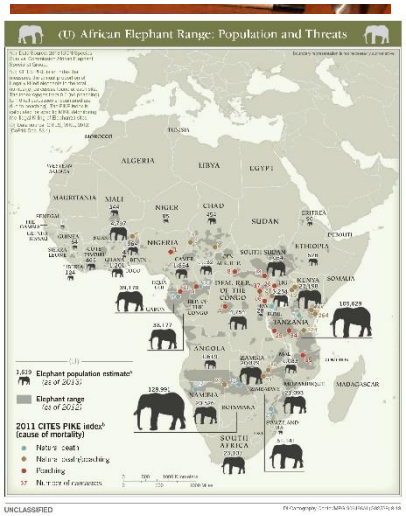
Speaking the Language of Coordinate Systems: From Field to Feature Class

Bill Trask

Fisher Associates

My Background



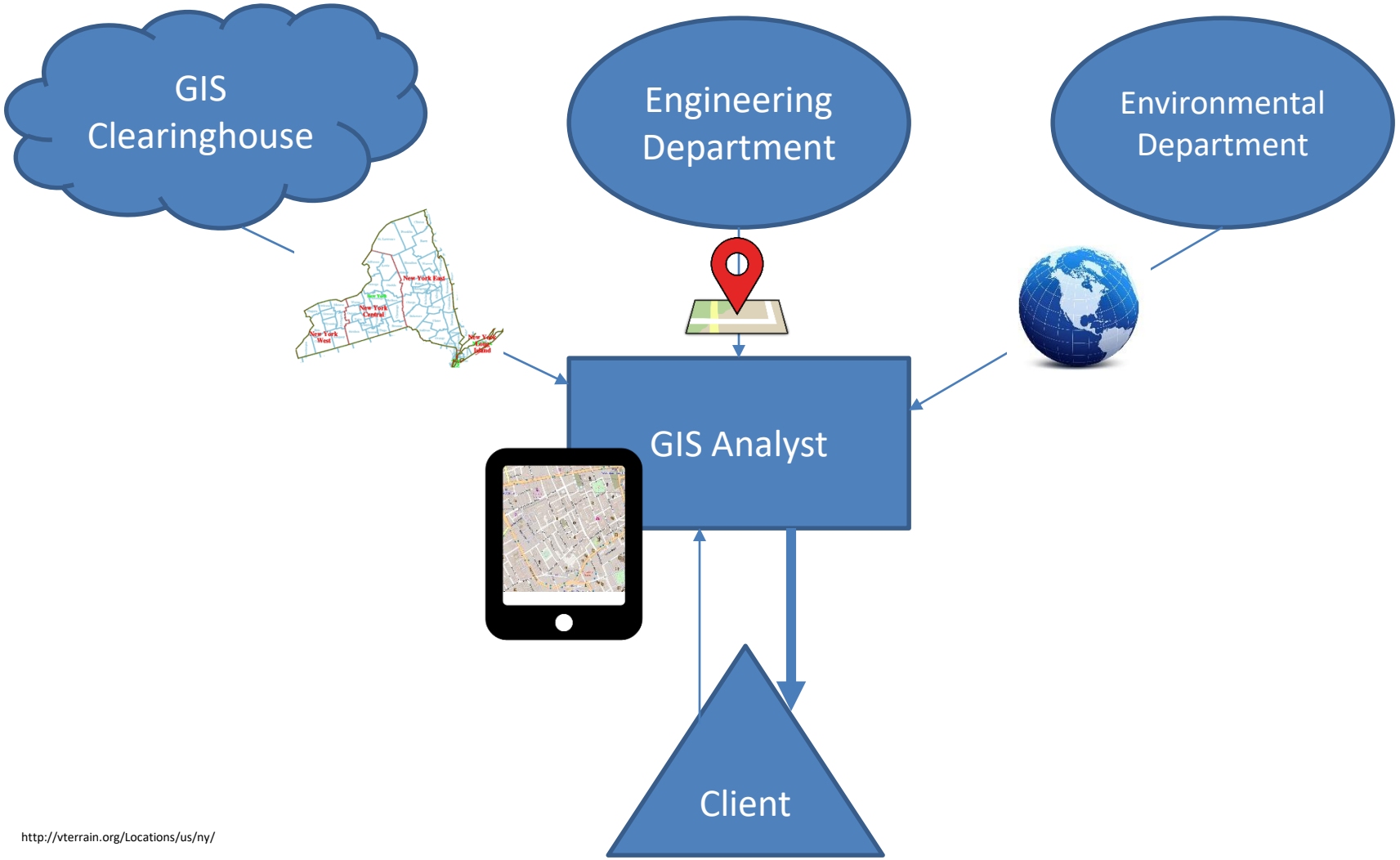
Outline

- GISers as the curators of coordinates
- Defining Spatial Reference Systems
- Using Spatial Reference Systems
- Strange Spatial Reference Systems

Theory

Practice

GISers as the nexus between other departments and coordinate systems



http://vterrain.org/Locations/us/ny/

GISers as the nexus between other departments and coordinate systems

Where am I?

What datum and coordinate system are you in?

I don't care…

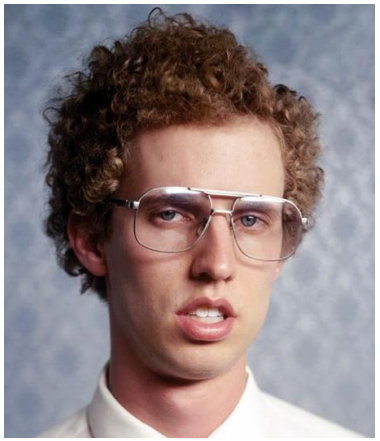
But I need to know that informat…

Whoa…getting too technical for me. **Just answer my question!**

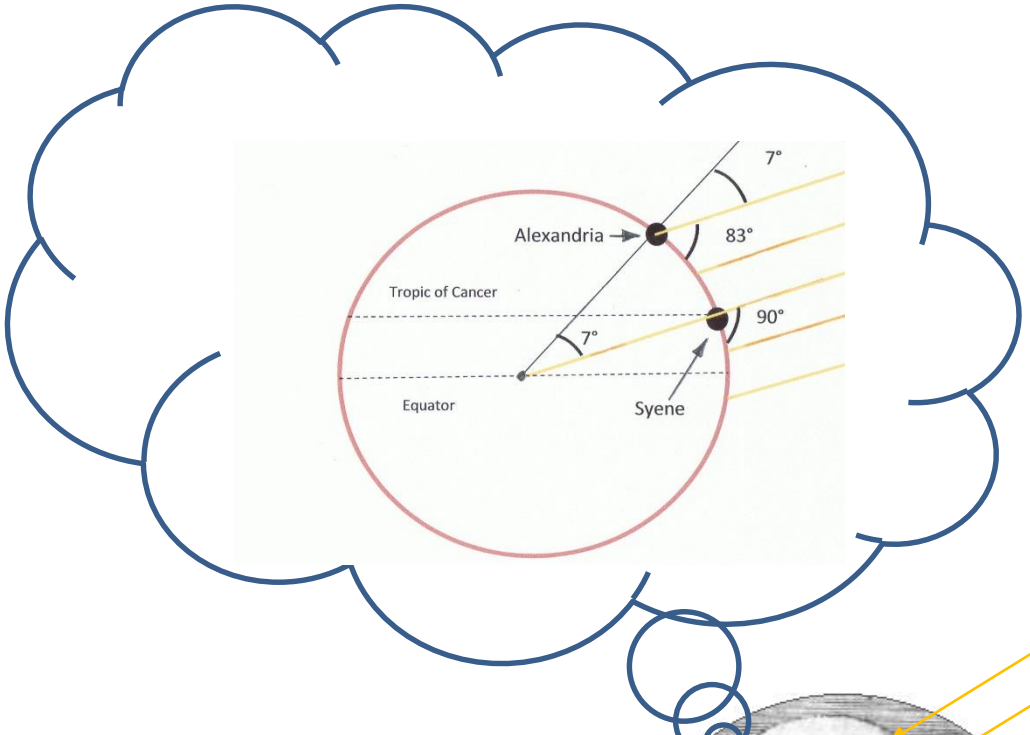
Ummm…3

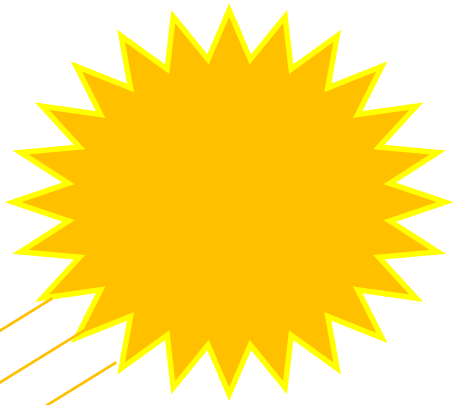
Great, thanks

You bet



Defining Spatial Reference Systems





http://www.crystalinks.com/eratosthenes.html

http://www.juliantrubin.com/bigten/eratosthenes.html

Defining Spatial Reference Systems

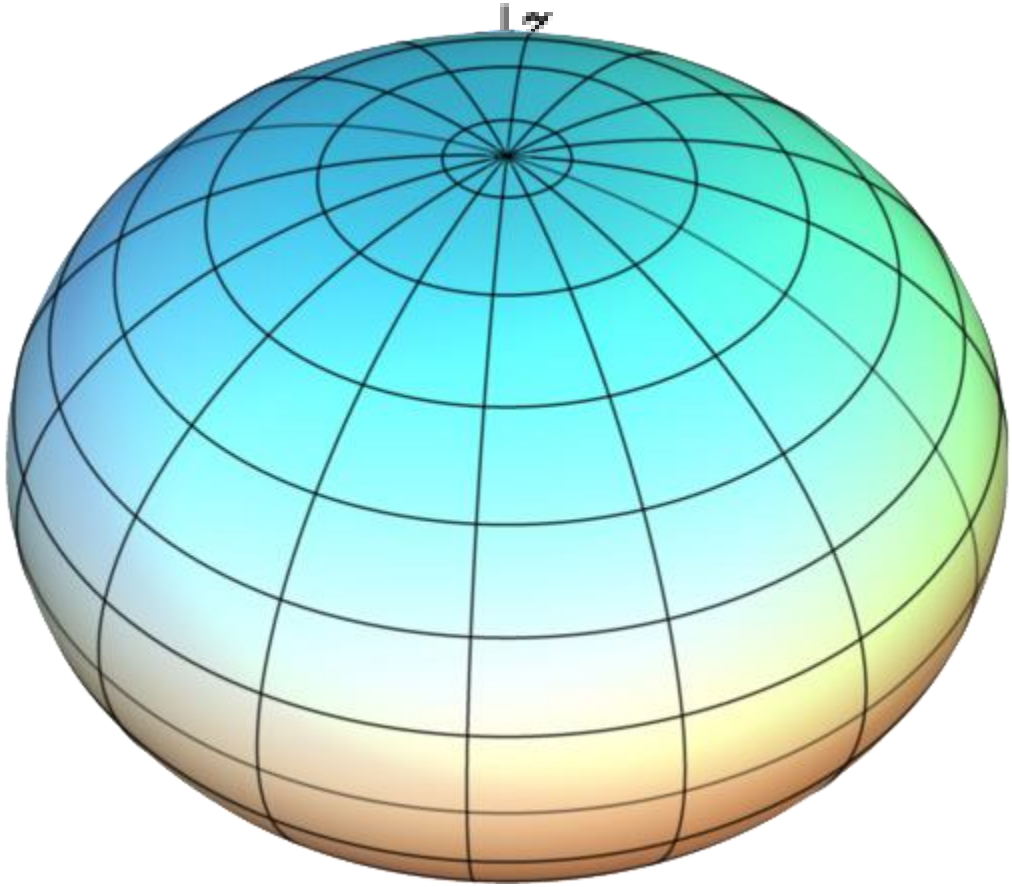
http://giphy.com/gifs/globe-12q22p3qYdD5V6

