Final Report: AmericaView Mini Grant to IowaView, GY15

Project Title: Develop an Image Stitching and Georeferencing Process for FSA Slide Scans using Microsoft Image Composite Editor and ArcGIS

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Project Background

The USDA Natural Resources Conservation Service (NRCS) has access to slides of aerial imagery flown as part of crop compliance for the Farm Service Agency (FSA) in Iowa. In 2015, thousands of color slides were scanned and saved to .tif format for flights in the 1970s, 1980s, 1990s and early 2000s. Each slide covers roughly two sections of land, an average Iowa township contains 36 sections, and an average Iowa county has 16 townships. The NRCS would like to have the slides available for use in GIS software for historical evaluation of land but the vast number of individual slides makes georeferencing each one individually time prohibitive. In order to make these data more useful, a process was developed to mosaic and georeference the images in a larger spatial aggregate than two sections.

Methods

Microsoft offers a free software package called Image Composite Editor (ICE) originally developed to stitch together individual photographs into a panorama. The software also seems to be quite good at creating stitches of aerial imagery with minimal input and then outputting a .tif. A pilot project was begun in late summer 2016 to test the ability of the software to handle a township or county level of imagery as input. Expensive software, such as ERDAS Imagine, exists that can tie together multiple input images into a mosaic but requires the software license, training and tie points. The NRCS was looking for a solution that would minimize the input needed to mosaic the individual slide scans, reduce the specialized training needed to run the process and access software that is either free or low cost.

An ISU student was hired to work hourly developing a repeatable and reliable process to stitch together individual slide scans for Iowa counties by township. The ICE software has many input parameters that affect the output image and each of those were tested to see the result on the same image. After doing a test county, the student realized that Simple Panorama, Auto Detect Camera Motion and Structured Panorama as the three input settings produced a good mosaic almost every time. The next best option if road mismatch occurred was to change Simple Panorama to Planar Motion with Perspective.

The ICE software produced an output .tif that was georeferenced in ArcGIS to produce a geotif. The student explored ArcGIS georeferencing settings to produce the best result given the input imagery. The best resulting imagery for this project was produced with a Spline Transformation and 30 – 40 tie points on the mosaicked image; in rough terrain more tie points were used. Images were resampled and saved out with the georeferencing tool Rectify to produce a new image with specified cell size and cubic convolution resampling.

Results

The main goal of the project was to make the color imagery available in a GIS format that could be used by anyone with the proper technology. To that end, ArcGIS Server services were created by decade for the imagery and served through the ISU GISF as REST services which will be updated as funding allows for additional work. The link to the REST services is:

https://athene.gis.iastate.edu/arcgis/rest/services/ortho. The three produced for this project are named ortho/usda<year>; currently some imagery is served for 1979, 1981 and 1991. Seven counties were completed for this funded period and some counties had more than one decade of imagery. Not all completed imagery is part of the ArcGIS service for a particular decade yet; image results are reviewed by the NRCS project collaborator before going live on the service.
Another goal of the project was to generate a repeatable process for image stitching/mosaicking and georeferencing so the process can be passed on to other staff to continue the work. The student wrote two very detailed process documents with screen shots and descriptions of steps – one for the ICE software and one for ArcGIS georeferencing. Lastly, the student gained knowledge about new software, learned a new process in ArcGIS, gained confidence with ArcGIS and GIS processes overall and was exposed to changes in the Iowa landscape over the last 40 years.

Student Statement

"Over the past year, I have worked at the Iowa State University GIS Facility as a Student GIS Technician geo-referencing historic aerial imagery to current satellite imagery. My role at the ISU GIS Facility has been a pilot program, so to speak, since I was tasked with figuring out the most efficient way to make a mosaic of the historic aerial photographs using Microsoft Image Composite Editor (ICE) and geo-reference them. Each aerial image contains two sections, so I "stitched" them together with twelve sections (or six photographs) per stitch for more accurate geo-referencing. This also increases quality in case one photograph was flawed, it would not alter the rest. Once this process was perfected, I wrote a manual for future technicians undertaking this project. The finished product of this project is a series of temporal maps depicting Iowa's surface from the 1970's, 80's, and 90's accessible to the public.

This project has brought many benefits to me as a graduate student and as a newcomer in the job market. I really enjoyed my first GIS class at ISU, which initially led to this student position. Aside from the financial benefit of having additional income, this position impressed upon me the importance of GIS in strengthening our understanding of our planet. In fact, due to this experience, I made GIS mapping at the heart of my Master's Thesis. Embedded in my thesis is the argument that GIS mapping technology has a wide array of applications in all disciplines, particularly the social sciences. My thesis uses my own survey of a coastline in Lima, Peru to create "use" maps of the coastal shelf to determine spatial allocation based on recreational activities and infrastructure. Since certain recreational uses are associated with certain socio-economic classes, we are able to track demographic changes that exemplify class divisions within the landscape.

During my year on this project, I have refined the ICE process, wrote a manual, and incorporated GIS into my thesis. Yet, all of the hours I have put in are still miniscule when compared to the work left to be done. With the end result being a public service that not only preserves historic imagery by bringing it into the 21st Century, but also learning how the landscape of our state has changed over time, it is important to continue onward with this project because there is always room for improvement. ICE will see updates in the future that may solve some of the stitch glitches, and slides that are currently deemed missing may be found and can be incorporated into the proper map. I value the time I have invested in this project, am thankful for the opportunity, and hope that this project continues for future students can have the experience I did, and map users have more options at their disposal."

-- Brandon Scheuring, Masters Student, Anthropology