



**TEXAS** Libraries

The University of Texas at Austin  
University of Texas Libraries

# Introduction to GIS for STEM Librarians

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GIS & Geospatial Data Coordinator

7/18/2019

# Workshop Plan

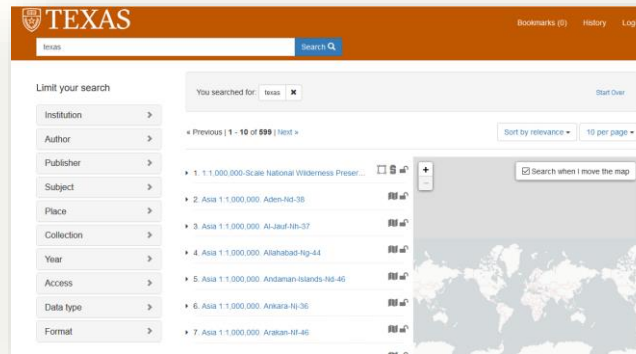
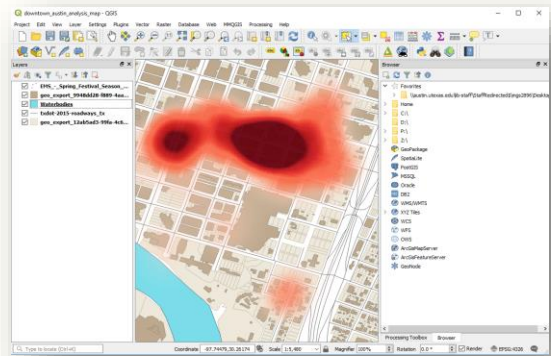
- ✦ Introduction to GIS and geospatial data
- ✦ Common geospatial software that it is useful to be familiar with
- ✦ Identifying researchers who might benefit from geospatial services
- ✦ Examples of library GIS and geospatial data services

**But, before we begin...**

what do you already know about GIS?

what are you most interested to learn?

# What is GIS?



Geographic information systems are specialized systems of software for...

Storing

Managing

Visualizing/Mapping

Sharing

Creating/Editing

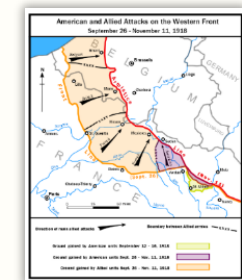
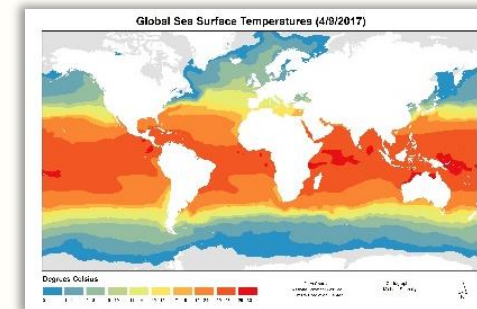
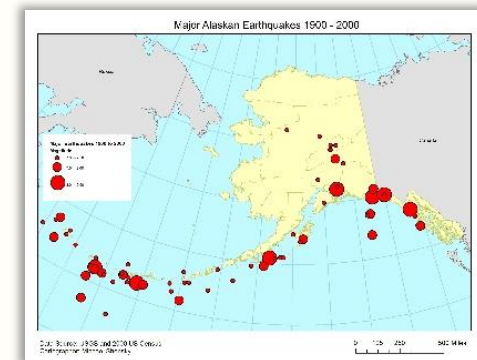
Analyzing



