I. GeMS Resources &
II. A Georeferencing Utility

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Caroline Rose (she/her)
Wisconsin Geological and Natural History Survey
caroline.rose@wisc.edu

I.
GeMS Resources

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resources from the Wisconsin Geo. Survey

github.com/wgnhs/gems

DMT 2019 presentation

DMT 2020 presentation

Workflow overview

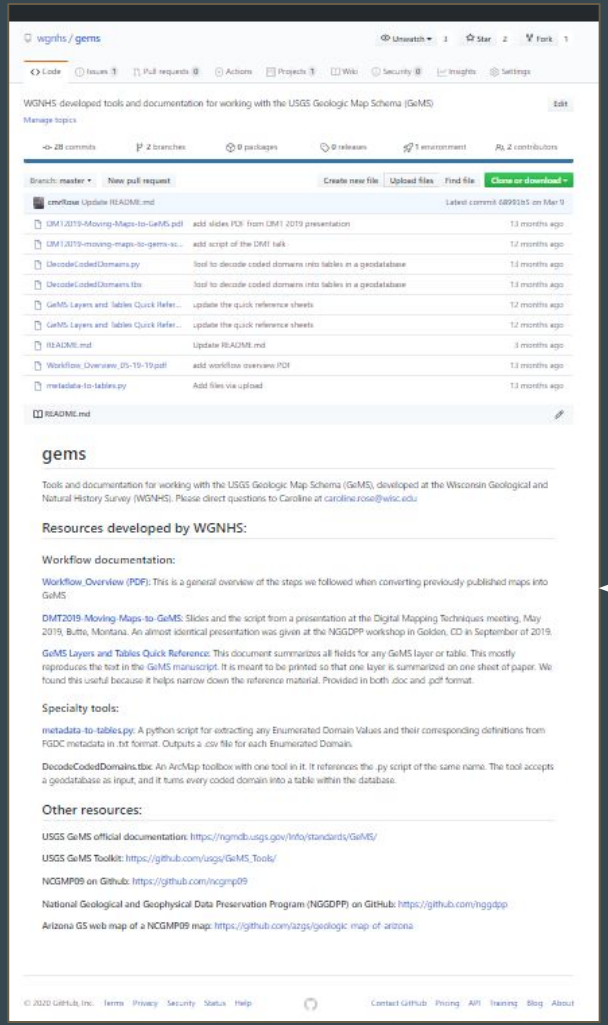
Layers and Tables Quick-reference sheets

GeMS Fields Checklist

Metadata in ArcCatalog: step-by-step

Metadata & GeMS Attributes reference

Python tools for working with domains in our original data



Summary of resources

github.com/ wgnhs/gems

Get a general overview of a GeMS workflow

See prior DMT presentations (scripts and slides on github).

We also have a summary document.

Workflow Overview

(PDF on github)

Workflow Step	Basic Steps	Tools/Scripts/Templates
Locate Data	• Create folders to house initial data, edited data, and eventually GeMS data. • Download from WGNHS website or • Find in past project folders	
Convert to use in ArcMaps	If in .E00 format: • Use conversion tool • Create a new file geodatabase (with correct spatial information) and within that create a new feature dataset. • Import the converted shapefiles into the geodatabase/feature dataset.	• Import from E00 (Conversion) (tool) • Create new File Geodatabase • Create new Feature Dataset
	If already in a geodatabase: • Create a new file geodatabase (with correct spatial information) and within that create a new feature dataset. • Import the other geodatabase files into the geodatabase/feature dataset.	• Create new File Geodatabase • Create new Feature Dataset
Examine Data	• Extract metadata from larger metadata txt (if necessary). • Write down the initial data type in the progress table.	• Run in-house extract from metadata script
	• Fill in tables	• Templates:

Populate your GeMS containers

Become familiar with each GeMS layer or table and its attributes

We have reference sheets for that.

MapUnitPolys (polygon feature class) required

Fields:

MapUnit	*Short plain-text key (identifier) for the map unit. Example values: "Qal", "Tg", "Kit", "water", "Trc3", etc. Foreign key to DescriptionOfMapUnits table. Null values not permitted—a mapped polygon must have an assigned map unit*
IdentityConfidence	*How confidently is this polygon identified as MapUnit? Value is usually "certain", "questionable", or "unspecified". Null values not permitted. Suggest setting default value to "certain". Values must be defined in Glossary.*
Label	*Determined from the appropriate value of the Label in the DescriptionOfMapUnits table and IdentityConfidence: if IdentityConfidence = "questionable", then append "?" to Label value from the DescriptionOfMapUnits table. Allows for subscripts and special characters. Null values permitted*
Symbol	*References an area fill symbol (background color + optional pattern). Area fill symbols must be defined in an accompanying style file. If Esri Cartographic Representations are used to symbolize map units, the value may be null or blank. Null values permitted*
DataSourceID	*Foreign key to DataSources table, to track provenance of each data element. Null values not permitted*
Notes	*Optional field. Free text for additional information specific to this polygon. Null values permitted*
MapUnitPolys_ID	*Primary key.* Example Values = MUP1, MUP2, MUP3, etc. Values must be unique in database. Null values not permitted

Topology rules:

- Polygons must not overlap
- No gaps between polygons
- Boundaries must be overlain by lines in ContactsAndFaults

Note that not all lines in ContactsAndFaults necessarily bound polygons; polygons

Quick-reference Sheets

(PDF on github)

Check over your GeMS database

In tandem with the USGS schema validation script/tool
(use before or after)

We have a checklist for that.

