# Objectives

- **Coordinate systems**
  - **Geographic versus projected**
  - **Project considerations**
  - **'Gotchas'**
- **Identifying an unknown coordinate system**
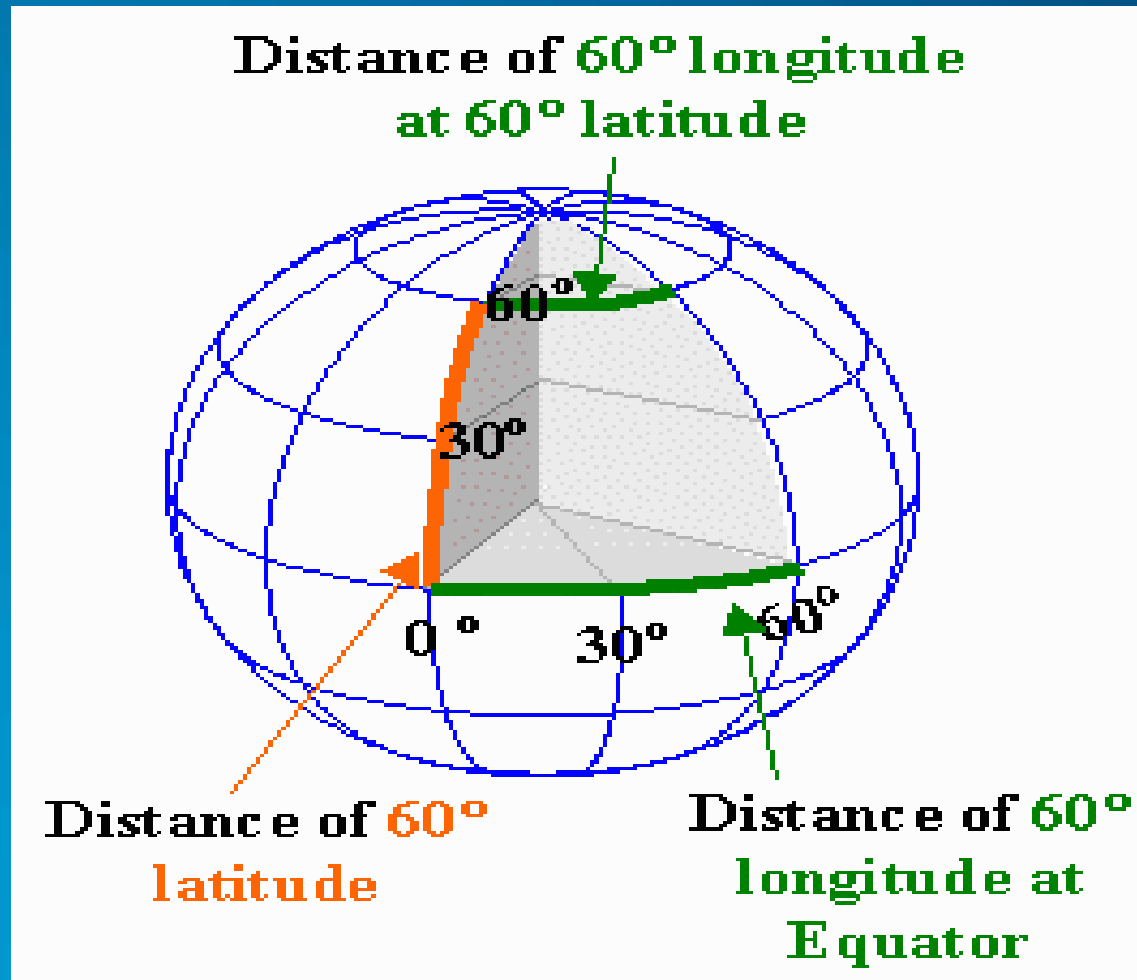- **Picking a geographic/datum transformation**

**Session ID: 1585**

*Note: Presentation will be available on the Proceedings CD*

# Coordinate systems

# Geographic coordinate system

# Geographic coordinate system

**(gcs, geogcs)**

- **Name**
- **Datum**
  - **Spheroid**
- **Prime Meridian**
- **Angular unit of measure**

