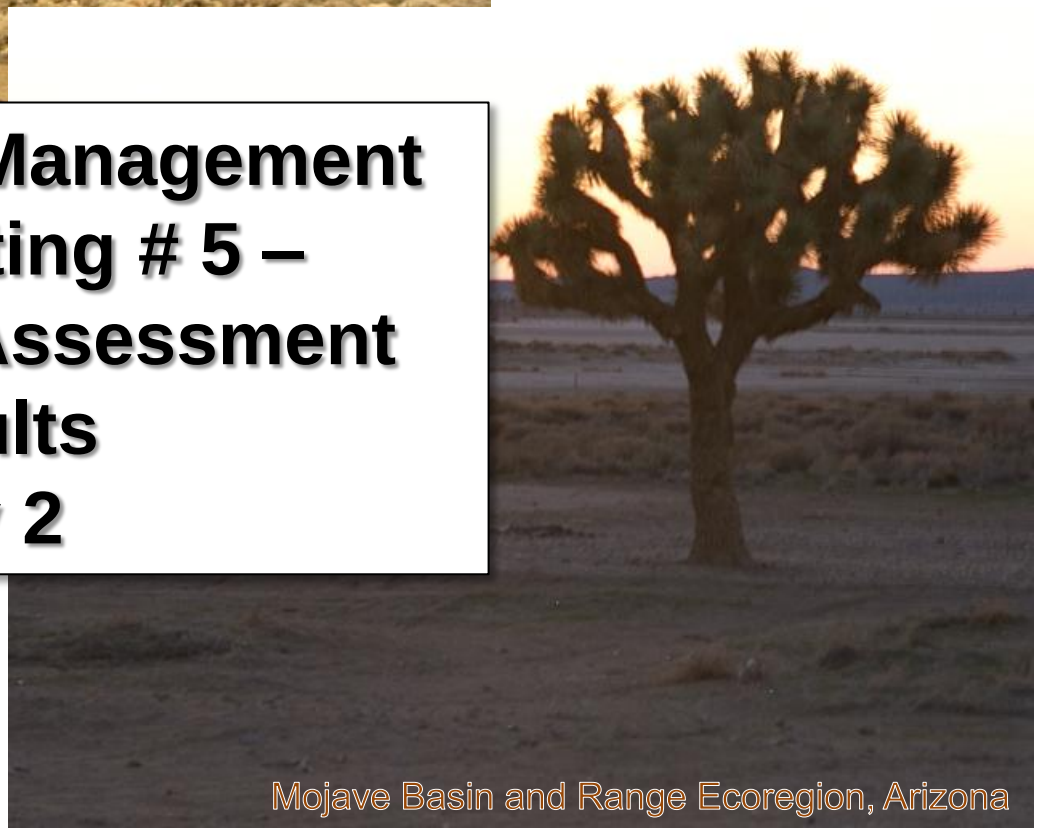
Rapid Ecoregional Assessment

Assessment Management Team Meeting # 5 – Preliminary Assessment Results
Day 2



BLM

Rapid Ecoregional Assessment

RECOVERY.GOV

Reconvene, Overview of the day's agenda

AMT Workshop V: Outline (General)

<u>Tuesday September 27, 2011</u>

8:00-8:30a Reconvene, Overview of the day's agenda
8:30p-10:00a 2025 land use scenario
10:15-12:00p Climate Space Trends analysis
12:00p Lunch (on your own)
1:00-2:15p Climate change effects (how are CEs changing?)
2:30-4:00p Final report outline/product formats (Ford)
4:00-5:00 Discussion, recap parking lot items, & identify new agenda items

2025 land use scenario (where are CAs forecasted to overlap with CEs?)

2025 Scenario

Primarily addresses MQs about CA cumulative impacts

- Everything from current scenario
- Major energy/infrastructure projects in agency approval pipeline as of May 2011
- Forecast urban land uses at 2025
- Forecast invasive species distribution
- Forecast fire regime changes

2025 Scenario

- Where are areas of planned or potential development CAs?
- Where do current locations of CEs overlap with forecasted development CAs?
- Where will locations of X,Y,Z CA potentially exist in 2025?
- Where do locations of current CEs overlap with areas of potential future locations of X,Y,Z Cas?

2025 Scenario

Primarily addresses MQs about CA cumulative impacts

- Everything from current scenario
- Major energy/infrastructure projects in agency approval pipeline as of May 2011
- Forecast urban land uses at 2025
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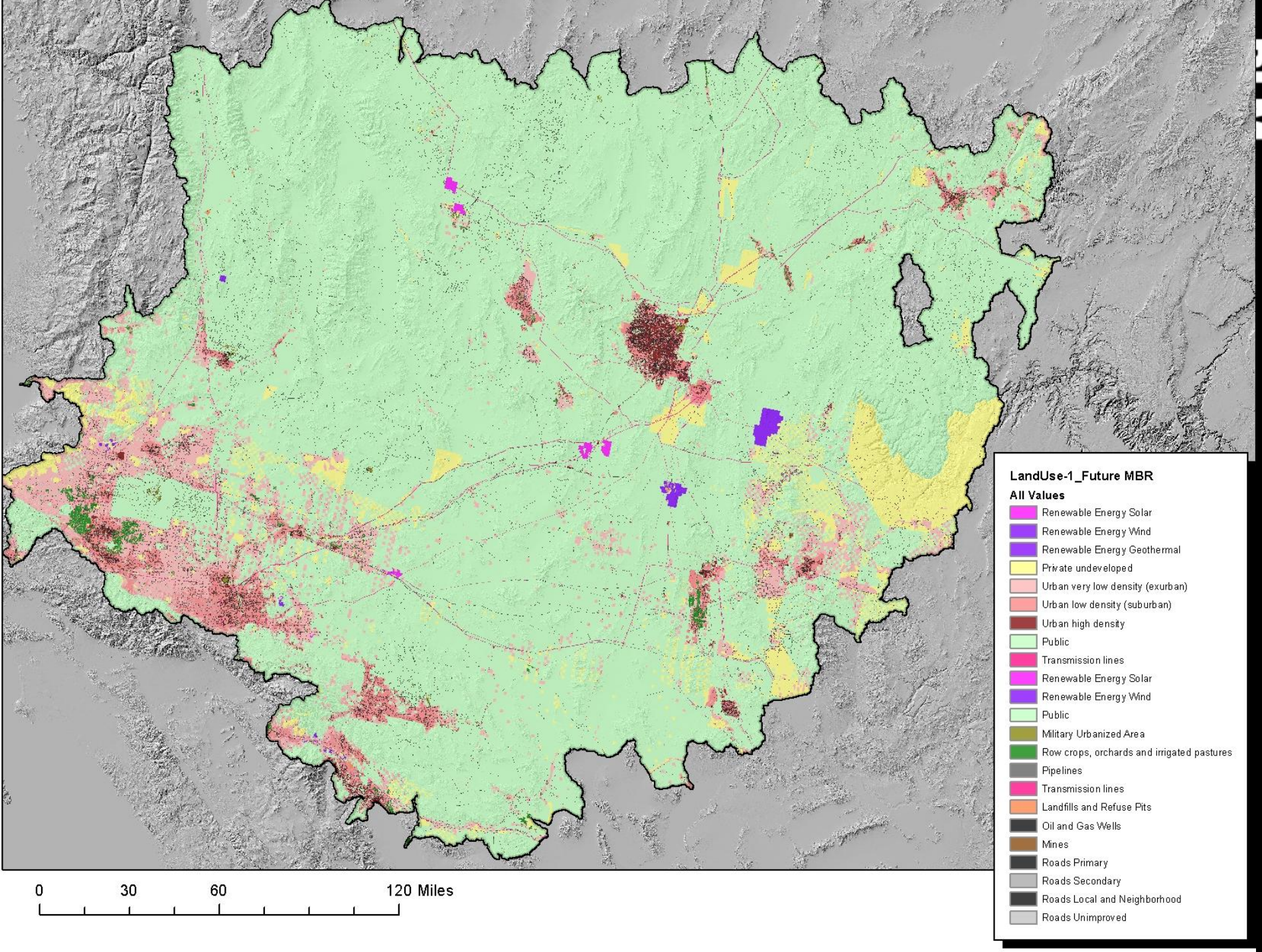
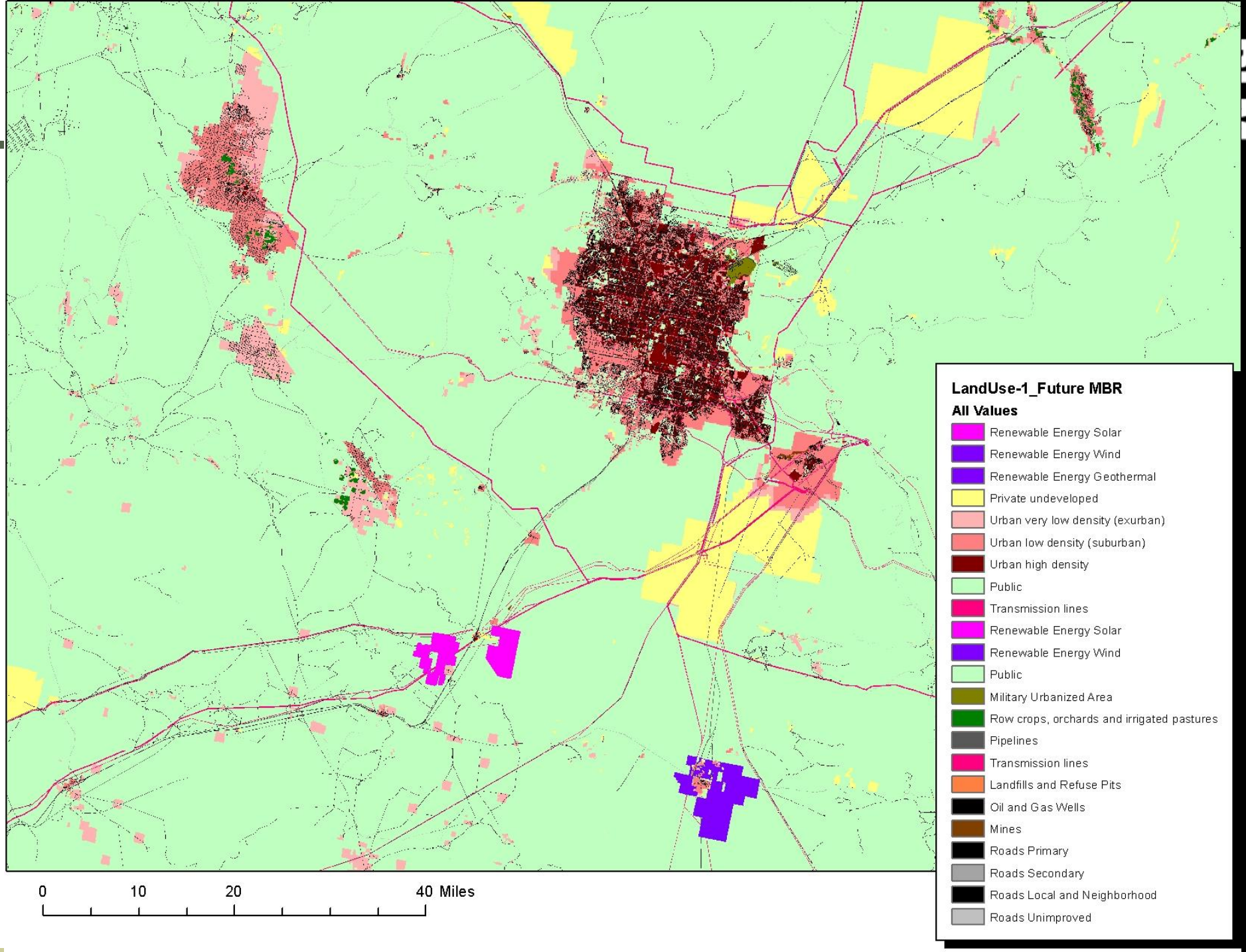

LandUse-1_Future MBR
All Values
Renewable Energy Solar
Renewable Energy Wind
Renewable Energy Geothermal
Private undeveloped
Urban very low density (exurban)
Urban low density (suburban)
Urban high density
Public
Transmission lines
Renewable Energy Solar
Renewable Energy Wind
Public
Military Urbanized Area
Row crops, orchards and irrigated pastures
Pipelines
Transmission lines
Landfills and Refuse Pits
Oil and Gas Wells
Mines
Roads Primary
Roads Secondary
Roads Local and Neighborhood
Roads Unimproved
0
30
60
120 Miles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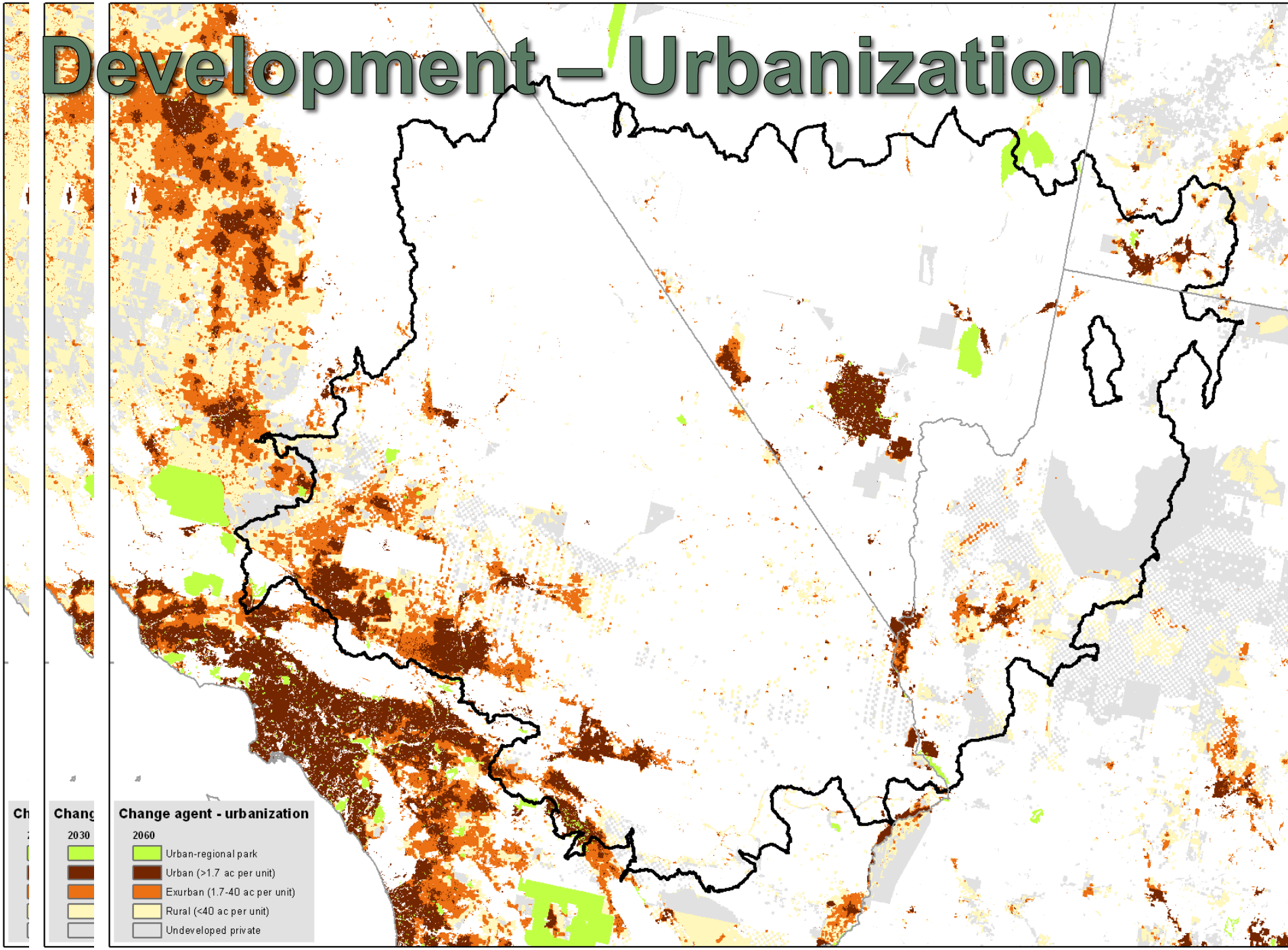
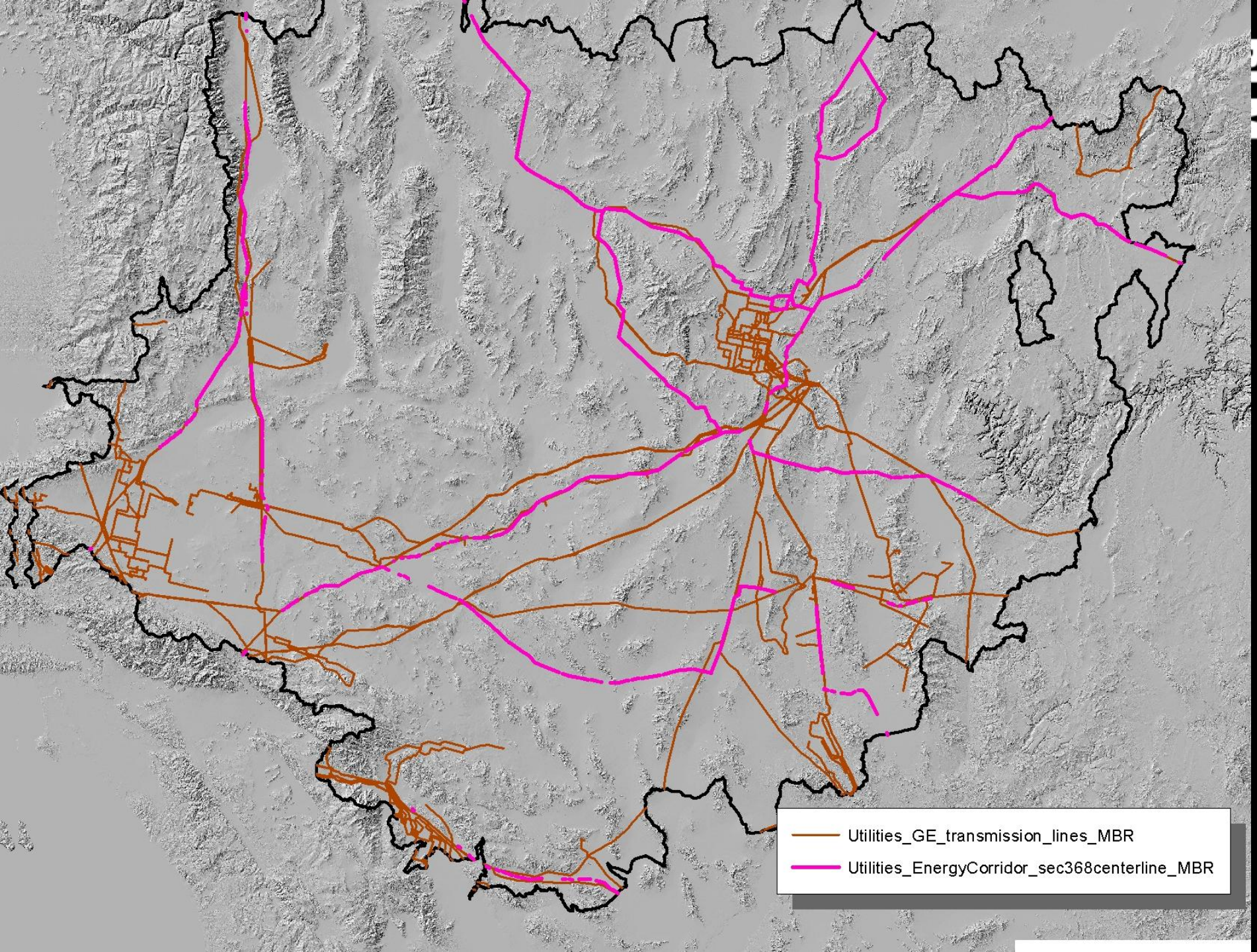
Pipelines
Transmission lines
Landfills and Refuse Pits
Oil and Gas Wells
Mines
Roads Primary
Roads Secondary
Roads Local and Neighborhood
Roads Unimproved
0
10
20
40 Miles

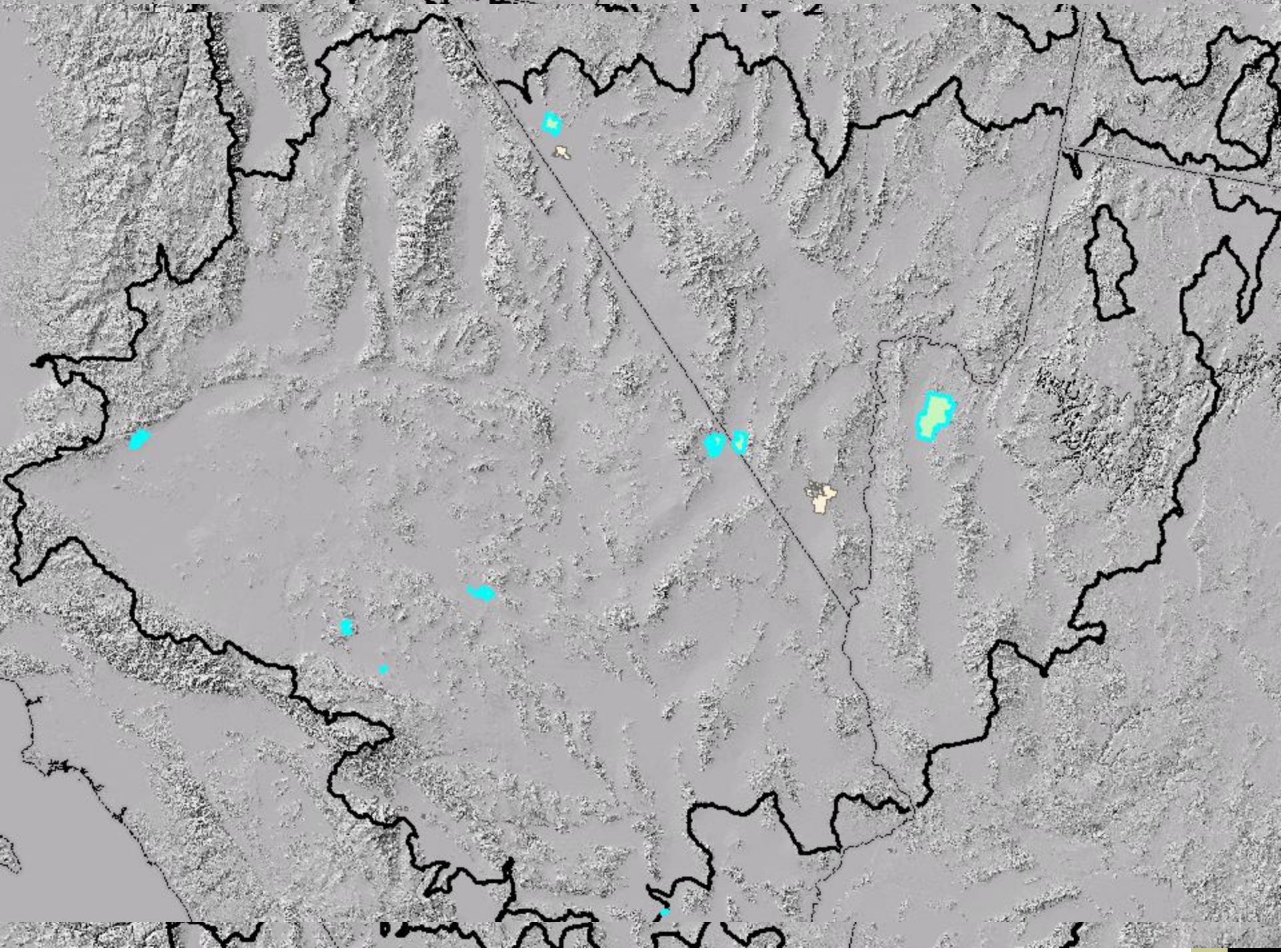
Development – Urbanization




Utilities_GE_transmission_lines_MBR
Utilities_EnergyCorridor_sec368centerline_MBR

Renewable Energy

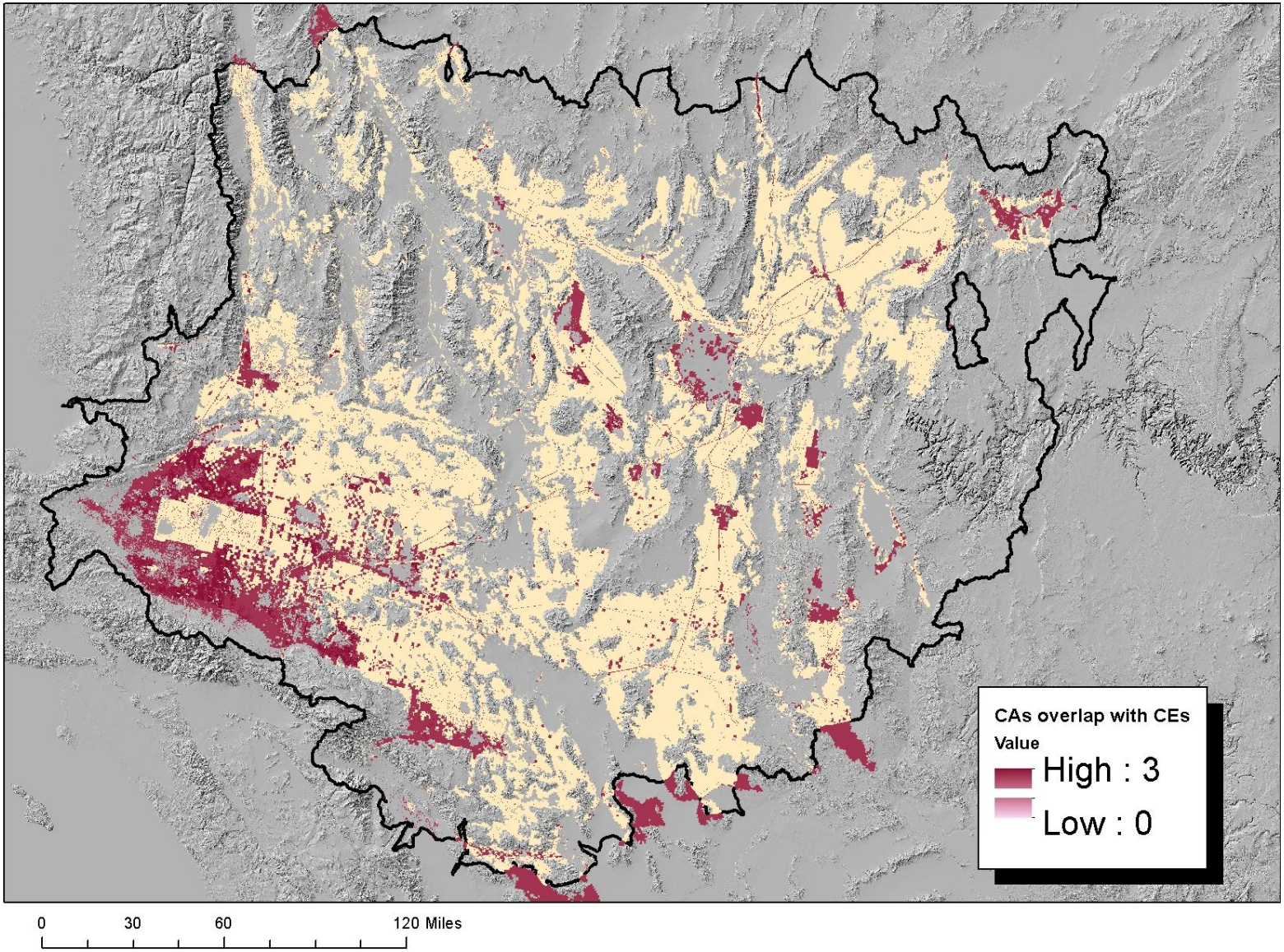
- BLM assembled priority projects for 2011-12 from state offices
- Projects in EIS/EA process
- Clarifications
  - Include new SEZ from PEIS as priority projects?
  - Include state priority zones? (RETI, AZ RDEP)



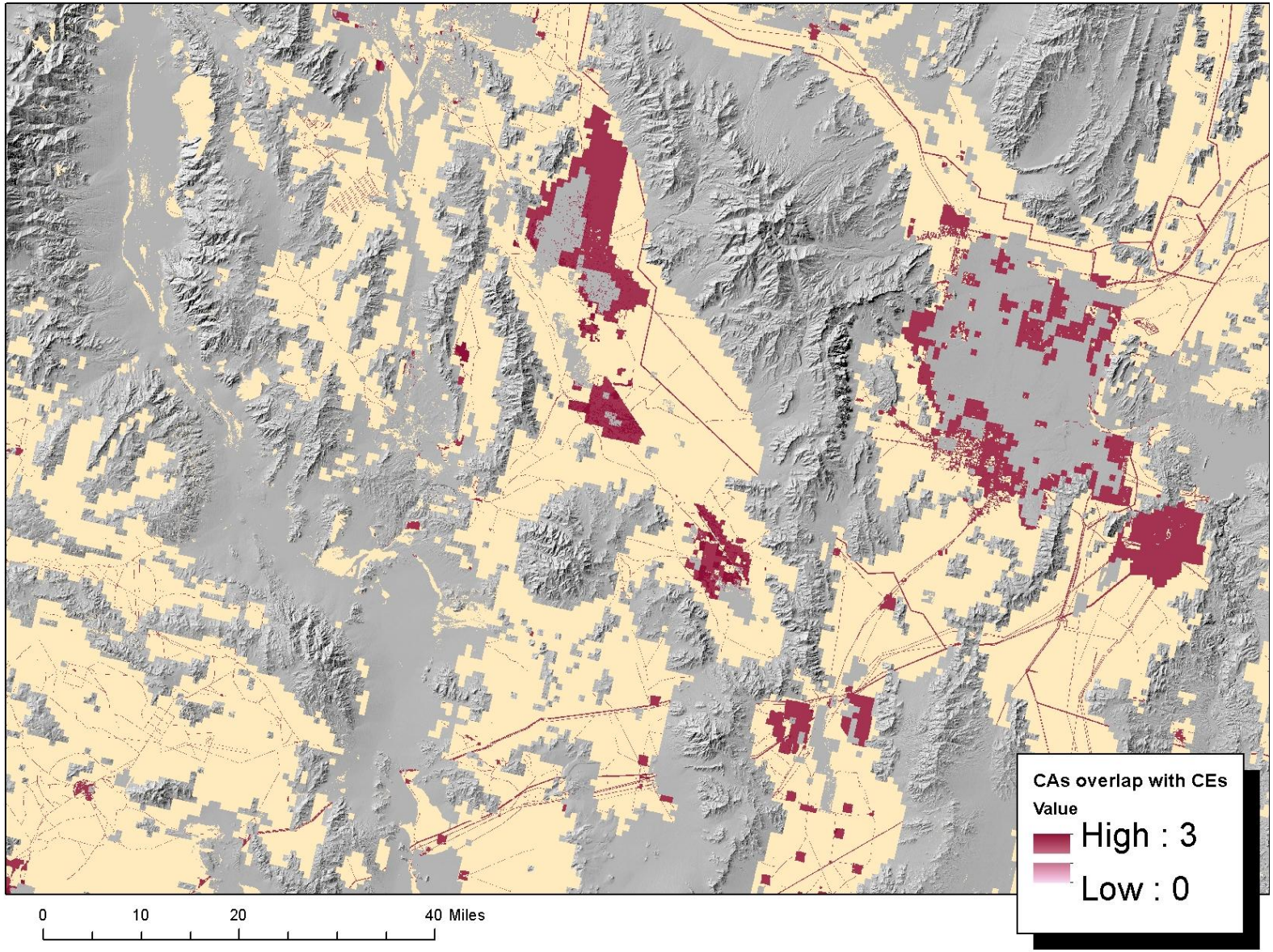
ProjectNam	SerialNumb	Commodity	Scenario	ACRES	Total Acres
Luning Solar	NVN XXXXXX	Wind Energy Facilities	Present	715.7	
Crescent Dunes	NVN XXXXXX	Wind Energy Facilities	Present	2075.5	
Spring Valley Wind	NVN-084148	Wind Energy Facilities	Present	7090.9	
Salt Wells	NVN 077271	Geothermal Energy Facil*	Present	2551.1	
Mammoth PLES1	CACA 011667	Geothermal Energy Facil*	Present	1341.5	
Steamboat Galena Hills	NVN 063124	Geothermal Energy Facil*	Present	501.6	
Brady Ormat	NVN 046566	Geothermal Energy Facil*	Present	120.7	
Desert Peak	NVN 013072A	Geothermal Energy Facil*	Present	640.2	
Brady Ormat	NVN 065561	Geothermal Energy Facil*	Present	362.5	
Dixie Valley	NVN 012862	Geothermal Energy Facil*	Present	1627.9	
Stillwater	NVN 051956	Geothermal Energy Facil*	Present	120.9	
Empire	NVN 042707	Geothermal Energy Facil*	Present	1793.4	
Blue Mountain	NVN 058196	Geothermal Energy Facil*	Present	667.2	
Wabuska	NVN 079988	Geothermal Energy Facil*	Present	1517.2	
Steamboat Galena Hills	NVN 029821	Geothermal Energy Facil*	Present	39.7	
Steamboat Galena Hills	NVN 012085	Geothermal Energy Facil*	Present	501.6	
Desert Peak	NVN 085777	Geothermal Energy Facil*	Present	479.6	
Blue Mountain	NVN 086668	Geothermal Energy Facil*	Present	596.6	
Thermo	UTU 071373	Geothermal Energy Facil*	Present	1786.5	
Roosevelt	UTU 027386	Geothermal Energy Facil*	Present	1171.3	
Dixie Valley	NVN 012863	Geothermal Energy Facil*	Present	1871.1	
Beowawe	NVN 010916	Geothermal Energy Facil*	Present	1330.2	28,902.77
Salt-Wells aka Carson Lake	NVN XXXXXX	Geothermal Energy Facil*	Future	6948.1	
McGuiness Hills	NVN XXXXXX	Geothermal Energy Facil*	Future	7443.6	
New York Canyon	NVN XXXXXX	Geothermal Energy Facil*	Future	15967.6	
Coyote Canyon	NVN XXXXXX	Geothermal Energy Facil*	Future	7159.0	
Salt-Wells	NVN XXXXXX	Geothermal Energy Facil*	Future	15535.8	
MIlford Wind Corridor Phase I	UTU-082972	Wind Energy Facilities	Future	3286.6	
Mineral Mountain	UTU-083061	Wind Energy Facilities	Future	4092.0	
Milford Wind Corridor Phase II	UTU-083073	Wind Energy Facilities	Future	4224.8	
Milford Wind Corridor Phase II SA	UTU-08307301	Wind Energy Facilities	Future	80.8	
Milford Wind Corridor Phase IV	UTU-088017	Wind Energy Facilities	Future	29498.6	94,236.78

ProjectNam	SerialNumb	Commodity	SCENARIO	ACRES	Total Acres
Chevron Energy Solutions - Lucerne Valley	CACA 049561	Solar Energy Facilities	Present	461.1	
Solar Partners I - Ivanpah 2	CACA 048668	Solar Energy Facilities	Present	3479.4	
Calico Solar, LLC - Calico	CACA 049537	Solar Energy Facilities	Present	4604.4	
Silver State Solar (combined South and North proj*	NVN-085077	Solar Energy Facilities	Present	7850.9	
Amargosa Farm Road, Amargosa Valley, Nye County	NVN-084359	Solar Energy Facilities	Present	6279.7	
BP-Edom Hills Project	CACA 014632	Wind Energy Facilities	Present	364.7	
Mark Technologies Corp. - Mesa	CACA 041695	Wind Energy Facilities	Present	277.3	
Oak Creek Energy - Tehachapi	CACA 013528	Wind Energy Facilities	Present	159.5	
PAMC Management Corp. - Alta Mesa	CACA 011688A	Wind Energy Facilities	Present	874.2	
FPL Energy - Cabazon Wind	CACA 013198	Wind Energy Facilities	Present	210.2	
Desert Wind Energy	CACA 015549	Wind Energy Facilities	Present	79.1	
Energy Unlimited Inc. - Eastridge	CACA 017192	Wind Energy Facilities	Present	77.4	
DIF Wind Farms V	CACA 037869	Wind Energy Facilities	Present	39.3	
DIFCO - Whitewater Floodplain	CACA 015562	Wind Energy Facilities	Present	962.5	
Cameron Ridge, LLC	CACA 009501	Wind Energy Facilities	Present	545.3	
San Gorgonio Farms - Whitewater Hill	CACA 009755	Wind Energy Facilities	Present	13.4	
Searchlight Wind Energy, Searchlight, Nevada	NVN-084626	Wind Energy Facilities	Present	24049.1	
Navy BLM China Lake	CACA 011402	Geothermal Energy Facil*	Present	2569.6	
Navy BLM China Lake	CACA 011402	Geothermal Energy Facil*	Present	2569.6	
Navy BLM China Lake	CACA 022512	Geothermal Energy Facil*	Present	40.7	
Navy BLM China Lake	CACA 025690	Geothermal Energy Facil*	Present	631.5	56,138.9
Silver-State Solar (combined South and North proj*	NVN xxxxxx	Solar Energy Facilities	Future	8373.7	
Amargosa-North, Big Dune Area, Nye County	NVN xxxxxx	Solar Energy Facilities	Future	9562.6	
Granite Wind LLC - Granite Mountains	CACA 048254	Wind Energy Facilities	Future	2085.0	
Palen Solar I, LLC - Palen	CACA 048810	Solar Energy Facilities	Future	360.5	
Alta Wind 1 - Golden Square	CACA 051335	Wind Energy Facilities	Future	554.1	
Rising Tree Wind Farm, LLC	CACA 052362	Wind Energy Facilities	Future	536.1	
First Solar - Stateline	CACA 048669	Solar Energy Facilities	Future	6096.8	
Chevron Energy Solutions - Lucerne Valley	CACA 049561	Solar Energy Facilities	Future	460.8	
Alta Windpower Development, LLC - Alta East	CACA 052537	Wind Energy Facilities	Future	2082.9	
Solar Partners I - Ivanpah 2	CACA 048668	Solar Energy Facilities	Future	3473.7	
Calico Solar, LLC - Calico	CACA 049537	Solar Energy Facilities	Future	4600.2	
Mohave County Wind Farm	AZA32315	Wind Energy Facilities	Future	49057.2	87,243.51

Footprint Assessment



Footprint Assessment



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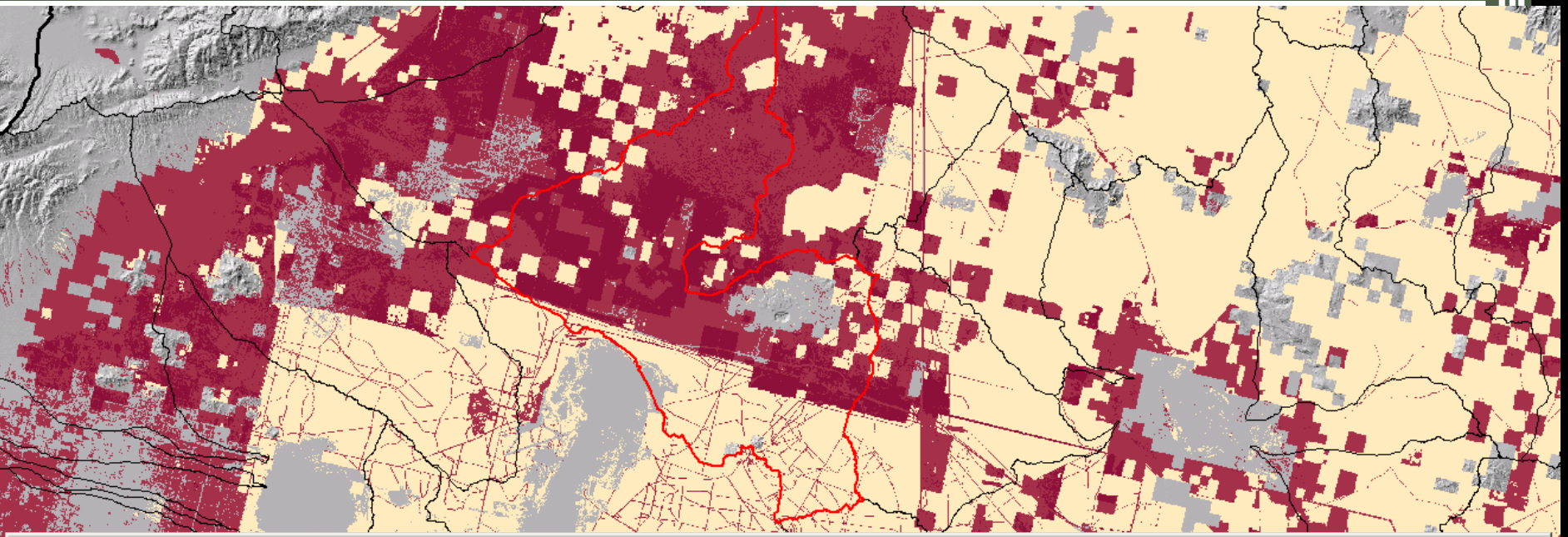
Footprint Assessment



Site Explorer

Test Elements
Scenario Evaluation
Site Layer PLIV_MBR_huc10_watersheds

Selection Attributes
FID: 156
FID: 157
FID: 158

Options ... | Help | Report | Less <<

Element Name	Total	Selection	Compatible Area	% Compat	Selection Compat	Response
Sonoran Mojave Salt Desert Scrub	406,642 occ's.; 2,250,909.32	54,924 occ's.; 443,607.78 ac.		73.8% occ's; 65.4%	29,224 occ's.; 225,234.9 ac.	(None)
North American Warm Desert Riparian Shrub	22,926 occ's.; 107,201.38 ac.	401 occ's.; 1,442.76 ac.		76.8% occ's; 76.2%	191 occ's.; 335.28 ac.	(None)
Desert Tortoise	667 occ's.; 13,681,304.78 ac.	5 occ's.; 929,887.86 ac.		97.3% occ's; 80.4%	3 occ's.; 506,974.16 ac.	(None)

Scenario Composition

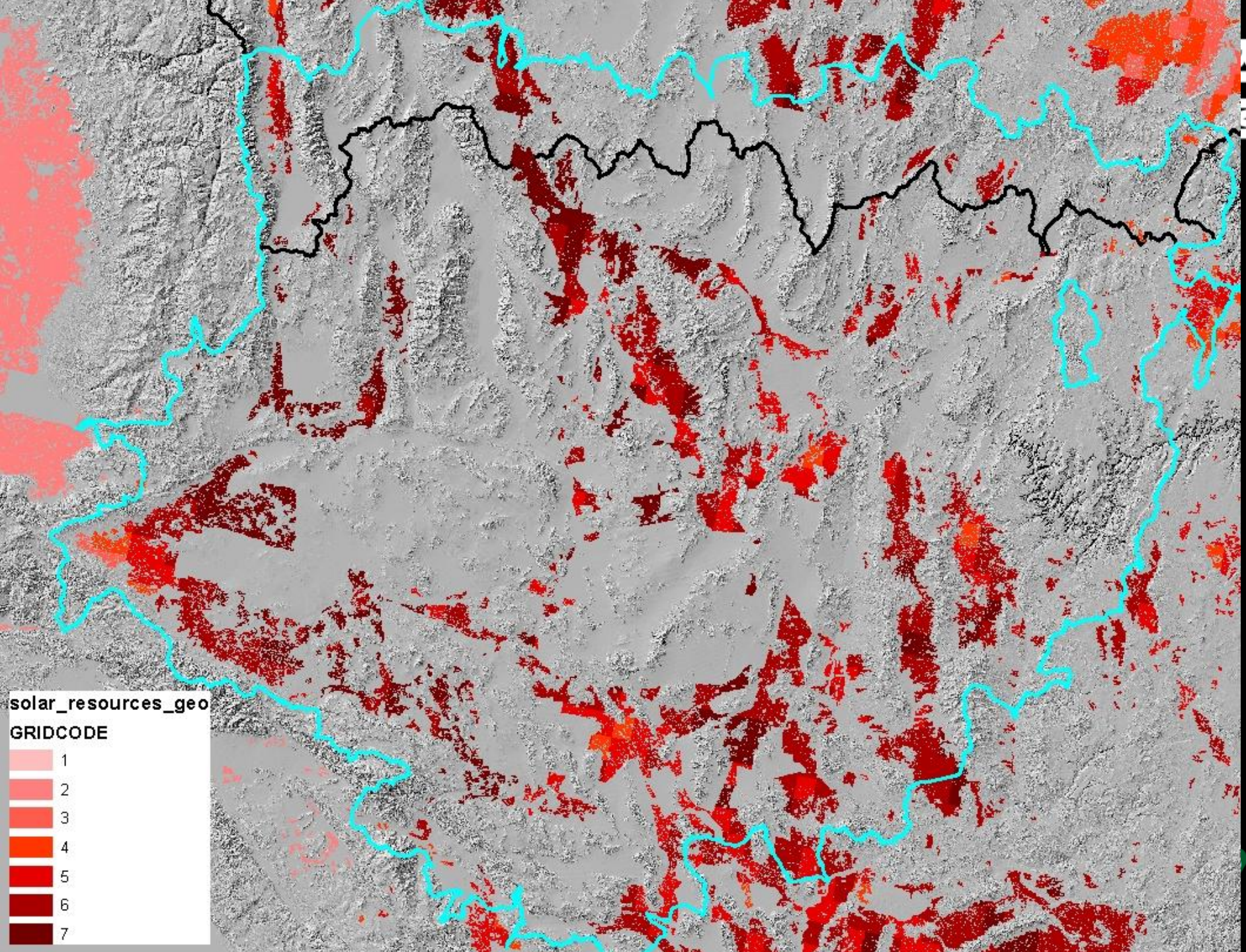
Component	Area	Land Use
Pipe_buf_MBR2	5380.98 acres	Pipelines
landfills_improved_	29.92 acres	Landfills and Refuse Pits
MBR_renewables_	300.52 acres	Renewable Energy Wind
urb_10_mbr	68293.72 acres	Private undeveloped
urb_10_mbr	474088.78 acres	Urban very low density (exurban)
urb_10_mbr	22711.26 acres	Urban low density (suburban)
urb_10_mbr	3921.5 acres	Urban high density

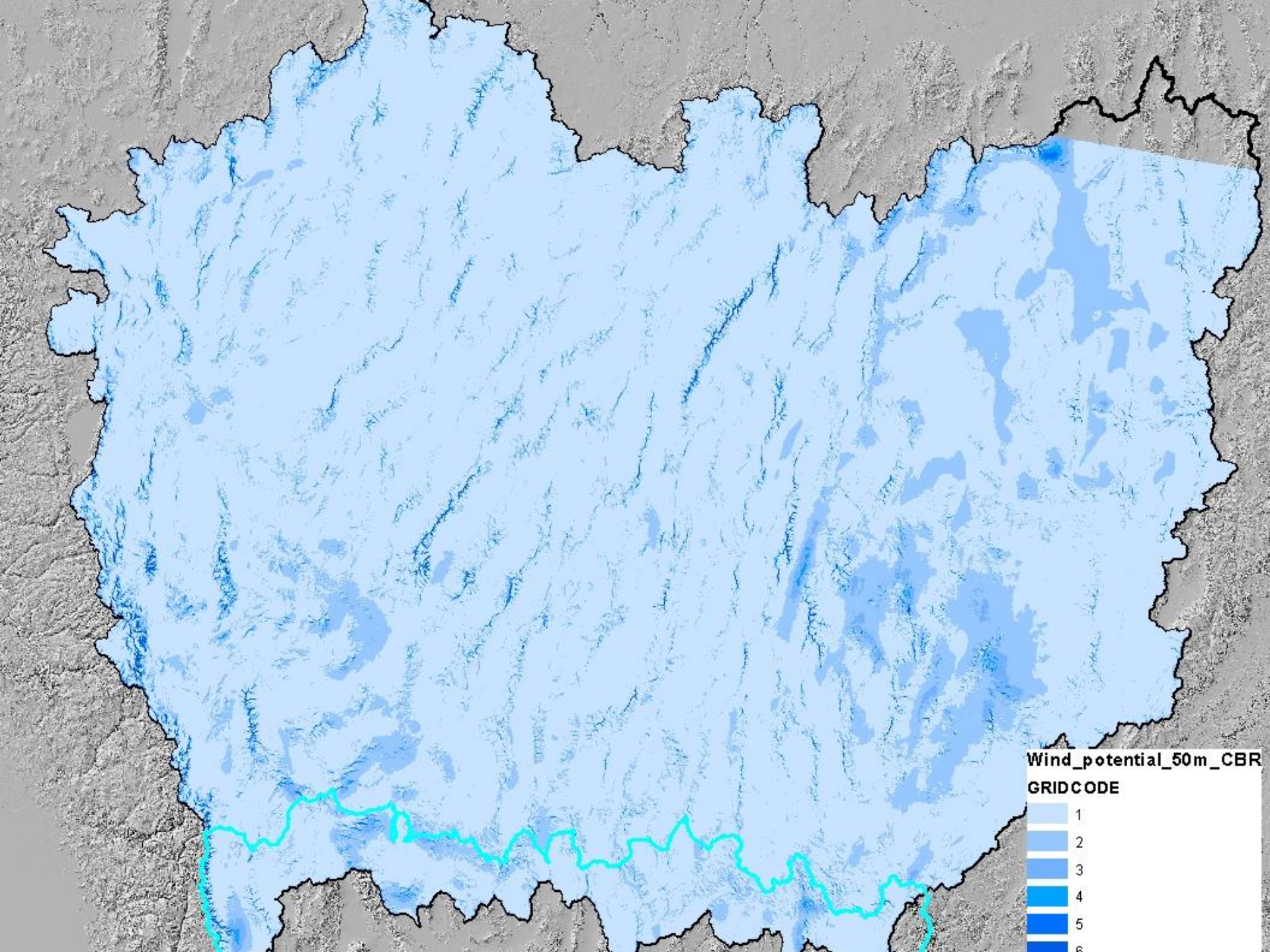
Apply | Undo | Review... | Save ...

Override <None>

Renewable Energy Potential

- Where are the areas identified by NREL as potential locations for renewable energy development?
- Where do current locations of CEs overlap with areas of potential future locations of renewable energy development (MQ 65)?
- Where are the areas of low renewable and non-renewable energy development that could potentially mitigate impacts to CEs from potential energy development?
- Not tied to a fixed time scenario


solar_resources_geo
GRIDCODE
1
2
3
4
5
6
7


Wind_potential_50m_CBR
GRIDCODE
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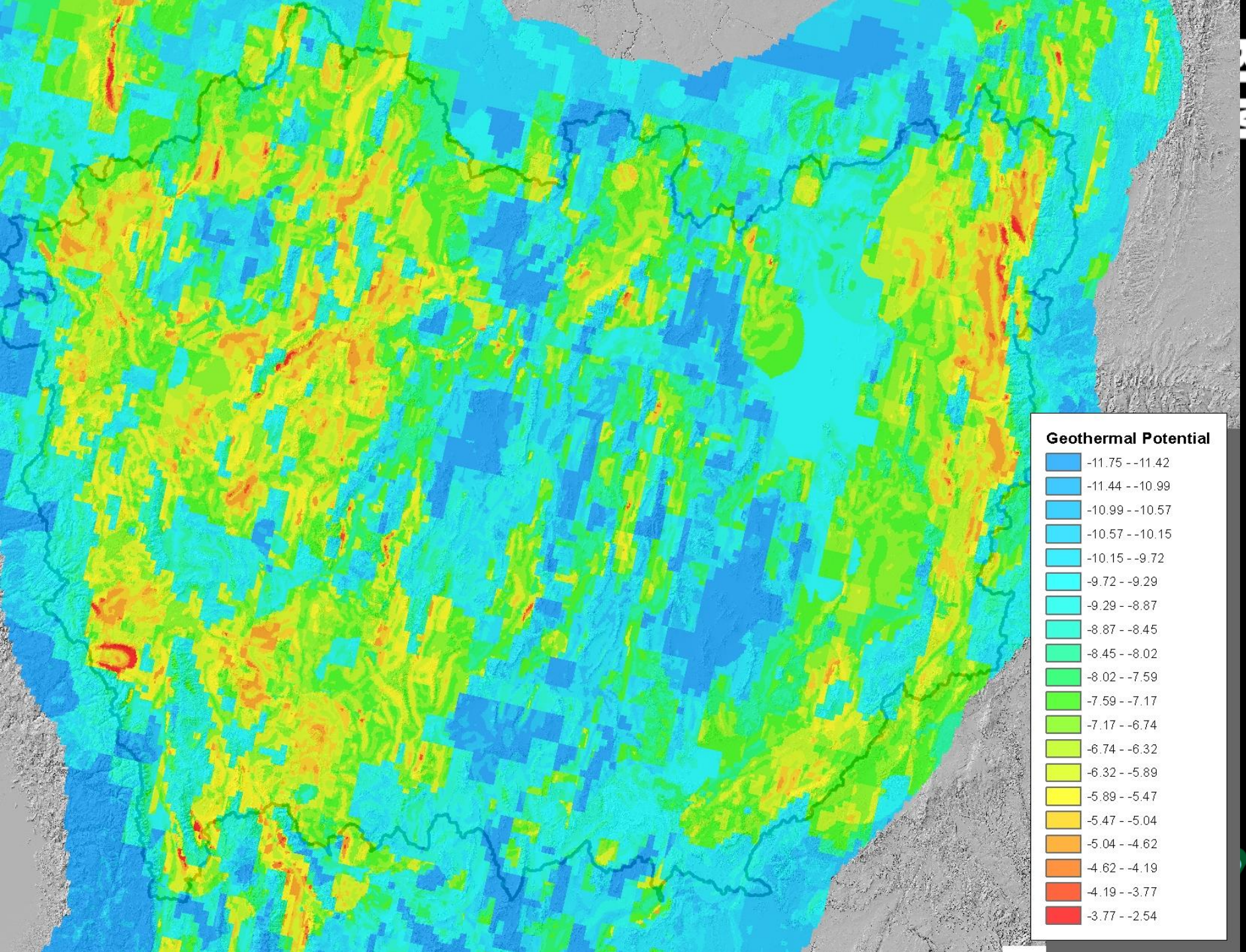
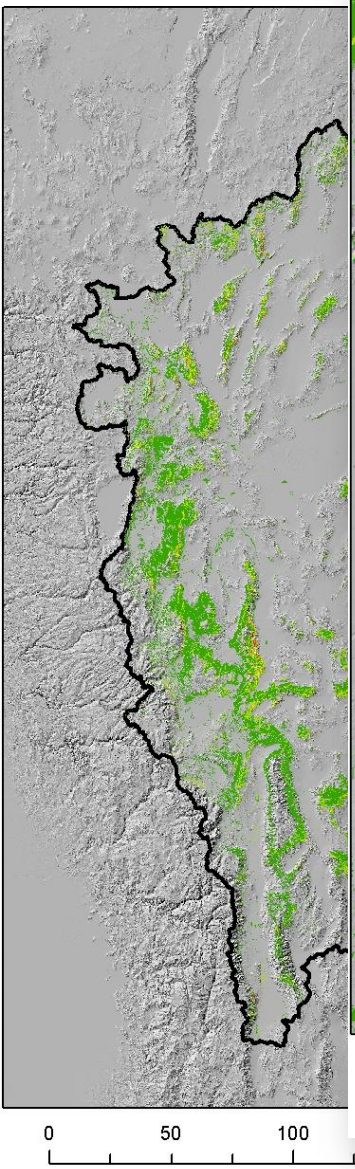
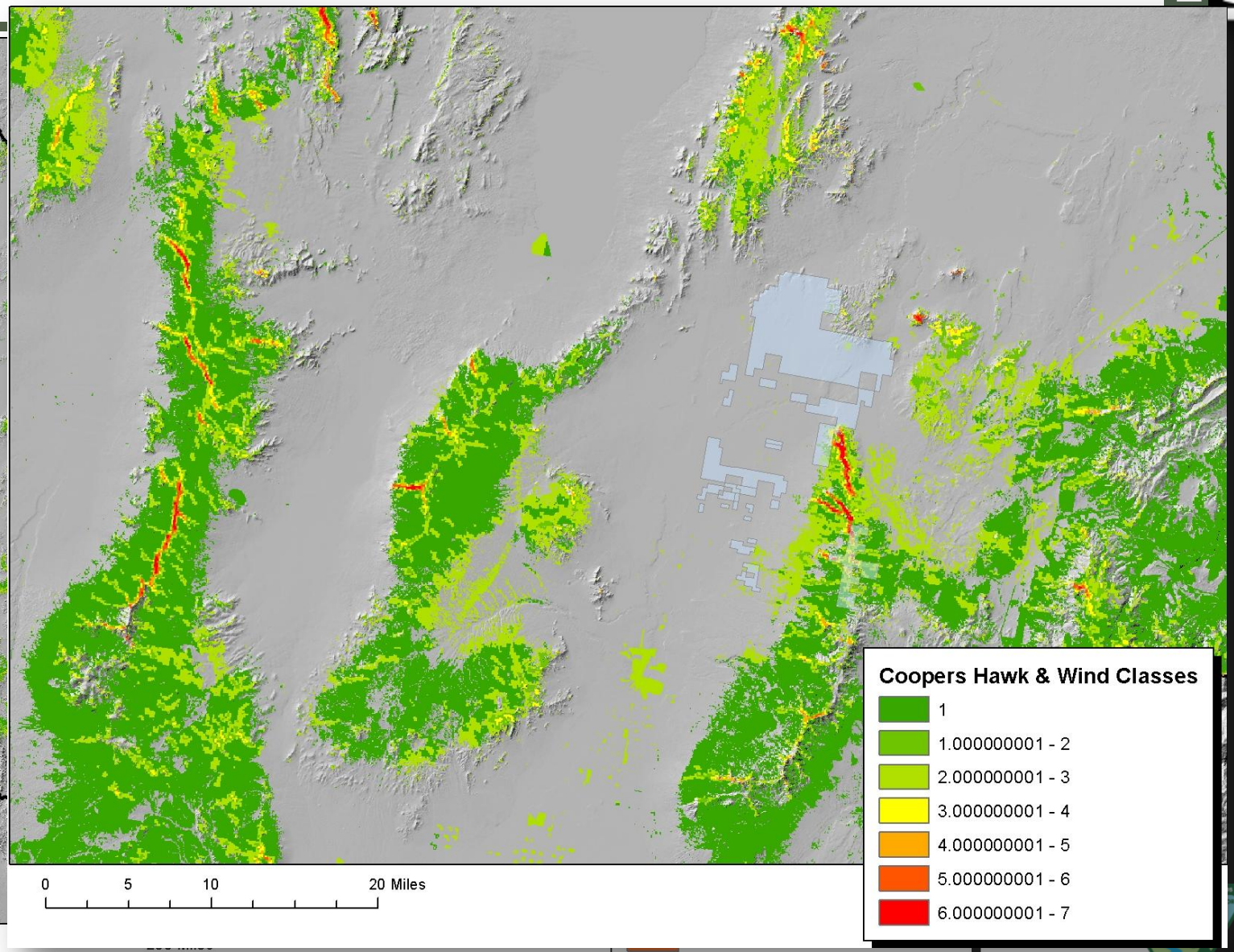
2
3
4
5
6


Geothermal Potential
-11.75 - -11.42
-11.44 - -10.99
-10.99 - -10.57
-10.57 - -10.15
-10.15 - -9.72
-9.72 - -9.29
-9.29 - -8.87
-8.87 - -8.45
-8.45 - -8.02
-8.02 - -7.59
-7.59 - -7.17
-7.17 - -6.74
-6.74 - -6.32
-6.32 - -5.89
-5.89 - -5.47
-5.47 - -5.04
-5.04 - -4.62
-4.62 - -4.19
-4.19 - -3.77
-3.77 - -2.54

Where do current locations of CEs overlap with areas of potential future locations of renewable energy development (MQ 65)?





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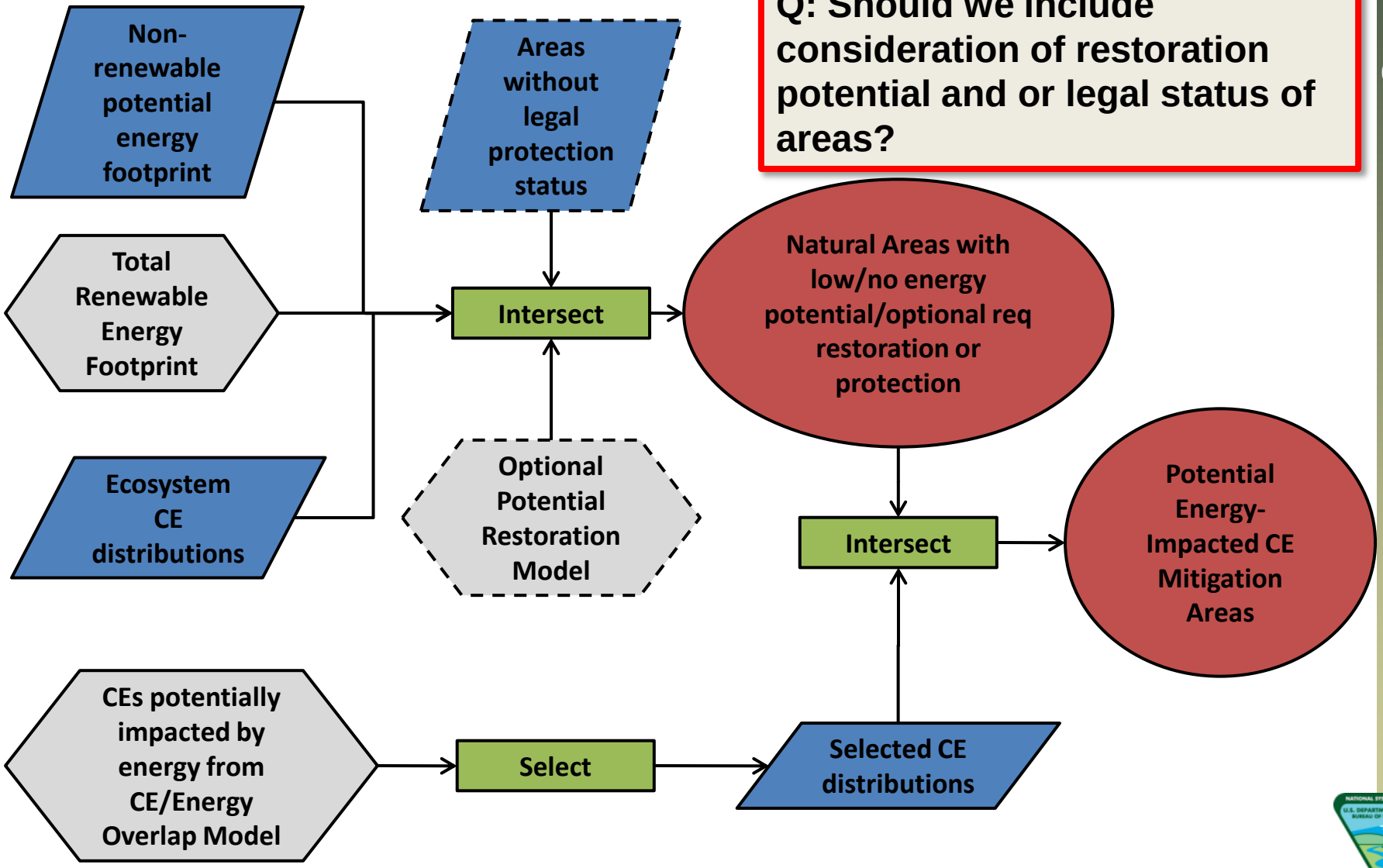
Where are the areas of low renewable and non-renewable energy development that could potentially mitigate impacts to CEs from potential energy development?

Q: Should we include consideration of restoration potential and or legal status of areas?



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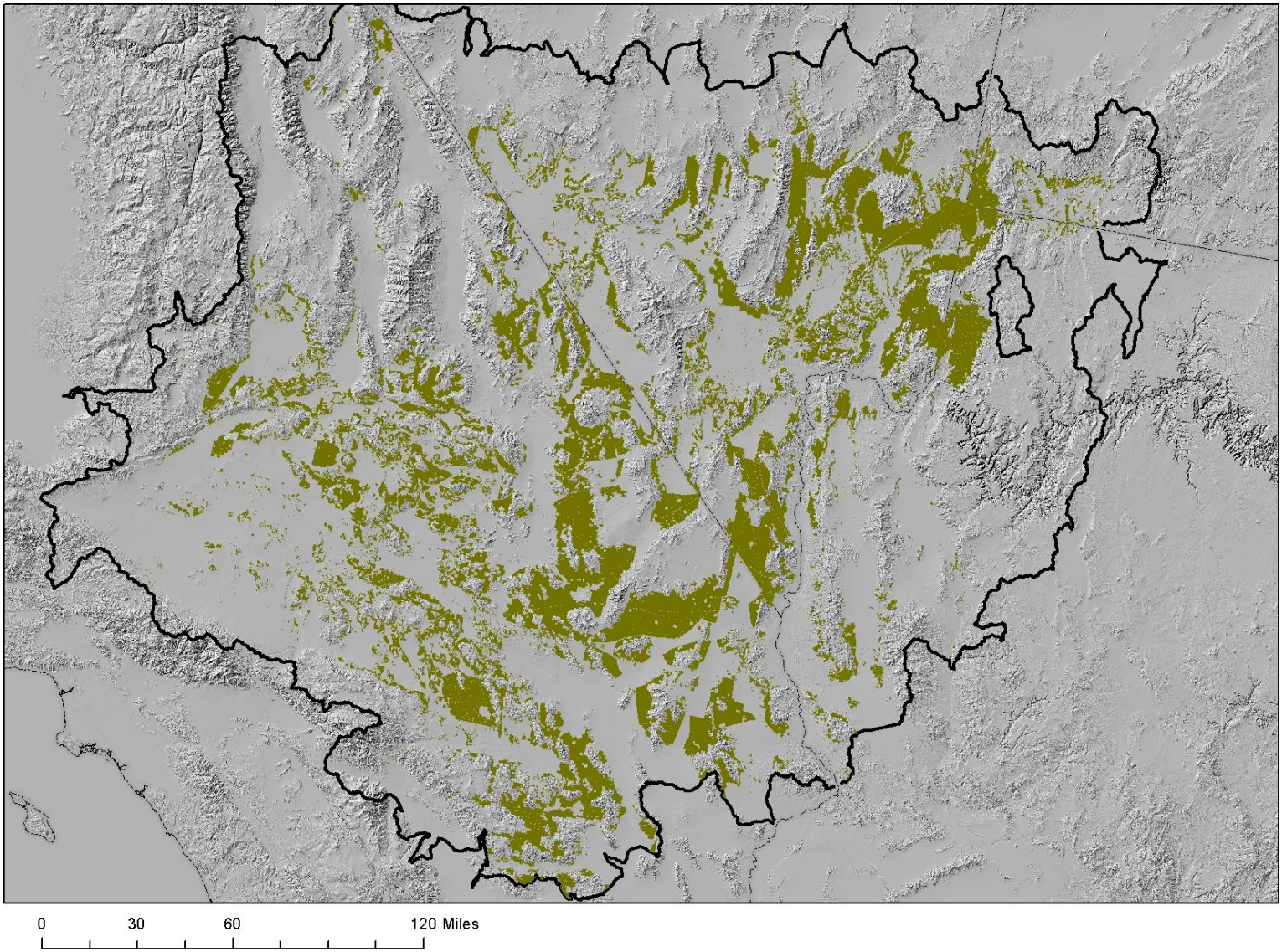

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Recreation Change Agent

Management questions

• Where are ecological areas with significant recreational use?

Enabling our answering MQs like….

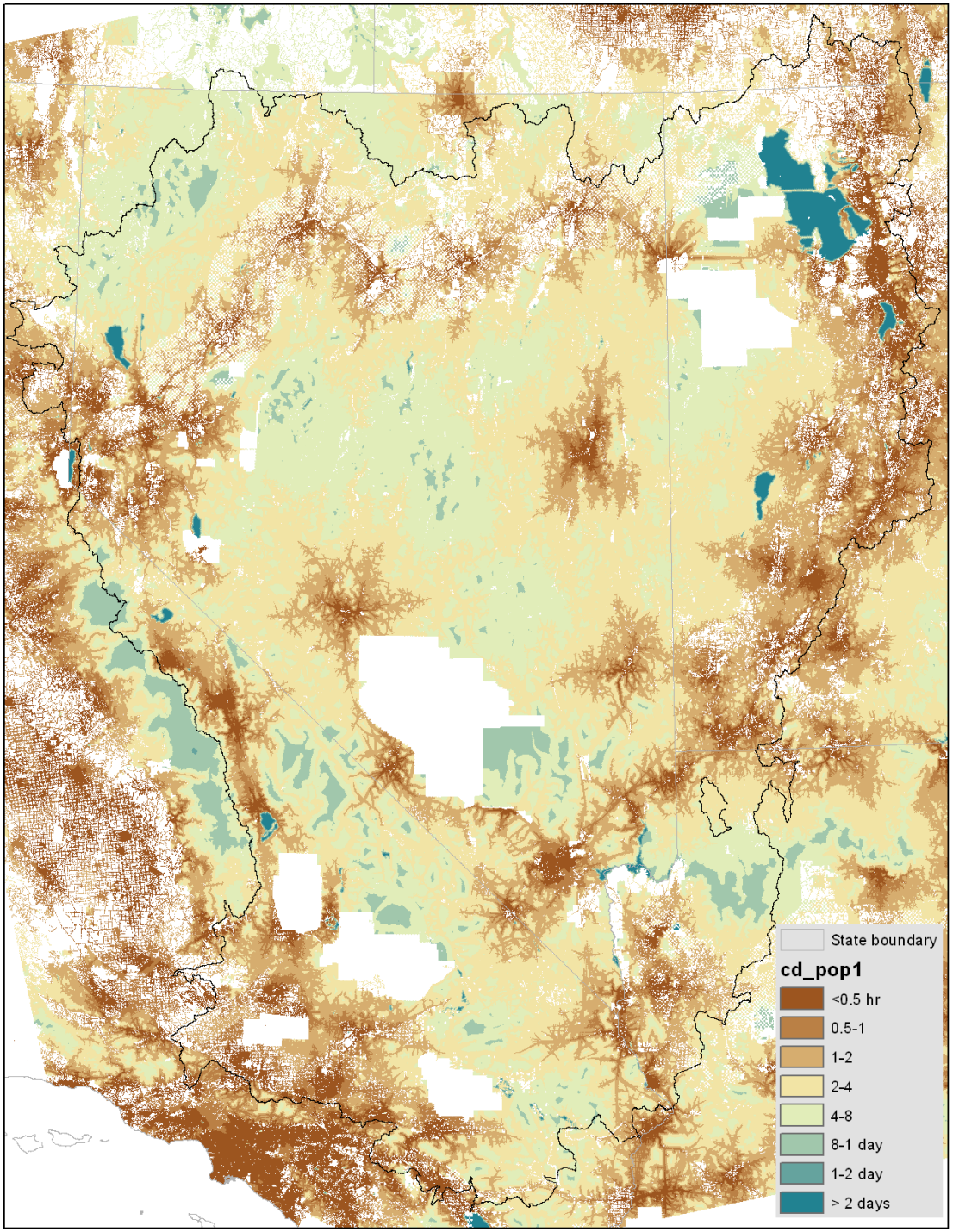
• How much desert tortoise habitat is in areas of high recreation use?
- Units in area
- Overlap of recreation use (in people or vehicles per year)

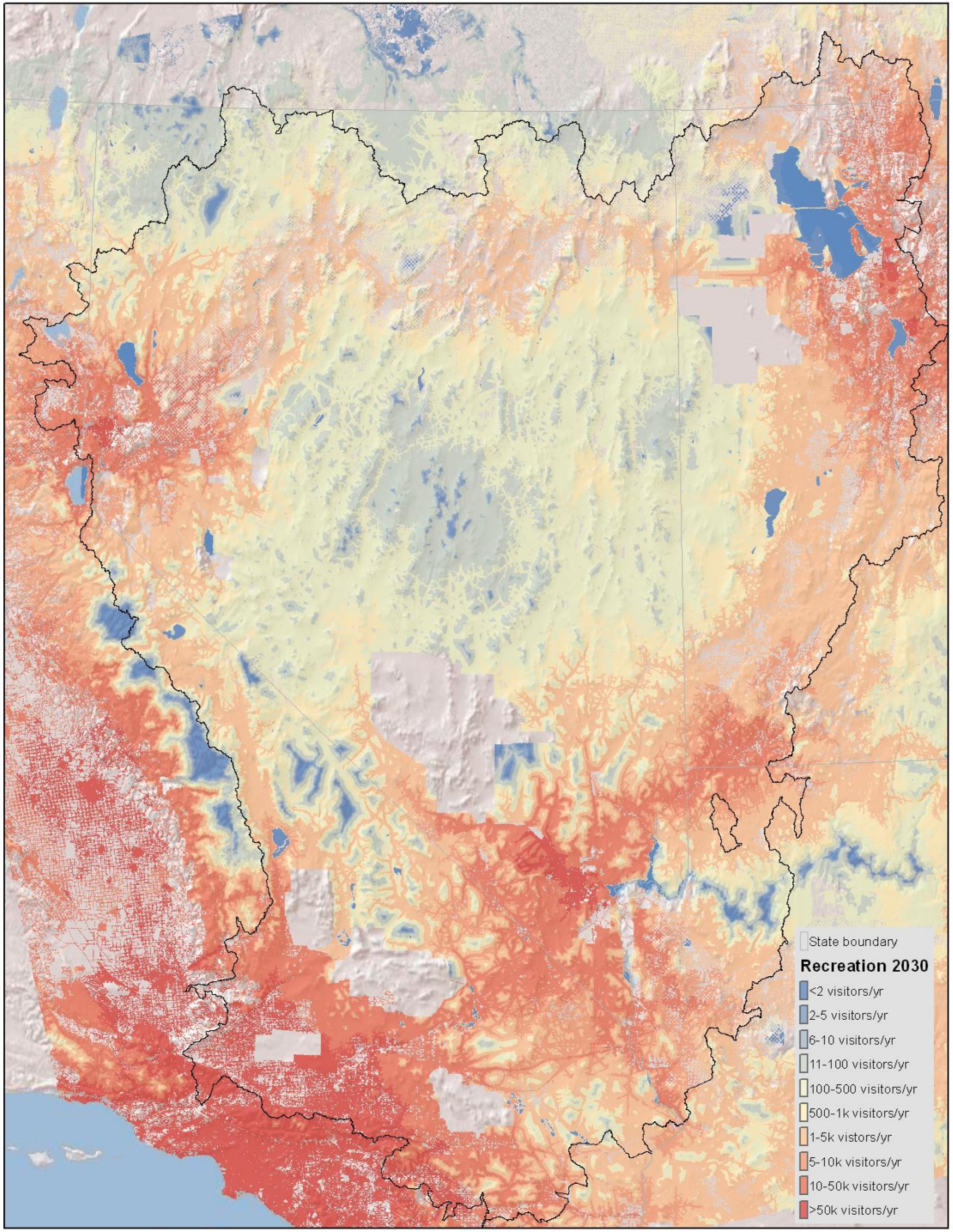
Data changes/additions

- Exclusion
  - PAD-US assigned:
    - Private, no public access
    - Recreation uses, motorized very likely
    - Wilderness, motorized precluded
    - Natural areas, motorized likely excluded
    - DOD, military, DOE, prison – all recreation excluded
    - Fishing access
  - Public access on interstates and highways is assumed
- Special Resource Management Areas
  - No designation about OHV or not, not used
  - DeAnza historic trail…. not used
- Recreation sites/settings
  - Campsite, picnic, day use area → "gate"
  - Boat launch, dock → "gate" for aquatic
  - LTVA, Recreation Camping Area → gate
- Features
  - Abandoned mine: dded (roads??/accessibility)? Attractions for rock-hounders
  - GNIS features (arch, cliff, falls, mine, spring, summit)
- OHV races
  - Found many sites with information, very few maps (and courses change), no readily-available GIS data, not incorporated
- Projections
  - From state demographers office,
  - Place population in 2000 was multiplied times the county growth rate (pop2030/pop2000)*

Recreation models

Type	Constraints	"Gates"	Destinations
R - general	Public lands but not DOD/DOE	None	None
Ra - Boater/fisher *assume 10 mph boat speed	Reservoirs, rivers, Non-wilderness, non-DOD	Marinas, boat ramps	Beaches, fishing holes, camping spots
Re - OHV enthusiast *assume no highway travel	Public, non-wilderness, non-DOD	OHV staging areas, trail heads	Potentially: race courses, ravines, washes
Rf – Hiker, cyclist	Public, non-DOD	Trail heads, campgrounds, RCAs/LTVAs	Springs, slot canyons, peaks, arches
Rr - OHV hunter/rock hounder	Public, non-wilderness, non-DOD	OHV trail heads, campgrounds, RCAs/LTVAs	Caves, mines, ruins

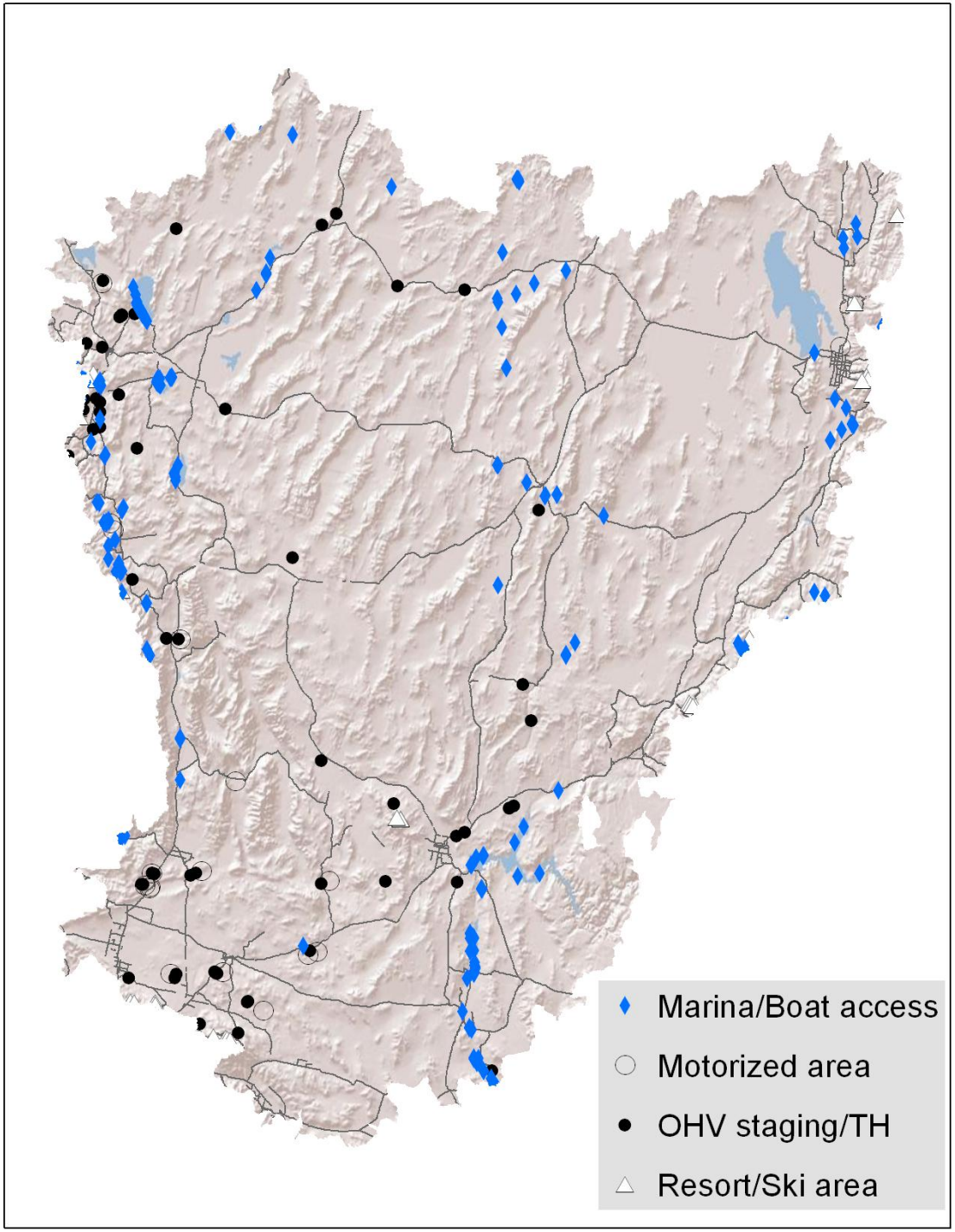

State boundary
cd_pop1
<0.5 hr
0.5-1
1-2
2-4
4-8
8-1 day
1-2 day
> 2 days


State boundary
Recreation 2030
<2 visitors/yr
2-5 visitors/yr
6-10 visitors/yr
11-100 visitors/yr
100-500 visitors/yr
500-1k visitors/yr
1-5k vistors/yr
5-10k visitors/yr
10-50k visitors/yr
>50k visitors/yr

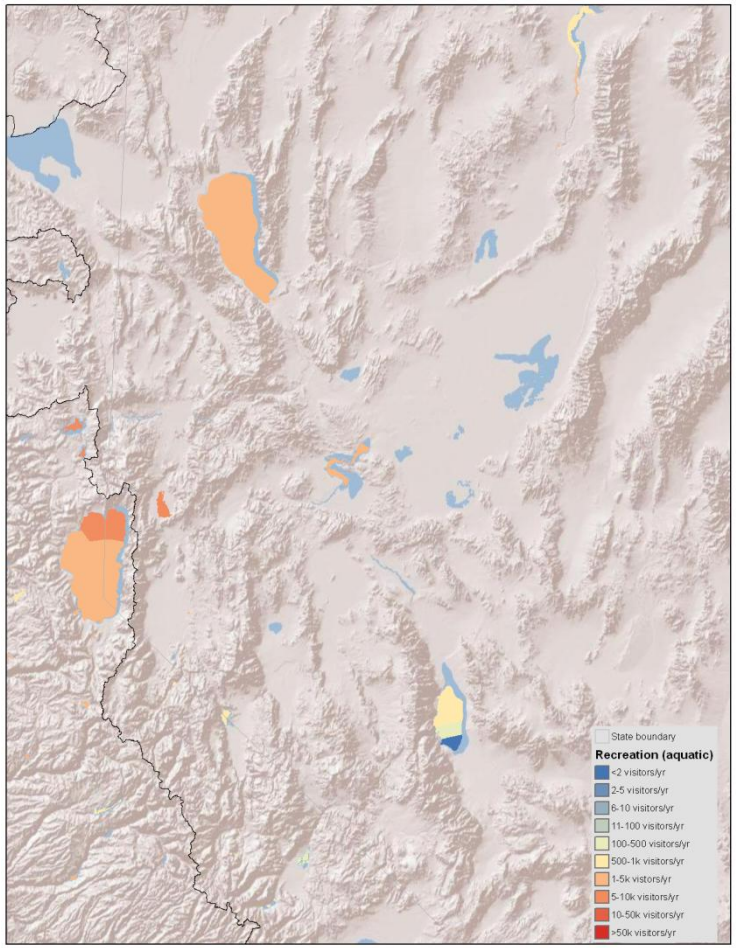
“Gates”

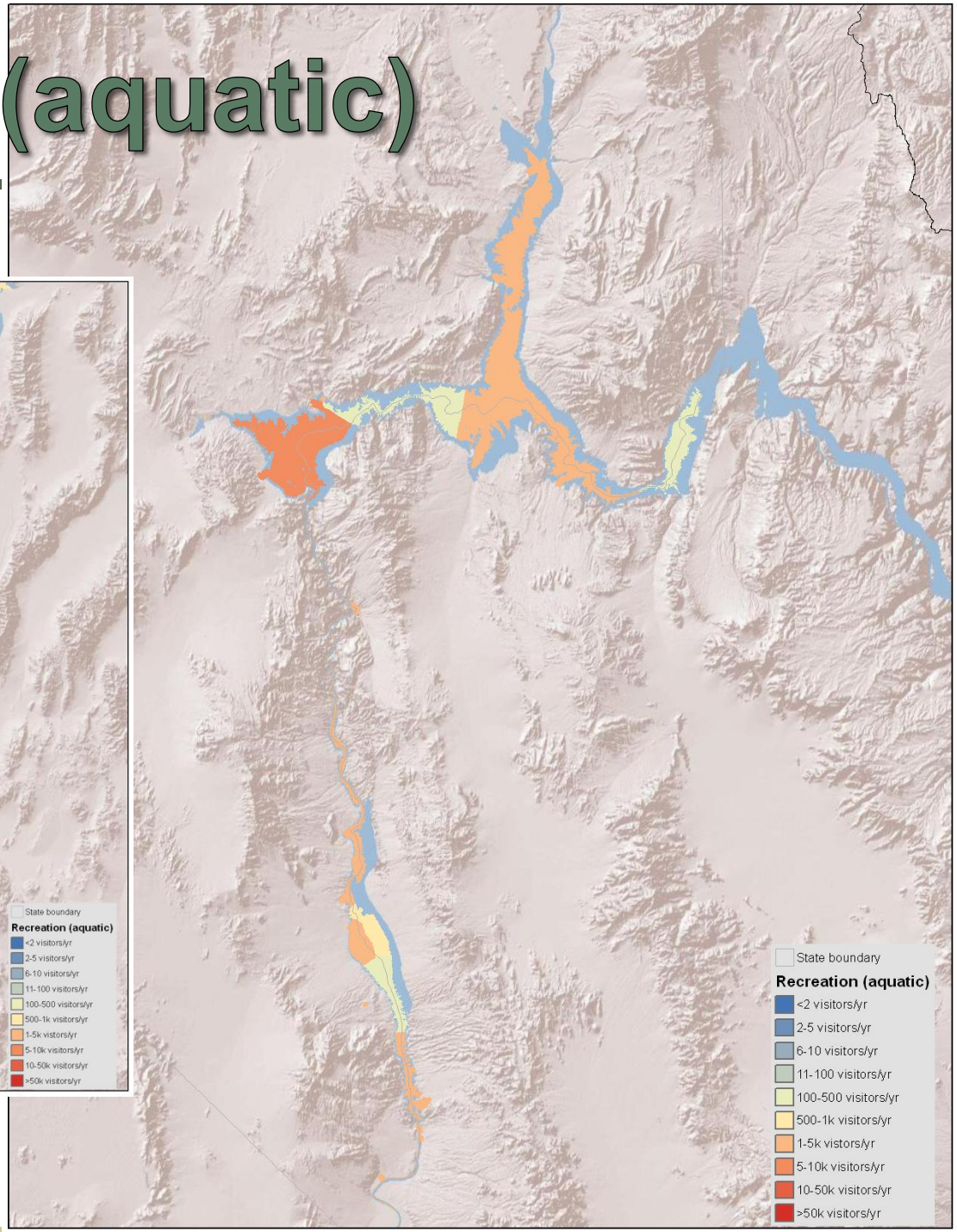
~100 OHV

~150 aquatic



Model: Ra (aquatic)





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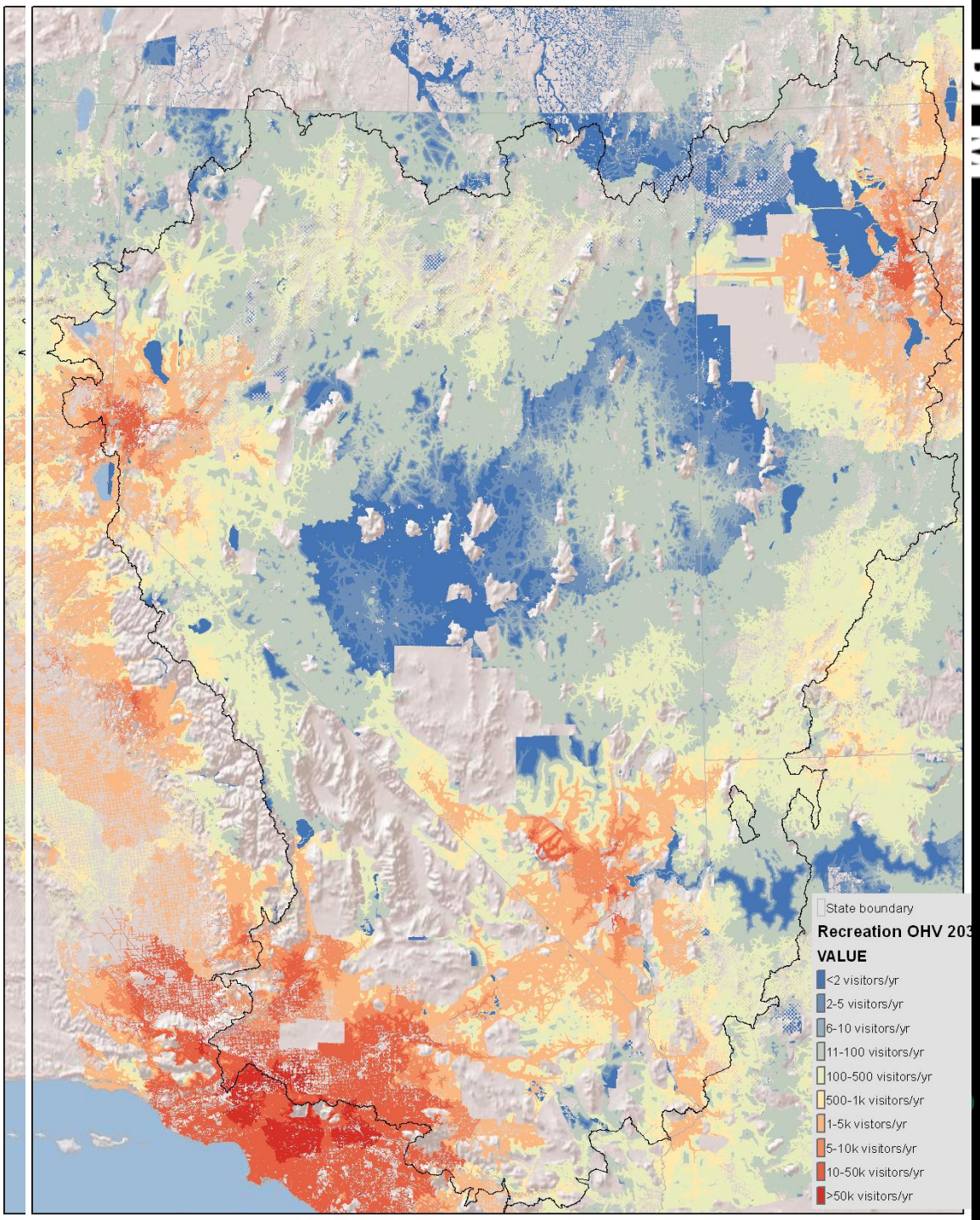
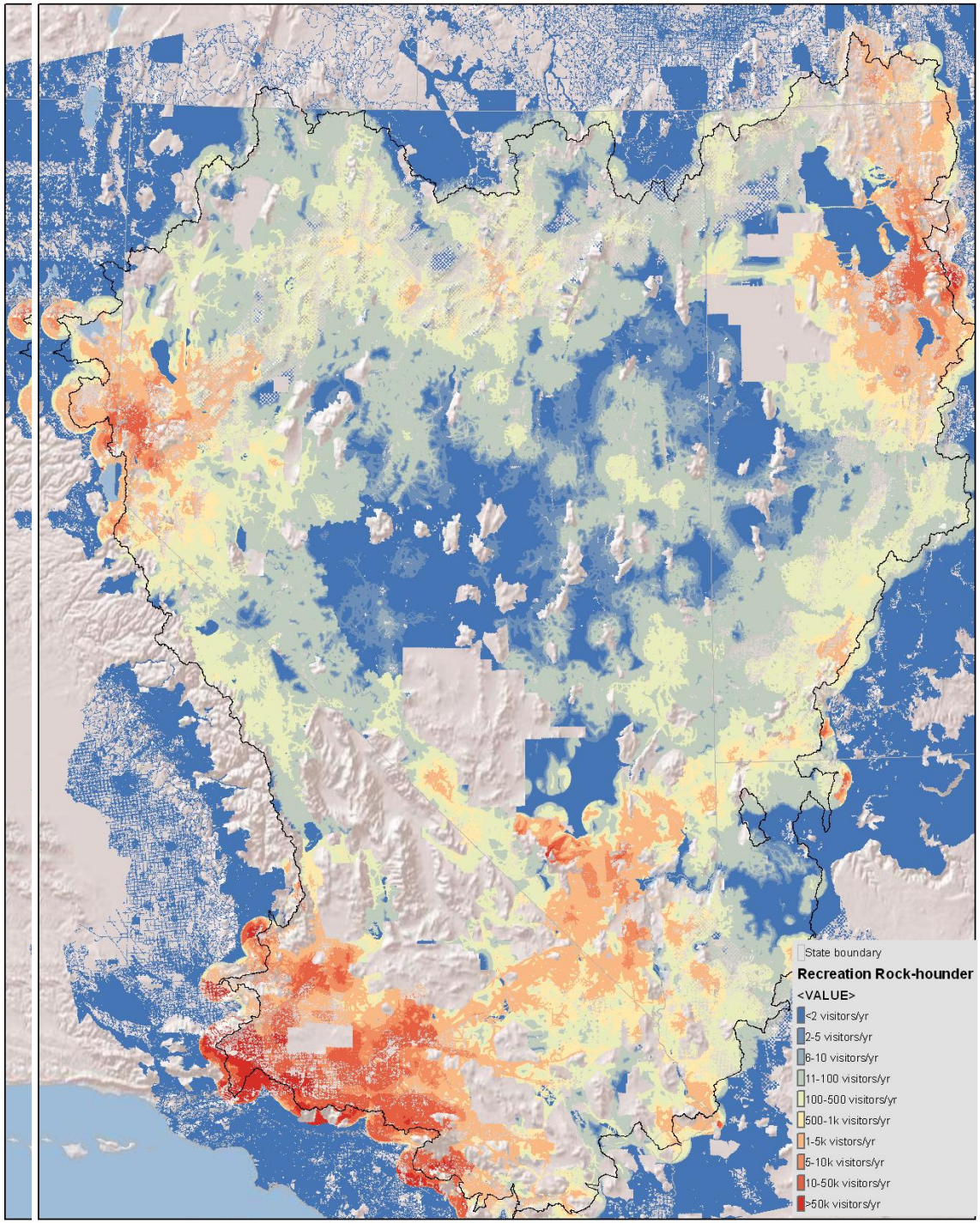
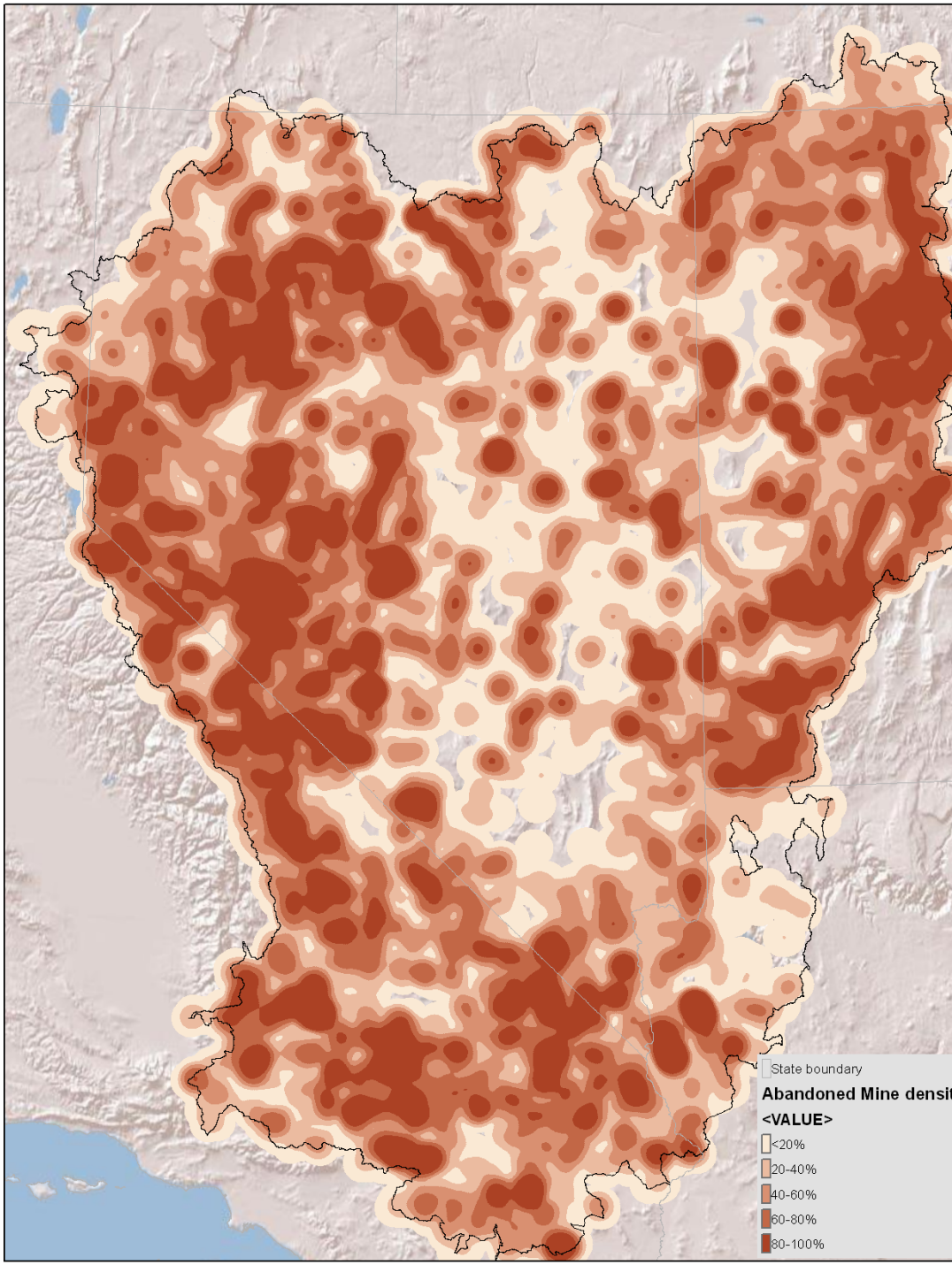
Model: Re (OHV enthusiast)

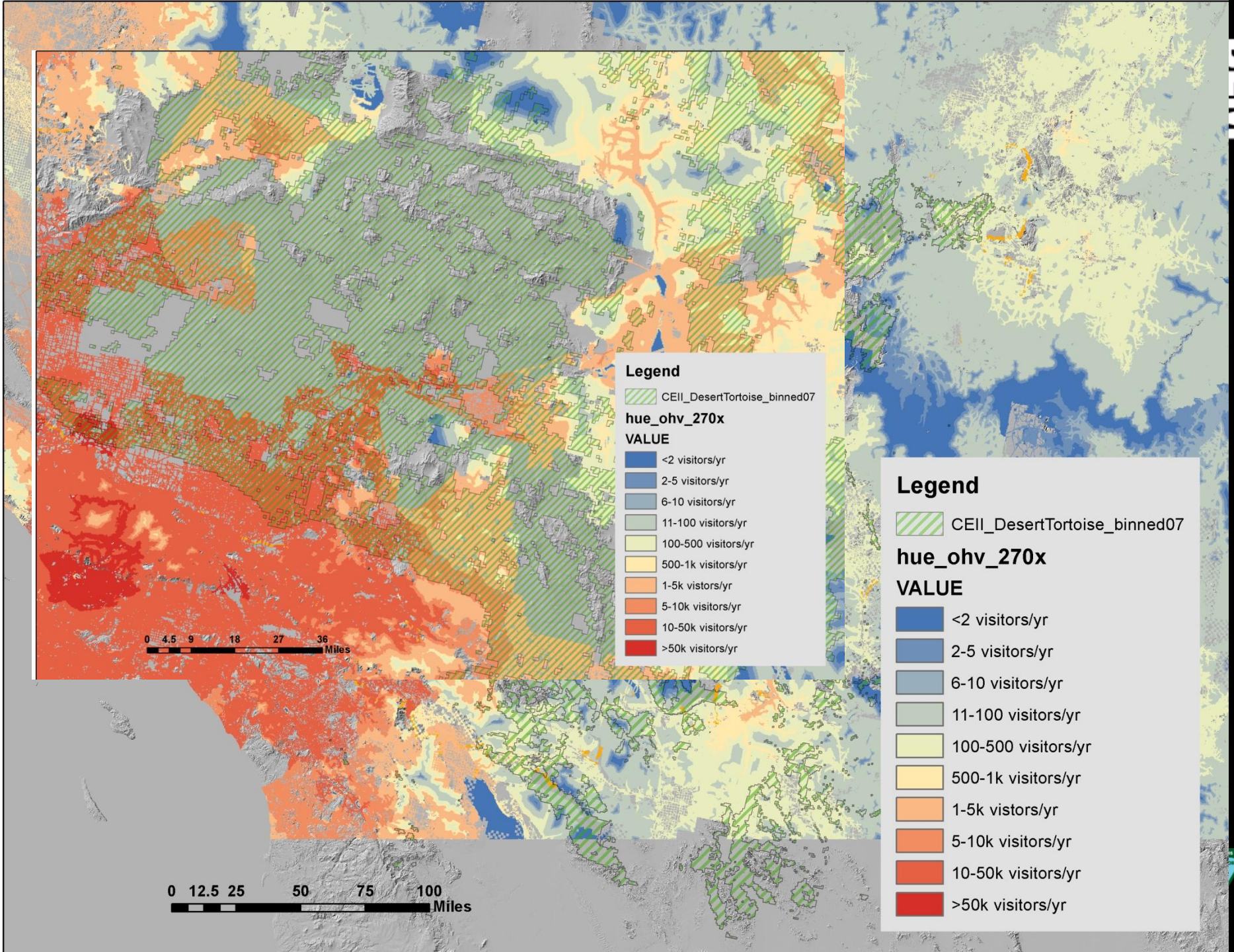


Model: Re OHV Hunter/Rock Hound



Abandoned mine Density




Legend
CEII_DesertTortoise_binned07
hue_ohv_270x
VALUE
<2 visitors/yr
2-5 visitors/yr
6-10 visitors/yr
11-100 visitors/yr
100-500 visitors/yr
500-1k visitors/yr
1-5k vistors/yr
5-10k visitors/yr
10-50k visitors/yr
>50k visitors/yr
0 4.5 9 18 27 36 Miles
0 12.5 25 50 75 100 Miles
BLM

Back to: Management questions

MQs

- Where are ecological areas with <u>significant</u> recreational use?

