



NYBG
NEW YORK BOTANICAL GARDEN

GEOREFERENCING: TOOLS AND METHODS USED IN OBTAINING HIGH- QUALITY GEOREFERENCED DATA

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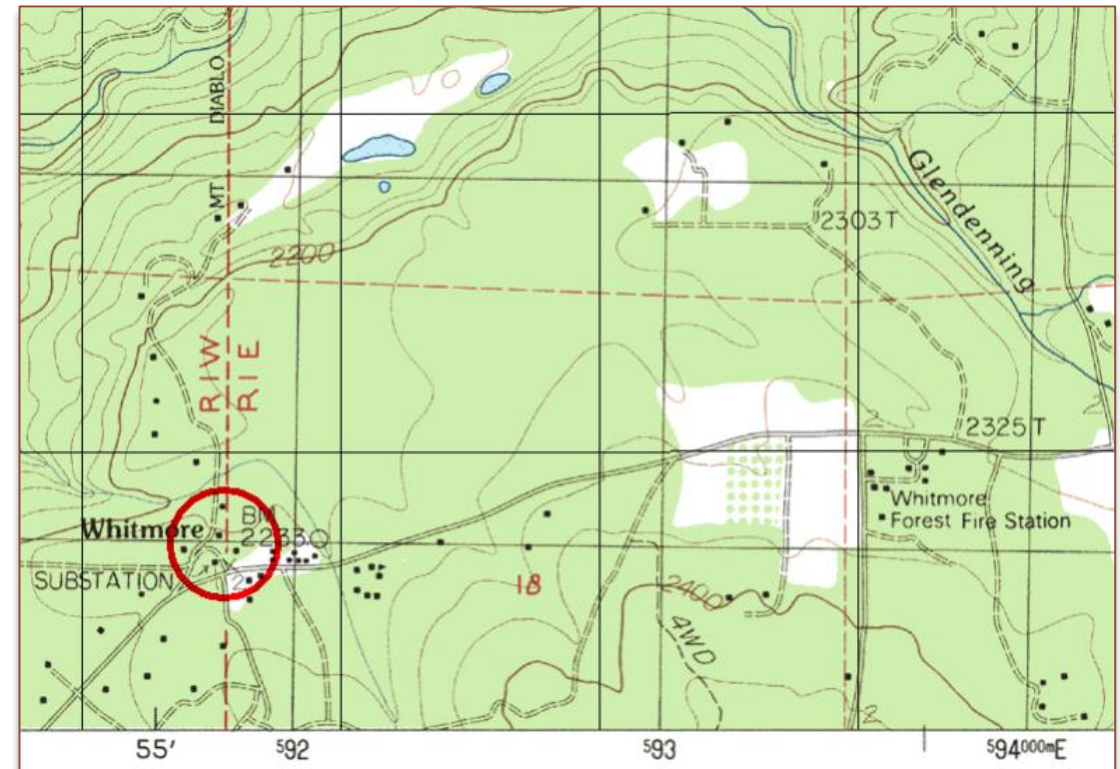


PART 1: INTRODUCTION & MAPPING TOOLS

What is Georeferencing?

- Interpreting a written description of a locality to locate coordinates and an uncertainty radius
- Standardized methods and tools to determine collection location
- **Accuracy:** Goal of finding accurate coordinates and minimizing error radius
- **Precision:** Capturing metadata so that the process is repeatable (reliability)

Stebbins, R. Newt
1945
Triturus granulosus
1 1/4 mi. E. & 1 1/4 mi. W. of Whitmore, approx.
3800 ft., Klamath Reservoir, Shasta Co.



Guides

- Recommended georeferencing procedures for the most commonly encountered type of localities
- Step-by-step instructions
- How to use the MaNIS Georeferencing Calculator
- [Georeferencing Quick Reference Guide](#) (2020)
- [Georeferencing Quick Reference Guide](#) (2012)
- [Best Practices Guide](#) (2020)

Locality Type: *Geographic feature only*

Step 1 – Determine the feature boundaries: This step is to determine the shape that contains the feature. This is typically done by drawing a polygon around the feature ([Figure 2A](#)), but some features may require more complex geometries, such as multiple polygons.



Record the source (including date) used to determine the boundaries (see [georeferenceSources](#)).

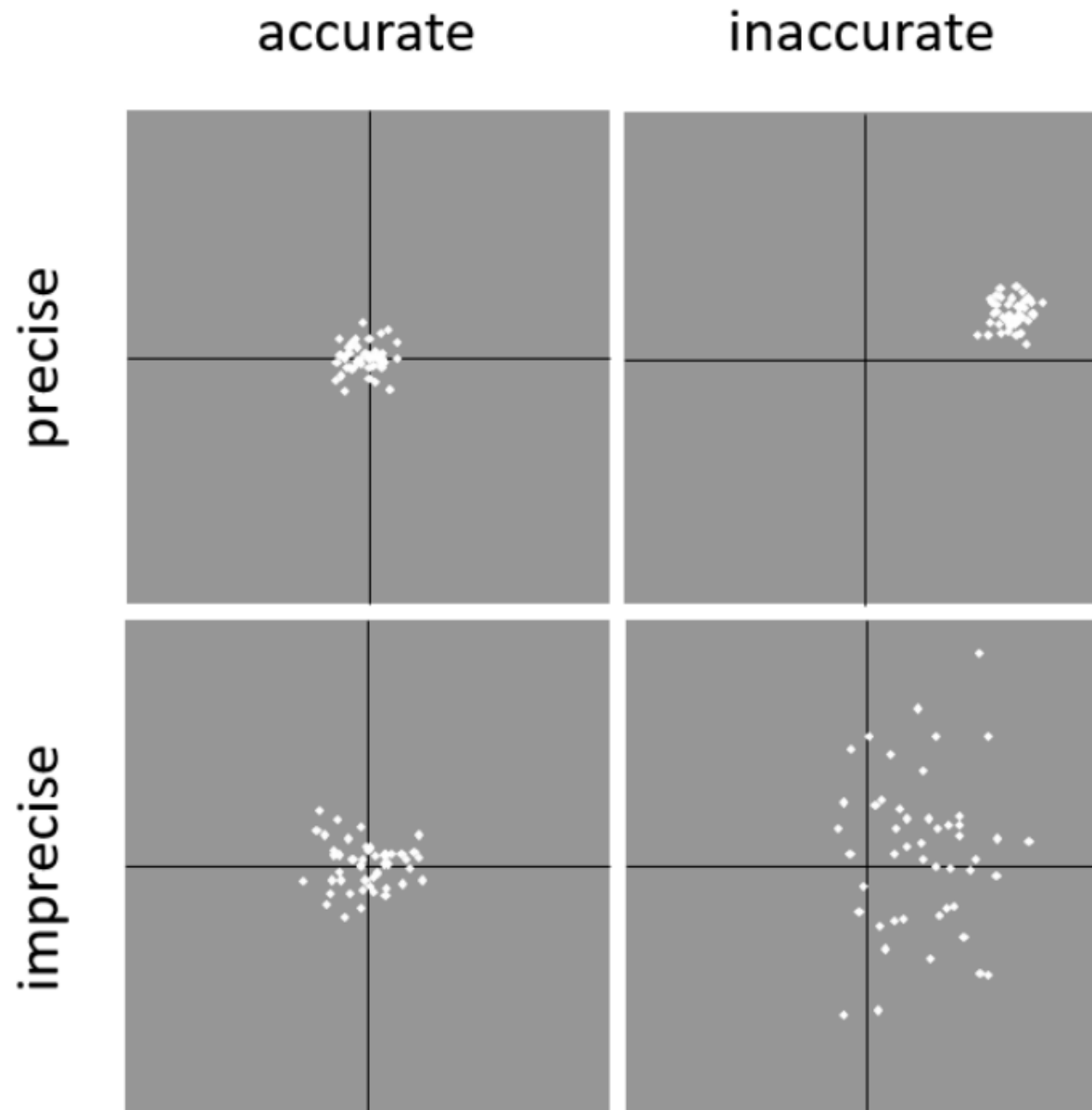
Step 2 – Determine the coordinates: Use the coordinates of the corrected center of the feature ("a" in [Figure 2B](#)) as the *Input Latitude and Longitude*.