http://giphy.com/gifs/cat-loop-ball-xkCK3tAhDSUBa

Defining Spatial Reference Systems

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1,$$

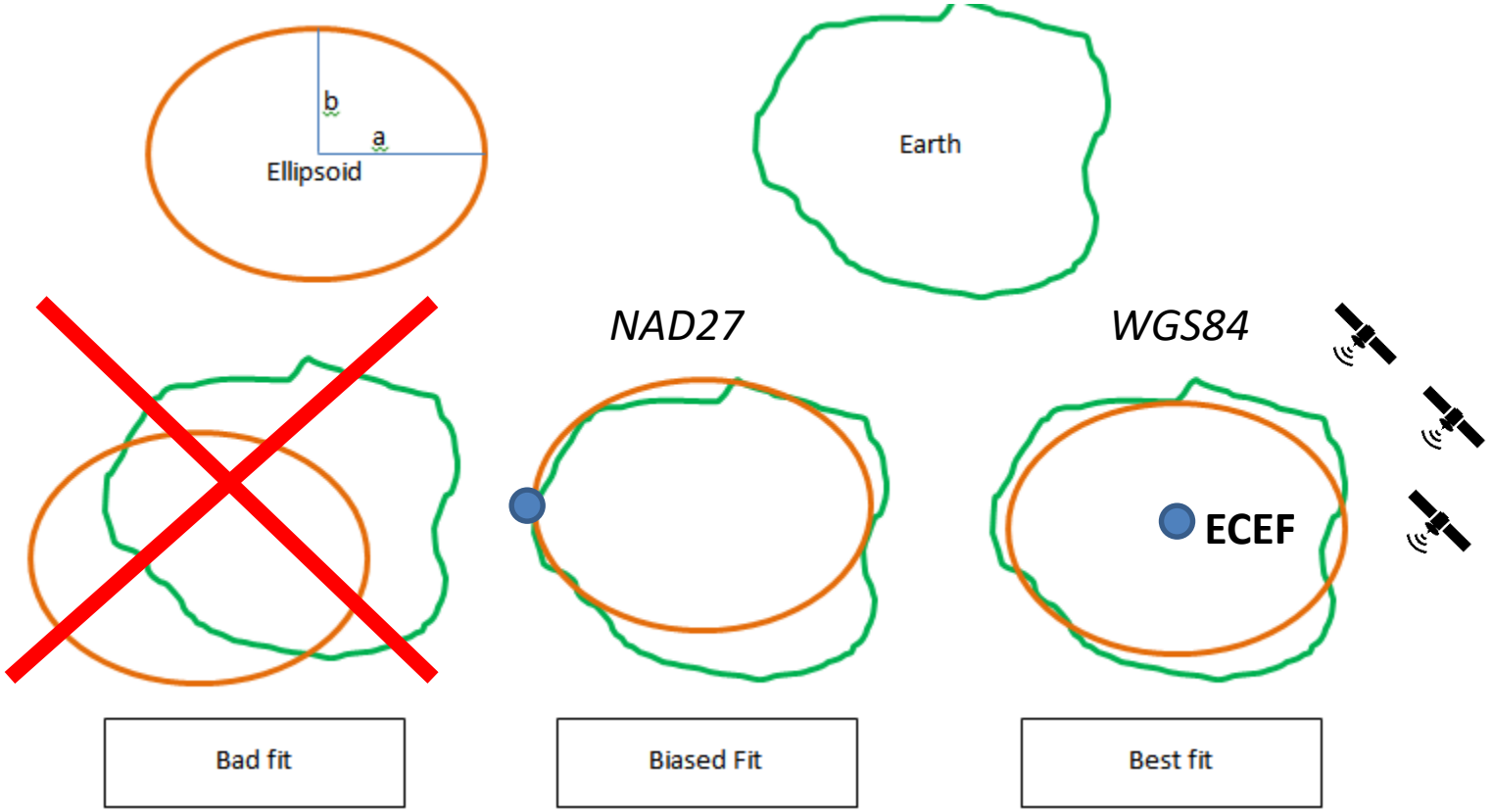
- $c < a$: **oblate** spheroid
- $c > a$: **prolate** spheroid



https://en.wikipedia.org/wiki/Ellipsoid
https://en.wikipedia.org/wiki/Spheroid#/media/File:OblateSpheroid.PNG
https://en.wikipedia.org/wiki/Spheroid#/media/File:ProlateSpheroid.png

Defining Spatial Reference Systems

Defining Spatial Reference Systems



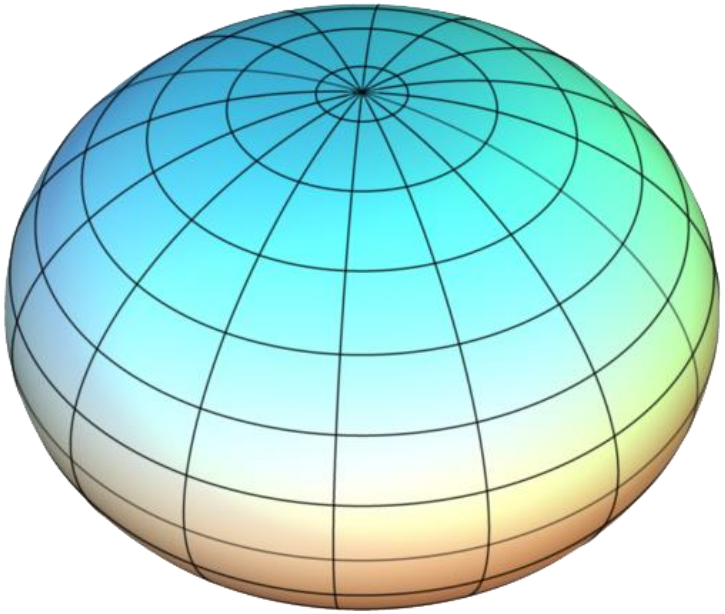
https://plus.google.com/wm/1/105201603605933379147/posts/FomFYLhcsRy?pid=6132717223925455330&oid=105201603605933379147

Defining Spatial Reference Systems

6 realizations

- WGS84(1987)
- G730(1994)
- G873(1997)
- G1150(2001)
- G1672(2005)
- G1674(2005)

ITRF90



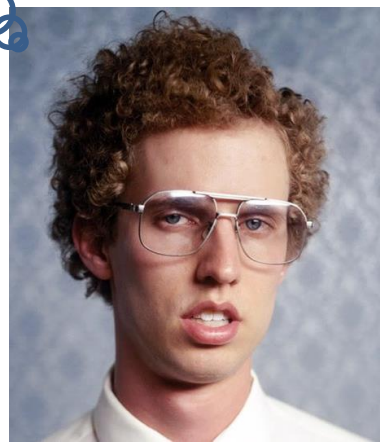
ITRF08

WGS 84

Defining Spatial Reference Systems

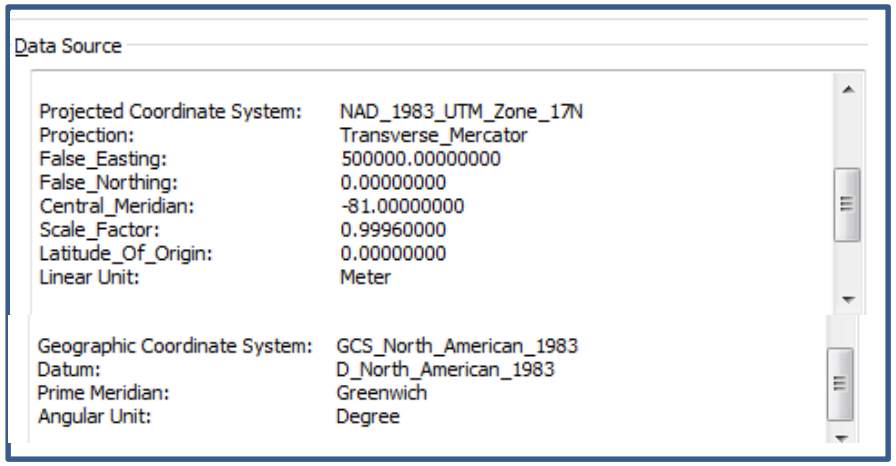
So what is a datum?

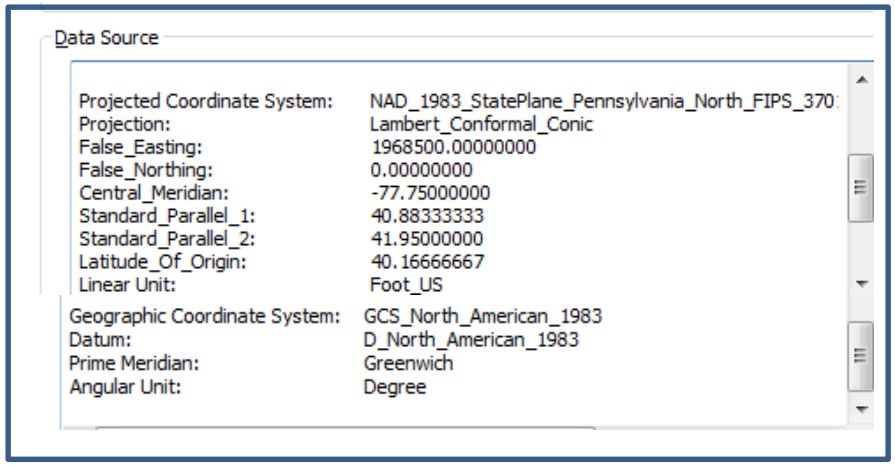
The point at which we attach the ellipsoid to the Earth.