“GeMS Fields Checklist” (PDF on github)

Glossary (non-spatial table)

	Term	❑ Check paragraphStyles against original map ❑ Terms are in the master glossary ❑ Master glossary has the map listed in the ‘Maps’ column
	Definition	Look for truncated definitions
	DefinitionSourceID	
	❖ SeeAlso	
	TermSrcFld	
	TermSrcFC	
	Glossary_ID	

DataSources (non-spatial table)

	DataSources_ID	Unique and readable abbreviations of the citations
	Source	❑ Cite the entire publication instead of the plate itself. ❑ Citations follow USGS format
	Notes	
	URL	If referencing a past Survey publication, the URL directs to the overall publication, not just the plate.

Metadata

Before running the USGS metadata script, you populate metadata at the Feature Dataset level in your geodatabase.

We have a step-by-step guide for that.

“Metadata For GeMS Maps - Step by Step in ArcCatalog”

(PDF on github)

ArcCatalog

FGDC metadata

Overview > Citation	Titles	2	Lineage > Source_Information > Source_Citation > Citation_Information		
Overview > Citation	FGDC Geospatial Data Presentation Form	1	Citation > Citation Information > Geospatial Data Presentation Form		Vector Digital Data
Overview > Citation	Dates > add a Publication Date	1	Time Period of Content >Time Period Information > Single Date/Time > Calendar Date	January 1 of the publication year	
Overview > Citation	Series > Name	1	Citation > Citation Information > Series Information > Series Name	Bulletin, Information Circular, etc	

Also reference:

The Esri Illustrated Guide to FGDC metadata:

http://desktop.arcgis.com/en/arcmap/10.6/manage-data/metadata/illustrated-guide-to-complete-fgdc-metadata.htm

Metadata

The USGS metadata tool/script will pull GeMS attribute values from throughout your database into your metadata (e.g., glossary definitions, data source citations, DMU fullnames)

We have a reference guide for that.

“Metadata Summary for GeMS Fields” (PDF on github)

Attribute	Is an Enumerated Domain	Links between Tables / Feature Classes	Appears in Enumerated_Domain_Value_Definition	Appears in Enumerated_Domain_Value_Definition_Source
MapUnitPolys / MapUnit	Yes	Links to DescriptionOfMapUnits / MapUnit		
Any Type field (e.g., in the ContactsAndFaults or GeologicLines feature classes)	Yes	Links to Glossary / Term		
Any Confidence Field (e.g., ExistenceConfidence, IdentityConfidence, etc.)	Yes	Links to Glossary / Term		
Any DataSource Field (e.g., DataSourceID, DefinitionSourceID, DescriptionSourceID, etc.)	Yes	Links to DataSources / DataSources_ID		
DescriptionOfMapUnits / ParagraphStyle	Yes	Links to Glossary / Term		
DescriptionOfMapUnits / GeoMaterial	Yes	Links to GeoMaterialDict / Definition *		
DescriptionOfMapUnits / GeoMaterialConfidence	Yes			
DescriptionOfMapUnits / MapUnit		Yes		
DescriptionOfMapUnits / FullName			Yes	
DataSources / Source			Yes	Yes

Metadata summary: MapUnitPolys (polygon feature class) required

Attribute Label:	Attribute Domain Values:
MapUnit	Enumerated Domain: ○ Value drawn from this table. ○ Value_Definition drawn from the “FullName” attribute of the DescriptionofMapUnits table (linked by foreign key “MapUnit”) ○ Value_Definition_Source is “this report, table DescriptionofMapUnits”
IdentityConfidence	Enumerated Domain: ○ Value drawn from this table. ○ Value_Definition drawn from the “Definition” attribute of the Glossary table (linked by foreign key “Term”) ○ Value_Definition_Source drawn from the “Source” attribute of the DataSources table (linked by foreign key “DataSources_ID” connected to the “DefinitionSourceID” in the Glossary table)
Label	Unrepresentable domain
Symbol	Unrepresentable domain
DataSourceID	Enumerated Domain: ○ Value drawn from this table

I’m here to help.

caroline.rose@wisc.edu

Emails, phone calls, video meetings

See our examples (20 maps): https://wgnhs.wisc.edu/catalog/publication?q=gems

II:
Quad-G

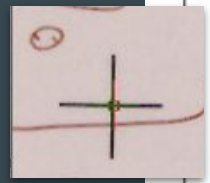
georeferencing made easier

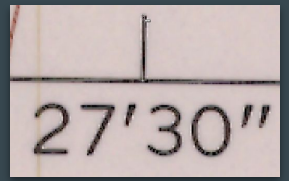
What is Quad-G?

