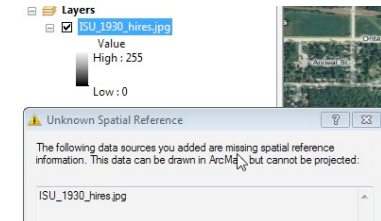


Geol588 - Georeferencing exercise

- Monica Haddad will introduce 2 new GIS courses (10 min)
- Georeferencing exercise
- Help with HW5 - cost distance exercise

1

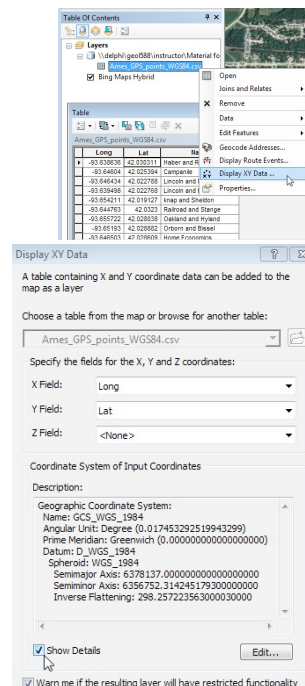
- data\Georeferencing Ex\
- load Georef_ex_start.mxd
- Georeferencing: draping a simple image (jpg, bmp, etc.) onto the right place on the Earth surface?
- Simple image has pixels, but no projection, datum
- Our scenario:
 - 1930 airphoto of the ISU campus (.jpg) (Arc will complain about lack of spatial reference)
 - GPS coordinates (Lat/long) of landmarks, road crossings as (Text/Excel) .csv file, real-world (“true”) coordinates
 - Online Hybrid (Road/Satellite image) basemap layer (also “true”)



2

Importing GPS points

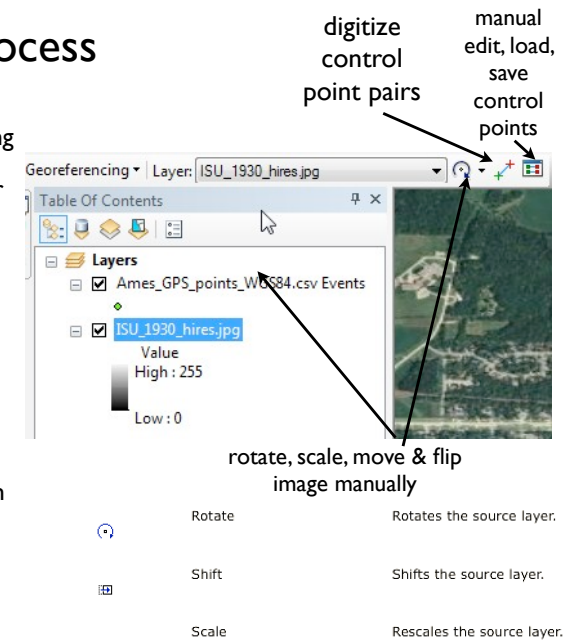
- Ames_GPS_points_WGS84.csv
- WGS84: coordinate system the GPS recorded in
- x and y columns: Long and Lat
- Display XY Data ...
- make a event layer (lives in Arc's memory only)- should later be exported into GeoDB or Shapefile (
- Show Details : coord. sys of to be created event layer
- Data frame has been set to WGS84 already



