Combining Digital Photos, GPS Coordinates, GIS, and the Web

Andrew Graettinger, PhD

Visiting Professor

University of Wisconsin – Madison

University of Alabama

Dept. of Civil and Env. Engineering

Overview

- Origins of the idea
- Equipment
- Approach
- Case Study
- Summary

Origins of the idea

- Member of a National Science Foundation reconnaissance team sent to the Gulf Coast after Katrina
- Primary responsibilities were site assessment and data management

Origins of the idea

Typical Equipment

- Digital Camera
  - $200 - $400
- Inexpensive GPS
  - either hand held or laptop based
  - $100 - $350
- GIS
- Web access

How can these work together?

Equipment - GPS Cameras

- ***Kodak Digital Science Field Imaging System (FIS265)***
- Introduced in 1999

Kodak DC265 Digital Camera and Garmin GPS

- Discontinued

Equipment

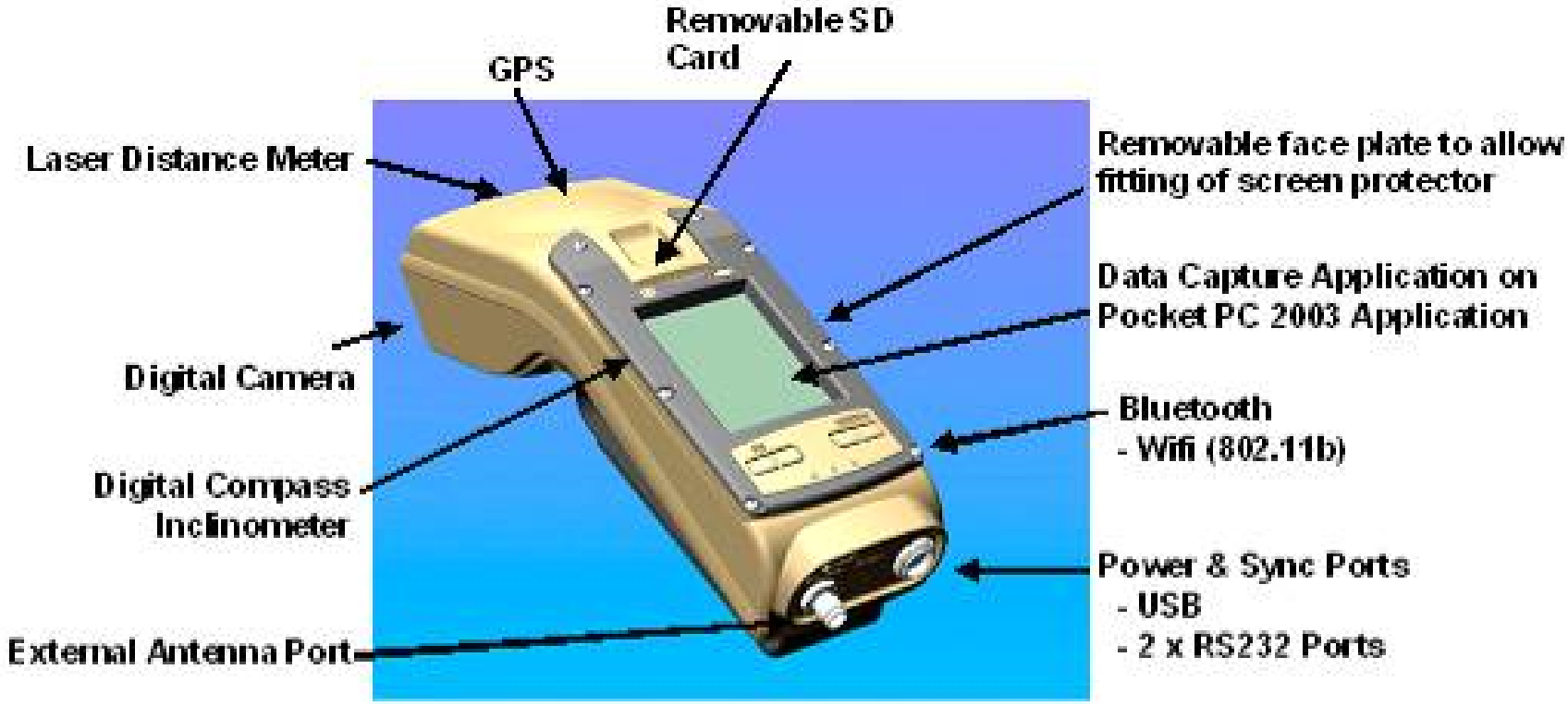
- **Ricoh Pro G3, Plug in GPS or Bluetooth GPS, Software**
- **Currently available**
- **~$1200**

Equipment

- ike 304
- Handheld digital reconnaissance tool
- Developed by Construction Engineering Research Laboratory (CERL) and Surveylab, Ltd.

Equipment

- ike 304 Features



$10,000

Approach Characteristics

- General approach for different equipment
- Keep cost down
- Eliminate tasks in the field
- Automate process as much as possible

Approach

- Common field between location and photo
  - TIME
- GPS is entirely based on very accurate time (but there are some problems)
- Digital photos almost always have a time stamp (but there are some problems)

Approach Overview

1. Correlate camera time to GPS
   - Take photo of GPS unit with time visible
2. Reduce infield tasks
   - Leave GPS unit run recording points
3. Take photos
4. Post process to clean location and photo data and create a common field
   - Freeware, custom program, and excel
5. Join photos to points in GIS
6. Publish to Web
   - HTML ImageMapper

GPS

- Typical GPS file
  - Latitude, Longitude, Date, Time, Satellite information, other
  - File Format - proprietary or exportable in a readable format
  - File Condition
    - » Missing time and locations
    - » Duplicate locations
- Best GPS File Condition
  - Lat, Long, Date-Time
  - without missing time and
  - without duplicate locations

GPS time - example

- Two GPS units for example
  - DeLorme ~$100
  - Trimble GeoExplorer ~$3500

GPS time - example

- DeLorme Proprietary GPL format
  - ReadGPL freeware program
  - Google ReadGPL
  - http://www.frontiernet.net/~werner/gps/
- Program functionality
  - Converts GPL to text
  - Can eliminate stops (speed < value)

STATUS	DUMMY1	LATITUDE	LONGITUDE	ALT	HEADG	SPEED	DATE	TIME (Z)	DUMMY2
1	%1242340	43.42880	-89.73155	833	0.0	0.0	06-05-2006	18:17:52	1242340
2	%20104	43.43303	-89.73569	949	0.0	0.0	06-05-2006	18:18:09	%20104
2	%1242340	43.43302	-89.73565	948	0.0	0.0	06-05-2006	18:18:10	1242340