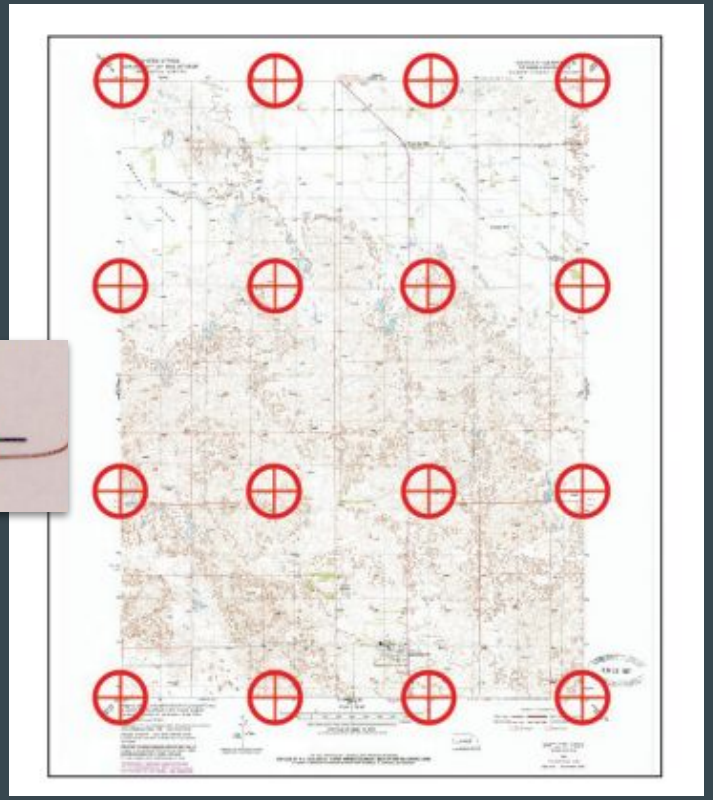
A program to facilitate georeferencing of USGS Quads (Quad-G) and/or any map with graticule control marks (Thematic-G).

It scans the image for control marks

Single file input or batch input (many maps)





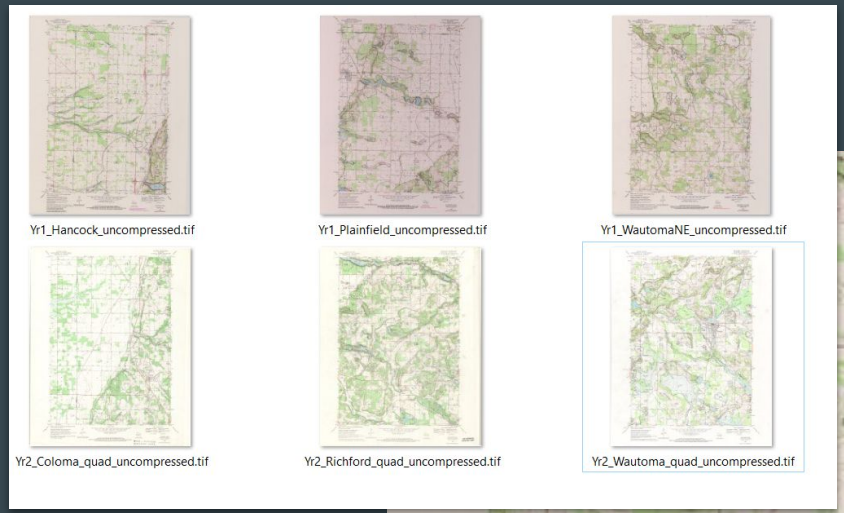


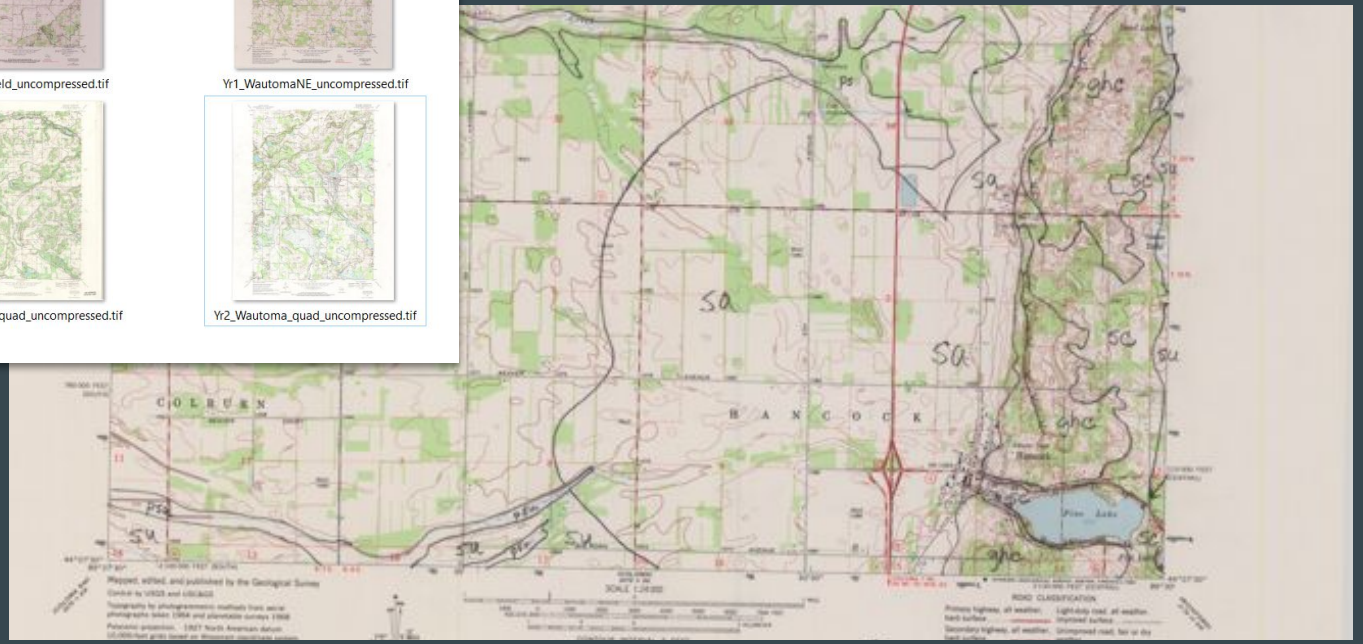
Why is it useful?

