



# **FILE** PART 3: STEP-BY-STEP EXAMPLES

# **EXAMPLES**

**Feature – with Obvious Spatial Extent** using GEOLocate

**Feature – without Obvious Spatial Extent** using Google Maps & MaNIS Georeferencing Calc.

**Offset – Distance at a Heading** using Google Maps & the MaNIS Georeferencing Calculator

**Offset – Path** using Google Maps and the MaNIS Georeferencing Calculator

# Feature – with Obvious Spatial Extent

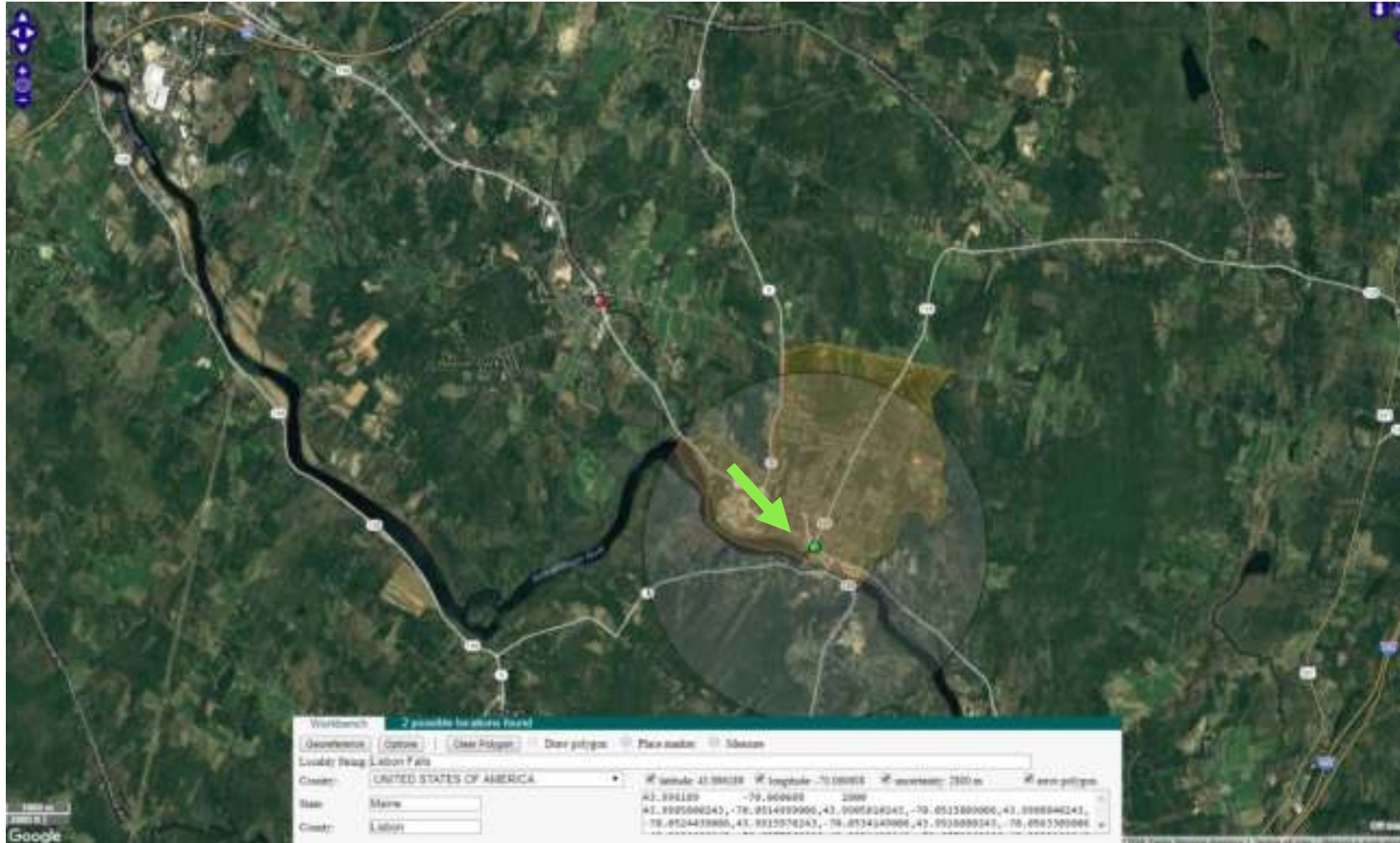
**Example: Lisbon Falls, Lisbon Co., Maine  
(U.S.)**

Procedure:

- Use GEOLocate to find coordinates and radial for the city
- Ensure coordinates are at corrected center of the city
- Edit radial to encompass area as precisely as possible (snap to feature)