- Significance varies by CE
- Generalize to use levels/classes
- Reporting Units?

Class II Development – Recreation:

output

- Model output will be calibrated to visitation estimates for concentrated areas (where data available) and by review by BLM recreation specialists

Clarifications

- How to deal with broad differences in precision in future/potential CA maps vs refined zones or footprints
- Do renewable energies affect all CEs or just a subset of particular concern?

CE Status Scorecard

Indicator	Justification	Rating			Index Score
		Sustainable	Transitioning	Degraded	
Rank Factor: LANDSCAPE CONTEXT					
Key Ecological Attribute: *Landscape Condition*					
Landscape Condition Model Index	Land use impacts vary in their intensity, affecting ecological dynamics that support ecological systems.	Cumulative level of impacts is sustainable. Landscape Condition Model Index is > 0.8	Cumulative level of impacts is transitioning system between a sustainable and degraded state. Landscape Condition Model Index is 0.8 – 0.5	Cumulative level of impacts has degraded system. Landscape Condition Model Index is< 0.5	**0.0 – 1.0**
Key Ecological Attribute: *Landscape Connectivity*					
Landscape Connectivity Index	Intact natural conditions support physical and biological dynamics occurring across diverse environmental conditions	Connectivity is moderate to high and adequate to sustain most CEs. Connectivity index is >0.6	Connectivity is moderate to low and will not some sustain CEs. Connectivity index is 0.6-0.2	Connectivity is low and will not sustain many CEs. Connectivity index is <0.2	**0.0 – 1.0**
Rank Factor: CONDITION					
Key Ecological Attribute: Species Composition					
Invasive Plants Index	Invasive annual vegetation displaces natural composition and provides fine fuels that significantly increase spread of catastrophic fire.	System is sustainable with low cover of invasive annual vegetation. Mean cover of annuals is <5%. Invasive Annual Cover Index is >0.8.	System is transitioning to degraded state by abundant invasive annual vegetation. Mean cover of annuals is 5-10%. Invasive Annual Cover Index is 0.8-0.5.	System is degraded by abundant invasive annual vegetation. Mean cover of annuals is >15%. Invasive Annual Cover Index is <0.5)	**0.0 – 1.0**
Key Ecological Attribute: Fire Regime					
Fire Regime Departure	Mixed of age classes among patches of the system is result of disturbance regime. Departure from mixture predicted under NRV indicates uncharacteristic disturbance regime and declining integrity.	Mixed of age classes indicate system is functioning inside or near NRV. System is in a sustainable state. Departure is < 20%. SCLASS Departure Index is > 0.8	Mixed of age classes indicate system is functioning near, but outside NRV. System is transitioning to degraded state. Departure is 20 -50%. SCLASS Departure Index is 0.8 – 0.5	Mixed of age classes indicate system is functioning well outside NRV. System is degraded. Departure is > 50%. SCLASS Departure Index is < 0.5	**0.0 – 1.0**
Rank Factor: Relative Extent					
Key Ecological Attribute: *Extent*					
Change in Extent	Indicates the proportion lost due to conversion to other land cover or land use, decreasing provision of ecological services provided previously.	Site is at or minimally is only modestly changed from its original natural extent (<20% change) Change in Extent Index is > 0.8.	Occurrence is substantially changed from its original natural extent (20-50% change). Change in Extent Index is 0.8-0.5	Occurrence is severely changed from its original natural extent (>50% change). Change in Extent Index is < 0.5.	**0.0 – 1.0**
Overall Ecological Integrity Rank					
				Mean Index Score 0.0 – 1.0	**0.0 – 1.0**

BLM
Rapid Ecoregional Assessment

Break

Climate Space Trends analysis (how is climate changing?)

Climate Change Impacts Assessment

Where will changes in climate be greatest relative to normal climate variability?

Where will CEs experience climate outside their current climate envelope?

Where will current locations of CEs experience significant and abrupt deviations from normal climate variation?

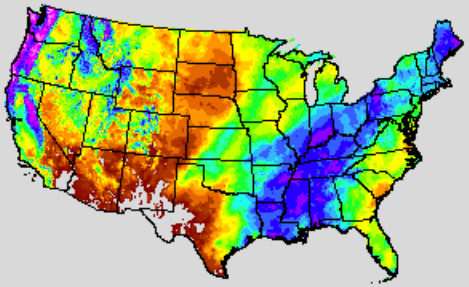
Which native plant communities will experience climate outside their normal range?

Where will wildlife habitat experience climate outside its normal range?

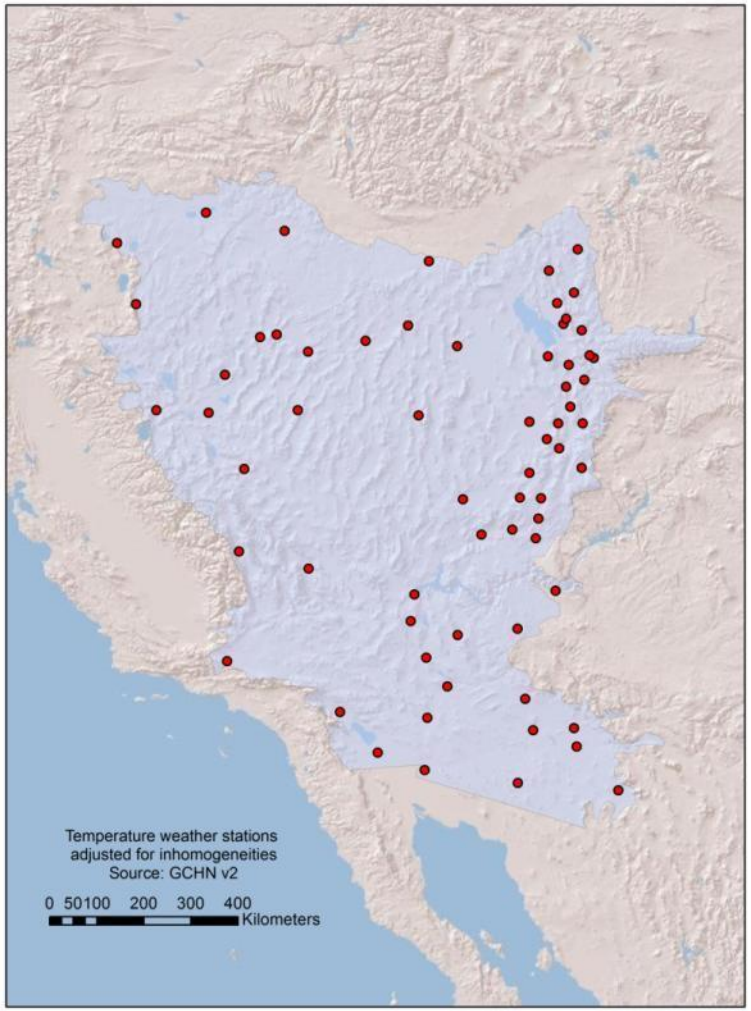
What is the spatial distribution of projected range shifts for CEs?

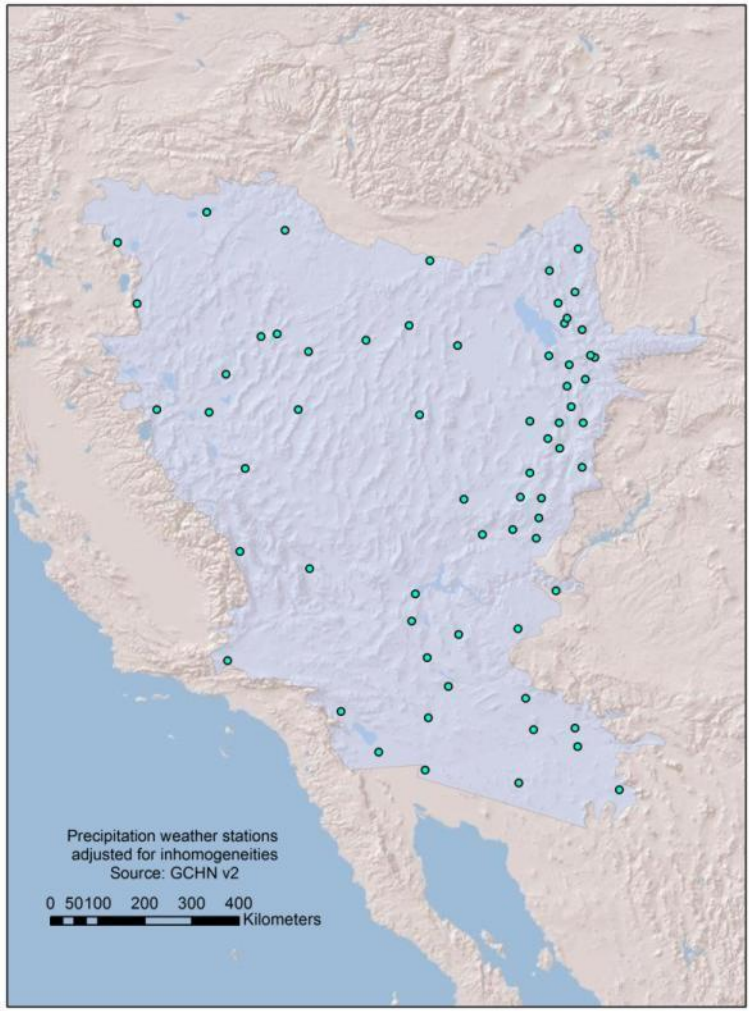
Spatial Climate Datasets - Observations

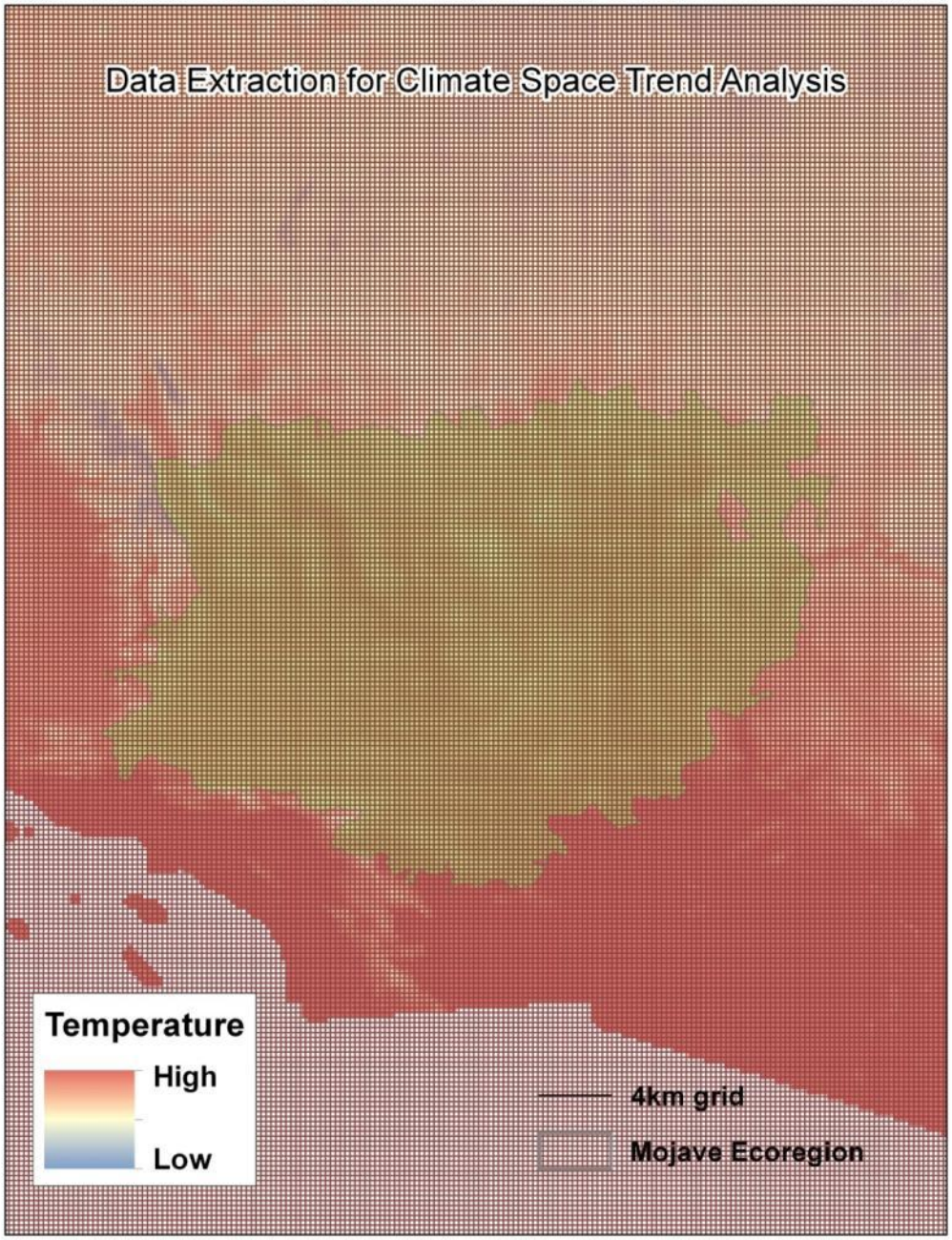
- Current climate
- Method: Parameter-elevation Regressions on Independent Slopes Model (Daly et al 2002)
- Yearly: 1895-Present
- Variables: Precipitation, Max Temp, Min Temp, Dewpoint, PPT % anomaly
- Spatial resolution: **4 km²**, 2km² & 800 m



Spatial Climate Data (Observations)





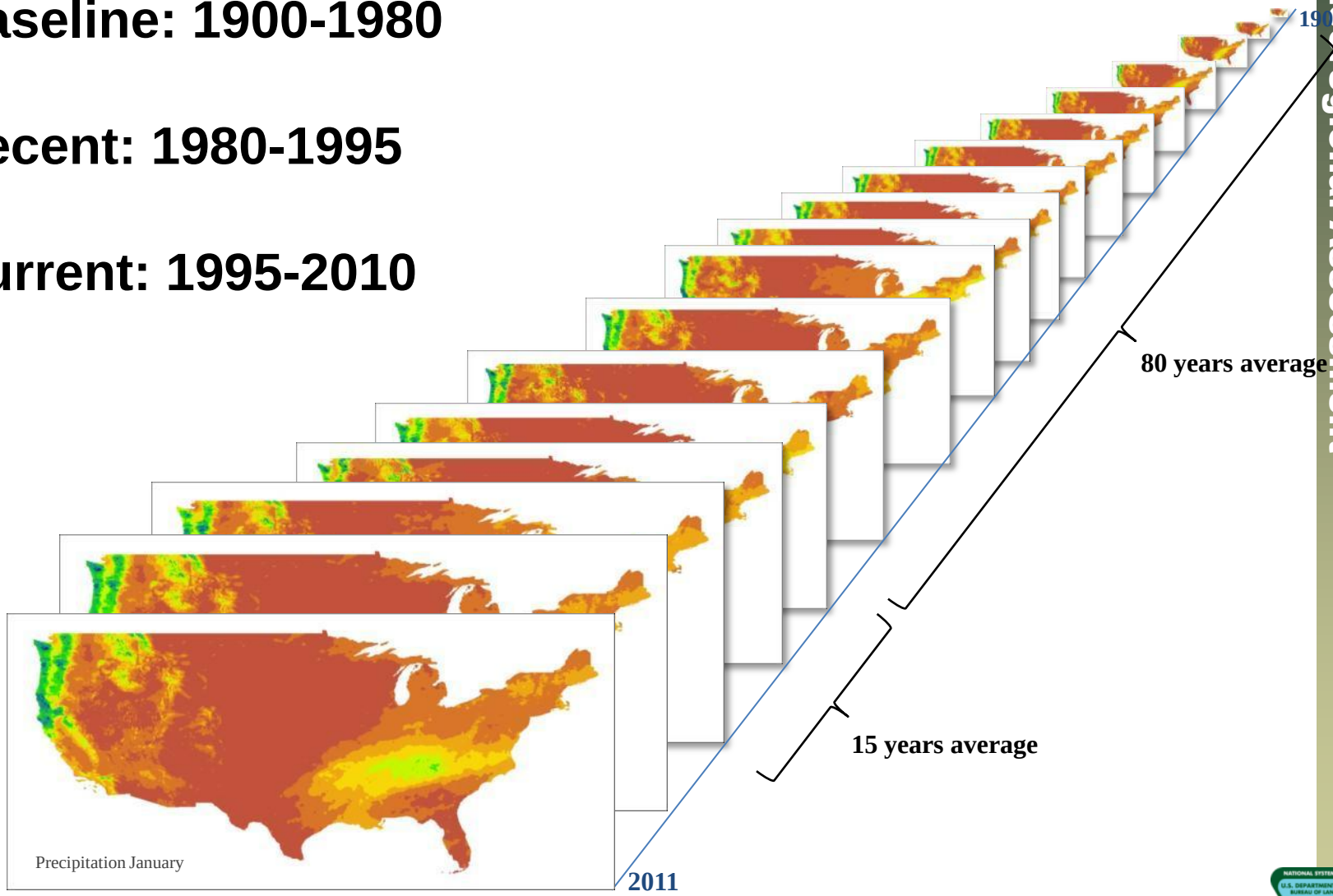

Data Extraction for Climate Space Trend Analysis
Temperature
High
Low
4km grid
Mojave Ecoregion

Observed climate space trends

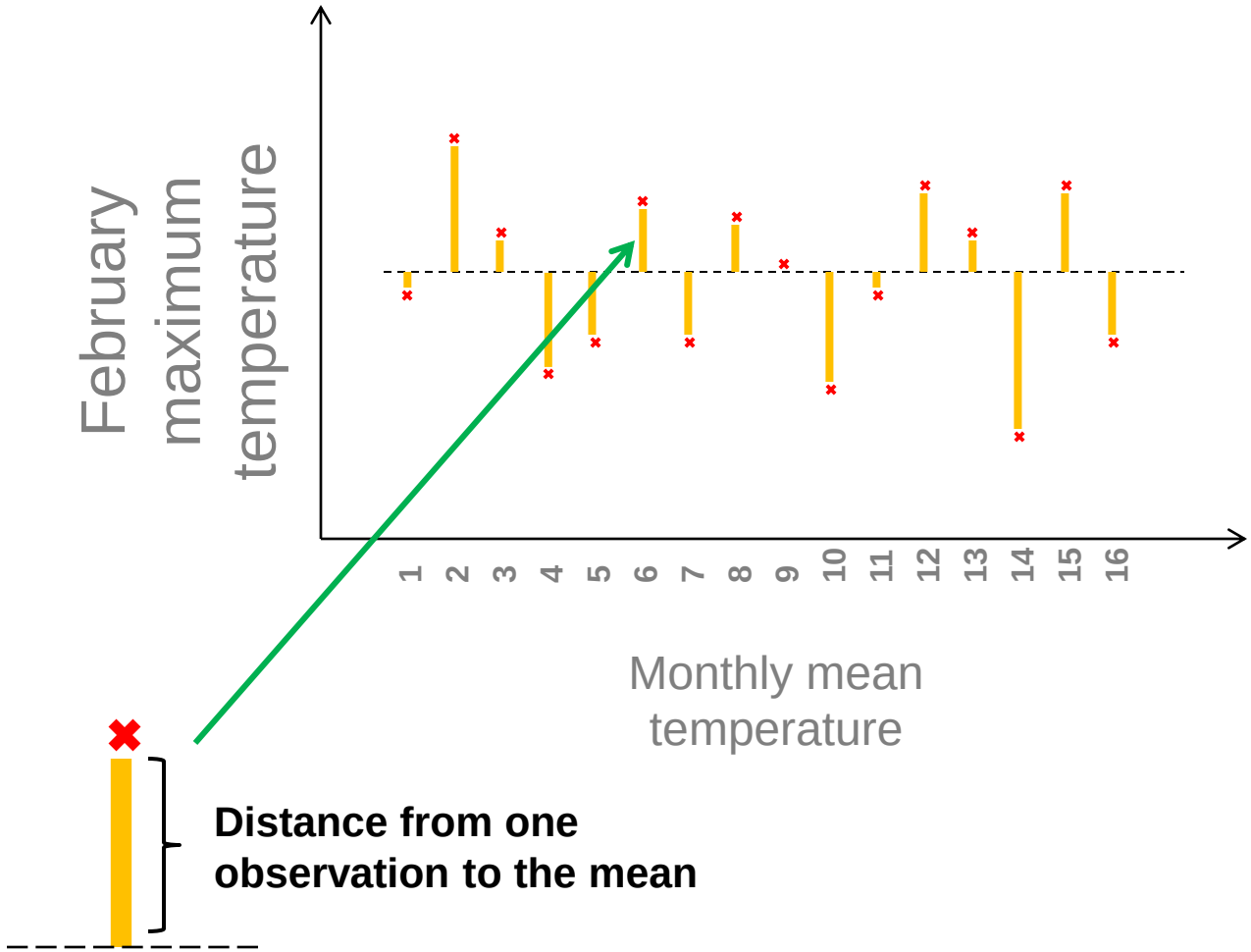
Baseline: 1900-1980

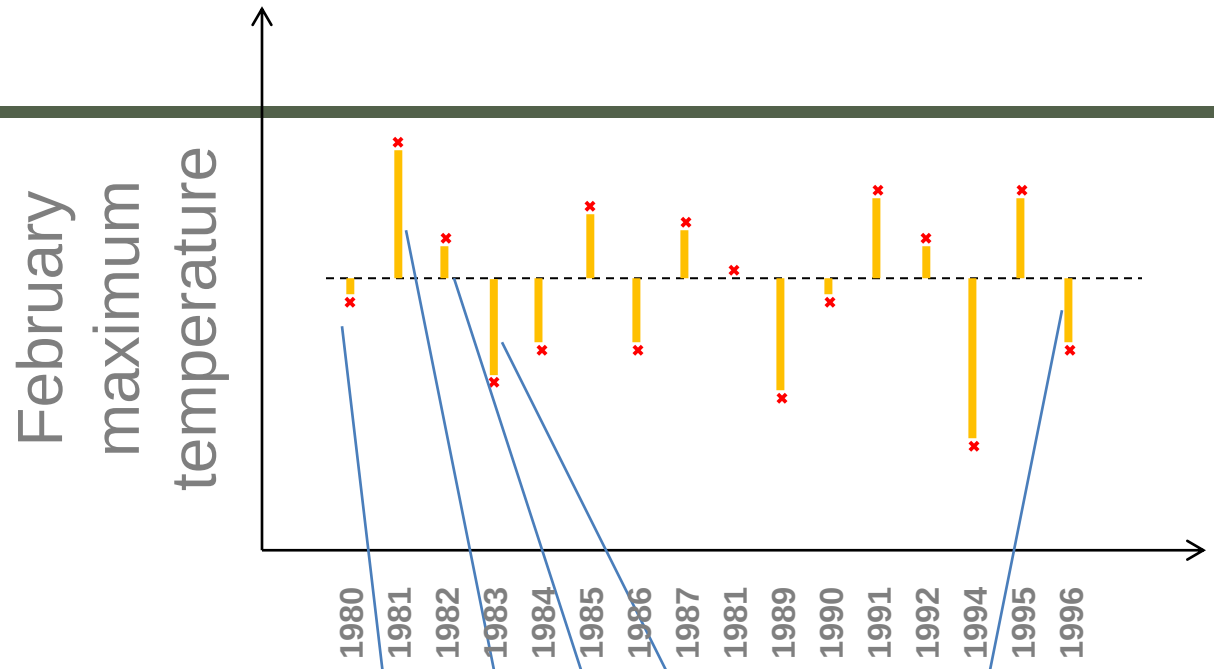
Recent: 1980-1995

Current: 1995-2010



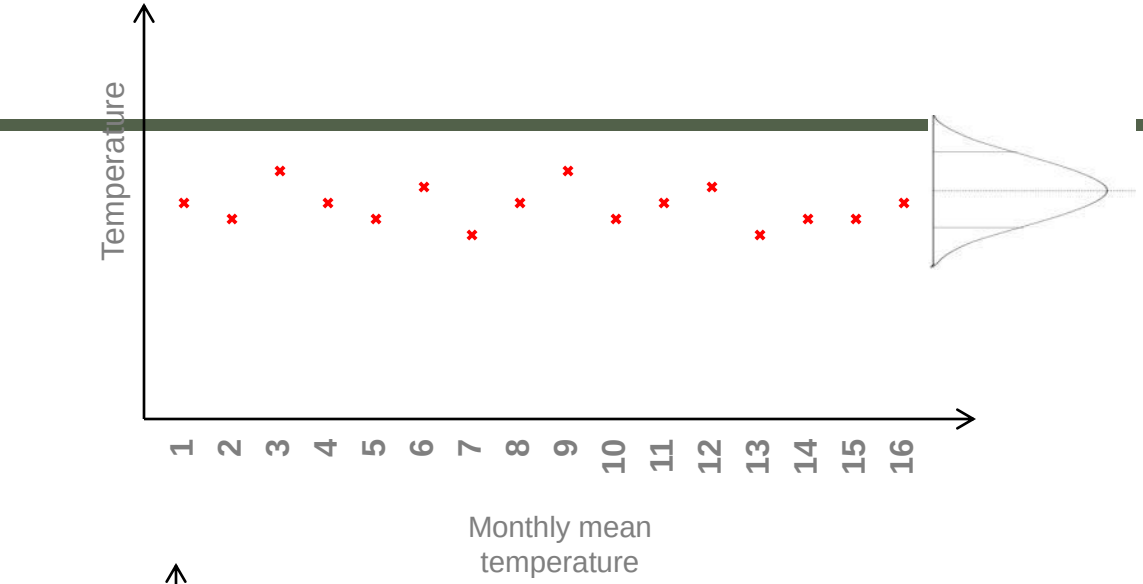
February maximum temperature
Mean
1980
1981
1982
1983
1984
1985
1986
1987
1981
1989
1990
1991
1992
1994
1995
1996

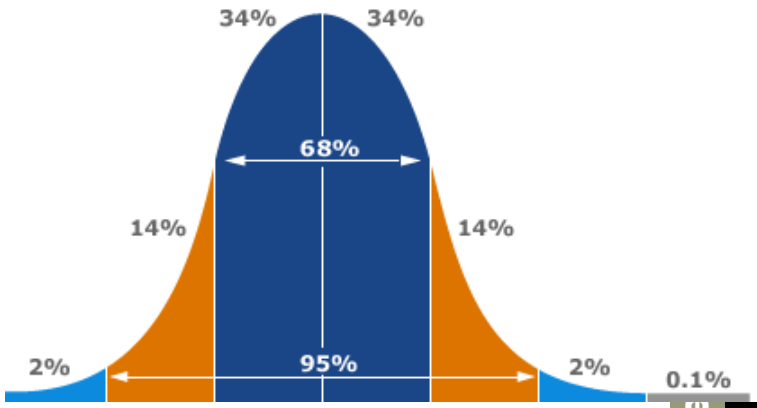

February maximum temperature
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Monthly mean temperature
Distance from one observation to the mean

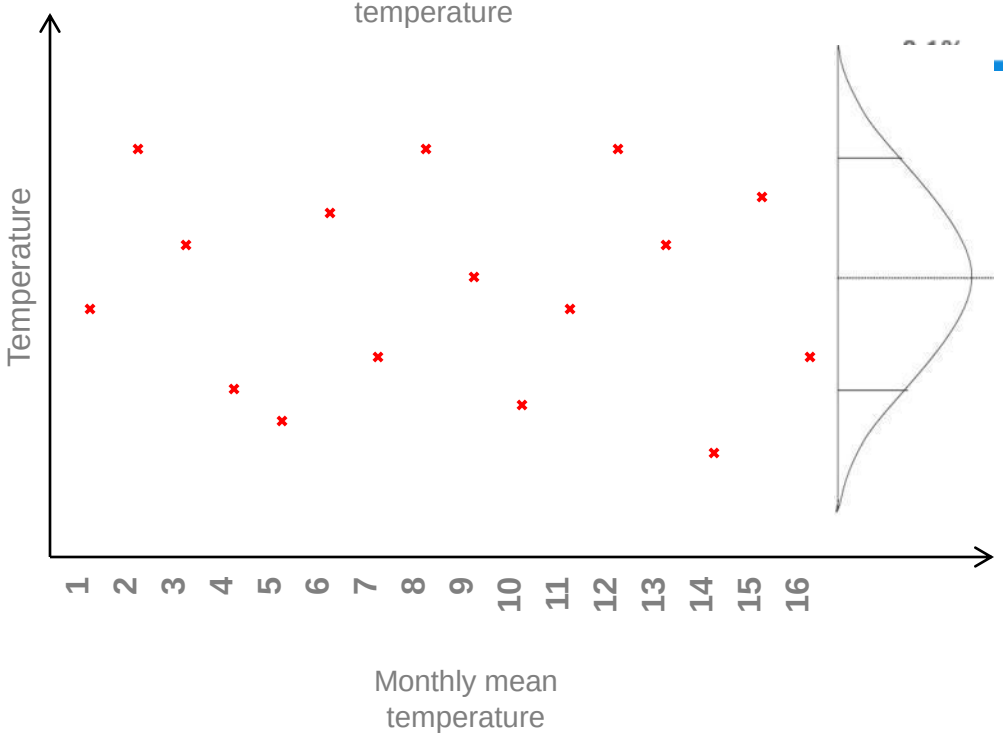


The average of the squared differences from the mean $= (X_1)^2 + (X_2)^2 + (X_2)^2 + (X_3)^2 + \ldots (X_{16})^2 =$ **Variance**

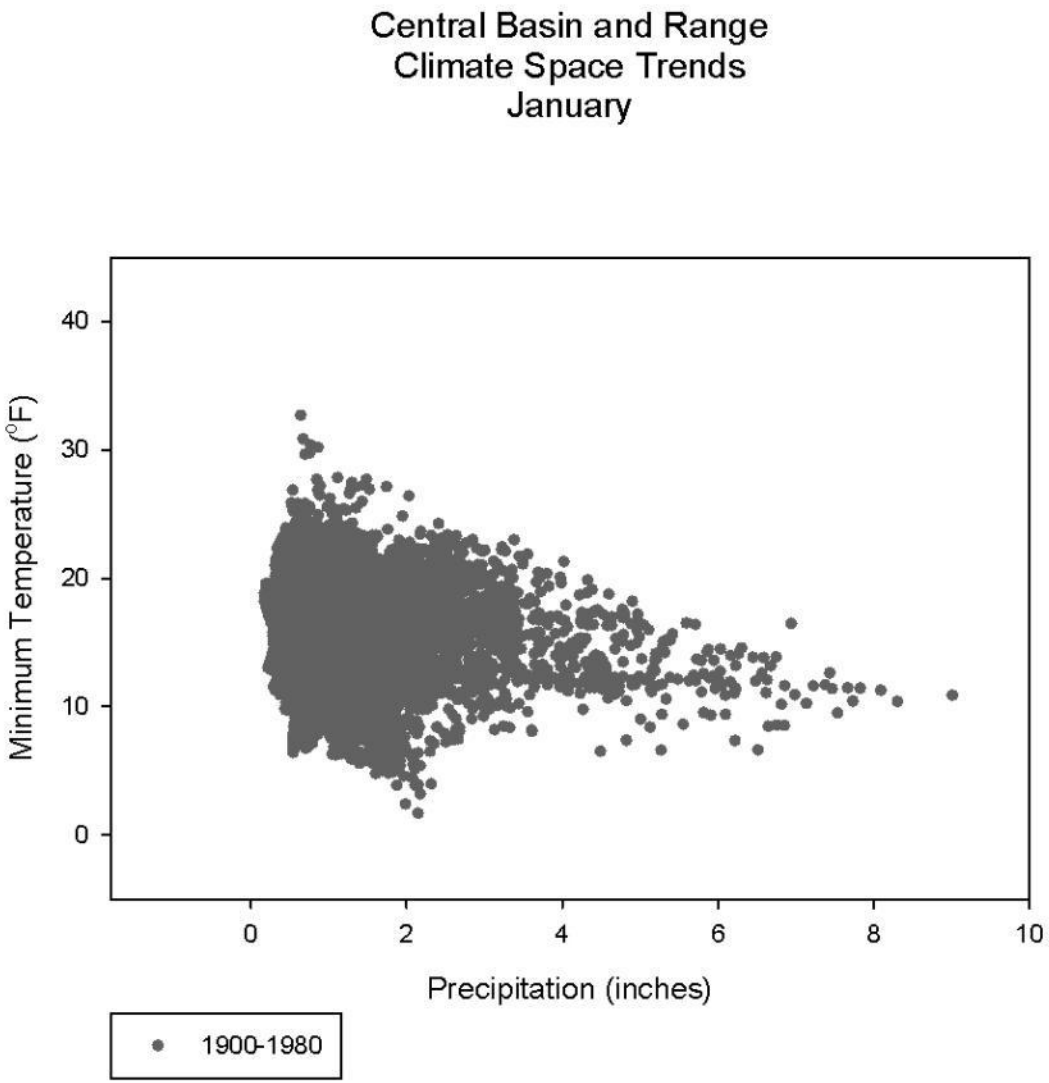
Standard deviation = Square root of the Variance

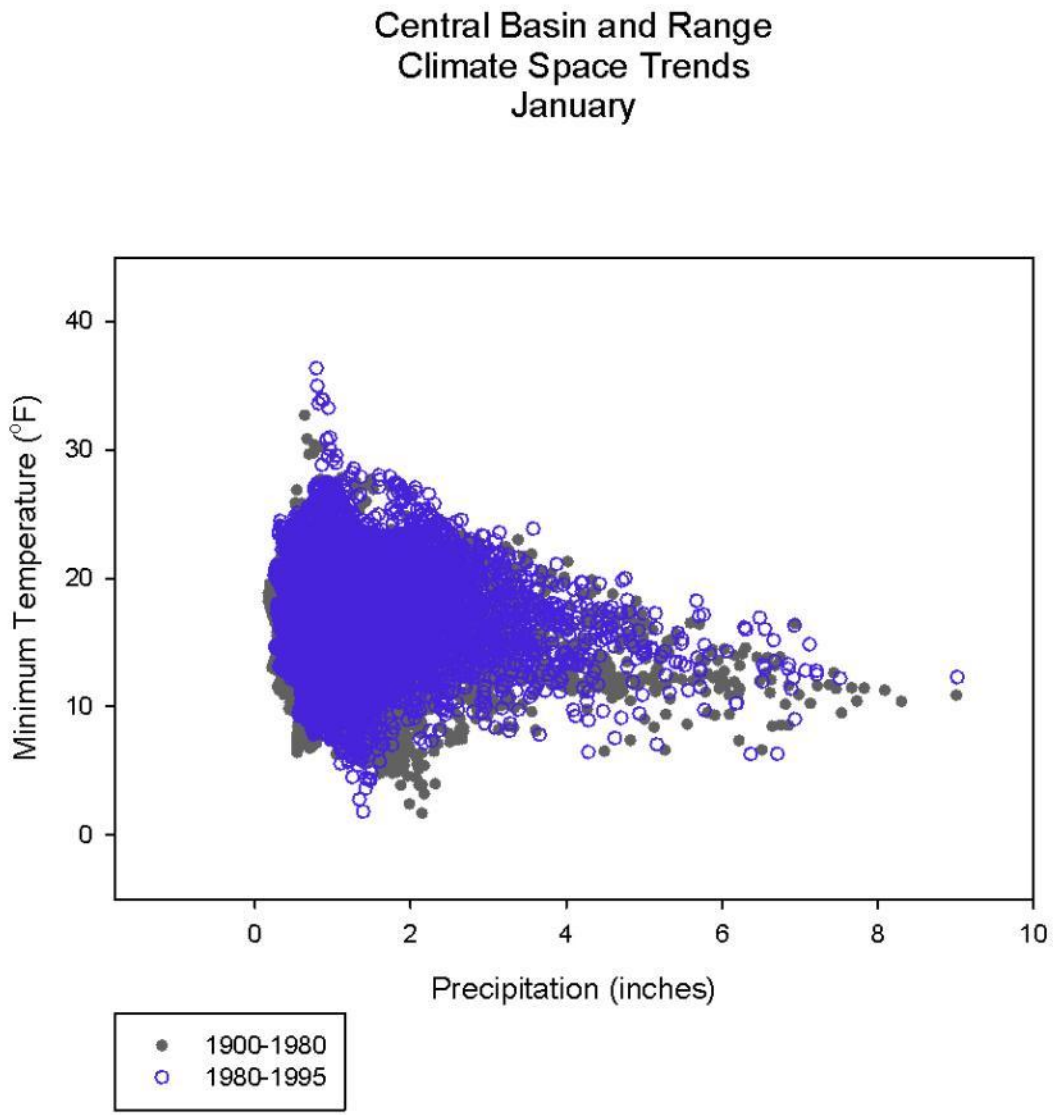






68 % of the observations fall within +/– 1 SD and 95% of observations fall within +/- 2 SD


Central Basin and Range
Climate Space Trends
January
Minimum Temperature (°F)
40
30
20
10
0
0
2
4
6
8
10
Precipitation (inches)
1900-1980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Climate Space Trends
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Minimum Temperature (°F)
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2
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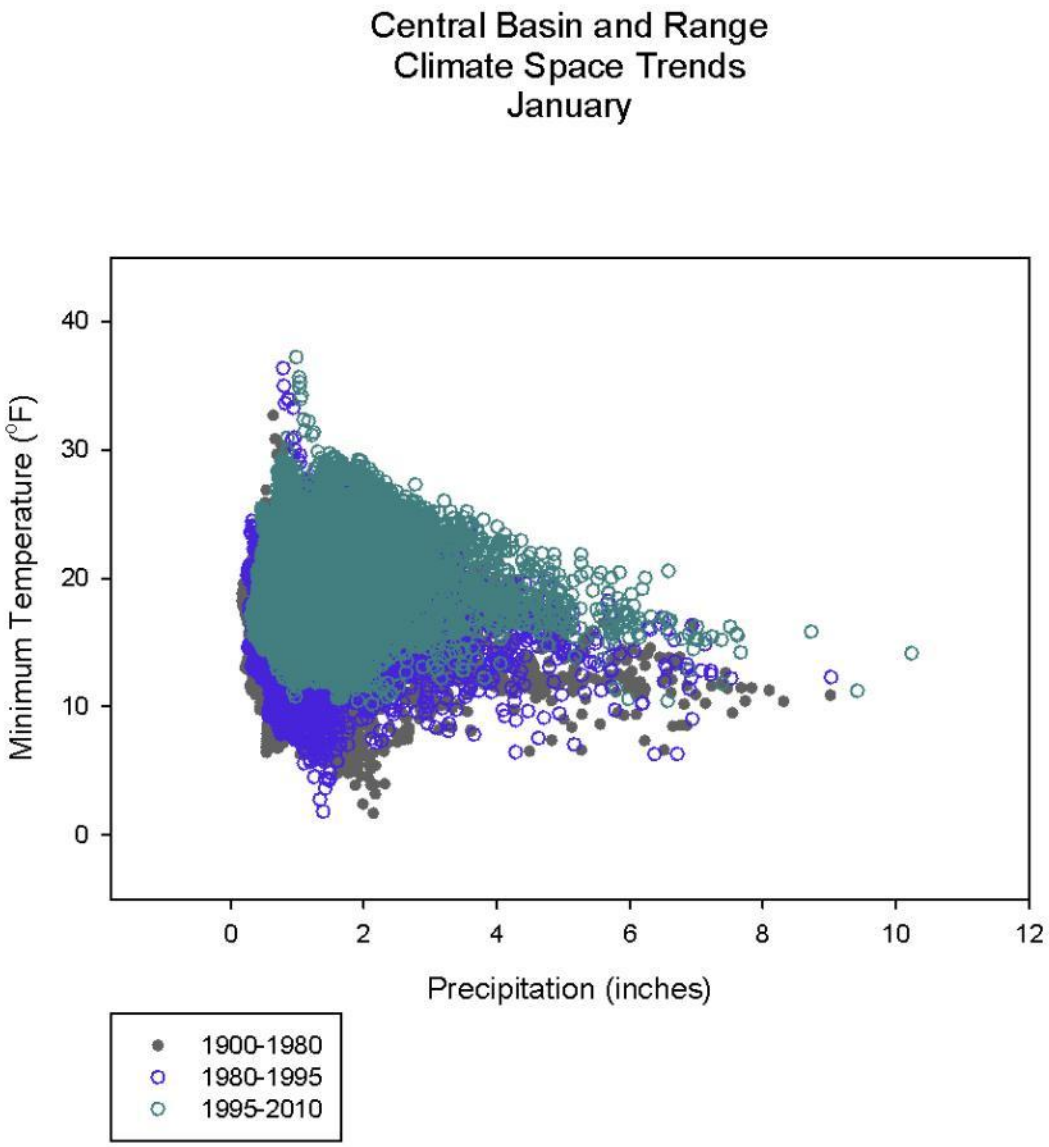
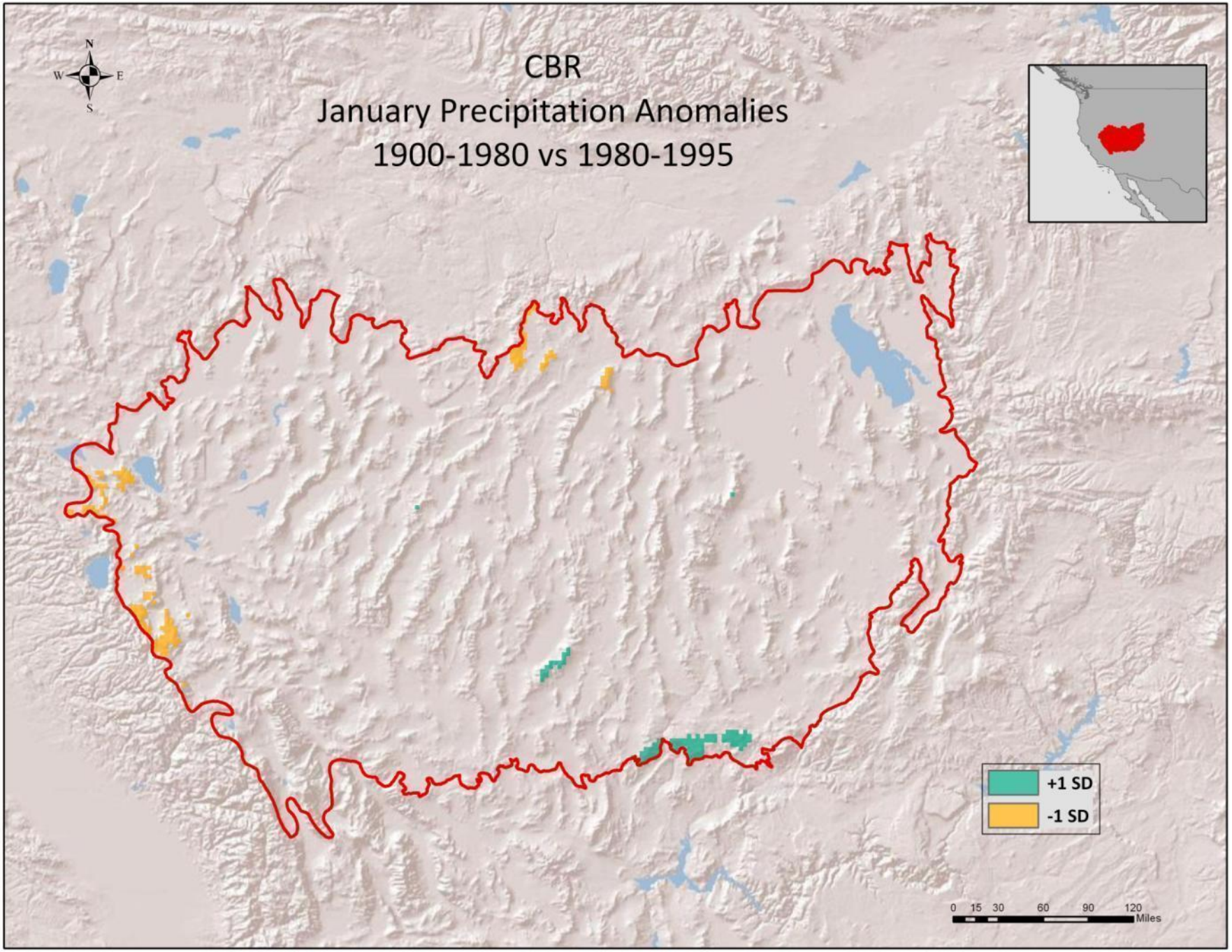
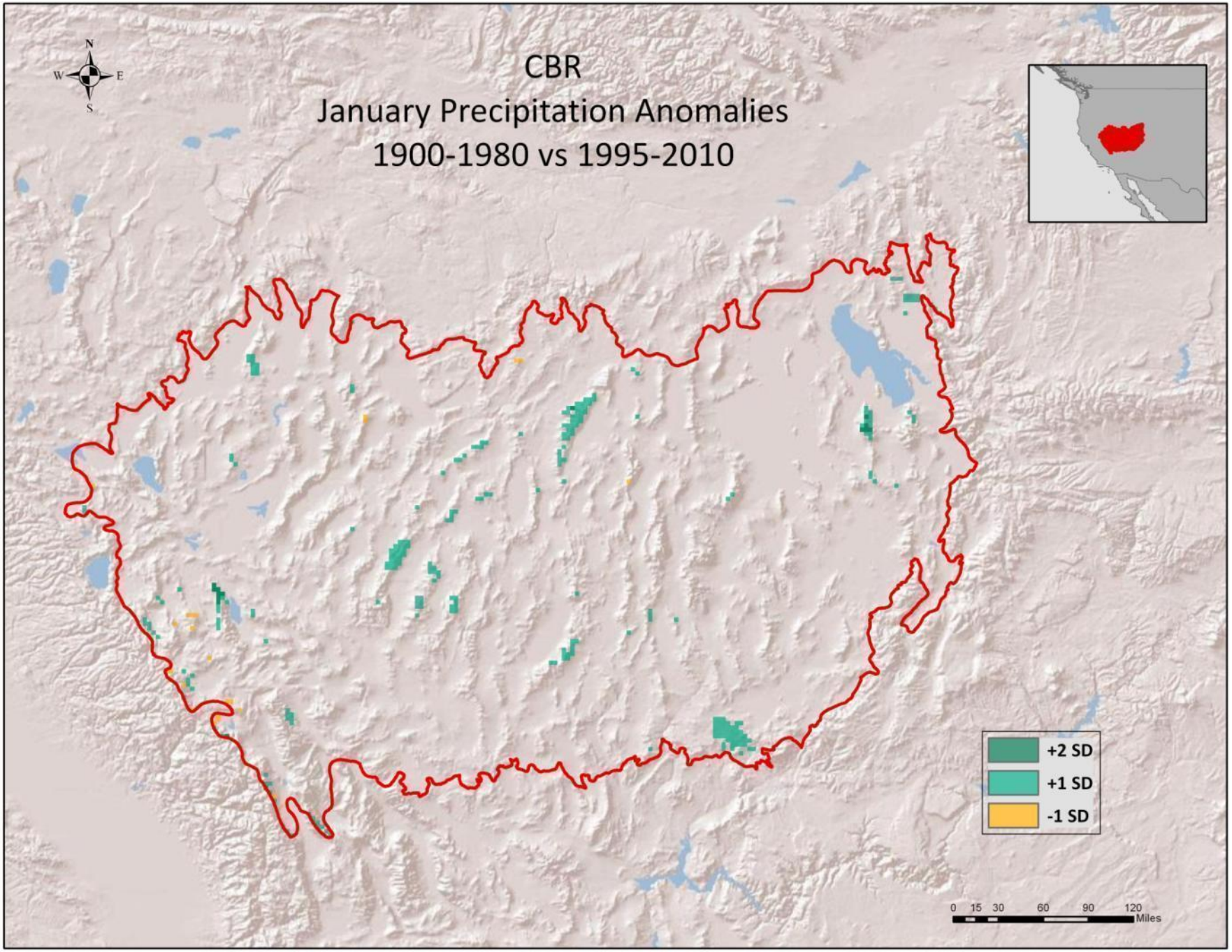
8
10
Precipitation (inches)
1900-1980
1980-1995

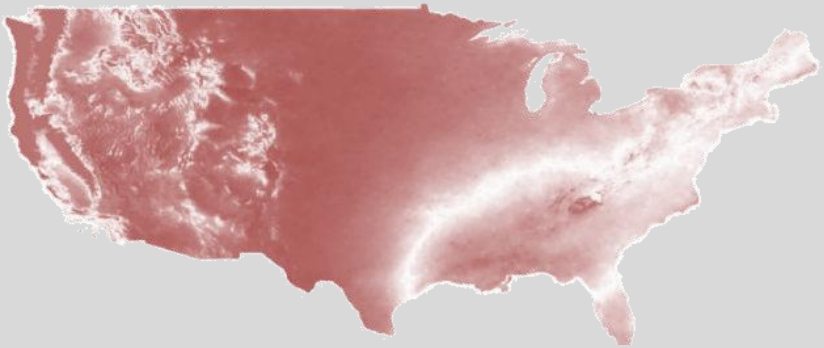

Central Basin and Range
Climate Space Trends
January
Minimum Temperature (°F)
40
30
20
10
0
0
2
4
6
8
10
12
Precipitation (inches)
1900-1980
1980-1995
1995-2010


CBR
January Precipitation Anomalies
1900-1980 vs 1980-1995
N
W
E
S
+1 SD
-1 SD
0 15 30 60 90 120
Miles


CBR
January Precipitation Anomalies
1900-1980 vs 1995-2010
N
W
E
S
+2 SD
+1 SD
-1 SD
0 15 30 60 90 120
Miles

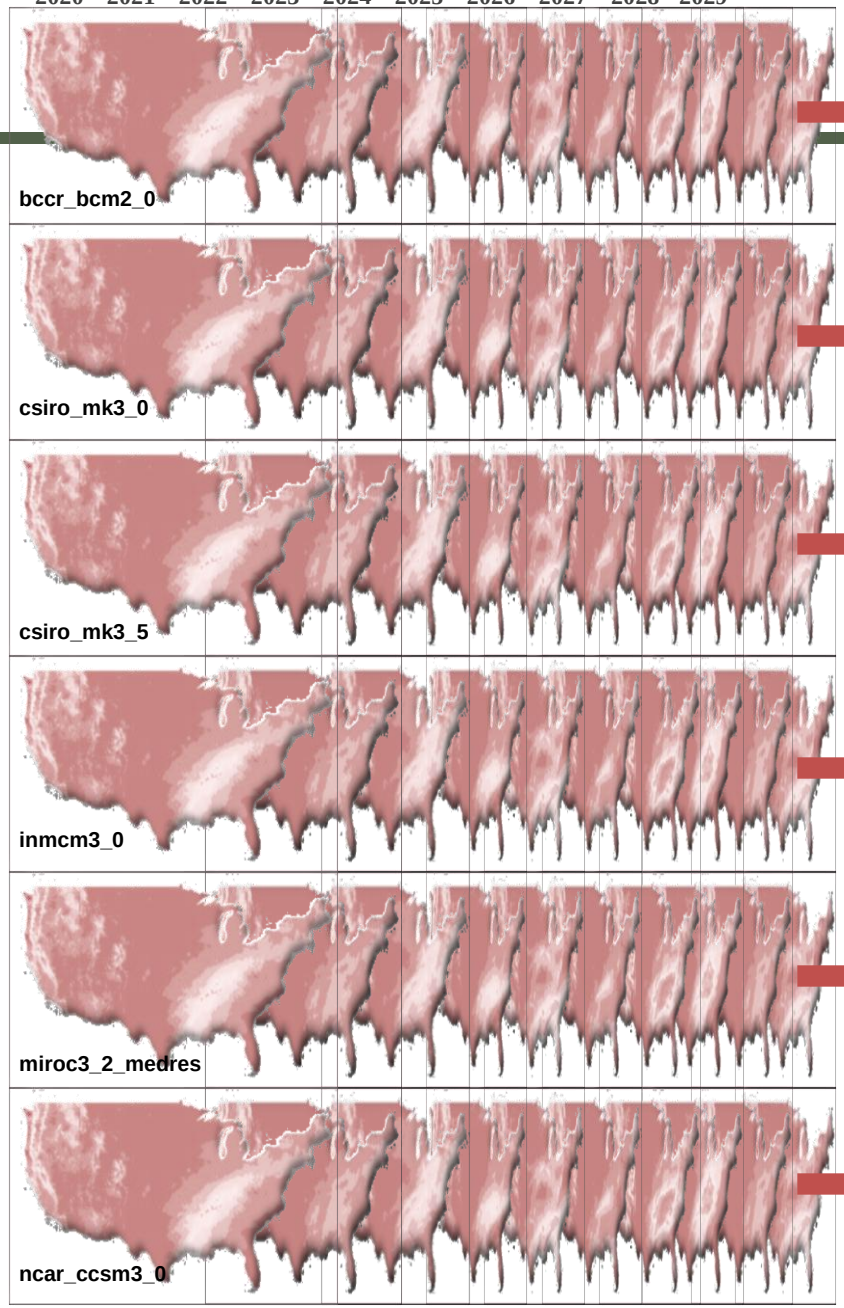
Spatial Climate Datasets - Future

- Future climate
- Method: Interpolated deltas integrated to PRISM
- Decadal averages: 2020-2029, 2050-2059
- Variables: monthly max temp, monthly min temp, and monthly total precipitation
- 6 GCMs, A2 emissions scenario
- Spatial resolution: $4km^2$

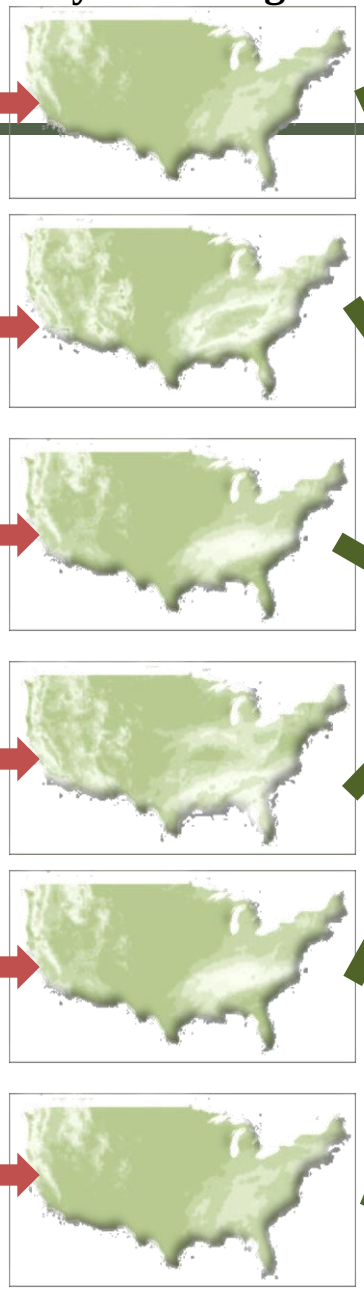


Single years

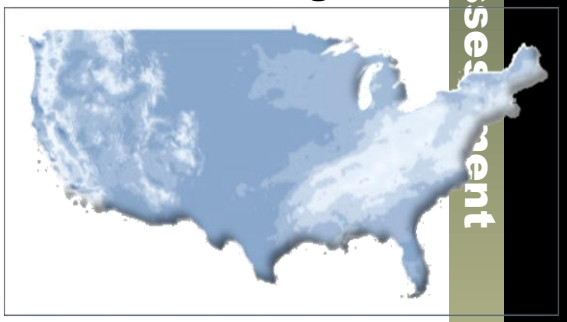
2020 – 2021 – 2022 – 2023 – 2024 – 2025 – 2026 – 2027 – 2028 - 2029



10 year average

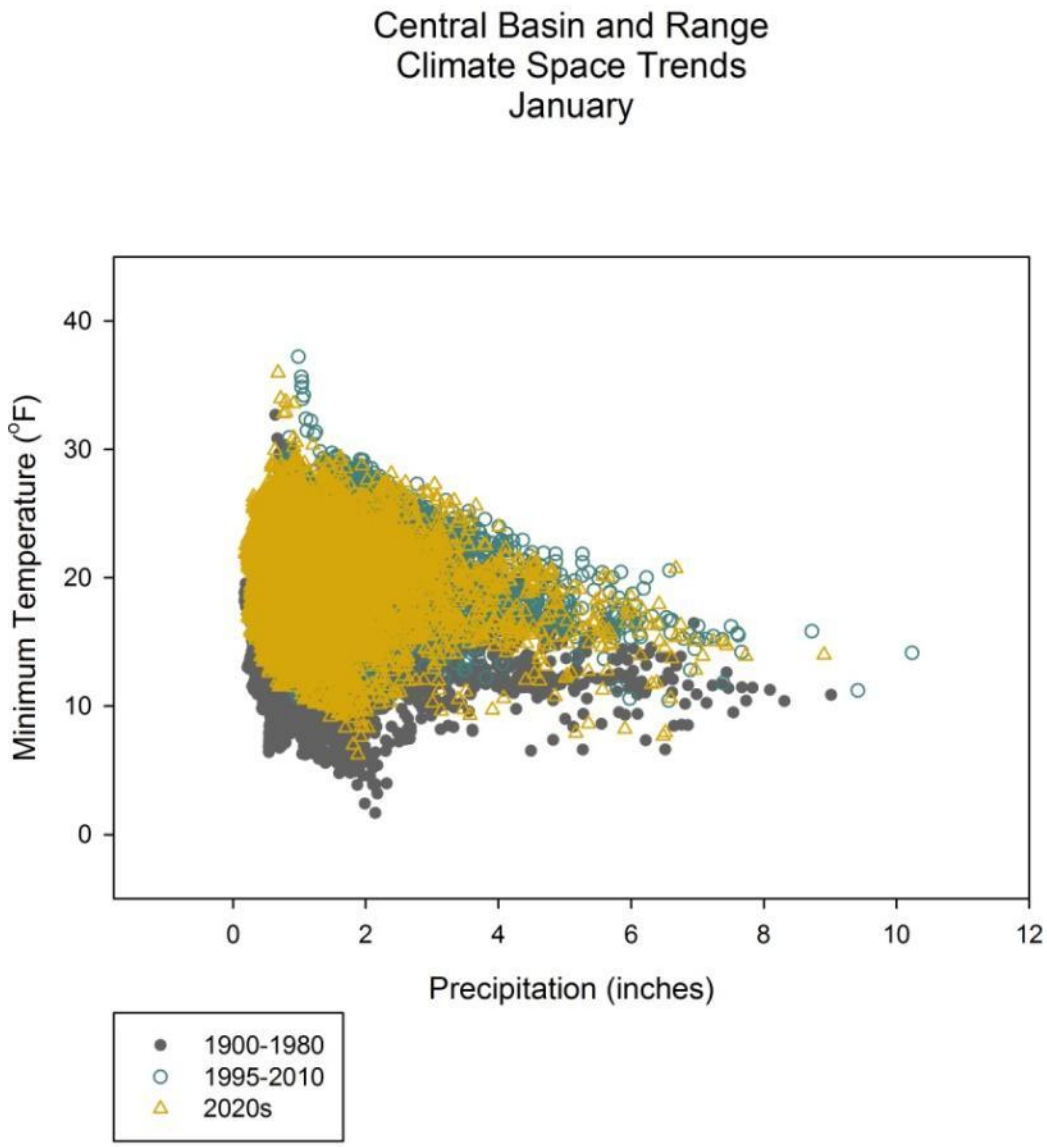


6 GCM average

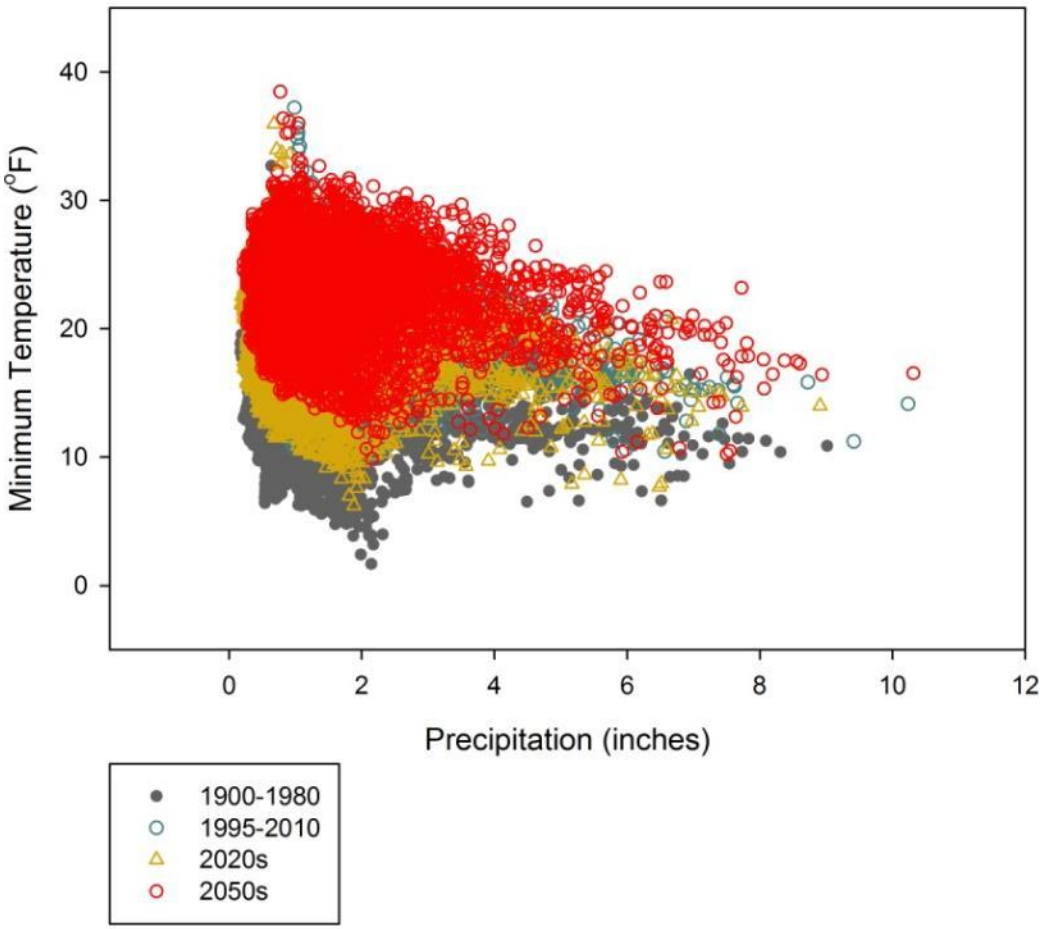


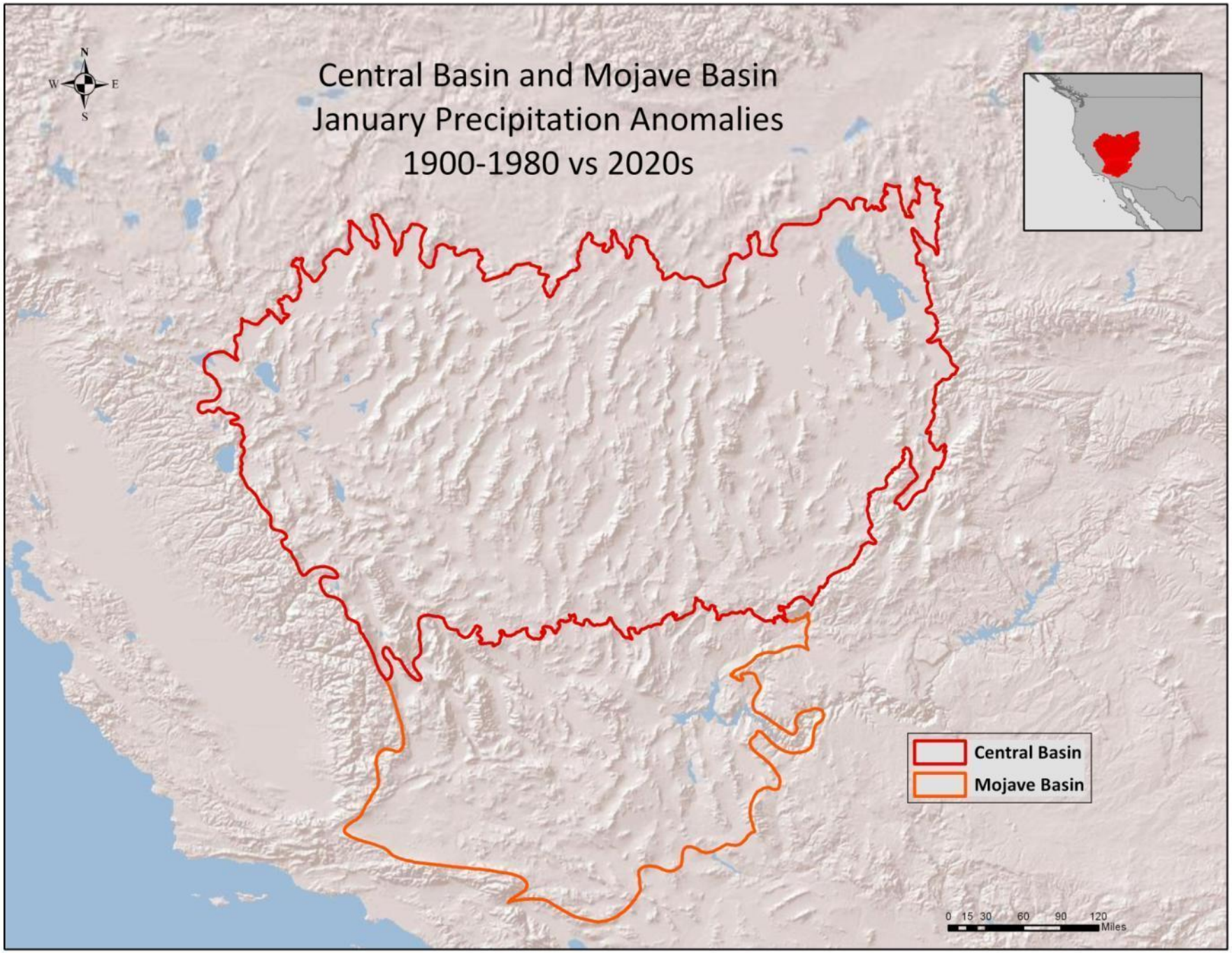
BLM

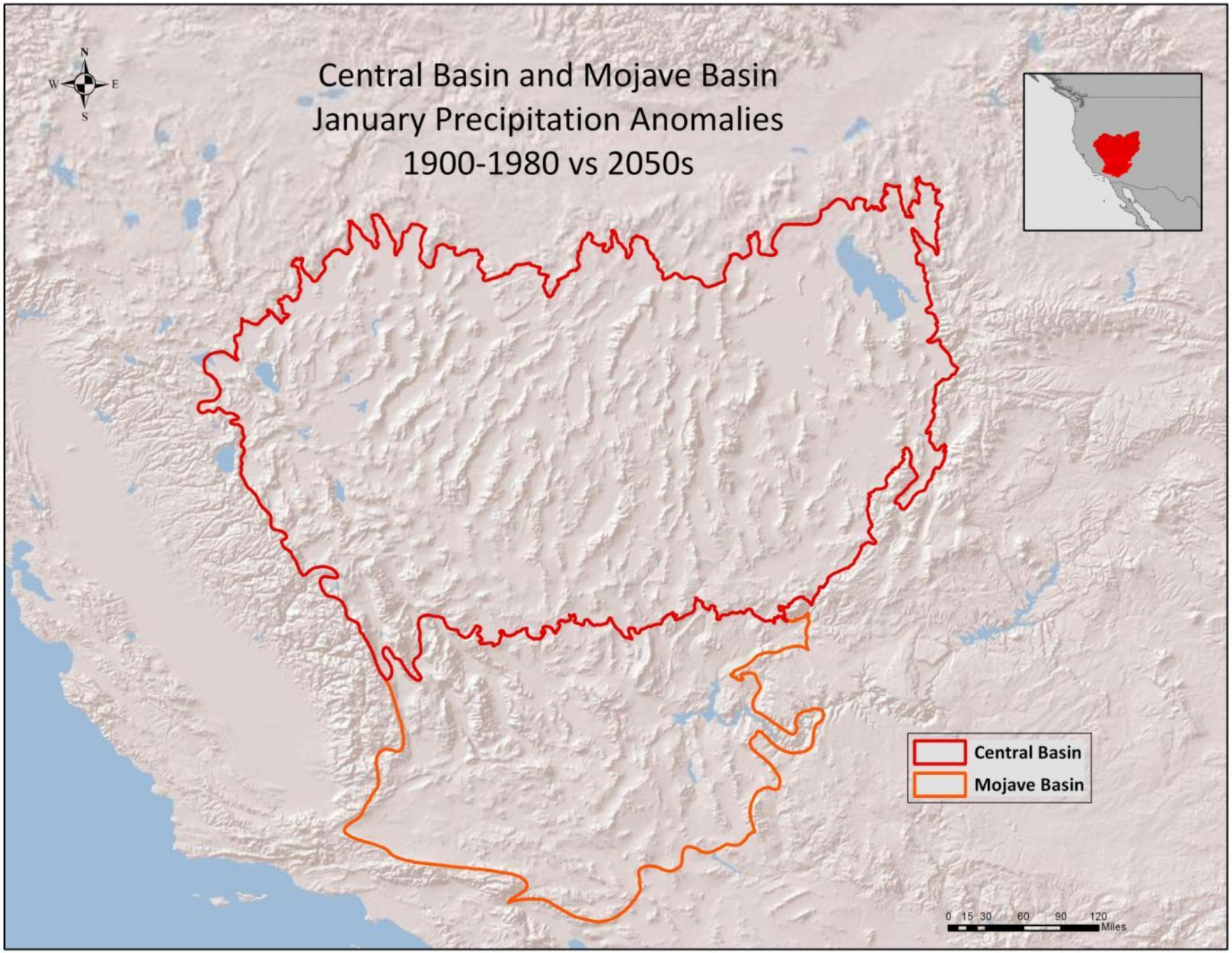
Rapid Ecoregional Assessment


Central Basin and Range
Climate Space Trends
January
Minimum Temperature (°F)
40
30
20
10
0
0
2
4
6
8
10
12
Precipitation (inches)
1900-1980
1995-2010
2020s

Central Basin and Range
Climate Space Trends
January




Central Basin and Mojave Basin
January Precipitation Anomalies
1900-1980 vs 2020s
N
W
E
S
Central Basin
Mojave Basin
0 15 30 60 90 120
Miles


Central Basin and Mojave Basin
January Precipitation Anomalies
1900-1980 vs 2050s
N
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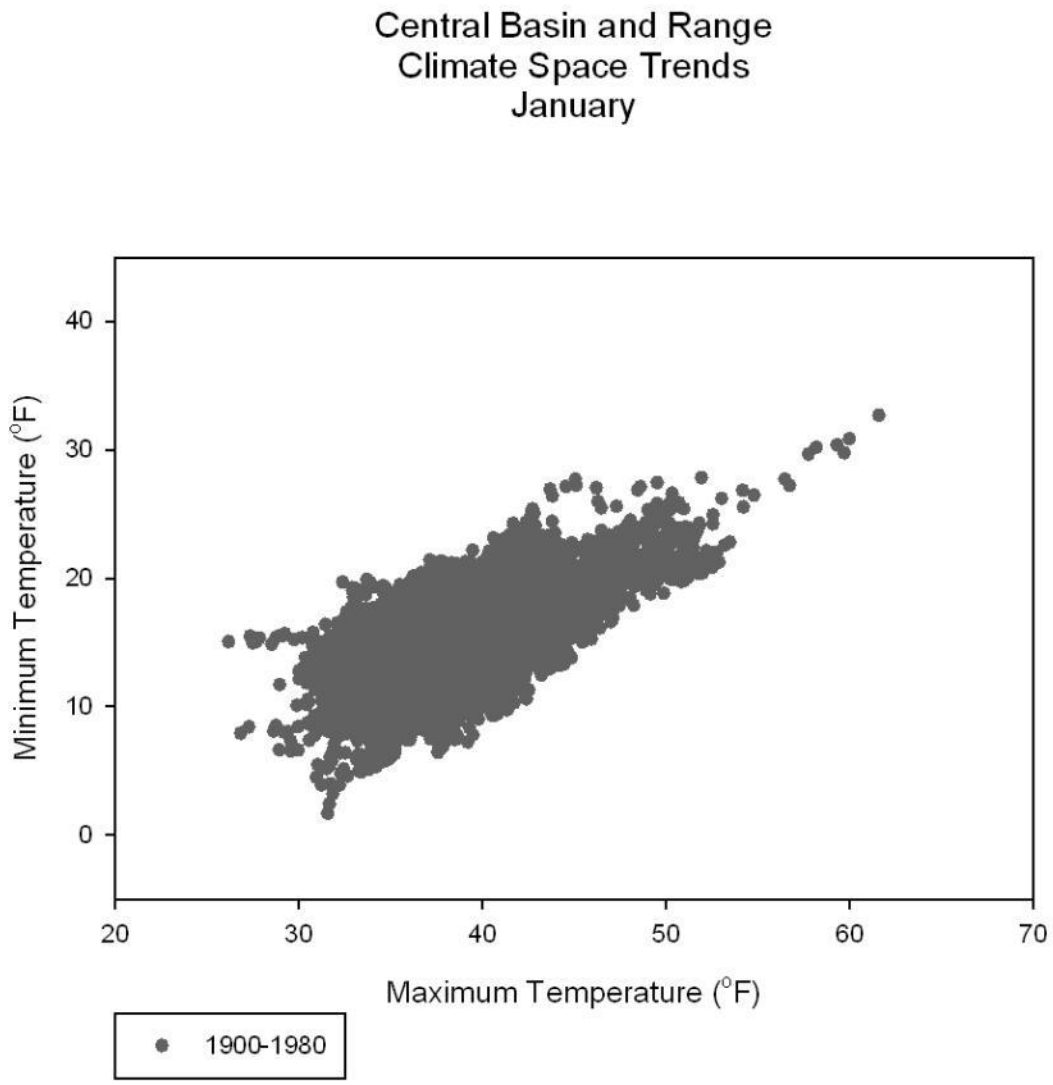
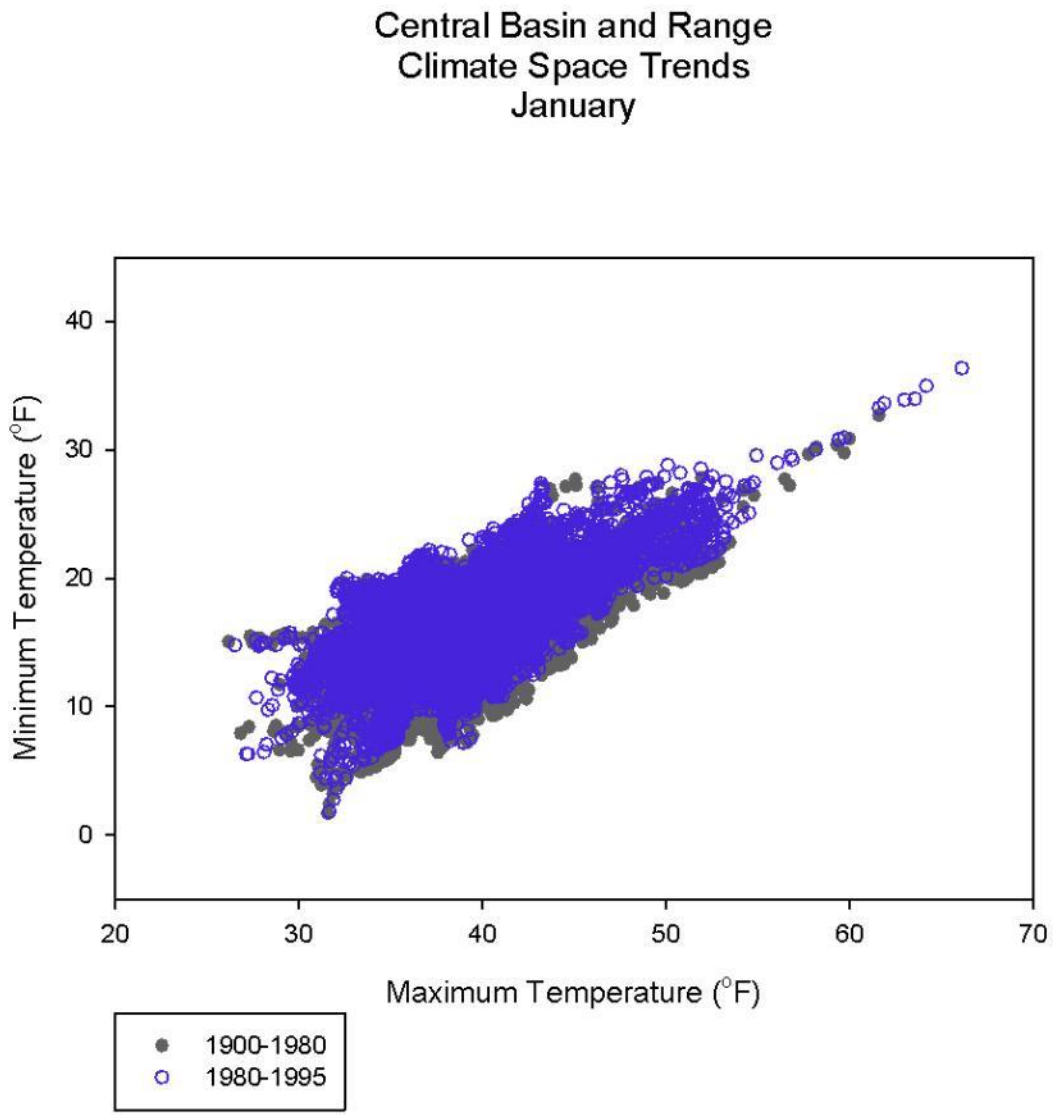
S
Central Basin
Mojave Basin
0 15 30 60 90 120
Miles


Central Basin and Range
Climate Space Trends
January
Minimum Temperature (°F)
40
30
20
10
0
20
30
40
50
60
70
Maximum Temperature (°F)
1900-1980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Climate Space Trends
January
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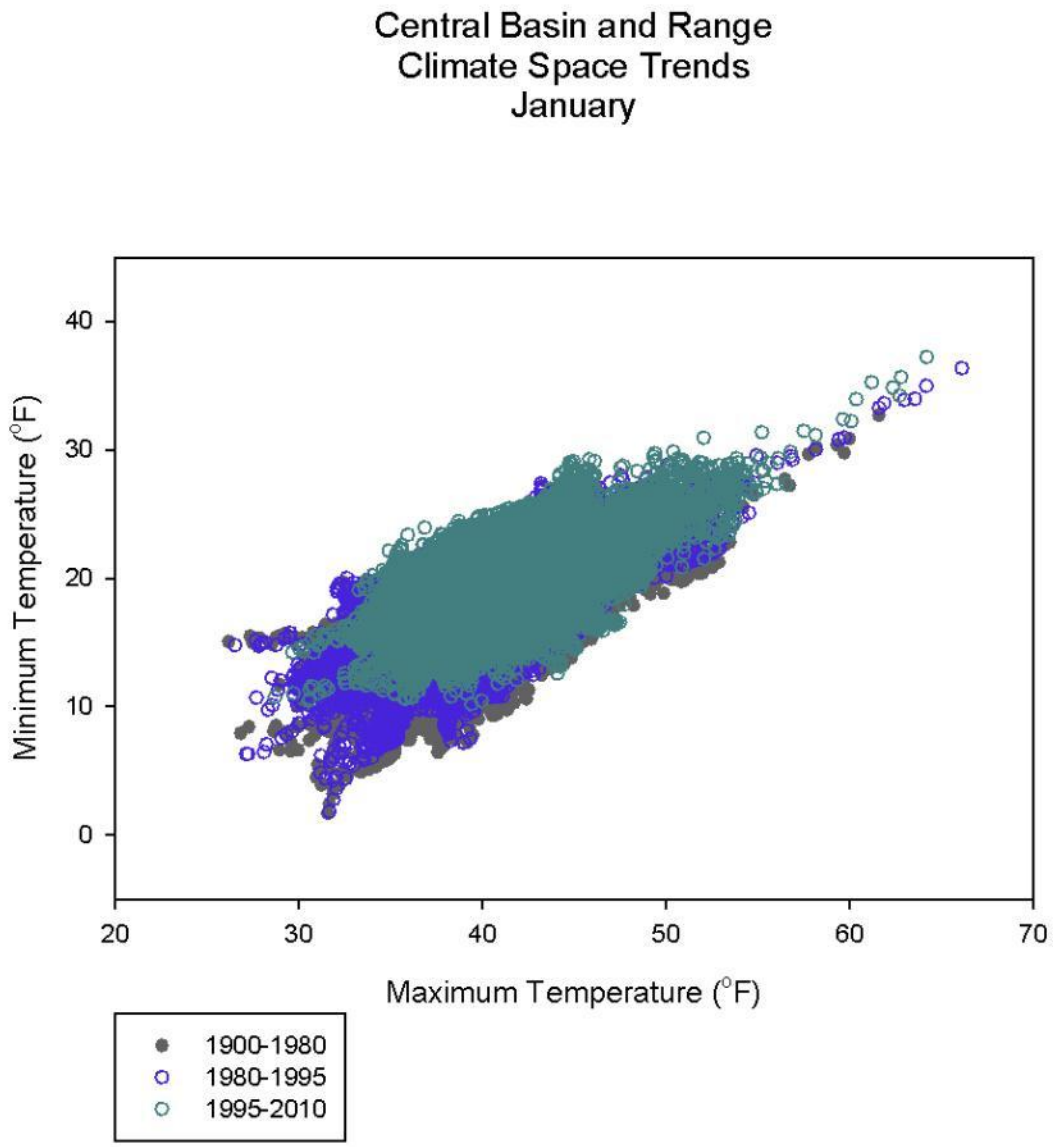
50
60
70
Maximum Temperature (°F)
1900-1980
1980-1995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January
Minimum Temperature (°F)
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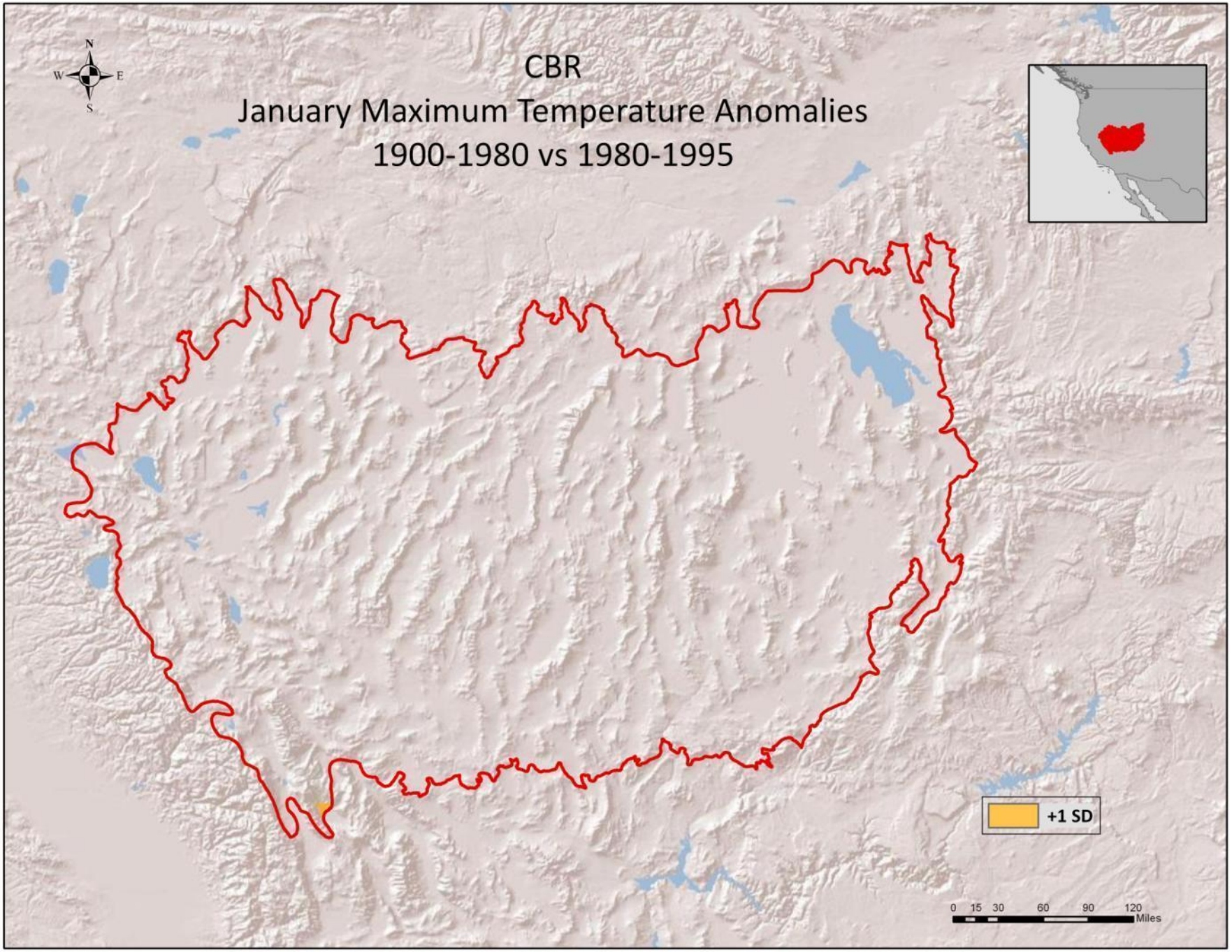
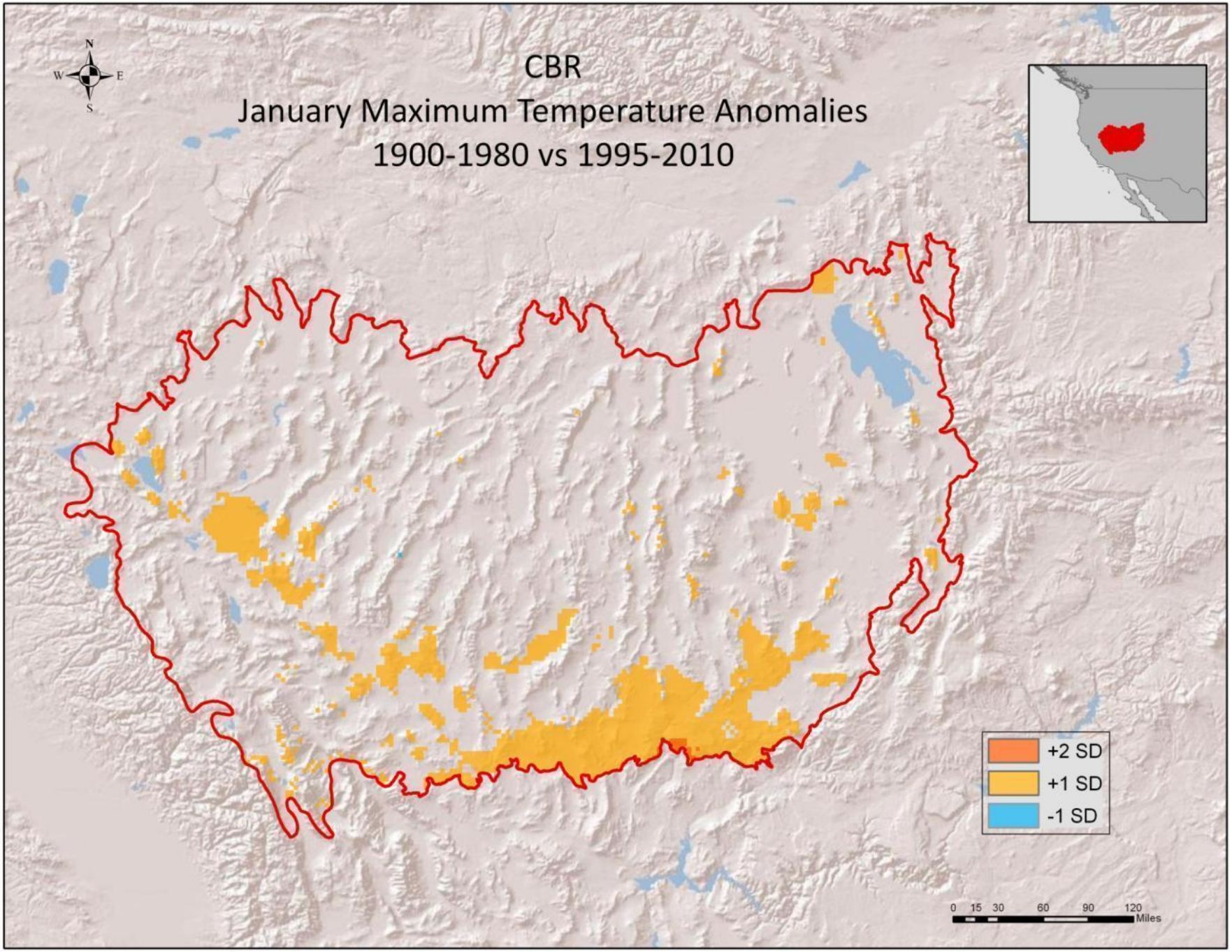
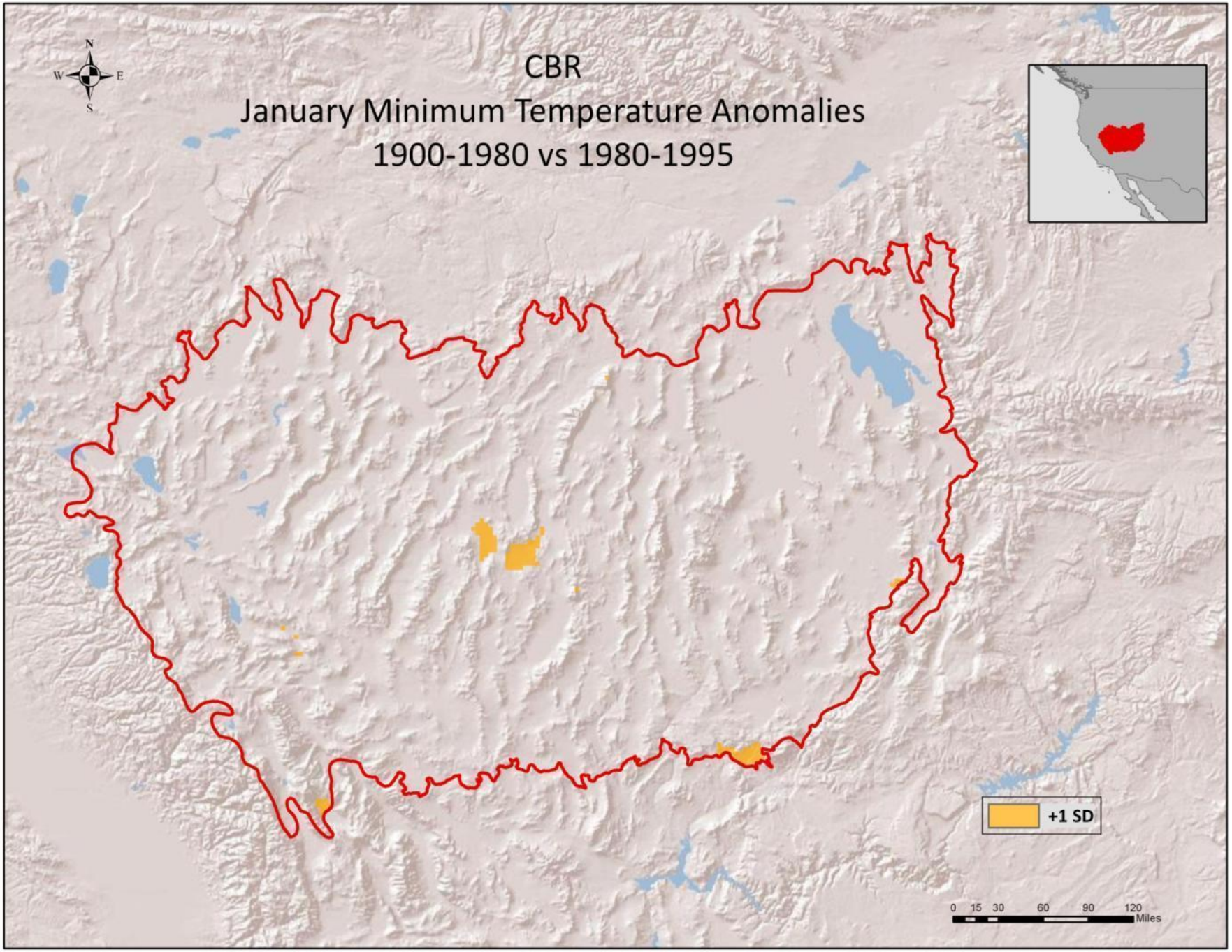
Maximum Temperature (°F)
1900-1980
1980-1995
1995-2010


CBR
January Maximum Temperature Anomalies
1900-1980 vs 1980-1995
N
W
E
S
+1 SD
0 15 30 60 90 120
Miles


