Labs 2-4: Cartography

GISC422

Introduction to GIS

Lab Stream 03 (Wednesday)

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1. LAB 2: INTRO TO ARCGIS PRO AND MAP PROJECTIONS

1.1 Summary

1.1.1 Introduction

The goal of this laboratory exercise was to investigate how different map projections distort or retain certain geographic features. Some projections are more suitable than others in certain situations and these are investigated in this lab exercise.

1.1.2 Methods

The first projection considered was the WGS 1984. The datasets used represent the locations of cities, the boundaries of countries, and intervals of latitude and longitude. The data frame gets its coordinate system from the first dataset, so this needed to be changed to WGS 1984. Multiple maps were produced, each with a different projection. The next was a conformal Mercator projection, followed by an equidistant conic projection, and finally, a cylindrical projection was chosen as an equal area projection for the last map. The relative sizes of Australia and Greenland were compared in each projection.

1.1.3 Results

The four maps produced are displayed in a layout in Figure 1. This clearly demonstrates the different aspects that are distorted in different types of projections.

1.1.4 Discussion

In the WGS1984 projection, Australia and Greenland appear to be of similar size, but by checking the counties attributes it was found that Australia was significantly larger in real life.

The conformal Mercator projection preserves shape and angle. The shapes of Greenland and Australia appeared to be accurate, however Greenland appears significantly larger than Australia in area.

The equidistant conic projection preserves distances but not shapes or areas. The area of Australia and Greenland appear to be closer to expectation but will not be an accurate area representation in this projection. Both appear heavily distorted.

The cylindrical projection distorts shape and distances but preserves area. This projection finally represents Australia and Greenland in its relative real-world area.

A spherical world cannot be represented in a way where all aspects are preserved in 2-dimensional space. Therefore, projection selection is incredibly important and should be made with the uses of the projection in mind.

