GEOL 452/552
-
GIS for Geoscientists I

Lecture 15 - chapter 11

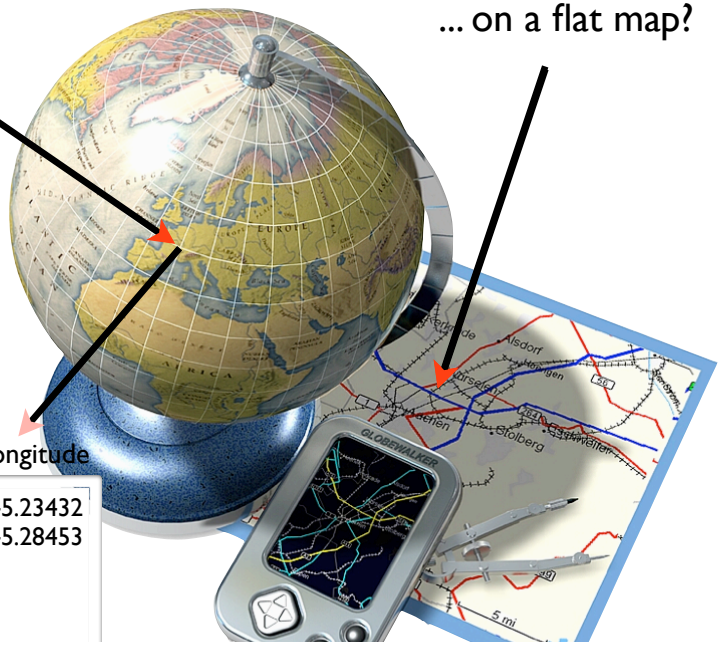
Lecture Plan

- Ch. 11, one lecture
  - Coordinate systems Projection, Datums, Dpheroid
  - Unprojected (geographic) coord. syst., UTM
  - On the fly projection vs. data file projection
- HW 7: only 1 exercise, we'll do in in class
- Introduce Mini project 2 (HW8) due next Thursday

Why use Projections?

How to draw locations from a round sphere ...

... on a flat map?

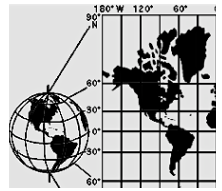


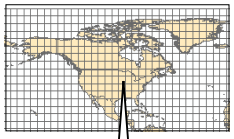
Latitude/Longitude

20.44395, 45.23432
20.44732, 45.28453
...

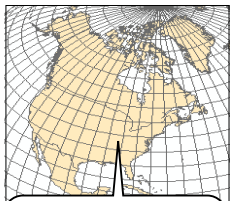
Different types of Projections

- All points on a **sphere** are measured in **angles** of **Lat**itude (N-S), Longitude (E-W) (DD = decimal degrees)
- How to best draw a points/lines/polygons on paper?
  - A) Unprojected ("GCS") - no conversion of Lat/Long , draw features on a canvas "grid"
    - Problem: Distortion of shapes increases when going further North (Size/shape of Greenland?)
  - B) use a Projection:
    - Translate Latitude/longitude angles (degrees) to distances (meters)
    - Aim: less distortion (locally) for angles, distances
    - Distance computation (ArcGIS) work better with projected coordinates (meters instead of degr.)

