Lab Report

Title: Lab 2
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Project Repository: https://github.com/cavaz020/GIS5571/
Google Drive Link: N/a
Time Spent: 35 hrs

Abstract
250 words max. Clearly summarize the following major sections. Each gets one or two sentences.
In this lab, I used skills from past labs to create an ETL system to download LiDAR data and manipulate said data with arcpy. I also performed analysis of the data in 2D versus 3D. The latter part of this work involved me

Problem Statement
The problem at hand involves using skills we have learned in API queries with raster, cube, TIN, and Terrain data transformation steps to create an extract, transfer, and load system for LiDAR data from the Minnesota DNR's FTP server. Within this work, we will use ArcPro to perform side-by-side exploratory spatial data analysis using 2D and Scene views. Finally, the final part of the work will involve us using ArcPy to export a visualization of LiDAR data to PDF format.

The second part of this problem involved describing and building an ETL in ArcPro Jupyter Notebooks that downloads the annual 30-Year Normals .bil files for precipitation from PRISM, converting the data into a spacetime cube and exporting it to disk.

Table 1. Qualitative elements used in this work

#	Requirement	Defined As	(Spatial) Data	Attribute Data	Dataset	Preparation
1	MNDNR FTP	A File Transport Protocol (FTP) is a standard communication protocol used for the transfer of computer files from a server to a client on a computer network.	LiDAR data		LiDAR Example dataset from MNDNR FTP (21-Mar-2012 09:10 372M)	N/A
2	PRISM Data	30-Year Normals .bil files for precipitation	PRISM .bil file		30-Year Normals for Precipitation	N/A

Input Data
The two main datasets used in this project were a LAS file from MN DNR and PRISM data in the form of a .bil file of 30 year normals of precipitation. Their purpose is described below and the methods section details the processes.

Table 2. Data used in these analyses.

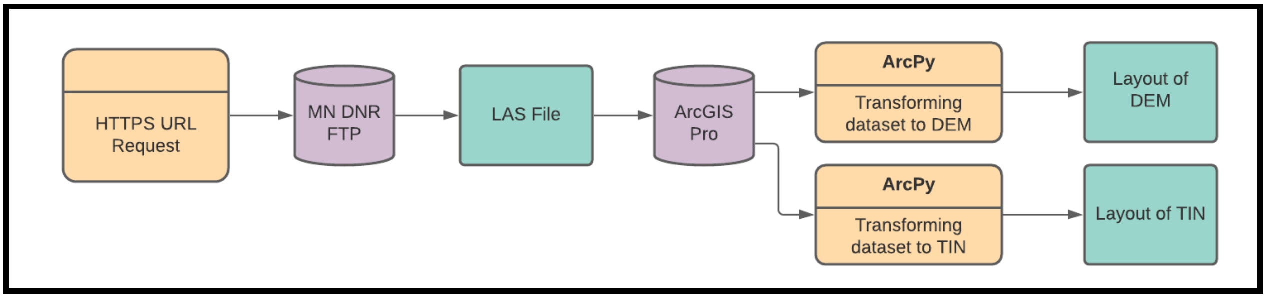
#	Title	Purpose in Analysis	Link to Source

1	LAS File from MN DNR FTP	LiDAR Example dataset from MNDNR FTP to be converted to DEM and TIN	21-Mar-2012 09:10 372M
2	30-Year Normals .bil files for precipitation	Used for creation of a spacetime cube	30-Year Normals for Precipitation

Methods

LAS Manipulation

Figure 1. Data flow diagram of downloading a LAS dataset from MNDNR FTP.

