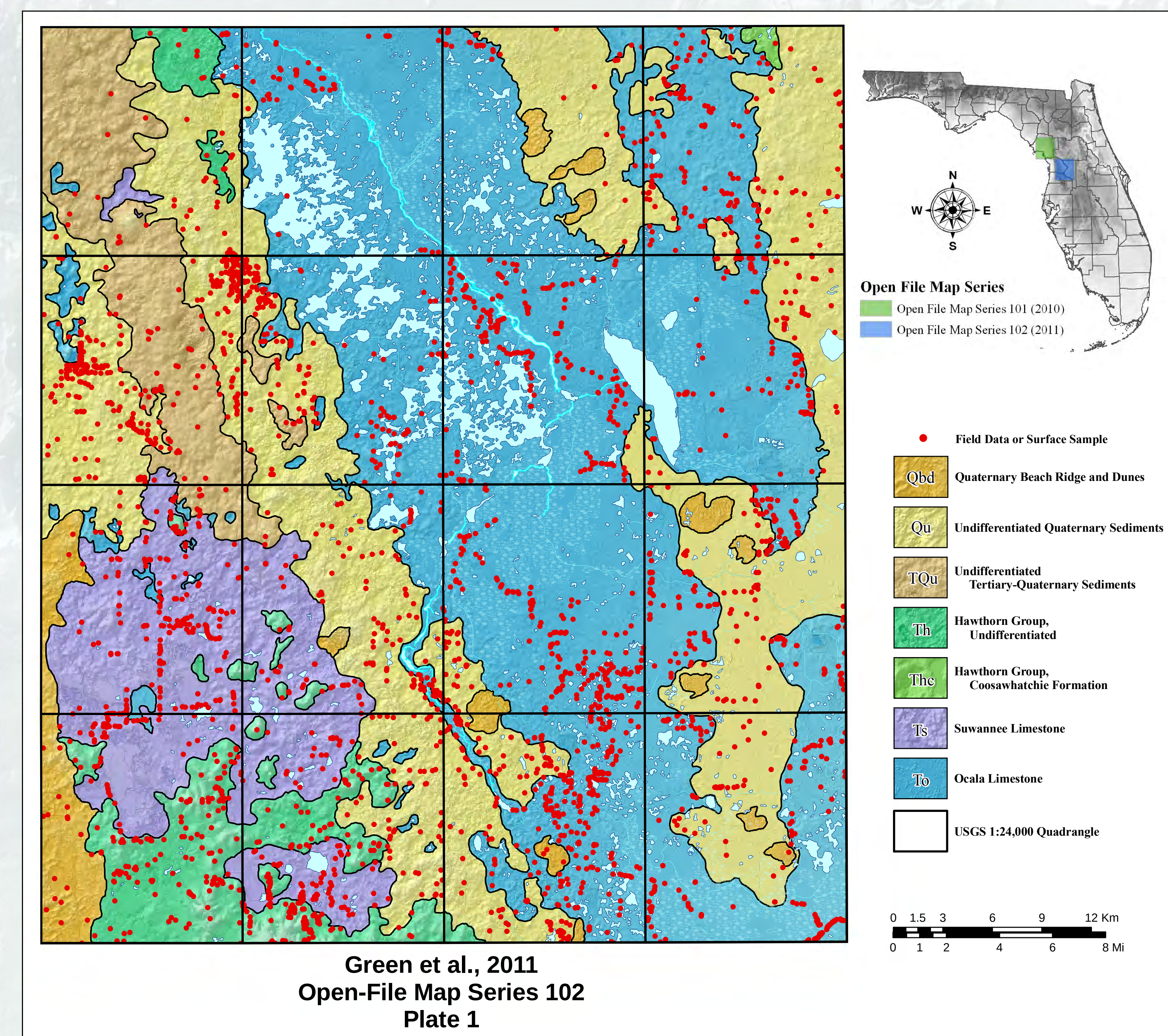