Step 3 – Measure the geographic radial: Measure the distance from the corrected center to the furthest point on the boundary of the feature ("b" in [Figure 2B](#)) as the *Radial of Feature*.

Step 4 – Calculate using the following additional parameters in the [Georeferencing Calculator](#): *Coordinate Source, Coordinate Format, Datum, Coordinate Precision, GPS Accuracy/Measurement Error, and Distance Units* (see [§1.6](#)).



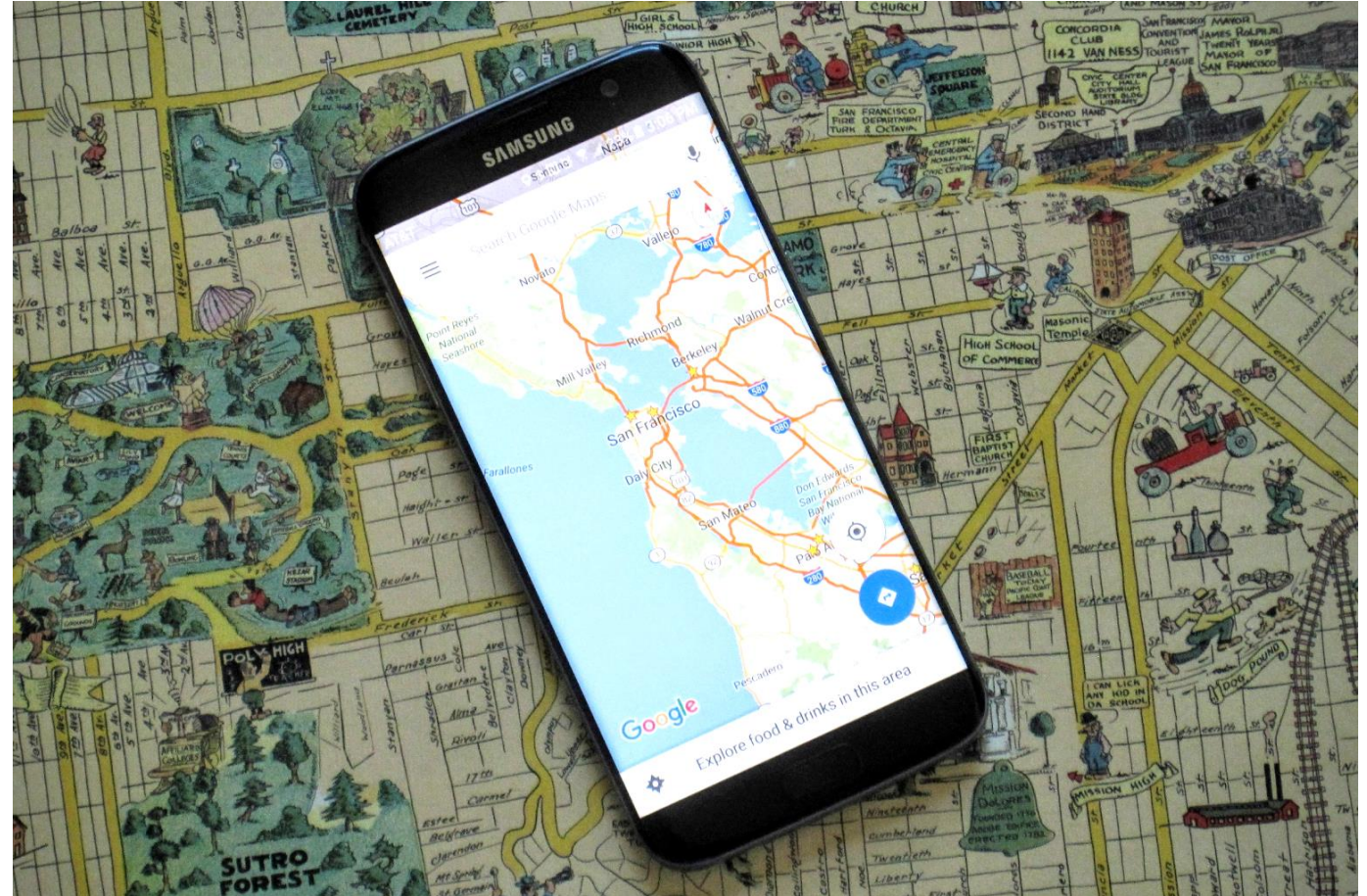
Accuracy and Precision



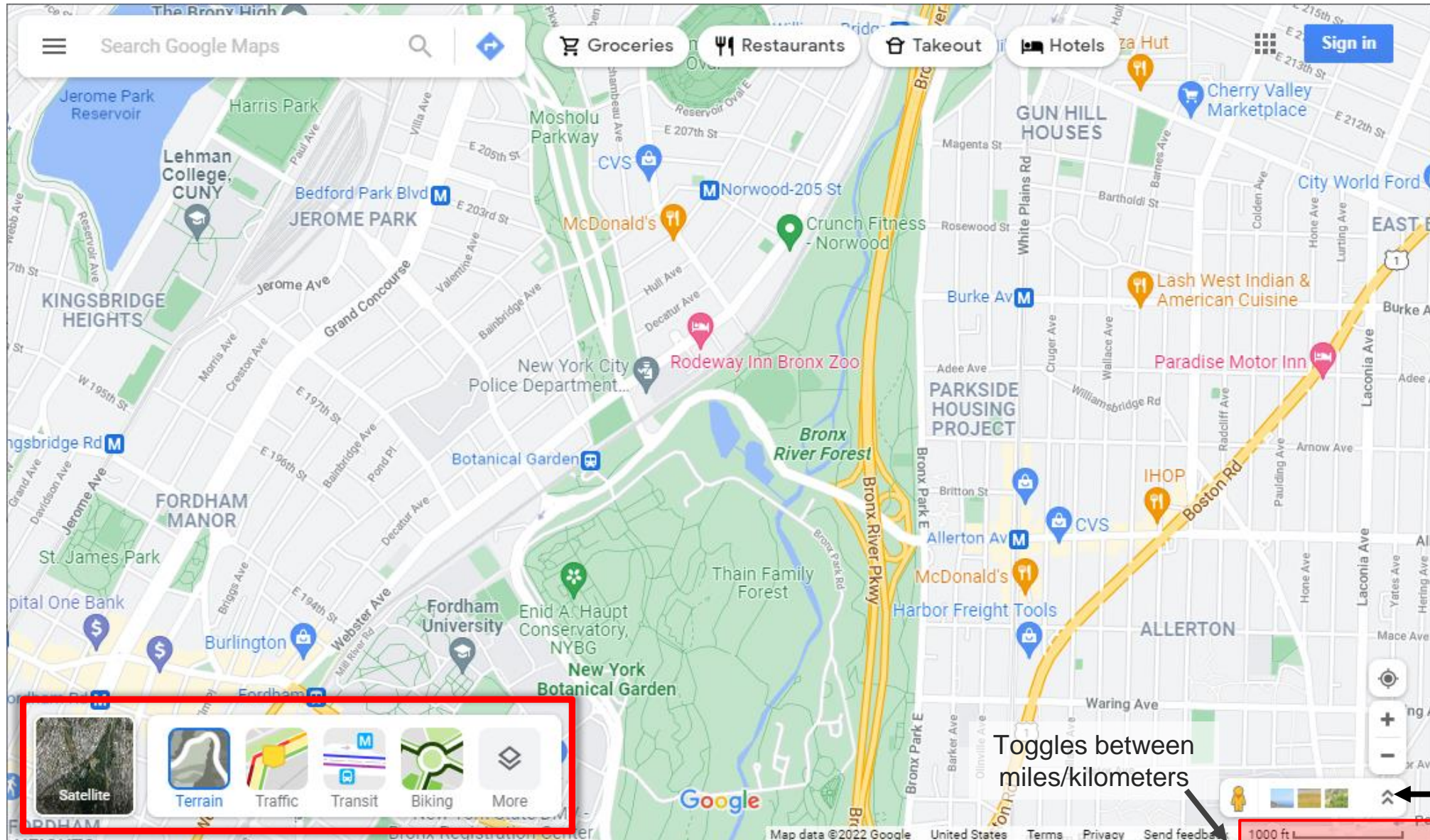