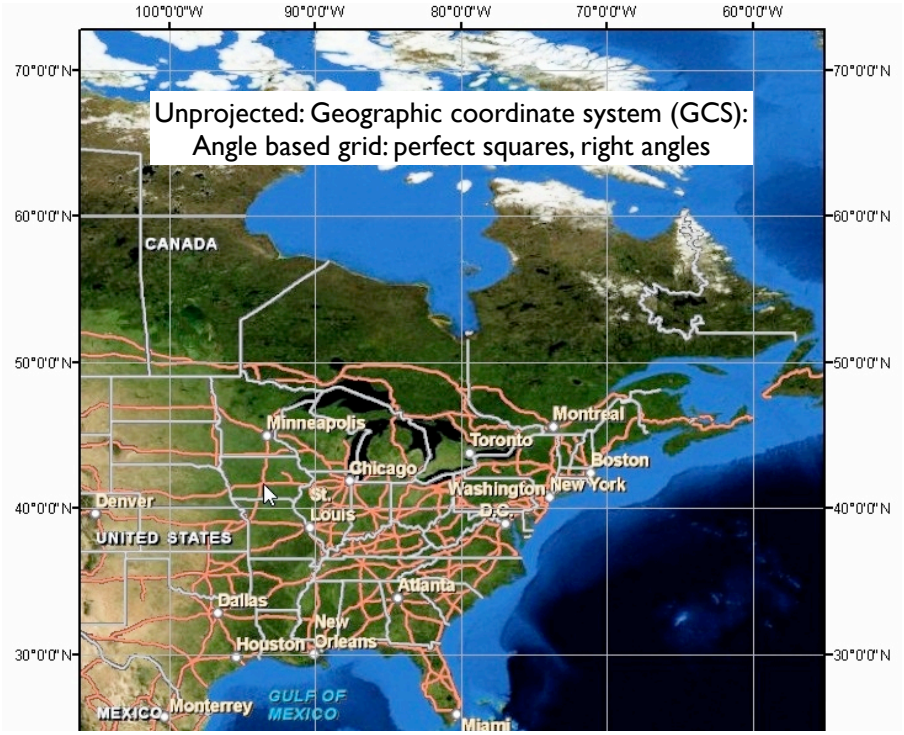


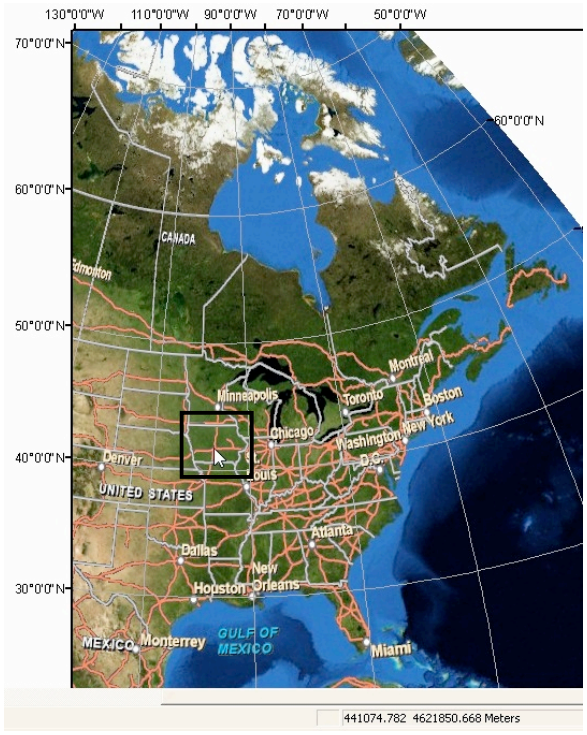


Lat = 43.567 DD
Long = -93.698 DD



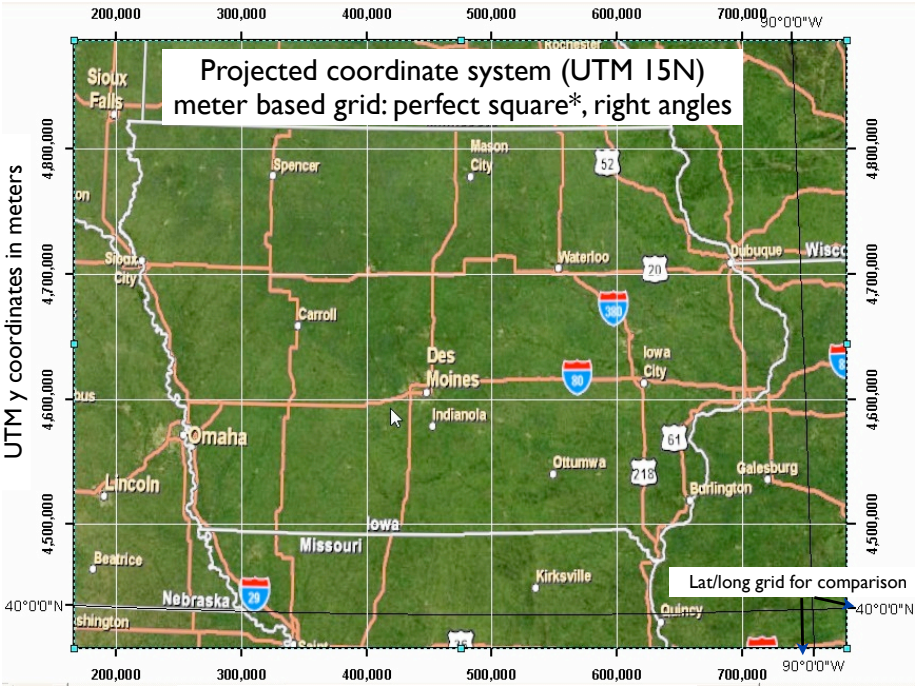
UTM x = 450460 m
UTM y = 4621850 m





Projected coordinate system (UTM)

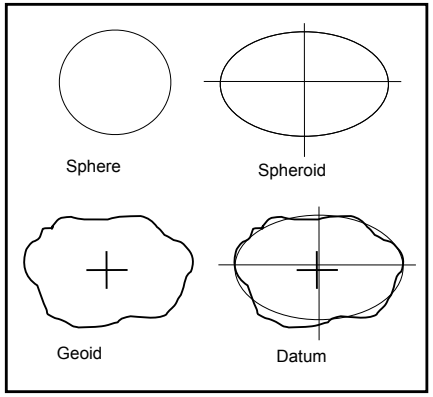
Angle grid: distorted "round rectangles"



- Projection: mathematical transformation (conversion, "formula") to convert x/y
  - **from** a spherical (geographic) coordinate system (GCS) to ("round)