3

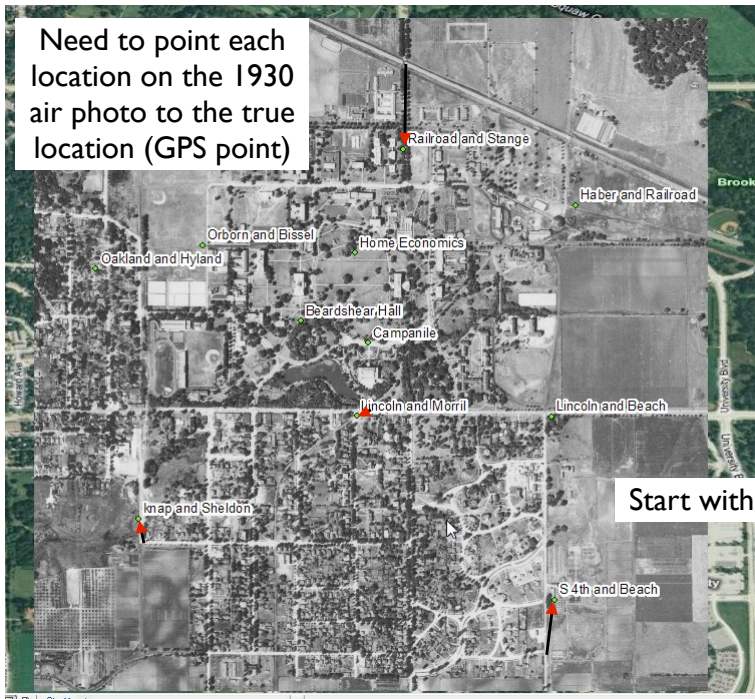
Georeferencing Process

- Add Georeferencing toolbar: View > Toolbars > Georeferencing
- Set the non-georef'd source-layer image (ISU_130_hires.jpg) as Layer in Georeferencing toolbar
- Also need: georef'd shapefiles (GPS points, roads) or raster (airphoto, topo sheet, etc.)
- Show a good view of Ames, click Georeferencing - Fit To Display
- manually move/rotate image - can be very bad!
- do a rough (bad) fit of railroad, Stange and Lincoln way
- switch off auto update for now



4

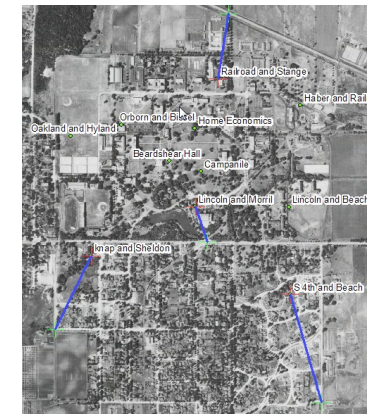
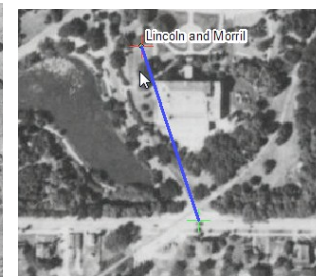
Need to point each location on the 1930 air photo to the true location (GPS point)



Start with 4 points ...



- digitize **control point** pairs (links)
- **green** = airphoto location (1), **red** = true (GPS) location (2)
- You can use zoom & pan during pair digitizing
- Use the Magnifier Window!
- You can always go back to digitizing after you used another tool
- Do 4 pairs - do not (yet) hit auto update!
- Use Escape key if you placed a bad first point
- Can delete pairs later



- Digitizing pairs create lines in the Link table
- X/Y Source: jpg internal (pixel) coordinate (origin upper left corner)
- X/Y Map: true coordinates (lat/long, UTM, etc.)
- X to delete a pair
- Load/Save to control point pairs to text file (see: 588_4_control_points.txt)
- lat/long can be hand edited
- Transformation: type of math used to stretch the overall jpg image based on the red to green pairs
- Once you have 4 pairs, press Auto Adjust



Link	X Source	Y Source	X Map	Y Map	Residual
1	1124.424496	-139.948338	-93.644763	42.032300	0.00016
2	1551.730548	-1929.439981	-93.639401	42.016241	0.00015
3	326.471758	-1593.890624	-93.654211	42.019127	0.00014
4	1025.860807	-1191.343535	-93.646434	42.022788	0.00046

Auto Adjust Transformation: 1st Order Polynomial (Affine) Total RMS Error: 0.00026

