

New NAD83(2011) Adjustment

**MSPS Annual Conference
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NGS Advisor**



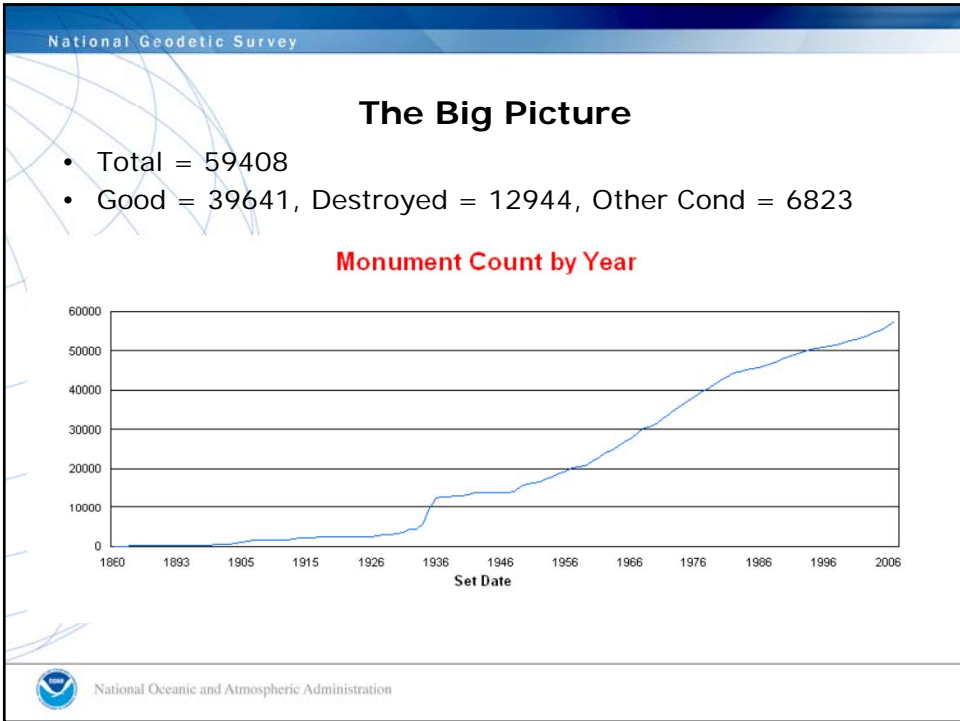
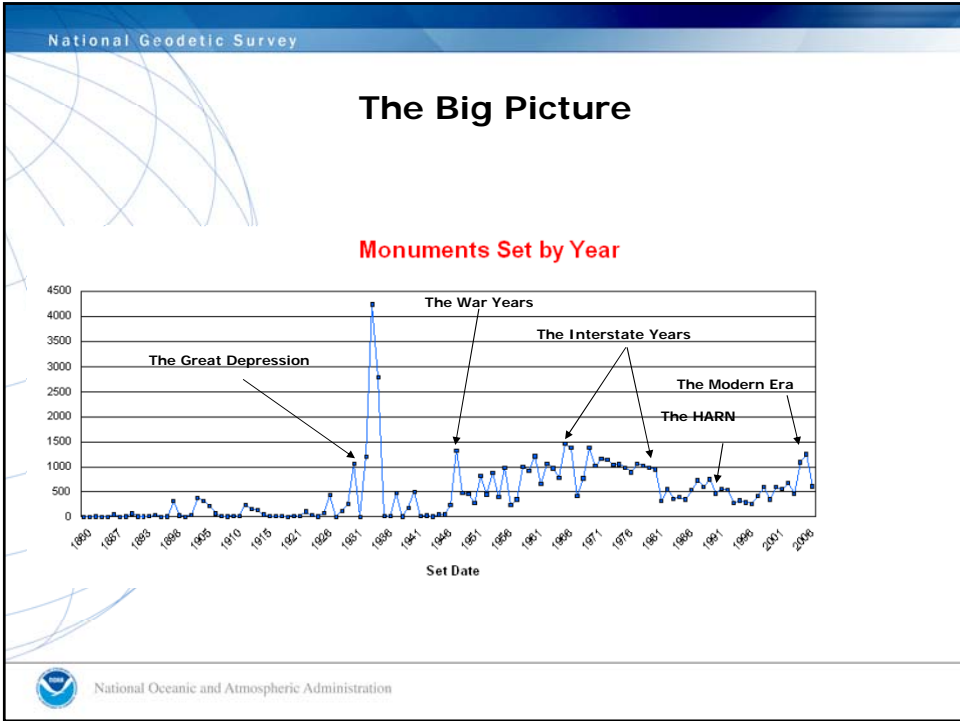
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A Brief History of Time in MN

- Reveal the development of the physical Geodetic Control Placement in MN from 1860 through 2007.
- Outline the historical Datums and Adjustments used over time.



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Sample Legend

Marks Set in the 2000 Decade
Contributors of Geodetic Control Data and number of marks

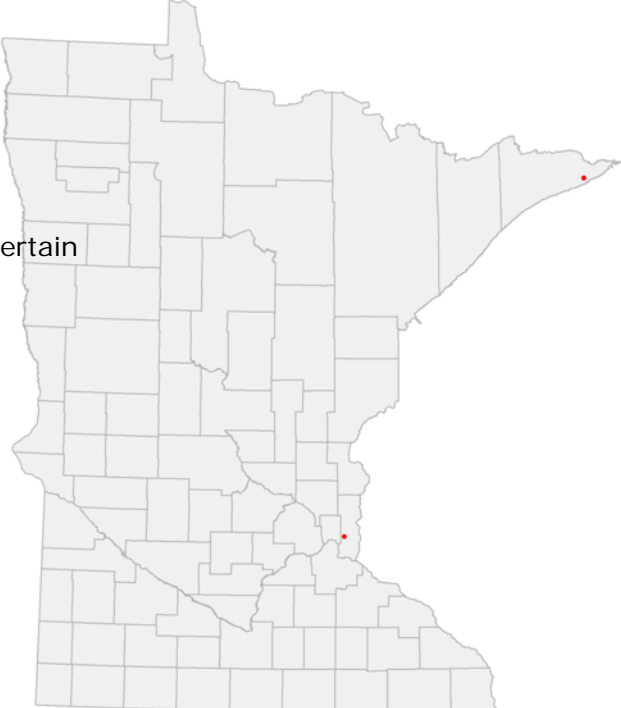
- National Agencies
- Inter-State or Inter Province Agencies
- ▲ State, Province, Commonwealth, and Territorial Agencies
- ◆ County Agencies
- ★ Other Agencies