...geospatial data

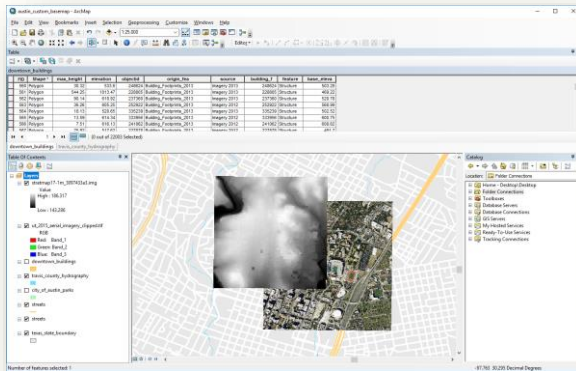
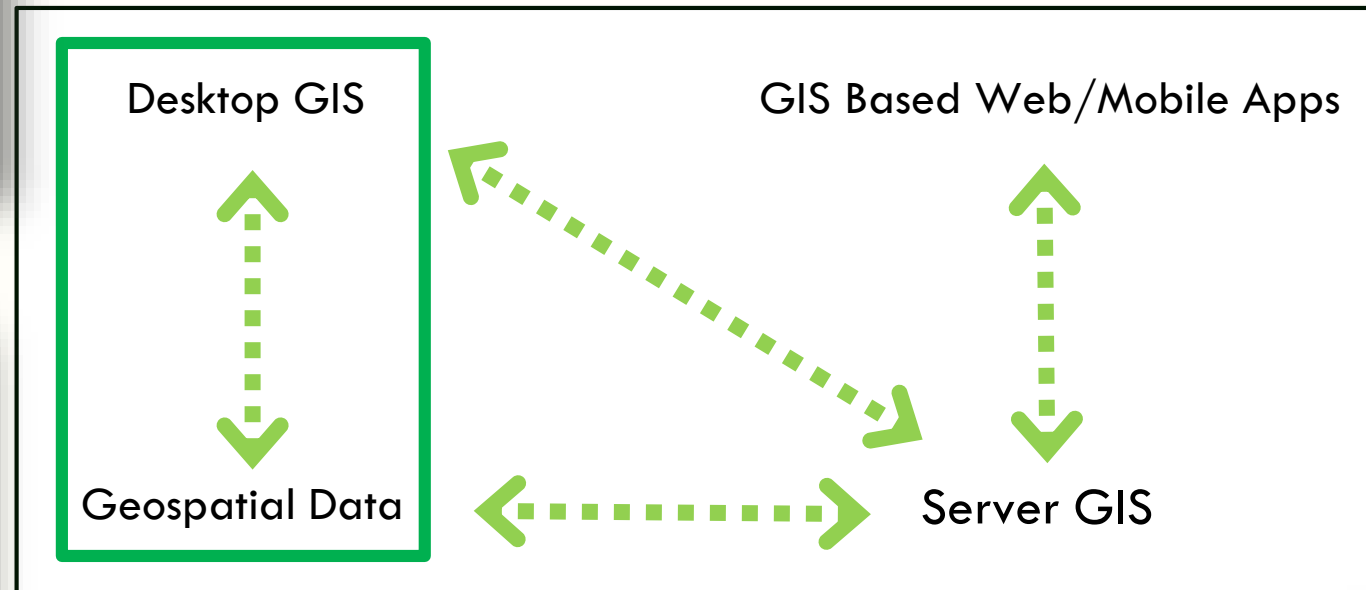
# Who Uses GIS Software?

Field	Spatial Data to Visualize
Anthropology	Archaeological excavations, human migration routes
Architecture	Landscape designs, building locations
Biology / Environmental Science	Species distributions, migration patterns, water/soil/air quality measurements
Economics / Business	Retail site suitability analysis results, trade flows, asset locations, logistical networks
Engineering (Civil, Petroleum, Etc.)	Construction site plans, environmental impacts, site suitability results
Epidemiology / Public Health	Health outcomes, disease transmission, health service locations
Geography / GISci	Data for pretty much everything on Earth
Geological Sciences	Earthquakes, fault lines, soil types, mineral resources, etc.
History	Trade routes, battles, migrations, elections
Humanities	Places described in literature, religious observance, language use, etc.
Journalism	Data for current events
Meteorology / Climatology	Current weather, historical climate patterns, storm events
Urban Planning	Zoning, transportation networks, demographics

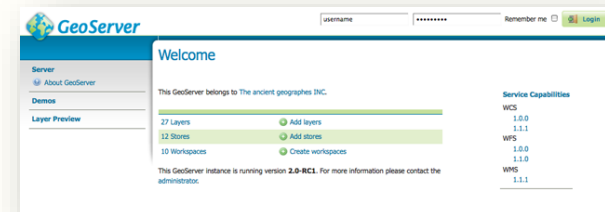
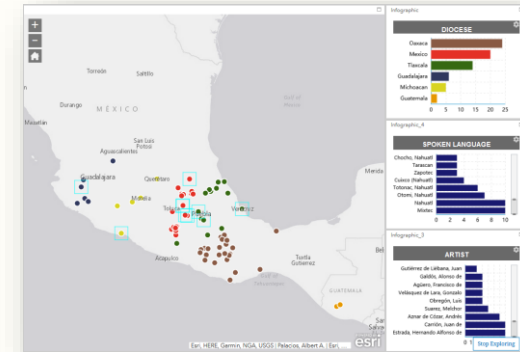


# The “System” in Geographic Information System

## Enterprise GIS Conceptual Framework



- addresses
- artifacts
- buildings
- contributors
- contributors\_to\_roles
- events
- events\_to\_places
- place\_lines
- place\_points
- place\_points\_to\_places
- place\_polygons
- placenames
- places
- places\_to\_placenames
- roles
- roles\_to\_events
- source\_collections
- source\_collections\_to\_contributors
- source\_collections\_to\_events
- source\_collections\_to\_placenames
- source\_collections\_to\_places
- terms
- vocabularies
- vocabularies\_to\_terms