Procedure - GPS time example

- Trimble exports in ASCII

Long	Lat	GPSDate	GPStime
-89.13738	30.45216	2005-09-25	03:21:20pm
-89.13737	30.45216	2005-09-25	03:21:21pm
-89.13737	30.45216	2005-09-25	03:21:22pm
-89.13894	30.45980	2005-09-25	03:25:49pm
-89.13905	30.45986	2005-09-25	03:25:50pm
-89.13915	30.45991	2005-09-25	03:25:51pm

Missing GPS time and stops

- GPS file cleaning FORTRAN program
- Reads GPS date, time, and location
- If missing time - program uses the last lat long and adds new second
- If locations are “close,” like at a stop, program takes one location and applies it to the rest

Result is a clean file with locations for every time

Digital photos

Procedure - Photo time example

- Primary Key – date and time
- Photos have a data exchange format EXIF
- Camera Date and Time in photo meta data

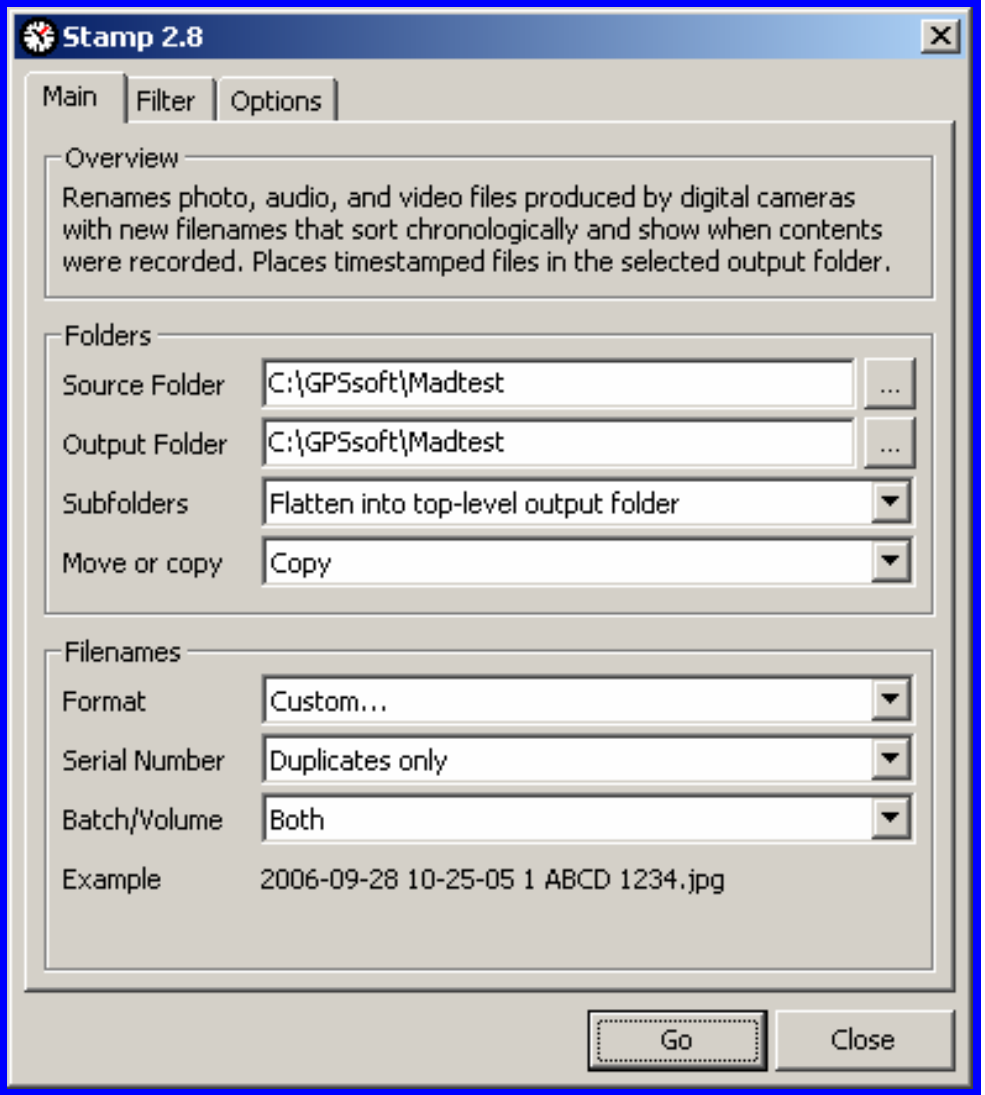
How do you get the date and time?

GPS fields in EXIF

GPS tag version
North or South Latitude
Latitude
East or West Longitude
Longitude
Altitude reference
Altitude
GPS time (atomic clock)
GPS satellites used for measurement
GPS receiver status
GPS measurement mode
Measurement precision
Speed unit
Speed of GPS receiver
Reference for direction of movement
Direction of movement
Reference for direction of image
Direction of image
Geodetic survey data used
Reference for latitude of destination
Latitude of destination
Reference for longitude of destination
Longitude of destination
Reference for bearing of destination
Bearing of destination
Reference for distance to destination
Distance to destination
Name of GPS processing method
UNDEFINED
Name of GPS area
GPS date
GPS differential correction