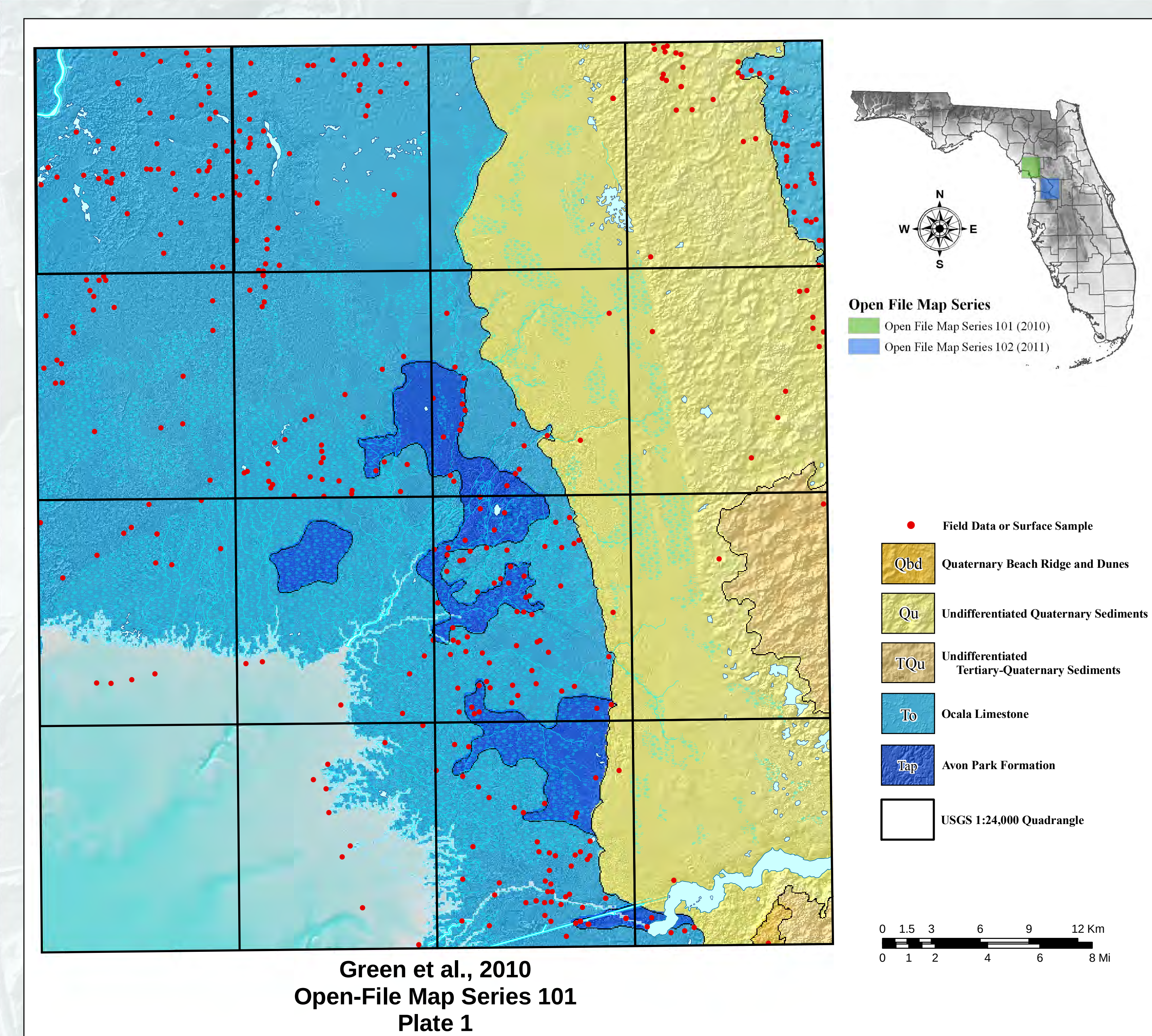


