DIGITAL MAPPING TECHNIQUES 2024

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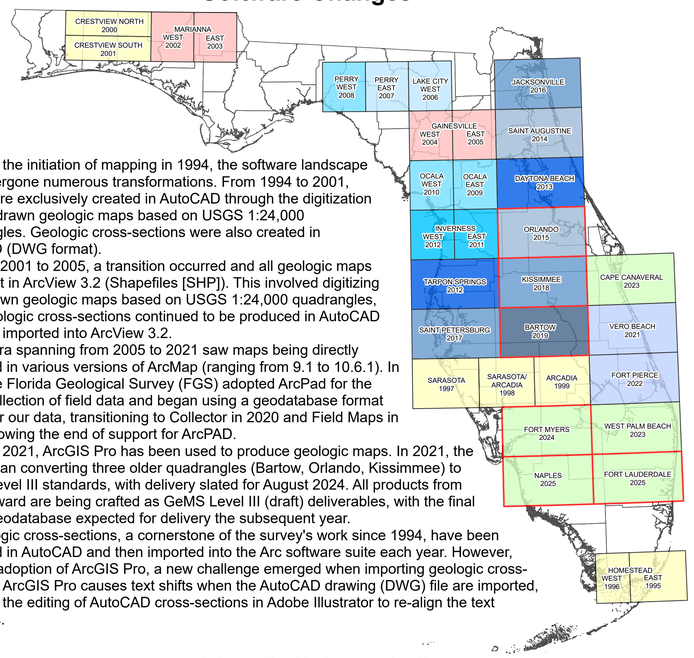
A Generation of STATEMAP: Challenges Dealing With 30 Years of Projects

by
Rick Green, Crystal Hebets, and Sean Jones
2024

Guy H. Means
State Geologist and Director

Software Changes



Since the initiation of mapping in 1994, the software landscape has undergone numerous transformations. From 1994 to 2001, maps were exclusively created in AutoCAD through the digitization of hand-drawn geologic maps based on USGS 1:24,000 quadrangles. Geologic cross-sections were also created in AutoCAD (DWG format).

From 2001 to 2005, a transition occurred and all geologic maps were built in ArcView 3.2 (Shapefiles [SHP]). This involved digitizing hand-drawn geologic maps based on USGS 1:24,000 quadrangles, while geologic cross-sections continued to be produced in AutoCAD and then imported into ArcView 3.2.

The era spanning from 2005 to 2021 saw maps being directly produced in various versions of ArcMap (ranging from 9.1 to 10.6.1). In 2010, the Florida Geological Survey (FGS) adopted ArcPad for the digital collection of field data and began using a geodatabase format (GDB) for our data, transitioning to Collector in 2020 and Field Maps in 2022 following the end of support for ArcPAD.

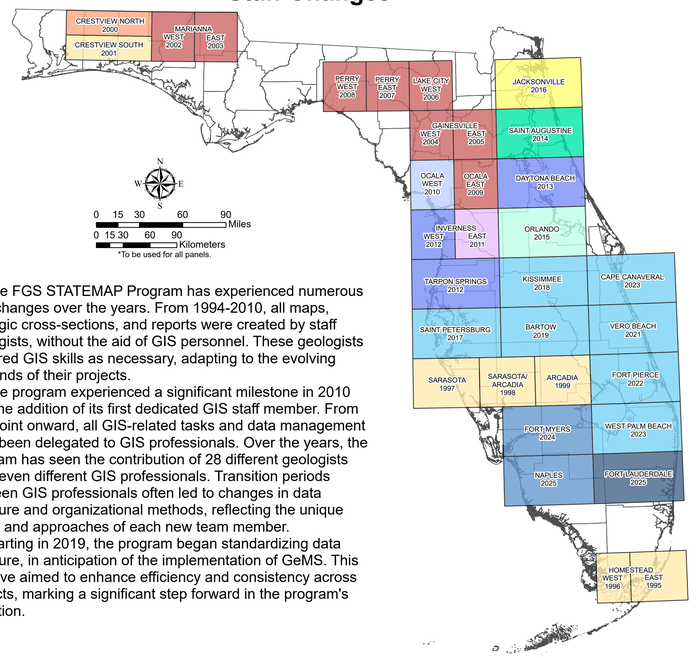
Since 2021, ArcGIS Pro has been used to produce geologic maps. In 2021, the FGS began converting three older quadrangles (Bartow, Orlando, Kissimmee) to GeMS Level III standards, with delivery slated for August 2024. All products from 2024 onward are being crafted as GeMS Level III (draft) deliverables, with the final GeMS geodatabase expected for delivery the subsequent year.