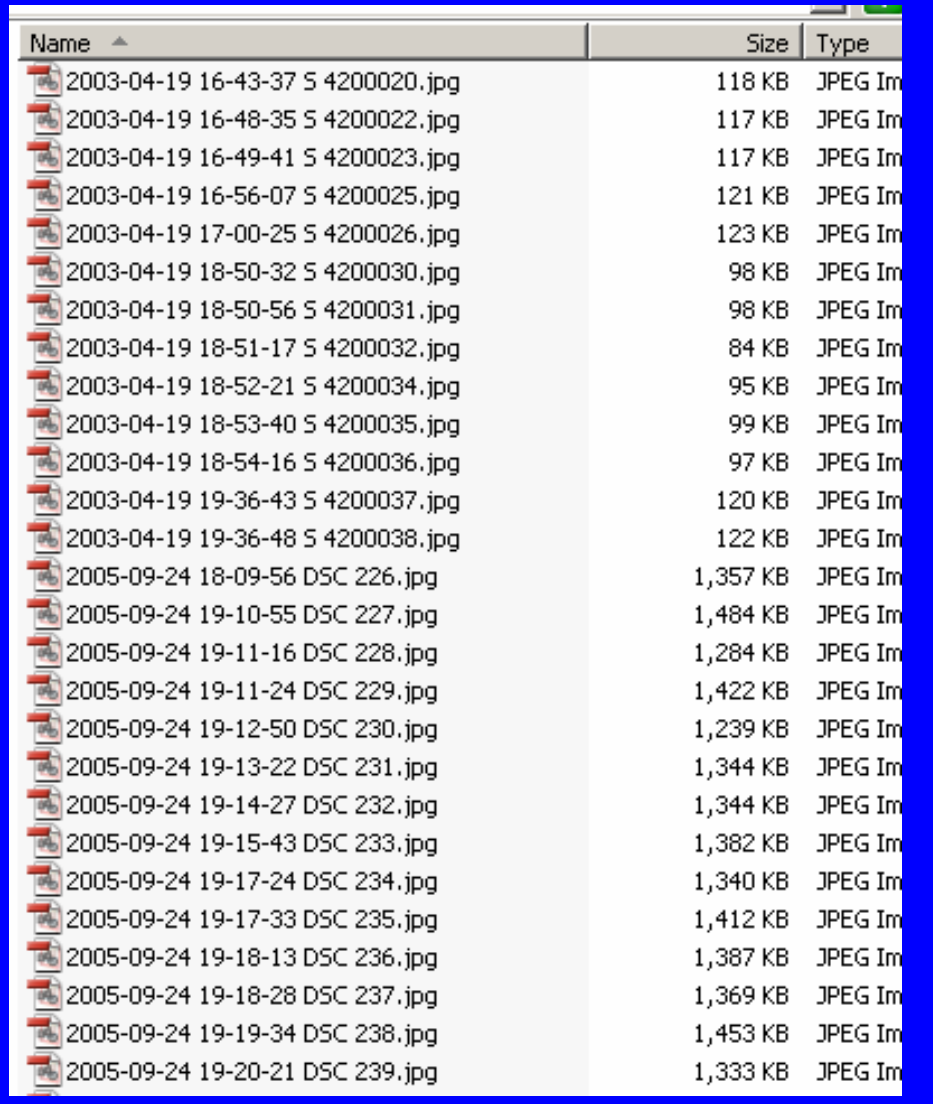
Procedure - Photo time example

- Extract photo Date and Time with Stamp 2.8
- Renames files as
  - date
  - time
  - photo name
- Great for organizing photos from multiple people



Procedure - Photo time example

- Extract photo Date and Time with Stamp 2.8
- Renames files as
  - date
  - time
  - photo name
- Great for organizing photos from multiple people



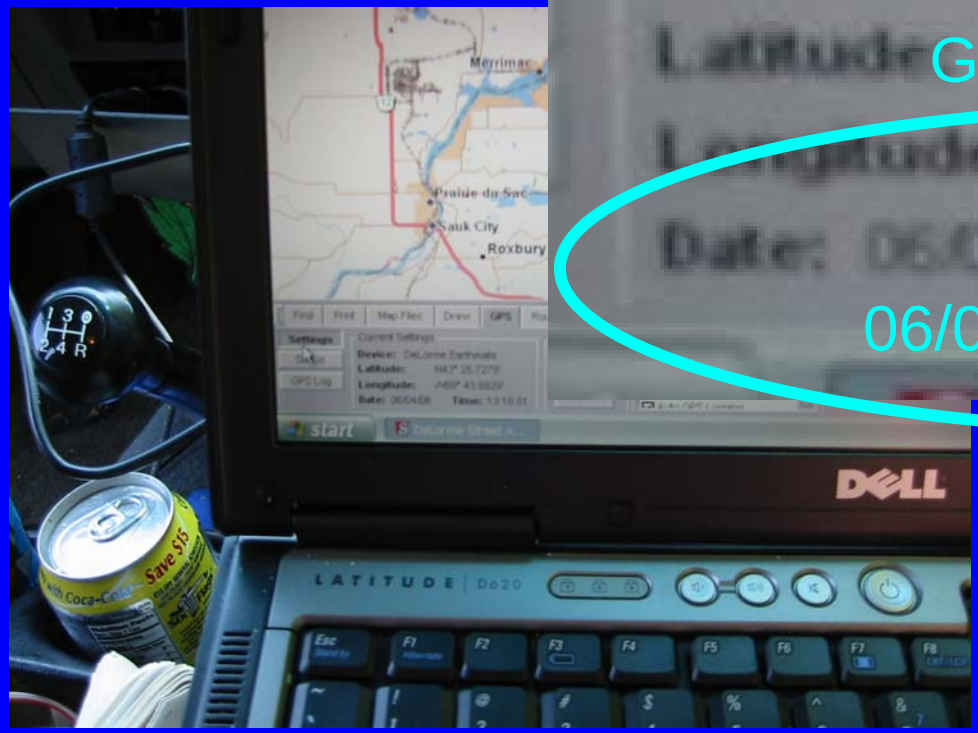
Name	Size	Type
2003-04-19 16-43-37 S 4200020.jpg	118 KB	JPEG Im
2003-04-19 16-48-35 S 4200022.jpg	117 KB	JPEG Im
2003-04-19 16-49-41 S 4200023.jpg	117 KB	JPEG Im
2003-04-19 16-56-07 S 4200025.jpg	121 KB	JPEG Im
2003-04-19 17-00-25 S 4200026.jpg	123 KB	JPEG Im
2003-04-19 18-50-32 S 4200030.jpg	98 KB	JPEG Im
2003-04-19 18-50-56 S 4200031.jpg	98 KB	JPEG Im
2003-04-19 18-51-17 S 4200032.jpg	84 KB	JPEG Im
2003-04-19 18-52-21 S 4200034.jpg	95 KB	JPEG Im
2003-04-19 18-53-40 S 4200035.jpg	99 KB	JPEG Im
2003-04-19 18-54-16 S 4200036.jpg	97 KB	JPEG Im
2003-04-19 19-36-43 S 4200037.jpg	120 KB	JPEG Im
2003-04-19 19-36-48 S 4200038.jpg	122 KB	JPEG Im
2005-09-24 18-09-56 DSC 226.jpg	1,357 KB	JPEG Im
2005-09-24 19-10-55 DSC 227.jpg	1,484 KB	JPEG Im
2005-09-24 19-11-16 DSC 228.jpg	1,284 KB	JPEG Im
2005-09-24 19-11-24 DSC 229.jpg	1,422 KB	JPEG Im
2005-09-24 19-12-50 DSC 230.jpg	1,239 KB	JPEG Im
2005-09-24 19-13-22 DSC 231.jpg	1,344 KB	JPEG Im
2005-09-24 19-14-27 DSC 232.jpg	1,344 KB	JPEG Im
2005-09-24 19-15-43 DSC 233.jpg	1,382 KB	JPEG Im
2005-09-24 19-17-24 DSC 234.jpg	1,340 KB	JPEG Im
2005-09-24 19-17-33 DSC 235.jpg	1,412 KB	JPEG Im
2005-09-24 19-18-13 DSC 236.jpg	1,387 KB	JPEG Im
2005-09-24 19-18-28 DSC 237.jpg	1,369 KB	JPEG Im
2005-09-24 19-19-34 DSC 238.jpg	1,453 KB	JPEG Im
2005-09-24 19-20-21 DSC 239.jpg	1,333 KB	JPEG Im