Defining Spatial Reference Systems

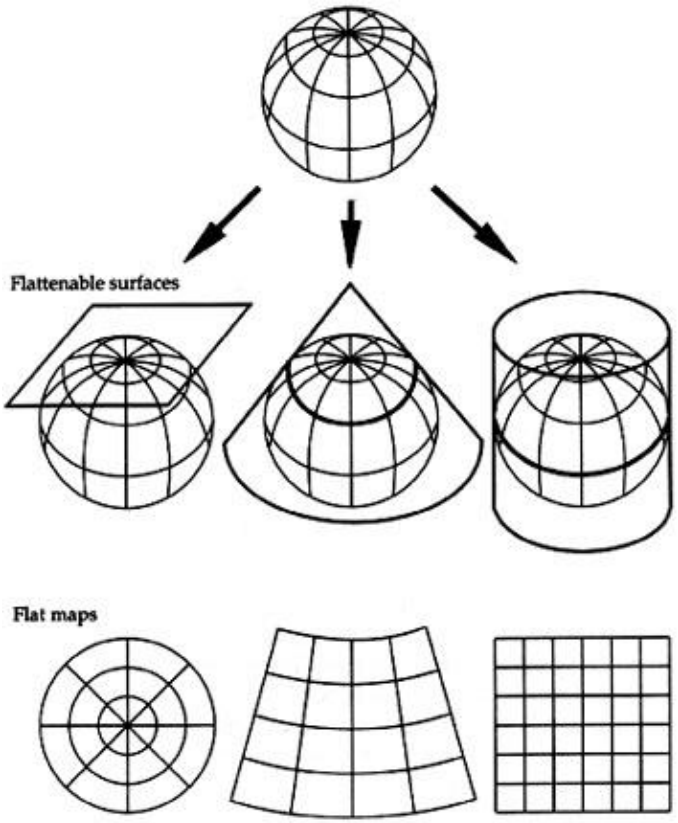
From Datums to Coordinate Systems





Defining Spatial Reference Systems

From Datums to Coordinate Systems



Defining Spatial Reference Systems

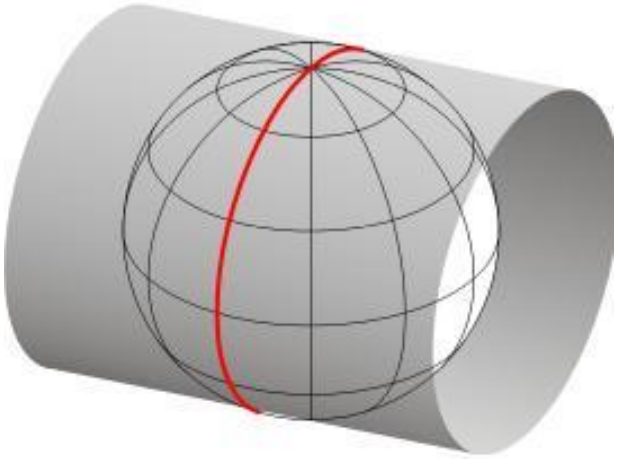
From Datums to Coordinate Systems

Data Source

Projected Coordinate System:	NAD_1983_UTM_Zone_17N
Projection:	Transverse_Mercator
False_Easting:	500000.00000000
False_Northing:	0.00000000
Central_Meridian:	-81.00000000
Scale_Factor:	0.99960000
Latitude_Of_Origin:	0.00000000
Linear Unit:	Meter
Geographic Coordinate System:	GCS_North_American_1983
Datum:	D_North_American_1983
Prime Meridian:	Greenwich
Angular Unit:	Degree

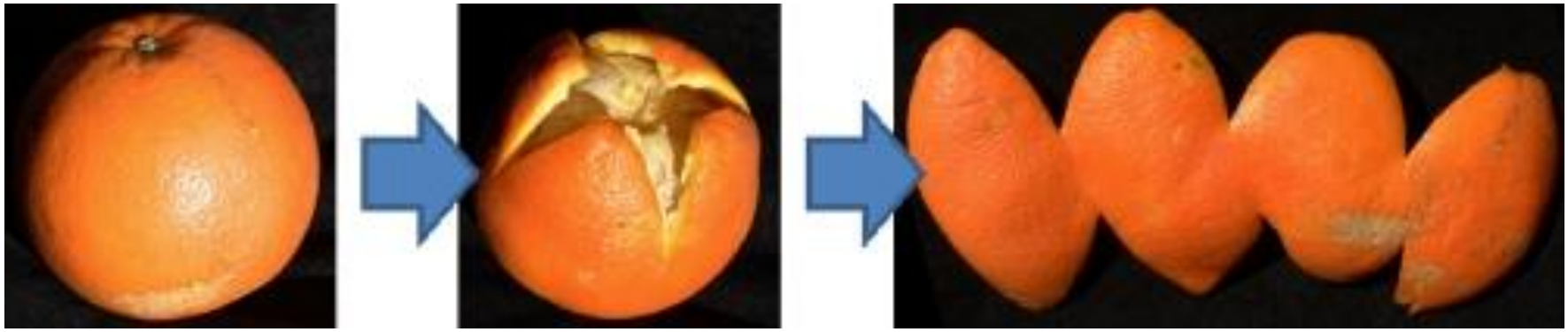
Data Source

Projected Coordinate System:	NAD_1983_StatePlane_Pennsylvania_North_FIPS_370
Projection:	Lambert_Conformal_Conic
False_Easting:	1968500.00000000
False_Northing:	0.00000000
Central_Meridian:	-77.75000000
Standard_Parallel_1:	40.88333333
Standard_Parallel_2:	41.95000000
Latitude_Of_Origin:	40.16666667
Linear Unit:	Foot_US
Geographic Coordinate System:	GCS_North_American_1983
Datum:	D_North_American_1983
Prime Meridian:	Greenwich
Angular Unit:	Degree



Secant
two standard parallels

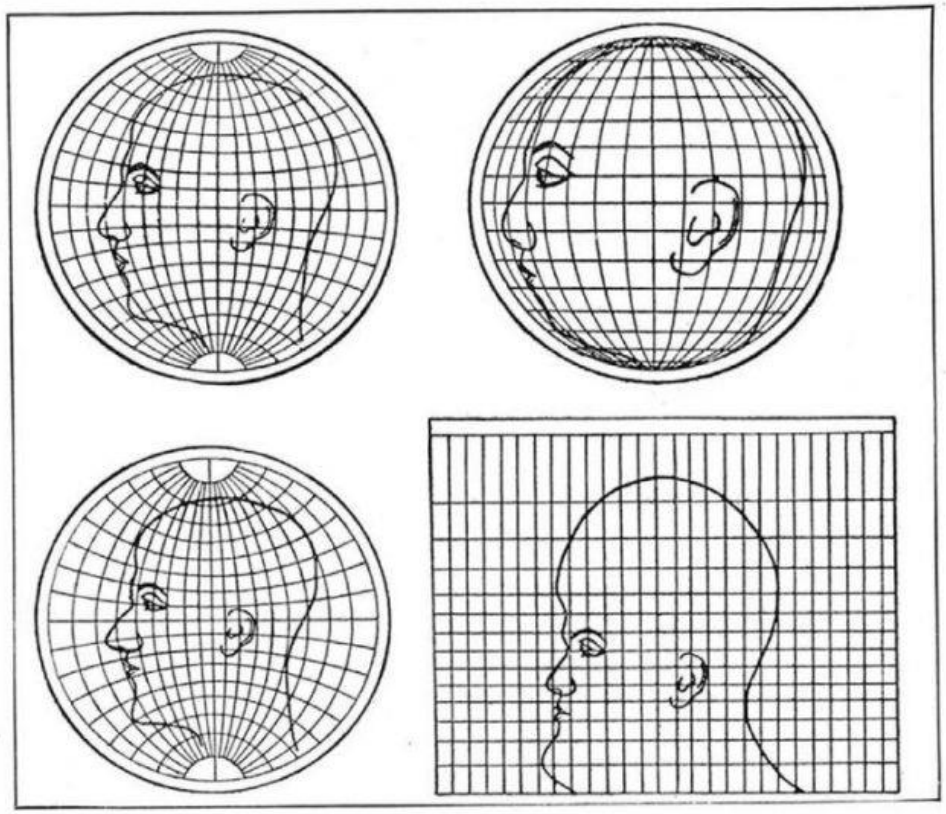
Projection Surfaces



Projection Surfaces

Projection Distortion

Elements in Map Projection (1921)



Upper left: Globular. *Upper right:* Orthographic. *Lower left:* Stereographic. *Lower right:* Mercator

What four commonly used projections do, as shown on a human head

Defining Spatial Reference Systems

Back To NAD83

1986 NAD83(Conus)

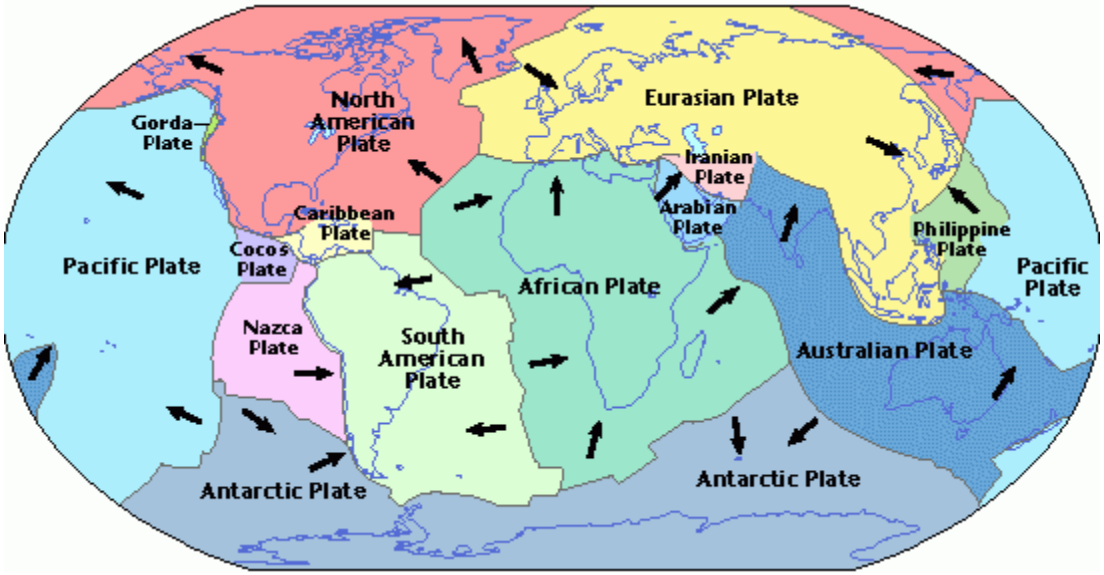
1992 NAD83(HARN/HPGN)

