



# Coordinate systems and transformations in action

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# Objectives

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

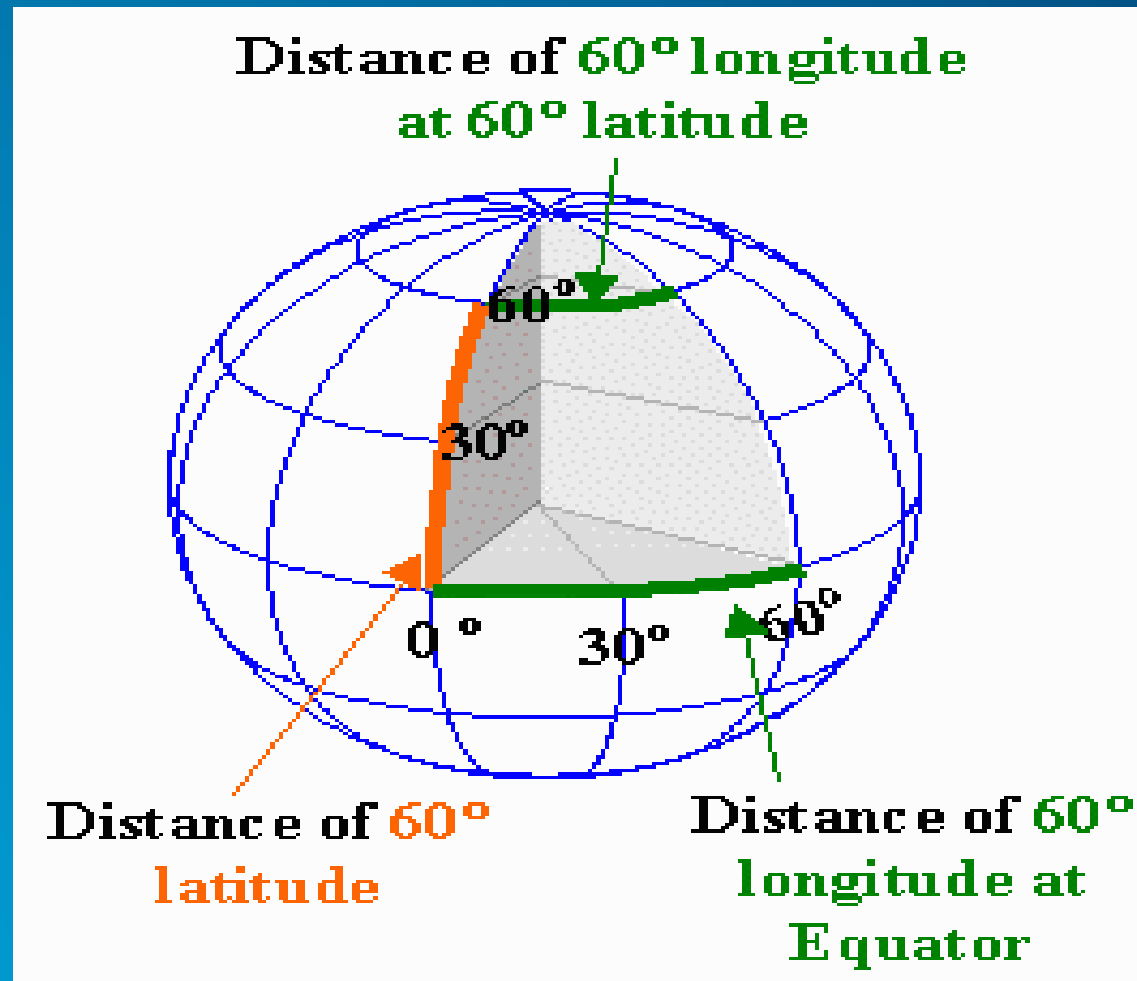
**Session ID: 1585**

*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

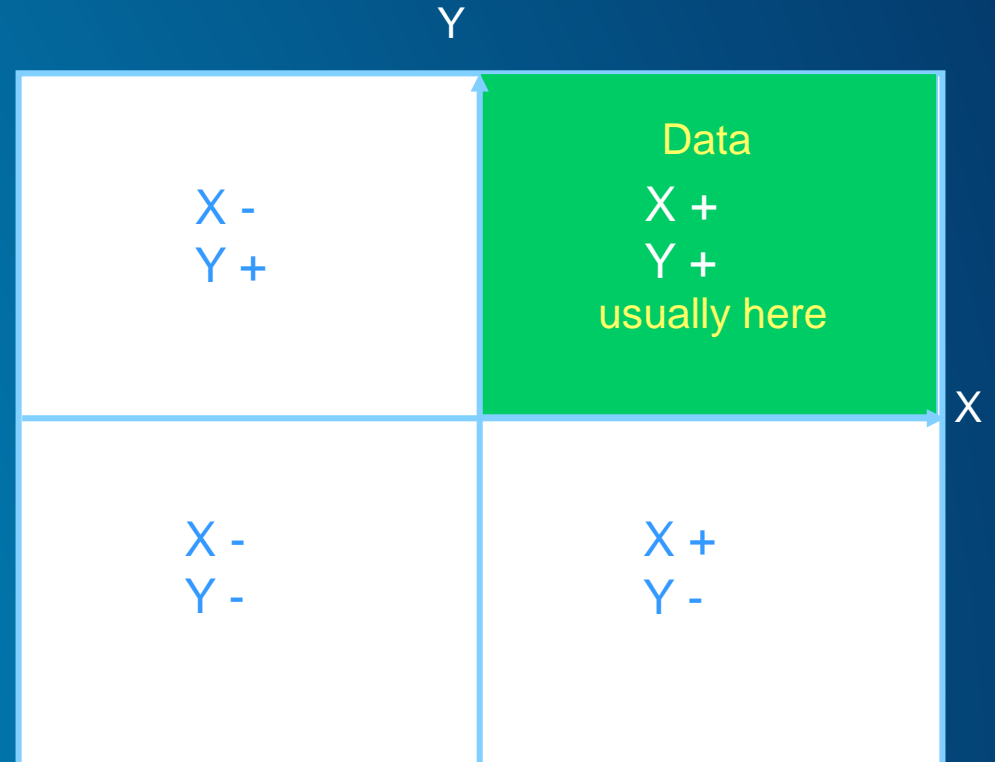
# Geographic coordinate system

(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