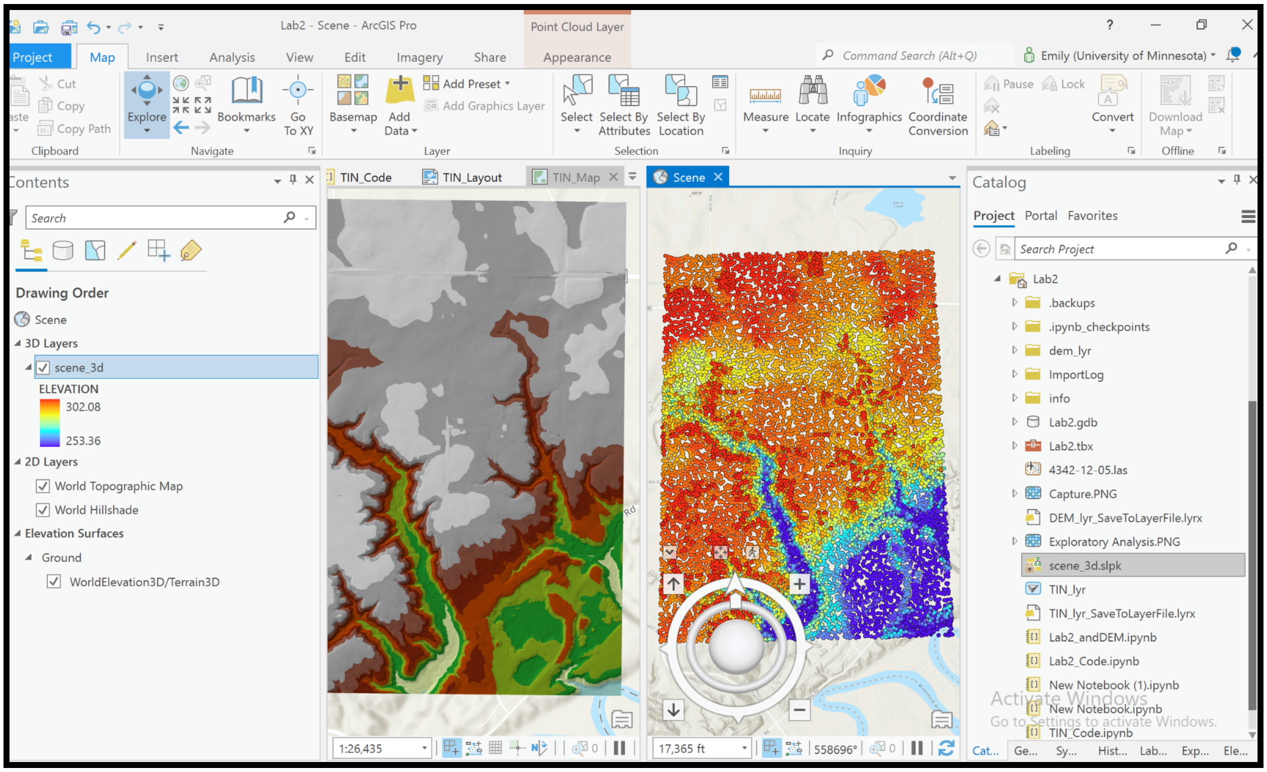


I downloaded a LAS file from the MNDNR FTP and put it into my directory using arcpy. I then used arcpy to manipulate the dataset and transform it into different file types. One file type was the DEM which held the pixel values and the other was a TIN which held more information such as aspect and slope and visualized this data using colors that make the image look more 3-dimensional.