CBR
January Maximum Temperature Anomalies
1900-1980 vs 1995-2010
N
W
E
S
+2 SD
+1 SD
-1 SD
0 15 30 60 90 120
Miles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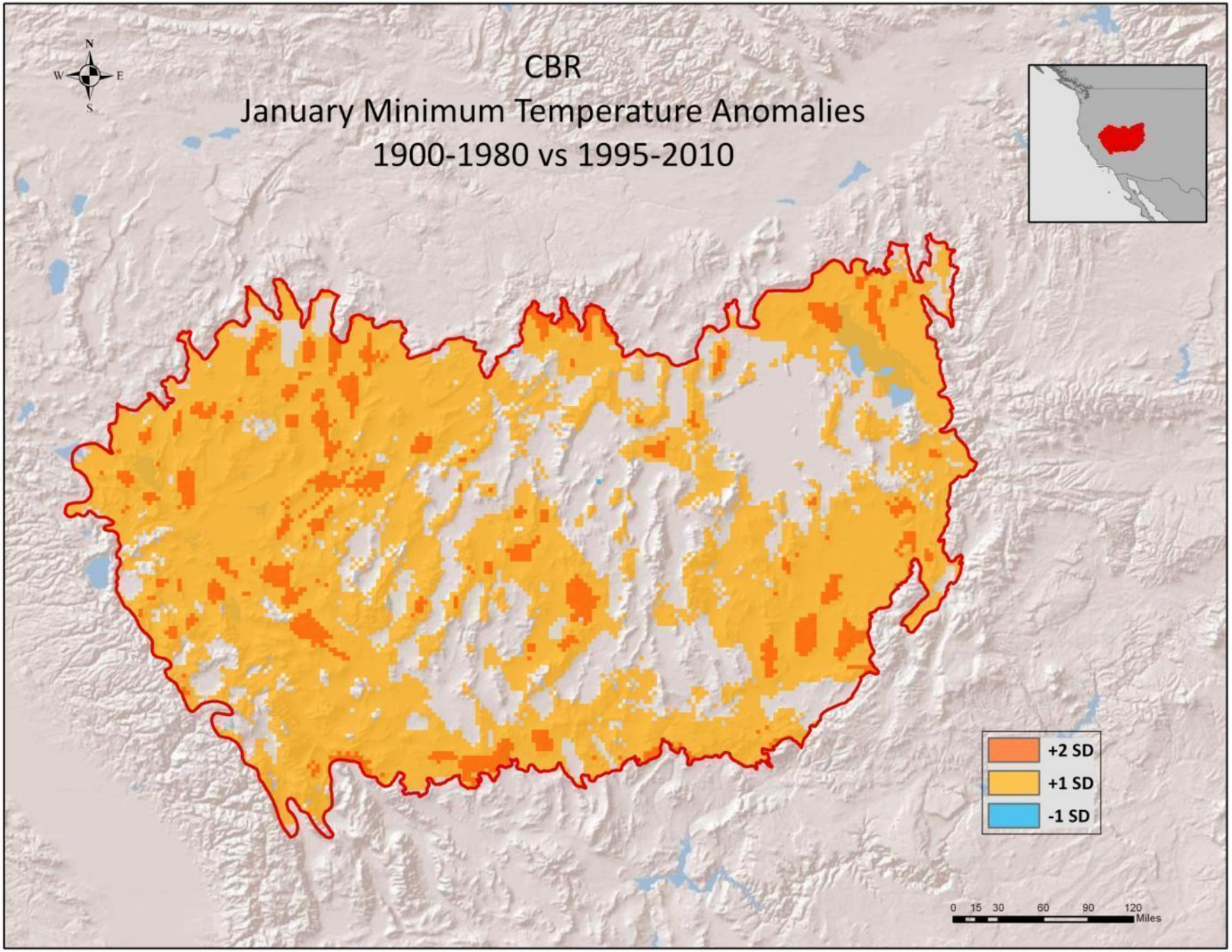
Miles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1900-1980 vs 1995-2010
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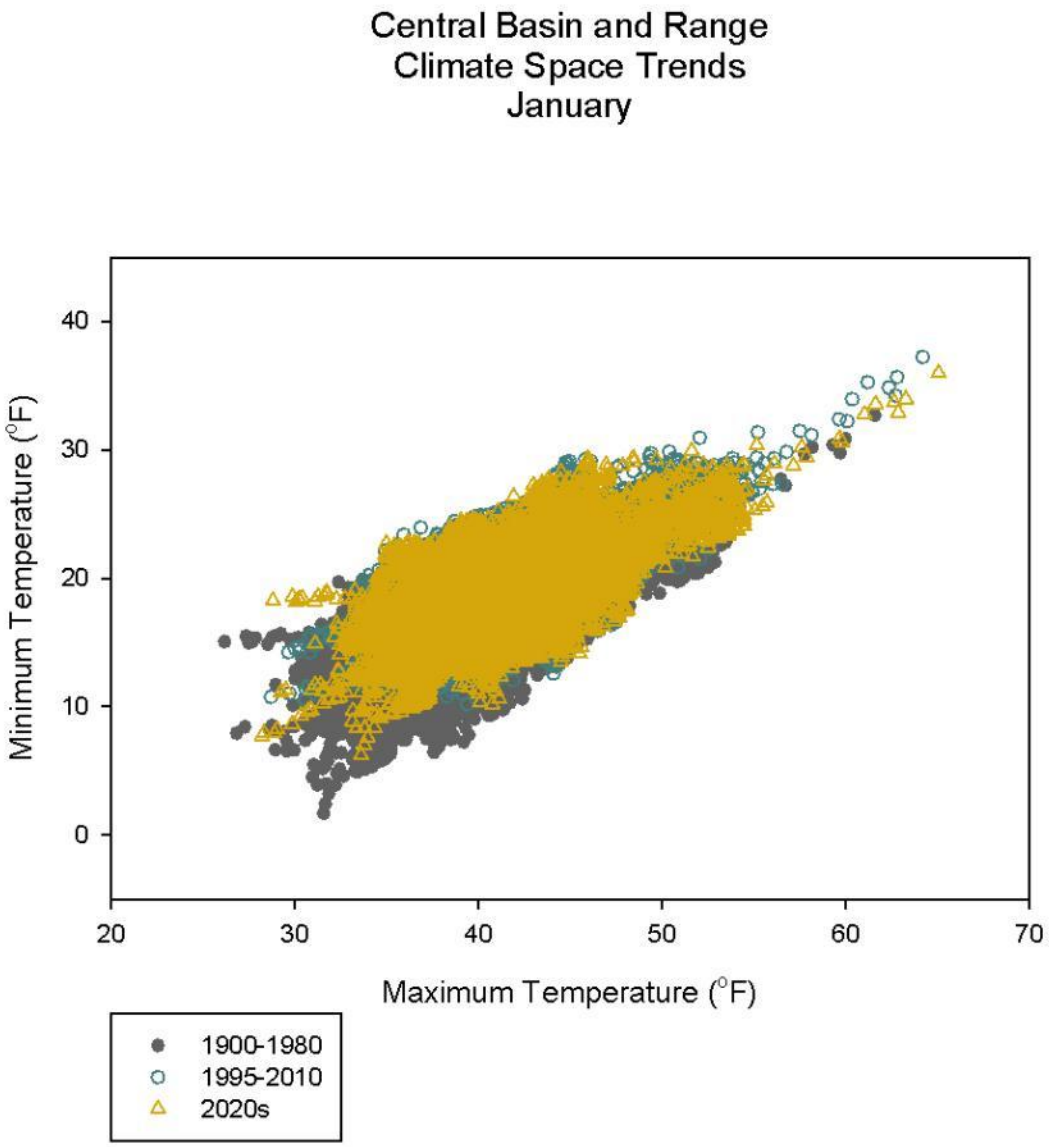
S
+2 SD
+1 SD
-1 SD
0 15 30 60 90 120
Miles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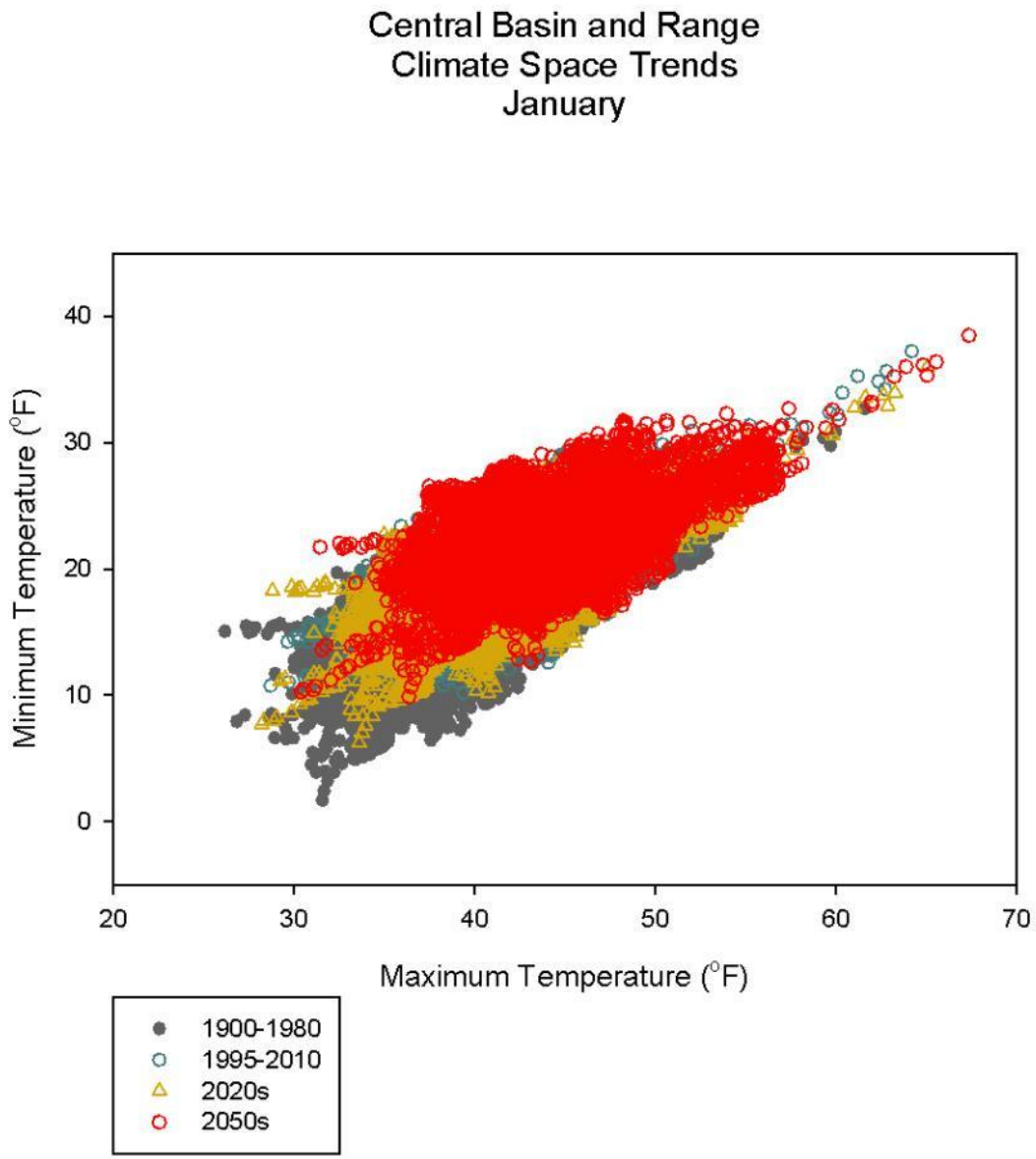
1995-2010
2020s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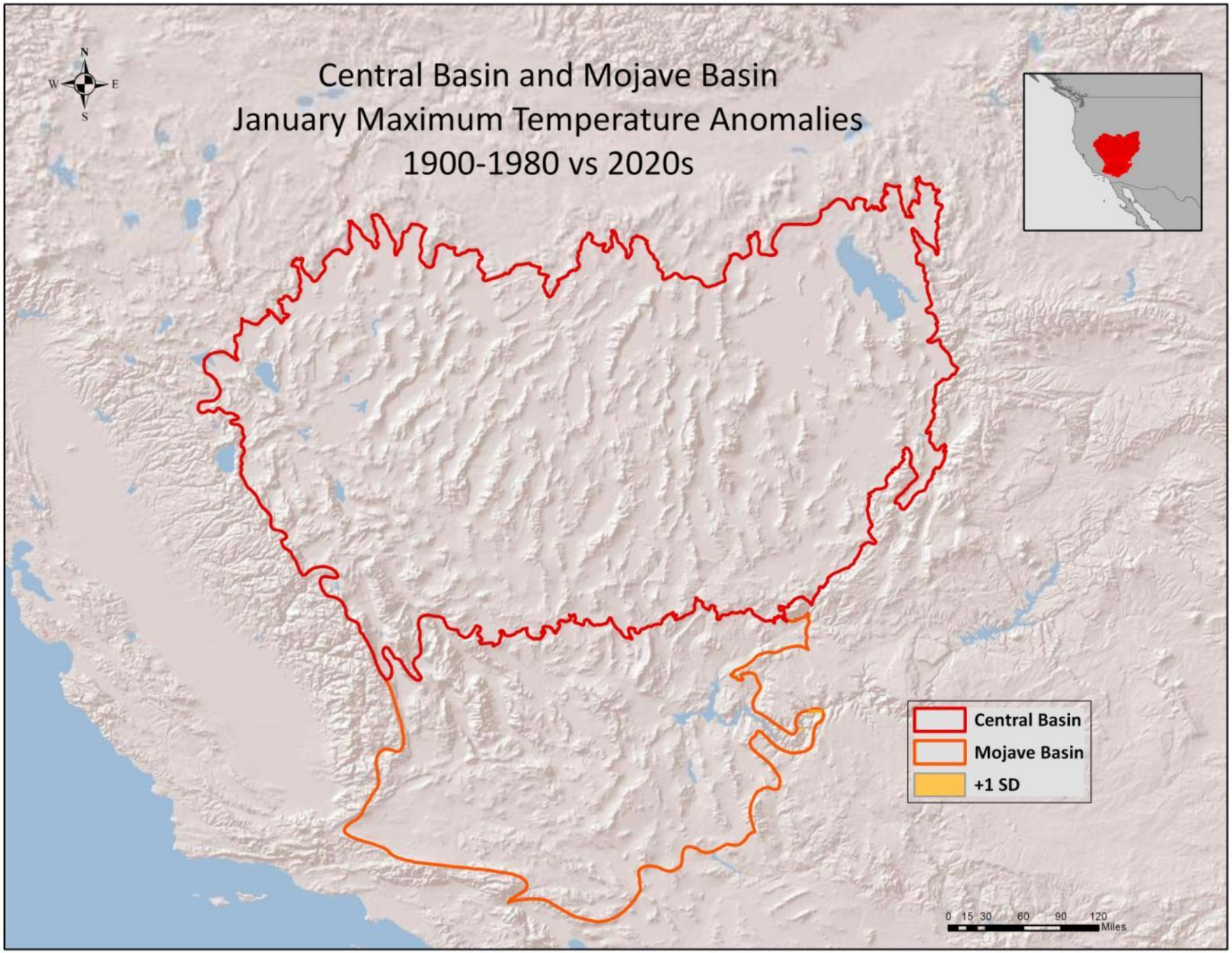
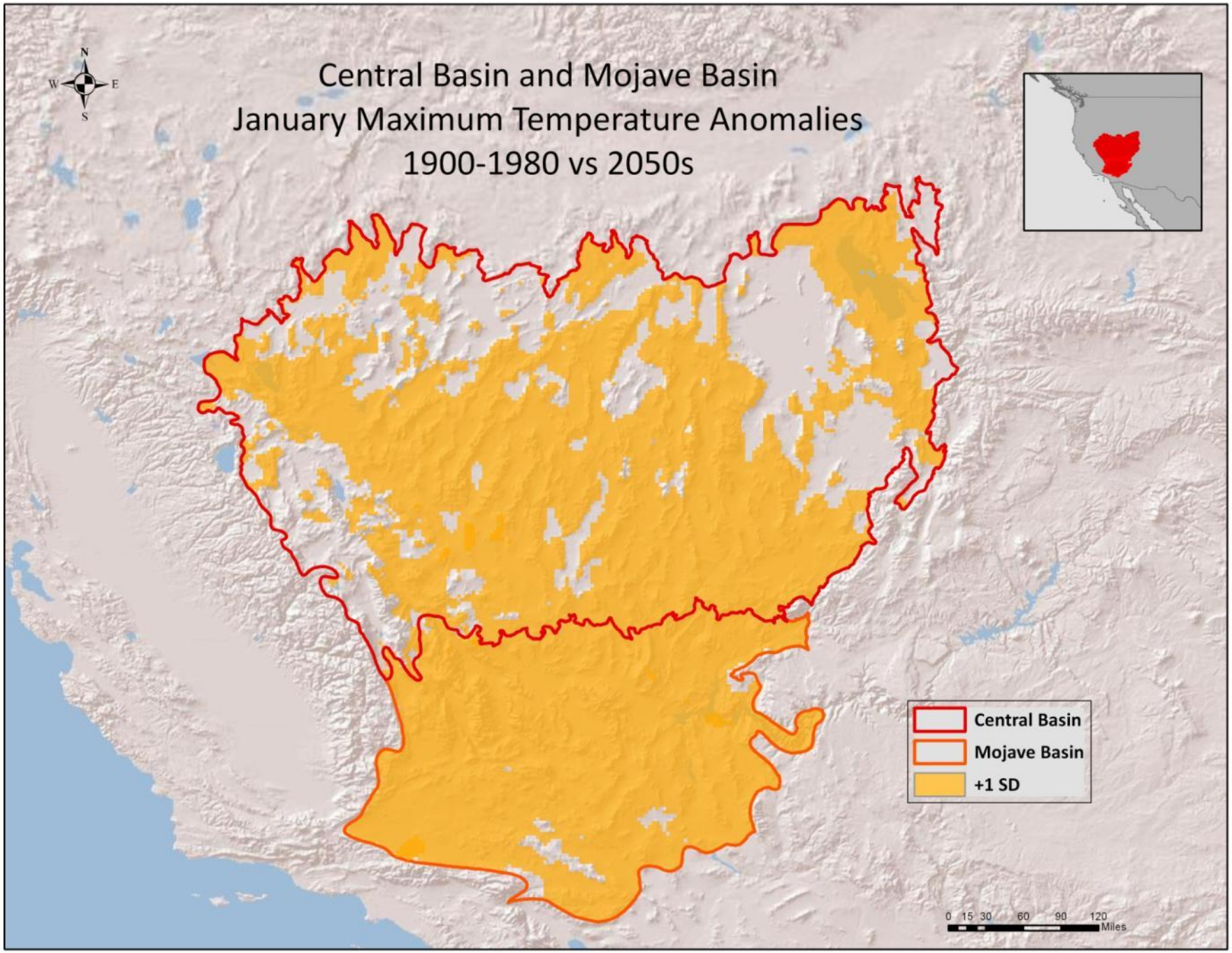
2020s
2050s


Central Basin and Mojave Basin
January Maximum Temperature Anomalies
1900-1980 vs 2020s
N
W
E
S
Central Basin
Mojave Basin
+1 SD
0 15 30 60 90 120
Miles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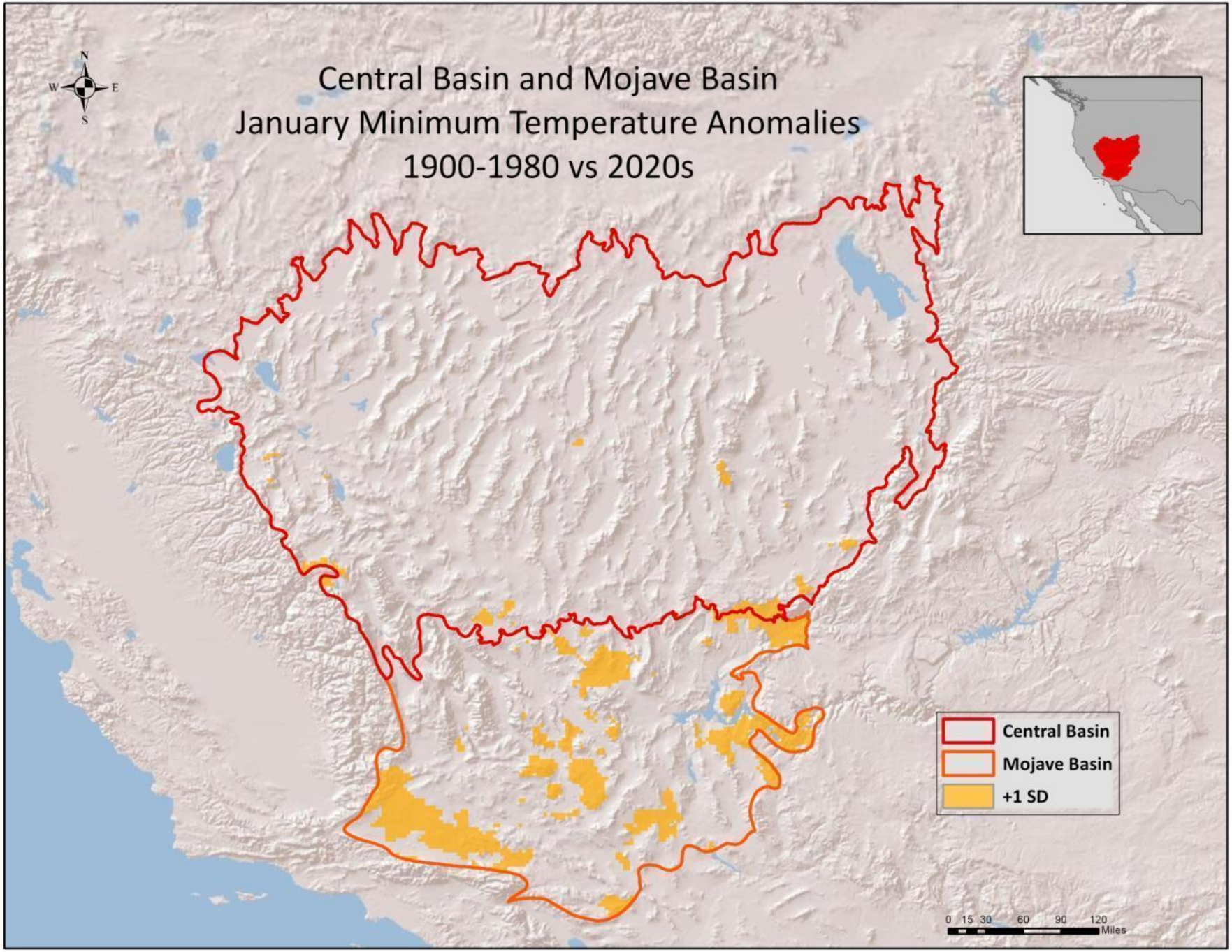
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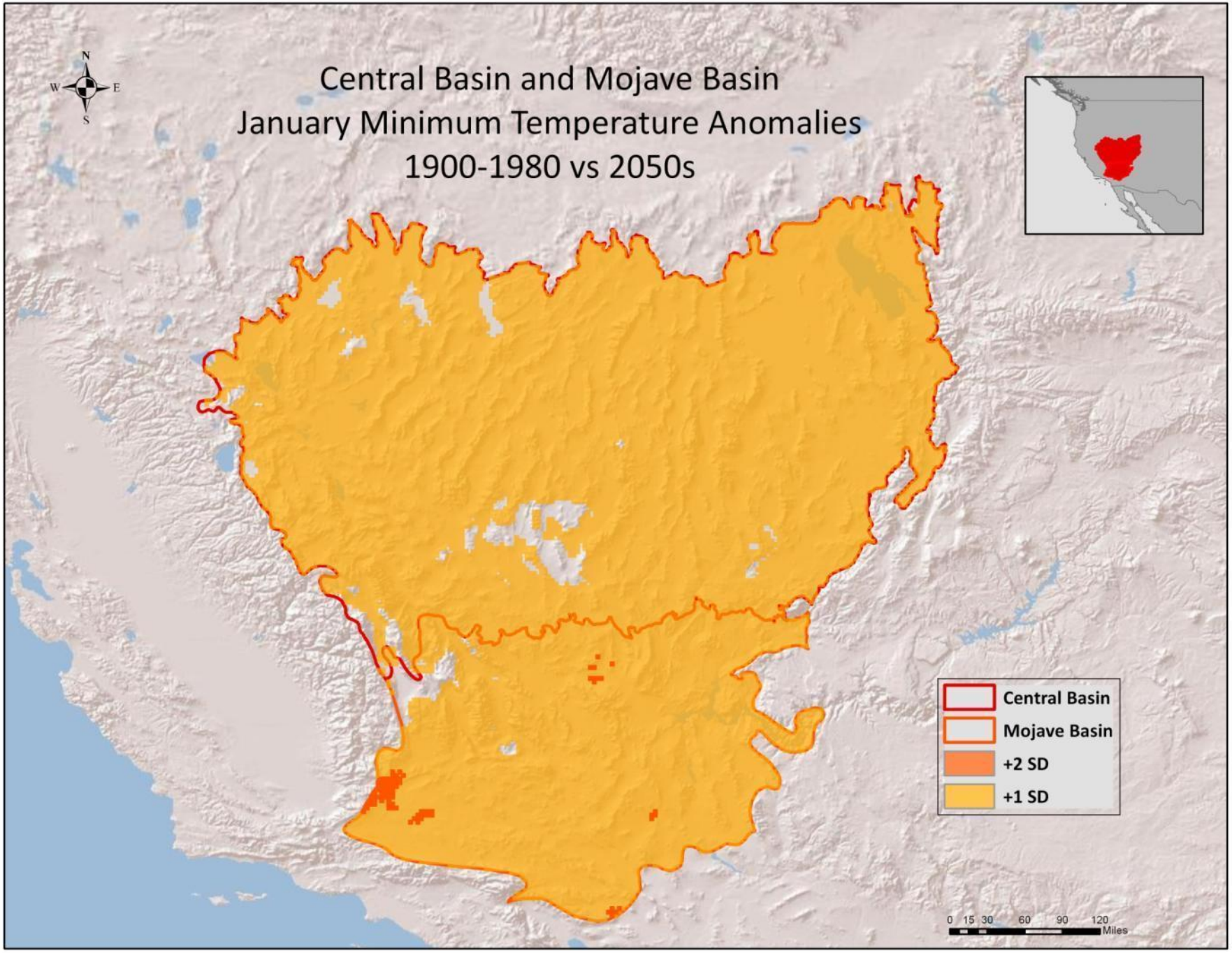
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1900-1980 vs 2050s
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Central Basin
Mojave Basin
+2 SD
+1 SD
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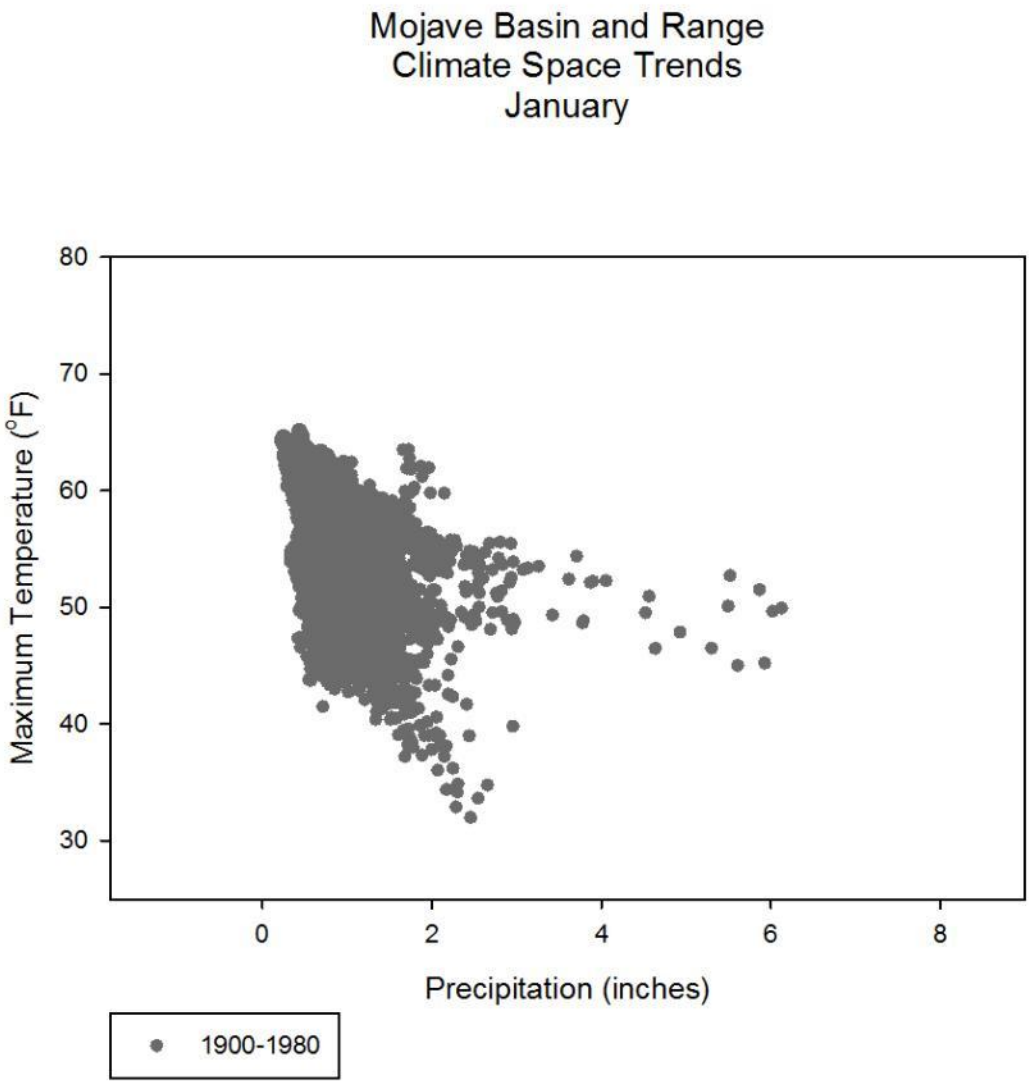
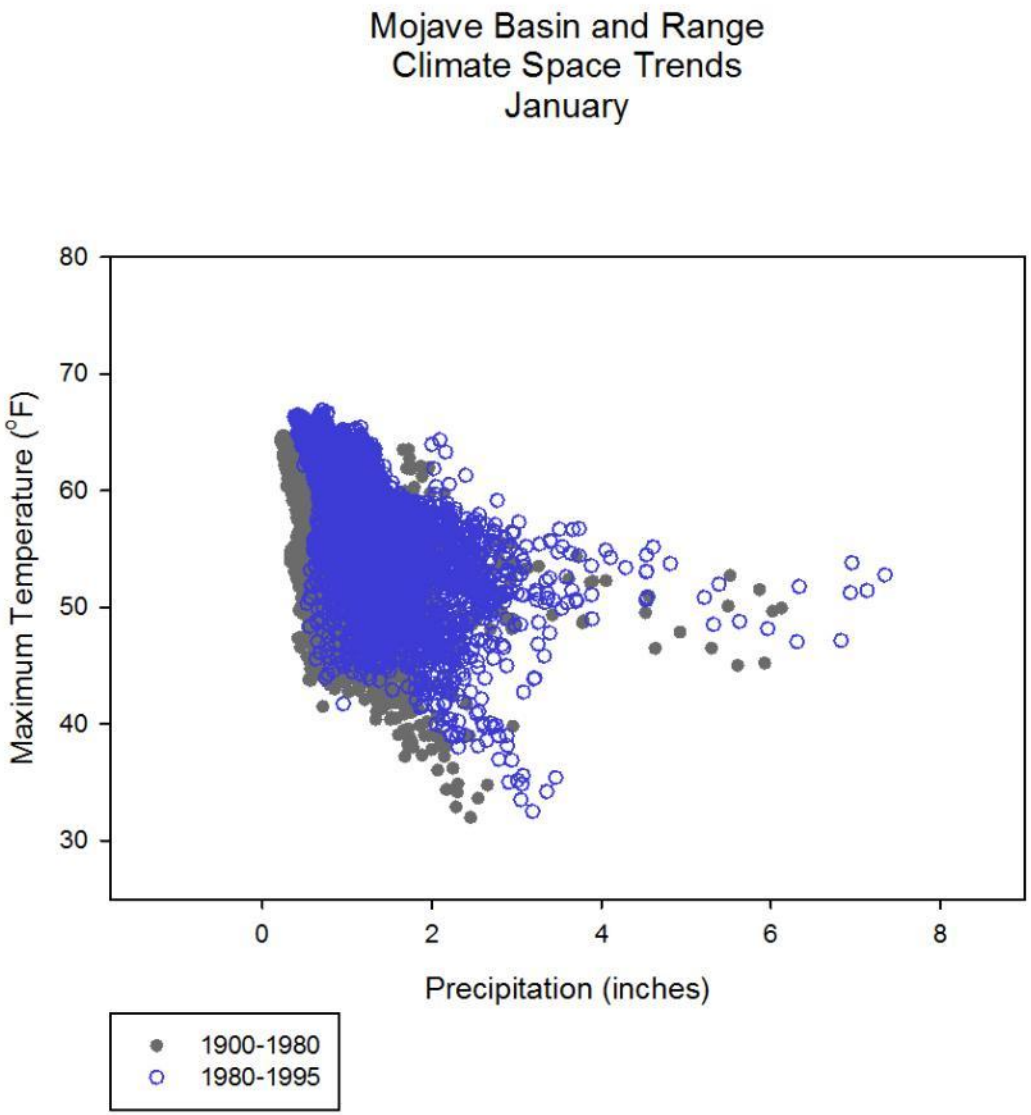
Miles


Mojave Basin and Range
Climate Space Trends
January
Maximum Temperature (°F)
80
70
60
50
40
30
0
2
4
6
8
Precipitation (inches)
1900-1980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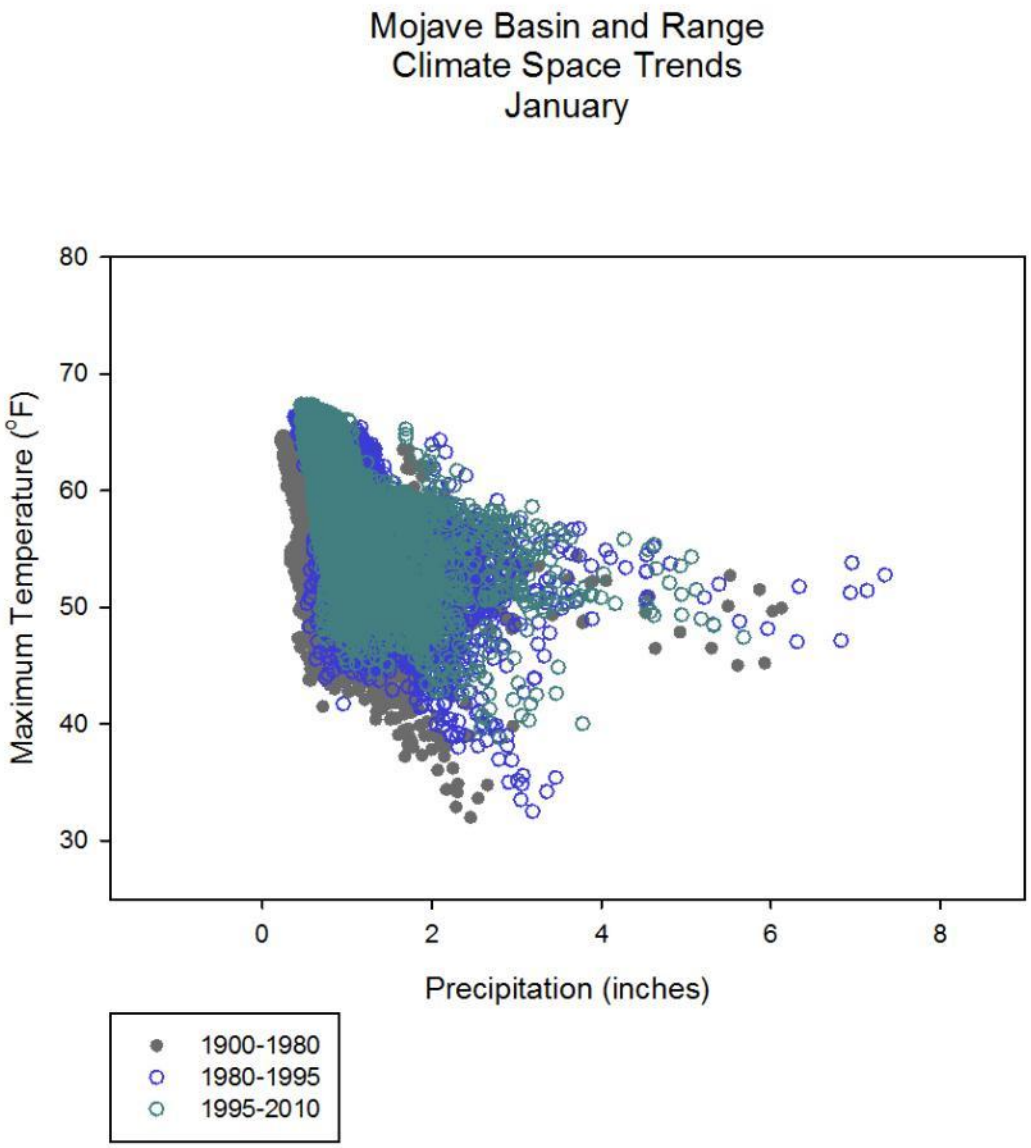
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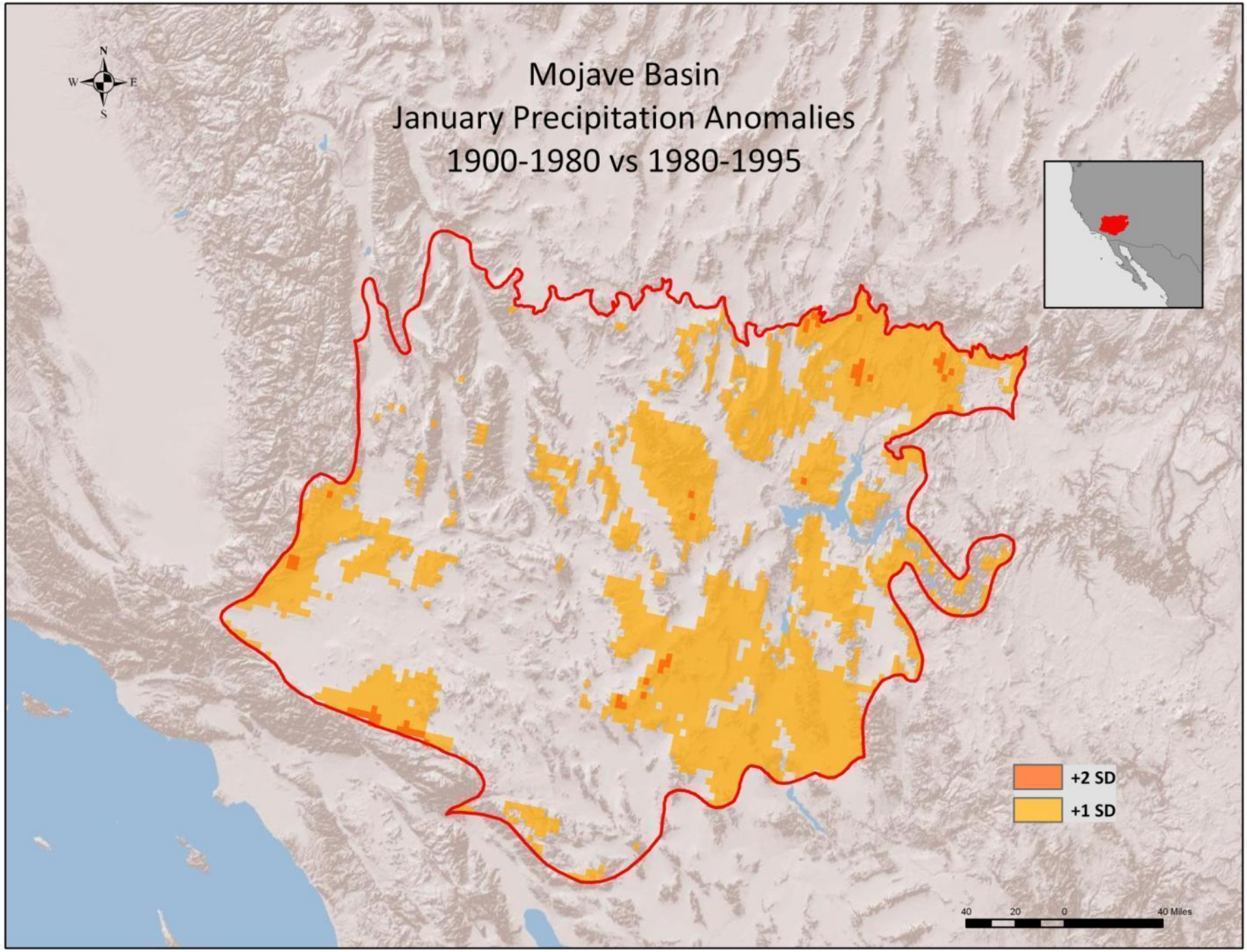
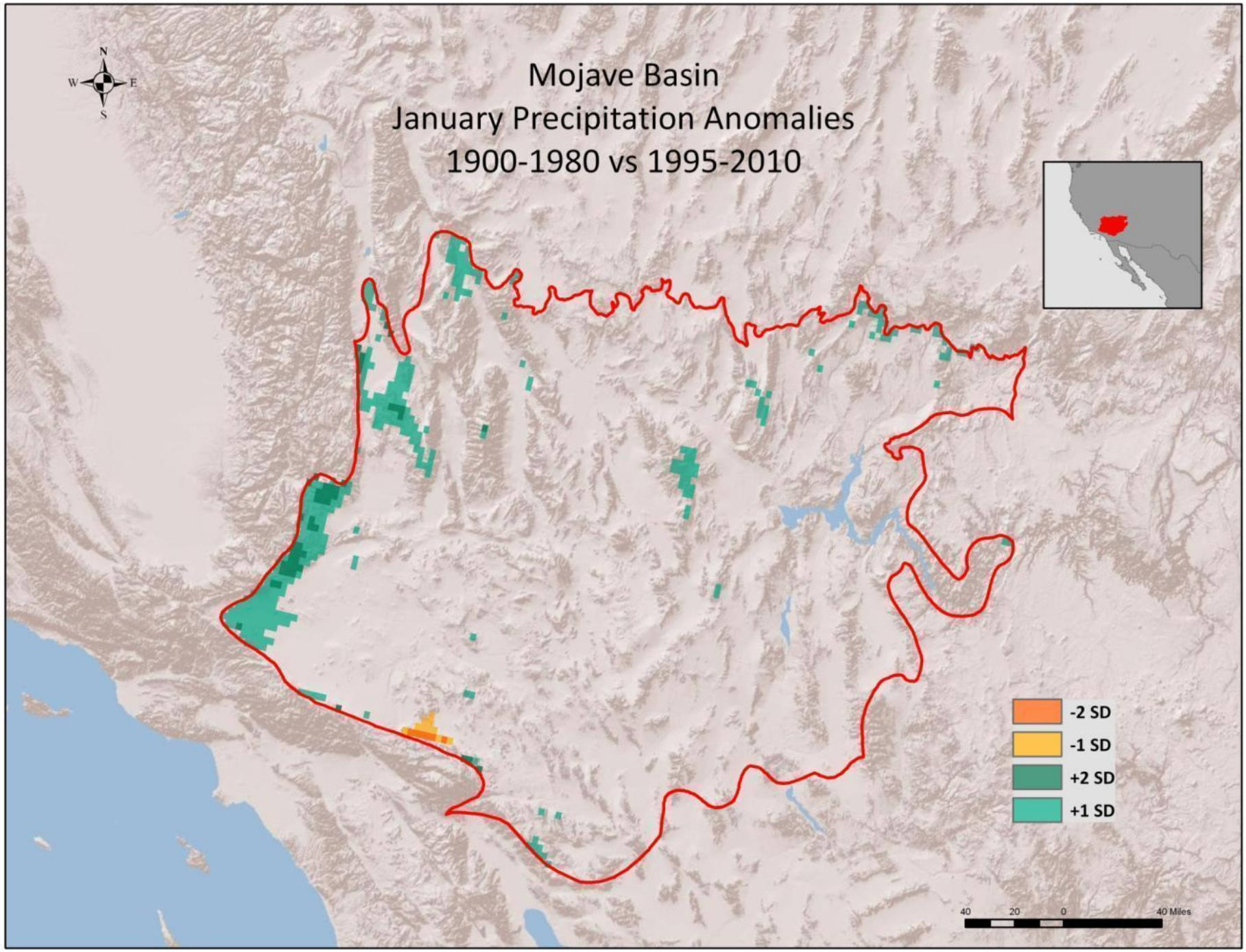
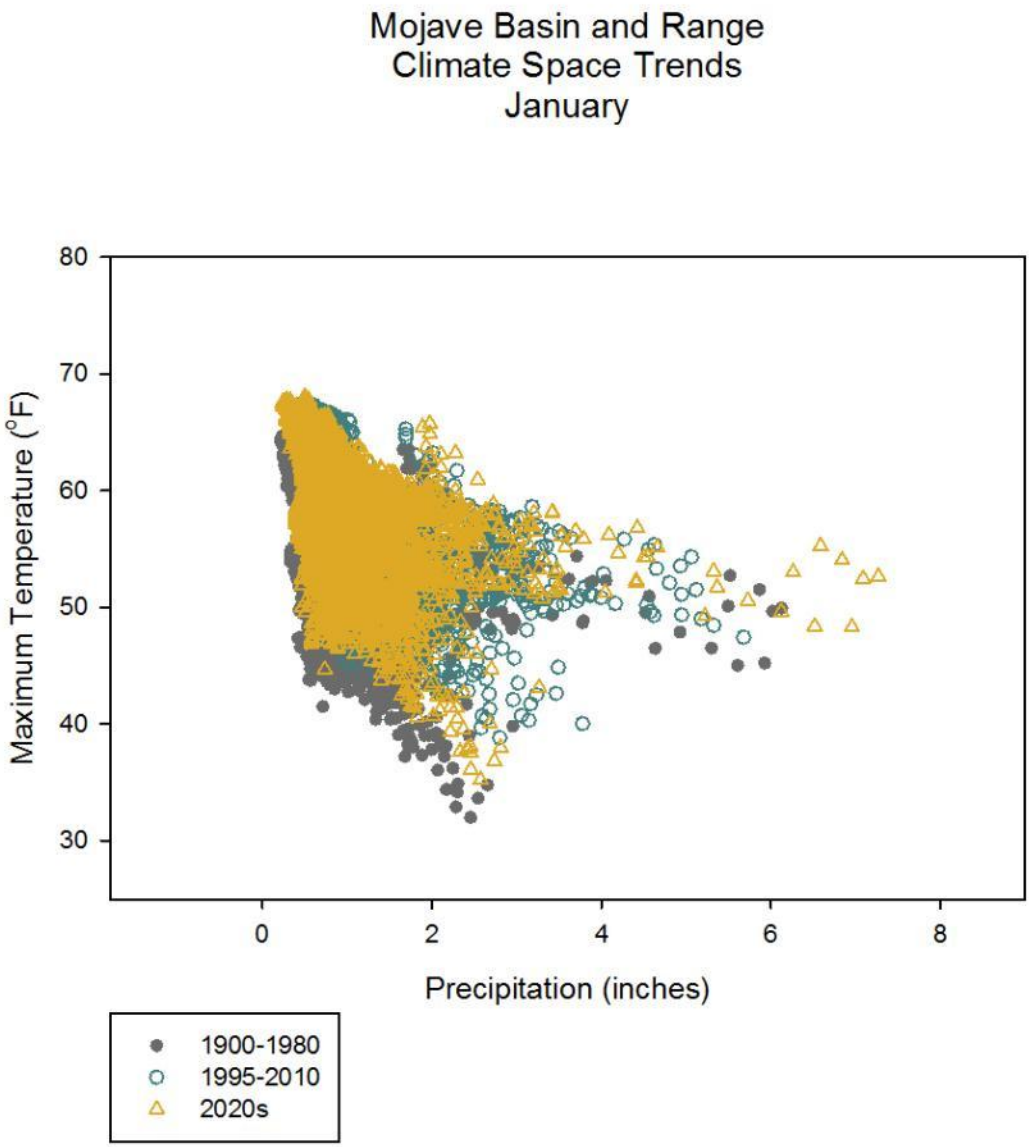
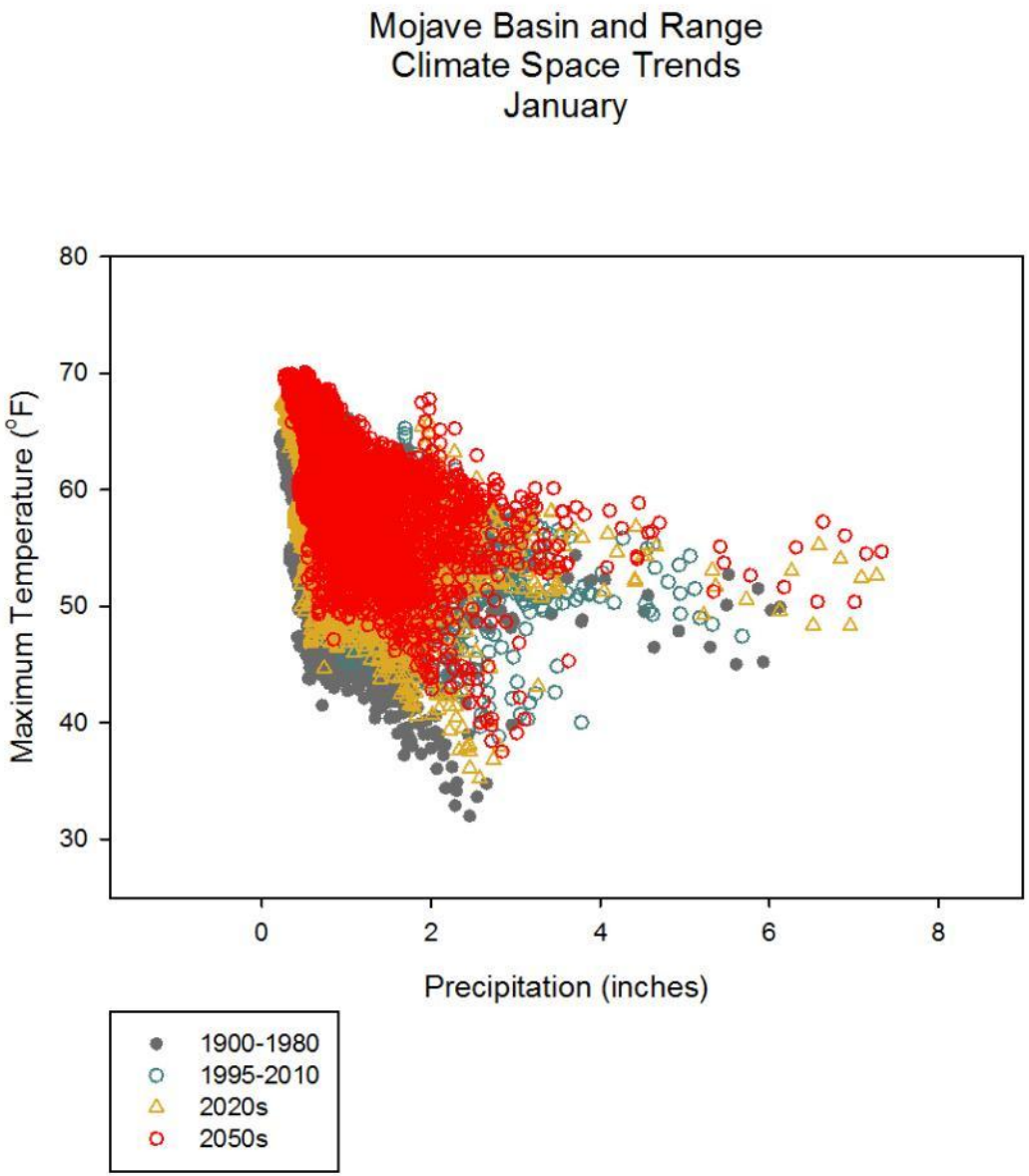
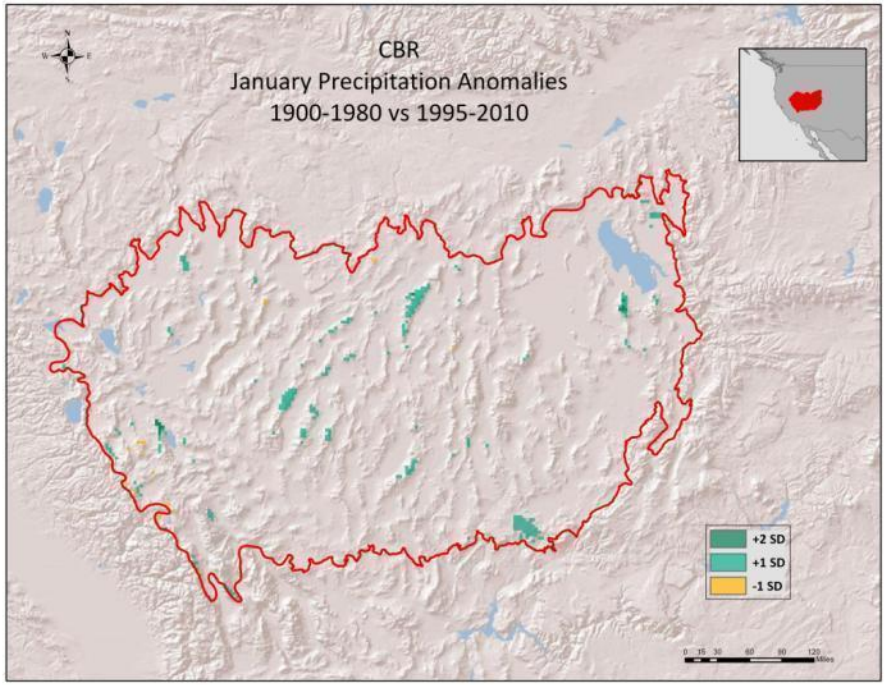
1980-1995
1995-2010

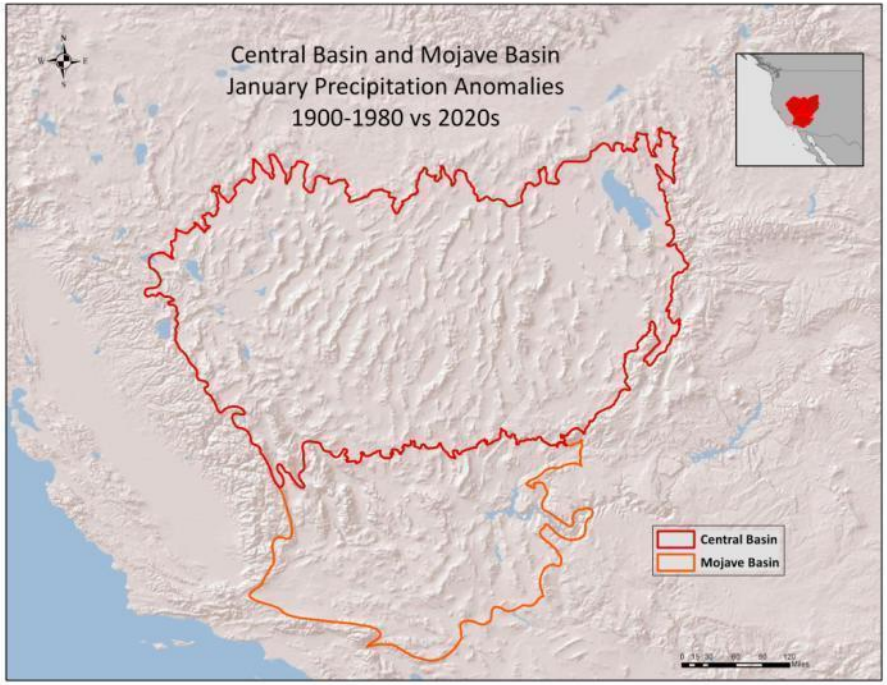

Mojave Basin
January Precipitation Anomalies
1900-1980 vs 1980-1995
N
W
E
S
+2 SD
+1 SD
40
20
0
40 Miles

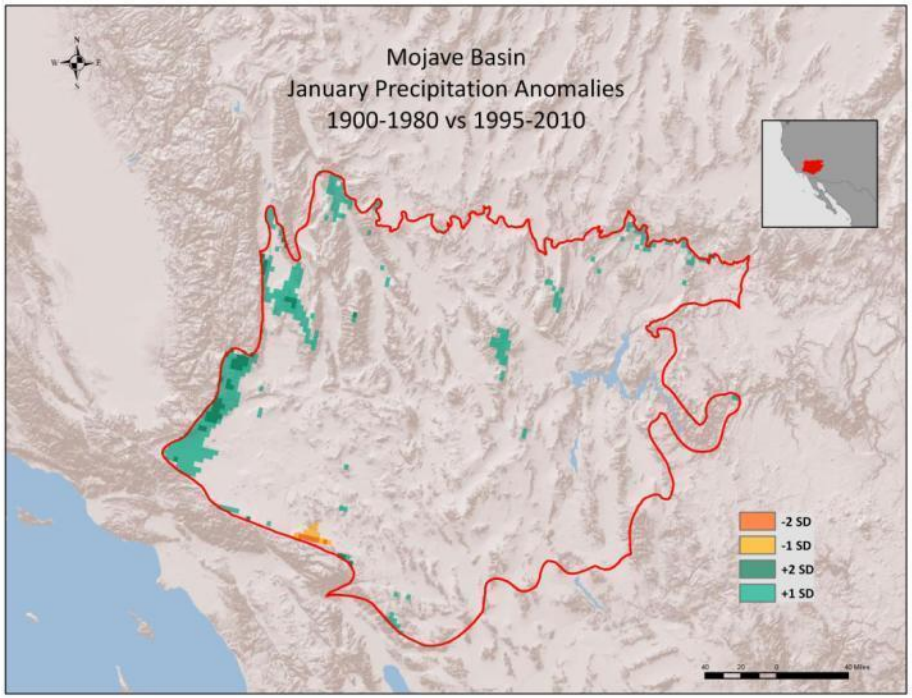

Mojave Basin
January Precipitation Anomalies
1900-1980 vs 1995-2010
N
W
E
S
-2 SD
-1 SD
+2 SD
+1 SD
40
20
0
40 Miles

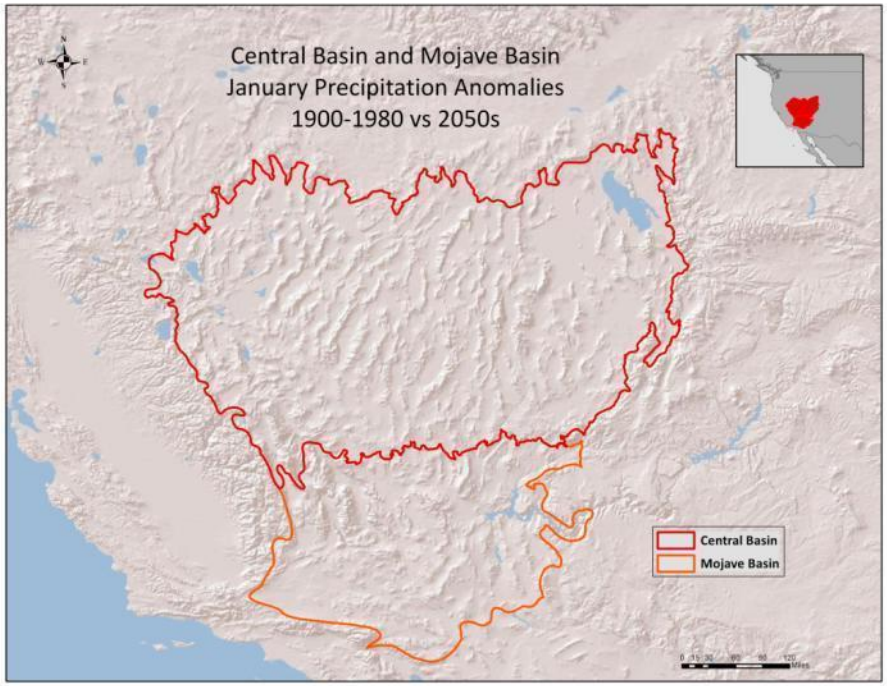

Mojave Basin and Range
Climate Space Trends
January
Maximum Temperature (°F)
80
70
60
50
40
30
0
2
4
6
8
Precipitation (inches)
1900-1980
1995-2010
2020s

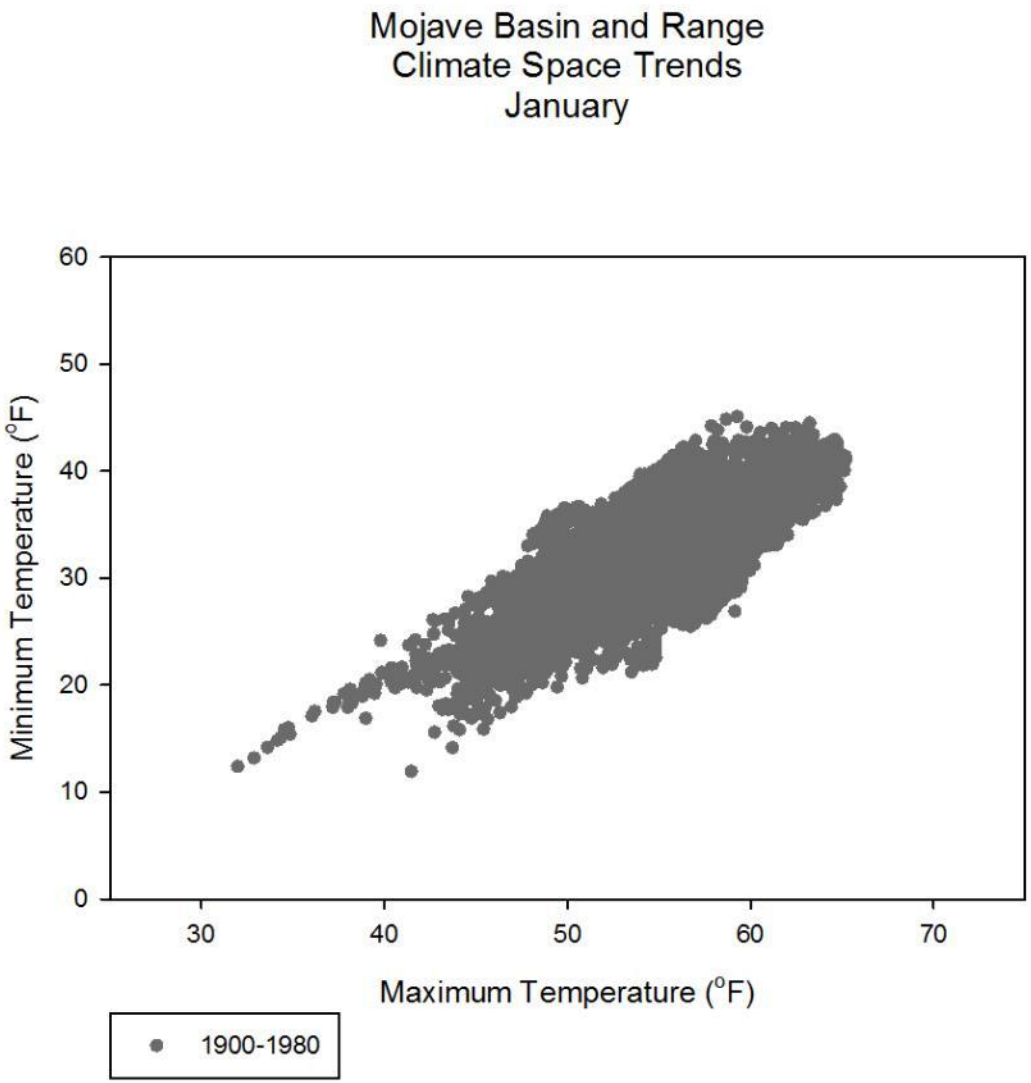

Mojave Basin and Range
Climate Space Trends
January
Maximum Temperature (°F)
80
70
60
50
40
30
0
2
4
6
8
Precipitation (inches)
1900-1980
1995-2010
2020s
2050s

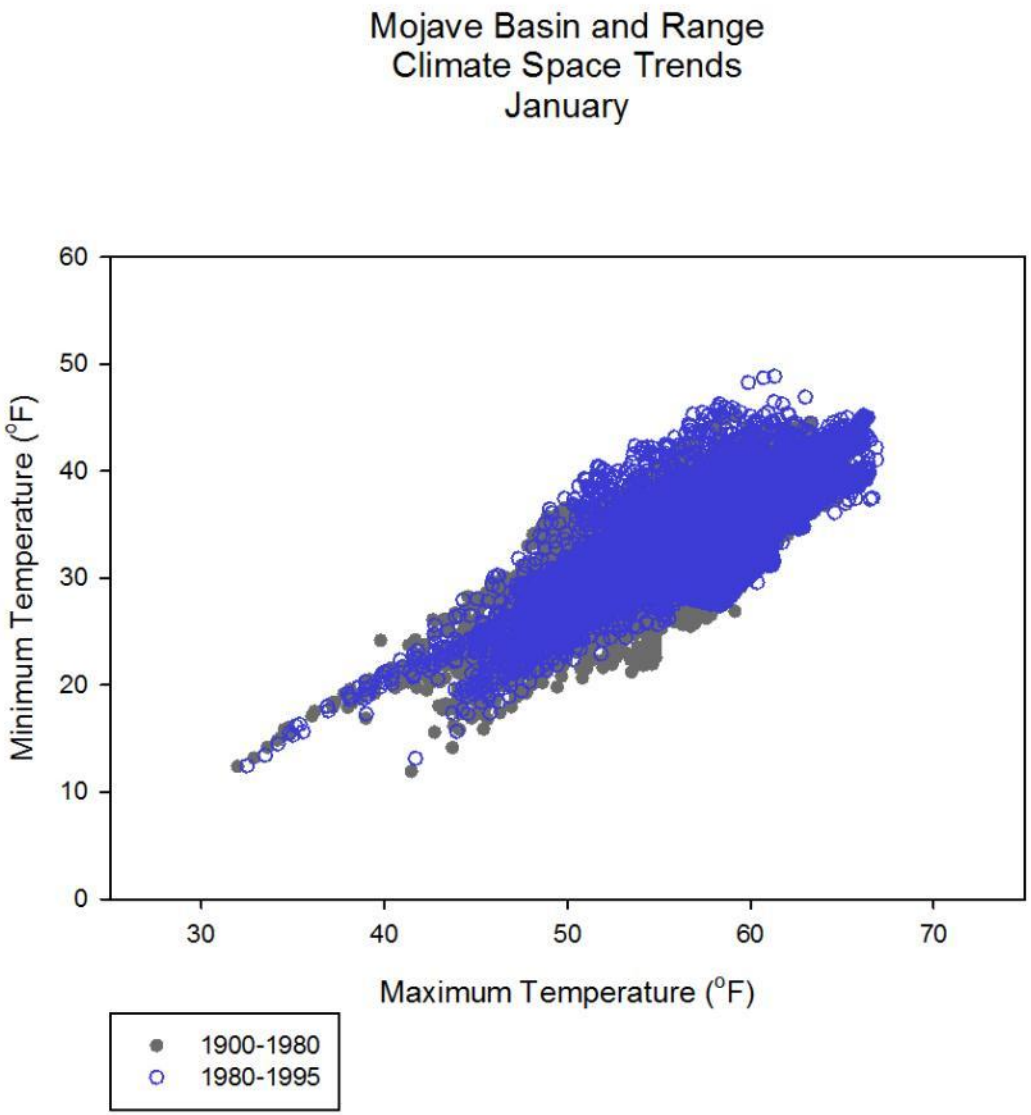

CBR
January Precipitation Anomalies
1900-1980 vs 1995-2010
+2 SD
+1 SD
-1 SD

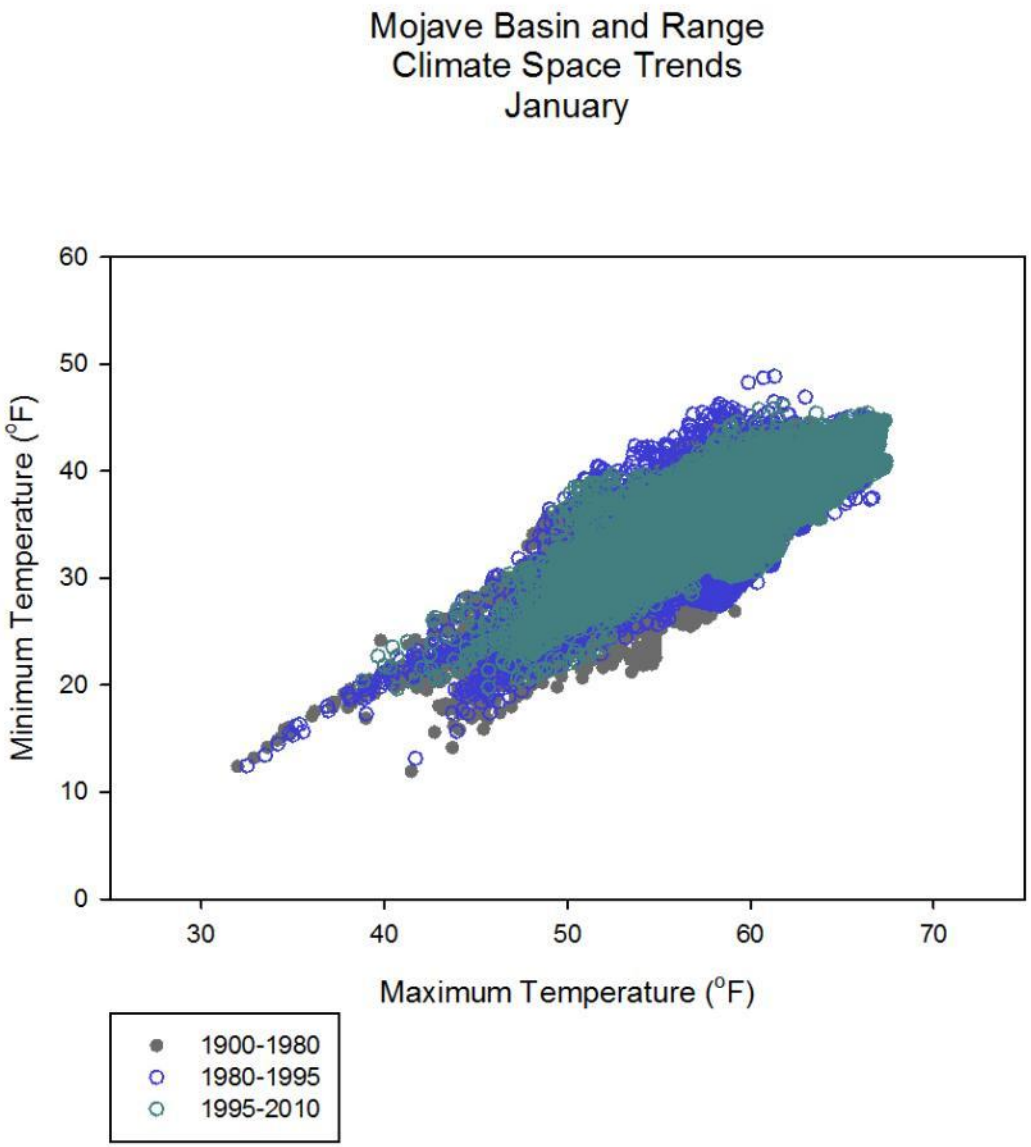

Central Basin and Mojave Basin
January Precipitation Anomalies
1900-1980 vs 2020s
Central Basin
Mojave Basin

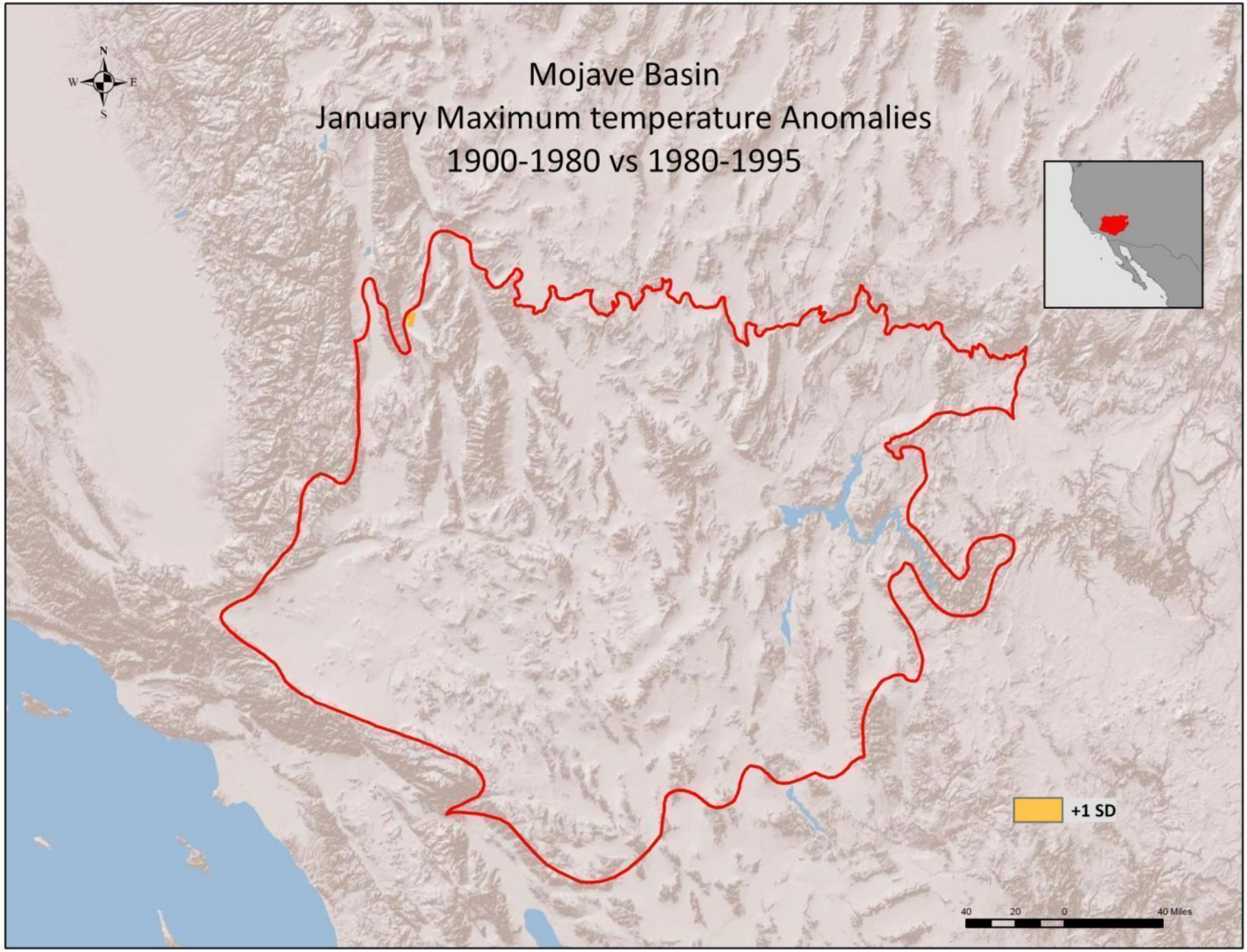

Mojave Basin
January Precipitation Anomalies
1900-1980 vs 1995-2010
-2 SD
-1 SD
+2 SD
+1 SD

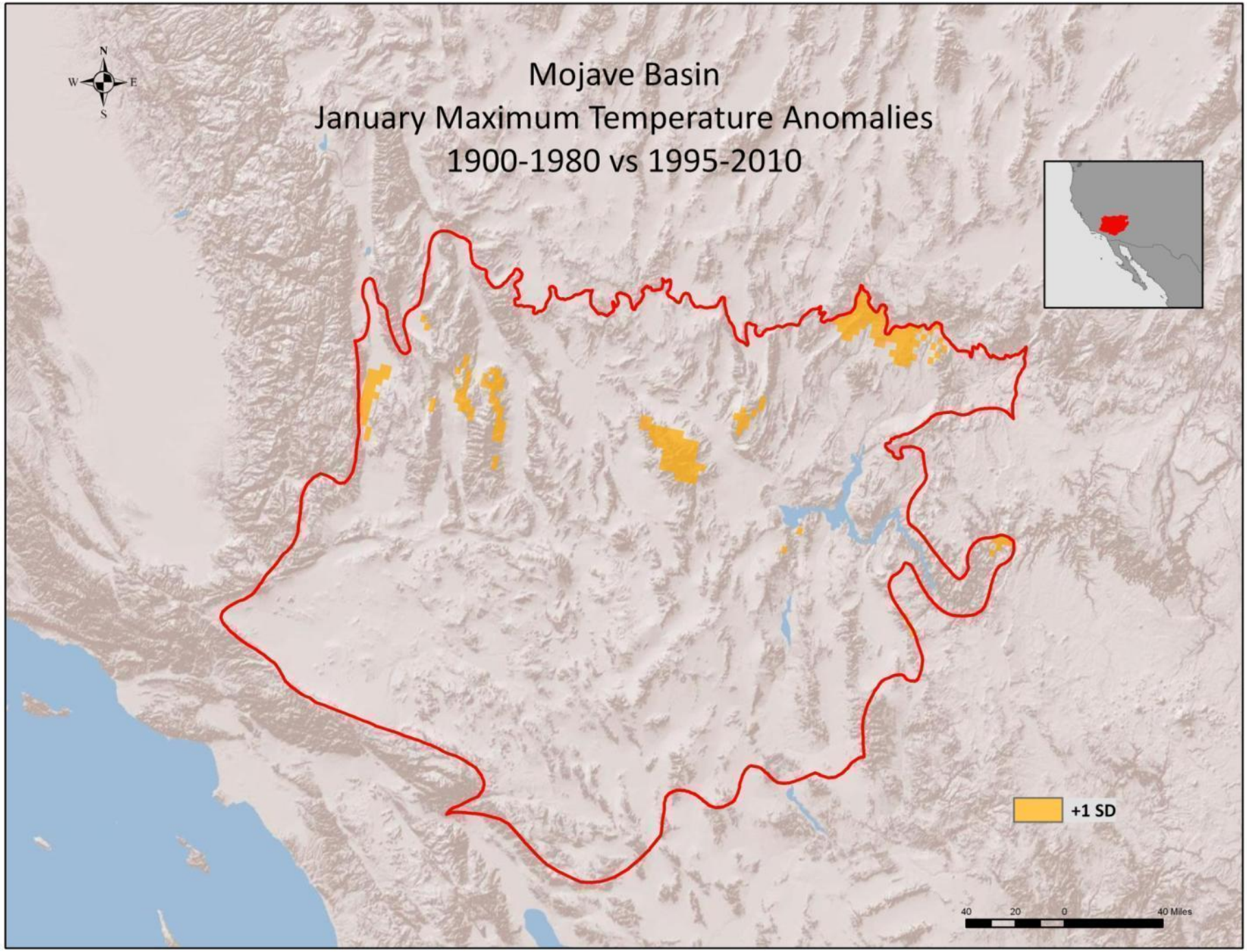

Central Basin and Mojave Basin
January Precipitation Anomalies
1900-1980 vs 2050s
Central Basin
Mojave Basin

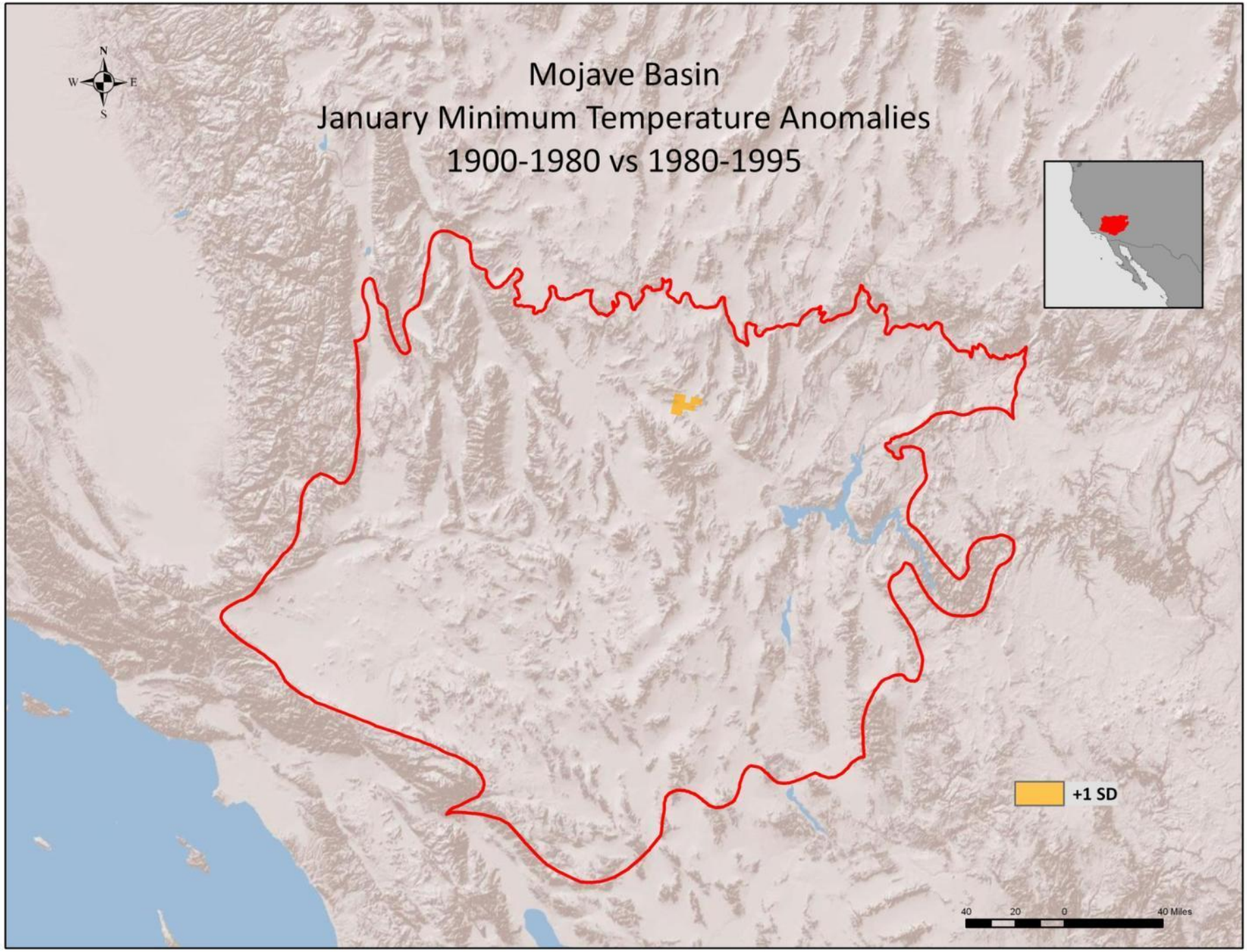

Mojave Basin and Range
Climate Space Trends
January
Minimum Temperature (°F)
Maximum Temperature (°F)
0
10
20
30
40
50
60
30
40
50
60
70
1900-1980

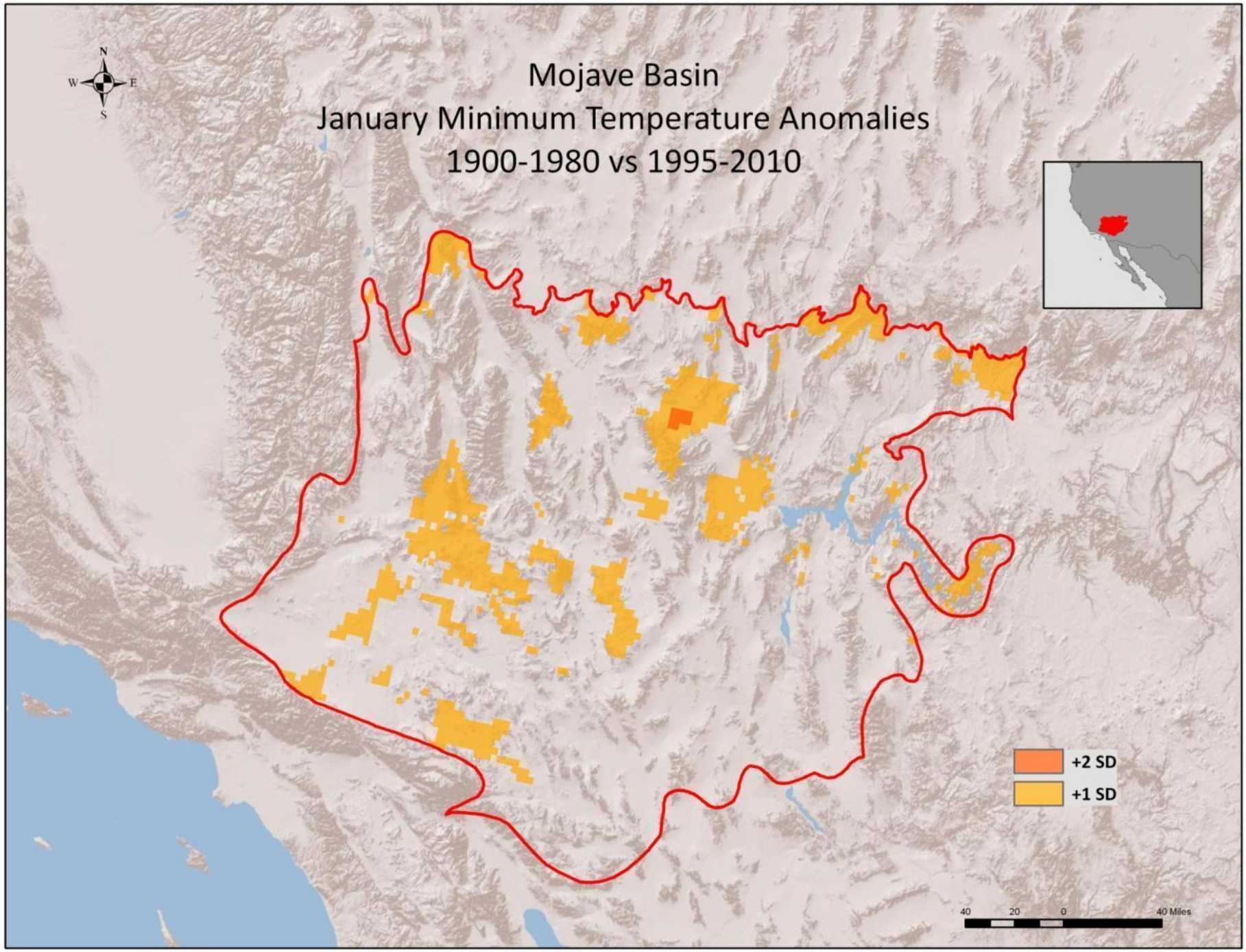

Mojave Basin and Range
Climate Space Trends
January
Minimum Temperature (°F)
Maximum Temperature (°F)
0
10
20
30
40
50
60
30
40
50
60
70
1900-1980
1980-1995

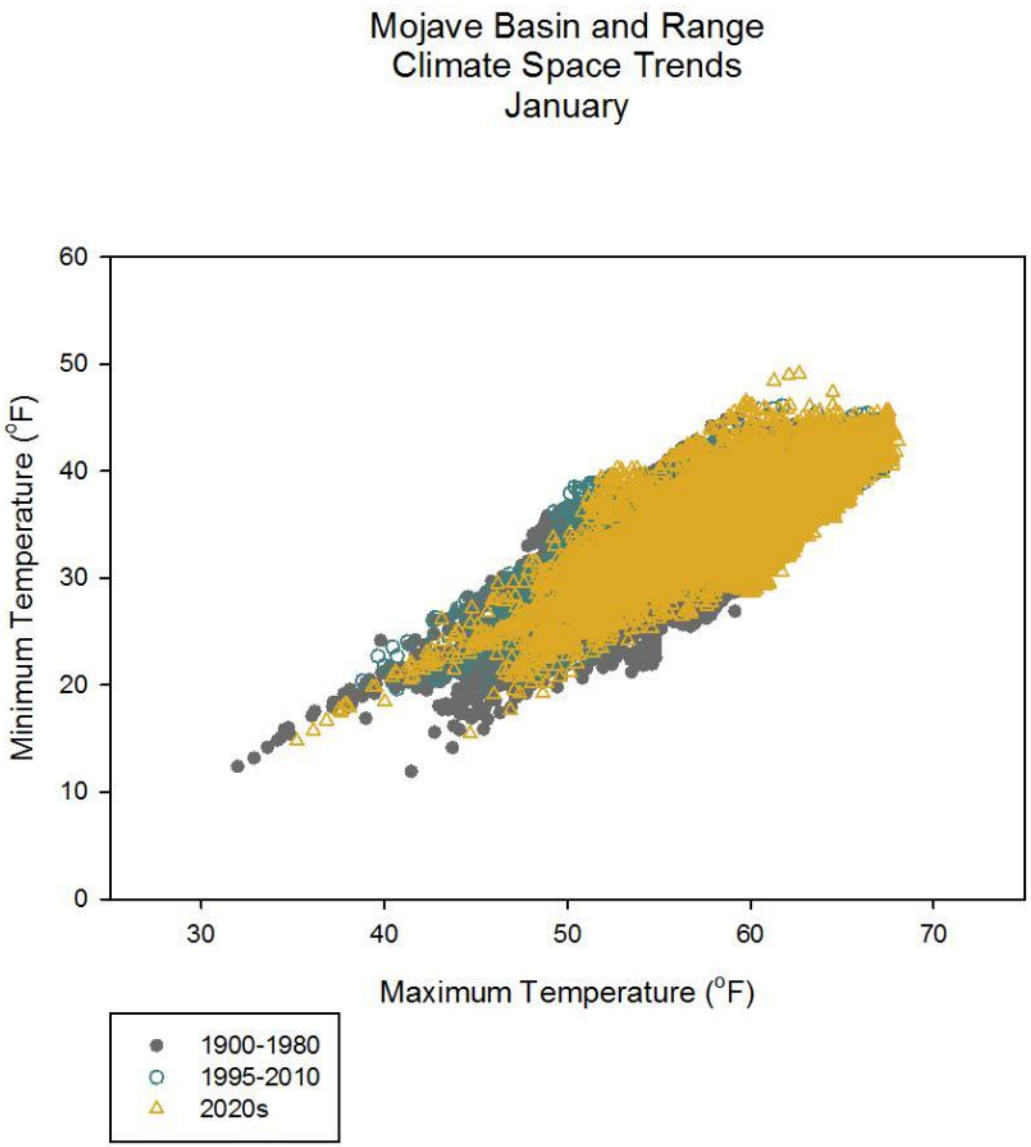

Mojave Basin and Range
Climate Space Trends
January
Minimum Temperature (°F)
Maximum Temperature (°F)
0
10
20
30
40
50
60
30
40
50
60
70
1900-1980
1980-1995
1995-2010

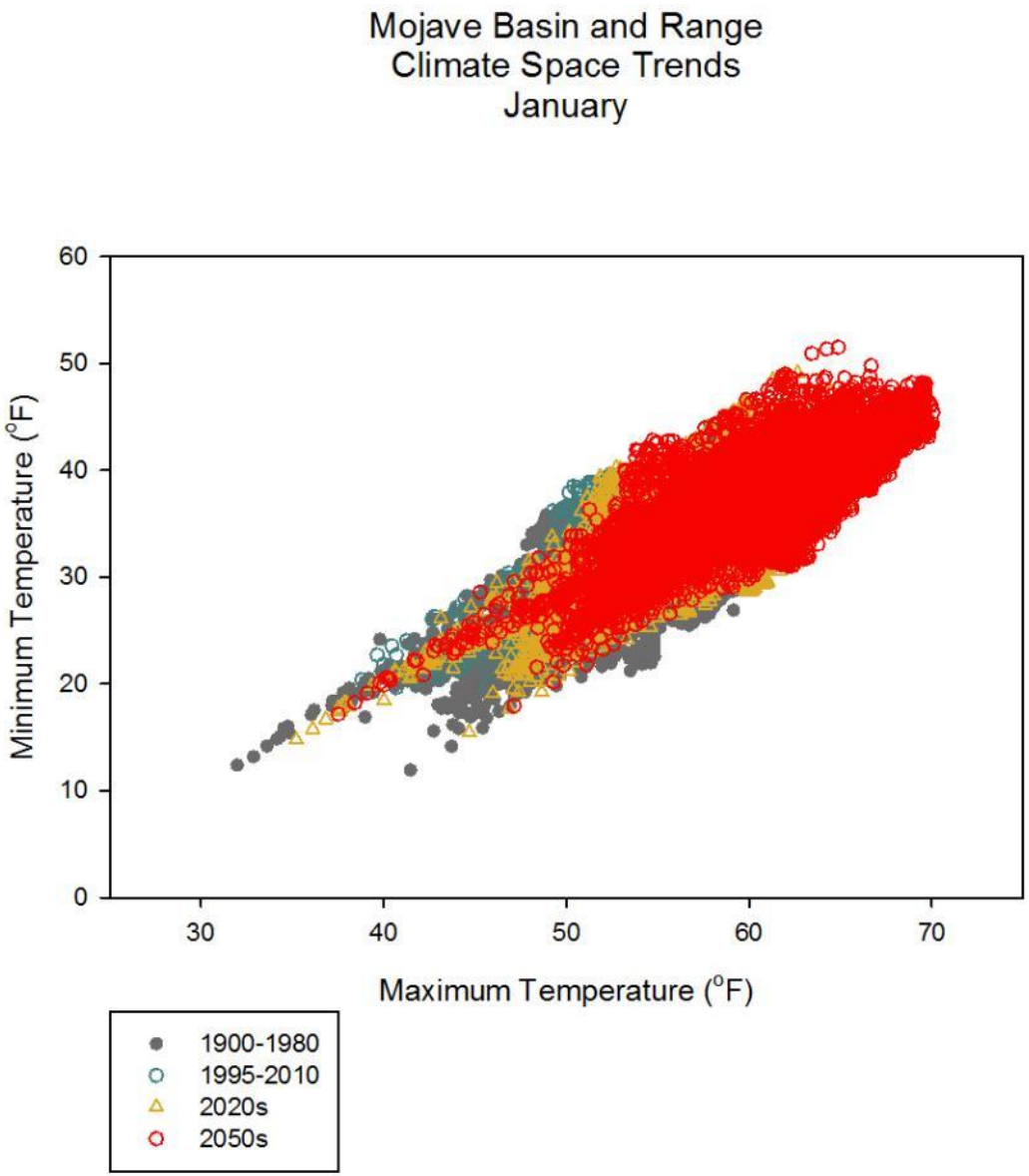

Mojave Basin
January Maximum temperature Anomalies
1900-1980 vs 1980-1995
N
W
E
S
+1 SD
40
20
0
40 Miles

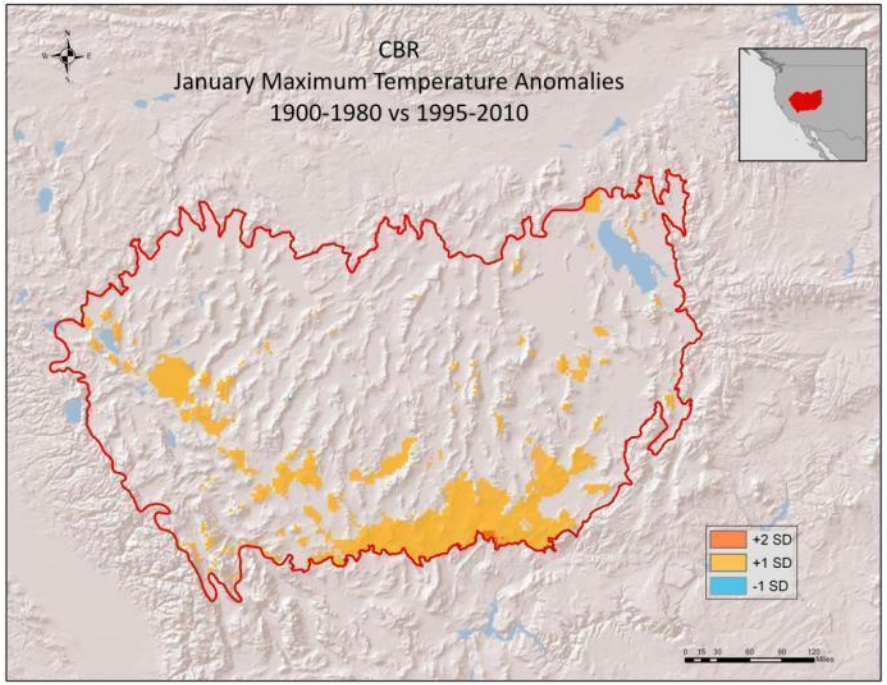

Mojave Basin
January Maximum Temperature Anomalies
1900-1980 vs 1995-2010
N
W
E
S
+1 SD
40
20
0
40 Miles

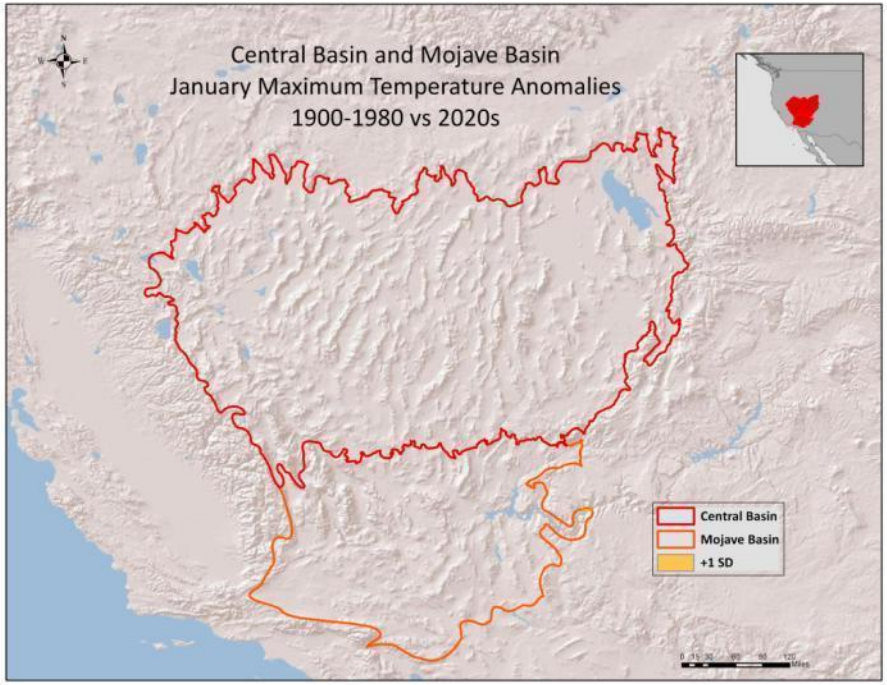

Mojave Basin
January Minimum Temperature Anomalies
1900-1980 vs 1980-1995
N
W
E
S
+1 SD
40
20
0
40 Miles

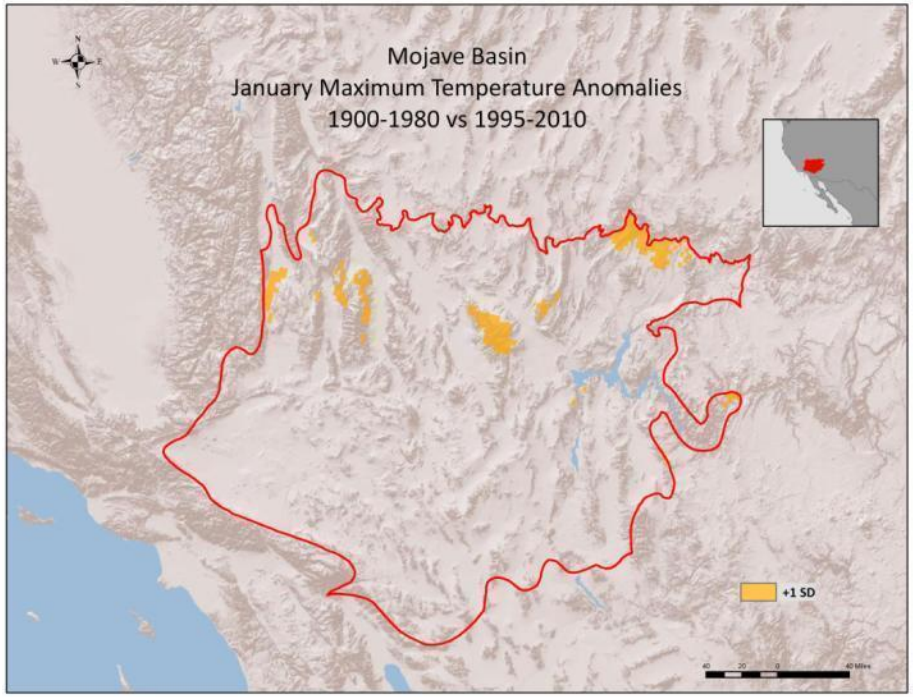

Mojave Basin
January Minimum Temperature Anomalies
1900-1980 vs 1995-2010
N
W
E
S
+2 SD
+1 SD
40
20
0
40 Miles

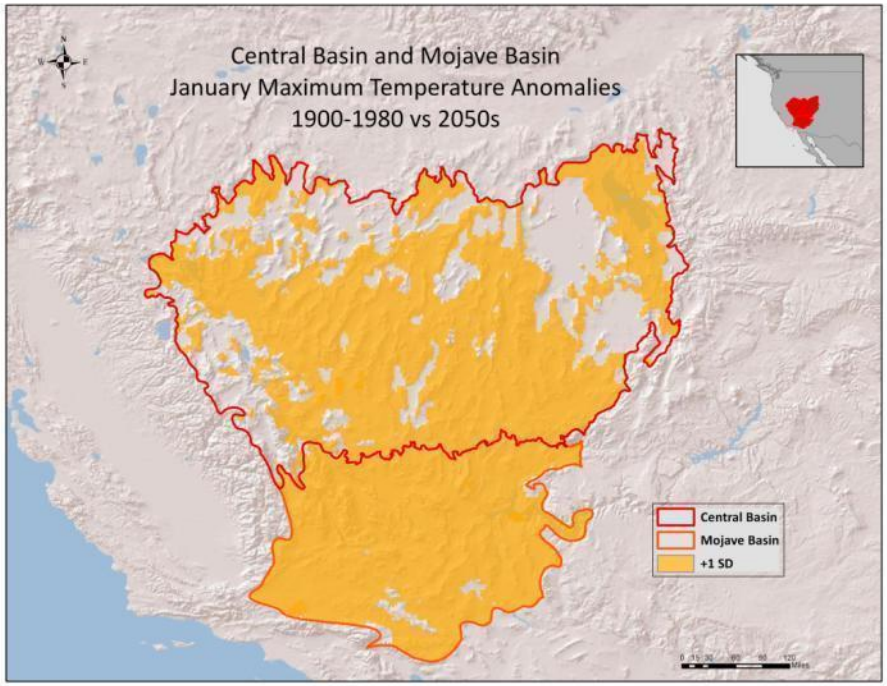

Mojave Basin and Range
Climate Space Trends
January
Minimum Temperature (°F)
Maximum Temperature (°F)
0
10
20
30
40
50
60
30
40
50
60
70
1900-1980
1995-2010
2020s

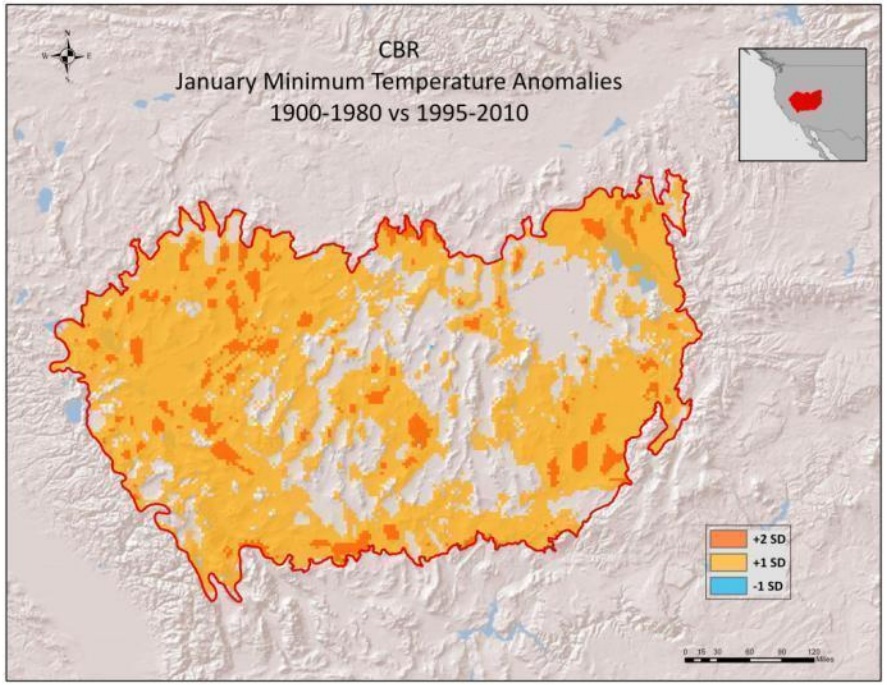

Mojave Basin and Range
Climate Space Trends
January
Minimum Temperature (°F)
Maximum Temperature (°F)
0
10
20
30
40
50
60
30
40
50
60
70
1900-1980
1995-2010
2020s
2050s

