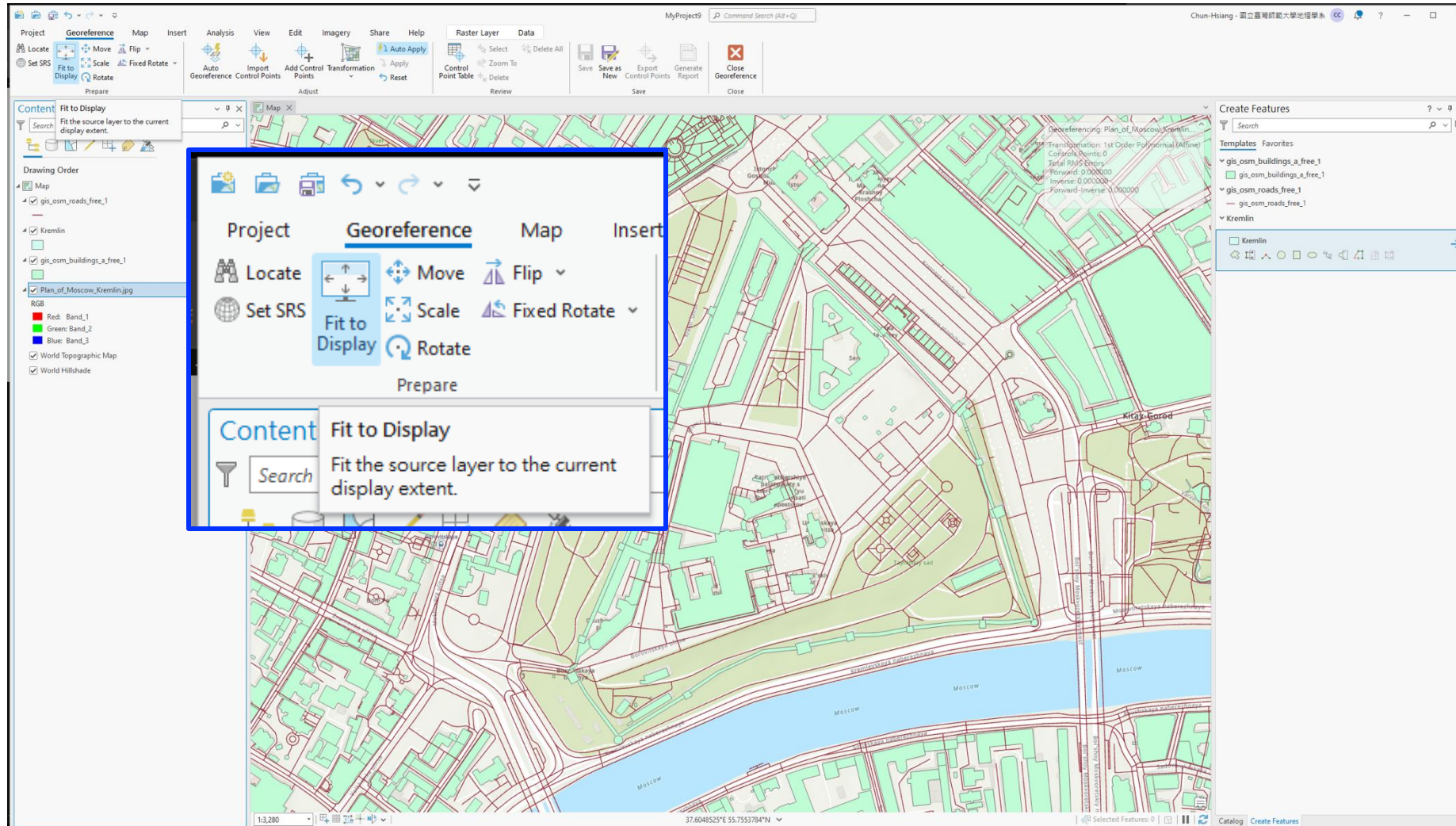
Create a Feature Class for Digitalization