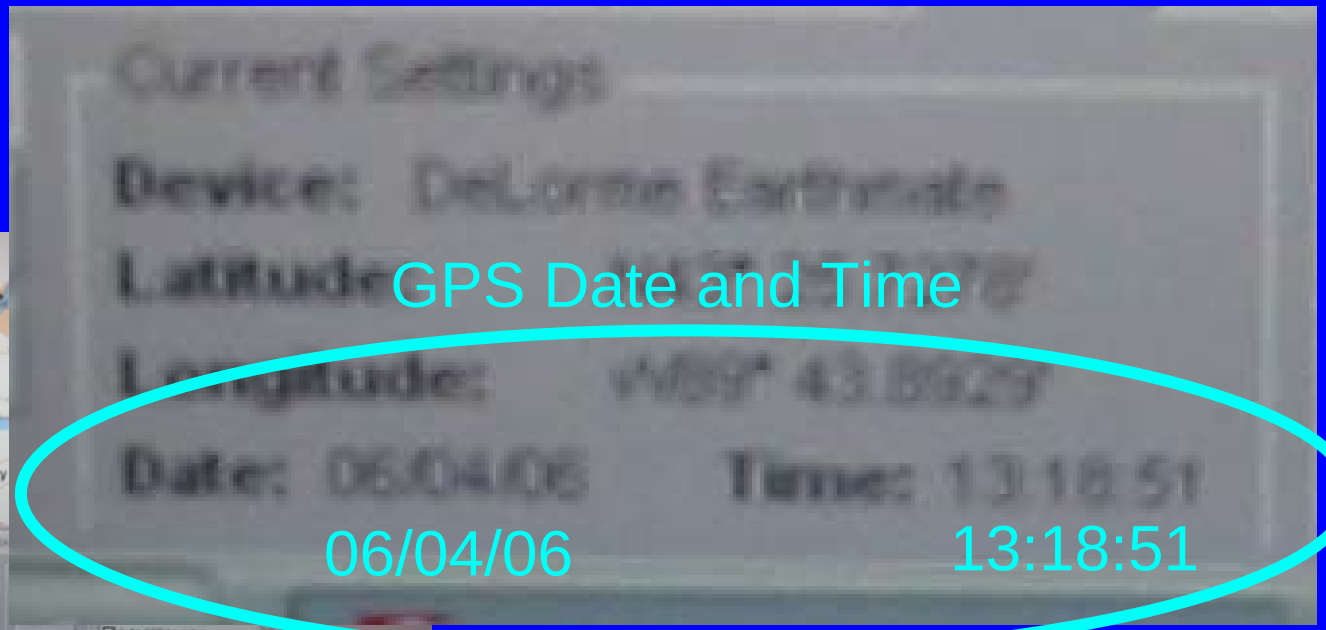
Procedure - Photo time example

- Have a directory of files with cammara date time name that we know is not GPS time.
- By taking a photo of the GPS screen we will have GPS time on a photo with Camara time.

Procedure – Correct photo time

- Correlated Photo to GPS
- Now you know photo time and GPS time





GPS Date and Time

06/04/06 13:18:51

EXIF camera date and time
06/04/06 12:17:03
1:01:48 off

Procedure - Photo time example

- Correct photo time
- Comand line program called

FILELIST Version 1.41

- Writes all file names in a directory to a file
- Use this file to start to create a linkable table

Procedure - Photo time example

- FILELIST Version 1.41 output

output_andy.txt - Notepad

File Edit Format View Help

```
File List of c:\research\katrina\day3photos\raw\andy

"Name","Path",Size in Bytes,Last Access,Last Change,Creation Date,"Extension"
"2005-09-25 11-17-33 IMG 2763.jpg","c:\research\katrina\day3photos\raw\andy\"
"2005-09-25 11-18-07 IMG 2764.jpg","c:\research\katrina\day3photos\raw\andy\"
"2005-09-25 11-18-22 IMG 2765.jpg","c:\research\katrina\day3photos\raw\andy\"
"2005-09-25 11-18-34 IMG 2766.jpg","c:\research\katrina\day3photos\raw\andy\"
"2005-09-25 11-18-38 IMG 2767.jpg","c:\research\katrina\day3photos\raw\andy\"
"2005-09-25 11-18-55 IMG 2768.jpg","c:\research\katrina\day3photos\raw\andy\"
"2005-09-25 11-19-27 IMG 2769.jpg","c:\research\katrina\day3photos\raw\andy\"
"2005-09-25 11-20-06 IMG 2770.jpg","c:\research\katrina\day3photos\raw\andy\"
"2005-09-25 11-21-48 IMG 2771.jpg","c:\research\katrina\day3photos\raw\andy\"
"2005-09-25 11-22-09 IMG 2772.jpg","c:\research\katrina\day3photos\raw\andy\"
"2005-09-25 11-29-04 IMG 2773.jpg","c:\research\katrina\day3photos\raw\andy\"
```

Procedure - Photo time correction

- Inport file of file names into excell and correct time

2005-09-25 11-17-33 IMG 2763.jpg

- Strip out date and time

2005-09-25 11-17-33

- Strip out time and turn it into decimal

11 17 33 = 11.2925

- Look at GPS screen photo and calculate the difference in time and correct photo time