# What is Geospatial Data?



**Lat:** 30.283

**Long:** -97.738

**City Name:** Austin

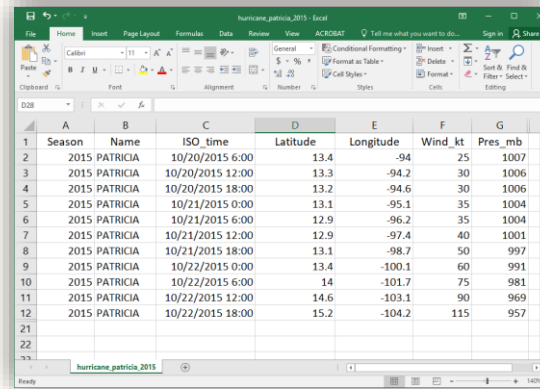
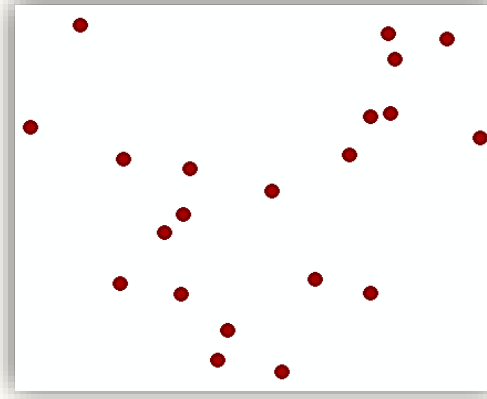
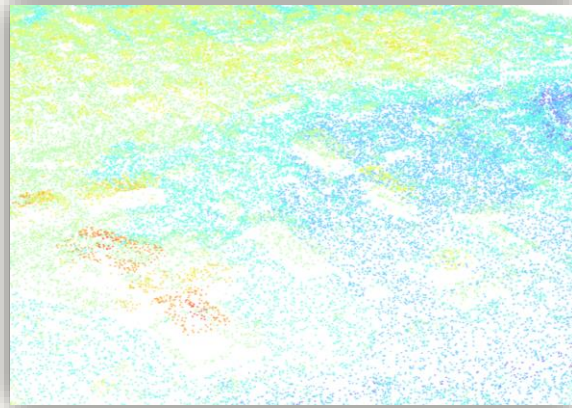
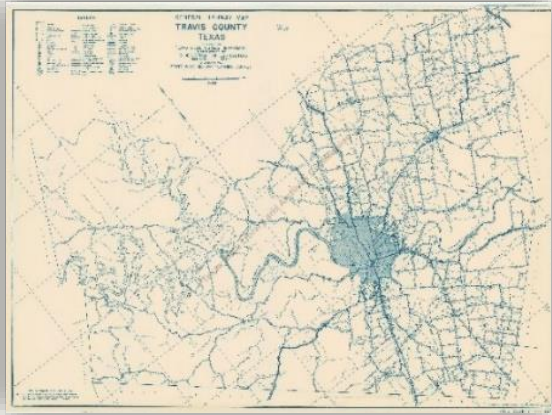
**Population:** 950715

**Incorporated:** 1839

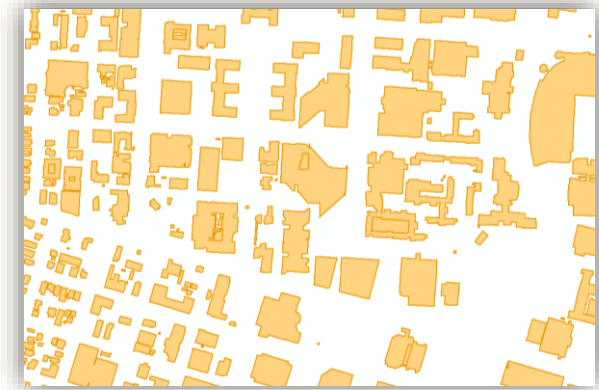
Geospatial data is data that contains both **location** and **attribute** information



# Geospatial Datasets



Season	Name	ISO_time	Latitude	Longitude	Wind_kt	Pres_mb
2015	PATRICIA	10/20/2015 6:00	13.4	-94	25	1007
2015	PATRICIA	10/20/2015 12:00	13.3	-94.2	30	1006
2015	PATRICIA	10/20/2015 18:00	13.2	-94.6	30	1006
2015	PATRICIA	10/21/2015 0:00	13.1	-95.1	35	1004
2015	PATRICIA	10/21/2015 6:00	12.9	-96.2	35	1004
2015	PATRICIA	10/21/2015 12:00	12.9	-97.4	40	1001
2015	PATRICIA	10/21/2015 18:00	13.1	-98.7	50	997
2015	PATRICIA	10/22/2015 0:00	13.4	-100.1	60	991
2015	PATRICIA	10/22/2015 6:00	14	-101.7	75	981
2015	PATRICIA	10/22/2015 12:00	14.6	-103.1	90	969
2015	PATRICIA	10/22/2015 18:00	15.2	-104.2	115	957



Geospatial data exists in many forms, but always has **location** & **attribute** information

# Geospatial Data Models

Geospatial data you find online is almost always going to be organized using one of these two data models