GEOLocate is best for 'simple' localities and to find offsets at a heading

# GEOLOCATE

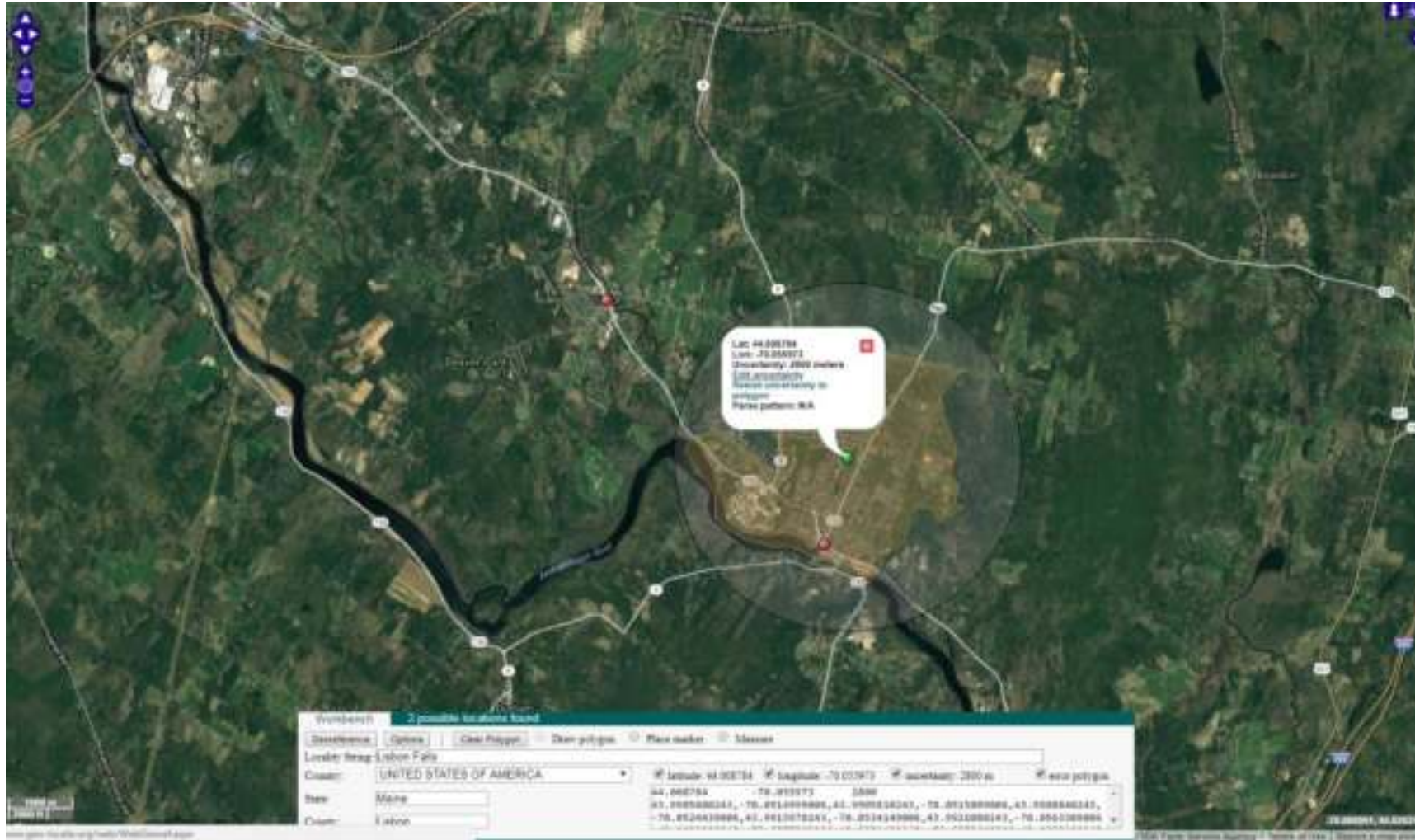


GEOLocate finds coordinates within Lisbon Falls

Coordinates need to be shifted to a more appropriate center

Uncertainty radius does not encompass entire area of city

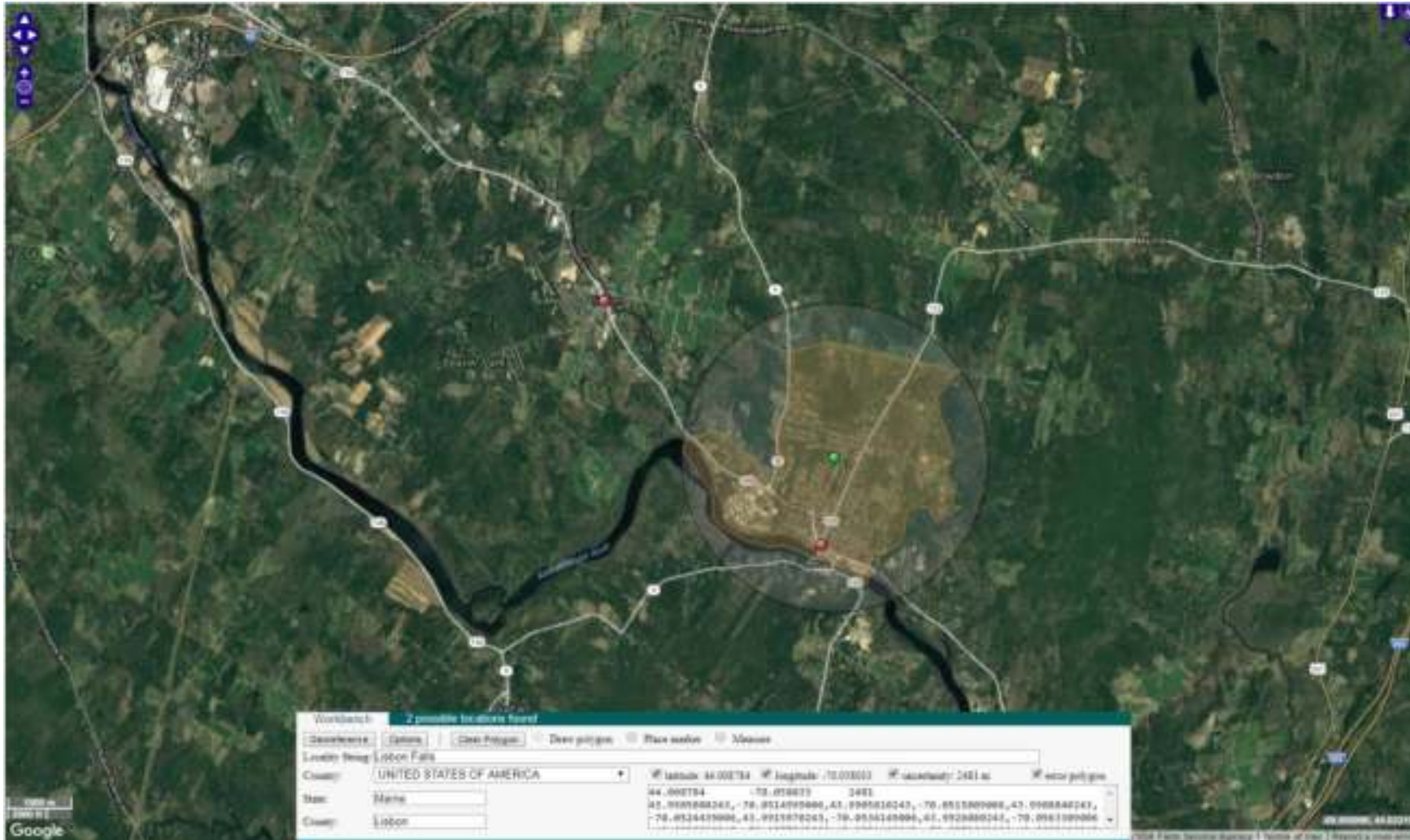
# COORDINATE ADJUSTMENT



Adjust point to be in approximate center of region

Uncertainty should encompass entire area of city (polygon)

# EDIT UNCERTAINTY



Resize  
uncertainty to  
polygon (faster  
than manually  
editing the  
radius)

