Future of State Plane Coordinates

New Jersey Society of Professional Land Surveyors
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State Plane History

NOAA Special Publication NOS NGS 13

- 1933 – NC requests that C&GS create a system of plane coordinates for the state
  - Decision to use a conformal projection
  - LCC used in a single zone
  - Used NJ as a test case for TM projections
  - Designed 110 (66 LCC and 44 TM) zones for all 48 states in one year
  - 1974 manuals list 131 zones: added AK, HI, PR and VI, Guam, American Samoa, additional Louisana zone for offshore Northern Gulf of Mexico

1930's – 1960's

- **1935.** Manuals of traverse computations were published
- **1936.** Federal Board of Surveys and Maps recommended that all federal agencies "adopt the system of plane coordinates
- **1945.** "The State Coordinate Systems (A Manual for Surveyors)" was published by C&GS
- **1947.** U.S. Army replaced the World Polyconic Grid with UTM
- **1948.** "Manual of Plane-Coordinate Computation" published by C&GS
- **1950.** To encourage the use of SPCS by engineers, C&GS published a manual on its use in route surveying
- **1950-1969.** Creation of projection tables (at 1 arc-minute intervals) for use in computing SPCS coordinates for all states (except Alaska)

- **1950s.** USGS began changing its topographic quadrangle maps from the Polyconic to the projection used in the SPCS for the principal state on the map
- **1952.** In recognition of the importance of conformal projections for the C&GS and their customers, "Conformal Projections in Geodesy and Cartography" was published
- **1957.** C&GS began using electronic computers for mass computation of SPCS 27 coordinates
- **ca. 1960.** C&GS defined ten SPCS 27 zones for Alaska and five for Hawaii. Zone 1 for the Alaska panhandle was based on the Oblique Mercator (OM) projection
- **1968.** Formulas for computing SPCS 27 coordinates by electronic means were published

1970's

- SPCS was not as widely used in the surveying and engineering community as what NGS had hoped
  - Sparseness of existing control?
- Mostly embraced DOT's and other state agencies
- In 1974, NGS describes procedure scaling SPCS to "ground" to create a "project datum"
  - This approach was widely taught in NGS workshops from the late 1960's into the 1990's
  - Requires adequate documentation

1980's to Present

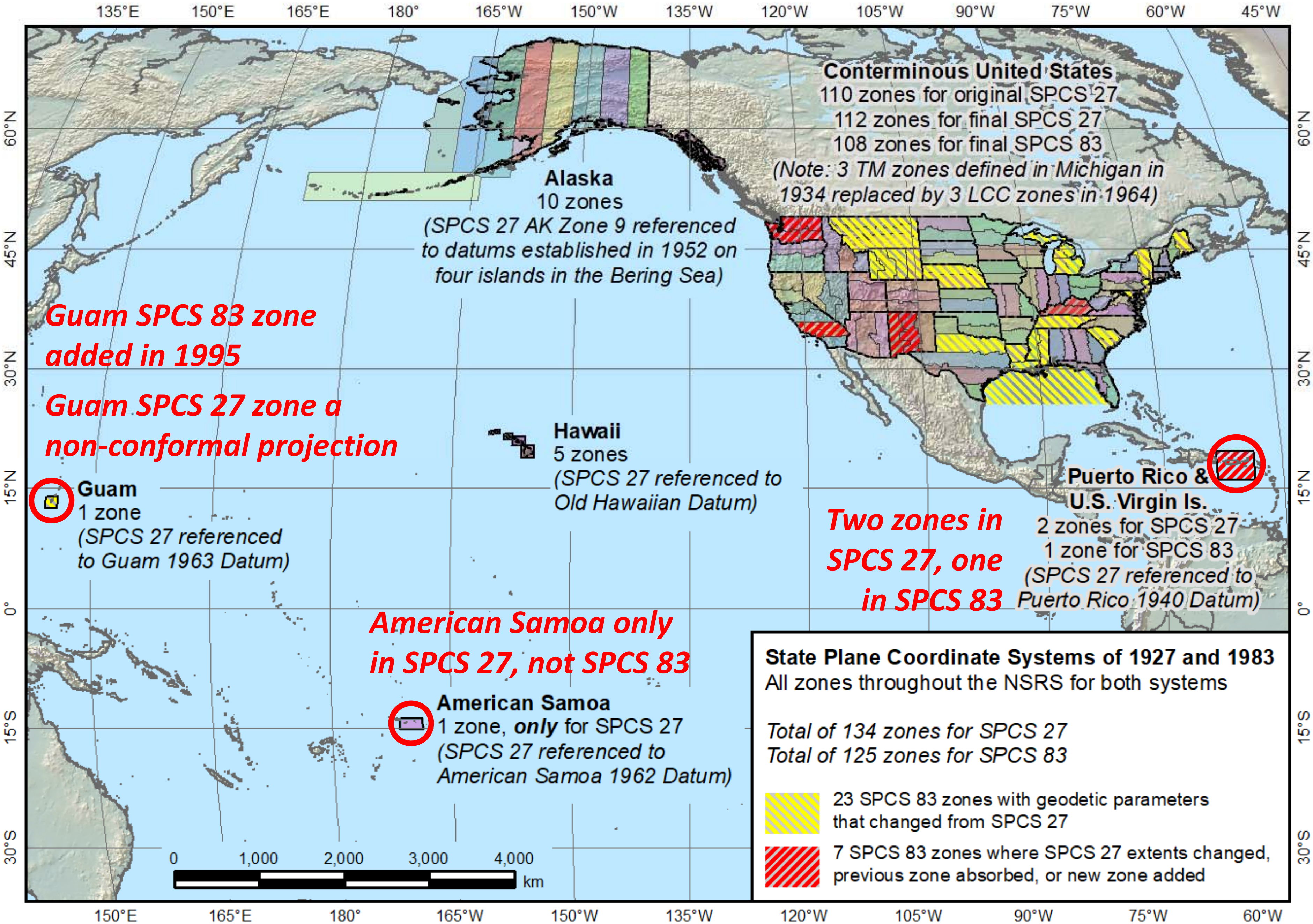
- SPCS use continues to increase
  - Byproduct of GNSS use?
- "Low Distortion" Projections adopted by some states (MI in 1968)

History and Future of State Plane

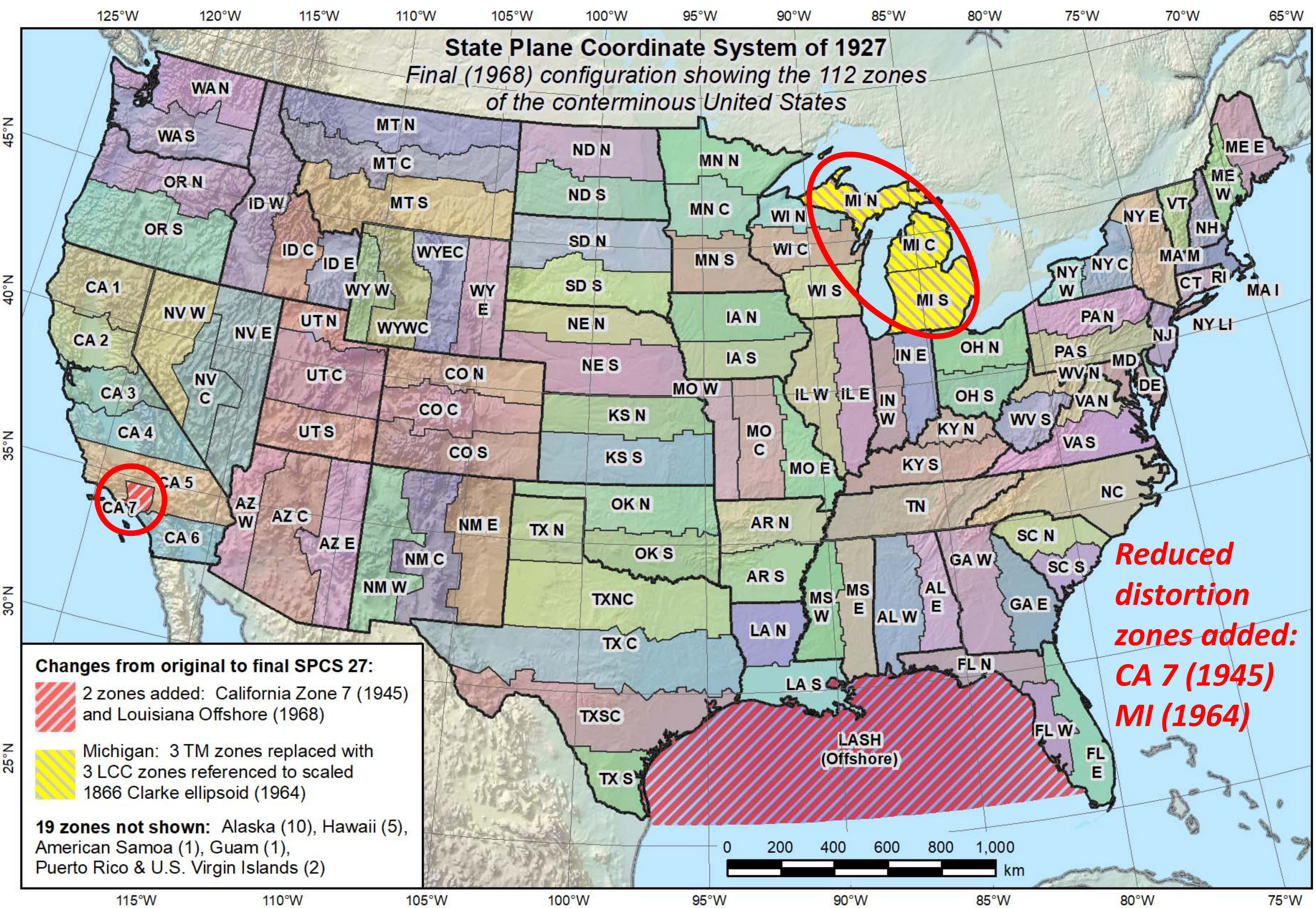
- SPCS created 85 years ago
  - **SPCS 27:** 1933 – 1986 (53 years, with some changes)
  - **SPCS 83:** 1986 – 2022 (36 years, with some changes)
  - **SPCS2022:** 2022 – ? (at least a few decades…)
- SPCS2022 will likely be around for a long time
  - Honor the history and legacy of SPCS…

…while building a system for the future

State Plane Coordinate Systems of 1927 (134 zones) and 1983 (125 zones)

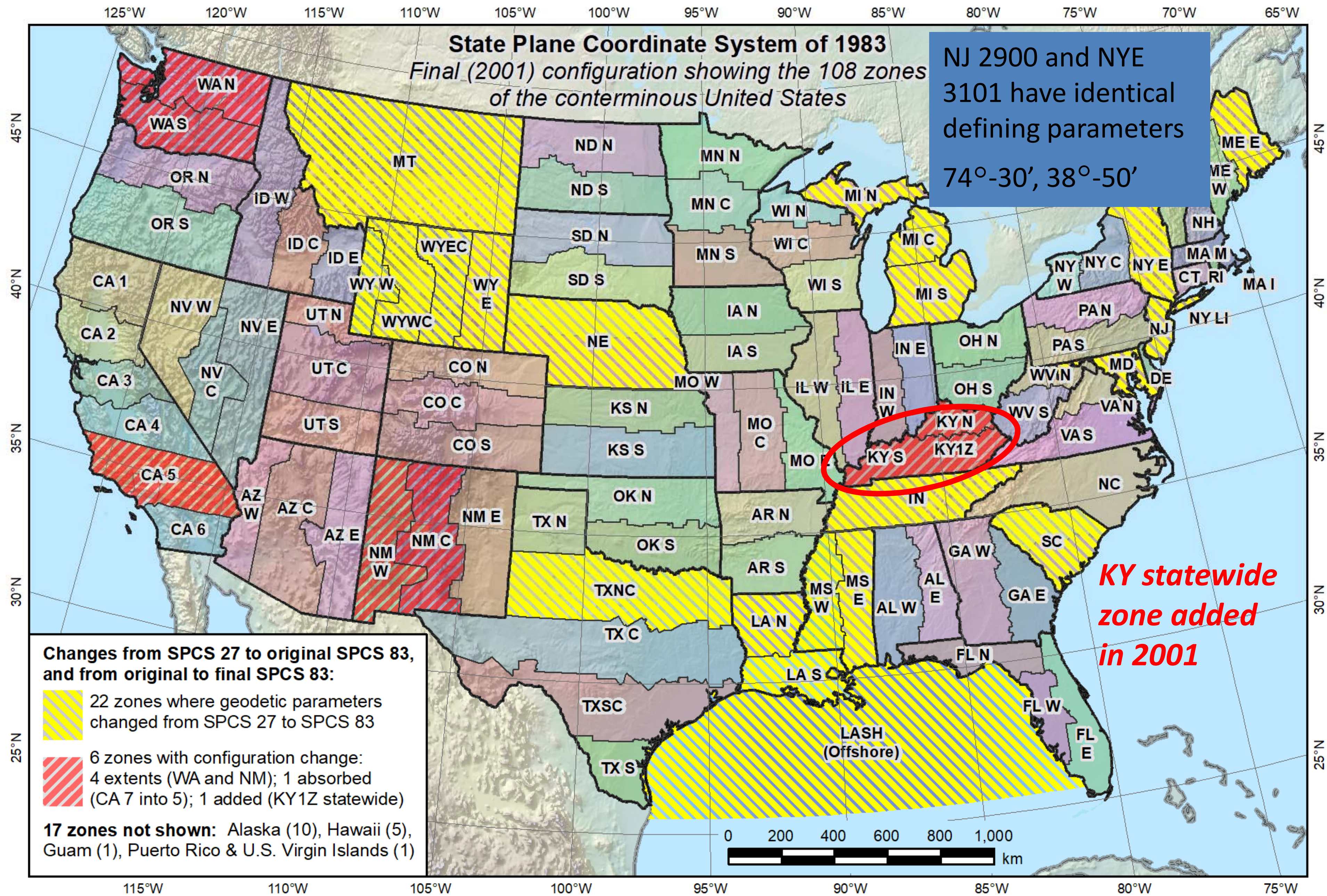


Final SPCS 27, as of 1968 (112 zones in CONUS, 131 zones total)



DM1

Final SPCS 83, as of 2001 (108 zones in CONUS, 125 zones total)



NJ 2900 and NYE 3101 have identical defining parameters

74°-30’, 38°-50’

KY statewide zone added in 2001

Slide 10

DM1 Dan Martin, 12/14/2018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Why change datums/Realizations

- NAD27 based on old observations and old system
- NAD83(86) based on old observations and new system
- NAD83(95) based on new and old observations and same system (HARN)
- NAD83(NSRS2007) based on new observations and same system. Removed regional distortions and made consistent with CORS
- NAD83(2011) based on new observations and same system. Kept consistent with CORS

Problems with NAD 83 and NAVD 88

- **NAD 83** is not as geocentric as it could be (approx. 2 m)
  - Positioning Professionals don't see this - **Yet**
- **NAD 83** is not well defined with positional velocities
- **NAVD 88** is realized by passive control (bench marks) most of which have not been re-leveled in at least 40 years.
- **NAVD 88** does not account for local vertical velocities (subsidence and uplift)
  - Post glacial isostatic readjustment (uplift)
  - Subsurface fluid withdrawal (subsidence)
  - Sediment loading (subsidence)
  - Sea level rise (1.33 ft – 1.49 ft per 100 years)
    - **Cape May, NJ 4.54 mm/yr (0.015 ft/yr) 1965-2015**
    - **Atlantic City, NJ 4.07 mm/yr (0.013 ft/yr) 1911-2015**
    - **Sandy Hook, NJ 4.05 mm/yr (0.013 ft/yr) 1932-2015**

Scientific Decisions

- Blueprint for 2022, Part 1: Geometric
  - ✓Four plate-fixed Terrestrial Reference Frames
    - ✓And what "plate fixed" means
  - ✓Mathematical equation between IGS and TRFs
    - ✓Plate Rotation Model for each plate
    - ✓Coordinates at survey epoch
  - ✓Intra-frame velocity model
    - ✓To compare coordinates surveyed at different epochs

Names

The Old:

NAD 83(2011) → The North American Terrestrial Reference Frame of 2022 (NATRF2022)

NAD 83(2011) → The Caribbean Terrestrial Reference Frame of 2022 (CTRF2022)

NAD 83(PA11) → The Pacific Terrestrial Reference Frame of 2022 (PTRF2022)

NAD 83(MA11) → The Mariana Terrestrial Reference Frame of 2022 (MTRF2022)

The New:

The North American Terrestrial Reference Frame of 2022
(NATRF2022)

The Caribbean Terrestrial Reference Frame of 2022
(CTRF2022)

The Pacific Terrestrial Reference Frame of 2022
(PTRF2022)

The Mariana Terrestrial Reference Frame of 2022
(MTRF2022)

Scientific Decisions!!

- Blueprint for 2022, Part 2: Geopotential
  - ✓Global 3-D Geopotential Model (GGM)
    - ✓Will contain all GRAV-D data
    - ✓Able to yield any physical value on/above surface
  - ✓Special high-resolution geoid, DoV and surface gravity products consistent with GGM
    - ✓Not global: NA/Pacific, American Samoa, Guam/CNMI
  - ✓Time-Dependencies
    - ✓Geoid monitoring service
      - ✓Impacts of deglaciation, sea level rise, earthquakes, etc

Names

The Old:

Orthometric Heights	NAVD 88
Normal Orthometric Heights	PRVD 02
	VIVD09
	ASVD02
	NMVD03
	GUVD04
Dynamic Heights	IGLD 85
Gravity	IGSN71
Geoid Undulations	GEOID12B
Deflections of the Vertical	DEFLEC12B

The New:

The North American-Pacific Geopotential Datum of 2022 (NAPGD2022)

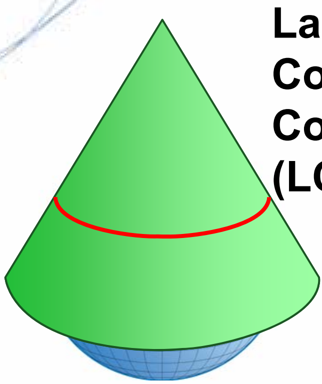
- Will include GEOID2022

Why replace NAVD 88 and NAD 83?

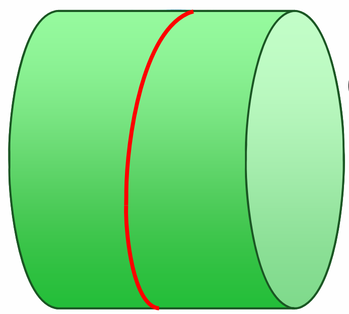
- **ACCESS!**
  - easier to find the sky than a 60-year-old bench mark
  - GNSS equipment is cheap and fast
- **ACCURACY!**
  - easier to trust the sky than a 60-year old bench mark
  - immune to passive mark instability
- **GLOBAL STANDARDS!**
  - systematic errors of many meters across the US
  - aligns with GPS, international efforts
  - aligns with Canada, Mexico

A New State Plane Coordinate System

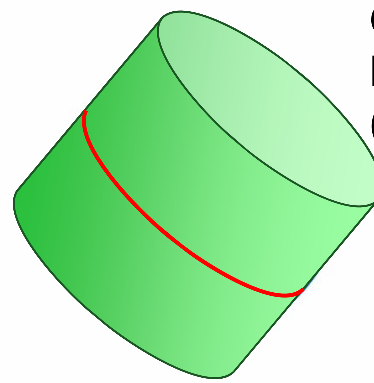
- **State Plane Coordinate System of 2022 (SPCS2022)**
  - Referenced to 2022 Terrestrial Reference Frames (TRFs)
  - Based on same reference ellipsoid as SPCS 83 (GRS 80)
  - Same 3 ***conformal*** projection types as SPCS 83 and 27:



Lambert Conformal Conic (LCC)



Transverse Mercator (TM)



Oblique Mercator (OM)

geodesy.noaa.gov/SPCS/

geodesy.noaa.gov

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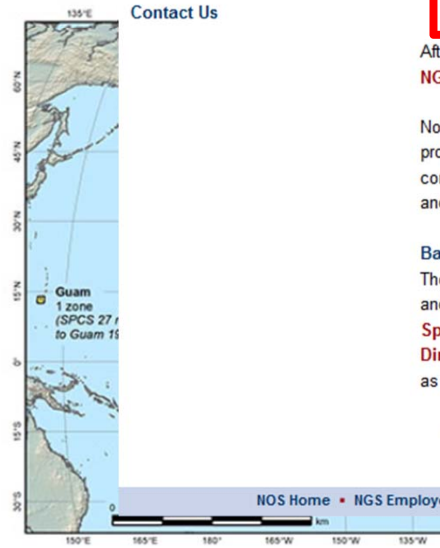
State Plane C…

SPCS is a syste… surveying, engine… projection is a sy… sphere or ellipsoi…

Since its inceptio… Spatial Reference… policies and othe… SPCS will chang…

The map below sl… map for a higher r…



Full extents and all zones of the 1927 and 1983 vers…

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2022 SPCS Policy Changes

An update of the State Plane Coordinate System (SPCS) is part of the transition from the North American Datum of 1983 (NAD 83) to the 2022 Terrestrial Reference Frames. To this end, NGS will establish the State Plane Coordinate System of 2022 (SPCS2022), which will replace SPCS 83, the version referenced to NAD 83.

A Federal Register Notice (FRN) was published on April 12, 2018, announcing that draft SPCS2022 policy and procedures are available for public comment. It also asks for input on "special purpose" SPCS2022 zones. The FRN, policy, and procedures documents are available at the following links:

- Read Federal Register Notice
- DRAFT SPCS2022 Policy (PDF, 336 KB)
- DRAFT SPCS2022 Procedures (PDF, 473 KB)

After reading the FRN and reviewing the draft documents, send your feedback to NGS.Feedback@noaa.gov. Comments may be provided until August 31, 2018.

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Documents

Related documents are listed below.

- Policy on Changes to State Plane Coordinates (PDF, 141 KB)
- Policy of the National Geodetic Survey Concerning Units of Measure for the State Plane Coordinate System of 1983 (PDF, 136 KB)
- NOAA Manual NOS NGS 5 (PDF, 2 MB)
- NOAA Special Publication NOS NGS 13 (PDF, 7 MB)

Webinars

NGS has and will host various webinars about State Plane. These will be added to the following list as they are developed.

- The State Plane Coordinate System: History, Policy, Future Directions (March 8, 2018)
- Building a State Plane Coordinate System for the Future (April 12, 2018)

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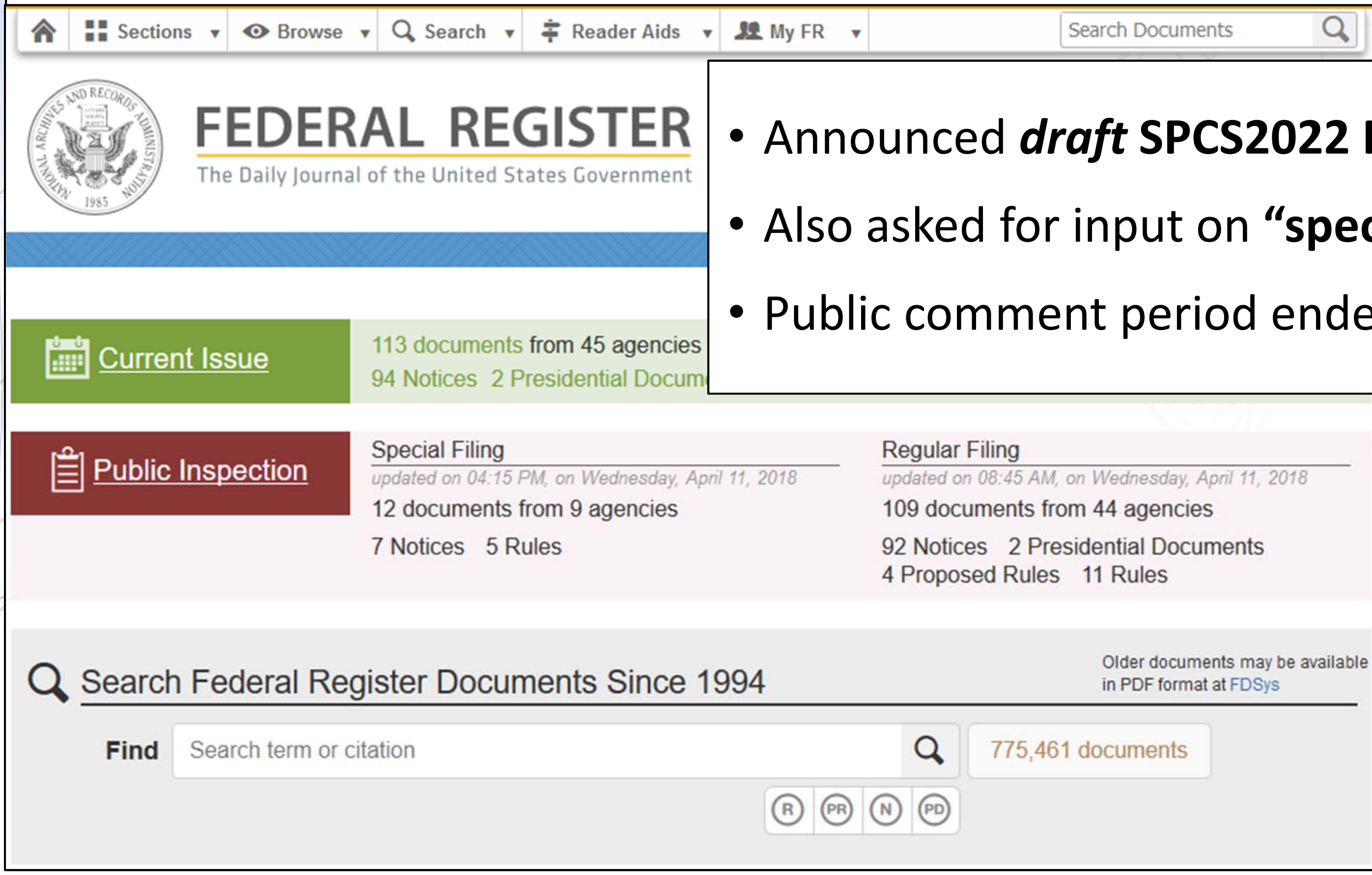
Who attended the SPCS2022 webinars?

Location	Mar 8	Apr 12	Location	Mar 8	Apr 12	Location	Mar 8	Apr 12
Alabama	7	8	Maryland	25	20	Rhode Island	0	1
Alaska	26	20	Massachusetts	1	1	South Carolina	7	6
Arizona	**48**	**42**	Michigan	34	57	South Dakota	7	4
Arkansas	1	1	Minnesota	124	34	Tennessee	1	1
California	35	30	Mississippi	8	6	Texas	20	16
Colorado	17	25	Missouri	7	11	Utah	2	9
Connecticut	4	11	Montana	16	13	Vermont	0	3
Delaware	1	2	Nebraska	16	11	Virginia	8	5
Florida	52	44	Nevada	5	1	Washington	12	16
Georgia	8	3	New Hampshire	1	1	West Virginia	1	0
Hawaii	5	6	New Jersey	4	1	Wisconsin	9	27
Idaho	12	11	New Mexico	12	7	Wyoming	3	2
Illinois	15	12	New York	4	5	American Samoa	0	0
Indiana	4	7	North Carolina	10	8	District of Columbia	2	1
Iowa	6	7	North Dakota	33	13	Guam	0	0
Kansas	5	3	Ohio	31	24	Mariana Islands	0	0
Kentucky	5	5	Oklahoma	3	1	Puerto Rico	2	3
Louisiana	13	10	Oregon	53	23	US Virgin Islands	0	1
Maine	1	1	Pennsylvania	23	18	International	8	13

Federal Register Notice

https://www.federalregister.gov/



- Announced ***draft*** **SPCS2022 Policy and Procedures**
- Also asked for input on **"special purpose"** zones
- Public comment period ended **Aug 31, 2018**

Overview: Policy, Procedures, and FRN

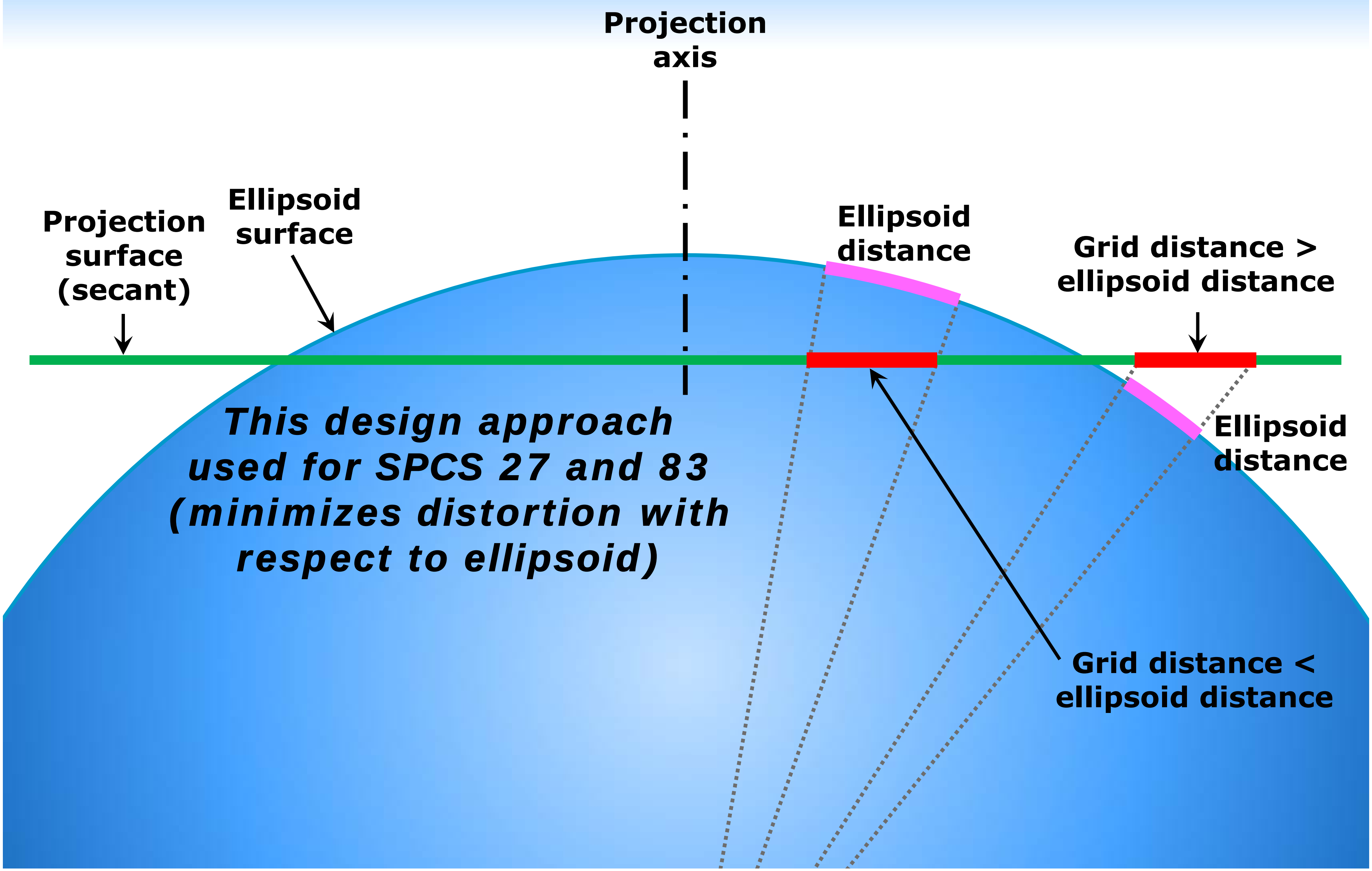
- Linear distortion at topographic surface
- One-parallel Lambert Conformal Conic projections
- Default SPCS2022 zone designs
- Statewide and "layered" zones
- Linear distortion design criteria
  - Maximum and minimum zone size and distortion
  - Low distortion projections (LDPs)
- "Special purpose" zones (in FRN only)
- Linear units
- Submittal process and deadlines
  - For Federal Register Notice comments
  - For requests, proposals, and submittal of designs