Geologic cross-sections, a cornerstone of the survey's work since 1994, have been produced in AutoCAD and then imported into the Arc software suite each year. However, with the adoption of ArcGIS Pro, a new challenge emerged when importing geologic cross-sections: ArcGIS Pro causes text shifts when the AutoCAD drawing (DWG) file are imported, requiring the editing of AutoCAD cross-sections in Adobe Illustrator to re-align the text elements.

Software Used in Constructing Maps

- AutoCAD
- ArcView 3.2
- ArcMap 9.1
- ArcMap 9.2
- ArcMap 9.2, ArcPad
- ArcMap 10, ArcPad
- ArcMap 10.2, ArcPad
- ArcMap 10.3, ArcPad
- ArcMap 10.6.1, ArcPad
- ArcMap 10.6.1, Collector
- ArcPro, FieldMaps
- GeMS Level III

Staff Changes



The FGS STATEMAP Program has experienced numerous staff changes over the years. From 1994-2010, all maps, geologic cross-sections, and reports were created by staff geologists, without the aid of GIS personnel. These geologists acquired GIS skills as necessary, adapting to the evolving demands of their projects.

The program experienced a significant milestone in 2010 with the addition of its first dedicated GIS staff member. From that point onward, all GIS-related tasks and data management have been delegated to GIS professionals. Over the years, the program has seen the contribution of 28 different geologists and seven different GIS professionals. Transition periods between GIS professionals often led to changes in data structure and organizational methods, reflecting the unique styles and approaches of each new team member.

Starting in 2019, the program began standardizing data structure, in anticipation of the implementation of GeMS. This initiative aimed to enhance efficiency and consistency across projects, marking a significant step forward in the program's evolution.

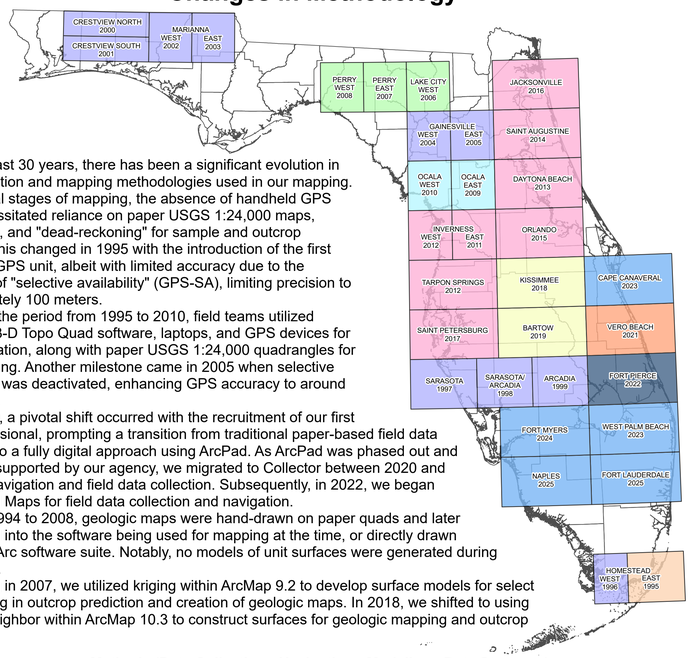
Geologists Creating Maps and Managing Data

- Green
- Means, Green
- Green, Paul
- Green, Flor

GIS Professionals Managing Data

- Hannon, White
- Bassett
- Bassett, Hannon
- Hannon
- White
- Hebets
- Hebets, Jones
- Jones, Hebets

Changes in Methodology



In the last 30 years, there has been a significant evolution in data collection and mapping methodologies used in our mapping. In the initial stages of mapping, the absence of handheld GPS units necessitated reliance on paper USGS 1:24,000 maps, odometers, and "dead-reckoning" for sample and outcrop location. This changed in 1995 with the introduction of the first handheld GPS unit, albeit with limited accuracy due to the presence of "selective availability" (GPS-SA), limiting precision to approximately 100 meters.