Note: polygon of  
city extent is  
not always  
displayed/known

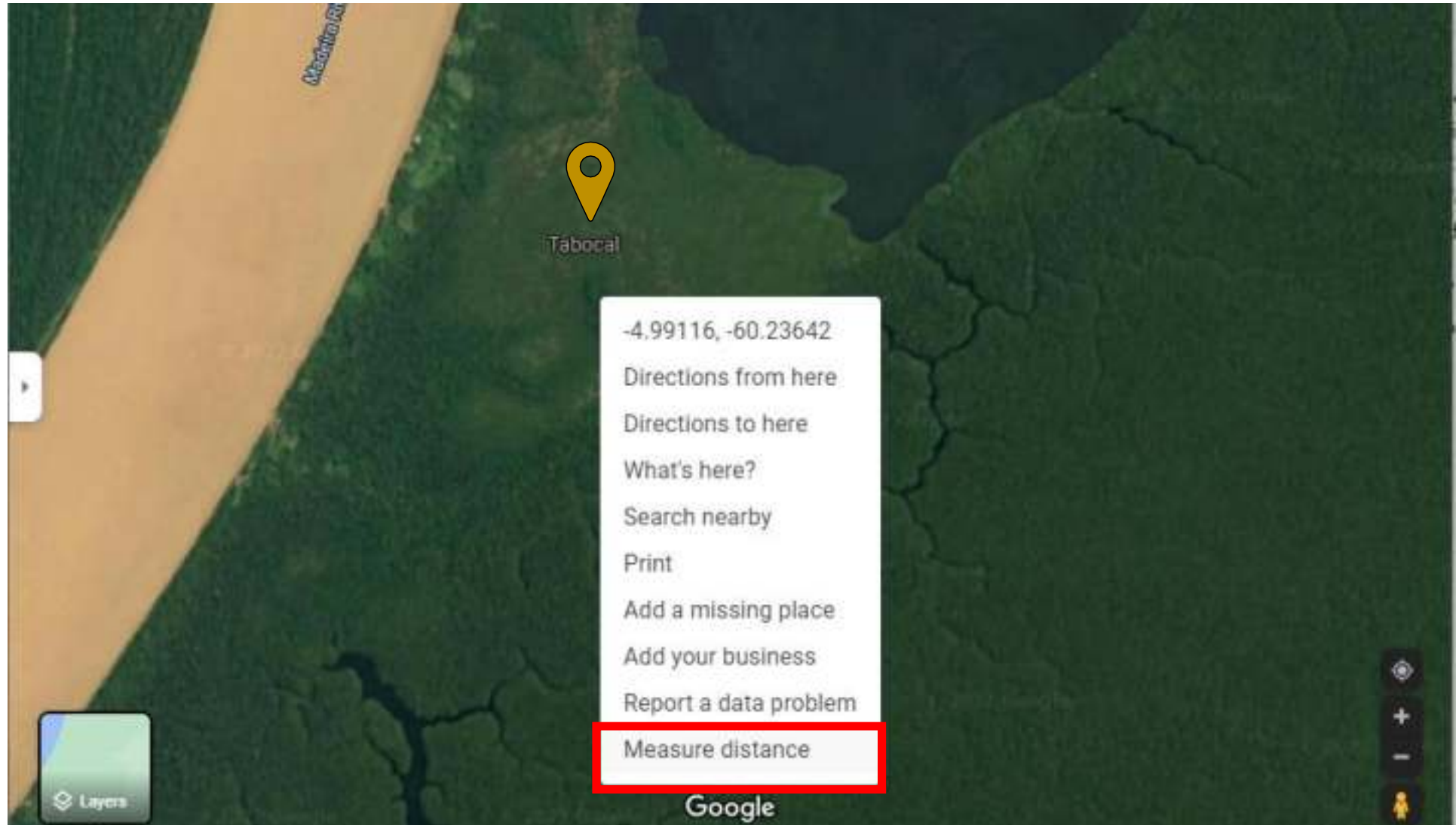
# Feature – without Obvious Spatial Extent

Example: Tabocal, Amazonas (Brazil)

- Use Google Maps to locate coordinates of the area
- Measure from the coordinates to the approximate center of the nearest feature (of similar locality type)
- Divide distance in half to approximate the radial
- Input information into the MaNIS Georef. Calculator to find the uncertainty radius

Instructions are from previous version of the Quick Reference Guide (Wieczorek 2012) but in agreement with the updated guide (Zermoglio 2020)

# PINNING YOUR LOCATION



To begin, right-click on the map where Google Maps displays the name of the location and select the "Measure distance" tool

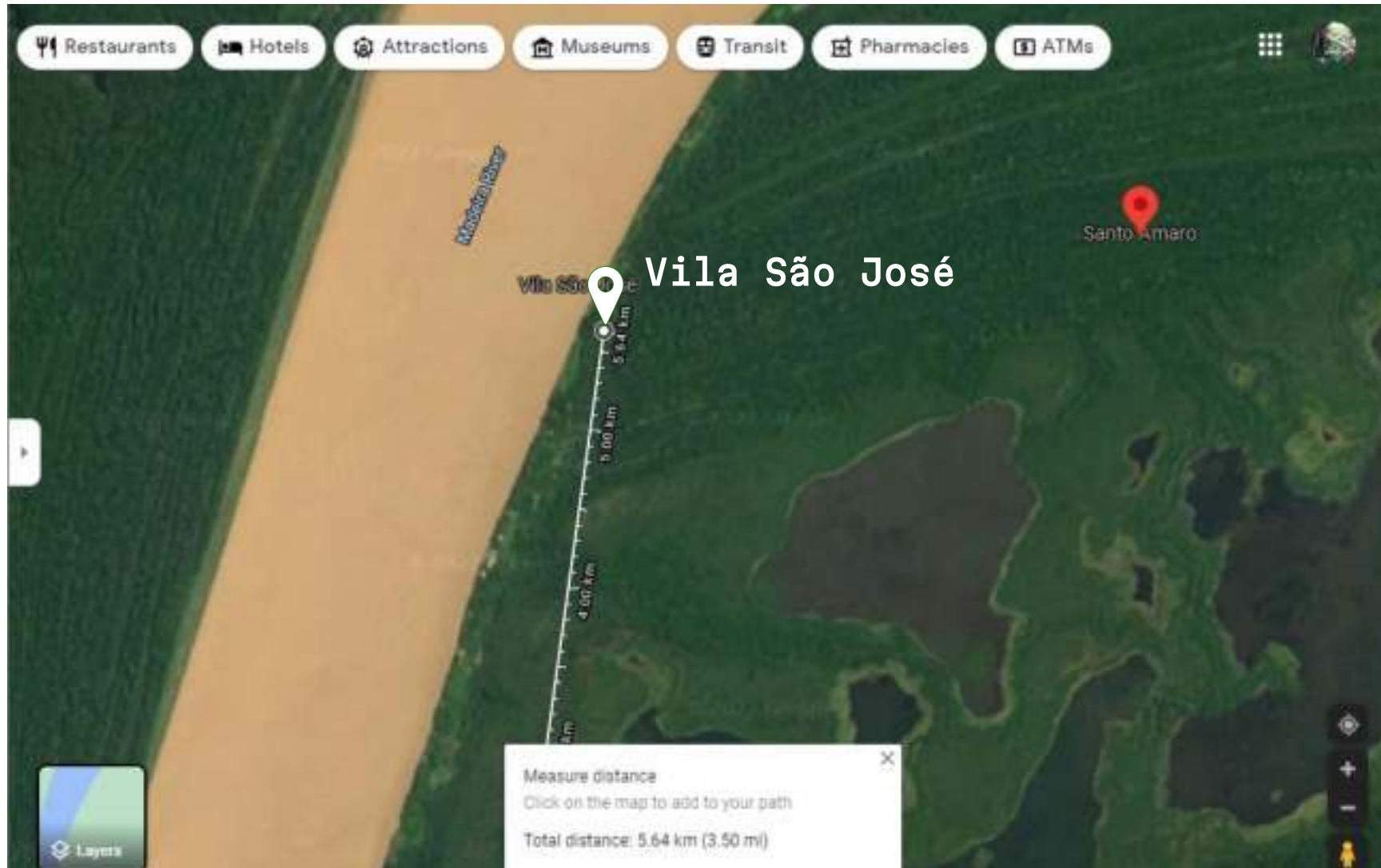


# FIND NEAREST NAMED PLACE



To find the nearest named feature you must pan around the map

# MEASURE



Vila São José is nearest; measure a straight line between centers of both features, then halve distance = radial