Precision is a measurement of the consistency of repeated measurements to each other

Mapping Applications

- Google Maps
- GEOLocate



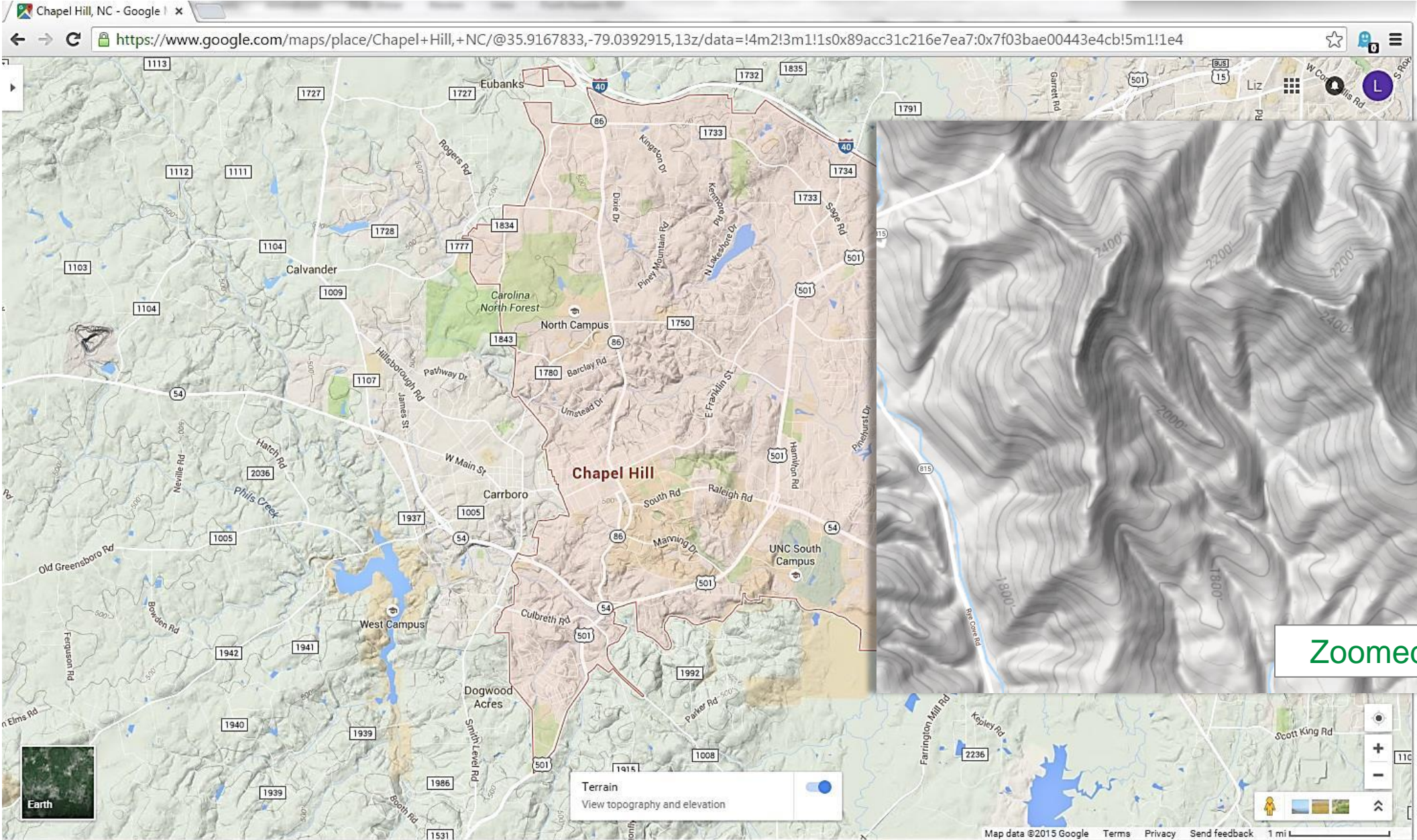
Google Maps: Map Layers



Toggles between miles/kilometers

Geo-tagged photographs

Terrain View



Zoomed-in

Terrain
View topography and elevation

Capturing Coordinates

Search Google Maps

Groceries Restaurants Takeout Hotels

Sign in

Bronx River Waterfall, NYBG

40.86194, -73.87493

Directions from here

Directions to here

What's here?