Historic field notes / sample locations on quads

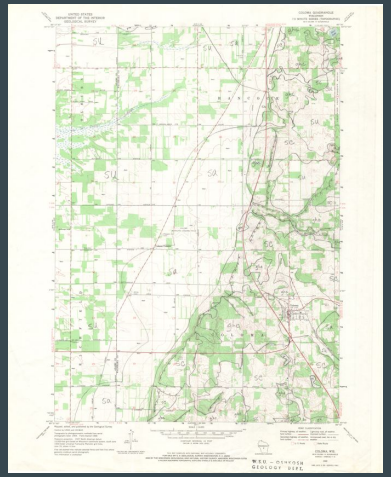
Emeritus faculty / mappers who prefer to work on paper

Example: Western Waushara Quaternary Geology





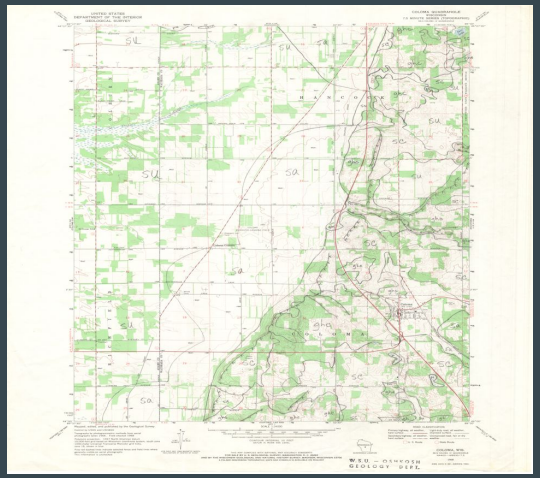
Example: Western Waushara Quaternary Geology