Time was off 45 min 28 sec – add to photo time

12 03 01

- Create primary key - GPS date and time

2005-09-25 12-03-01

GIS - Add GPS points as events

GIS - Add GPS points as events

GIS - Add photo file as a table

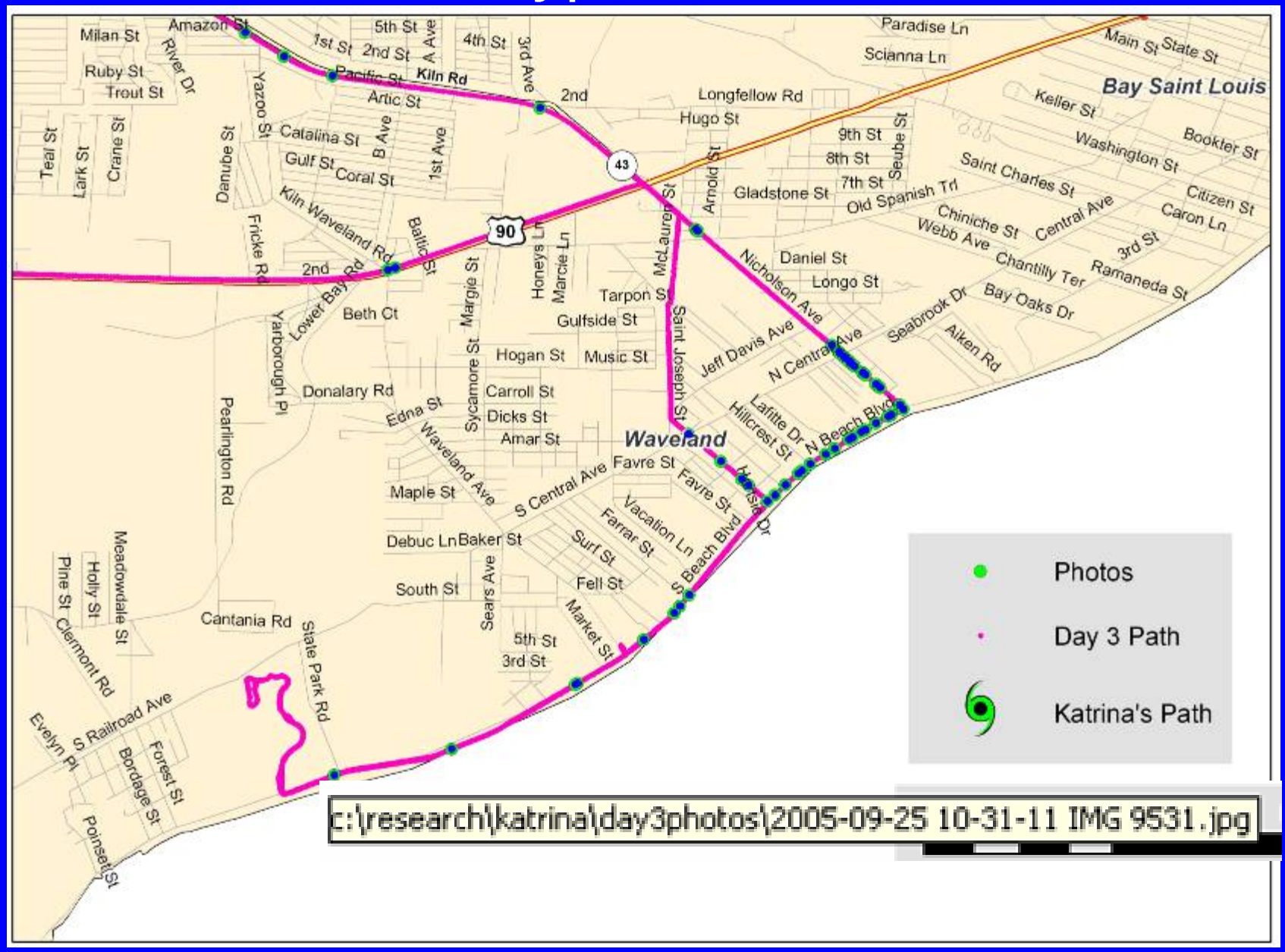
s of photodir

	PK*	HYPER
0	2005-09-25 12-03-01	c:\research\katrina\day3photos\2005-09-25 11-17-33 IMG 2763.jpg
1	2005-09-25 12-03-35	c:\research\katrina\day3photos\2005-09-25 11-18-07 IMG 2764.jpg
2	2005-09-25 12-03-50	c:\research\katrina\day3photos\2005-09-25 11-18-22 IMG 2765.jpg
3	2005-09-25 12-04-02	c:\research\katrina\day3photos\2005-09-25 11-18-34 IMG 2766.jpg
4	2005-09-25 12-04-06	c:\research\katrina\day3photos\2005-09-25 11-18-38 IMG 2767.jpg
5	2005-09-25 12-04-23	c:\research\katrina\day3photos\2005-09-25 11-18-55 IMG 2768.jpg
6	2005-09-25 12-04-55	c:\research\katrina\day3photos\2005-09-25 11-19-27 IMG 2769.jpg
7	2005-09-25 12-05-34	c:\research\katrina\day3photos\2005-09-25 11-20-06 IMG 2770.jpg
8	2005-09-25 12-07-16	c:\research\katrina\day3photos\2005-09-25 11-21-48 IMG 2771.jpg
9	2005-09-25 12-07-37	c:\research\katrina\day3photos\2005-09-25 11-22-09 IMG 2772.jpg
10	2005-09-25 12-14-32	c:\research\katrina\day3photos\2005-09-25 11-29-04 IMG 2773.jpg
11	2005-09-25 08-09-45	c:\research\katrina\day3photos\2005-09-25 05-09-26 IMG 617.jpg
12	2005-09-25 09-14-54	c:\research\katrina\day3photos\2005-09-25 06-14-35 IMG 618.jpg
13	2005-09-25 09-15-48	c:\research\katrina\day3photos\2005-09-25 06-15-29 IMG 619.jpg
14	2005-09-25 09-17-33	c:\research\katrina\day3photos\2005-09-25 06-17-14 IMG 620.jpg
15	2005-09-25 09-22-17	c:\research\katrina\day3photos\2005-09-25 06-21-58 IMG 621.jpg
16	2005-09-25 09-26-07	c:\research\katrina\day3photos\2005-09-25 06-25-48 IMG 622.jpg
17	2005-09-25 09-26-19	c:\research\katrina\day3photos\2005-09-25 06-26-00 IMG 623.jpg
18	2005-09-25 09-28-10	c:\research\katrina\day3photos\2005-09-25 06-27-51 IMG 624.jpg
19	2005-09-25 09-47-48	c:\research\katrina\day3photos\2005-09-25 06-47-29 IMG 625.jpg
20	2005-09-25 10-00-12	c:\research\katrina\day3photos\2005-09-25 06-59-53 IMG 626.jpg
21	2005-09-25 10-12-07	c:\research\katrina\day3photos\2005-09-25 07-12-48 IMG 627.jpg