## Vector

**Best for:**  
Spatially discrete objects

**Location Modeling:**  
Coordinates pairs define points, lines, & polygons

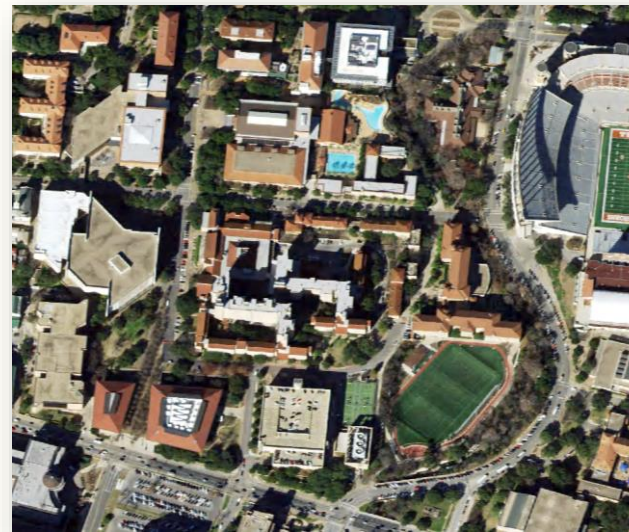
**Attribute Storage:**  
Multiple attributes

## Raster

**Best for:**  
Spatially continuous phenomena

**Location Modeling:**  
Georeferenced grid cells

**Attribute Storage:**  
Single attribute

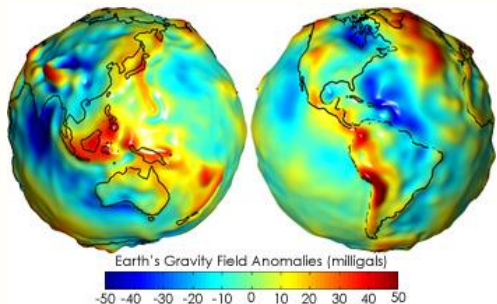




# Coordinate Reference Systems (CRS)

## Geoid

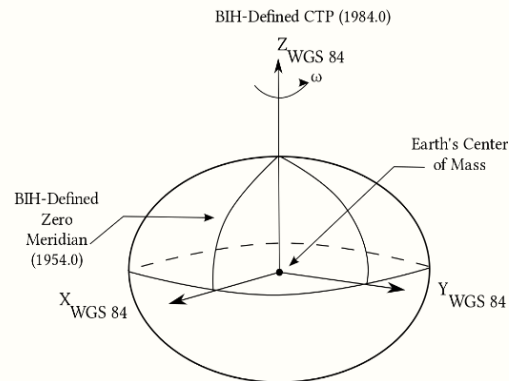
A detailed gravitational model of the Earth representing its size and shape



Public Domain, <https://commons.wikimedia.org/w/index.php?curid=479365>

## Reference Ellipsoid

A mathematical formula defining a smooth oblate spheroid approximation of the geoid



## Coordinate System

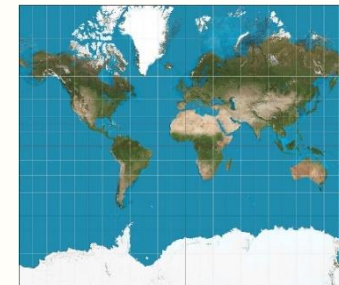
The grid system applied on top of a reference ellipsoid that makes it possible to assign coordinates to locations



By Stefan Kühn (Fotograf) - [https://commons.wikimedia.org/wiki/File:Azimutalprojektion-schief\\_kl.jpg](https://commons.wikimedia.org/wiki/File:Azimutalprojektion-schief_kl.jpg), CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=41844485>

## Map Projection

A mathematical formula for transforming 3D geospatial coordinates onto a 2D surface (paper, computer screen, etc.)



By Strebe - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=16115320>  
By Strebe - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=16115307>

**These choices affect the display of both raster and vector data**

# GIS Software for Managing Geospatial Data



**QGIS**

Free

Open Source

Extensible with Plugins

Windows, MacOS, & Linux

Widely used in Europe

Growing popularity in the US



**ArcMap**

Developed by Esri

Expensive to purchase

Free UT student/staff licensing available

Windows only

Integrates with ArcGIS Online

Widely used but being phased out



**ArcGIS Pro**

Developed by Esri

Expensive to purchase

Free UT student/staff licensing available

Windows only

Integrates with ArcGIS Online

Growing adoption, replacing ArcMap

# Installing GIS Software

University of Texas Libraries / LibGuides / Install GIS Software / Installing ArcMap

## Install GIS Software

Search this Guide [Search](#)

### Installing ArcMap

Intro to GIS Software

- Installing QGIS
- Installing ArcMap**
- Installing ArcGIS Pro

#### ArcGIS Desktop Installation Instructions

If you are interested in installing and working with ArcMap software you must install Esri's entire ArcGIS Desktop suite of GIS software products - it is not possible to install ArcMap just by itself. This page will walk you through the process of installing and licensing ArcGIS Desktop on your personal computer so that you can start using ArcMap. Please be aware that ArcGIS Desktop software can only be installed and used on a computer that runs the Windows operating system. If you have a Windows PC you can start following the steps below to load ArcGIS Desktop onto your machine, but if you are interested in installing the software on a Mac please refer to the guide in the right column which provides an overview of options for running Windows on your Mac and take care of this set up before proceeding to the installation instructions below.