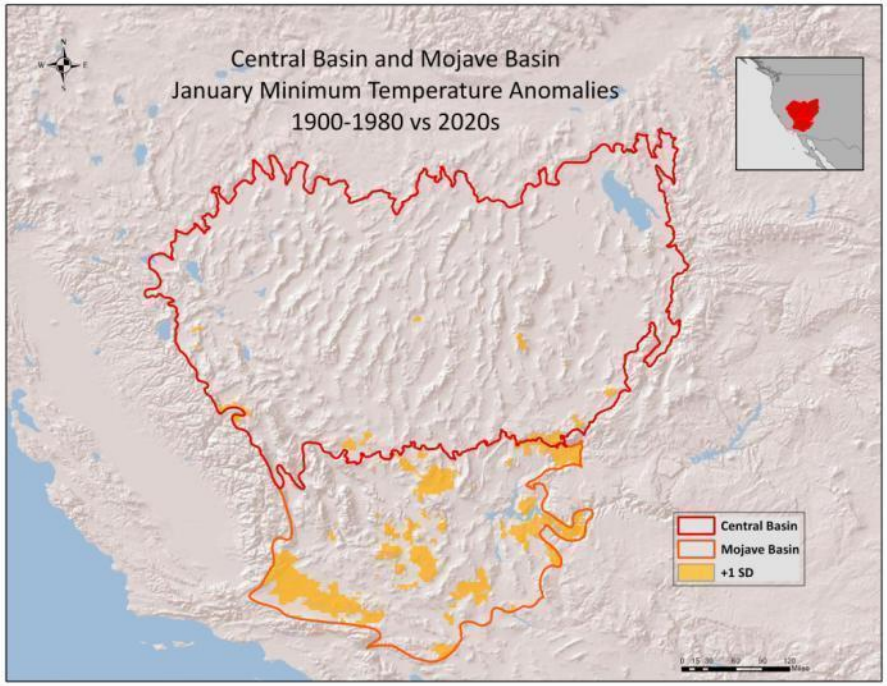

CBR
January Maximum Temperature Anomalies
1900-1980 vs 1995-2010
+2 SD
+1 SD
-1 SD

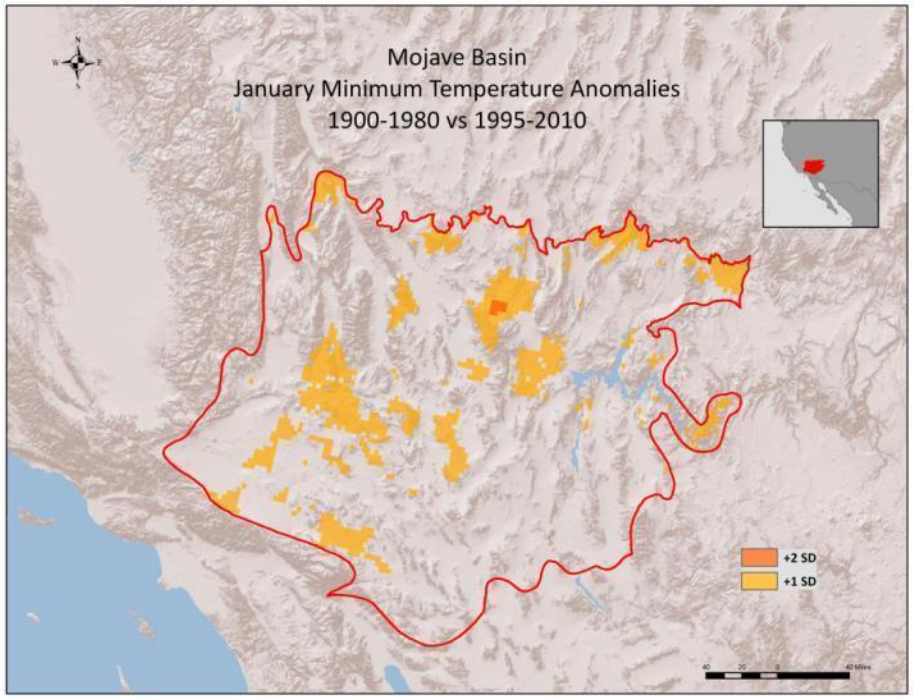

Central Basin and Mojave Basin
January Maximum Temperature Anomalies
1900-1980 vs 2020s
Central Basin
Mojave Basin
+1 SD

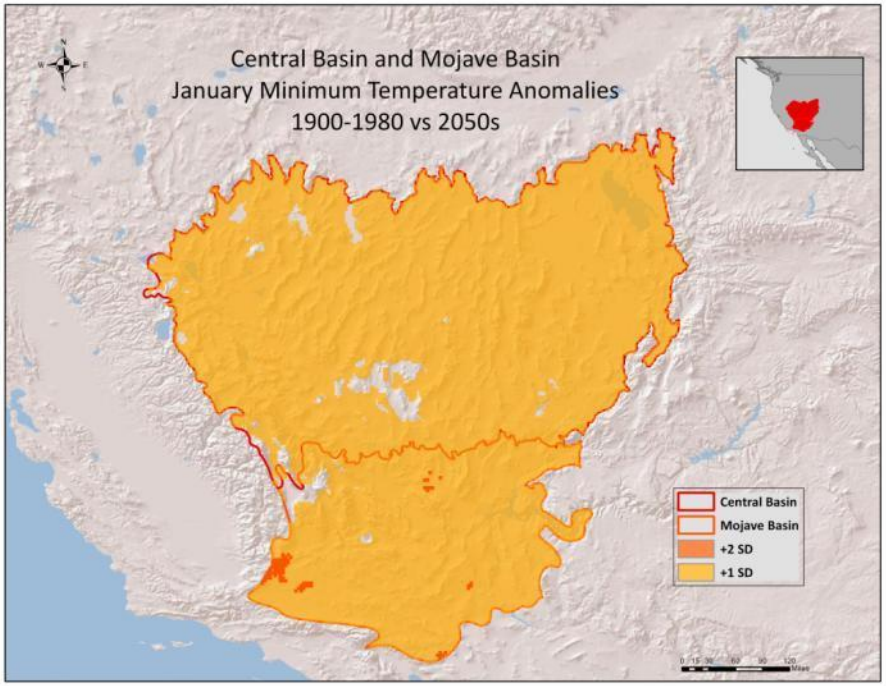

Mojave Basin
January Maximum Temperature Anomalies
1900-1980 vs 1995-2010
+1 SD

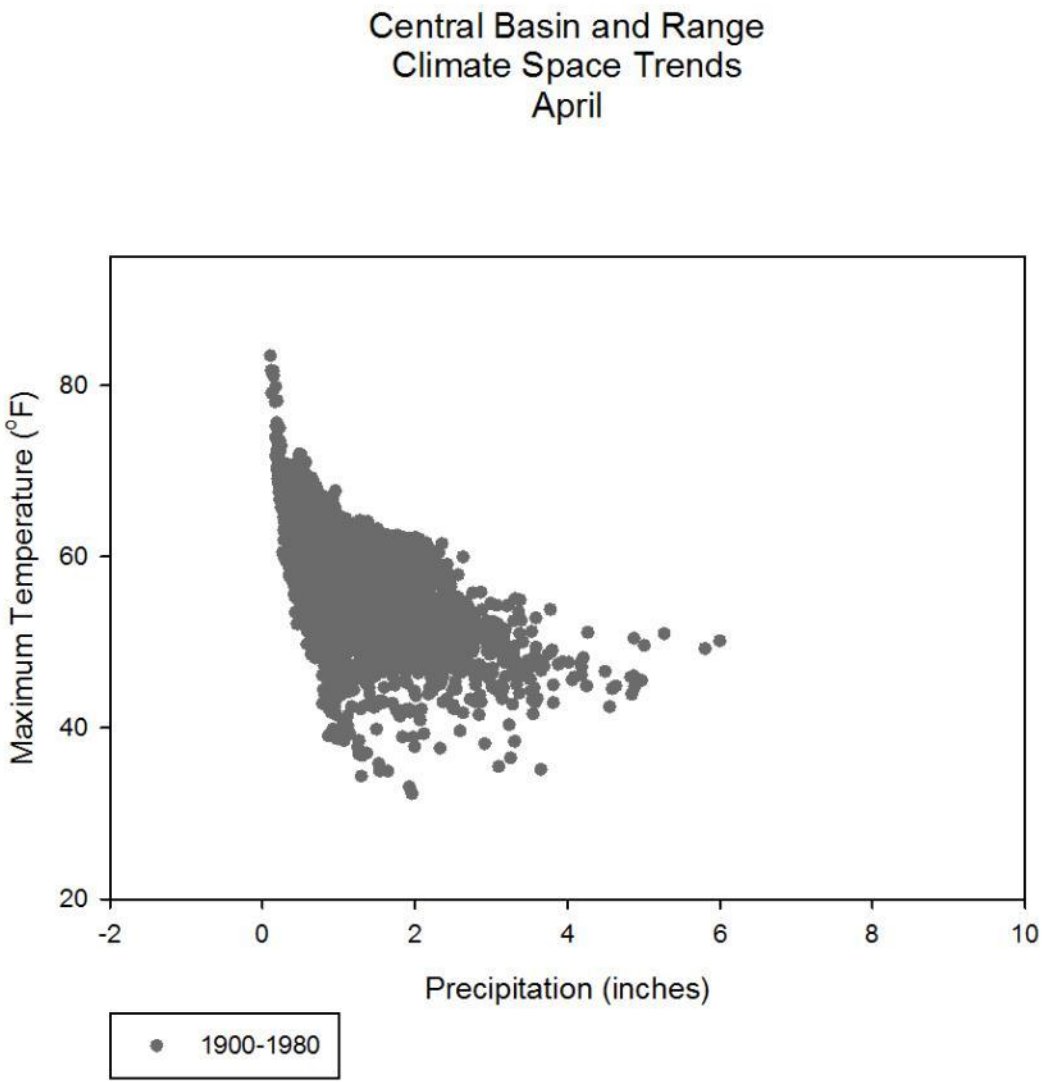

Central Basin and Mojave Basin
January Maximum Temperature Anomalies
1900-1980 vs 2050s
Central Basin
Mojave Basin
+1 SD

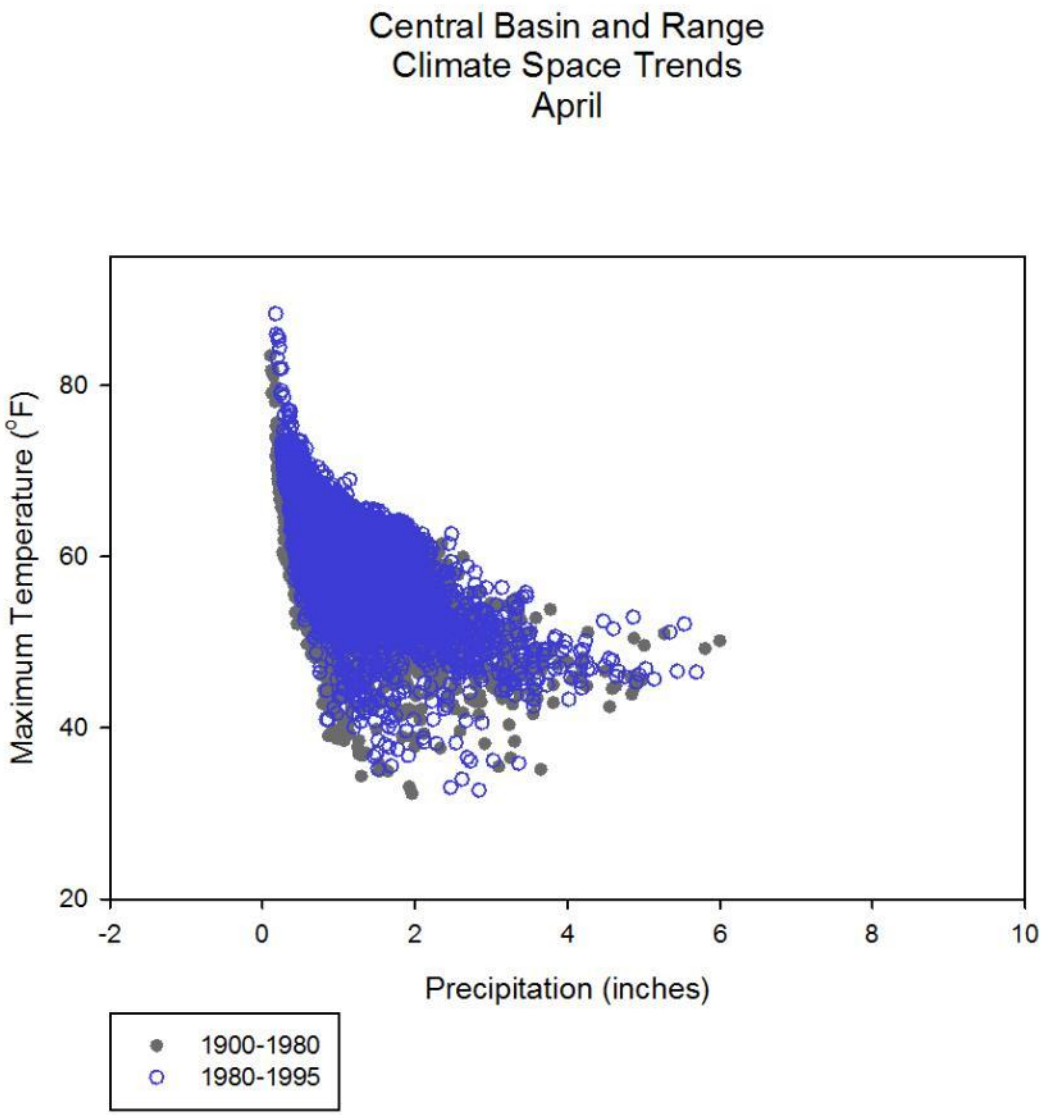

CBR
January Minimum Temperature Anomalies
1900-1980 vs 1995-2010
+2 SD
+1 SD
-1 SD

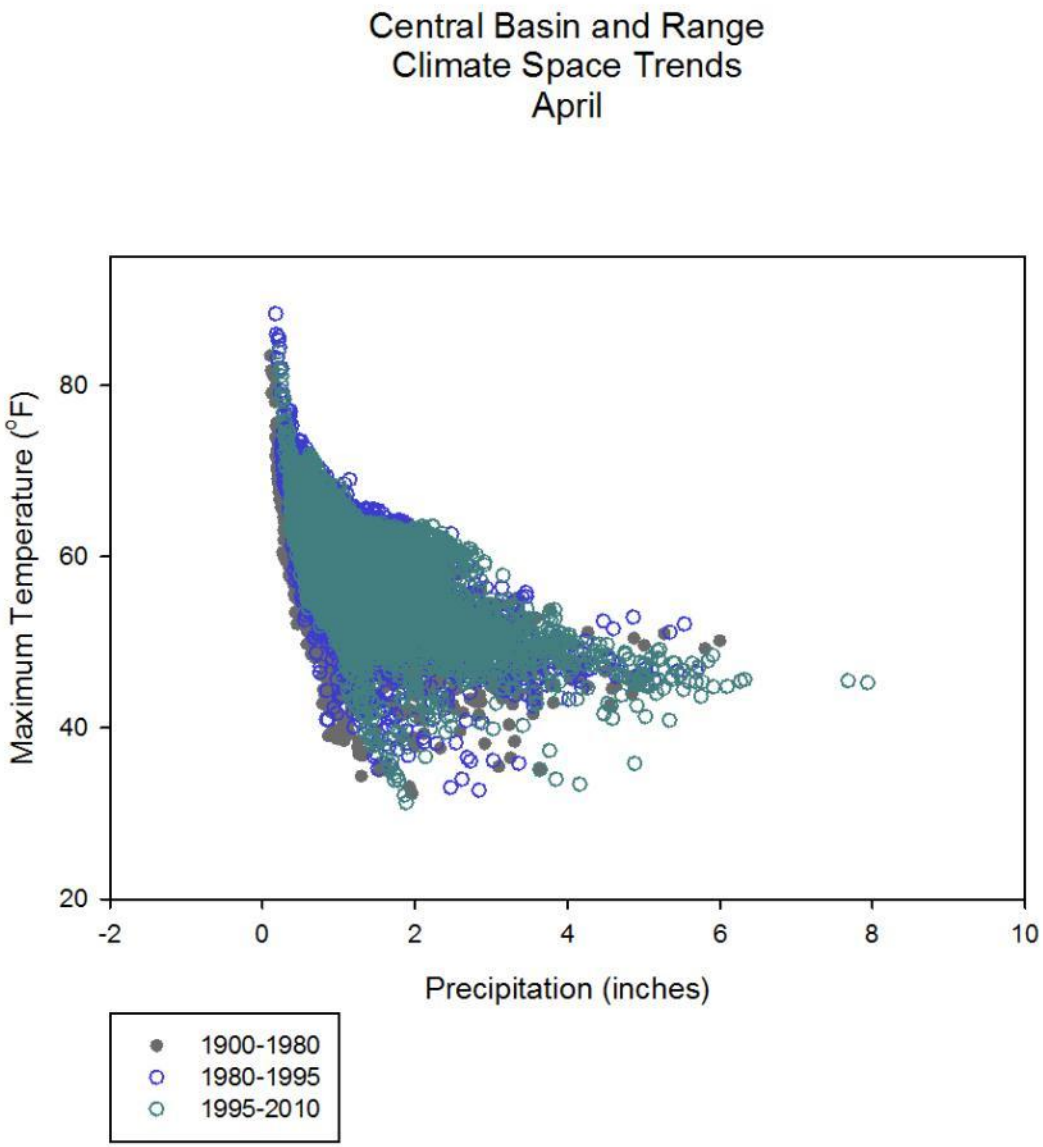

Central Basin and Mojave Basin
January Minimum Temperature Anomalies
1900-1980 vs 2020s
Central Basin
Mojave Basin
+1 SD

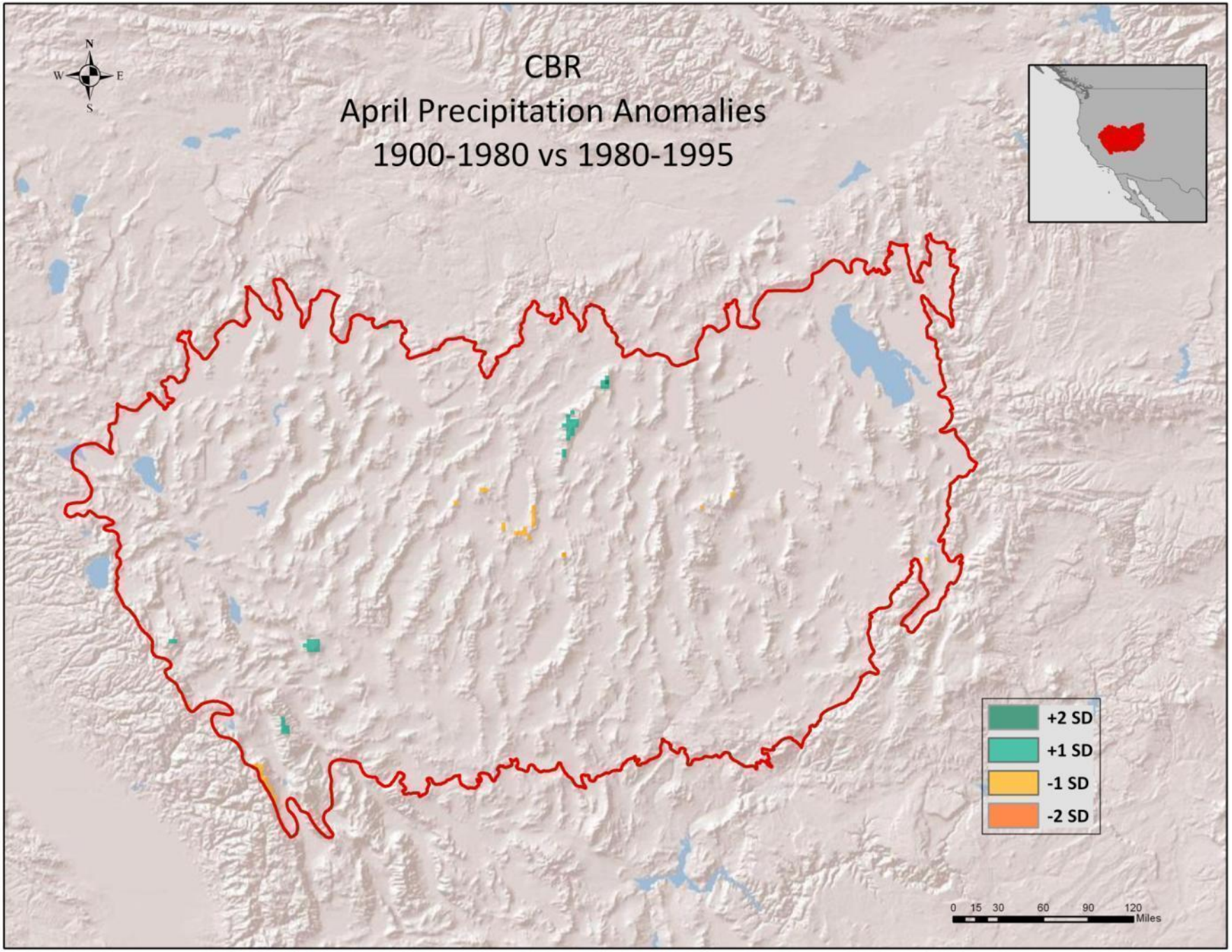

Mojave Basin
January Minimum Temperature Anomalies
1900-1980 vs 1995-2010
+2 SD
+1 SD

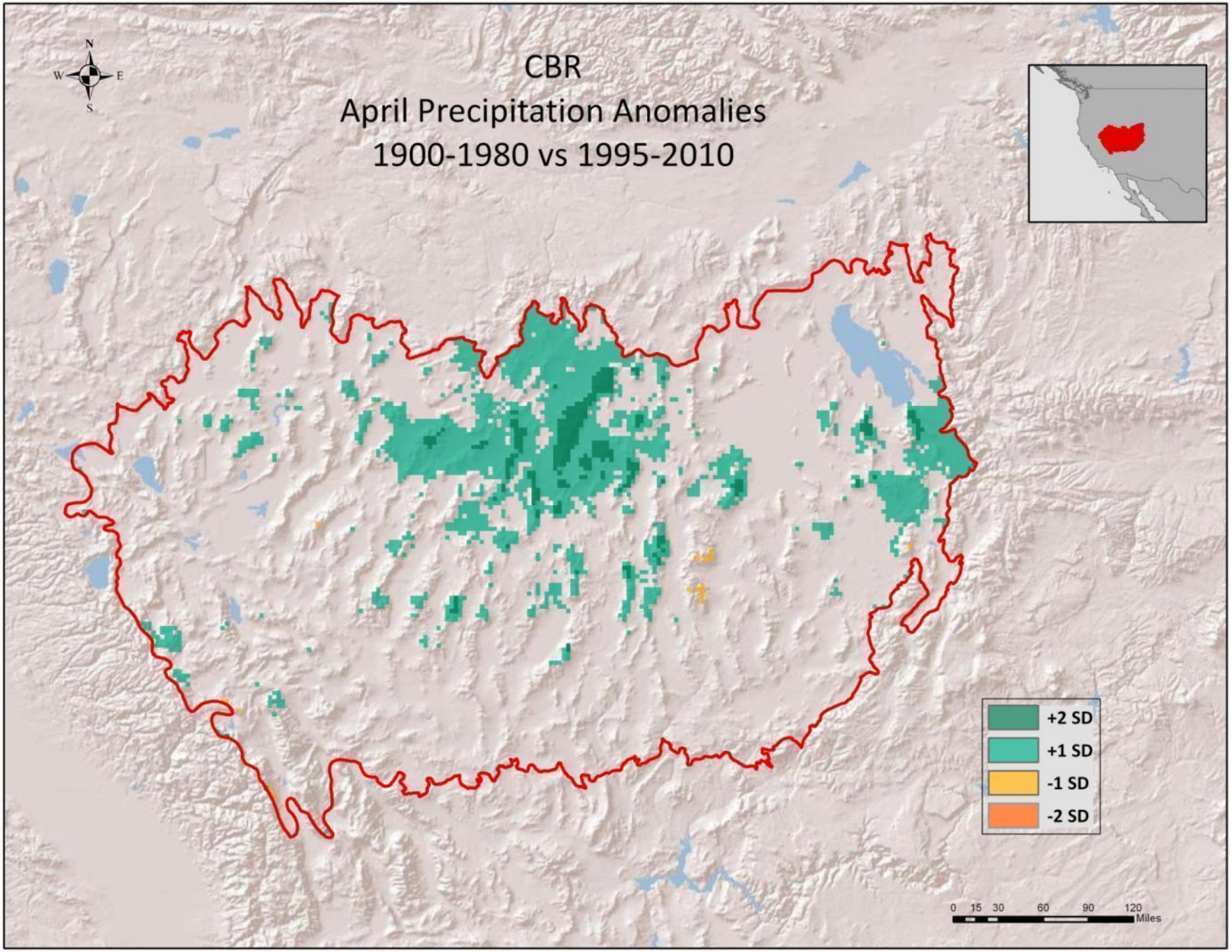

Central Basin and Mojave Basin
January Minimum Temperature Anomalies
1900-1980 vs 2050s
Central Basin
Mojave Basin
+2 SD
+1 SD

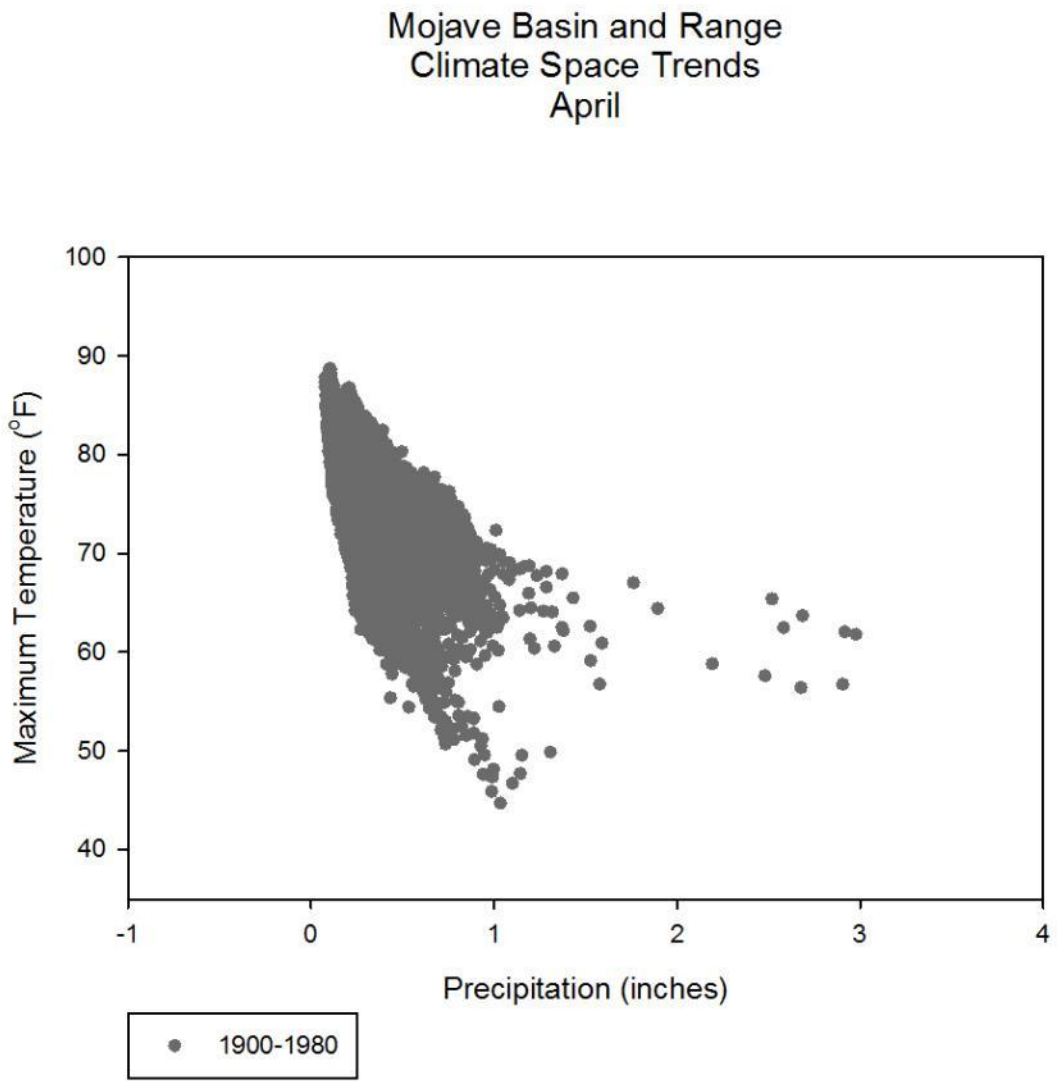

Central Basin and Range
Climate Space Trends
April
Maximum Temperature (°F)
80
60
40
20
-2
0
2
4
6
8
10
Precipitation (inches)
1900-1980

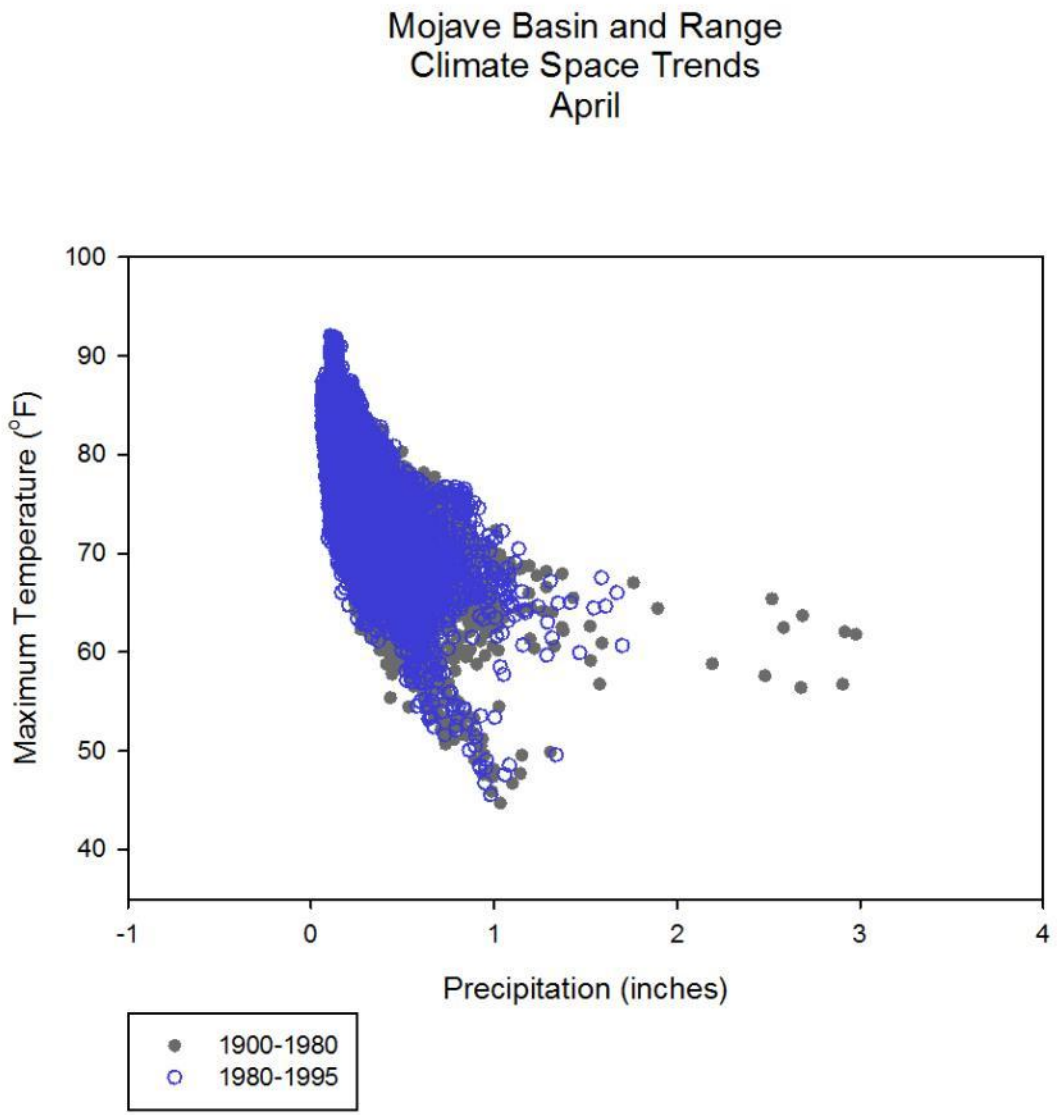

Central Basin and Range
Climate Space Trends
April
Maximum Temperature (°F)
80
60
40
20
-2
0
2
4
6
8
10
Precipitation (inches)
1900-1980
1980-1995

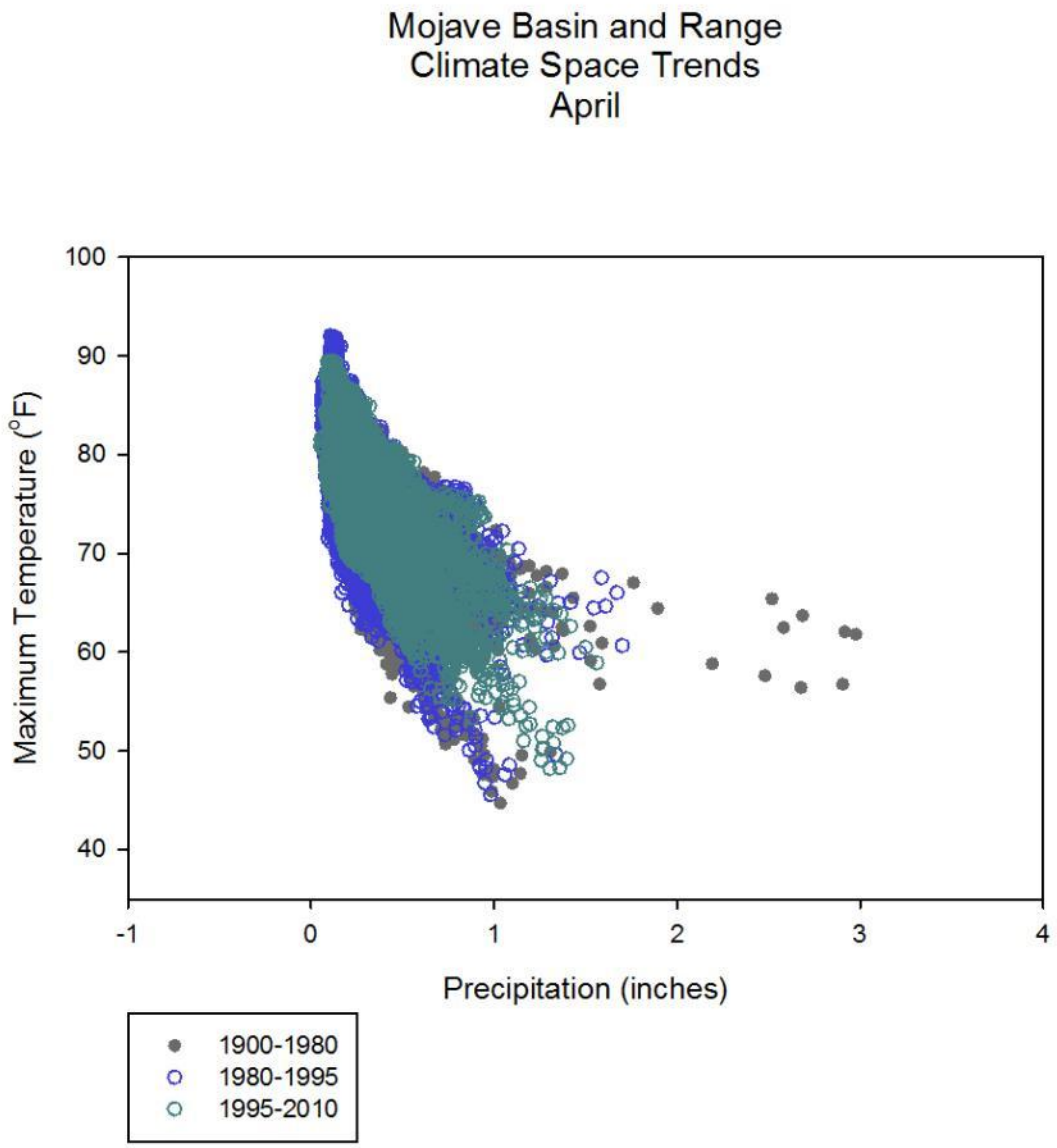

Central Basin and Range
Climate Space Trends
April
Maximum Temperature (°F)
80
60
40
20
-2
0
2
4
6
8
10
Precipitation (inches)
1900-1980
1980-1995
1995-2010

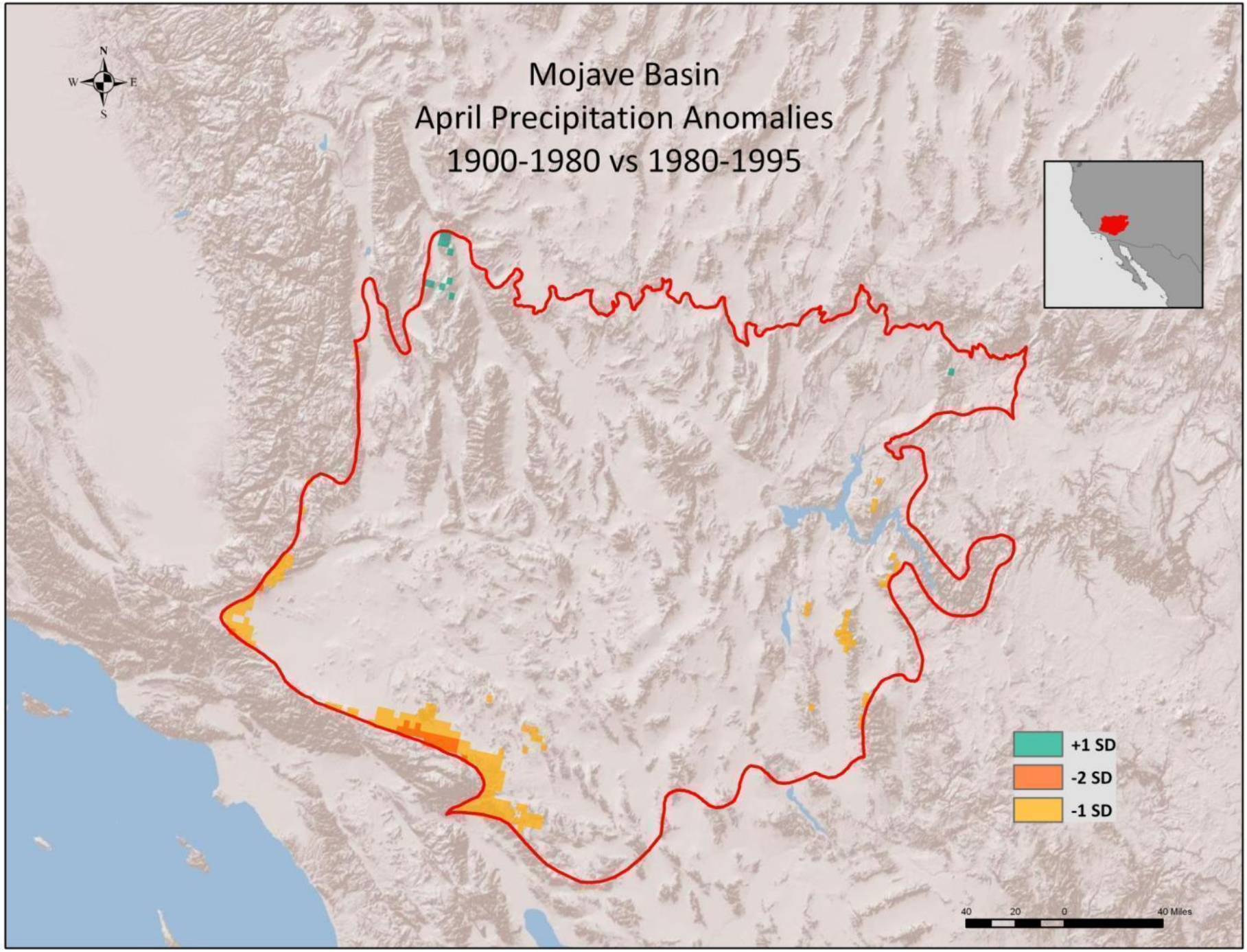

CBR
April Precipitation Anomalies
1900-1980 vs 1980-1995
N
W
E
S
+2 SD
+1 SD
-1 SD
-2 SD
0 15 30 60 90 120
Miles

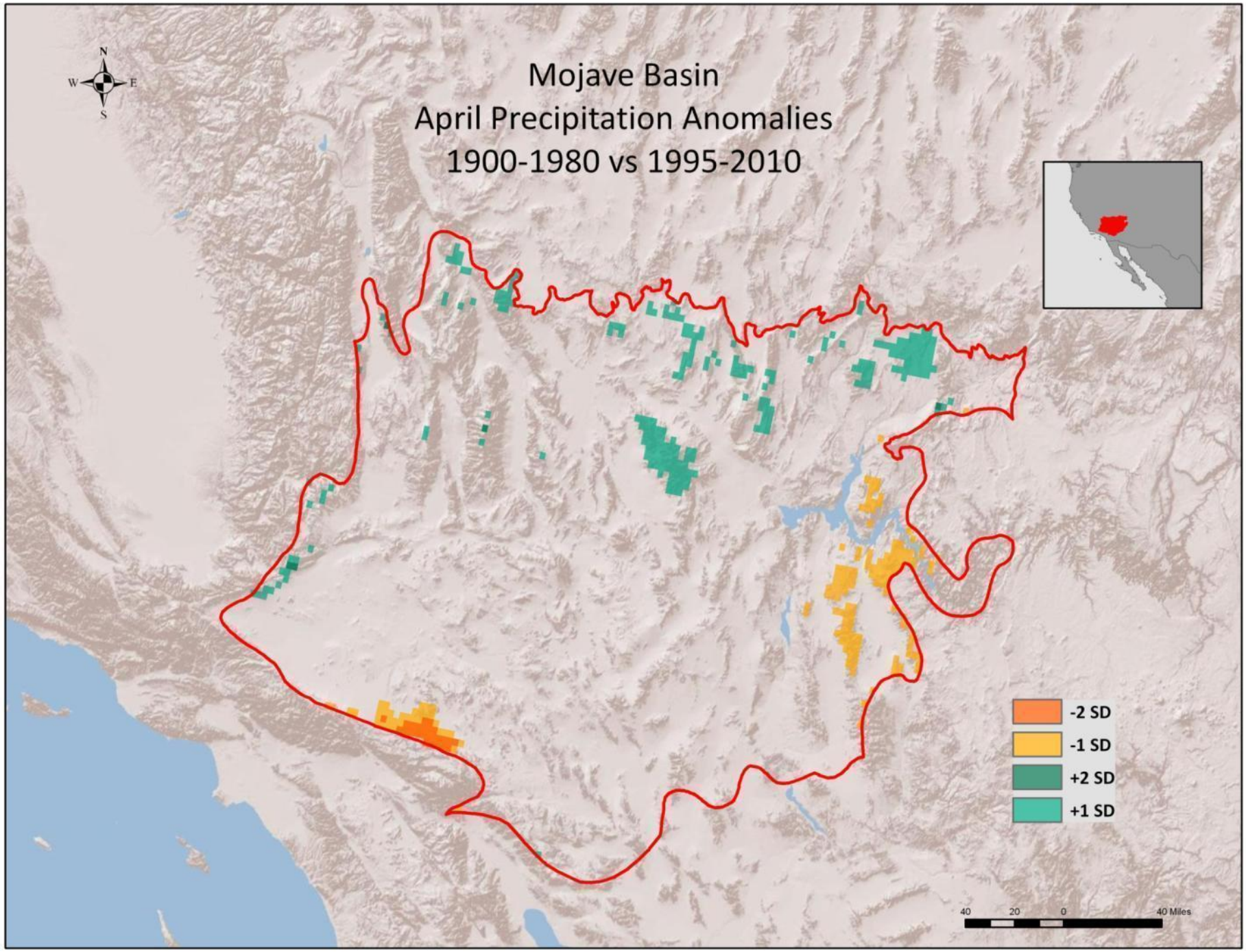

CBR
April Precipitation Anomalies
1900-1980 vs 1995-2010
N
W
E
S
+2 SD
+1 SD
-1 SD
-2 SD
0 15 30 60 90 120
Miles

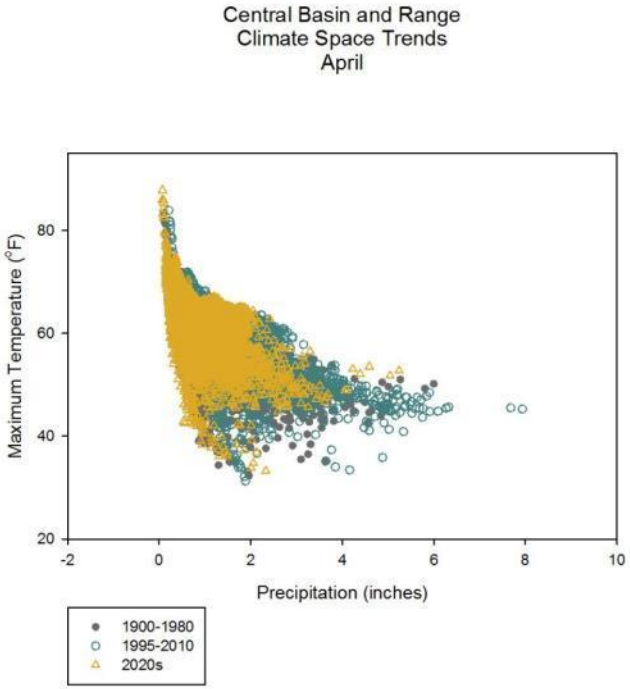

Mojave Basin and Range
Climate Space Trends
April
Maximum Temperature (°F)
100
90
80
70
60
50
40
-1
0
1
2
3
4
Precipitation (inches)
1900-1980

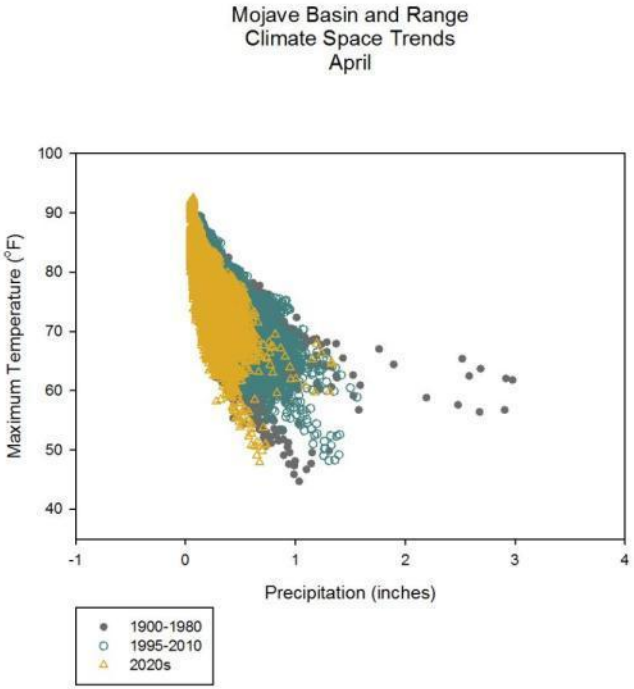

Mojave Basin and Range
Climate Space Trends
April
Maximum Temperature (°F)
100
90
80
70
60
50
40
-1
0
1
2
3
4
Precipitation (inches)
1900-1980
1980-1995

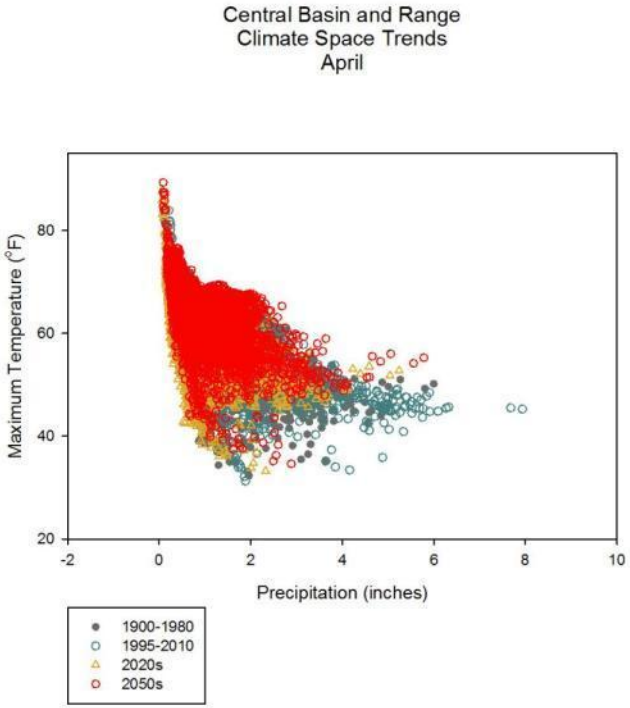

Mojave Basin and Range
Climate Space Trends
April
Maximum Temperature (°F)
100
90
80
70
60
50
40
-1
0
1
2
3
4
Precipitation (inches)
1900-1980
1980-1995
1995-2010

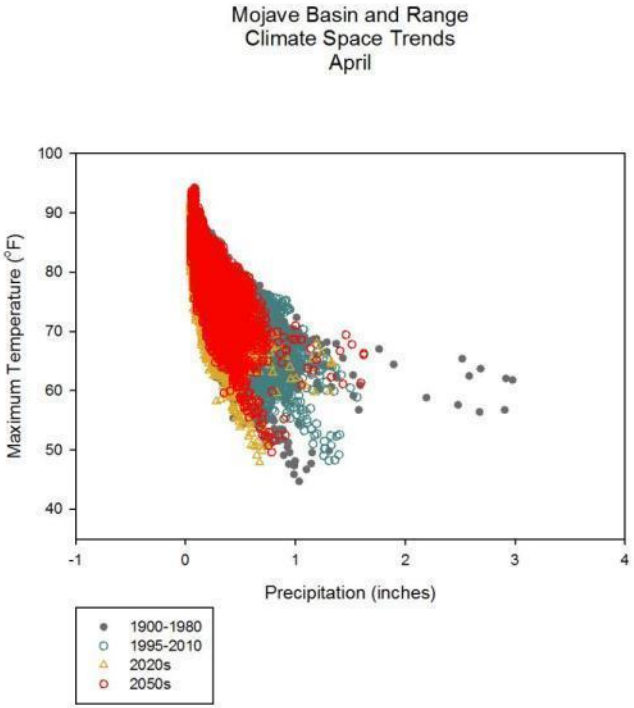

Mojave Basin
April Precipitation Anomalies
1900-1980 vs 1980-1995
N
W
E
S
+1 SD
-2 SD
-1 SD
40
20
0
40 Miles

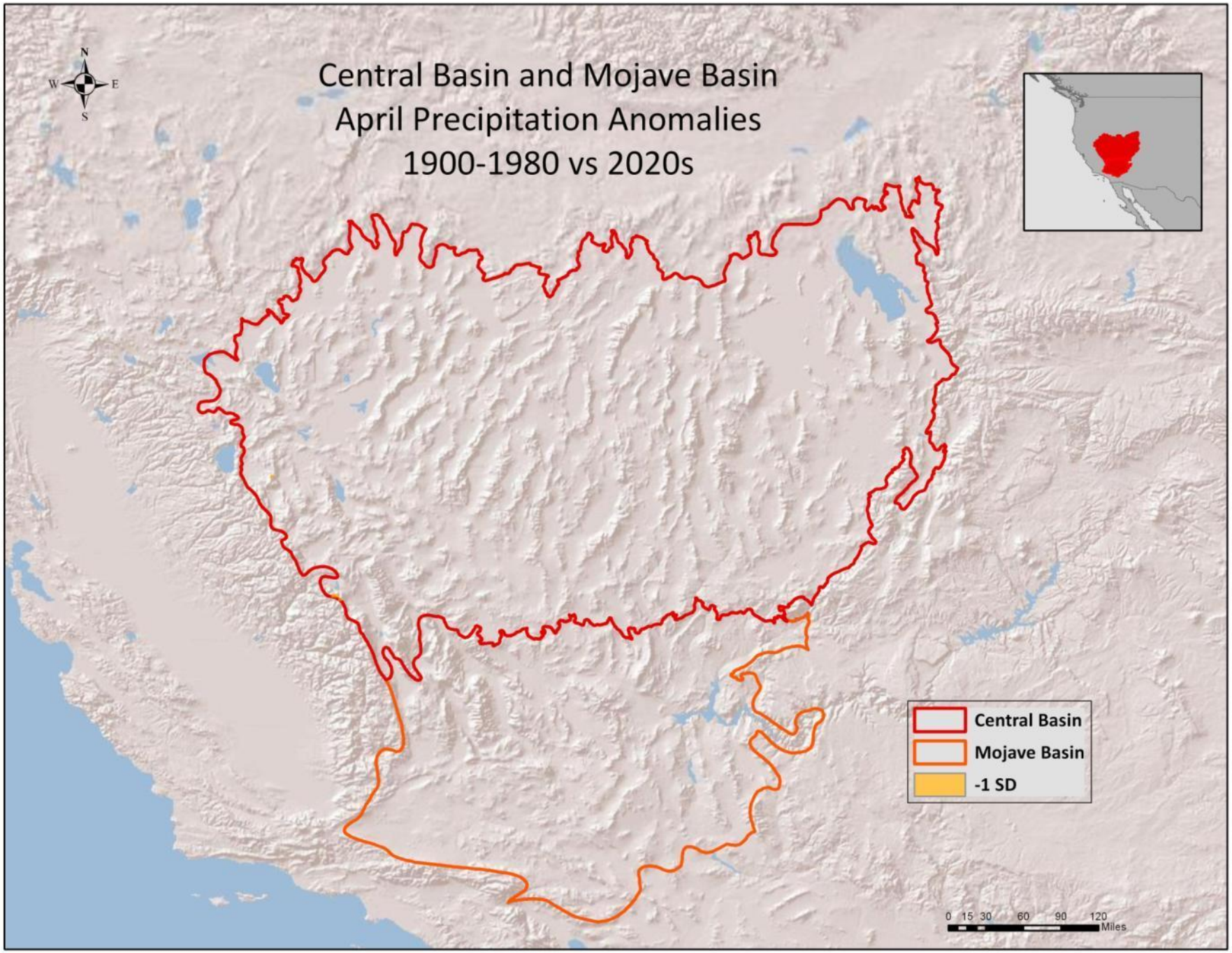

Mojave Basin
April Precipitation Anomalies
1900-1980 vs 1995-2010
N
W
E
S
-2 SD
-1 SD
+2 SD
+1 SD
40
20
0
40 Miles

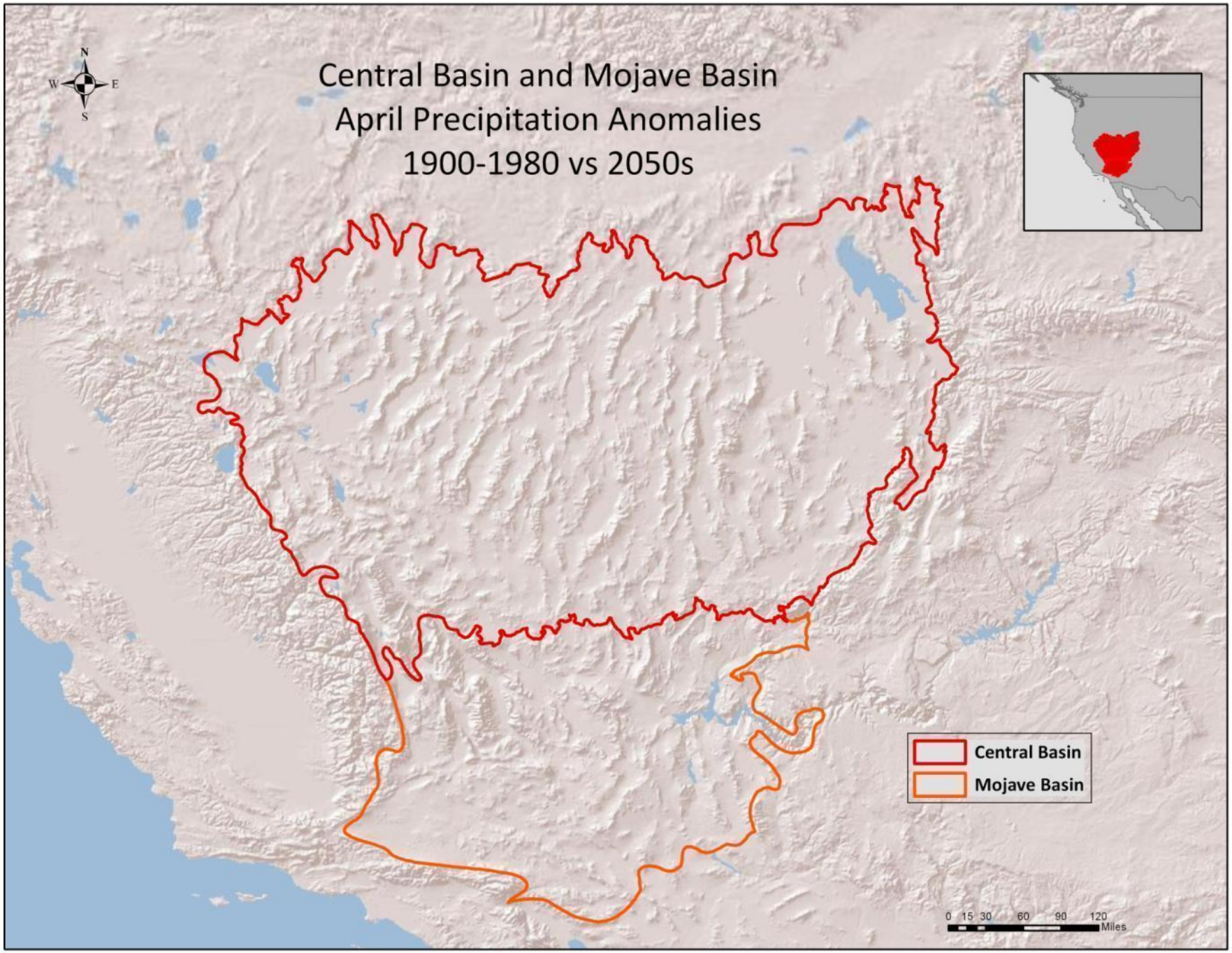

Central Basin and Range
Climate Space Trends
April
Maximum Temperature (°F)
Precipitation (inches)
20
40
60
80
-2
0
2
4
6
8
10
1900-1980
1995-2010
2020s

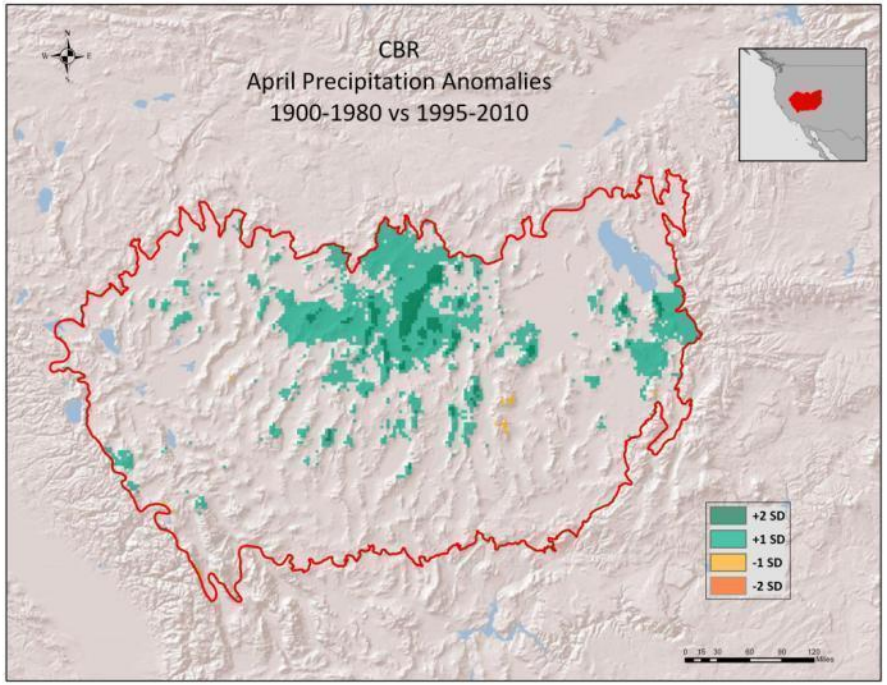

Mojave Basin and Range
Climate Space Trends
April
Maximum Temperature (°F)
Precipitation (inches)
40
50
60
70
80
90
100
-1
0
1
2
3
4
1900-1980
1995-2010
2020s

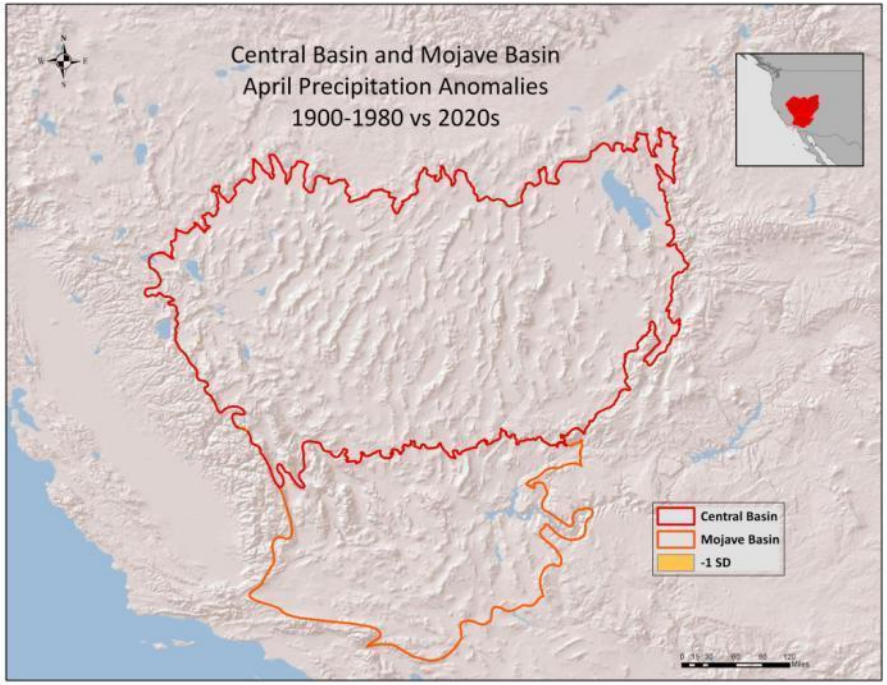

Central Basin and Range
Climate Space Trends
April
Maximum Temperature (°F)
Precipitation (inches)
1900-1980
1995-2010
2020s
2050s

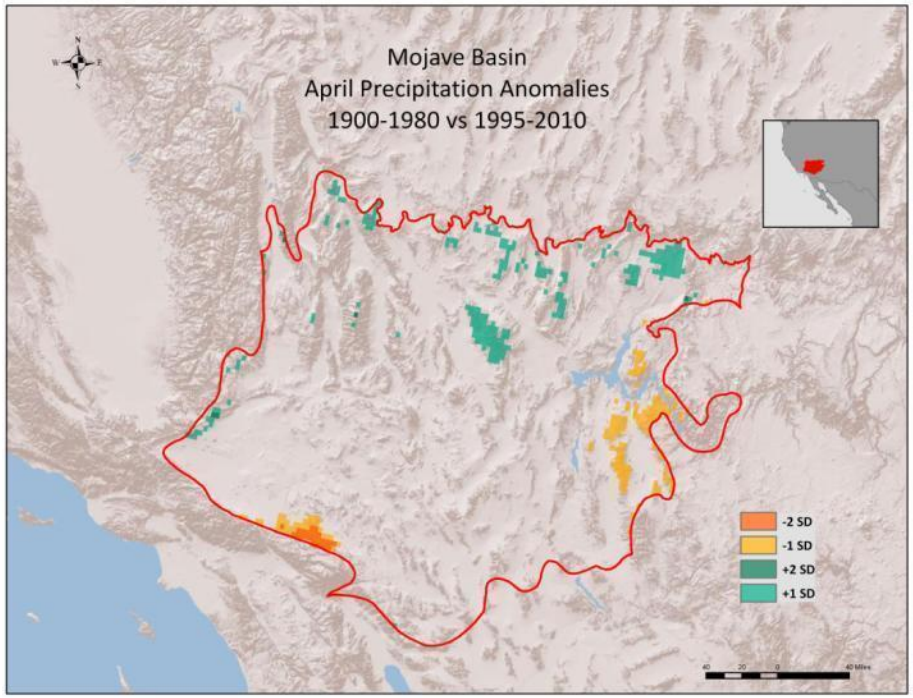

Mojave Basin and Range
Climate Space Trends
April
Maximum Temperature (°F)
Precipitation (inches)
1900-1980
1995-2010
2020s
2050s

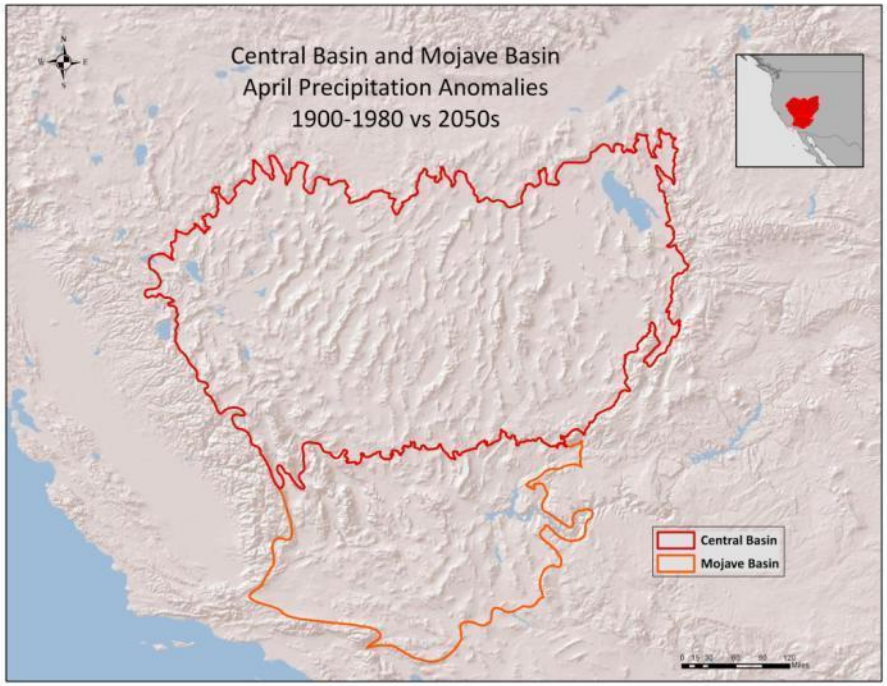

Central Basin and Mojave Basin
April Precipitation Anomalies
1900-1980 vs 2020s
N
W
E
S
Central Basin
Mojave Basin
-1 SD
0 15 30 60 90 120
Miles

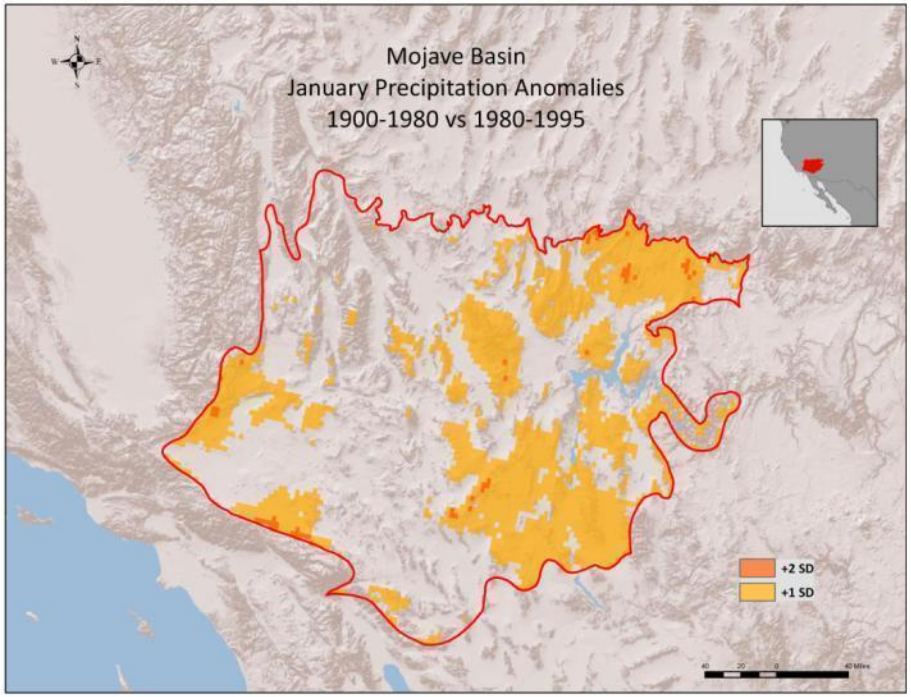

Central Basin and Mojave Basin
April Precipitation Anomalies
1900-1980 vs 2050s
N
W
E
S
Central Basin
Mojave Basin
0 15 30 60 90 120
Miles

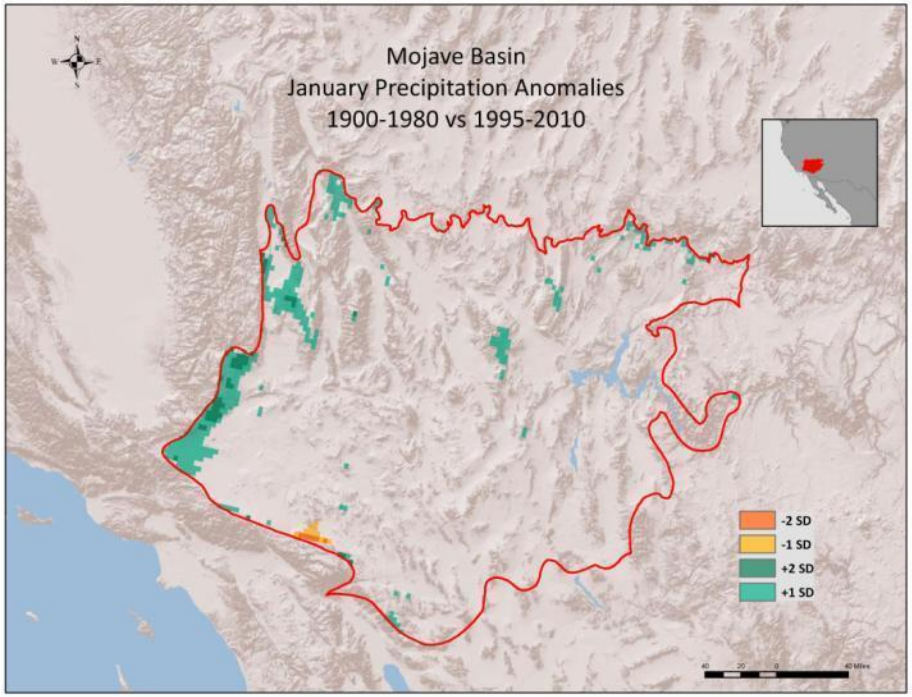

CBR
April Precipitation Anomalies
1900-1980 vs 1995-2010
+2 SD
+1 SD
-1 SD
-2 SD

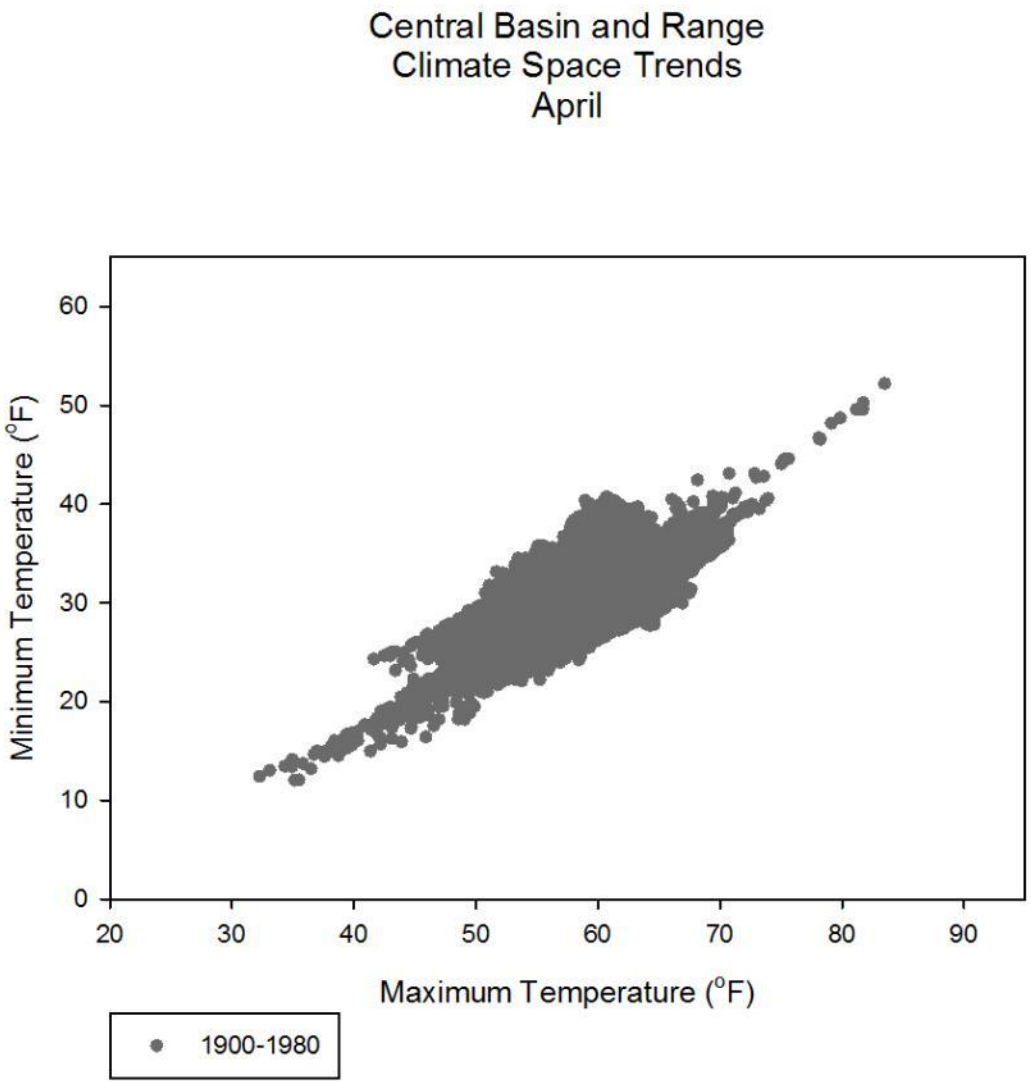

Central Basin and Mojave Basin
April Precipitation Anomalies
1900-1980 vs 2020s
Central Basin
Mojave Basin
-1 SD

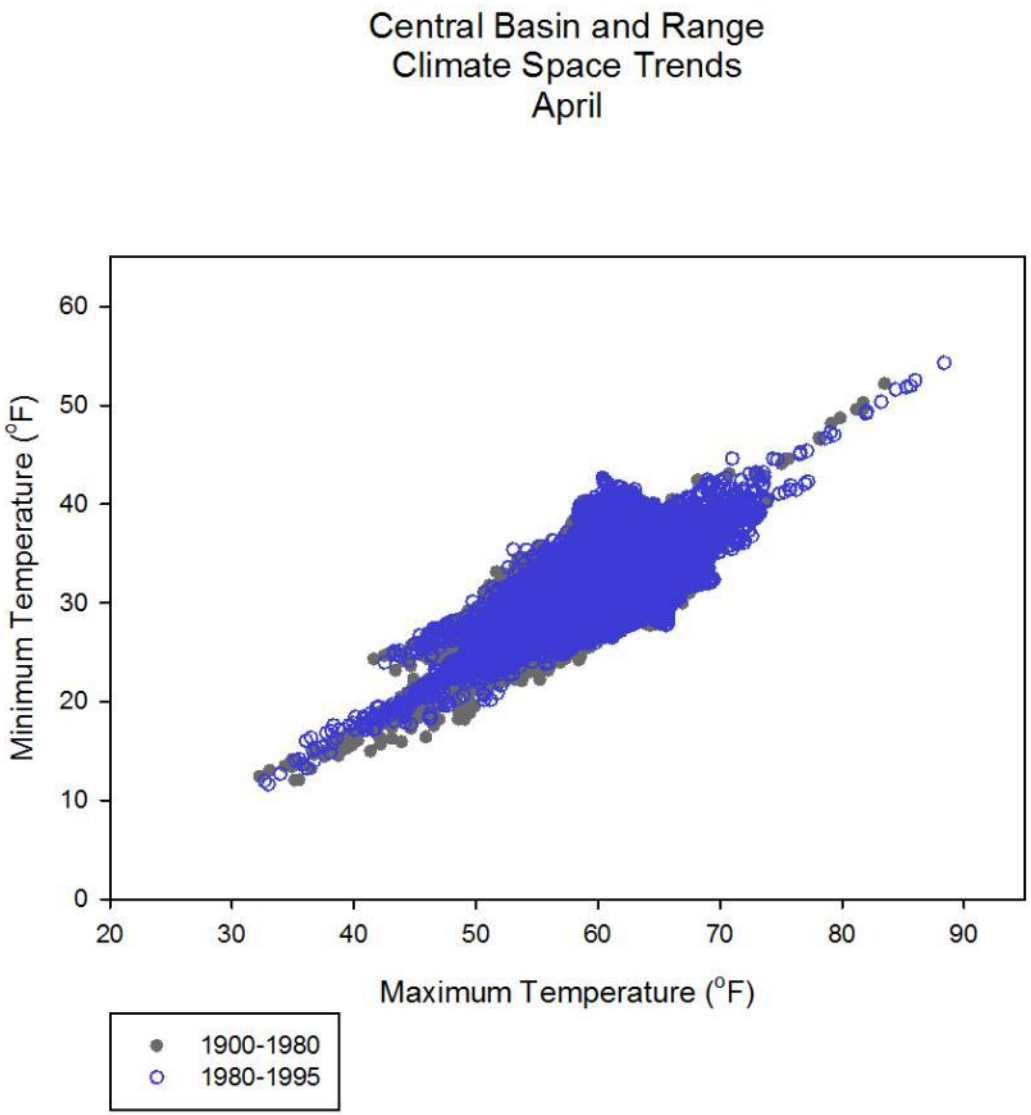

Mojave Basin
April Precipitation Anomalies
1900-1980 vs 1995-2010
-2 SD
-1 SD
+2 SD
+1 SD

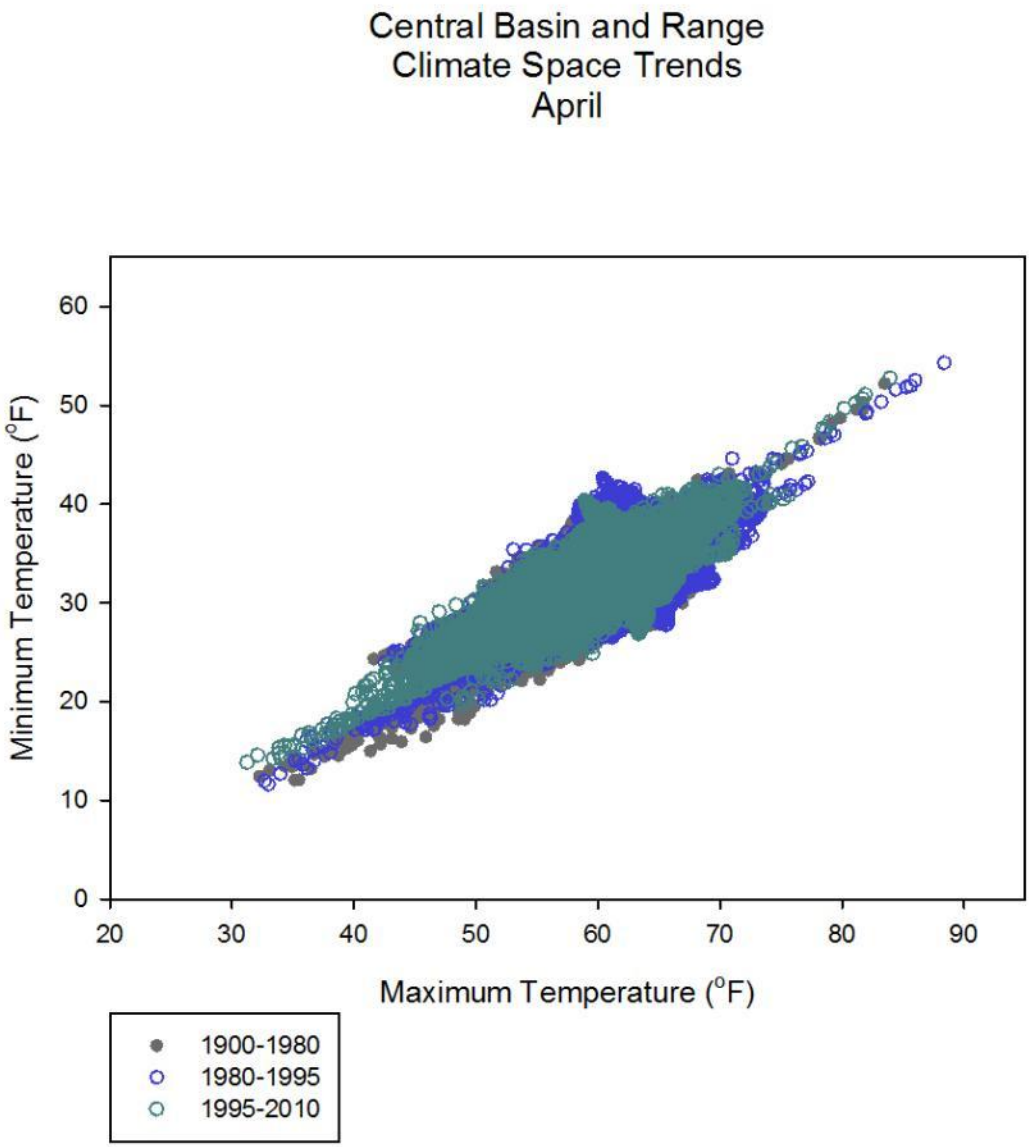

Central Basin and Mojave Basin
April Precipitation Anomalies
1900-1980 vs 2050s
Central Basin
Mojave Basin

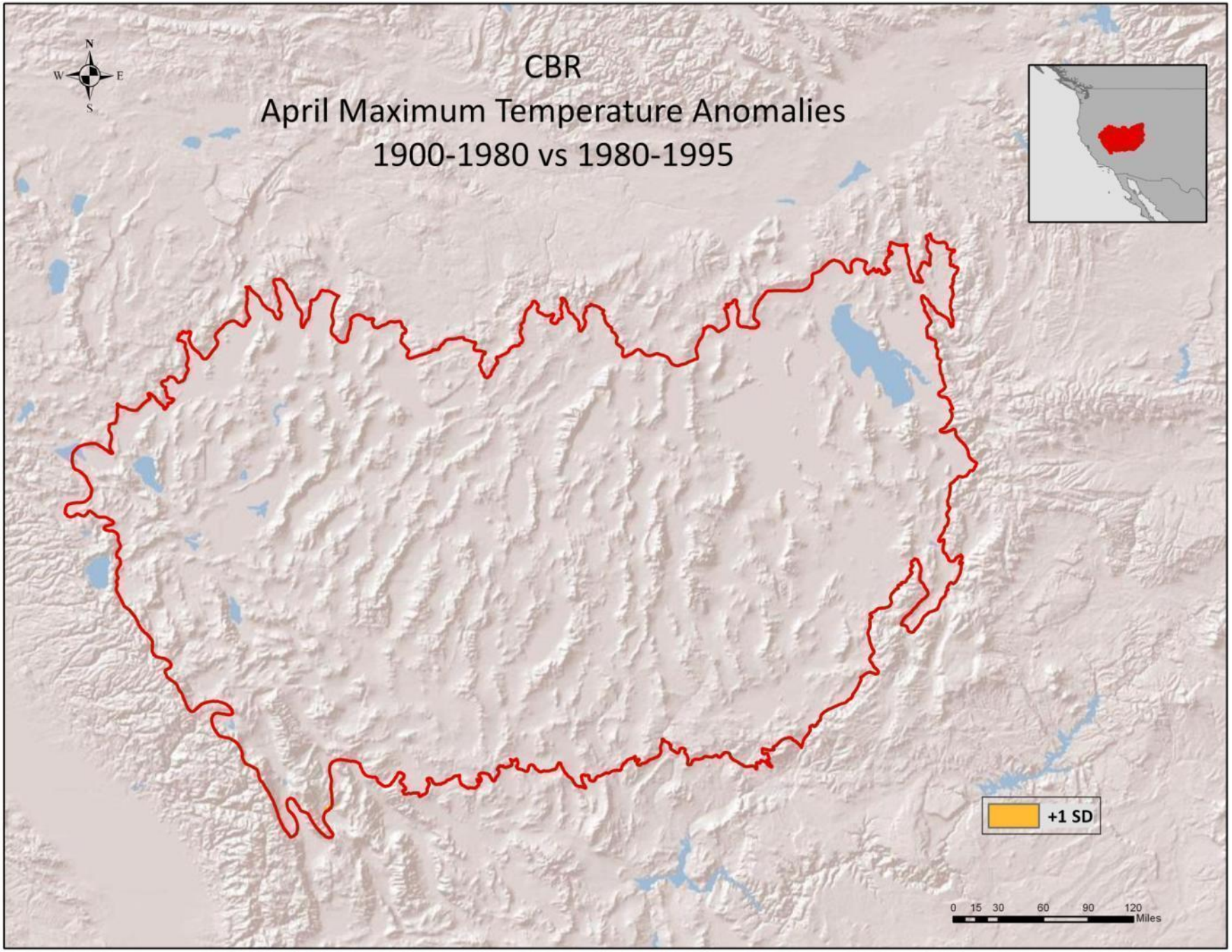

Mojave Basin
January Precipitation Anomalies
1900-1980 vs 1980-1995
+2 SD
+1 SD

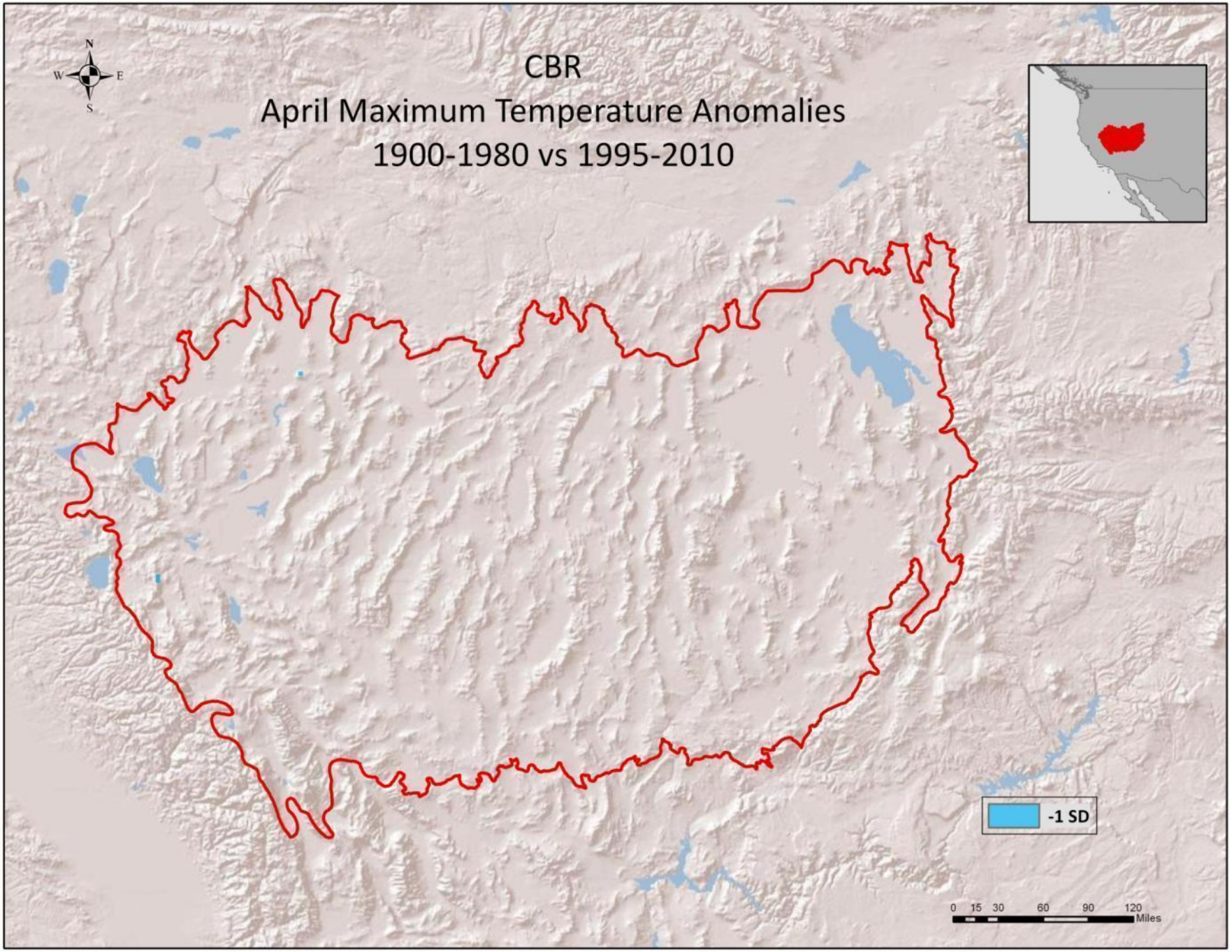

Mojave Basin
January Precipitation Anomalies
1900-1980 vs 1995-2010
-2 SD
-1 SD
+2 SD
+1 SD

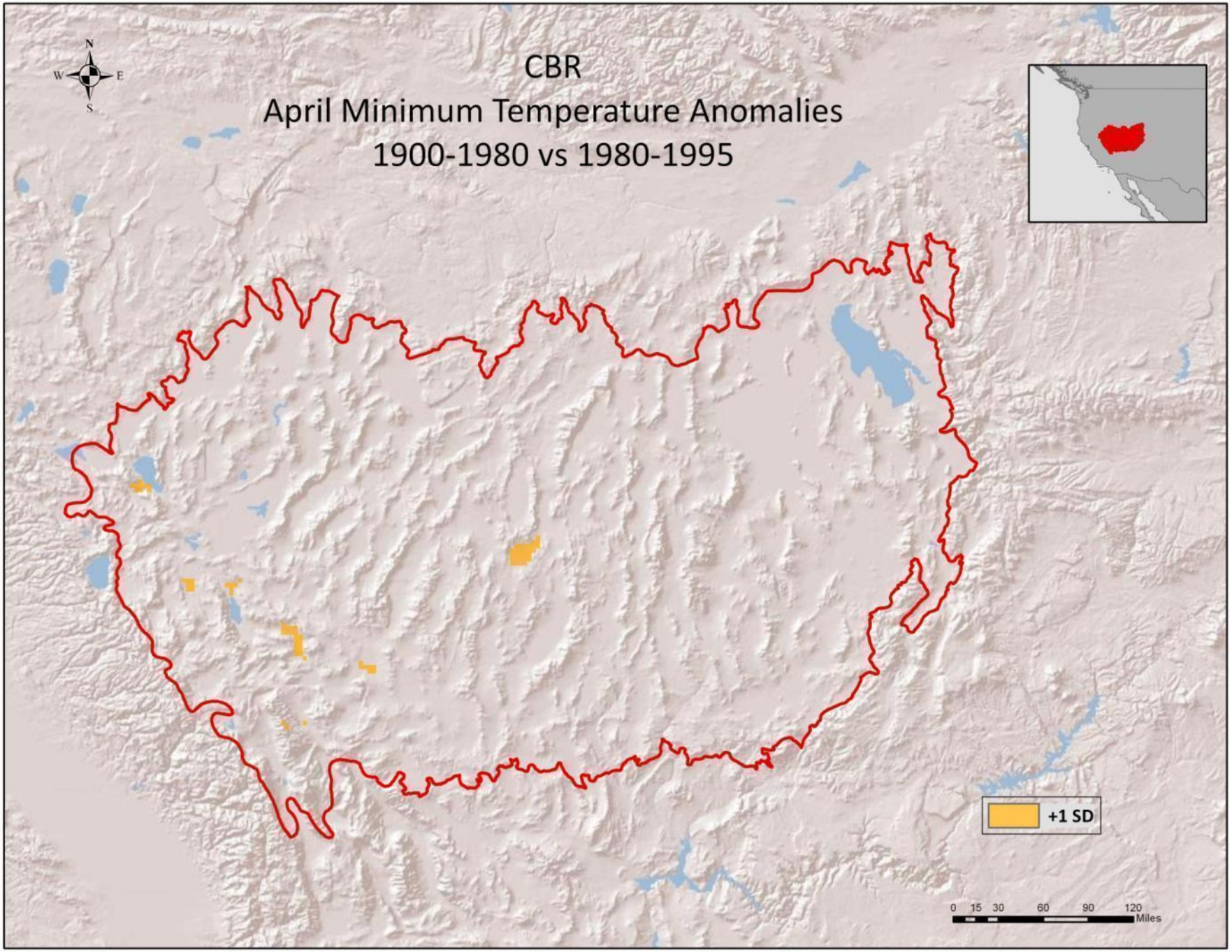

Central Basin and Range
Climate Space Trends
April
Minimum Temperature (°F)
0
10
20
30
40
50
60
20
30
40
50
60
70
80
90
Maximum Temperature (°F)
1900-1980

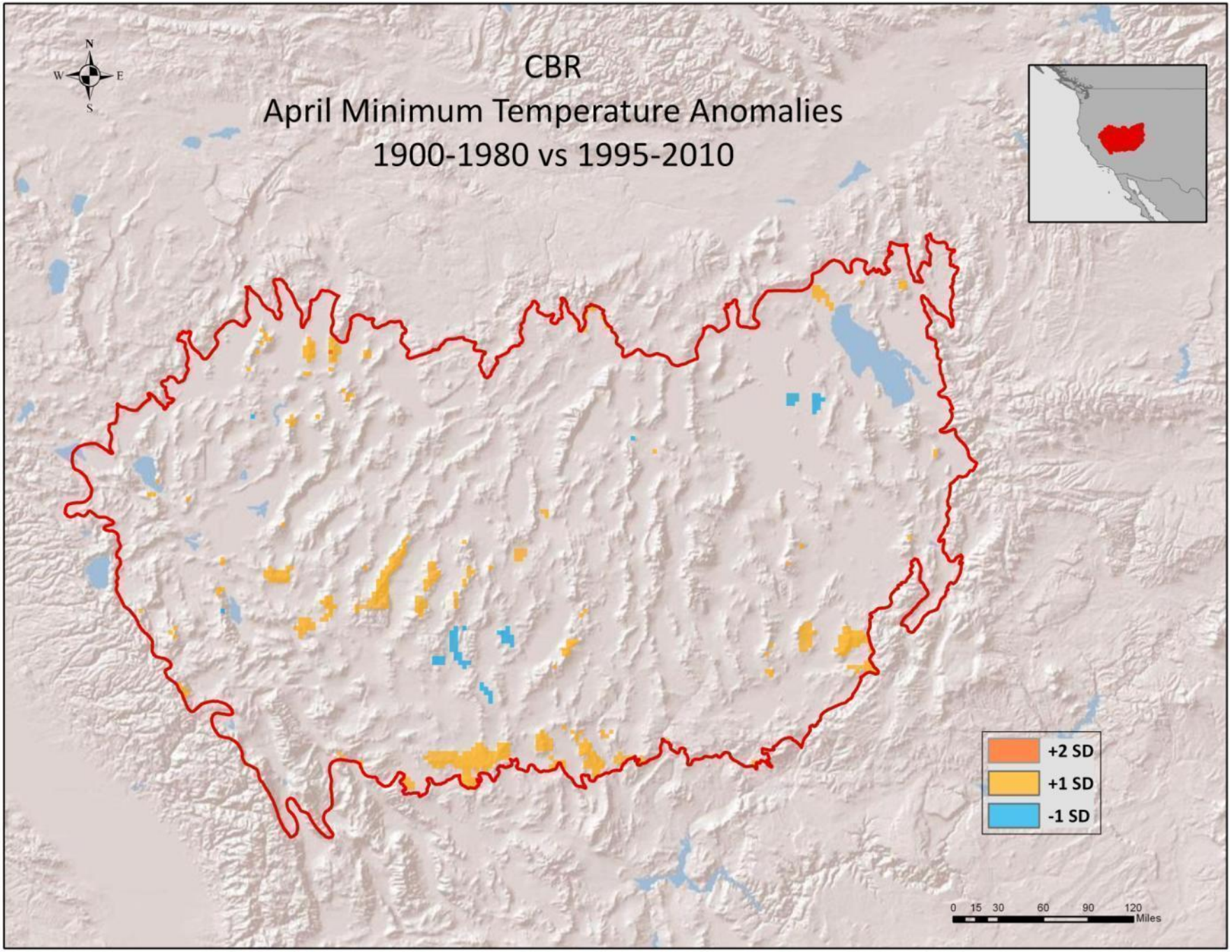

Central Basin and Range
Climate Space Trends
April
Minimum Temperature (°F)
Maximum Temperature (°F)
0
10
20
30
40
50
60
20
30
40
50
60
70
80
90
1900-1980
1980-1995