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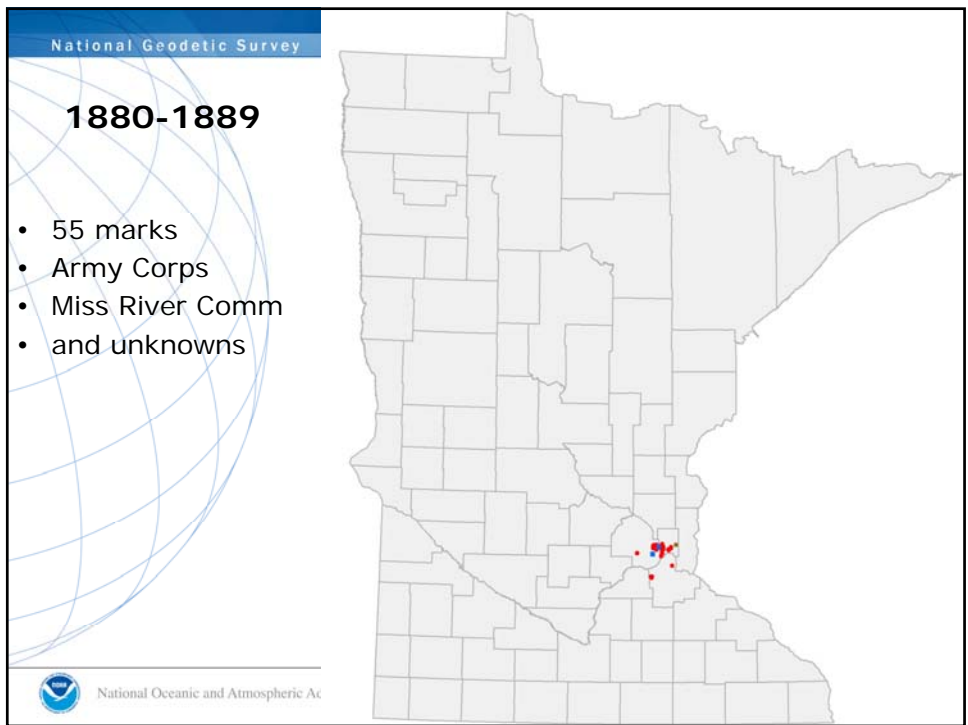
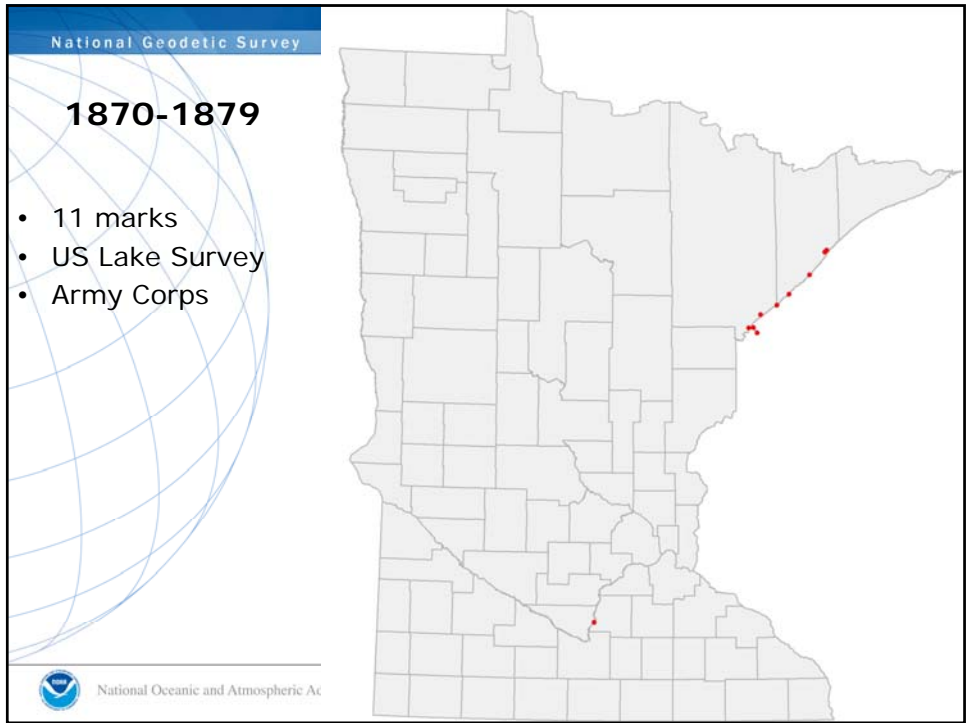
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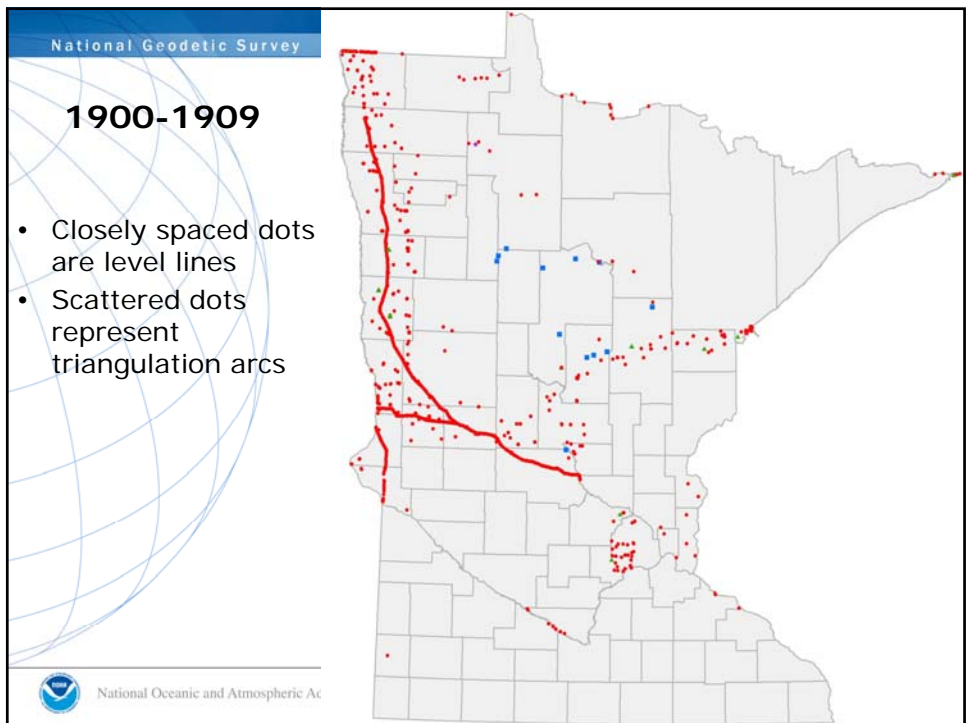
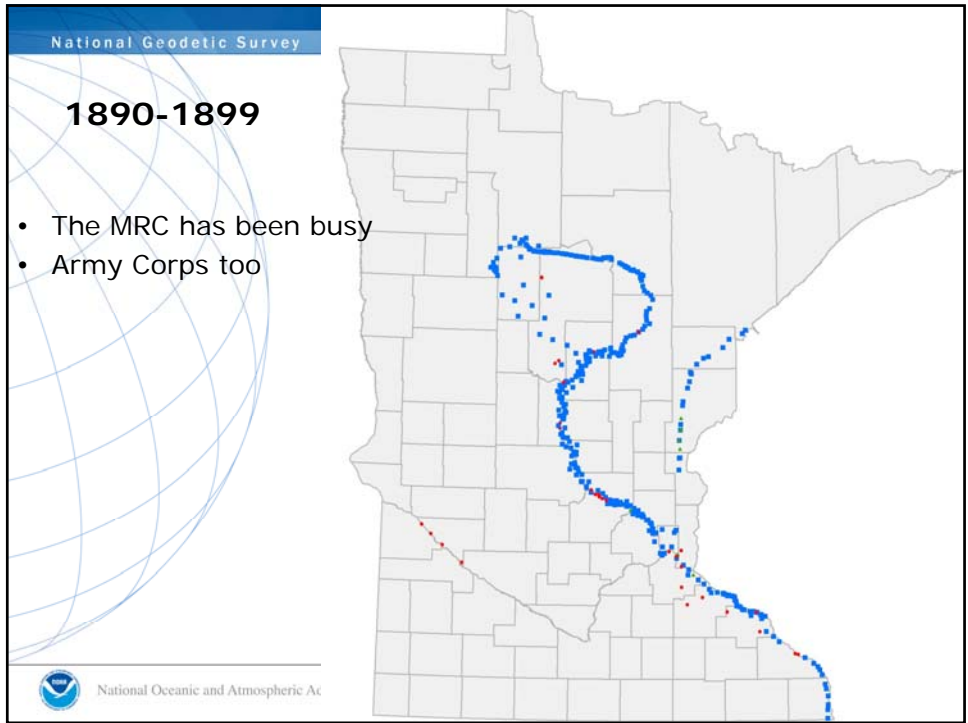
1860-1869

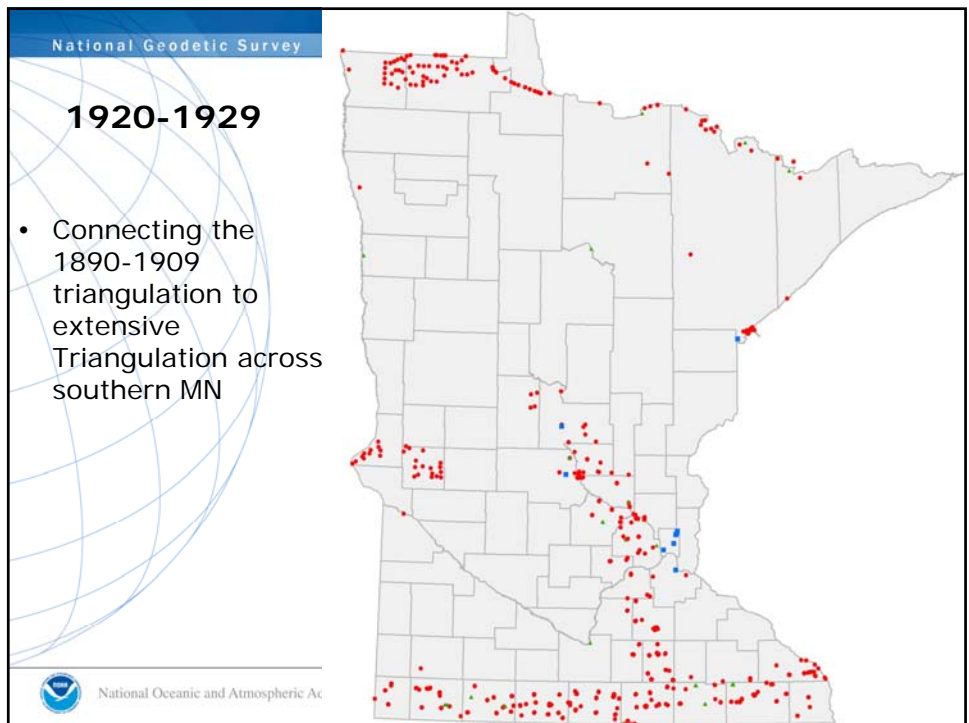
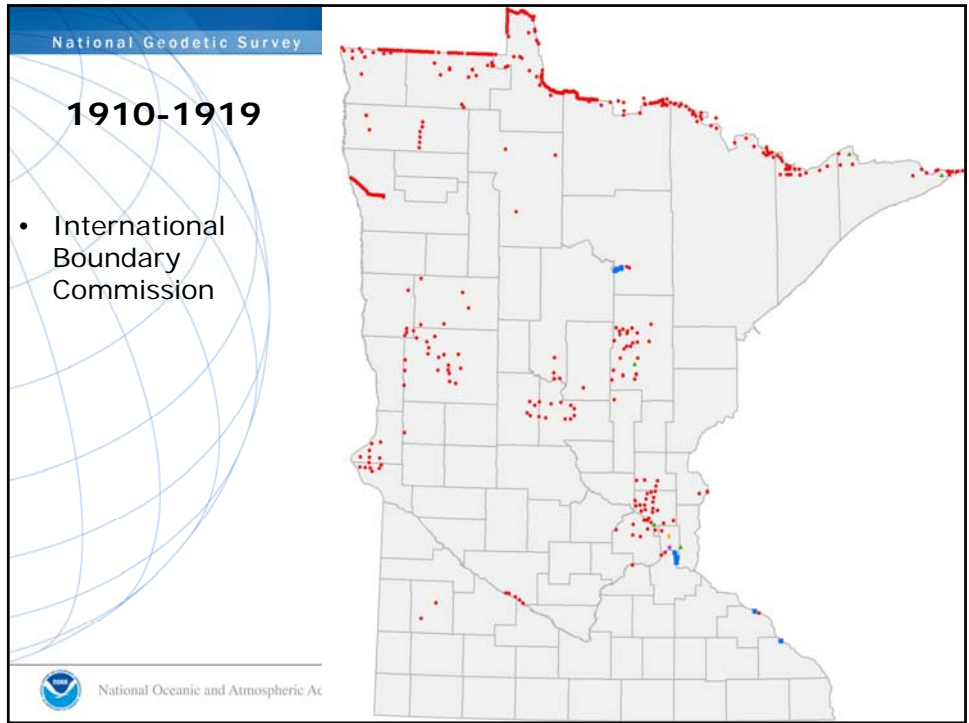
- 3 marks
- Old set dates are uncertain