#### Options for Running Windows on a Mac

1. Use Bootcamp, which is a free program included by default on all modern Macs, to install Windows as a complementary operating system on the computer. Once Windows is installed, you can choose to boot into Windows at startup or into macOS. To install ArcGIS software, just boot into Windows and startup and follow the steps listed in the center column of this guide. This approach provides ArcGIS

3.6.1  
3.4.6 LTR

DISCOVER QGIS FOR USERS GET INVOLVED DOCUMENTATION

English

## QGIS

A Free and Open Source Geographic Information System



New release: 3.6!  
Get the [installer or packages](#) for your Operating System!

Create, edit, visualise, analyse and publish geospatial information on Windows, Mac, Linux, BSD (Android coming soon)

For your desktop, server, in your web browser and as developer libraries

[Download Now](#) [Support QGIS](#)

Version 3.6.1  
Version 3.4.6 LTR

Donate now!

Time until next release 2019-04-26 12:00:00 UTC 24d 20h 8m  
Time until packaging 2019-05-21 12:00:00 UTC 50d 20h 8m  
Time until next point release 2019-04-19 12:00:00 UTC 17d 20h 8m

<https://guides.lib.utexas.edu/install-gis-software/software-options>

# Desktop GIS Software & Geospatial Data

**Desktop GIS software is used for:**

Visualizing data

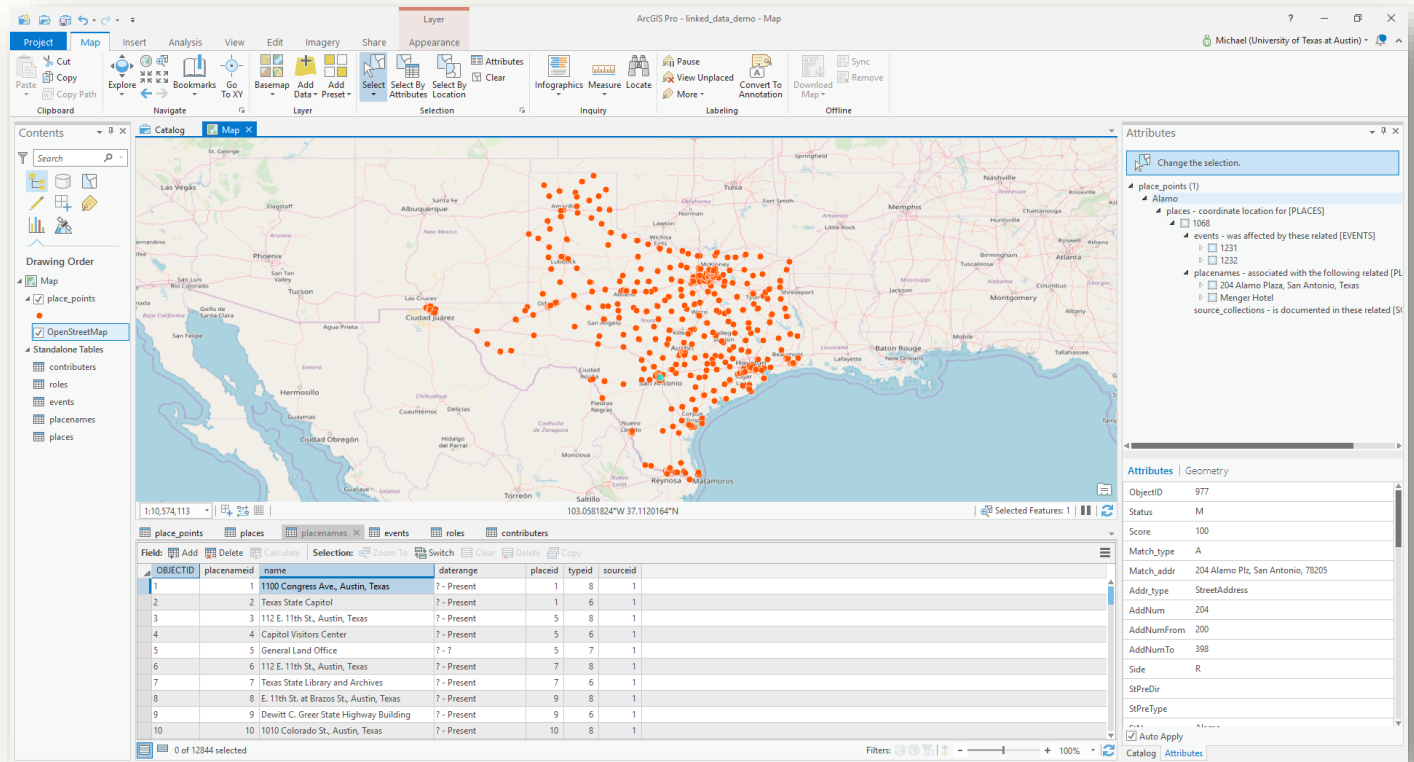
Producing digital maps

Managing data storage

Creating/editing data

Analyzing data

Publishing data to the web for sharing



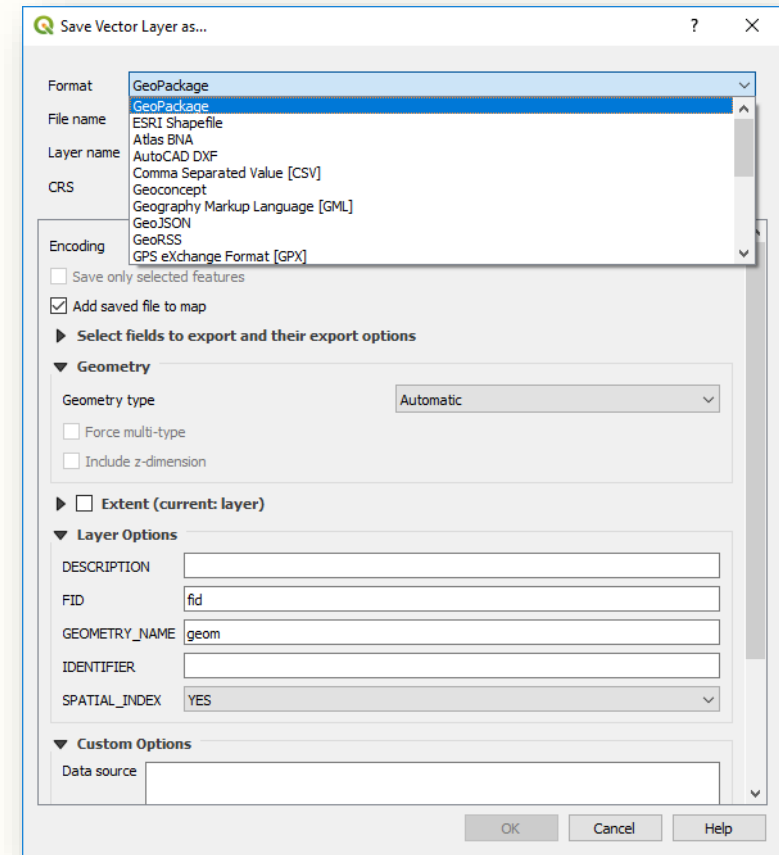
**DEMONSTRATION**

# Common Geospatial Data Formats

- **Shapefile**
- **Geopackage**
- **File geodatabase**
- **GeoJSON** (Geographic JavaScript Object Notation)
- **File Raster** (.jpg, .png, .tiff, .img)
- **Web Services** (Map services, WMS, WFS, etc.)
- **CSV** (Comma Separated Values)
- **Other**