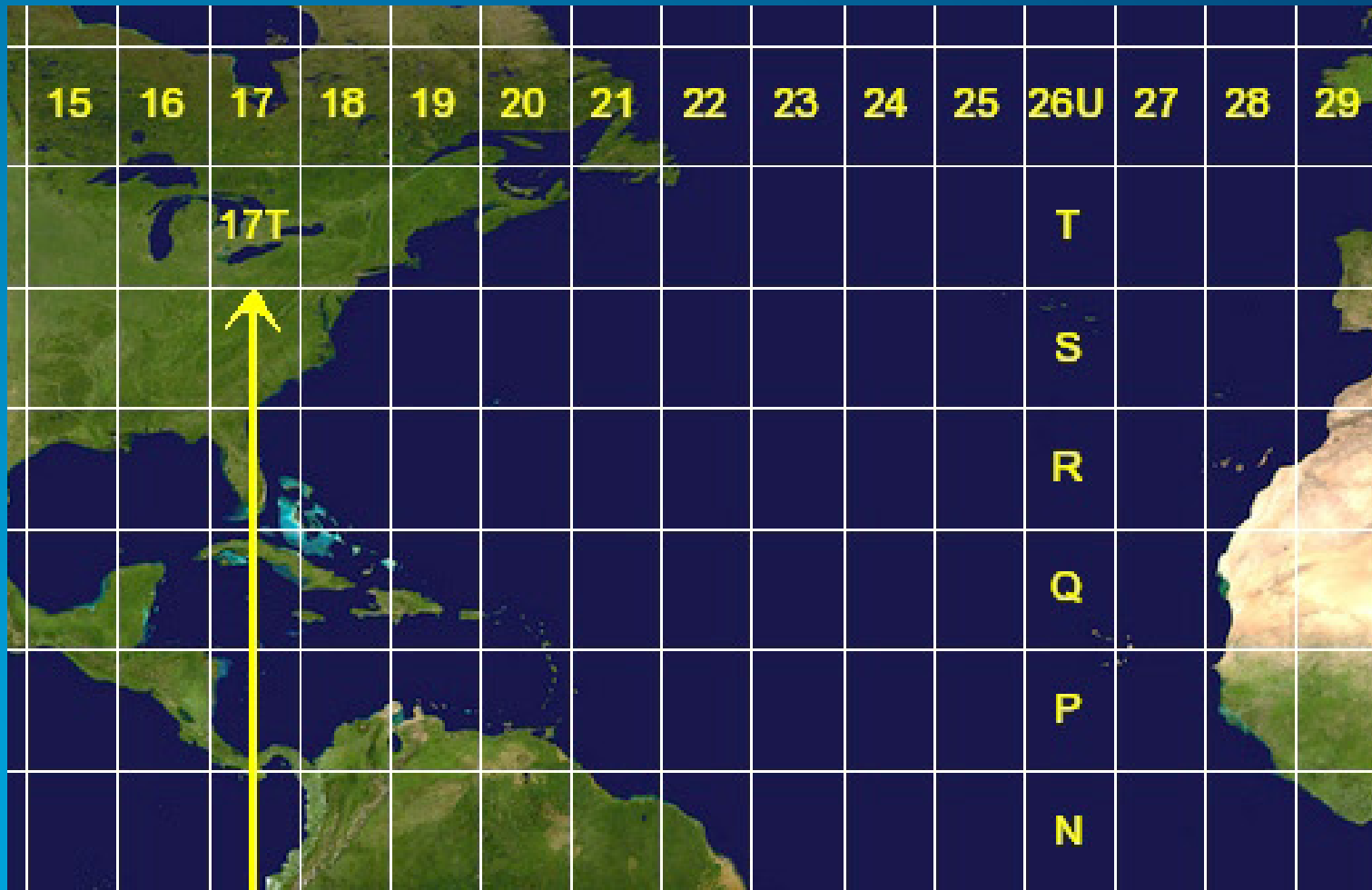
# Choosing the right coordinate system

- 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

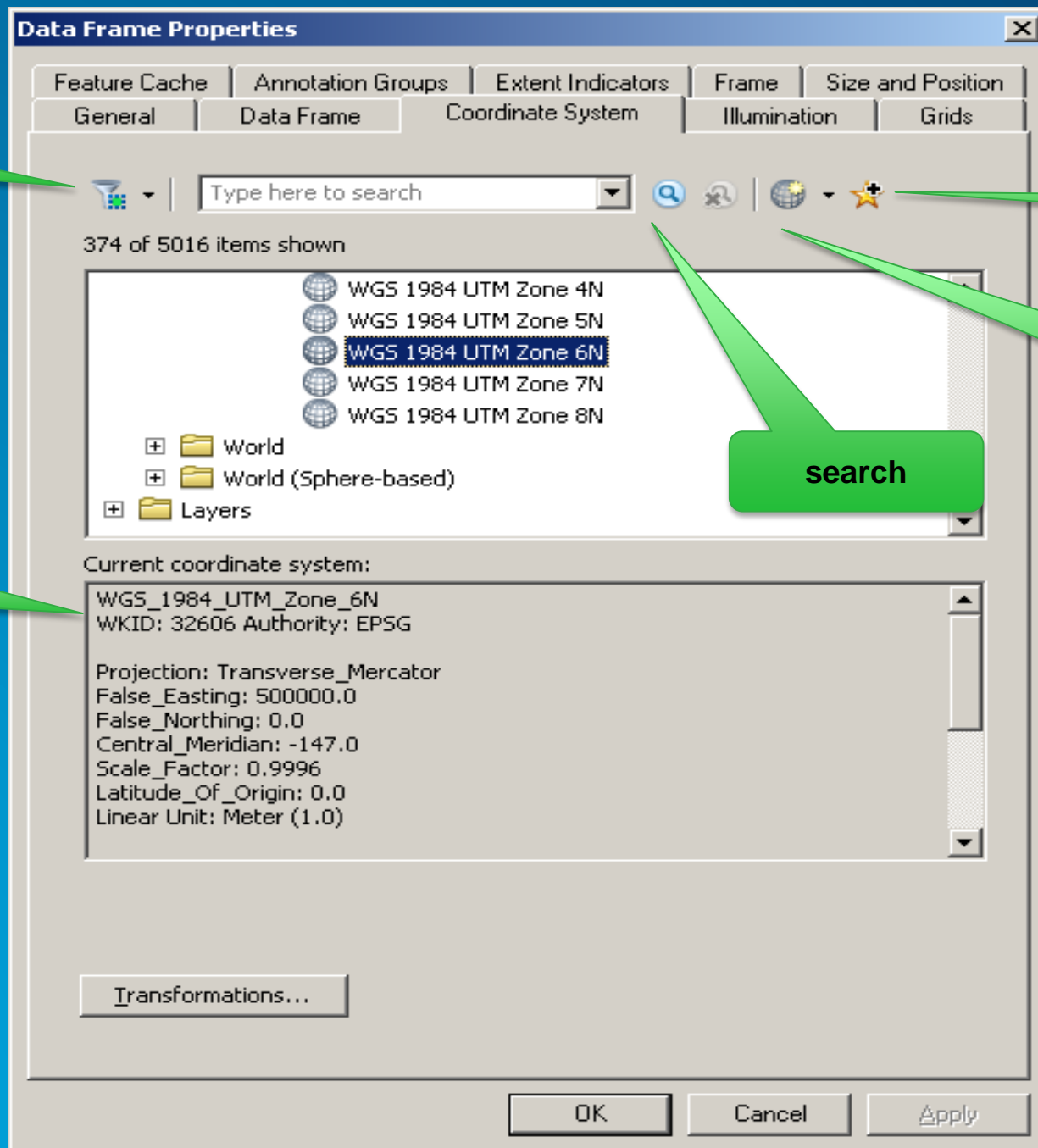
## UTM zones and latitude bands



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**



spatial filter

favorites

create or import  
coordinate system

search

well-known ID



# 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](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

Latitude: 28.738369

Calculated NAD 27 XY Coords:

Longitude: 10431702.916855

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NAD27

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No units

# What do you know?

In the U.S.

decimal degrees

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Latitude: 28.738369

NAD27

Calculated NAD 27 XY Coords:

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Latitude: 1202802.892336

X or Y?

No units



# Demonstration

Identifying Unknown Data

The background features a blue gradient with abstract geometric shapes in purple and yellow. A small yellow map fragment is visible on the left side.