1.2 Graphics

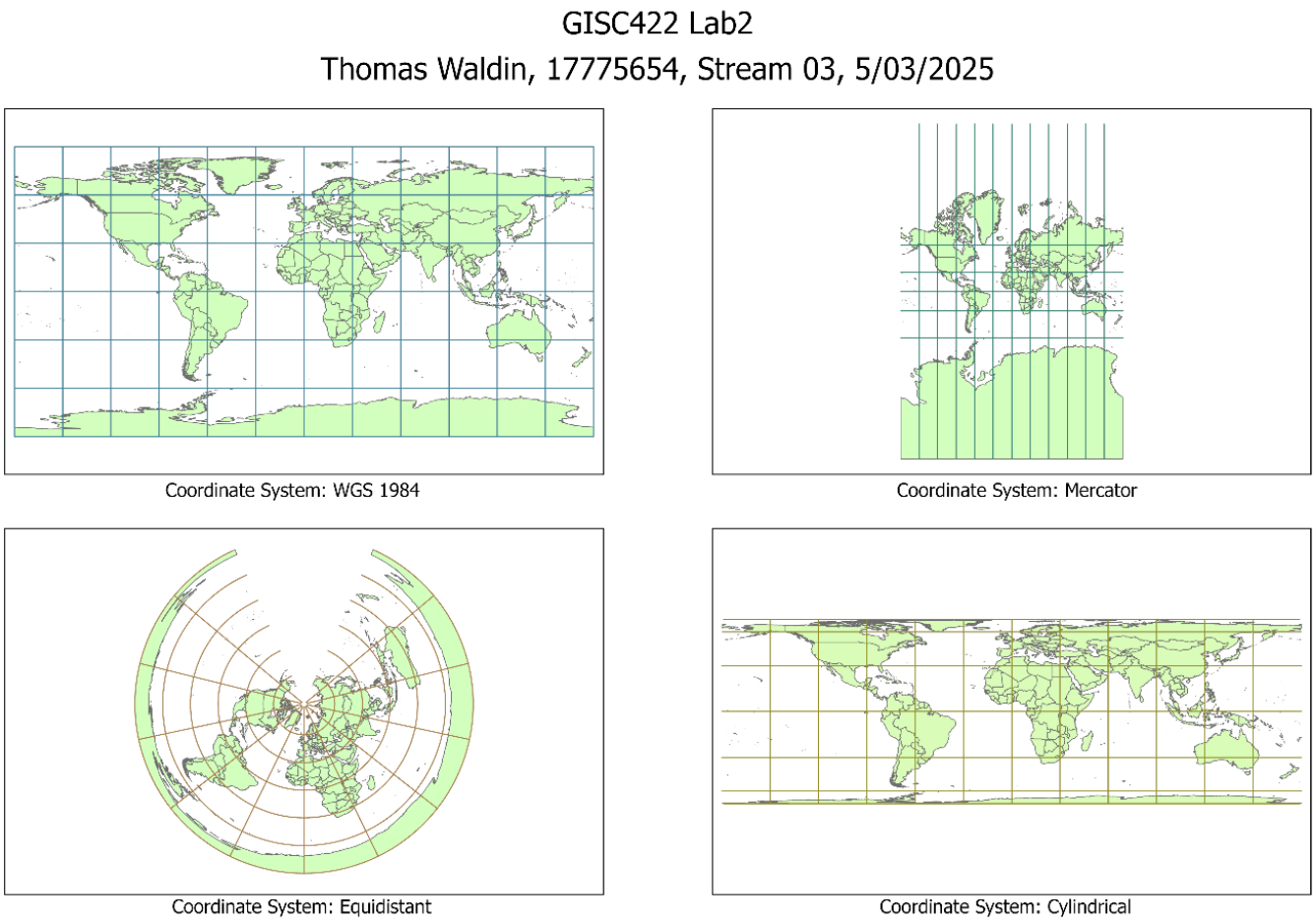

Figure 1: *A layout showing four different map projections, the WGS 1984, a conformal Mercator, an equidistant conic, and an equal-area cylindrical projection. Each projection preserves and distorts different geographic features.*

2. LAB 3: AERIAL PHOTOGRAPHS, DISTORTION, AND FEATURE CAPTURE

2.1 Summary

2.1.1 Introduction

The aim of this laboratory exercise is to gain an understanding of how to geo-reference air photos and digitise features from them, while having an awareness of accuracy and sources of error.

2.1.2 Methods

A new map was created with the coast of New Zealand automatically geo-referenced in the NZTM coordinate system. An air image of the UC campus was brought in and needed to be manually geo-referenced. The method to geo-reference the image used an existing georeferenced data source; in this case it was the road layer around UC. A 'fit to display' placed the image in the general area, then the fit was fine-tuned by adding a series of control points at road intersections. Once georeferenced, the resolution of the image could be found by measuring the pixel size in real world units.

Digitising is the process where information is converted into a digital format. In this exercise buildings and parking lots visible in the aerial image are digitised to vector features. A feature class was created, and the footprint of the law building was sketched, estimating where the obscured footprint would be behind the radial displacement of the roof.

The parking area south of the Law building was also digitised, following a similar method. The polygon was split to create areas for staff, students, visitors, and bicycles.

2.1.3 Results

The digitisation of the law building footprint was compared to a georeferenced file of UC buildings and was found to be fairly accurate.

The digitisation of the Law building carpark is presented in Figure 2.

2.1.4 Discussion

There are many things that can cause distortion in aerial photos, such as the tilt and angle of the camera. Orthorectification can alleviate some distortions but this orthorectified image may have been ground only, as the tops of tall buildings appeared displaced from their footprints. The example used in this exercise was the Law building and is an example of radial displacement.