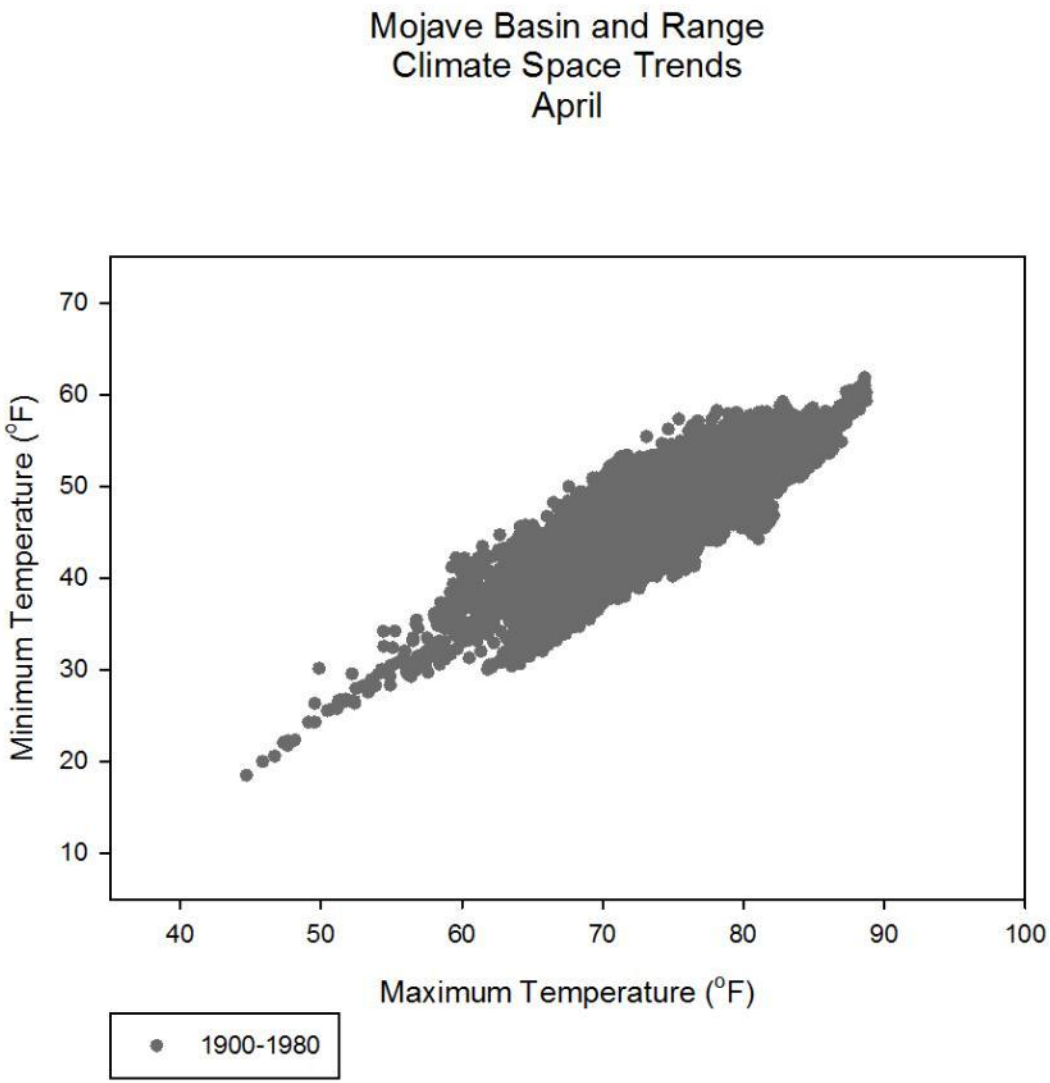

Central Basin and Range
Climate Space Trends
April
Minimum Temperature (°F)
Maximum Temperature (°F)
0
10
20
30
40
50
60
20
30
40
50
60
70
80
90
1900-1980
1980-1995
1995-2010

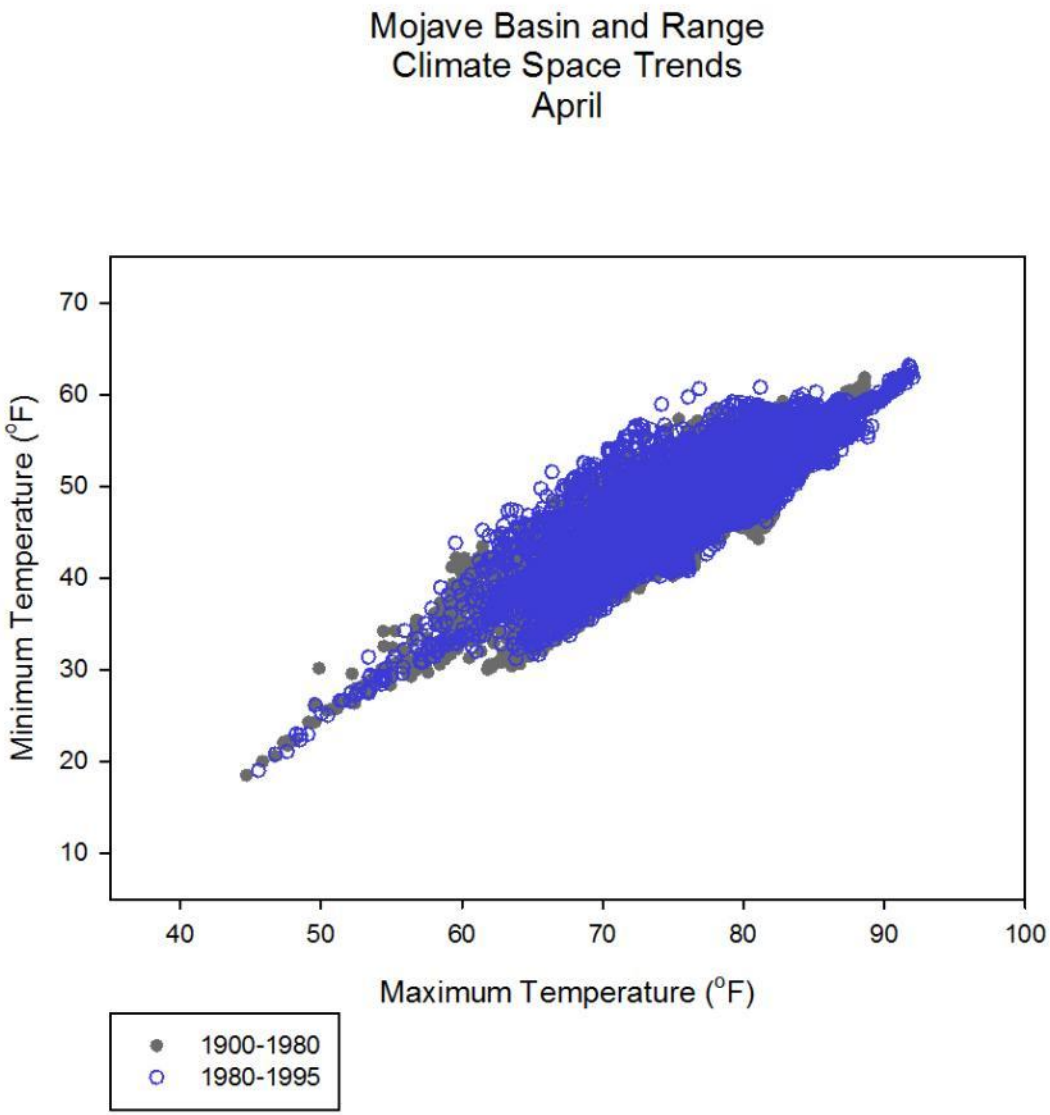

CBR
April Maximum Temperature Anomalies
1900-1980 vs 1980-1995
N
W
E
S
+1 SD
0 15 30 60 90 120
Miles

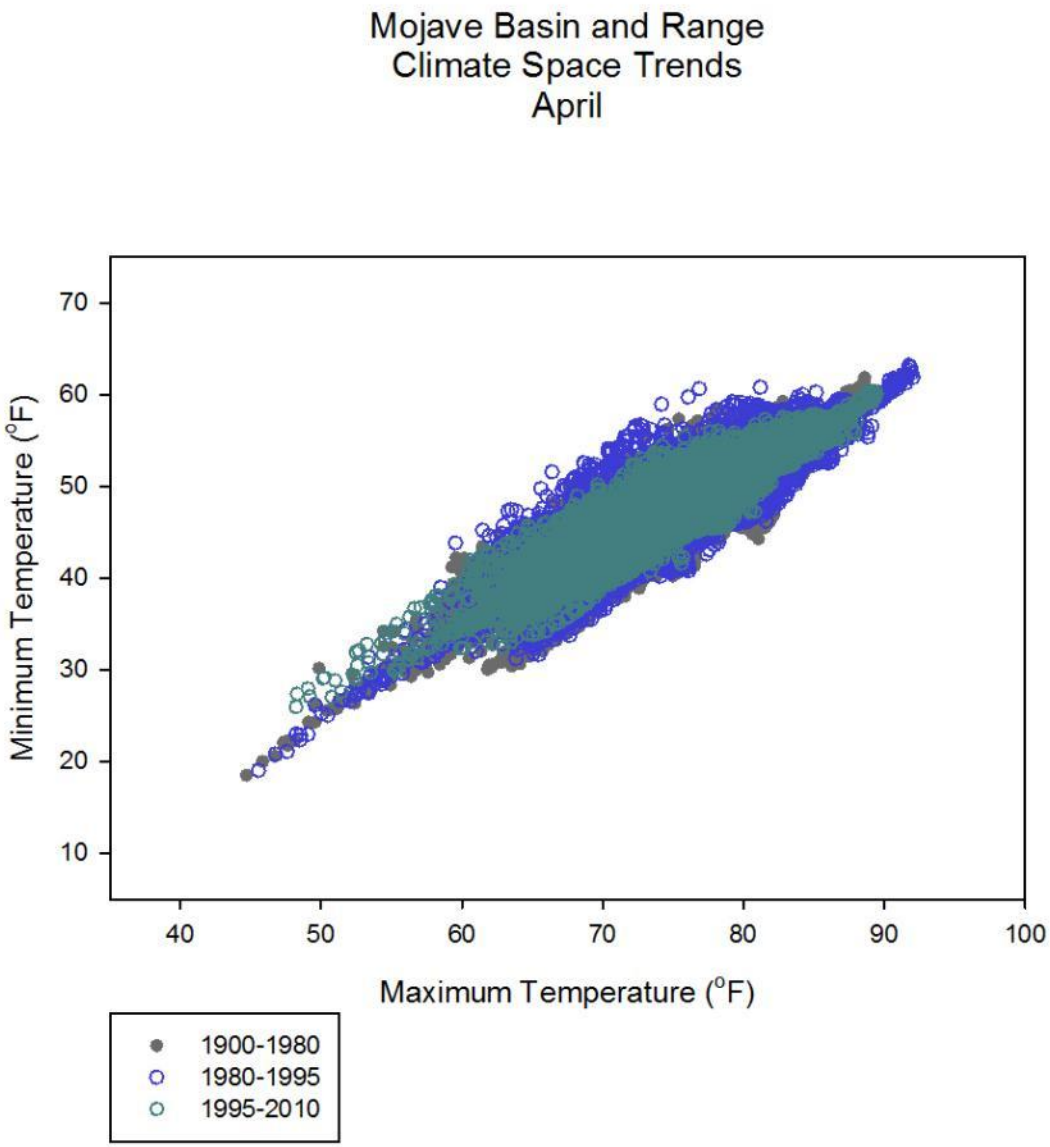

CBR
April Maximum Temperature Anomalies
1900-1980 vs 1995-2010
N
W
E
S
-1 SD
0 15 30 60 90 120
Miles

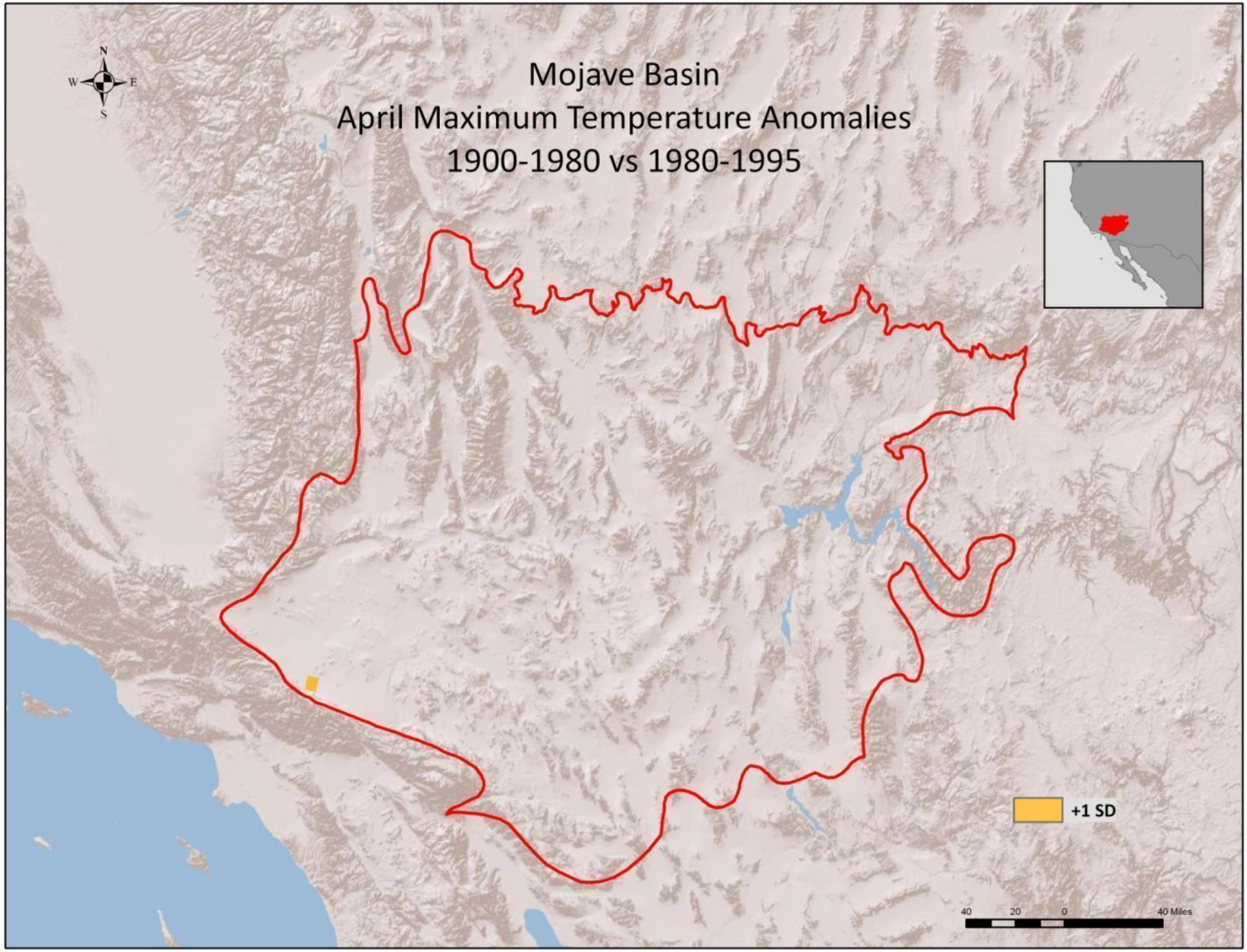

CBR
April Minimum Temperature Anomalies
1900-1980 vs 1980-1995
N
W
E
S
+1 SD
0 15 30 60 90 120
Miles

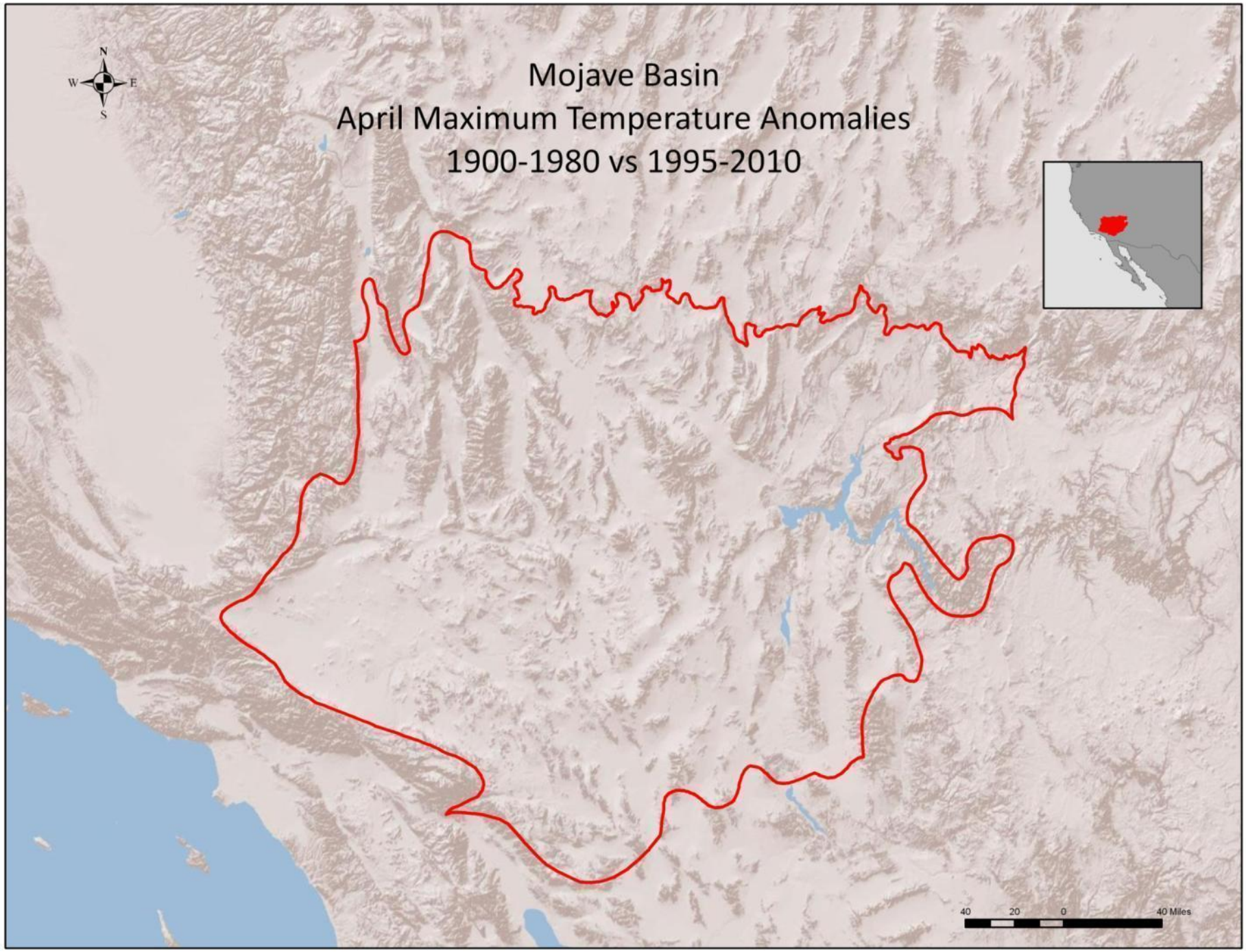

CBR
April Minimum Temperature Anomalies
1900-1980 vs 1995-2010
N
W
E
S
+2 SD
+1 SD
-1 SD
0 15 30 60 90 120
Miles

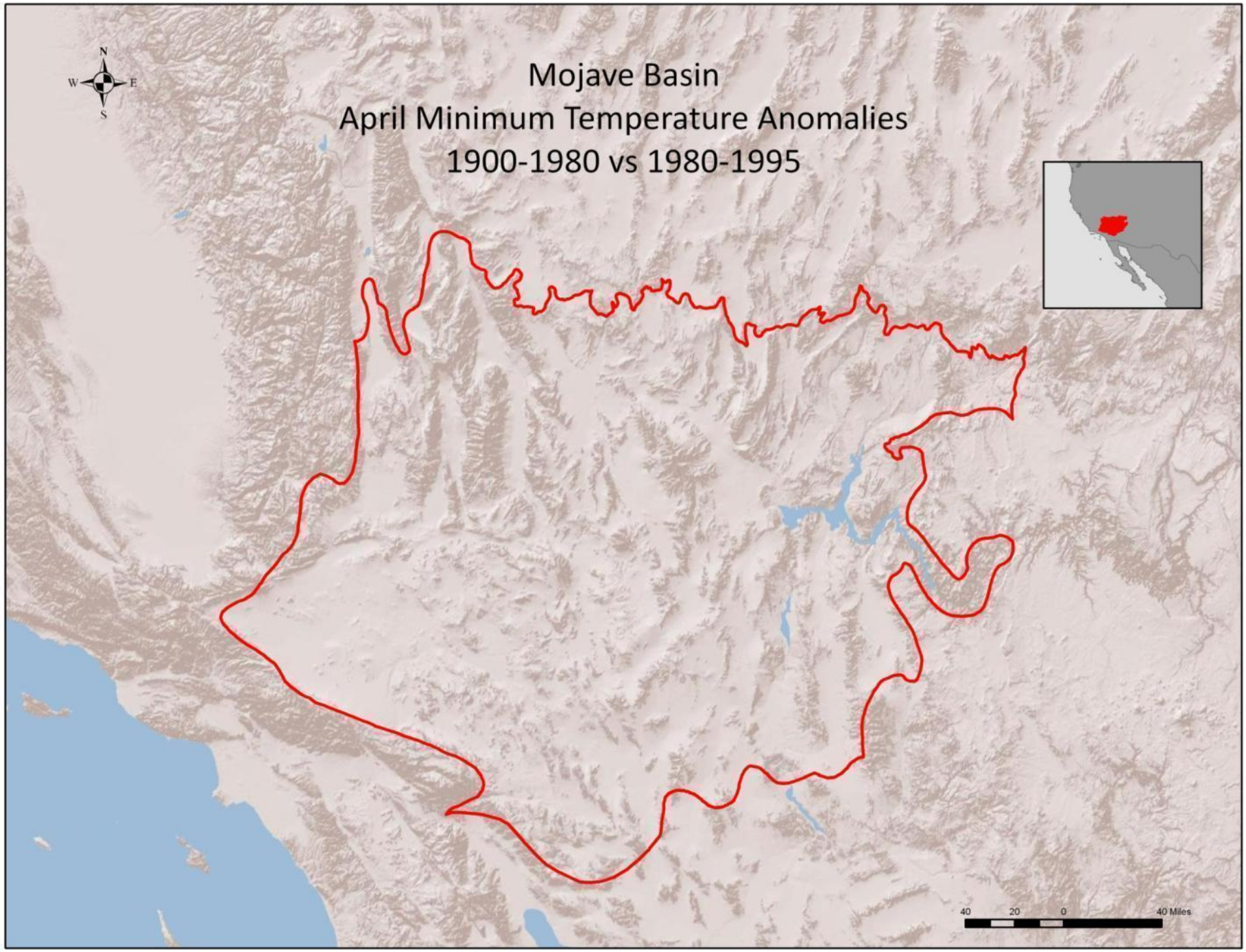

Mojave Basin and Range
Climate Space Trends
April
Minimum Temperature (°F)
70
60
50
40
30
20
10
40
50
60
70
80
90
100
Maximum Temperature (°F)
1900-1980

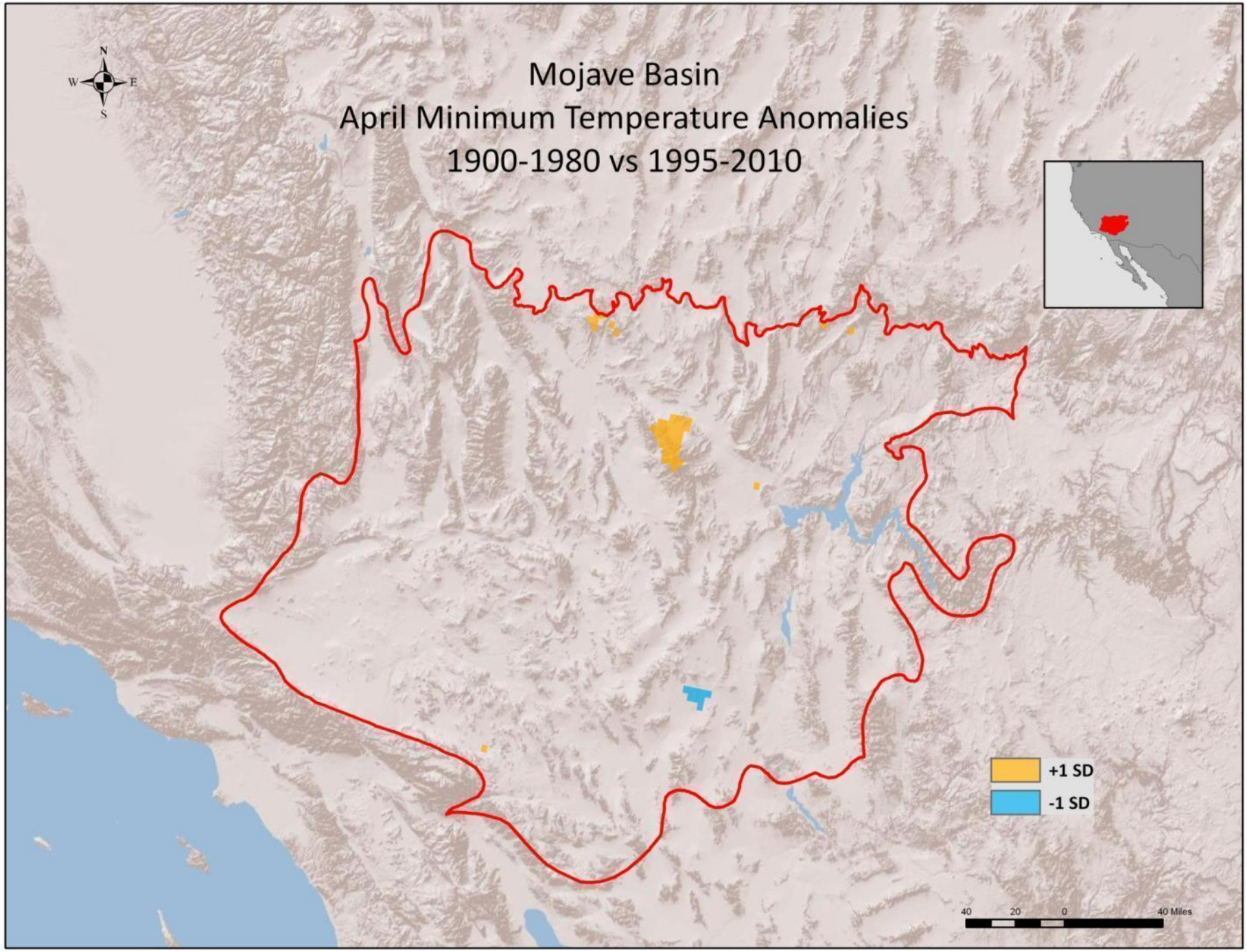

Mojave Basin and Range
Climate Space Trends
April
Minimum Temperature (°F)
70
60
50
40
30
20
10
40
50
60
70
80
90
100
Maximum Temperature (°F)
1900-1980
1980-1995

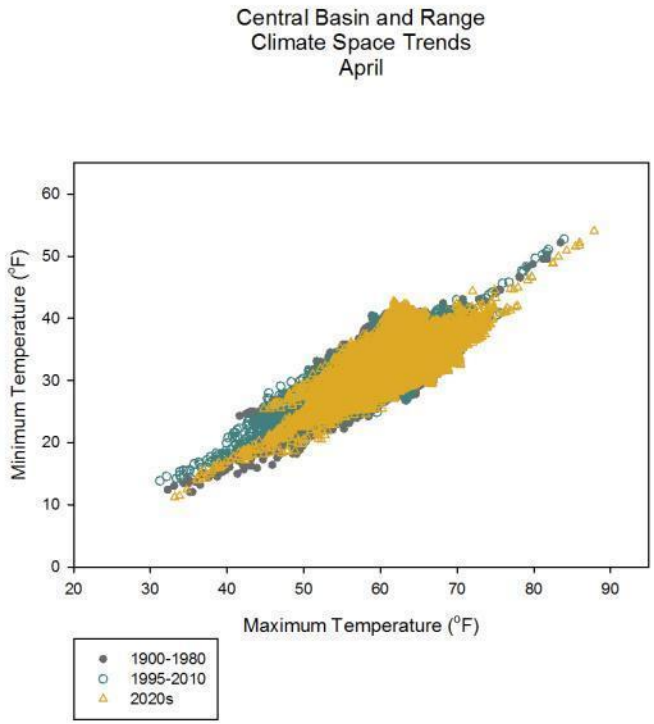

Mojave Basin and Range
Climate Space Trends
April
Minimum Temperature (°F)
70
60
50
40
30
20
10
40
50
60
70
80
90
100
Maximum Temperature (°F)
1900-1980
1980-1995
1995-2010

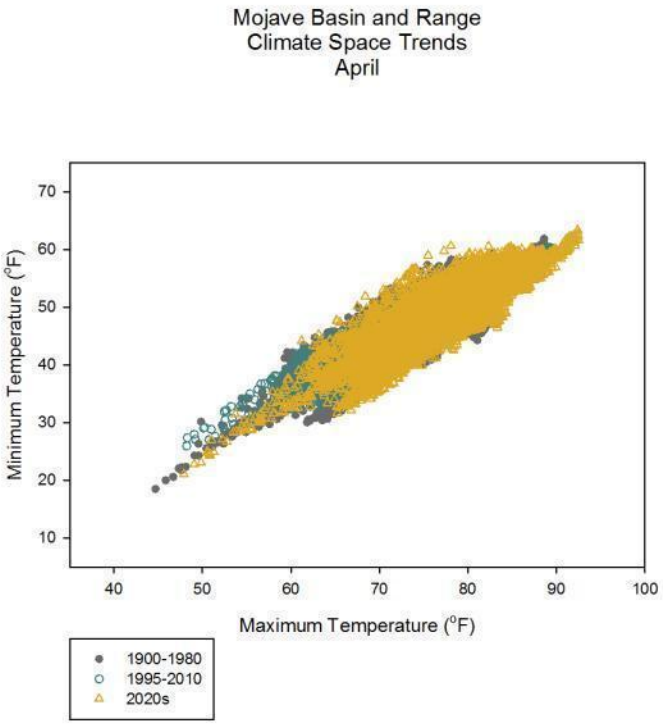

Mojave Basin
April Maximum Temperature Anomalies
1900-1980 vs 1980-1995
N
W
E
S
+1 SD
40
20
0
40 Miles

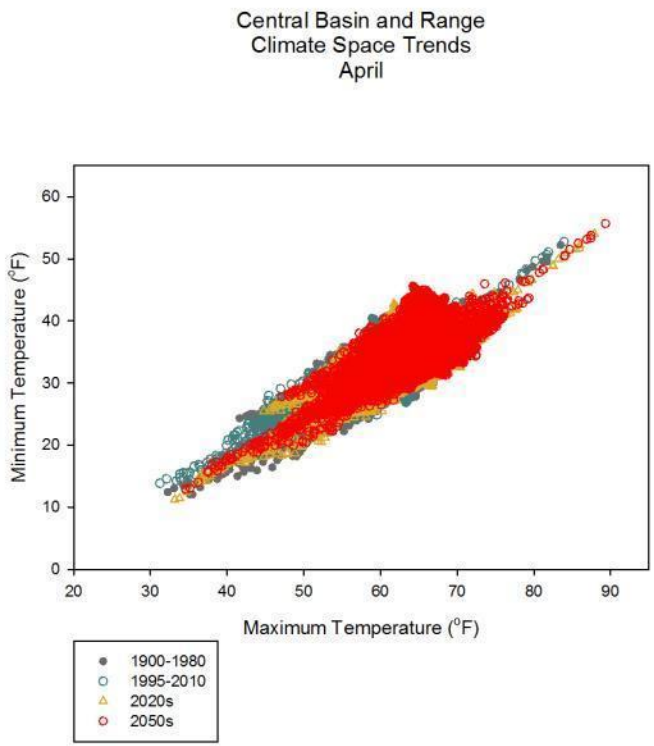

Mojave Basin
April Maximum Temperature Anomalies
1900-1980 vs 1995-2010
N
W
E
S
40
20
0
40 Miles


Mojave Basin
April Minimum Temperature Anomalies
1900-1980 vs 1980-1995
N
W
E
S
40
20
0
40 Miles


Mojave Basin
April Minimum Temperature Anomalies
1900-1980 vs 1995-2010
N
W
E
S
+1 SD
-1 SD
40
20
0
40 Miles


Central Basin and Range
Climate Space Trends
April
Minimum Temperature (°F)
Maximum Temperature (°F)
0
10
20
30
40
50
60
20
30
40
50
60
70
80
90
1900-1980
1995-2010
2020s


Mojave Basin and Range
Climate Space Trends
April
Minimum Temperature (°F)
Maximum Temperature (°F)
10
20
30
40
50
60
70
40
50
60
70
80
90
100
1900-1980
1995-2010
2020s


Central Basin and Range
Climate Space Trends
April
Minimum Temperature (°F)
Maximum Temperature (°F)
0
10
20
30
40
50
60
20
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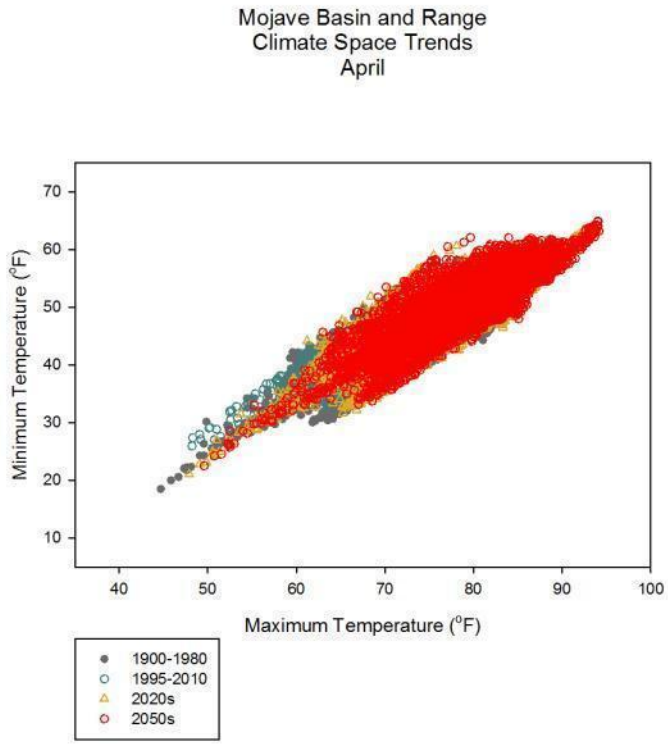
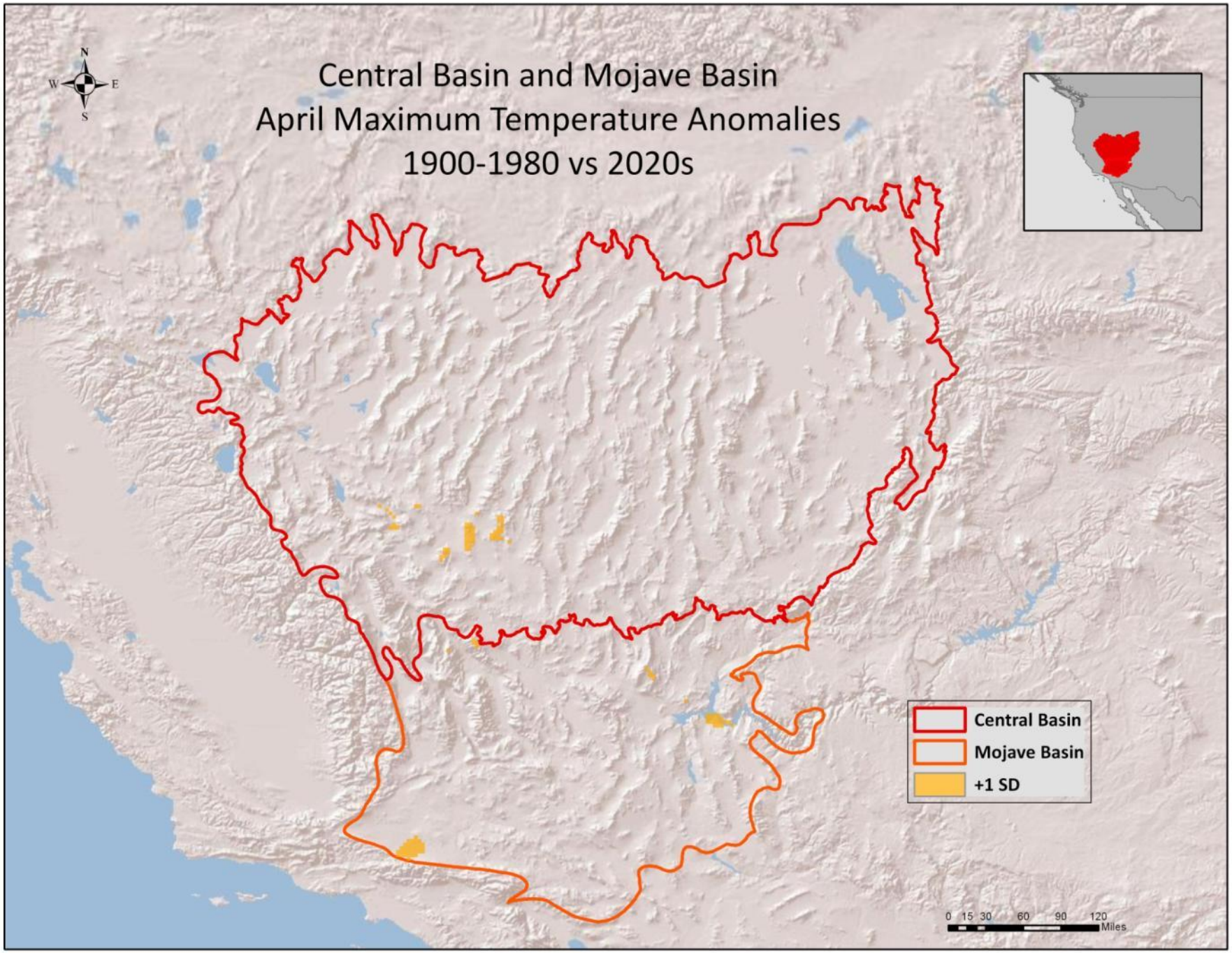
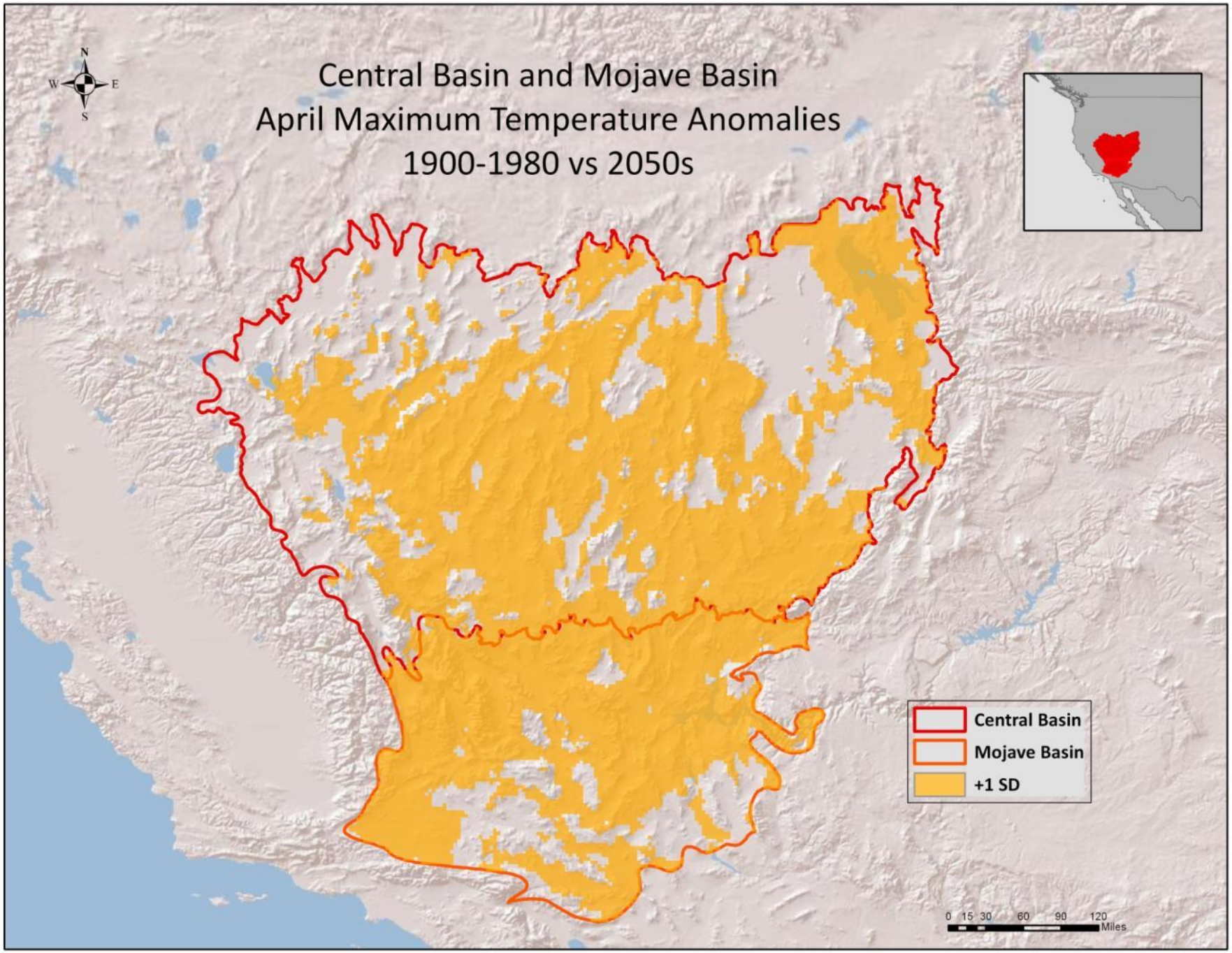
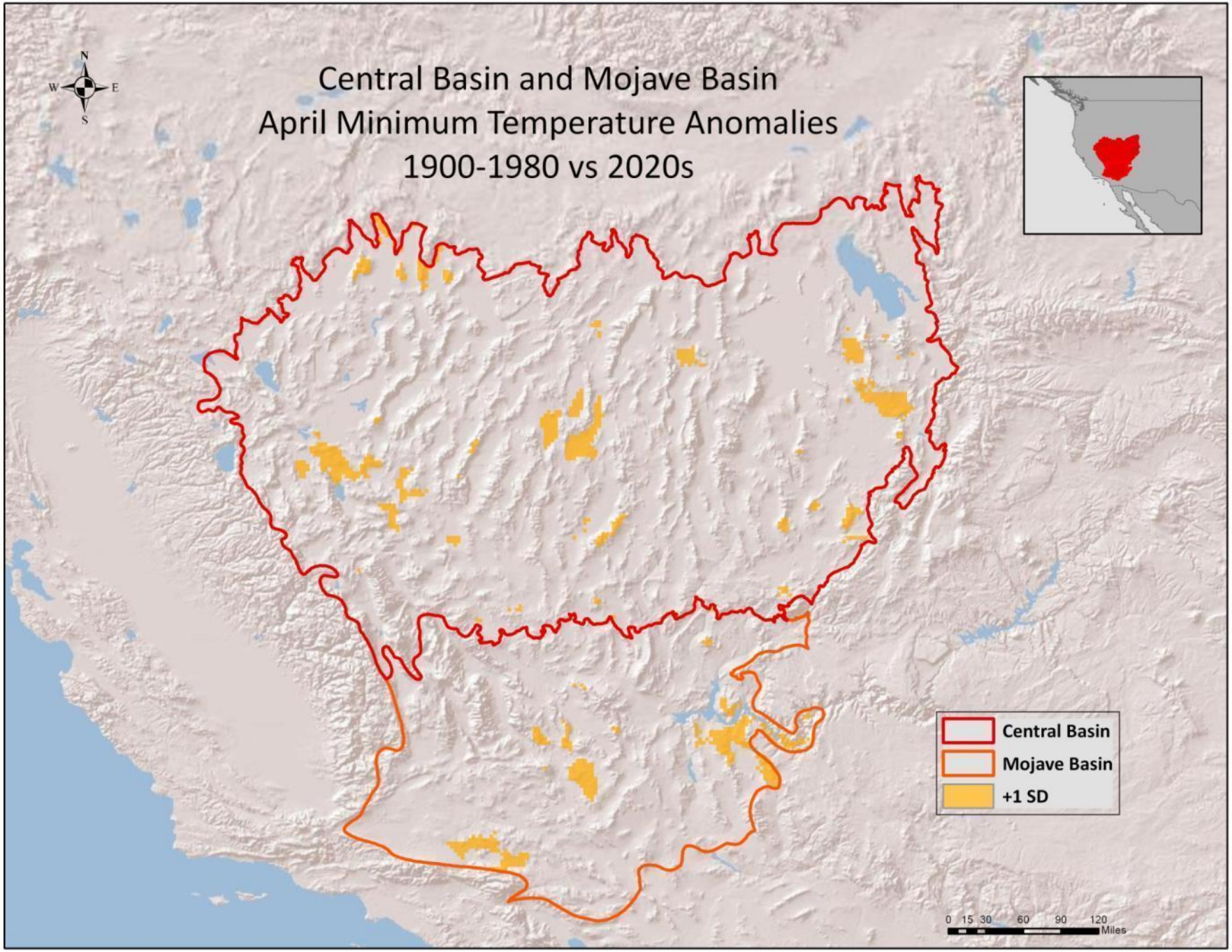
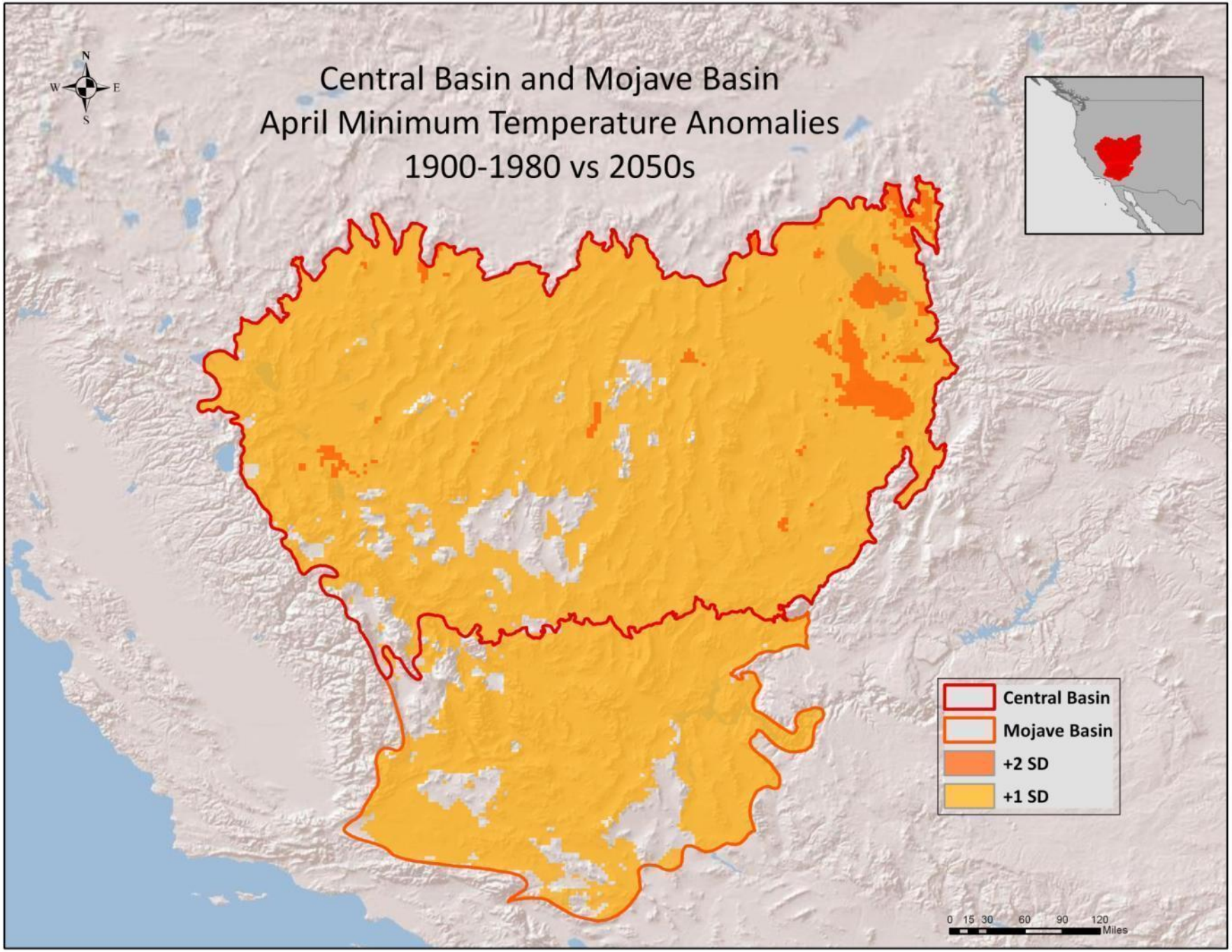
50
60
70
80
90
1900-1980
1995-2010
2020s
2050s

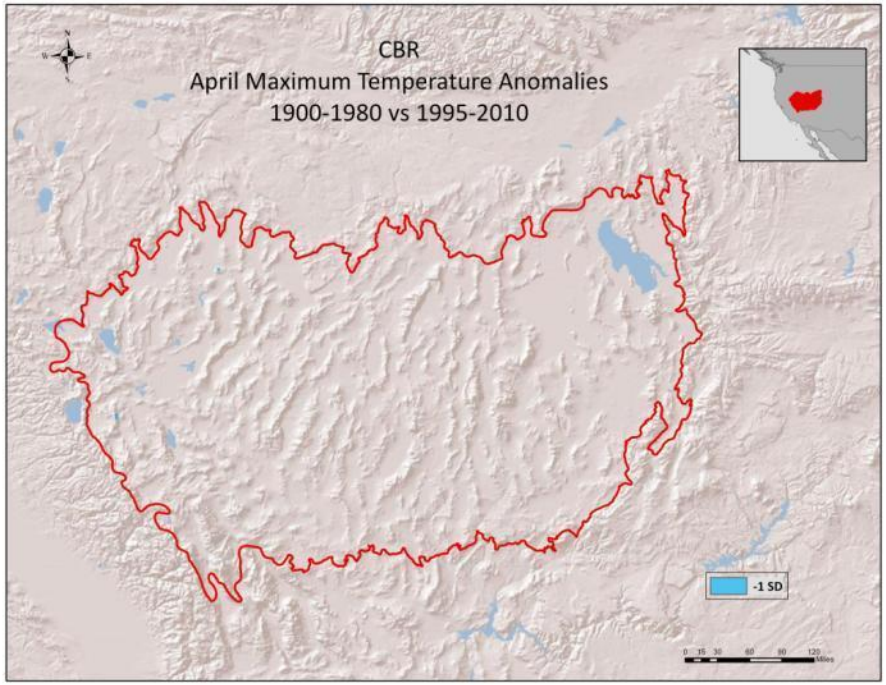

Mojave Basin and Range
Climate Space Trends
April
Minimum Temperature (°F)
Maximum Temperature (°F)
10
20
30
40
50
60
70
40
50
60
70
80
90
100
1900-1980
1995-2010
2020s
2050s

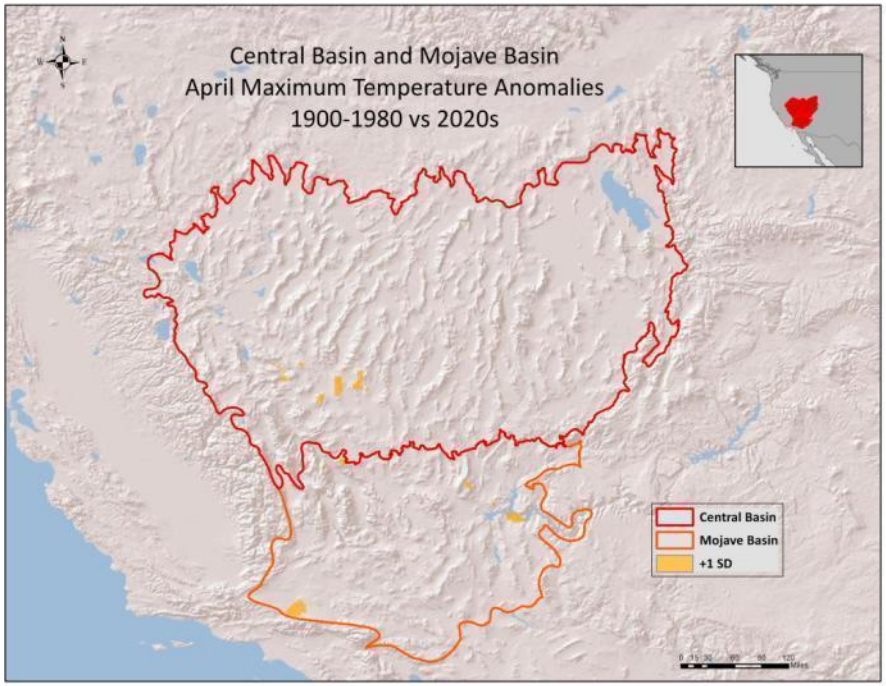

Central Basin and Mojave Basin
April Maximum Temperature Anomalies
1900-1980 vs 2020s
N
W
E
S
Central Basin
Mojave Basin
+1 SD
0 15 30 60 90 120
Miles

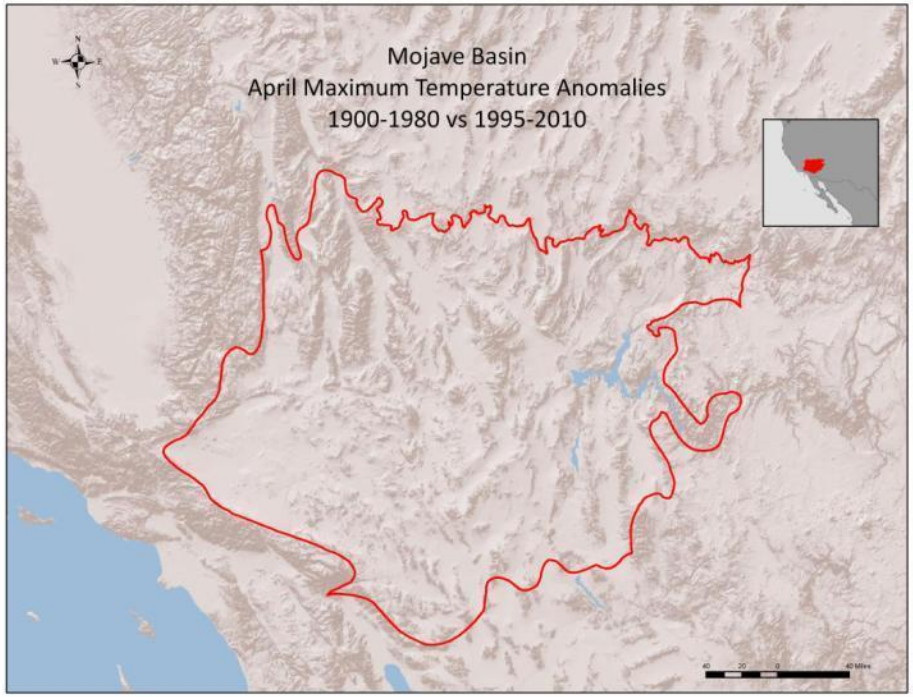

Central Basin and Mojave Basin
April Maximum Temperature Anomalies
1900-1980 vs 2050s
N
W
E
S
Central Basin
Mojave Basin
+1 SD
0 15 30 60 90 120
Miles

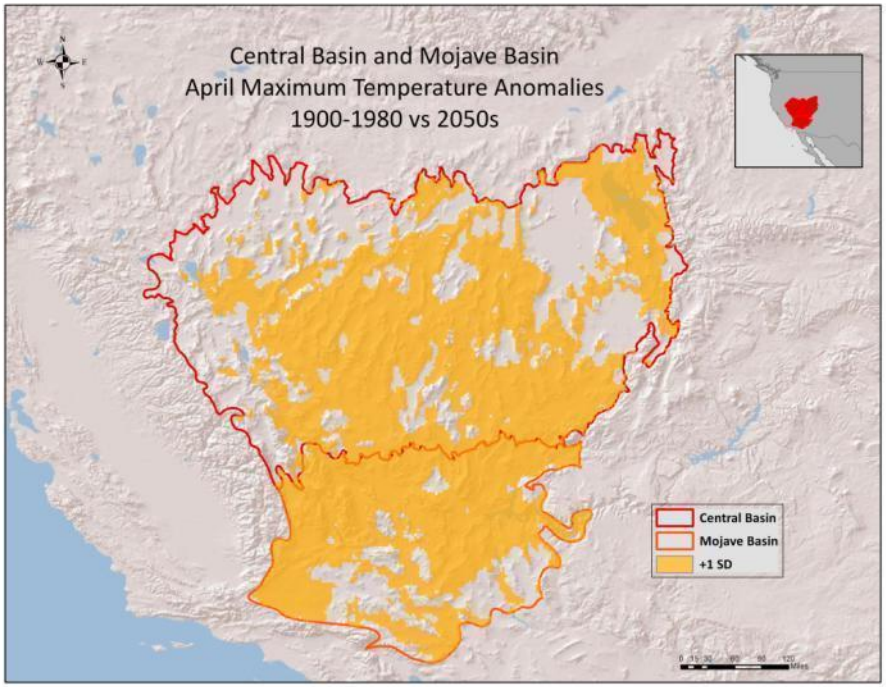

Central Basin and Mojave Basin
April Minimum Temperature Anomalies
1900-1980 vs 2020s
N
W
E
S
Central Basin
Mojave Basin
+1 SD
0 15 30 60 90 120
Miles

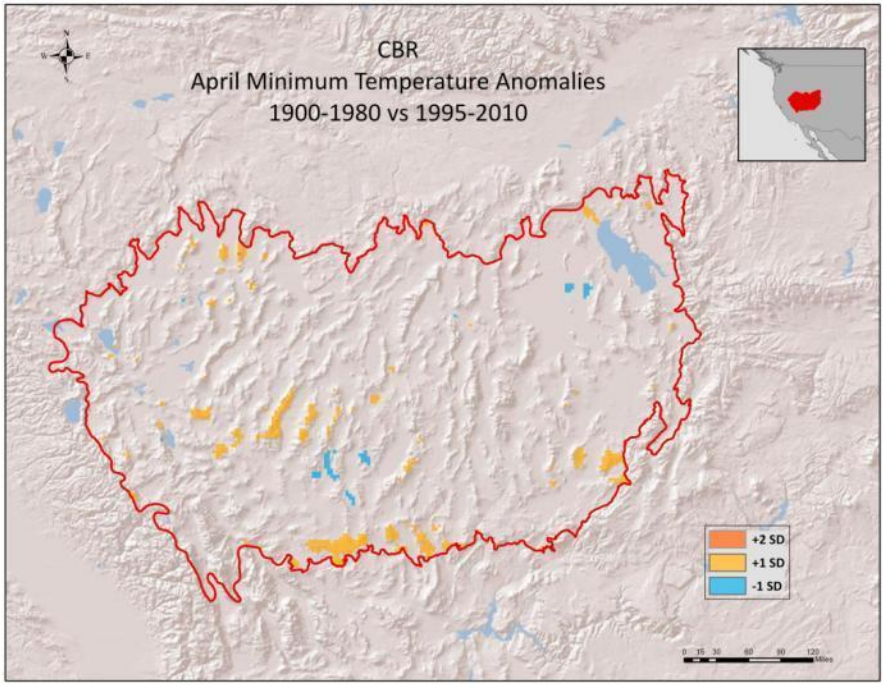

Central Basin and Mojave Basin
April Minimum Temperature Anomalies
1900-1980 vs 2050s
N
W
E
S
Central Basin
Mojave Basin
+2 SD
+1 SD
0 15 30 60 90 120
Miles

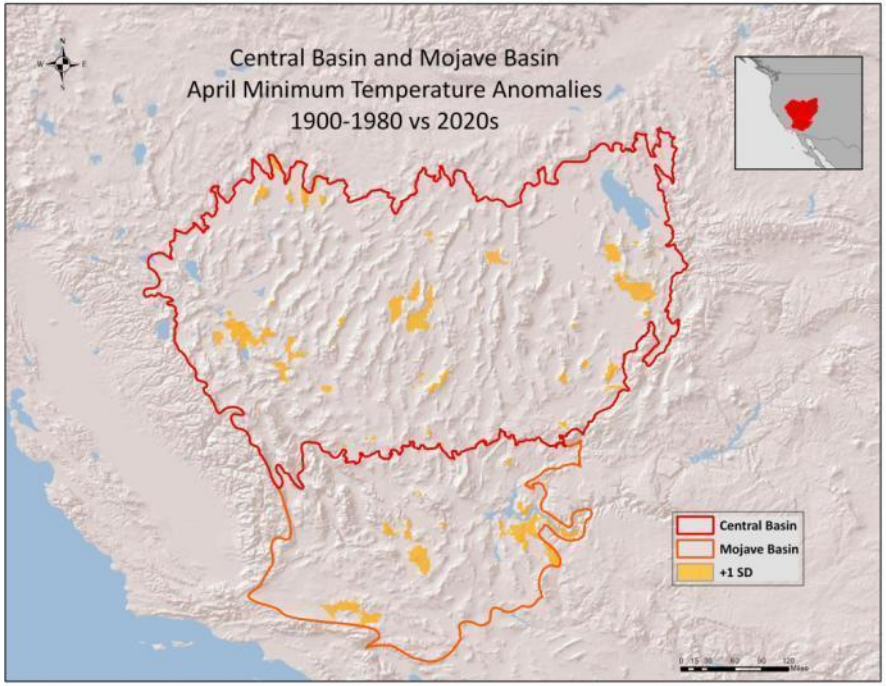

CBR
April Maximum Temperature Anomalies
1900-1980 vs 1995-2010
-1 SD

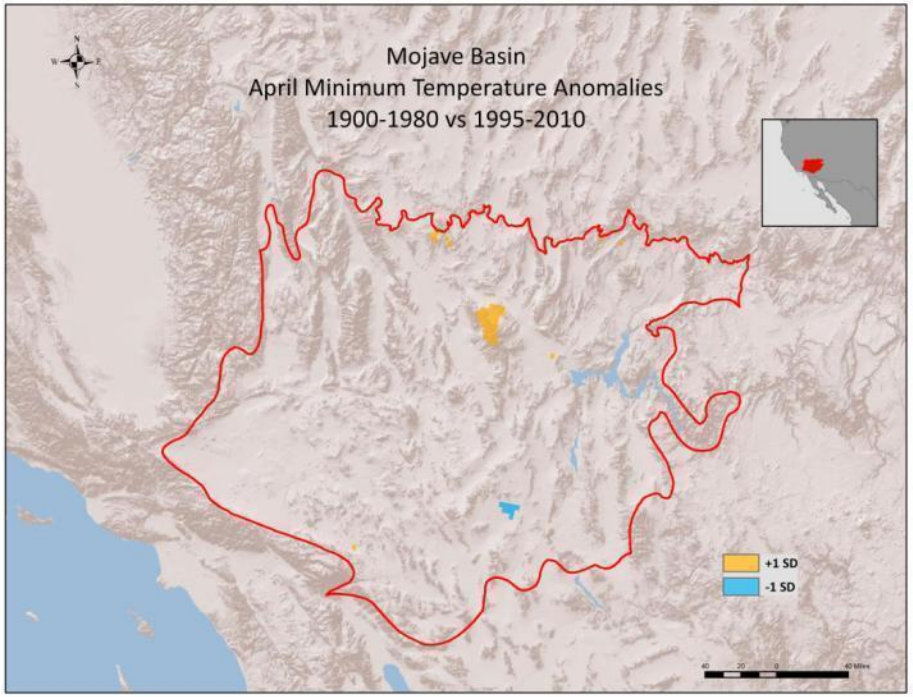

Central Basin and Mojave Basin
April Maximum Temperature Anomalies
1900-1980 vs 2020s
Central Basin
Mojave Basin
+1 SD

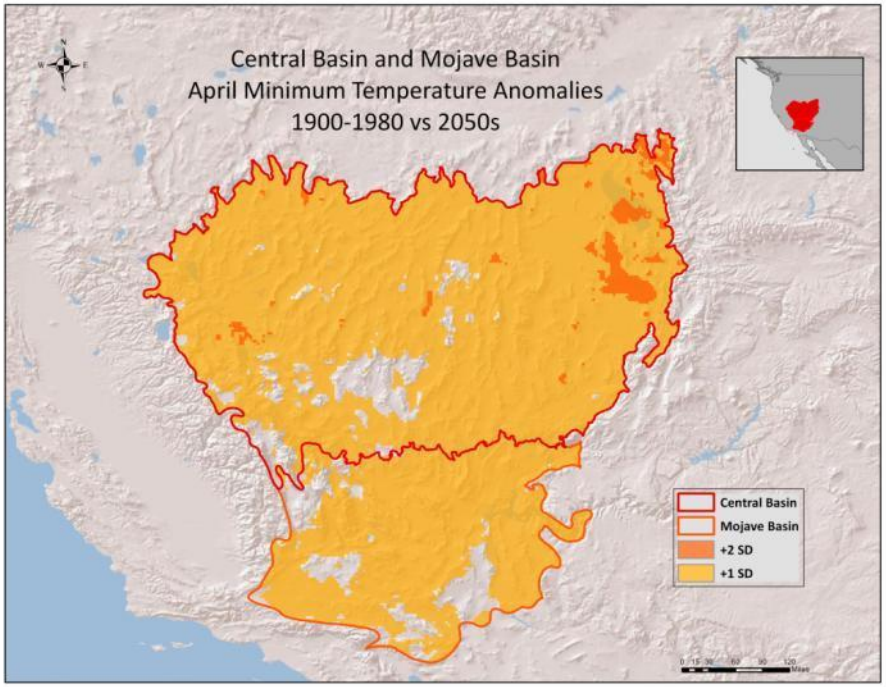

Mojave Basin
April Maximum Temperature Anomalies
1900-1980 vs 1995-2010

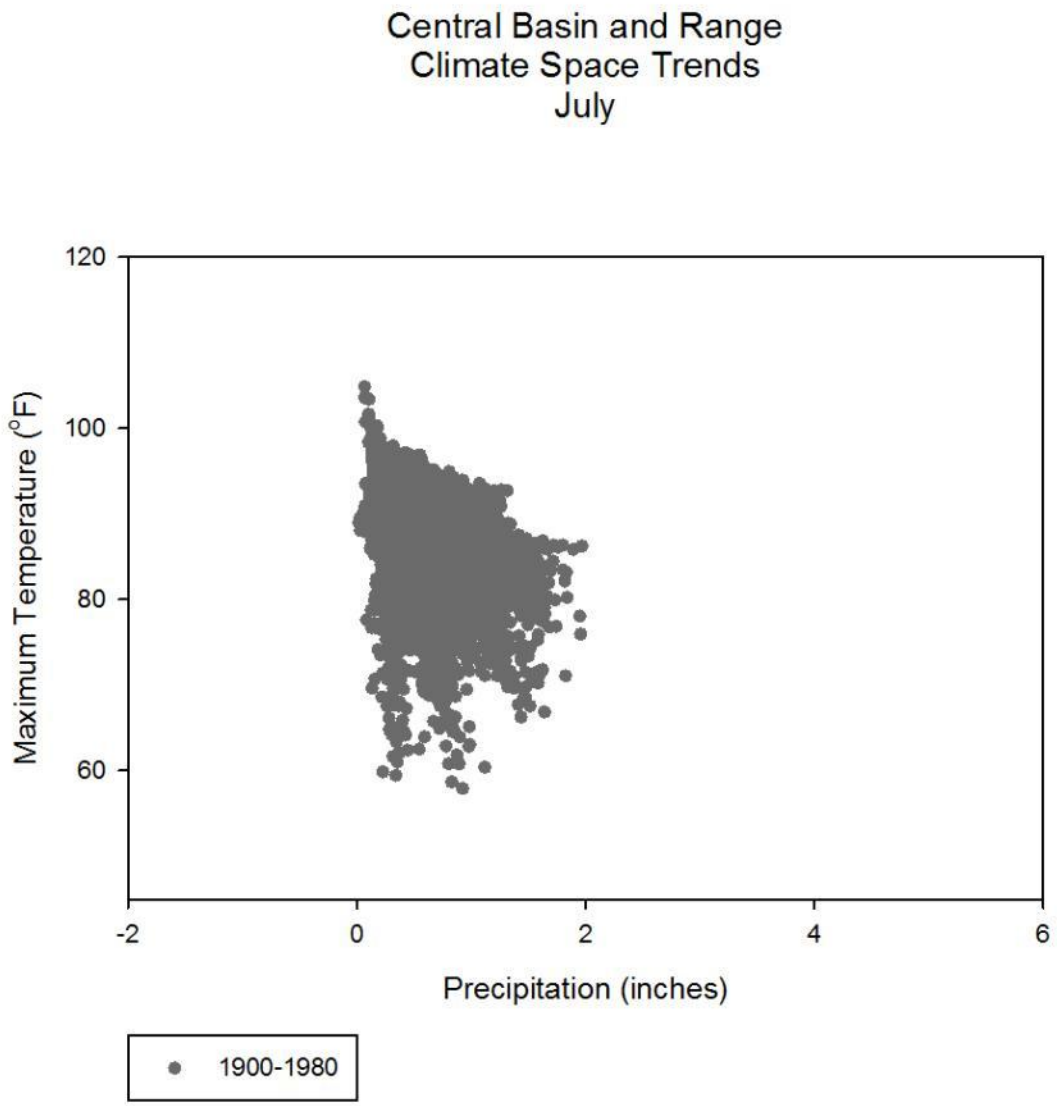

Central Basin and Mojave Basin
April Maximum Temperature Anomalies
1900-1980 vs 2050s
Central Basin
Mojave Basin
+1 SD

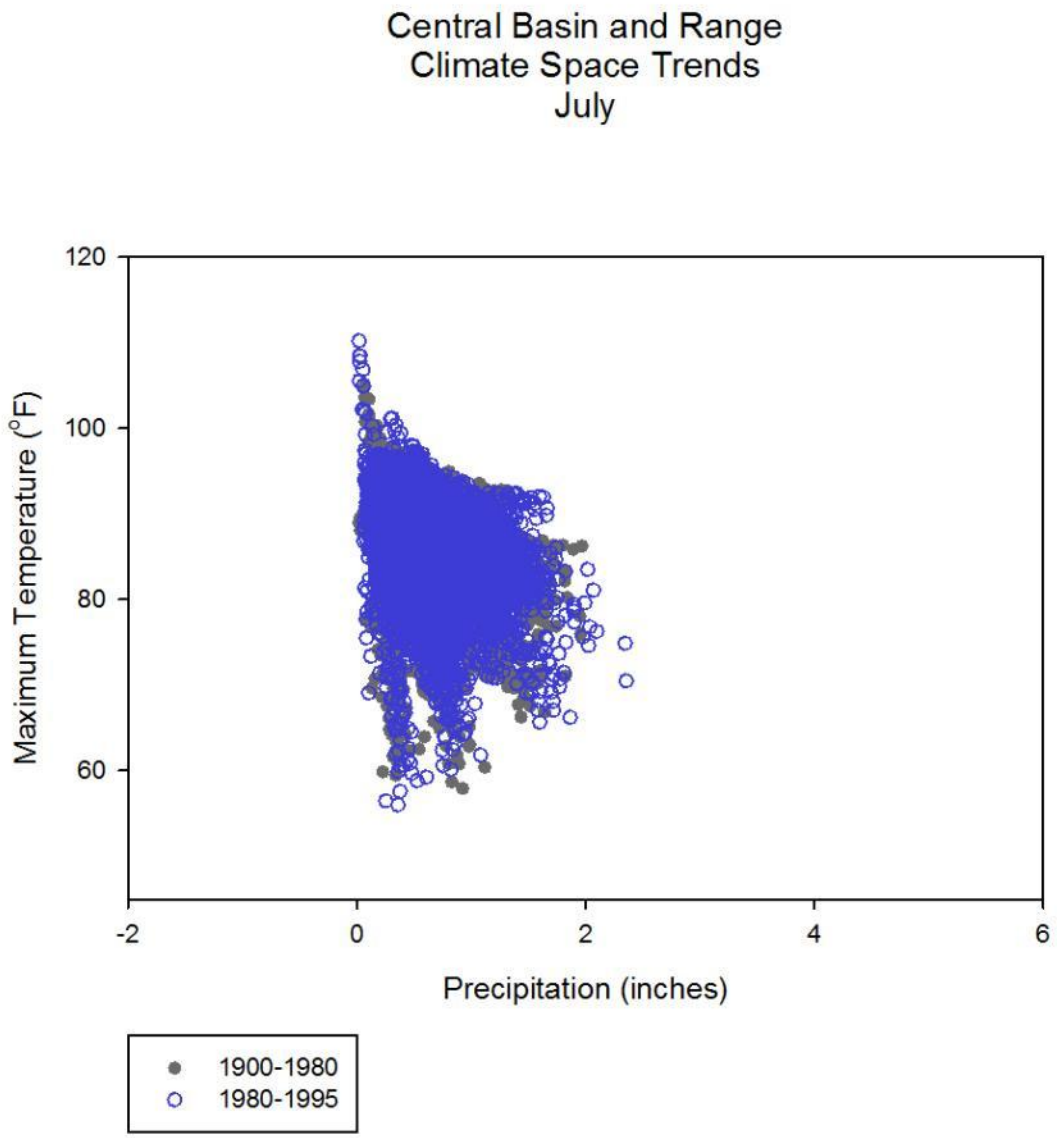

CBR
April Minimum Temperature Anomalies
1900-1980 vs 1995-2010
+2 SD
+1 SD
-1 SD

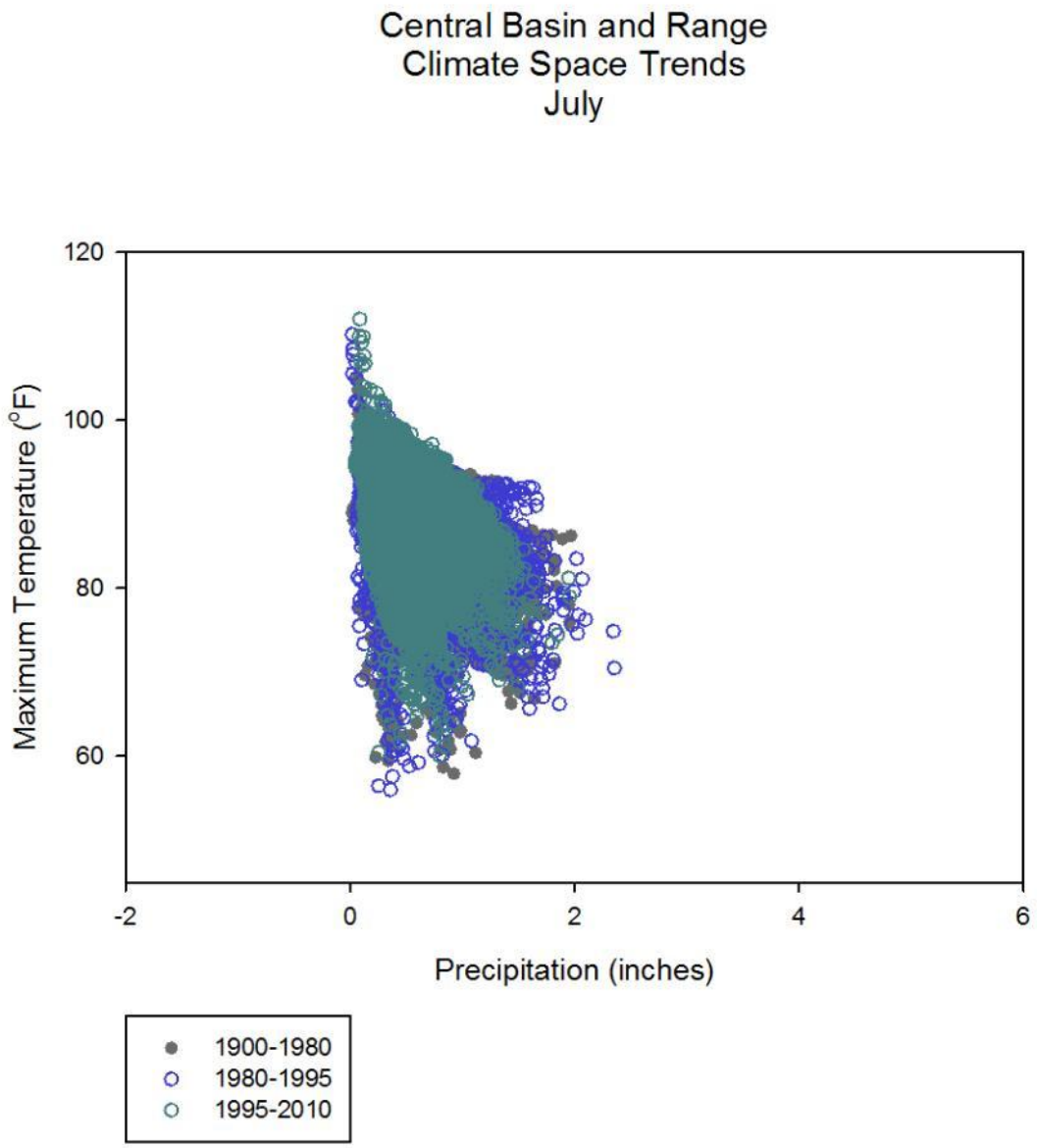

Central Basin and Mojave Basin
April Minimum Temperature Anomalies
1900-1980 vs 2020s
Central Basin
Mojave Basin
+1 SD

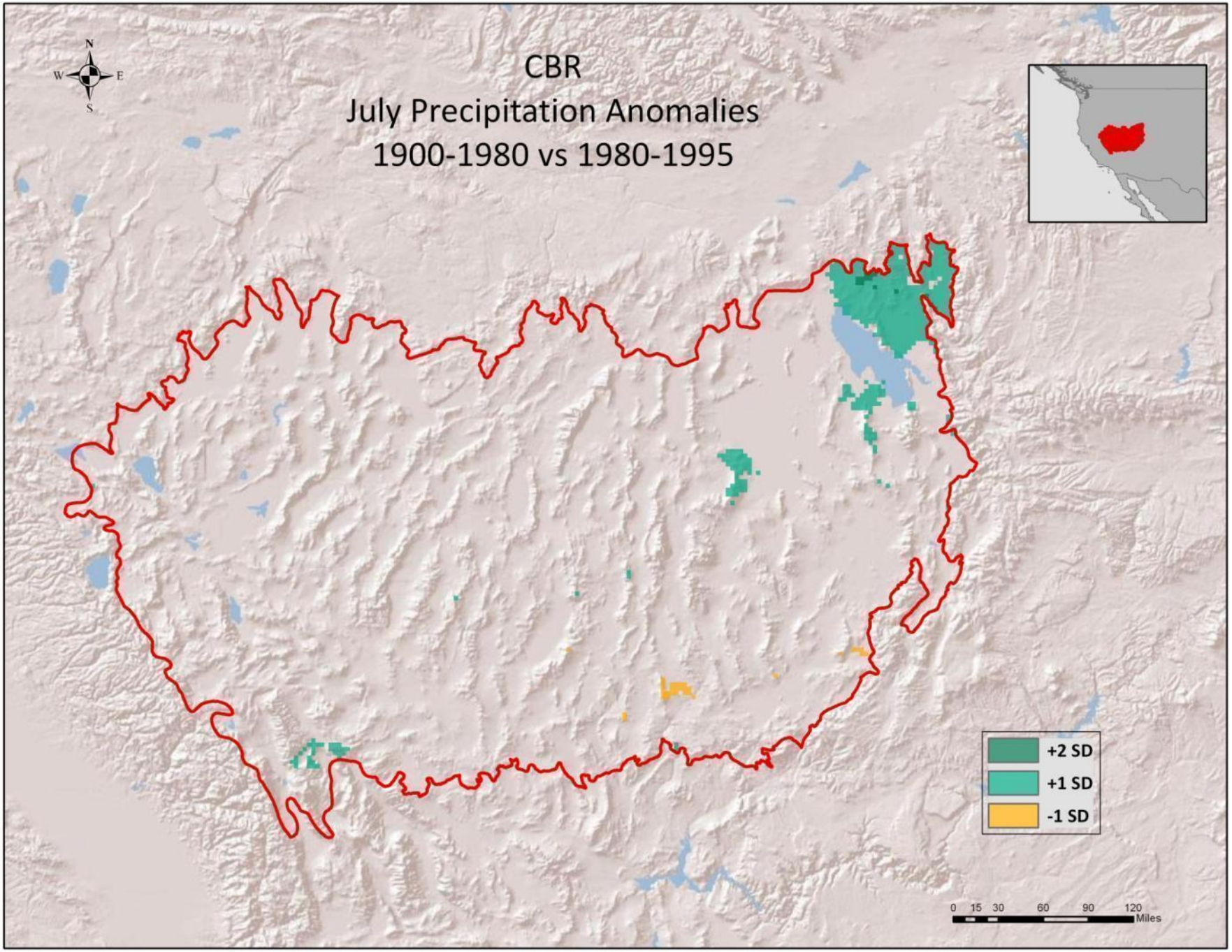

Mojave Basin
April Minimum Temperature Anomalies
1900-1980 vs 1995-2010
+1 SD
-1 SD

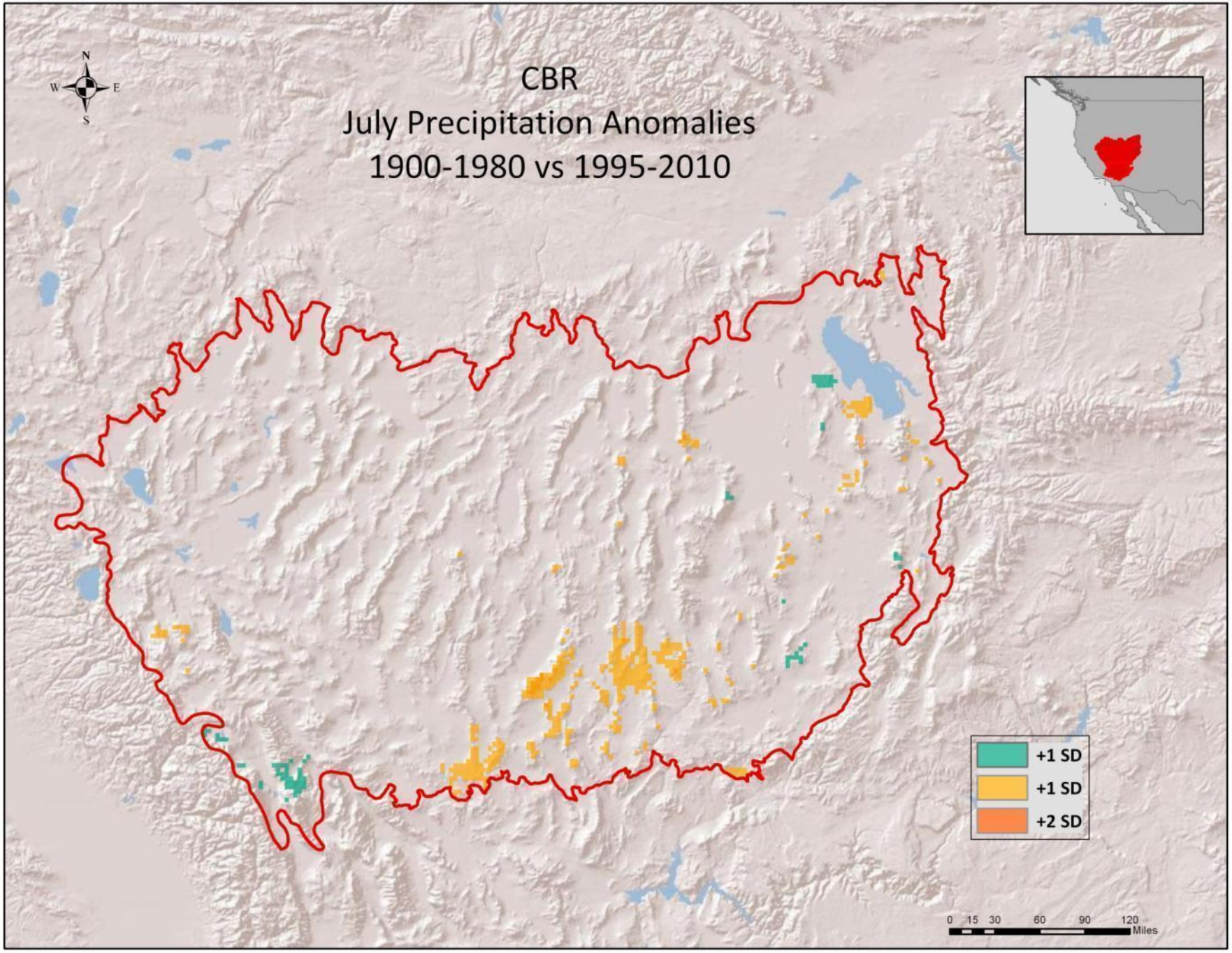

Central Basin and Mojave Basin
April Minimum Temperature Anomalies
1900-1980 vs 2050s
Central Basin
Mojave Basin
+2 SD
+1 SD

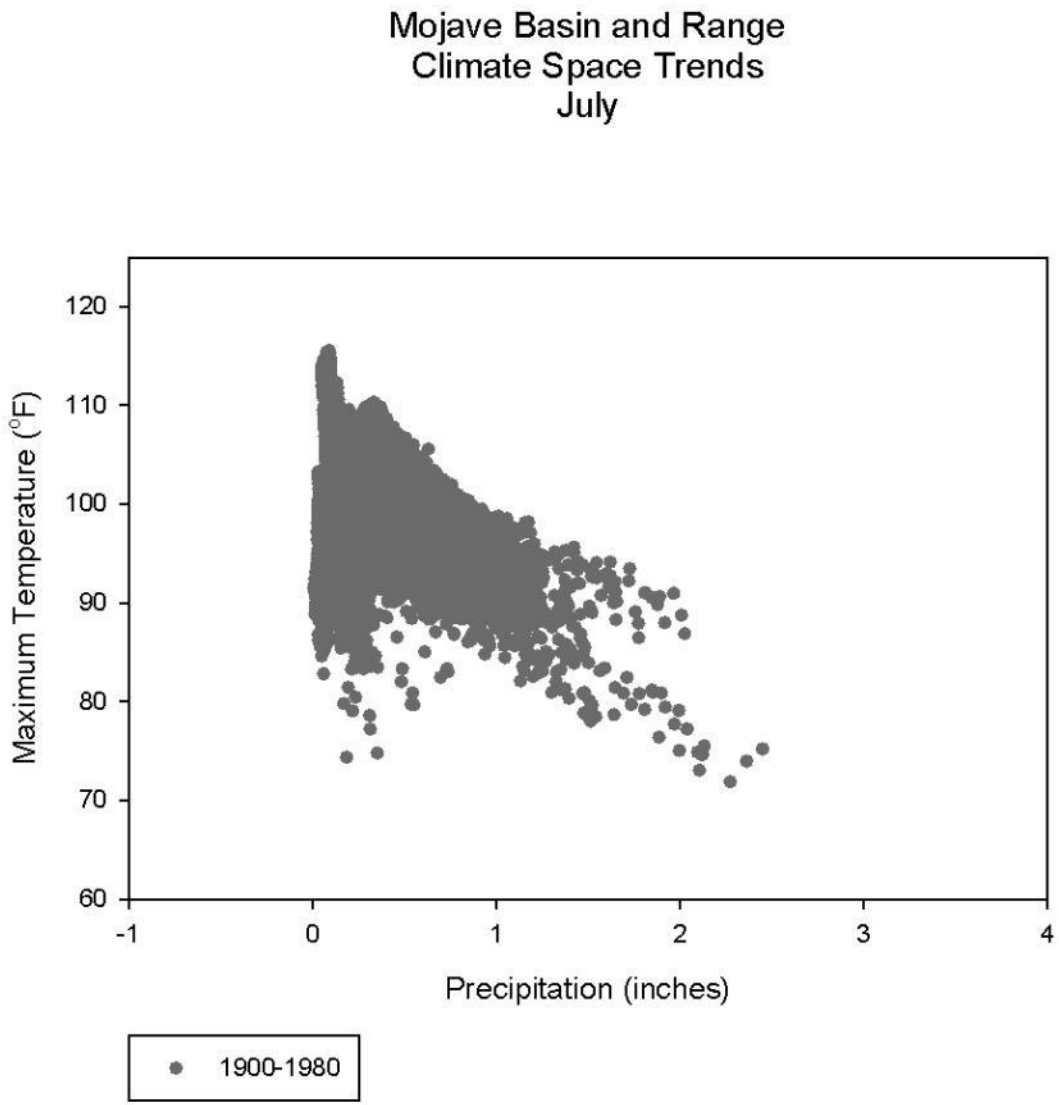

Central Basin and Range
Climate Space Trends
July
Maximum Temperature (°F)
120
100
80
60
-2
0
2
4
6
Precipitation (inches)
1900-1980

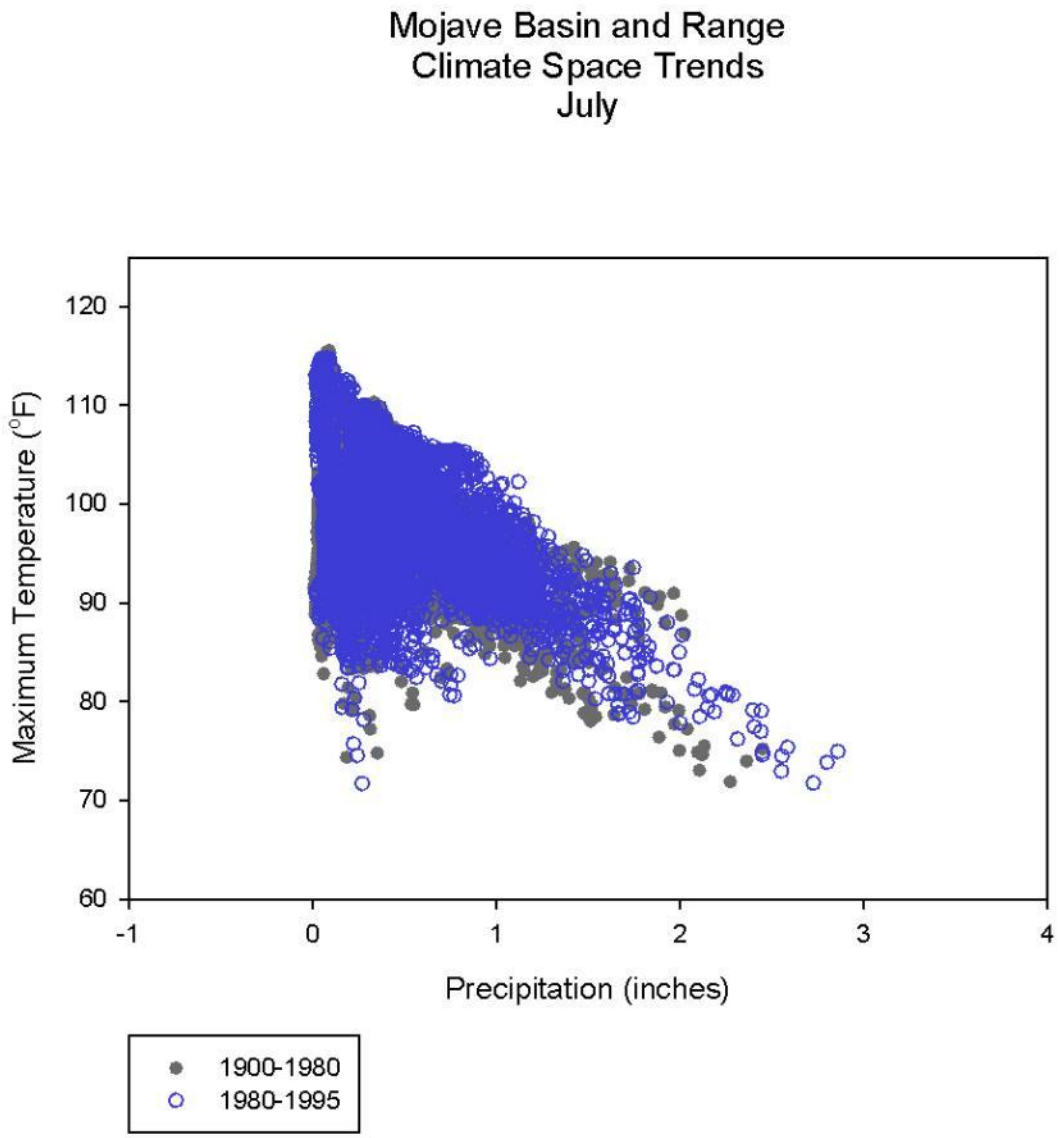

Central Basin and Range
Climate Space Trends
July
Maximum Temperature (°F)
120
100
80
60
-2
0
2
4
6
Precipitation (inches)
1900-1980
1980-1995

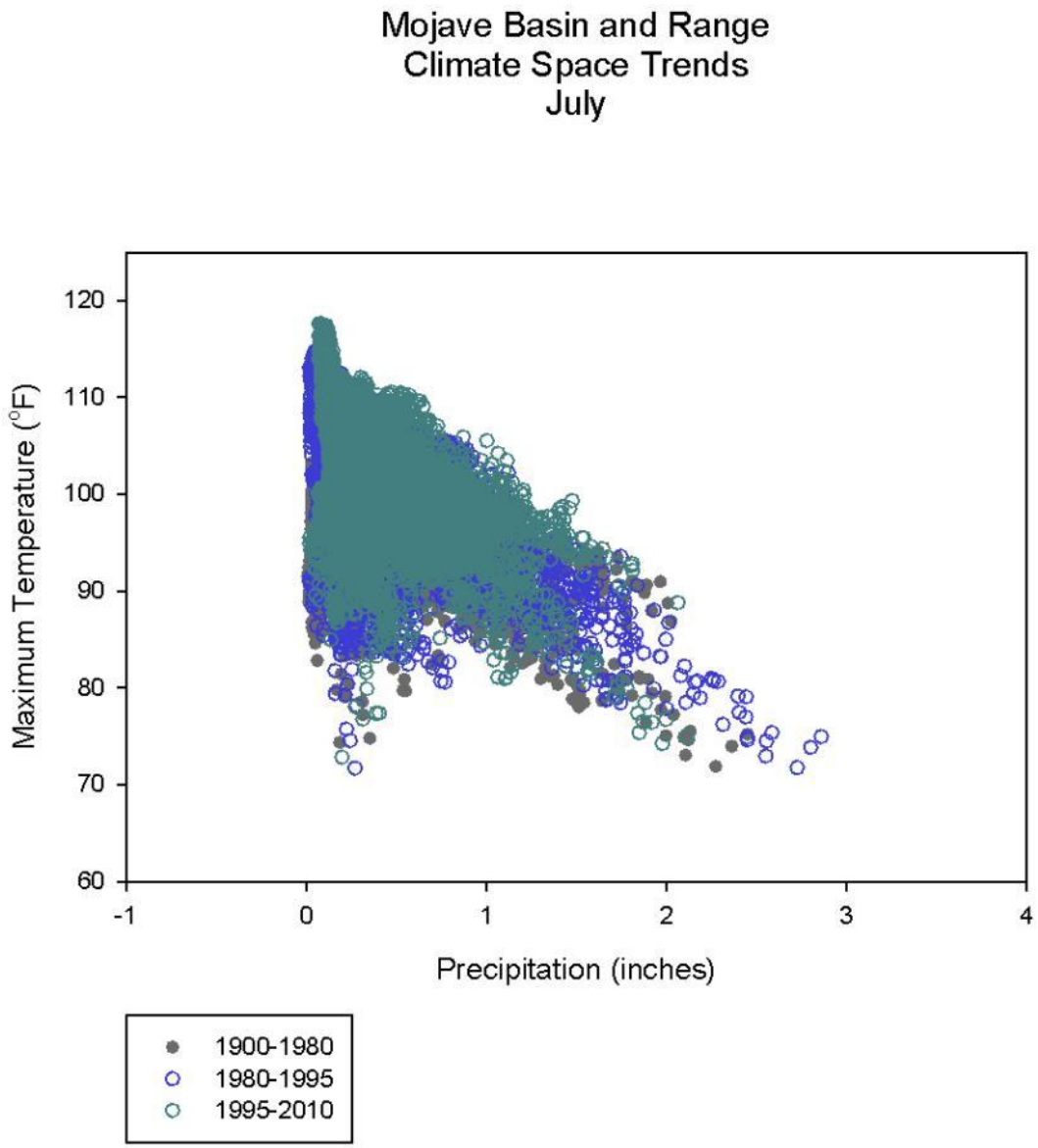

Central Basin and Range
Climate Space Trends
July
Maximum Temperature (°F)
120
100
80
60
-2
0
2
4
6
Precipitation (inches)
1900-1980
1980-1995
1995-2010

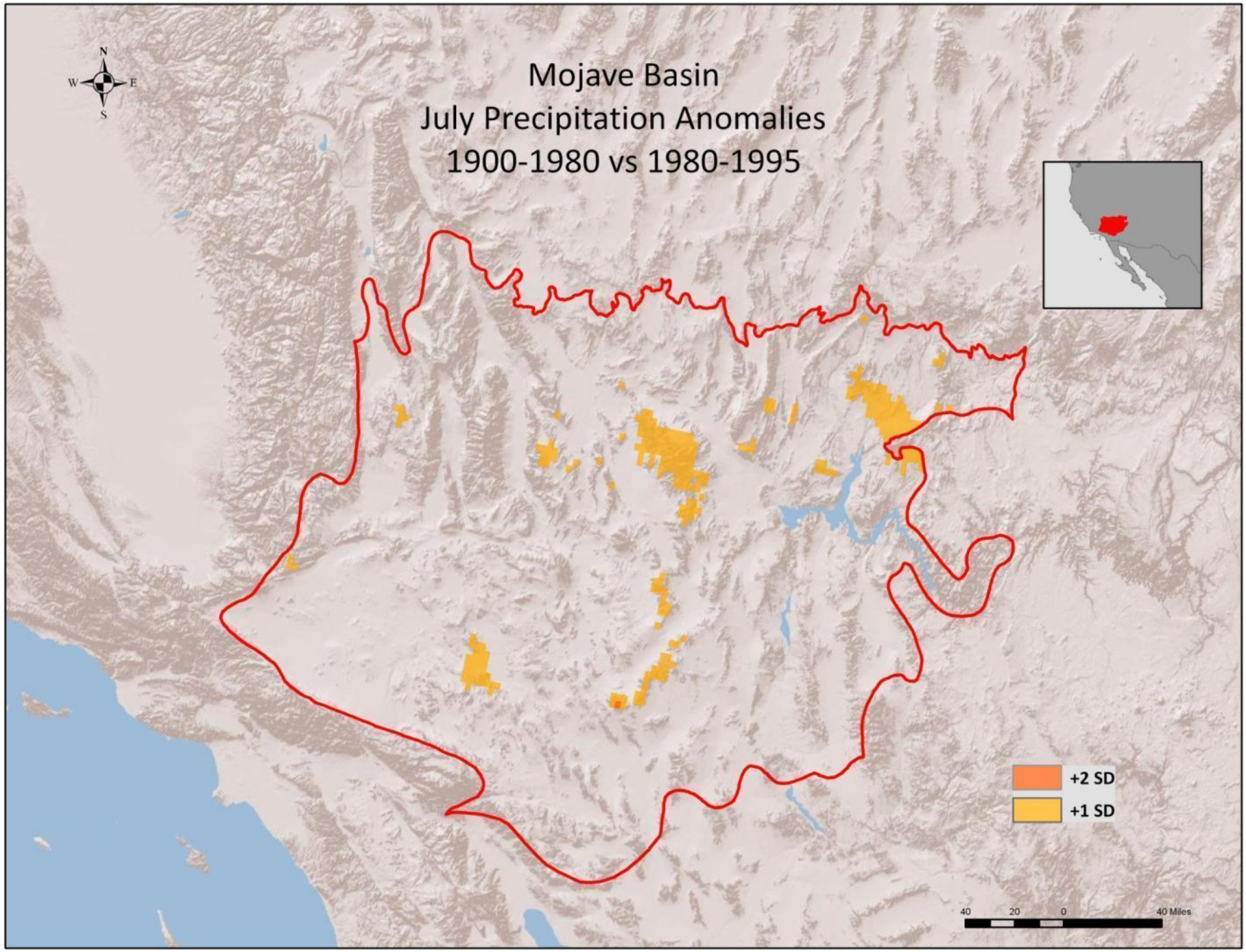

CBR
July Precipitation Anomalies
1900-1980 vs 1980-1995
N
W
E
S
+2 SD
+1 SD
-1 SD
0 15 30 60 90 120
Miles