# Geographic coordinate system

**(gcs, geogcs)**

- **Name** **(European Datum 1950)**
- **Datum** **(European Datum 1950)**
  - **Spheroid** **(International 1924)**
- **Prime Meridian (Greenwich)**
- **Angular unit of measure (Degrees)**

# Projected coordinate system

- **Linear units**
- **Lengths, angles, and areas are constant**
- **Shape, area, and distance may be distorted**
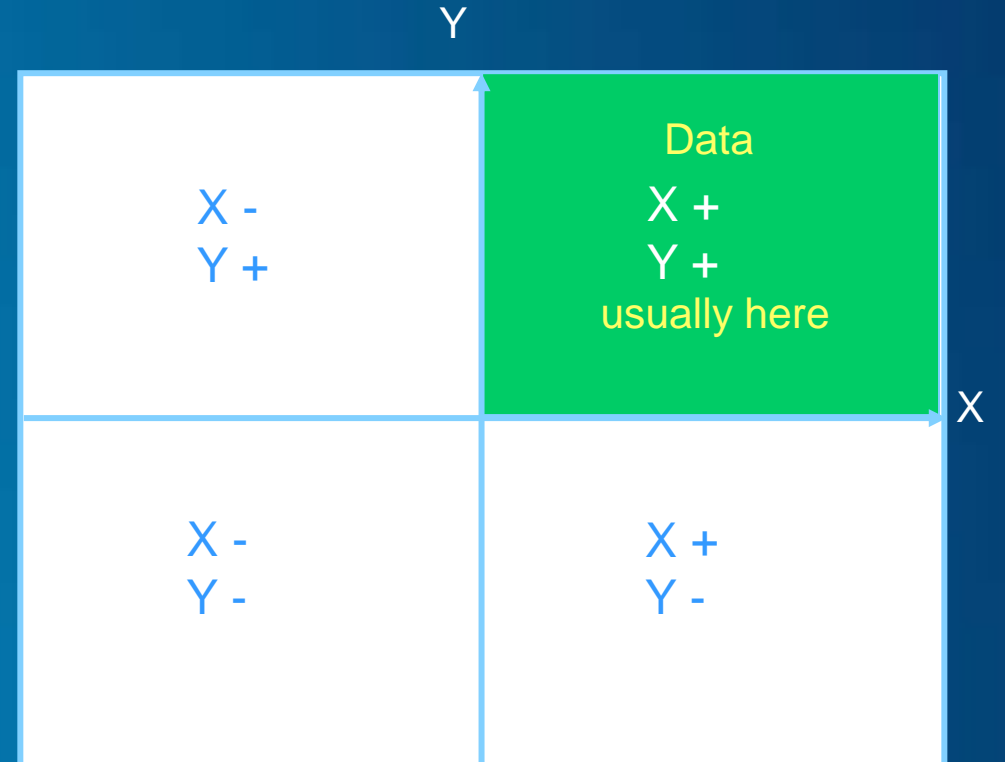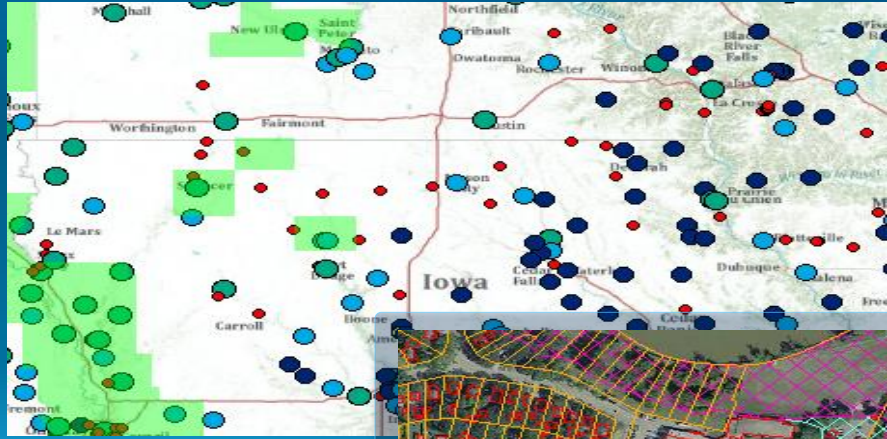
# Projected coordinate system