A New GIS-Based Method for Gathering Geological Field Data



Analog

Prior to the development of the mobile GIS solution detailed in this poster, Florida Geological Survey geologists used paper-based methods for recording fieldwork observations. Project geologists typically map 16 1:24,000 quadrangles in a one year period. Dense vegetative cover and extensive private land ownership often requires performing as much mapping as possible from a vehicle in order to maximize the area covered in the time allowed. This generally involved recording field observations (such as outcrop locations, access points, location of karst features, and various other field notes) on paper 1:24,000 scale quadrangles while in a vehicle. While many observations could be made while moving, any but the most cursory notes required that the vehicle be pulled off the road and stopped for more-detailed notes to be taken.

When field samples were collected, information was recorded in a standard field book and latitude and longitude coordinates were manually read from a GPS and written next to the appropriate entry, along with other relevant location information (i.e., elevation). Additional field observations were recorded by hand on the appropriate 1:24,000 USGS paper quadrangle. Although a GPS was used to track position, the geologist also was required to keep track of the position on the paper quadrangle manually. This required a division of attention from taking notes on a paper quadrangle, to observing the geology out of the window, and observation of position on the map.

Additionally, this system for recording field observations required a substantial amount of ancillary staff time and resources to implement through all phases of an investigation. Prior to going into the field, a staff member had to locate, download and plot high resolution digital copies of the 1:24,000 USGS quads in a study area. After completing a session in the field, yet another staff member would have to digitally scan the annotated paper quadrangles as high resolution images, georeference these images in ArcGIS, and begin the process of manually transcribing every track, observation, field note and sample information into a digital format, a process which was very time-consuming and inefficient.

This paper-based system resulted in less time being available in the field and office to make geologic interpretations and observations. In 2011, the FGS STATEMAP Program was able to hire a full-time GIS person. He immediately recognized a more efficient way to gather the information use GIS to increase the tools available to the geologist in the field for interpretations.

Digital

The new GIS system developed by STATEMAP staff has numerous advantages over the old paper-based methodology. The laborious process of printing, notating, scanning, georeferencing, and transcribing 1:24,000 USGS quadrangles is no longer necessary. This represents a substantial reduction in the duplication of effort through all phases of a given project.

Another advantage of the new system is that ArcPad[®] automatically records a tracklog for the path of the vehicle, allowing the geologist in the field to dispense with the responsibility of manually logging where the team has been and focus instead on the surrounding environment. This results in a much more efficient use of the geologist's time while in the field.

Inadvertent errors in recording observations are substantially reduced, since basic information such as the date, time, location and the name of the geologist making the observations are automatically attributed to every new data point.

The enhanced functionality of the Logitech G13 keyboard allows for a much more rapid pace of data acquisition. Since the G13 keyboard allows a geologist to record multiple types of observations via a variety of customized macros assigned to individual keys, it allows for many more records to be collected than using the paper-based methods.

Another advantage to this system is that field teams now have access to all of the electronic data that they otherwise would not have access to in the field: LiDAR data, recent and historical aerial imagery, cadastral data, historical well and sample descriptions, as well as thematic vector data such as permitted mining areas.

Data transfer between the field staff and office staff is facilitated. Field staff can request, receive, and view new layers while in the field via e-mail. Execution of a simple batch file allows for backing up of data to a compact flash card at any point. These backups are typically performed at midday and at the end of the field day and the files are e-mailed to the office staff at the end of every working day, thus adding another layer of data backup to the process.

Post-hoc analyses of the ancillary data recorded by ArcPad[®] have also proven to be a veritable gold mine of information. Since field teams primarily work from a moving vehicle, the speed the vehicle is travelling when an observation is made has a significant impact on the reliability of that observation; observations made at 15 mph are considered more reliable than those made at 45 mph. After a field team returns to the office, the data points that the field team has collected are married with the "speed over ground" attribute of the nearest tracklog point, indicating at what speed that the vehicle was travelling when the observation was made. This process reveals areas that potentially need to be covered again in more detail on a later expedition. Data collection metrics can also be developed and assessed for each geologist or field team, with a goal of improving performance: the time a team spent collecting data in the field, the average vehicle speed while collecting data, the number of each type of observation recorded by a geologist or pair of geologists, and the number of additional notes made by each geologist can all be quantified and compared.

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Abstract

In 2011, the Florida Geological Survey's STATEMAP program upgraded its collection methods for in situ data collection. Priority was placed on developing a mobile GIS platform that allowed for direct digitization of field data.