Search nearby

Print

Add a missing place

Add your business

Report a data problem

Measure distance

Right click on a location to find coordinates

Coordinates of the point are provided at top of menu – select to auto-copy. Or select “What’s here?” to capture coordinates

Trail Bridge Trail Bronx River Waterfall Tray

Layers

Bronx River Waterfall, NYBG

New York Botanical Garden

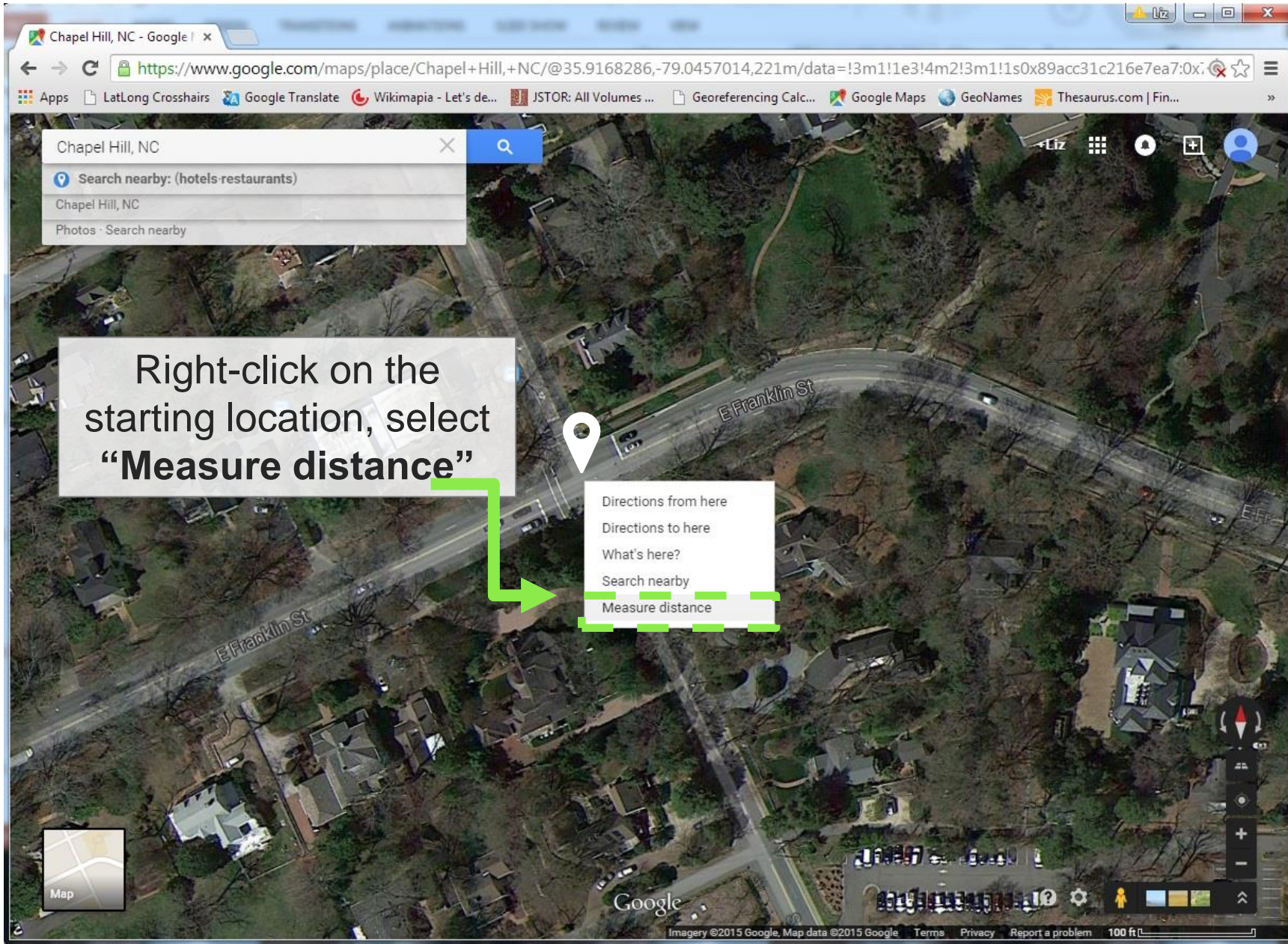
View of Water Falls

New York Botanical Garden

New York Bot

Imagery ©2022 Bluesky, Maxar Technologies, Map data ©2022 United States Terms Privacy Send feedback 20 ft

Measure Distance



Measuring Distance

Chapel Hill, NC - Google | x

https://www.google.com/maps/place/Chapel+Hill,+NC/@35.9168286,-79.0457014,221m/data=!3m1!1e3!4m2!3m1!1s0x89acc31c216e7ea7:0x...

Apps LatLong Crosshairs Google Translate Wikimapia - Let's de... JSTOR: All Volumes ... Georeferencing Calc... Google Maps GeoNames Thesaurus.com | Fin...

Chapel Hill, NC

Search nearby: (hotels restaurants)

Chapel Hill, NC

Photos - Search nearby

Total distance: 165.81 m (543.98 ft)