2002 NAD83(CORS96)

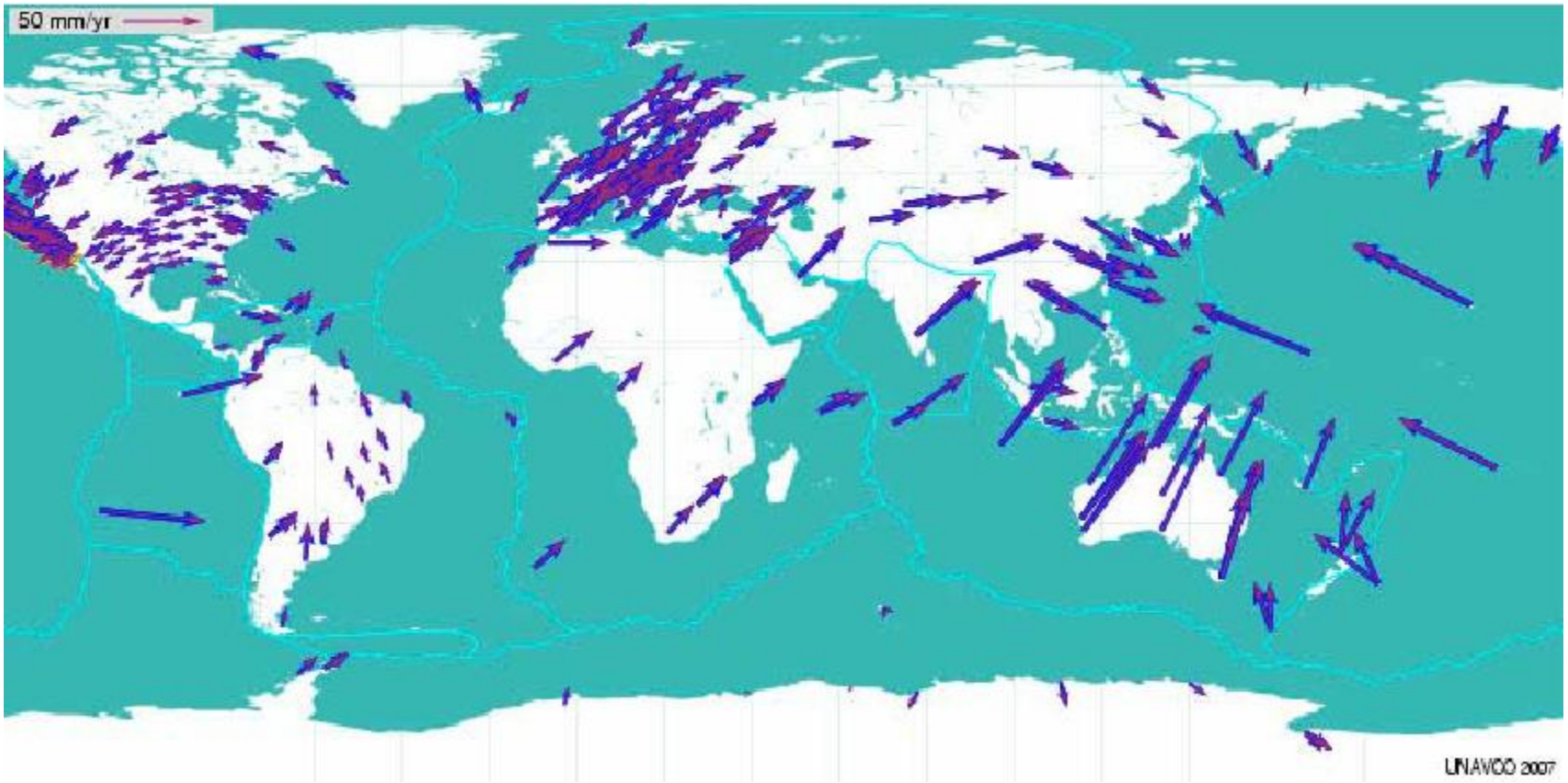
2007 NAD83(NSRS2007)

2011 NAD83(2011)

Global vs Local Coordinate Systems

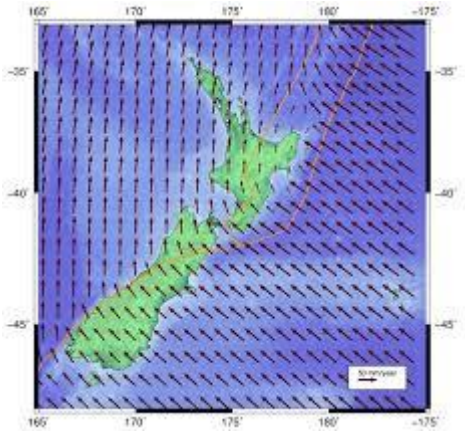


Datum Types



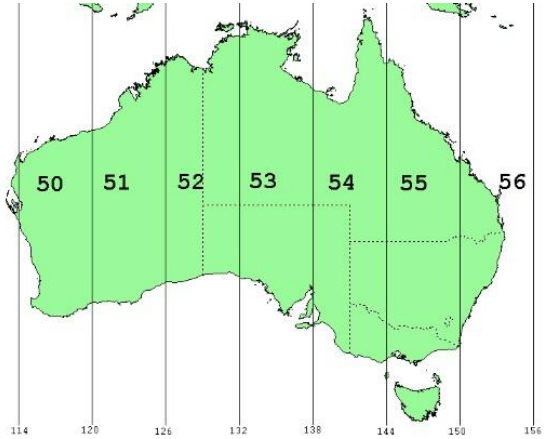
Datum Types

Dynamic



NZGD2000

Static



GDA94

Defining Spatial Reference Systems

Back To NAD83

1986 NAD83(Conus)

1992 NAD83(HARN/HPGN)

2002 NAD83(CORS96)

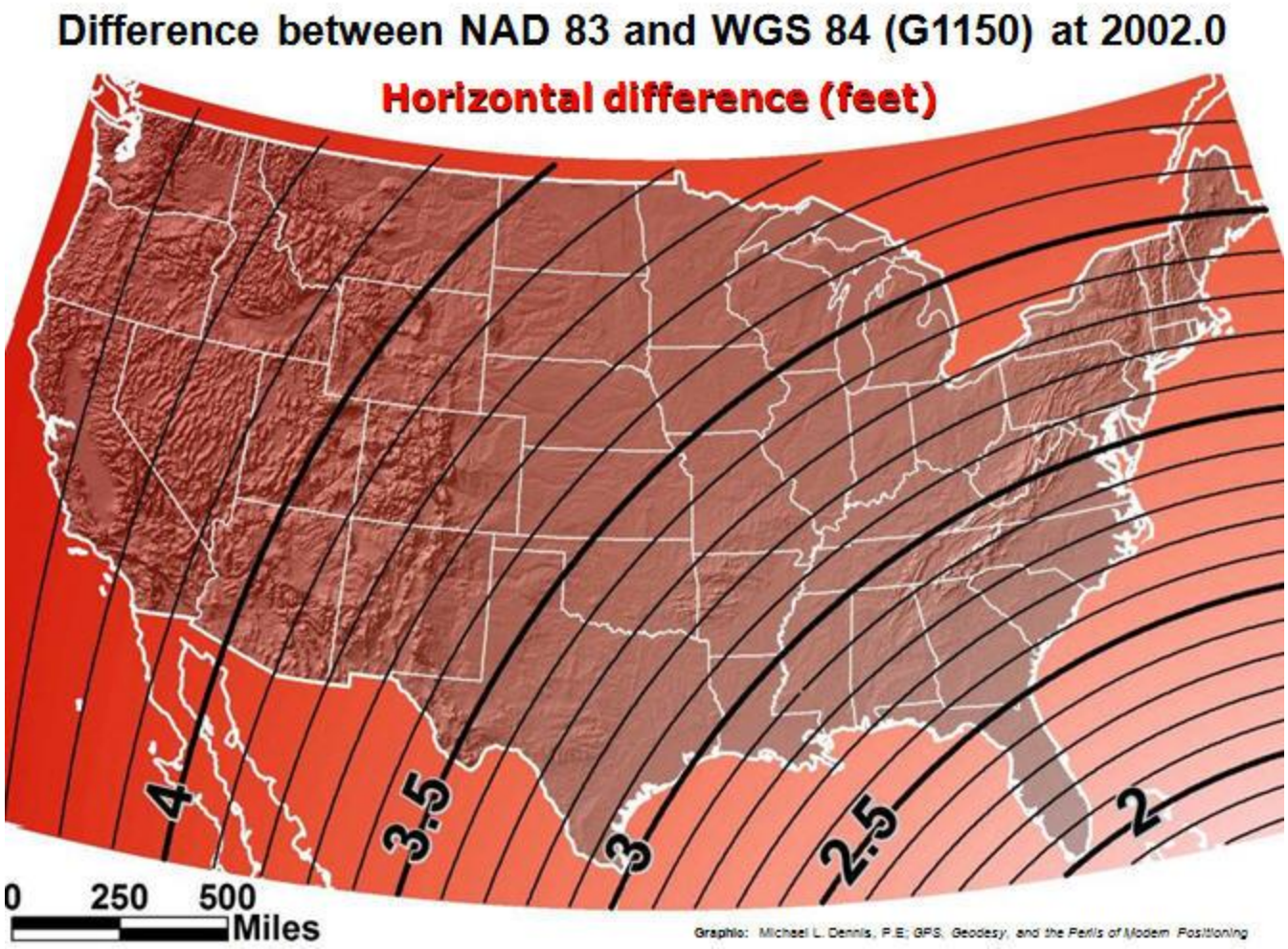
2007 NAD83(NSRS2007)