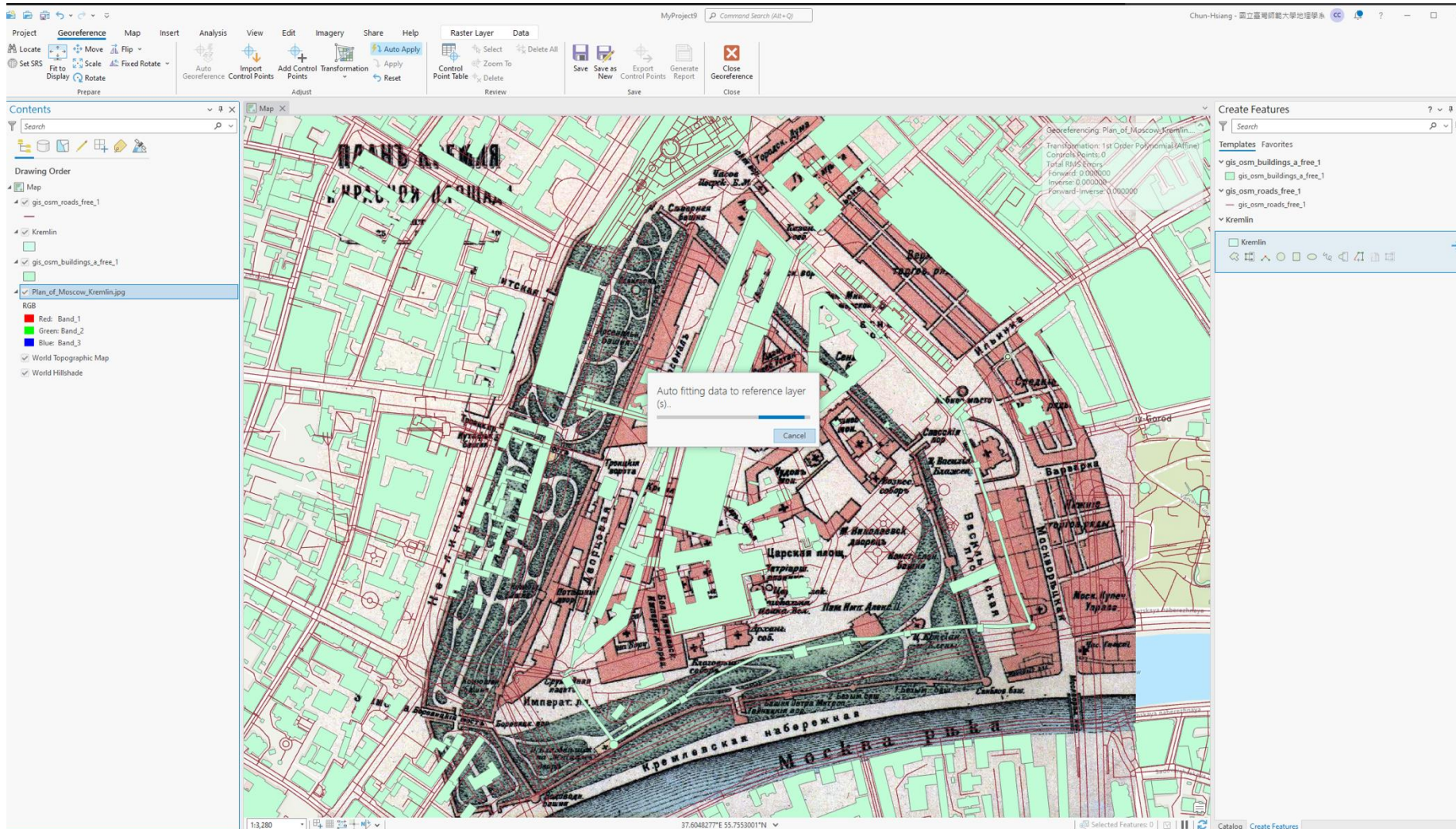
Georeferencing



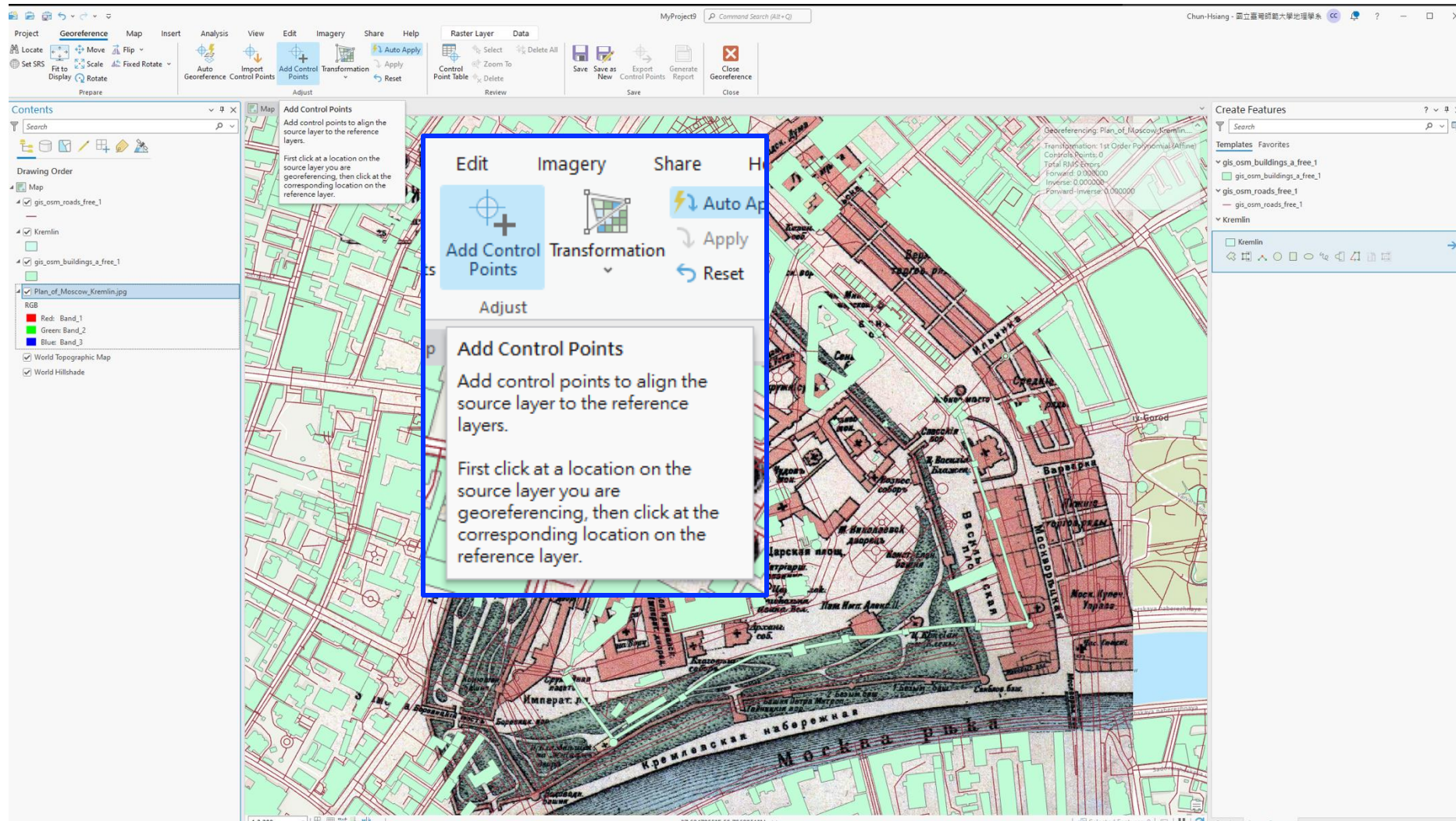
Georeferencing



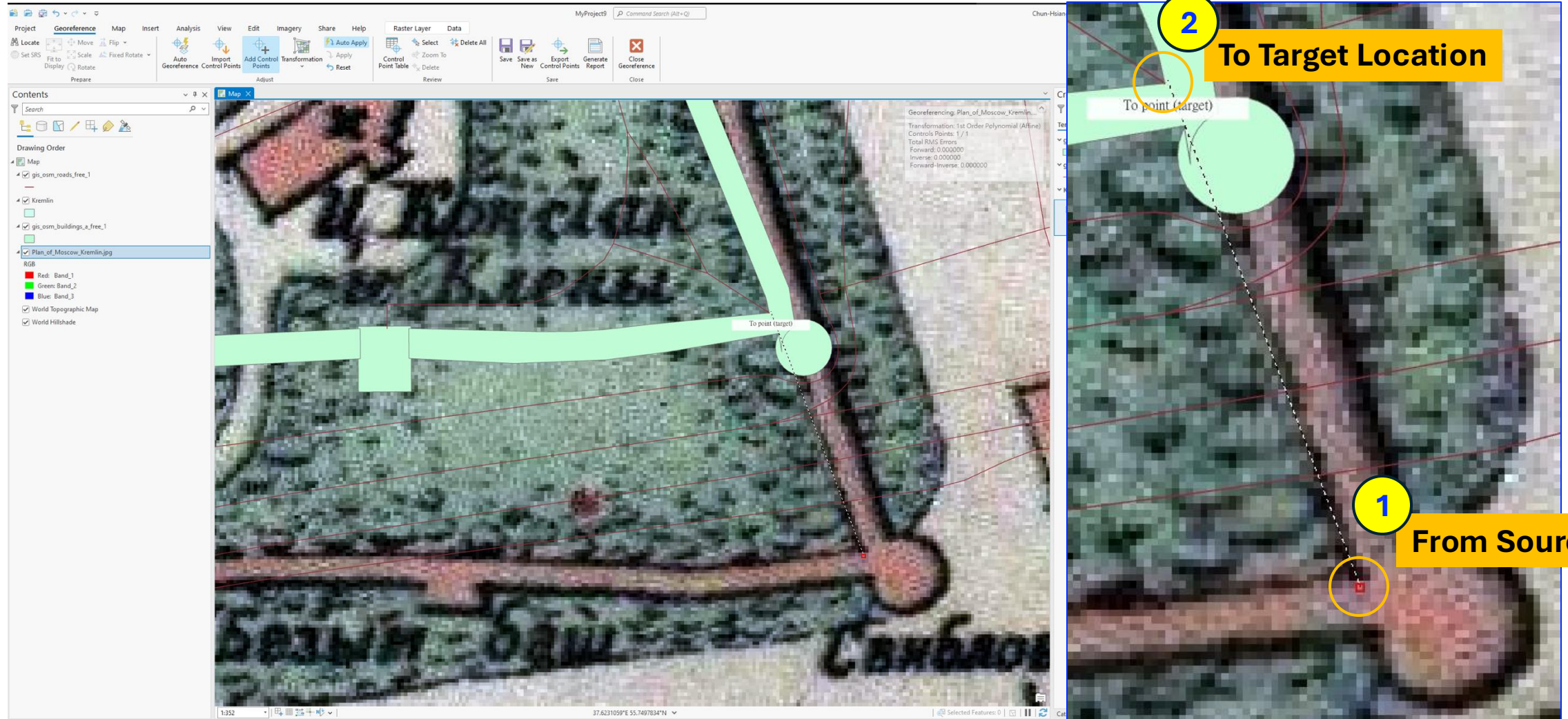
Georeferencing



Georeferencing



Georeferencing



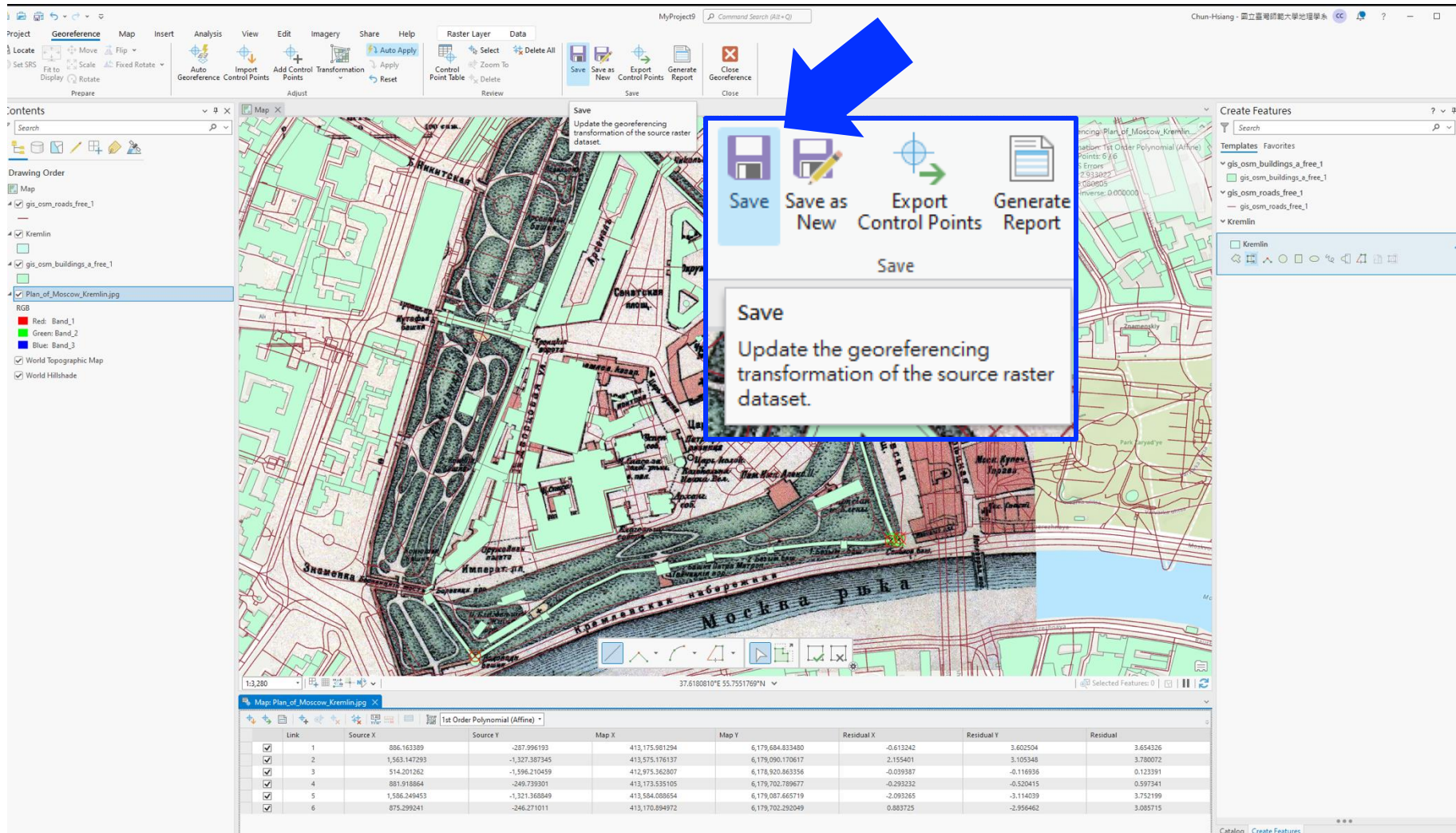
Georeferencing

The screenshot displays the QGIS Georeferencing interface. The main map area shows a satellite image of the Moscow Kremlin with a georeferenced map overlaid. The map is labeled with 'Moskva' and 'Кремль'. The interface includes a menu bar, a toolbar, and a sidebar. The 'Contents' panel on the left lists the layers: 'gis_osm_roads_free_1', 'Kremlin', 'gis_osm_buildings_a_free_1', and 'Plan_of_Moscow_Kremlin.jpg'. The 'Create Features' panel on the right shows the 'Kremlin' layer. The 'Control Point Table' is visible at the bottom, showing a table of control points with columns for Link, Source X, Source Y, Map X, Map Y, Residual X, Residual Y, and Residual. A blue box highlights the 'Control Point Table' and the 'Raster Layer Data' menu item. A blue arrow points from the 'Control Point Table' to the map area.