Right click on the map to measure.
The nodes may be adjusted/deleted

E Franklin St

100 m

165.81 m

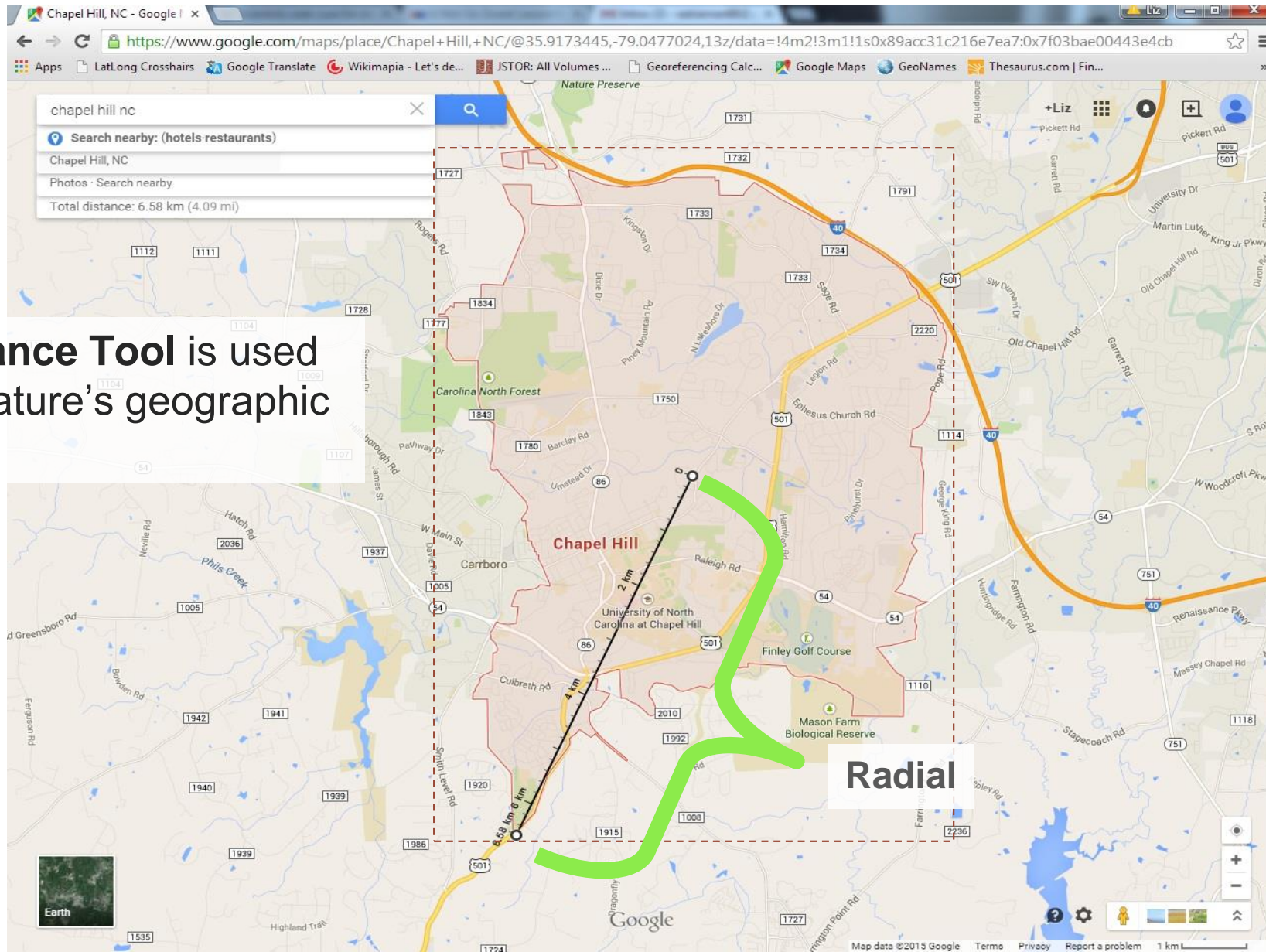
Map

Units

Imagery ©2015 Google, Map data ©2015 Google Terms Privacy Report a problem 20 m

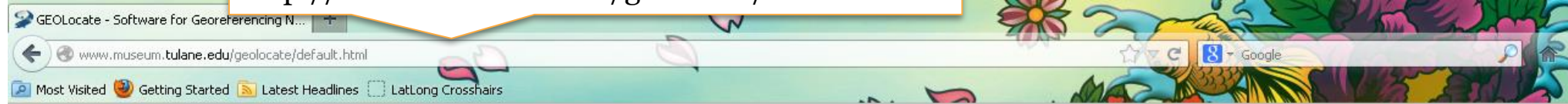
Radial

Measure Distance Tool is used to capture a feature's geographic radial



GEOLocate

<http://museum.tulane.edu/geolocate/default.html>



Home | Web Application | Standalone App | Collaborative Georeferencing | Developer Resources | Workshops | Support and Contacts

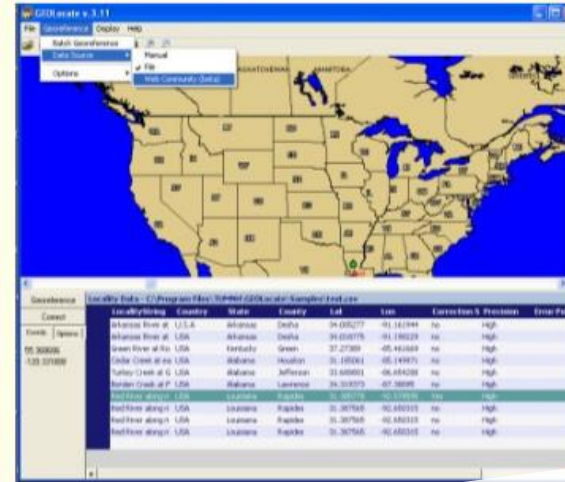


A Platform for Georeferencing Natural History Collections Data

For Users:

- Overview
- GEOLocate Web Application
- Collaborative Georeferencing
- GEOLocate 3.xx (standalone)
 - Global Expansion
- Education & Outreach

Brief overview (video) of the GEOLocate Project.



Works best for U.S., Canada, and Europe

For Developers:

- SOAP Services
- JSON/GeoJSON
- Embeddable Web Client

Automates georeferencing!



Web Application

Georeference collections data using your web browser. Quick and easy georeferencing.

Web Services

Integrate georeferencing into your own databases and applications using GEOLocate webservices.

Desktop Application

The original standalone desktop application.

Collaborative Georeferencing

Build communities, share data, relate records across collections and improve verification efficiency.



GEOLocate Web Application

Home | Standalone App | Web Application | Collaborative Georeferencing | Developer Resources | Workshops | Support and Contacts

GEOLocate Web Application ?

Full screen view +

Pan around map +

Zoom tool +

Base layer and overlay options

Coordinates at cursor position

Map scale



Country drop-down list

Locality search fields

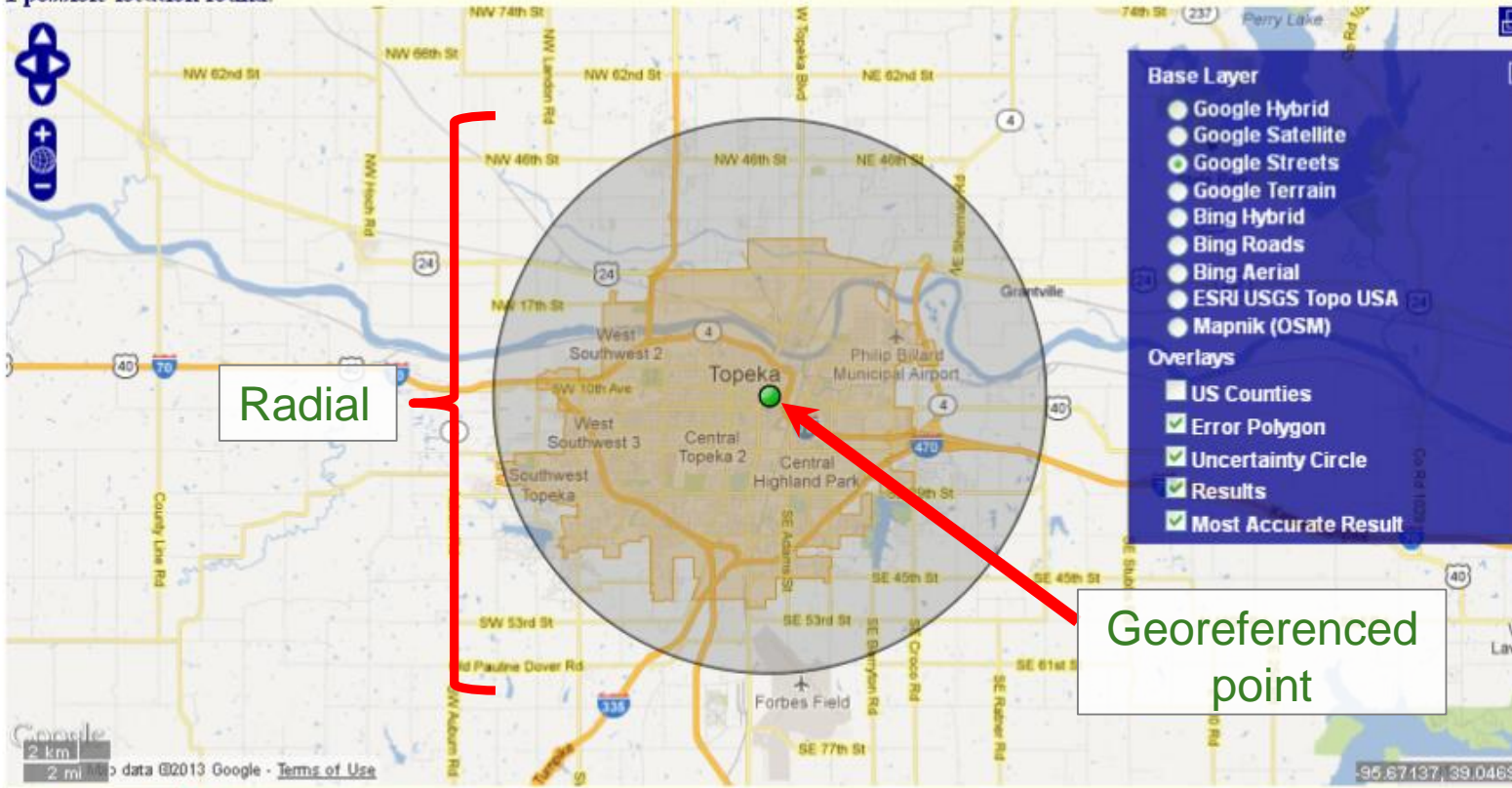
The screenshot displays the GEOLocate Web Application interface. At the top, a navigation bar includes links for Home, Standalone App, Web Application, Collaborative Georeferencing, Developer Resources, Workshops, and Support and Contacts. Below this is the application title 'GEOLocate Web Application' and a help icon. The main area is a map of North America, with a red dashed box highlighting the navigation controls (pan and zoom) on the left and a red dashed box highlighting the full-screen button in the top right. A red dashed box also highlights the coordinates '-148.61132, 41.26954' at the bottom right of the map. Below the map is a control panel with a 'Workbench' tab and a 'Results' tab. The 'Results' tab contains a 'Georeference' button, an 'Options' button, and radio buttons for 'Draw polygon', 'Place marker', and 'Measure'. There are input fields for 'Locality String', 'Country' (with a dropdown menu showing 'UNITED STATES OF AMERICA'), 'State', and 'County'. Checkboxes for 'latitude', 'longitude', 'uncertainty', and 'error polygon' are also present.