2011 NAD83(2011)

Using Spatial Reference Systems

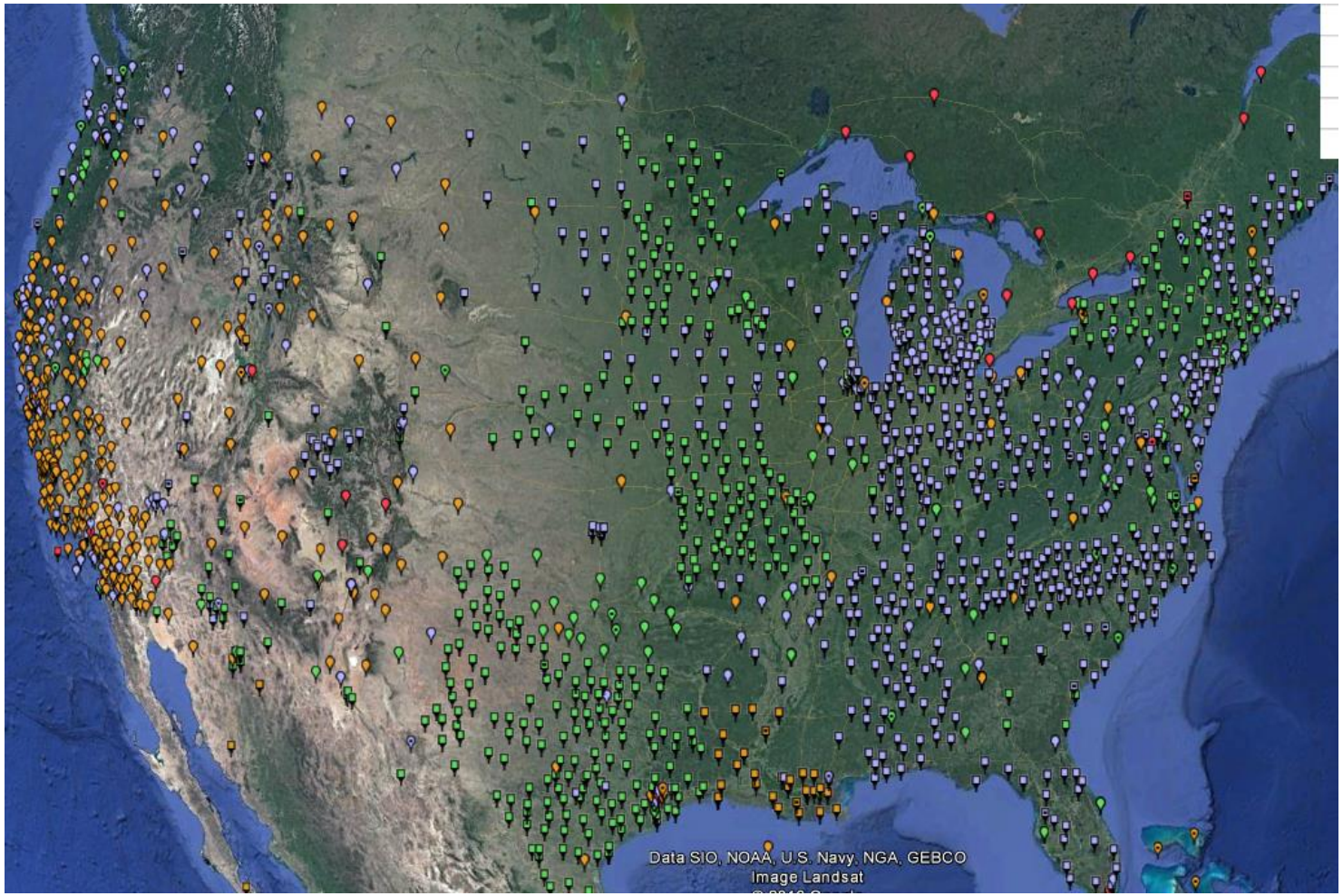
NAD83

****ALWAYS ASK WHICH NAD83 VERSION YOU'RE RECEIVING****



Using Spatial Reference Systems

CORS Stations



Using Spatial Reference Systems

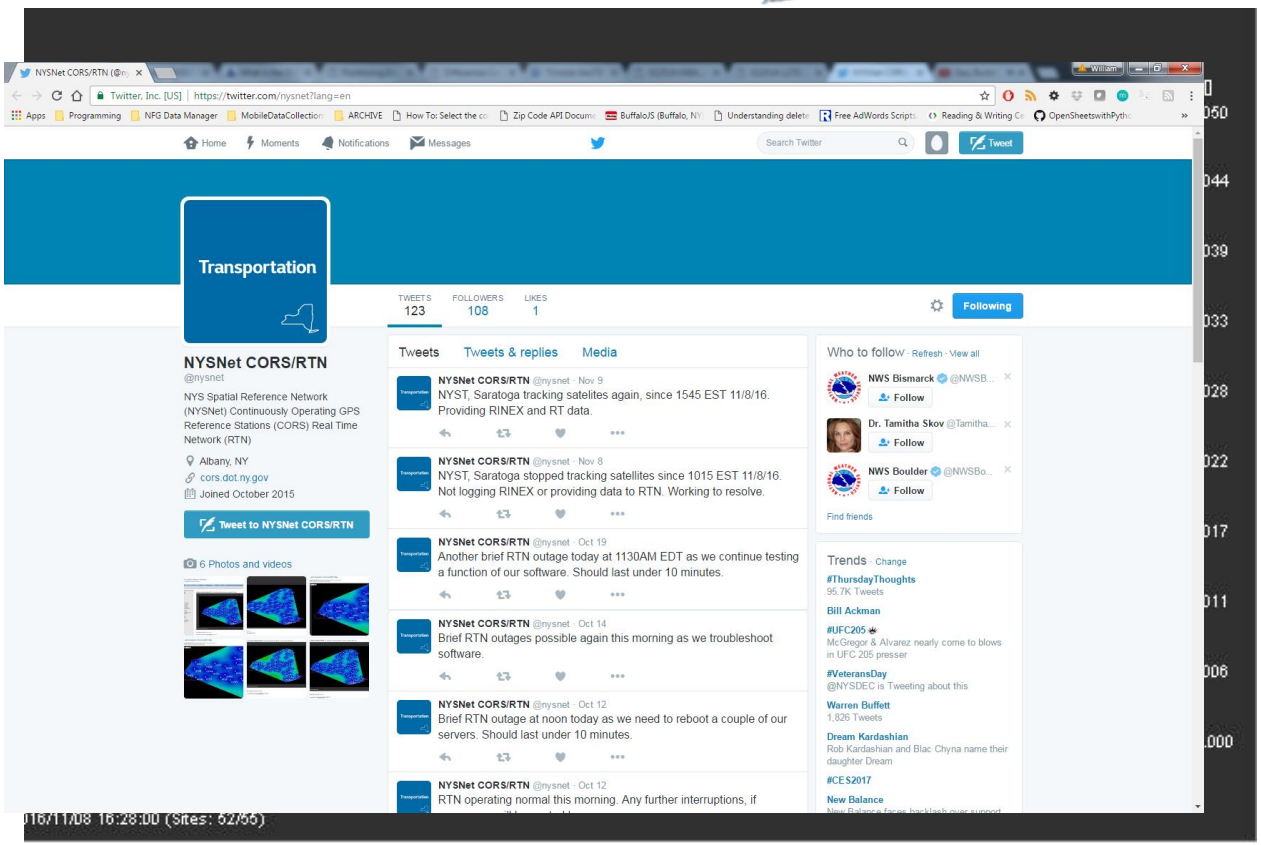
NYSNET

SET UNITS TO COLLECT IN NAD83 (2011)

IT'S FREE

RTN: Real Time Network

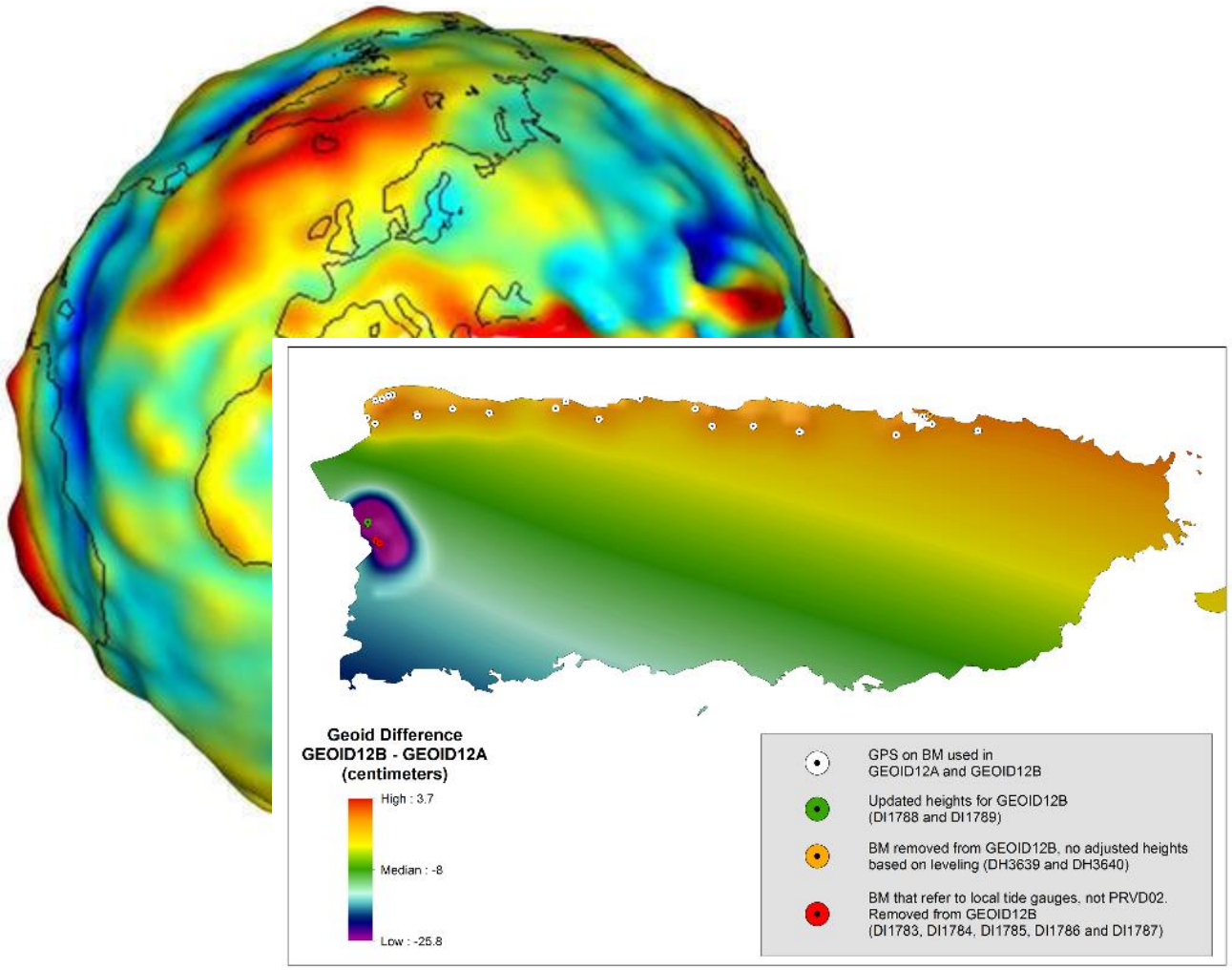
NYSNet (NYS Spatial Reference Network)
CORS/Real Time GPS Network