  - **to** a cartesion coordinate system ("flat")
- Three ingredients for coordinate transformation:
  - Type of **Spheroid**
  - Type of **Datum**
  - Type of **Projection**

Type of Spheroid used

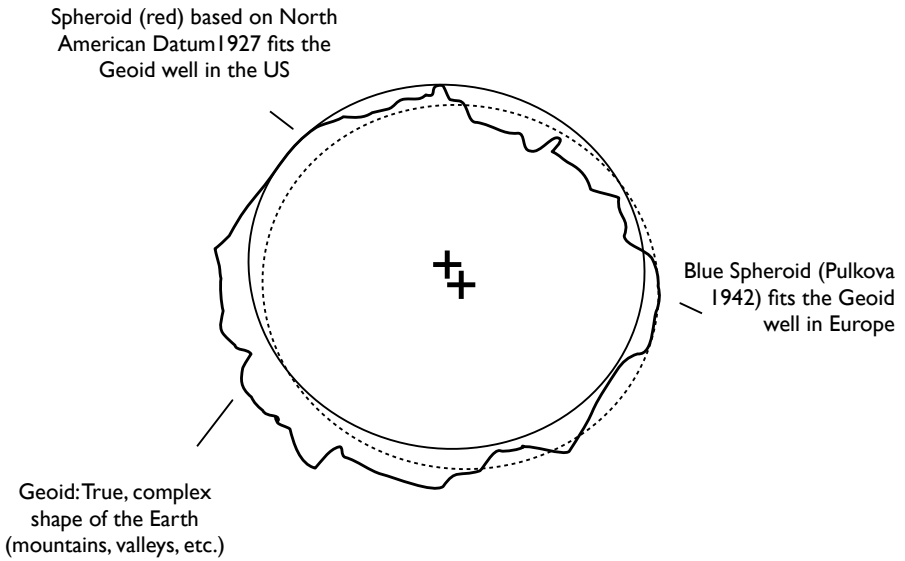
- Spheroid = sphere (3D) with different axis length
- Geoid, more complex, true shape of the earth
- But: We can locally **approximate** a geoid with a spheroid
- Common spheroids:
  - Clark 1866 Spheroid
  - GRS 1980 Spheroid