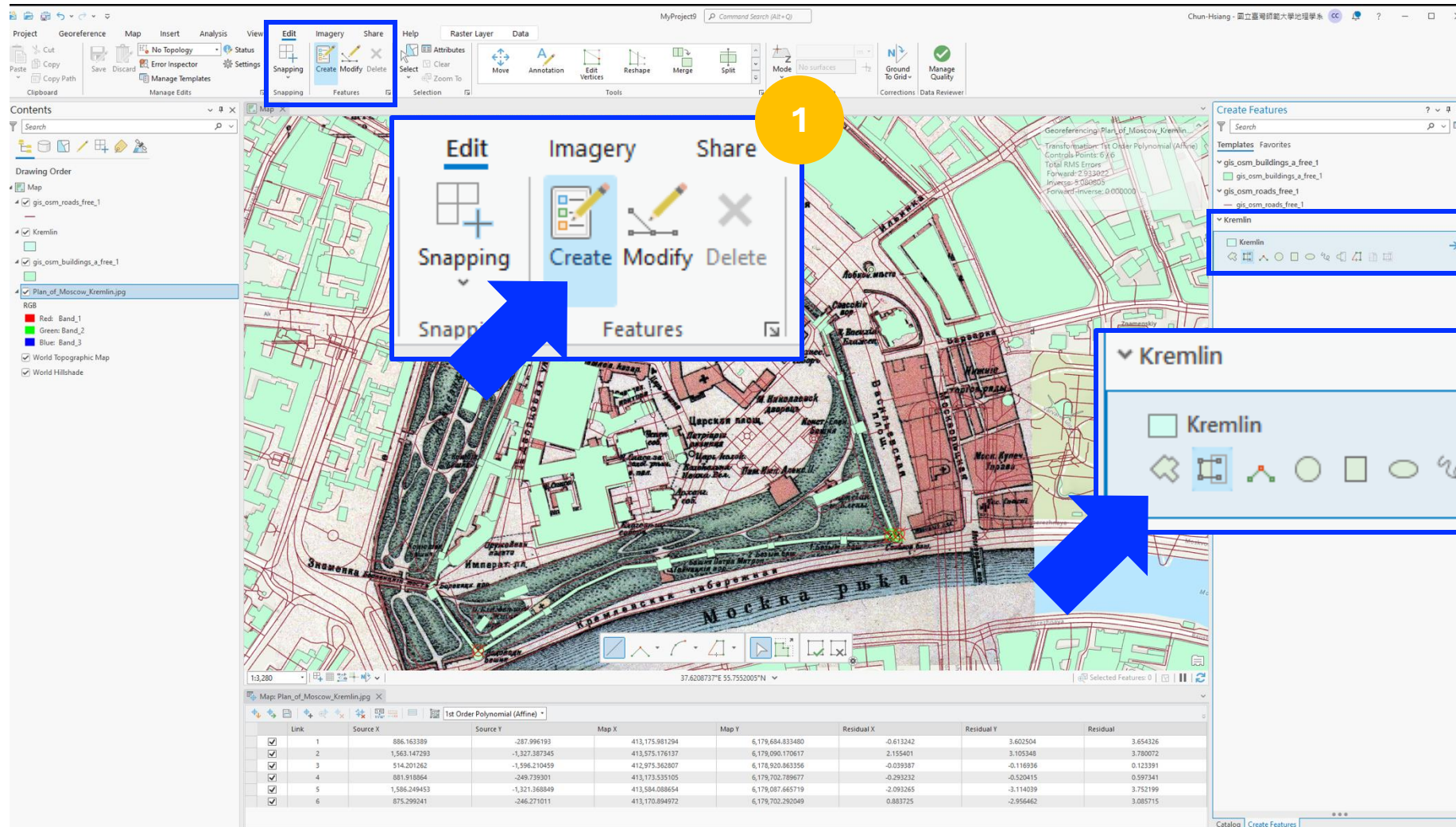
Control Point Table

Link	Source X	Source Y	Map X	Map Y	Residual X	Residual Y	Residual
1	886.163309	-287.996193	413.175.981294	6.179.604.823480	-0.613242	3.602504	3.654326
2	1.363.147299	-1.327.387345	413.575.176137	6.179.090.170617	2.155401	3.105348	3.780072
3	514.201262	-1.586.210459	412.975.362807	6.178.920.863356	-0.093387	-0.116936	0.123391
4	881.918864	-249.739301	413.173.535105	6.179.702.789677	-0.293232	-0.520415	0.597341
5	1.586.249453	-1.321.368849	413.584.088654	6.179.087.665719	-2.093265	-3.114039	3.752199
6	875.299241	-246.271011	413.170.894972	6.179.702.292049	0.883725	-2.956462	3.085715

Georeferencing



Editing :: Digitalization



Editing :: Digitalization

The screenshot shows the QGIS software interface with a map of the Moscow Kremlin. The 'Create Features' panel on the right is active, showing the 'Kremlin' layer. A blue arrow points from the 'Kremlin' layer to the map canvas. A yellow circle with the number '3' is also present.