(pcs, projcs)

- Name
- Geographic coordinate system
- Map projection
- Projection parameters

- Linear unit of measure

# Projected coordinate system

(pcs, projcs)

- Name      (NAD 1983 UTM Zone 11N)
- GCS           (NAD 1983)
- Map projection (Transverse Mercator)
- Projection parameters (central meridian, latitude of origin, scale factor, false easting, false northing)
- Linear unit of measure (Meters)

**Demonstration**
Geographic versus Projected

# Choosing the right coordinate system

- **What does your boss think?**

- **What are other government agencies/partners using?**

- **For what purposes are the data going to be used?**

- **Minimize projecting data on the fly**
  - Impacts performance

# Coordinate system gotchas

- **Defining a coordinate system updates the metadata ONLY**
  - Doesn't affect the coordinate values
  - Define data in its current coordinate system, then project
- **Add XY Data tool uses the map's coordinate system by default**
- **Exporting a layer in ArcMap using the data frame's coordinate system**
  - SAME as using the Project or Project Raster tools
- **UTM "N" and "S"**
  - North and South, not the "N" and "S" latitude band designations
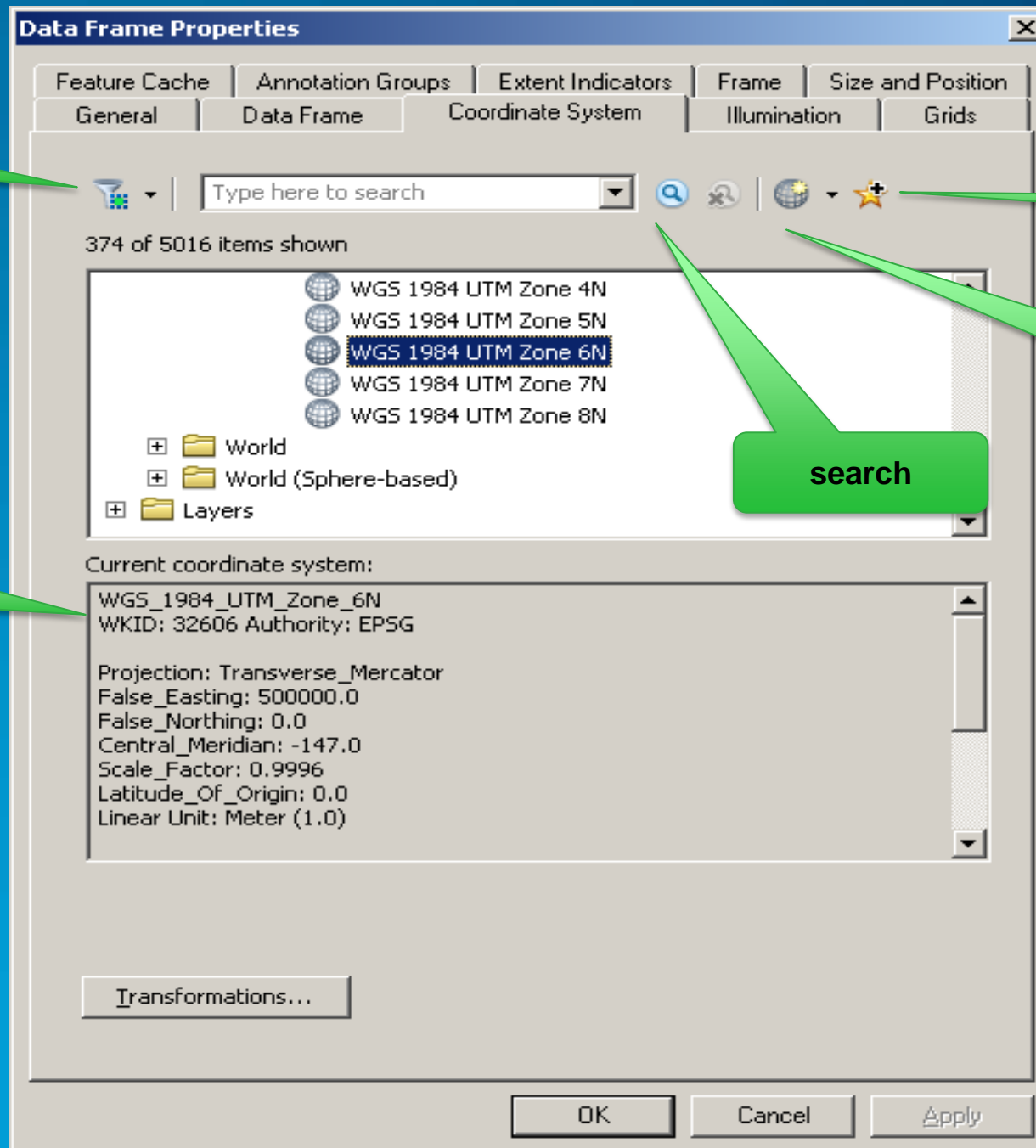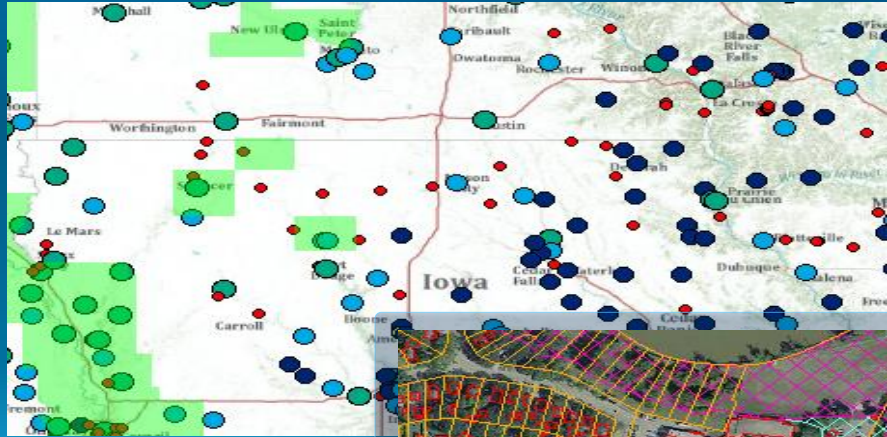
# UTM zones and latitude bands