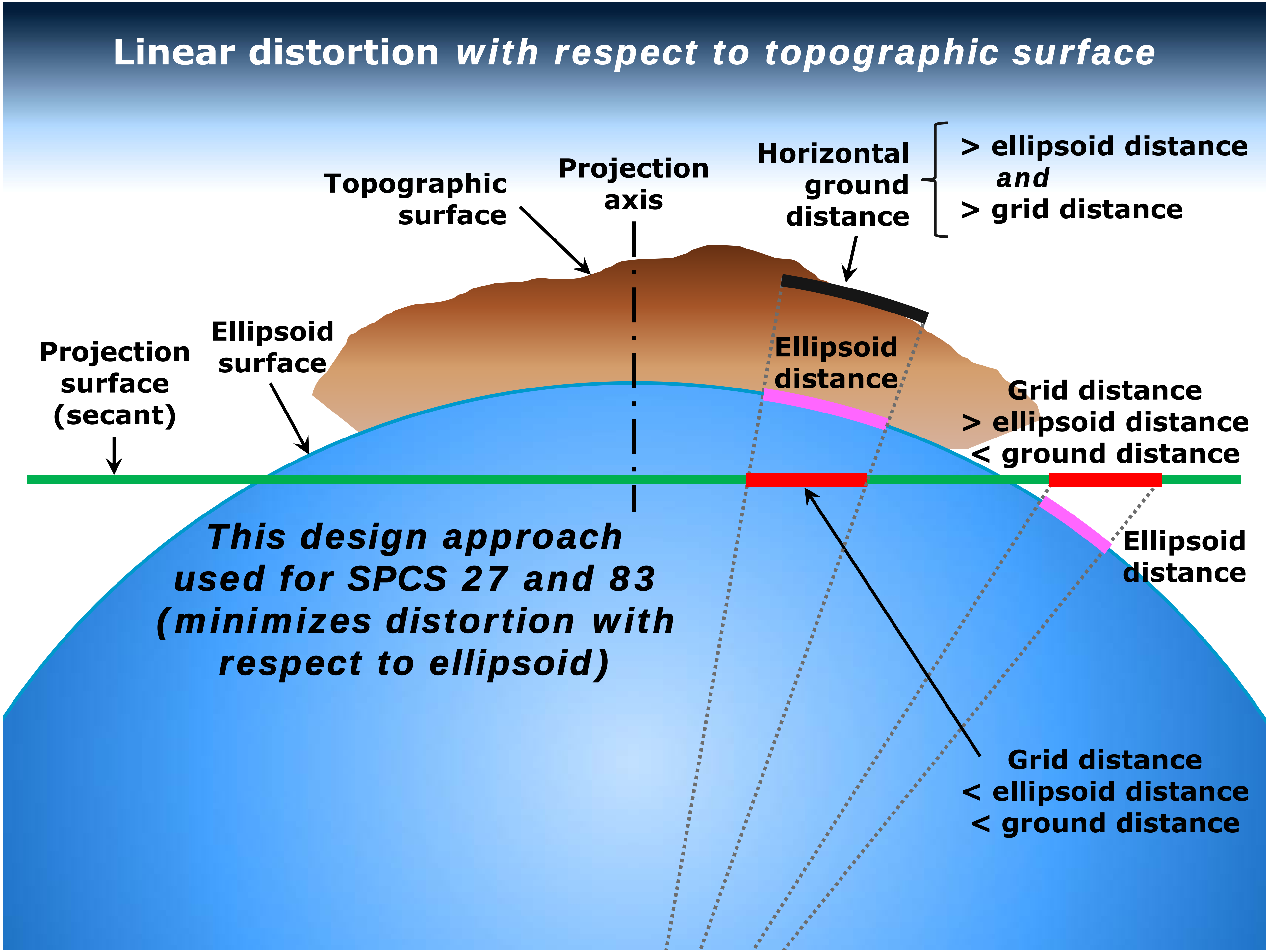
Linear distortion at topo surface

Policy § II.C and Procedures § 5.c.

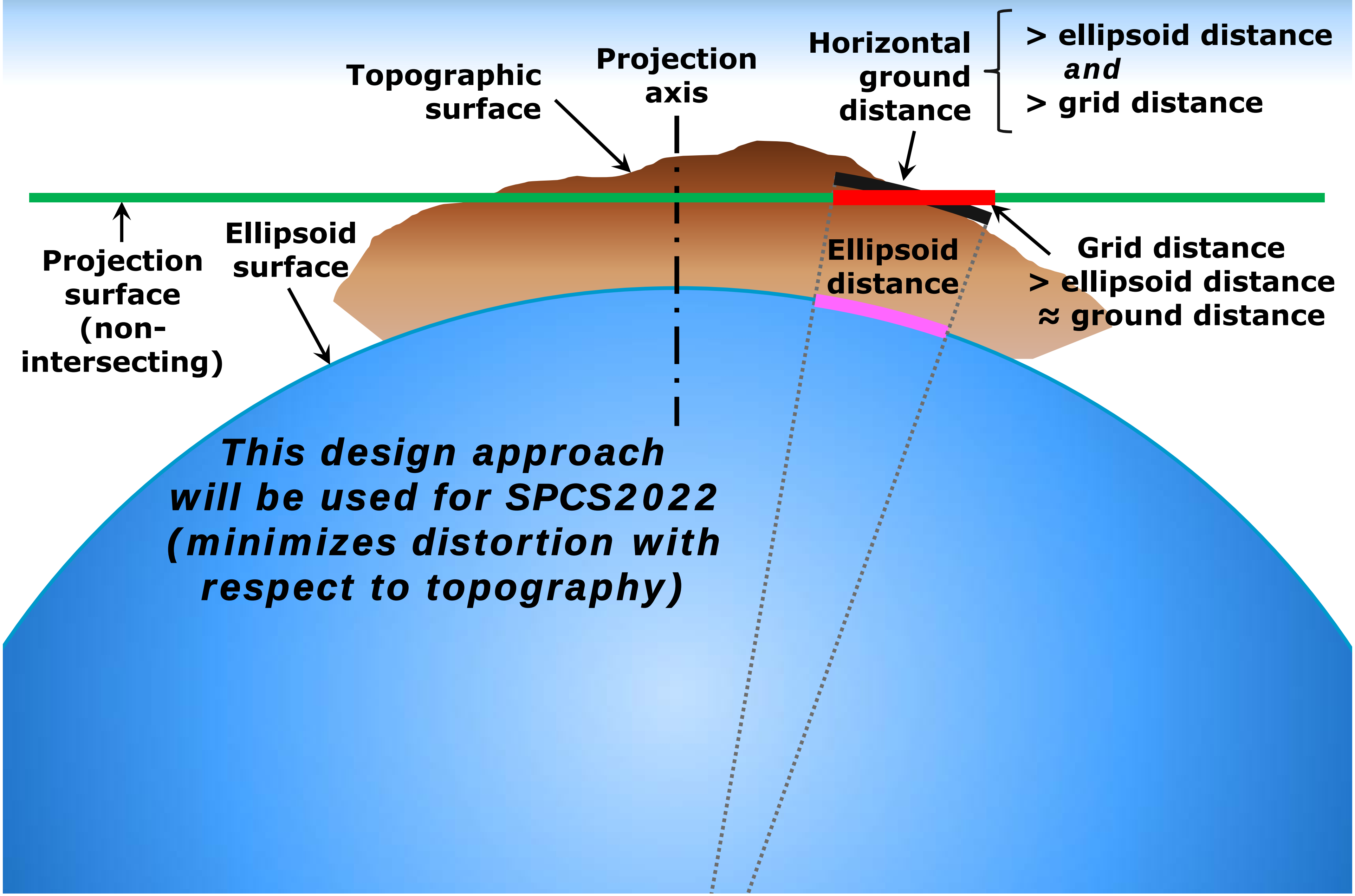
- Distortion for design evaluated at **topo surface**
  - Minimize range and mean distortion in zone
  - Account for cities with distortion weighted by population
- Design ***not*** evaluated at the ellipsoid surface
  - Nobody lives or works on the ellipsoid
  - Likely used in past because it is easier
- Projection ***scaled*** to topo surface ("ground")
  - Reduces difference between "grid" and "ground"
  - Topographic ellipsoid height not part of definition

Linear distortion *with respect to ellipsoid*




Linear distortion *with respect to topographic surface*
Topographic surface
Projection axis
Horizontal ground distance
> ellipsoid distance
and
> grid distance
Projection surface (secant)
Ellipsoid surface
Ellipsoid distance
Grid distance
> ellipsoid distance
< ground distance
This design approach used for SPCS 27 and 83 (minimizes distortion with respect to ellipsoid)
Ellipsoid distance
Grid distance
< ellipsoid distance
< ground distance

Linear distortion *with respect to topographic surface*



Linear distortion magnitudes

ppm = parts per million (mm/km)

- **±20 ppm** = 2 cm/km = 0.1 ft/mile = 1 : 50,000
  Often used as "low distortion" design criterion (***at ground***)
- **±50 ppm** = 5 cm/km = 0.3 ft/mile = 1 : 20,000
  Minimum design criterion for SPCS2022 designs by NGS (***at ground***)
- **±100 ppm** = 10 cm/km = 0.5 ft/mile = 1 : 10,000
  "Nominal" maximum State Plane value (***on ellipsoid***)
  Can be much greater at topo surface
- **±400 ppm** = 40 cm/km = 2.1 ft/mile = 1 : 2,500
  Maximum design criterion for SPCS2022 zones (***at ground***)
  Maximum UTM value (***on ellipsoid***)

Nominal distortion criterion (on ellipsoid) for SPCS 27 and 83 zones (although greatly exceeded for some zones in SPCS 83).

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Distortion range (at ground) for zones designed by NGS, as proposed in draft SPCS2022 policy and procedures.

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  Maximum design criterion for SPCS2022 zones (***at ground***)
  Maximum UTM value (***on ellipsoid***)

Distortion criterion (at ground) often used for "low distortion projection" (LDPs); designed by others for SPCS2022 (not by NGS)

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Default SPCS2022 designs

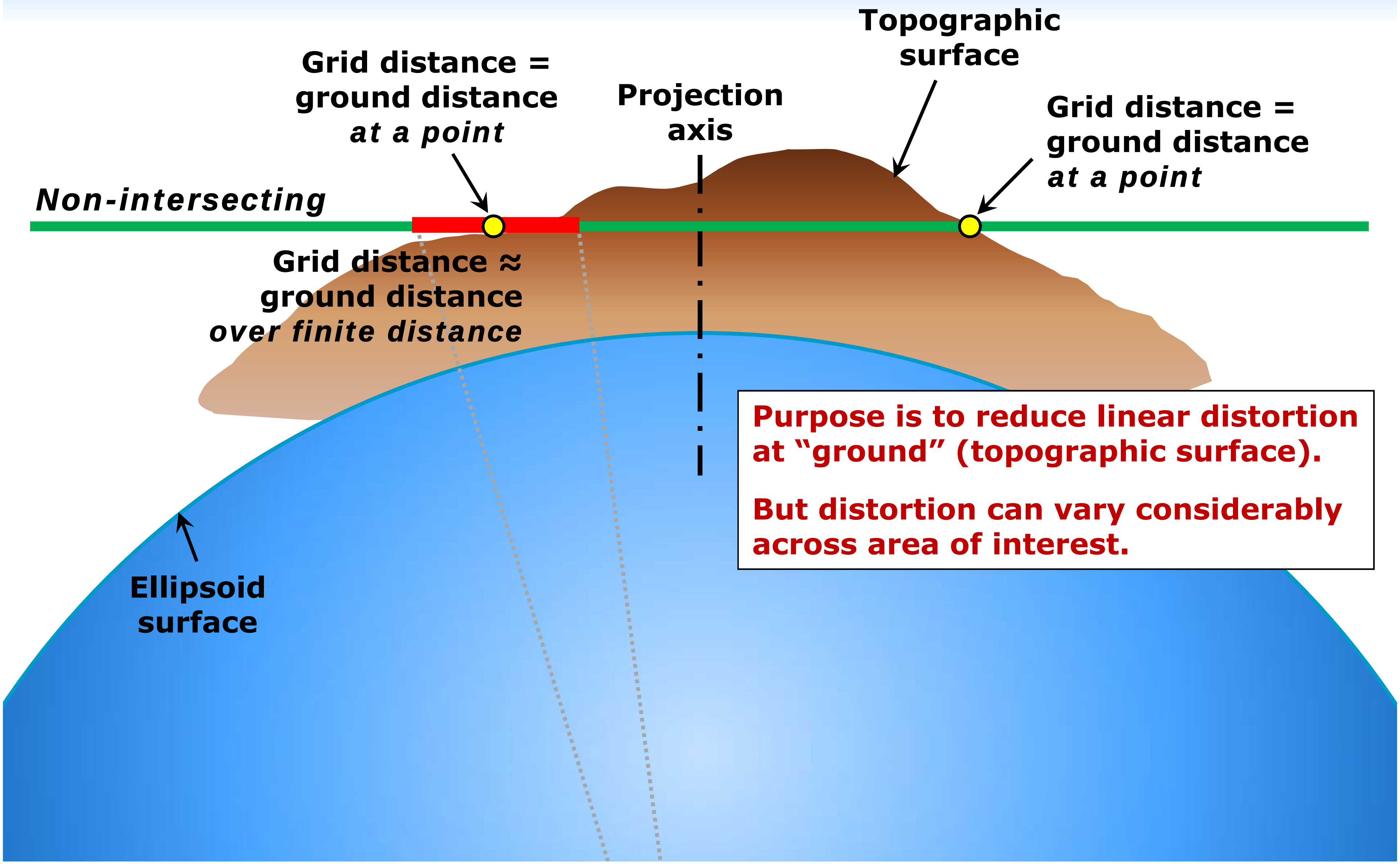
Policy § IV and Procedures § 5.g.

- For complete system even with no stakeholder input
  - To ensure coverage of ***all*** states and U.S. territories
- Nearly same as SPCS 83 but with some modifications
  - Almost all zone projection types and extents the same
  - Modified to align with SPCS2022 policy and procedures
  - Small number of zones may change projection type, extents
- Modifications to align with SPCS2022 policy:
  - Scale redefined with respect to **topographic surface**
  - One-parallel Lambert and local Oblique Mercator

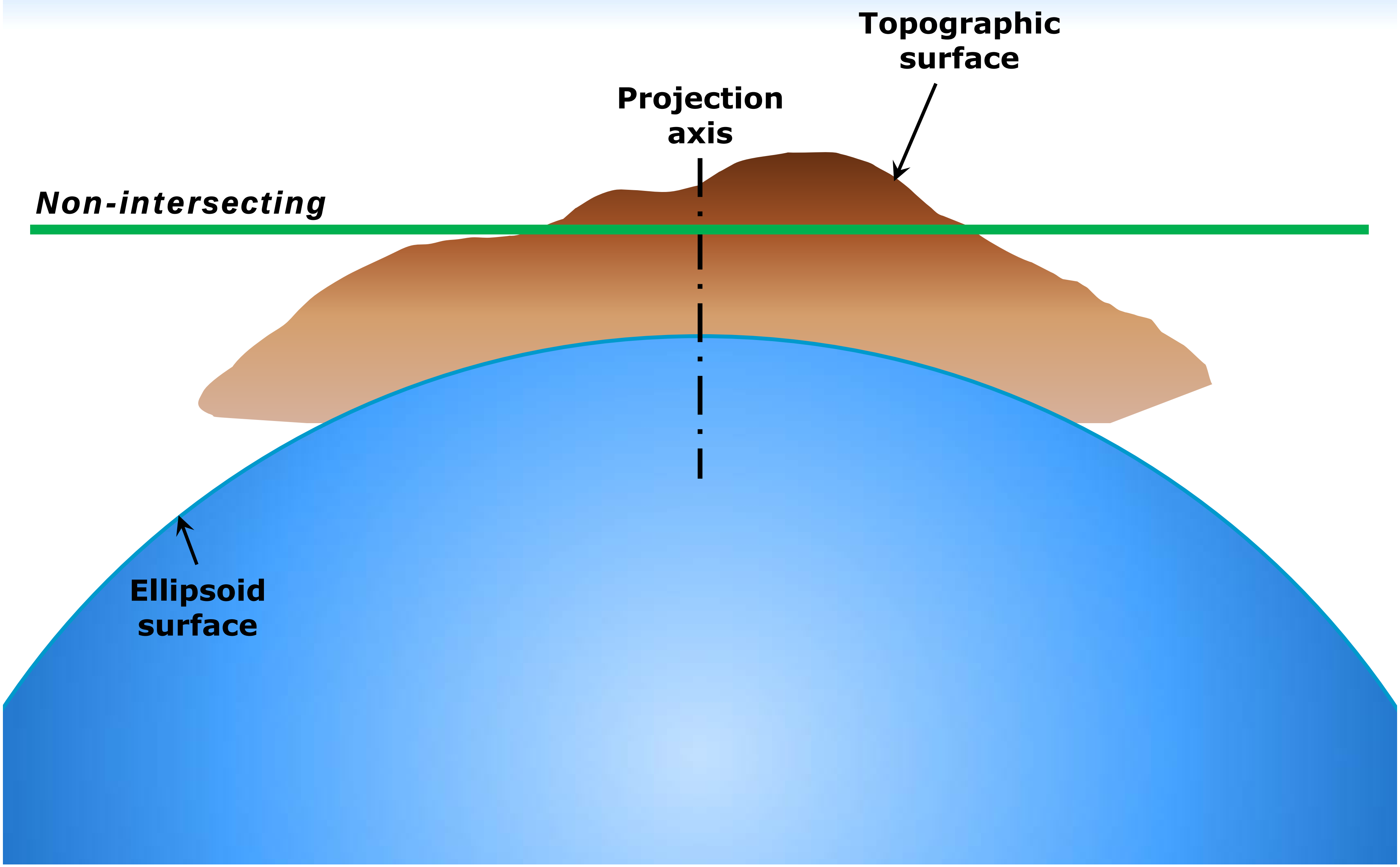
Examples of combined characteristics

- Characteristics for default design examples:
  - Designs are "SPCS 83-like"
  - But minimize linear distortion at "ground"
    - Minimize distortion range and mean for entire zone
    - Also mean distortion of cities (weighted by population)
  - Define LCC projections with 1 standard parallel
- Example default zones:
  - Arizona Central Zone (Transverse Mercator)
  - Colorado South Zone (Lambert Conformal Conic)

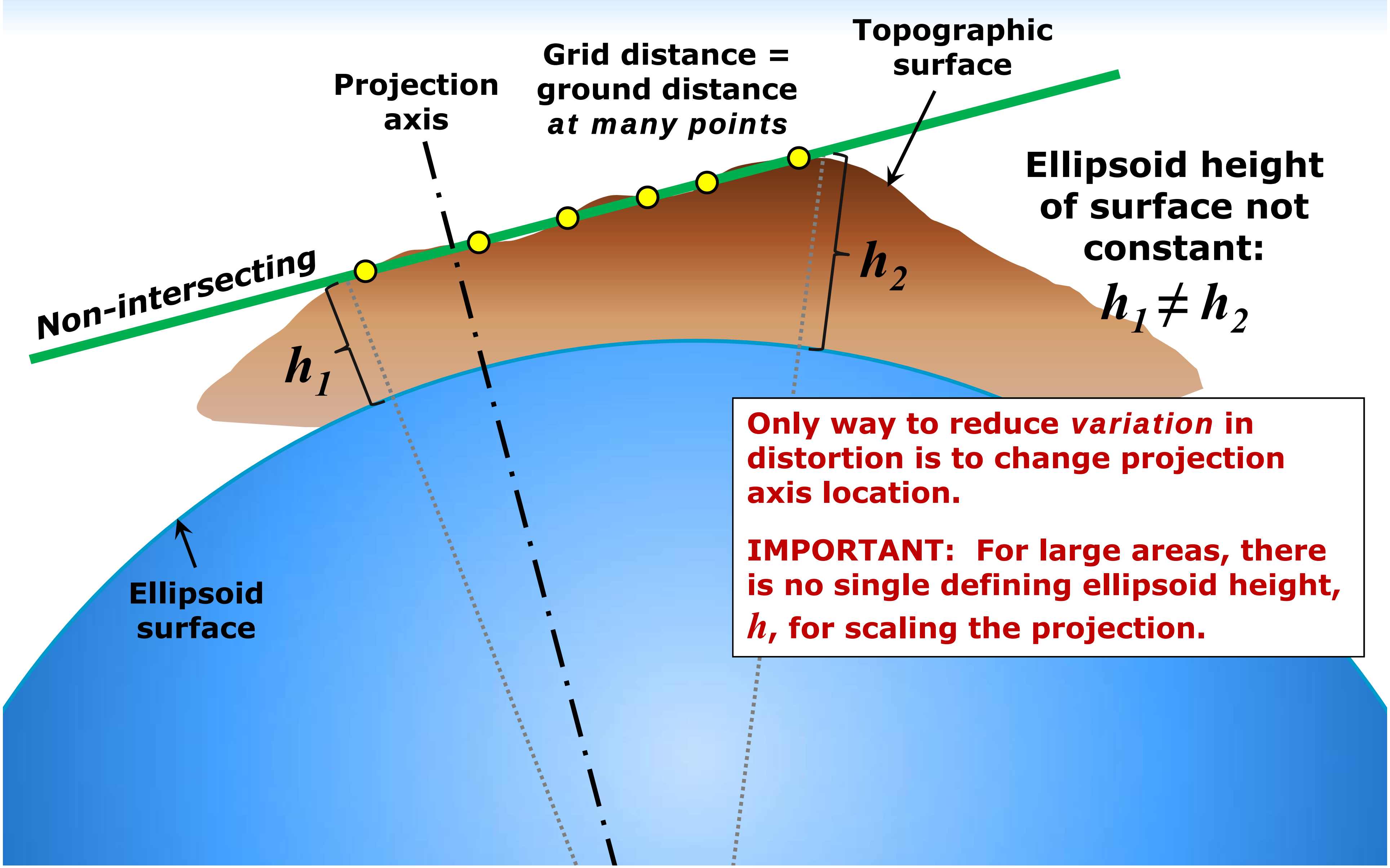
"Non-intersecting" conformal map projection

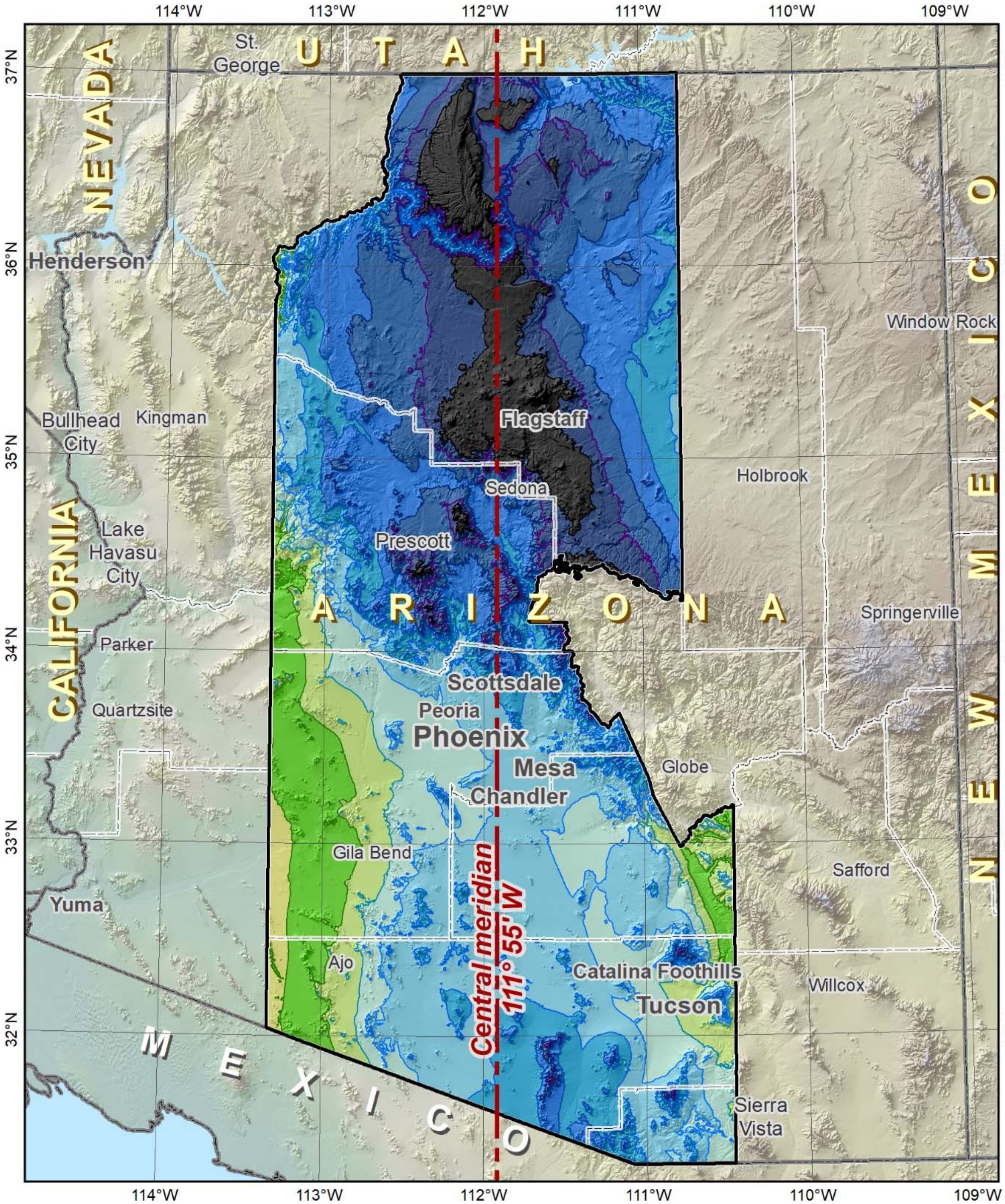


“Non-intersecting” conformal map projection



Changing projection axis to reduce distortion variation





Existing SPCS 83 design: Arizona Central Zone

NOAA's National Geodetic Survey

Transverse Mercator projection

North American Datum of 1983

Central meridian: 111° 55' W

Cen merid scale: 0.999 9 (exact)

Areas within ±100 ppm distortion (±0.53 ft per mile):

14% of entire zone

10% of all cities and towns

2% of population

Distortion values (ppm)

Entire zone:	***Cities and towns:***
Min = -684	Min, Max = -491, +53
Max = +100	Range = 544
Range = 784	Median = -164
Mean = -224	Mean = -151 (weighted by population)

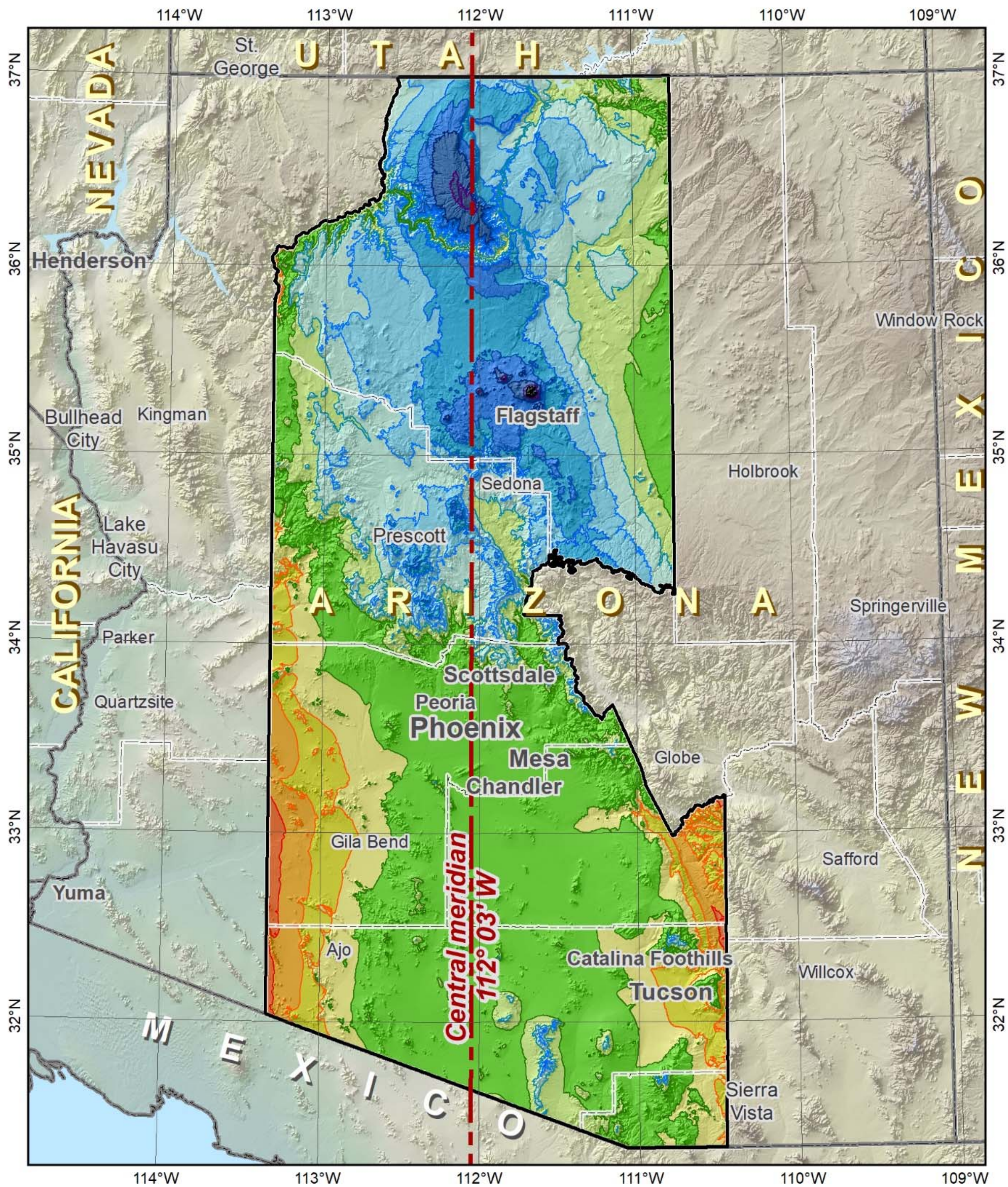
Linear distortion at topographic surface (parts per million)

- < -400
- to -400
- to -350
- to -300
- to -250
- to -200
- to -150
- to -100
- ±50
- to +100
- to +150
- to +200
- to +250
- to +300
- \> +300

