Geographical Concepts

The world as a globe showing the longitude and latitude values.
Map Projections

Projections are algorithmic representations of the round surface of the earth onto flat paper.
But the earth isn’t even round! So before the projection can be calculated, first there’s a mathematical equation that generates the Geoid, then the Spheroid/Ellipsoid, then the projection.
Map Projections

**Lambert Azimuthal Equal Area**
Distortion is zero at the center of the projection, and increases radially away from this point.

**Mercator Projection**
The Mercator projection has straight meridians and parallels that intersect at right angles. Scale is true at the equator or at two standard parallels equidistant from the equator. The projection is often used for marine navigation because all straight lines on the map are lines of constant azimuth.
Lambert Azimuthal Equal Area
Directions from center are conserved (hence, azimuthal) and the size (area) of the objects are kept. But shapes in the periphery are heavily distorted.
Mercator projection
Mercator is a classic projection used for mapmaking: shapes are conserved, but objects close to the poles are heavily inflated.
The main value of Cartesian coordinates is for making measurements on maps. Before the age of computers formulas for converting latitude and longitude were too cumbersome to be done quickly, but Cartesian coordinates offered a satisfactory solution.
Georeferencing Concepts

**Named place**: a place of reference in a locality description. Example: “Davis” in “5 mi N of Davis”

**Linear extent**: the distance from the geographic center to the furthest point of the areal extent of a named place.

**Areal extent**: the geographic area covered by a named place (feature). Example: the area inside the boundaries of a town.
**Offset:** The *distance* from a named place. Example: “27km” in “27 km W of Port Alfred”.

**Heading:** The *direction* from a named place. Example: “W” in “27 km W of Port Alfred”.

Georeferencing concepts
Sources of uncertainty:

- Coordinate Uncertainty
- Map scale
- The extent of the locality
- GPS accuracy
- Unknown datum
- Imprecision in direction measurements
- Imprecision in distance measurements (1km vs. 1.1 km)

<table>
<thead>
<tr>
<th>Scale</th>
<th>Uncertainty (ft)</th>
<th>Uncertainty (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:1,200</td>
<td>3.3 ft</td>
<td>1.0 m</td>
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<tr>
<td>1:2,400</td>
<td>6.7 ft</td>
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<td>1:4,800</td>
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Location: 20° 30’ N 112° 36’ W
Georeferencing Concepts

Accuracy
Precision
Uncertainty
Accuracy vs Precision Disambiguated

Accuracy

A measure of how close a given value is to the true value. Confusion with precision arises because we often describe them the same way “accurate to the within 100m” or “precise to the nearest second.”

If I use this data, will I find what I’m looking for? Will I get close?
Accuracy vs Precision Disambiguated

Precision

The level of detail contained in or described by the data.

How small an area will the data take me to?
Assuming the data is accurate, as described above, how close to the true location will it take me?
Accuracy vs Precision

Georeferencing concepts

Less Precise  More Precise

Less Accurate  More Accurate
• Use as many decimal places as given by the coordinate source for high precision.
• Seven digits of precision in decimal degrees are required to make reversible transformations to nearest meter.
• Decimal degrees given to five decimal places is more precise than degrees minutes seconds.
• **False precision** can result if data are converted from DMS to decimal degrees.
  
  
  \[
  \text{Eg. } 15^\circ 20' 20'' \rightarrow 15.3388889
  \]

• Record the **GPS accuracy** (how well the GPS measures the true value of the location) when saving a GPS waypoint.
• **Coordinate Uncertainty In Meters:**
  “The horizontal distance (in meters) from the given decimalLatitude and decimalLongitude describing the smallest circle containing the whole of the Location. Leave the value empty if the uncertainty is unknown, cannot be estimated, or is not applicable (because there are no coordinates). Zero is not a valid value for this term.” (from Darwin Core)

• **Maximum Error Distance:**
  Same as Coordinate Uncertainty In Meters, except the units are the same is in the locality description, not necessarily meters.
Uncertainty

Georeferencing concepts
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Add

- many places with same name
Reading co-ordinates on labels

33° 45’S vs 33° 75.22’S (33.45S)
35° 75’ 22.6754”S (35.75.22,6754S)