Georeferencing
Determining Space from Place

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Agriculture and Agri-Food Canada
Guide to Best Practices In Georeferencing

Arthur D. Chapman et al. 2006
Fitness for use

In a database, the data have no actual quality or value; they only have potential value. That value is realized only when someone uses the data to do something useful (English 1999). The quality of data cannot be assessed independently of the users of that data (Strong et al. 1997).
Data are of high quality if they are fit for their intended use in operations, decision-making, and planning.

(Juran 1964)
Documenting Fitness for Use

- In general, error must not be treated as a potentially embarrassing inconvenience, because error or uncertainty provides a critical component in judging fitness for use.

- Uncertainty measures for georeferencing
  - HerpNet Workshop
The point-radius method for georeferencing locality descriptions and calculating associated uncertainty

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Figure 4. Uncertainty due to the combination of distance imprecision and the extent of a named place.
<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) dubious</td>
<td>The locality explicitly states that the information contained therein is in question.</td>
<td>‘Isla Boca Brava’?, ‘presumably central Chile’</td>
</tr>
<tr>
<td>2) can not be located</td>
<td>Either the locality data are missing, or they contain other than locality information, or the locality cannot be distinguished from among multiple possible candidates, or the locality cannot be found with available references.</td>
<td>‘locality not recorded’, ‘Bob Jones’, ‘lab born’, ‘summit’, ‘San Jose, Mexico’</td>
</tr>
<tr>
<td>3) demonstrably inaccurate</td>
<td>The locality contains irreconcilable inconsistencies.</td>
<td>‘Sonoma County side of the Gualala River, Mendocino County’</td>
</tr>
<tr>
<td>4) coordinates</td>
<td>The locality consists of a point represented with coordinate information.</td>
<td>‘42.4532 84.8429’, ‘UTM 553160 4077280’</td>
</tr>
<tr>
<td>5) named place</td>
<td>The locality consists of a reference to a geographic feature (e.g., town, cave, spring, island, reef, etc.) having a spatial extent.</td>
<td>‘Alice Springs’, ‘junction of Dwight Avenue and Derby Street’</td>
</tr>
<tr>
<td>6) offset</td>
<td>The locality consists of an offset (usually a distance) from a named place.</td>
<td>‘5 km outside Calgary’</td>
</tr>
<tr>
<td>7) offset along a path</td>
<td>The locality describes a route from a named place.</td>
<td>‘1 km S of Missoula via Route 93’</td>
</tr>
<tr>
<td>8) offsets in orthogonal directions</td>
<td>The locality consists of a linear distance in each of two orthogonal directions from a named place.</td>
<td>‘600m up the W Fork of Willow Creek’, ‘6 km N and 4 km W of Welna’</td>
</tr>
<tr>
<td>9) offset at a heading</td>
<td>The locality contains a distance in a given direction.</td>
<td>‘50 km NE Mombasa’</td>
</tr>
</tbody>
</table>
Georeferencing Using MaNIS/HerpNET/ORNIS Guidelines

Parallels of Latitude

Meridians of Longitude

Graticular Network

Slides Compliments HerpNet
http://www.herpnet.org/
Geographical Concepts:

- **Datum (Geodetic):** Defines the position of the origin, scale, and the orientation of the axes of a coordinate system. A model of the earth used for geodetic calculations.

- **Coordinate reference system:** a coordinate system that relates a system of numbers (latitude, longitude) to the real word via a datum.
Map Projections:

- Projections are the mathematical transformation of the three-dimensional surface of the earth into a flat map sheet, or the projection of the 3-D spheroid into a 2-D map (e.g. conical, cylindrical, azimuthal and these types can be equal area or equidistant).

- They all suffer from distortions, either in area, shape, distance, or direction.

- When measuring distances on paper maps, use an equal distant projection or equal area if near the central meridian.
Extents:

- **Extent**: the geographic range, magnitude or distance that a location may actually represent. (With a town, the extent is the polygon that encompasses the area inside the town’s boundaries.)

- **Linear extent**: what we use for the Point-Radius Method. Defined as the distance from the geographic center of the location to the furthest point of the geographic extent of the location.
MaNIS/HerpNet/ORNIS Guidelines

http://manisnet.org/GeorefGuide.html

- The point-radius method of georeferencing
- Uses the coordinate (point) of the center of a place, and an uncertainty (“error”) around it to account for extent of the named place, uncertainty of direction and distance, datum used, etc.
- We assume that the point and radius will contain the actual collection locality
- Purpose behind these methods is to provide assumptions that will produce consistent results that can be replicated
- If more information is known about a locality and the georeferencer wants to use this information, then state any assumptions made in the “LatLong Remarks”.
Types of Localities:

- **Named Place** –
  
  Used to refer to traditional and non-traditional features (towns, cities, mountains, ranches, highway mile markers, townships). We take the extent of the named place.