Exploratory Analysis

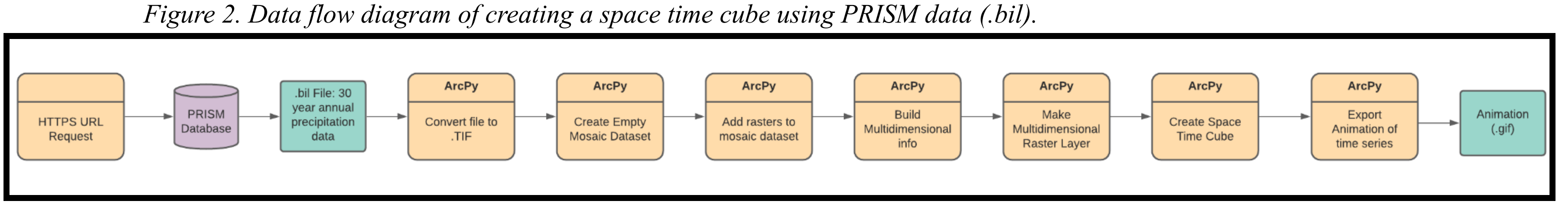
2D features store x and y coordinates with their geometry whereas 3D features store x, y, and z coordinates with their geometry. In ArcGIS Pro, the differences first strike me in the color ramps. For the 2D image on the right, the color ramp is from black to white with grays in between. For the 3D image on the left, the color ramp is represented by a colorful color ramp.

Image 1. TIN vs 3D scene.



Spacetime Cube

Figure 2. Data flow diagram of creating a space time cube using PRISM data (.bil).