Contents Panel:

- gis_osm_roads_free_1
- Kremlin
- gis_osm_buildings_a_free_1
- Plan_of_Moscow_Kremlin.jpg

RGB Legend:

- Red: Band_1
- Green: Band_2
- Blue: Band_3

World Topographic Map Legend:

- World Topographic Map
- World Hillshade

Georeferencing Plan of Moscow Kremlin:

- Transformation: 1st Order Polynomial (Affine)
- Controls Points: 6 / 6
- Total RMS Error: 0.00000
- Forward: 2.933072
- Inverse: 5.000000
- Forward Inverse: 0.000000

Map Canvas:

Map: Plan_of_Moscow_Kremlin.jpg

13,280

37.6244139°E 55.7552090°N

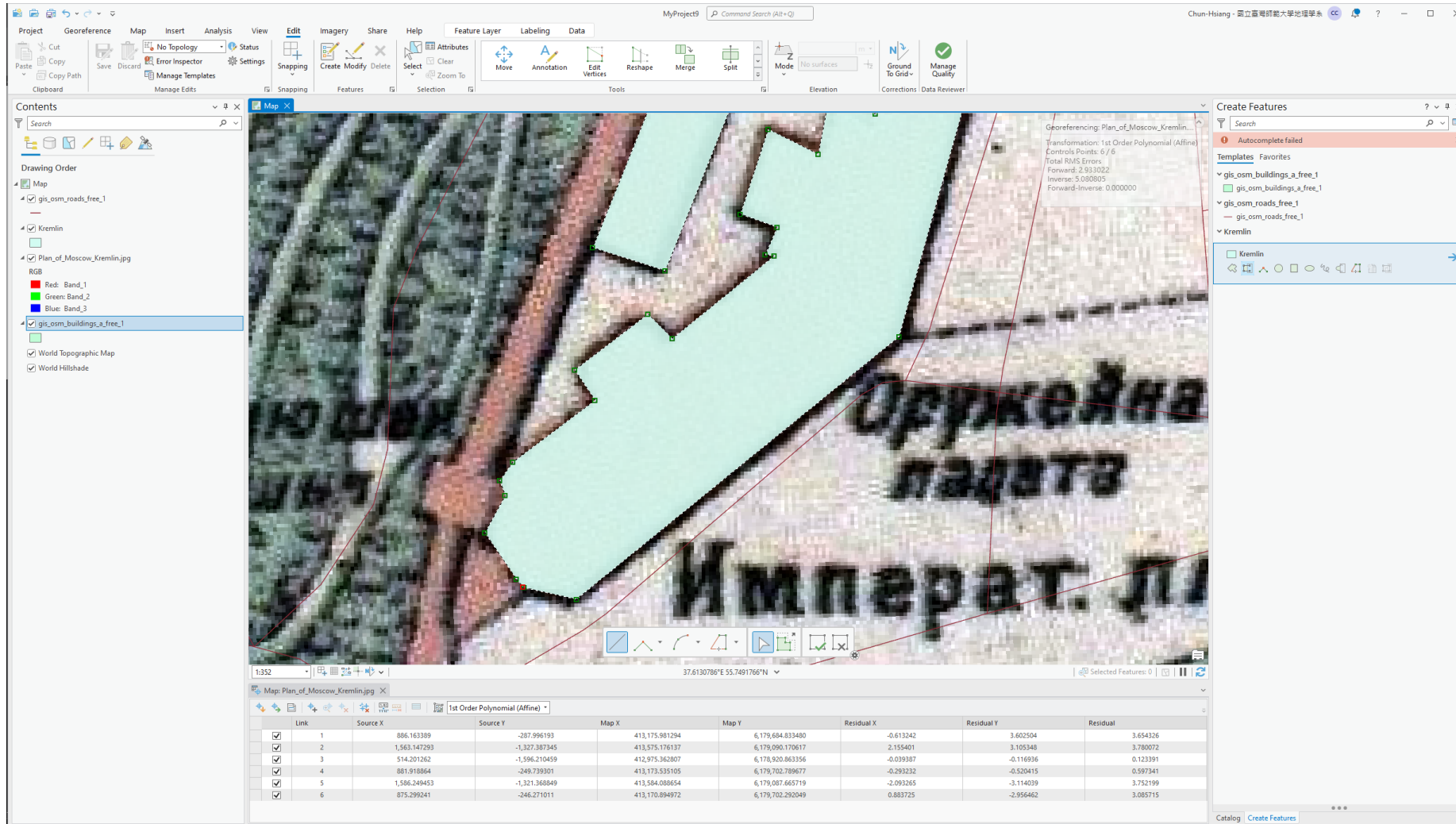
Table:

Link	Source X	Source Y	Map X	Map Y	Residual X	Residual Y	Residual
1	886.16389	-287.996193	413,175.981294	6,179,654.833480	-0.613242	3.602504	3.654326
2	1,563.147293	-1,327.387345	413,575.176137	6,179,090.170617	2.155401	3.105348	3.780072
3	514.201262	-1,596.210459	412,975.362807	6,178,920.863356	-0.039387	-0.116936	0.123391
4	881.918864	-249.739301	413,173.535105	6,179,702.789677	-0.293232	-0.520415	0.597341
5	1,586.249453	-1,321.368049	413,584.088654	6,179,087.665719	-2.093265	-3.114039	3.752199
6	875.299241	-246.271011	413,170.894972	6,179,702.292049	0.883725	-2.956462	3.085715