The new system had to meet the following minimum requirements before being used in the field: 1) must be easy to use, 2) must be able to quickly record observations from a moving vehicle, 3) must utilize hardware or software already owned by the FGS, 4) software environment must be robust to prevent the accidental loss of data.

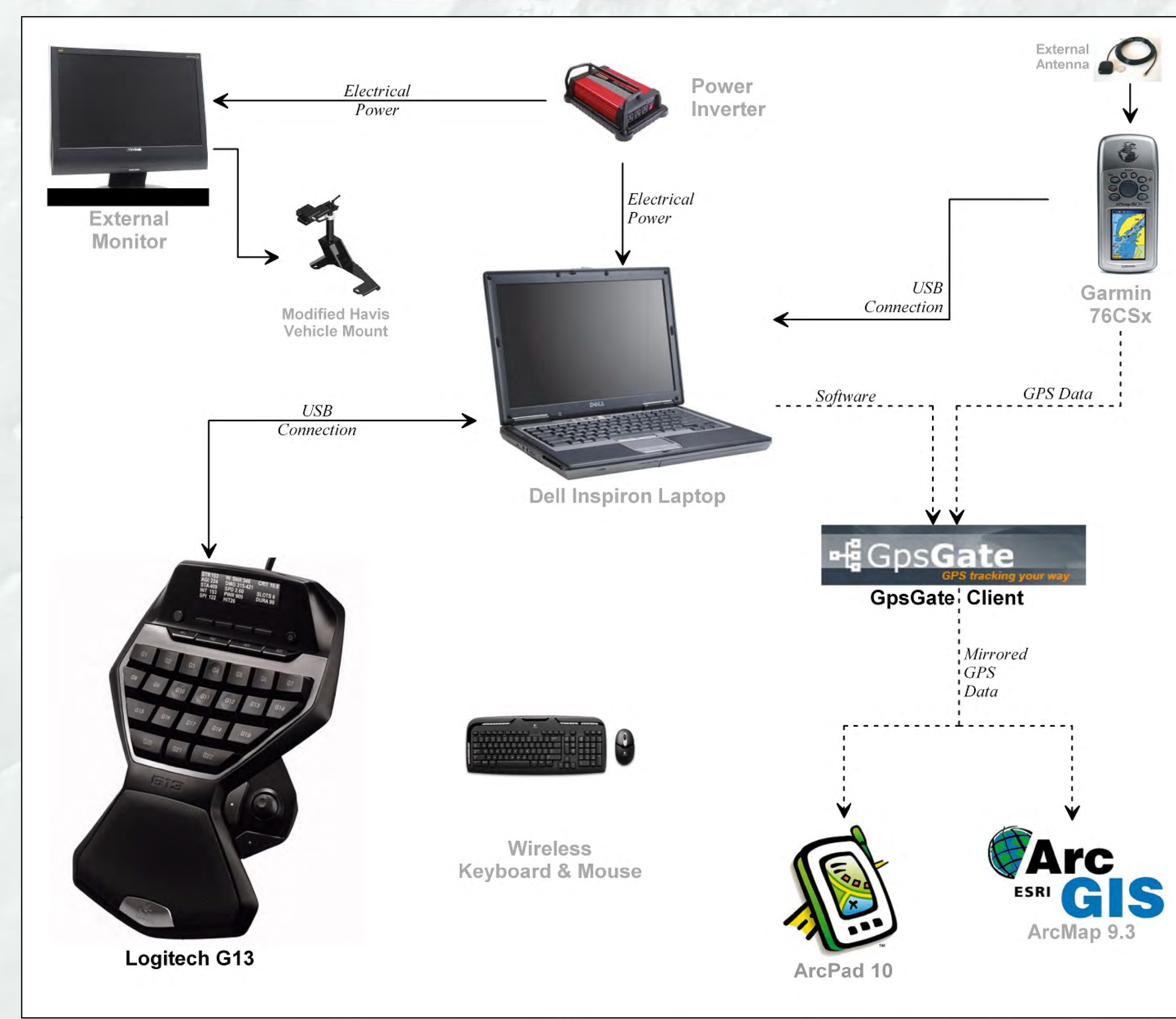
What emerged is an innovative GIS solution that is easy to use, reliable, low-cost, and highly customizable to a field team's needs. A Windows XP laptop computer, full-sized monitor, and Garmin GPS unit form the core of the vehicle-based system. Data collection is primarily handled in ESRI's ArcPad[®], which runs a customized collection of tools that bypass time-consuming digital forms. It automatically attributes the relevant fields when a new point is added to the map, latitude and longitude, date and time, the type and geologic classification of observation, and the geologist recording the observation. These custom tools are supplemented by a Logitech G13 advanced gameboard, a programmable keypad operated with the left hand. This allows the user to perform a variety of operations - toggle layers on and off; record a variety of point, line and polygon features of a specific type or class; and perform basic operations such as pan, zoom and switching the current ArcPad[®] tool in use - by pressing a single key, rather than navigating multiple on-screen menus and forms.