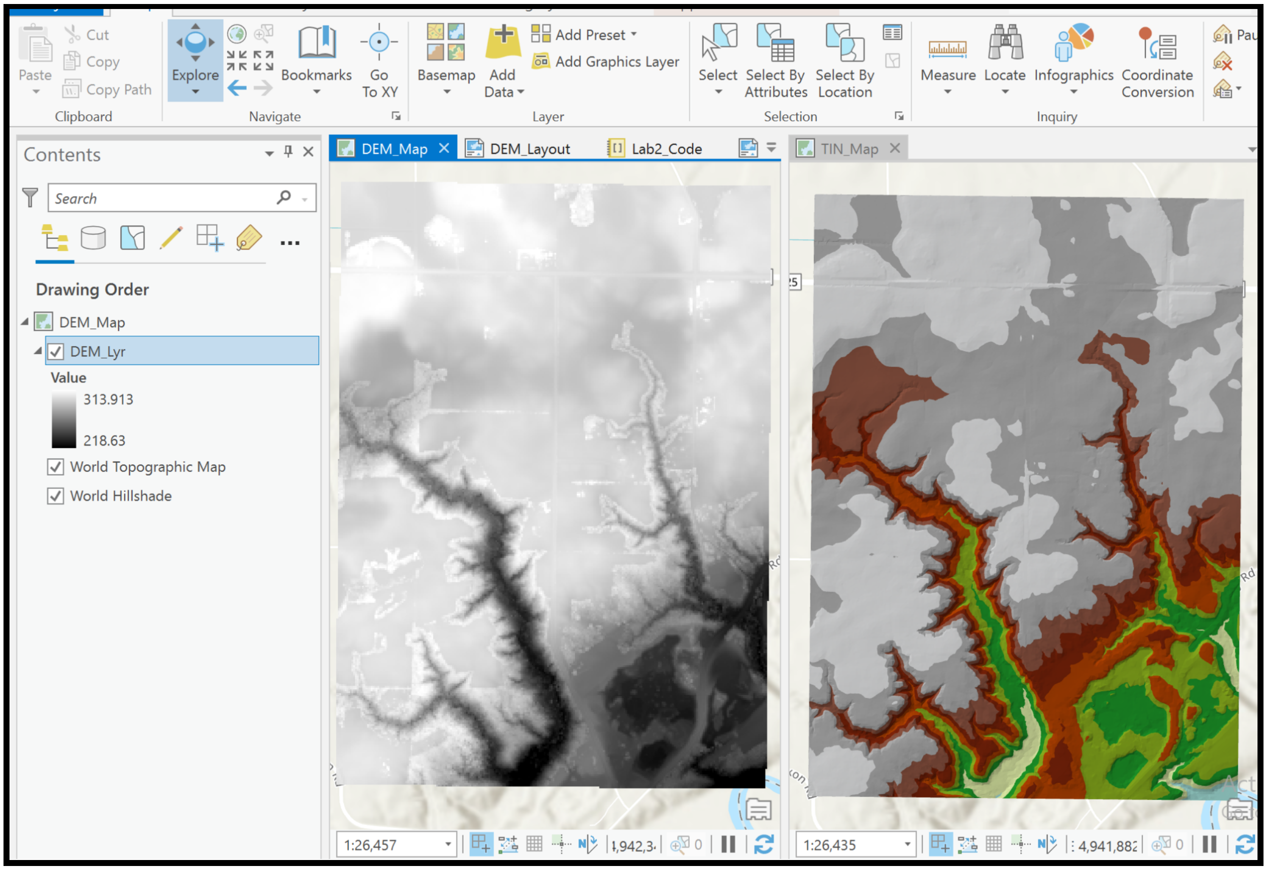


The creation of the spacetime cube was a very long process. I created a tif using the PRISM data and then added the rasters to a mosaic dataset. I then built the multidimensional information by creating two variables - one describing the data in text form (ppt to represent that it is about precipitation) and the other using an arcade expression to capture the timestamp of all of the data. The expression I used was as follows: DateAdd(Date(1981,0,1), $feature.OBJECTID-1, ‘year’). Finally, I created a multidimensional raster layer and created a space time cube.

Results

The resulting DEM and TIN rasters are pictured below. This was a fairly simple process.

Image 2. Resulting DEM and TIN rasters.



I was not able to visualize the spacetime cube in ArcGIS Pro because it was too costly and my computer would crash.

Results Verification

I was also not really able to export the time-enabled data as a gif but I was able to view it and move through the slider myself.

Discussion and Conclusion

What did you learn?

I learned a lot about rasters in this lab. I learned how to convert them to different file types and what those file types could be used for. This also carried over to the second part of the lab in creating a cost surface raster. I also learned about space time cubes although they are still a bit of an enigma in my opinion. I also learned that you are able to export time enabled data into a gif format although I would love to have more time to practice this and actually produce a tangible product in the future. The 3D scene was also new for me to use and I'm not sure how this would be useful so this would also be something to practice using and applying it to more real world scenarios.

References

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3. *ArcGIS User Seminar – Time-Enabled 3D Spatial Analysis Using a Space Time Cube in ArcGIS Pro (Elec)*. n.d. Accessed October 24, 2021. https://www.esri.com/watchvideoid=3llyL0biFlw.
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5. "Introduction to Arcpy.Mp—ArcGIS Pro | Documentation." n.d. Accessed October 24, 2021. https://pro.arcgis.com/en/pro-app/latest/arcpy/mapping/introduction-to-arcpy-mp.htm.
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12. N.d. Accessed October 24, 2021a. https://prism.oregonstate.edu/documents/PRISM_formats.pdf.
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Self-score

Category	**Description**	**Points Possible**	**Score**
Structural Elements	All elements of a lab report are included **(2 points each)**: Title, Notice: Dr. Bryan Runck, Author, Project Repository, Date, Abstract, Problem Statement, Input Data w/ tables, Methods w/ Data, Flow Diagrams, Results, Results Verification, Discussion and Conclusion, References in common format, Self-score	28	**28**
Clarity of Content	Each element above is executed at a professional level so that someone can understand the goal, data, methods, results, and their validity and implications in a 5 minute reading at a cursory-level, and in a 30 minute meeting at a deep level **(12 points)**. There is a clear connection from data to results to discussion and conclusion **(12 points)**.	24	**20**

Reproducibility	Results are completely reproducible by someone with basic GIS training. There is no ambiguity in data flow or rationale for data operations. Every step is documented and justified.	28	**24**
Verification	Results are correct in that they have been verified in comparison to some standard. The standard is clearly stated **(10 points)**, the method of comparison is clearly stated **(5 points)**, and the result of verification is clearly stated **(5 points)**.	20	**18**
		100	**90**