Lecture 5: Coordinate Systems and Global Grids

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Coordinate Systems

• A coordinate system is a standardized method for assigning codes to locations so that locations can be found using the codes alone
• Standardized coordinate systems use absolute locations
• A map captured in the units of the paper sheet on which it is printed is based on relative locations or map millimeters
• In a coordinate system, the x-direction value is the easting and the y-direction value is the northing. Most systems make both values positive
A very simple coordinate system
Advantages of standardization

• Can avoid confusion among cities
• Cells of grid can be comparable in size
• Can be terse
• Can have authority
• Will work when other reference systems fail
• Can be used in positioning systems
Jourdan Street: Lower 9th Ward, New Orleans, August 2005
Coordinates in action
We’ve already met Geographic Coordinates

CLARKE 1866 ELLIPSOID

PointA  34 24  20.83000N  119 50  39.93000W
PointB  34 25  03.94000N  119 49  8.56000W
Accuracy

• A degree is on average 111,111m
• A degree is 3600 seconds
• A second is 30.86m
• A tenth of a second is 3.09m
• A hundredth is 0.31m
• A thousandth is 0.031 or 3.1 cm
Google Earth: 100th of a second
Why not just use Geographic Coordinates?
We will cover only a few systems in Geography 12: There are many more!

- Universal Transverse Mercator System (UTM)
- National Grid
- State Plane Coordinate System
- USPLSS (Next class)
UTM

• Takes advantage of the Transverse Mercator projection’s properties
• Distortion is minimized along a central meridian that goes from pole to pole
• Actually, the projection is made secant
• 60 zones cover 84°N to 80°S
• UPS Polar stereographic projection covers the poles
UTM Zones

Figure 11.—Universal Transverse Mercator (UTM) grid zone designations for the world shown on a horizontally expanded Equidistant Cylindrical projection index map.
Prettier map (But no poles)
UTM zones in the lower 48
We’re close to a zone boundary!
Example

- Point A
- 239 305 m E; 3 810 798mN; 11, N
- WGS84 necessary!
Using UTM on the Goleta Quad

Produced by the United States Geological Survey 1988
Revision by USDA Forest Service 1995


North American Datum of 1927 (NAD 27). Projection and 10,000-foot ticks:
- California coordinate system, zone 5 (Lambert conformal conic)
- Blue 1000-meter Universal Transverse Mercator ticks, zone 11

North American Datum of 1983 (NAD 83) is shown by dashed corner ticks
The values of the shift between NAD 27 and NAD 83 for 7.5-minute intersections are obtainable from National Geodetic Survey NADCON software

Non-National Forest System lands within the National Forest
Inholdings may exist in other National or State reservations

This map is not a legal land line or ownership document. Public lands are subject to change and leasing, and may have access restrictions; check with local offices. Obtain permission before entering private lands.
The Military Grid (aka National Grid)
USNG in the lower 48
Military Grid Coordinates
USNG

Principal Digits...
...identify the grid line.

In this example, the principal digits for grid lines 22 and 07 are circled.

The superscript values are for complete UTM values.
Issues: grid boundaries
USNG: 11S KU 38527 10830 (NAD83)
Last but not least: State Plane Coordinates

- Works only in the US and territories
- Old system based on NAD27 and feet shown on many USGS maps
- New system based on NAD83 and GRS80 uses slightly different zones and meters
- Each state works independently
- More accurate than UTM, used in surveying and engineering
Nationally

- Zones elongated N-S use Transverse Mercator
- Zones elongated E-W use Lambert Conformal Conic
- Some exceptions
State Plane Zones in California

UTM Zones 10 and 11
New Mexico vs. Texas

UTM Zones 12 and 13

Lambert Conformal Conic
Zone false origins

- Formerly some number of feet west and south of zone edge
- Each zone different, need to look up details
- Origins changed when converted to metric

Example from the Georgia data:
Georgia West Zone 1002 (Includes Atlanta)
Latitude of Origin = 30° 00' 00"
Longitude of Origin and Central Meridian = 84° 10' 00"
Datum = NAD-83
Scale = 0.9999
False Northing at Origin = 0 meters
False Easting at Origin = 700,000 meters
Example: Campus Point

N342420.83 W1195039.93

NAD83 405 CA 5
602029 m E 1830437 m N

NAD27 405 CA 5
1443680 ft E 334733 ft N
Summary

• Coordinate systems are best when standardized
• Not all systems are global
• UTM, National grid, MGRS based on UTM and zones
• State Plane projection used for most surveying applications
• Often need to transform