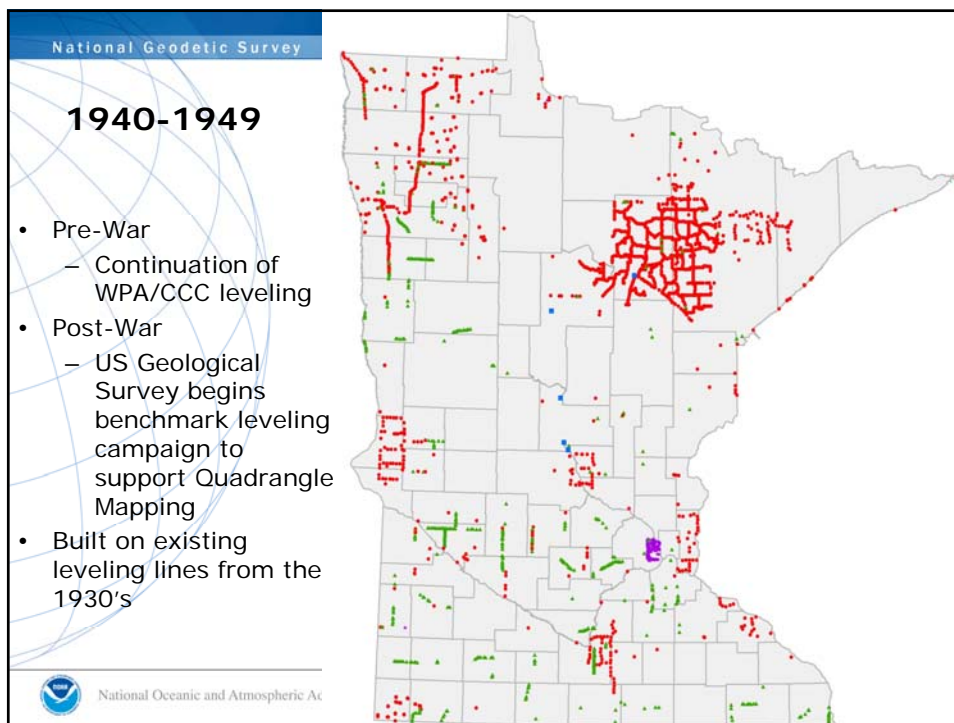
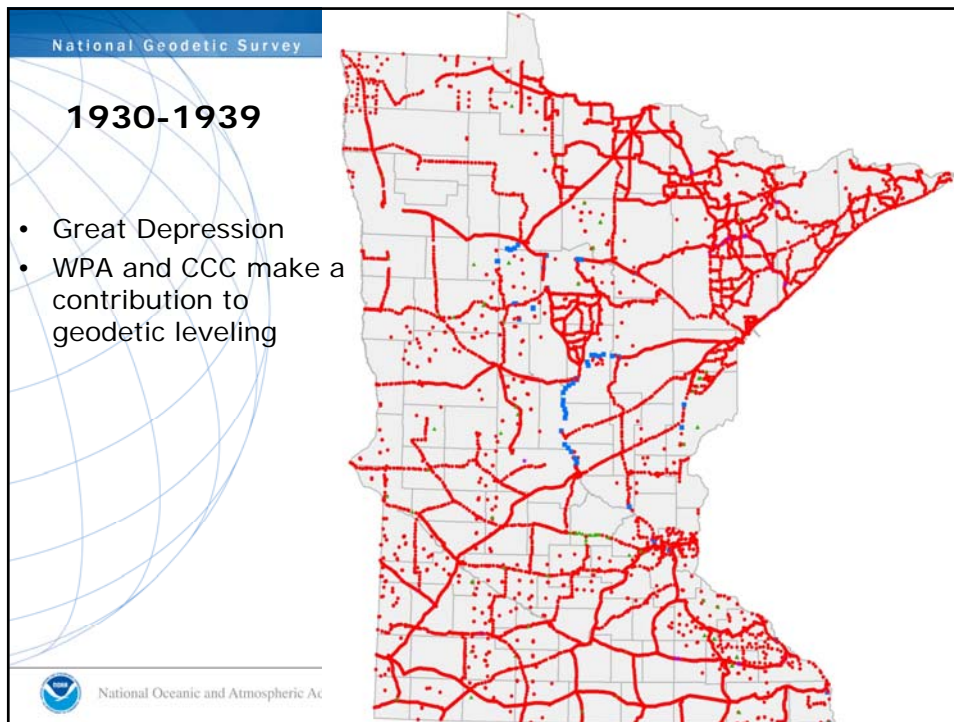