Type of Datum

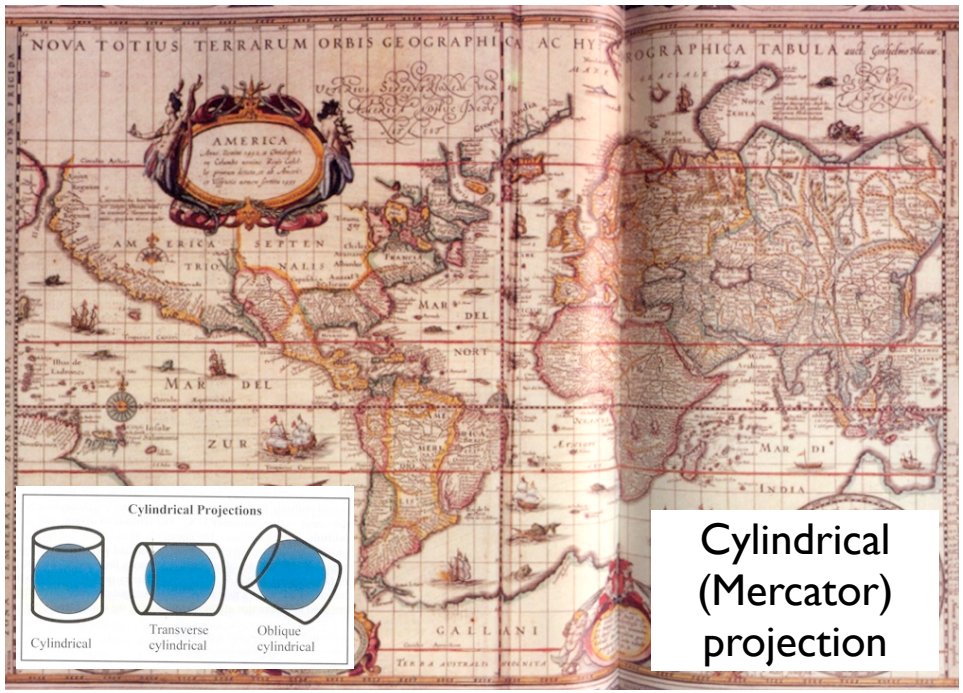
- Datum: 3D **center** of the simple approximation (sphereoid) of the Earth
- Difference from the true center of the Earth (Geoid)
- In North America: **N**orth **A**merican **D**atum (NAD)
  - NAD27 implies Clark1866 spheroid
  - NAD83 implies GRS 1980 spheroid
- Geographic coord. systems (GCS) also have a Datum (e.g. WGS 84, used in Google Earth)

Different Datums improve local fit



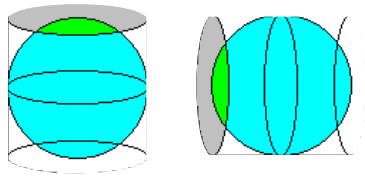
UTM system

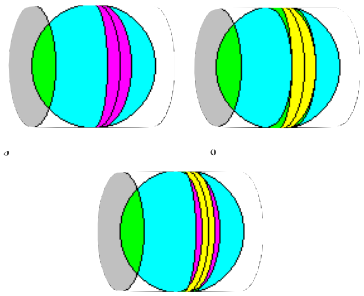
- Very common type of projected coordinate system
- Let's explain the acronym, but backwards (M-T-U)
- **Mercator** means cylindrical projection
  - Named after Gerhard Kremer, a Flemish cartographer who lived from 1512 to 1594.
  - Gerhardus Mercator was the latinized form of his name.
  - used this projection for a map in 1569