Adapted from Wikimedia Commons and attributed to a NASA image

# What happened to the prj files?

- **Coordinate systems were stored as .prj files**
  - **ArcGIS home\Coordinate Systems**
- **At 10.1, virtual folder structure**
- **Search by area, name, WKID/code**
- **Favorites are usable everywhere**
- **Use Import to access your own prj files**

**Demonstration**

Improved coordinate system dialogs

# Unknown coordinate systems

# Unknown coordinate systems

- **ALWAYS define the coordinate system**
- **Good professional practice - help your successor**
- **Units are unknown**
- **Map scale is incorrect**
- **Geodatabase tools can't use default values**

# What if I don't know my data's coordinate system?

- Check the data provider or source
- Check any existing metadata
- Similar data types
- What coordinate systems are used in the area?
  - http://www.epsg.org
  - http://www.epsg-registry.org

# What if I don't know my data's coordinate system?

- **Try using ArcMap to figure it out**
    - **See Knowledge Base article 24893**

      *HowTo:  Identify an unknown coordinate system using ArcMap*

    - **Live Training Seminar (free)**

      **Working with Map Projections and Coordinate Systems in ArcGIS**

      **http://training.esri.com/acb2000/showdetl.cfm?did=6&Product_id=826&2**

# Familiarize yourself with common coordinate systems

- Know what ones are used in the area
- Learn what the layer extents should be

| San Diego, California | | |
|---|---|---|
| **NAD 1983** | X / longitude | Y / latitude |
| **Geographic** | **-116.67 °** | **33 °** |
| **UTM zone 11N** | **530,000 m** | **3,650,000 m** |
| **State Plane (California zone 6)** | **1,960,000 m** | **593,000 m** |