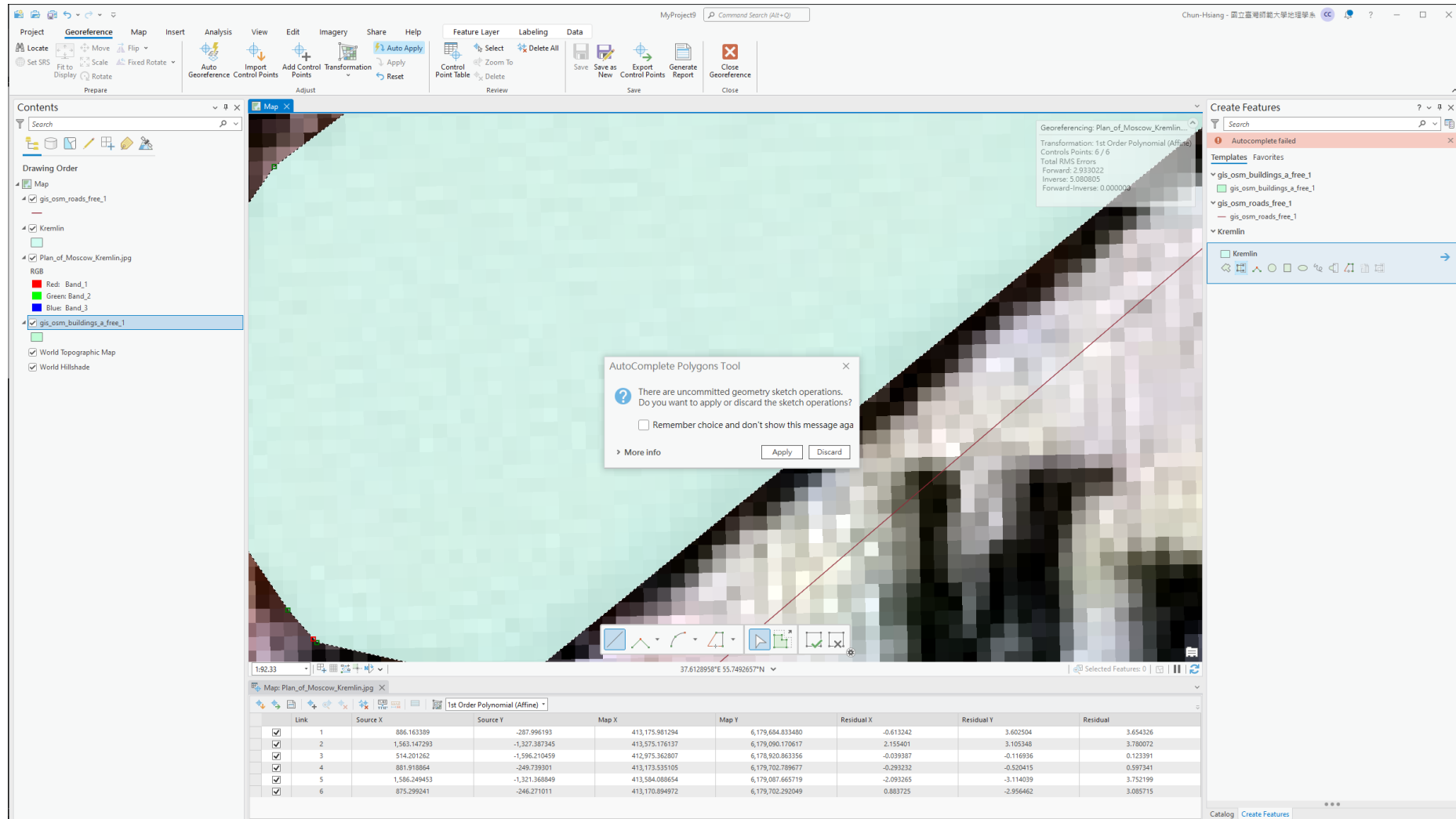
Map: Plan_of_Moscow_Kremlin.jpg

1st Order Polynomial (Affine)

Editing :: Digitalization



Editing :: Digitalization



Editing :: Digitalization

The screenshot displays the QGIS interface with a map of the Moscow Kremlin. The map shows various features like buildings, roads, and green spaces. The left sidebar contains the 'Contents' panel with a list of layers: 'Map', 'gis_osm_roads_free_1', 'Kremlin', 'Plan_of_Moscow_Kremlin.jpg', 'gis_osm_buildings_a_free_1', 'World Topographic Map', and 'World Hillshade'. The 'Kremlin' layer is selected. The bottom-left panel shows the 'Kremlin' layer's data table with columns: OBJECTID, SHAPE, Shape_Length, Shape_Area, Area, and Length. The table contains one row of data for a polygon.

OBJECTID	SHAPE	Shape_Length	Shape_Area	Area	Length
1	Polygon Z	1102.3117	9377.190438	<Null>	<Null>

Create a Feature Class for Erase the Overlapped Areas

Create Feature Class

Define

Name: Kremlin_shape4clip

Alias:

Feature Class Type: Polygon

Type of features stored in the feature class.

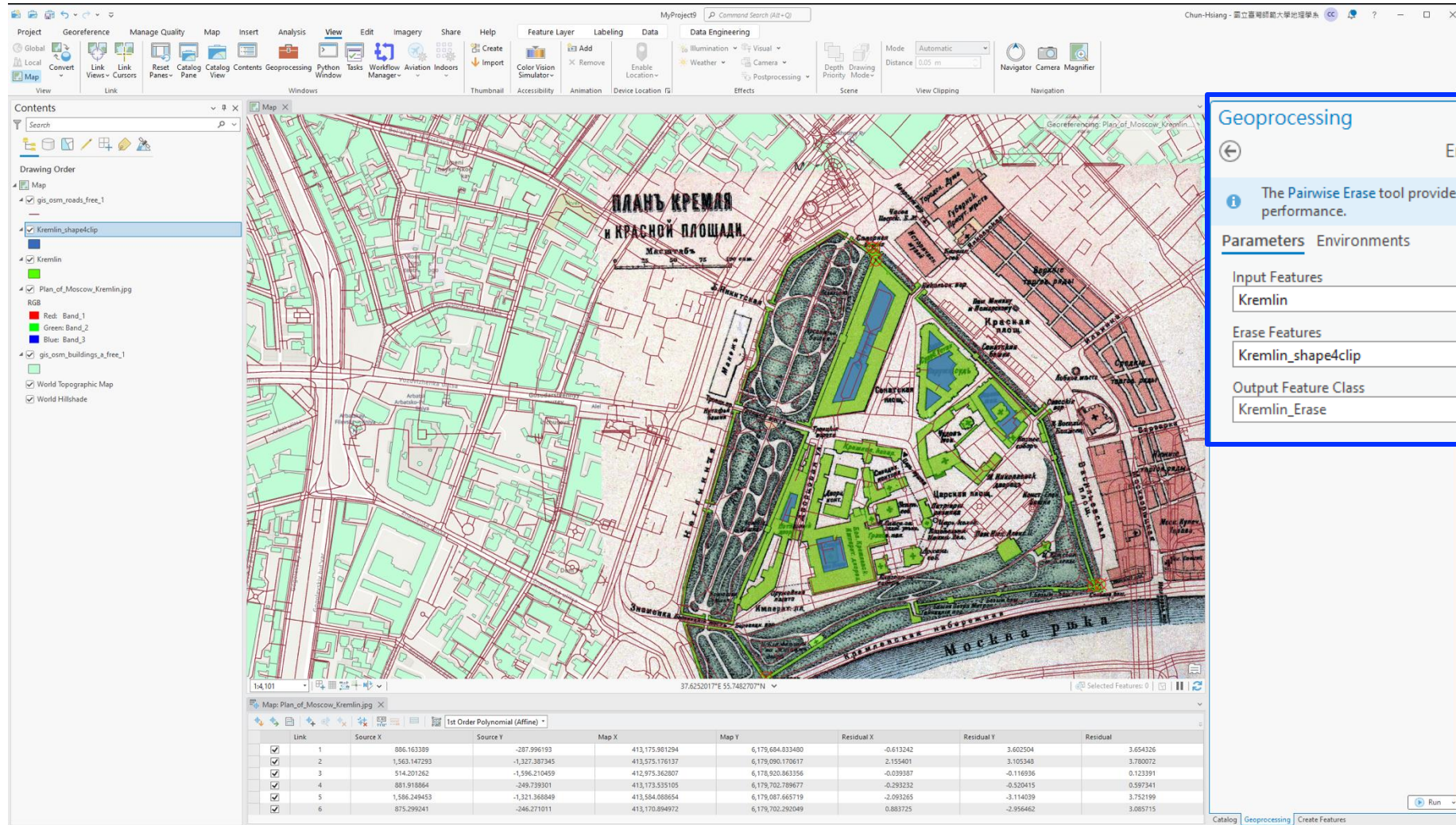
Geometric Properties

- ☐ M Values - Coordinates include M values used to store route data.
- ☒ Z Values - Coordinates include Z values used to store 3D data.