# RADIAL PROTOCOL



# CALCULATOR PROCEDURE

LOCALITY TYPE	CALCULATION PROCEDURE (instructions on how to use the Georeferencing Calculator)
<p><b>Named place</b></p> <p><b>Undefined Area:</b> Locality refers to a geographic feature that does not have a clear spatial boundary</p> <p><i>Example: "Pampa Grande" (the extent is 4.7 km given that the center of the nearest named place, "Colonia Mariano Sarratea" is 9.4 km distant)</i></p>	<p><b>Calculation Type:</b> <del>"Error only - enter Lat/Long for the actual locality"</del></p> <p><b>Locality Type:</b> "Named place only" ←</p> <p><b>Coordinates:</b> Determine the coordinates for the named place as well as possible using visible evidence near the label for the named place on the map.</p> <p><b>Extent:</b> Use half the measured distance from the selected coordinates to the center of the nearest named place. Make note of the measure and the nearest named place in <u>georeferenceRemarks</u>.</p>

# LOCALITY TYPE

Locality Type = Geographic  
feature only

English ▾

Georeferencing Calculator

Locality Type: Geographic feature only (e.g., Bakersfield) ▾

Distance Converter:  km ▾ =  km ▾

Scale Converter:  mm ▾ 1:24000 ▾ =  km ▾

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[MaNIS Georeferencing Calculator](#)

Undefined Area: Tabocal, Município Borba, Amazonas (Brazil)

# COORDINATE SOURCE, FORMAT, DATUM, PRECISION

- Coordinate Source: **Google Maps > 2008**
- Coordinate Format: Based on coordinate source (Google Maps) = **decimal degrees**
- Datum: **WGS84** (Google Maps)
- Precision (of the coordinates): **exact** (Google Maps)

The screenshot shows the 'Georeferencing Calculator' web application. The interface includes a language dropdown set to 'English', a 'Locality Type' dropdown set to 'Geographic feature only (e.g., Bakersfield)', a 'Coordinate Source' dropdown set to 'Google Earth/Maps >2008', and a 'Coordinate Format' dropdown set to 'decimal degrees'. There are input fields for 'Input Latitude' and 'Input Longitude', and dropdowns for 'Datum' (set to '(WGS84) World Geodetic System 1984') and 'Precision' (set to 'exact'). On the right side, there are input fields for 'Radial of Feature', 'Measurement Error', and a 'Distance Units' dropdown set to 'km'. Below these are 'Calculate', 'Copy', and 'Go here' buttons. A table below the buttons has columns for 'Latitude', 'Longitude', 'Uncertainty (m)', and 'Datum'. Another table below that has columns for 'Precision', 'Date', 'Georeferenced by', and 'Protocol', with the 'Protocol' dropdown set to 'protocol not recorded'. At the bottom, there are 'Distance Converter' and 'Scale Converter' sections with input fields and unit dropdowns. The footer shows 'Version 20210127en' and 'Copyright 2020 Rauthiflor LLC'.

Undefined Area: Tabocal, Município Borba, Amazonas (Brazil)

# LATITUDE AND LONGITUDE

Latitude & Longitude do not need to be entered – important only when calculating offset coordinates

The image shows a web application titled "Georeferencing Calculator". It features a background map of the world. The interface includes several input fields and dropdown menus for configuring georeferencing parameters. At the bottom, there are sections for "Distance Converter" and "Scale Converter".

Latitude	Longitude	Uncertainty (m)	Datum

Precision	Date	Georeferenced by	Protocol
			protocol not recorded

Distance Converter:  km =  km

Scale Converter:  mm 1:24000 =  km

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Undefined Area: Tabocal, Município Borba, Amazonas (Brazil)

# RADIAL

Radial of Feature: calculated radial of Tabocal

Measurement Error: 10m (standard)

= Error associated with the georeferencer's ability to measure on the map

Distance Unit: m (must reflect the two fields above)

The image shows a screenshot of a web application titled "Georeferencing Calculator". The interface includes several input fields and dropdown menus. The "Locality Type" is set to "Geographic feature only (e.g., Bakersfield)". The "Coordinate Source" is "Google Earth/Maps >2008" and the "Coordinate Format" is "decimal degrees". The "Input Latitude" and "Input Longitude" fields both contain the value "0". The "Datum" is set to "(WGS84) World Geodetic System 1984" and the "Precision" is "exact". On the right side, the "Radial of Feature" is set to "2820", the "Measurement Error" is "10", and the "Distance Units" are set to "m". Below these fields are buttons for "Calculate", "Copy", and "Go here". A table at the bottom displays the calculated results:

Latitude	Longitude	Uncertainty (m)	Datum
Precision	Date	Georeferenced by	Protocol
	2022-01-27T00:06.		protocol not recorded

At the bottom of the interface, there are "Distance Converter" and "Scale Converter" sections, each with input fields and dropdown menus for units (km, mm) and scale (1:24000). The footer of the page includes "Version 20210127en" and "Copyright 2020 Rauthiflor LLC".

Undefined Area: Tabocal, Município Borba, Amazonas (Brazil)



# CALCULATE

Uncertainty radius  
is provided in  
meters, regardless  
of the input unit

**Georeferencing Calculator**

English

Locality Type: Geographic feature only (e.g., Bakersfield)

Coordinate Source: Google Earth/Maps >2008

Coordinate Format: decimal degrees

Input Latitude: 0

Input Longitude: 0

Datum: (WGS84) World Geodetic System 1984

Precision: exact

Radial of Feature: 2820

Measurement Error: 10

Distance Units: m

**Calculate** Copy Go here

Latitude	Longitude	Uncertainty (m)	Datum
0	0	2838	(WGS84) World Geodetic System 1984

Precision	Date	Georeferenced by	Protocol
0.000001	2022-01-27T00:06:10		protocol not recorded

Distance Converter: [ ] km = [ ] km

Scale Converter: [ ] mm 1:24000 = [ ] km

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Undefined Area: Tabocal, Município Borba, Amazonas (Brazil)