During the period from 1995 to 2010, field teams utilized DeLorme 3-D Topo Quad software, laptops, and GPS devices for field navigation, along with paper USGS 1:24,000 quadrangles for field mapping. Another milestone came in 2005 when selective availability was deactivated, enhancing GPS accuracy to around 10 meters.

In 2010, a pivotal shift occurred with the recruitment of our first GIS professional, prompting a transition from traditional paper-based field data collection to a fully digital approach using ArcPad. As ArcPad was phased out and no longer supported by our agency, we migrated to Collector between 2020 and 2021 for navigation and field data collection. Subsequently, in 2022, we began using Field Maps for field data collection and navigation.

From 1994 to 2008, geologic maps were hand-drawn on paper quads and later transferred into the software being used for mapping at the time, or directly drawn within the Arc software suite. Notably, no models of unit surfaces were generated during this period.

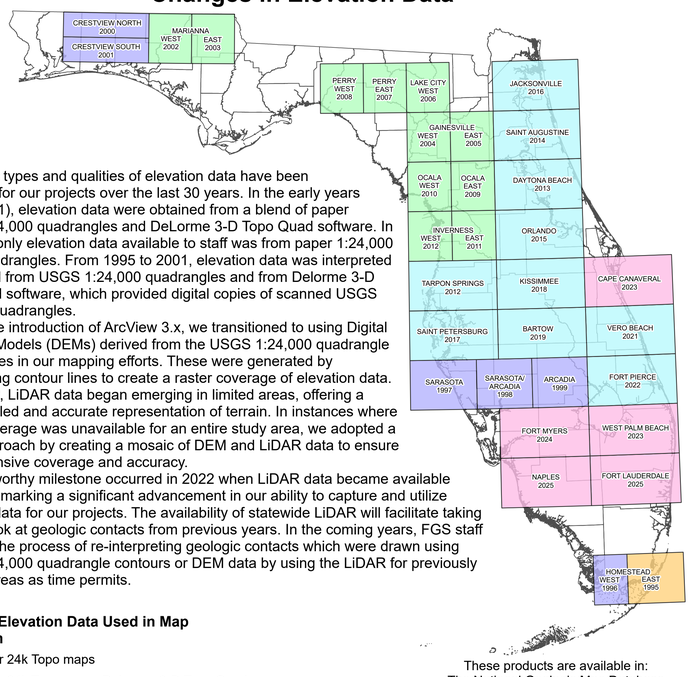
Starting in 2007, we utilized kriging within ArcMap 9.2 to develop surface models for select units, aiding in outcrop prediction and creation of geologic maps. In 2018, we shifted to using Natural Neighbor within ArcMap 10.3 to construct surfaces for geologic mapping and outcrop prediction.

Methods (Data Collection : Navigation : Modeling : Data Structure)

- PM : PM : N/A : DWG
- PM: GPS-SA : N/A : DWG
- PM : GPS-SA : 3DT : SHP
- PM : GPS : 3DT : SHP
- PM : GPS : Kriging : SHP
- ArcPad : GPS : NN : GDB
- Collector : GPS : NN : GDB
- FieldMaps : GPS : NN : GDB

PM = Paper Maps 3DT = DeLorme 3-D TopoQuads NN = Natural Neighbor SHP = Shapefile DWG = Drawing

Changes in Elevation Data



Various types and qualities of elevation data have been employed for our projects over the last 30 years. In the early years (1994-2001), elevation data were obtained from a blend of paper USGS 1:24,000 quadrangles and DeLorme 3-D Topo Quad software. In 1994, the only elevation data available to staff was from paper 1:24,000 USGS quadrangles. From 1995 to 2001, elevation data was interpreted or digitized from USGS 1:24,000 quadrangles and from Delorme 3-D Topo Quad software, which provided digital copies of scanned USGS 1:24,000 quadrangles.