This customized GIS platform has met or exceeded all of the original criteria. After six months of field testing, the field teams report that it is intuitive and easy to use and data collection has proved to be robust with no data lost to inadvertent errors. The system was developed on a budget of less than \$300 for new software and equipment purchases by utilizing existing hardware.

This poster was created using Florida Department of Environmental Protection (FDEP) databases and data obtained from the Florida Geological Survey (FGS). It was completed October 26, 2011, by the FGS Geological Investigations Section. This document was prepared for the presentation of the technical information shown and is not intended to replace site-specific or site-specific investigations. The FGS does not guarantee this document is free from errors or inaccuracies and disclaims any responsibility or liability for inappropriate change of scale, interpretation, or decisions based thereon. The system discussed herein was developed by the FGS while working as the U.S. Geological Survey, National Cooperative Geologic Mapping Program, under USGS assistance award number G10AC00628. The views and conclusions in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

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Customized Applets and Menus in ArcPad[®] and ArcPad[®] Studio

STATEMAP Data Model

ArcPad[®] 10 is ESRI's mobile GIS software, designed as "map-centric, Windows-based mapping and field data collection application designed for GIS-trained professionals in small- to medium-sized workgroups who typically perform ad-hoc data collection" (ESRI 2011). ESRI has designed ArcPad[®] to allow for substantial customization of the default ArcPad[®] interface, including the creation of customized apps, data entry and retrieval forms, and visual symbologies. These customized components are easily modified in the accompanying ArcPad[®] Studio software, which uses a set of VB- and XML-based files that are either called upon by the ArcPad[®] interface at startup, or included with existing shapfiles.

TYPE		FORM	
TYPE	Float	Generic Abundant	Boat Ramp
	Generic Boulder	Gate - With Access	Gate - No Access
Outcrop	Avon Park Formation	Gate - No Trespassing	Gate - No Trespassing
	Ocala Limestone	Road - Blocked Road	Road - Does Not Exist on Map
Outcrop	Suwannee Limestone	Road - New Road not on Map	
Other	Borrow Pit		
	Cabbage Palm		
Other	Abundant Cabbage Palm		
	Digital Photo		
Other	Quarry		
	Generic Pit		
Other	Sinkhole		

The mobile GIS system described on this poster relies upon a hierarchical data model with two levels of classification. The primary category - type of observation (TYPE) - records a basic classification for each observation: whether that point is a piece of float, a geological outcrop, a point relevant to legal access to an area by a field team, or a point that falls within a more general classification as "other". The second level of classification - form of observation (FORM) - further subdivides the TYPE of observation by geologic formation (Avon Park Formation, Hawthorn Group, etc.) or other logical categories.

When ArcPad[®] is first started, a customized app initializes and first requires the user to complete a login form. After the user logs in and connects ArcPad[®] to the GPS, there are two basic types of customized commands that are available to the user that are accessible via either the graphical menus at the top of the screen or by pressing the correct key on the G13: layer toggles and data collection buttons. Layer toggles control the visibility of a standardized set of layers - aerial imagery, LiDAR coverage, hillshade, rasterized 1:24,000 topographic maps, or existing geological layers - allowing the user to turn these layers on and off at the press of a button.