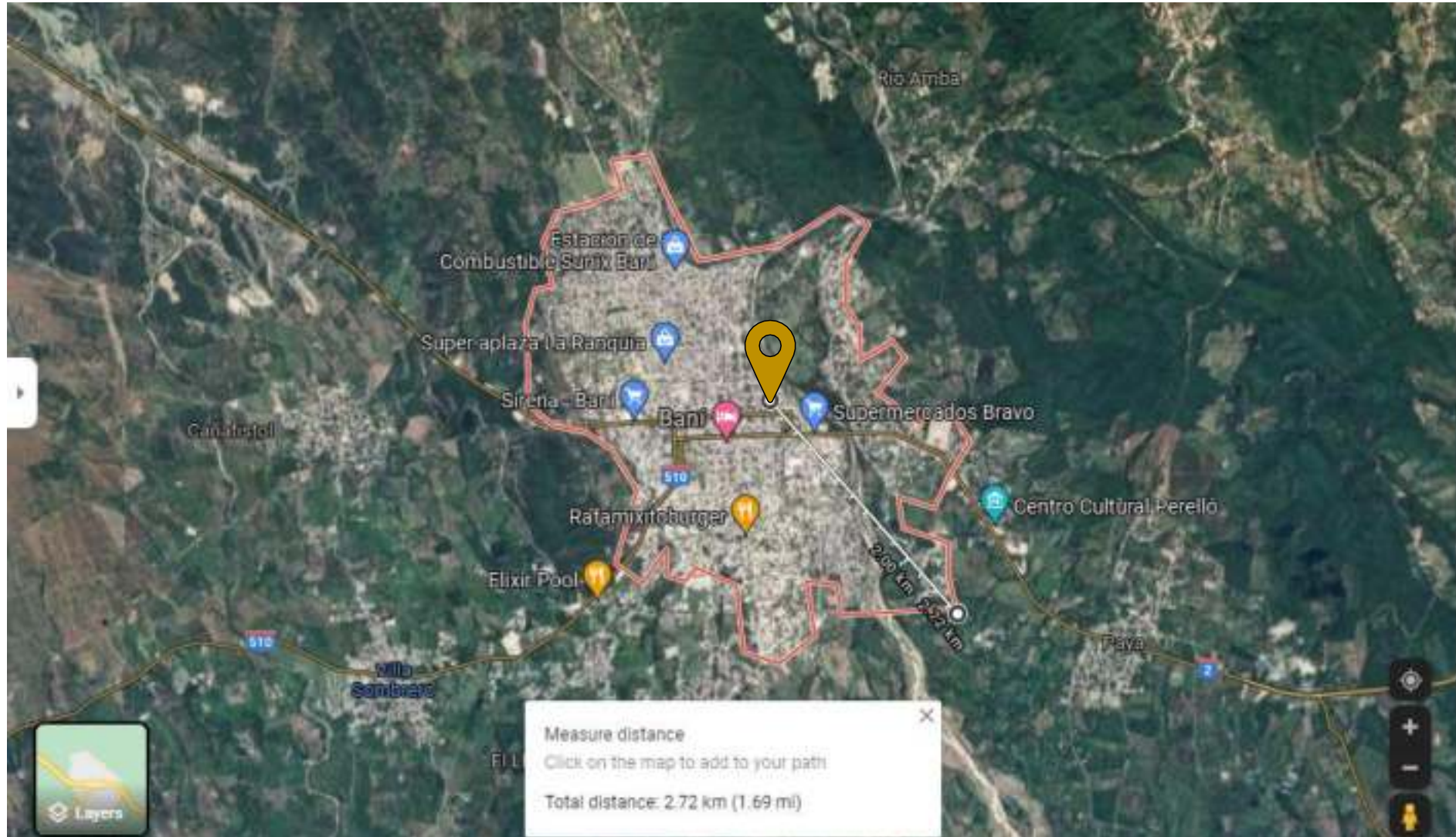
# Offset – Distance at a Heading

Example: 5km north of Baní, Dominican Republic

- Use Google Maps to locate coordinates of the city
- Find radial by measuring from coordinates to the farthest extent of the city
- Input information into the MaNIS Georeferencing Calculator to find the offset coordinates and the uncertainty radius.

Note: Use GEOLocate when applicable (U.S., Canada, Europe)

# COORDINATES & RADIAL



Locate coordinates of Bani center (18.282270, -70.328719) and radial (2.72km to match offset units)