GEOLocate Web Application

Home | Standalone App | Web Application | Collaborative Georeferencing | Developer Resources | Workshops | Support and Contacts

 GEOLocate Web Application 

1 possible location found.



Base Layer

- Google Hybrid
- Google Satellite
- Google Streets
- Google Terrain
- Bing Hybrid
- Bing Roads
- Bing Aerial
- ESRI USGS Topo USA
- Mapnik (OSM)

Overlays

- US Counties
- Error Polygon
- Uncertainty Circle
- Results
- Most Accurate Result

Workbench 1 possible location found

Georeference Options | Clear Polygon | Draw polygon | Place marker | Measure

Locality String: Topeka

Country: UNITED STATES OF AMERICA

State: Kansas

County: Shawnee

latitude: 39.04833 longitude: -95.67778 uncertainty: 10539 m error polygon

```
39.04833 -95.67778 10539
39.1020860198,-95.6874469244,39.1020860198,-95.6853439244,39.102074
0198,-95.6834039244,39.1020830198,-95.6825809244,39.1020920198,-95.
```


Uncertainty: Automated

GEOLocate Web Application

Click "Resize uncertainty to polygon" to snap the radial to the region of the city. Available when polygon of feature is present.

Lat: 39.048334
Lon: -95.678037
Uncertainty: 10539 m
Parse pattern: TOPEKA

Edit uncertainty
Resize uncertainty to polygon
Pin here

Workbench 2 possible locations found

Georeference Options Clear Polygon Draw polygon Place marker Measure

Locality String: Topeka

Country: UNITED STATES OF AMERICA

State: Kansas

County:

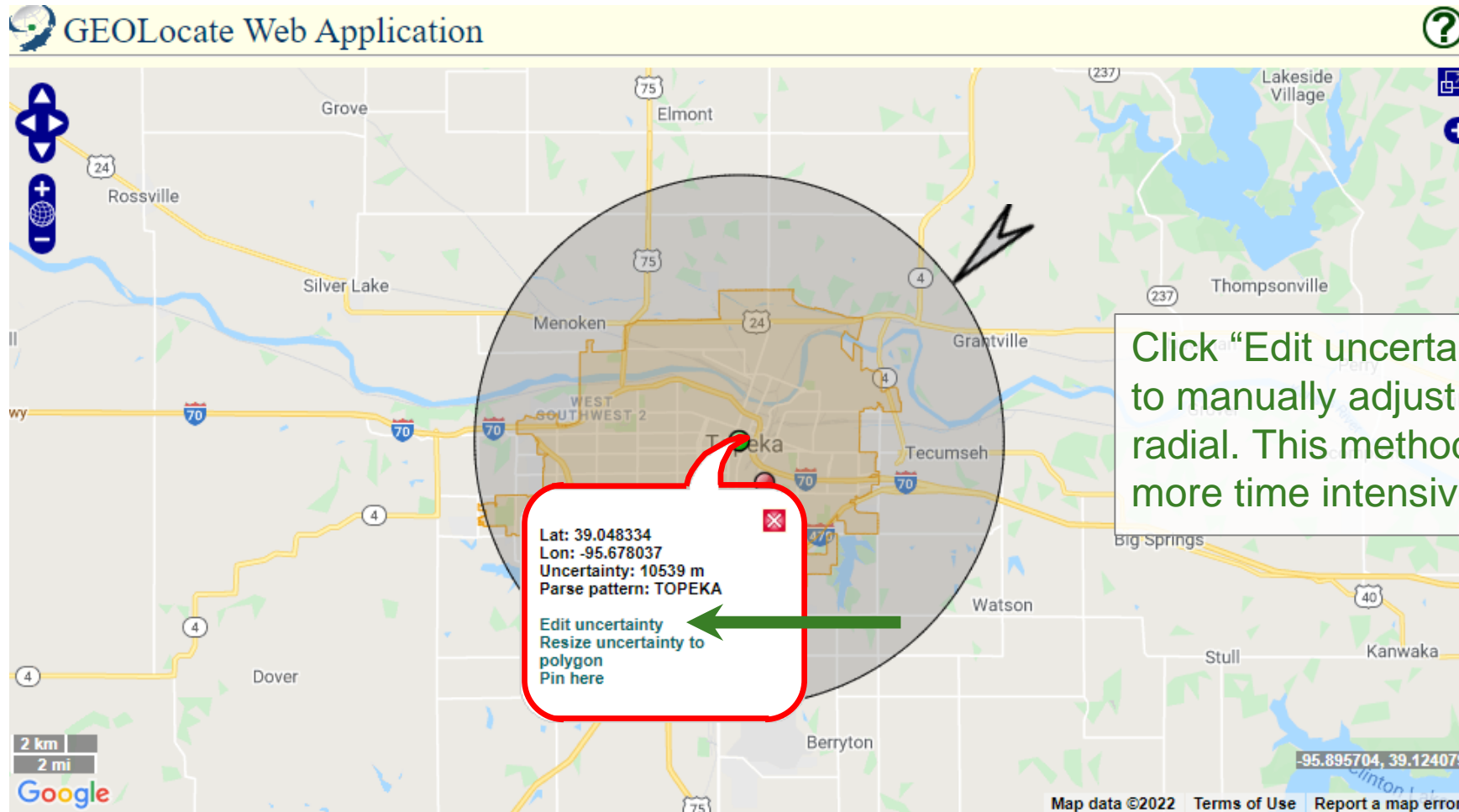
latitude: 39.048334 longitude: -95.678037 uncertainty: 10539 m error polygon