Using Spatial Reference Systems

Geoids

Geoid96
Geoid99
Geoid93
Geoid96
Geoid99
Geoid03
Geoid06
Geoid09
Geoid12
Geoid12a
Geoid12b



[Geoids for Trimble]

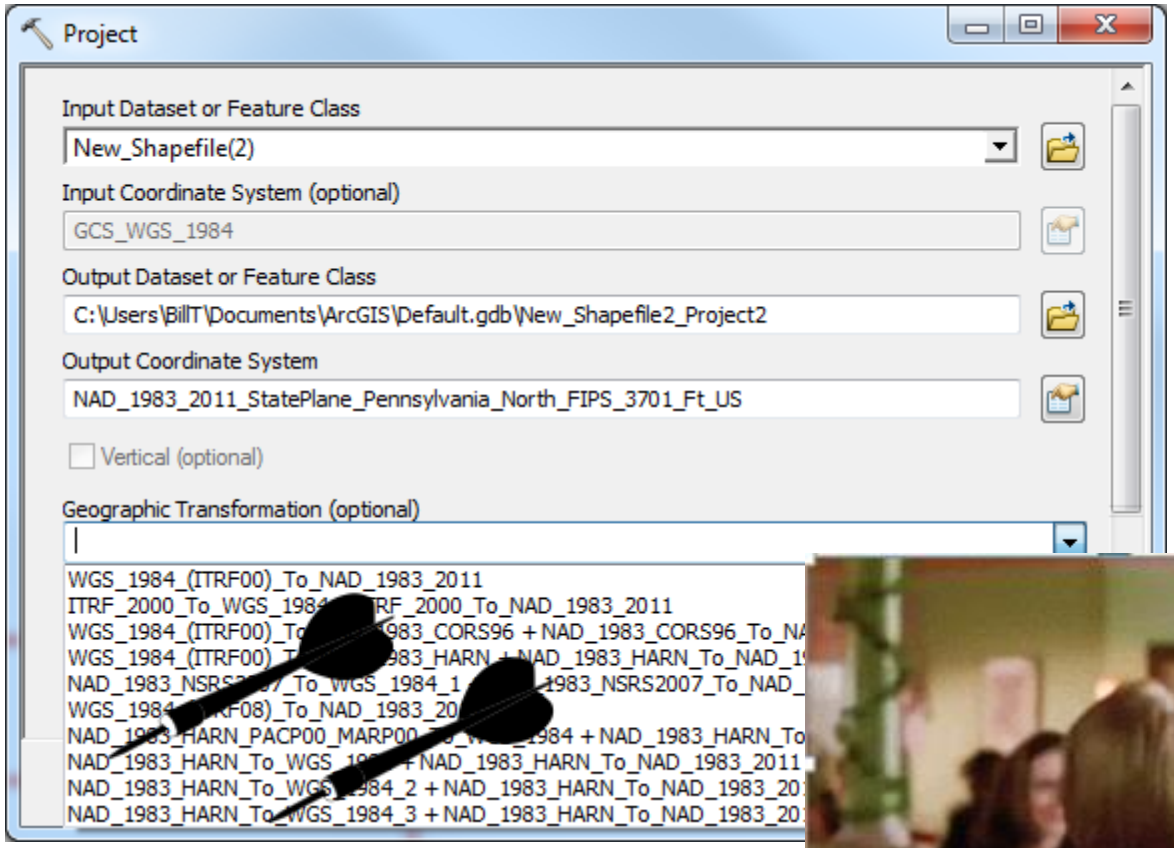
Using Spatial Reference Systems

What is your Accuracy?

Miles to Base Station	Unit	Network RTK Accuracy	in Feet	in Inches
10	GEO 7x	Horizontal (external GNSS)	0.06	0.71
	GEO 7x	Vertical (external GNSS)	0.08	0.91
	GEO 7x	Horizontal (internal GNSS)	0.11	1.30
	GEO 7x	Vertical (internal GNSS)	0.16	1.89
	Trimble R1	Vertical (internal GNSS)	0.27	3.27