0 50 100 150 200 250 km

Preliminary SPCS2022 default design: Arizona Central Zone

NOAA's National Geodetic Survey



Transverse Mercator projection

North American Terrestrial Reference Frame of 2022

Central meridian: 112° 03' W
Cen merid scale: 1.000 07 (exact)

Areas within ±100 ppm distortion (±0.53 ft per mile):
55% of entire zone
76% of all cities and towns
95% of population

Distortion values (ppm)

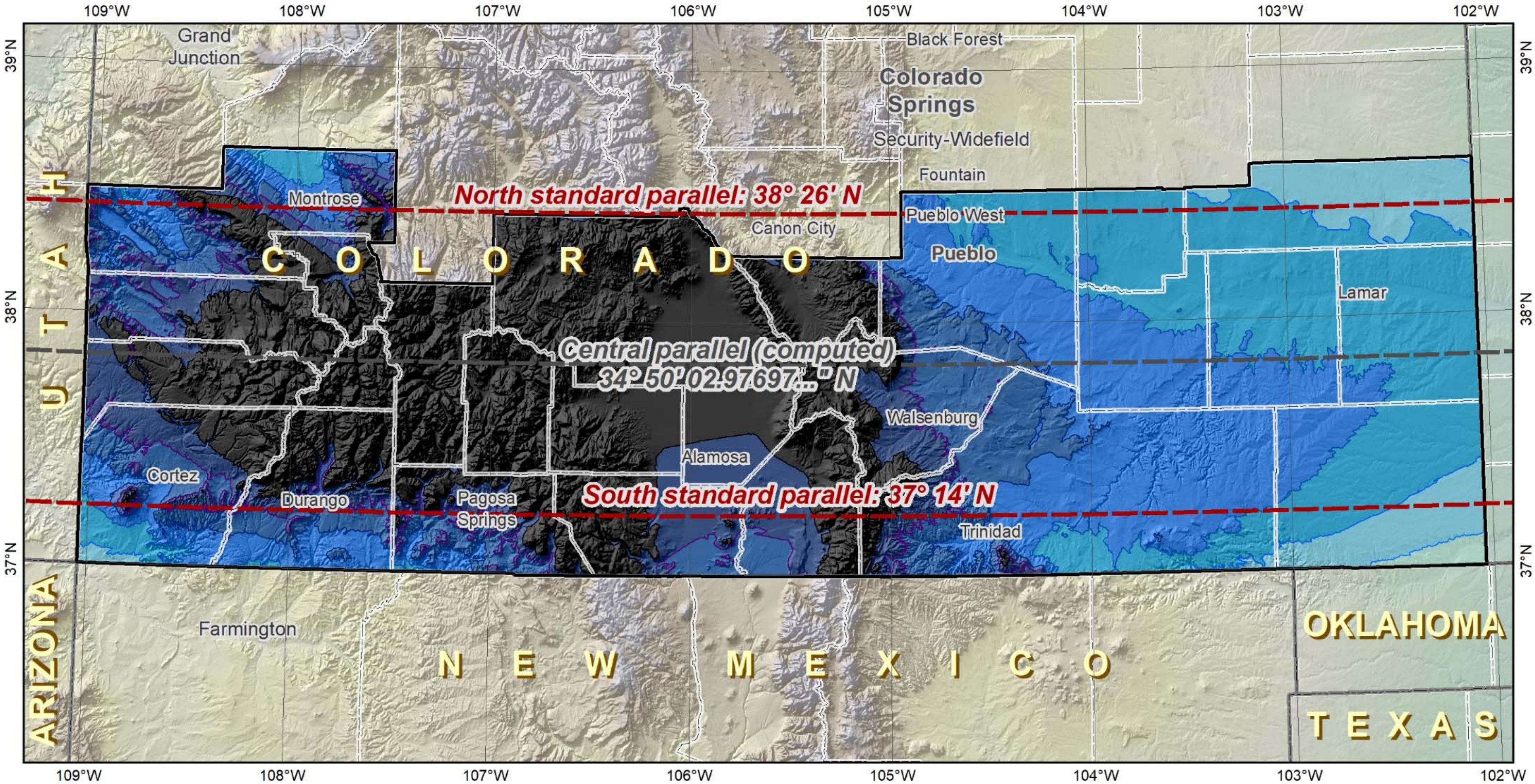
Entire zone:	***Cities and towns:***
Min = -506	Min, Max = -323, +188
Max = +232	Range = 511
Range = 738	Median = +13
Mean = -54	Mean = +24 (weighted by population)

Linear distortion at topographic surface (parts per million)

< -400	to -200	to +150
to -400	to -150	to +200
to -350	to -100	to +250
to -300	±50	to +300
to -250	to +100	> +300

0 50 100 150 200 250 km

Existing SPCS 83 design: Colorado South Zone



Lambert Conformal Conic projection

North American Datum of 1983

Central parallel: 37° 50' 03.0..." N

Cen parallel scale: 0.999 945 398...

Areas within ±100 ppm distortion (±0.53 ft per mile):

0% of entire zone

0% of all cities and towns

0% of population

NOAA's National Geodetic Survey

Distortion values (ppm)

For entire zone:

Min = -715 Range = 598

Max = -117 Mean = -352

Cities and towns:

Min = -515 Range = 338

Max = -177 Median = -317

Mean = -280

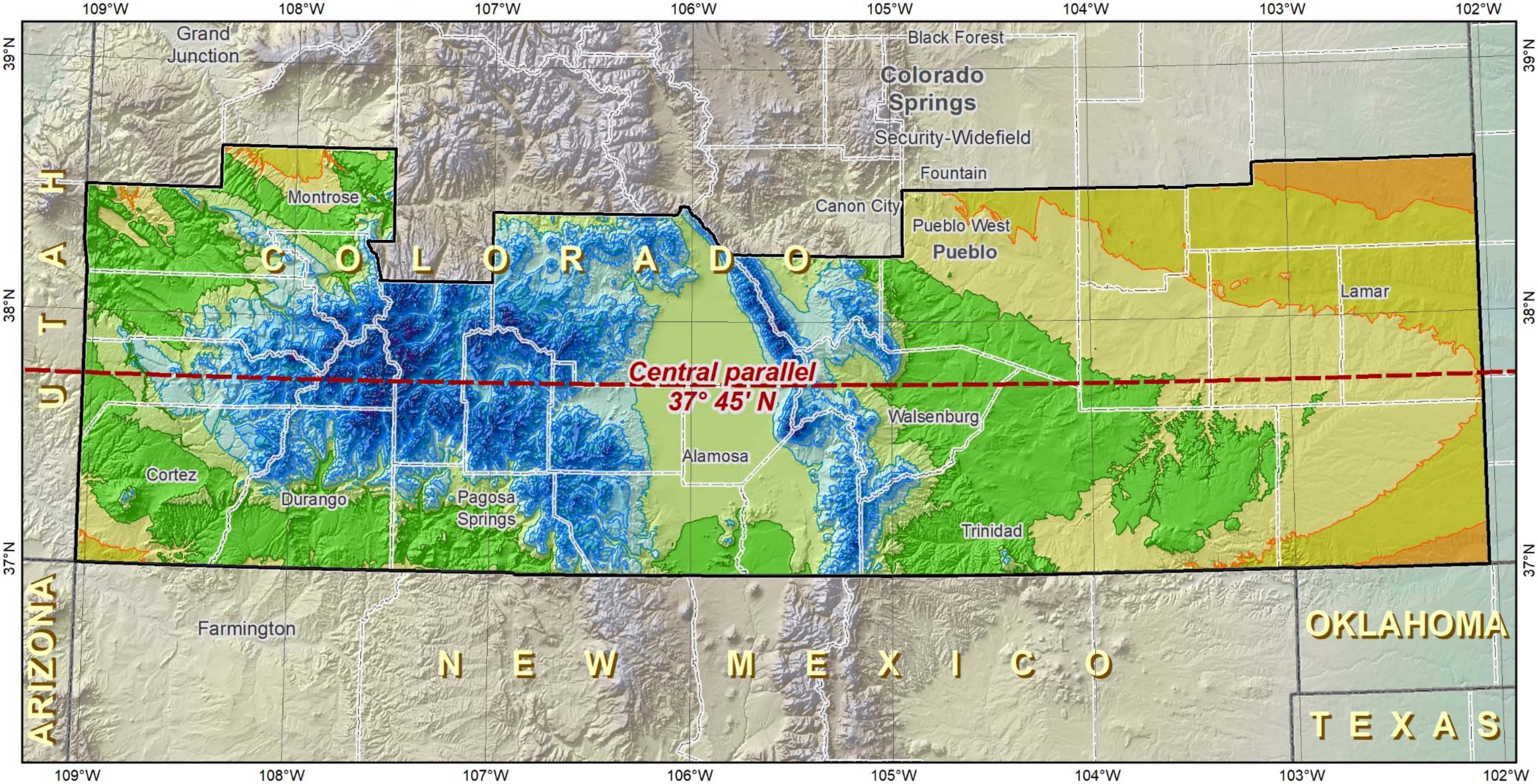
(weighted by population)

Linear distortion at topographic surface (parts per million)

< -400	to -200	to +150
to -400	to -150	to +200
to -350	to -100	to +250
to -300	±50	to +300
to -250	to +100	> +300

0 50 100 150 200 km

Preliminary SPCS2022 default design: Colorado South Zone



Lambert Conformal Conic projection

North American Terrestrial Reference Frame of 2022

Central parallel: 37° 45' N

Cen parallel scale: 1.000 27 (exact)

Areas within ±100 ppm distortion (±0.53 ft per mile):

59% of entire zone

76% of all cities and towns

91% of population

NOAA's National Geodetic Survey

Distortion values (ppm)

For entire zone:

Min = -389 Range = 589

Max = +200 Mean = -28

Cities and towns:

Min = -189 Range = 354

Max = +165 Median = -0.1

Mean = +50

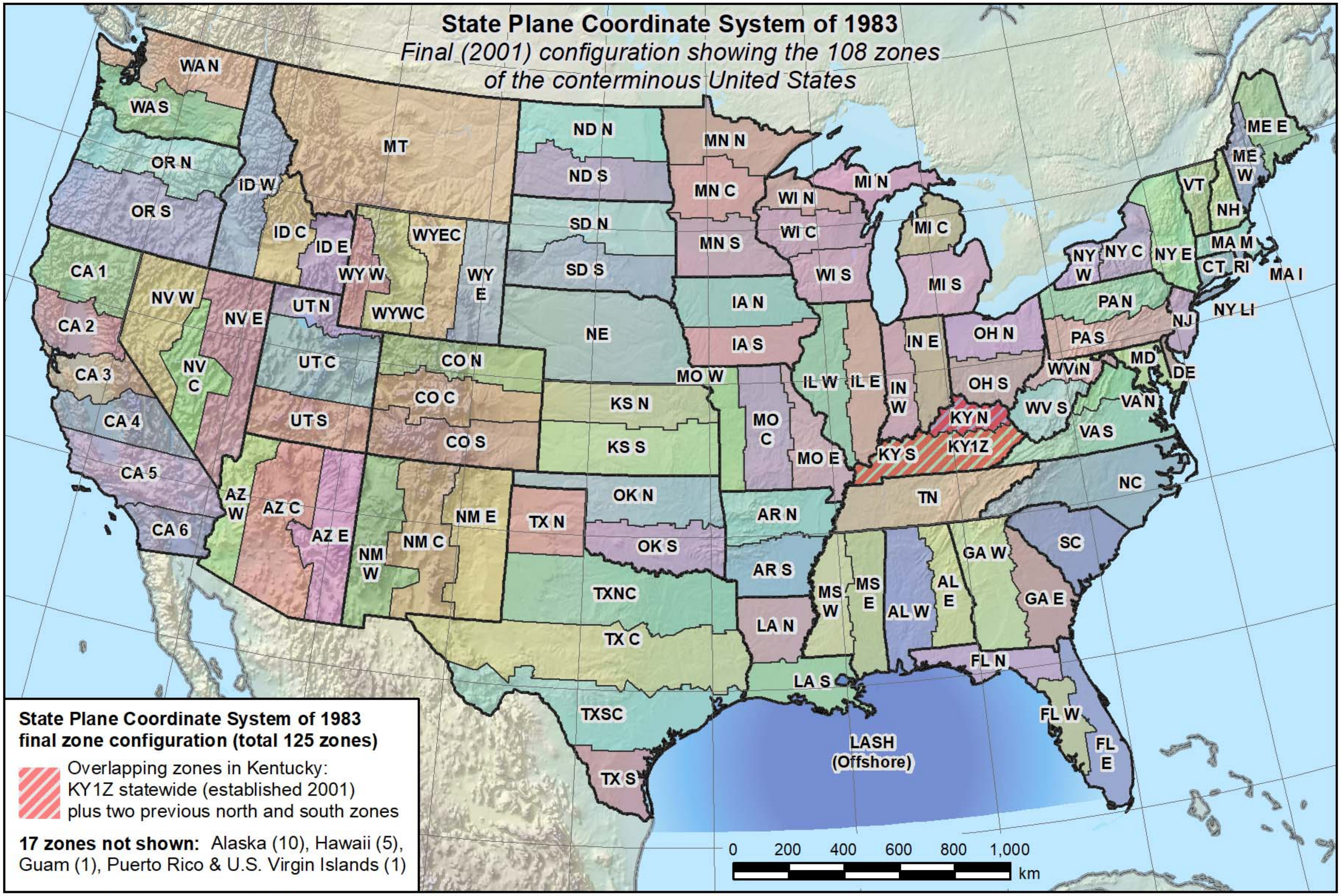
(weighted by population)

Linear distortion at topographic surface (parts per million)

< -400	to -200	to +150
to -400	to -150	to +200
to -350	to -100	to +250
to -300	±50	to +300
to -250	to +100	> +300

0 50 100 150 200 km

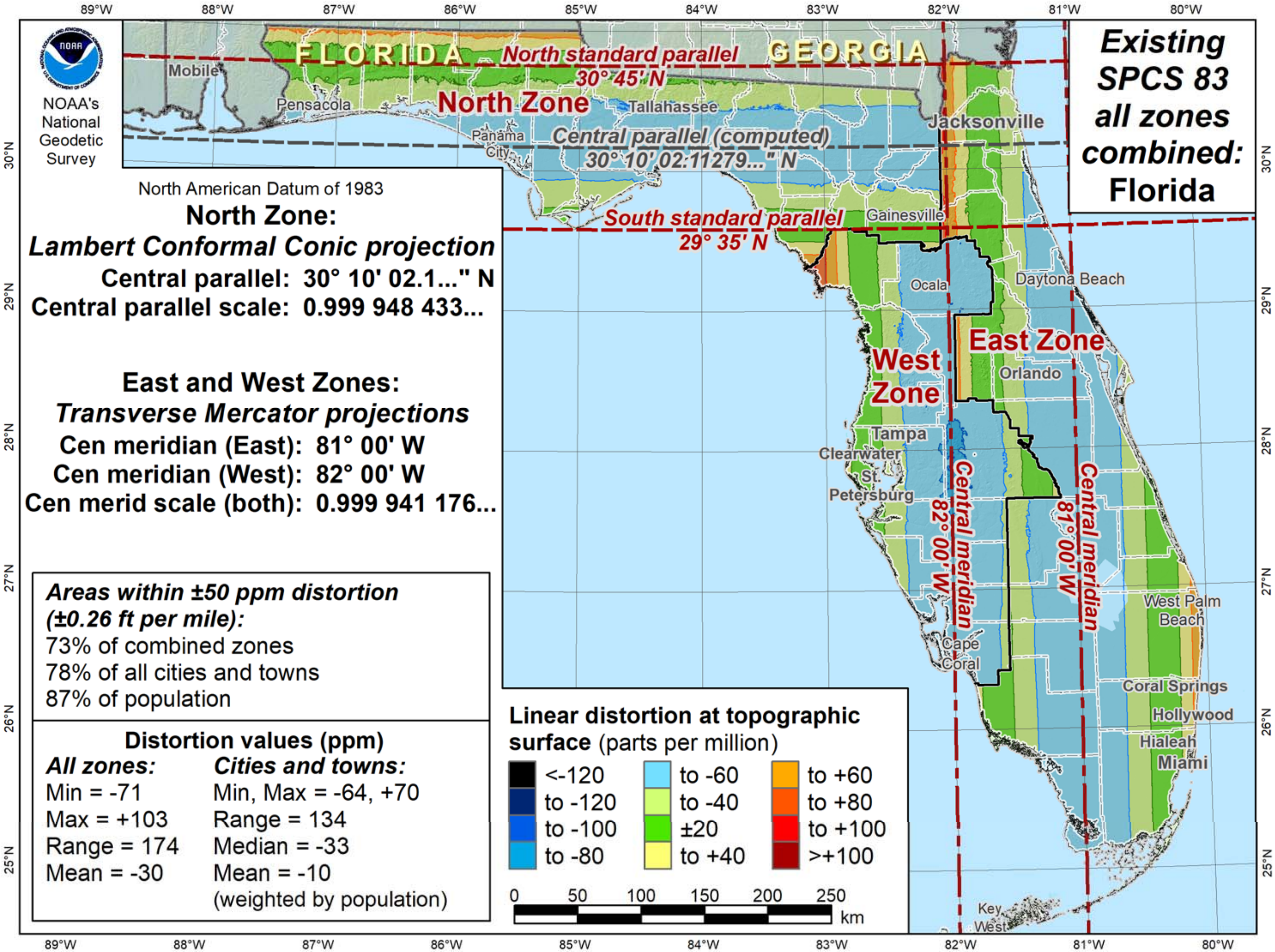
Default SPCS2022 would look a lot like SPCS 83…



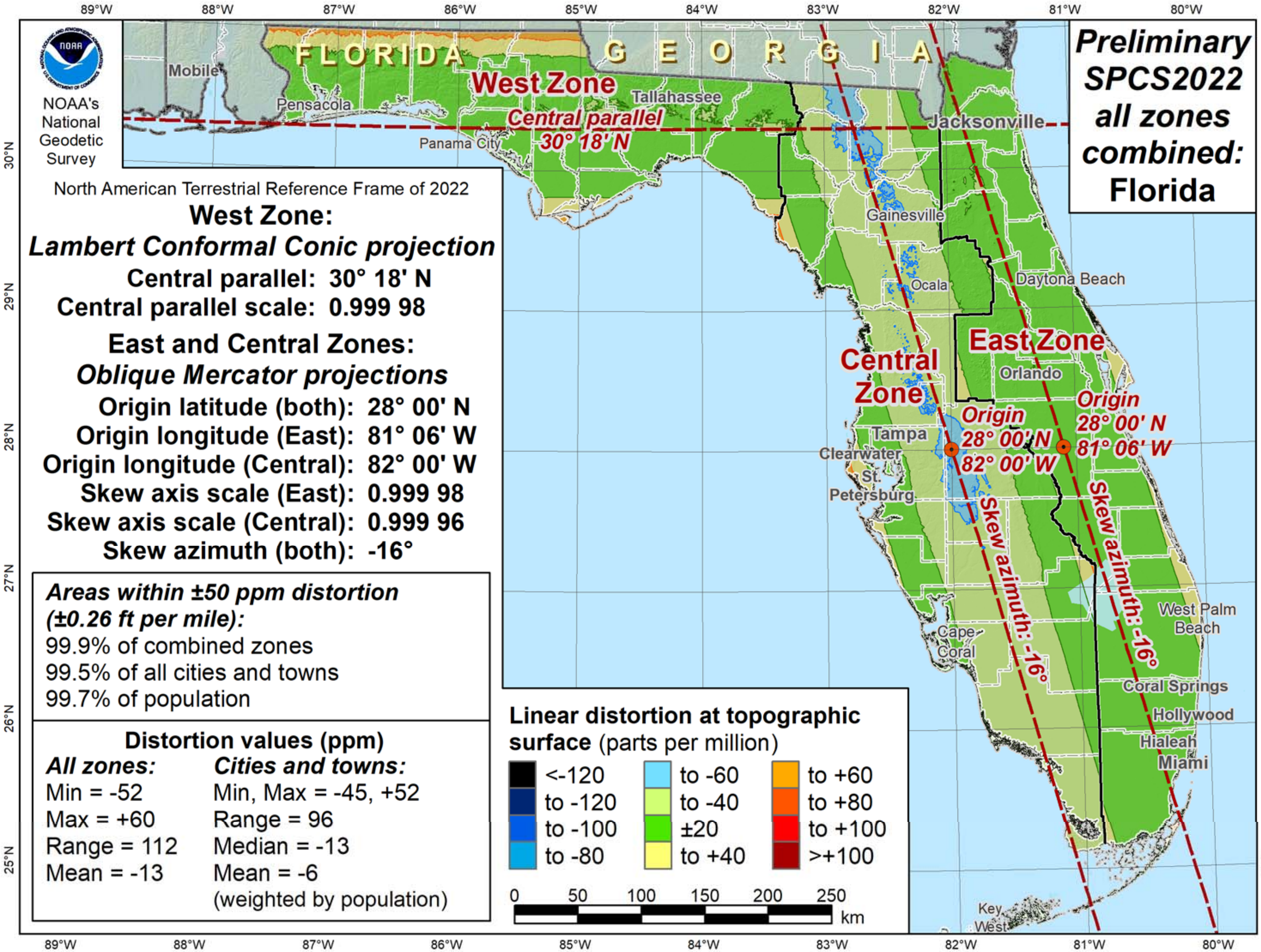
What changes for default designs?

- Most zones will keep same extents and projection type
- Possible changes in projection types and zone extents
  - 1 or 2 OM zones for FL peninsula (currently 2 TM zones)
  - 1 OM zone for Hawaii (replaces 5 TM zones)
  - 1 OM zone for NJ (currently 1 TM)
  - Include Guam and CNMI in 1 TM zone (currently only Guam)
  - Define LCC zone for American Samoa (no SPCS 83 zone)
  - Redefine AK zones to better correspond to land use
  - Add zone for Washington D.C.

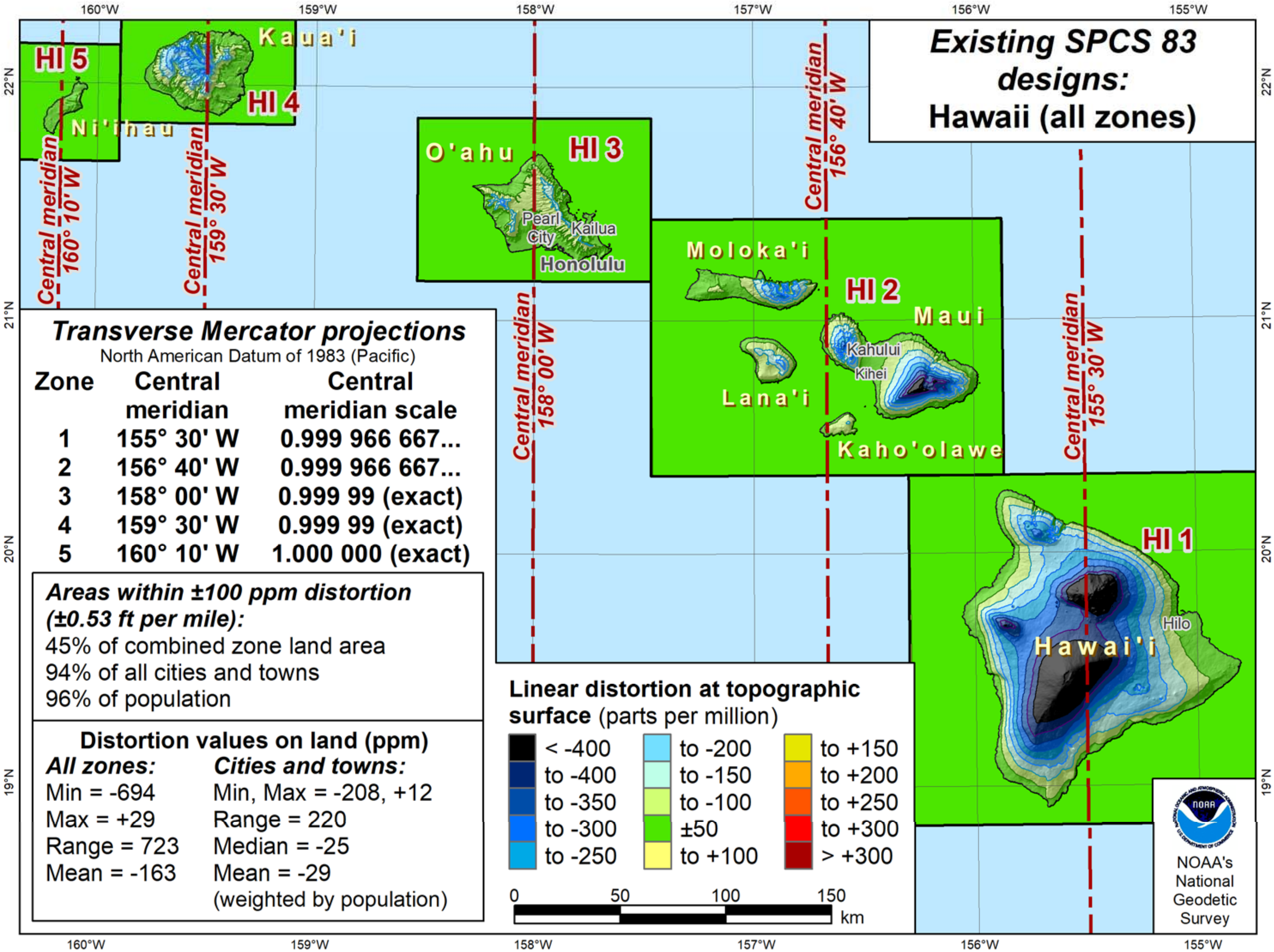
Examples follow of zones where proposed projection type and/or extents change.

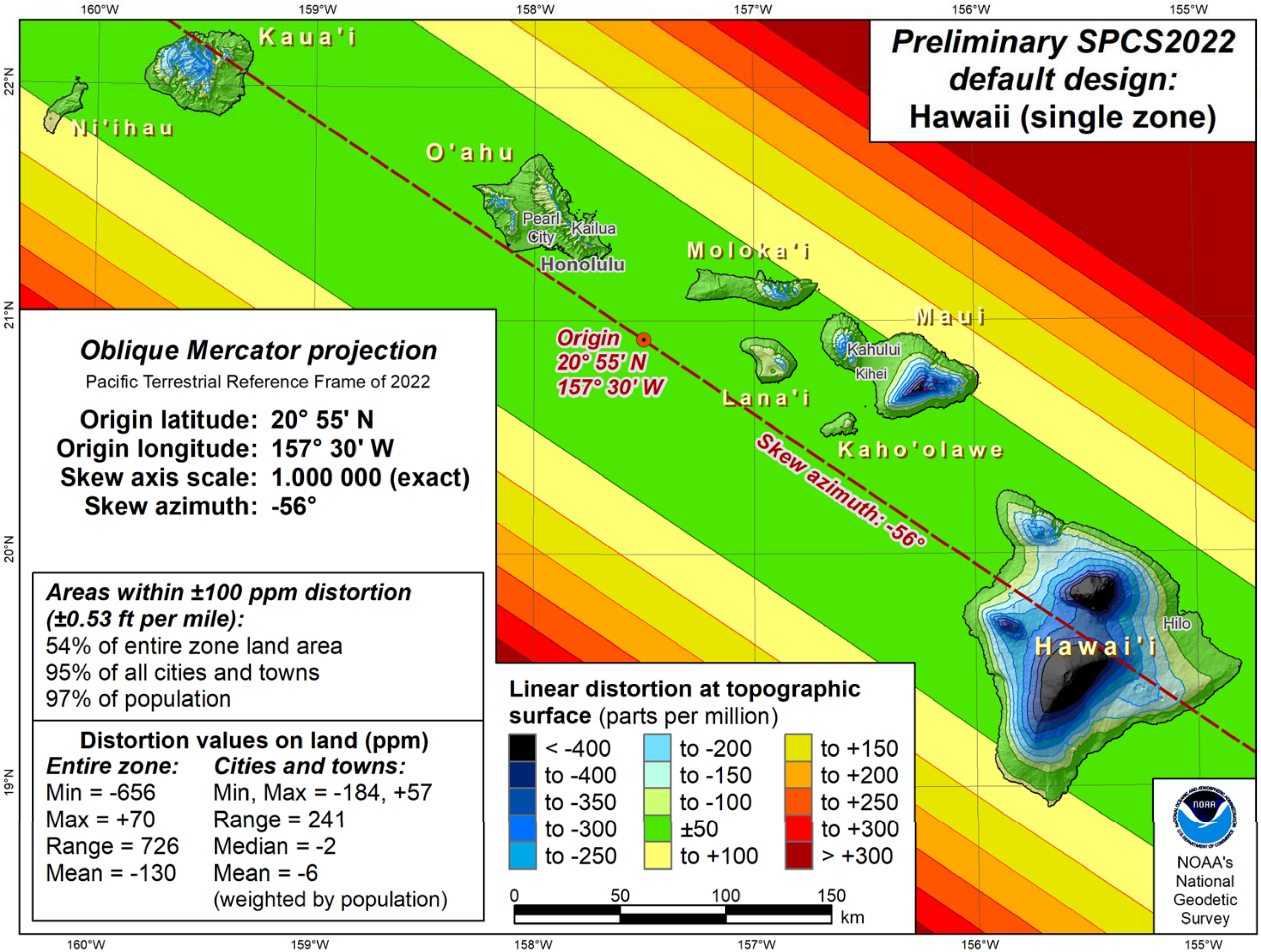


Existing SPCS 83 all zones combined: Florida
NOAA's National Geodetic Survey
North American Datum of 1983
North Zone:
Lambert Conformal Conic projection
Central parallel: 30° 10' 02.1..." N
Central parallel scale: 0.999 948 433...
East and West Zones:
Transverse Mercator projections
Cen meridian (East): 81° 00' W
Cen meridian (West): 82° 00' W
Cen merid scale (both): 0.999 941 176...
Areas within ±50 ppm distortion (±0.26 ft per mile):
73% of combined zones
78% of all cities and towns
87% of population
Distortion values (ppm)
All zones:
Min = -71
Max = +103
Range = 174
Mean = -30
Cities and towns:
Min, Max = -64, +70
Range = 134
Median = -33
Mean = -10
(weighted by population)
Linear distortion at topographic surface (parts per million)
<-120
to -120
to -100
to -80
to -60
to -40
±20
to +40
to +60
to +80
to +100
>+100
0 50 100 150 200 250 km
FLORIDA
GEORGIA
North standard parallel 30° 45' N
North Zone
Central parallel (computed) 30° 10' 02.11279..." N
South standard parallel 29° 35' N
West Zone
East Zone
Central meridian 82° 00' W
Central meridian 81° 00' W
Mobile
Pensacola
Tallahassee
Panama City
Jacksonville
Gainesville
Ocala
Daytona Beach
Orlando
Tampa
Clearwater
St. Petersburg
Cape Coral
West Palm Beach
Coral Springs
Hollywood
Hialeah
Miami
Key West
89°W 88°W 87°W 86°W 85°W 84°W 83°W 82°W 81°W 80°W
30°N 29°N 28°N 27°N 26°N 25°N