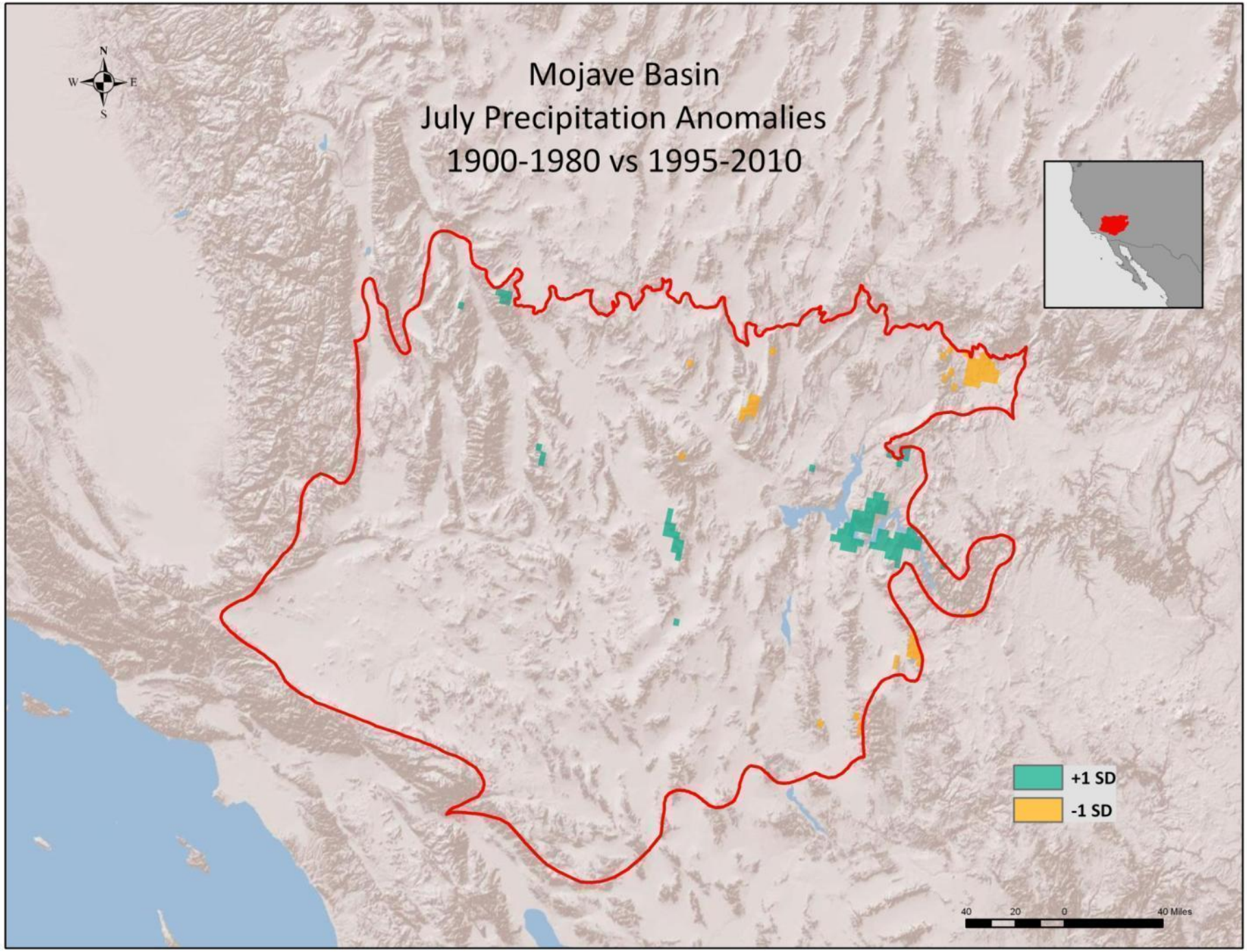

CBR
July Precipitation Anomalies
1900-1980 vs 1995-2010
N
W
E
S
+1 SD
+1 SD
+2 SD
0 15 30 60 90 120
Miles

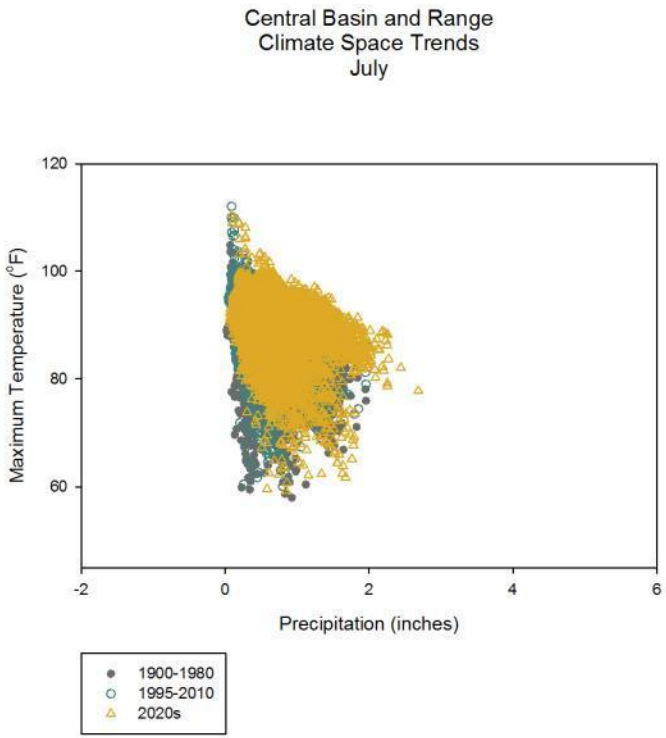

Mojave Basin and Range
Climate Space Trends
July
Maximum Temperature (°F)
120
110
100
90
80
70
60
-1
0
1
2
3
4
Precipitation (inches)
1900-1980

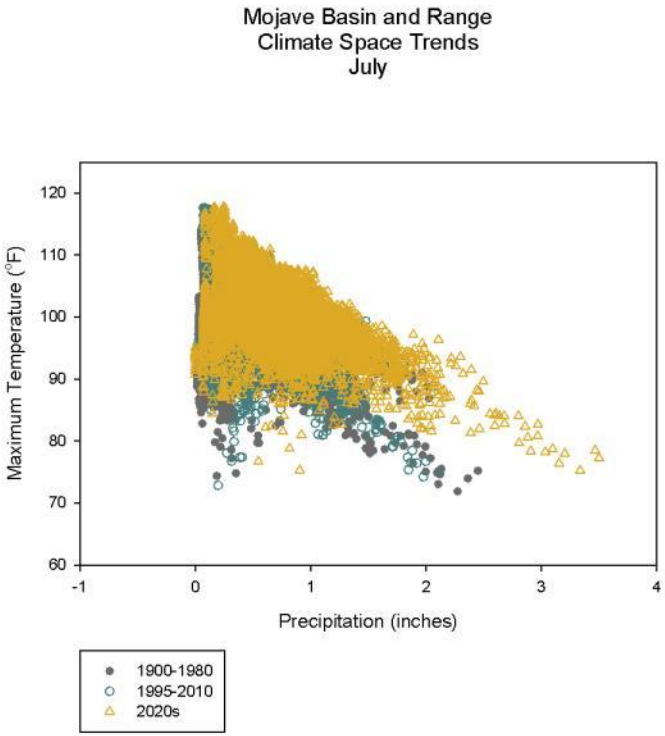

Mojave Basin and Range
Climate Space Trends
July
Maximum Temperature (°F)
120
110
100
90
80
70
60
-1
0
1
2
3
4
Precipitation (inches)
1900-1980
1980-1995

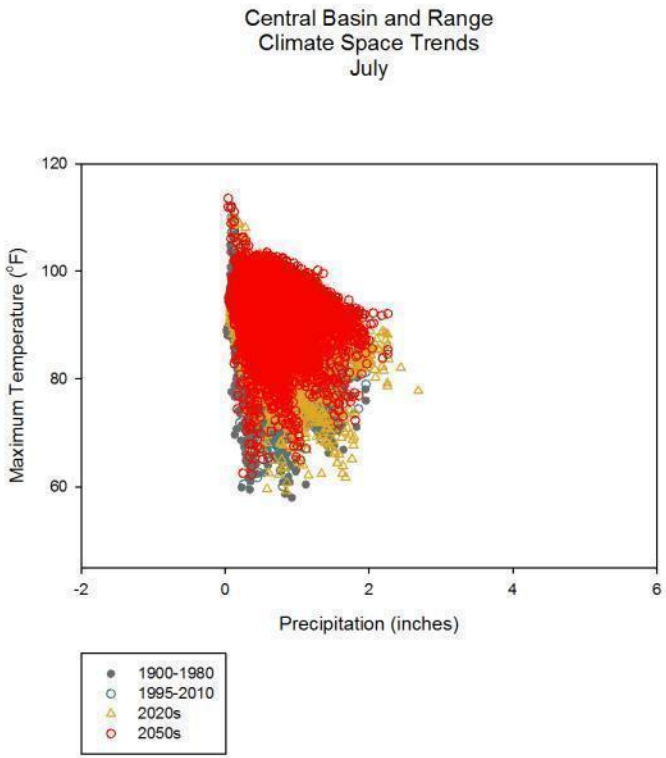

Mojave Basin and Range
Climate Space Trends
July
Maximum Temperature (°F)
120
110
100
90
80
70
60
-1
0
1
2
3
4
Precipitation (inches)
1900-1980
1980-1995
1995-2010

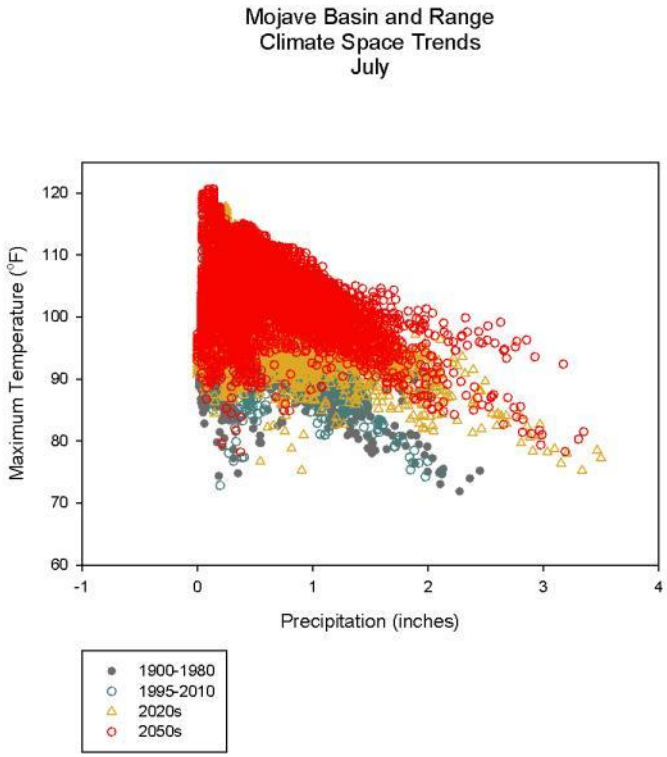

Mojave Basin
July Precipitation Anomalies
1900-1980 vs 1980-1995
N
W
E
S
+2 SD
+1 SD
40
20
0
40 Miles

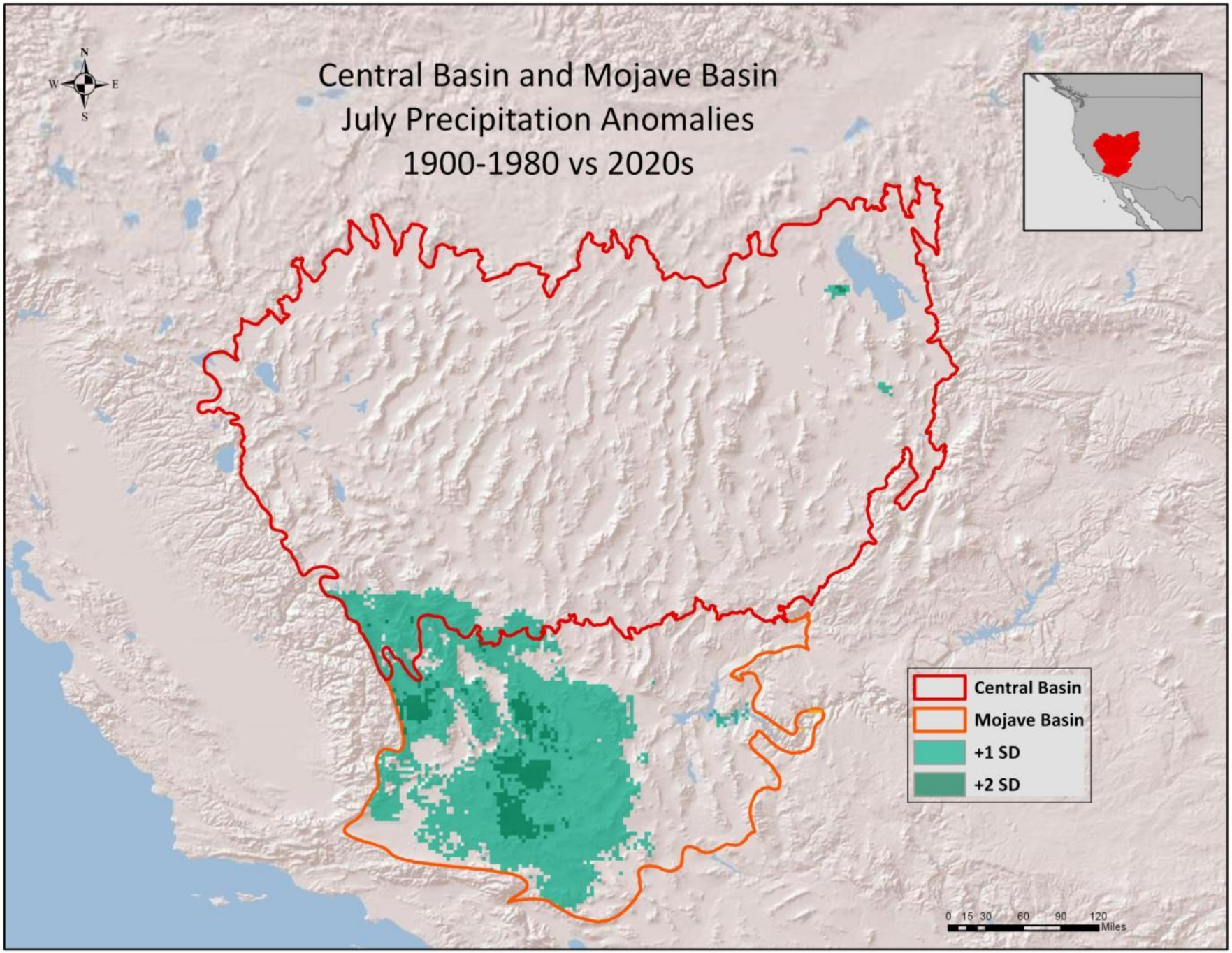

Mojave Basin
July Precipitation Anomalies
1900-1980 vs 1995-2010
N
W
E
S
+1 SD
-1 SD
40
20
0
40 Miles

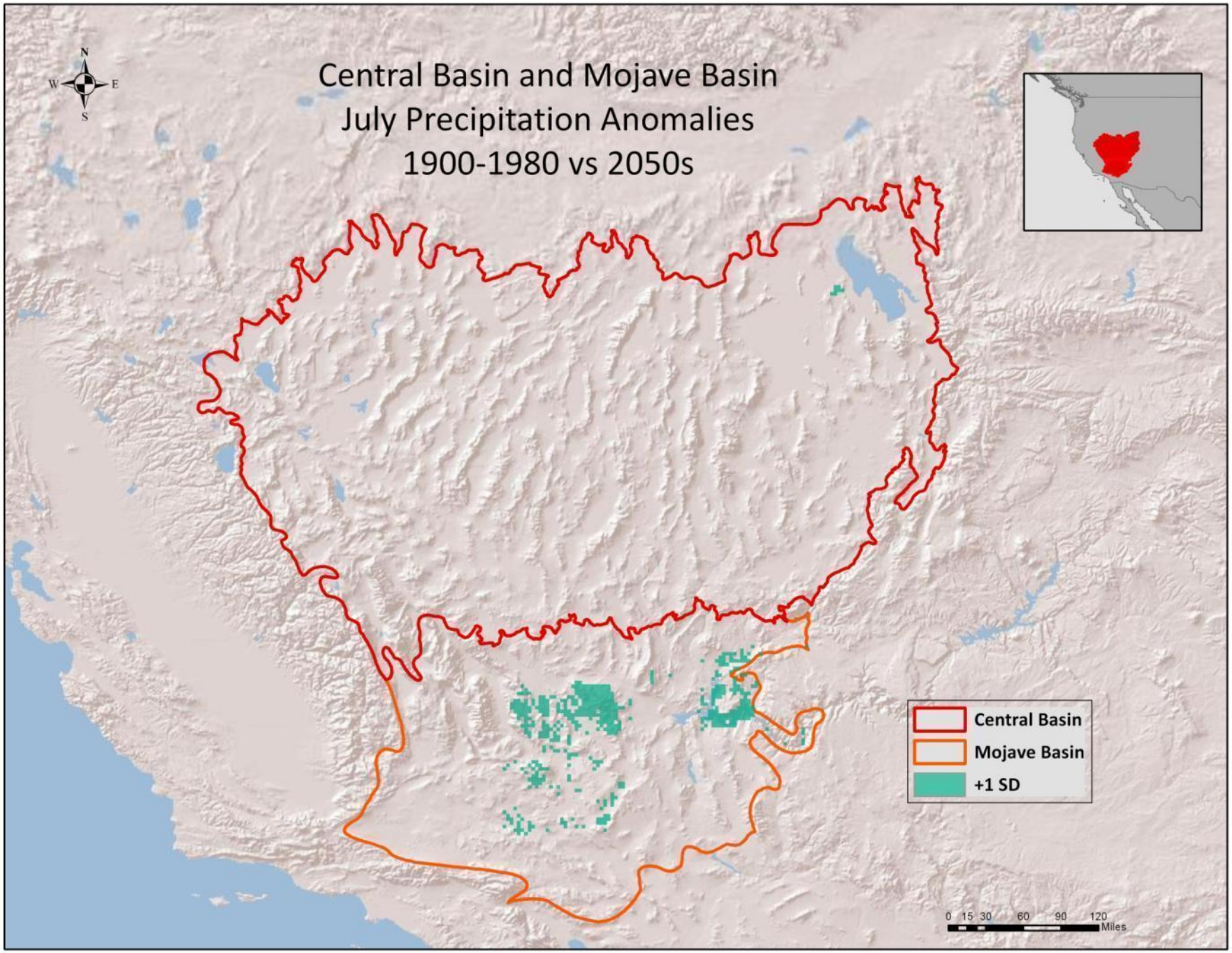

Central Basin and Range
Climate Space Trends
July
Maximum Temperature (°F)
120
100
80
60
-2
0
2
4
6
Precipitation (inches)
1900-1980
1995-2010
2020s

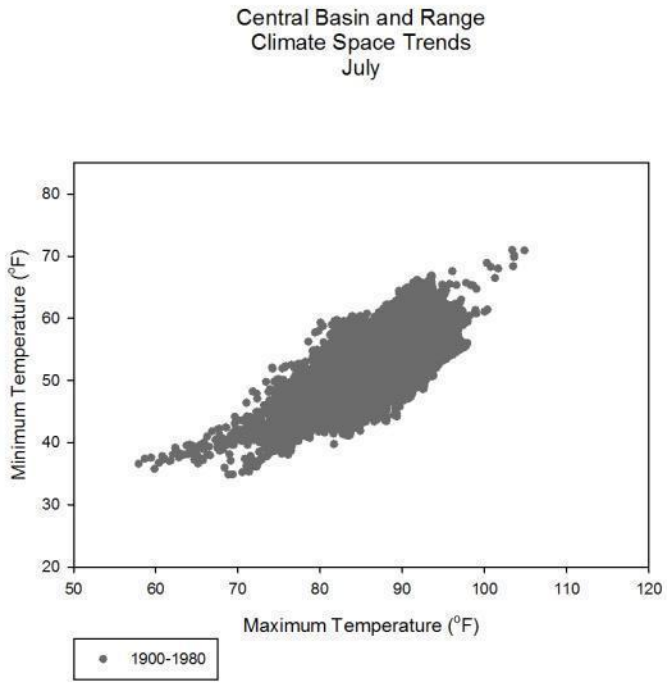

Mojave Basin and Range
Climate Space Trends
July
Maximum Temperature (°F)
120
110
100
90
80
70
60
-1
0
1
2
3
4
Precipitation (inches)
1900-1980
1995-2010
2020s

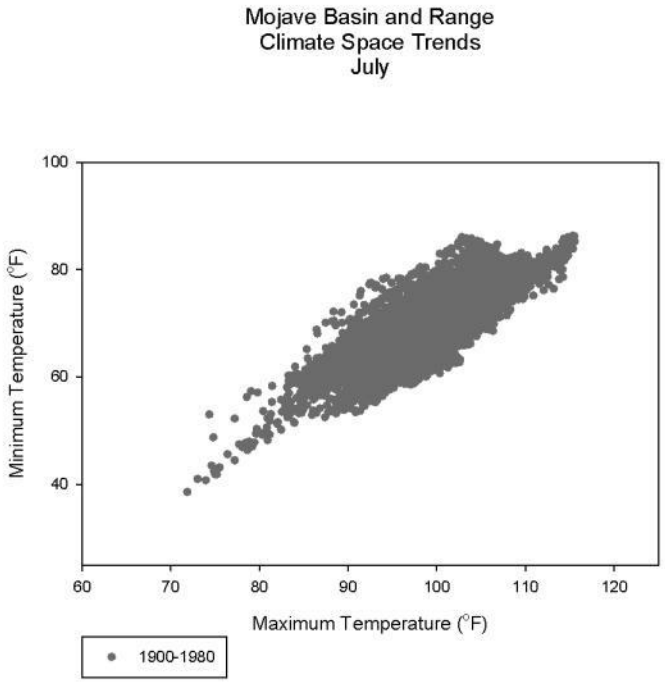

Central Basin and Range
Climate Space Trends
July
Maximum Temperature (°F)
Precipitation (inches)
120
100
80
60
-2
0
2
4
6
1900-1980
1995-2010
2020s
2050s

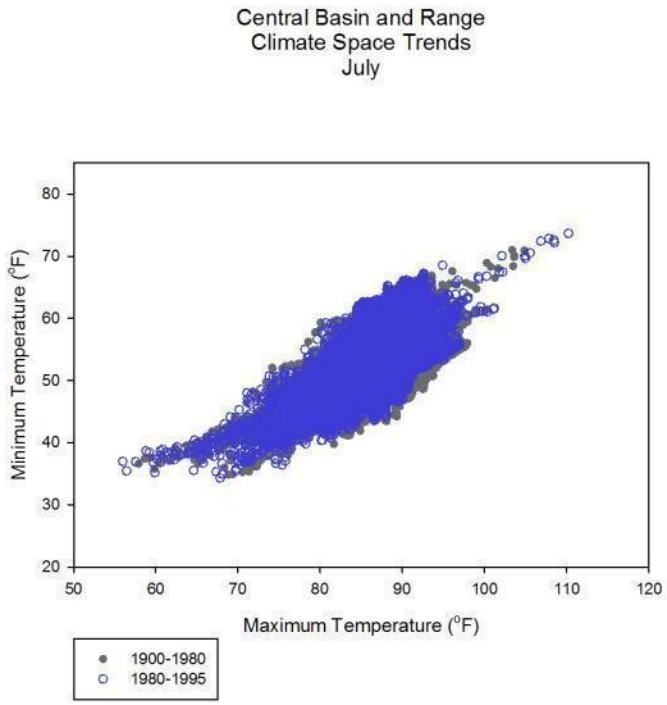

Mojave Basin and Range
Climate Space Trends
July
Maximum Temperature (°F)
Precipitation (inches)
120
110
100
90
80
70
60
-1
0
1
2
3
4
1900-1980
1995-2010
2020s
2050s

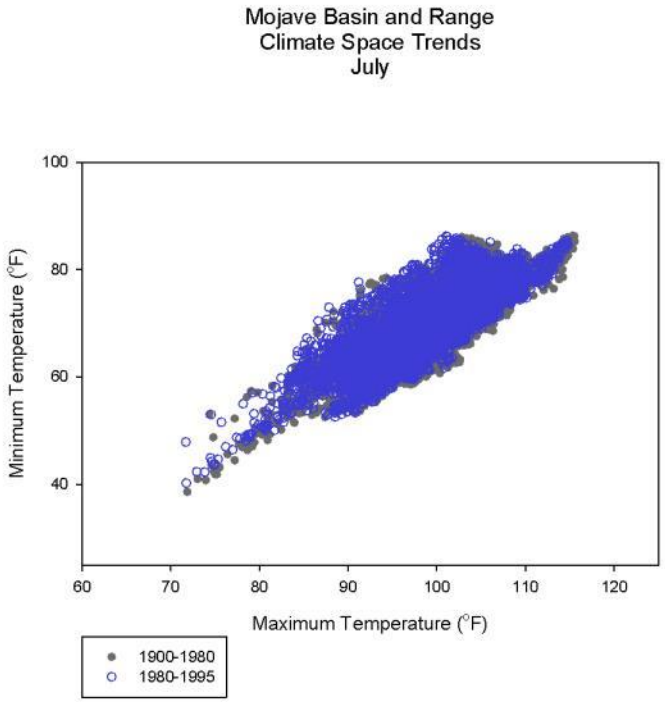

Central Basin and Mojave Basin
July Precipitation Anomalies
1900-1980 vs 2020s
N
W
E
S
Central Basin
Mojave Basin
+1 SD
+2 SD
0 15 30 60 90 120
Miles

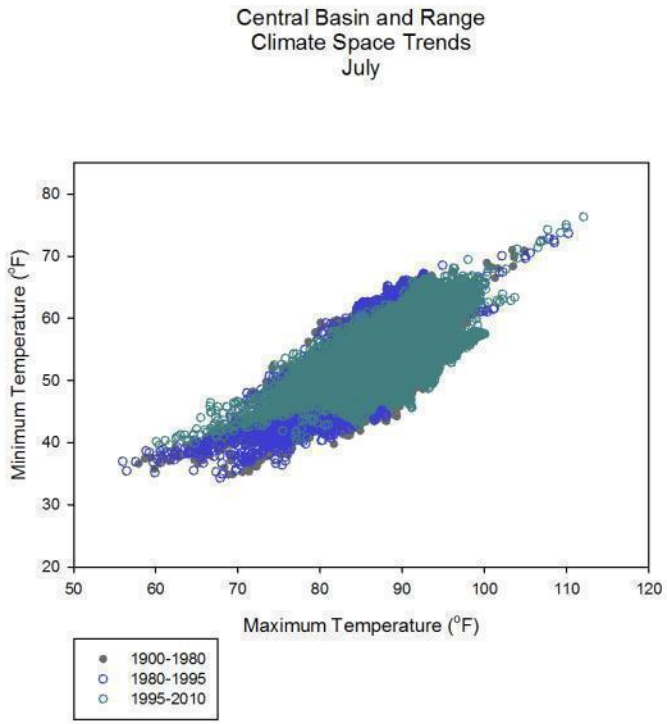

Central Basin and Mojave Basin
July Precipitation Anomalies
1900-1980 vs 2050s
N
W
E
S
Central Basin
Mojave Basin
+1 SD
0 15 30 60 90 120
Miles

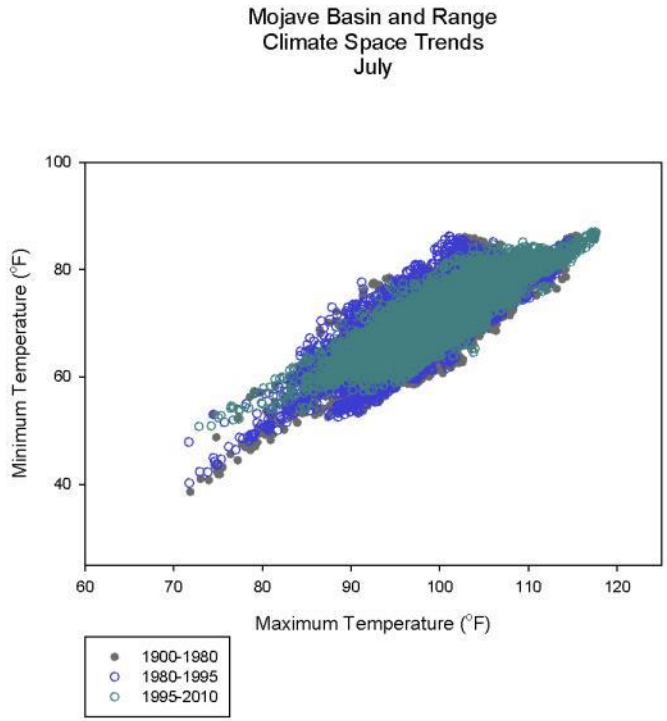

Central Basin and Range
Climate Space Trends
July
Minimum Temperature (°F)
Maximum Temperature (°F)
1900-1980

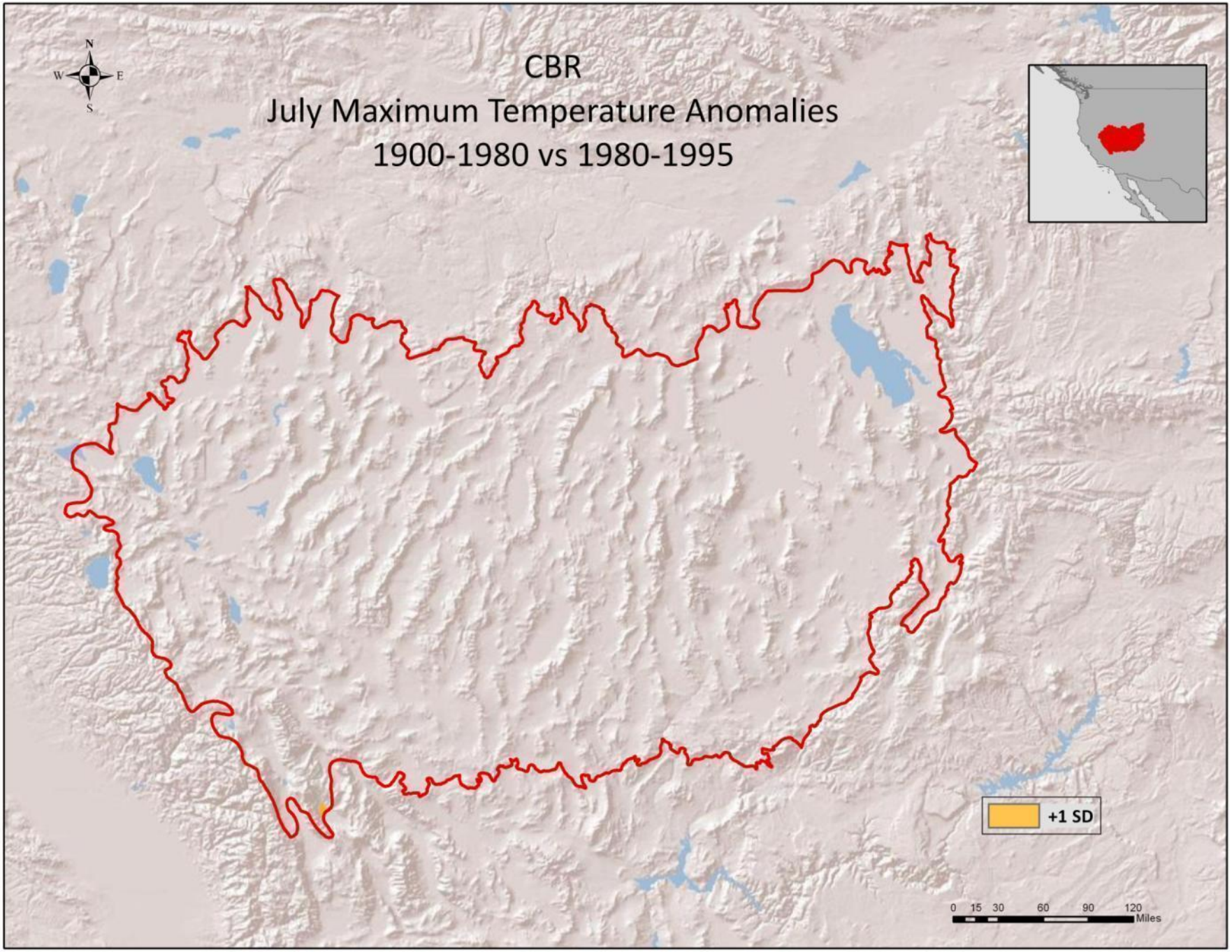

Mojave Basin and Range
Climate Space Trends
July
Minimum Temperature (°F)
Maximum Temperature (°F)
1900-1980

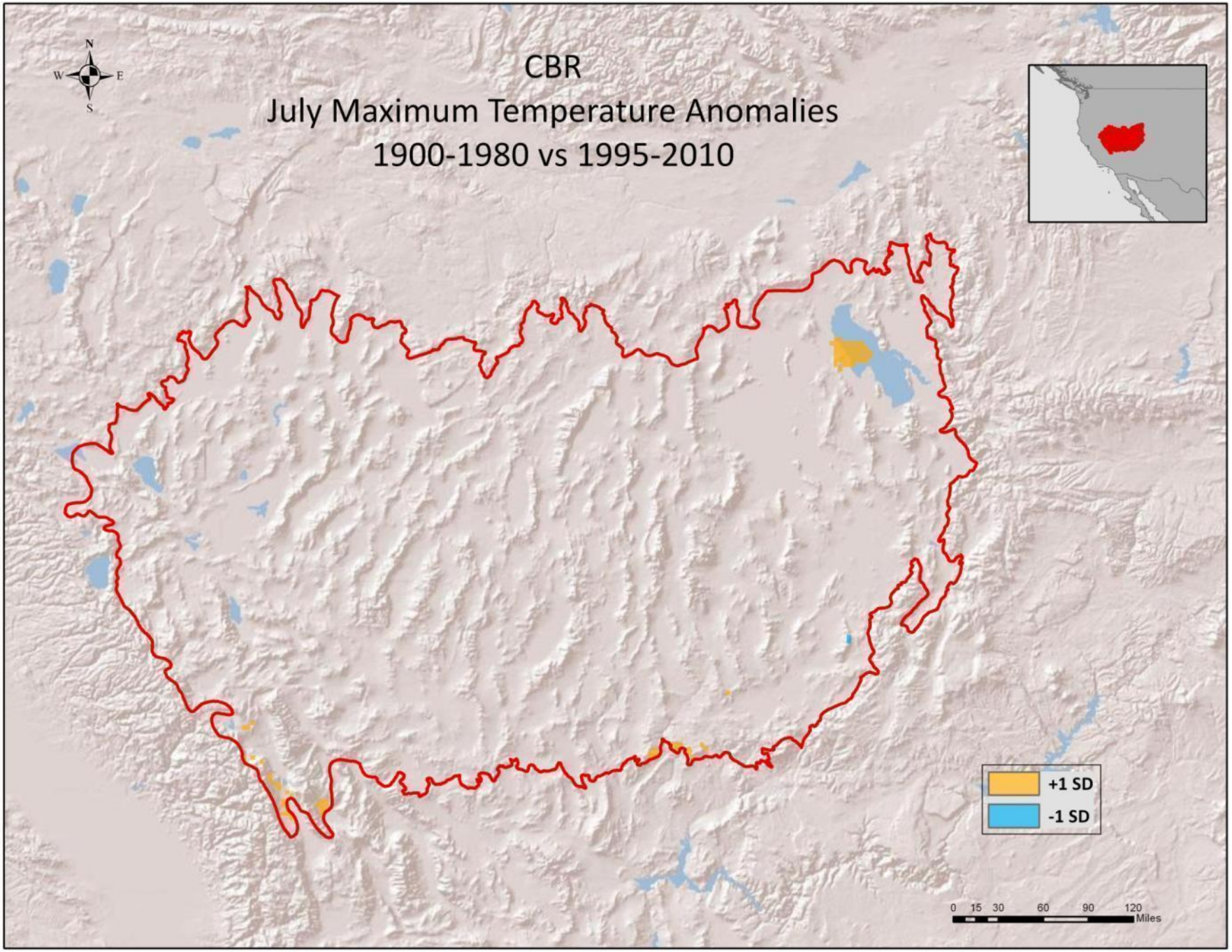

Central Basin and Range
Climate Space Trends
July
Minimum Temperature (°F)
Maximum Temperature (°F)
1900-1980
1980-1995

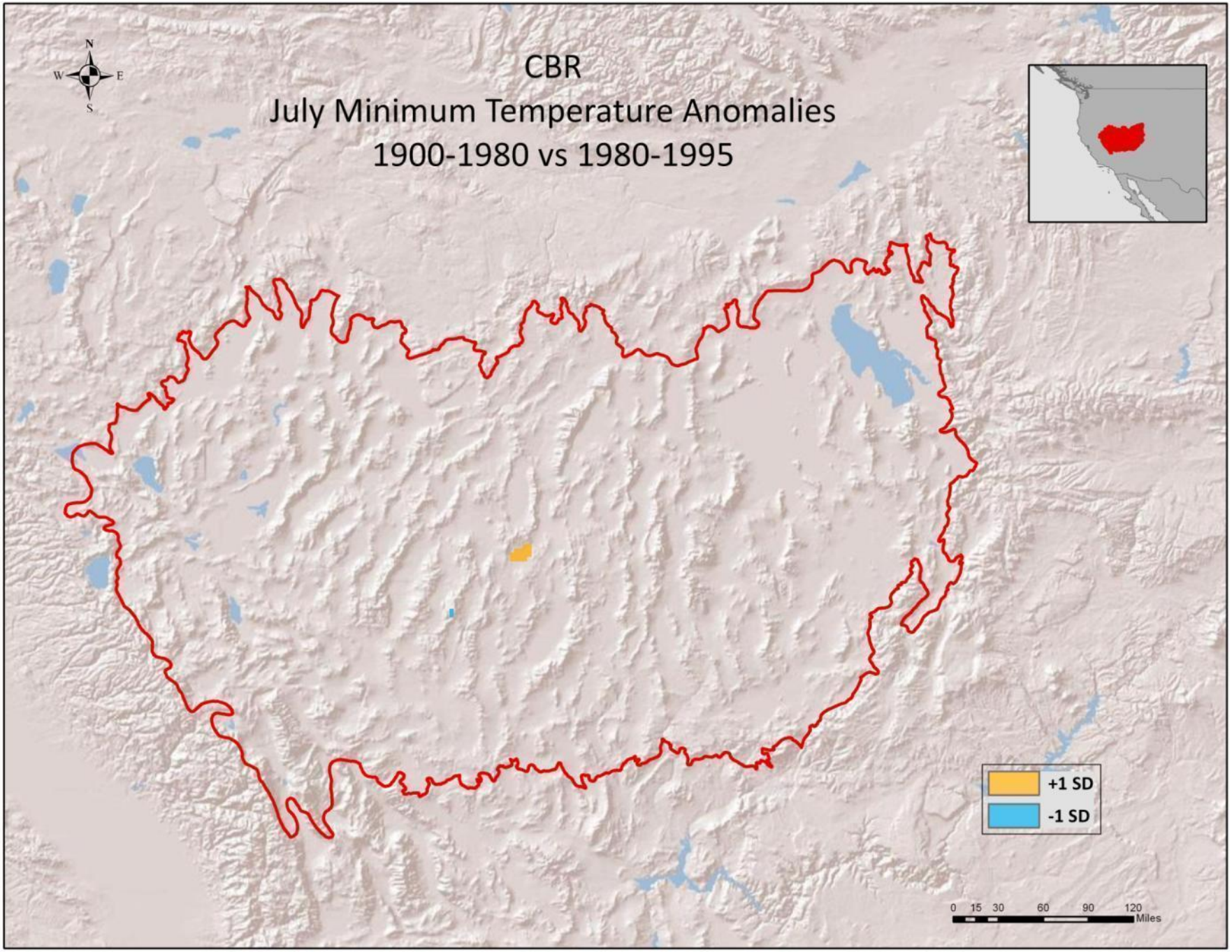

Mojave Basin and Range
Climate Space Trends
July
Minimum Temperature (°F)
Maximum Temperature (°F)
1900-1980
1980-1995

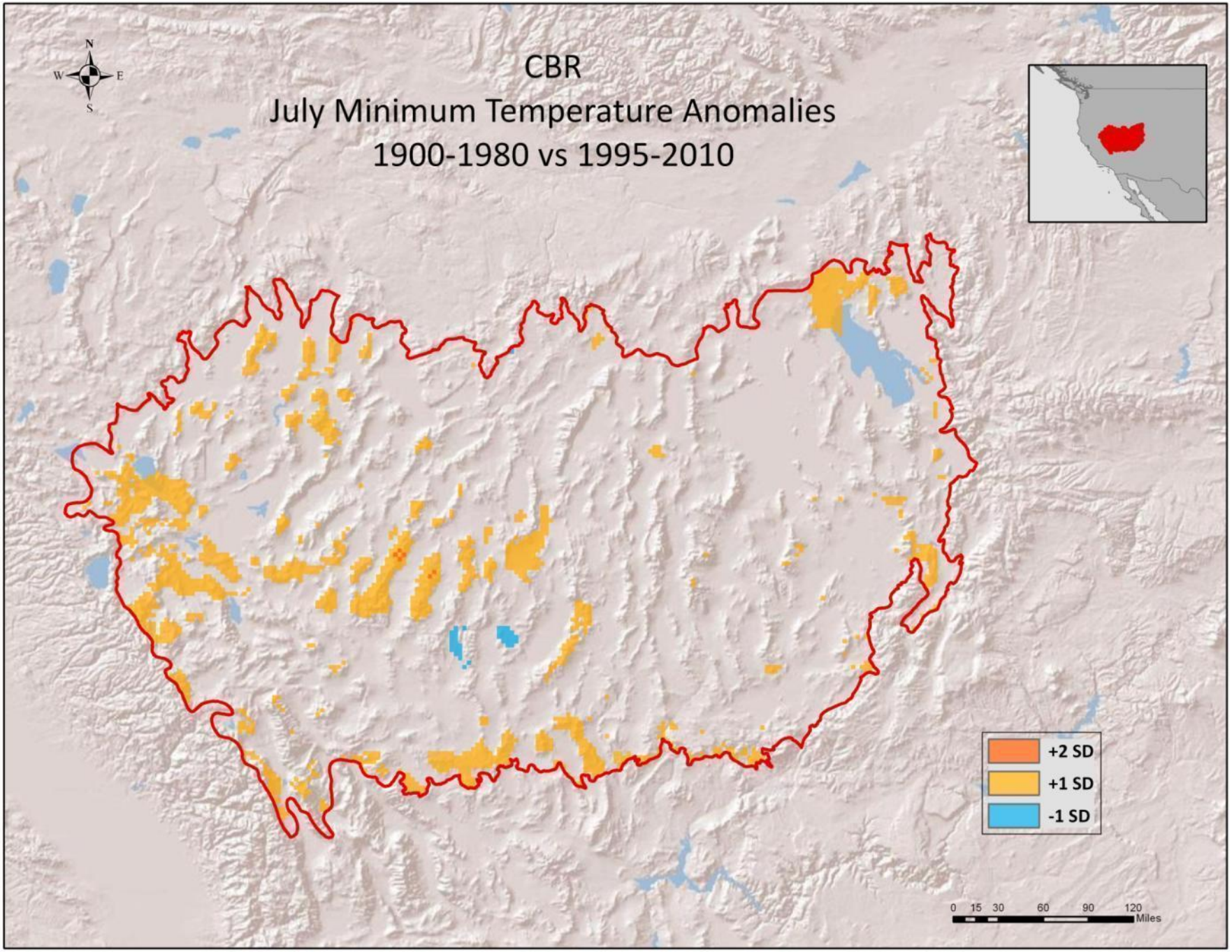

Central Basin and Range
Climate Space Trends
July
Minimum Temperature (°F)
Maximum Temperature (°F)
1900-1980
1980-1995
1995-2010

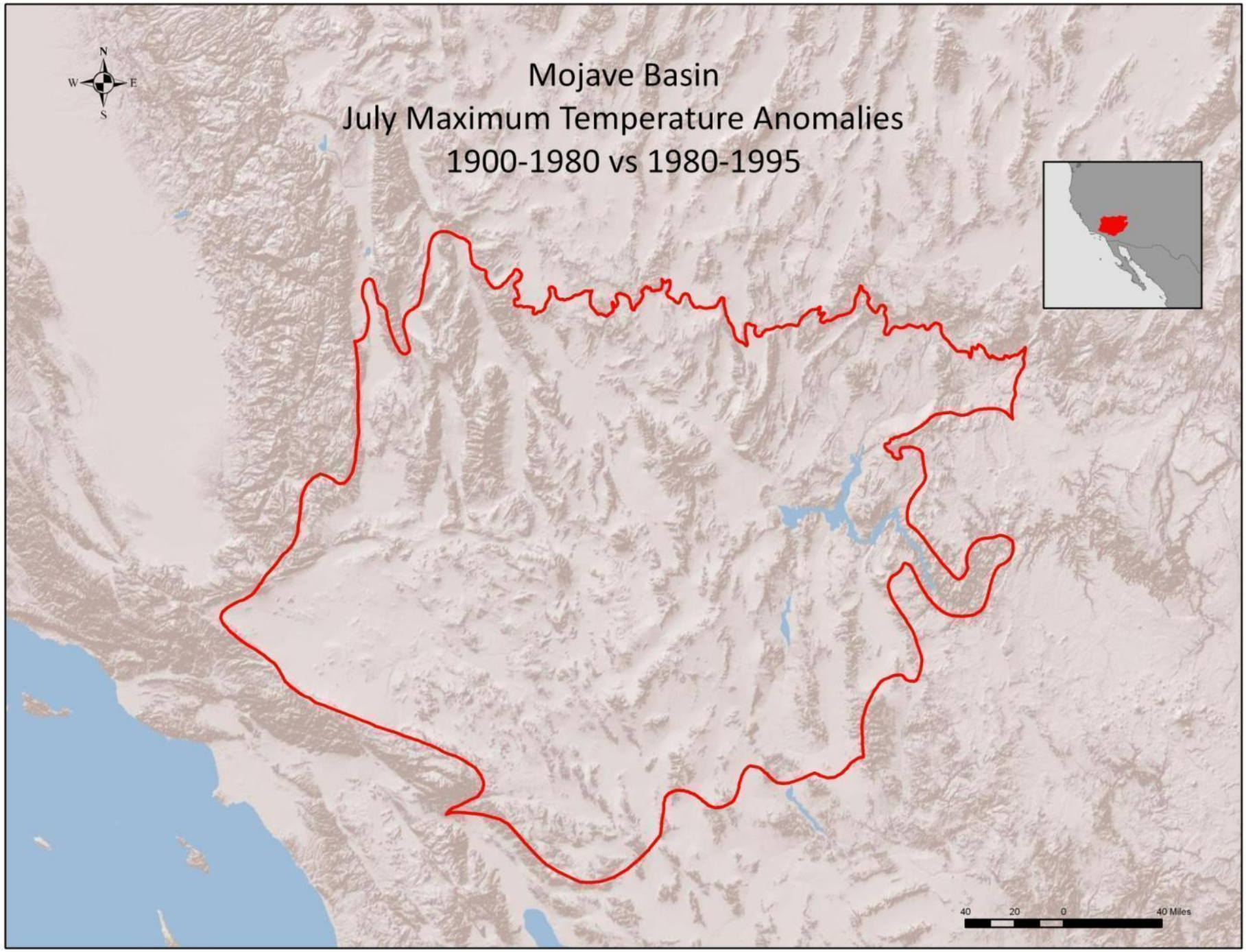

Mojave Basin and Range
Climate Space Trends
July
Minimum Temperature (°F)
Maximum Temperature (°F)
1900-1980
1980-1995
1995-2010

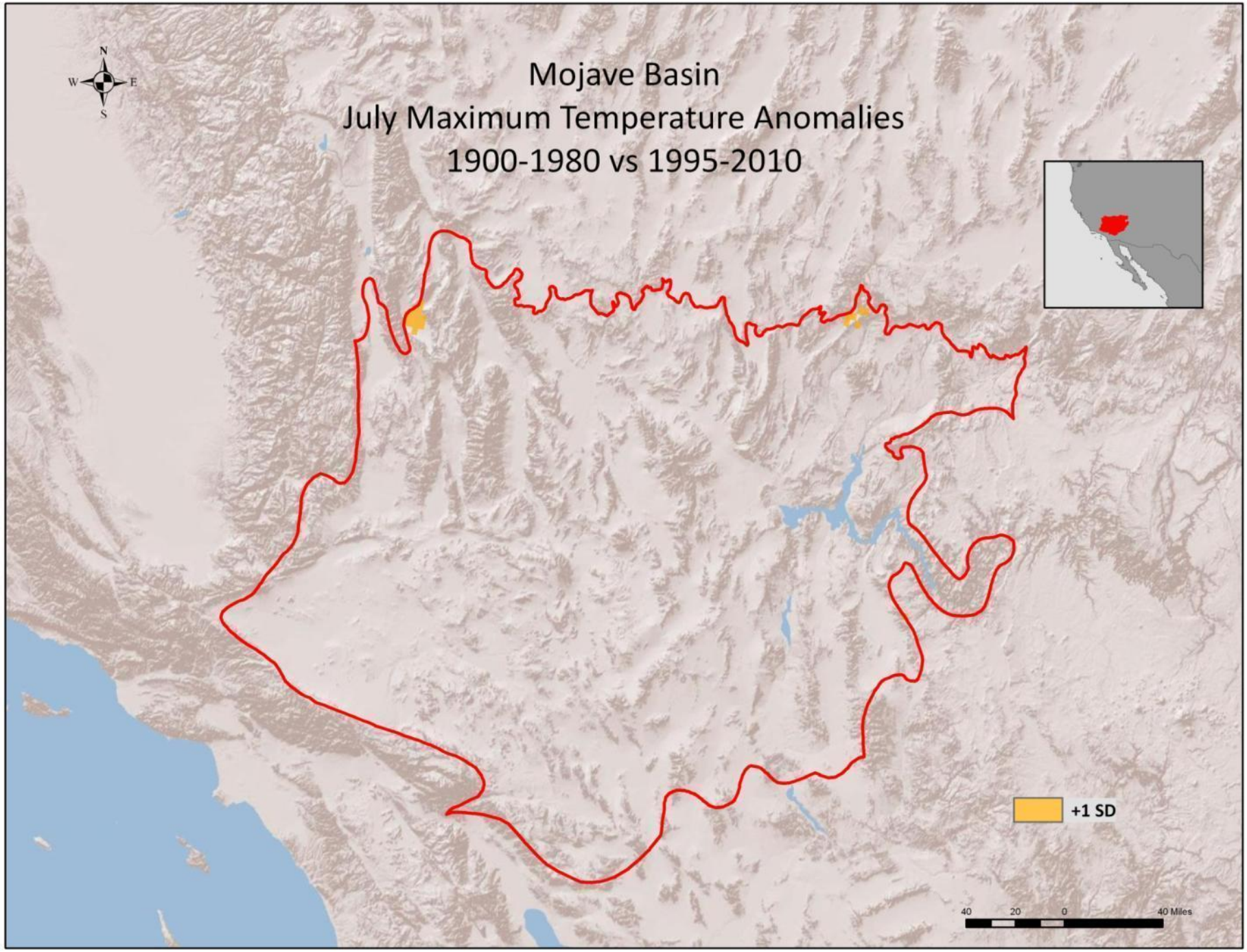

CBR
July Maximum Temperature Anomalies
1900-1980 vs 1980-1995
N
W
E
S
+1 SD
0 15 30 60 90 120
Miles

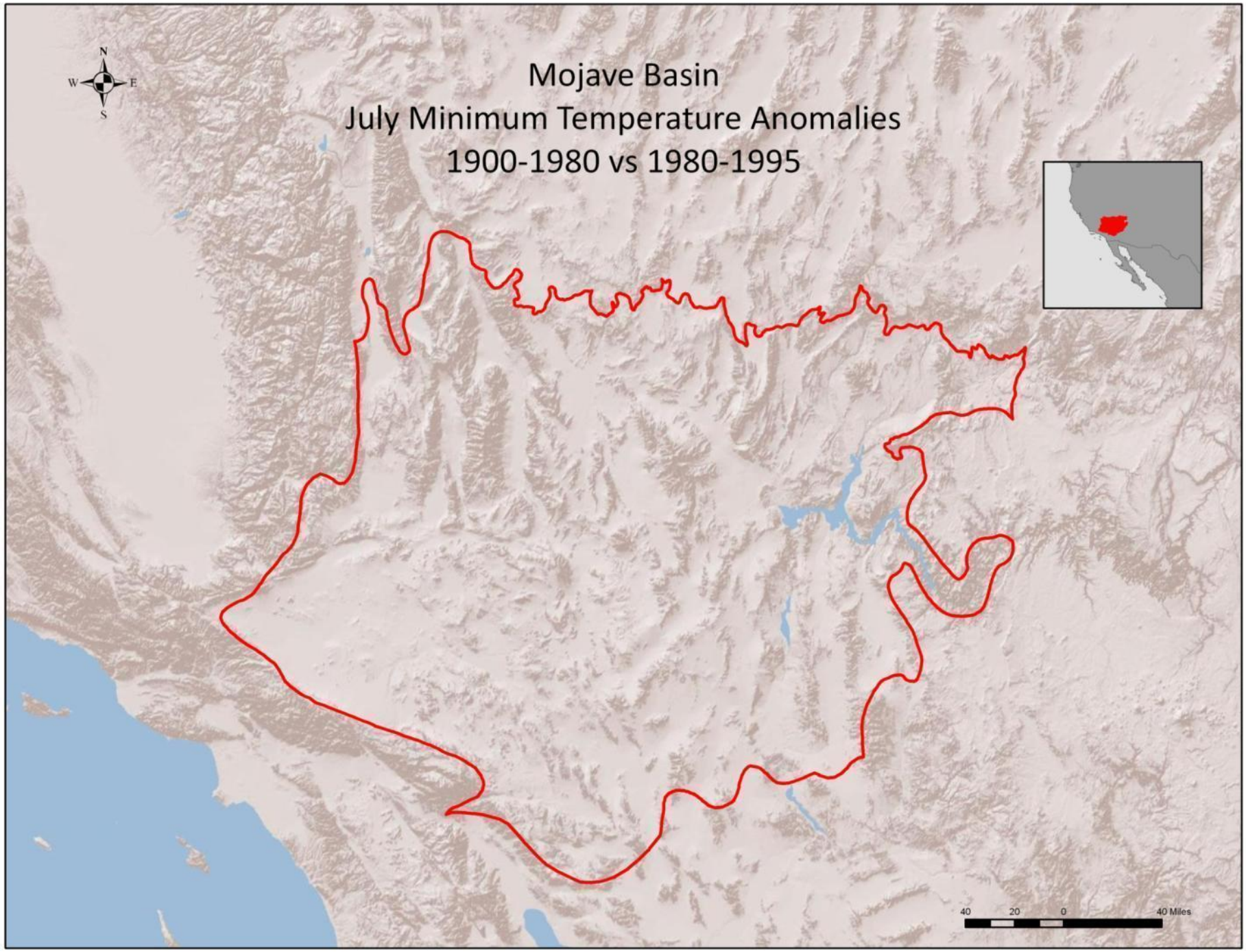

CBR
July Maximum Temperature Anomalies
1900-1980 vs 1995-2010
N
W
E
S
+1 SD
-1 SD
0 15 30 60 90 120
Miles

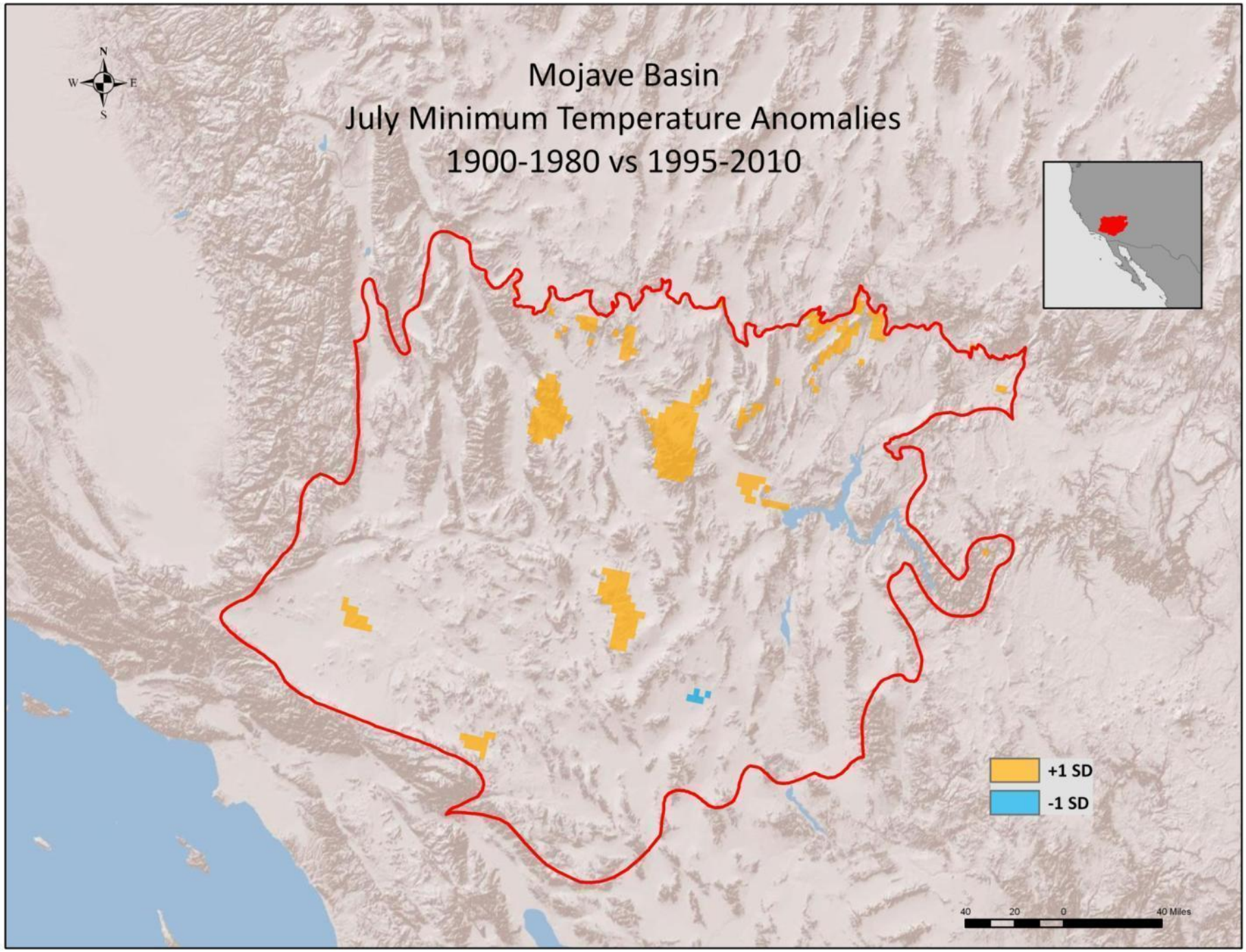

CBR
July Minimum Temperature Anomalies
1900-1980 vs 1980-1995
N
W
E
S
+1 SD
-1 SD
0 15 30 60 90 120
Miles

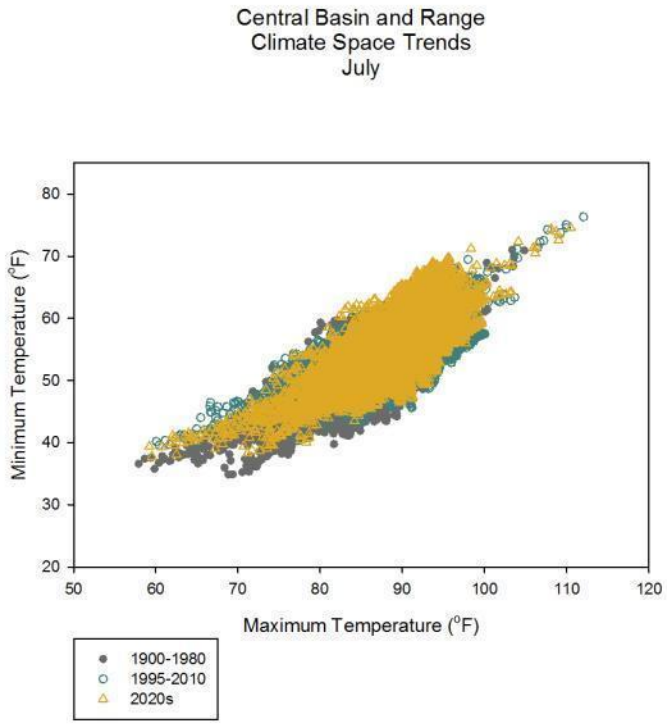

CBR
July Minimum Temperature Anomalies
1900-1980 vs 1995-2010
N
W
E
S
+2 SD
+1 SD
-1 SD
0 15 30 60 90 120
Miles

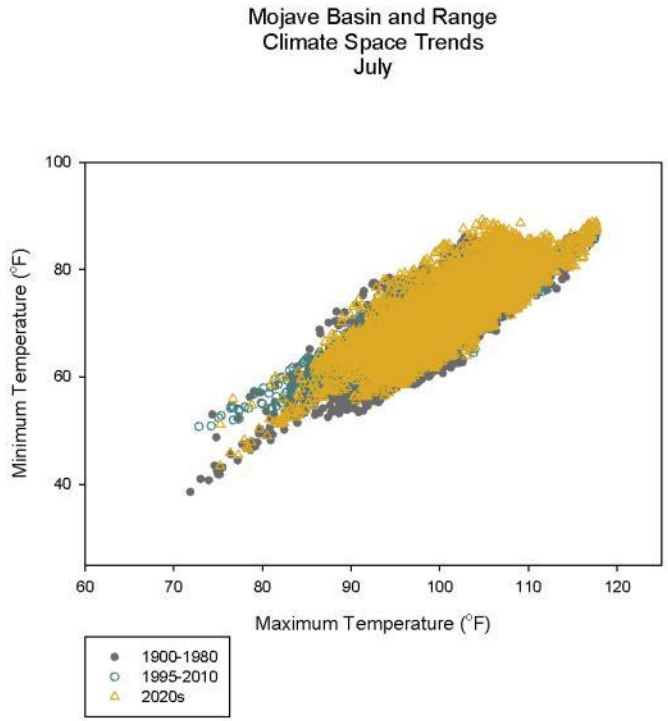

Mojave Basin
July Maximum Temperature Anomalies
1900-1980 vs 1980-1995
N
W
E
S
40
20
0
40 Miles

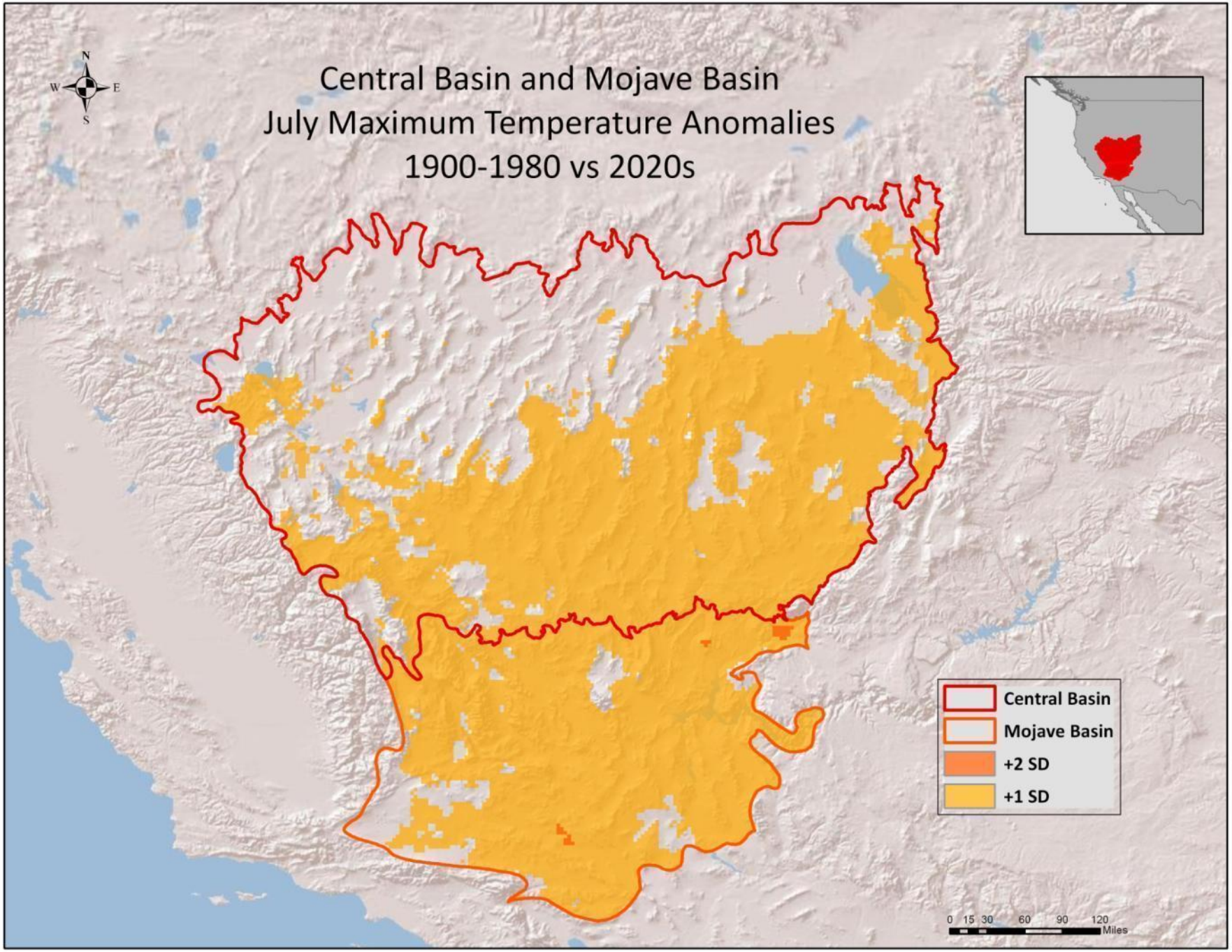

Mojave Basin
July Maximum Temperature Anomalies
1900-1980 vs 1995-2010
N
W
E
S
+1 SD
40
20
0
40 Miles

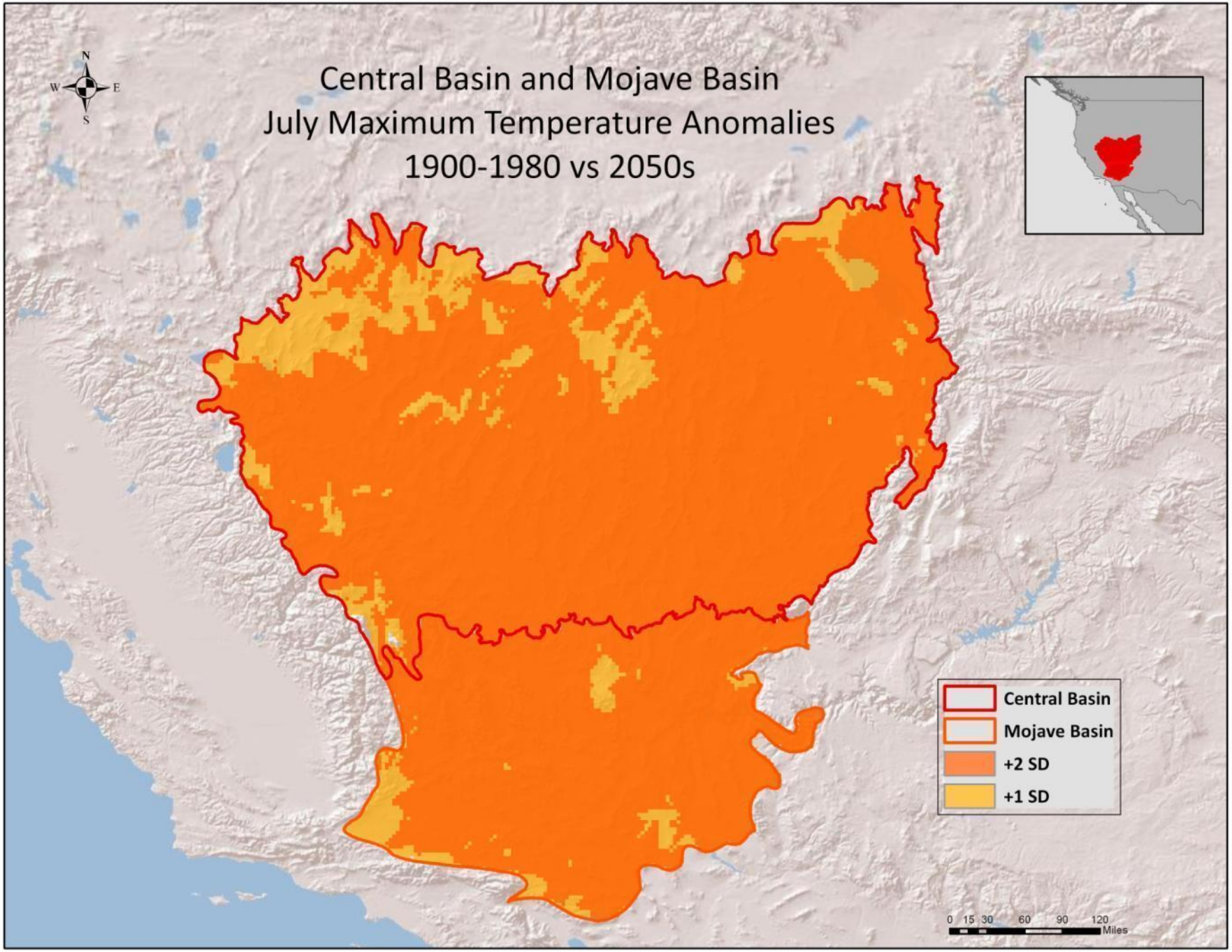

Mojave Basin
July Minimum Temperature Anomalies
1900-1980 vs 1980-1995
N
W
E
S
40
20
0
40 Miles

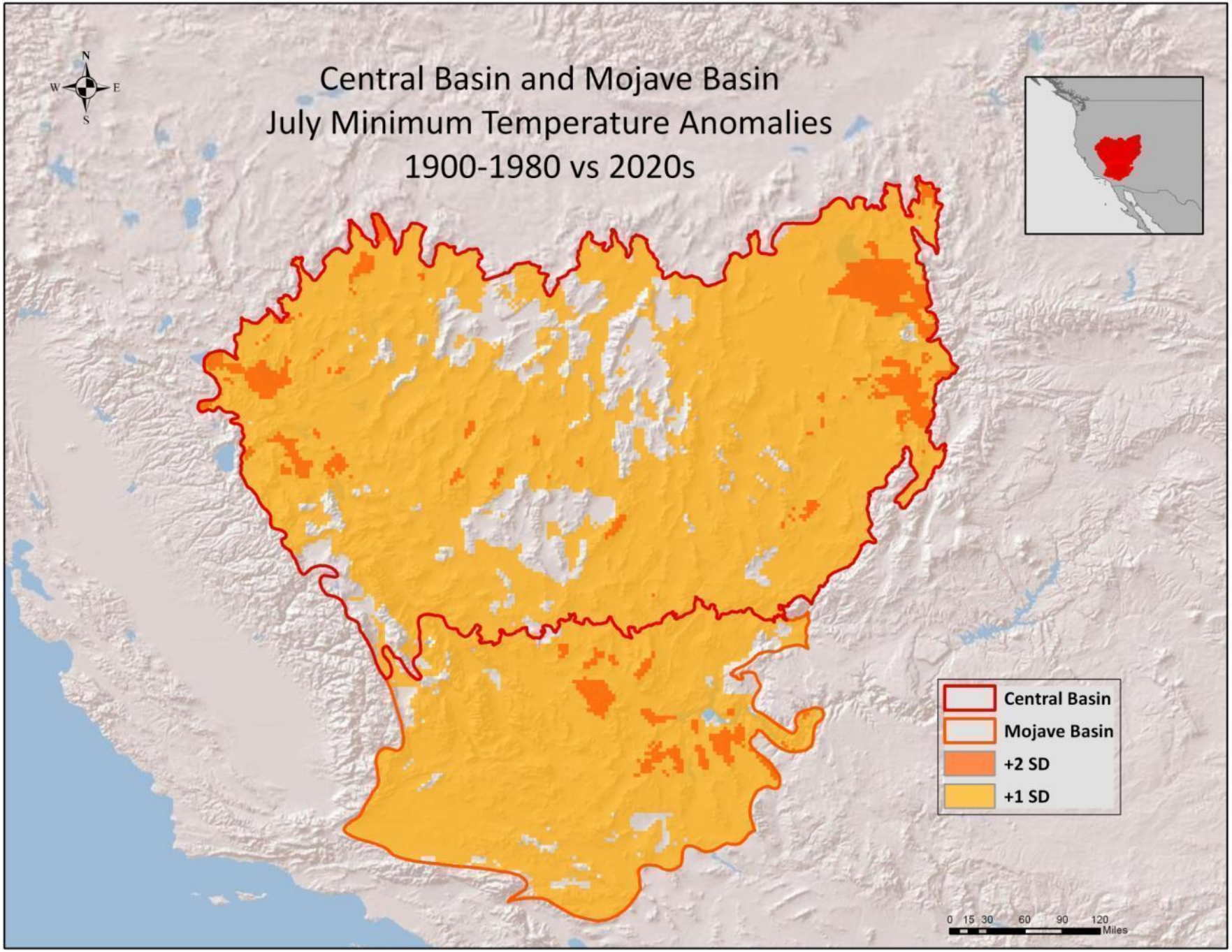

Mojave Basin
July Minimum Temperature Anomalies
1900-1980 vs 1995-2010
N
W
E
S
+1 SD
-1 SD
40
20
0
40 Miles

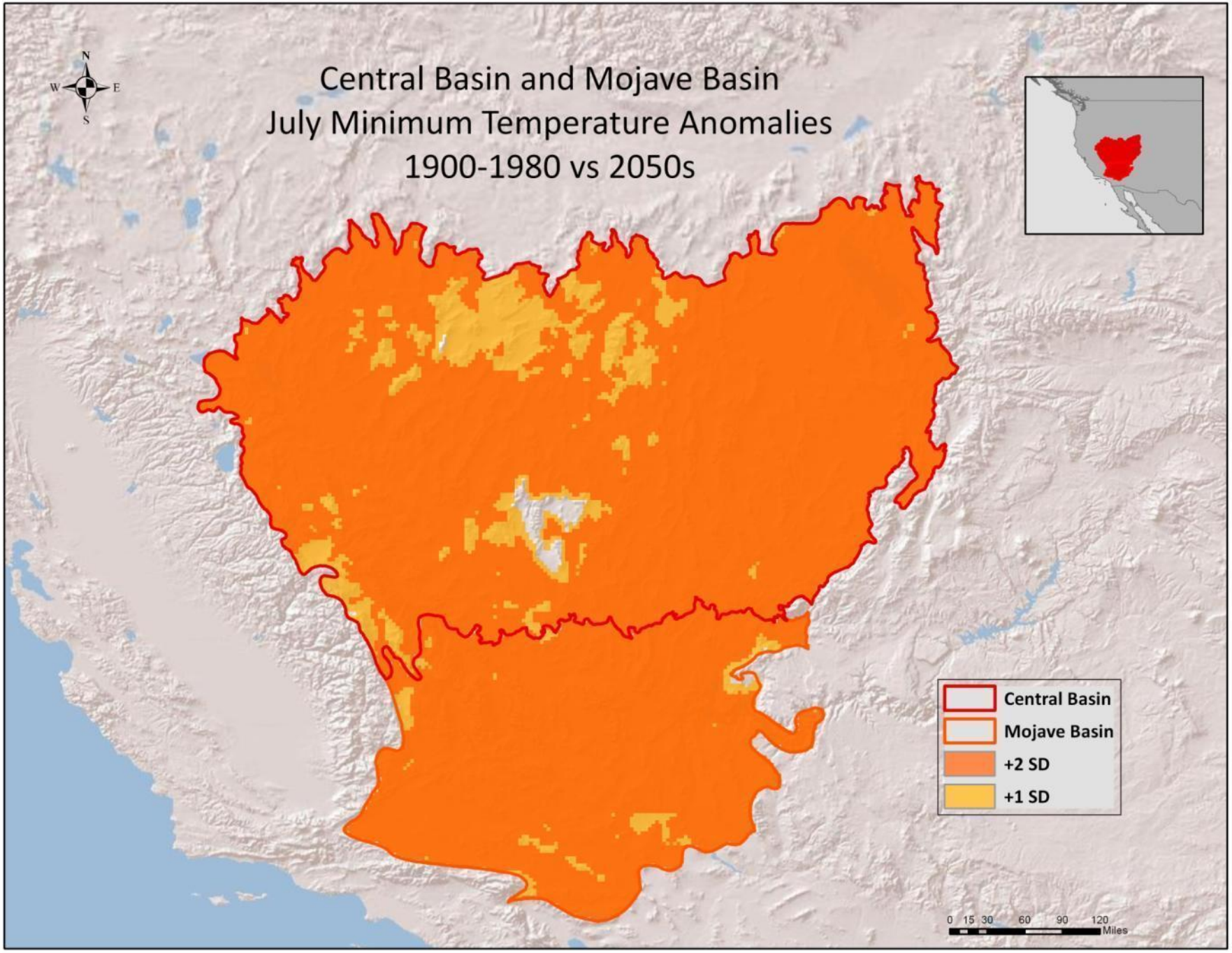

Central Basin and Range
Climate Space Trends
July
Minimum Temperature (°F)
Maximum Temperature (°F)
1900-1980
1995-2010
2020s

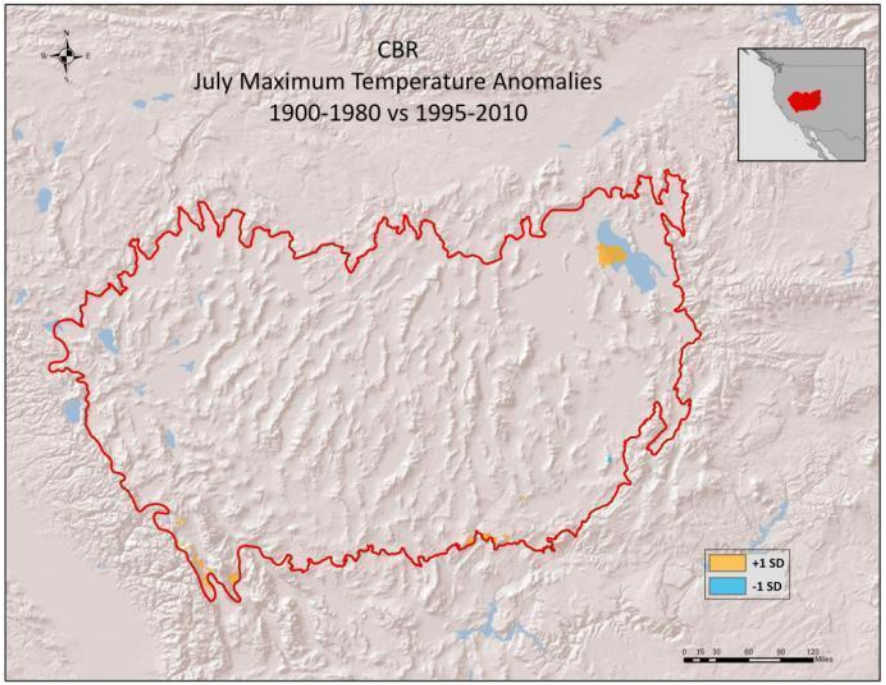

Mojave Basin and Range
Climate Space Trends
July
Minimum Temperature (°F)
Maximum Temperature (°F)
1900-1980
1995-2010
2020s

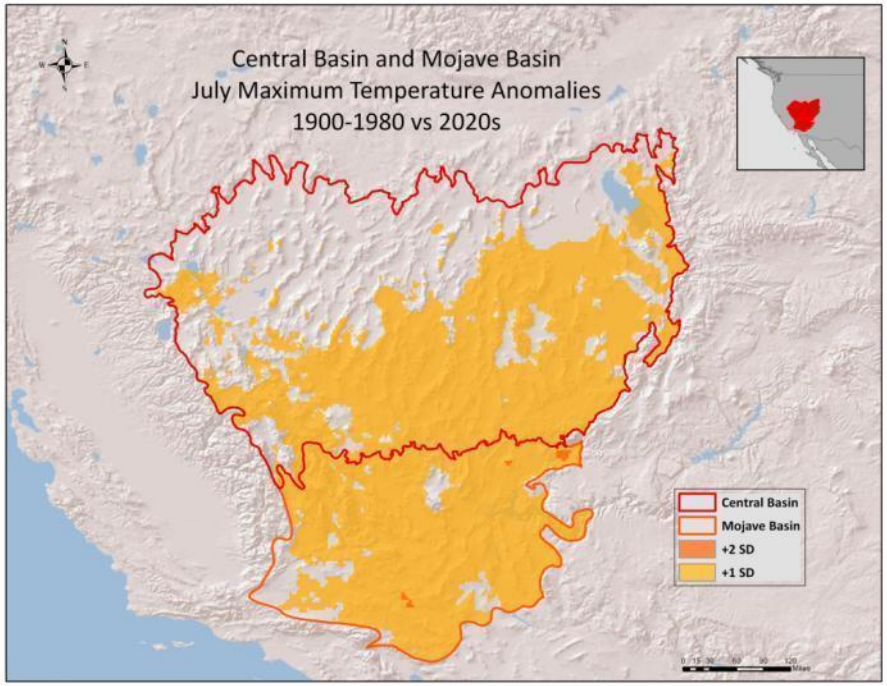

Central Basin and Mojave Basin
July Maximum Temperature Anomalies
1900-1980 vs 2020s
N
W
E
S
Central Basin
Mojave Basin
+2 SD
+1 SD
0 15 30 60 90 120
Miles

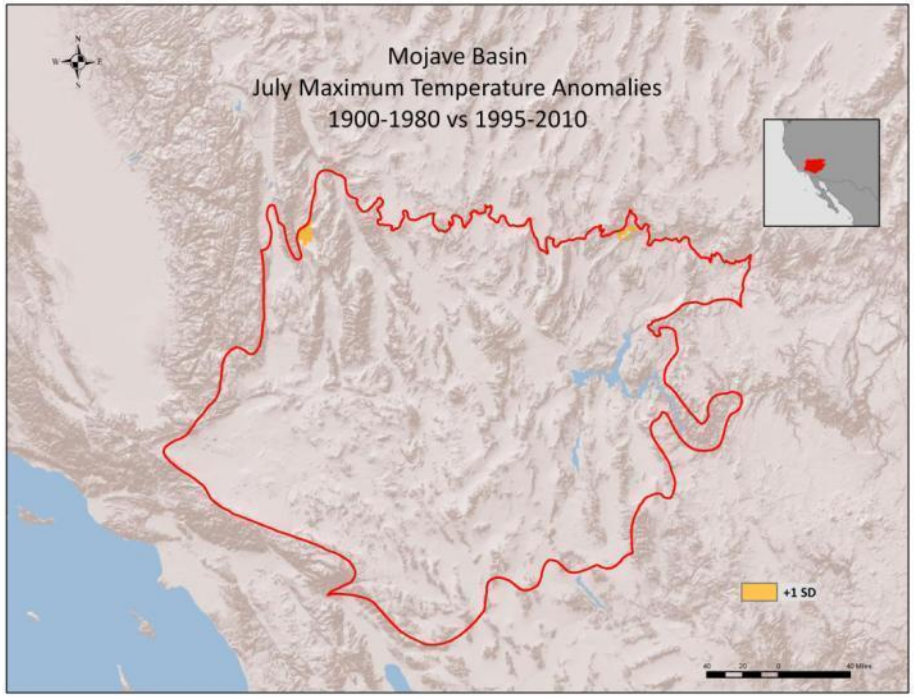

Central Basin and Mojave Basin
July Maximum Temperature Anomalies
1900-1980 vs 2050s
N
W
E
S
Central Basin
Mojave Basin
+2 SD
+1 SD
0 15 30 60 90 120
Miles

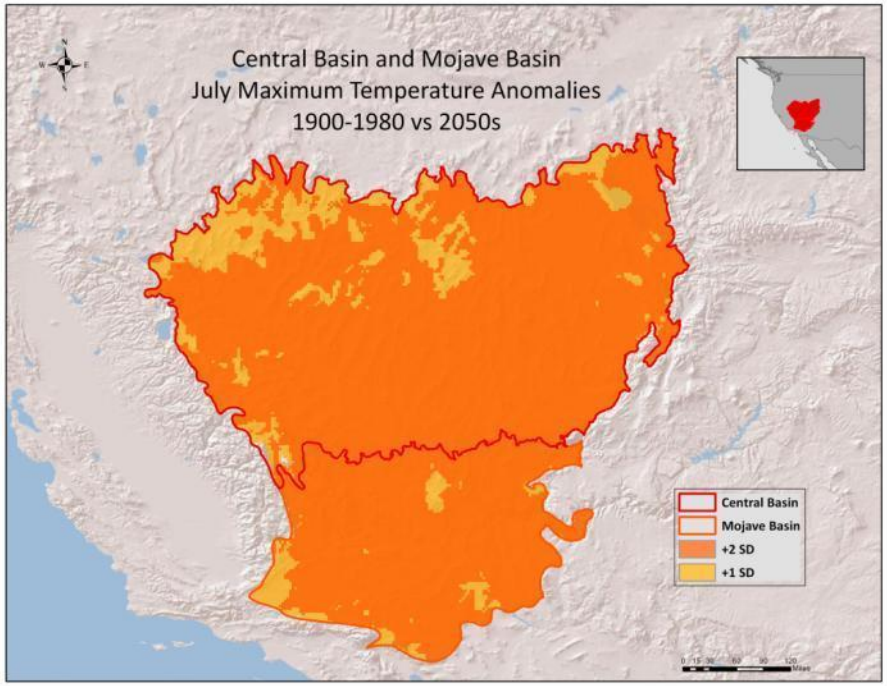

Central Basin and Mojave Basin
July Minimum Temperature Anomalies
1900-1980 vs 2020s
N
W
E
S
Central Basin
Mojave Basin
+2 SD
+1 SD
0 15 30 60 90 120
Miles

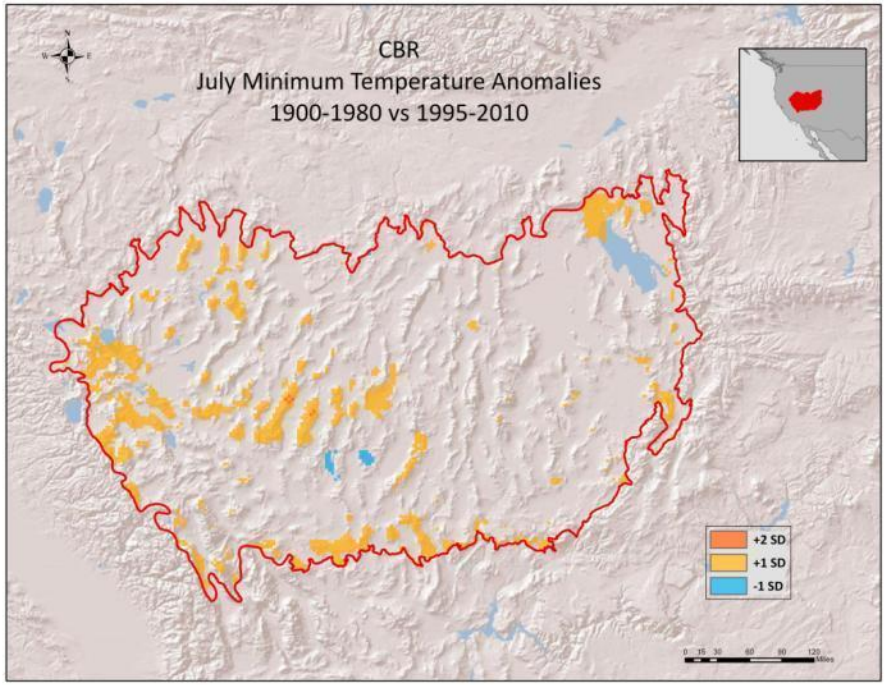

Central Basin and Mojave Basin
July Minimum Temperature Anomalies
1900-1980 vs 2050s
N
W
E
S
Central Basin
Mojave Basin
+2 SD
+1 SD
0 15 30 60 90 120
Miles

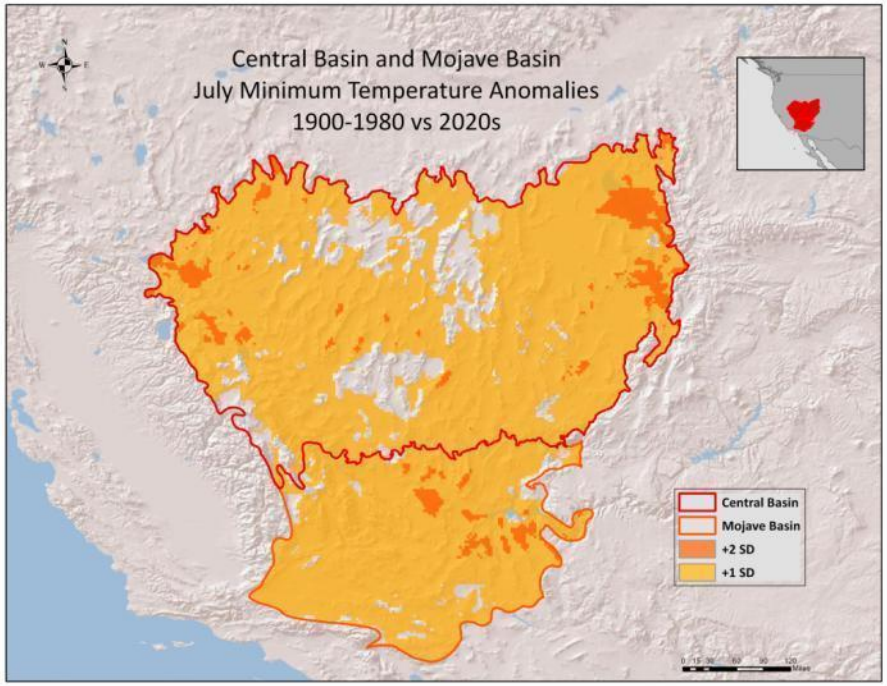

CBR
July Maximum Temperature Anomalies
1900-1980 vs 1995-2010
+1 SD
-1 SD

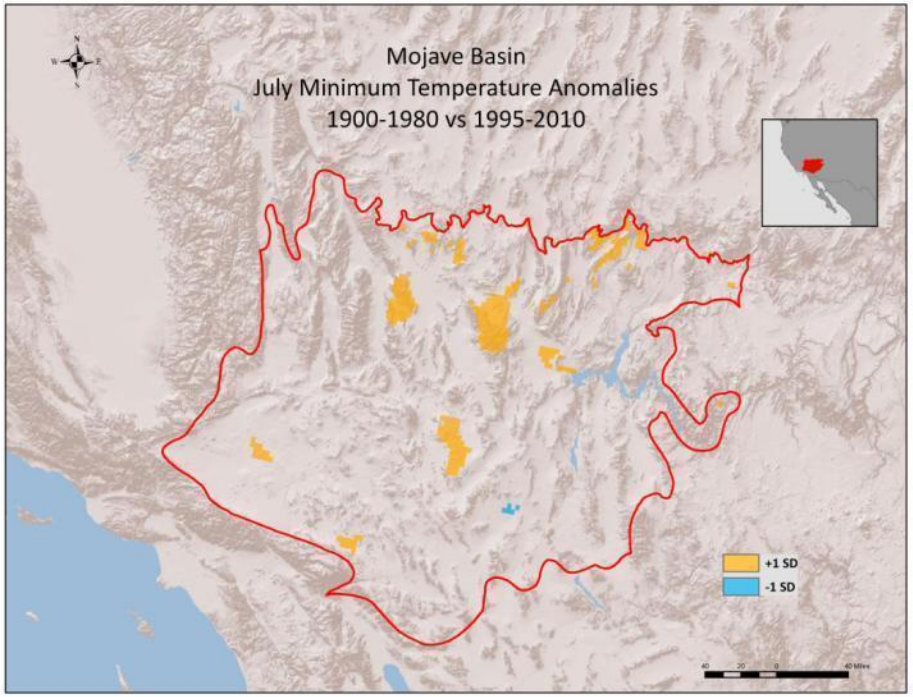

Central Basin and Mojave Basin
July Maximum Temperature Anomalies
1900-1980 vs 2020s
Central Basin
Mojave Basin
+2 SD
+1 SD

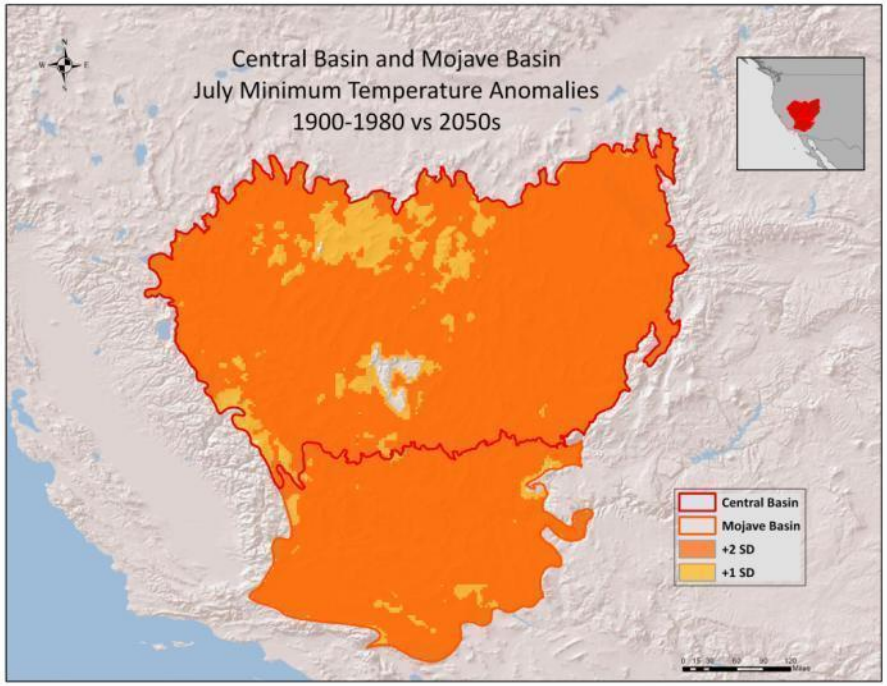

Mojave Basin
July Maximum Temperature Anomalies
1900-1980 vs 1995-2010
+1 SD

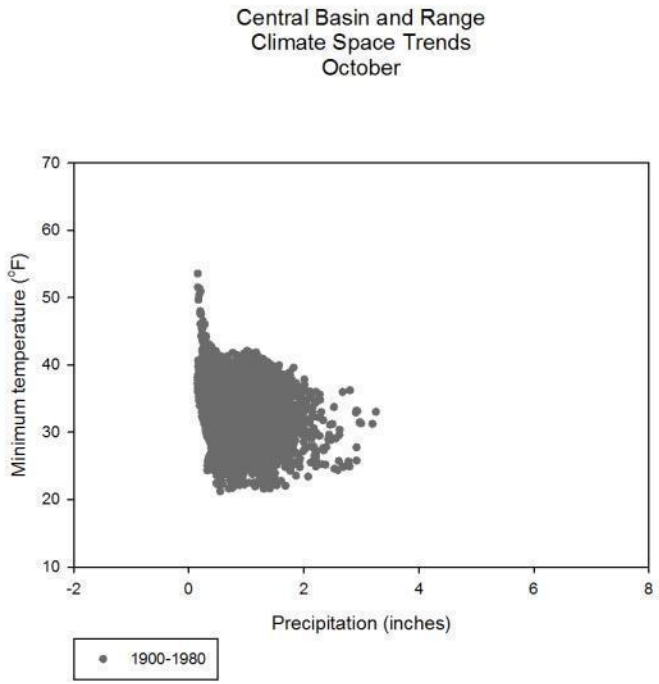

Central Basin and Mojave Basin
July Maximum Temperature Anomalies
1900-1980 vs 2050s
Central Basin
Mojave Basin
+2 SD
+1 SD

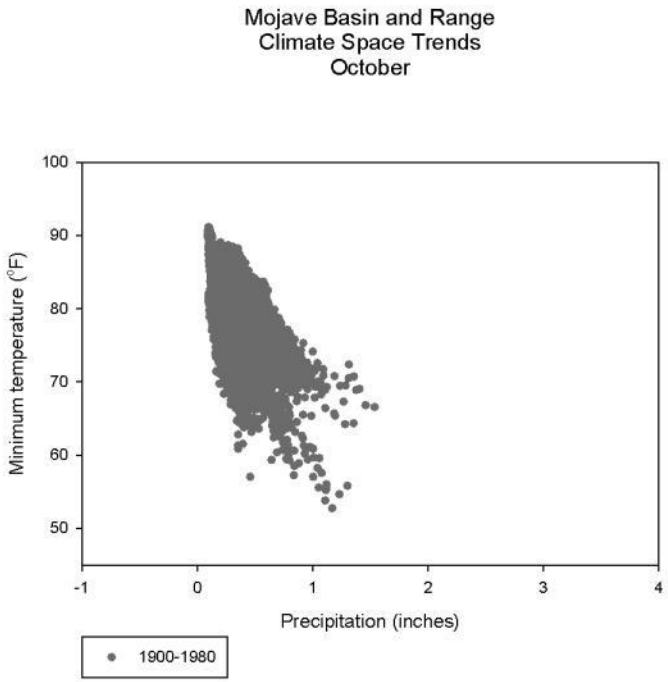

CBR
July Minimum Temperature Anomalies
1900-1980 vs 1995-2010
+2 SD
+1 SD
-1 SD

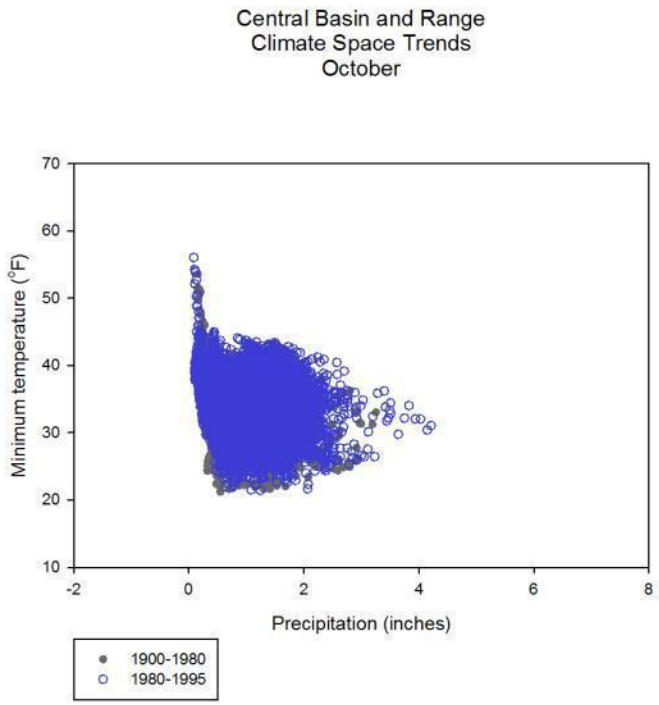

Central Basin and Mojave Basin
July Minimum Temperature Anomalies
1900-1980 vs 2020s
Central Basin
Mojave Basin
+2 SD
+1 SD