Using Spatial Reference Systems

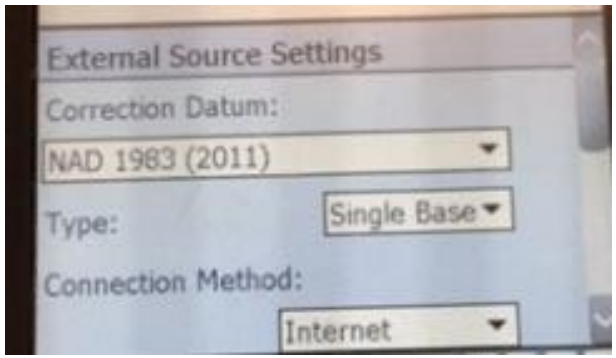
A Word on Transformations

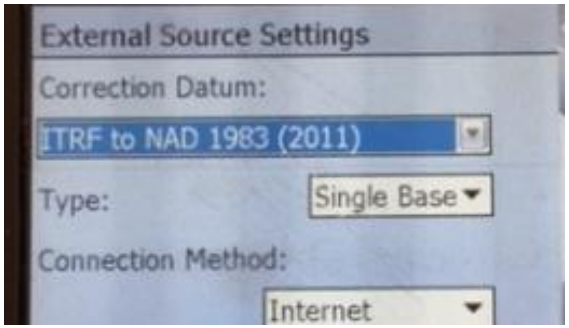


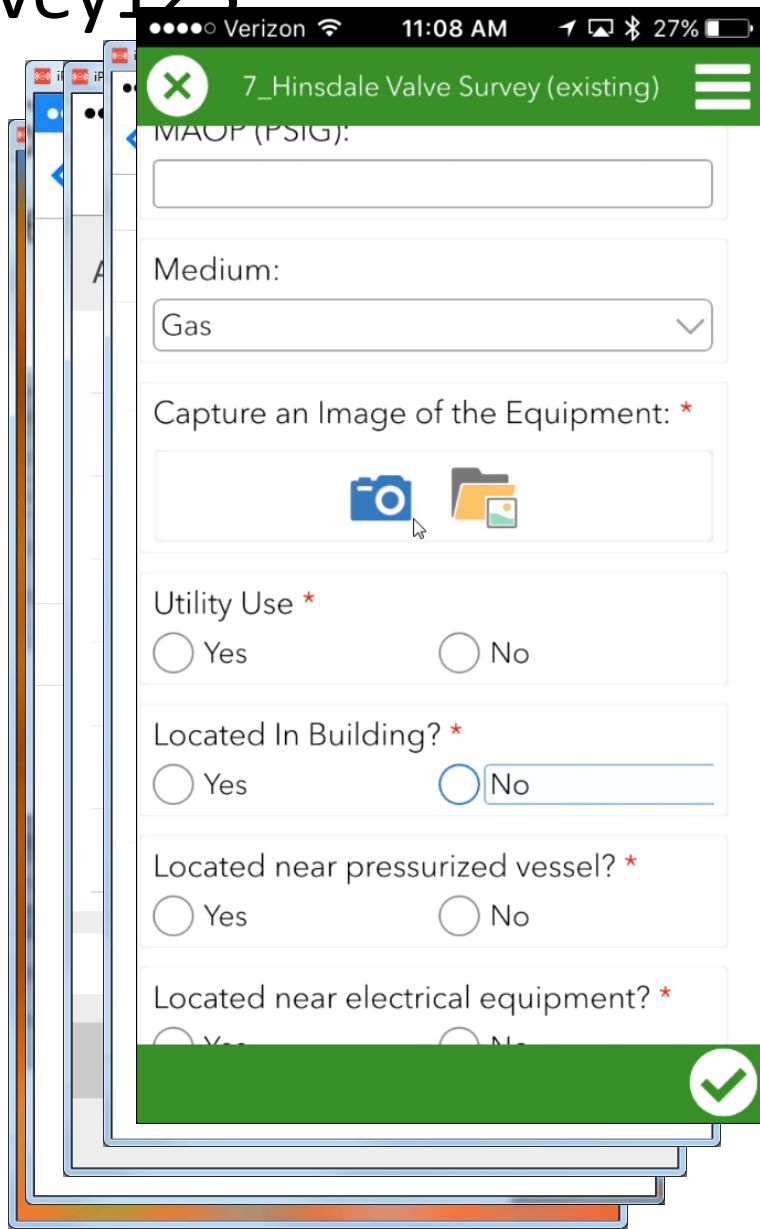
NAD_1983_To_WGS_1984_5

Using Spatial Reference Systems

Terra Sync and Survey123



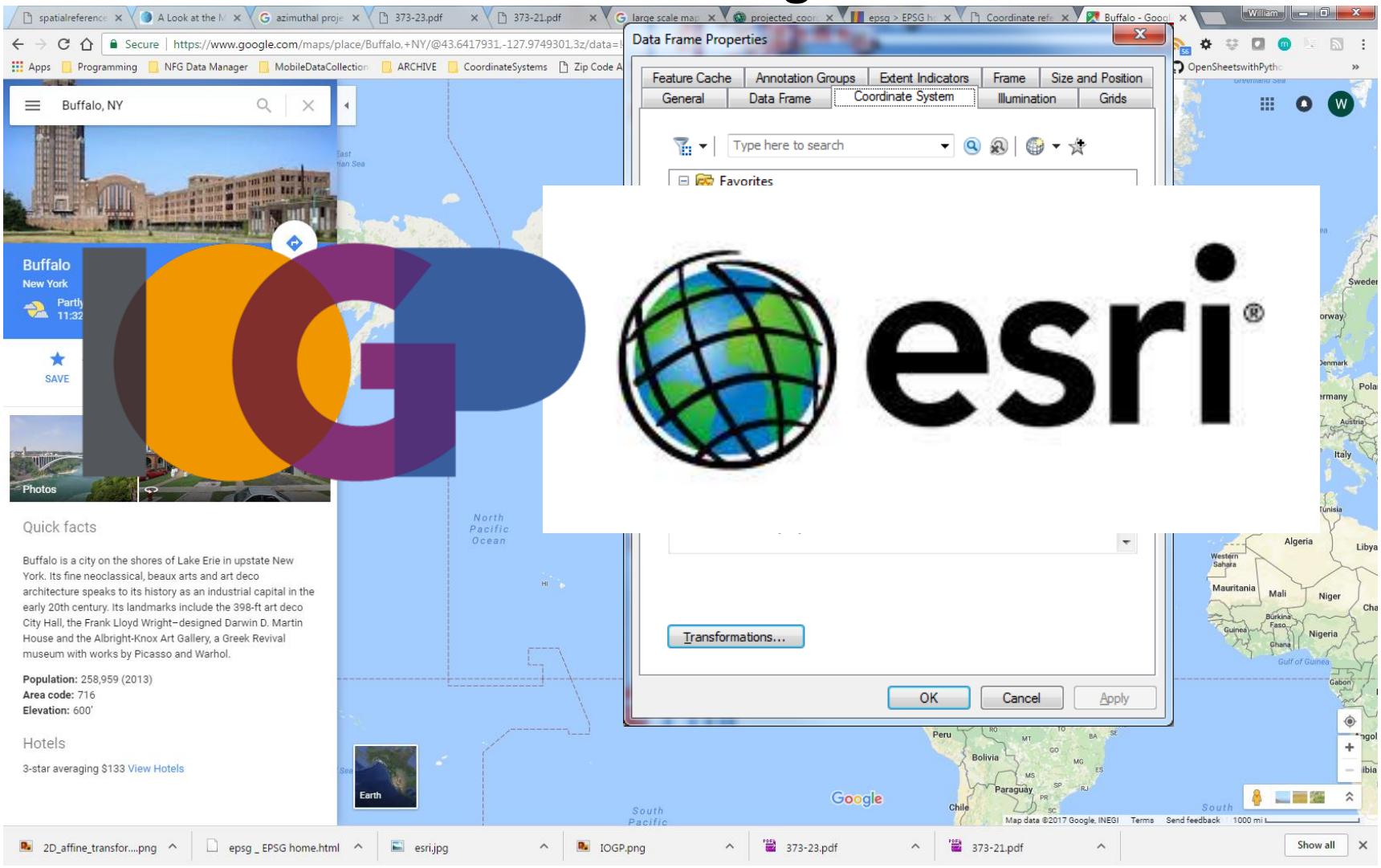




Using Spatial Reference Systems

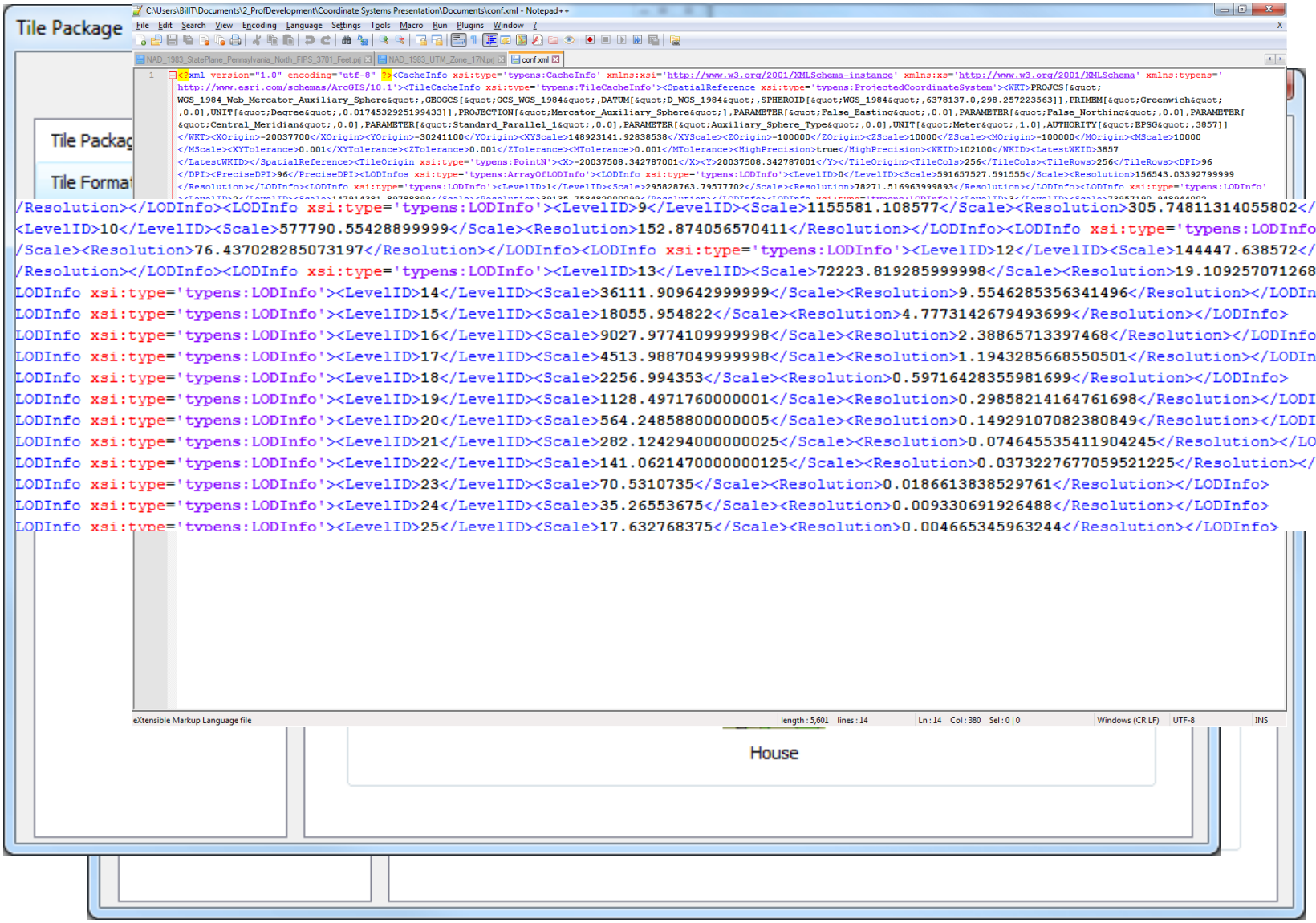
Why Web Mercator?

Because Google…



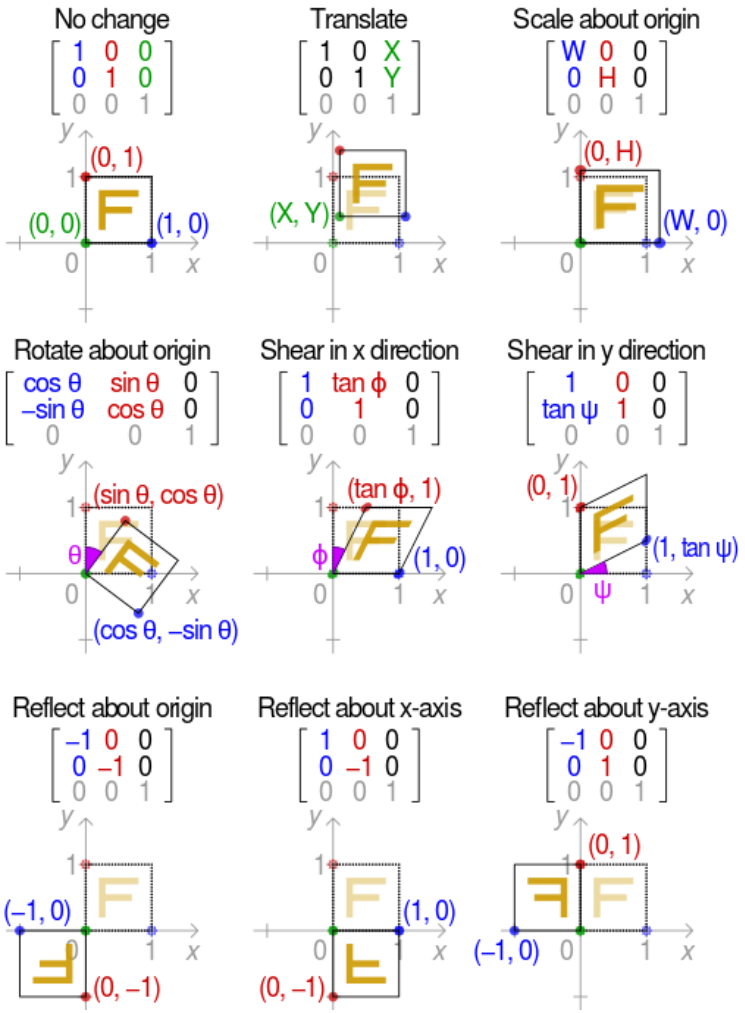
Using Spatial Reference Systems:

Hacking the Zoom Levels in Collector

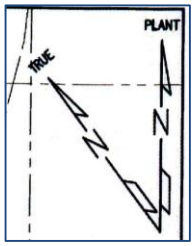


Using Spatial Reference Systems

Coordinate System Transformations



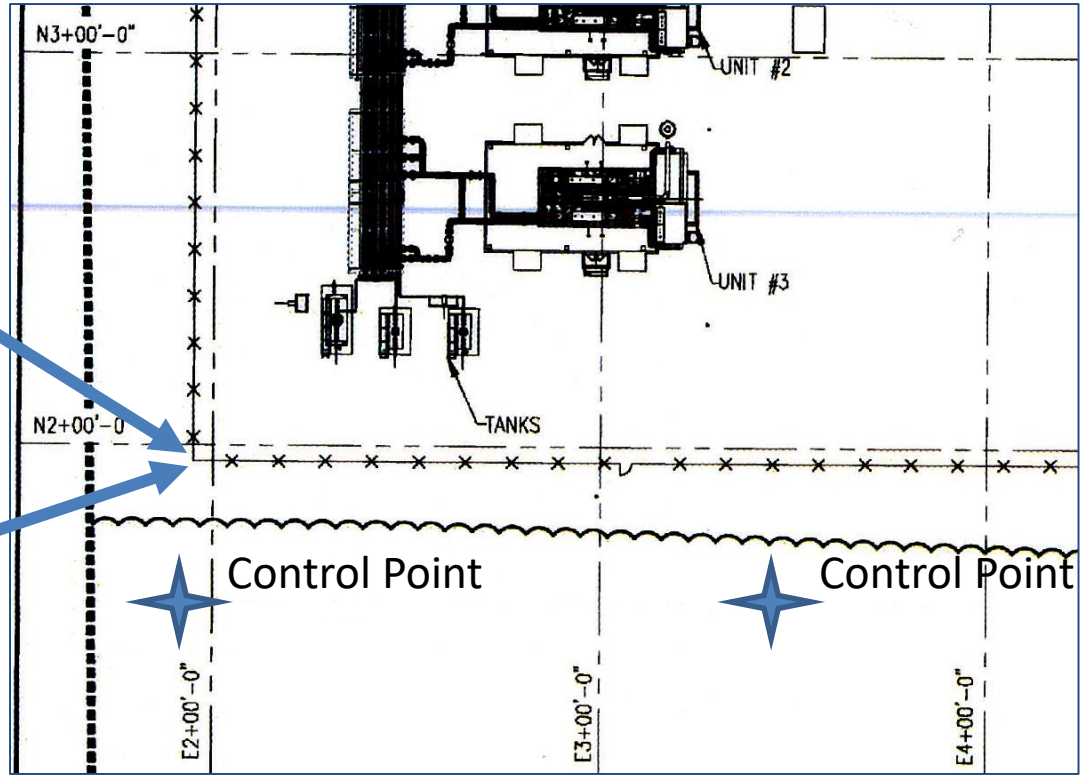
Strange Coordinate Systems: Construction Coordinates