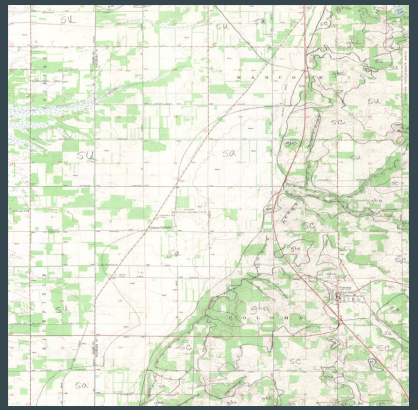
.tif
scan

Quad-G

Single
file input

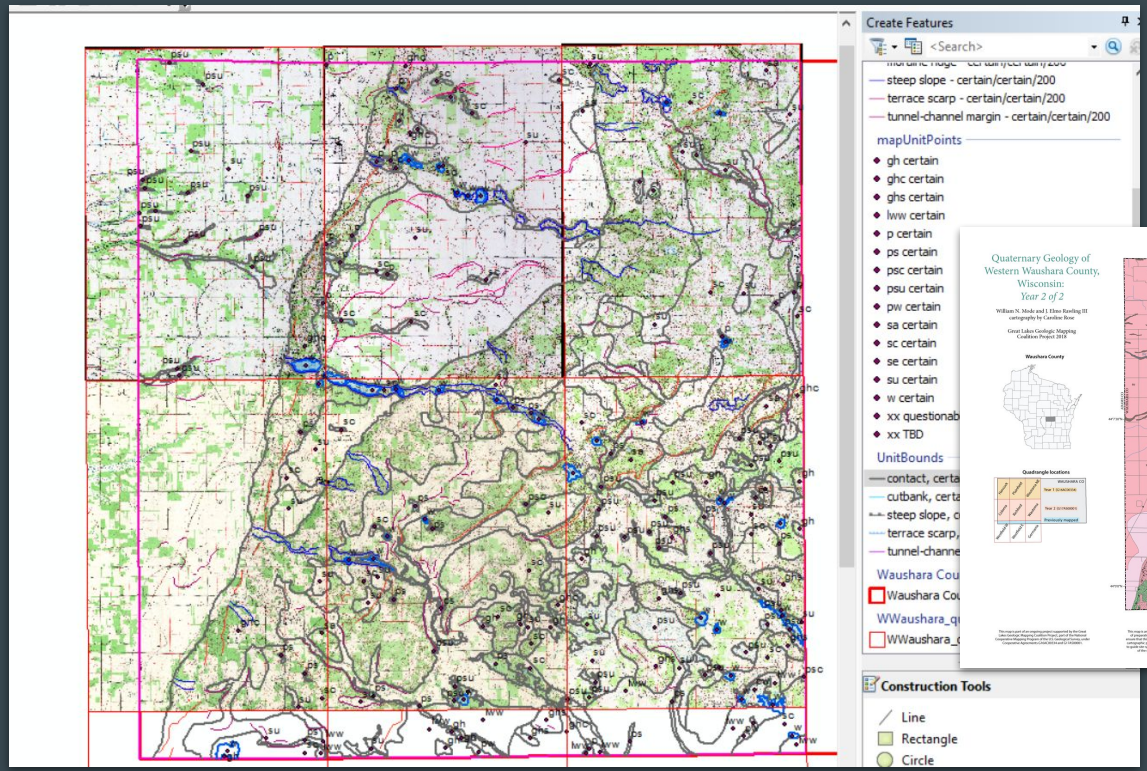


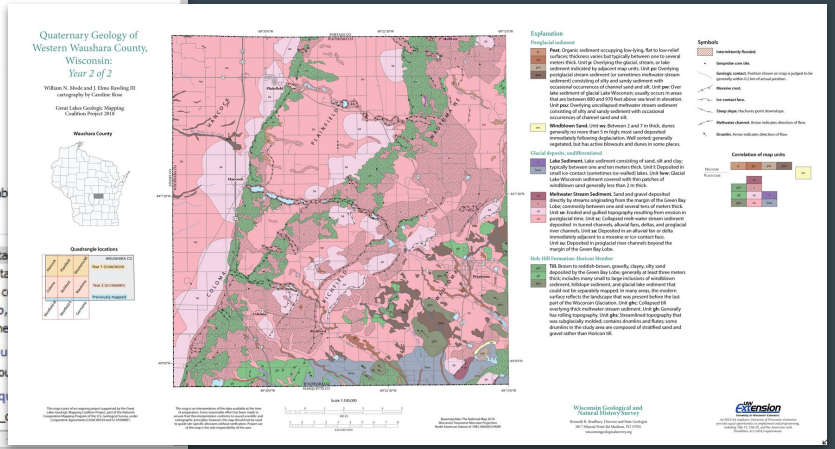
geotif



geotif
without
collar

Example: Western Waushara Quaternary Geology

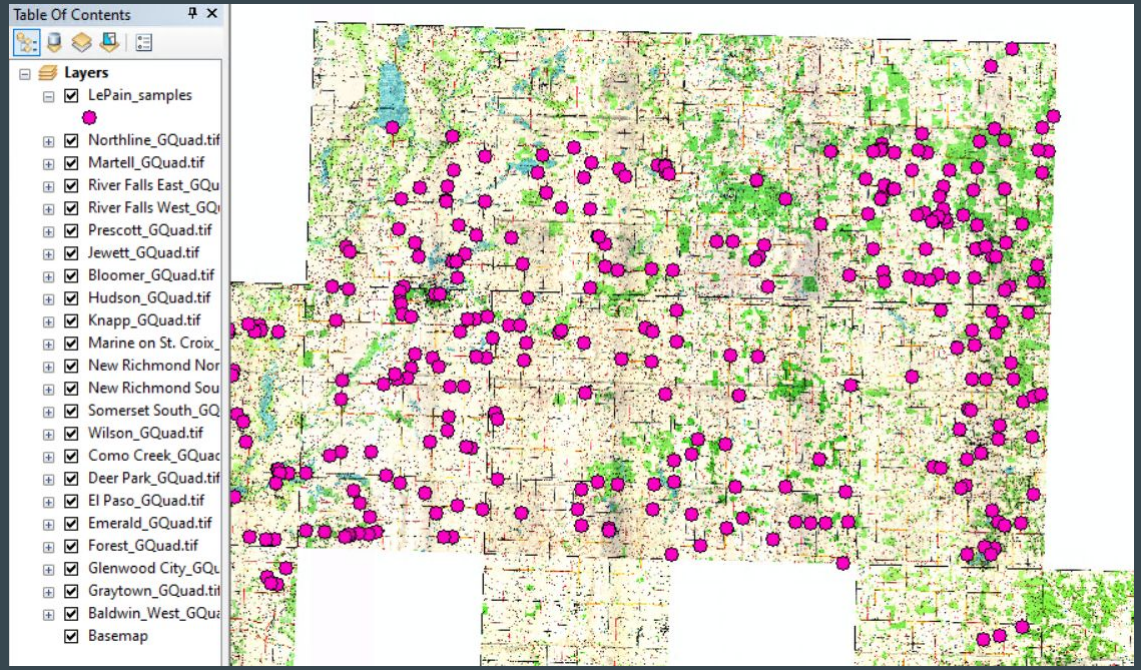




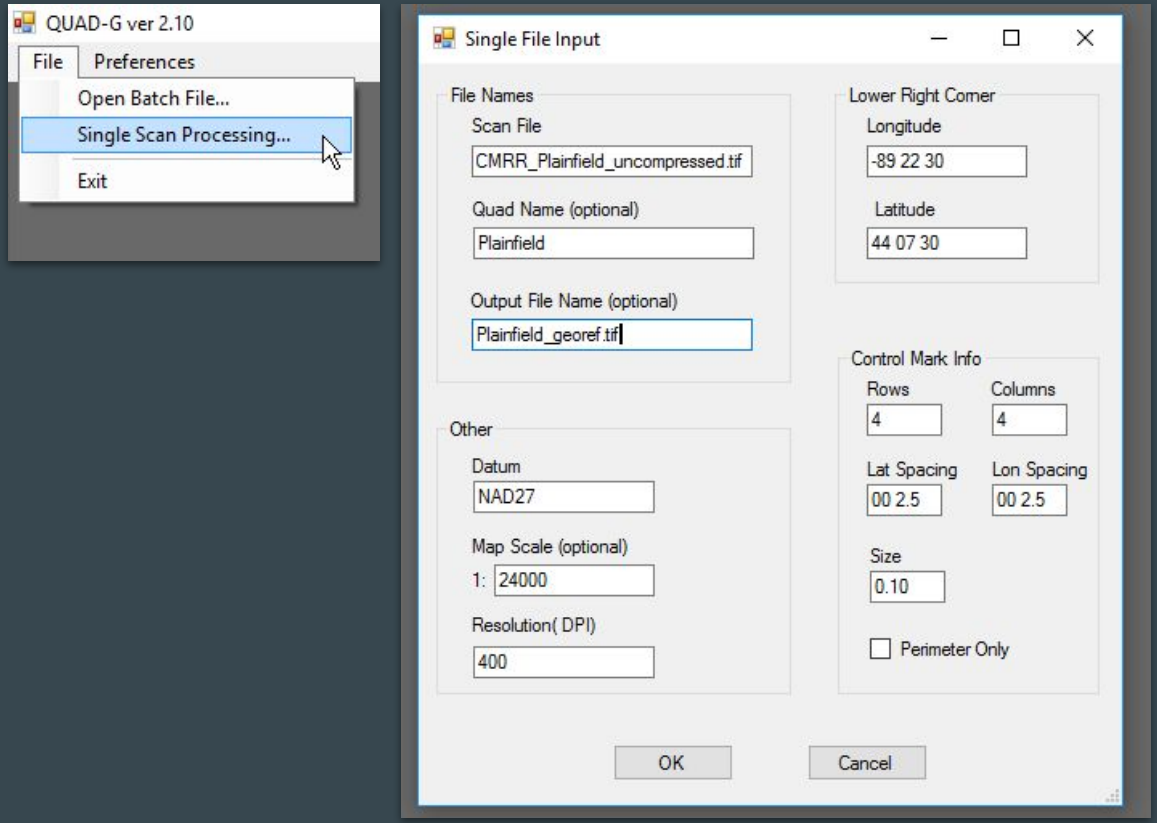
Example: Data Preservation Grant for Historic Field Notes