Preliminary SPCS2022 all zones combined: Florida
NOAA's National Geodetic Survey
North American Terrestrial Reference Frame of 2022
West Zone:
Lambert Conformal Conic projection
Central parallel: 30° 18' N
Central parallel scale: 0.999 98
East and Central Zones:
Oblique Mercator projections
Origin latitude (both): 28° 00' N
Origin longitude (East): 81° 06' W
Origin longitude (Central): 82° 00' W
Skew axis scale (East): 0.999 98
Skew axis scale (Central): 0.999 96
Skew azimuth (both): -16°
Areas within ±50 ppm distortion (±0.26 ft per mile):
99.9% of combined zones
99.5% of all cities and towns
99.7% of population
Distortion values (ppm)
All zones:
Min = -52
Max = +60
Range = 112
Mean = -13
Cities and towns:
Min, Max = -45, +52
Range = 96
Median = -13
Mean = -6
(weighted by population)
Linear distortion at topographic surface (parts per million)
<-120
to -120
to -100
to -80
to -60
to -40
±20
to +40
to +60
to +80
to +100
>+100
0 50 100 150 200 250 km
FLORIDA
GEORGIA
West Zone
Central parallel 30° 18' N
Central Zone
East Zone
Origin 28° 00' N 82° 00' W
Origin 28° 00' N 81° 06' W
Skew azimuth: -16°
Skew azimuth: -16°
Mobile
Pensacola
Panama City
Tallahassee
Jacksonville
Gainesville
Ocala
Daytona Beach
Orlando
Tampa
Clearwater
St. Petersburg
Cape Coral
West Palm Beach
Coral Springs
Hollywood
Hialeah
Miami
Key West
89°W
88°W
87°W
86°W
85°W
84°W
83°W
82°W
81°W
80°W
30°N
29°N
28°N
27°N
26°N
25°N


Existing SPCS 83 designs: Hawaii (all zones)
160°W
159°W
158°W
157°W
156°W
155°W
22°N
21°N
20°N
19°N
HI 5
HI 4
HI 3
HI 2
HI 1
Kaua'i
Ni'ihau
O'ahu
Pearl City
Kailua
Honolulu
Moloka'i
Maui
Kahului
Kihei
Lana'i
Kaho'olawe
Hawai'i
Hilo
Central meridian 160° 10' W
Central meridian 159° 30' W
Central meridian 158° 00' W
Central meridian 156° 40' W
Central meridian 155° 30' W
Transverse Mercator projections
North American Datum of 1983 (Pacific)
Zone | Central meridian | Central meridian scale
1 | 155° 30' W | 0.999 966 667...
2 | 156° 40' W | 0.999 966 667...
3 | 158° 00' W | 0.999 99 (exact)
4 | 159° 30' W | 0.999 99 (exact)
5 | 160° 10' W | 1.000 000 (exact)
Areas within ±100 ppm distortion (±0.53 ft per mile):
45% of combined zone land area
94% of all cities and towns
96% of population
Distortion values on land (ppm)
All zones:
Min = -694
Max = +29
Range = 723
Mean = -163
Cities and towns:
Min, Max = -208, +12
Range = 220
Median = -25
Mean = -29
(weighted by population)
Linear distortion at topographic surface (parts per million)
< -400
to -400
to -350
to -300
to -250
to -200
to -150
to -100
±50
to +100
to +150
to +200
to +250
to +300
> +300
0
50
100
150
km
NOAA's National Geodetic Survey


Preliminary SPCS2022 default design: Hawaii (single zone)
160°W
159°W
158°W
157°W
156°W
155°W
22°N
21°N
20°N
19°N
Kaua'i
Ni'ihau
O'ahu
Pearl City
Kailua
Honolulu
Moloka'i
Maui
Kahului
Kihei
Lana'i
Kaho'olawe
Hawai'i
Hilo
Origin
20° 55' N
157° 30' W
Skew azimuth: -56°
Oblique Mercator projection
Pacific Terrestrial Reference Frame of 2022
Origin latitude: 20° 55' N
Origin longitude: 157° 30' W
Skew axis scale: 1.000 000 (exact)
Skew azimuth: -56°
Areas within ±100 ppm distortion (±0.53 ft per mile):
54% of entire zone land area
95% of all cities and towns
97% of population
Distortion values on land (ppm)
Entire zone:
Min = -656
Max = +70
Range = 726
Mean = -130
Cities and towns:
Min, Max = -184, +57
Range = 241
Median = -2
Mean = -6
(weighted by population)
Linear distortion at topographic surface (parts per million)
< -400
to -400
to -350
to -300
to -250
to -200
to -150
to -100
±50
to +100
to +150
to +200
to +250
to +300
> +300
0
50
100
150
km
NOAA's National Geodetic Survey

Overview: Policy, Procedures, and FRN

- Linear distortion at topographic surface
- One-parallel Lambert Conformal Conic projections
- Default SPCS2022 zone designs
- Statewide and “layered” zones
- Linear distortion design criteria
  - Maximum and minimum zone size and distortion
  - Low distortion projections (LDPs)
- “Special purpose” zones (in FRN only)
- Linear units
- Submittal process and deadlines
  - For Federal Register Notice comments
  - For requests, proposals, and submittal of designs

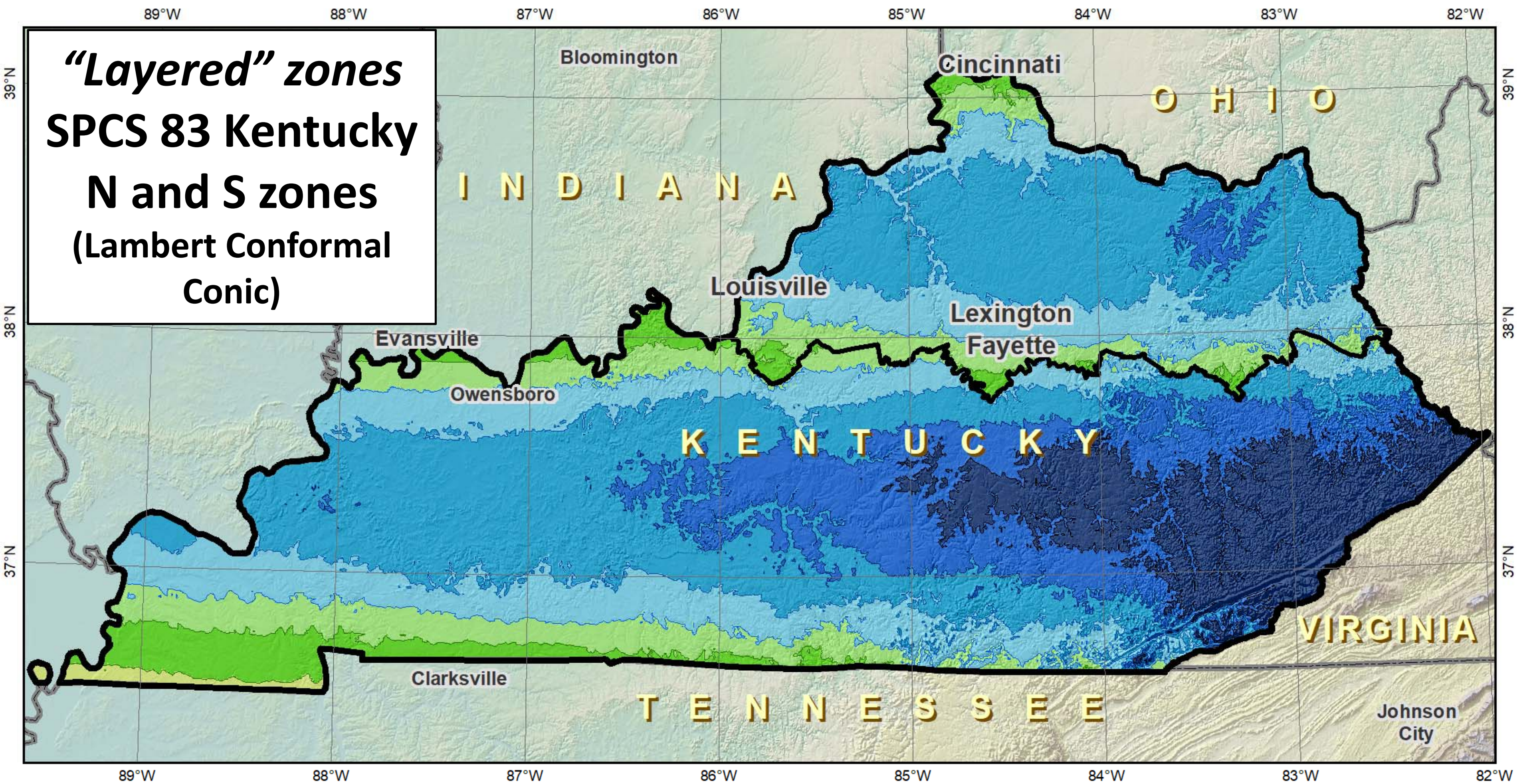
Statewide and "layered" zones

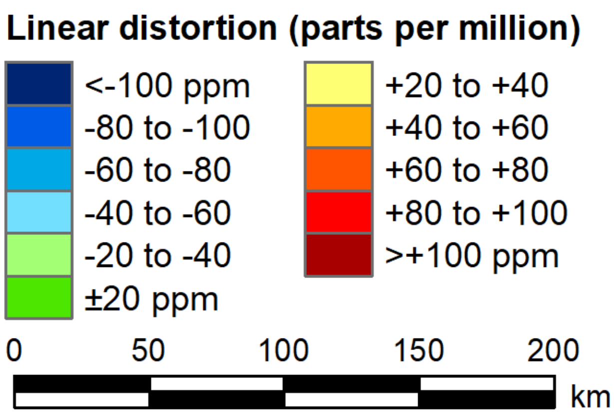
Policy § III.A.2.

- Limitations
  - Max of ***TWO*** layers: Statewide and sub-zones
  - If two layers, one ***MUST*** be statewide
  - Minimum subzone dimension > 50 km
- States often want statewide ***and*** small zones
  - *Statewide:* Single geometry required for state GIS
  - *Sub-zones:* Lower distortion for surveying/engineering
- Accommodates state needs, but with restrictions
  - Prevent poor design choices for statewide zones
- One already exists in SPCS 83…

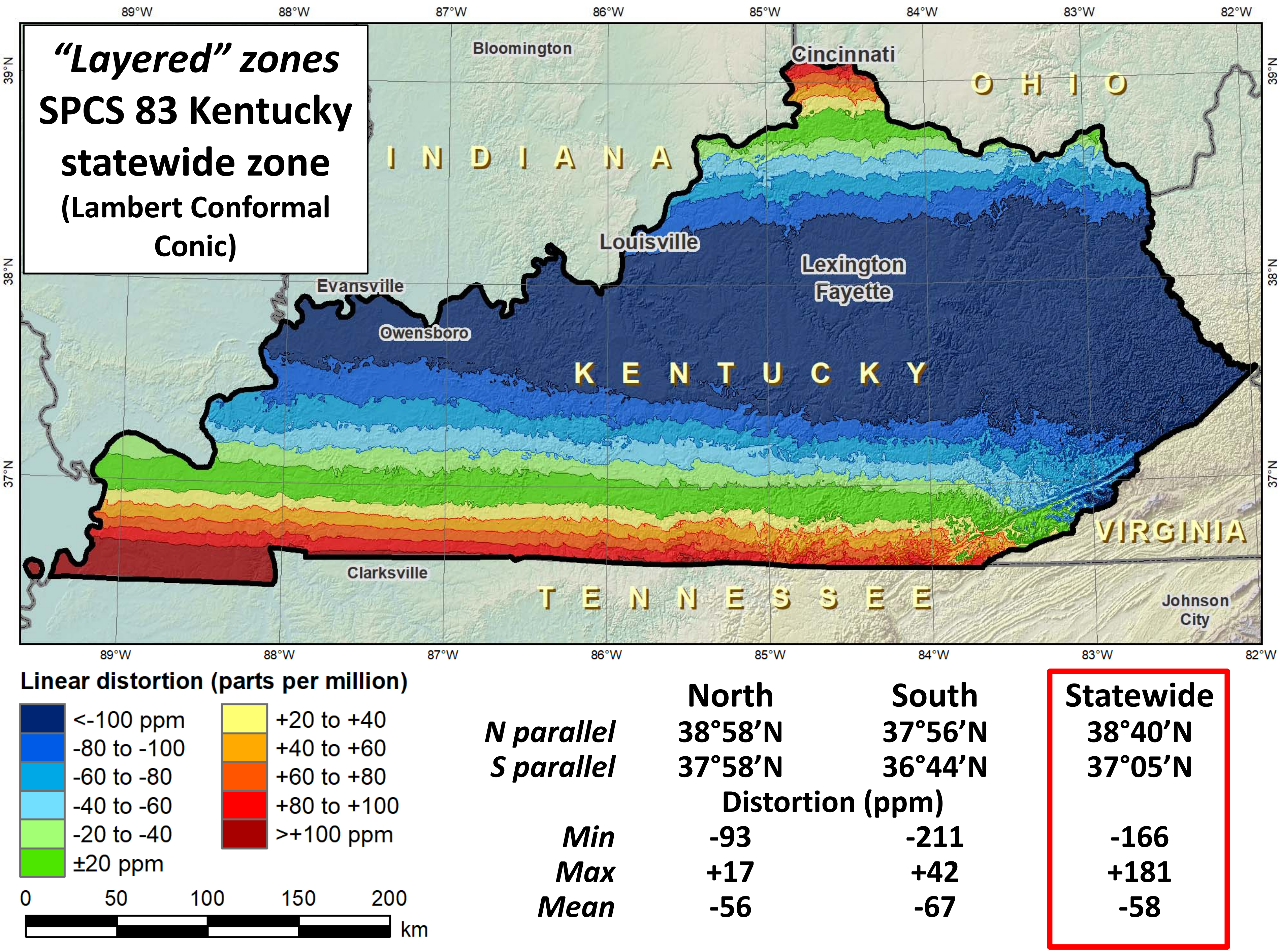
"Layered" zones SPCS 83 Kentucky N and S zones

(Lambert Conformal Conic)

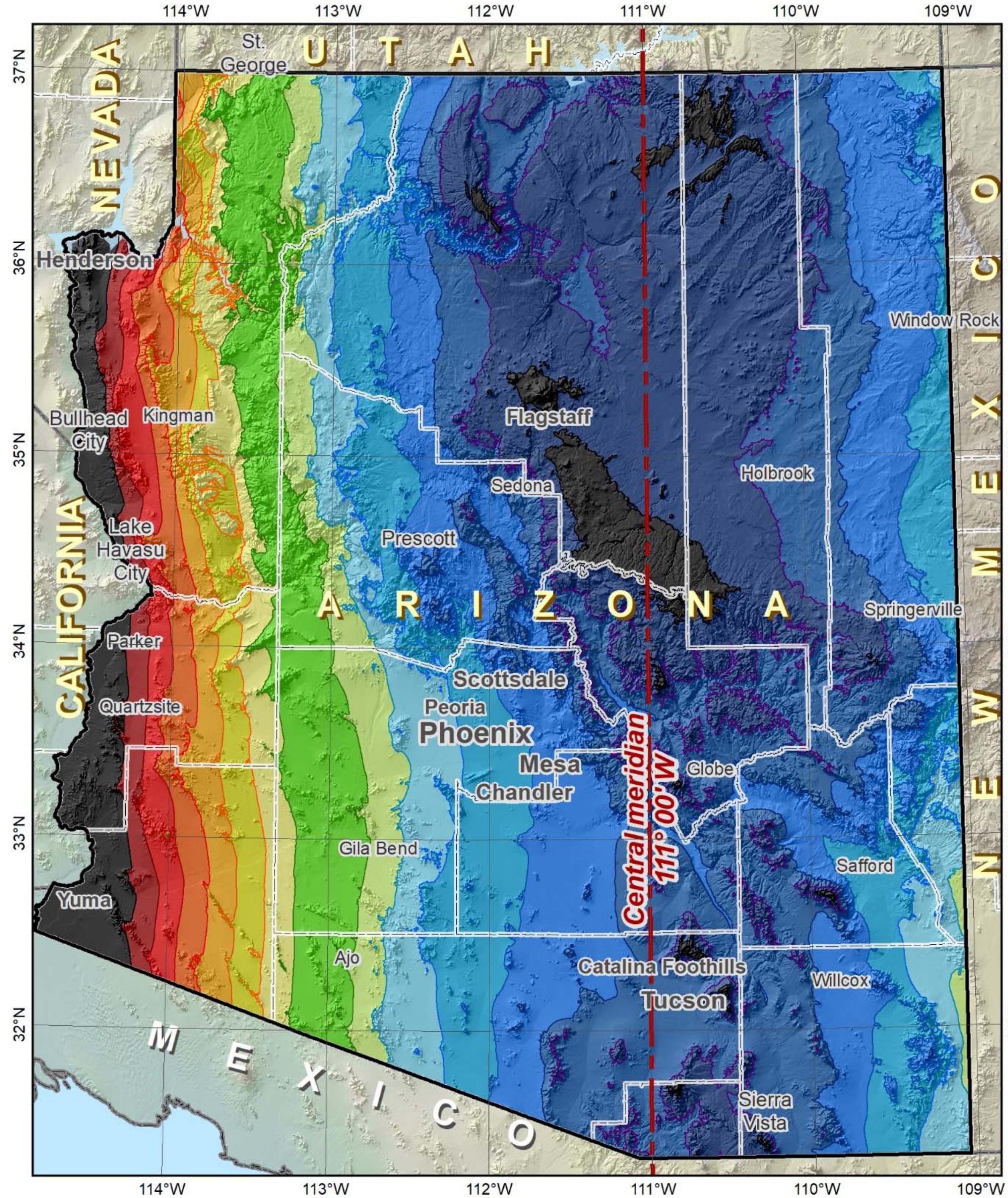




	North	South
N parallel	38°58'N	37°56'N
S parallel	37°58'N	36°44'N
	Distortion (ppm)	
Min	-93	-211
Max	+17	+42
Mean	-56	-67



	North	South	Statewide
N parallel	38°58’N	37°56’N	38°40’N
S parallel	37°58’N	36°44’N	37°05’N
	Distortion (ppm)		
Min	-93	-211	-166
Max	+17	+42	+181
Mean	-56	-67	-58



Existing UTM Zone 12 North used as statewide zone: Arizona

NOAA's National Geodetic Survey

Transverse Mercator projection

North American Datum of 1983

Central meridian: 111° 00' W
Cen merid scale: 0.999 6 (exact)

Areas within ±400 ppm distortion (±2.11 ft per mile):
36% of entire zone
33% of all cities and towns
67% of population

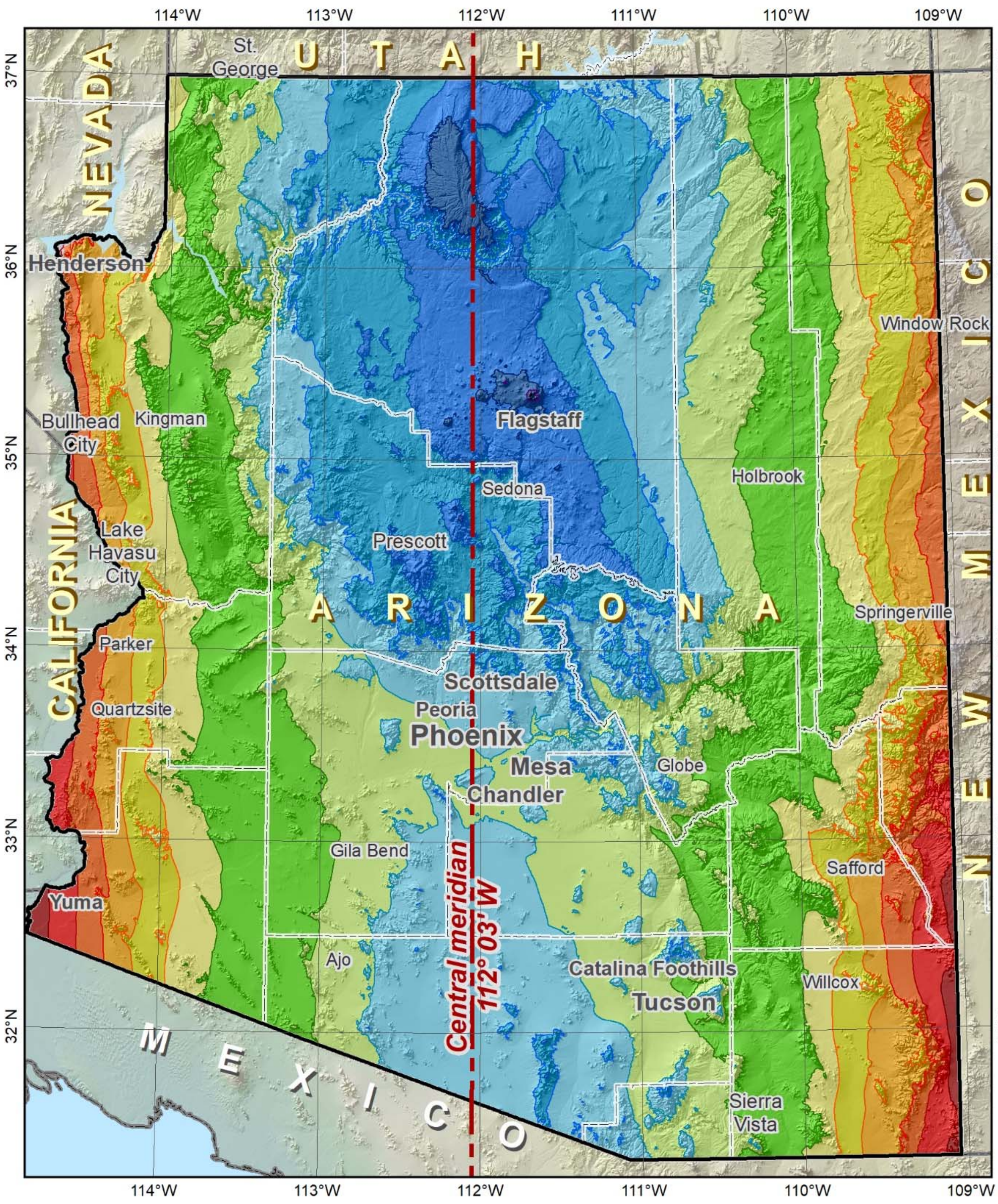
Distortion values (ppm)

Entire zone:	***Cities and towns:***
Min = -943	Min, Max = -756, +1159
Max = +1187	Range = 1915
Range = 2130	Median = -433
Mean = -300	Mean = -318 (weighted by population)

Linear distortion at topographic surface (parts per million)

< -700	to -300	to +400
to -700	to -200	to +500
to -600	±100	to +600
to -500	to +200	to +700
to -400	to +300	> +700

0 50 100 150 200 250 km



Preliminary SPCS2022 statewide zone design: Arizona

NOAA's National Geodetic Survey

Transverse Mercator projection

North American Terrestrial Reference Frame of 2022

Central meridian: 112° 03' W

Cen merid scale: 0.999 85 (exact)

Areas within ±400 ppm distortion (±2.11 ft per mile):

88% of entire zone

89% of all cities and towns

95% of population

Distortion values (ppm)

Entire zone:	***Cities and towns:***
Min = -725	Min, Max = -543, +664
Max = +684	Range = 1207
Range = 1409	Median = -150
Mean = -79	Mean = -148 (weighted by population)

Linear distortion at topographic surface (parts per million)

< -700	to -300	to +400
to -700	to -200	to +500
to -600	±100	to +600
to -500	to +200	to +700
to -400	to +300	> +700

0 50 100 150 200 250 km

Overview: Policy, Procedures, and FRN

- Linear distortion at topographic surface
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  - Maximum and minimum zone size and distortion
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Linear distortion design criteria

Procedures §4.b.i-ii and §5.c.i.

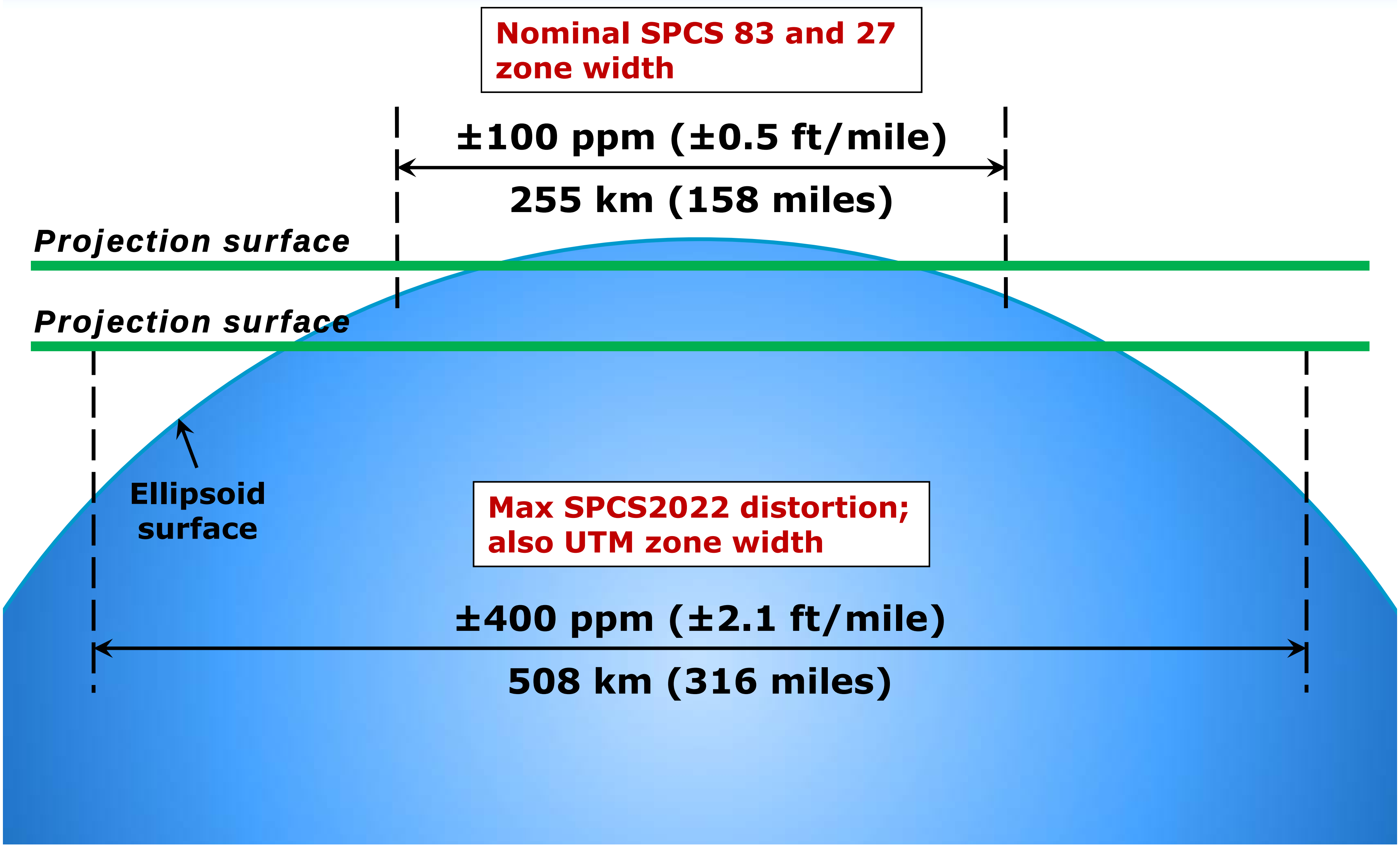
- NGS design of zones requested by stakeholders
  - Limited to zones with 50-400 ppm distortion criterion
    - **50 ppm** = 5 cm/km = 0.3 ft/mi = 1:20,000
    - **400 ppm** = 40 cm/km = 2.1 ft/mi = 1:2,500
- Design criterion < 50 ppm (i.e., ***"low distortion"***)
  - Low distortion projections (LDPs)
  - Must be designed by others (not by NGS)
  - Proposed and final design reviewed by NGS