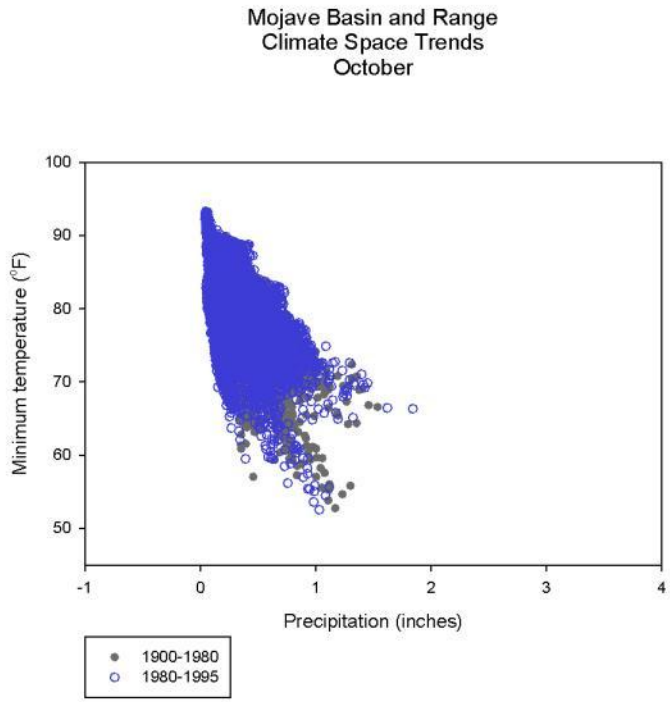

Mojave Basin
July Minimum Temperature Anomalies
1900-1980 vs 1995-2010
+1 SD
-1 SD

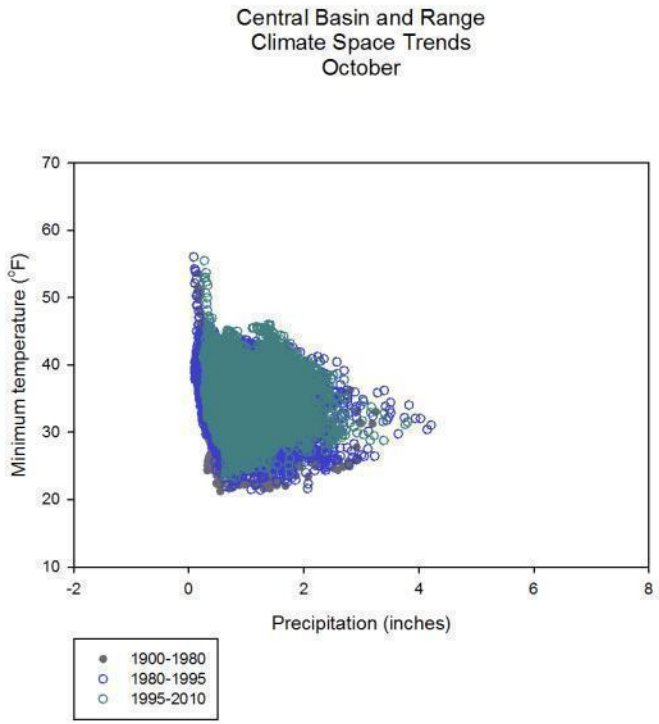

Central Basin and Mojave Basin
July Minimum Temperature Anomalies
1900-1980 vs 2050s
Central Basin
Mojave Basin
+2 SD
+1 SD

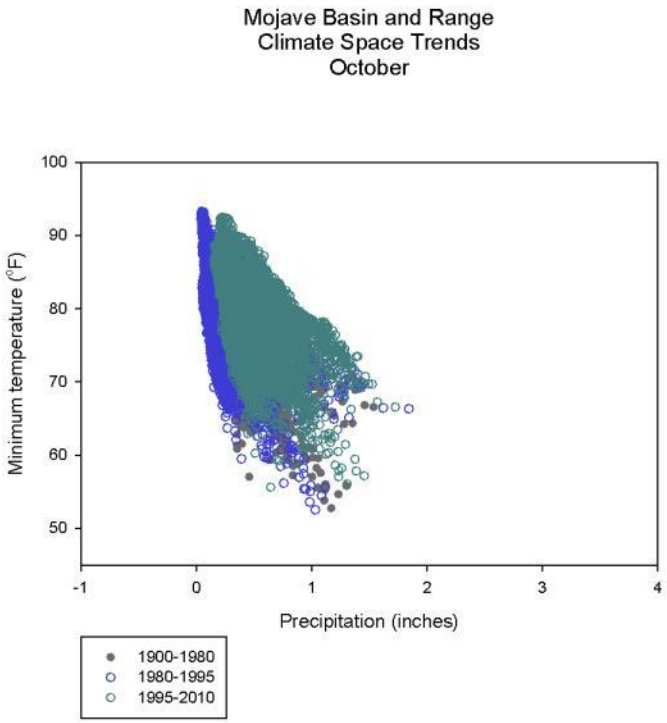

Central Basin and Range
Climate Space Trends
October
Minimum temperature (°F)
70
60
50
40
30
20
10
-2
0
2
4
6
8
Precipitation (inches)
1900-1980

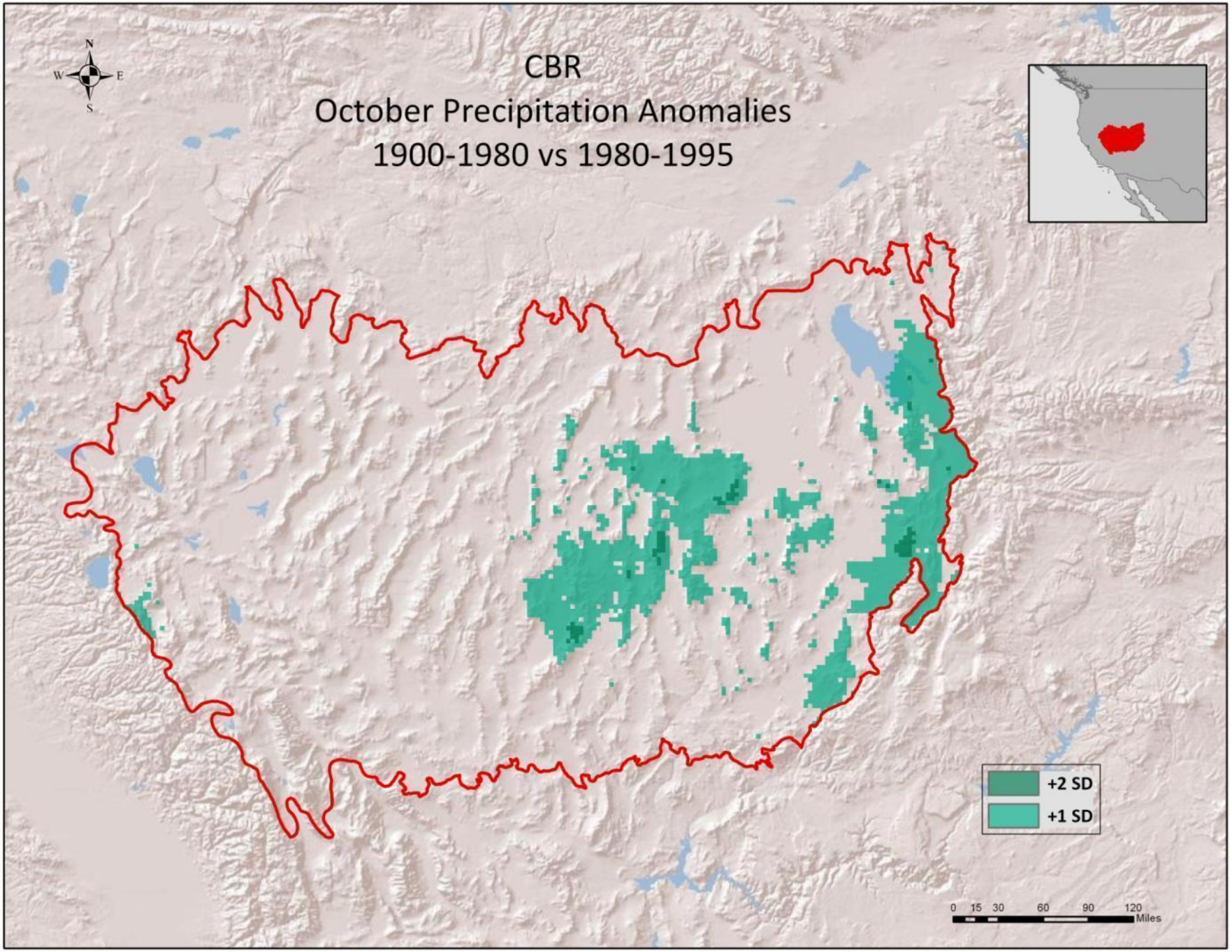

Mojave Basin and Range
Climate Space Trends
October
Minimum temperature (°F)
100
90
80
70
60
50
-1
0
1
2
3
4
Precipitation (inches)
1900-1980

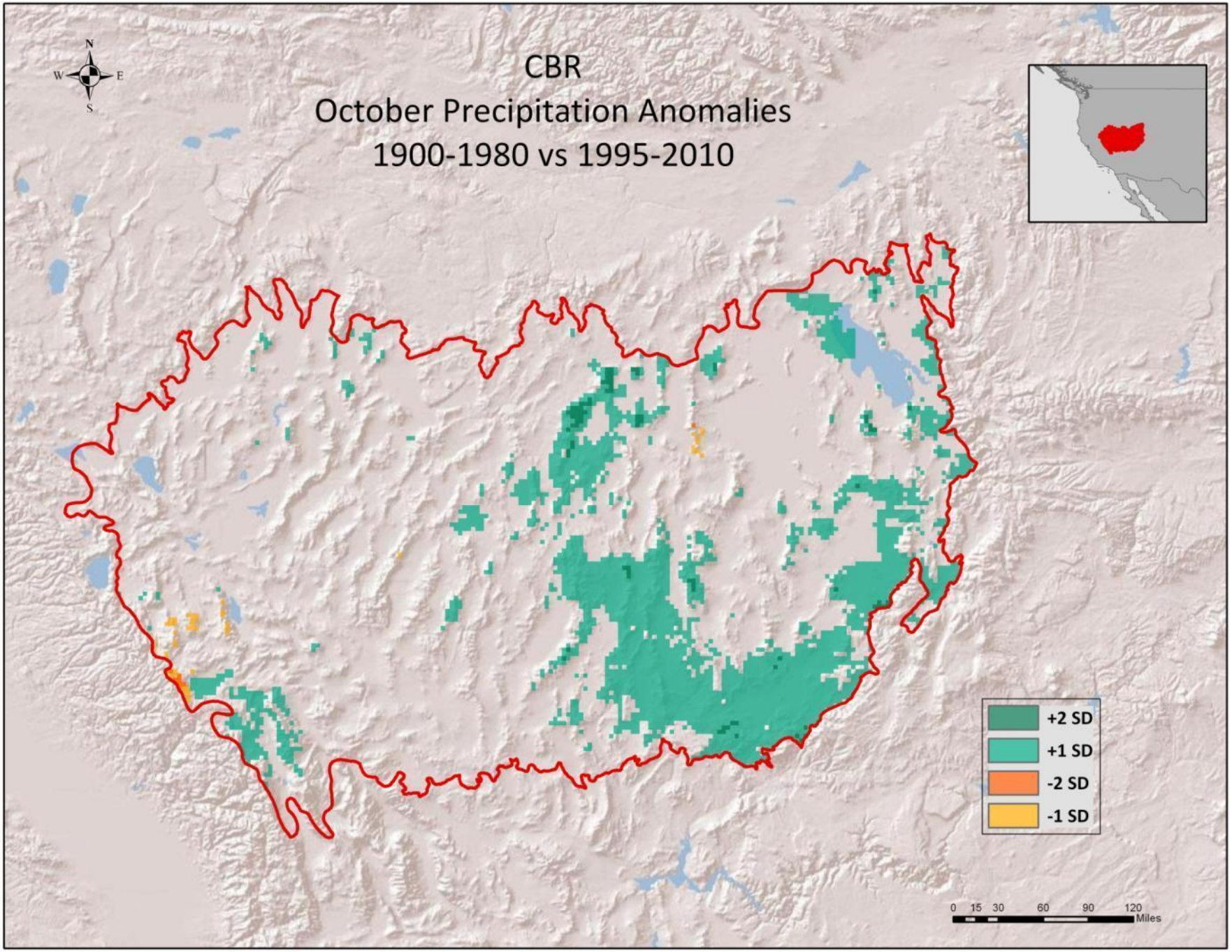

Central Basin and Range
Climate Space Trends
October
Minimum temperature (°F)
Precipitation (inches)
70
60
50
40
30
20
10
-2
0
2
4
6
8
1900-1980
1980-1995

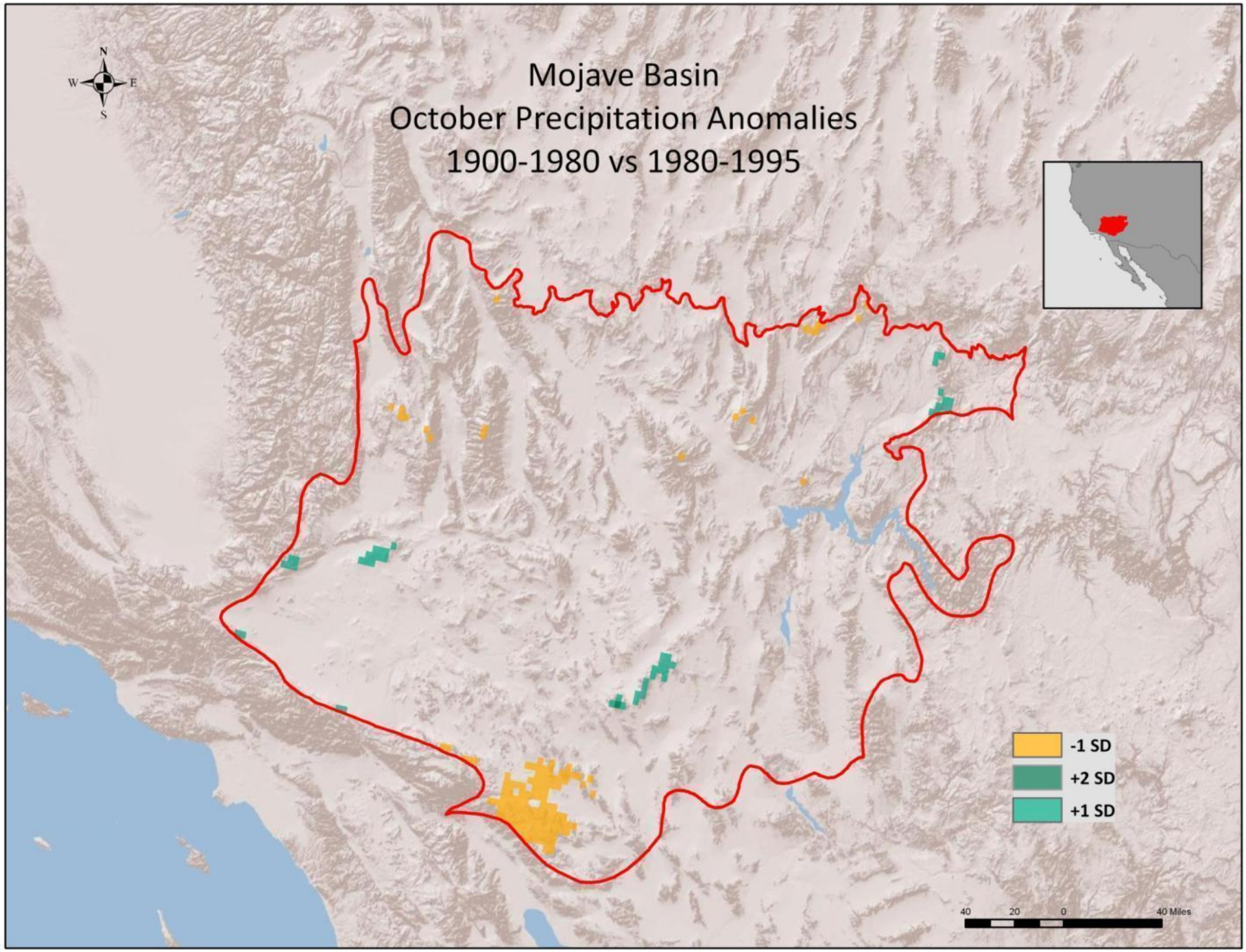

Mojave Basin and Range
Climate Space Trends
October
Minimum temperature (°F)
Precipitation (inches)
100
90
80
70
60
50
-1
0
1
2
3
4
1900-1980
1980-1995

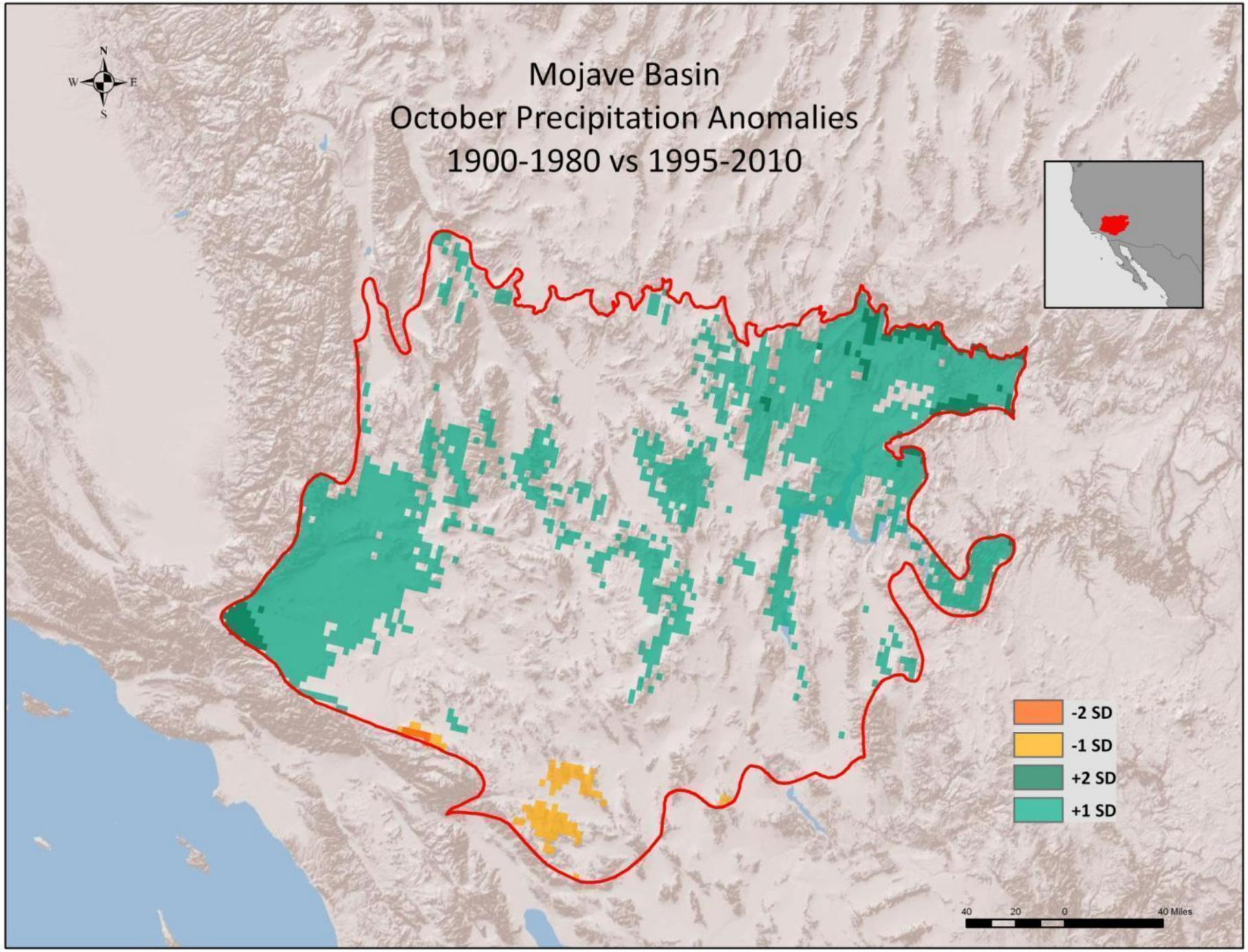

Central Basin and Range
Climate Space Trends
October
Minimum temperature (°F)
Precipitation (inches)
70
60
50
40
30
20
10
-2
0
2
4
6
8
1900-1980
1980-1995
1995-2010

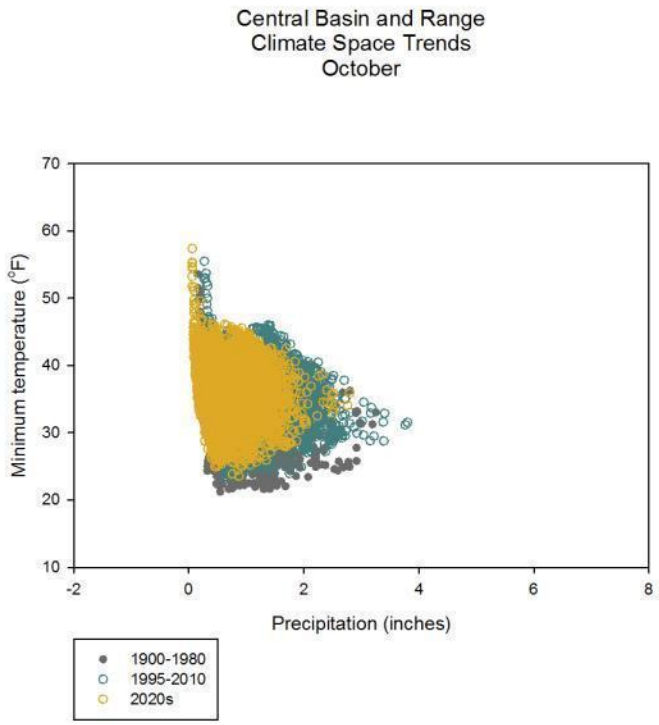

Mojave Basin and Range
Climate Space Trends
October
Minimum temperature (°F)
Precipitation (inches)
100
90
80
70
60
50
-1
0
1
2
3
4
1900-1980
1980-1995
1995-2010

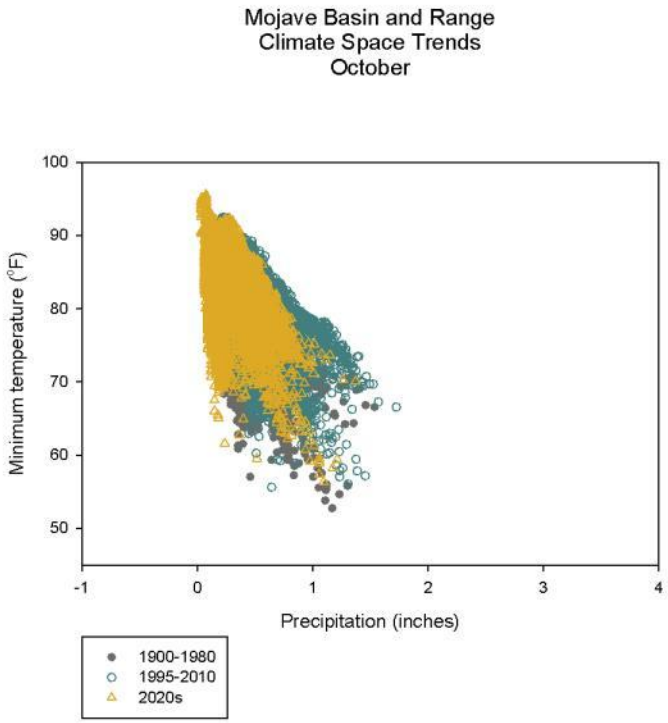

CBR
October Precipitation Anomalies
1900-1980 vs 1980-1995
N
W
E
S
+2 SD
+1 SD
0 15 30 60 90 120
Miles

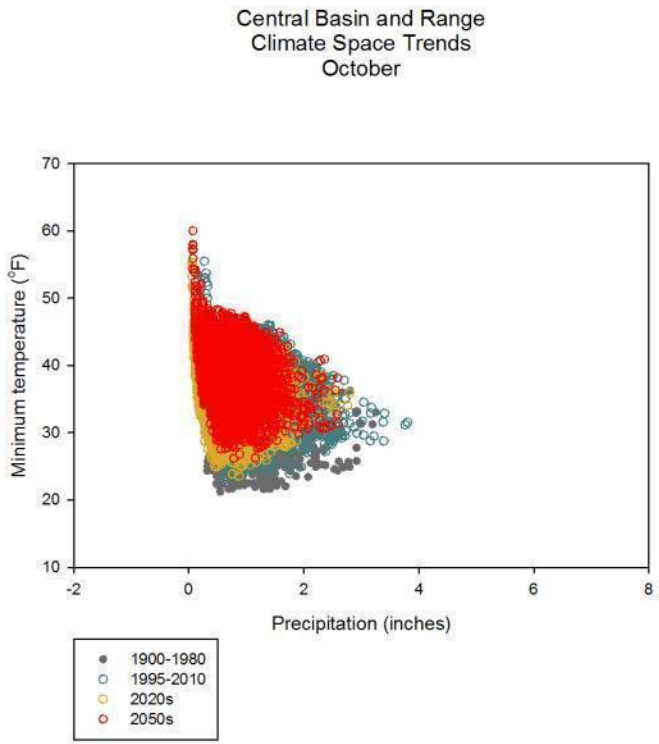

CBR
October Precipitation Anomalies
1900-1980 vs 1995-2010
N
W
E
S
+2 SD
+1 SD
-2 SD
-1 SD
0 15 30 60 90 120
Miles

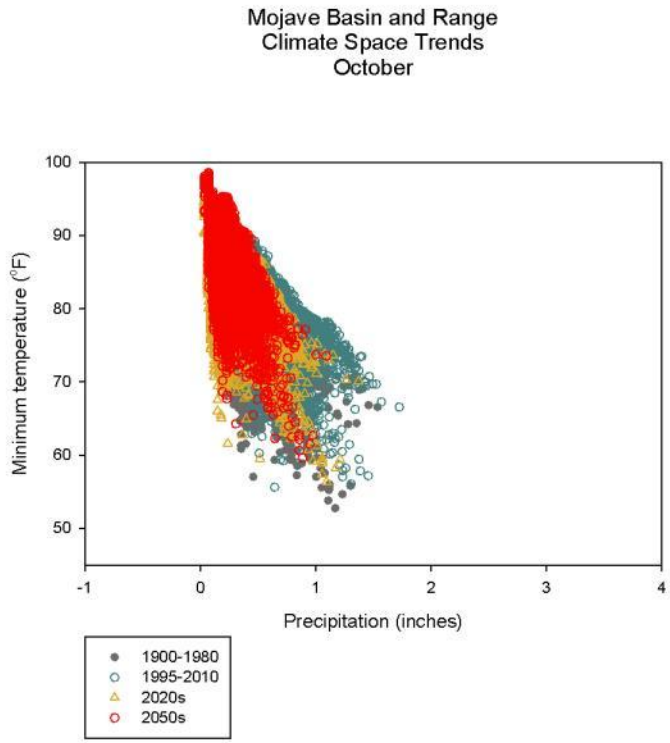

Mojave Basin
October Precipitation Anomalies
1900-1980 vs 1980-1995
N
W
E
S
-1 SD
+2 SD
+1 SD
40
20
0
40 Miles

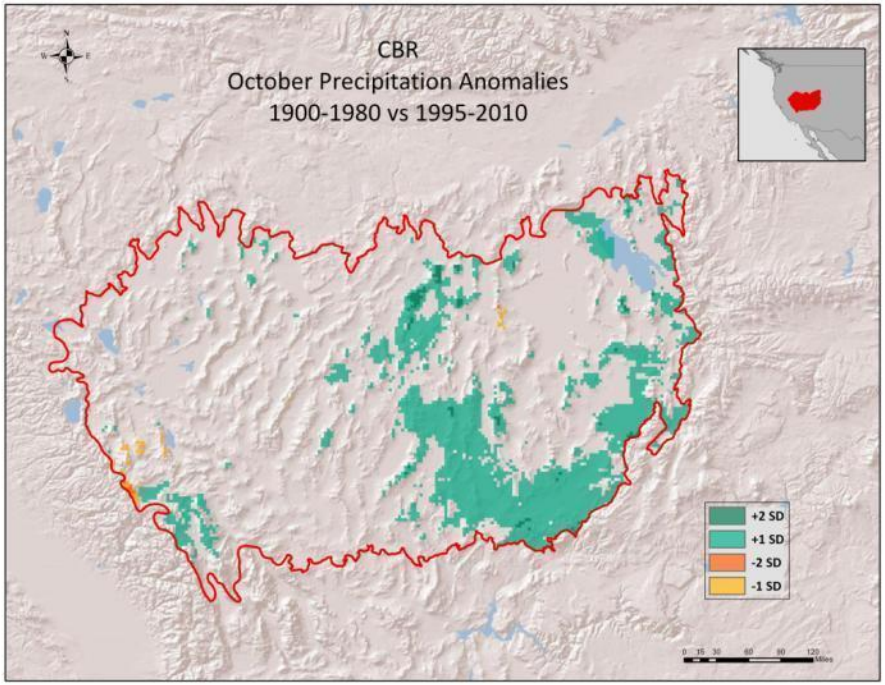

Mojave Basin
October Precipitation Anomalies
1900-1980 vs 1995-2010
N
W
E
S
-2 SD
-1 SD
+2 SD
+1 SD
40
20
0
40 Miles

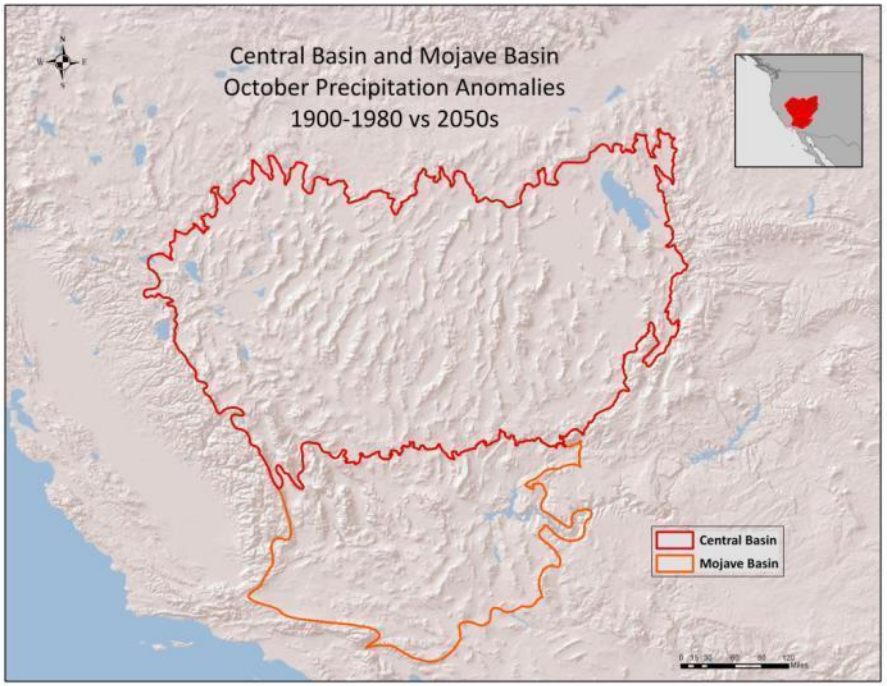

Central Basin and Range
Climate Space Trends
October
Minimum temperature (°F)
Precipitation (inches)
70
60
50
40
30
20
10
-2
0
2
4
6
8
1900-1980
1995-2010
2020s

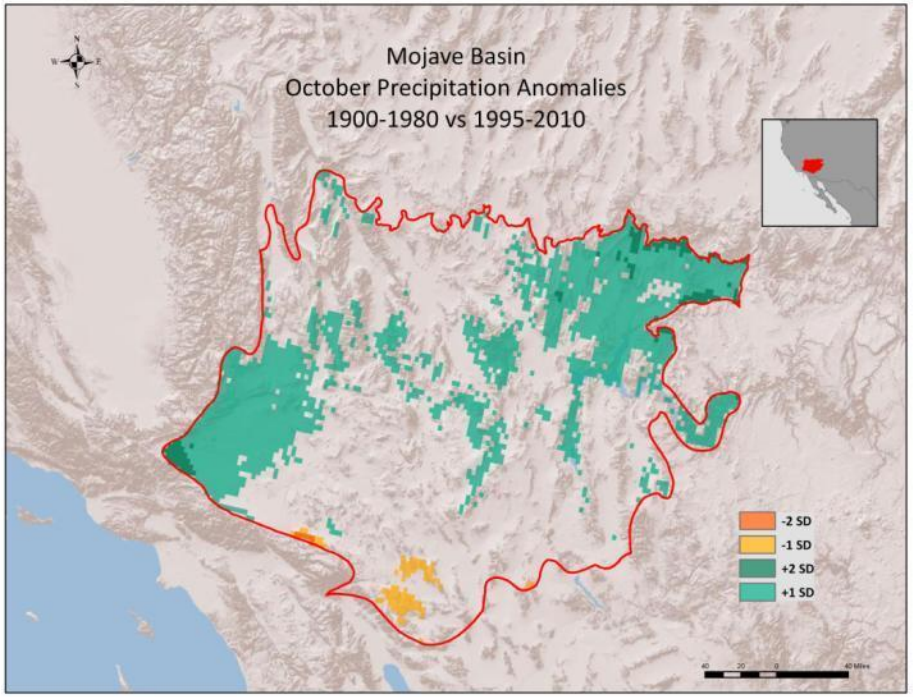

Mojave Basin and Range
Climate Space Trends
October
Minimum temperature (°F)
Precipitation (inches)
100
90
80
70
60
50
-1
0
1
2
3
4
1900-1980
1995-2010
2020s

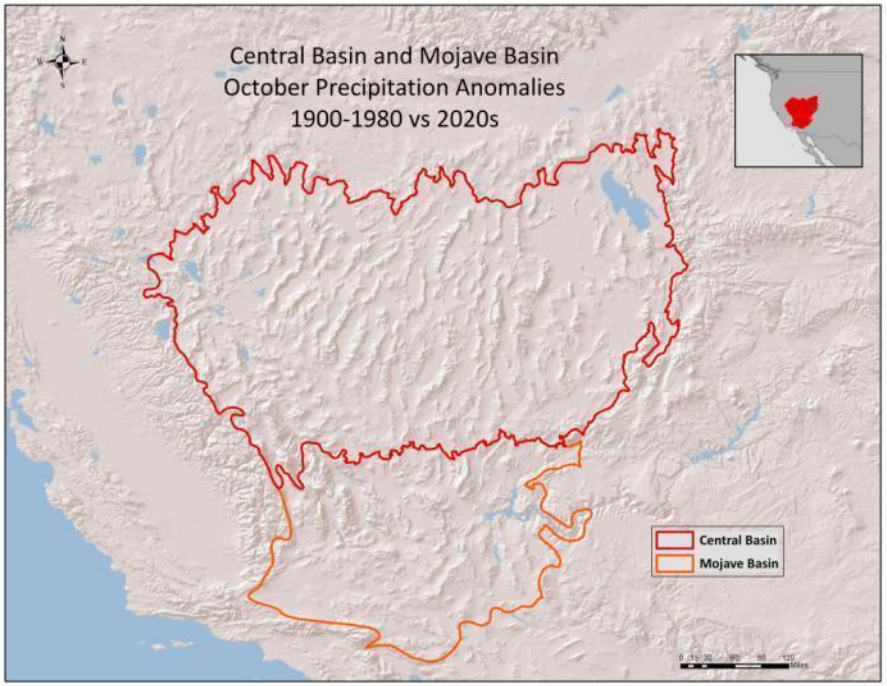

Central Basin and Range
Climate Space Trends
October
Minimum temperature (°F)
Precipitation (inches)
70
60
50
40
30
20
10
-2
0
2
4
6
8
1900-1980
1995-2010
2020s
2050s

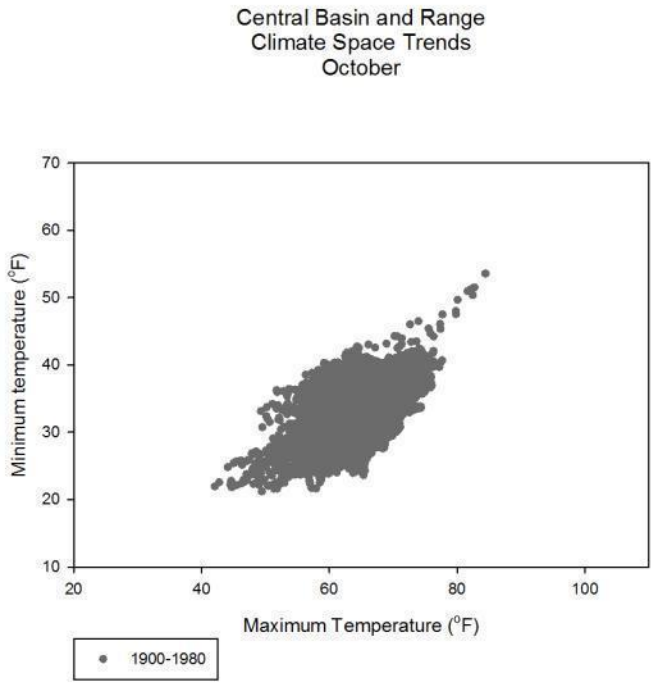

Mojave Basin and Range
Climate Space Trends
October
Minimum temperature (°F)
Precipitation (inches)
100
90
80
70
60
50
-1
0
1
2
3
4
1900-1980
1995-2010
2020s
2050s

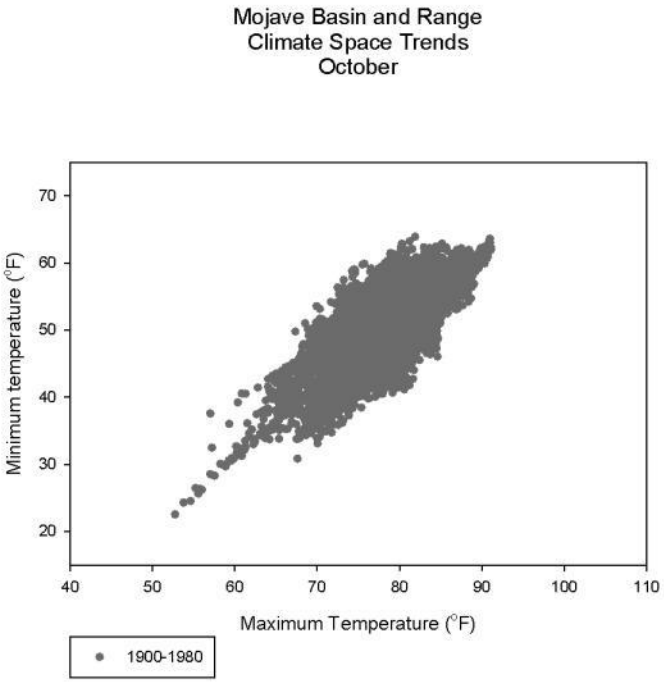

CBR
October Precipitation Anomalies
1900-1980 vs 1995-2010
+2 SD
+1 SD
-2 SD
-1 SD

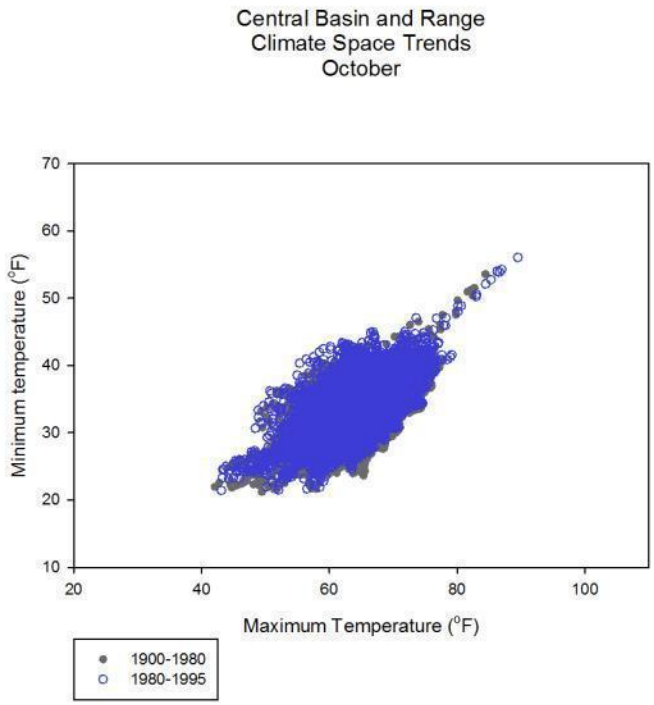

Central Basin and Mojave Basin
October Precipitation Anomalies
1900-1980 vs 2050s
Central Basin
Mojave Basin

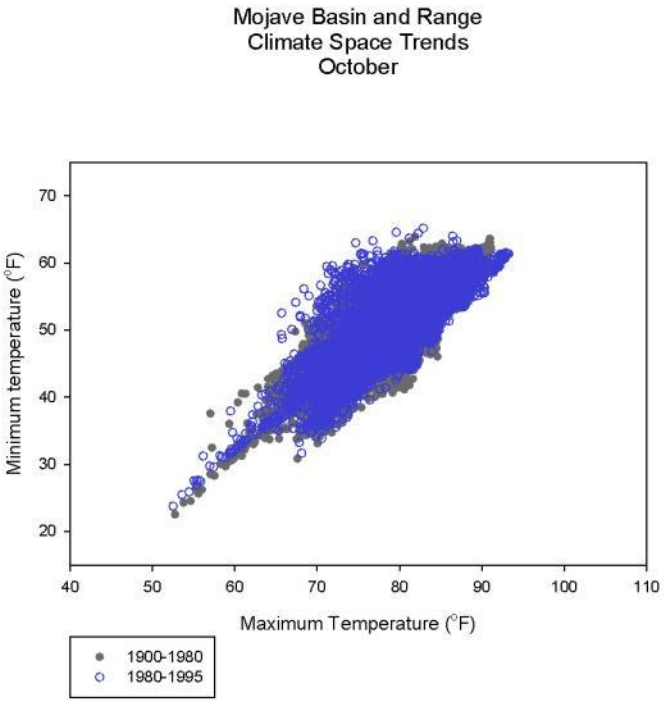

Mojave Basin
October Precipitation Anomalies
1900-1980 vs 1995-2010
-2 SD
-1 SD
+2 SD
+1 SD


Central Basin and Mojave Basin
October Precipitation Anomalies
1900-1980 vs 2020s
Central Basin
Mojave Basin

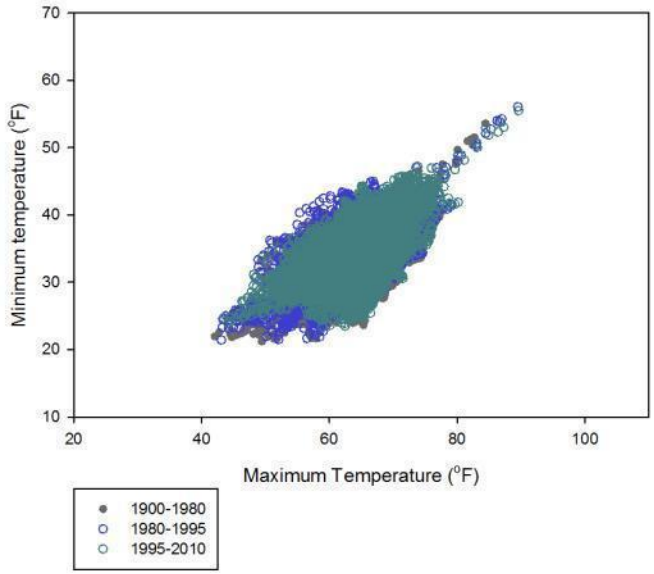

Central Basin and Range
Climate Space Trends
October
Minimum temperature (°F)
Maximum Temperature (°F)
1900-1980


Mojave Basin and Range
Climate Space Trends
October
Minimum temperature (°F)
Maximum Temperature (°F)
1900-1980

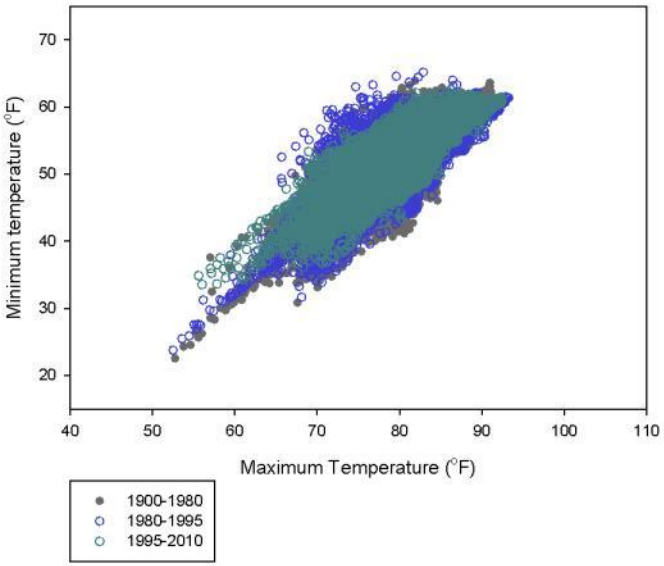

Central Basin and Range
Climate Space Trends
October
Minimum temperature (°F)
Maximum Temperature (°F)
1900-1980
1980-1995

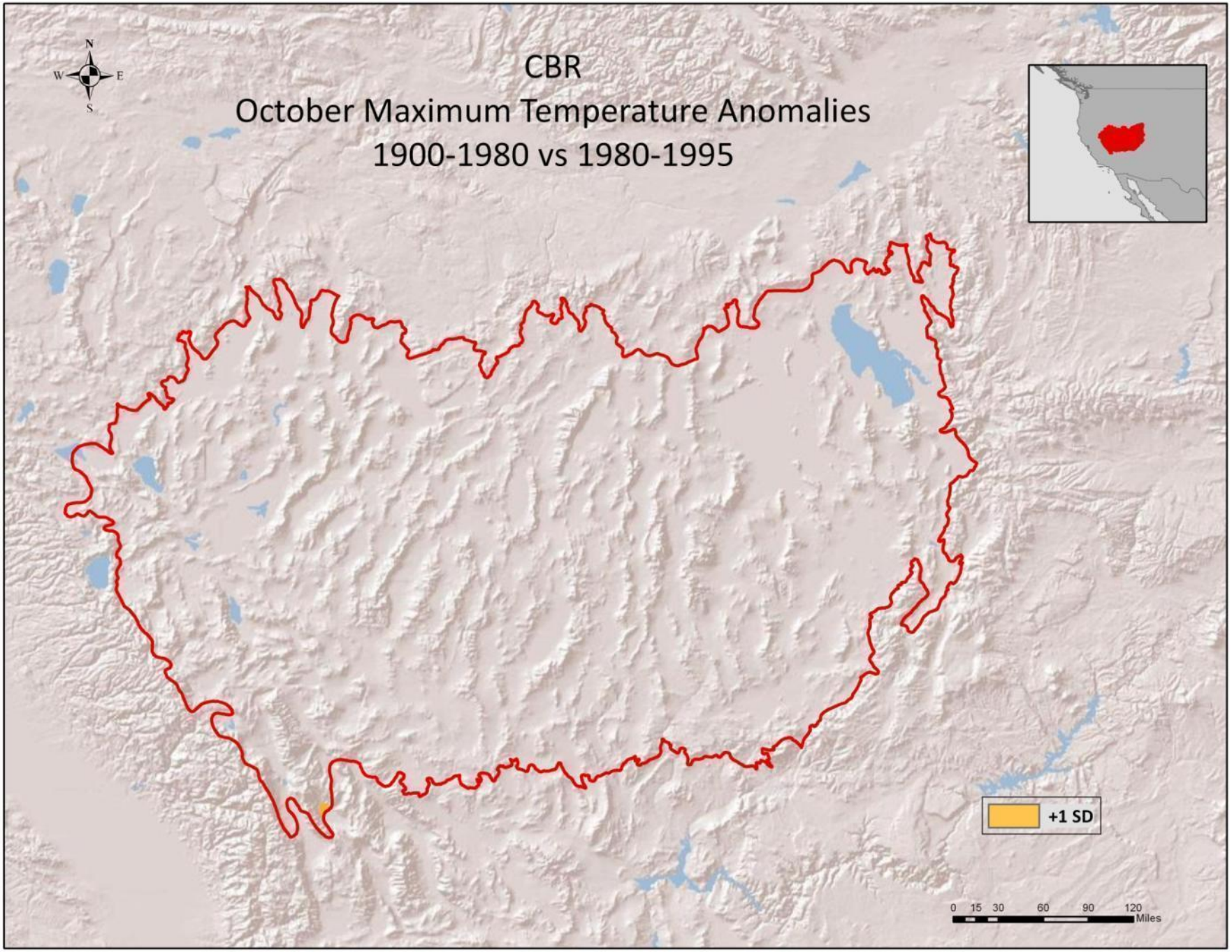

Mojave Basin and Range
Climate Space Trends
October
Minimum temperature (°F)
Maximum Temperature (°F)
1900-1980
1980-1995

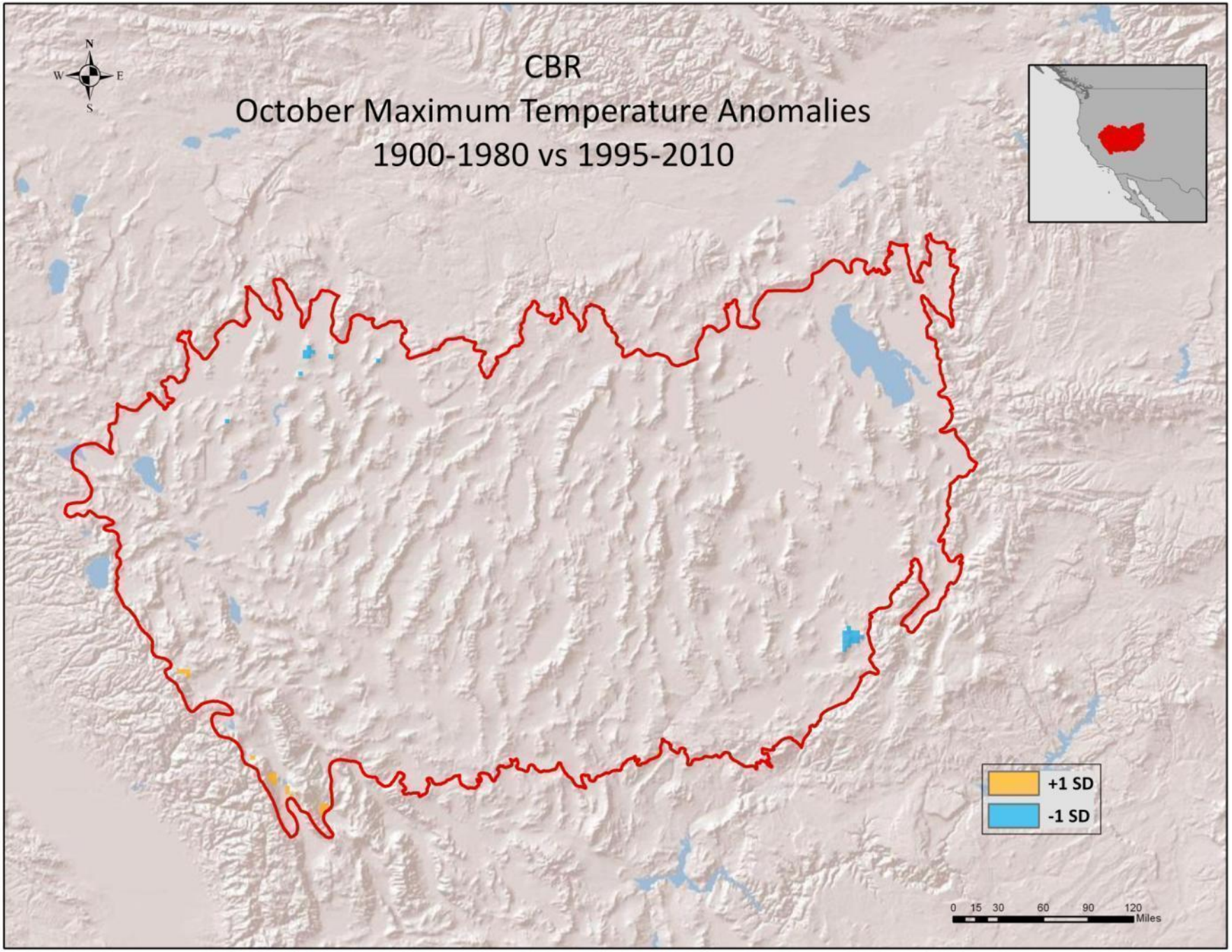
Central Basin and Range
Climate Space Trends
October

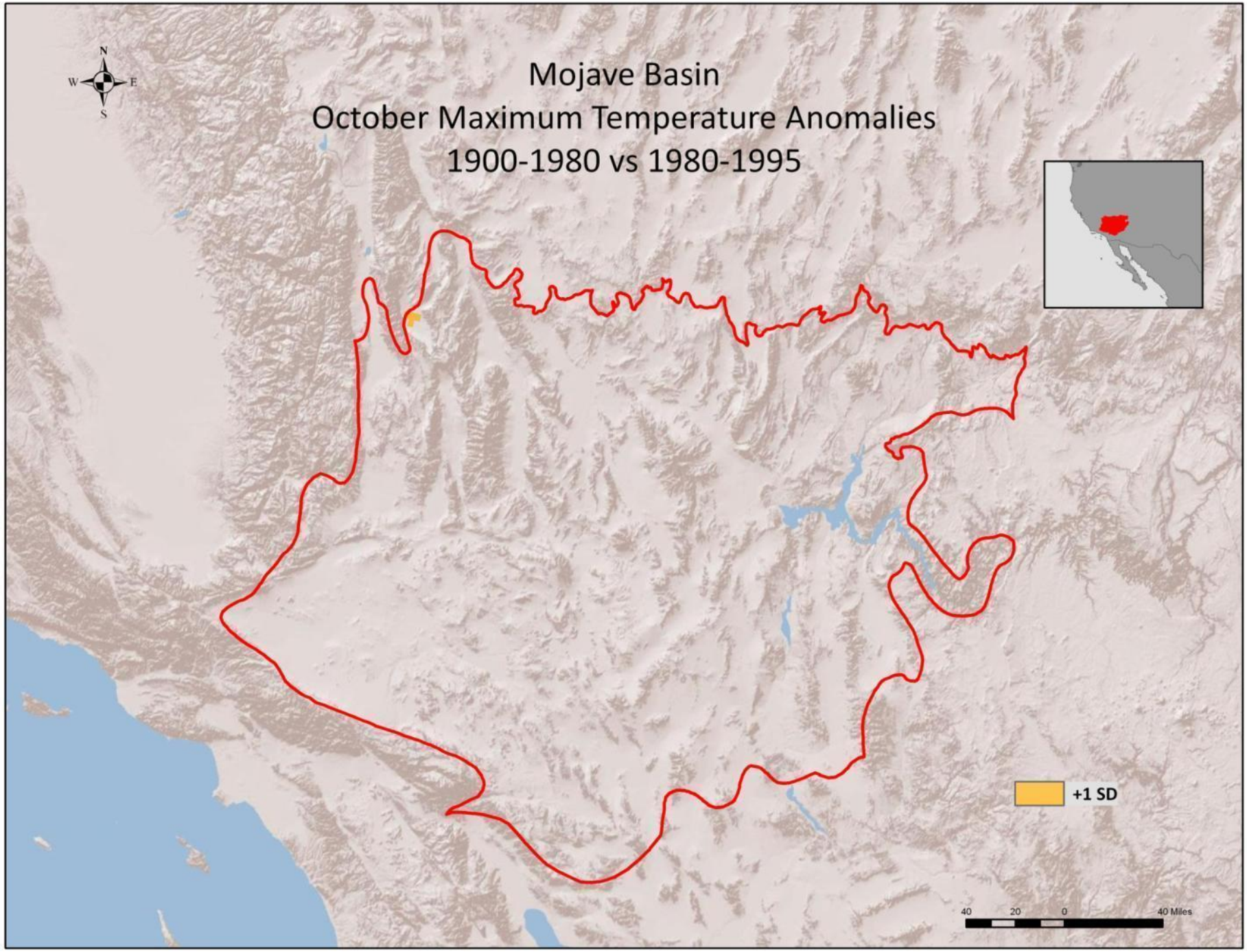


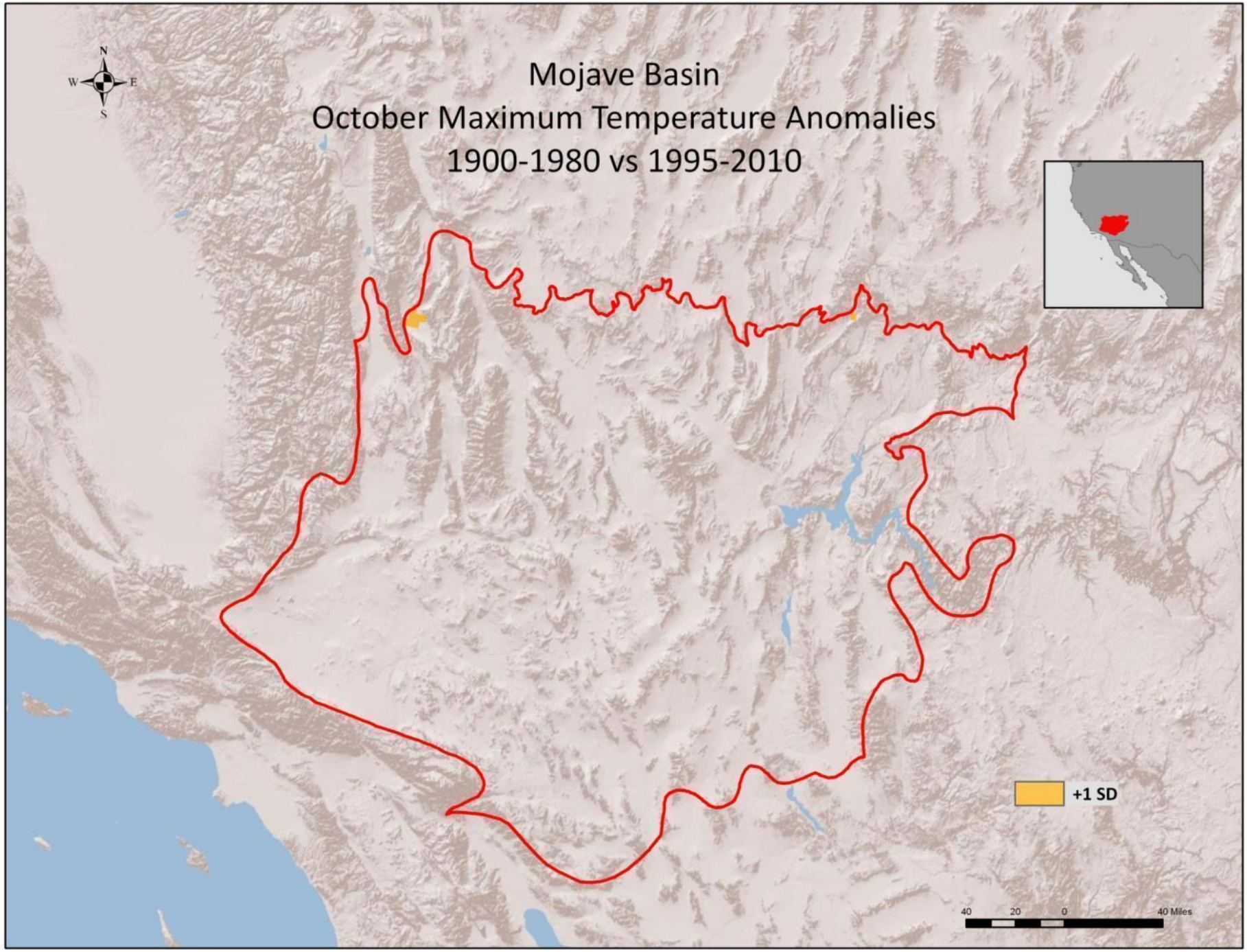
Mojave Basin and Range
Climate Space Trends
October

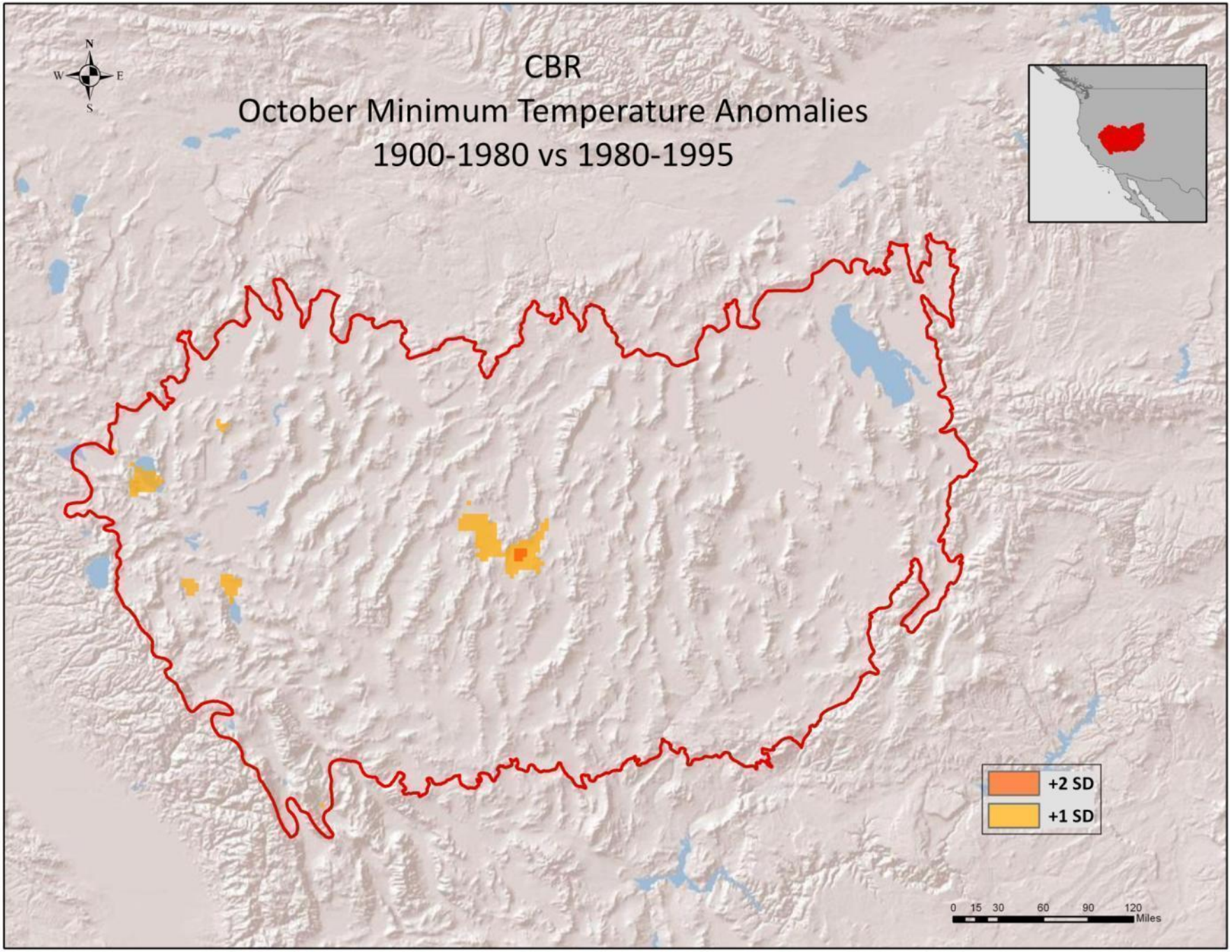


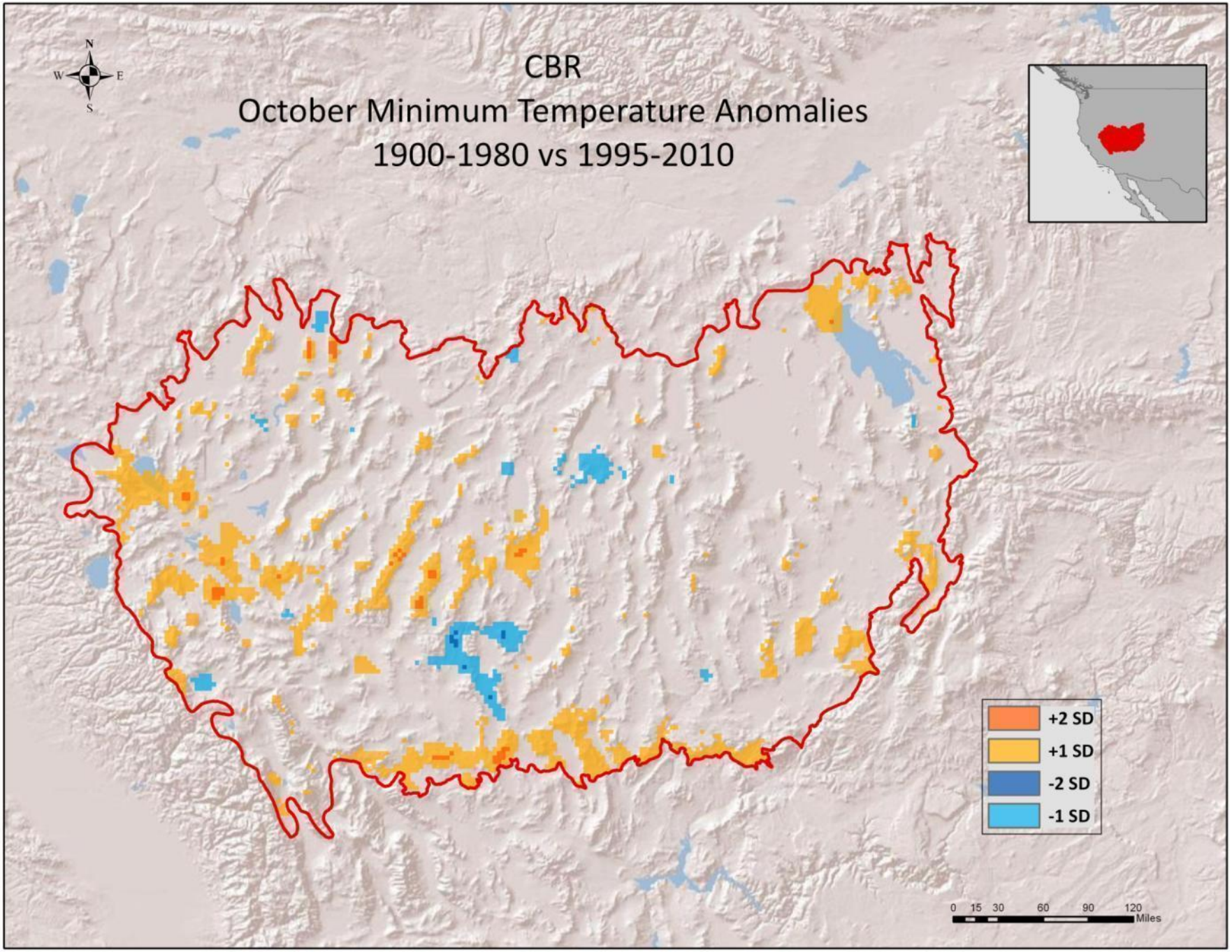

CBR
October Maximum Temperature Anomalies
1900-1980 vs 1980-1995
N
W
E
S
+1 SD
0 15 30 60 90 120
Miles

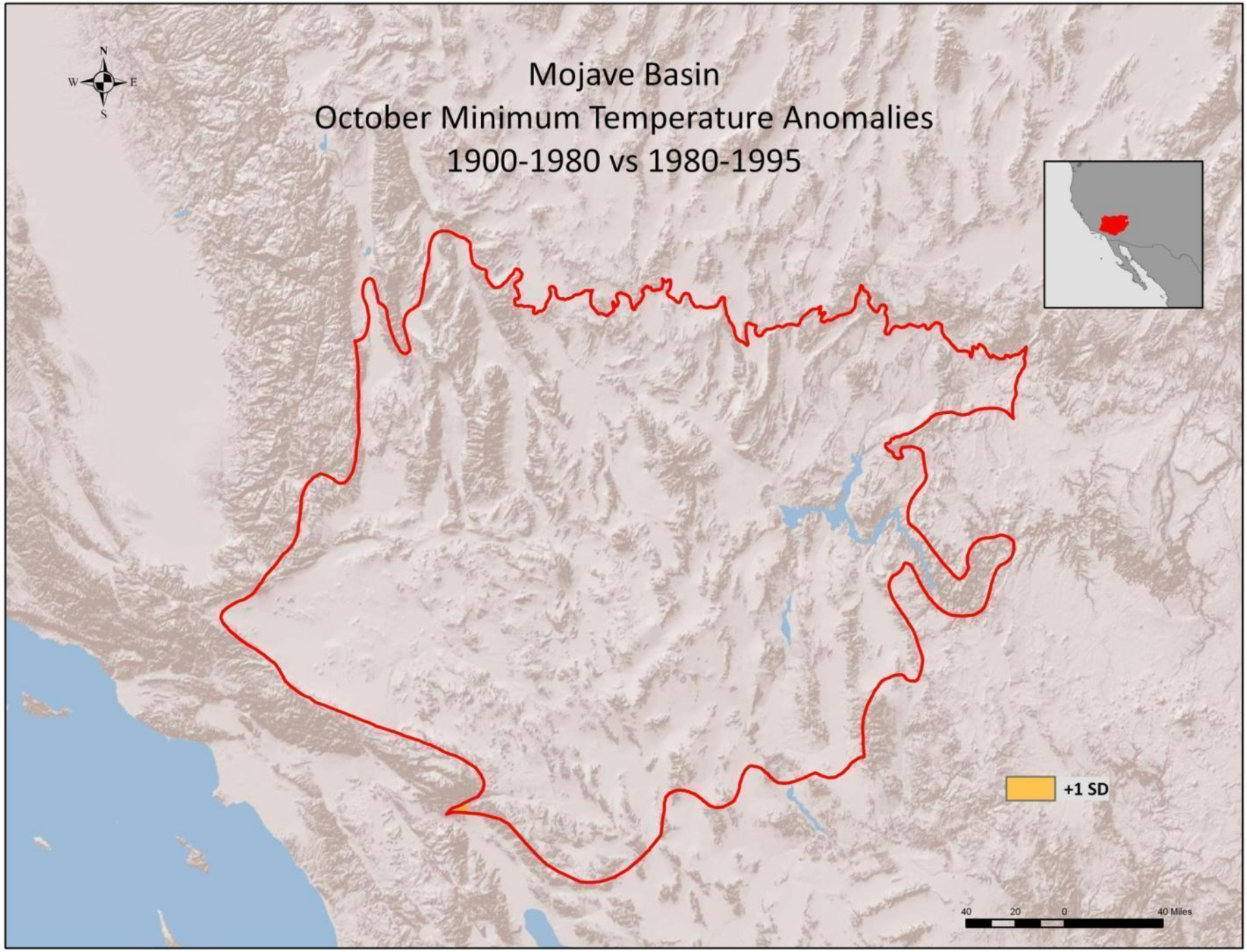

CBR
October Maximum Temperature Anomalies
1900-1980 vs 1995-2010
N
W
E
S
+1 SD
-1 SD
0 15 30 60 90 120
Miles

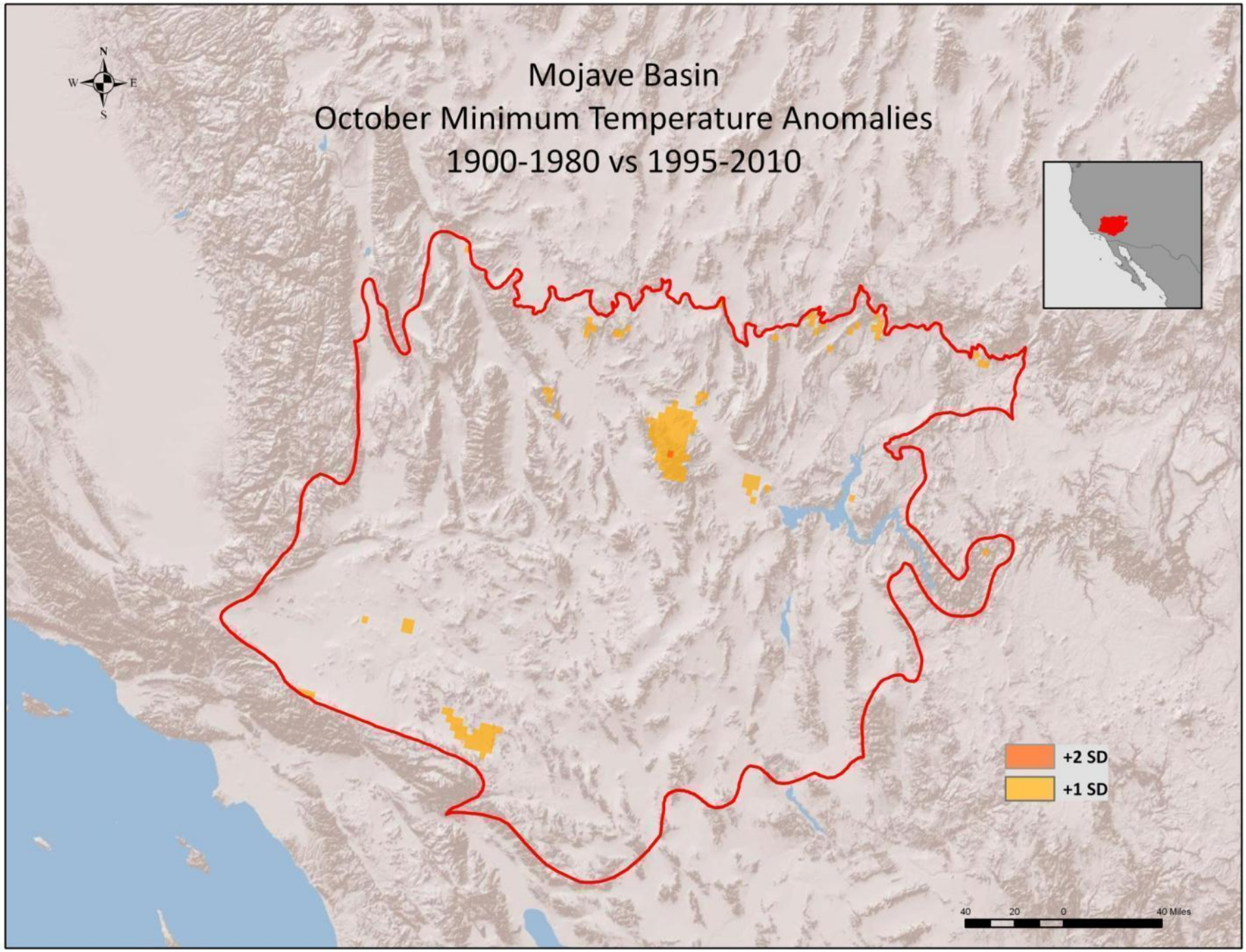

Mojave Basin
October Maximum Temperature Anomalies
1900-1980 vs 1980-1995
N
W
E
S
+1 SD
40
20
0
40 Miles

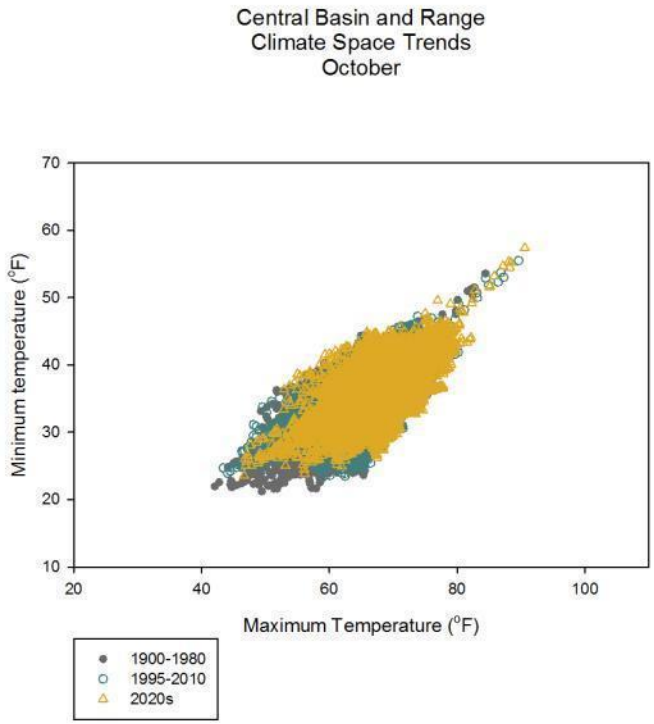

Mojave Basin
October Maximum Temperature Anomalies
1900-1980 vs 1995-2010
N
W
E
S
+1 SD
40
20
0
40 Miles

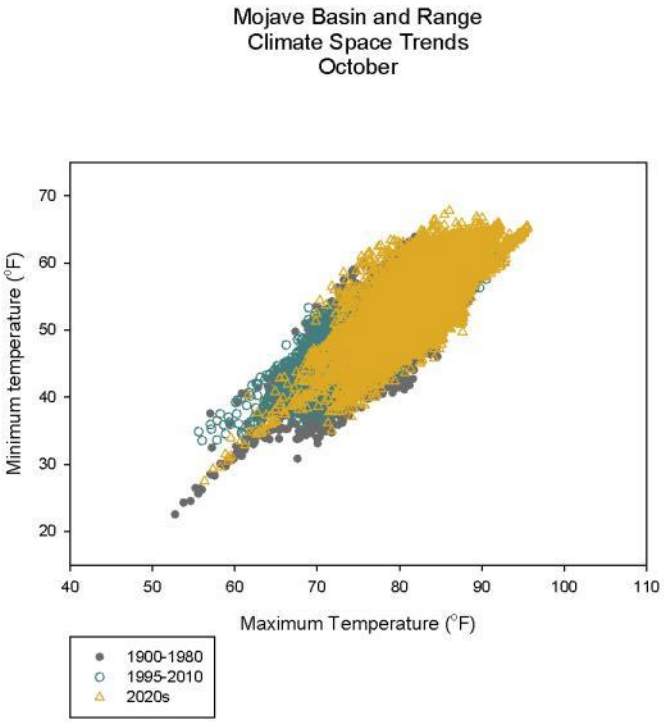

CBR
October Minimum Temperature Anomalies
1900-1980 vs 1980-1995
N
W
E
S
+2 SD
+1 SD
0 15 30 60 90 120
Miles

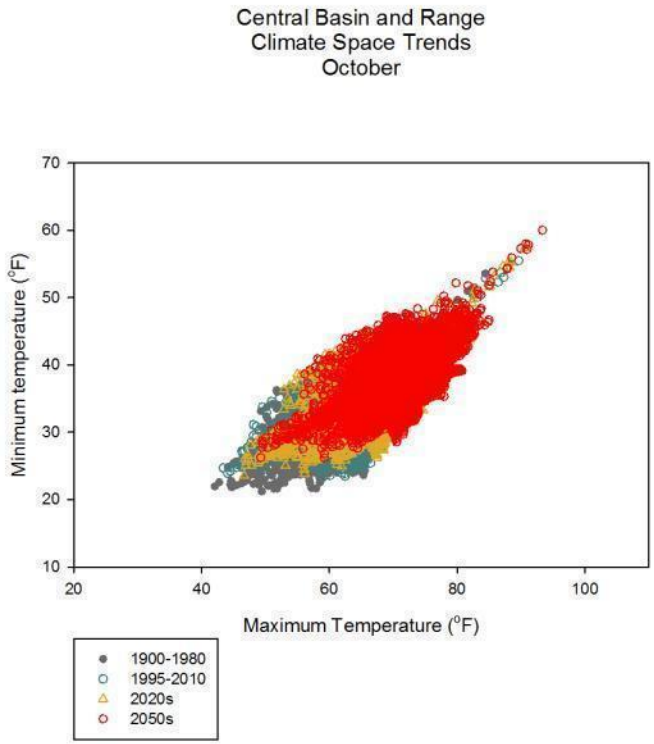

CBR
October Minimum Temperature Anomalies
1900-1980 vs 1995-2010
N
W
E
S
+2 SD
+1 SD
-2 SD
-1 SD
0 15 30 60 90 120
Miles

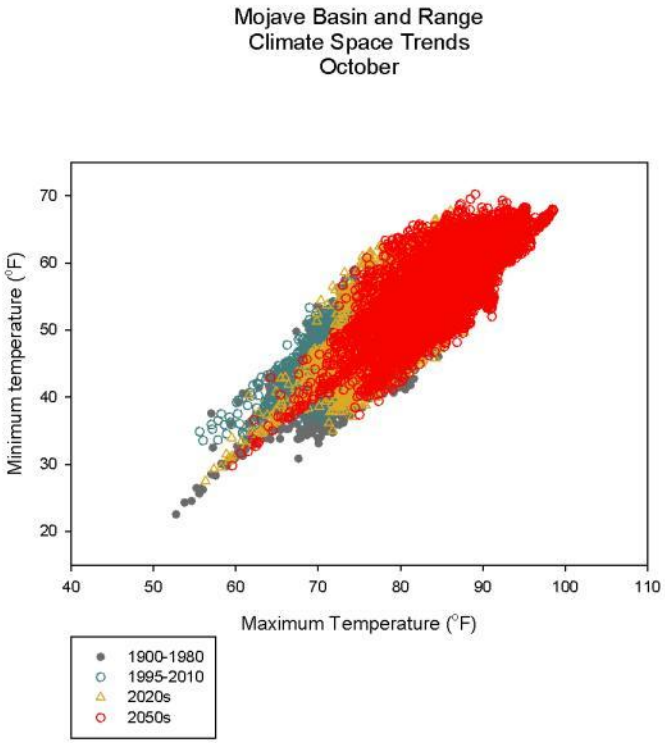

Mojave Basin
October Minimum Temperature Anomalies
1900-1980 vs 1980-1995
N
W
E
S
+1 SD
40
20
0
40 Miles

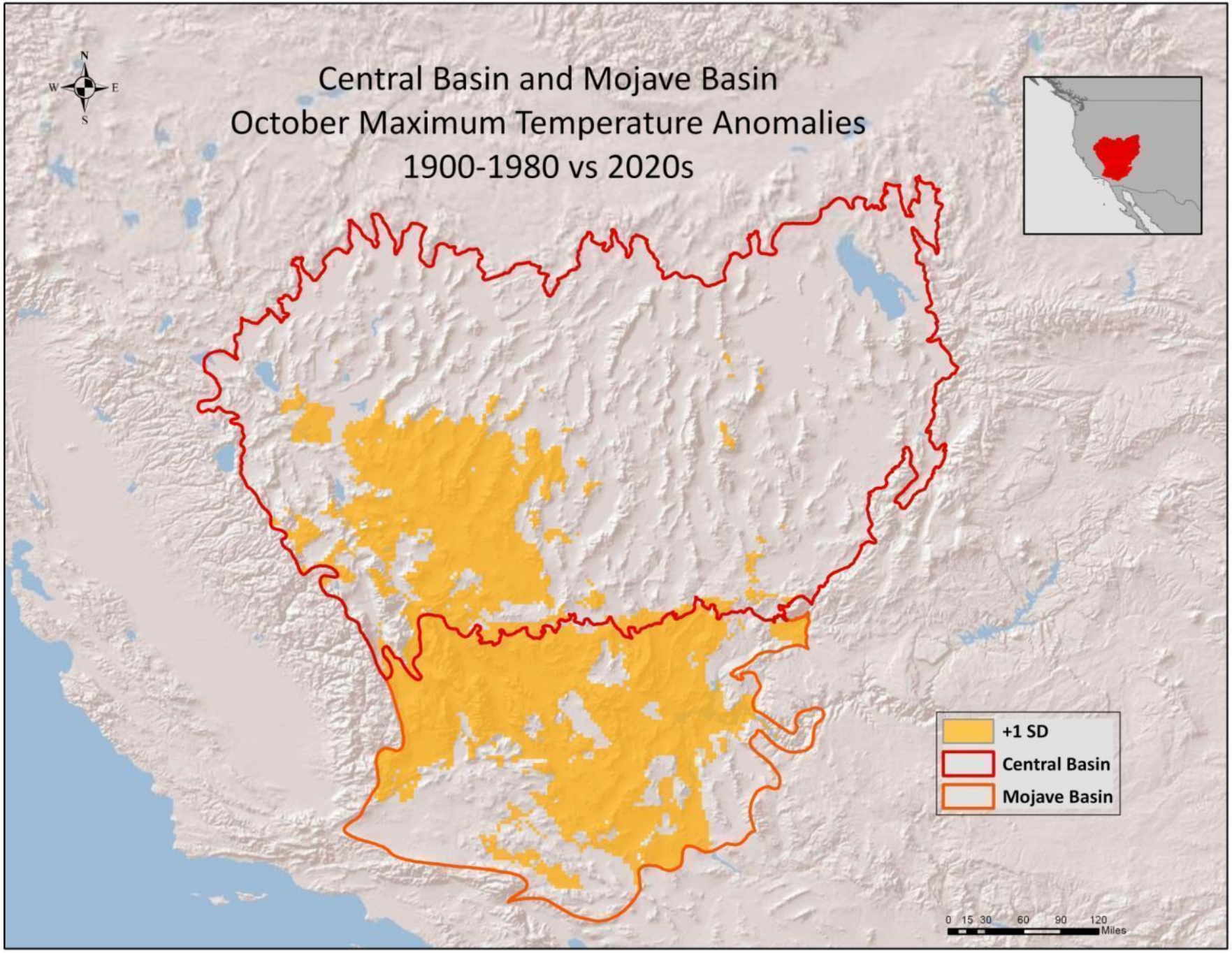

Mojave Basin
October Minimum Temperature Anomalies
1900-1980 vs 1995-2010
N
W
E
S
+2 SD
+1 SD
40
20
0
40 Miles

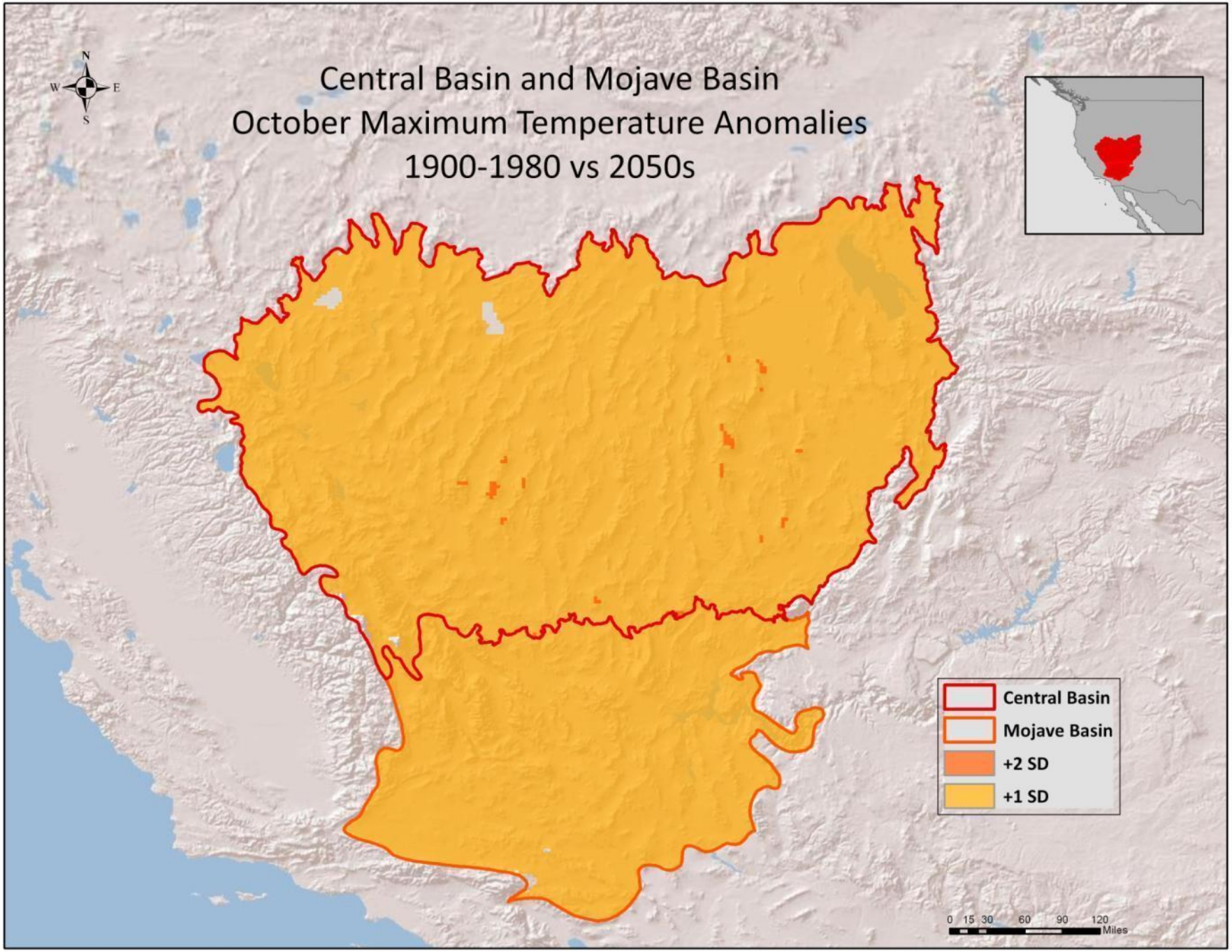

Central Basin and Range
Climate Space Trends
October
Minimum temperature (°F)
Maximum Temperature (°F)
1900-1980
1995-2010
2020s

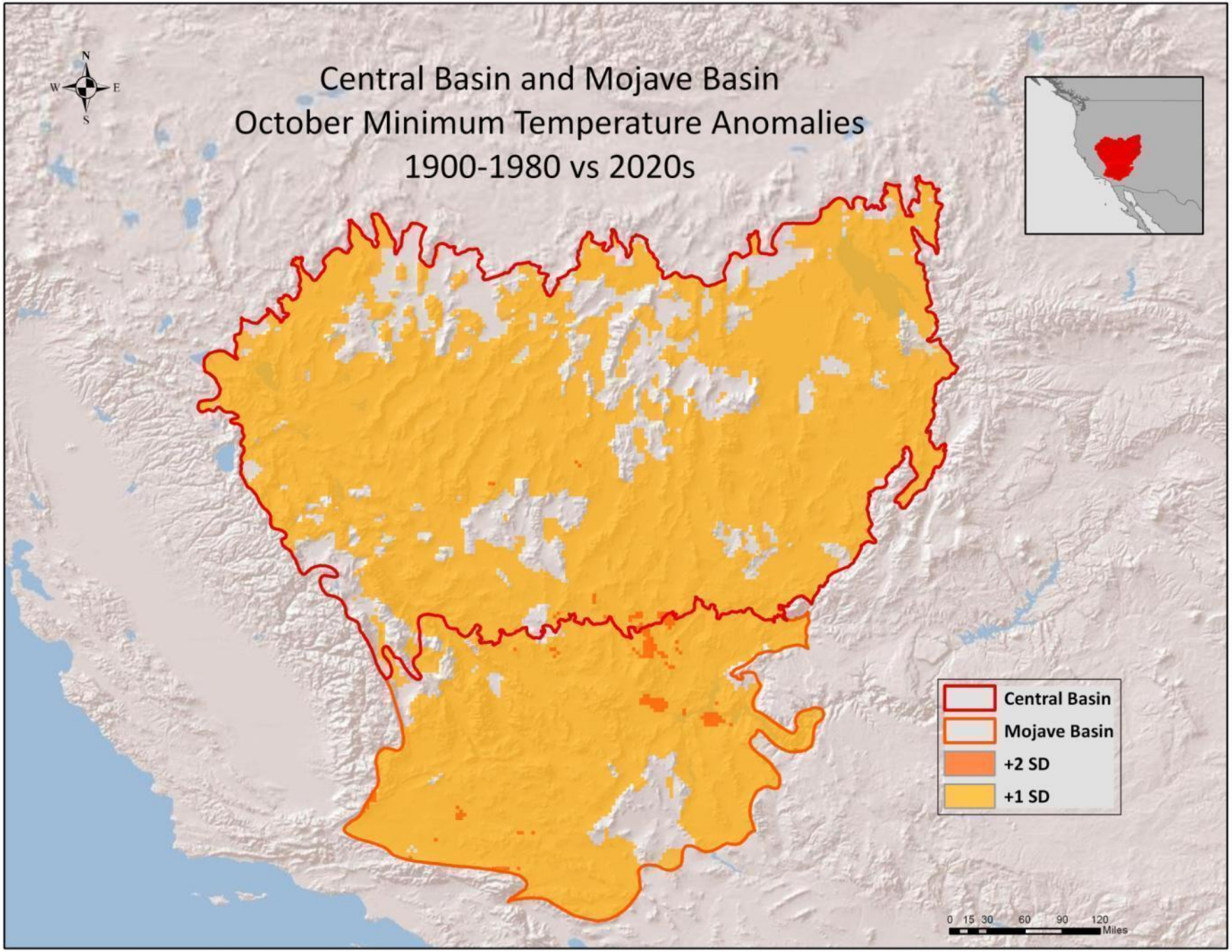

Mojave Basin and Range
Climate Space Trends
October
Minimum temperature (°F)
Maximum Temperature (°F)
1900-1980
1995-2010
2020s

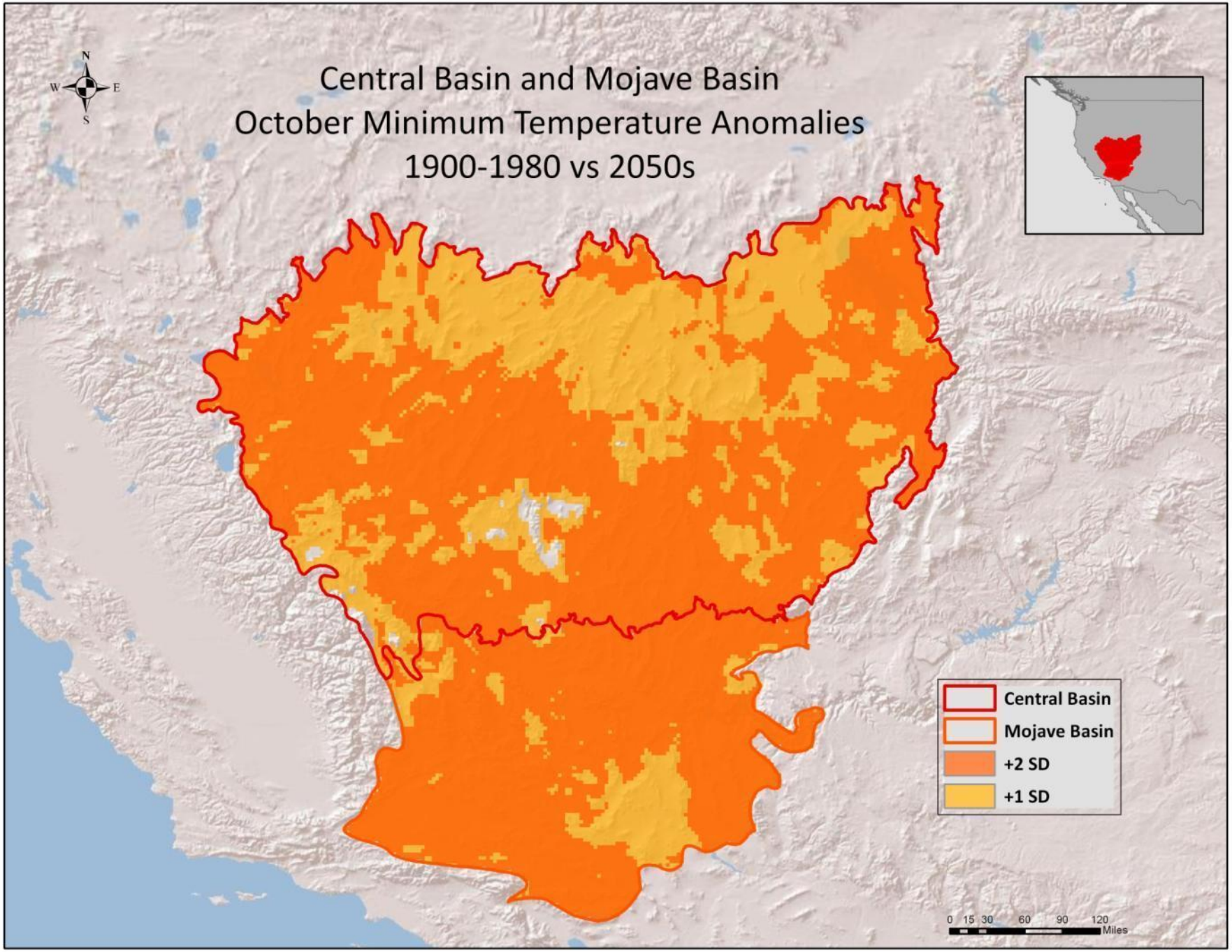

Central Basin and Range
Climate Space Trends
October
Minimum temperature (°F)
Maximum Temperature (°F)
70
60
50
40
30
20
10
20
40
60
80
100
1900-1980
1995-2010
2020s
2050s

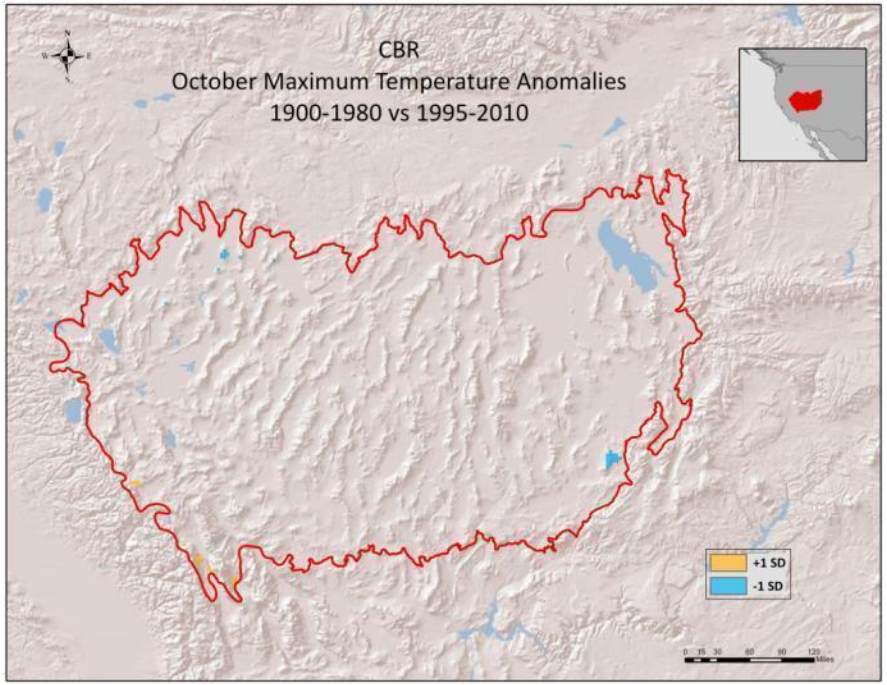

Mojave Basin and Range
Climate Space Trends
October
Minimum temperature (°F)
Maximum Temperature (°F)
70
60
50
40
30
20
40
50
60
70
80
90
100
110
1900-1980
1995-2010
2020s
2050s