39.048334	-95.678037	10539
39.1020860198, -95.6874469244, 39.1020860198, -95.6853439244, 39.1020740198,		
-95.6834039244, 39.1020830198, -95.6825809244, 39.1020920198, -95.6818049244		

Map data ©2022 Terms of Use Report a map error

GEOLocate

Uncertainty: Manual



Workbench 2 possible locations found

Georeference Options | Clear Polygon Draw polygon Place marker Measure

Locality String: Topeka

Country: UNITED STATES OF AMERICA latitude: 39.048334 longitude: -95.678037 uncertainty: 10539 m error polygon

State: Kansas

County:

39.048334	-95.678037	10539
39.1020860198, -95.6874469244, 39.1020860198, -95.6853439244, 39.1020740198, -95.6834039244, 39.1020830198, -95.6825809244, 39.1020920198, -95.6818049244		

Offset at a Heading

20 km N of Nantes, France

The screenshot displays the GEOLocate Web Application interface. At the top, the title "GEOLocate Web Application" is visible, with a search result notification "7 possible locations found." circled in red. The main map shows France and surrounding regions, with a green dot marking the best match near Nantes and several red dots indicating other possible locations. The interface includes navigation controls on the left and a workbench at the bottom. The workbench shows the search criteria: "20 km. north of Nantes" and "FRANCE". It also displays the selected location's coordinates and uncertainty: latitude: 47.396454, longitude: -1.55, and uncertainty: 15838 m. The state is identified as "Loire-Atlantique".

7 possible locations found.

green dot = best match

Workbench 7 possible locations found

Georeference Options | Draw polygon Place marker Measure

Locality String: 20 km. north of Nantes

Country: FRANCE

State: Loire-Atlantique

County:

latitude: 47.396454 longitude: -1.55 uncertainty: 15838 m error polygon

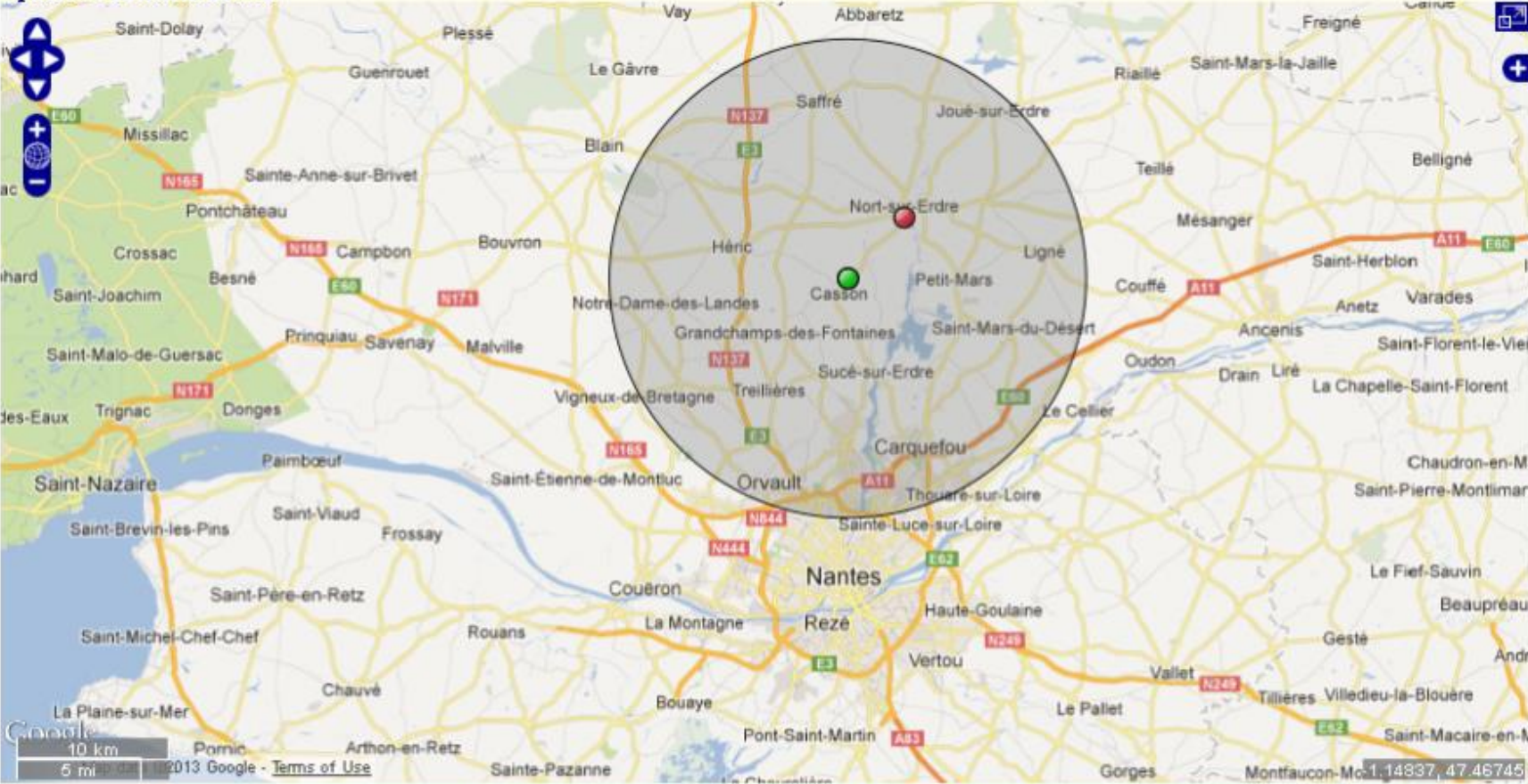
47.396454 -1.55 15838 Unavailable

Offset at a Heading

20 km N of Nantes, France

GEOLocate Web Application ?

7 possible locations found.