# Geographic (datum) transformations

# Geographic transformations

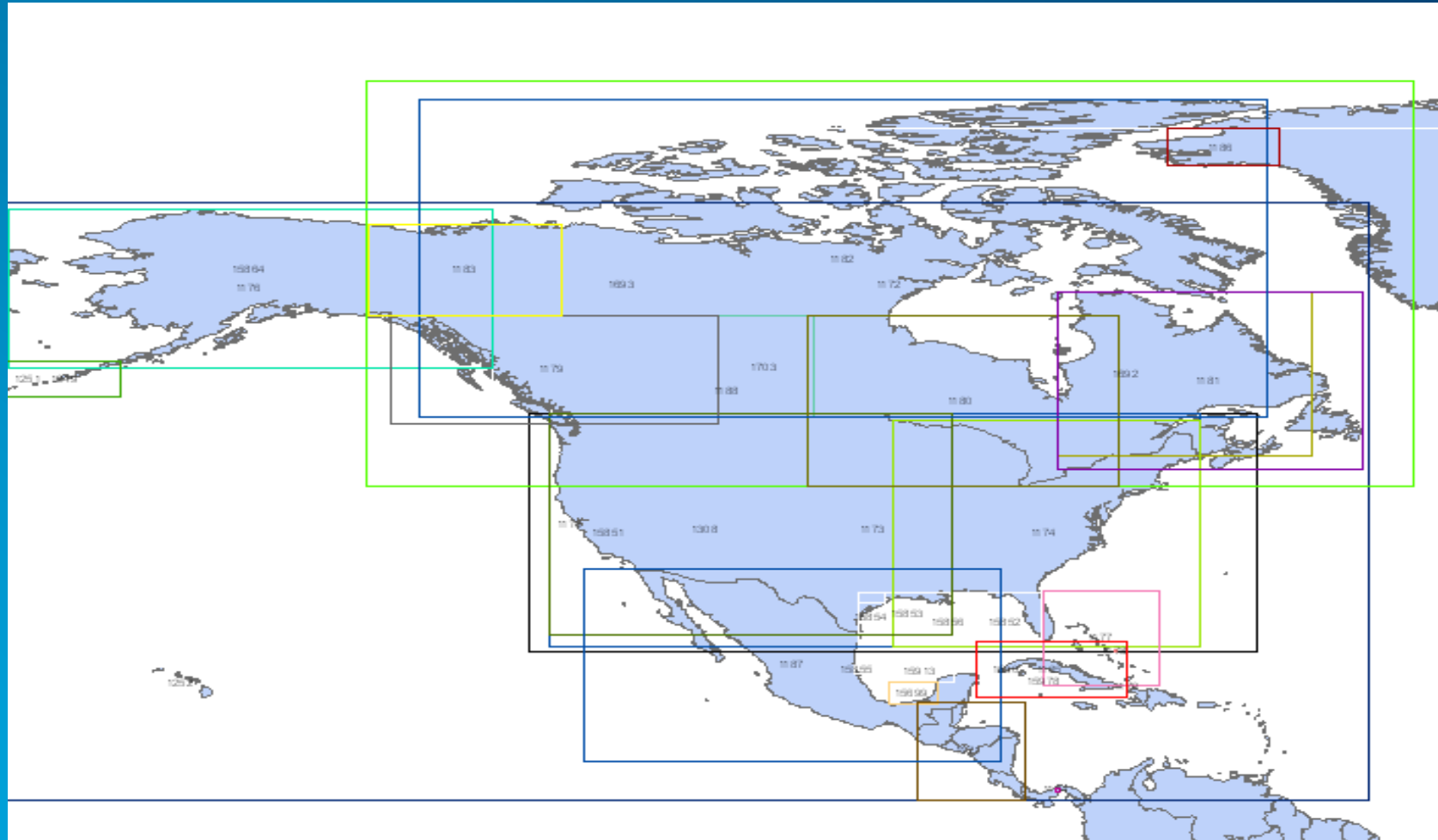
- Convert between two geographic coordinate systems
- Offsets can be significant

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!