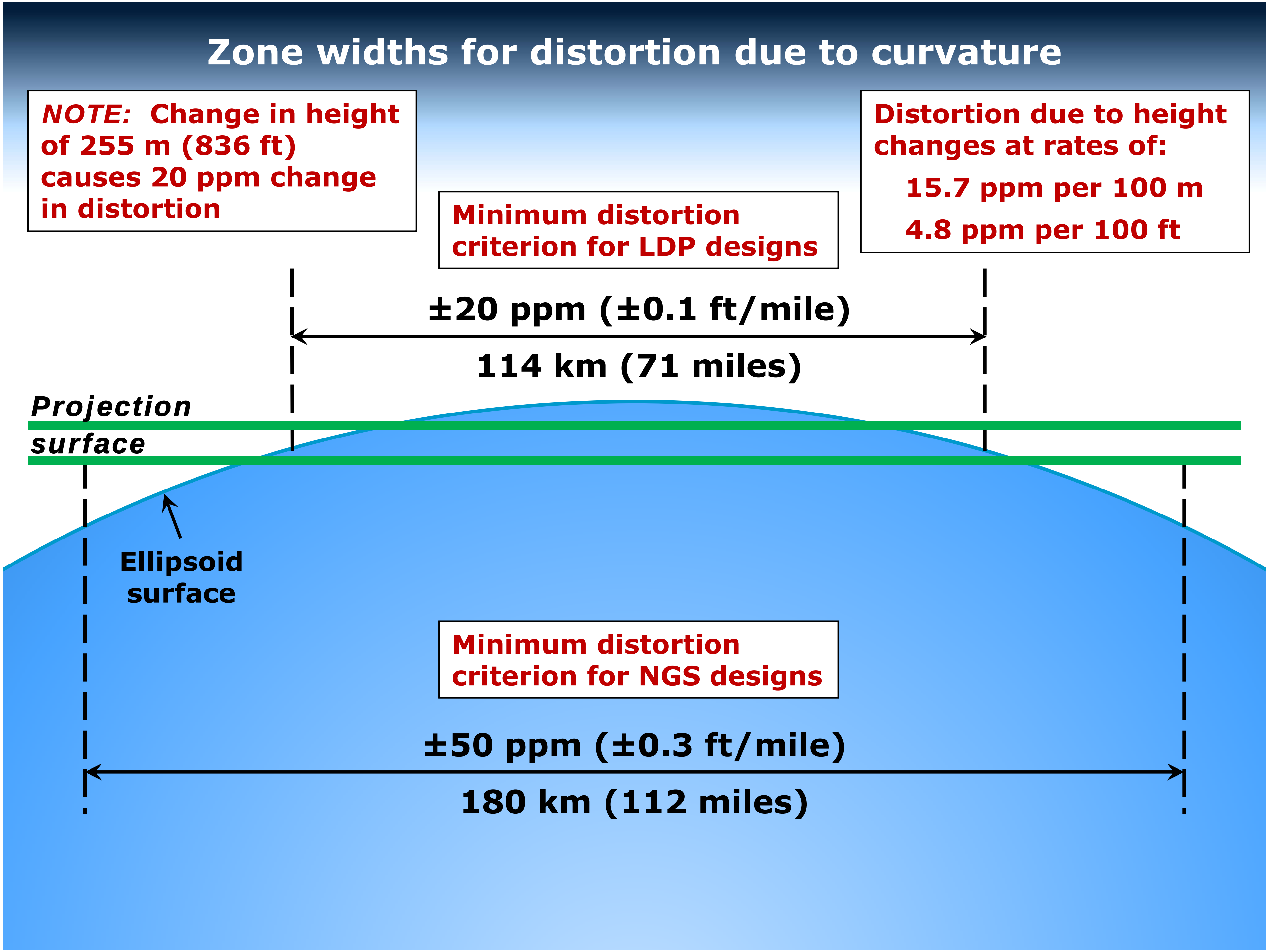
Minimum LDP distortion & zone size

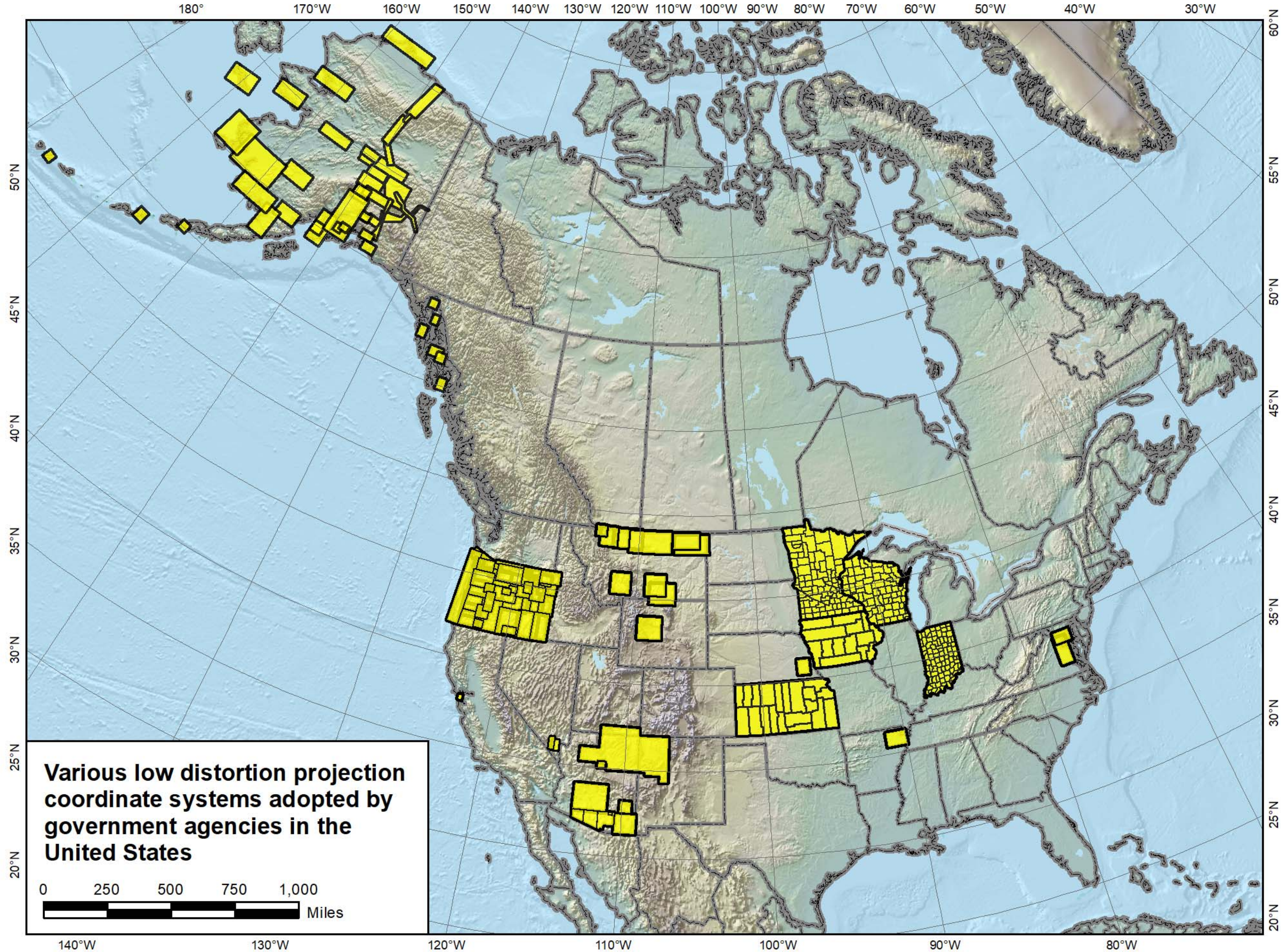
Procedures § 5.c.ii

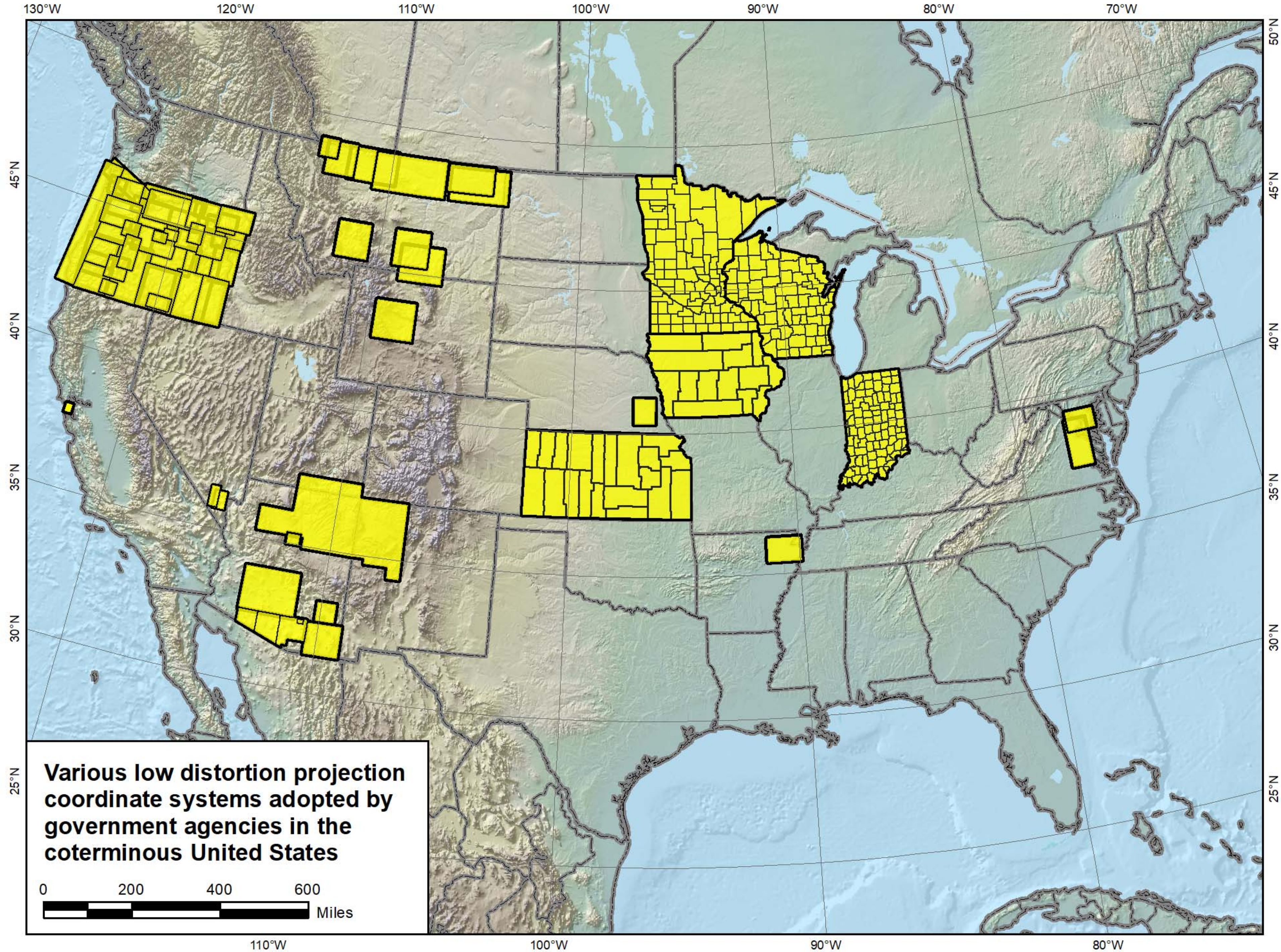
- Create largest zone that meets distortion criterion
  - To avoid creating excessive number very small zones
- Minimum distortion design criterion
  - **20 ppm** = 2 cm/km = 0.1 ft/mi = 1:50,000
  - Nominal zone width of 114 km (71 miles)
  - Nominal height change of 255 m (836 ft)
- Minimum allowable zone width **50 km** (31 miles)
  - Exception: if height change in zone > 250 m (820 ft)
  - Note: 50 km corresponds to approx ±5 ppm distortion

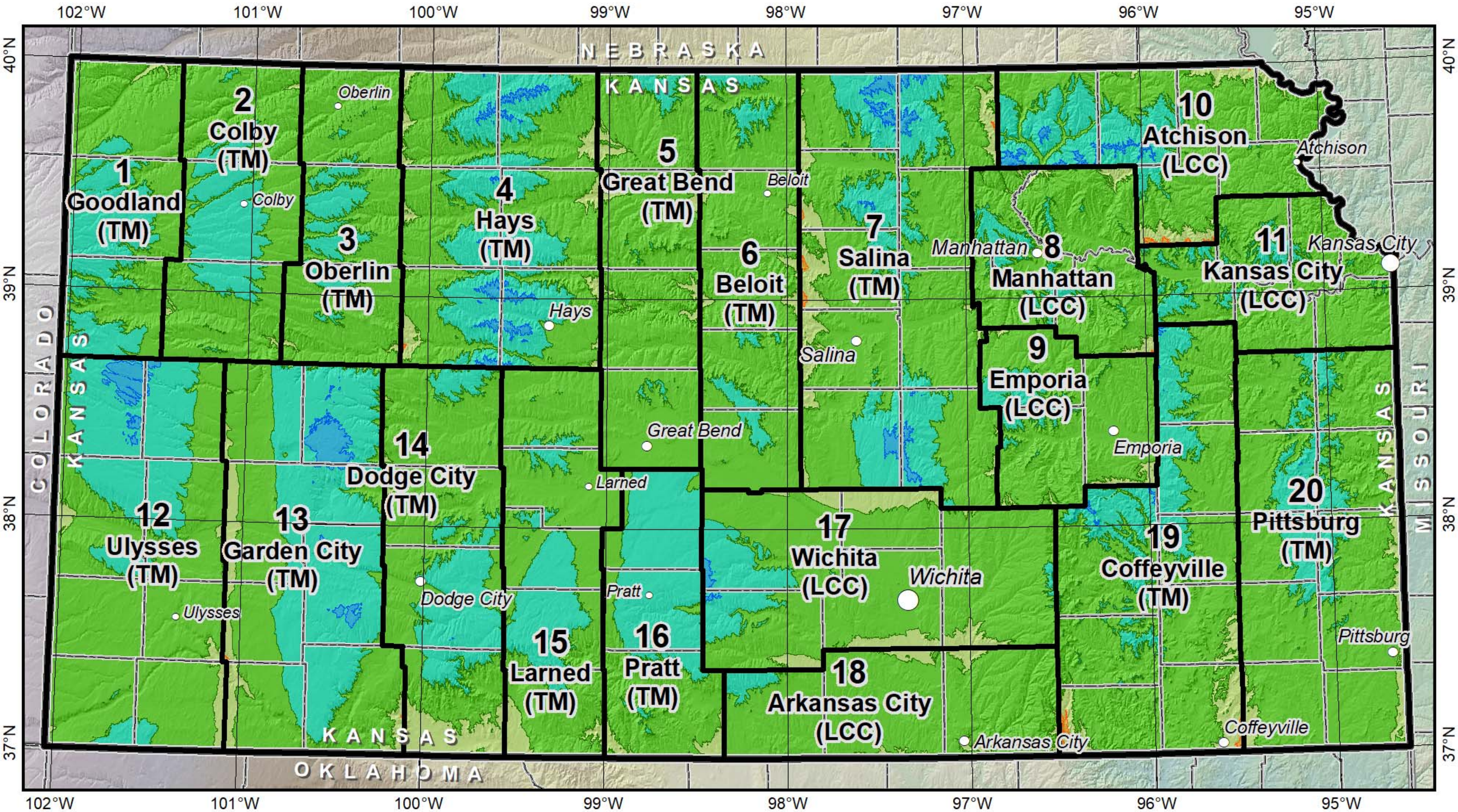
Zone widths for distortion due to curvature




Zone widths for distortion due to curvature
NOTE: Change in height of 255 m (836 ft) causes 20 ppm change in distortion
Distortion due to height changes at rates of:
15.7 ppm per 100 m
4.8 ppm per 100 ft
Minimum distortion criterion for LDP designs
±20 ppm (±0.1 ft/mile)
114 km (71 miles)
Projection surface
Ellipsoid surface
Minimum distortion criterion for NGS designs
±50 ppm (±0.3 ft/mile)
180 km (112 miles)


Various low distortion projection coordinate systems adopted by government agencies in the United States
0
250
500
750
1,000
Miles
180°
170°W
160°W
150°W
140°W
130°W
120°W
110°W
100°W
90°W
80°W
70°W
60°W
50°W
40°W
30°W
140°W
130°W
120°W
110°W
100°W
90°W
80°W
20°N
25°N
30°N
35°N
40°N
45°N
50°N
55°N
60°N


130°W
120°W
110°W
100°W
90°W
80°W
70°W
50°N
45°N
40°N
35°N
30°N
25°N
Various low distortion projection coordinate systems adopted by government agencies in the coterminous United States
0
200
400
600
Miles



Kansas Regional Coordinate System (KRCS)

All zones referenced to the North American Datum of 1983

Statewide Distortion Statistics

Minimum:	-26.9 ppm	
Maximum:	+26.0 ppm	
Mean:	-4.0 ppm	
Std dev:	±8.2 ppm	

Area of the state that is:

within ±10 ppm = 68.330%
within ±20 ppm = 98.802%
within ±25 ppm = 99.998%

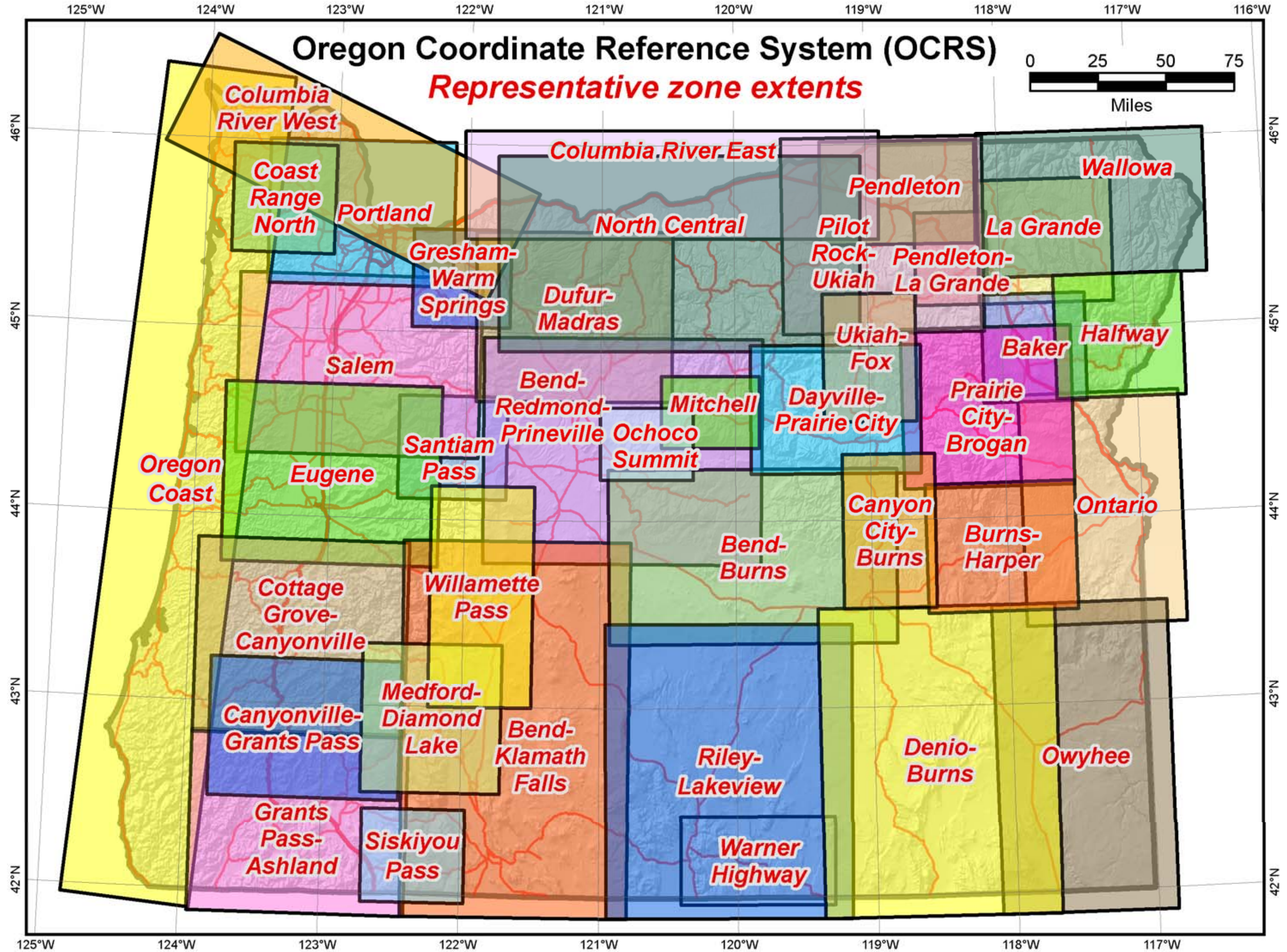
Linear Distortion (parts per million)

- <-25 ppm (0.16 ft/mile)
- -20 to -25 ppm
- -10 to -20 ppm
- ±10 ppm (0.05 ft/mile)
- +10 to +20 ppm
- +20 to +25 ppm
- >+25 ppm (0.13 ft/mile)

Projection Types

TM = Transverse Mercator
LCC = Lambert Conformal Conic

0 25 50 75 100 Miles



Oregon Coordinate Reference System (OCRS)
Representative zone extents
0 25 50 75
Miles
125°W
124°W
123°W
122°W
121°W
120°W
119°W
118°W
117°W
116°W
46°N
45°N
44°N
43°N
42°N
Columbia River West
Columbia River East
Wallowa
Coast Range North
Portland
Pendleton
North Central
Pilot Rock-Ukiah
La Grande
Gresham-Warm Springs
Pendleton-La Grande
Dufur-Madras
Ukiah-Fox
Halfway
Baker
Salem
Bend-Redmond-Prineville
Mitchell
Dayville-Prairie City
Prairie City-Brogan
Santiam Pass
Ochoco Summit
Oregon Coast
Eugene
Canyon City-Burns
Ontario
Burns-Harper
Bend-Burns
Cottage Grove-Canyonville
Willamette Pass
Medford-Diamond Lake
Canyonville-Grants Pass
Bend-Klamath Falls
Riley-Lakeview
Denio-Burns
Owyhee
Grants Pass-Ashland
Siskiyou Pass
Warner Highway

Area of state within:

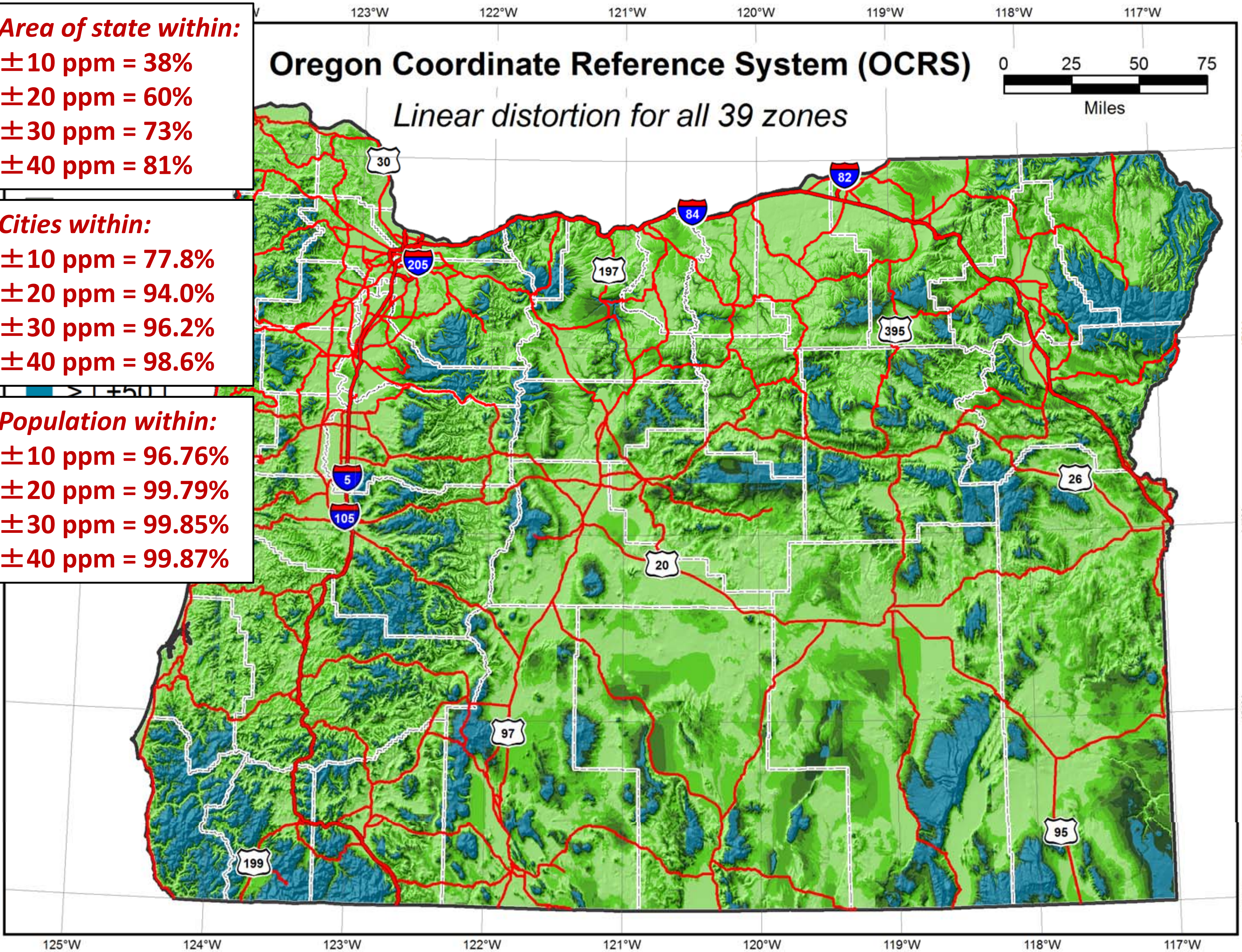
±10 ppm = 38%
±20 ppm = 60%
±30 ppm = 73%
±40 ppm = 81%

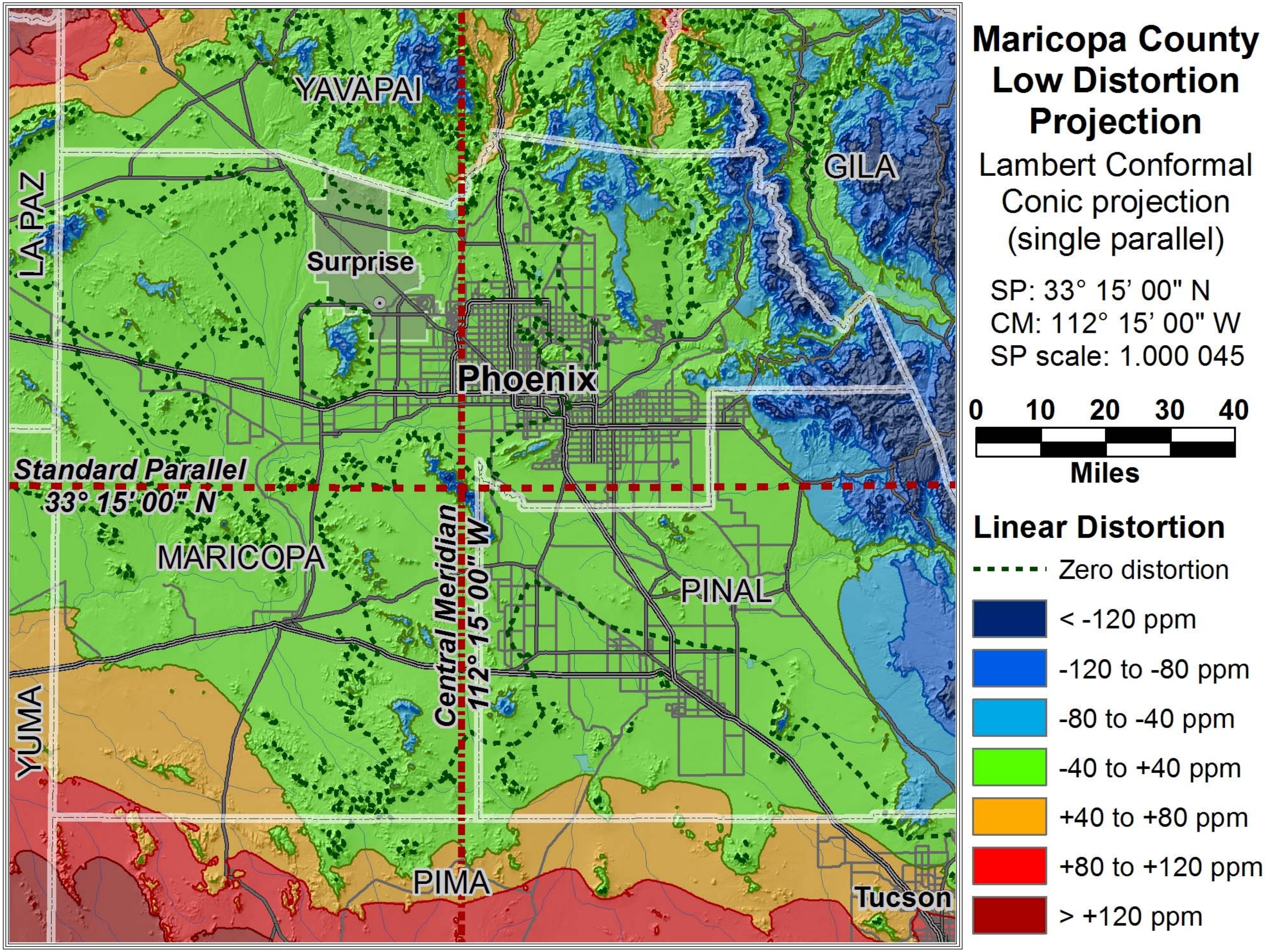
Cities within:

±10 ppm = 77.8%
±20 ppm = 94.0%
±30 ppm = 96.2%
±40 ppm = 98.6%

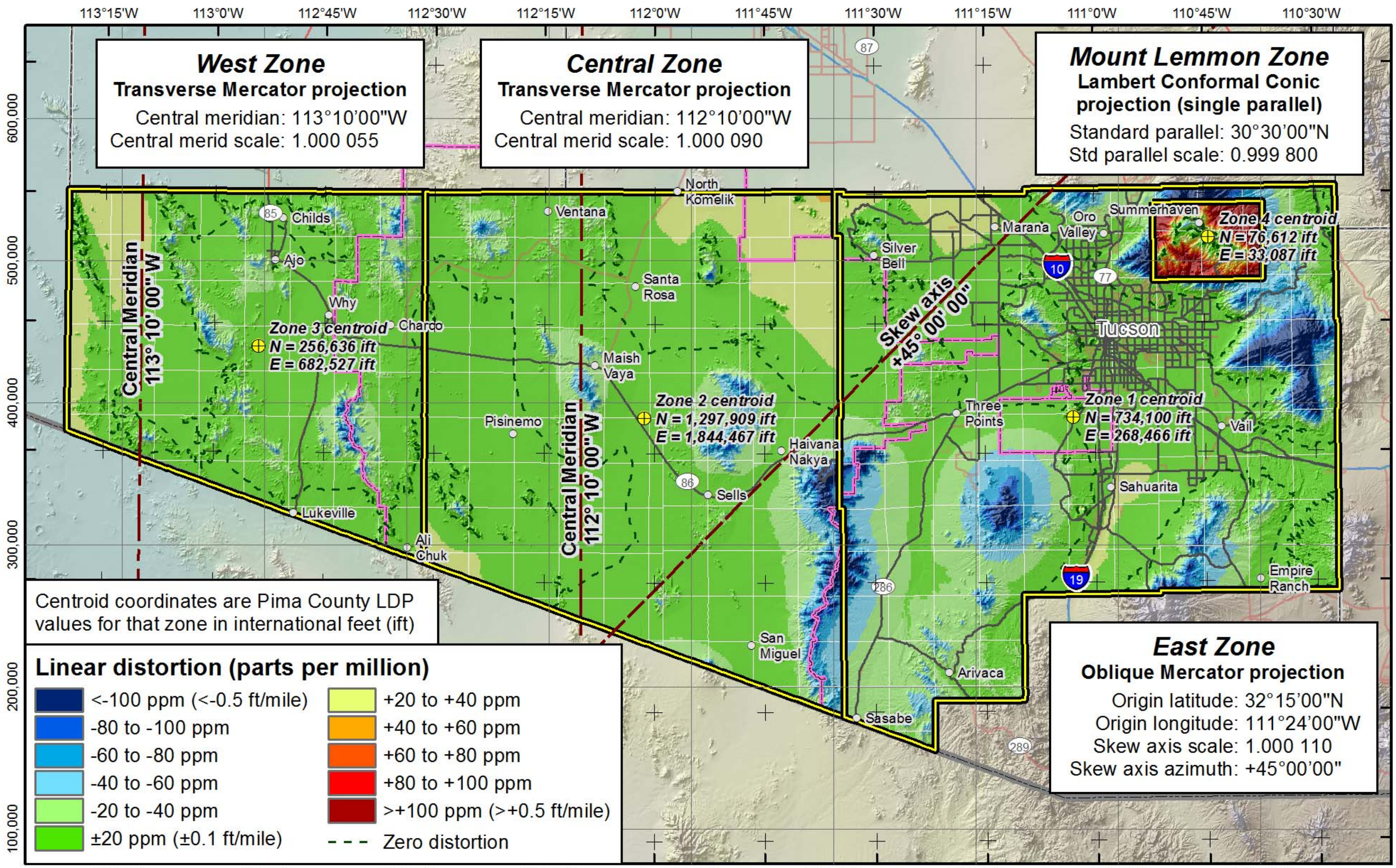
Population within:

±10 ppm = 96.76%
±20 ppm = 99.79%
±30 ppm = 99.85%
±40 ppm = 99.87%





Maricopa County
Low Distortion
Projection
Lambert Conformal
Conic projection
(single parallel)
SP: 33° 15' 00" N
CM: 112° 15' 00" W
SP scale: 1.000 045
0 10 20 30 40
Miles
Linear Distortion
Zero distortion
< -120 ppm
-120 to -80 ppm
-80 to -40 ppm
-40 to +40 ppm
+40 to +80 ppm
+80 to +120 ppm
> +120 ppm
YAVAPAI
GILA
LA PAZ
Surprise
Phoenix
Standard Parallel
33° 15' 00" N
MARICOPA
Central Meridian
112° 15' 00" W
PINAL
YUMA
PIMA
Tucson