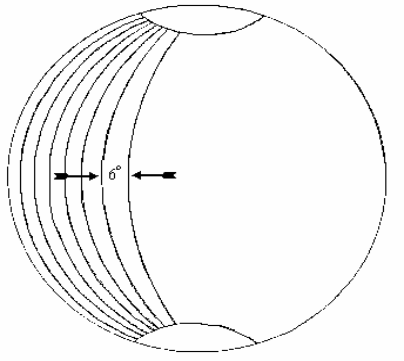


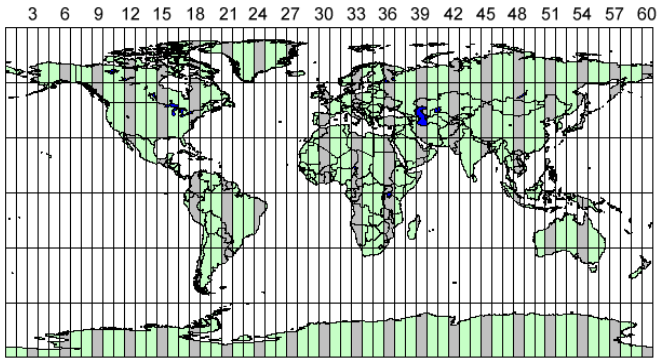
Cylindrical (Mercator) projection

- **Transverse**: Means cylinder is rotated to the side
- make one N-S slice per UTM zone
- 1 UTM zone = 6 degree wide slice (yellow)

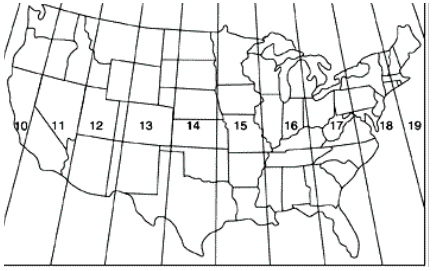






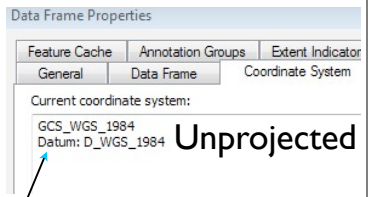


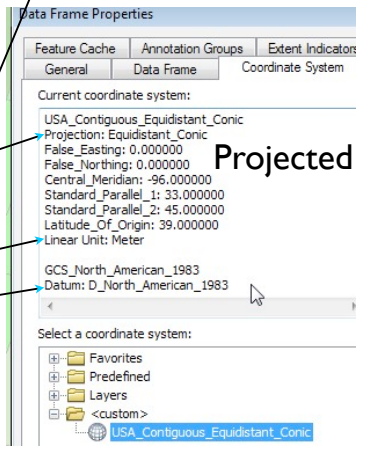
- **Universal**
- meaning: works (nearly) everywhere (except poles)
- location as x/y
- meter based offset from artificial origin
- 6 or 7 digits for coordinates



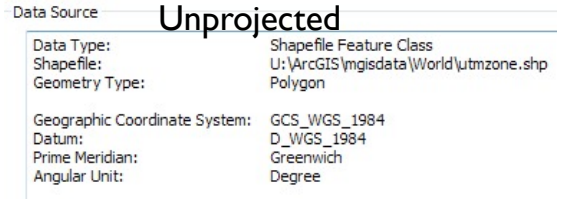
Coordinate systems in ArcGIS

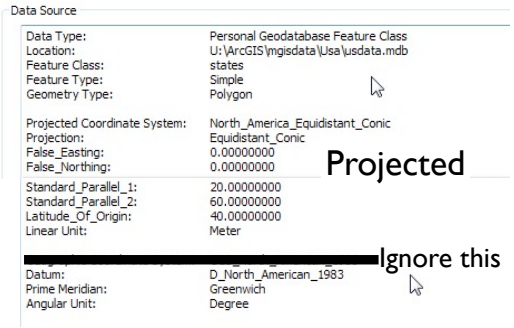
- Each Data frame uses a projection (R-click-Data frame - Properties - Coordinate system
- This supersedes a layer's coordinate system!
- Important parts:
  - Projection type
  - Linear Units (meters, ft)
  - Datum (ignore the GCS)
  - Not shown: Spheroid (inferred from Datum)