Customized Scripting for the Logitech G13



The Logitech G13 Advanced Gameboard is a consumer grade, left-handed keyboard intended for use in computer gaming. The G13 is completely programmable using the provided drivers. The main keyboard consists of 25 "G" keys and a thumb joystick. There are three "M" keys above the main keyboard that serves as menu keys. This allows the user to access a total of 75 shortcuts for the ArcPad[®] software at any one time. Integrating key presses on the G13 with the appropriate action in ESRI's ArcPad[®] software occurs in one of three ways:

1. Through ArcPad[®]'s default shortcut assignment of tools to the "F" keys of the keyboard (e.g. F8). Here, the G13 merely replicates the pressing of an "F" key, with the shortcut in question assigned in ArcPad[®].
2. By replicating a combination of keystrokes, e.g. "Ctrl + S" for saving a project.
3. By replicating a combination of mouse movement and clicks to select a tool. Traditionally, the user had to first move the mouse over the tool in questions, next select that tool, and then return the mouse to its original position. This action makes use of an array of XY locations on screen that map the location of the relevant graphical buttons in the ArcPad[®] interface, and occurs at a speed fast enough as to be unnoticeable by the user.

In the STATEMAP field vehicle, the G13 is placed on the center console (see photos below) and the user controls the G13 with the left hand, while controlling the pointer in ArcPad[®] with a mouse in the right hand. Graphical "cheat sheets" for each of the three menus are typically taped to the dashboard of the vehicle for quick referencing. These have been reproduced graphically above as pictures of the customized ArcPad[®] tool icons superimposed on a picture of the G13.

Conclusions

The system described in this poster for digital collection of field data is highly adaptable for a wide variety of needs. With minimal effort, the custom coding for the G13 keyboard can be adapted to collect a wide variety of geologic information. Codes could be written for sinkhole investigations, field collection of water quality data, and numerous other applications. By eliminating the need for creating paper records and time-consuming scanning and transference of analog data to the GIS project, the system has greatly increased the efficiency of field mapping. This has resulted in significant time and money savings.

- Reduced needed field time by an estimated 10 percent due to increased efficiency
- Collected 5 times more data (~2500 points versus 500 points)
- Saved two weeks worth of office time by eliminating need for scanning quads and entering data.
- Allows for access to any type of GIS data "on the go"
- When coupled with wireless access, data can be shared directly from the field with home office, thus saving even more time and money
- Data can be backed up to flash drive or e-mailed to home office at any time