Pima County Low Distortion Projection Coordinate System *(preliminary)*

All zones (large zones clipped to townships)

Projected grid is SPCS 83 AZ C (international feet)

Overview: Policy, Procedures, and FRN

- Linear distortion at topographic surface
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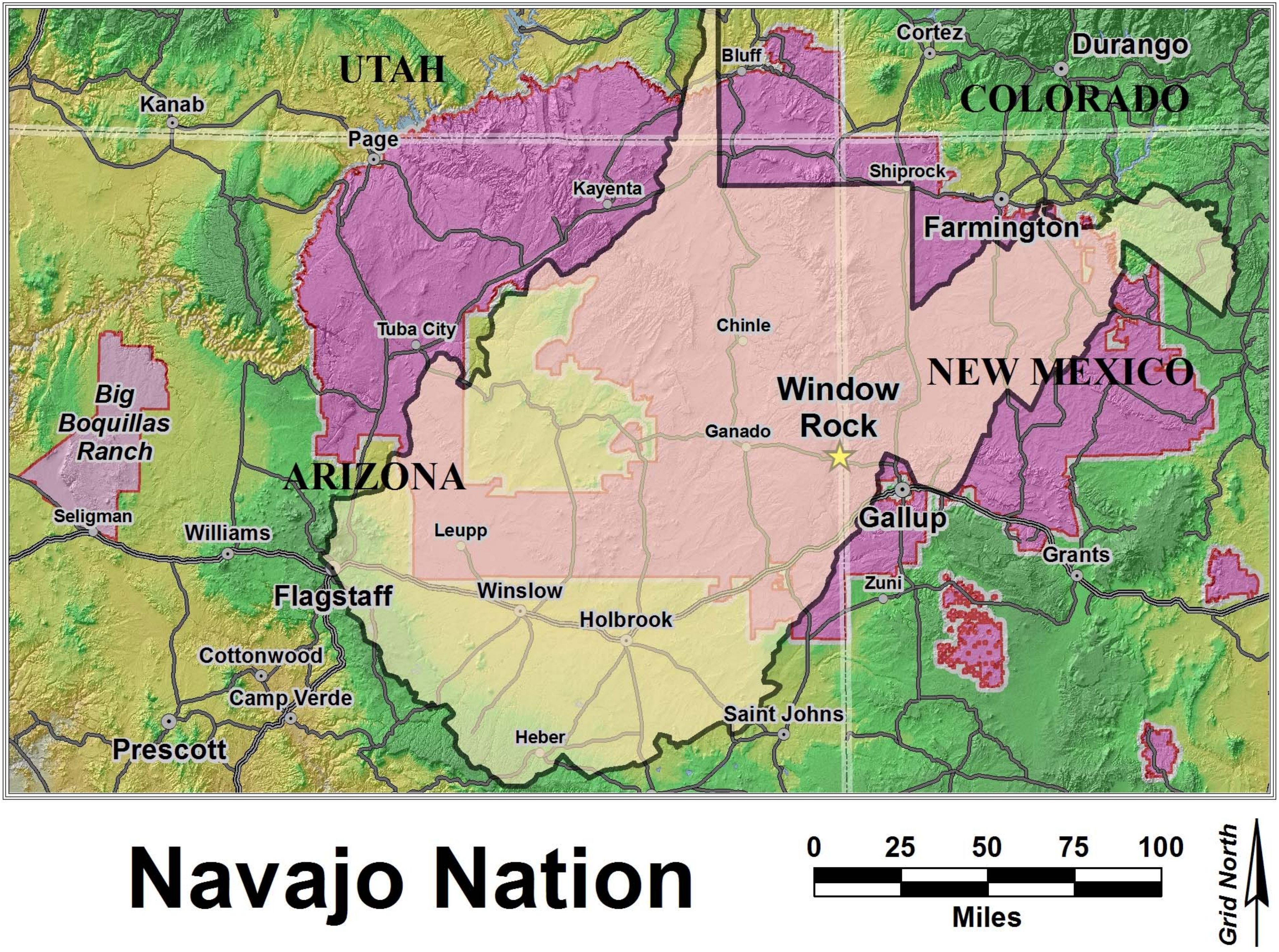
  - For Federal Register Notice comments
  - For requests, proposals, and submittal of designs

"Special purpose" zones

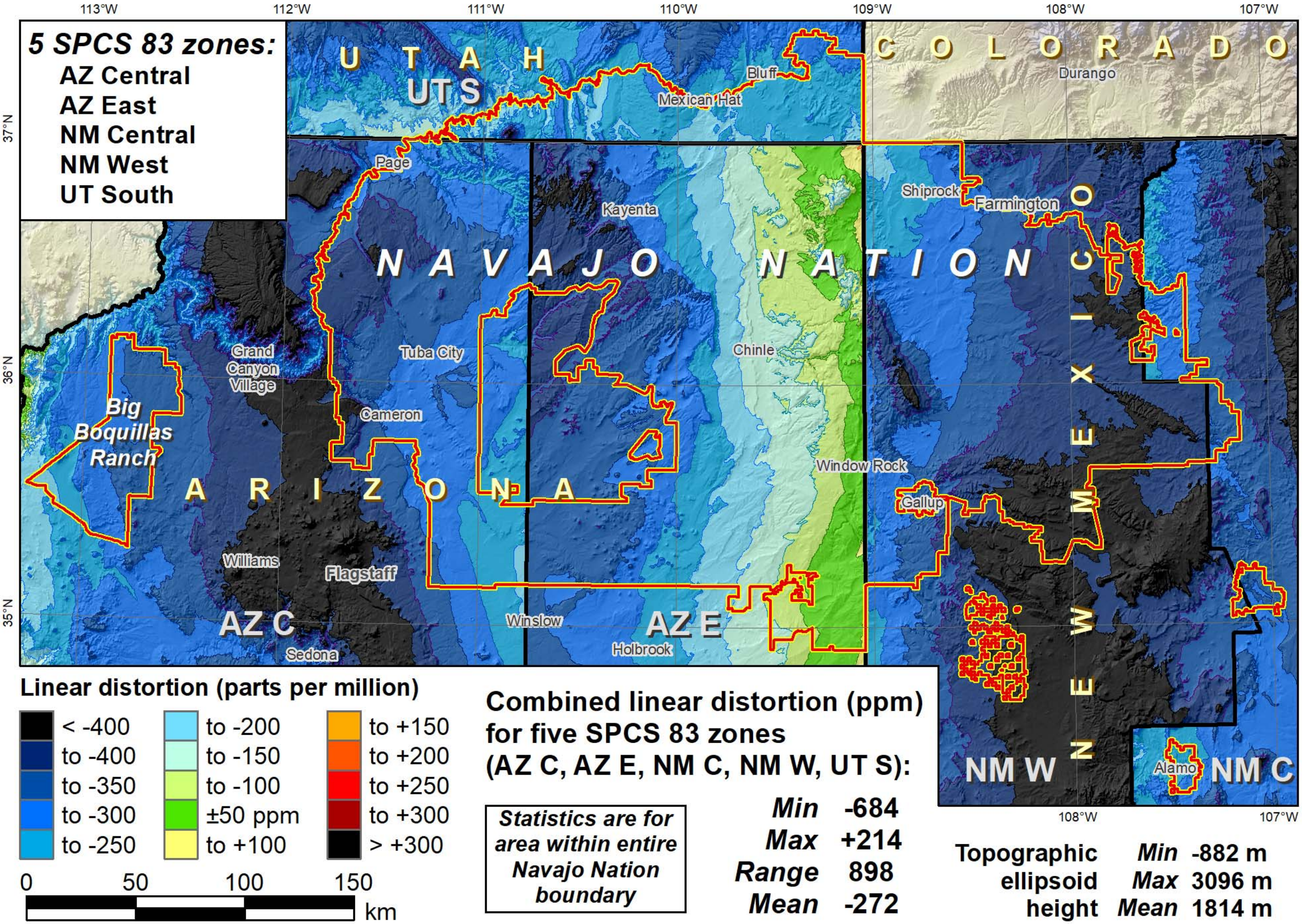
In Federal Register Notice (not in policy & procedures)

- For areas with inadequate SPCS zone coverage
  - Usually areas that are in more than one zone
- Categories:
  - Major urban areas (e.g., New York, Chicago, St. Louis, Denver)
  - Large Indian reservations (e.g., Navajo Nation)
  - Federal applications covering large areas (e.g., coastal mapping of Atlantic Coast; Grand Canyon National Park)
- Permitted for metro areas in 1977 policy (but never used)
- Only in FRN, ***not*** in draft policy & procedures

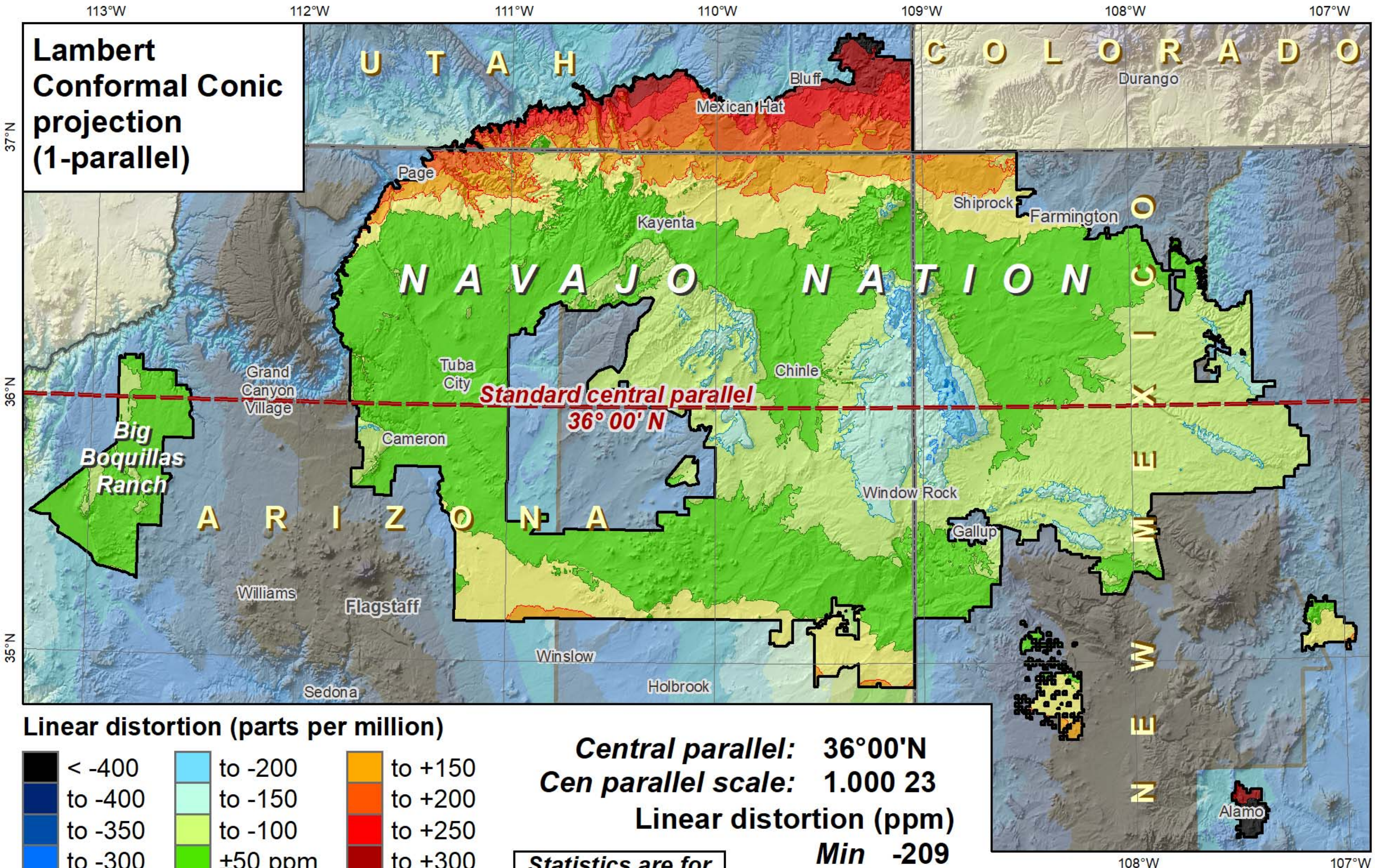


Navajo Nation

Existing State Plane coverage for Navajo Nation



"Special purpose" zone: Navajo Nation Coordinate System



Linear distortion (parts per million)

< -400	to -200	to +150
to -400	to -150	to +200
to -350	to -100	to +250
to -300	±50 ppm	to +300
to -250	to +100	> +300

0 50 100 150 km

Central parallel: **36°00'N**

Cen parallel scale: **1.000 23**

Statistics are for area within entire Navajo Nation boundary

Linear distortion (ppm)

Min	**-209**
Max	**+348**
Range	**557**
Mean	**0**

Topographic ellipsoid height

Min	**-882 m**
Max	**3096 m**
Mean	**1814 m**

Overview: Policy, Procedures, and FRN

- Linear distortion at topographic surface
- One-parallel Lambert Conformal Conic projections
- Default SPCS2022 zone designs
- Statewide and "layered" zones
- Linear distortion design criteria
  - Maximum and minimum zone size and distortion
  - Low distortion projections (LDPs)
- "Special purpose" zones (in FRN only)
- Linear units
- Submittal process and deadlines
  - For Federal Register Notice comments
  - For requests, proposals, and submittal of designs

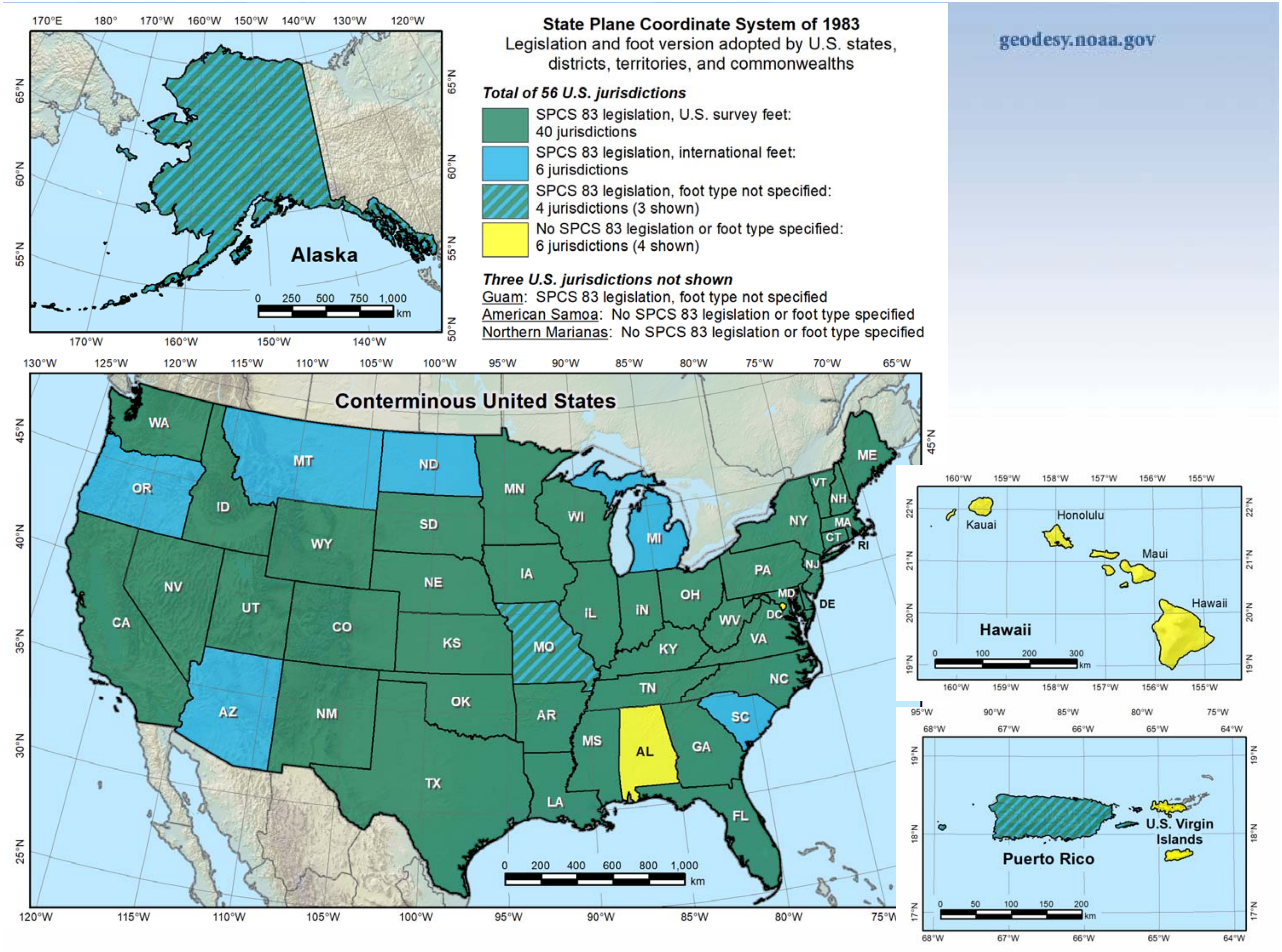
Linear units

Policy § II.D and E

- All linear parameters defined in ***meters***
- Will also give output in feet version if specified by state

Policy § IV.C *(for default zones only)*

- Will use foot as defined currently for SPCS 83
  - Appendix C of *NOAA Special Publication NOS NGS 13*



geodesy.noaa.gov
State Plane Coordinate System of 1983
Legislation and foot version adopted by U.S. states, districts, territories, and commonwealths
Total of 56 U.S. jurisdictions
SPCS 83 legislation, U.S. survey feet: 40 jurisdictions
SPCS 83 legislation, international feet: 6 jurisdictions
SPCS 83 legislation, foot type not specified: 4 jurisdictions (3 shown)
No SPCS 83 legislation or foot type specified: 6 jurisdictions (4 shown)
Three U.S. jurisdictions not shown
Guam: SPCS 83 legislation, foot type not specified
American Samoa: No SPCS 83 legislation or foot type specified
Northern Marianas: No SPCS 83 legislation or foot type specified
Alaska
0 250 500 750 1,000 km
Conterminous United States
WA
OR
ID
MT
ND
MN
SD
WY
NV
CA
UT
CO
NE
IA
WI
MI
KS
MO
IL
IN
OH
PA
NY
VT
NH
ME
MA
CT
RI
NJ
MD
DE
DC
WV
VA
KY
TN
NC
SC
GA
AL
MS
AR
LA
OK
TX
NM
AZ
FL
0 200 400 600 800 1,000 km
Hawaii
Kauai
Honolulu
Maui
Hawaii
0 100 200 300 km
Puerto Rico
U.S. Virgin Islands
0 50 100 150 200 km

Overview: Policy, Procedures, and FRN

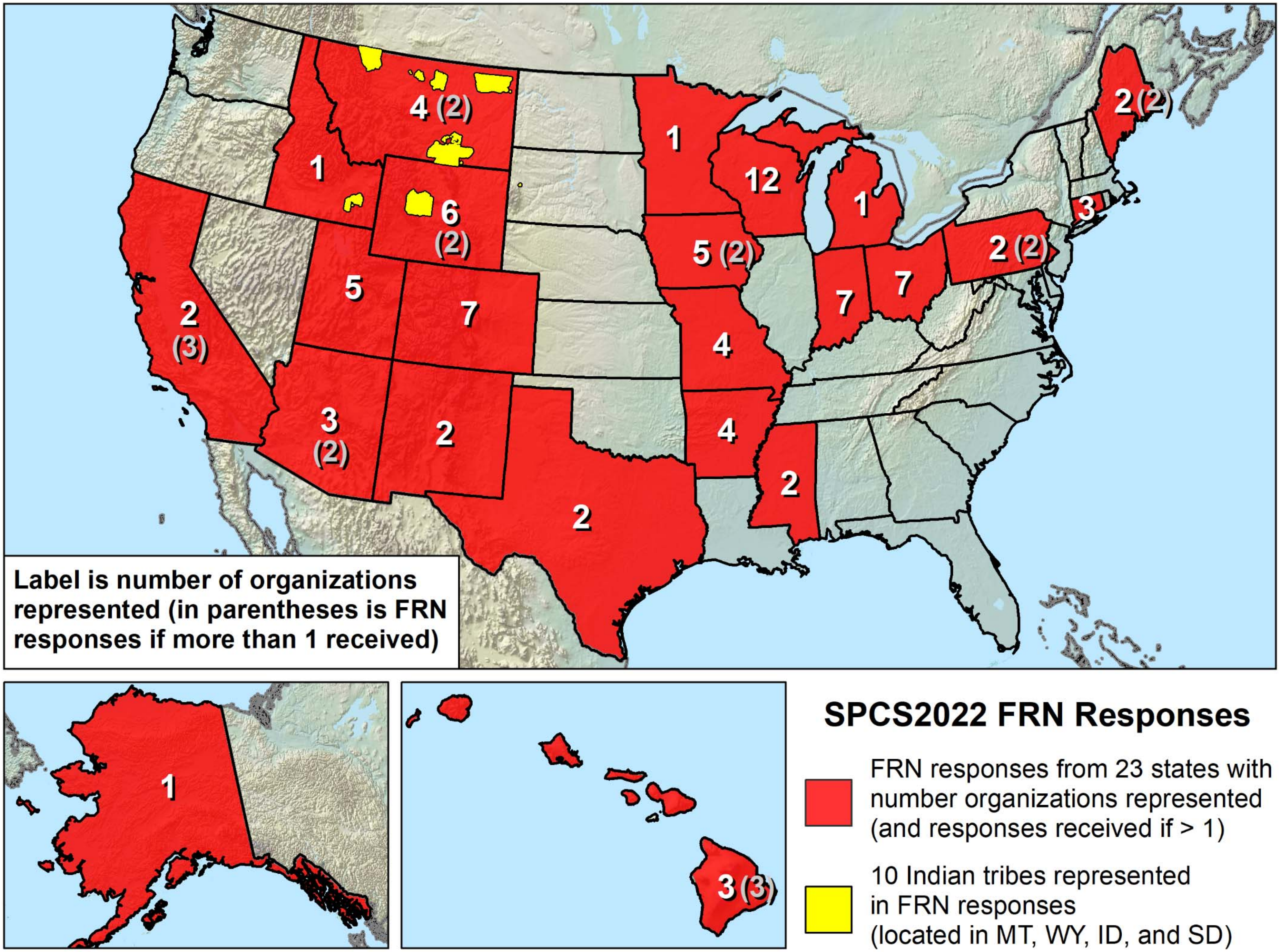
- Linear distortion at topographic surface
- One-parallel Lambert Conformal Conic projections
- Default SPCS2022 zone designs
- Statewide and "layered" zones
- Linear distortion design criteria
  - Maximum and minimum zone size and distortion
  - Low distortion projections (LDPs)
- "Special purpose" zones (in FRN only)
- Linear units
- Submittal process and deadlines
  - For Federal Register Notice comments
  - For requests, proposals, and submittal of designs

Overview of FRN feedback

- FRN public comment period April 18-Aug 31
  - For ***draft*** SPCS2022 policy & procedures
  - Wide variety of formats and content
  - Individuals, organizations, and groups of organizations
- Received 41 unique responses:
  - 4 national in scope (3 from USGS)
  - 3 for Indian tribes
  - 1 from NGS Rocky Mountain Regional Advisor
  - 33 from states
- 105 people represented by name
- 97 organizations represented

Organizations represented

- 1 federal agency (USGS)
- 10 Indian tribes
- 23 states (includes state and private organizations)
  - 17 state DOTs
  - 12 state GIS/GIO/cartographer offices
  - 21 state professional societies (surveying and GIS)
  - 12 universities and colleges
  - 6 city and county groups
  - 7 private companies
  - 10 other state organizations

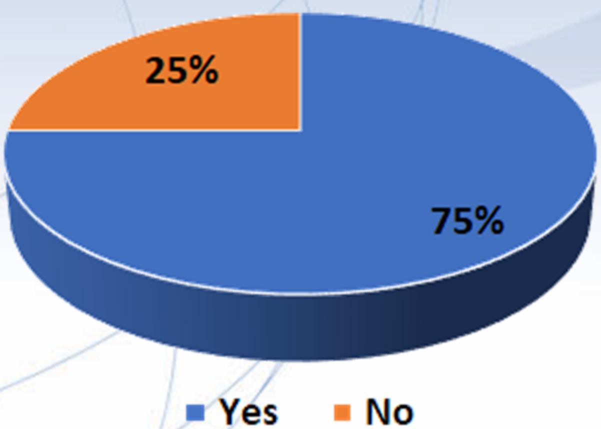

Label is number of organizations represented (in parentheses is FRN responses if more than 1 received)
SPCS2022 FRN Responses
FRN responses from 23 states with number organizations represented (and responses received if > 1)
10 Indian tribes represented in FRN responses (located in MT, WY, ID, and SD)
4 (2)
1
6 (2)
5
7
2 (3)
3 (2)
2
2
1
12
1
5 (2)
4
4
2
7
7
2 (2)
3
2 (2)
1
3 (3)

The 5 FRN questions

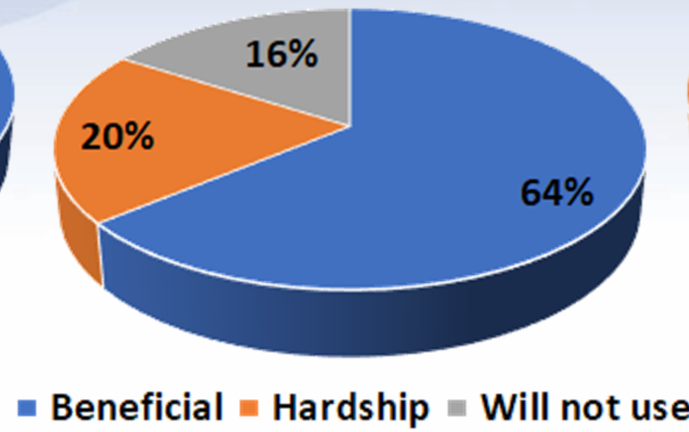
1. **Usage of current SPCS** in your organization.
2. Whether **default SPCS2022 definitions** impose hardship or are beneficial.
3. Whether there is sufficient **flexibility** in SPCS2022 characteristics.
4. Whether the SPCS2022 **deadlines** are acceptable.
5. Whether **"special purpose" zones** in SPCS2022 would be beneficial, problematic, or irrelevant.

Responses to the 5 FRN questions

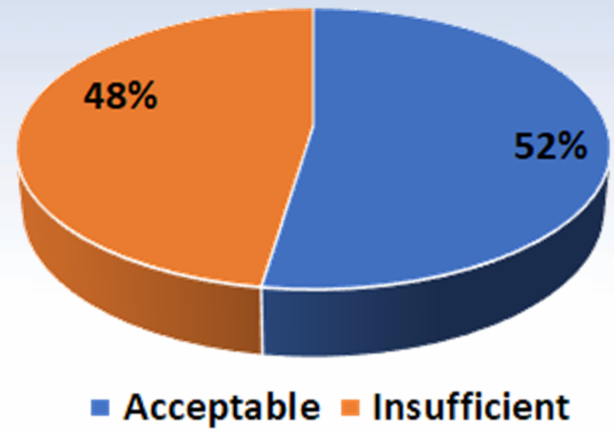
1. Currently use SPCS?
(24 responses)



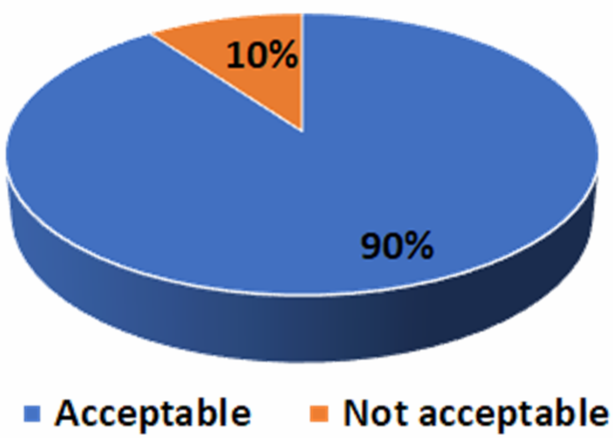
2. Default SPCS2022 zones
(25 responses)



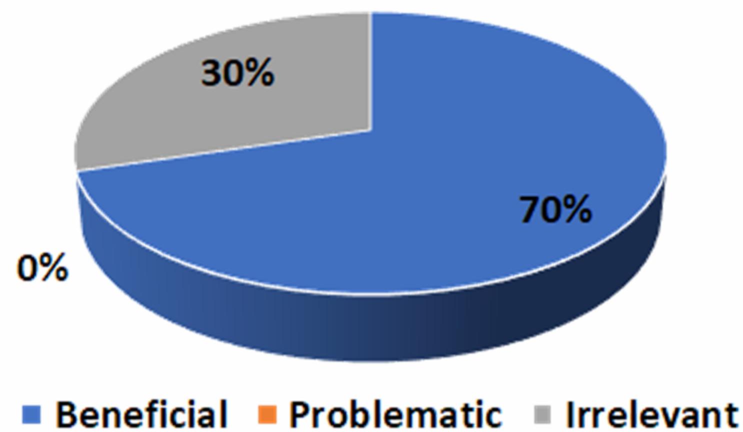
3. Flexibility of policy
(21 responses)



4. Deadlines
(20 responses)

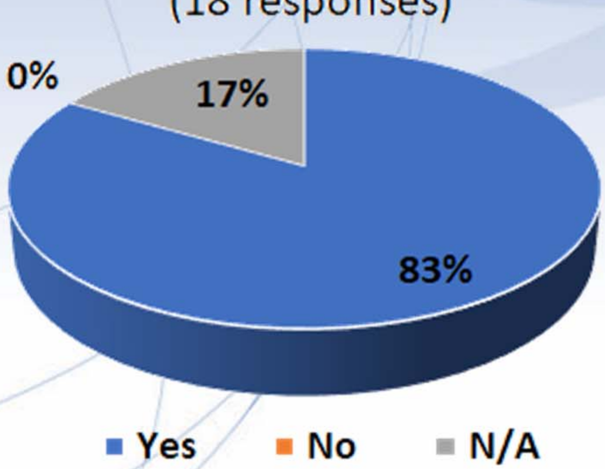


5. Special purpose zones
(27 responses)

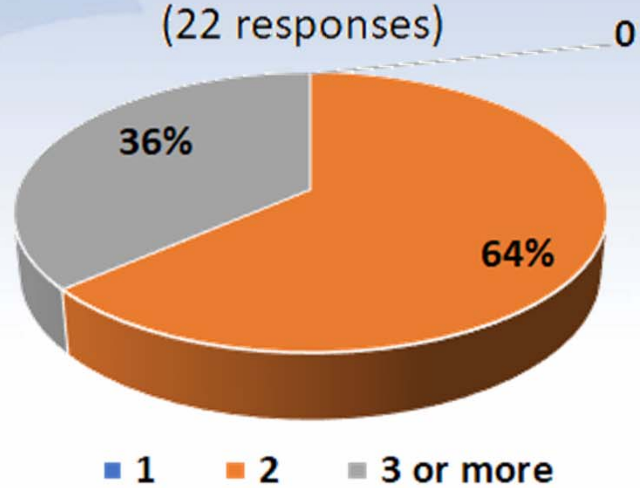


Summary of other FRN input

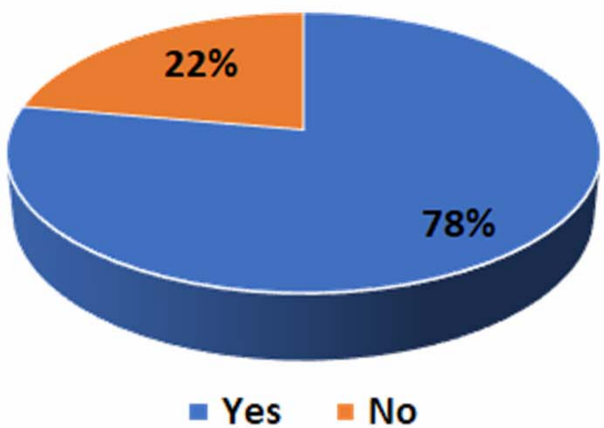
Want a statewide zone
(18 responses)