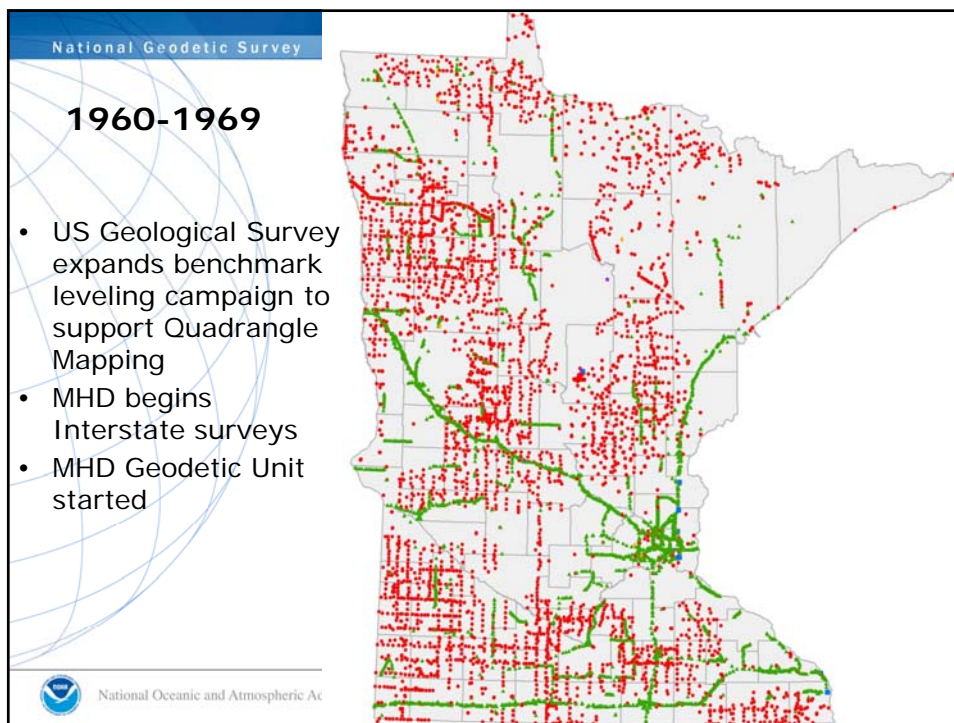
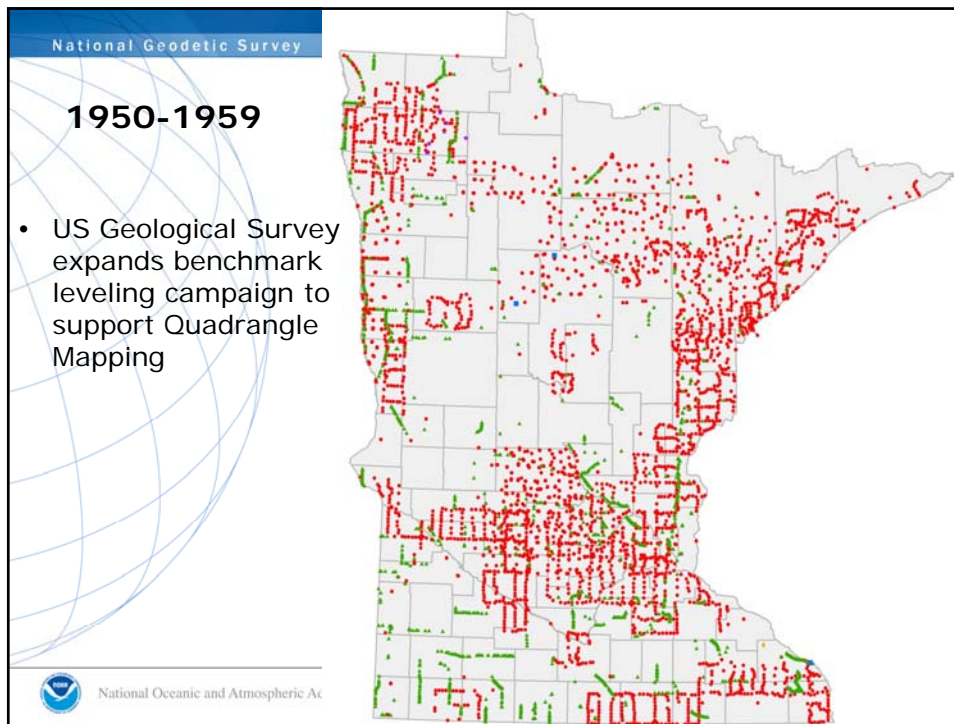
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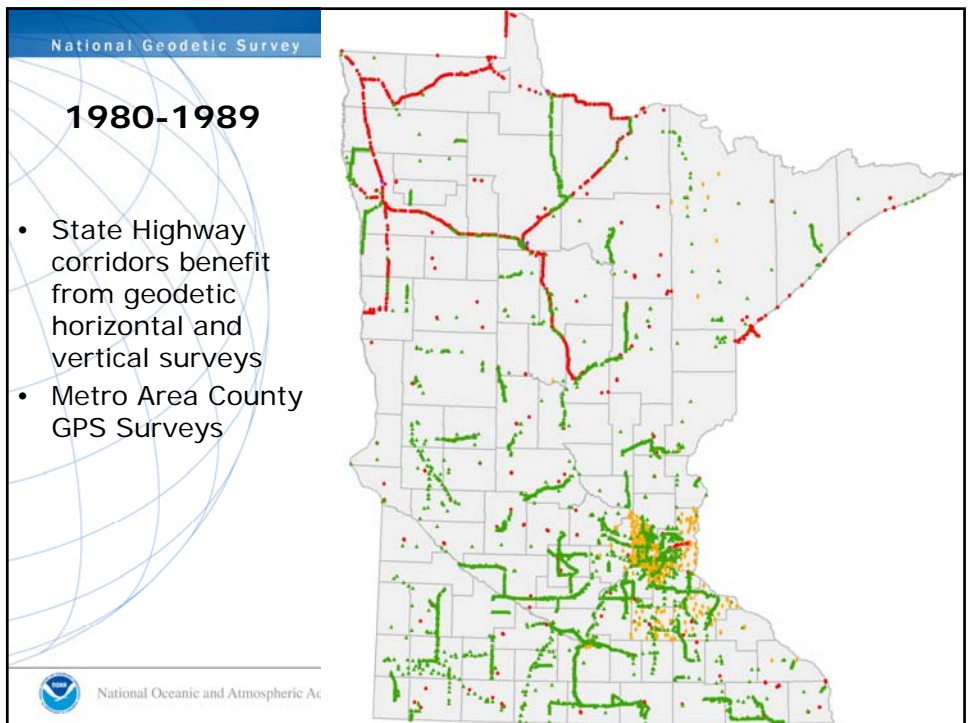
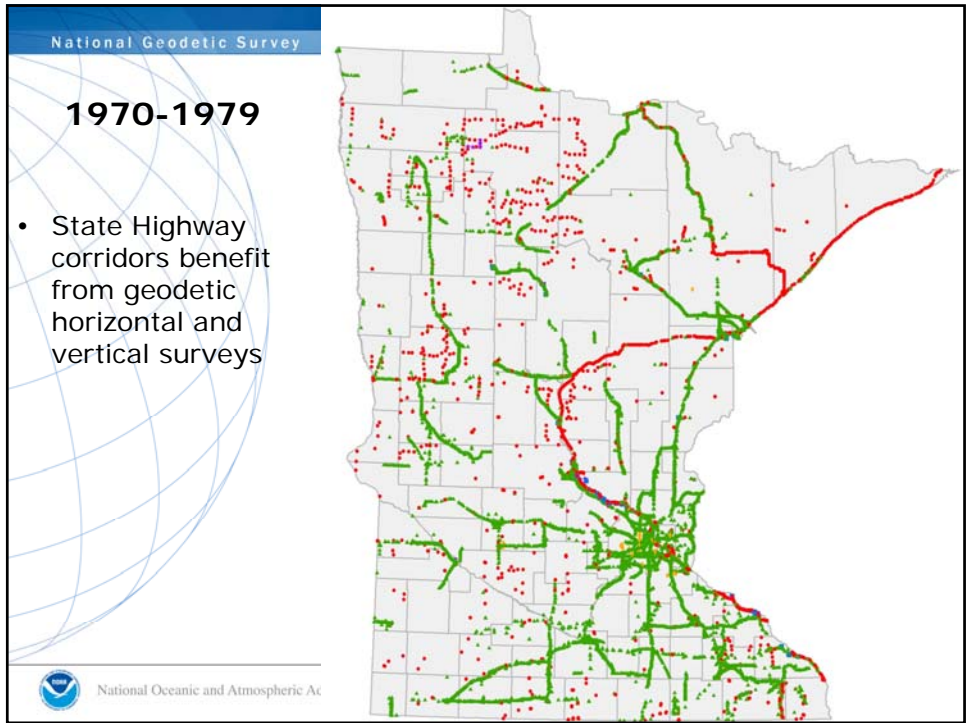


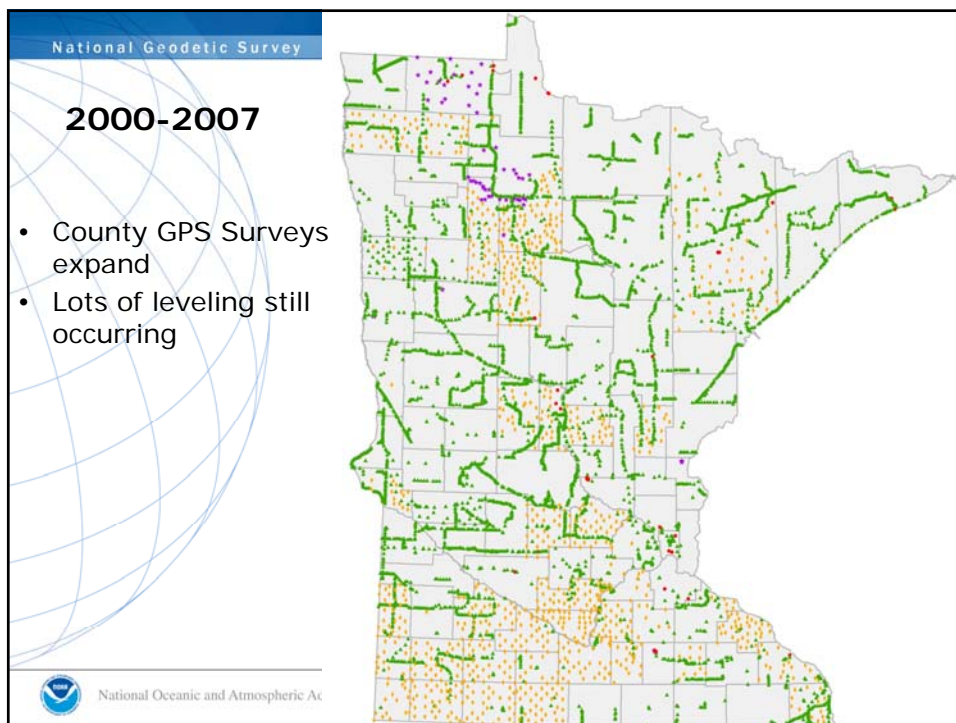
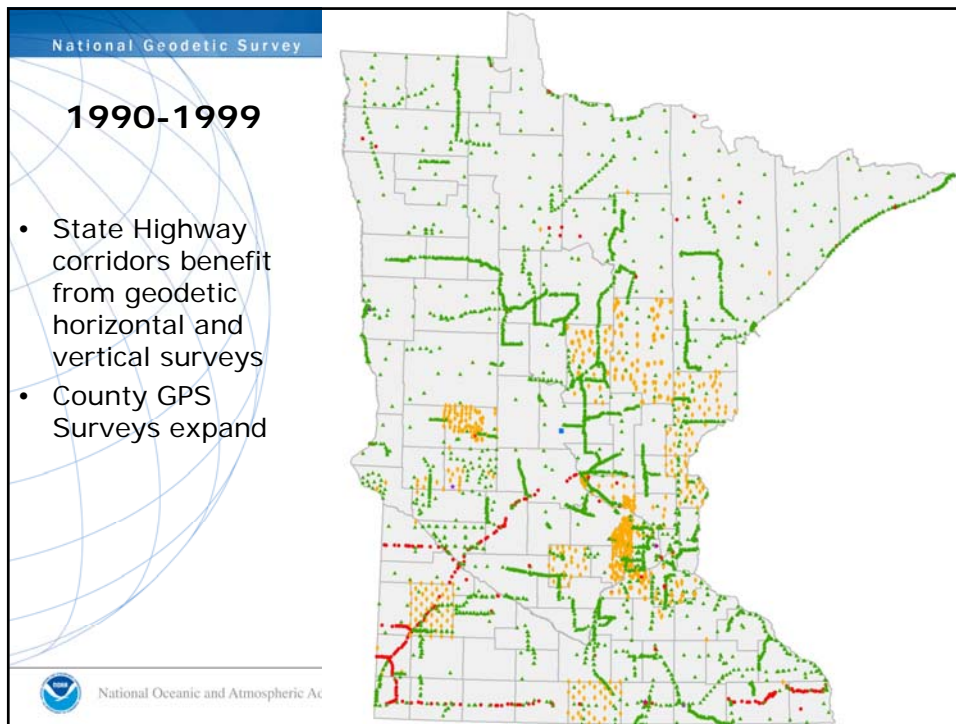