Georeferenced about 30 quad maps to reference historic sample locations

Non-GIS Staff georeferenced and used the scans



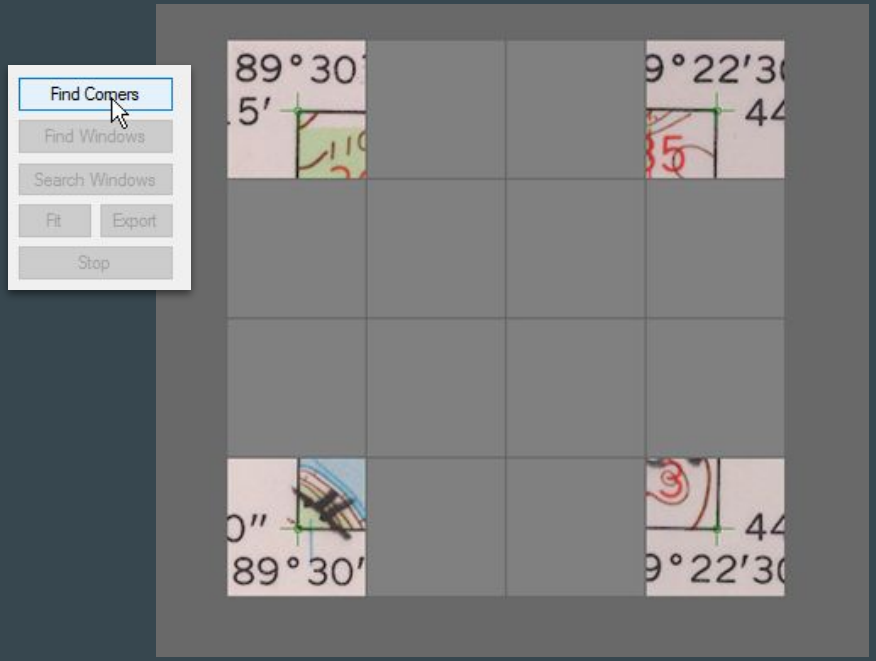
Using the software

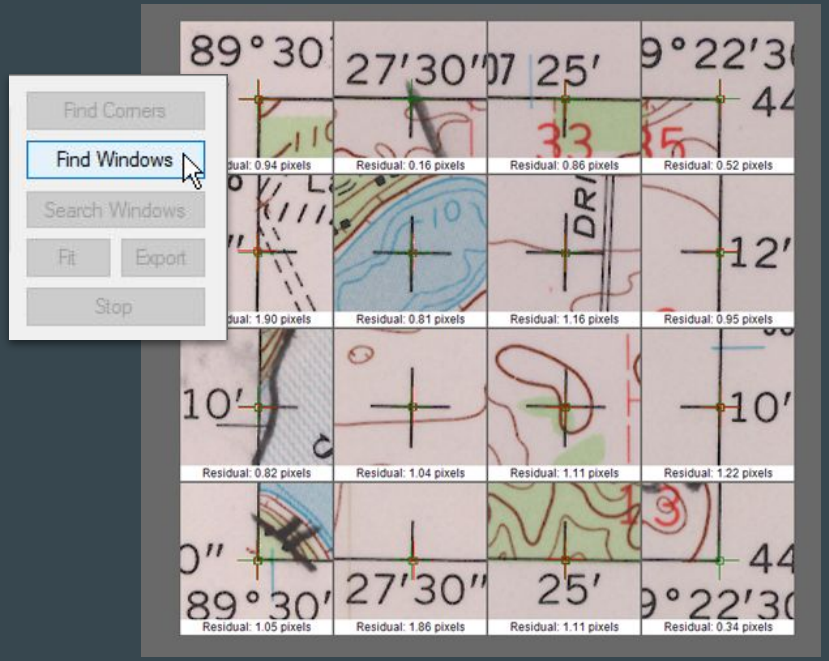


Input image file

Specify datum, lower-right coordinate, image dpi, scale, number of rows and columns, control mark length