■ You may find data in text formats or other non-spatial formats from which you can extract geospatial information

QGIS alone can  
save vector data  
in 21 different  
file formats!













# Shapefiles

It is important to be familiar with shapefiles because data available online will commonly be found in this format

- A very common, decades old format
- Store vector data as points, lines, or polygons
- Are comprised of multiple files that are used together
- Have significant limitations in their functionality
- Have a simple, open standard

Name	Date modified	Type	Size
 utlarch_bot_gm_point_v1_buildings_of_texas.cpg	7/17/2019 6:16 PM	CPG File	1 KB
 utlarch_bot_gm_point_v1_buildings_of_texas.dbf	7/17/2019 6:16 PM	DBF File	12,623 KB
 utlarch_bot_gm_point_v1_buildings_of_texas.prj	7/17/2019 6:16 PM	PRJ File	1 KB
 utlarch_bot_gm_point_v1_buildings_of_texas.sbn	7/17/2019 6:16 PM	SBN File	59 KB
 utlarch_bot_gm_point_v1_buildings_of_texas.sbx	7/17/2019 6:16 PM	SBX File	2 KB
 utlarch_bot_gm_point_v1_buildings_of_texas.shp	7/17/2019 6:16 PM	SHP File	170 KB
 utlarch_bot_gm_point_v1_buildings_of_texas.shp	7/17/2019 6:16 PM	XML File	23 KB
 utlarch_bot_gm_point_v1_buildings_of_texas.shx	7/17/2019 6:16 PM	SHX File	49 KB

Extension	Description	Required?
.shp	The main file that stores the feature geometry. No attributes are stored in this file—only geometry.	Yes
.shx	A companion file to the .shp that stores the position of individual feature IDs in the .shp file.	Yes
.dbf	The dBASE table that stores the attribute information of features.	Yes
.sbn and .sbx	Files that store the spatial index of the features.	No
.atx	Created for each dBASE attribute index created in ArcCatalog.	No
.ixs and .mxs	Geocoding index for read-write shapefiles.	No
.prj	The file that stores the coordinate system information.	No
.xml	Metadata for ArcGIS; stores information about the shapefile.	No