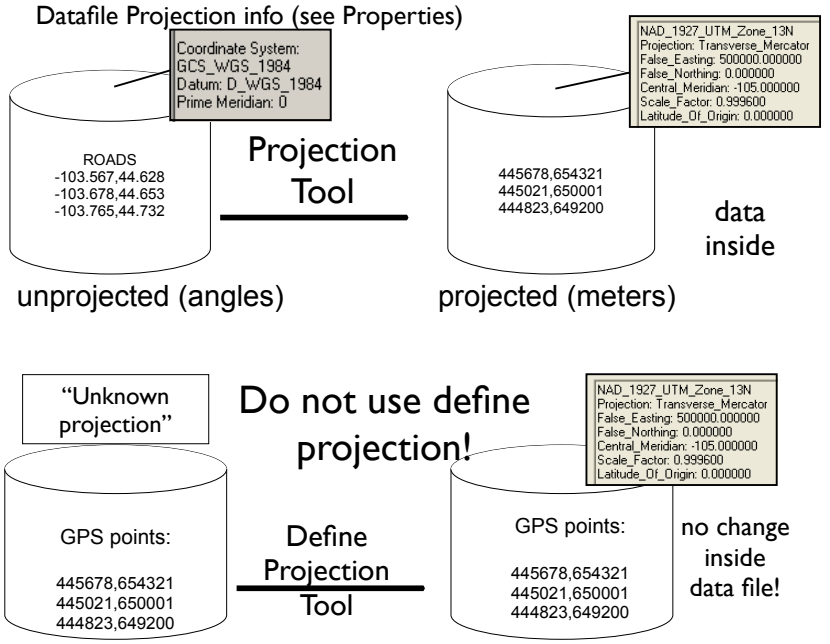


- For layers: R-Click - Properties - Data Source
- When ArcMap draws a layer, its coordinate system will be (on-the-fly) converted to the CS of the data frame!
- This on-the-fly projection does not alter the file internally





ArcGIS tools: projecting a GIS data File manually



Lab part1: HW 7 - due next tuesday but finish ASAP to move on the miniproj2!

- Open ex_11.mxd (mgisdata/Map Documents)
- Open a Word file, make sceenshots as we go along
- For Data frame and States Layer: What's the coordinate system, projection, datum and map units? 3 pts
- For the States layer only, show lower 48 states, make a screenshot
- Measure width (East-West, in meters) of the UTM Zone 14 in North Dakota, compare that to width of the zone in Texas (3 pts)
- Now Set Data frame to Unprojected GCS - North America - NAD 83)
- Make another screenshot of lower 48 (in GCS - NAD83)
- Again compare the width of UTM zone 14 (N. Dakota vs. Texas) but this time in degrees (3 pts)
- Which UTM zones cover Iowa and where do they start and end (East-West direction only, in degrees)? (3 pts)

Lab part 2:
HW 8 - Miniproject 2 (Iowa data) - due next Thursday

- Think of chains of operations from operations: attribute or spatial query, DB Join, spatial join, summarize, statistics
- Pose a (somewhat sensical) GIS question, and solve it. Document your solution!
- Focus on questions involving Distance, counting, average/smallest/largest, sum (total)
- Ex: How many people in XYZ county live within 10 miles of a river and within 5 miles of a confined feeding operation (CAFO)
  - For counties where old people outnumber young people, what is the average/ total number of towns with less than 500 people
  - What is the average (min/max) distance of schools to fast food places?
- Create at least 2 chains of operations, each chain is worth 5 to 10 pts, depending on complexity
- For now, let's only snoop around for data and do some brainstorming!
- in U:\ArcGIS make a miniproj2 folder (to collect potentially relevant data) and open a Word doc to jot down ideas for chains
- Part of Iowa Data: data\Miniproj 2 data , full version \\pub\pub\IowaDNR\IA_state

- Possible themes:
  - Tourists/Travellers
  - Geology & environmental issues
  - Transportation
  - Water
  - Population (census)
  - Marketing study (who/where to sell a product)
- May add a base layers from ESRI (File - Add Data - Add Basemap)
- Basemaps should be semi-transparent
- Make sure you present data effectively, use colors, symbol sizes, labels, etc
- Optional: make a nice map, save as pdf (up to 5 pts per map)