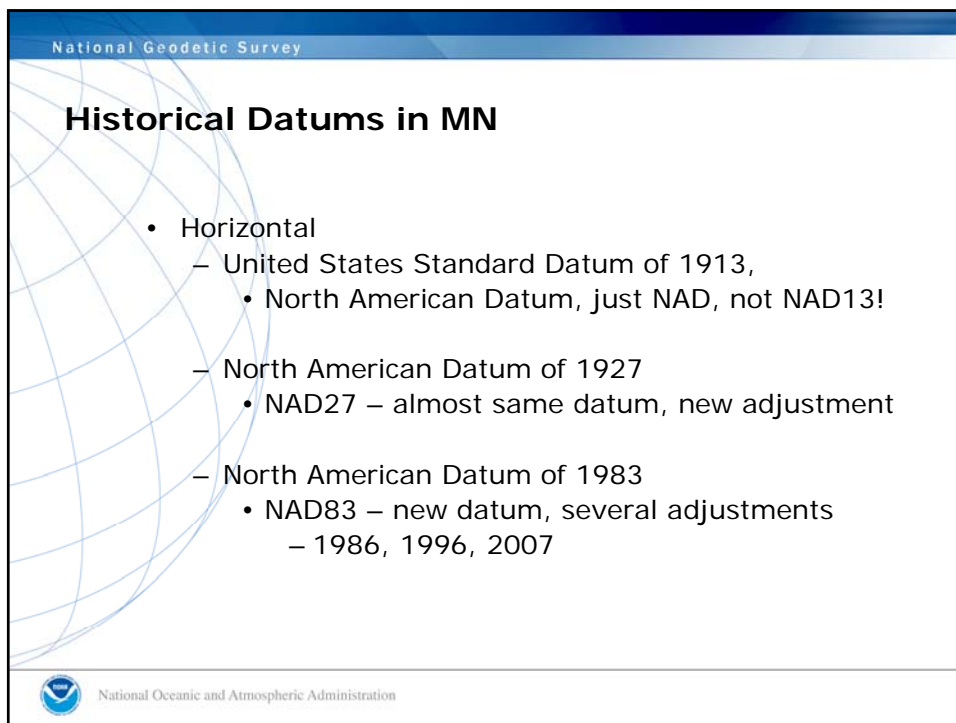
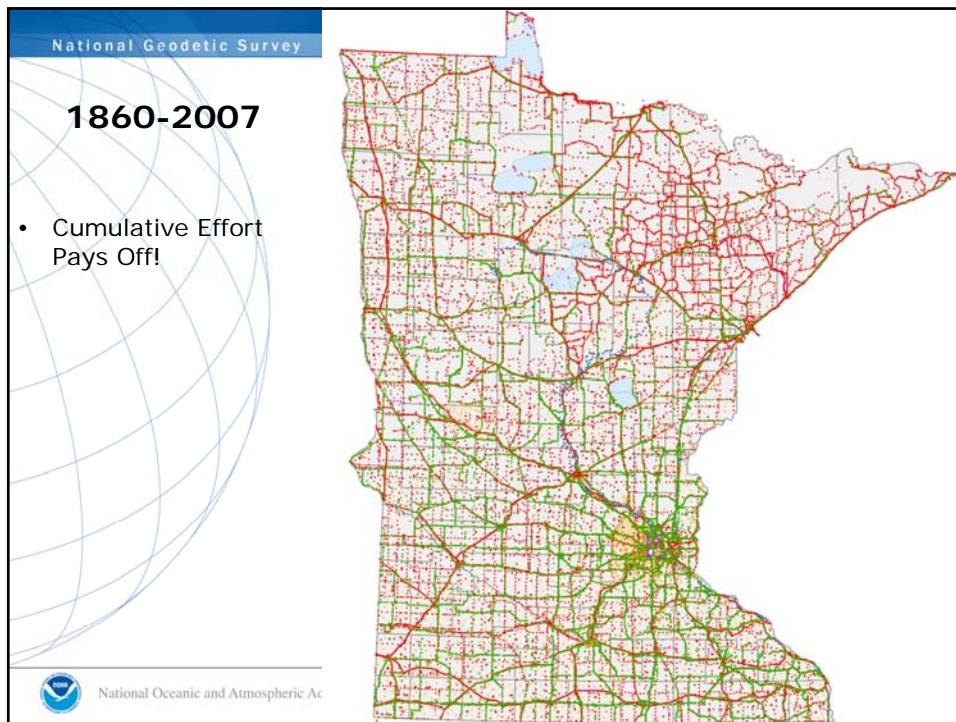












Sample Datum/Adjustment Shifts

TUCKY MNDT Nicollet County Coordinates (meters)					
Datum Tag	Easting	E Shift		Northing	N Shift
NAD27	n/a			n/a	
NAD83(1986)	176327.286			82099.219	
NAD83(1996)	176327.312	-0.026		82099.328	-0.109
NAD83(2007)	176327.300	0.012		82099.343	-0.015



Sample Datum/Adjustment Shifts

ANTRIM MNDT					
Datum Tag	Longitude	Lon Shift (m)		Latitude	Lat Shift (m)
NAD27	94 26 33.36931			43 52 36.98645	
NAD83(1986)	94 26 34.22535	26.357		43 52 36.83501	-3.232
NAD83(1996)	94 26 34.22980	0.137		43 52 36.83769	0.057
NAD83(2007)	94 26 34.23013	0.010		43 52 36.83833	0.014



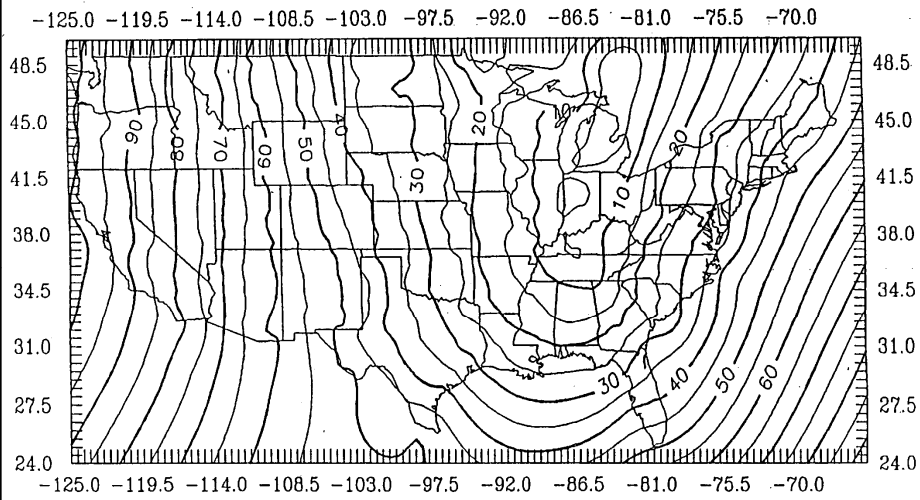
Sample Datum/Adjustment Shifts

APGAR MNDT				
Datum Tag	Longitude	Lon Shift (m)	Latitude	Lat Shift (m)
NAD27	93 31 49.11572		44 47 03.08770	
		25.631		-2.836
NAD83(1986)	93 31 49.94811		44 47 02.95481	
		0.031		0.111
NAD83(1996)	93 31 49.94913		44 47 02.96001	
		n/a		n/a
NAD83(2007)	not GPS		not GPS	



Historical Datums in MN • Shifts from NAD27 to NAD83

MAGNITUDE OF DATUM SHIFT (METERS)



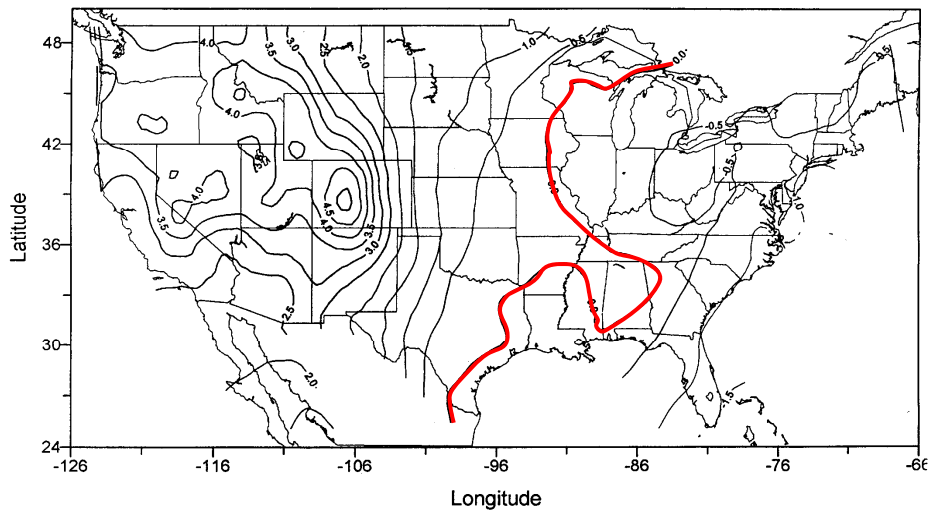
Historical Datums in MN

- Vertical
 - Great Lakes Datums
 - USLS1903, USLS1935, IGLD1955, IGLD1985
 - Mississippi River Datums
 - Cairo, Memphis, Mean Gulf Level, others
 - St Paul City Datum (-694.28 ft)
 - Minneapolis City Datum (-710.48 ft)
 - National Geodetic Vertical Datum of 1929 (NGVD29)
 - North American Vertical Datum of 1988 (NAVD88)

