Digital Geology Express

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Modern Digital Field Methods: Equipment, Software, Techniques

Table 1

1:00, 1:20, 1:40, 2:00, 2:40, 3:00 & 3:20 PM

Modern Digital Field Methods: Equipment, Software, Techniques

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Abstract

The modern world of iPhones, iPads, Android devices, and apps of all varieties has transformed how we access and process information in the field. This has profound consequences for field geoscientists, as techniques and methods for data acquisition and mapping in the field have been dramatically advanced and simplified by these new tools. At this digital poster station we will discuss new devices and apps for geologic fieldwork and demonstrate example workflows. Examples include iPads running the iGIS and GeoFieldBook apps, Open Data Kit for Android devices, and an app implementation of the Open source GIS program Quantum GIS on various platforms. These applications expand the capabilities of field data acquisition to virtually any mobile platform and largely supplant traditional paper maps and hardback field books.

A particularly useful digital tool for field geologists is GeoFieldBook, an iOS and Android based app that can be used to collect structural and other field observations. Records log location and date information, orientation measurements, formation names, text observations and photos taken with the tablet camera. Records are customizable, so users can add fields of their own choosing. Data are displayed on an image base in real time with oriented structural symbols. The image base can also be used for in-field navigation, replacing paper field maps. All data can be exported to a .csv file for use in other analysis applications.

For many geologists the only traditional tools that remain in their field kit are a hand lens and compass, and some would argue that even the venerable Brunton compass's days are numbered! For example, most smart phones and tablets now contain magnetometers and accelerometers and several apps use these sensors to make routine measurement of orientations of planes, lines, or both in a single measurement. Nonetheless, the underlying inexpensive hardware in these devices is highly variable, and work is needed to determine the precision and variances among devices before they should be routinely used for geologic measurements.

Support

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GeoFieldBook/Mapping Base

Replaces the traditional field book and airphoto/image base

Projects Stored as Folders:

Field Observations Stored Within Folders:

Real-time Mapping

Imaging of each field location can be done using the integrated iPad camera. Images are geo-registered using the GPS data and are exported with the data file

Location information from the on-board GPS, date and time

Observation block can be used to record additional information as necessary

Real-Time mapping of the Data

* In-field navigation using Apple image base and on-board GPS
  - Continually updated with cellular data plan or cached maps
* Real-time display of structural information
  - Strike and dip (± dip value)
  - Color-coded by formation
  - Display all or selected records
  - Selectable datapoints - instant recall of recorded data
  - Filter by record type (bedding, contacts, faults, joints, "other")

Screens are customized for the type of observation and provide control on what data should be collected (helpful for students)
* Bedding, Contact, Fault, Joints, Other
* Five user customizable entry fields

Formation Lists and Names can be modified within the application and exported to or imported from your computer.

Import and export of data and formation lists.

* Export all data, selected folders or selected records
* Exported Data file is in .csv format
  - Importable into many different data management, display and processing applications.
* Images exported with data file
* Existing data files and images can be imported into App

Sample Student Map and cross-section

Apple and Android Versions Available

StratLogger

Create Realtime Strat Logs in the Field

*Field app for bed-by-bed measured strat columns

*Multiple columns organized into project folders

*Lithology, contact, fossil content, color, & thickness recorded w/ linked bed photos & other description

*Strat column diagram appears in real time, allowing for hypothesis testing & recognition of trends and cycles in depositional sequences

*Export all data via iTunes. Media images & .csv format data for use in spreadsheet programs

*Stratigraphic column image exported as .jpeg

*Fields are modifiable & allow user-defined entries for customizable app use in different field areas

*Embedded reflection questions ask students to interpret depositional environment and it's change while gathering data in the field

Field GIS systems on Handheld Computers and Tablets

HARDWARE

Our aging equipment--win mobile and win tablets

aging winmobile devices

Our goal--new equipment (tablets and phones)

Pixel Qi Windows Tablet from Sun computer (great display, crappy cpu; no stylus)

$$$

Android tablets and phones--Samsung is not cursed by Apple!

$

Microsoft's windows surface tablet--big winner here?

$$

cost--

SOFTWARE SOLUTIONS

We still love Arcpad--but %$#@ ESRI refuses to port to anything but windows.

Goldilocks potential--Open Source GIS, QGIS--as friendly as Arcpad without application creep! Advantage--almost any platform (except iOS) (downside--VERY unstable on Android as of this moment)

Strong competition--FieldMove

Our emphasis:

1) Field GIS captures the power of GIS--live attribute capture
2) Linework key to the field work; POLYGONS ARE FORBIDDEN IN THE FIELD (waste of time for something best left to the office)
3) GPS and live line capture allow unprecedented resolution of complex geology (structural knots to complex stratigraphic relationships)
4) Digital recording compasses (aka, your phone) can lead to unprecedent amounts of orientation data (analogous to automated microprobes) (with important caveats on accuracy)
5) Different workflows are needed in poor outcrop areas vs good outcrop with modern aerial photography
6) All workflows for field work need to be re-evaluated
7) Paper mapping is dead

In Development--live 3D field work

*Long way to go
*Move-Fieldmove combo vs QGIS-Move workflow
* Google Earth Interface?

Conventional Geologic map from Field GIS system

Goal--full 3D visualization in field environment

iPads with the iGIS app

A sample workflow, as used at the James Madison University Geology Field Course in Ireland

The field area: the mountain of Bencorragh in County Mayo, western Ireland

Field mapping and data collection with an iPad

The iGIS app showing point data over the Apple base imagery

Simple shapefile data table for outcrop data collection in iGIS

Outcrop data collected by 16 student teams during 2013 mapping project

Compiled data from five (5) years of digital mapping projects on the mountain of Bencorragh. Each year's field area has moved progressively west; the approximate field area for 2013 is outlined by the white box.

Preparing for the field

* Create shapefiles (data files) in ArcGIS
  - Point data, line data, and polygon data can all be collected in iGIS
* Make sure the files associated with each shapefile are in their own folder
  - Zip (compress) each shapefile folder
* iGIS automatically uses the standard Apple aerial image base for basemaps
  - Custom imagery (raster files) can be imported for use in iGIS, but they need to be tiled first - use MapTiler for that
  - Zip any imagery folders
* Connect the iPad to your PC, and use iTunes to upload all zipped folders to the iGIS app data window
* In iGIS (on the iPad):
  - Create a project
  - Import all of the shapefiles
  - Add each shapefile to the project, and set the projection for each layer
  - Adjust the transparency, symbol color, etc. for each layer

In the field

* Open the project in iGIS
  - Collect a Waypoint using the built-in GPS (or select a location by hand)
* Enter outcrop data into the shapefile data table
  - Data can be edited by selecting the data point and choosing Edit
* Move to the next outcrop and repeat...

Back in the lab

* From within iGIS, Export the shapefiles with your outcrop data
* Connect the iPad to your PC and transfer the Exported zipped folders from the iGIS data window (in iTunes) to your PC
  - Unzip the folders, and replace your original ArcGIS shapefile files with the new ones containing your field data
* Continue to build your final geologic map in ArcGIS

NOTE: we save each day's field data files in date-stamped folders on the PC, so that we have daily backups of our data

Comments? Suggestions? Things We Missed? Things We Should Try?