Using the software





Historical Topographic Map Collection (HTMC)

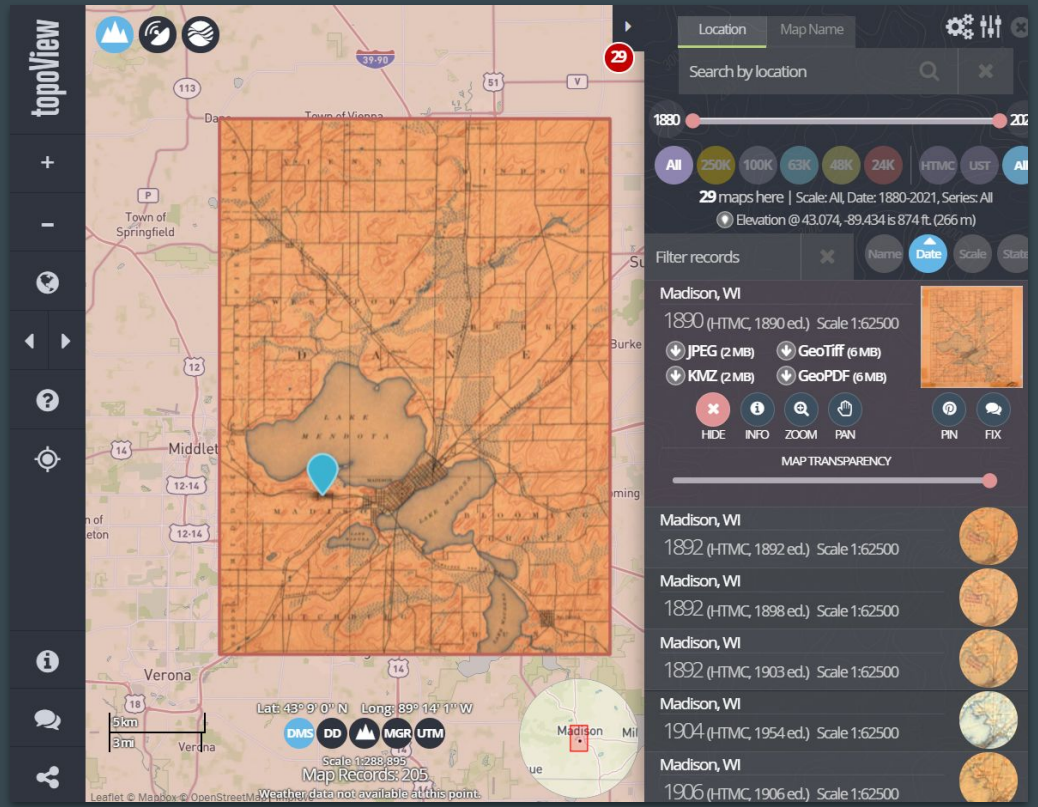
190,000 historic USGS quadrangle maps, published 1884 - 2006

Scanned, color-corrected, georeferenced, catalogued in the Historic Quadrangle Scanning Project 2009 - 2012+

Made available online

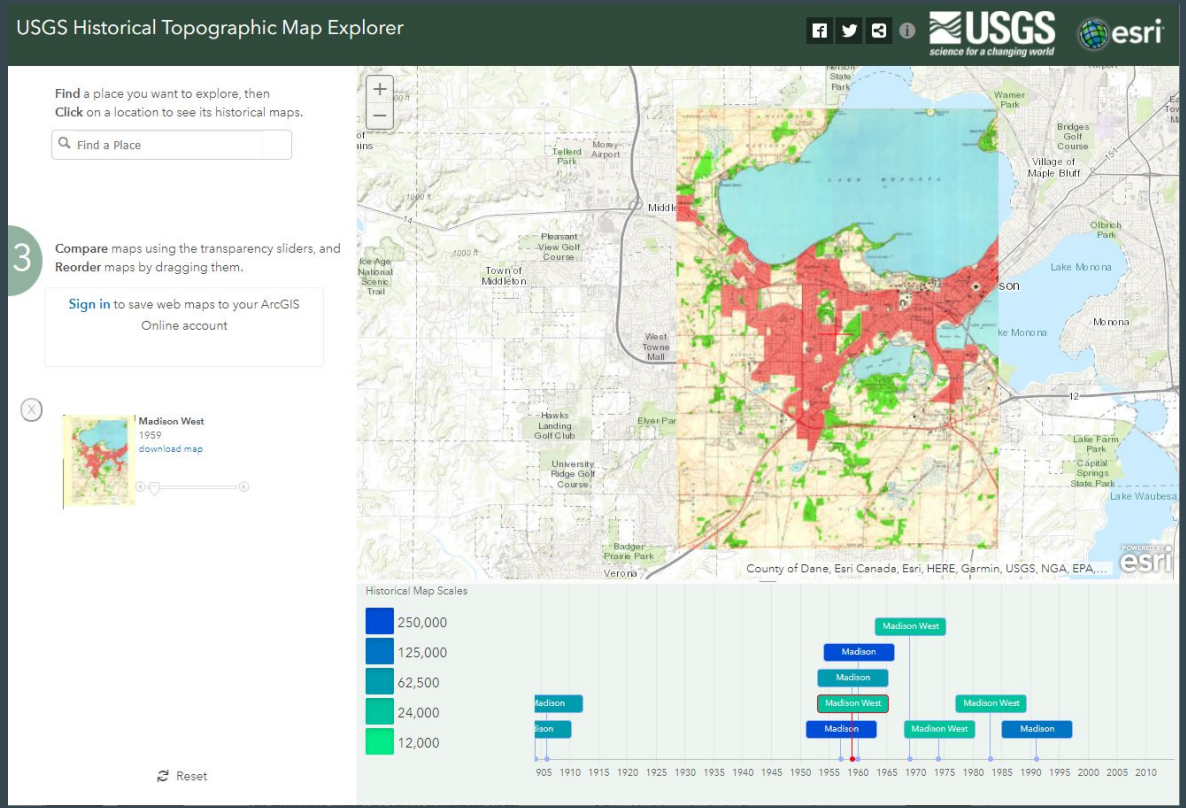
Find them in USGS topoview...