Shapefile extensions

# Individual Raster Files

## Commonly used for:

Digital elevation models (DEMs)

Aerial imagery

Scanned paper map images

Other continuous phenomena



Raster files are commonly saved in variety of file formats:

**JPG**




**TIFF (GeoTIFF)**

**ECW**

**IMG**

Georeferencing and projection information may be stored in associated external files

This can lead to issues if the **.aux** or **.prj** file are not moved along with the raster file

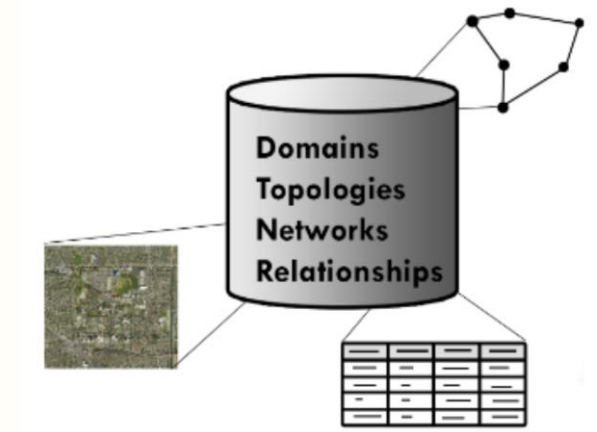
 lju_and_sv_2009_NAIP.img	11/1/2013 12:13 PM	IMG File	296,970 KB
 lju_and_sv_2009_NAIP.img	11/1/2013 12:12 PM	XML Document	13 KB
 lju_and_sv_2009_NAIP.rrd	11/1/2013 12:13 PM	RRD File	25,383 KB

# Geodatabases

The term geodatabase typically refers specifically to Esri ArcGIS spatial databases

There are 3 types of Esri geodatabase each with a different structure

**Personal Geodatabase:** (OLD FORMAT, DON'T USE IT)



**File Geodatabase:** Data stored in a file system directory (RECOMMENDED FORMAT FOR ARCGIS SOFTWARE)

**Enterprise Geodatabase:** Data stored in a relational database on a server (USED IN LARGE ORGANIZATIONS)

# Other Options for Working with Geospatial Data

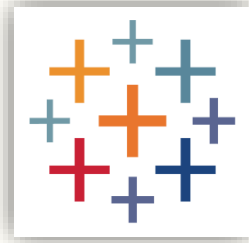


**R**

Free

Open Source

Windows, MacOS, & Linux



**Tableau**

Proprietary software

Free “public” version available



**Google Earth Pro**

Free, Google develop software

Not as powerful as GIS software



**ArcGIS Online**

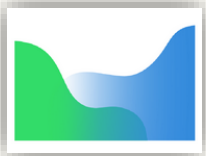
Esri online cloud GIS platform

No software required

Integrates well with ArcGIS Pro

# Other Options for Working with Geospatial Data

## Remote Sensing & Image Processing Software



**Metashape (PhotoScan)**



**eCognition**



**Pix4D**



**Cloud Compare**



**ERDAS Imagine**



**Python**



**ENVI**

**Many others...**



# Options for Collecting Geospatial Data

## SOFTWARE

**ArcGIS Online + Collector for ArcGIS**



**Qfield**



**ArcPad**



**Terraflex**



**Terrasync**

**Other software...**

## HARDWARE

**iPhones / iPads**



**Android phones / tablets**

**Trimble GPS units**




**Garmin GPS units**



**Total station**



# Identifying Researchers In Need of Geospatial Data Services



Agronomy/Horticulture/Forestry  
Atmospheric Science/Meteorology  
Biology  
Civil/Environmental Engineering  
Aeronautical/Automotive Engineering  
Mining/Petroleum Engineering  
Geology  
Environmental Science  
Marine Science  
Geography/Geomatics  
Epidemiology  
Other STEM fields?

**Potential GIS service beneficiaries include those:**

Using geospatial software

Working with geospatial data

Have geospatial research ideas

“distribution”, “location”, “mapping”, “migration”, etc.

# University Library GIS Services

**Host geospatial training workshops focused on data management, analysis, visualization, etc.**


Offer personalized geospatial consultation services to faculty, students, and staff

Develop GIS focused training guides and educational resources for the libraries website

Utilize technology to enhance discoverability of geospatial data from distinctive library collections

Build relationships with local, state, and national partners to foster collaboration and knowledge exchange

## List of Upcoming Events



**Map Georeference-a-thon**


**Date:** 4/12/2019 (Fri.)  
**Time:** 12:00 p.m.  
**Location:** PCL Learning Lab 1  
**Event Type:** Crowd sourcing  
**Event Series:** Special Event

Learn how to georeference scanned images of historical maps with QGIS and help enhance the PCL Maps collection.