# CALCULATOR PROCEDURE

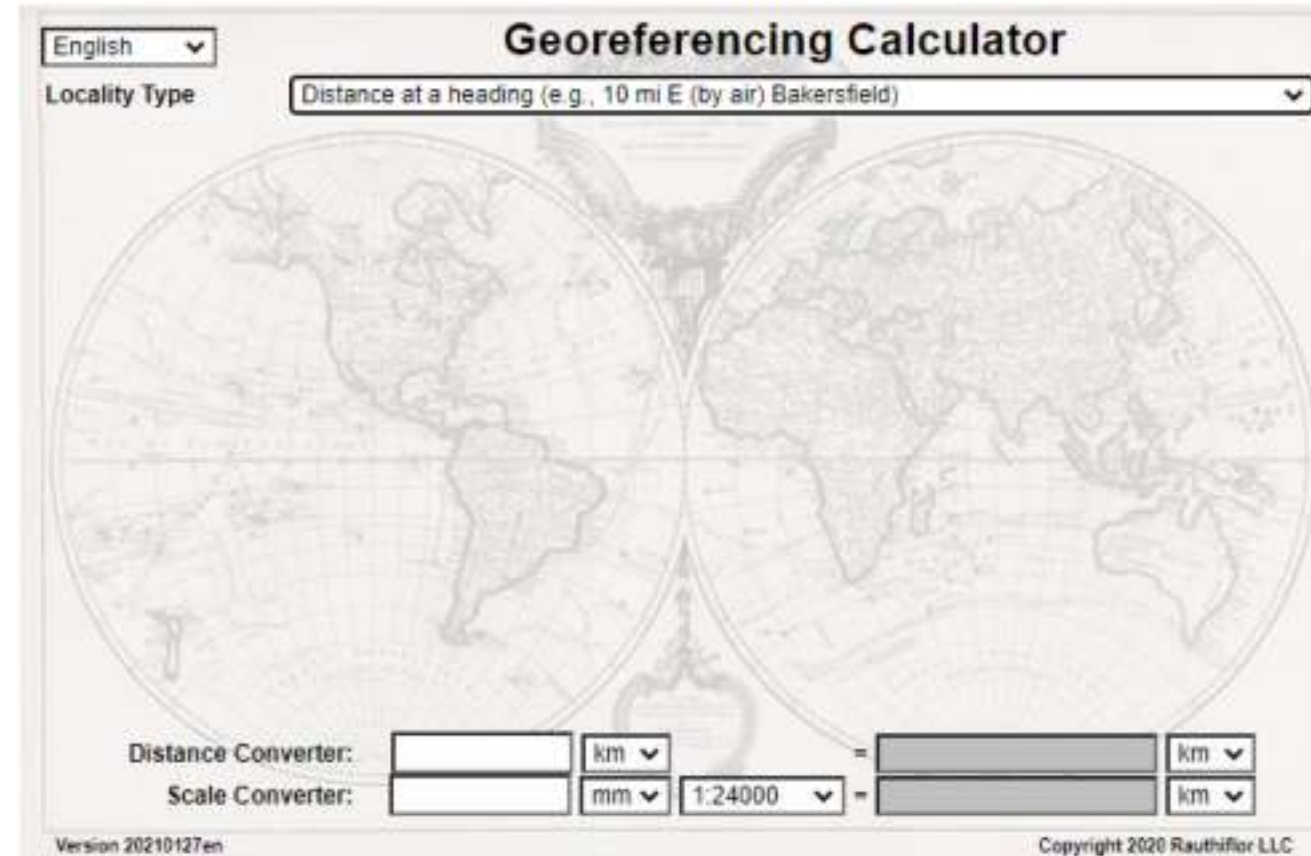
GEOREFERENCING QUICK REFERENCE GUIDE

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LOCALITY TYPE	CALCULATION PROCEDURE (instructions on how to use the Georeferencing Calculator)
<p><b>Offset</b></p> <p><b>Offset at a heading</b></p> <p><i>Examples: "50 miles W of Las Vegas", "10 km E de Amamá"</i></p>	<p><del>Calculation Type: "Coordinates and error - enter the Lat/Long for the named place or starting point"</del></p> <p><b>Locality Type:</b> <u>"Distance at a heading"</u> ←</p> <p><b>Coordinates:</b> If "by road" or other path is specified in the locality description, use the method under <b>Offset Along a Path</b>. If the description could be interpreted reasonably either by a route or by air, use the method under <b>More Than One Possibility</b>. Otherwise, assume that the heading is "by air" and note this assumption in <b>georeferenceRemarks</b>. In this case use the coordinates of the geographic center of the named place as a starting point in the Georeferencing Calculator. These are not the coordinates of the locality, which will be given in the fields to the left of the <b>Calculate</b> button when it is clicked after all the fields above it have been entered.</p> <p><b>Extent:</b> As for <b>Named Places – Bounded Area</b> or <b>Named Places – Undefined Area</b>, as appropriate.</p>

# LOCALITY TYPE

Locality Type: Distance at a heading



The image shows a web-based interface for a "Georeferencing Calculator". At the top left, there is a language dropdown menu set to "English". The main title is "Georeferencing Calculator". Below the title, there is a "Locality Type" dropdown menu with the selected option being "Distance at a heading (e.g., 10 mi E (by air) Bakersfield)". The central part of the interface features a world map with a grid overlay. At the bottom, there are two conversion sections: "Distance Converter" and "Scale Converter". The "Distance Converter" has two input fields, both currently empty, with "km" dropdown menus. The "Scale Converter" has two input fields, both empty, with "mm" and "1:24000" dropdown menus. The bottom left corner displays "Version 20210127en" and the bottom right corner displays "Copyright 2020 Rauthiflor LLC".

Offset at a Heading: 5km N of Baní

# COORDINATE SOURCE, FORMAT, DATUM, PRECISION

- Coordinate Source: **Google Maps > 2008**
- Coordinate Format: Based on coordinate source (Google Maps) = **decimal degrees**
- Input Latitude/Long.: **coordinates** must be entered in order to calculate the offset coordinates according to input parameters
- Datum: **WGS84** (Google Maps)
- Precision (of the coordinates): **exact** (Google Maps)

**Georeferencing Calculator**

English

Locality Type: Distance at a heading (e.g., 10 mi E (by air) Bakersfield)

Coordinate Source: Google Earth/Maps >2008

Coordinate Format: decimal degrees

Direction: degrees from N

Input Latitude: 18.282227044

Input Longitude: -70.32871990

Datum: (WGS84) World Geodetic System 1984

Precision: exact

Offset Distance: [ ]

Radial of Feature: [ ]

Measurement Error: [ ]

Distance Units: km

Precision: 1 km

Calculate Copy Go here

Latitude	Longitude	Uncertainty (m)	Datum

Precision	Date	Georeferenced by	Protocol
	2022-01-27T00:06:		protocol not recorded

Distance Converter: [ ] km = [ ] km

Scale Converter: [ ] mm 1:24000 = [ ] km

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Offset at a Heading: 5km N of Baní

# OFFSET

Offset Direction: **N**

Offset Distance: **5(km)** –  
according to locality description.

Radial of Feature: (Starting point  
of offset)  
City of Baní = **2.72(km)**

Measurement Error:  
Always use 10m (or **0.01km**)

Distance Precision:  
precision of 5km distance is **1km**

\* Maintain consistency in  
measurement units

**Georeferencing Calculator**

English

Locality Type: Distance at a heading (e.g., 10 mi E (by air) Bakersfield)

Coordinate Source: Google Earth/Maps >2008

Coordinate Format: decimal degrees

Input Latitude: 18.282227044

Input Longitude: -70.32871990

Datum: (WGS84) World Geodetic System 1984

Precision: exact

Direction: N

Offset Distance: 5

Radial of Feature: 2.72

Measurement Error: .010

Distance Units: km

Precision: 1 km

Distance	Precision
8 km →	1 km
8.5 km →	0.5 km
8.25 km →	0.25 km
8.75 km →	0.25 km
8.6 km →	0.1 km
8.0 km →	0.1 km
8.16 km →	0.01 km
-----	
80 km →	10 km
800 km →	100 km
1000 km →	500 km

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Offset at a Heading: 5km N of Baní

# CALCULATE

Offset coordinates and uncertainty radius (in meters) are provided.

The screenshot shows the 'Georeferencing Calculator' interface. The 'Calculate' button is circled in red. The output table is also highlighted with a red border.

Latitude	Longitude	Uncertainty (m)	Datum
18.3274008	-70.3287199	5883	(WGS84) World Geodetic System 1984

Additional output fields include: Precision: 0.0000001, Date: 2022-01-27T01:20:00, Georeferenced by: (empty), Protocol: protocol not recorded.