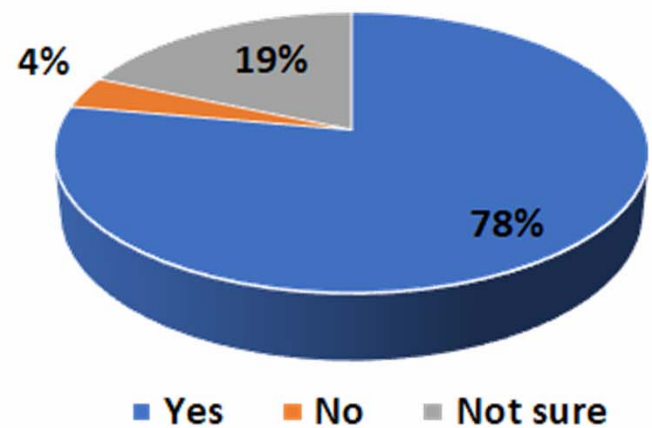
Number of layers
(22 responses)



Currently use LDPs?
(18 responses)



Want SPCS2022 LDP layer
(27 responses)



Deadlines for SPCS2022 requests

SPCS2022 Procedures (draft)

- **Consensus** input per SPCS2022 procedures
  - ***Requests*** for designs done by NGS
  - ***Proposals*** for designs by contributing partners
- Submittal of **approved** designs
  - Proposal must first be approved by NGS
  - Designs must be complete for NGS to review
- Later requests will be for ***changes*** *to* SPCS2022

NGS.SPCS@noaa.gov
by **December 31, 2019** for ***requests*** and ***proposals***
by **December 31, 2020** for ***submittal*** of ***approved*** designs

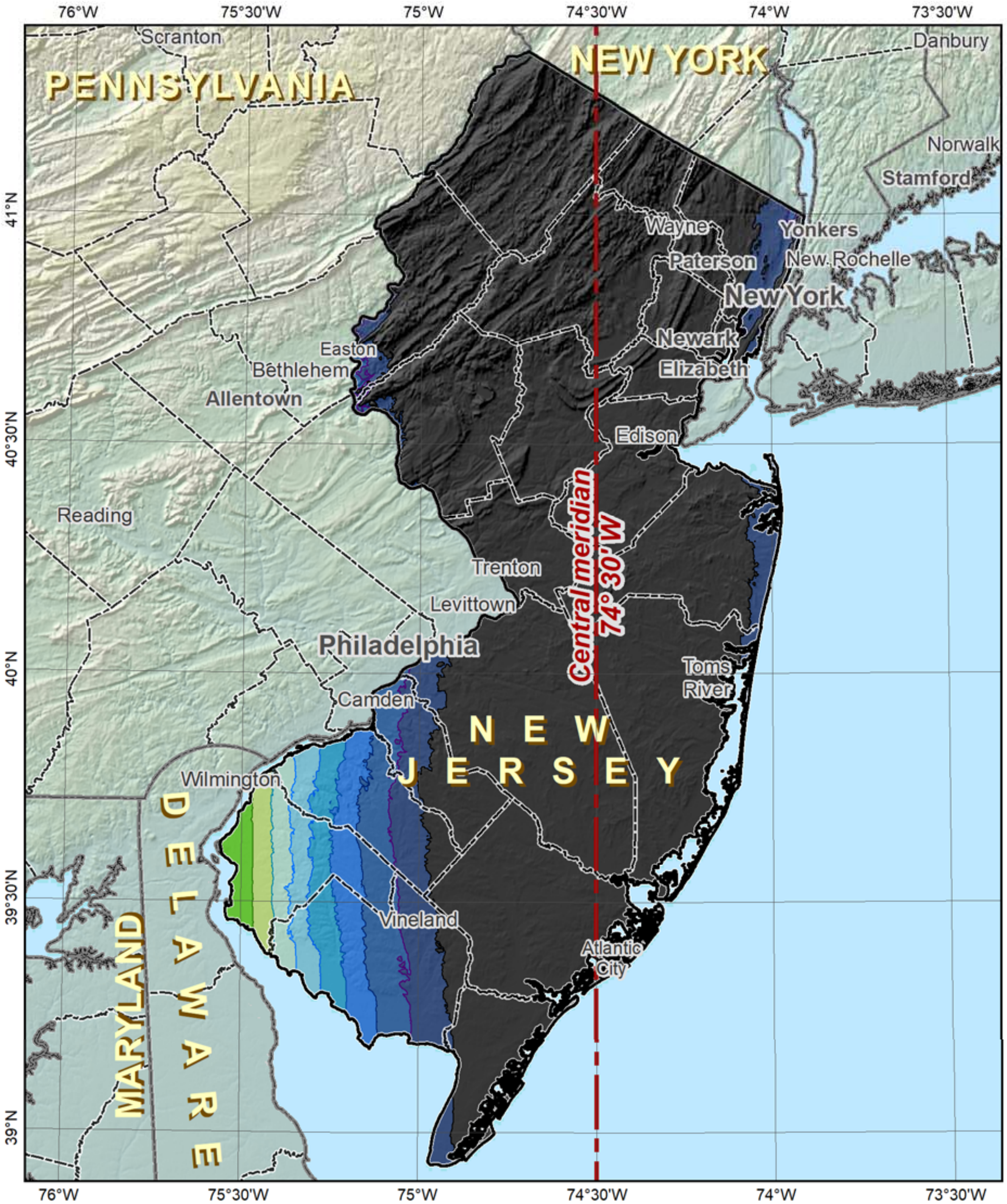
Summary

- *Draft* SPCS2022 **policy** and **procedures**
  - Standardized definitions and computations
  - Designed with respect to "ground"
  - Default designs similar to existing SPCS 83
  - Can include a statewide zone plus ***one*** subzone layer
  - LDPs can be used but must be designed by others
- **Federal Register Notice** (FRN) input received
  - On SPCS2022 policy & procedures
  - On "special purpose" zones
- ***Consensus*** state stakeholder input ***required*** for SPCS2022 zone requests, proposals, and designs

P.S. Default and statewide zones design maps available for download at **ftp://www.ngs.noaa.gov/pub/SPCS/DistortionMaps/**

Existing SPCS 83 design: New Jersey Zone

NOAA's National Geodetic Survey



Transverse Mercator projection

North American Datum of 1983

Central meridian: 74° 30' W
Cen merid scale: 0.999 9 (exact)

Areas within ±20 ppm distortion (1:50,000 = ±0.11 ft per mile):
0.6% of population
1.4% of all cities and towns
1.8% of entire zone area

Distortion values (ppm)

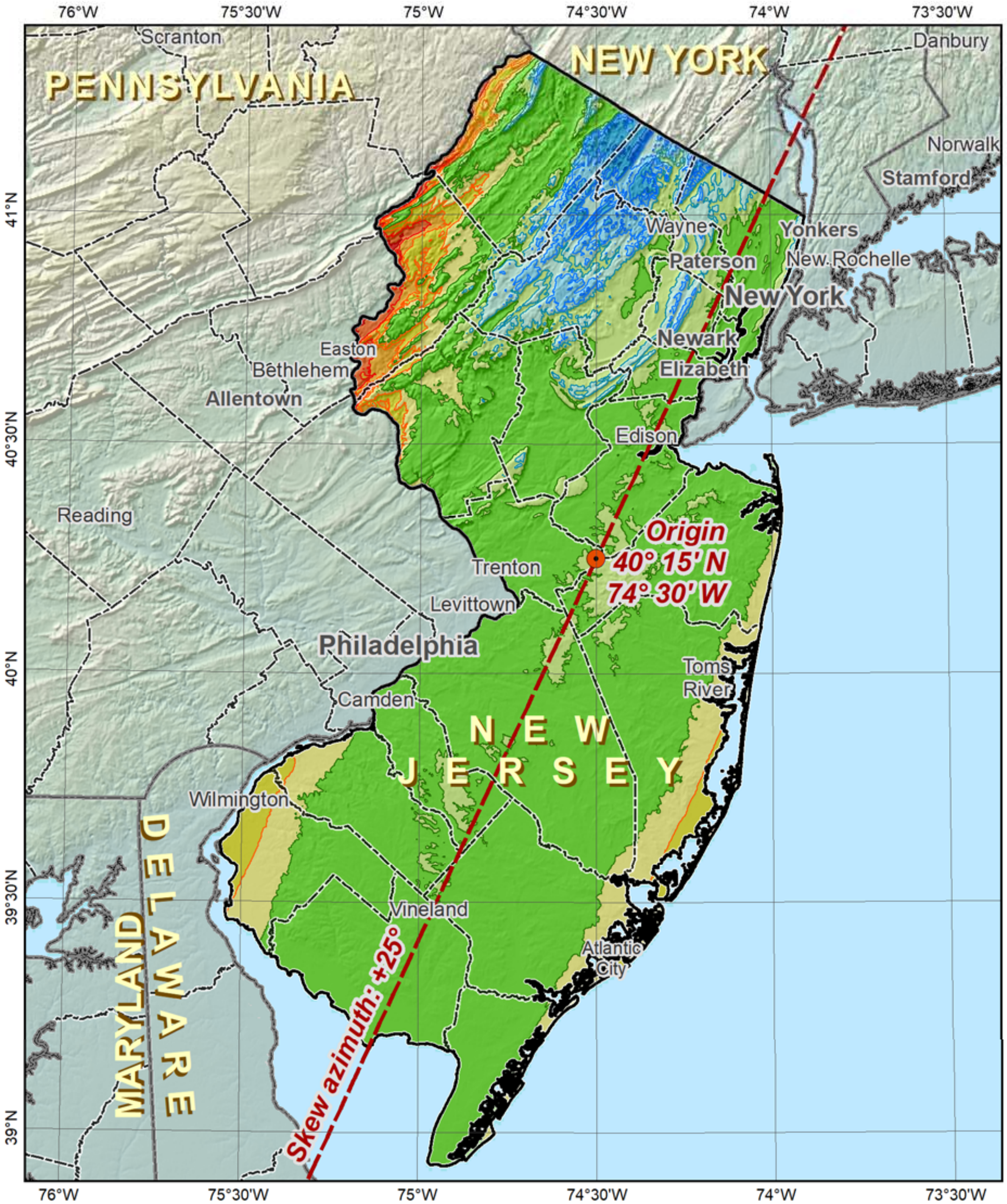
Entire zone:	***Cities and towns:***
Min = -175	Min, Max = -156, -2
Max = +7	Range = 155
Range = 182	Mean = -88
Mean = -92	(weighted by population)

Linear distortion at topographic surface (parts per million)

< -80	to -40	to +30
to -80	to -30	to +40
to -70	to -20	to +50
to -60	±10	to +60
to -50	to +20	> +60

0 25 50 75 100 km

Created 01/29/2019



Preliminary SPCS2022 default design: New Jersey Zone (alternative 2)

NOAA's National Geodetic Survey

Oblique Mercator projection

North American Terrestrial Reference Frame of 2022

Origin latitude: 40° 15' N
Origin longitude: 74° 30' W
Skew axis scale: 0.999 99 (exact)
Skew azimuth: +25°

Areas within ±20 ppm distortion (1:50,000 = ±0.11 ft per mile):
94% of population
87% of all cities and towns
86% of entire zone area

Distortion values (ppm)

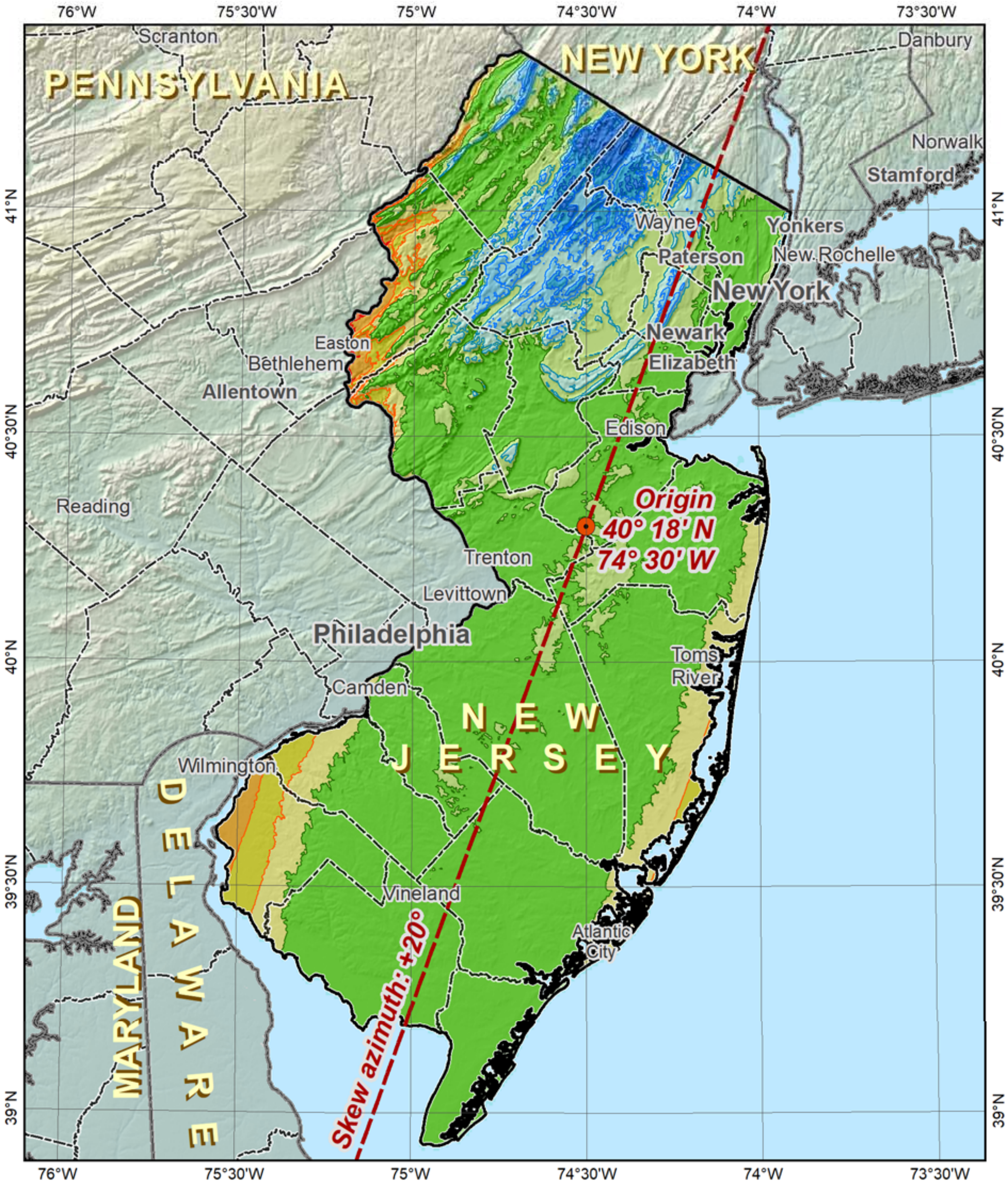
Entire zone:	***Cities and towns:***
Min = -60	Min, Max = -46, +54
Max = +66	Range = 99
Range = 126	Mean = -5
Mean = -3	(weighted by population)

Linear distortion at topographic surface (parts per million)

< -80	to -40	to +30
to -80	to -30	to +40
to -70	to -20	to +50
to -60	±10	to +60
to -50	to +20	> +60

0 25 50 75 100 km

Created 01/29/2019



Preliminary SPCS2022 default design: New Jersey Zone

(alternative 1)

NOAA's National Geodetic Survey

Oblique Mercator projection

North American Terrestrial Reference Frame of 2022

Origin latitude: 40° 18' N
Origin longitude: 74° 30' W
Skew axis scale: 0.999 99 (exact)
Skew azimuth: +20°

Areas within ±20 ppm distortion (1:50,000 = ±0.11 ft per mile):
94% of population
85% of all cities and towns
85% of entire zone area

Distortion values (ppm)

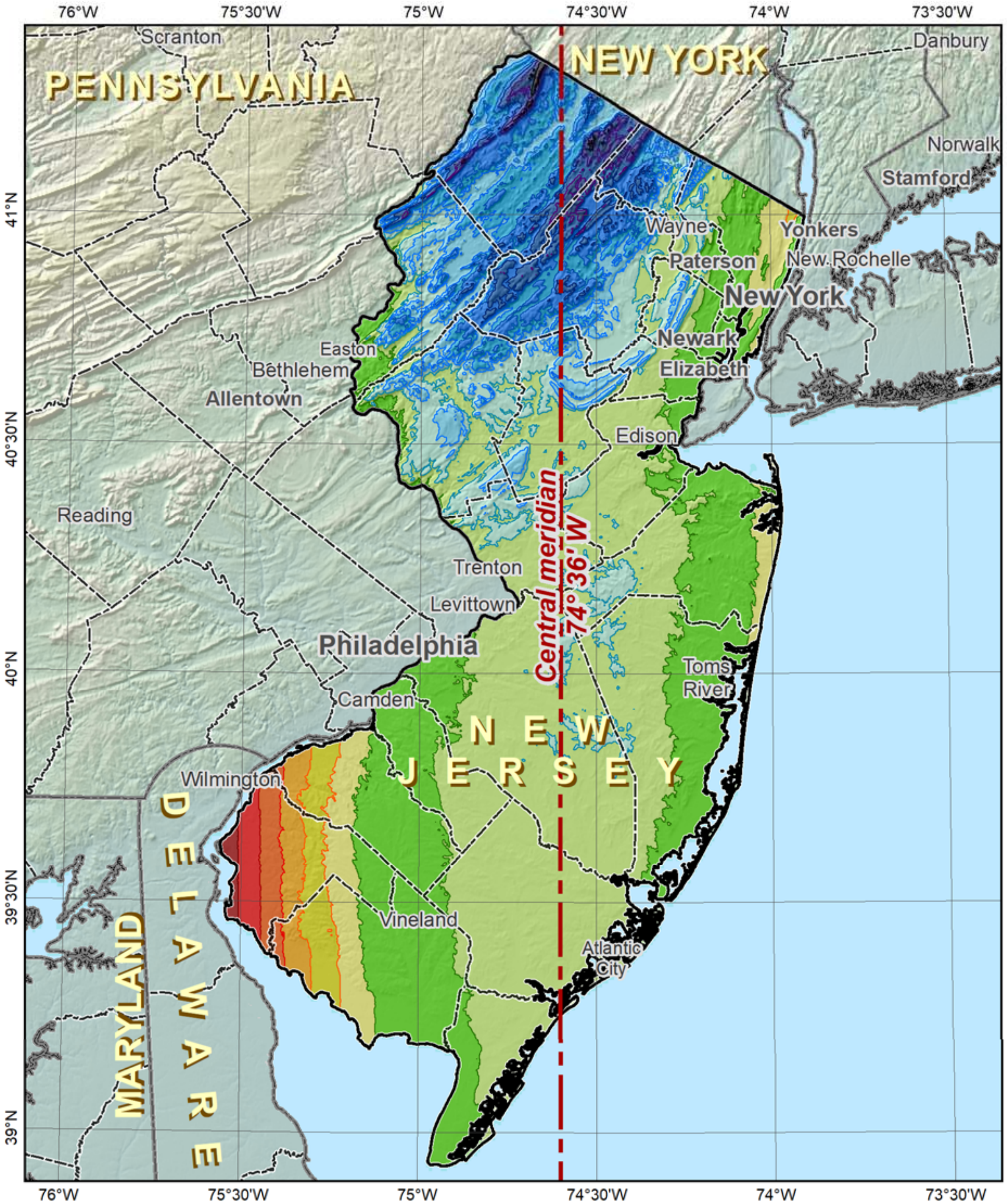
Entire zone:	***Cities and towns:***
Min = -67	Min, Max = -55, +45
Max = +52	Range = 100
Range = 120	Mean = -5
Mean = -4	(weighted by population)

Linear distortion at topographic surface (parts per million)

- < -80
- to -80
- to -70
- to -60
- to -50
- to -40
- to -30
- to -20
- ±10
- to +20
- to +30
- to +40
- to +50
- to +60
- > +60

0 25 50 75 100 km

Created 01/29/2019



Preliminary SPCS2022 default design: New Jersey Zone

(alternative 3)

NOAA's National Geodetic Survey

Transverse Mercator projection

North American Terrestrial Reference Frame of 2022

Central meridian: 74° 36' W

Cen merid scale: 0.999 98 (exact)

Areas within ±20 ppm distortion (1:50,000 = ±0.11 ft per mile):

90% of population

74% of all cities and towns

65% of entire zone area

Distortion values (ppm)

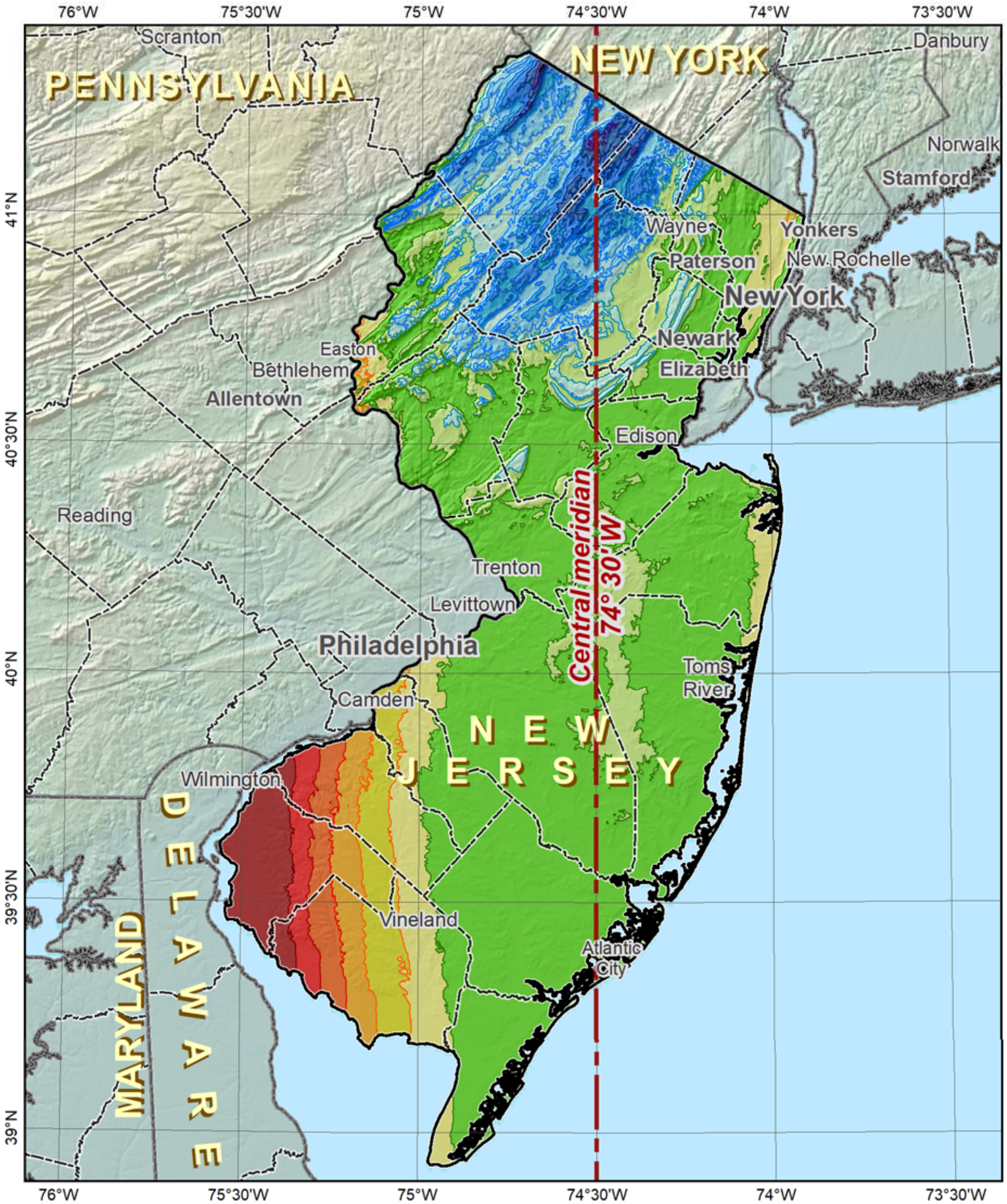
Entire zone:	***Cities and towns:***
Min = -97	Min, Max = -75, +61
Max = +69	Range = 136
Range = 166	Mean = -4
Mean = -15	(weighted by population)

Linear distortion at topographic surface (parts per million)

< -80	to -40	to +30
to -80	to -30	to +40
to -70	to -20	to +50
to -60	±10	to +60
to -50	to +20	> +60

0 25 50 75 100 km

Created 01/29/2019



Preliminary SPCS2022 default design: New Jersey Zone

(alternative 4)

NOAA's National Geodetic Survey

Transverse Mercator projection

North American Terrestrial Reference Frame of 2022

Central meridian: 74° 30' W

Cen merid scale: 0.999 99 (exact)

Areas within ±20 ppm distortion (1:50,000 = ±0.11 ft per mile):

88% of population

77% of all cities and towns

71% of entire zone area

Distortion values (ppm)

Entire zone:	***Cities and towns:***
Min = -85	Min, Max = -66, +88
Max = +97	Range = 155
Range = 182	Mean = +2
Mean = -2	(weighted by population)

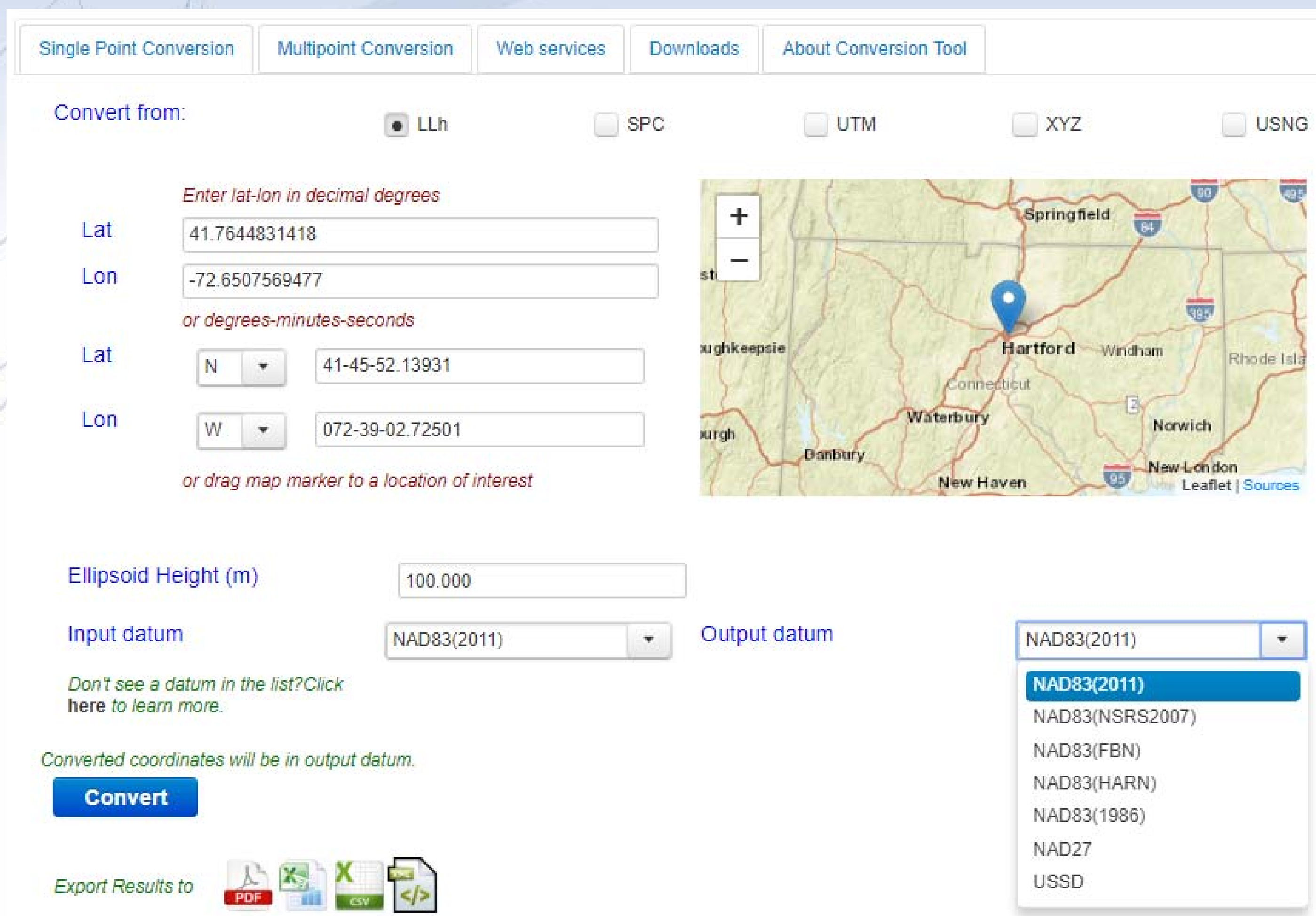
Linear distortion at topographic surface (parts per million)

< -80	to -40	to +30
to -80	to -30	to +40
to -70	to -20	to +50
to -60	±10	to +60
to -50	to +20	> +60