☒ Add output dataset to current map

Link	Source X	Source Y	Map X	Map Y	Residual X	Residual Y	Residual
1	886.163589	-287.996193	413.175.981294	6.179.684.833480	-0.613242	3.602504	3.654326
2	1,563.147293	-1,327.387345	413,575.176137	6,179,090.170617	2.155401	3.105348	3.780072
3	514.201262	-1,596.210459	412,975.362807	6,178,920.863356	-0.039387	-0.116936	0.123391
4	861.918864	-249.739301	413,173.535105	6,179,702.789677	-0.293232	-0.520415	0.597341
5	1,586.249453	-1,321.368849	413,584.088654	6,179,087.665719	-2.093265	-3.114039	3.752199

Erase the Overlapped Areas



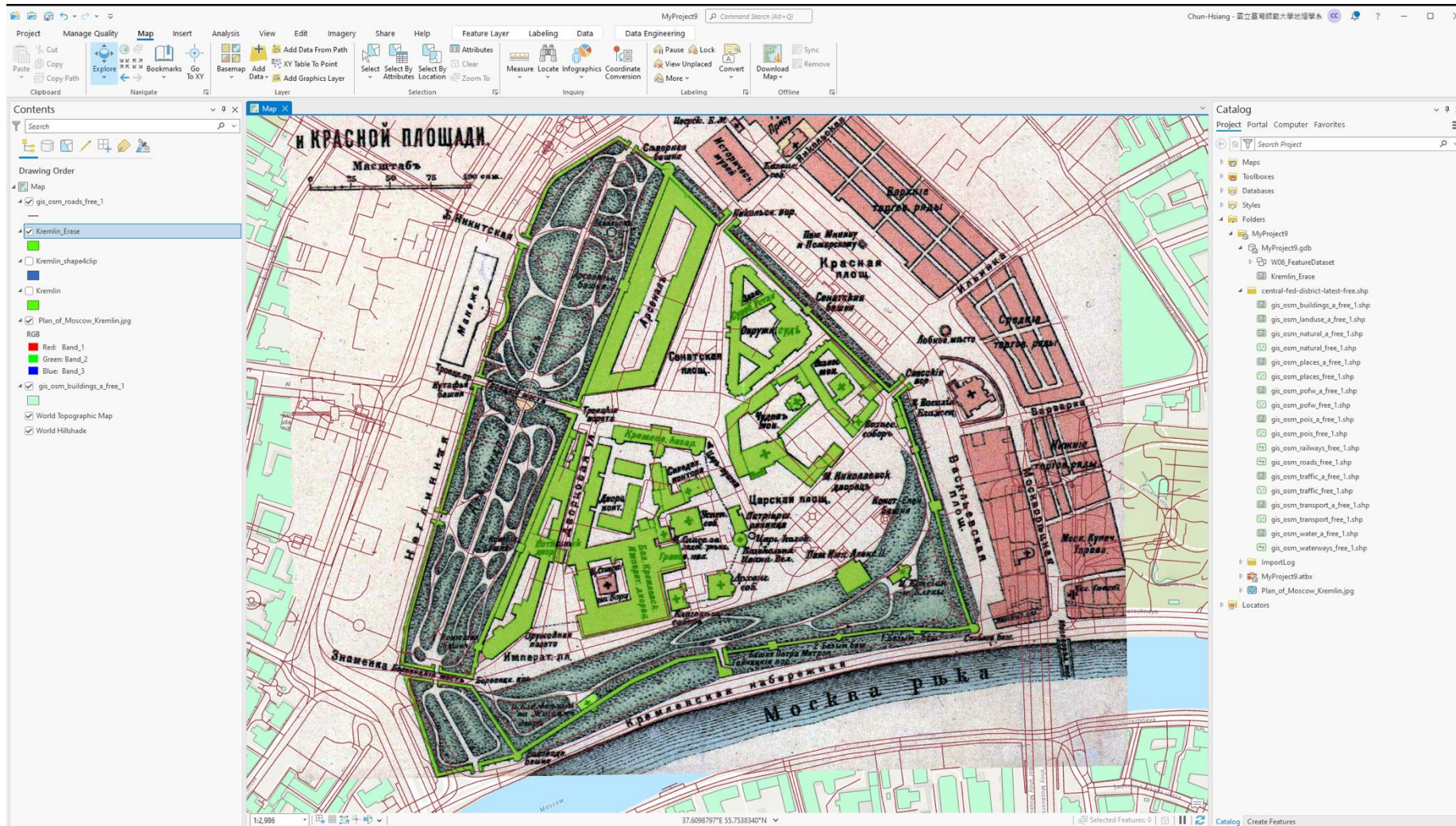
The screenshot shows the ArcGIS Pro interface with the Geoprocessing pane open. The Erase tool is selected, and the following parameters are configured:

- Input Features:** Kremlin
- Erase Features:** Kremlin_shape4clip
- Output Feature Class:** Kremlin_Erase

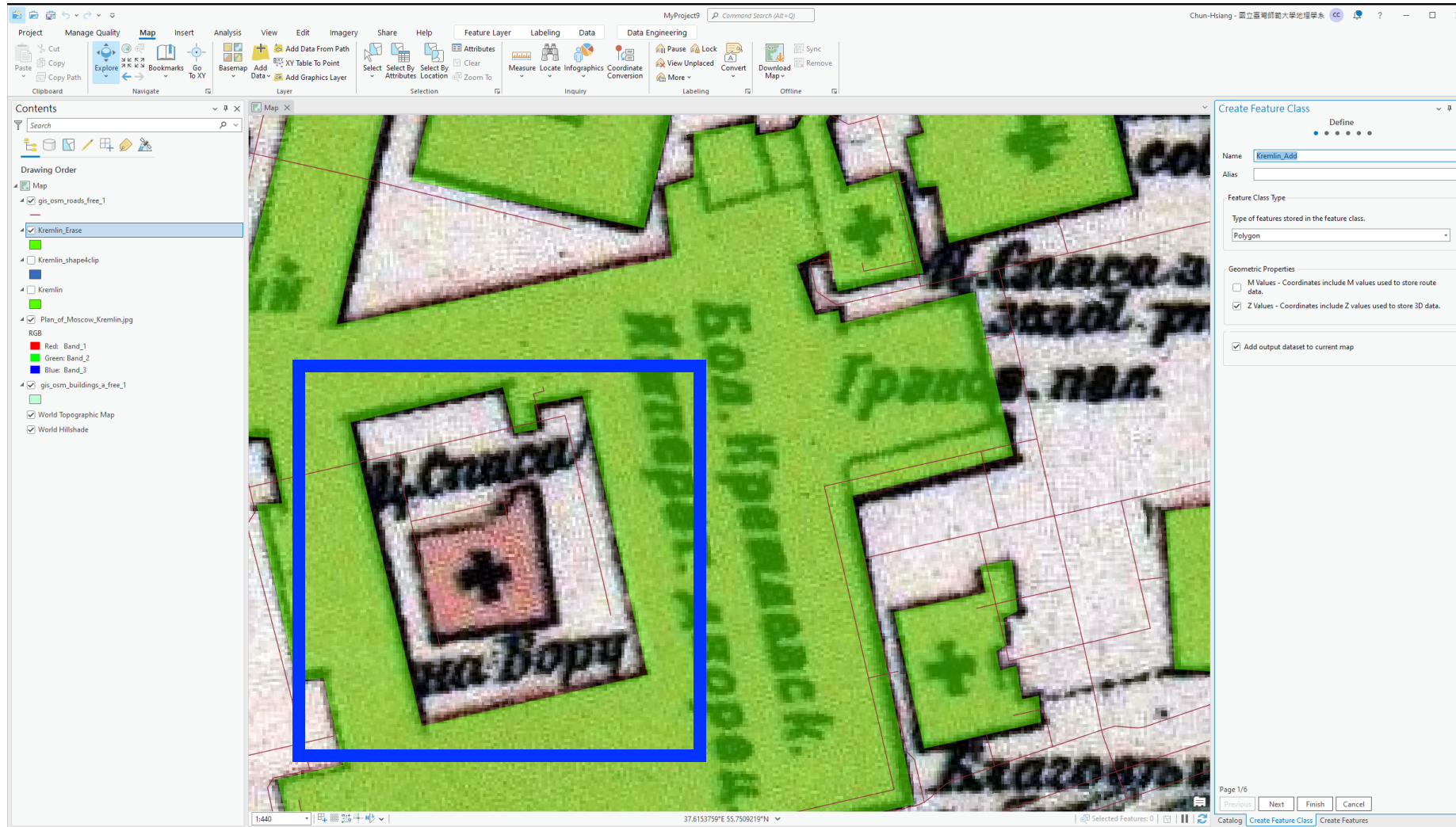
The map displays the Kremlin area with overlapped features, including the Moskva river and surrounding urban areas. The Geoprocessing pane also shows a table of residuals for the 1st Order Polynomial (Affine) transformation.