Offset at a Heading: 5km N of Baní

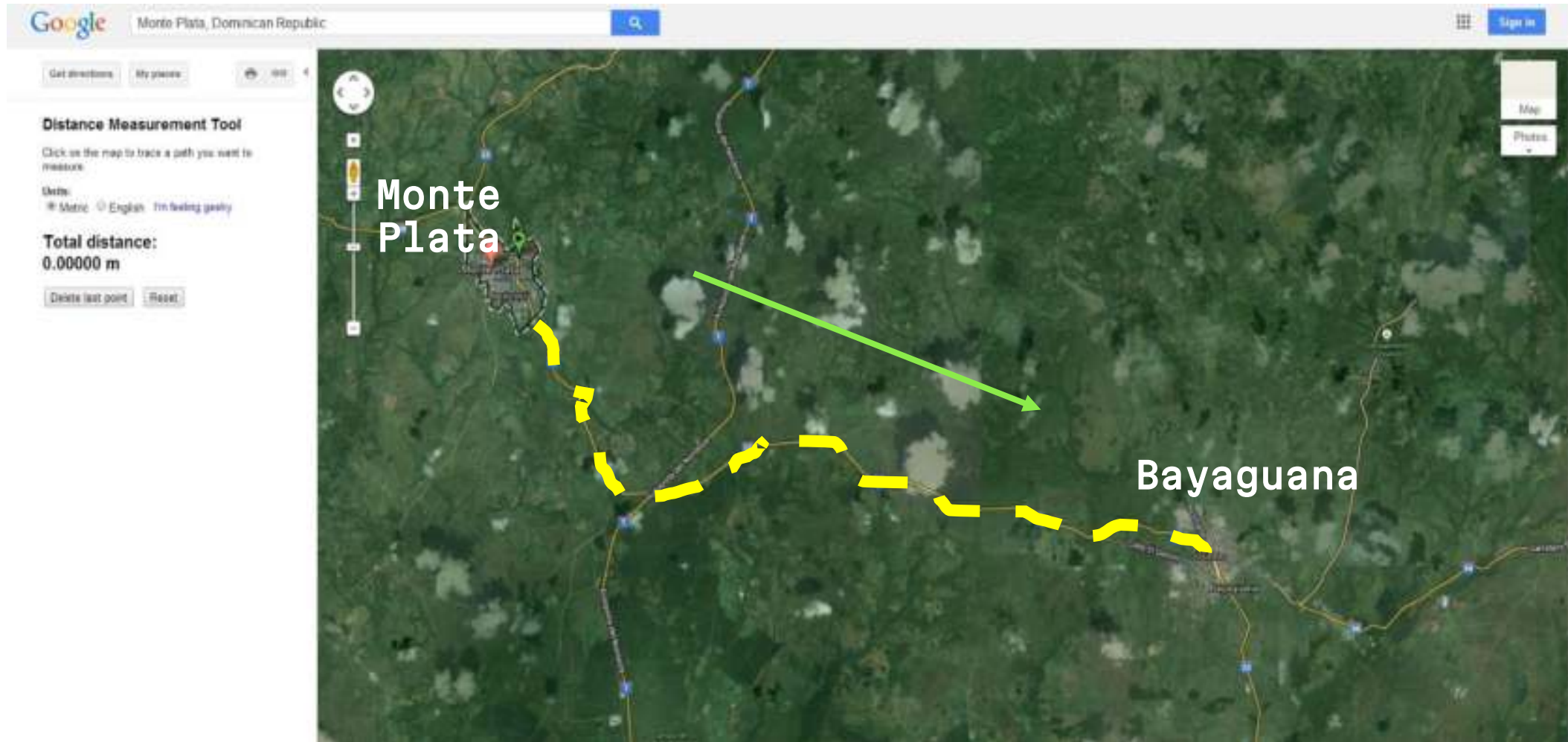


# Offset – Offset along a Path

Example: 3km along Monte Plata–Bayaguana Road, D.R.

- Use Google Maps to locate road connecting the cities
- Measure 3km along road in specified direction (from Monte Plata toward Bayaguana) starting from first named place and capture coordinates
- Find radial by measuring from starting location of offset to farthest extent of linear feature within city bounds
- Input information into the MaNIS Georeferencing Calculator to find the uncertainty radius.

# ASSESS



Locate road connecting the cities. Begin measuring offset from location where road comes nearest to Monte Plata center

# COORDINATES

The image is a screenshot of the Google Maps interface. At the top, the search bar contains "Monte Plata, Dominican Republic". On the left side, the "Distance Measurement Tool" is active, showing a total distance of "2.99999 km". A path is drawn on the map, consisting of several connected line segments along a road. A red location pin is placed on the path. A white popup window is overlaid on the map, displaying the text "The page at https://maps.google.com says:" followed by "Latitude and Longitude" and a text input field containing the coordinates "18.7862601-69.7738961". The popup also has "OK" and "Cancel" buttons. The map itself shows a road winding through a hilly, green landscape. The Google logo and search bar are visible at the top left, and the "Sign in" button is at the top right.

Zoom in and precisely measure along the road to the offset distance stated (toward the city of Bayaguana); capture coordinates

# RADIAL



The starting node of the ruler (1) marks the starting location for the offset, the second node (2) marks the farthest reaches of the road within city limits.

# CALCULATOR PROCEDURE

LOCALITY TYPE	CALCULATION PROCEDURE (instructions on how to use the Georeferencing Calculator)
<p><b>Offset</b></p> <p><b>Offset along a path</b></p> <p><i>Examples: "7.9 mi N Beatty, on US 95", "3 km en el Rio Jimenez arriba de Anita Grande", "left bank of the Mississippi River, 16 mi downstream from St. Louis", "Ruta Nacional 81, 8 km W de Ingeniero Guillermo Nicasio Juárez"</i></p>	<p><del>Calculation Type: "Error only - enter Lat/Long for the actual locality"</del></p> <p>Locality Type: <u>"Distance along a Path"</u> ←</p> <p><b>Coordinates:</b> Find the center of the named place as you would for <b>Named Place – Bounded Area</b> or <b>Named Place – Undefined Area</b>, as appropriate. Use a measuring tool on a printed or digital map to follow the specified route for the given distance. Use the end point as the coordinates. If no specific path is specified in the locality description, be sure to note in <b>georeferenceRemarks</b> which path was measured.</p> <p><b>Extent:</b> As for <b>Named Place – Bounded Area</b> or <b>Named Place – Undefined Area</b>, as appropriate.</p>

# LOCALITY TYPE

Locality Type: Distance along a path

The image shows a screenshot of the 'Georeferencing Calculator' web application. The interface includes a language dropdown set to 'English', a 'Locality Type' dropdown with the selected value 'Distance along path (e.g., 13 mi E (by road) Bakersfield)', a 'Coordinate Source' dropdown set to 'Google Earth/Maps >2008', and a 'Coordinate Format' dropdown set to 'decimal degrees'. There are input fields for 'Input Latitude' and 'Input Longitude'. On the right side, there are input fields for 'Radial of Feature' (13.457), 'Measurement Error' (010), 'Distance Units' (km), and 'Precision' (1 km). A 'Datum' dropdown is set to '(WGS84) World Geodetic System 1984'. Below these fields are 'Calculate', 'Copy', and 'Go here' buttons. A table below the buttons has columns for 'Latitude', 'Longitude', 'Uncertainty (m)', and 'Datum'. Below the table, there are fields for 'Precision', 'Date' (2021-05-18T17:19), 'Georeferenced by', and 'Protocol' (protocol not recorded). At the bottom, there are 'Distance Converter' and 'Scale Converter' sections with input fields and dropdown menus. The footer contains 'Version 20210127en' and 'Copyright 2020 Rauthiflor LLC'.

Offset Along a Path: 3km along Monte Plata – Bayaguana road (road 23) in D.R.

# COORDINATE SOURCE, FORMAT, DATUM, PRECISION

- Coordinate Source: **Google Maps > 2008**
- Coordinate Format: Based on coordinate source (Google Maps) = **decimal degrees**
- Datum: **WGS84** (Google Maps)
- Precision (of the coordinates): **exact** (Google Maps)

The screenshot shows the 'Georeferencing Calculator' interface. It includes a language dropdown set to 'English', a locality type dropdown with the text 'Distance along path (e.g., 13 mi E (by road) Bakersfield)', a coordinate source dropdown set to 'Google Earth/Maps >2008', and a coordinate format dropdown set to 'decimal degrees'. Input fields for latitude and longitude are present but empty. The datum is set to '(WGS84) World Geodetic System 1984' and precision is set to 'exact'. On the right side, there are fields for 'Radial of Feature' (13.457), 'Measurement Error' (010), 'Distance Units' (km), and 'Precision' (1 km). There are 'Calculate', 'Copy', and 'Go here' buttons. Below these is a table with columns for Latitude, Longitude, Uncertainty (m), Datum, Precision, Date, Georeferenced by, and Protocol. The Date field contains the value '2021-05-18T17:19:'. At the bottom, there are distance and scale converters.