- **Named Place - Urban Area**
  
  Locality consists of a reference to a geographical feature having a spatial extent, example is “Las Vegas, Nevada”

If the geographic center does not fall within the shaded urban area, choose the nearest point to the center within the shape.
Locality Types:

Named Place – Street Address

“#10 Downing St., London, England”

Extent is the smallest area possible that cannot be mistaken for another address, sometimes ½ a city block.
Locality Types:

- **Named Place – Remote**

A locality that does not have a clear boundary on the map

“Amargosa Valley (town), NV”

- Extent is half the distance to the center of the nearest named place (or feature).
Locality Types:

- **Named Place** – Lake, Mountain, Cultural Land, or Other Geographic Entity

  “Mount Vesuvius, Italy”

- Extent is usually half the length from the coordinates of the center of the named place to the furthest point within the named place.
Offsets:

- Distance from a named place using the location of the named place as a starting point. Used with a heading to give direction and distance from named place.

- These can be in a direction, direction and distance, direction along a path, etc.

“5 miles north of Beatty, on US 95”
Maximum Error Distance from Uncertainties:
Defined as the numerical value for the upper limit of the distance from the coordinates of a locality to the outer extremity of the area within which the whole of the described locality must lie (i.e., what can be mistaken for that locality based on the description given).

<table>
<thead>
<tr>
<th>Scale</th>
<th>Uncertainty (ft)</th>
<th>Uncertainty (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:1200</td>
<td>3.3 ft</td>
<td>1.0 m</td>
</tr>
<tr>
<td>1:2400</td>
<td>6.7 ft</td>
<td>2.0 m</td>
</tr>
<tr>
<td>1:4800</td>
<td>13.3 ft</td>
<td>4.1 m</td>
</tr>
<tr>
<td>1:10,000</td>
<td>27.8 ft</td>
<td>8.5 m</td>
</tr>
<tr>
<td>1:24,000</td>
<td>40.0 ft</td>
<td>12.2 m</td>
</tr>
<tr>
<td>1:25,000</td>
<td>41.8 ft</td>
<td>12.8 m</td>
</tr>
<tr>
<td>1:63,360</td>
<td>106 ft</td>
<td>32.2 m</td>
</tr>
<tr>
<td>1:100,000</td>
<td>167 ft</td>
<td>50.9 m</td>
</tr>
<tr>
<td>1:250,000</td>
<td>417 ft</td>
<td>127 m</td>
</tr>
</tbody>
</table>

Causes of uncertainty:

- Map scale
- The extent of the locality
- GPS accuracy
- Unknown datum (results in >100 m)
- Imprecision in distance measurements
- Imprecision in direction measurements
Georeferencing Error Calculator

Version 0.00.123

Georeferencing Calculator

Calculation Type: Coordinates and error - enter the Lat/Long for the named place or starting point
Locality Type: Distance at a heading (e.g., 10 mi E (by air) Bakersfield)

Step 3) Enter all of the parameters for the locality.

Coordinate Source: USGS map: 1:10,000
Coordinate System: decimal degrees
Latitude: 30
Longitude: -110
Datum: (WGS84) World Geodetic System 1984
Coordinate Precision: 0.0001 degrees
Offset Distance: 10
Extent of Named Place: 10
Distance Units: mi
Distance Precision: 1/2 mi
Direction: N

Decimal Latitude: 30.14518
Decimal Longitude: -110.00000
Maximum Error Distance: 15.191

Calculate

Georeferencing Calculator Manual
Georeferencing Guidelines

This application was originally written by John Wieczorek. Later versions benefitted from contributions from Qinghua Guo, Carr

John Wieczorek 3 Nov 2001
Rev. 21 Jan 2006, JRW
Precision and Accuracy:

- Always use as many decimal places as given by the coordinate source.
- A measurement in decimal degrees give to five decimal places is more precise than a measurement in degrees minutes seconds.
- **False precision** will result if data are recorded with a greater number of decimal points.
- Always record the **accuracy of your GPS readings** (how well the GPS measures the true value of the location). The accuracy is given at the same time as the coordinate but usually will not be recorded with the coordinates on most GPS units.
Acknowledgements:

- MaNIS/HerpNet/ORNIS Georeferencing Guidelines
- Figures from MHO Guidelines, Terrain Navigator, Geographer’s Craft and Carla Cicero
**On-line Tools and Guidelines**

*BioGeoMancer*


*splink.cria.org.br/tools/

*MaNIS/HerpNet*


**Canadian Geographical Names Service**

[http://gnss.nrcan.gc.ca/index_e.html](http://gnss.nrcan.gc.ca/index_e.html)

**GNSS User’s Guide**


[http://mapstedi.colorado.edu/geocoding.html](http://mapstedi.colorado.edu/geocoding.html)
Community Participation
Community Resources

Develop a Canadian collecting locality gazetteer

Distributed Georeferencing