Construction Grid Coordinates

N 1664571.88 US Survey Feet
E 556708.76 US Survey Feet

N 1+96’ – 0”
E 1+96’ – 0”

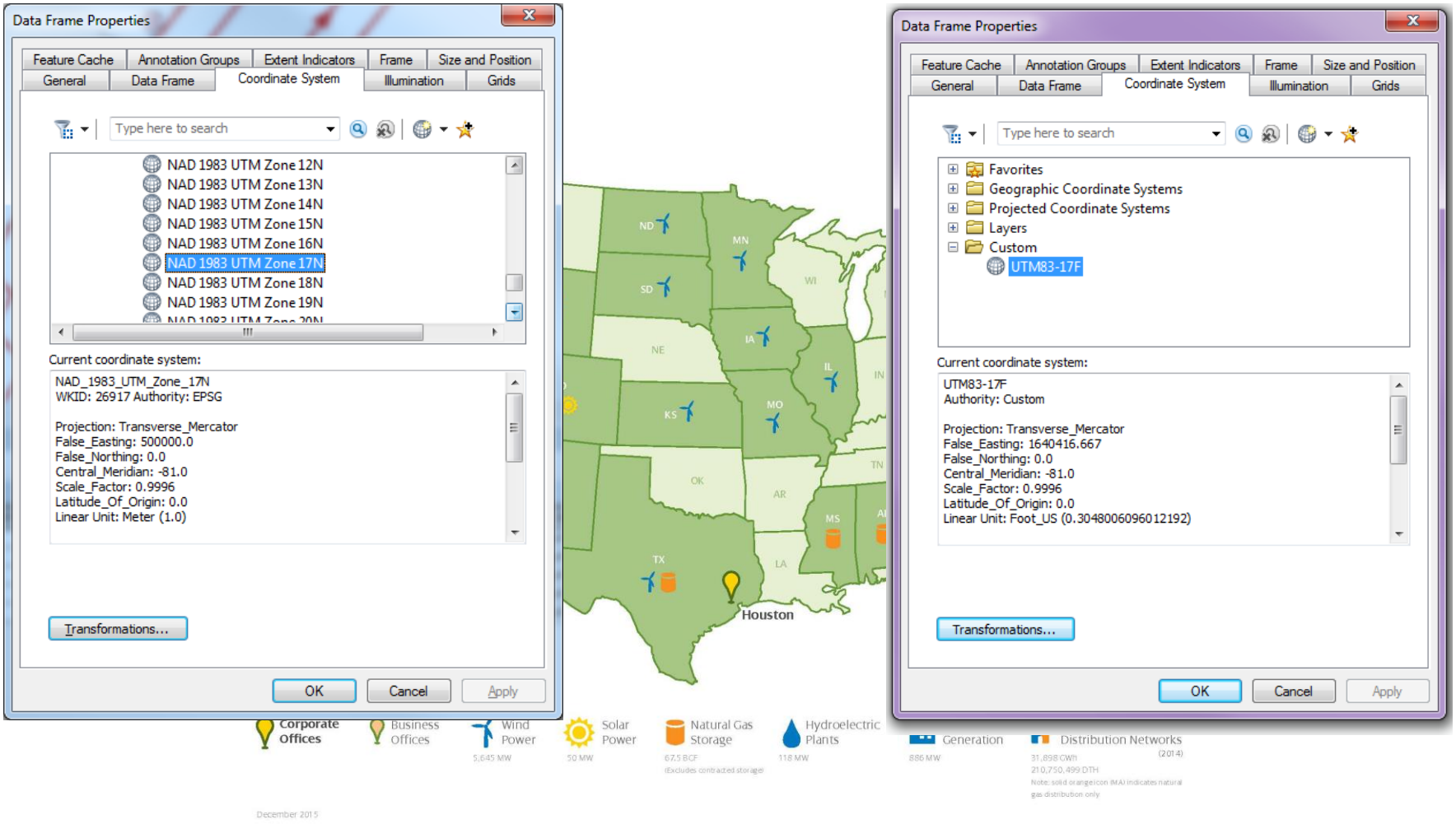


NAD83(2011) → Construction Grid Coordinates → NAD83(2011)

E0+00’-0”

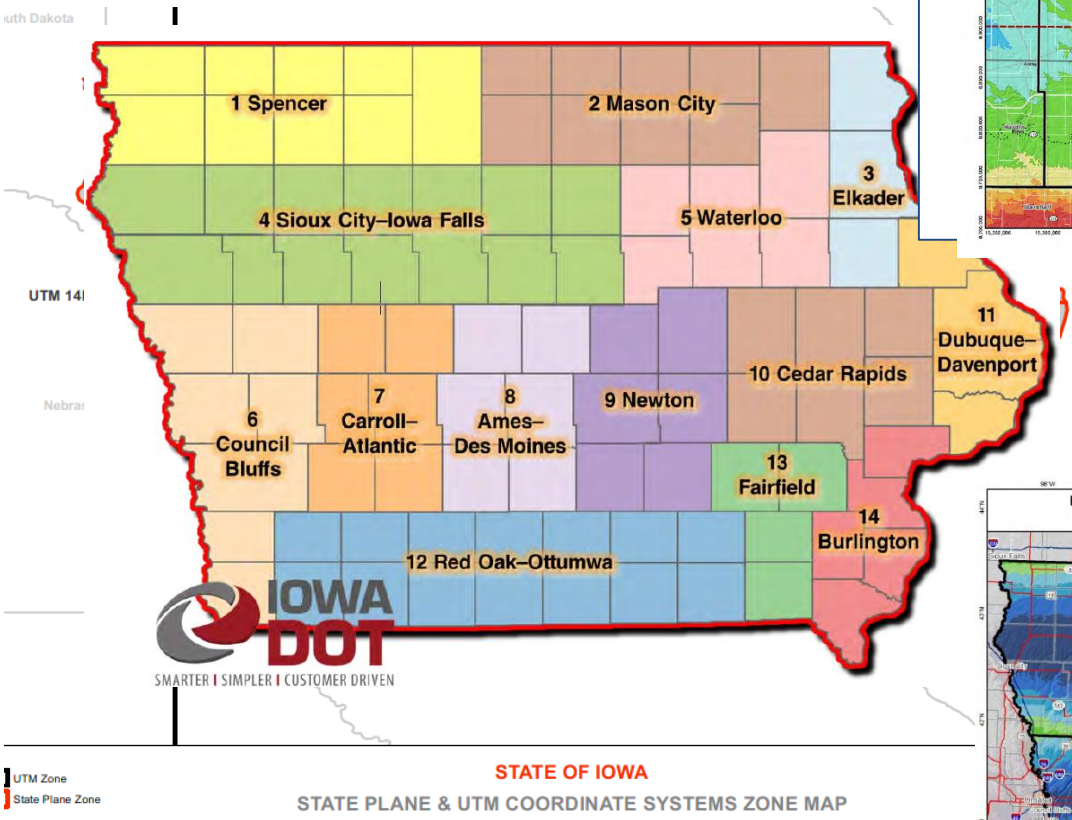
N0+00’-0”

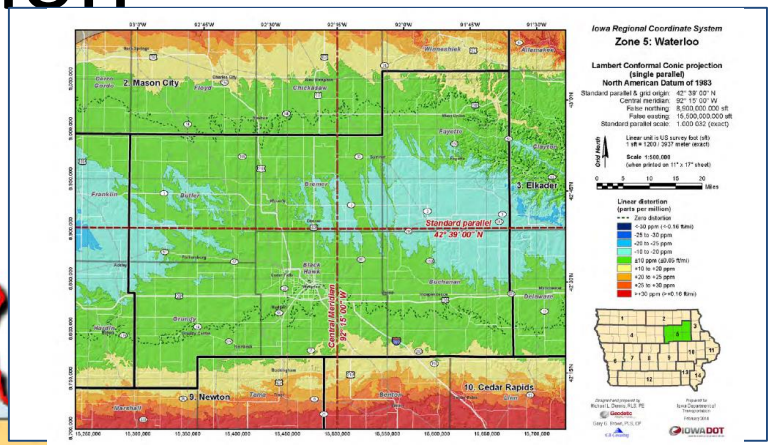
Strange Coordinate Systems: UTM-17F???

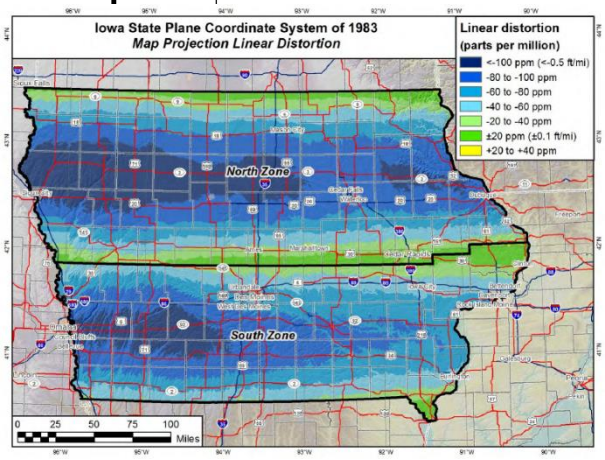


Strange Coordinate Systems: SPCS Rebellion

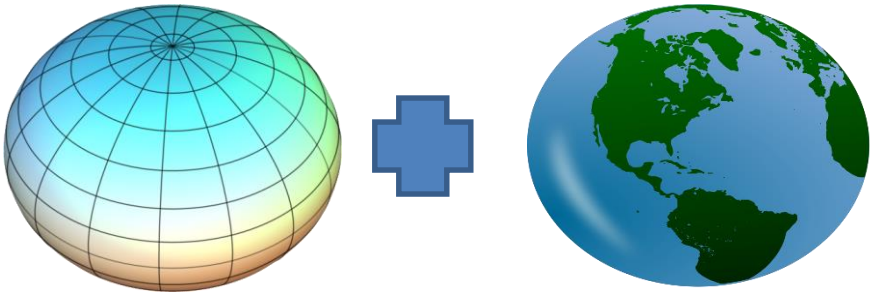
The Iowa Regional Coordinate System (IaRCS)







Take Away Points

Datum = 

Old NAD83 tracked the center of Earth's mass, new NAD83 tracks North America's crust.

Sources for education…educate yourself, ask questions from trusted sources/vendors. The coordinate buck stops with us!

Closing Thoughts