0 25 50 75 100 km

Created 01/29/2019

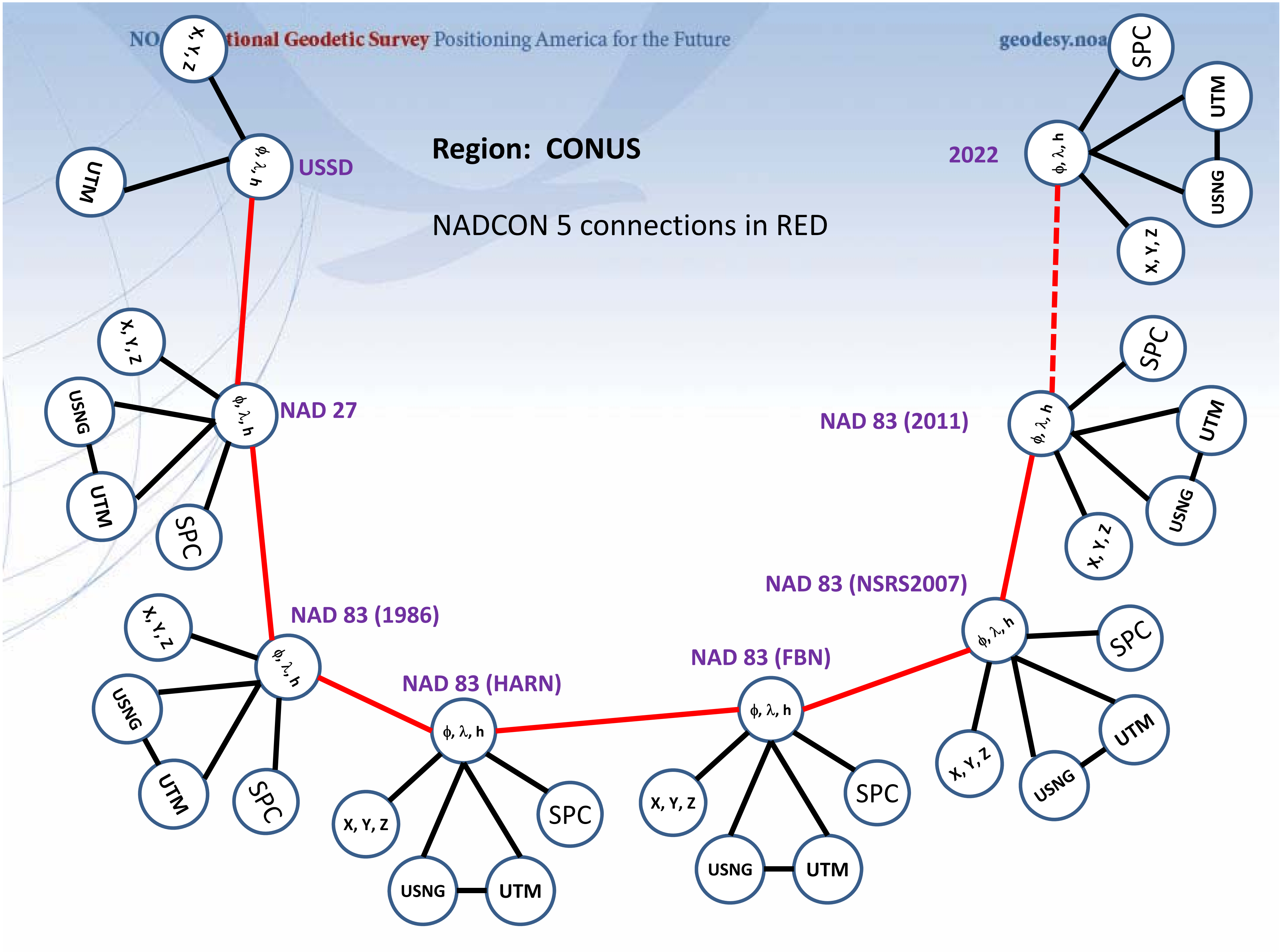
NGS Coordinate Conversion and Transformation Tool (NCAT)



NCAT Output

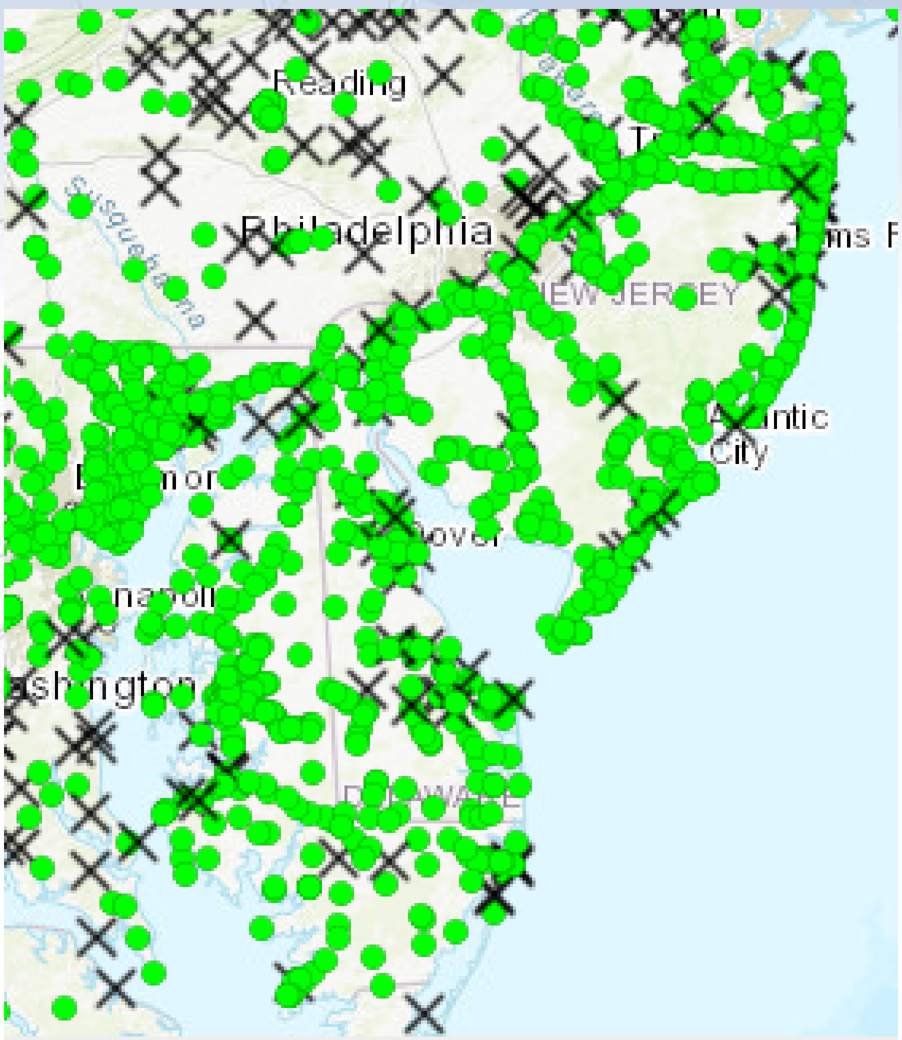
LLh		SPC		UTM (m)		XYZ (m)		USNG
SrcLat	41.7644831418 N414552.13931	Zone	CT-0600	Zone	18	X	1,420,762.820	18TXM9528026294
DestLat	41.7644831407 N414552.13931	Northing (m)	255,818.505	Northing	4,626,294.971	Y	-4,547,774.146	
Siglat (arcsec)	±0.000053	Northing (usft)	839,297.880	Easting	695,280.741	Z	4,226,194.529	
SrcLon	-72.6507569477 W0723902.72501	Northing (ift)	839,299.558	Convergence (dms)	01 33 54.92			
DestLon	-72.6507571320 W0723902.72568	Easting (m)	313,053.132	Scale factor	1.00006929			
Siglon (arcsec)	±0.000103	Easting (usft)	1,027,075.151	Combined factor	1.00005360			
SrcEht (m)	100.000	Easting (ift)	1,027,077.205					
DestEht (m)	100.001	Convergence (dms)	00 03 56.89					
sigeht (m)	±0.002	Scale factor	0.99999124					
		Combined factor	0.99997556					

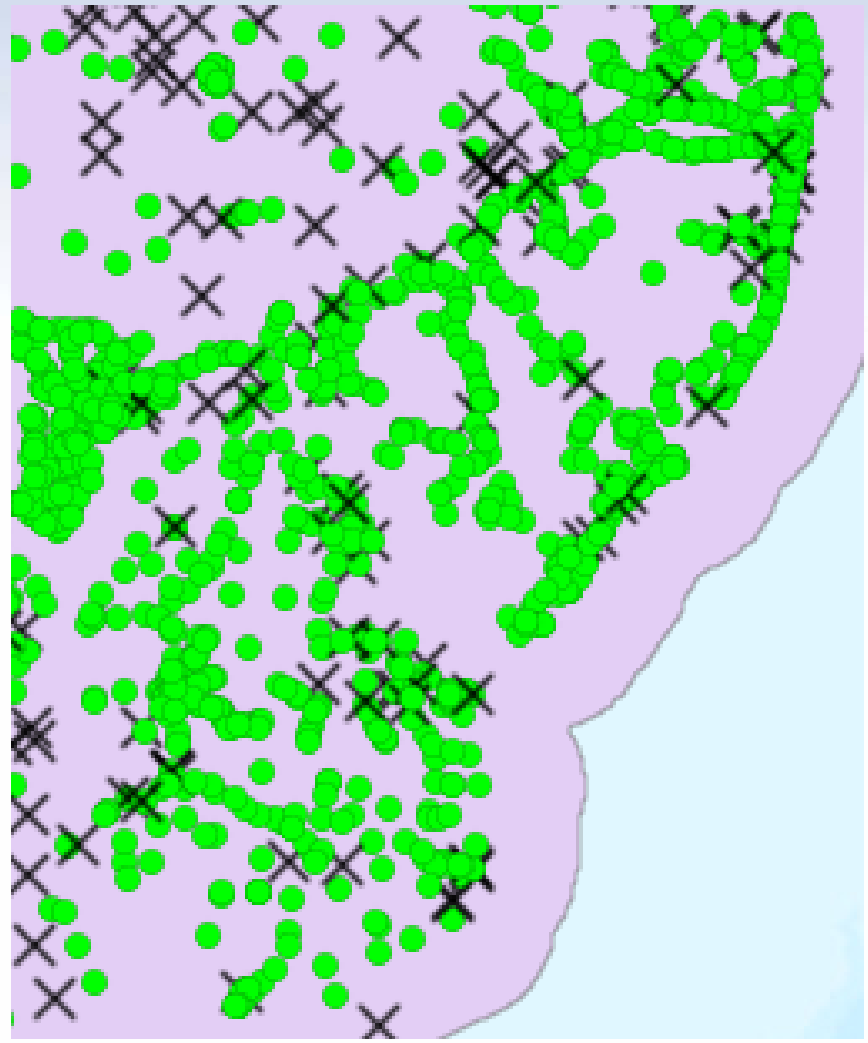
You may change the default UTM and SPC zones, where applicable. The change is processed interactively once a lat-long is converted; DO NOT click the Convert button.



NO tional Geodetic Survey Positioning America for the Future
geodesy.noa
Region: CONUS
NADCON 5 connections in RED
USSD
NAD 27
NAD 83 (1986)
NAD 83 (HARN)
NAD 83 (FBN)
NAD 83 (NSRS2007)
NAD 83 (2011)
2022
φ, λ, h
x, y, z
UTM
USNG
SPC

GPS on BM for GEOID18



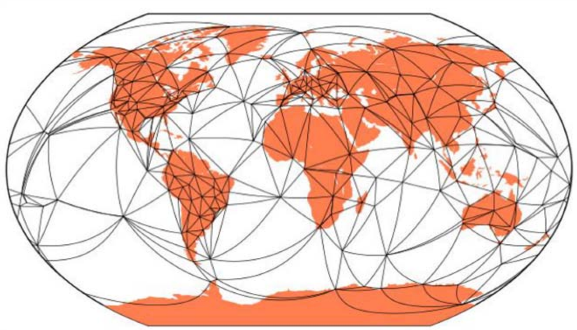


New Multi-Year CORS Solution

- IGS08 coordinates and velocities were released in 2011 through the first reprocessing campaign
- Need for the new coordinates and velocities due to:
  - The geophysical activities (earthquakes) in some area,
  - The equipment changes,
  - New CORS stations and 6 more years of data since 2011, and
  - New frame released (IGS14)
- Model update since Repro1 campaign
  - IGb08 reference frame model
  - Updated IGS08 absolute antenna calibration
  - Generally implement IERS 2010 convention

Processing

- Data span 1994 to 2016 (23 years)
  - 3050 stations including decommissioned
  - ~25 TB of data volume
- 15 iterations for the rigorous quality control and discontinuity checking
- To be released in September 2018
- Global processing to solve for orbits and the IGS station coordinates
- Tie remaining CORS to backbone sites
  - holding fixed NGS orbits, troposphere and EOPs



Modernized Database

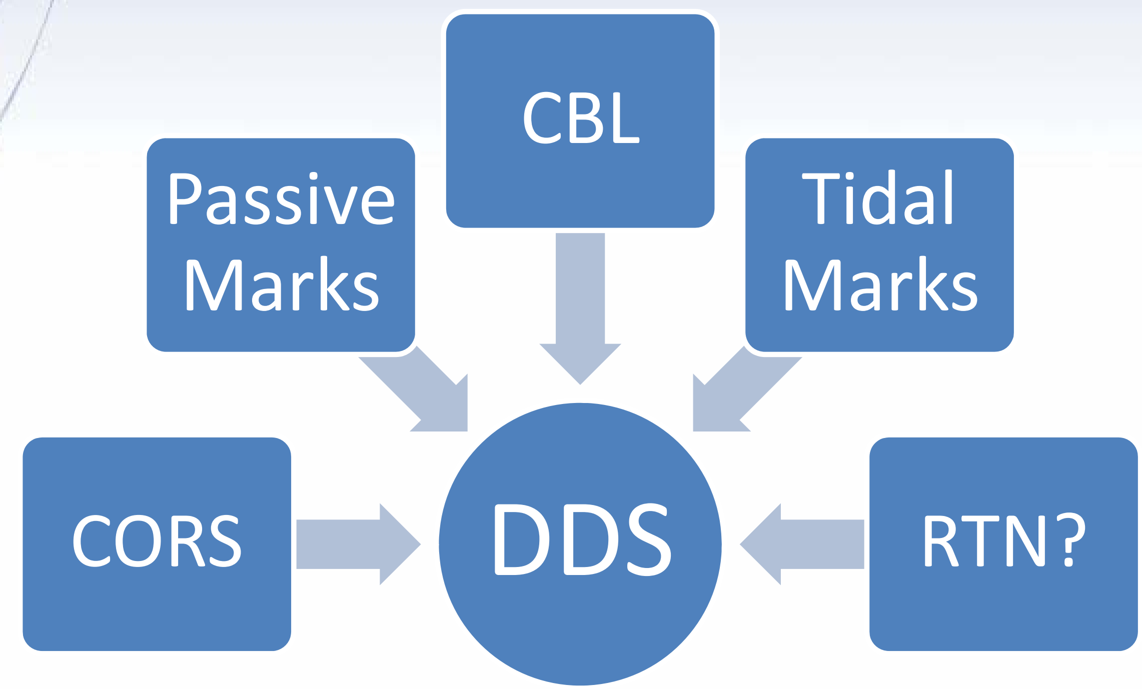
- Foundation for all NGS data of the future
  - Spatial Database
  - Hold all data from existing Integrated DataBase
  - Hold all future data generated by and for NGS
  - Capable of representing everything in 4-D
  - Be easily loadable by NGS personnel
  - Be easily retrievable by NGS and the public
  - Capable of permanently storing all of NGS survey data (future and historic)
  - Capable of tracking all changes to the data

Data Delivery System (DDS)

(Working Group)

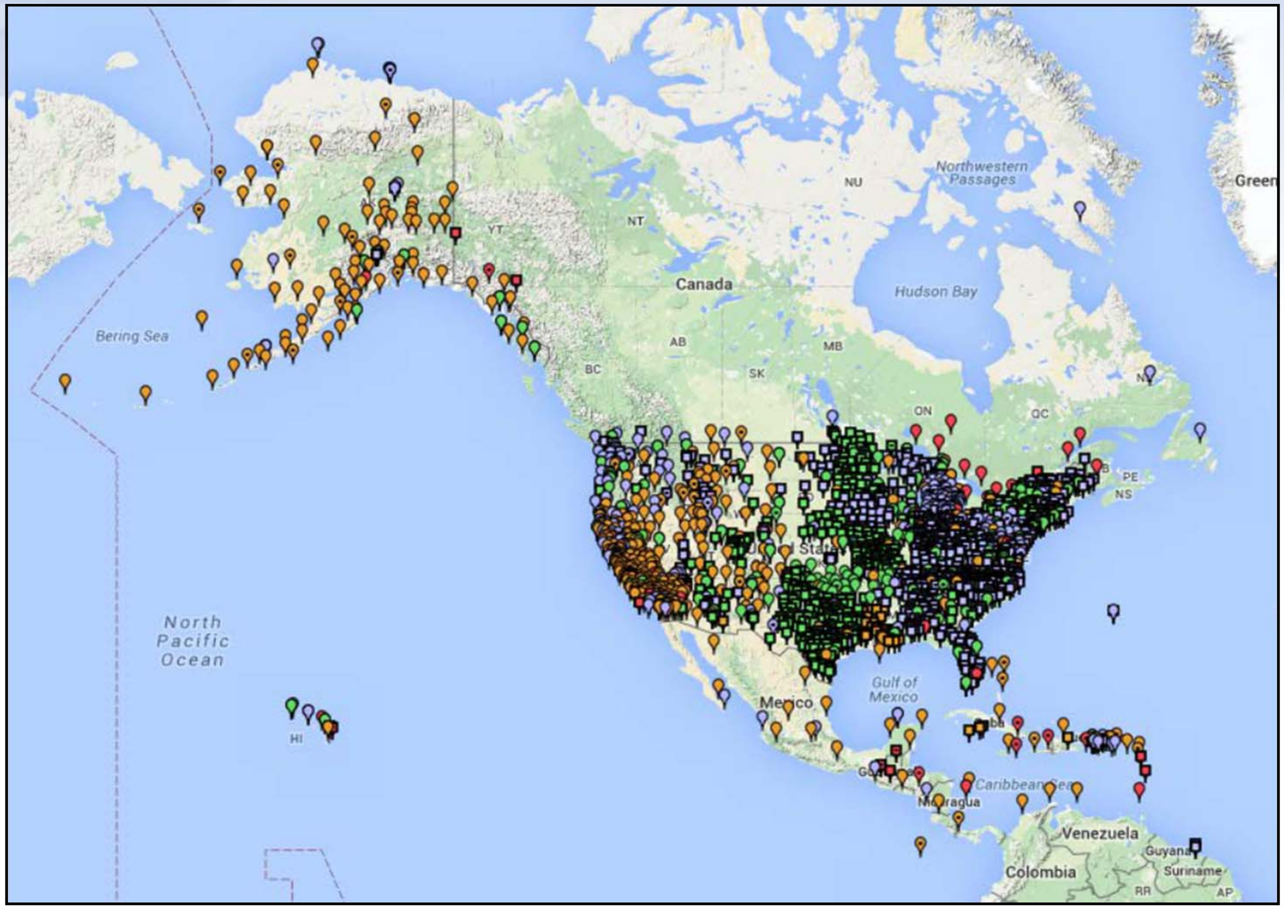
- More than just new "datasheets"
- Ability to deliver dynamic data
- Ability to generate time-based data
- Ability for user to customize output

What will go in DDS



Current Partnership Network

- Consists of **~2000** **Continuously Operating Reference Stations (CORS)**
- Run by more than **200 organizations** (various government, academic, and private organizations)
- Provides access to the U.S. National Spatial Reference System (NSRS)



Foundation CORS Requirements

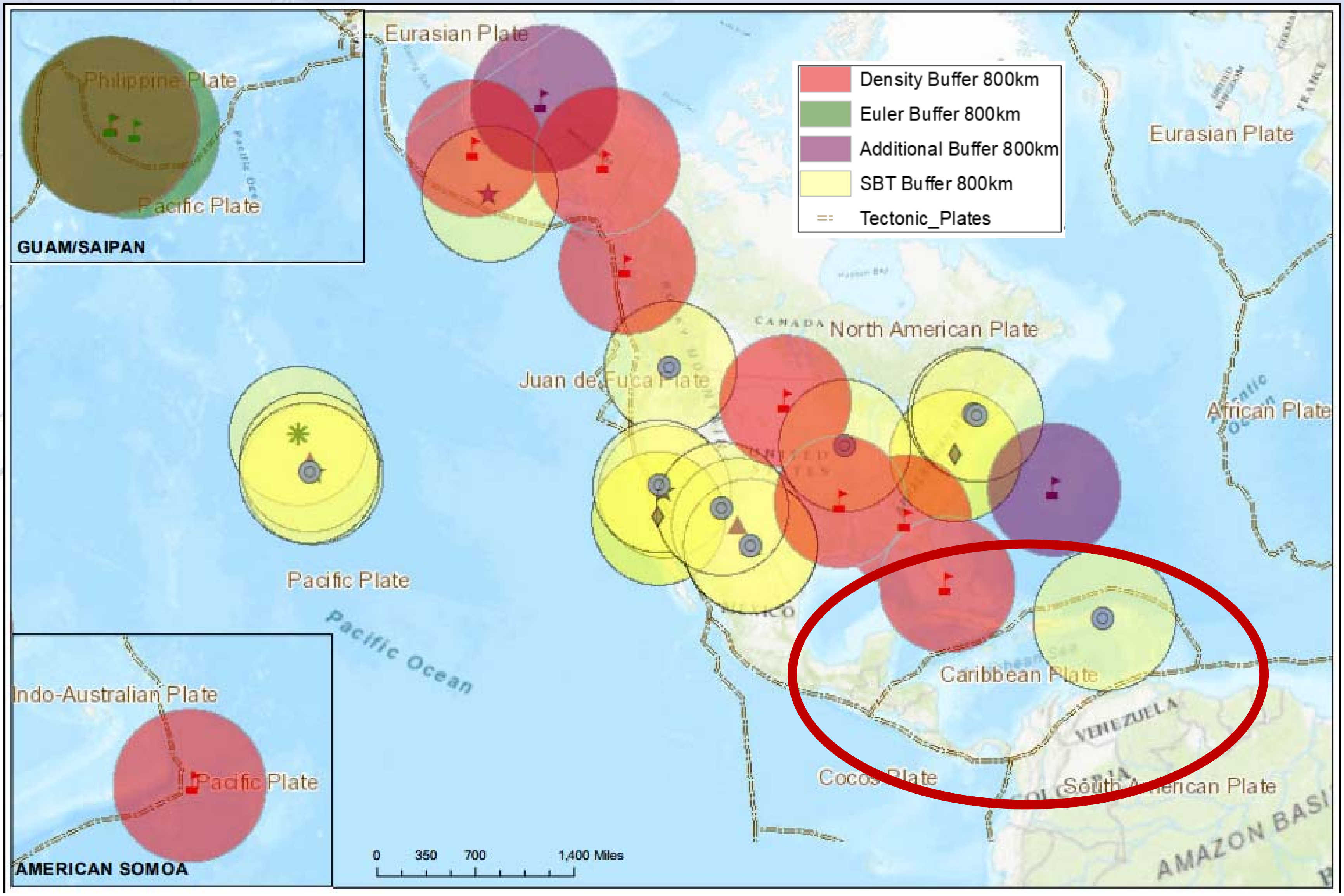
Baseline Foundation CORS Network:

- **COLLOCATE - All Sites** within the Foundation CORS target area of the United States that have **existing space based geodetic techniques (SLR, VLBI or DORIS)** will have a **collocated Foundation CORS.**

Additional Desired Foundation CORS Network Requirements:

- **DENSITY** – Install or adopt new stations within the Foundation CORS target area of the United States to **fulfill the spacing criteria of 800 km** within the Foundation CORS target area, after the above criteria are met.
- **EULER** – Install or adopt new stations within the Foundation CORS target area of the United States to raise the minimum number of Foundation CORS to **3 on each of the 4 plates of interest**, once the above criteria are met.
- **ADDITIONAL (Gap Filling)** – Install or adopt new stations, on a case-by-case basis, once the above criteria is met.

Future "Foundation CORS" Network



Project Implementation

- **Phase 1** – **Incorporate ~28 existing partner and NGS CORS** into Foundation CORS network
- **Phase 2** – **Upgrade ~7 existing CORS to GNSS** to meet Foundation CORS requirements
- **Phase 3** – **Construct ~8 new Foundation CORS**

NOAA's **National Geodetic Survey** Positioning America for the Future geodesy.noaa.gov

National Geodetic Survey

Positioning America for the Future

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New Datums

- Home
- Background
- What to Expect
- Get Prepared
- Policy Decisions
- Track our Progress
- Naming Convention
- Watch Videos
- Related Projects
- New Datums FAQ
- Contact Us

Subscribe for email notifications

Events

- Industry Engagement
- 2019 Summit
- 2017 Summit
- 2015 Summit
- 2010 Summit

New Datums: Replacing NAVD 88 and NAD 83

To improve the National Spatial Reference System (NSRS), NGS will replace the North American Datum of 1983 (NAD 83) and the North American Vertical Datum of 1988 (NAVD 88) with a new geometric reference frame and geopotential datum in 2022.

The new reference frames will rely primarily on Global Navigation Satellite Systems (GNSS), such as the Global Positioning System (GPS), as well as on a gravimetric geoid model resulting from our Gravity for the Redefinition of the American Vertical Datum (GRAV-D) Project.

These new reference frames will be easier to access and to maintain than NAD 83 and NAVD 88, which rely on physical survey marks that deteriorate over time.

Background | What to Expect | Get Prepared

Policy Decisions | Track our Progress | Naming Convention

FAQs | Watch Videos | Related Projects

Updates

Save the Date: Next Geospatial Summit on May 6-7, 2019

09/07/18 - ASPRS Hosted Webinar on Modernizing the NSRS

NGS Subscription Services

From NGS homepage: geodesy.noaa.gov,

visit geodesy.noaa.gov/INFO/subscribe.shtml

Created 10-16-2018

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National Geodetic Survey

Positioning America for the Future

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2019 GEOSPATIAL SUMMIT
MAY 6th & 7th

2019 Geospatial Summit

On May 6-7, 2019 NGS will host the 2019 Geospatial Summit at the Silver Spring Civic Building at 1 Veterans Pl, Silver Spring, MD 20910.

The 2019 Geospatial Summit will provide updated information about the planned modernization of the National Spatial Reference System (NSRS). Specifically, NGS plans to replace the North American Datum of 1983 (NAD 83) and the North American Vertical Datum of 1988 (NAVD 88) in 2022.

The Summit will provide an opportunity for NGS to share updates and discuss the progress of projects related to NSRS Modernization. NGS also looks forward to hearing feedback and collecting requirements from its stakeholders across the federal, public and private sectors. This event will also help continue discussions from previous Geospatial Summits held in 2010, 2015 and 2017.

- 2019 Summit Home
- Logistics
- FAQs

Related Links

- NGS 10-year plan
- New Datums
- 2017 Summit
- 2017 Summit Report
- 2015 Summit Report
- 2010 Summit

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Online Lessons

NGS, in partnership with The COMET Program, is developing a series of self-paced lessons on geodetic and remote sensing topics . Create a free user account to gain access to the courses below and many others that may be of interest. You will have the option of printing out a certificate upon successful completion of the quiz at the end of each lesson.

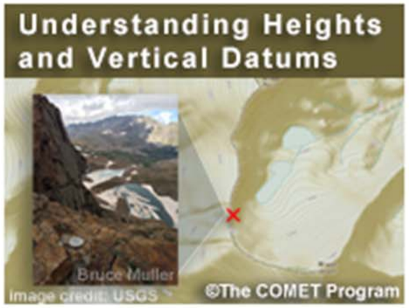
For additional lessons designed to supplement existing curricula at the middle and high school levels visit the National Ocean Service Lesson Plan Library.

Understanding Heights and Vertical Datums

45 minutes to 1 hour

This lesson provides a basic understanding of vertical datums and how to choose the appropriate datum for a given application, with a conceptual introduction to ellipsoidal, geopotential, and tidal datums.

View lesson online.

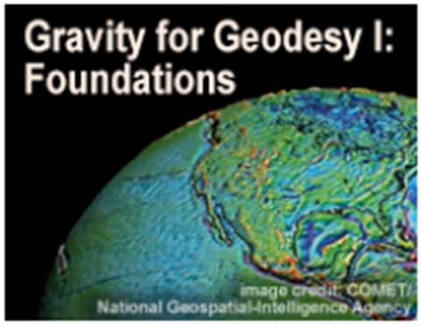


Gravity for Geodesy I: Foundations

50 minutes to 1 hour

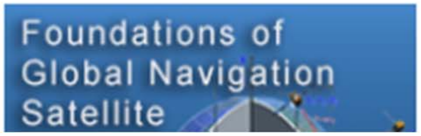
The first of a two-part series, this is intended to help professionals with basic science background better understand the Earth's gravity field and what causes its variations.

View lesson online.



Foundations of Global Navigation Satellite Systems (GNSS)

1.25 to 1.5 hours



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Video Library

NGS, in partnership with The COMET Program, has developed short videos about topics related to geodesy and mapping. View or download our featured video or previous videos. Please visit the COMET YouTube Channel to view the entire playlist or browse additional training resources.

What are Geodetic Datums?

How Were Geodetic Datums Established?

What Is the Status of Today's Geodetic Datums?

What's Next for Geodetic Datums?

Precision and Accuracy in Geodetic Surveying

Two Right Feet? U.S. Survey Feet vs. International Survey Feet

Geospatial Infrastructure for Coastal Communities: Informing Adaptation to Sea Level Rise

Best Practices for Minimizing Errors during GNSS Data Collection

The Importance of Accurate Coastal Elevation and Shoreline Data

NOAA's VDatum Tool: Transforming Heights Between Vertical Datums

Geodetic Control in Land Surveying: Active vs. Passive

Location Science Improves Everyday Life

NOAA's **National Geodetic Survey** Positioning America for the Future geodesy.noaa.gov

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Webinar Series

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- Frequently Asked Questions (FAQ)
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Overview

The NGS Webinar Series invites speakers to present information related to NGS programs, projects, products and services. The webinars educate constituents about NGS activities, and provide opportunities for NGS to gather feedback from its customers.

Webinars are held on the second Thursday of every month, from 2:00-3:00 p.m. eastern time. Registration is free, and video recordings are made of all webinars for later viewing. To participate in the webinar series:

- Subscribe to receive monthly notices about upcoming webinars.
- Register for upcoming webinars or view recent recordings.
- Explore the Webinar archive to view recordings from previous years.
- Read our Frequently Asked Questions (FAQs) to learn more.

This webinar series is a continuation of National Height Modernization Program's monthly presentations hosted from January 2011 through March 2015. Presentations are available online:

- Visit the monthly Height Modernization Coordination meeting archive.

Website Owner: National Geodetic Survey / Last modified by NGS Training Team Oct 03 2018

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2018 Recorded Webinars

2018 | 2017 | 2016 | 2015 | 2014 - 2009 | »

NOVEMBER 15 2018

Vertical Datum Changes for Floodplain Mapping

Nicole Kinsman, NGS Regional Geodetic Advisor for Alaska and the U.S. Arctic

This webinar provides an introduction to geodetic control in the context of flood mapping, presents case studies that highlight the importance of well-defined heights, and outlines the expected impacts of a modernized vertical datum on flood maps and related products.

Intermediate Technical Content Rating: Some prior knowledge is helpful.

56 mins | PPT 0.0 MB

OCTOBER 11 2018

Geodesy Fundamentals

Dave Zenk, PE, LS, NGS Northern Plains Regional Geodetic Advisor

This webinar discusses the fundamentals of astronomy, geodesy, geodetic datums, map projections, and GPS. It is intended to serve as a review tool for students and point toward additional sources for more in-depth study.

Intermediate Technical Content Rating: Some prior knowledge is helpful.

59 mins | PPT 6.3 MB

SEPTEMBER 13 2018

BETA OPUS-Projects: the Next Generation of OPUS-Projects

Dr. Mark Schenewerk, NGS

BETA OPUS-Projects will be the next generation of the OPUS-Projects online tool. This webinar is not training, but rather, is an overview of BETA OPUS-Projects highlighting the enhancements and steps needed to submit survey data for publication.

62 mins | PPT 4.7 MB

Questions?