Workbench **7 possible locations found**

Georeference | Options | Draw polygon Place marker Measure

Locality String: 20 km. north of Nantes

Country: FRANCE latitude: 47.396454 longitude: -1.55 uncertainty: 15838 m error polygon

State: Loire-Atlantique 47.396454 -1.55 15838 Unavailable

County:

GEOLocate

Reference Map Layers

Click map to search

- Harlem 1897
- Harlem 1898
- Harlem 1900
- New York 1949
- New York 1954
- New York 1958
- New York 1969

Base Layer

- Google Hybrid
- Google Satellite
- Google Streets
- Google Terrain
- Bing Hybrid
- Bing Roads
- Bing Aerial
- ESRI USGS Topo USA
- ESRI USGS Topo USA (faster)
- ESRI World Topo
- ESRI Ocean Base Map
- ESRI Navigation Charts
- Mapnik (OSM)

Overlays

- USGS State Geologic Maps
- US Hydrography Dataset
- NZ Topo50
- US Counties
- GEBCO 2019 Bathymetry
- Error Polygon
- Uncertainty Circle
- Results
- Mapnik (OSM)
- Historical USGS Topo (beta)

Workbench 3 possible locations found

Georeference Options | Clear Polygon Draw polygon Place marker Measure

Locality String: Yonkers

Country: UNITED STATES OF AMERICA

State: New York

County:

latitude: 40.93121 longitude: -73.898747 uncertainty: 7222 m error polygon

40.93121 -73.898747 7222

40.9174990215, -73.9180809042, 40.9194990215, -73.9176809042, 40.9248990215, -73.9155809042, 40.9354990215, -73.9122809042, 40.9413990215, -73.9105809042

Translating Coordinate Systems

- Geographic coordinates can be provided in a number of different coordinate systems
- Decimal degrees provides the most convenient coordinates to use and is what we aim to obtain (example: 40.866680, -73.878735)
- Conversions can be made readily between coordinate systems (to decimal degrees)

[Township, Range, and Section \(PLSS\)](#)

[UTM coordinates](#)

Public Land Survey System (TRS)

- **United States ONLY**
 - *Mainly in the **West**, **Midwest**, and some **Southern** states*
- Uses **Township-Range-Section** Coordinate System (TRS)
 - Ex. **T21N, R1W, S5** = Township 21 North / Range 1 West / Section 5
 - **MUST specify State** (and sometimes “Meridian”, if a state has more than one!)
 - Datum: **NAD27**
- *Useful tools:* **GEOLocate** or **TRS Conversion Calculator**
 - For obtaining Lat/Long coordinates and other geographical information

GEOLocate to Convert TRS

GEOLocate can translate TRS into decimal degrees if entered as: T(value and direction) R(value and direction) S(value), example: T37N R21W S14

Screenshot of the GEOLocate desktop application interface. The 'Locality Details (cont.)' section is highlighted with a red box, showing Township: 37N, Range: 21W, and Section: 14. A red arrow points from this box to the web application screenshot on the right.

Screenshot of the GEOLocate Web Application interface. It shows a satellite map of a rural area with a green dot indicating a location near Preston, Missouri. The interface includes a navigation bar, a search bar, and a 'Workbench' section at the bottom.

Workbench 1 possible location found

Georeference Options Draw polygon Place marker Measure

Locality String: T37N R21W S14

Country: UNITED STATES OF AMERICA

State: Missouri

latitude: 37.955349 longitude: -93.20735 uncertainty: 969 m error polygon

37.955349 -93.20735 969 Unavailable

UTM Calculator

Lat/Lon and UTM Converter <http://rcn.montana.edu/Resources/Converter.aspx>

www.rcn.montana.edu/Resources/Converter.aspx

MONTANA STATE UNIVERSITY

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Convert Geographic Units

NOTE: no attempt is made to compensate for the irregular grid in the area around the southwestern coast of Norway and Svalbard (zones 32V and 31X, 33X, 35X and 37X). Because of this results returned for NATO coordinates for lat/long or UTM values located in these regions may not be correct.

Javascript used in this converter is adapted from [Prof. Steven Dutch at UW Green Bay](#).


Select Map Datum
WGS 84

Decimal Degrees
Latitude: Longitude:
Convert Decimal Degrees Reset Form

Degrees, Minutes, Seconds
Latitude: Degrees: Minutes: Seconds: Hemisphere: N/S
Longitude: Degrees: Minutes: Seconds: Hemisphere: W/E
Convert Degrees, Minutes, Seconds Reset Form

Standard UTM
Zone: Hemisphere: N/S Easting: Northing:
Convert Standard UTM Reset Form

NATO UTM
Long. Zone: Lat. Zone: Bigraph: Easting: Northing:
Convert NATO UTM Reset Form



Click for larger version in new window

**What is UTM?
Universal Transverse
Mercator coordinate
reference system**

To use ONLY when coordinates provided on label in UTM format

UTM Calculator

http://www.rcn.montana.edu/Resources/Converter.aspx

The screenshot shows the website's navigation bar with logos for Montana State University, NST, and RCN. Below the navigation bar is a menu with links: Home, Geothermal Sites, Organisms, Participants, Publications, Resources, Advanced Search, Announcements, Links, Contact Us, and About. The main heading is "Convert Geographic Units". A note explains that the converter does not compensate for irregular grids in certain regions. Below the note are three input sections: "Lat/Long Coordinates" (with a red dashed box around the Decimal Degrees fields), "Degrees, Minutes, Seconds", and "Standard UTM". A "Zoom-able map" (with a red box around it) shows a topographic map with a red location pin. At the bottom, there are sections for "NATO UTM" and a footer with site information.

The photograph shows a botanical specimen label from Northern Arizona University (ASC). The text on the label includes: "PLANTS OF ARIZONA", "Flora of Grand Canyon NP, North Kaibab", "Solanaceae", "*Physalis hederifolia* Gray var. *fendleri* (Gray) Cronq.", "USA. ARIZONA Coconino", "Vicinity of Cliff Spring near Cape Royal.", "UTM: 12S 414200E 3998050N NAD27", "Elevation: 7600 ft", "Associated species: *Pinus ponderosa*, *P. edulis*, *Ericameria nauseosa*, *Salix exigua*, *Ivesia arizonica*, *Quercus gambelii*, *Rosa woodsii*, *Abies concolor*", "G. Rink 6542 9 August 2007 with: W. Hodgson, B. Phillips", and "Northern Arizona University (ASC)". A red oval highlights the UTM coordinates and elevation information.

Search fields

Zoom-able map

Note: This information is captured in the Mapping Tab of the Sites Module in EMu

To use ONLY when coordinates provided on label in UTM format

Online Resources

It may be necessary to reference gazetteers or other sources

Example: Merced Falls, California, was an industrial center served by the Yosemite Valley R.R. until the 1940s, after which the town faded ([Merced Falls - California Ghost Town \(ghosttowns.com\)](http://Merced Falls - California Ghost Town (ghosttowns.com)))

- Historical places
- Ghost towns
- Remote villages/regions
- Natural/geological features
- Spelling/translation variations or misspellings



present day

c.1900

Resources/Gazetteers

Please refer to these resources for help in finding more difficult localities:

- [GeoNames](#) (crowd/open source*) crowdsourced gazetteer
- [Statoids](#): administrative subdivisions by country
- [GEOnet Names Server](#): Worldwide data from the National Geospatial-Intelligence Agency & U.S. Board on Geogr. Names
- [Wikimapia](#) (crowd/open source*) helpful if you have approx. coordinates
- [OpenStreetMap](#) (crowd/open source*) open geographic database
- [Digitized Perry-Castañeda Library \(PCL\) Map Collection](#) digitized paper map collection
- [Falling Rain Global Gazetteer](#) global gazetteer
- Google **Web and Image Search**
- **Paper maps/ atlases**

Crowdsourced
information should be
cross-referenced with
other sources