1 Show: All Selected Records (0 out of 201 Selected.) Options

GIS – link, select, and create layer of photo locations

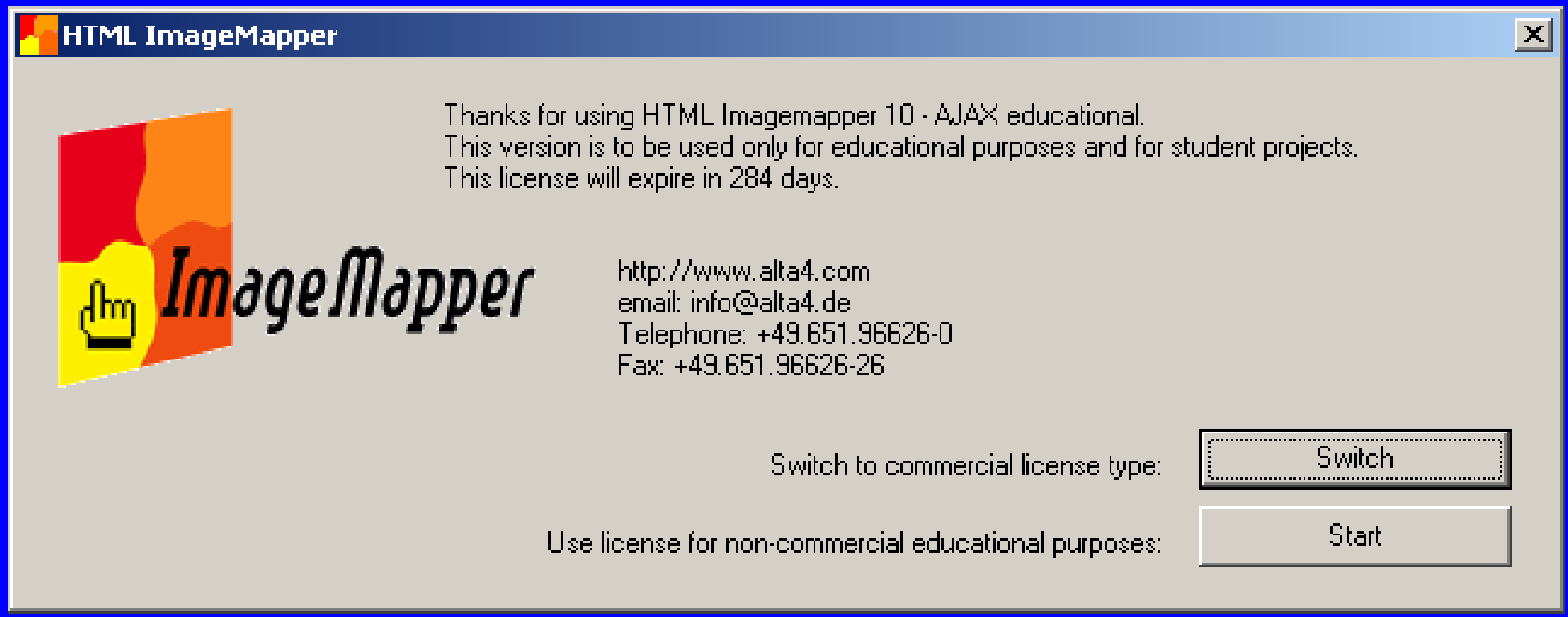
GIS – create hyperlinks



GIS – create hyperlinks

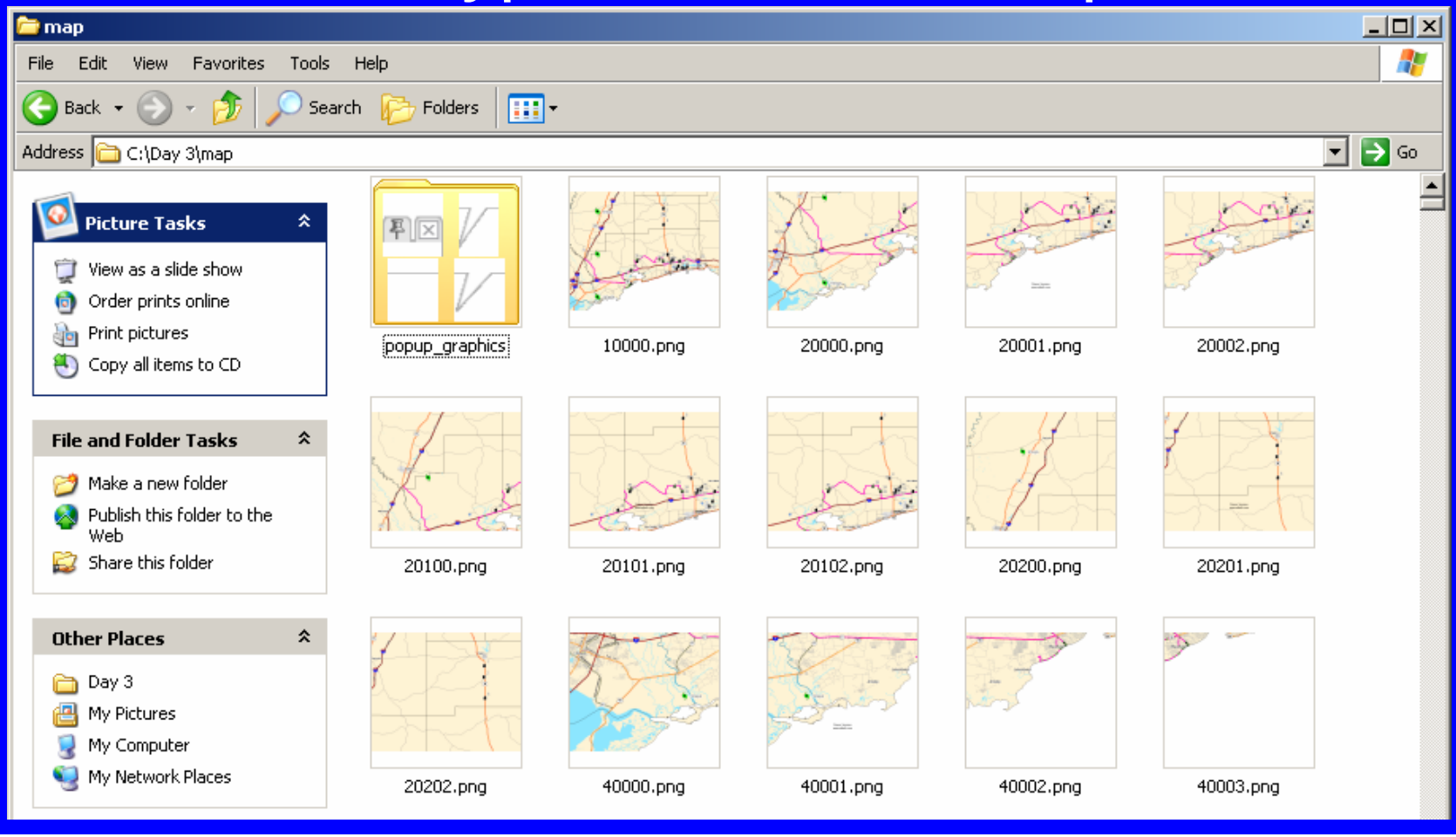