# Real world example

- **Longitude: -88.365934**
  **Latitude: 28.738369**

  **Calculated NAD 27 XY Coords:**
  **Longitude: 10431702.916855**
  **Latitude: 1202802.892336**

# What do you know?

decimal degrees

Longitude: -88.365934
Latitude: 28.738369

Calculated NAD 27 XY Coords:
Longitude: 10431702.916855
Latitude: 1202802.892336

# What do you know?

In the U.S.

decimal degrees

Longitude: -88.365934
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Calculated NAD 27 XY Coords:
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NAD27

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NAD27

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Longitude: 10431702.916855
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No units

# What do you know?

In the U.S.

decimal degrees

Longitude: -88.365934
Latitude: 28.738369

NAD27

Calculated NAD 27 XY Coords:
Longitude: 10431702.916855
Latitude: 1202802.892336

X or Y?

No units

# Demonstration

Identifying Unknown Data

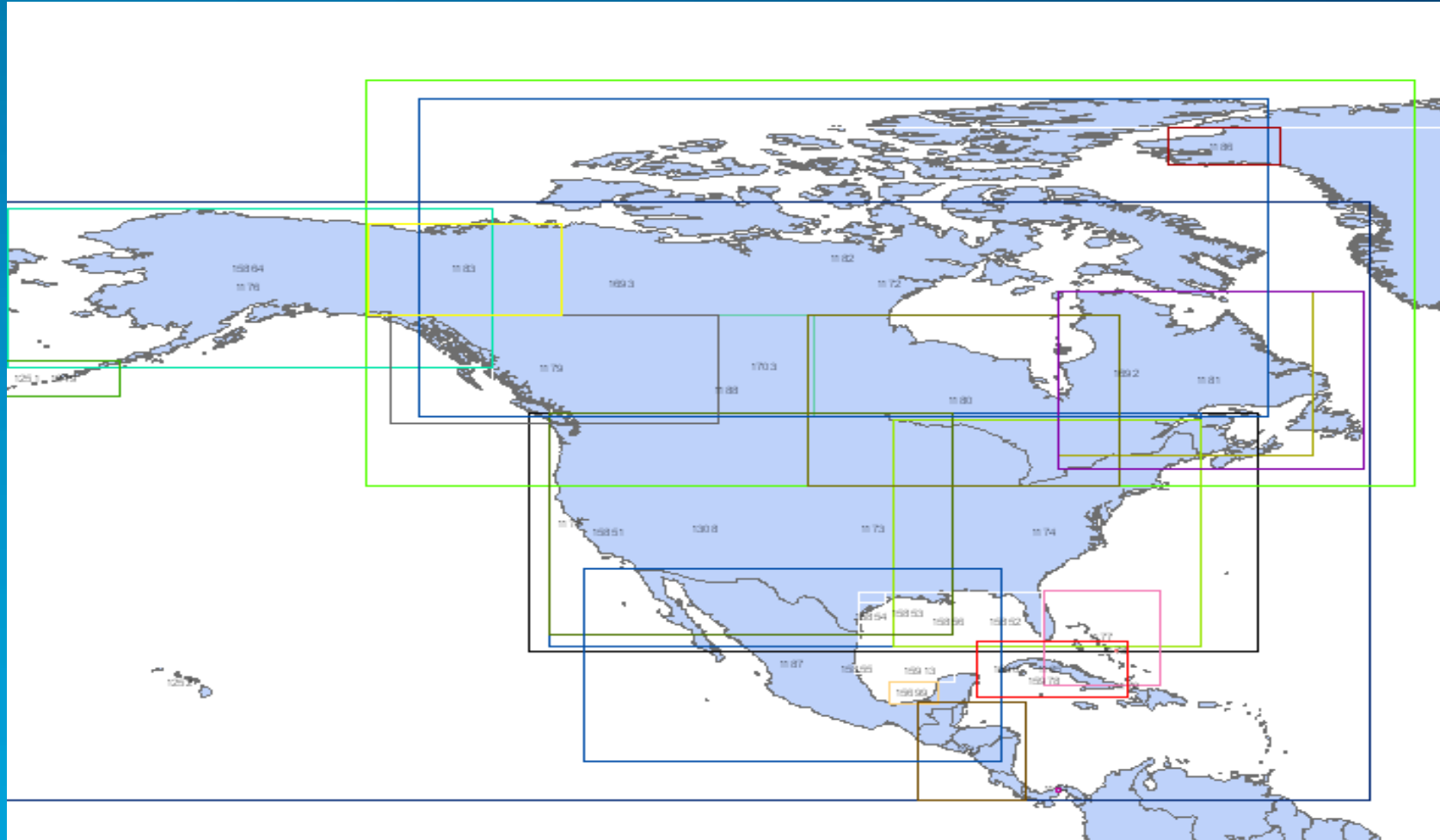# Geographic (datum) transformations

# Geographic transformations

- Convert between two geographic coordinate systems
- Offsets can be significant

| San Diego, California | | |
|---|---|---|
| **Geographic** | Longitude | Latitude |
| **NAD 1927** | **-116.6691455°** | **32.9999533°** |
| **NAD 1983** | **-116.6700000°** | **33.0000000°** |
| **NAD 1983 HARN** | **-116.6700004°** | **33.0000000°** |

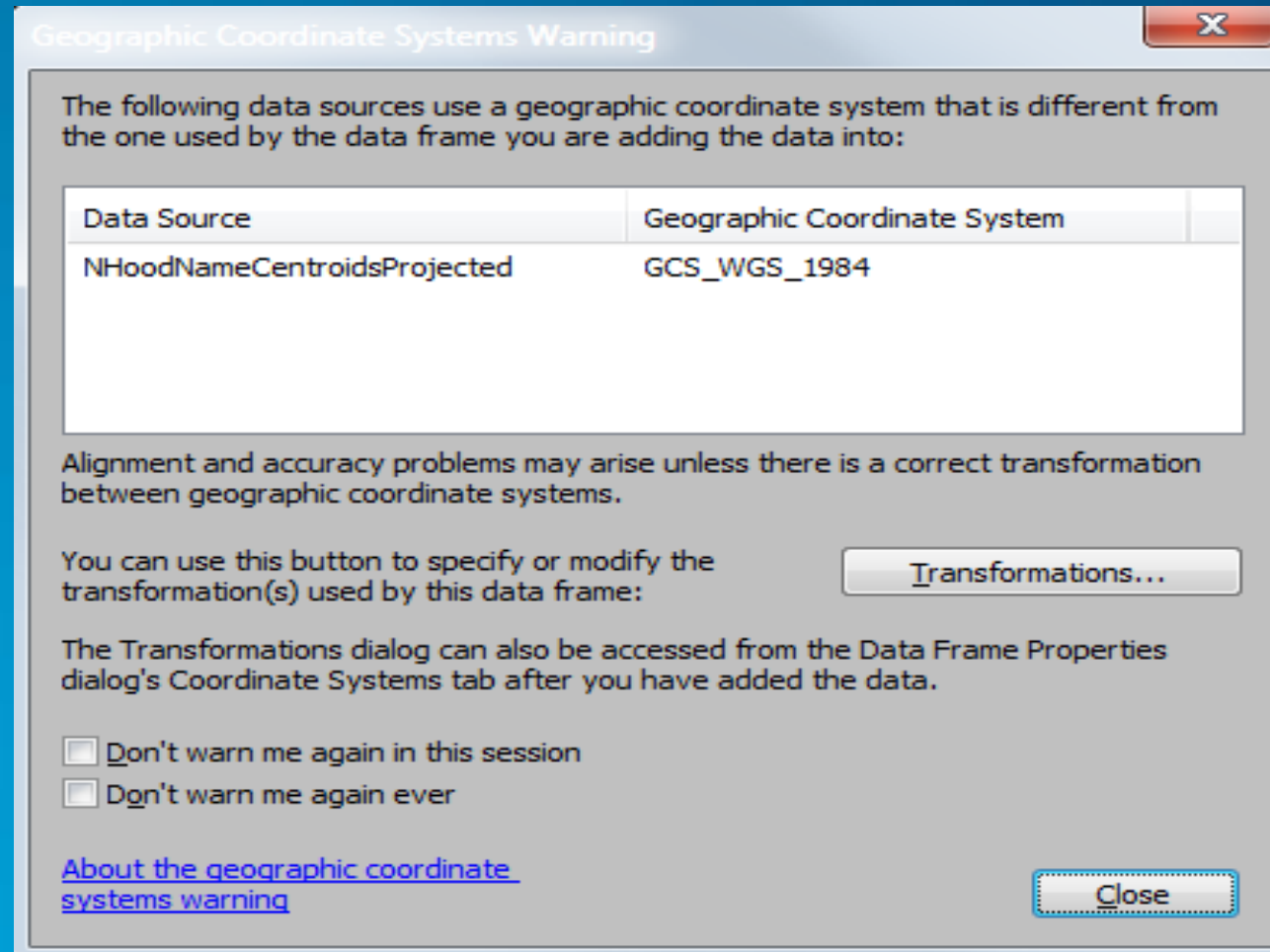# Datum transformations are important!