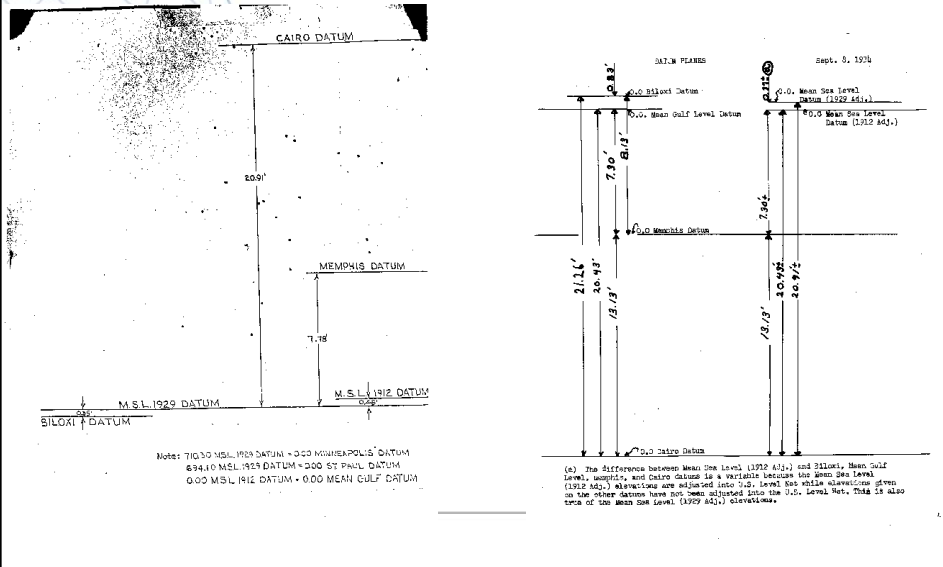


Historical Datums in MN

NAVD88 - NGVD29 (feet)



General Relationships Among Vertical Datums



Historical Datums in MN

- National Height Modernization
 - GPS + GEOID = ORTHOMETRIC HEIGHT
- 3D Datum of 2022
 - Is this the Future?
 - If everything is moving, what does a datum mean?
 - Is there anything that's not moving?
- WANT MORE DETAIL?
 - <http://www.olmweb.dot.state.mn.us>
 - Technology and Tools – then download:
 - 2007 Adjustment of the National Spatial Reference System in Minnesota
 - Geodetic History in MN



National Geodetic Survey

Datum Conversion Tools

- HORIZONTAL Conversion Tools
 - NADCON - NGS converter from NAD27 to NAD83
 - MNCON – MNDOT written conversion tool
 - CONAD – DOS program from MNDOT, use MNCON now
- VERTICAL Conversion Tools
 - VERTCON - NGS converter from NAD27 to NAD83
- Combined Conversion Tools
 - CORPSCON – US Army Corps of Engineers
 - Combines NADCON and VERTCON

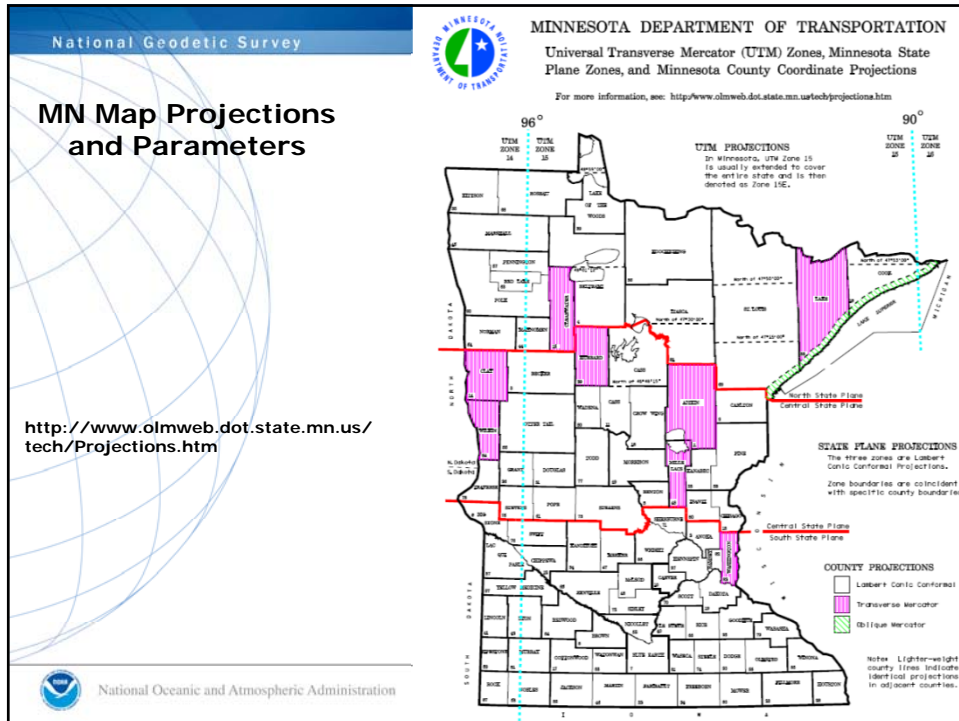
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MNCON

<http://www.olmweb.dot.state.mn.us/tech/OlmSoftware.html#MCN>

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National Geodetic Survey

New NAD83(2011) Adjustment

- NAD83(1986) Original realization
 - Consisted (almost) entirely of classical (optical) observations
- NAD83(1996)
 - “High Precision Geodetic Network” (HPGN) and High Accuracy Reference Network” (HARN) realizations
 - Most done in 1990s, essentially state-by-state
 - Based on GNSS but classical stations included in adjustments

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New NAD83(2011) Adjustment

- NAD83(2007) National Re-Adjustment of 2007
 - Used NAD 83(CORS96) epoch 2002.0 as constraint
 - Simultaneous nationwide adjustment (GNSS only)
- Needed badly to resolve the state-by-state biases of the “HARN” era adjustments.
- Underlying CORS coordinates were known to be less-than-perfect, but the Multi-Year CORS Solution (MYCS) was not even close to completed.



New NAD83(2011) Adjustment

- Completion of MYCS in 2011 made a set of constraints available that could truly be described as: “state-of-the art”
 - Reprocessed all CORS GPS data 1994-2011
 - 2264 CORS & other global GPS tracking stations
 - New orbits were computed for all satellites for all years.
 - The X,Y,Z and V_x,V_y,V_z for every CORS was solved for as unknowns in a set of millions of equations
 - Accurate computed velocities and consistent coordinates for all CORS



New NAD83(2011) Adjustment

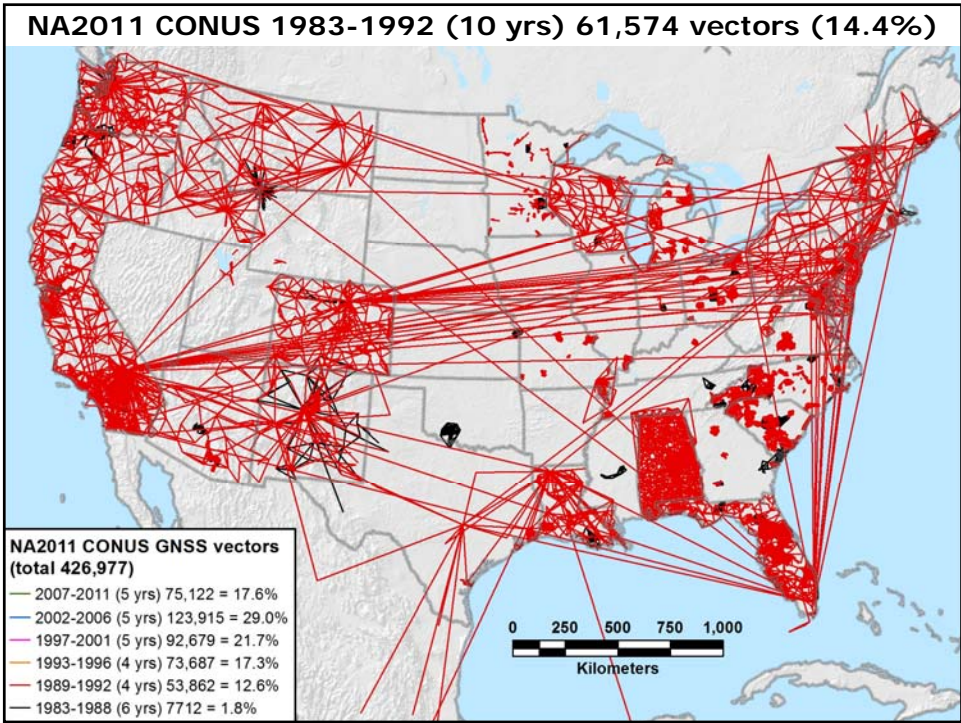
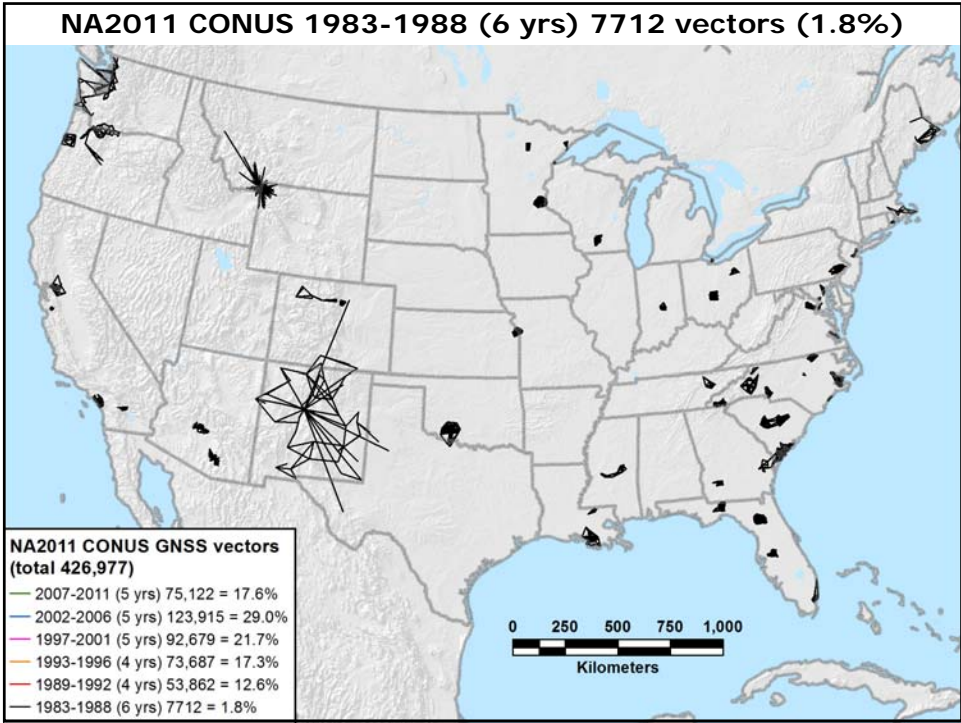
- Using the MYCS coordinates and velocities as constraints – the new adjustment could include:
 - 4196 projects
 - 80,077 stations
 - 430,766 vectors total – approx 387,000 enabled
- New realization: NAD 83(2011) epoch 2010.00