2.2 Graphics

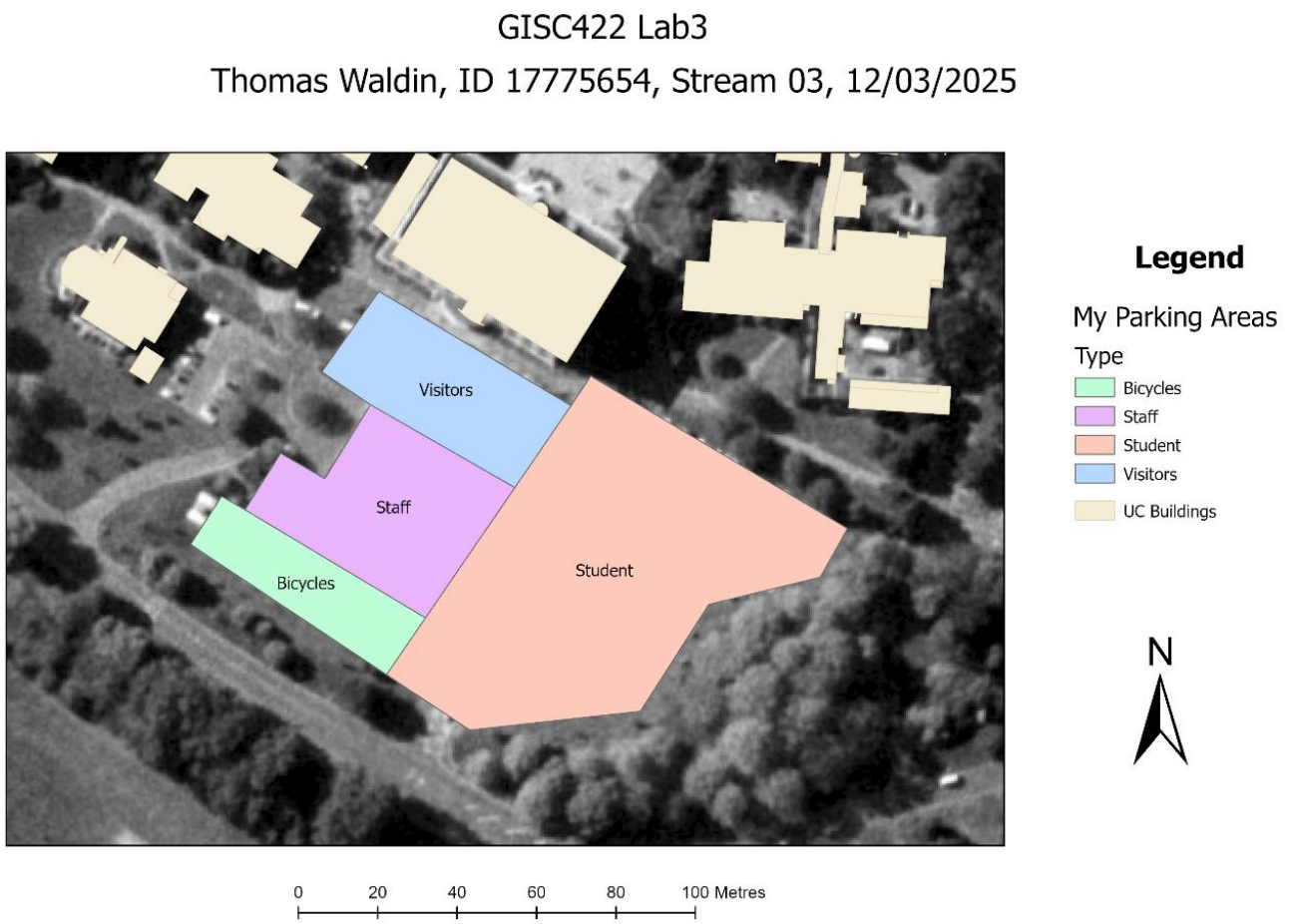

Figure 2: *A layout of the Law building carpark, digitised and split into proposed parking areas for students, staff, visitors, and bicycles. The carpark was digitised from a geo-referenced image of the UC campus and surveyed data of UC Buildings is shown over top.*

3. LAB 4: MAP LAYOUTS

3.1 Summary

3.1.1 Introduction

The objective of this laboratory exercise is to be exposed to a range of the cartographic functionality of ArcGIS Pro and to produce a comprehensive map layout of the USA and Canada.

3.1.2 Methods

A regional map was generated, centred on continental North America and features of countries, lakes, and rivers were added. A projection was applied to the map and appropriate symbology was added to the lakes and rivers. Different countries were symbolised by their political affiliation and all other than the USA and Canada were excluded from the map. Cities were also added to the map and the capital cities of Ottawa and Washington D.C. were symbolised differently. River and country labels were also added. Both the Regional and World map frames were placed on a layout, with an added legend and other frame specific features. The world map was converted to a 'world from space' projection and the regional map extent was shown over it.

3.1.3 Results

The finished layout is shown in the Graphics section as Figure 3. The regional map shows the countries, water bodies, and major cities in continental North America.

3.1.4 Discussion

When choosing a projection to apply to the map, Equal Area/Albers or Conformal/Lambert were considered. The Conformal/Lambert was chosen, as the relative distortion of the northern islands of Canada was less than the Equal Area/Albers projection.