- Omit or choose the wrong one—up to 200 m
- Multiple ones exist
  - Have different areas of use or accuracies
  - Up to you to decide which one is best
- See Knowledge Base article #21327

# Transformations in North America

# Warning: different geographic coordinate system…

# Services and coordinate systems

- **If publishing through ArcMap, set up transformations there**
    1. Change the coordinate system of the data frame or add data in 'other' GCS
    2. Set the appropriate transformation
    3. Change back the data frame's coordinate system or remove the data
- **Server will use the transformation if data is requested in that coordinate system**
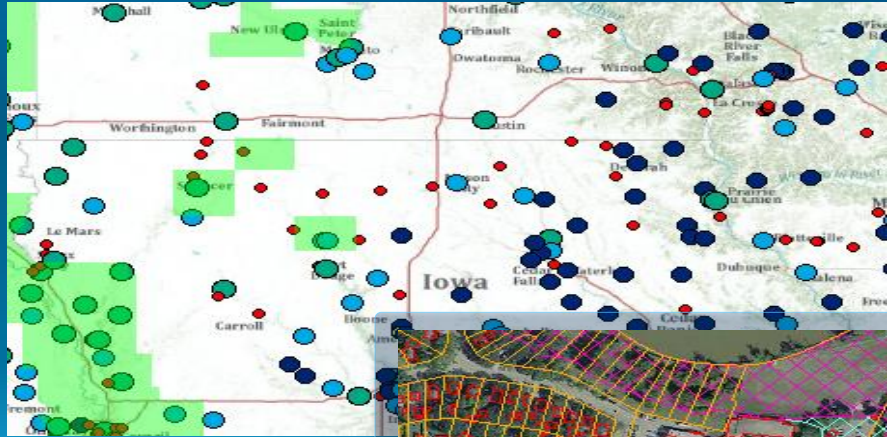
# Demonstration

Working with Geographic Transformations

# Wrap-up

# More information

- **Don't forget the Knowledge Base!**
  - **http://support.esri.com**
    - **23025, 29129, 24893, 29035, 17420**
- **Esri forums for user-to-user help**
  - **http://geonet.esri.com**
- **Virtual Campus**
  - **http://campus.esri.com**
  - **Live Training Seminar and Course**
- ***http://www.epsg.org***
  - Database of coordinate systems & datums
  - *Guidance Note 7-2*

# Books, etc.

- **Maher.** *Lining Up Data in ArcGIS*

- **Meyer.** *Introduction to Geometrical and Physical Geodesy*

- **Snyder.** *Map Projections: A Working Manual*
  - **http://pubs.er.usgs.gov/djvu/PP/PP_1395.pdf**

- **Flacke & Kraus.** *Coordinate systems in ArcGIS*

- **Snyder & Voxland.** *An Album of Map Projections*. **USGS PP 1453**
  - **http://infotrek.er.usgs.gov/pubs**

- **Iliffe and Lott.** *Datums and Map Projections*

# Thank you…

- *Please fill out the session survey*

- Online – search using the session name
- Paper – pick up and put in drop box

Understanding our world.