WEB –

- WEB map just to show photos

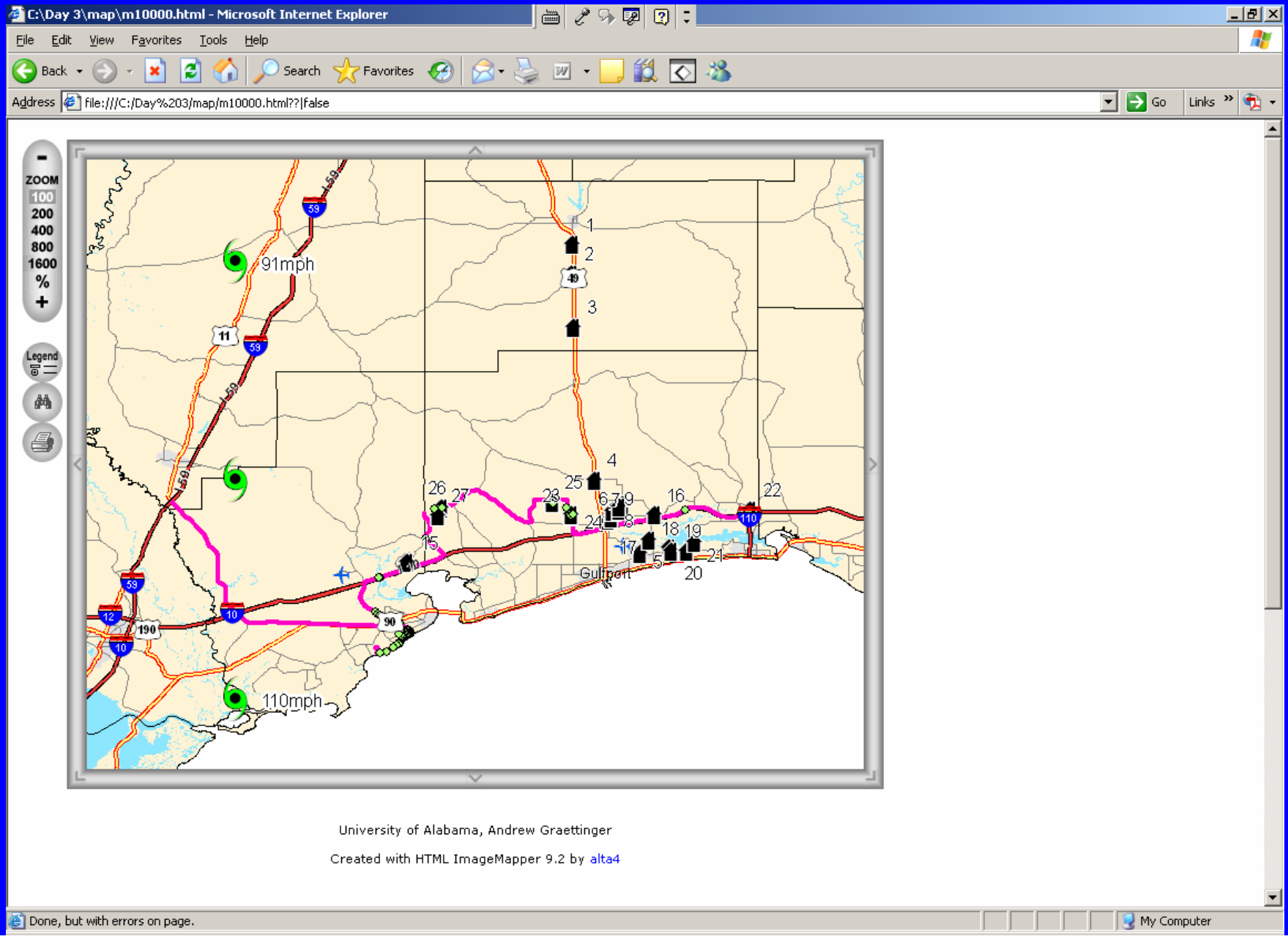


WEB –

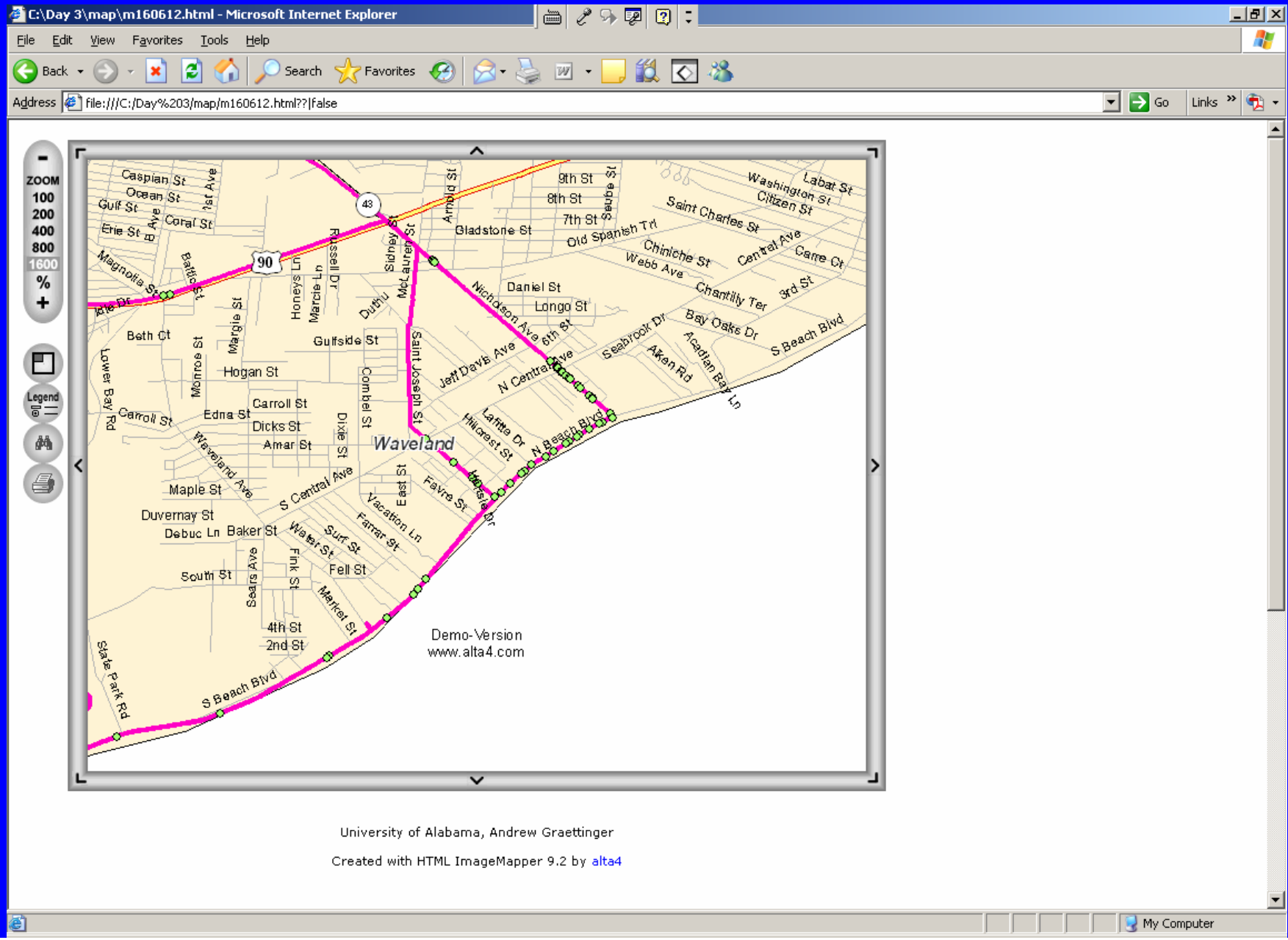
- HTML ImageMapper writes png image files with supporting html code to make zoomable hyperlinked web maps