Link	Source X	Source Y	Map X	Map Y	Residual X	Residual Y	Residual
1	806.163389	-287.996193	413.175.981294	6,179,684.933400	-0.613242	3.602504	3.654326
2	1,563.147293	-1,327.387345	413,575.176137	6,179,090.170617	2.155401	3.105348	3.780072
3	514.201262	-1,596.210459	412,975.362807	6,178,920.863356	-0.039387	-0.114696	0.123391
4	881.918864	-249.739301	413,173.535105	6,178,702.788677	-0.293232	-0.520415	0.597341
5	1,586.249453	-1,321.368849	413,584.088654	6,178,087.665719	-2.093265	-3.114039	3.752199
6	875.299241	-246.271011	413,170.894972	6,178,702.292049	0.883725	-2.956462	3.085715

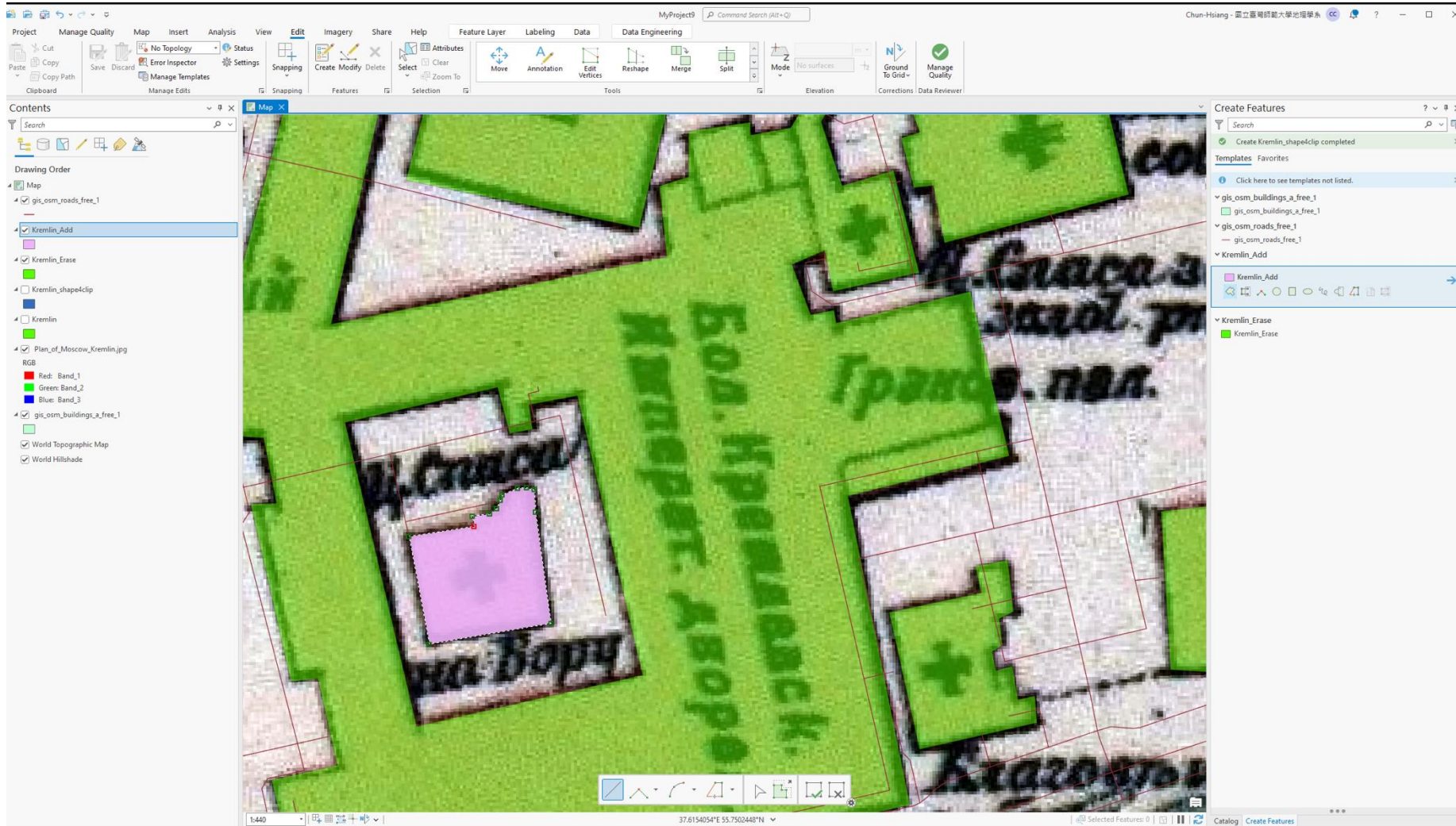
Erased the Overlapped Areas



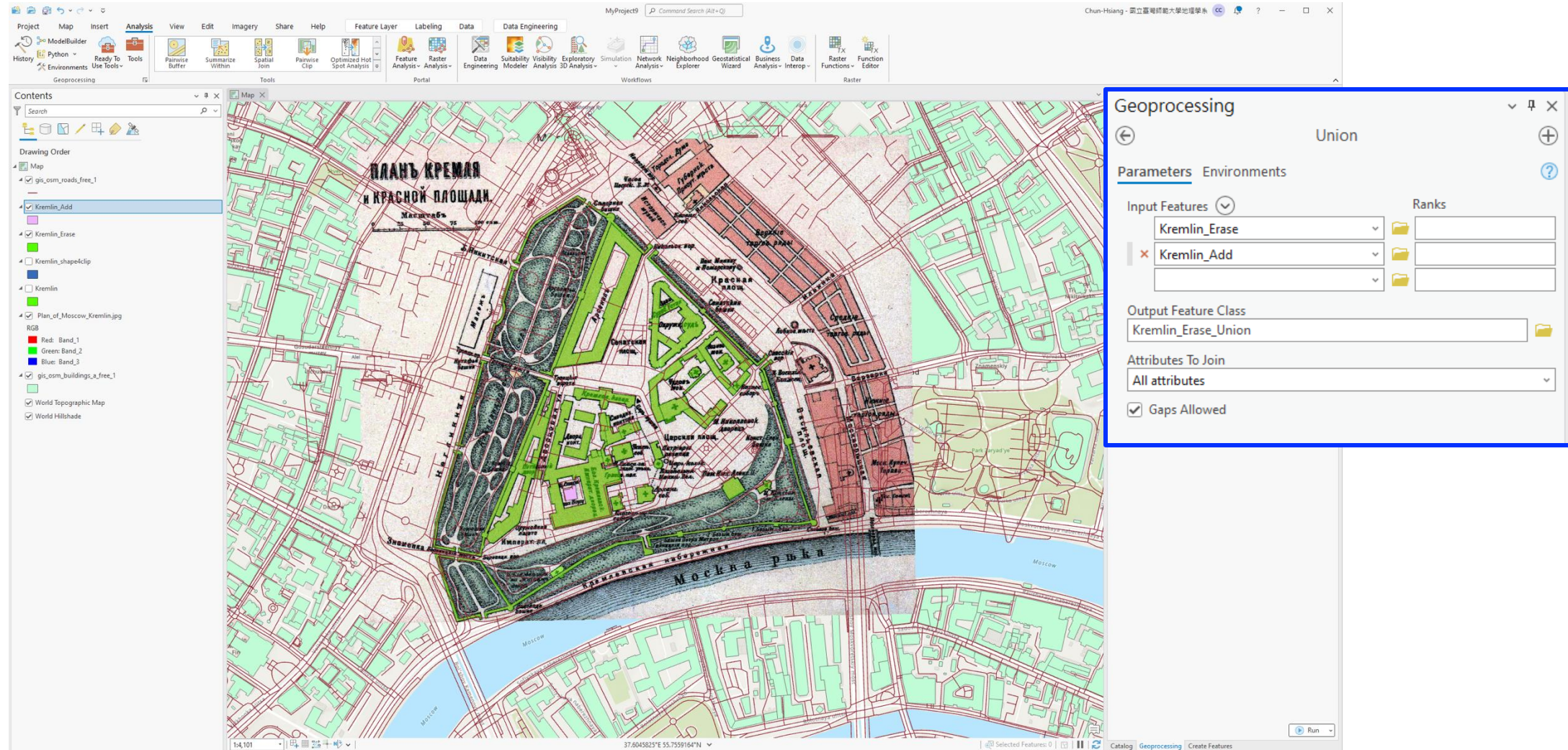
Create a Feature Class for Adding Polygon