**Open Source GIS  
for Social,  
Community, and  
Non-Profit Work**

Michael Shensky  
Fall 2016

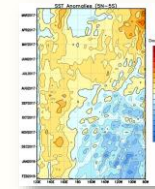


**Business  
Applications  
of GIS**

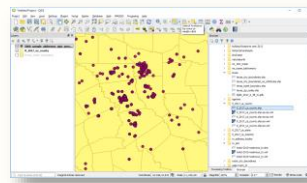
Michael Shensky  
May 6, 2015

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How?



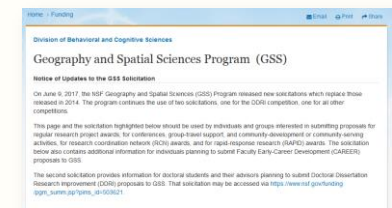
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Where?



Why?

Build relationships with local, state, and national partners to foster collaboration and knowledge exchange

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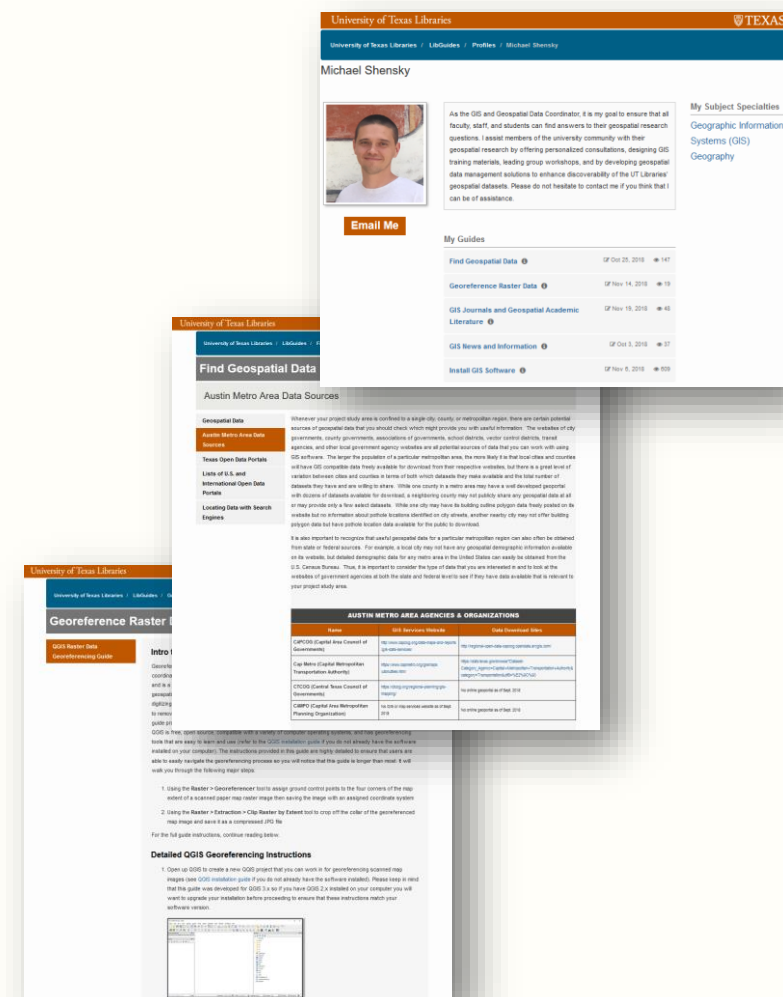
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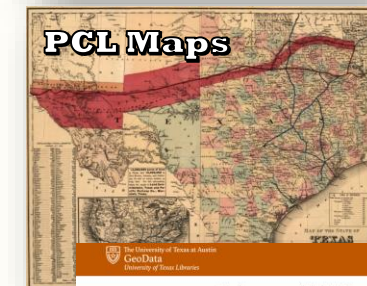
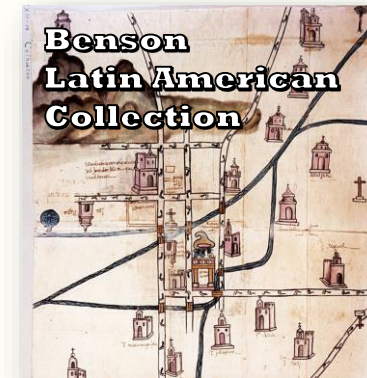
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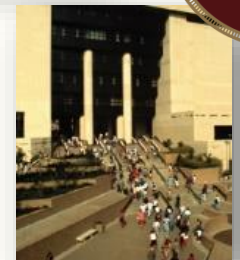
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# Conclusions and Discussion

What GIS services do you think would be most useful for the researchers you work with?

What GIS services do you think your library might be able to provide?

Questions about any GIS topics we've covered?

Any requests for GIS demonstrations?

Interested in continuing to develop GIS skills?

[https://docs.qgis.org/3.4/en/docs/training\\_manual/](https://docs.qgis.org/3.4/en/docs/training_manual/)

<https://learn.arcgis.com/en/gallery/>

## Contact Info

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m.shensky@austin.utexas.edu

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