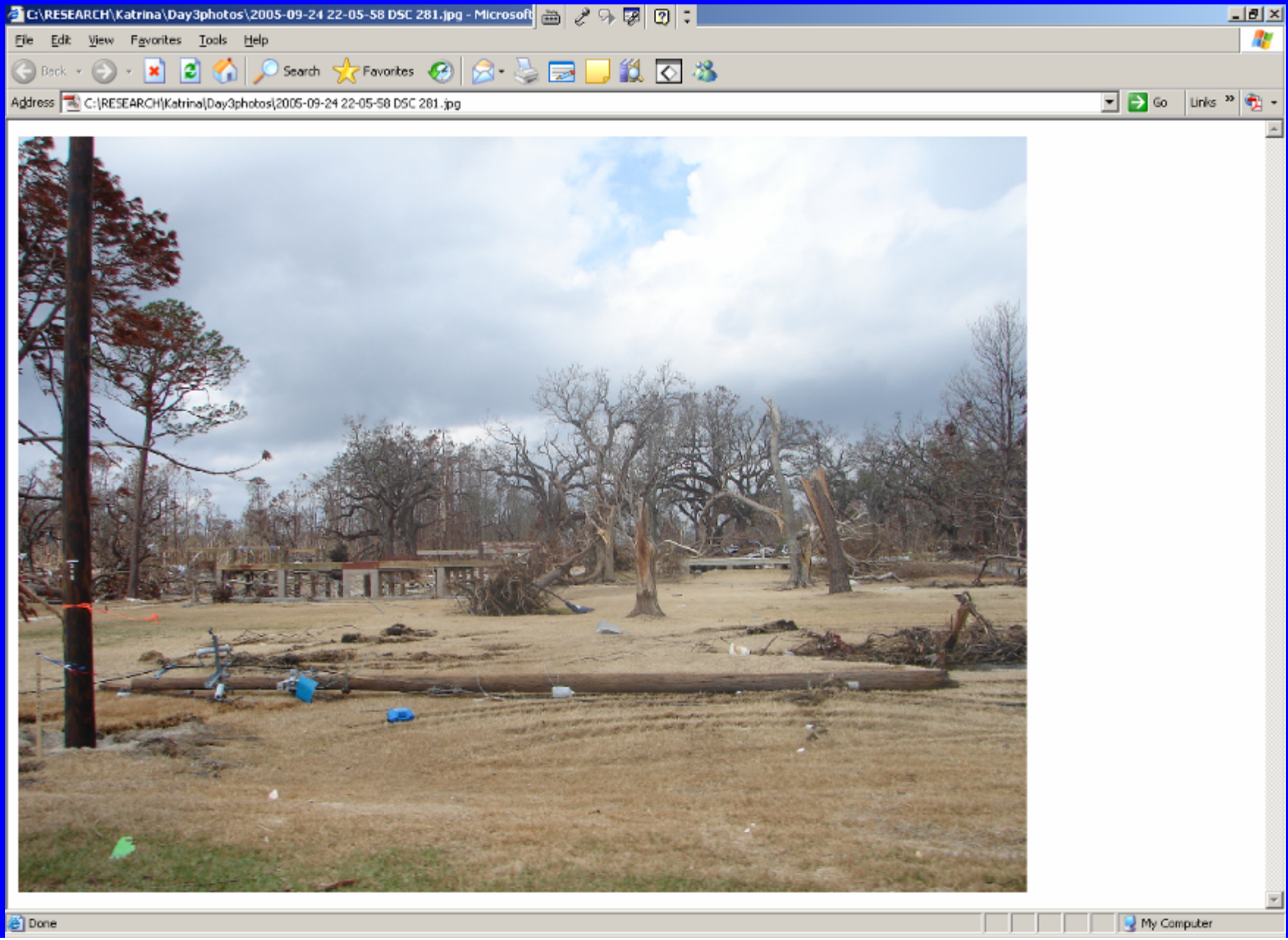
WEB –


C:\Day 3\map\m10000.html - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address file:///C:/Day%203/map/m10000.html??false
Go Links
ZOOM
100
200
400
800
1600
%
Legend
91mph
110mph
Gulfport
University of Alabama, Andrew Graettinger
Created with HTML ImageMapper 9.2 by alta4
Done, but with errors on page.
My Computer

WEB –


C:\Day 3\map\m160612.html - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address file:///C:/Day%203/map/m160612.html??|false
Go Links
ZOOM
100
200
400
800
1600
%
Legend
Waveland
Demo-Version
www.alta4.com
Caspian St
Ocean St
Gulf St
Erie St
Coral St
1st Ave
Magnolia St
Battle St
Erie Pl
Beth Ct
Lower Bay Rd
Carroll St
Monroe St
Margie St
Honeys Ln
Marcie Ln
Russell Dr
Dubhu
Sidney St
McLaurean St
Armbid St
Gulfside St
Hogan St
Edna St
Dicks St
Amar St
Combel St
Dixie St
Waveland Ave
Maple St
Duvernay St
Debuc Ln
Baker St
S Central Ave
East St
Vacation Ln
Farrar St
Favre St
Surf St
Water St
Fell St
South St
Sears Ave
Fink St
Market St
4th St
2nd St
State Park Rd
S Beach Blvd
Gladstone St
9th St
8th St
7th St
Seube St
Old Spanish Trl
Daniel St
Longo St
Nicholson Ave
6th St
Saint Joseph St
Jeff Davis Ave
N Central Ave
Hillcrest St
Lafitte Dr
N Beach Blvd
Saint Charles St
Washington St
Citizen St
Labat St
Chiniche St
Webb Ave
Central Ave
Carre Ct
Chantilly Ter
3rd St
Bay Oaks Dr
Seabrook Dr
Aiken Rd
Acadian Bay Ln
S Beach Blvd
University of Alabama, Andrew Graettinger
Created with HTML ImageMapper 9.2 by alta4
My Computer

WEB –


C:\RESEARCH\Katrina\Day3photos\2005-09-24 22-05-58 DSC 281.jpg - Microsoft
File Edit View Favorites Tools Help
Back Search Favorites
Address C:\RESEARCH\Katrina\Day3photos\2005-09-24 22-05-58 DSC 281.jpg
Go Links
Done
My Computer

WEB – Case Study Katrina

- HTML ImageMapper demo

Future work

- Package all code into a user-friendly application
- Test on multiple cameras and GPS units
- Add digital compass to get photo orientation
- Other digital equipment

Summary

- Simple approach and inexpensive approach to add location to photos
- Date and time are the common data between GPS and Photos
- Need to correct and link data
- HTML ImageMapper makes a simple and usable web map

2005 Hurricane Season