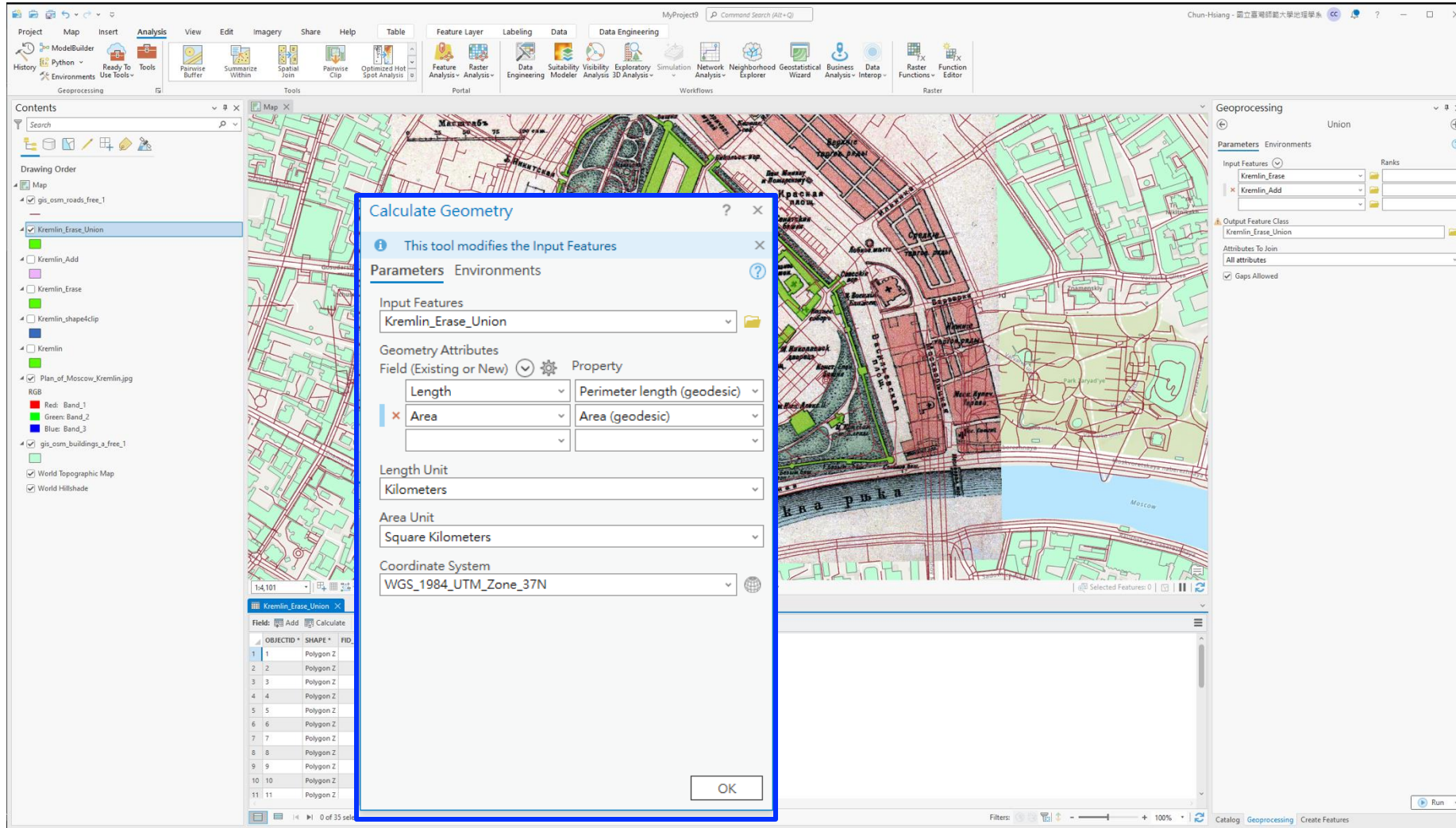
Create a Feature Class for Adding Polygon



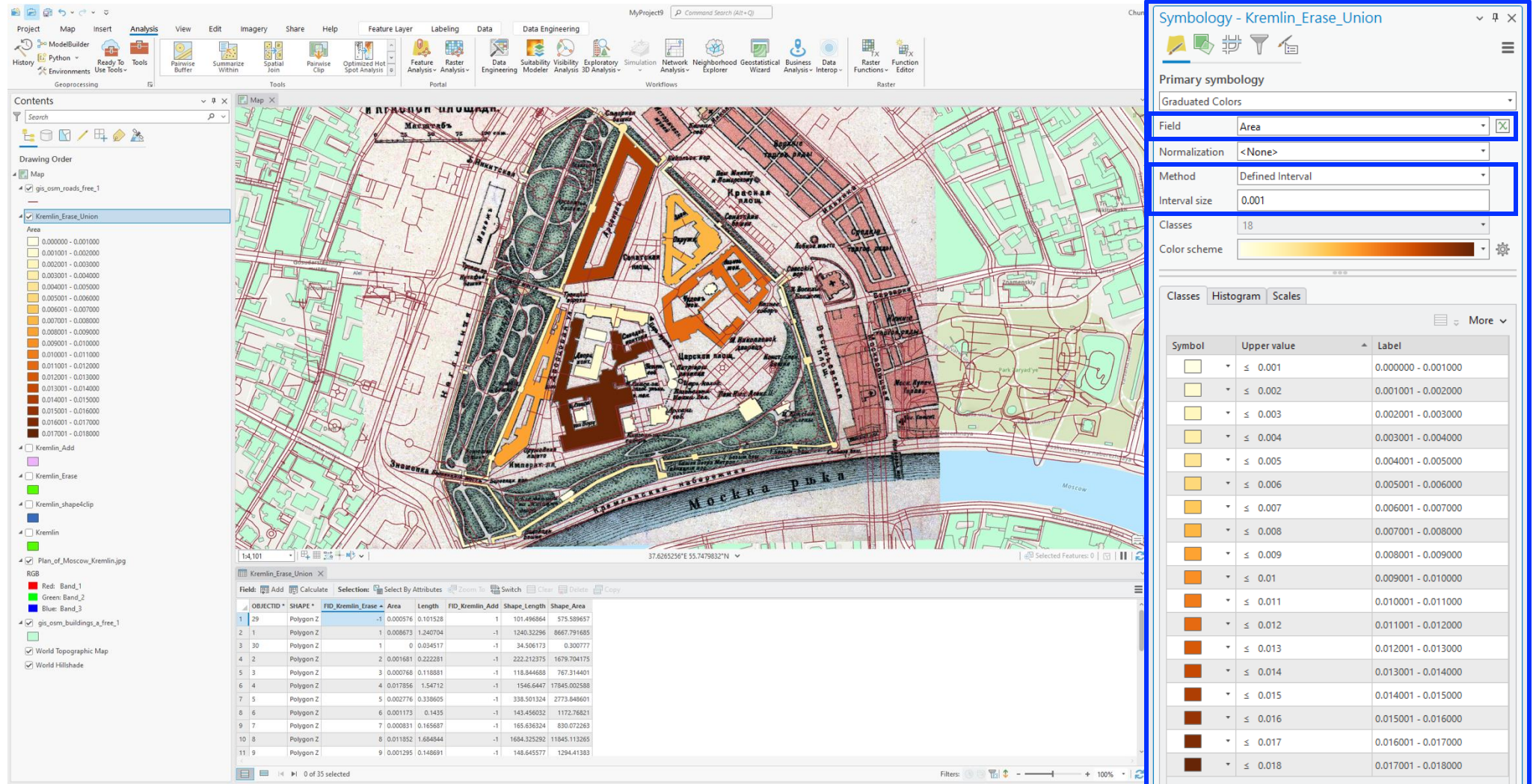
Union Two Shapefiles Together



Calculate Geometry



Symbology with Building Areas



A satellite night view of Earth, showing a dense network of city lights and connections across the continents, primarily North and South America. The lights are bright yellow and orange, contrasting against the dark blue of the oceans and the black of space.

The End

Thank you for your attention!

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Web: toodou.github.io