Teaching Assignment: Changes along Fountain Creek, Colorado (1989-2006)
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Title:

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Overview

For this assignment, you will focus on a 4 km stretch of Fountain Creek in El Paso Country, Colorado (38.7 N, 104.715 W). Fountain Creek drains the Front Range near Colorado Springs, and eventually joins the Arkansas River in Pueblo, Colorado. The section you will look at lies on the plains south of Colorado Springs, just north of the town of Fountain, CO. A quick look at some air photos for Fountain Creek reveals that this river is on the move, having changed its path quite frequently over the past 20 years.

Your task in this assignment is to evaluate how Fountain Creek has changed through the years. The 1st, more straightforward part will be visually presenting how it has change by producing a map that depicts the river course through time. The 2nd, more open-ended part is figuring out a way to systematically quantify (i.e, measure/calculate) the rates and degree of change through time. This will require that you understand the significance of the map you just created, are able describe in words what's happening to the channel through time, and put numbers to your description. Armed with your knowledge of alluvial river behavior and meander bends, keep thinking about the geologic or environmental conditions that are driving the change you're seeing (i.e., what happened, or didn't happen, in between images).

How it works

The main nuts and bolts of the assignment are an analysis of repeat air photos for our section of Fountain Creek. We have imagery for 1989, 1998, 1999, 2004, 2005 and 2006. You need to produce of a map that depicts how the course of the river (or its cut-banks, point bars and bank-to-bank width) changes through time. To make this map, you can use trace paper/Mylar, or software such as ArcGIS or Adobe Photoshop or Illustrator, but whatever your method you need to be able to establish a SCALE allowing you to measure and calculate rates of change. I will provide the necessary instructions for the ArcGIS skills needed (georeferencing, adding/editing new shapefiles) if you choose to use ArcGIS.

After producing your map, you need to make measurements and calculations indicating how things are changing through time. What change to quantify is purposely left open ended and may not be constant over the entire study area, requiring you to establish a consistent methodology for making measurements. For example, a high amount of channel migration might be observed, but is it the same everywhere, the width of the 'active' channel may appear to change, but how might you defined what is 'active', or the length of the river might seem to change, but you need to establish a consistent starting and ending point to standardized lengths measured. Keep in mind that the time between images varies for the six air photos, so magnitudes of change (e.g., meters moved, differences in length) need to be divided by the number of years in between to determine comparable rates of change such as meters per year.

The final part of the assignment is synthesis. In the final questions, you are asked to summarize and describe in words what's happening to the channel through time, with reference to your map and calculations, and to consider the environmental conditions that are driving the changes observed.

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Thought Questions

The following set of questions asks you to summarize what's happening to the channel through time and think about the environmental conditions that are driving the changes observed. In answering these questions, please keep in mind the terms and concepts related to alluvial river behavior and meander bends, including: patterns of erosion and deposition, shear stress, point bars, cut-banks, bank stability (natural and man-made), the influence of large floods, and river avulsion.

1) What do the sequence of air photos indicate is happening to the channel through time? In answering, feel free to describe in words what's happening to the channel through time and be sure to reference you maps and calculations.
2) Where is erosion and deposition occurring along the channel?
3) Can the rates of channel migration indicated by the air photos be sustained? Is there any evidence for older stability and a recent increase in channel migration? If so, what may be driving this, or have caused the recent increase?
4) What are the ways in which Fountain Creek is contained/controlled? Could this be having an impact?
5) You also have the discharge records. Were there any significant floods in the 1989-2006 range that could be driving the migration? If there are, do you think the large floods are doing the bulk of the erosion, or is it more continuous?

http://nwis.waterdata.usgs.gov/co/nwis/nwisman/?site_no=07105500&agency_cd=USGS

Evaluation

Your final, handed in assignment should consist of the map, calculations and summary discussion. The map is evaluated based on it quality, accuracy and completeness (including essential map elements such as legend and scale). The measurements and calculations are evaluated based on their accuracy and presentation (plots, tables, etc.). The summary discussion and final questions are evaluated based the whether they synthesize the ideas and concepts associated with alluvial river behavior and meander bends with what you see and present in their map and how they put words to what they measure in terms of change.

About the Air Photos:
Air Photos record the land's surface at the time the images are taken.
Air Photos for this Assignment:

- Natural Color Aerial Photography (NAIP)
  - OrthoImagery (NAIP) - 2004, 2m Natural Color (late Spring, April/May)
  - OrthoImagery (NAIP) - 2005, 1m Natural Color (late Spring, April/May)
  - OrthoImagery (NAIP) - 2006, 2m Natural Color (late Spring, April/May)
- Digital Orthophoto Quarter Quadrangles (DOQQ)
  - Digital Orthophotos (DOQ/DOQQ) - 1m, B/W County Mosaic, 1999 (Fall?)
- Commercial Air Photos (acquired from the Colorado Aerial Photo Service)
  - Air Photo taken 10/20/89
  - Air Photo taken 10/10/98

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ArcGIS GAME PLAN (if USED):

- Open Blank ArcMap Project
- Set the Data Frame Properties (Topo Map system)
- Add the Topo Map
  - Use the Topo Map as a base map
- Georeference (Rubber sheet) the air photos...(road intersection, things that haven't likely changed) – INSTRUCTIONS provided
- Editing/making shapefiles (.shps) in ArcMap (make new shapefiles (polylines/polygons?) with draw toolbar method or starting in ArcCatalog) – INSTRUCTIONS provided
  - What to trace (known as digitizing)? The river course for each year, banks (inner/outer), etc….
- Save as you go!
- Analyze and Quantify - Measure tool, etc...(focus areas, cut banks rates where easy...)
  - For measuring, pay attention to the map coordinate system, units, etc…meters easier to understand than decimal degrees!
  - EXAMPLE of what to measure: zoom in on actively migrating river bends, use the measure tool to calculate the amount of cut-bank erosion (orientation matters!)
  - ANOTHER example: measure how the length of the river in changing through time.
- End Result, base map with river layers depicted in colors...make pretty...
  - Base Map can be the TopoMap, or one of the Air Photos, or DEM...
- THINK about what you've create...make general observations about the changes within our focus area, as well as more detailed measurements...

Issues/Things to keep in mind:

- Imagery, time of year (water line easiest to digitize, but you could be seeing different discharges (likely that you are))...width of river changes...
- Resolution, how well will you be able to delineate a channel edge...
- Irregular time intervals for comparison...what happened, or didn't happen, in between images?