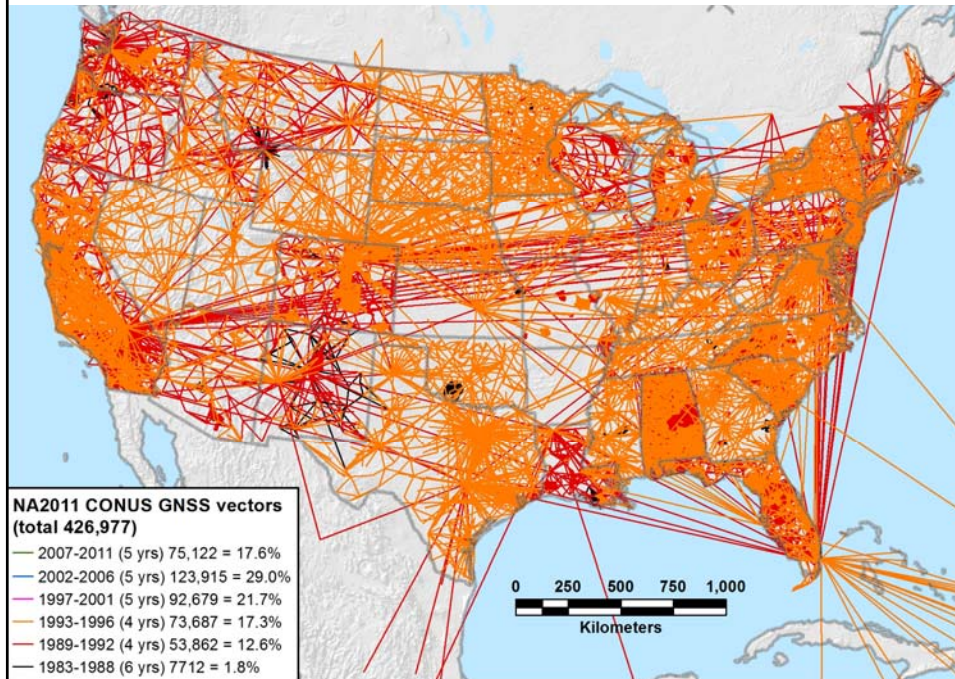
New NAD83(2011) Adjustment

- Build up of network over time

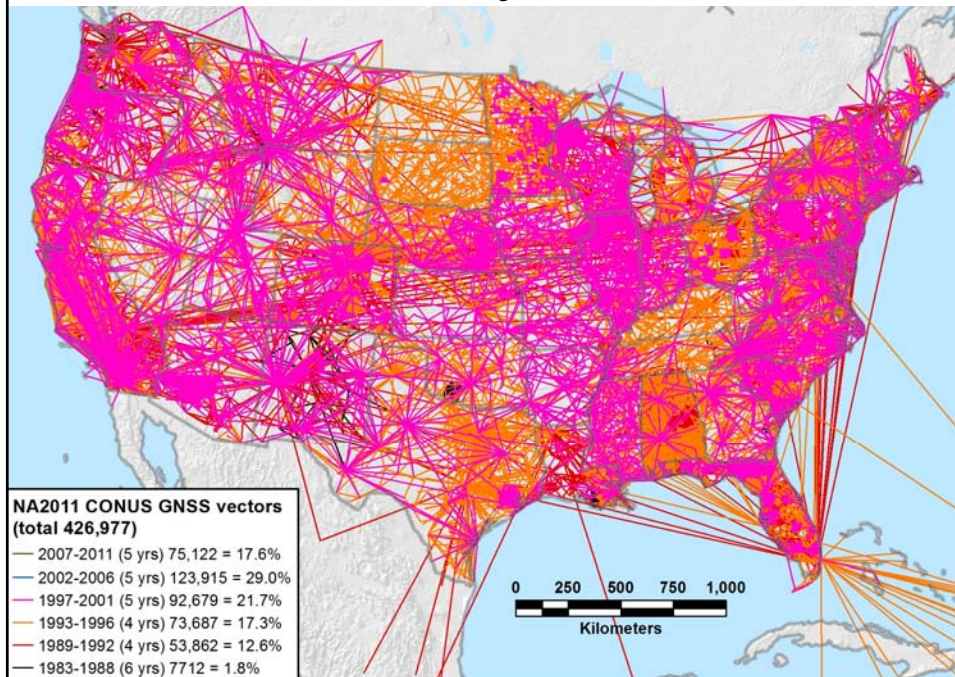




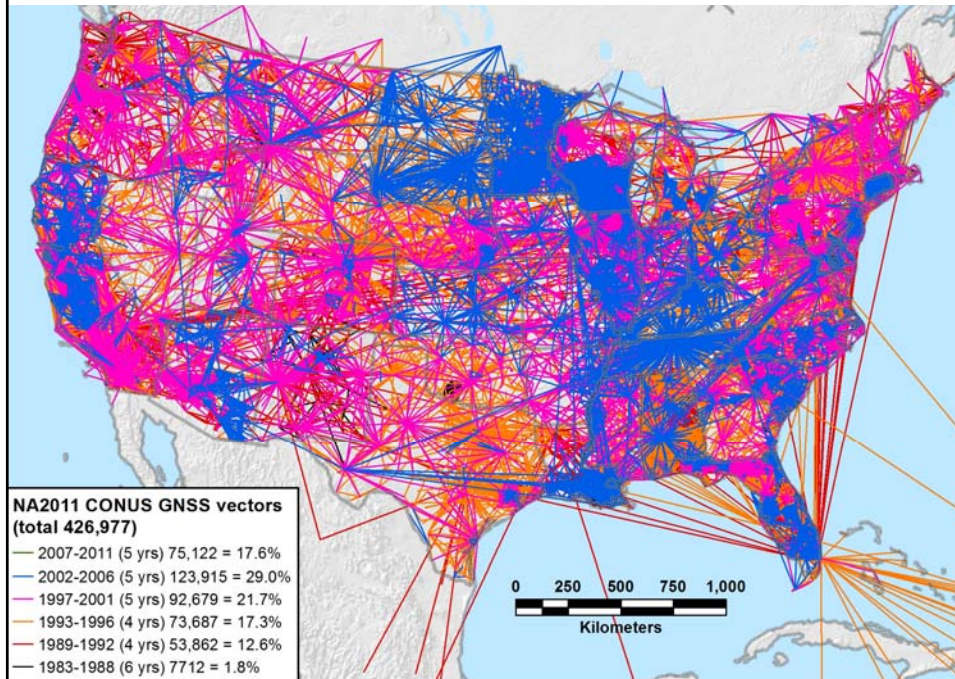
NA2011 CONUS 1983-1996 (14 yrs) 135,261 vectors (31.7%)



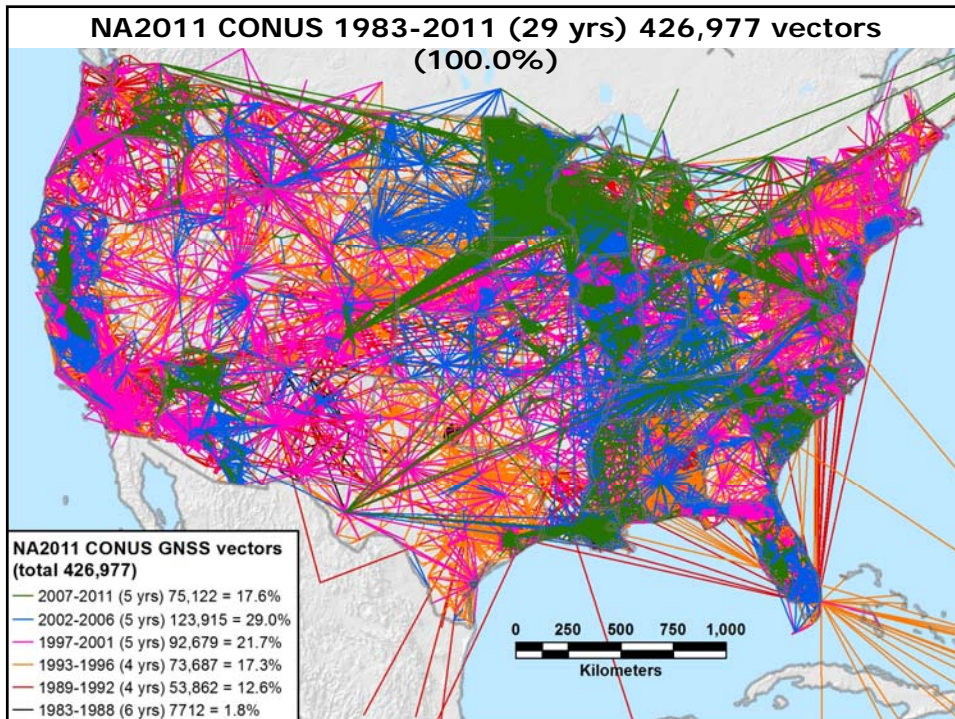
NA2011 CONUS 1983-2001 (19 yrs) 227,940 vectors (53.4%)