Latitude	Longitude	Uncertainty (m)	Datum

Precision	Date	Georeferenced by	Protocol
	2021-05-18T17:19:		protocol not recorded

Distance Converter: [ ] km = [ ] km  
Scale Converter: [ ] mm 1:24000 = [ ] km

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Offset Along a Path: 3km along Monte Plata – Bayaguana road (road 23) in D.R.

# RADIAL

Radial of Feature: **Extent of the linear feature** within the bounds of the starting location (city of Monte Plata). Enter extent in the same units as the offset distance

Measurement Error: Use 10m (= **0.010km**)

Distance Precision: Dependent on the offset distance. The 3km offset = **1km** distance precision.

**Distance  
Precision**

**3km → 1km**

Offset Along a Path: 3km along Monte Plata – Bayaguana road (road 23) in D.R.

**Georeferencing Calculator**

English

Locality Type: Distance along path (e.g., 13 mi E (by road) Bakersfield)

Coordinate Source: Google Earth/Maps >2008

Coordinate Format: decimal degrees

Input Latitude:

Input Longitude:

Datum: (WGS84) World Geodetic System 1984

Precision: exact

Radial of Feature: 13.457

Measurement Error: 0.010

Distance Units: km

Precision: 1 km

Calculate Copy Go here

Latitude	Longitude	Uncertainty (m)	Datum
Precision	Date	Georeferenced by	Protocol
	2021-05-18T17:19:19		protocol not recorded

Distance Converter:  km =  km

Scale Converter:  mm 1:24000 =  km

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# MANIS: CALCULATE

Uncertainty radius provided in meters

The screenshot shows the 'Georeferencing Calculator' interface. The 'Locality Type' is 'Distance along path (e.g., 13 mi E (by road) Bakersfield)'. The 'Coordinate Source' is 'Google Earth/Maps >2008' and the 'Coordinate Format' is 'decimal degrees'. The 'Input Latitude' and 'Input Longitude' are both '0'. The 'Datum' is '(WGS84) World Geodetic System 1984' and the 'Precision' is 'exact'. The 'Radial of Feature' is '13.457' and the 'Measurement Error' is '010'. The 'Distance Units' are 'km' and the 'Precision' is '1 km'. The 'Calculate' button is highlighted in blue. Below the form is a table with the following data:

Latitude	Longitude	Uncertainty (m)	Datum
0	0	13975	(WGS84) World Geodetic System 1984

Below the table, the 'Precision' is '0.0000001', the 'Date' is '2021-05-18T19:11:00', and the 'Protocol' is 'protocol not recorded'. At the bottom, there are 'Distance Converter' and 'Scale Converter' fields. The version is '20210127en' and the copyright is '2020 Rauthiflor LLC'.

Offset Along a Path: 3km along Monte Plata – Bayaguana road (road 23) in D.R.

# QUESTIONS?



[Google Maps](#)

[GEOLocate Web Application](#)

[MaNIS Georef. Calculator](#)

[Georef. Quick Ref. Guide](#)

# NYBG

# CREDITS

This is an updated compilation of information provided by the iDigBio's first Train-the-Trainers Georeferencing Workshop (put together by K. Watson, S. Gottschalk, S. Ascencio, 2013), altered to fit NYBG georeferencing needs over the years (<https://www.idigbio.org/content/idigbios-first-train-trainers-georeferencing-workshop>)

## **Georeferencing Quick Reference Guide (2020)**

Zermoglio PF, Chapman AD, Wieczorek JR, Luna MC & Bloom DA. 2020. Georeferencing Quick Reference Guide. Copenhagen: GBIF Secretariat. <https://doi.org/10.35035/e09p-h128>

## **Georeferencing Quick Reference Guide (2012):** consolidated guide for inputs for the MaNIS Georeferencing Calculator

Wieczorek J, Bloom D, Constable H, Fang J, Koo M, Spencer C & Yamamo K (2012) Georeferencing Quick Reference Guide, version 2012-10-08. <https://www.idigbio.org/wiki/images/1/1e/GeoreferencingQuickReferenceGuide.pdf>

**BioGeomancer Guide to Best Practices for Georeferencing (2006)** is a basis for documentation of collecting & georeferencing protocols: Chapman, A.D. and J. Wieczorek (eds). 2006. Guide to Best Practices for Georeferencing. Copenhagen: Global Biodiversity Information Facility. <https://www.gbif.org/document/80536/biogeomancer-guide-to-best-practices-in-georeferencing> (2006 version). Chapman AD & Wieczorek JR (2020) Georeferencing Best Practices. Copenhagen: GBIF Secretariat. <https://doi.org/10.15468/doc-gg7h-s853> (2020 version)

**The MaNIS Georeferencing Calculator** is a JavaScript application used in finding an uncertainty radius that incorporates all possible sources of error in the georeferencing process (tool: <http://georeferencing.org/georefc/calculator/gc.html>, manual: <http://georeferencing.org/georefc/calculator/docs/GeoreferencingCalculatorManual.pdf>)

# RESOURCES

Bloom DA, Wieczorek JR & Zermoglio PF (2020) Georeferencing Calculator Manual. Copenhagen: GBIF Secretariat. <https://doi.org/10.35035/gdwq-3v93>

Chapman AD & Wieczorek JR (2020) Georeferencing Best Practices. Copenhagen: GBIF Secretariat. <https://doi.org/10.15468/doc-gg7h-s853>

Spencer C, Yamamoto K, Fang J, Constable H, Koo M, & Wieczorek J (2008) Georeferencing for Dummies.  
<http://georeferencing.org/docs/georeffordummy.xls>

TDWG (2018) Darwin Core quick reference guide. Biodiversity Information Standards (TDWG). <https://dwc.tdwg.org/terms/>

Wieczorek J (2001) MaNIS/HerpNET/ORNIS Georeferencing Guidelines. University of California, Berkeley: Museum of Vertebrate Zoology.  
[http://georeferencing.org/georefcator/docs/52\\_GeorefGuide.html](http://georeferencing.org/georefcator/docs/52_GeorefGuide.html)

Wieczorek J & Bloom DA (2015) Manual for the Georeferencing Calculator. University of California, Berkeley: Museum of Vertebrate Zoology.  
<http://georeferencing.org/gci2/docs/GeoreferencingCalculatorManualv2.html>

Wieczorek J, Guo Q & Hijmans R (2004) The point-radius method for georeferencing locality descriptions and calculating associated uncertainty. International Journal of Geographical Information Science. 18: 745-767. <https://doi.org/10.1080/13658810412331280211>