With the introduction of ArcView 3.x, we transitioned to using Digital Elevation Models (DEMs) derived from the USGS 1:24,000 quadrangle contour lines in our mapping efforts. These were generated by interpolating contour lines to create a raster coverage of elevation data.

In 2013, LiDAR data began emerging in limited areas, offering a more detailed and accurate representation of terrain. In instances where LiDAR coverage was unavailable for an entire study area, we adopted a hybrid approach by creating a mosaic of DEM and LiDAR data to ensure comprehensive coverage and accuracy.

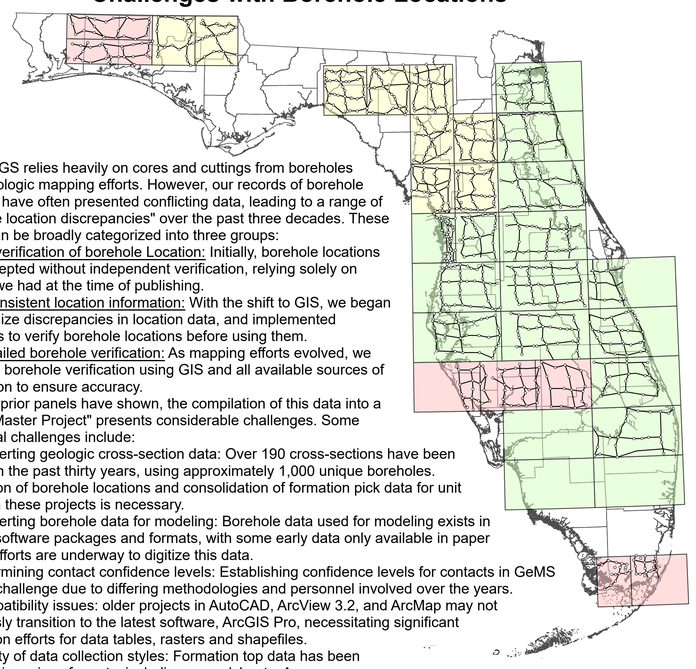
A noteworthy milestone occurred in 2022 when LiDAR data became available statewide, marking a significant advancement in our ability to capture and utilize elevation data for our projects. The availability of statewide LiDAR will facilitate taking another look at geologic contacts from previous years. In the coming years, FGS staff will begin the process of re-interpreting geologic contacts which were drawn using USGS 1:24,000 quadrangle contours or DEM data by using the LiDAR for previously mapped areas as time permits.

Source of Elevation Data Used in Map Generation

- Paper 24k Topo maps
- Paper 24k Topo maps, DeLorme 3-D Topo Quads
- DEM (derived from 24k topo maps)
- DEM/LiDAR mosaic
- LiDAR

These products are available in:
The National Geologic Map Database

Challenges with Borehole Locations



The FGS relies heavily on cores and cuttings from boreholes for its geologic mapping efforts. However, our records of borehole locations have often presented conflicting data, leading to a range of "borehole location discrepancies" over the past three decades. These issues can be broadly categorized into three groups:

1. No verification of borehole Location: Initially, borehole locations were accepted without independent verification, relying solely on location we had at the time of publishing.
2. Inconsistent location information: With the shift to GIS, we began to recognize discrepancies in location data, and implemented measures to verify borehole locations before using them.
3. Detailed borehole verification: As mapping efforts evolved, we improved borehole verification using GIS and all available sources of information to ensure accuracy.