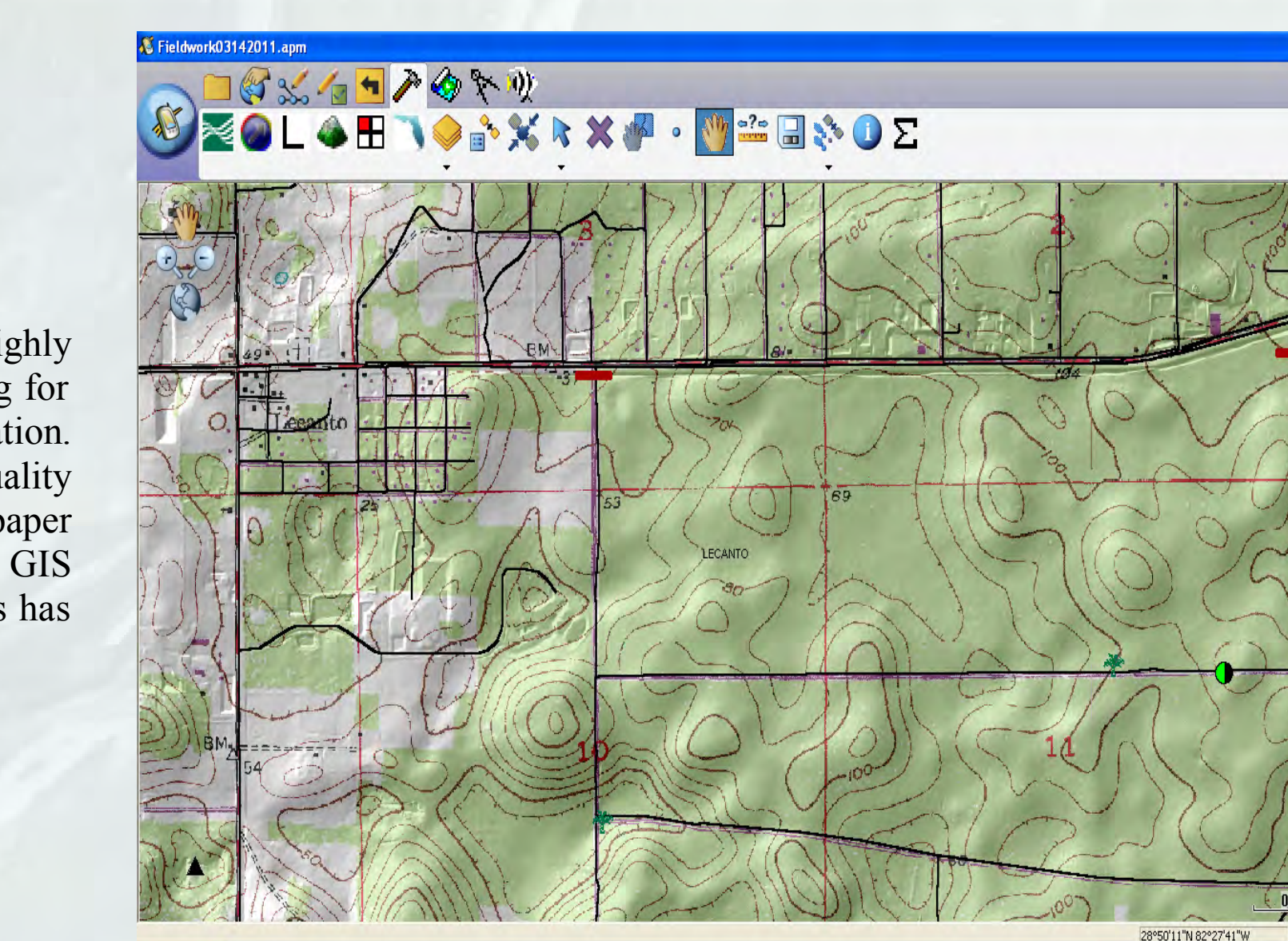
References

ESRI, 2011. "ArcPad: Custom questions," available at: <http://www.esri.com/software/arcgis/arcpad/custom-questions.html>.

Green, R.C., Williams, C.P., Flor, A.D., Paul, D.T., Kromhout, C.K., and Scott, T.M., 2010. Geologic map of the eastern portion of the U.S.G.S. Ocala 1:24,000 scale, north-central Florida. Florida Geological Survey Open File Map Series 101, scale 1:100,000.

Green, R.C., Williams, C.P., Burdette, K.E., Bassett, S.W., Flor, A.D., and Paul, D.T., 2011. Geologic map of the eastern portion of the U.S.G.S. Suwannee 1:24,000 scale, central Florida. Florida Geological Survey Open File Map Series 102, scale 1:100,000.