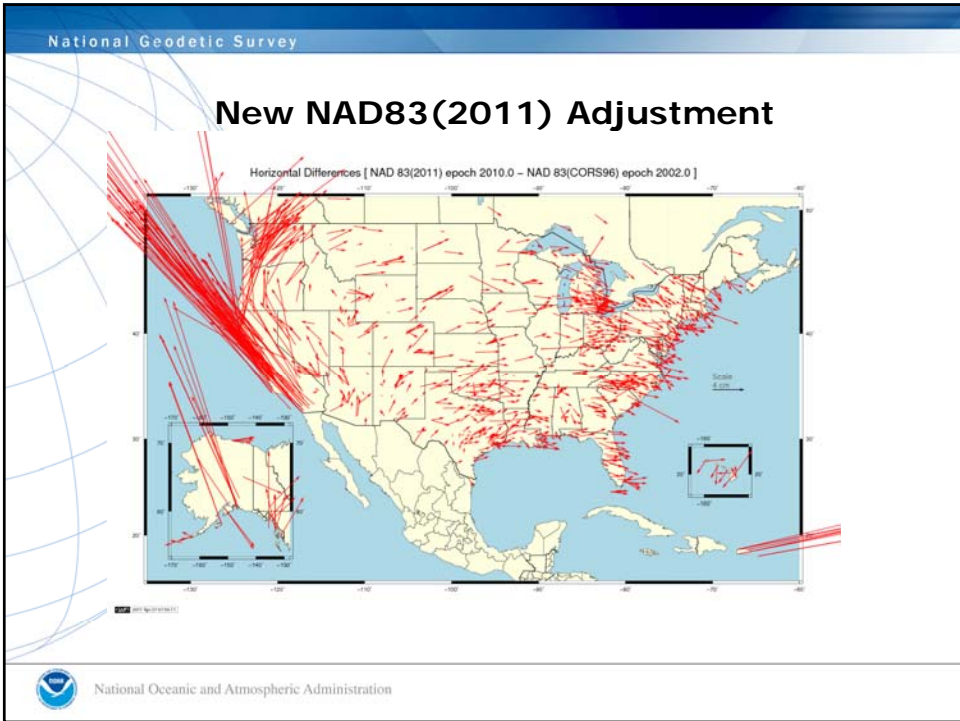
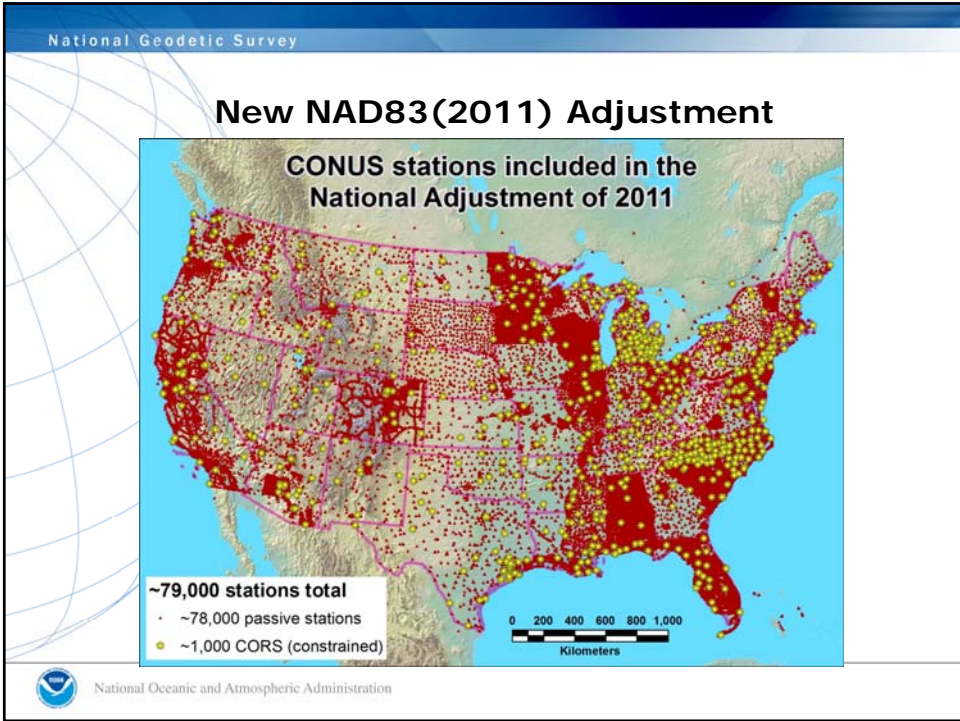


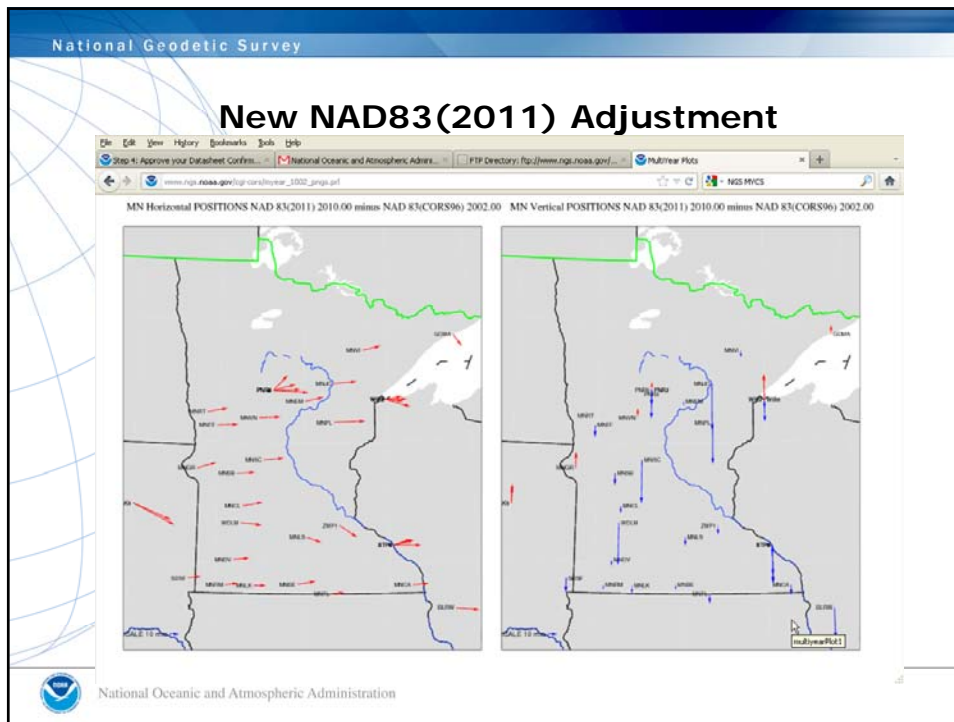
NA2011 CONUS 1983-2006 (24 yrs) 351,855 vectors (82.4%)



NA2011 CONUS 1983-2011 (29 yrs) 426,977 vectors (100.0%)







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New NAD83(2011) Adjustment

- NAD 83(CORS96) epoch 2002.00 → NAD 83(2011) epoch 2010.00
- Expect overall coordinate change about same as MYCS
 - Horizontal: Mean ~2 cm (± 8 cm), median ~0 cm
 - Vertical: Mean ~ -1 cm (± 2 cm), median ~ -1 cm
 - This is for change in realization **and** reference epoch

- In MINNESOTA, the changes are about
 - Horizontal: about 2 cm
 - Vertical: about 2-3 cm

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New NAD83(2011) Adjustment

- Changes in Ellipsoid Heights mean that a new GEOID Model will be needed.
- New hybrid geoid model (GEOID12)
 - Use NAD 83(2011) epoch 2010.00 ellipsoid heights on NAVD 88 benchmarks
 - Might also use OPUS-Database results on NAVD 88 BMs
 - Plan release same time as NA2011



New NAD83(2011) Adjustment

- Multi-Year CORS Solution
 - Officially released coordinates September 2011
- National Adjustment of 2011
 - Goal: Complete by mid-April 2012
 - Deadline for submitted projects was Aug 31, 2011
- OPUS (Online Positioning User Service)
 - Provides solutions referenced both to previous (CORS96) and new (MYCS) coordinates
 - Dual solutions will be available until NA2011 complete



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Future Datum

- NGS is planning to release an all-new 3D datum
- Timeline not definite.
- Consider 10 years away.

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