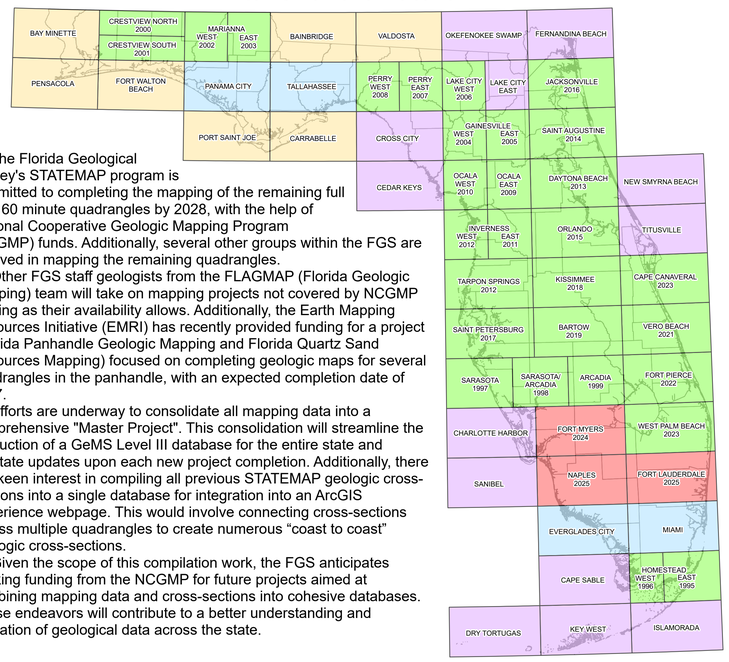
As the prior panels have shown, the compilation of this data into a unified "Master Project" presents considerable challenges. Some additional challenges include:

- Converting geologic cross-section data: Over 190 cross-sections have been created in the past thirty years, using approximately 1,000 unique boreholes. Verification of borehole locations and consolidation of formation pick data for unit tops from these projects is necessary.
- Converting borehole data for modeling: Borehole data used for modeling exists in multiple software packages and formats, with some early data only available in paper format. Efforts are underway to digitize this data.
- Determining contact confidence levels: Establishing confidence levels for contacts in GeMS poses a challenge due to differing methodologies and personnel involved over the years.
- Compatibility issues: older projects in AutoCAD, ArcView 3.2, and ArcMap may not seamlessly transition to the latest software, ArcGIS Pro, necessitating significant conversion efforts for data tables, rasters and shapefiles.
- Variety of data collection styles: Formation top data has been collected in various formats, including spreadsheets, Access databases, and other GIS table formats, adding complexity to data integration efforts.

Borehole Location Information

- No Verification of Borehole Location
- Inconsistencies in Location Information
- Detailed Borehole Verification
- Cross Section Wells
- Cross Section Lines

Plans for the Future



The Florida Geological Survey's STATEMAP program is committed to completing the mapping of the remaining full 30 x 60 minute quadrangles by 2028, with the help of National Cooperative Geologic Mapping Program (NCGMP) funds. Additionally, several other groups within the FGS are involved in mapping the remaining quadrangles.

Other FGS staff geologists from the FLAGMAP (Florida Geologic Mapping) team will take on mapping projects not covered by NCGMP funding as their availability allows. Additionally, the Earth Mapping Resources Initiative (EMRI) has recently provided funding for a project (Florida Panhandle Geologic Mapping and Florida Quartz Sand Resources Mapping) focused on completing geologic maps for several quadrangles in the panhandle, with an expected completion date of 2027.

Efforts are underway to consolidate all mapping data into a comprehensive "Master Project". This consolidation will streamline the production of a GeMS Level III database for the entire state and facilitate updates upon each new project completion. Additionally, there is a keen interest in compiling all previous STATEMAP geologic cross-sections into a single database for integration into an ArcGIS Experience webpage. This would involve connecting cross-sections across multiple quadrangles to create numerous “coast to coast” geologic cross-sections.

Given the scope of this compilation work, the FGS anticipates seeking funding from the NCGMP for future projects aimed at combining mapping data and cross-sections into cohesive databases. These endeavors will contribute to a better understanding and utilization of geological data across the state.

Geologic Mapping Plans

- Completed STATEMAP Areas
- Current Ongoing Projects
- STATEMAP 3-5 Year Plan
- FLAGMAP Areas
- Florida Panhandle Geologic Mapping and Florida Quartz Sand Resource Mapping

For more information contact:
Rick Green
Florida Geological Survey
3000 Commonwealth Blvd., Suite 1
Tallahassee, FL 32303
Rick.Green@FloridaDEP.gov

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