Load... Save... Restore From Dataset OK

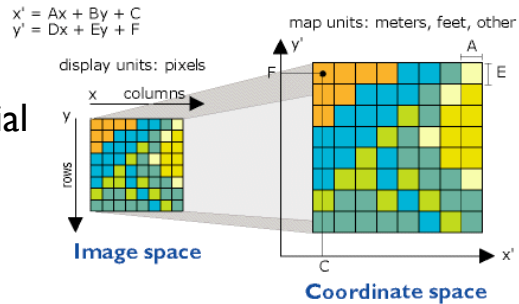
- After Adjustment: every pixel of jpg image is moved to a true geo-location
- Polynomial (1,2,3) - won't produce a perfect overlap
- Residual: for the control points what's difference source to map
- smaller Residuals are good
- Total RMS Error: overall fit
- one bad pair will affect the overall fit

Link	X Source	Y Source	X Map	Y Map	Residual
1	1124.424496	-139.948338	-93.644763	42.032300	0.00016
2	1551.730548	-1929.439981	-93.639401	42.016241	0.00015
3	326.471758	-1593.890624	-93.654211	42.019127	0.00014
4	1025.860807	-1191.343535	-93.646434	42.022788	0.00046

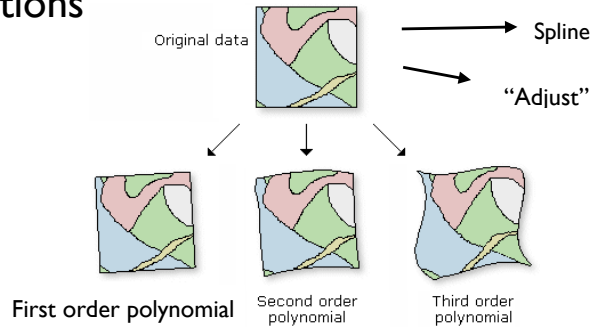
Auto Adjust Transformation: 1st Order Polynomial (Affine) Total RMS Error: 0.00026

Load... Save... Restore From Dataset OK

1. order polynomial



other types of transformations



- Higher order polynomial transformations need more points (2. order: at least 6 links, 3.order: at least 20 links) but can provide a better fit
- get a total of 6 links and switch to 2. order
- connect all 11 links and switch to 3. order
- Optional: Make the air photo transparent and now use the basemap to plant more links
- Which order is better?
- Does the Total RMS go down as the polyn. order goes up?
- Warning: 2. and 3. order poly. can give crazy results for pixels that are far away from control points

Link	X Source	Y Source	X Map	Y Map	Residual
1	1125.491205	-136.022513	-93.644763	42.022300	0.00001
2	1554.839553	-1928.947822	-93.639401	42.016241	0.00000
3	326.429521	-1590.495062	-93.654211	42.019127	0.00000
4	1024.742597	-1192.553325	-93.646434	42.022788	0.00005
5	905.122896	-808.616388	-93.648419	42.026177	0.00005
6	1003.991502	-900.239766	-93.646040	42.025394	0.00114
7	968.952793	-538.547620	-93.646503	42.028609	0.00007
8	526.303790	-805.015073	-93.651930	42.028862	0.00003
9	217.772283	-604.789613	-93.655722	42.028038	0.00001
10	1552.051295	-1201.065364	-93.639498	42.022768	0.00001
11	1625.165737	-361.706051	-93.638636	42.030311	0.00000

Total RMS Error: 0.00005

- Transformation = Adjust:
 - TIN based rubber sheeting
 - needs 3+ points
 - gives no error measurement
- Transformation = Spline
 - TIN based rubber sheeting
 - needs 10+ points
 - gives no error measurement
- Final step: save image in georef'd raster
- Georeferencing - Rectify
- save as inside GeodB, as .tif or as .img
- note the crummy cellsize (GCS)

- See ArcGIS Desktop 10 Help on georeferencing
- Good blog post on georeferencing: <http://blogs.esri.com/Dev/blogs/geoprocessing/archive/2010/10/19/Georef1.aspx>