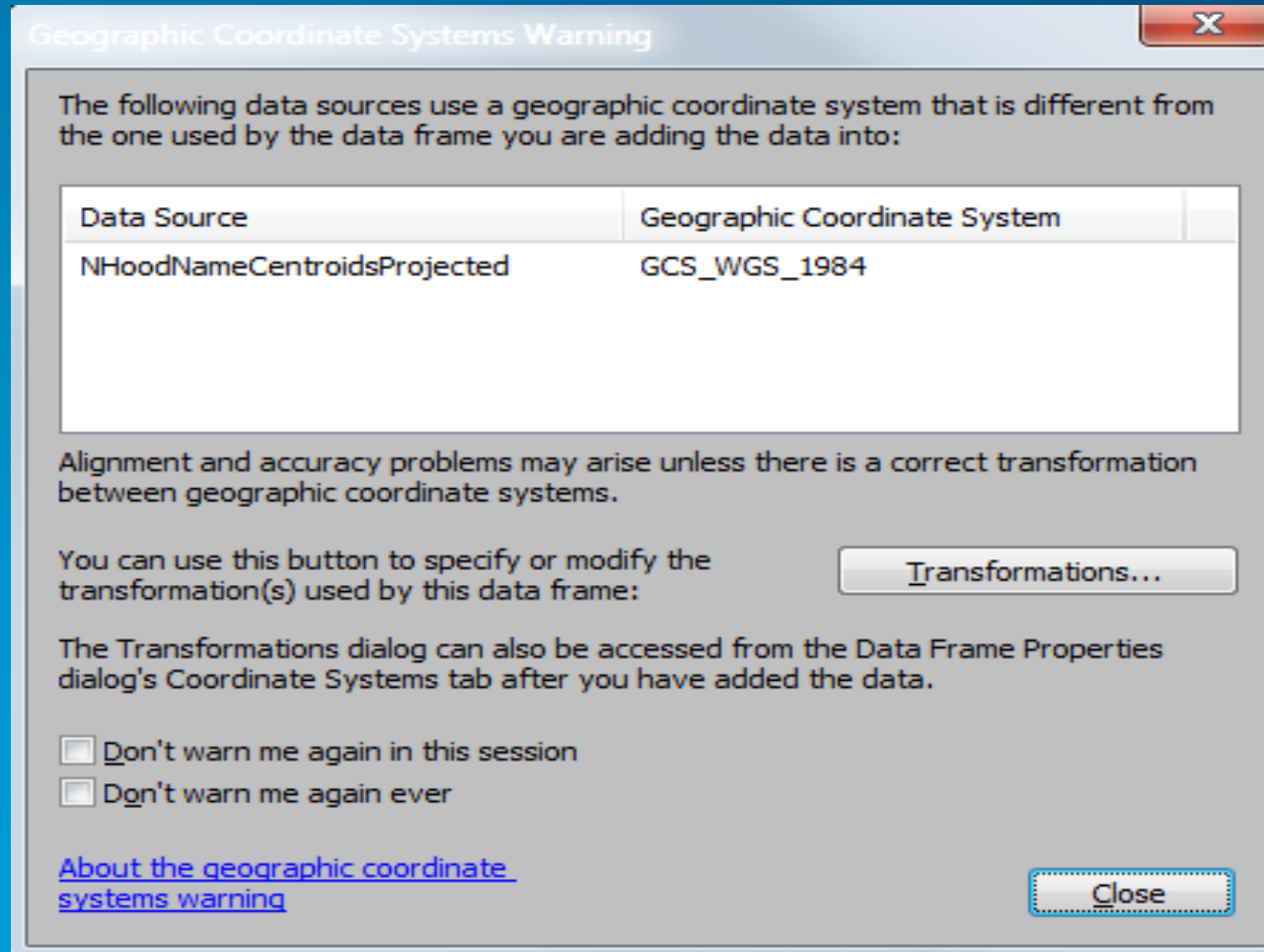
- Omit or choose the wrong one—up to 200 m
- Multiple ones exist
  - Have different areas of use or accuracies
  - Up to you to decide which one is best
- See Knowledge Base article #21327

# 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](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...**

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- **Paper – pick up and put in drop box**



Understanding our world.