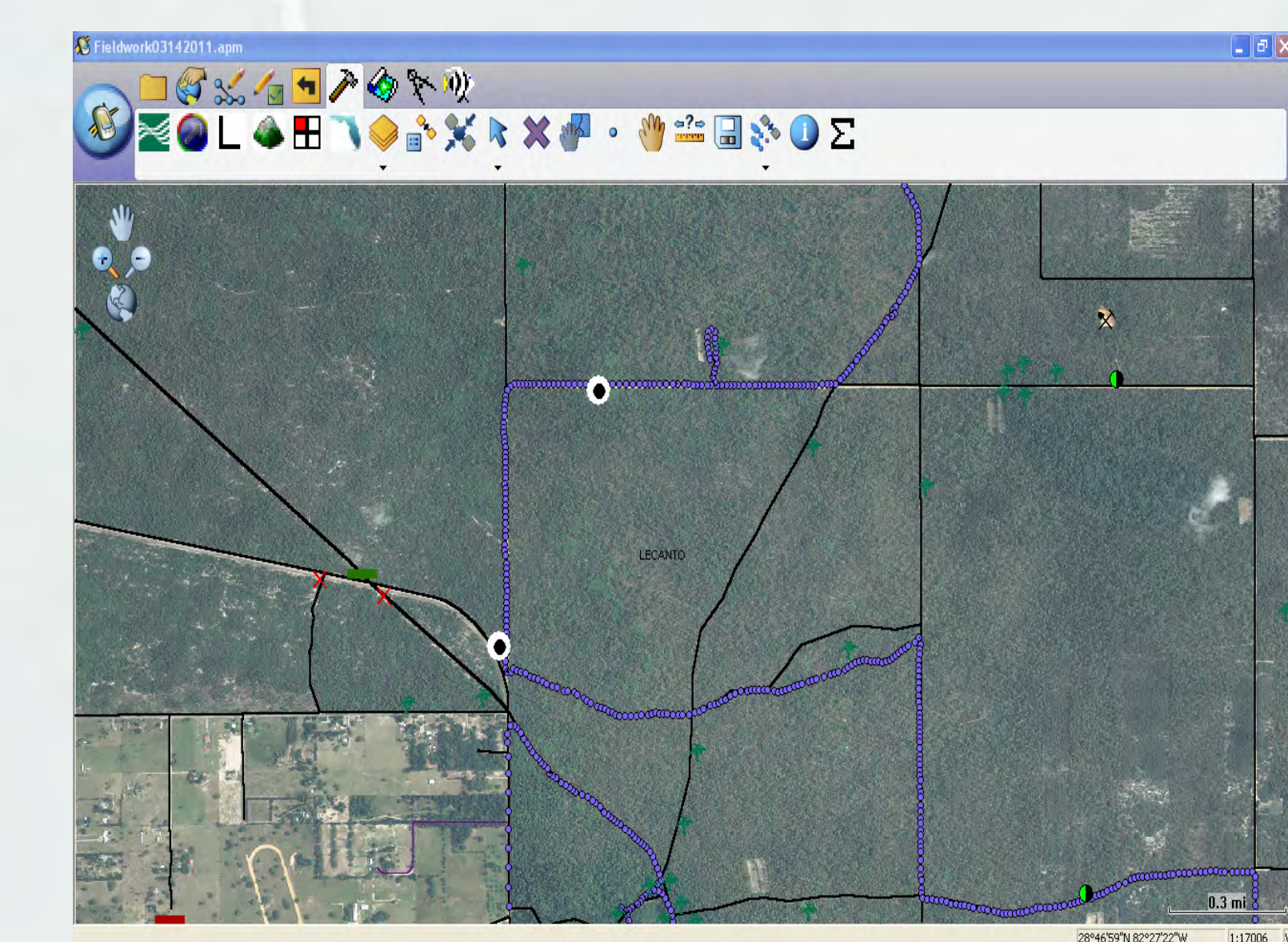
QR Links to Webpages



Screenshot of ArcPad[®] in operation. A transparent hillshade layer based upon LiDAR imagery is overlaid on a digital raster graphic of a 1:24,000 USGS topographic quadrangle. The hillshade layer both enhances the relief of the topographic map and serves to highlight areas where LiDAR and quadrangle elevations differ.



Photograph showing the FGS mobile mapping unit in "collection mode". The collection mode allows the passenger full field of view and the ability to quickly collect geologic and other data and is only used at slow speeds, where a collision will not deploy the airbags.



Screenshot of ArcPad[®] in operation. Aerial imagery (as well as a variety of other layers) can be toggled with a single press of the appropriate button on the G13. Tracklogs are shown as a series of blue dots.



Photograph showing the FGS mobile mapping unit in "navigation mode". The navigation configuration allows the driver and passenger to quickly locate the vehicle in real-time and determine a course of action based on activated layers while keeping the screen out of the way of the airbag in the event of a collision.