Some of the map labels were missing due to conflicts with other labels. In maps showing a large area, thoughtful feature selection needs occur, so that the map does not become too crowded, but still achieves its purpose. As the map shows multiple countries, it was decided that the capital cities needed to be prioritised, and other cities included provide geographic context.

3.2 Graphics

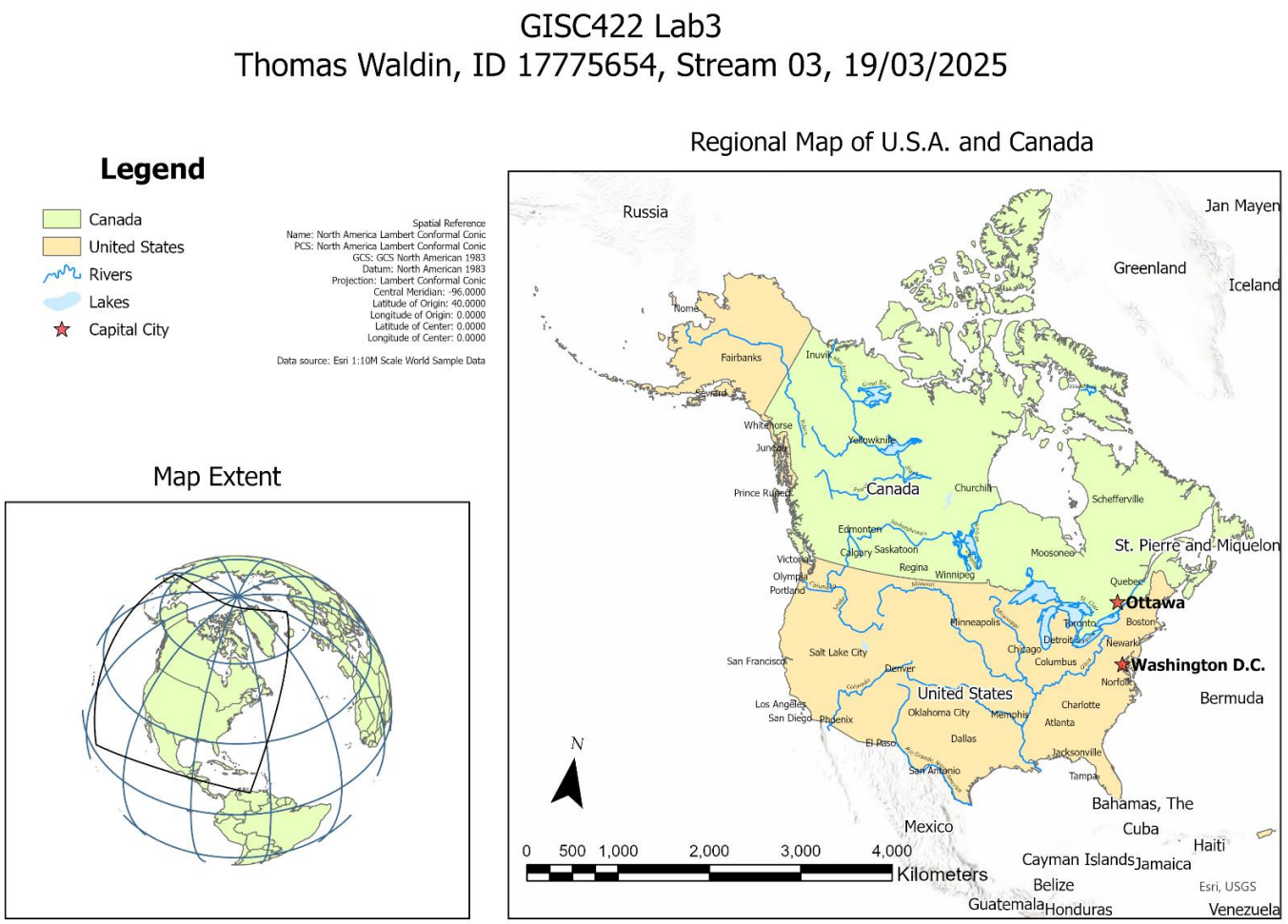

Figure 3: *A comprehensive regional map of continental North America, specifically showing the USA and Canada, along with the capital cities, some major cities, and notable rivers. A legend describes the map features, and the map extent is shown on a globe-style world map.*