https://ngmdb.usgs.gov/topoview/viewer/



...or in the Esri Historical Topo Map Explorer

https://livingatlas.arcgis.com/topoexplorer/index.html



190,000 maps were not georeferenced by one-by-one “single file input”

Cartography and Geographic Information Science ›
Volume 47, 2020 - Issue 1

Articles

Automated and semi-automated map georeferencing

James E. Burt, Jeremy White, Gregory Allord, Kenneth M. Then & A-Xing Zhu

Pages 46-66 | Received 03 Sep 2018, Accepted 03 Apr 2019, Published online: 29 May 2019

 https://doi.org/10.1080/15230406.2019.1604161

ABSTRACT

Historical maps contain a wealth of information not generally available, but they must be referenced to well-known coordinate systems for maximum use in spatial analysis. Existing georeferencing tools are essentially manual, requiring considerable data entry, much panning and zooming, and precise on-screen digitizing. Here we present alternative approaches based on pattern-matching and spatial computing intended to overcome the inefficiencies of standard tools. We also describe and make available two computer programs implementing the methods discussed. The first, designed for large-scale quadrangles, locates map boundaries, finds ground control points, and produces georeferenced images without operator assistance. Experiments show that quadrangle georeferencing can be reliably automated (88% success rate in our tests). A second program, developed for general maps at any scale, uses self-learning and other approaches to overcome most of the manual aspects of georeferencing. Both programs find control points with single-pixel accuracy, yield transform errors on the order of map linewidth, and can produce warped or unwarped images as desired.

https://doi.org/10.1080/15230406.2019.1604161

National Geospatial Program

Specification for the U.S. Geological Survey Historical Topographic Map Collection

By Gregory J. Allord, Jennifer L. Walter, Kristin A. Fishburn, and Gale A. Shea

Introduction

This document provides the detailed requirements for producing, archiving, and disseminating a comprehensive digital collection of topographic maps for the U.S. Geological Survey (USGS) Historical Topographic Map Collection (HTMC). The HTMC is a digital archive of about 190,000 printed topographic maps published by the USGS from the inception of the topographic mapping program in 1884 until the last paper topographic map using lithographic printing technology was published in 2006. The HTMC provides a comprehensive digital repository of all scales and all editions of USGS printed topographic maps that is easily discovered, browsed, and downloaded by the public at no cost. The HTMC provides ready access to maps that are no longer available for distribution in print. A digital file representing the original paper historical topographic map is produced for each historical map in the HTMC in georeferenced PDF (GeoPDF) format (a portable document format [PDF] with a geospatial extension).

First posted December 1, 2014

- **Report** PDF (13.9)

For additional information contact:

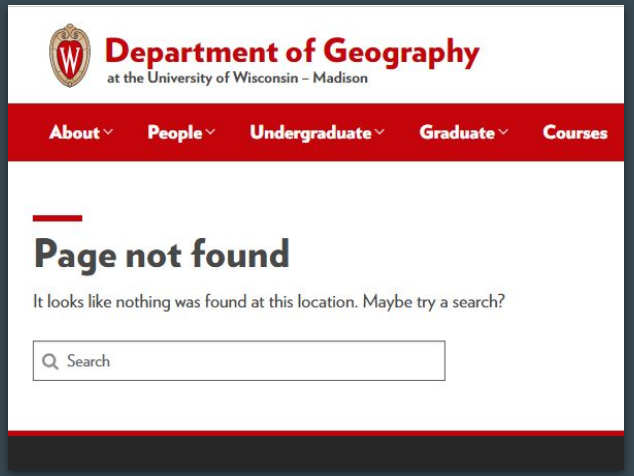
National Geospatial Technical Operations Center NGTOC
U.S. Geological Survey
P.O. Box 25046, MS 510
Denver, CO 80225
http://ngtoc.usgs.gov/

https://pubs.usgs.gov/tm/11b6/

How to get it

Geography Dept website?

Not right now.



...email me: caroline.rose@wisc.edu

Thanks!

github.com/wgnhs/gems

Caroline Rose
Wisconsin Geological and Natural History Survey
caroline.rose@wisc.edu