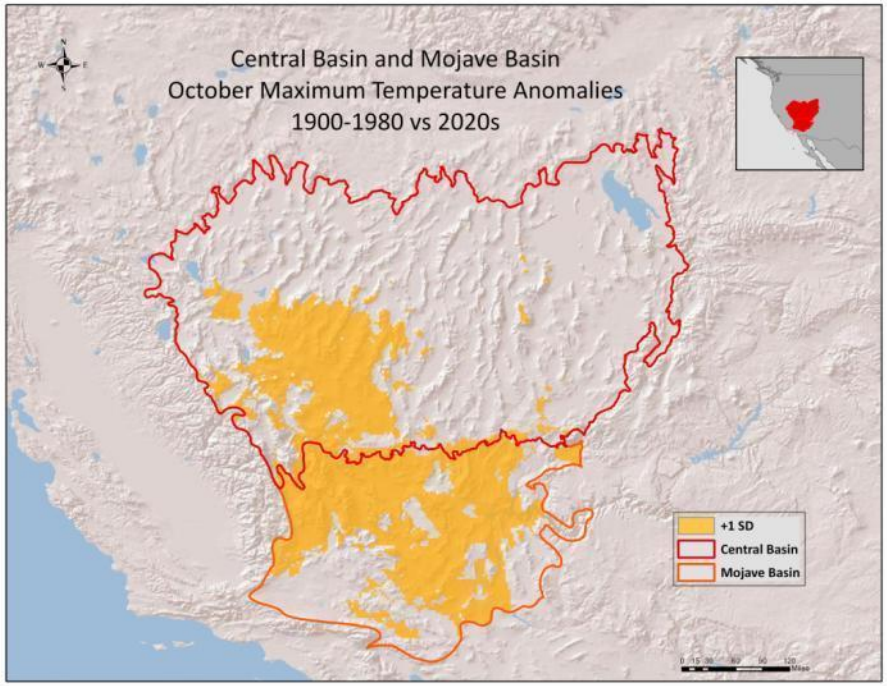

Central Basin and Mojave Basin
October Maximum Temperature Anomalies
1900-1980 vs 2020s
N
W
E
S
+1 SD
Central Basin
Mojave Basin
0 15 30 60 90 120
Miles

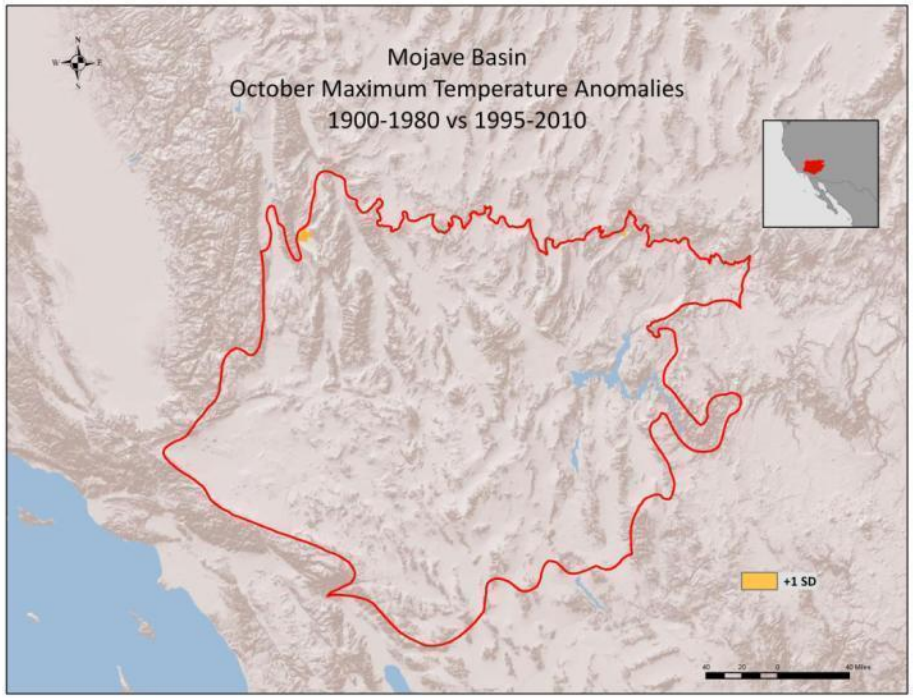

Central Basin and Mojave Basin
October Maximum Temperature Anomalies
1900-1980 vs 2050s
N
W
E
S
Central Basin
Mojave Basin
+2 SD
+1 SD
0 15 30 60 90 120
Miles

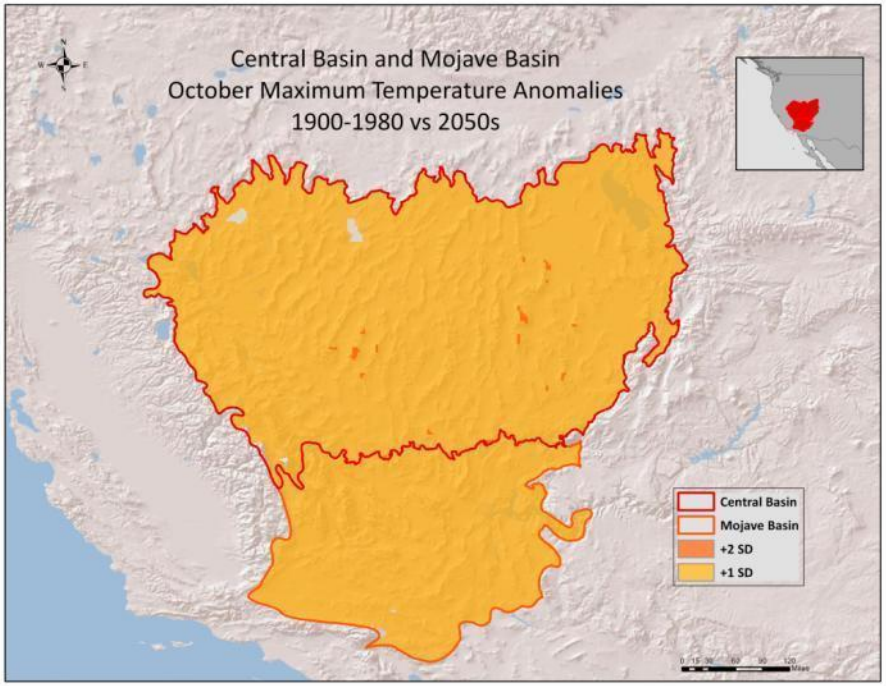

Central Basin and Mojave Basin
October Minimum Temperature Anomalies
1900-1980 vs 2020s
N
W
E
S
Central Basin
Mojave Basin
+2 SD
+1 SD
0 15 30 60 90 120
Miles

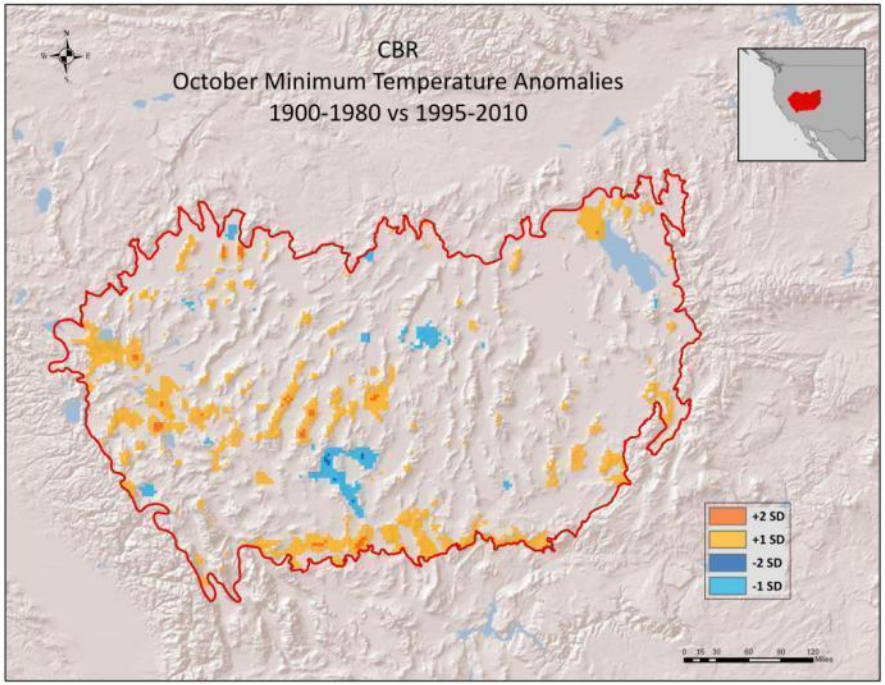

Central Basin and Mojave Basin
October Minimum Temperature Anomalies
1900-1980 vs 2050s
N
W
E
S
Central Basin
Mojave Basin
+2 SD
+1 SD
0 15 30 60 90 120
Miles


CBR
October Maximum Temperature Anomalies
1900-1980 vs 1995-2010
+1 SD
-1 SD


Central Basin and Mojave Basin
October Maximum Temperature Anomalies
1900-1980 vs 2020s
+1 SD
Central Basin
Mojave Basin


Mojave Basin
October Maximum Temperature Anomalies
1900-1980 vs 1995-2010
+1 SD


Central Basin and Mojave Basin
October Maximum Temperature Anomalies
1900-1980 vs 2050s
Central Basin
Mojave Basin
+2 SD
+1 SD


CBR
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+2 SD
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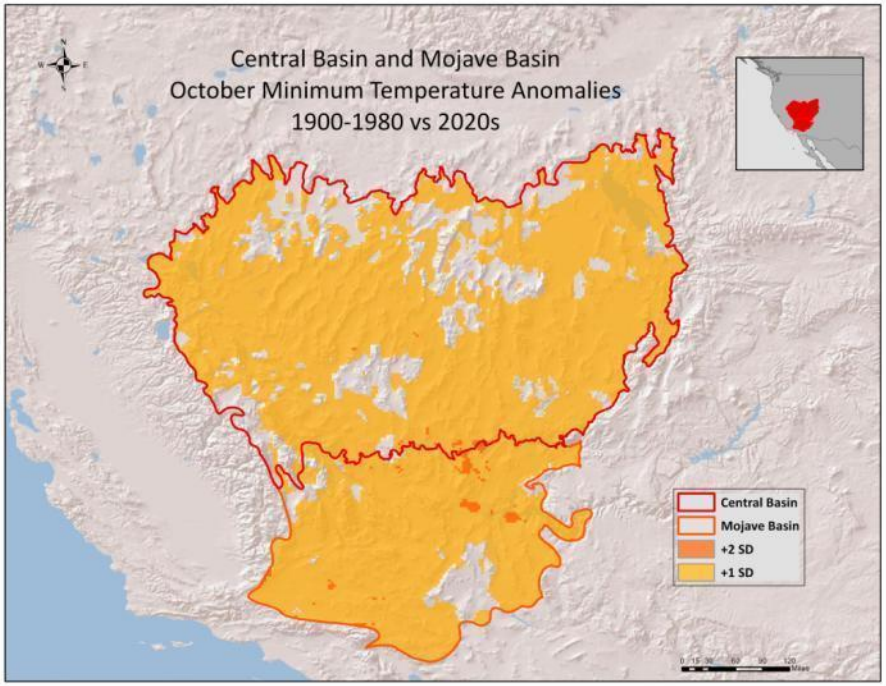
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+2 SD
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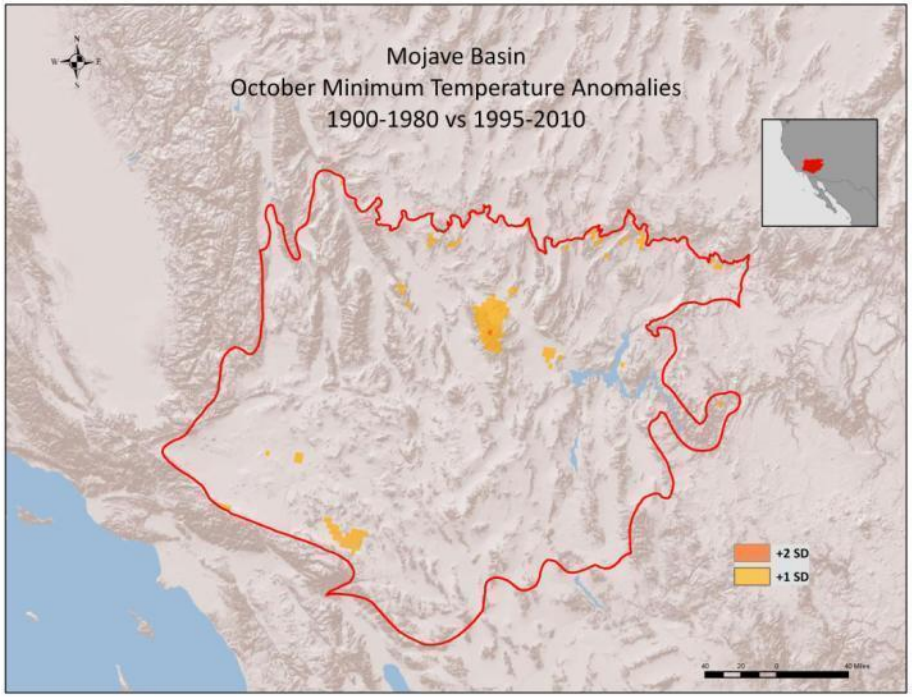
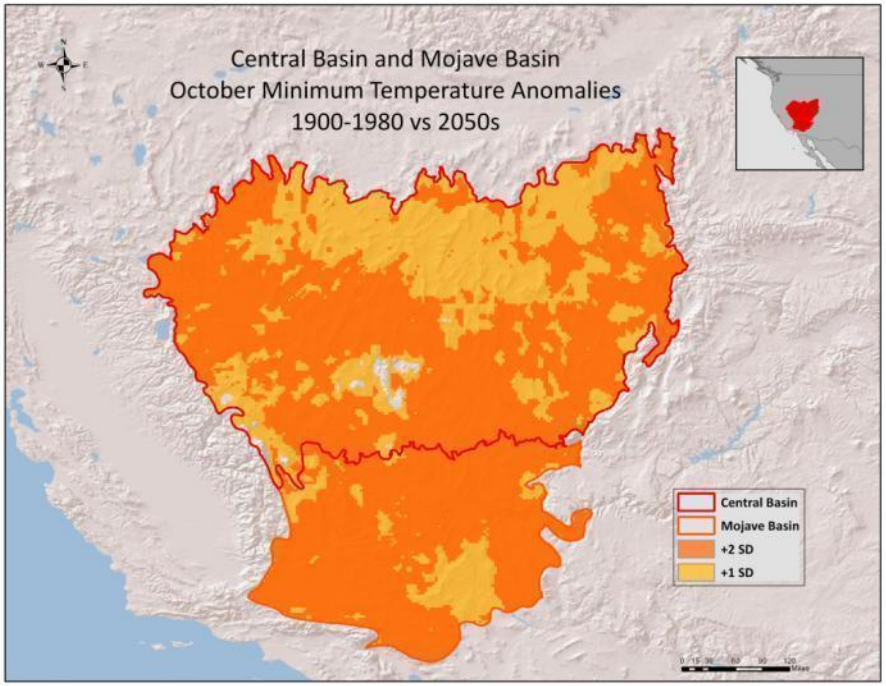

Mojave Basin
October Minimum Temperature Anomalies
1900-1980 vs 1995-2010
+2 SD
+1 SD


Central Basin and Mojave Basin
October Minimum Temperature Anomalies
1900-1980 vs 2050s
Central Basin
Mojave Basin
+2 SD
+1 SD

Climate Drivers for Aquatic CEs

- Monthly watershed water budget components
  - Precipitation, runoff, recharge, evapotranspiration, snowpack/snowmelt
- Climate drivers of monthly watershed water budget
  - *Monthly Precipitation*
  - *Monthly Tmin*
  - *Monthly Tmax*
- Climate driver of Spring snowmelt pulse (where applicable)
  - *April 1 Snowpack (as Snow Water Equivalent)*

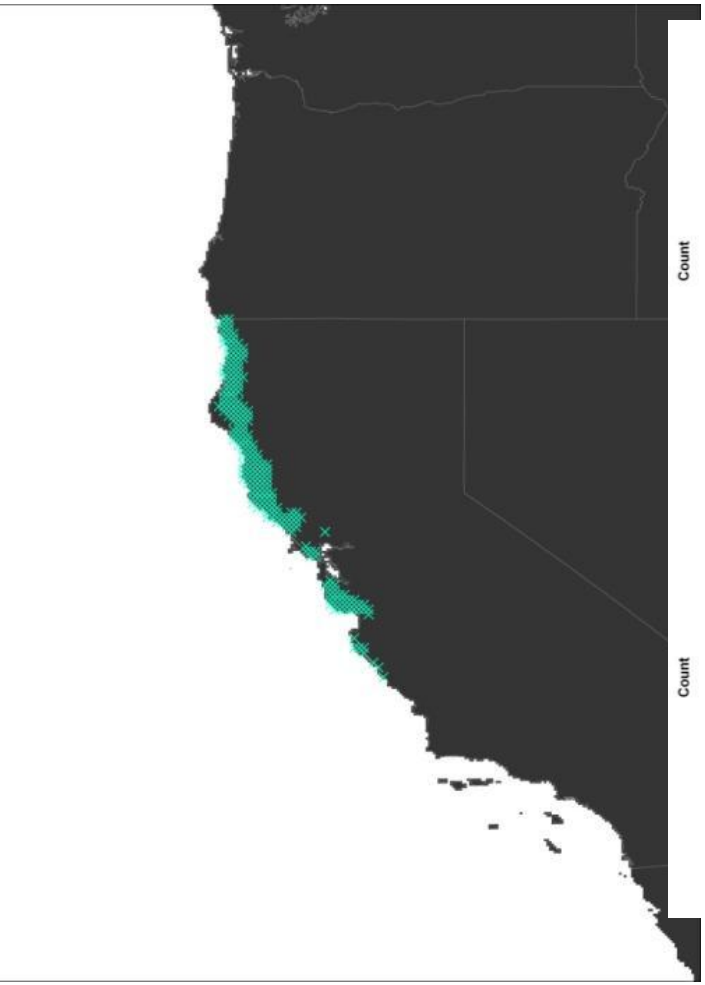
Lunch break on your own

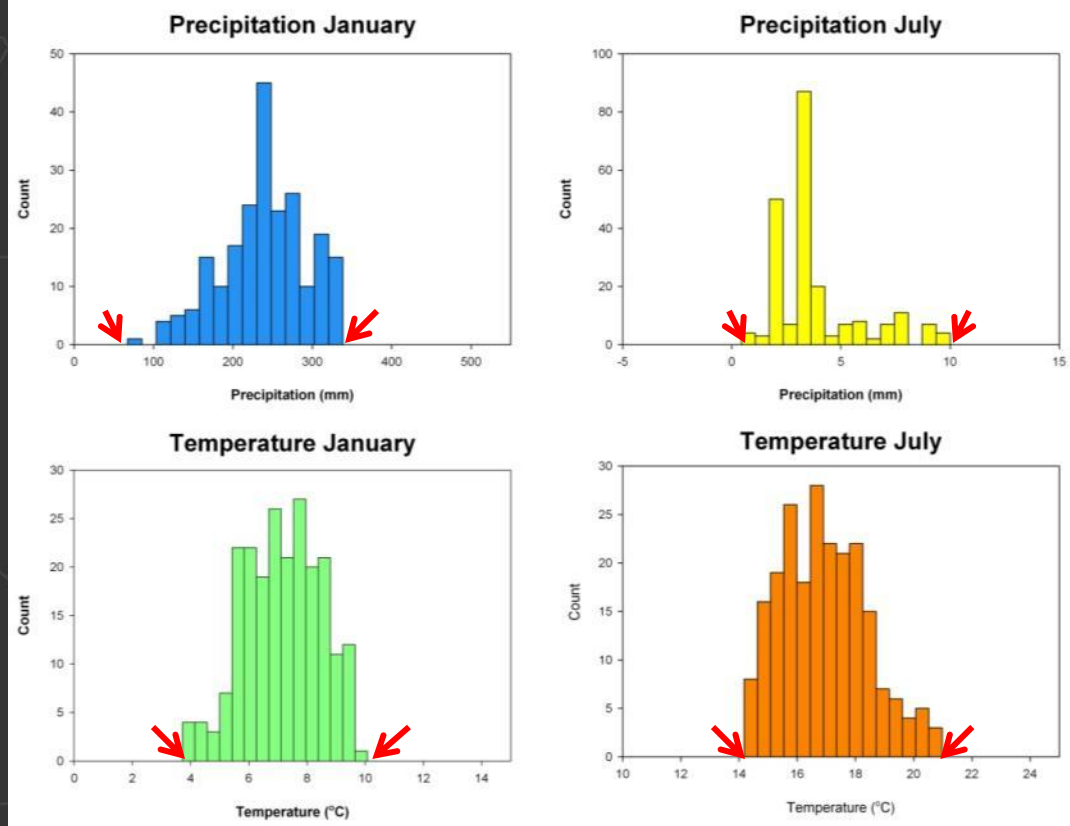
Climate change effects (how are CEs changing?)

Bioclimatic Niche Modeling – comparison of two future climate datasets

- PRISM 4km^2, 36 variables: monthly Tmax, Tmin, and precip
- EcoClim, 6 GCMs, 4km^2 resolution, 36 variables: monthly Tmax, Tmin, and precip
- USGS/Hostetler data, 2 GCMs,15km^2 resolution
- 88 monthly and/or annual climate/environmental variables

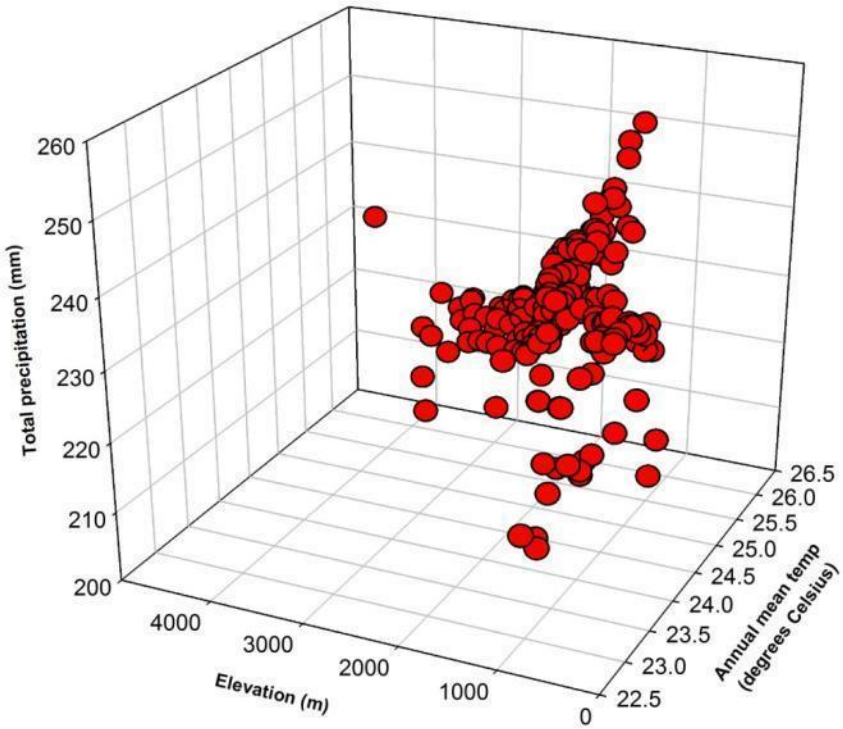
Tools for investigating relationships of species and climate: Ecological niche modeling algorithms



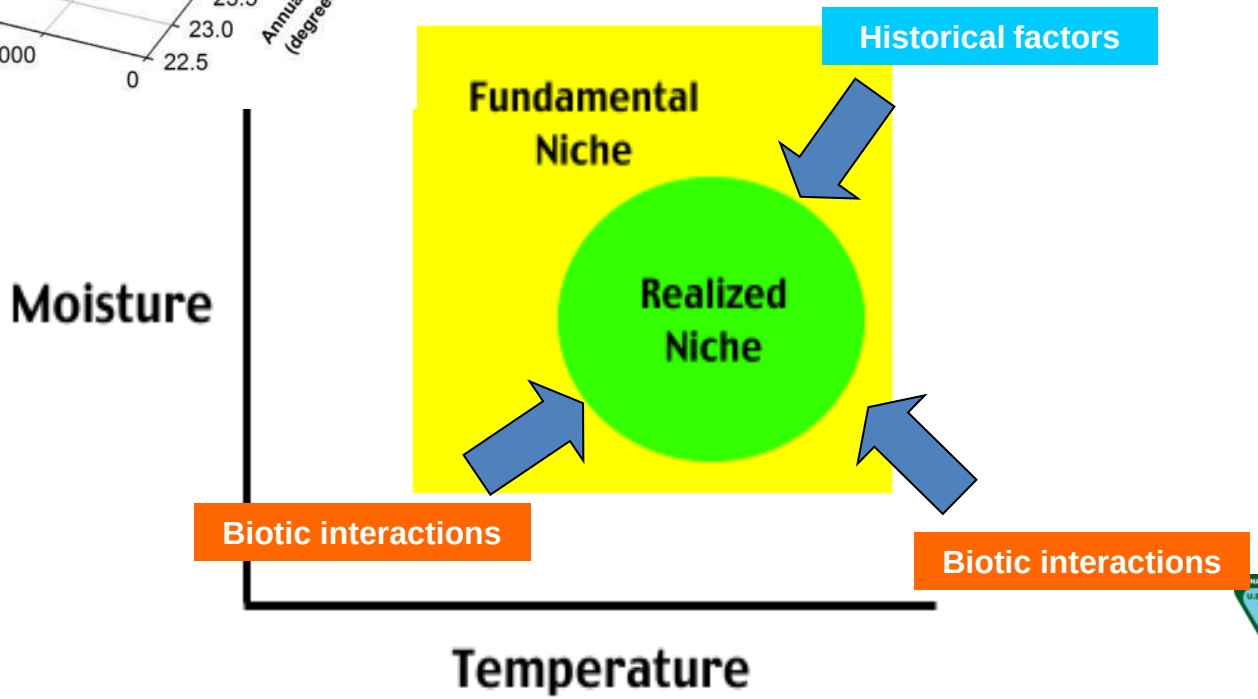


Coast redwood (Sequoia sempervirens) occurences

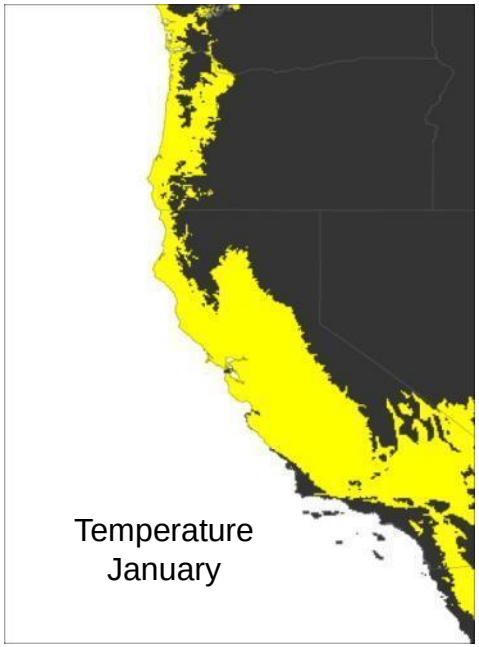
BLM
Rapid Ecoregional Assessment

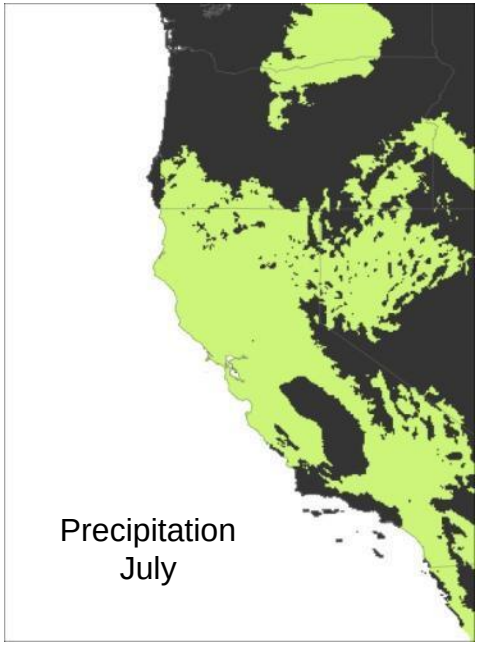


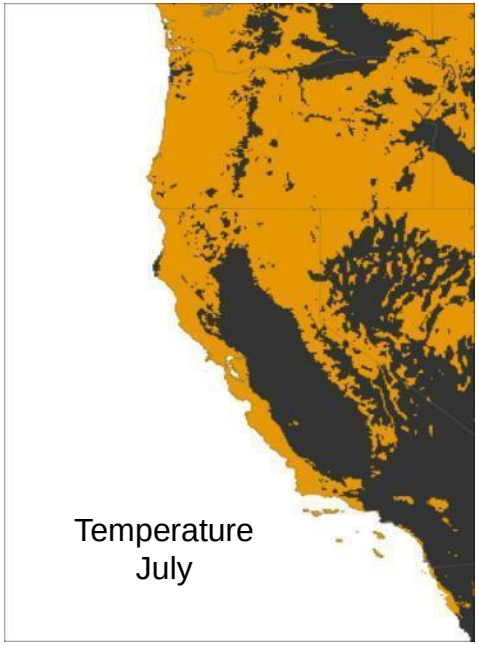
G. Evelyn Hutchinson 1903-1991

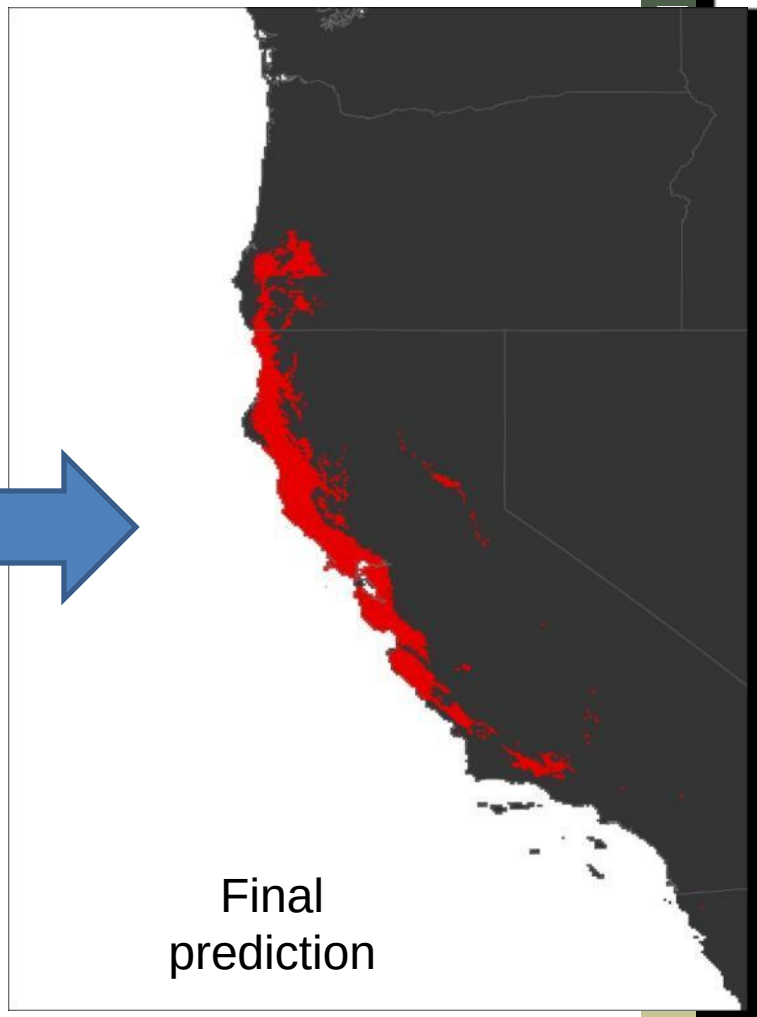


Precipitation
January


Temperature
January


Precipitation
July

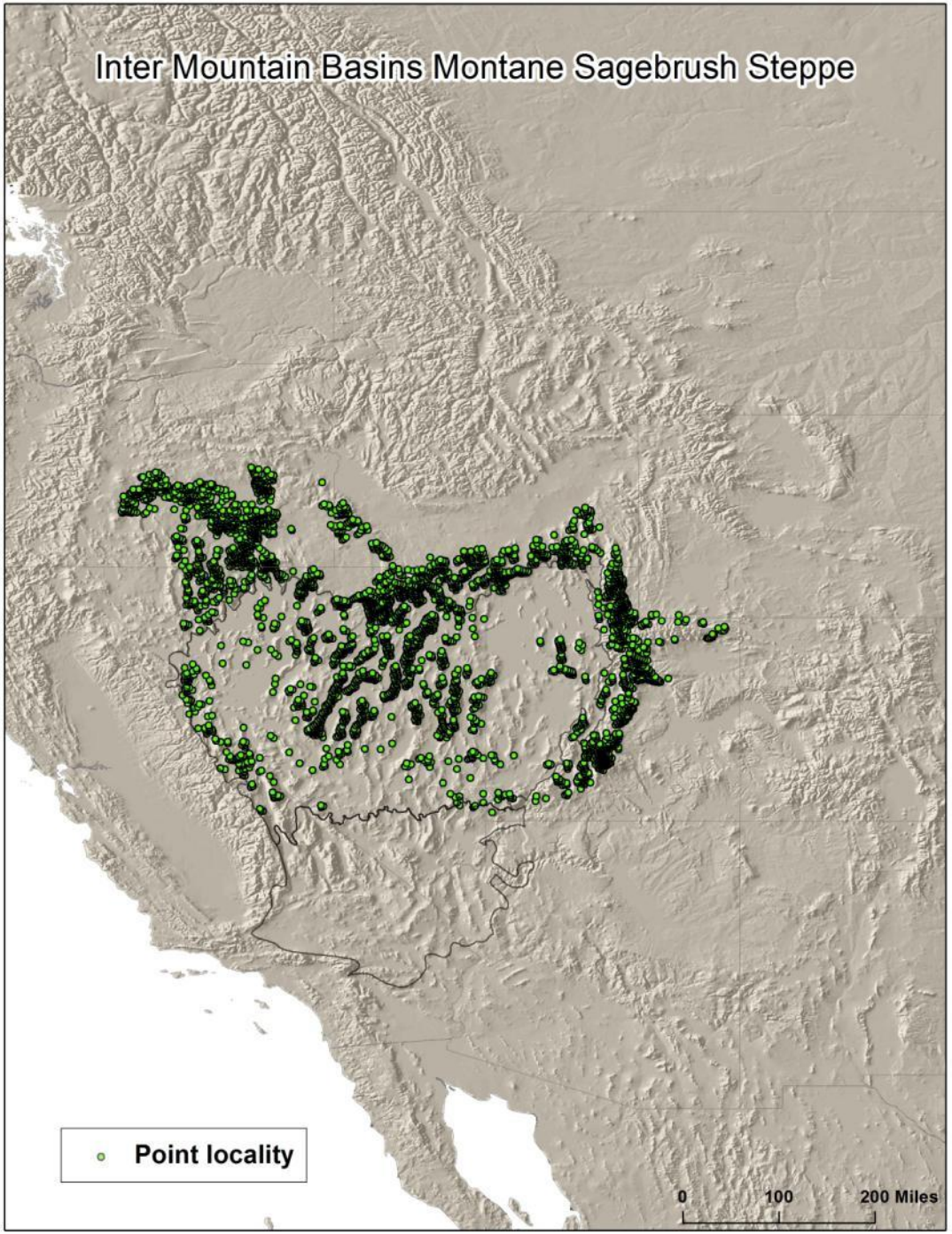

Temperature
July

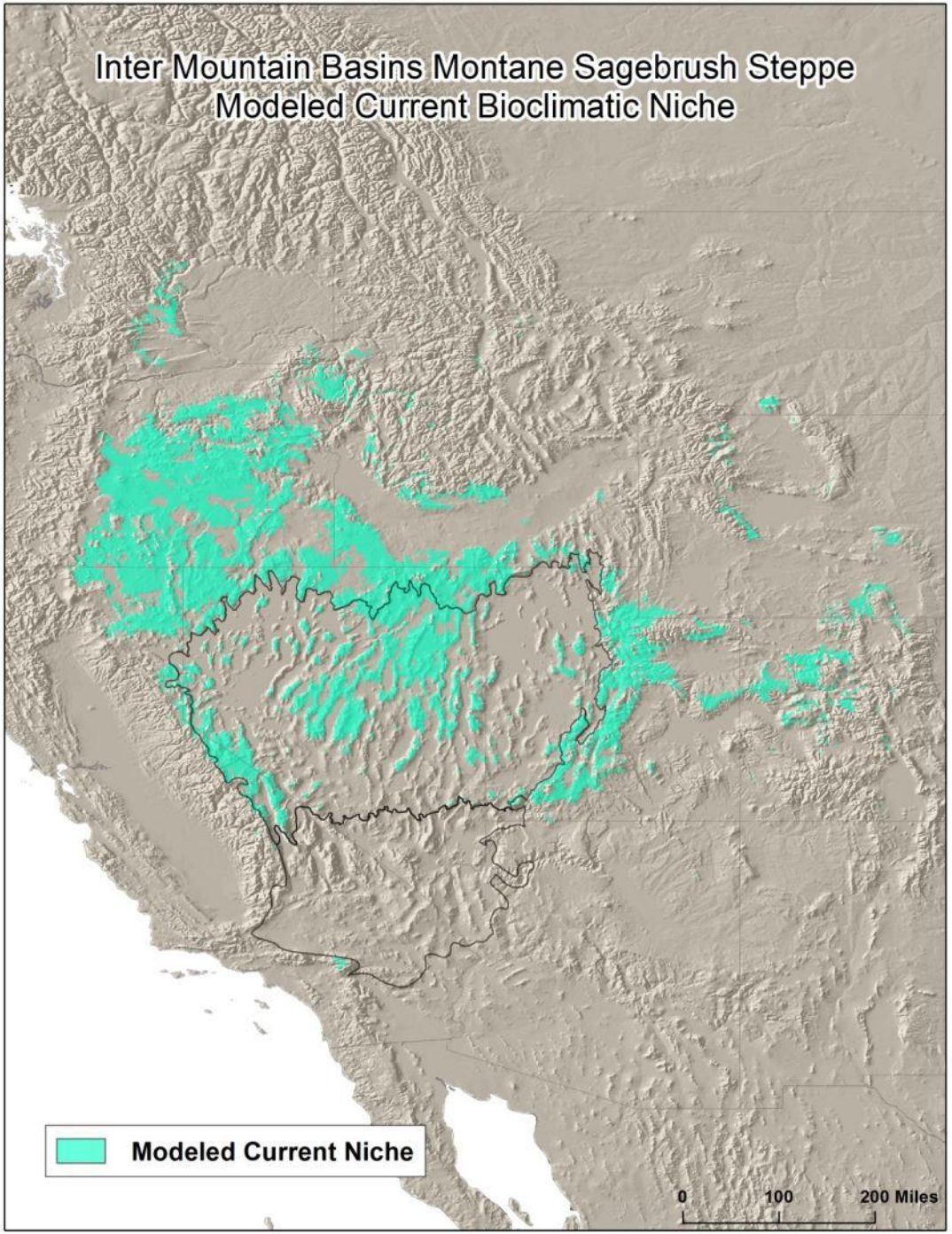

Final
prediction

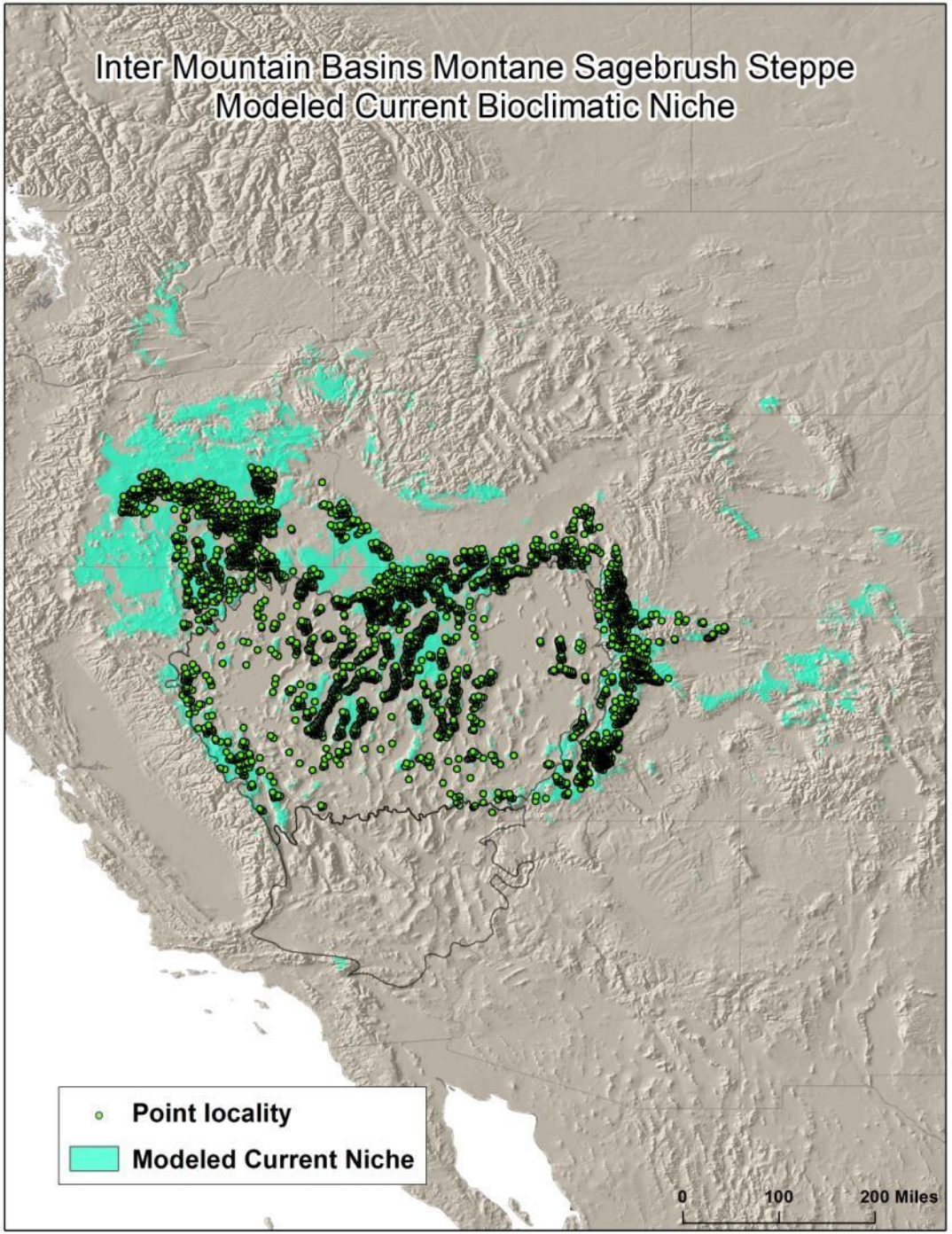
BLM Rapid

EcoClim
4km^2

36 climate variables

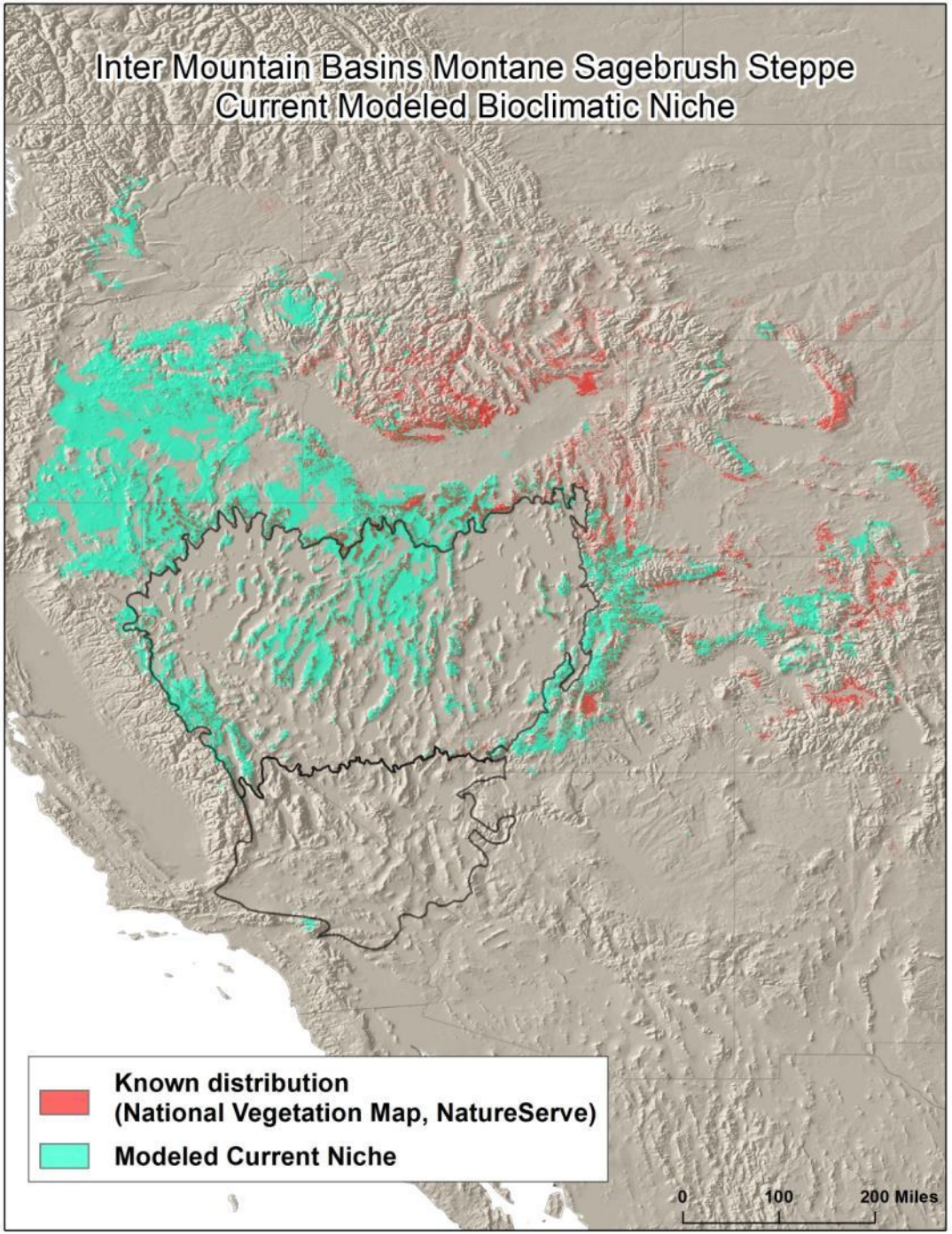


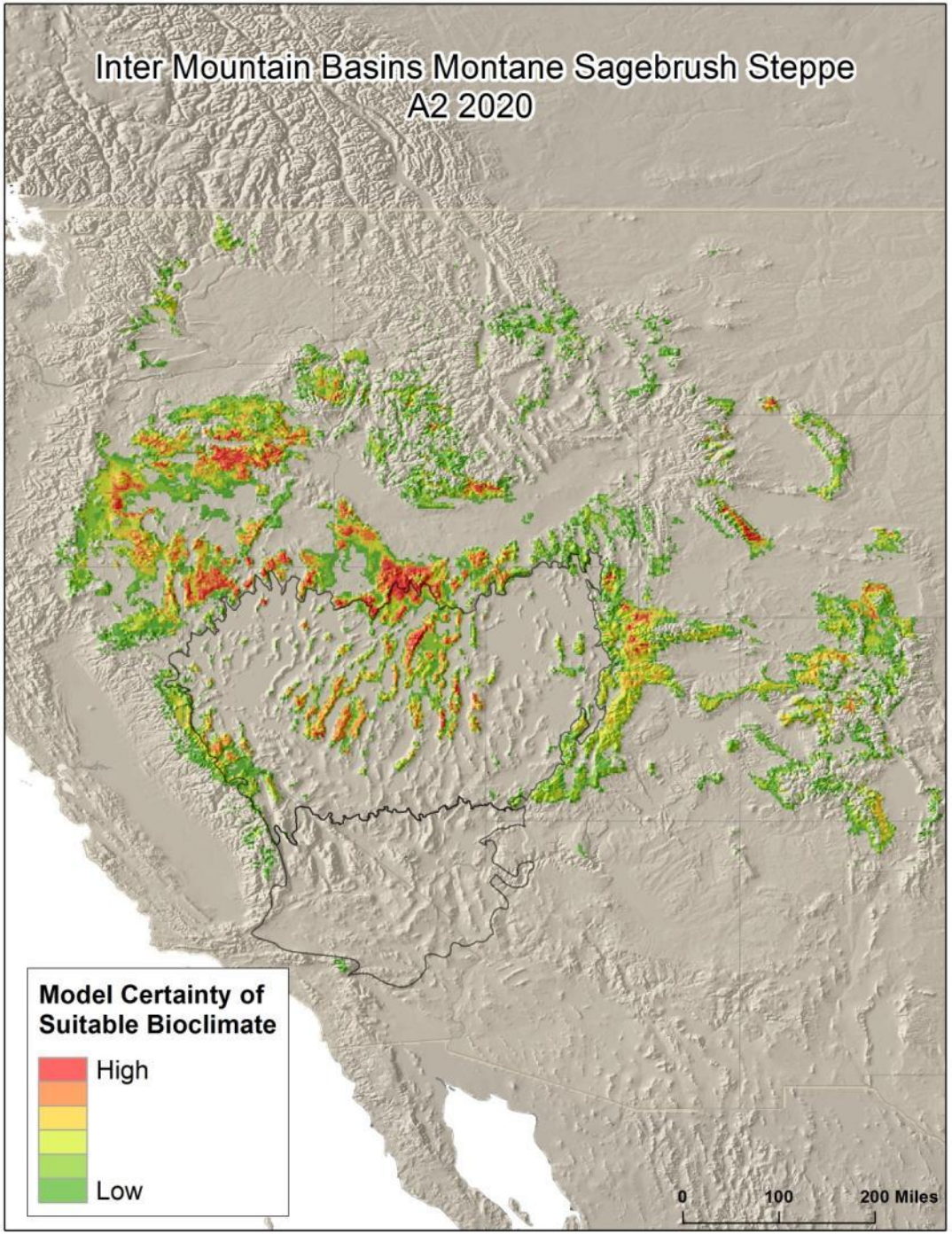

Inter Mountain Basins Montane Sagebrush Steppe
Modeled Current Bioclimatic Niche
Modeled Current Niche
0
100
200 Miles



BLM

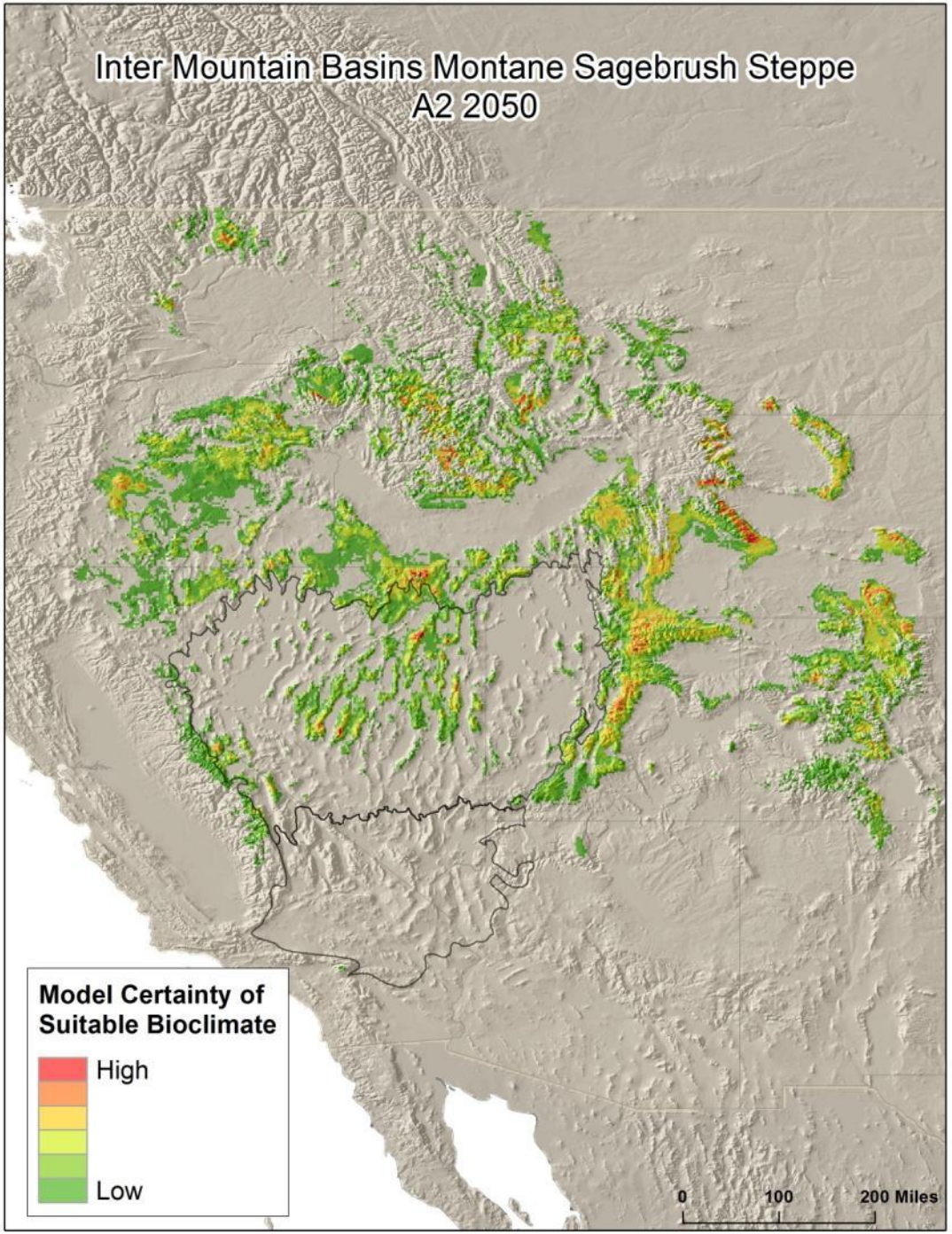
Rapid Ecoregional Assessment


Inter Mountain Basins Montane Sagebrush Steppe
Current Modeled Bioclimatic Niche
Known distribution
(National Vegetation Map, NatureServe)
Modeled Current Niche
0
100
200 Miles



BLM

Rapid Ecoregional Assessment

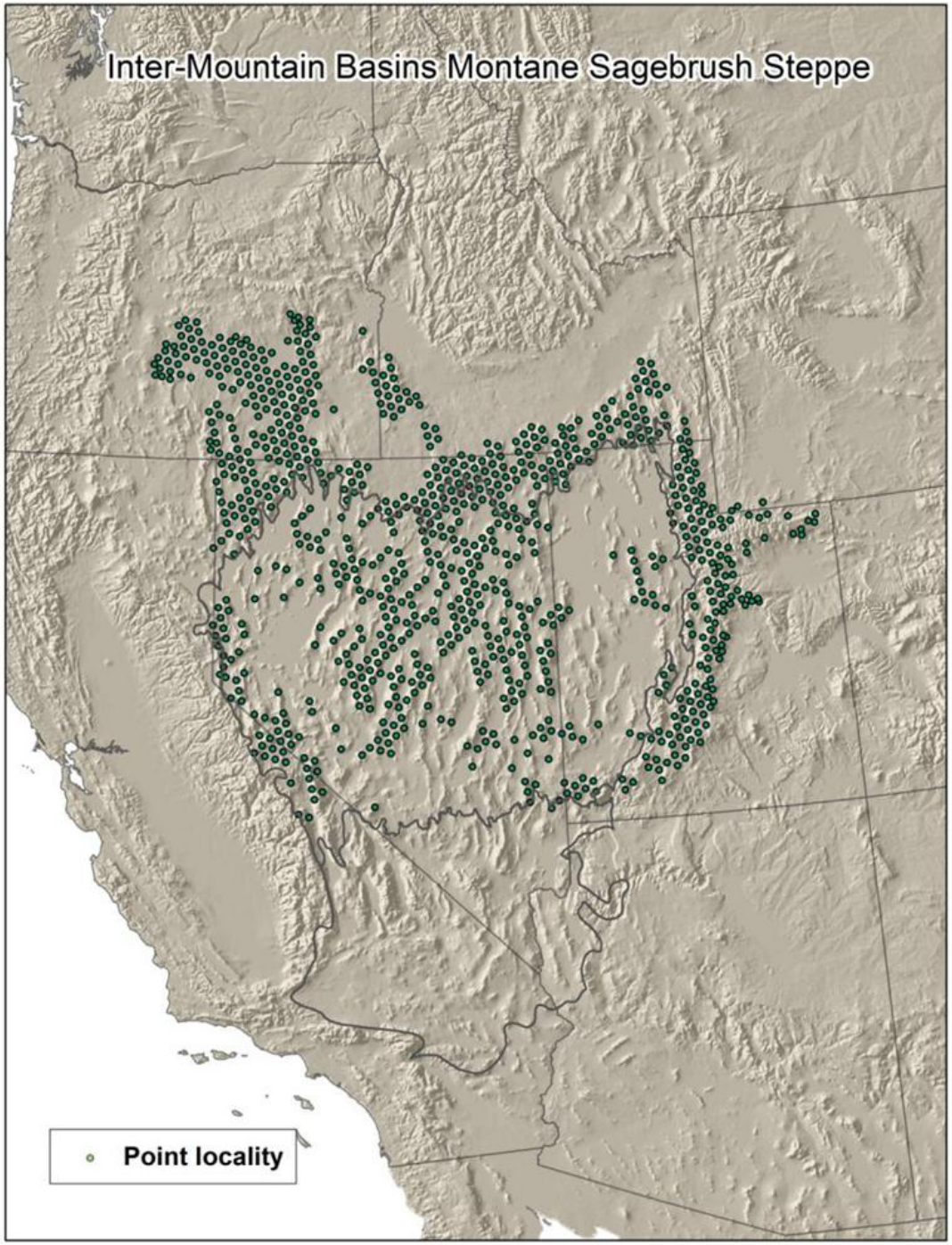


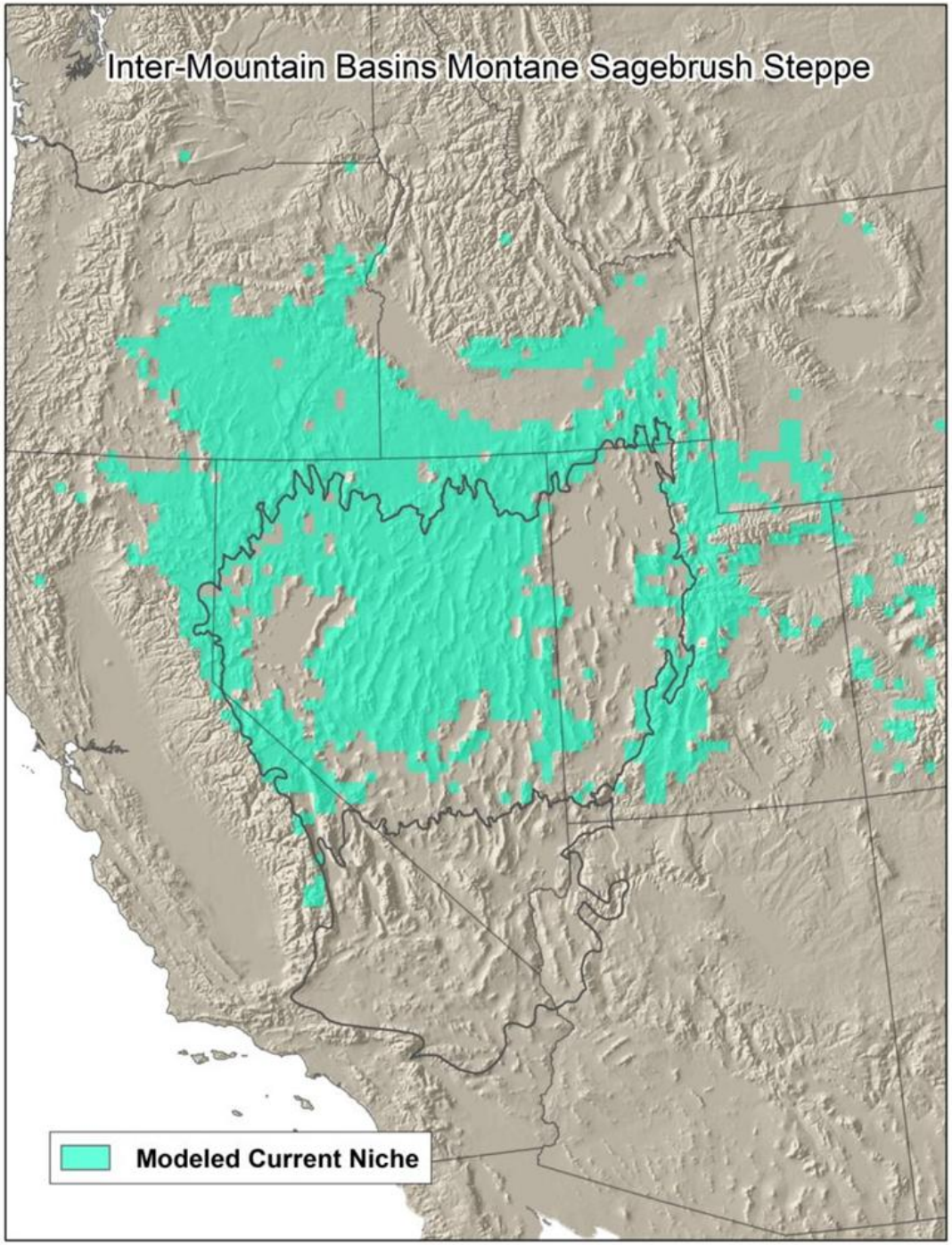
BLM

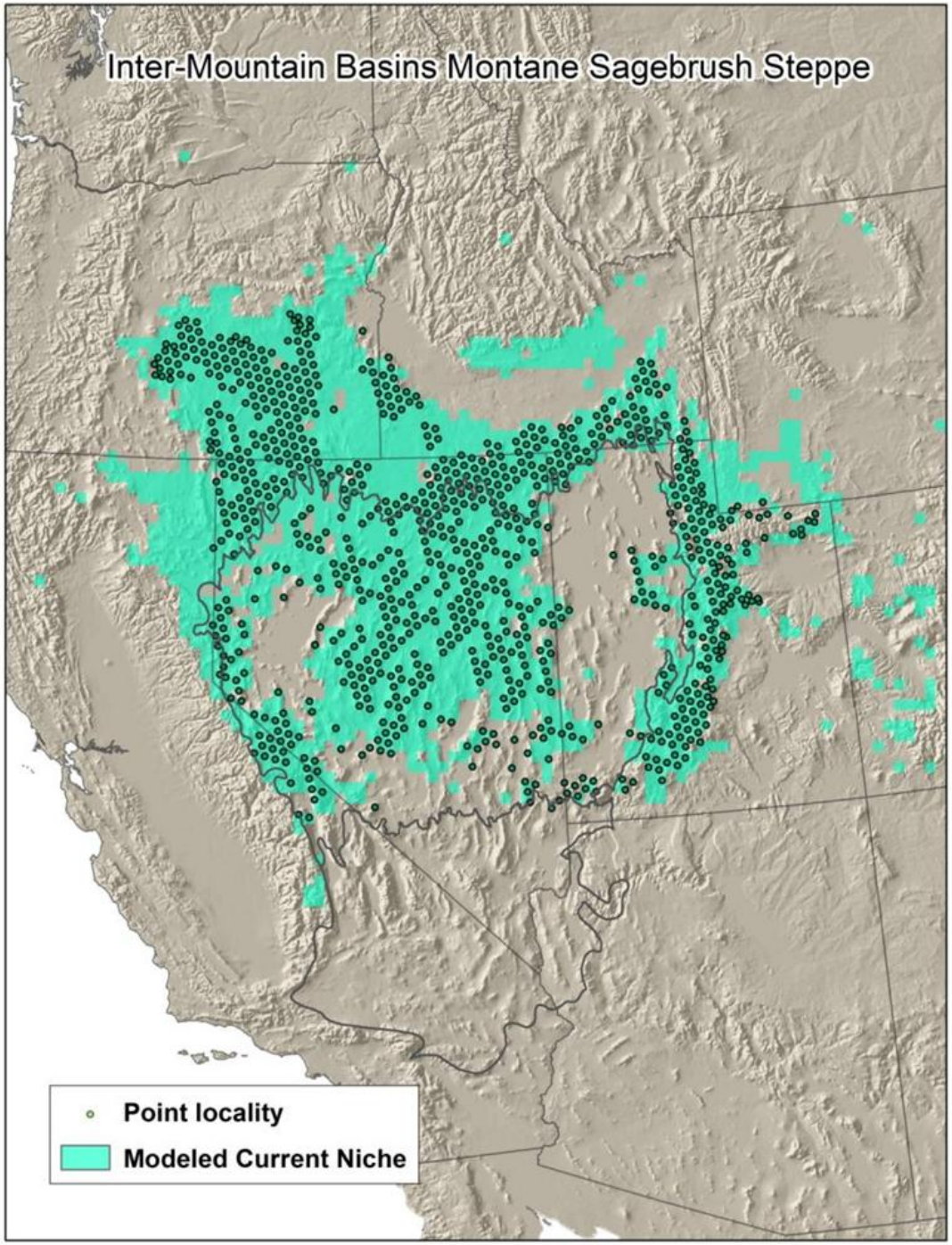
Rapid Ecoregional Assessment

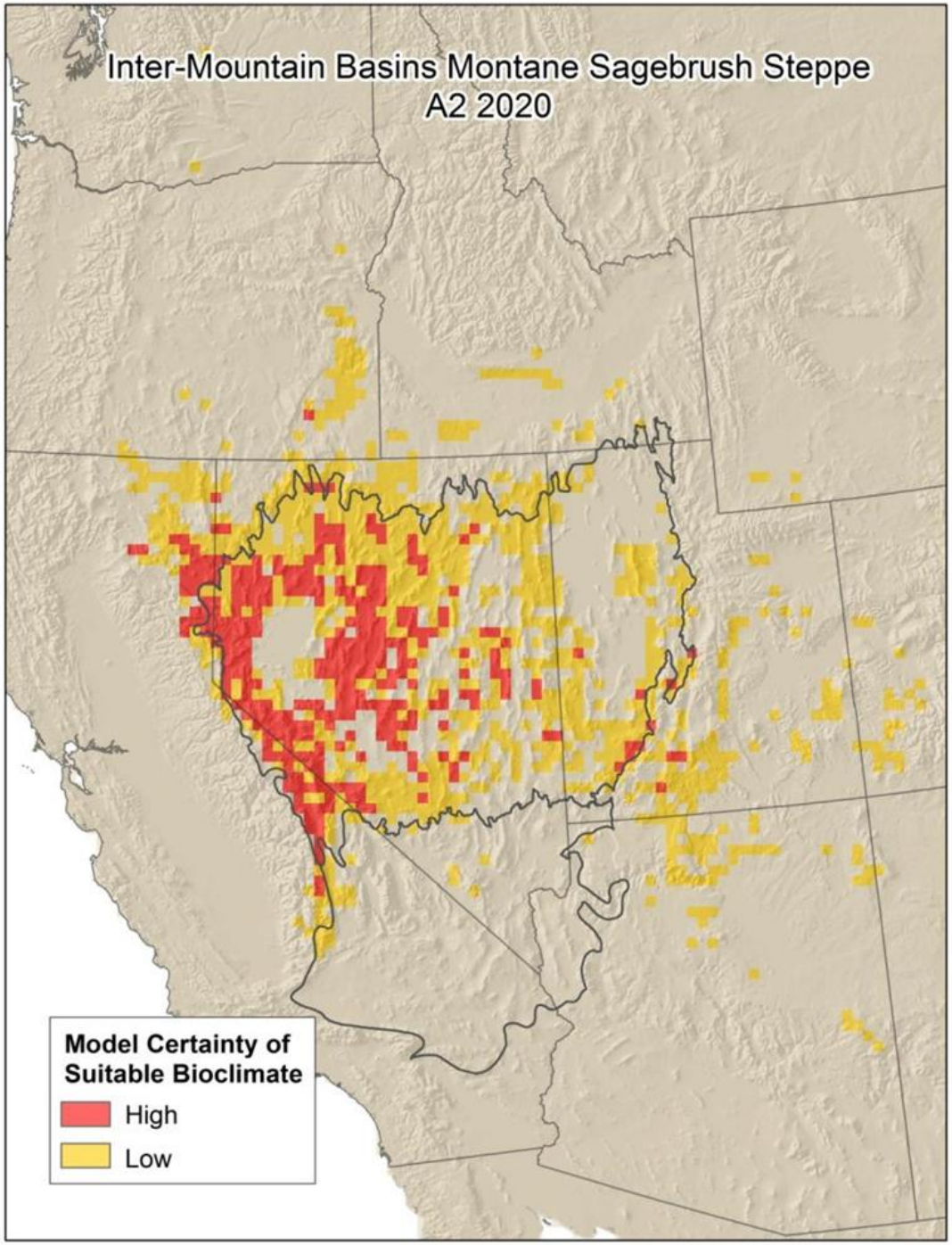
Hostetler/ USGS
15 km^2

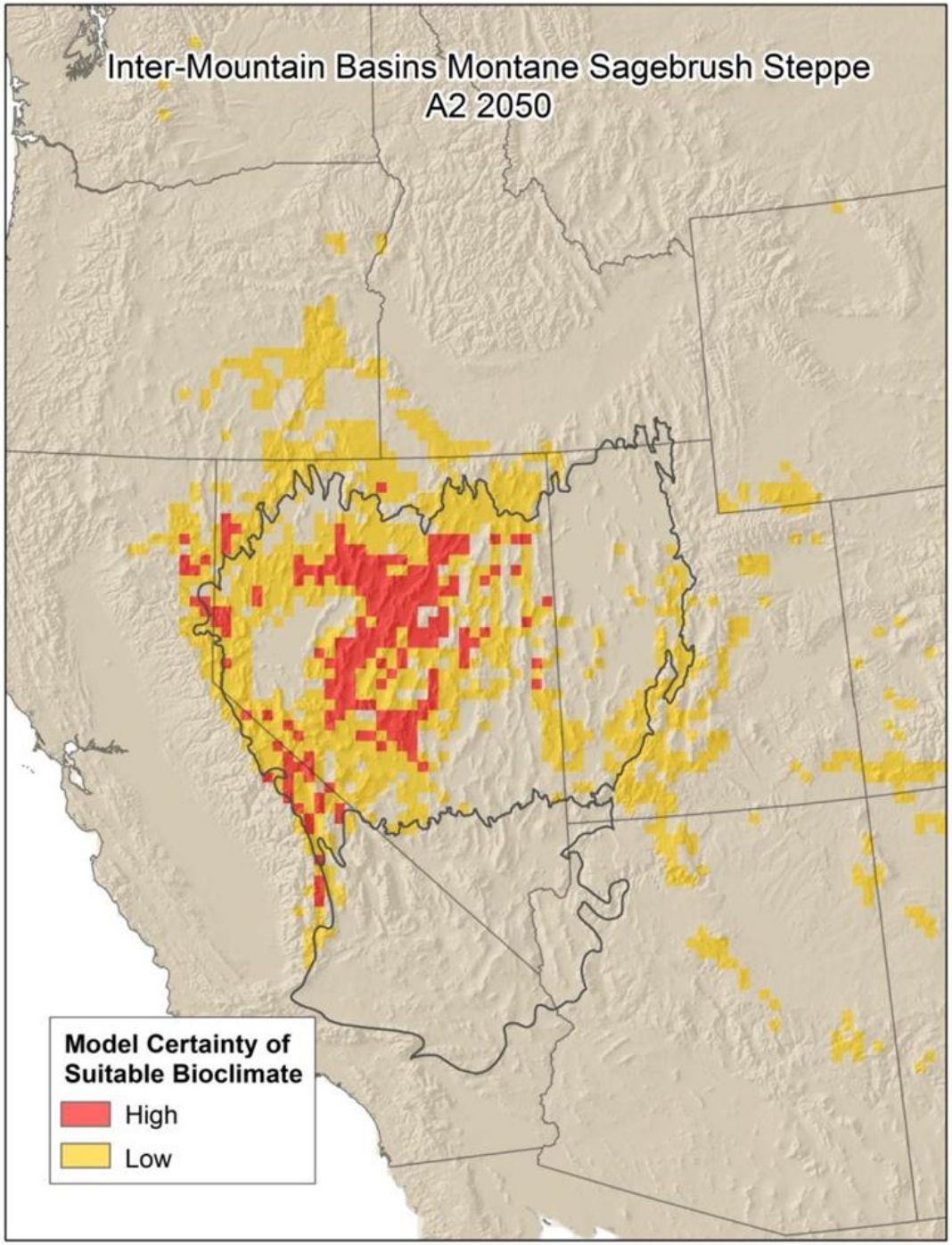
88 climate variables

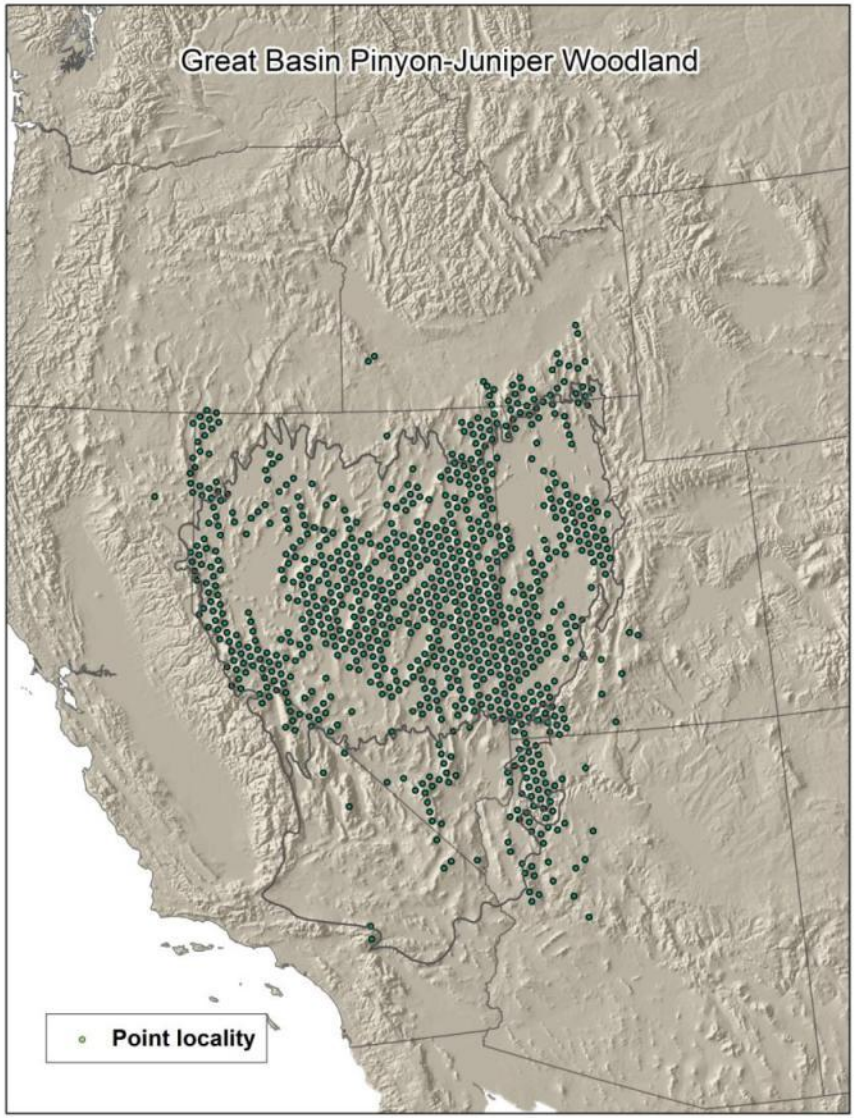


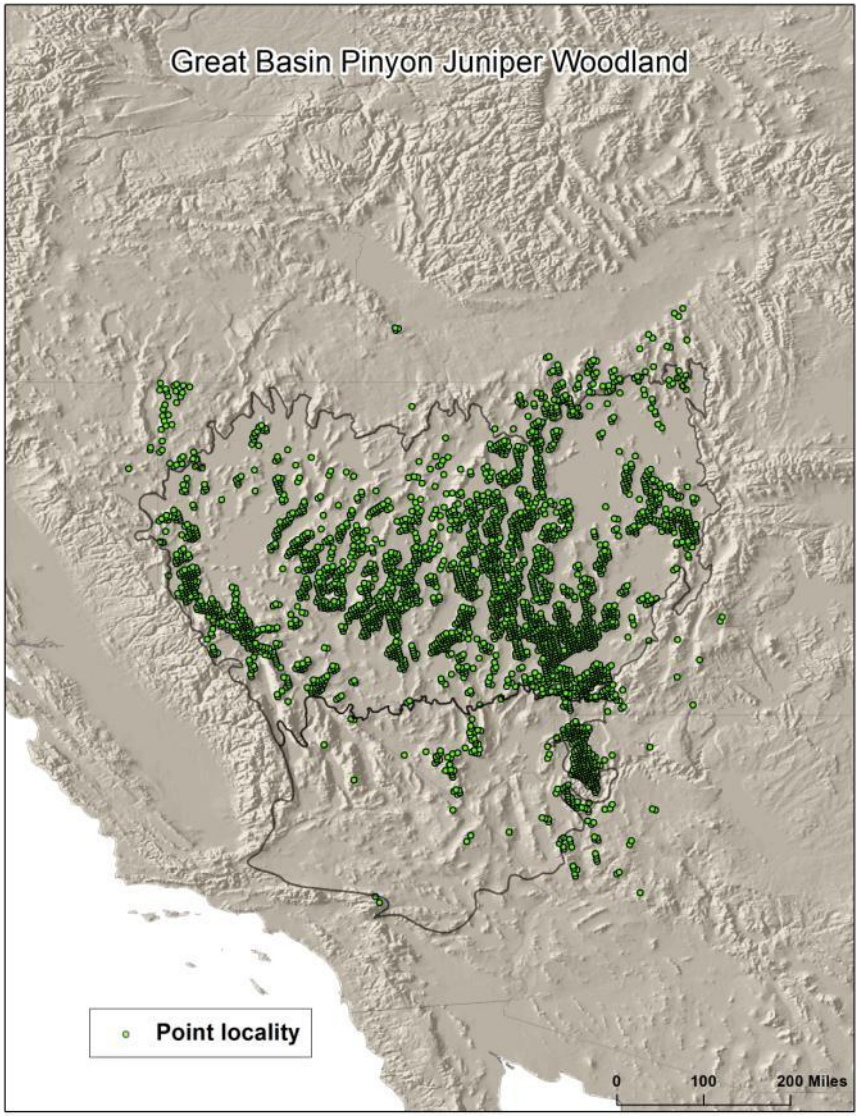

Inter-Mountain Basins Montane Sagebrush Steppe
Modeled Current Niche

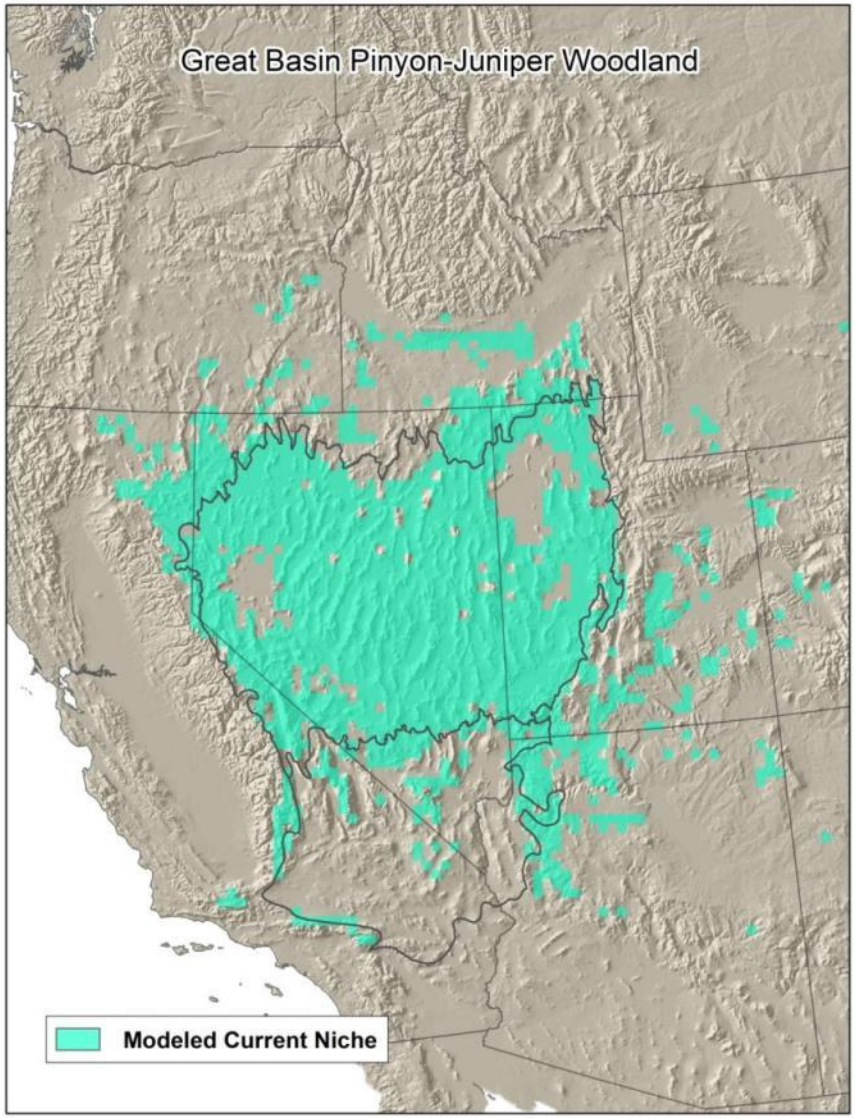

Inter-Mountain Basins Montane Sagebrush Steppe
Point locality
Modeled Current Niche

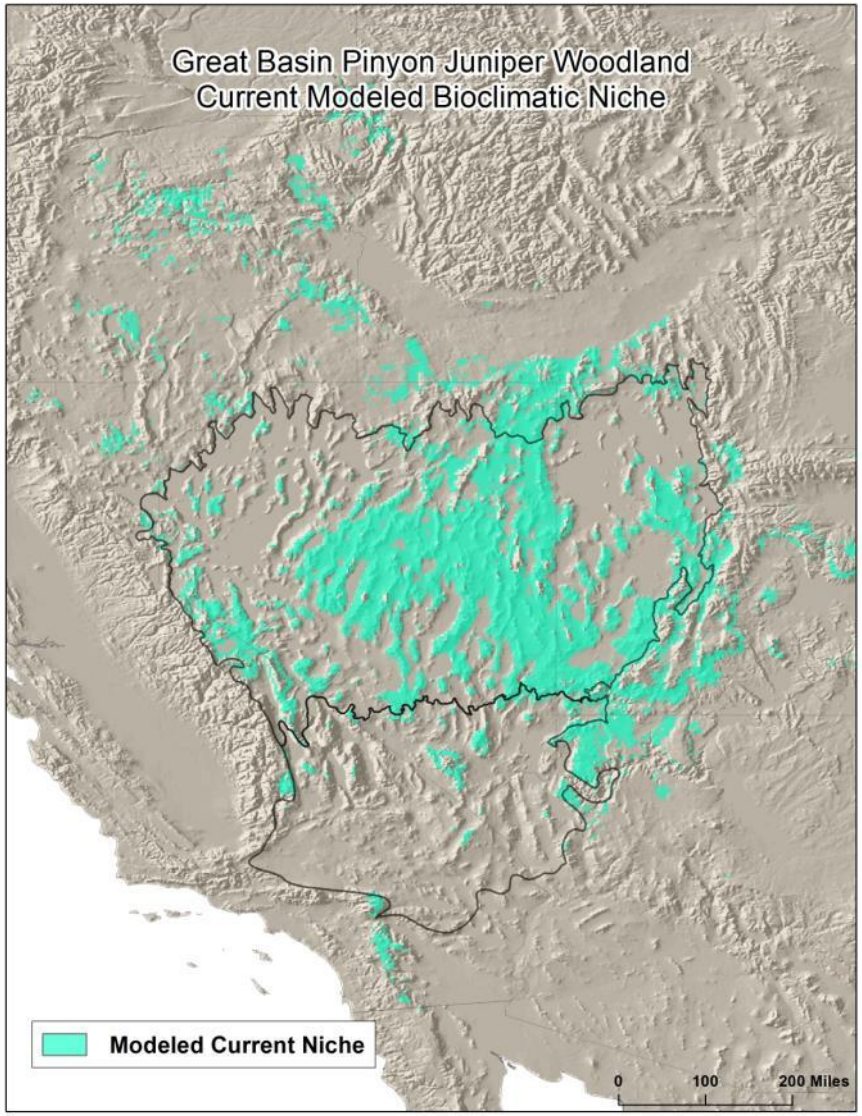

Inter-Mountain Basins Montane Sagebrush Steppe
A2 2020
Model Certainty of Suitable Bioclimate
High
Low

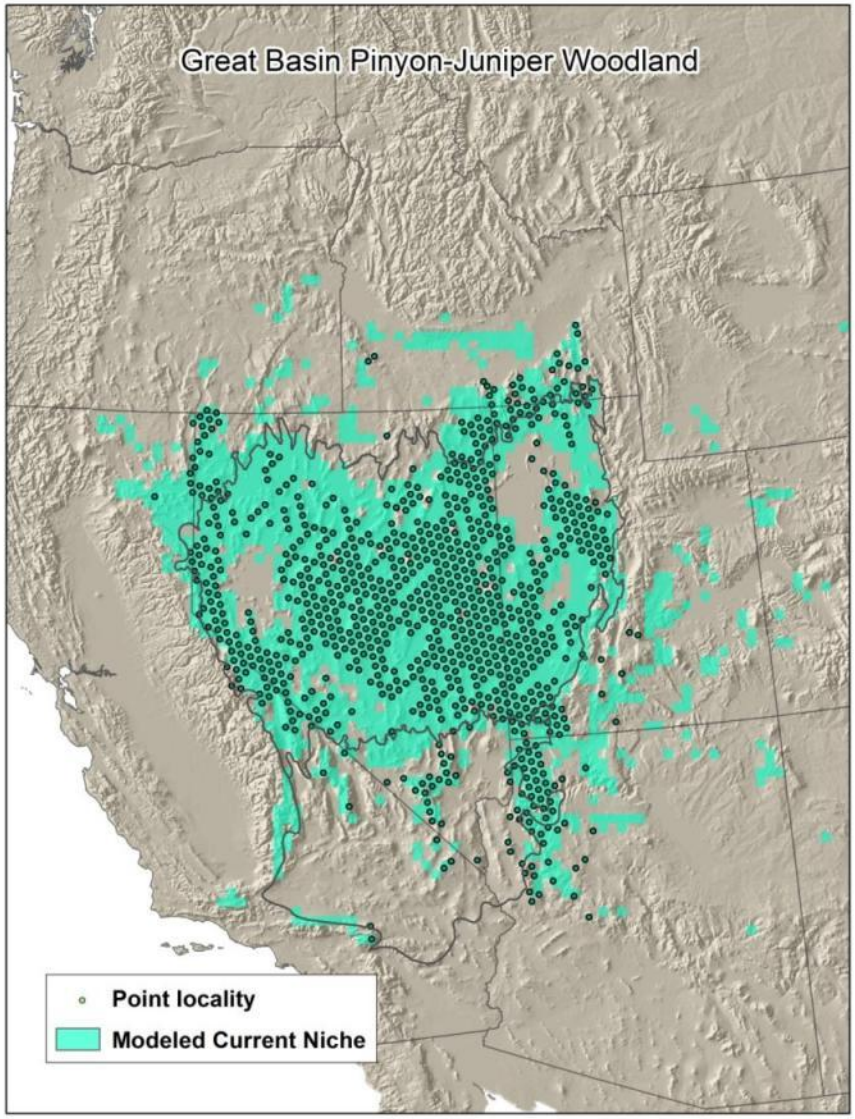

Inter-Mountain Basins Montane Sagebrush Steppe
A2 2050
Model Certainty of Suitable Bioclimate
High
Low

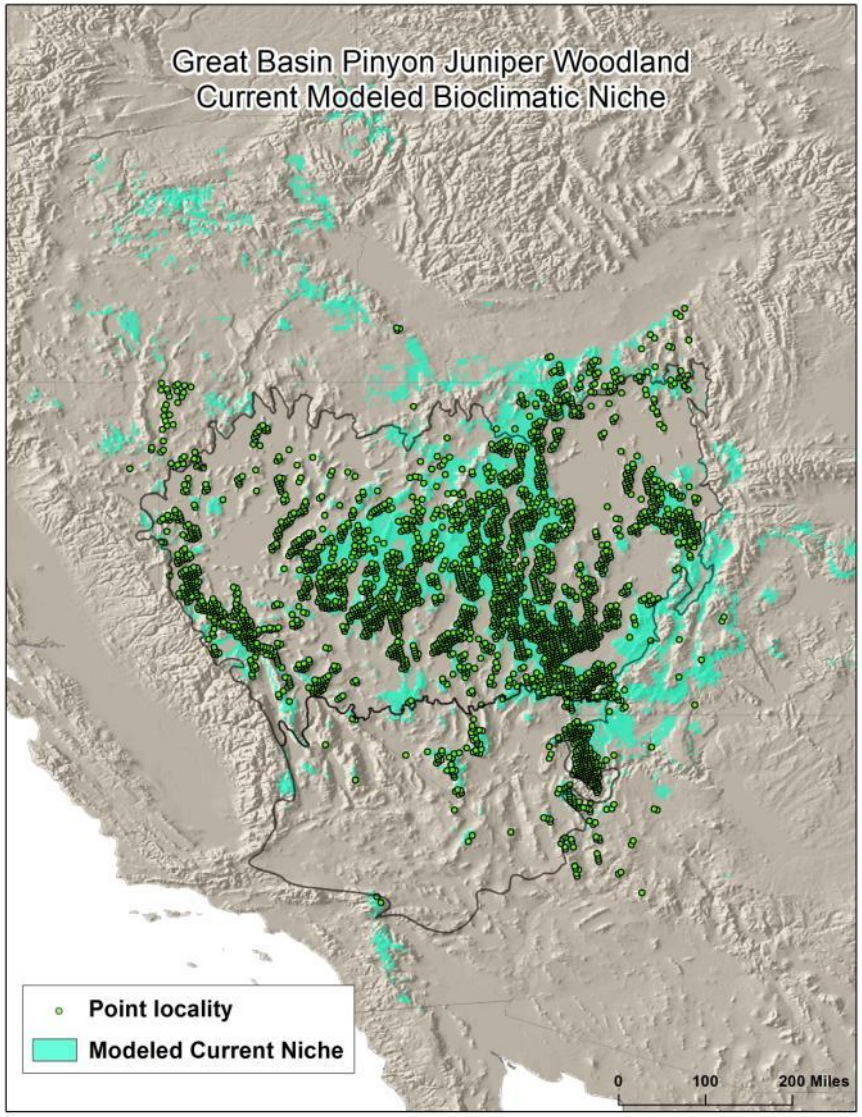

Great Basin Pinyon-Juniper Woodland
Point locality

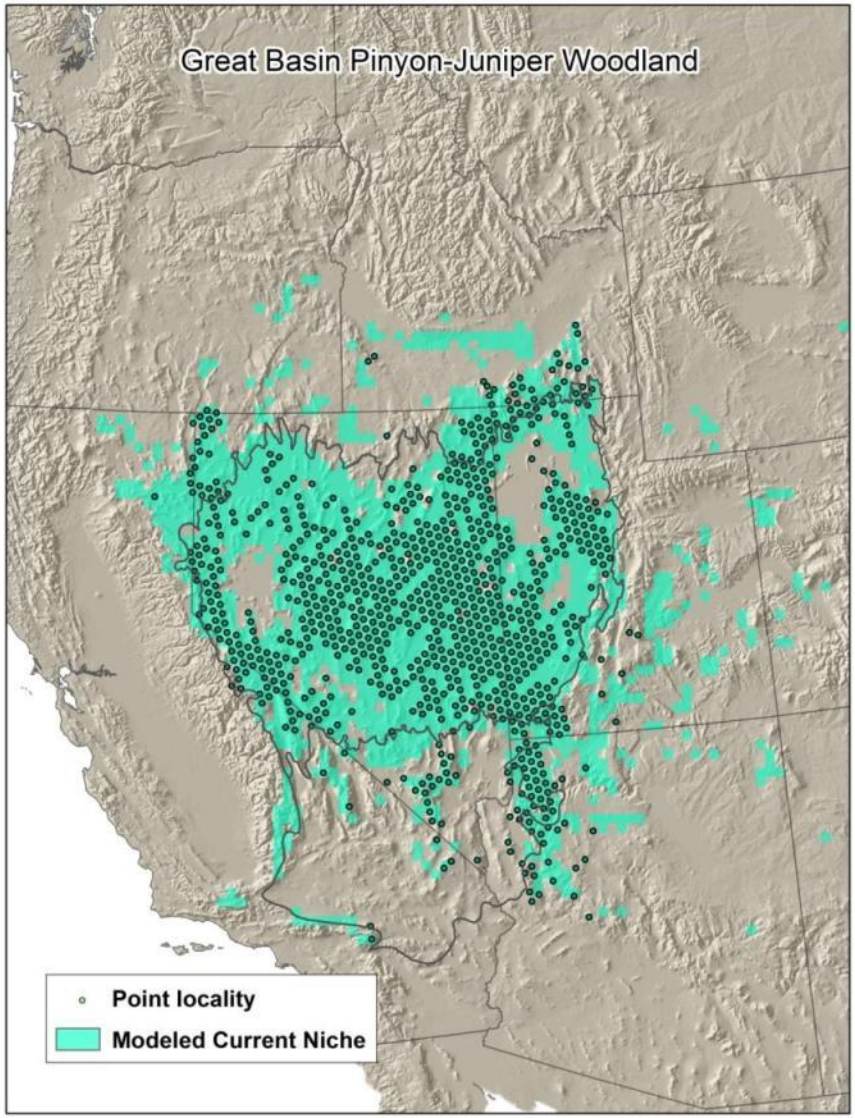

Great Basin Pinyon Juniper Woodland
Point locality
0
100
200 Miles

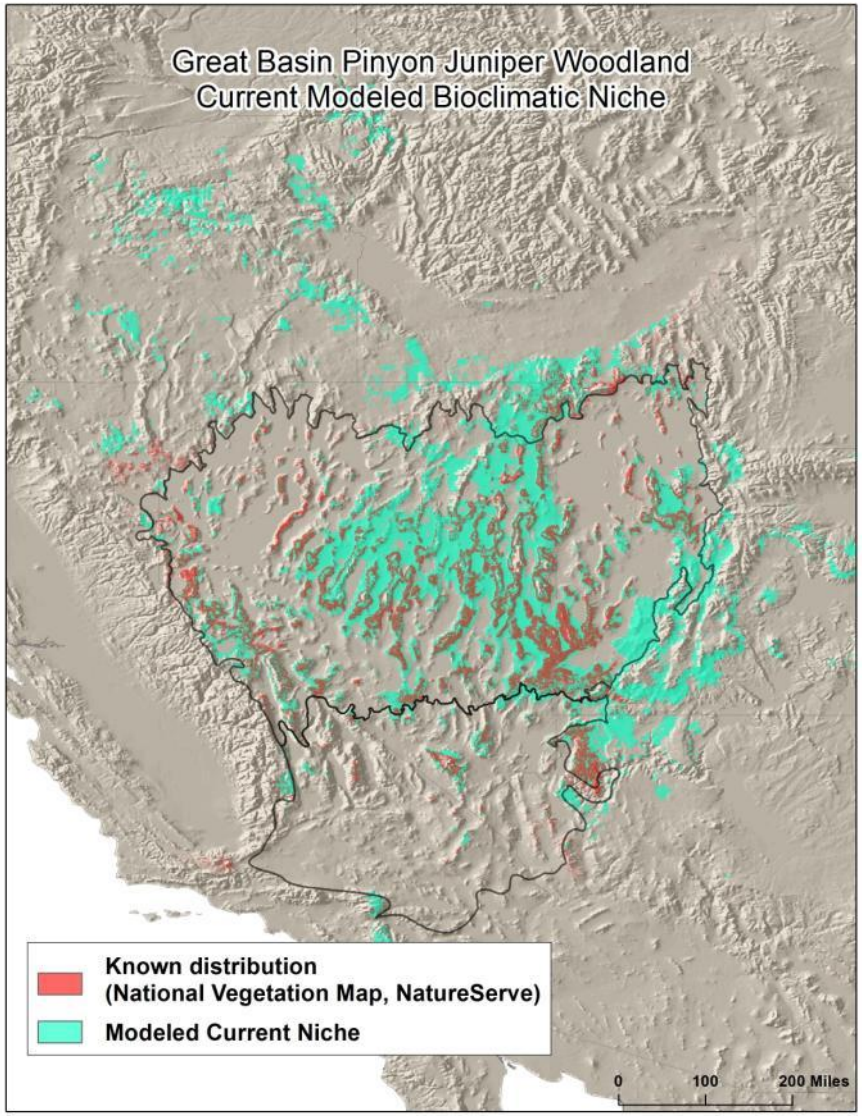

Great Basin Pinyon-Juniper Woodland
Modeled Current Niche

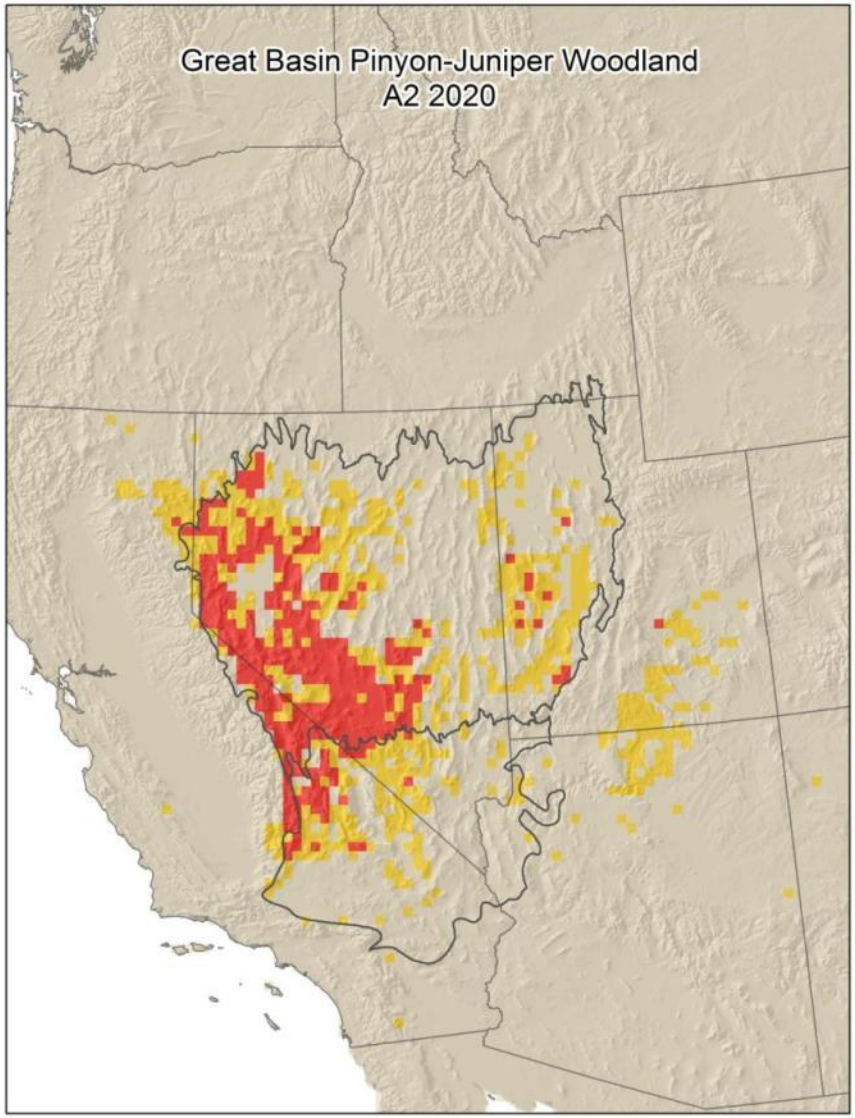

Great Basin Pinyon Juniper Woodland
Current Modeled Bioclimatic Niche
Modeled Current Niche
0
100
200 Miles

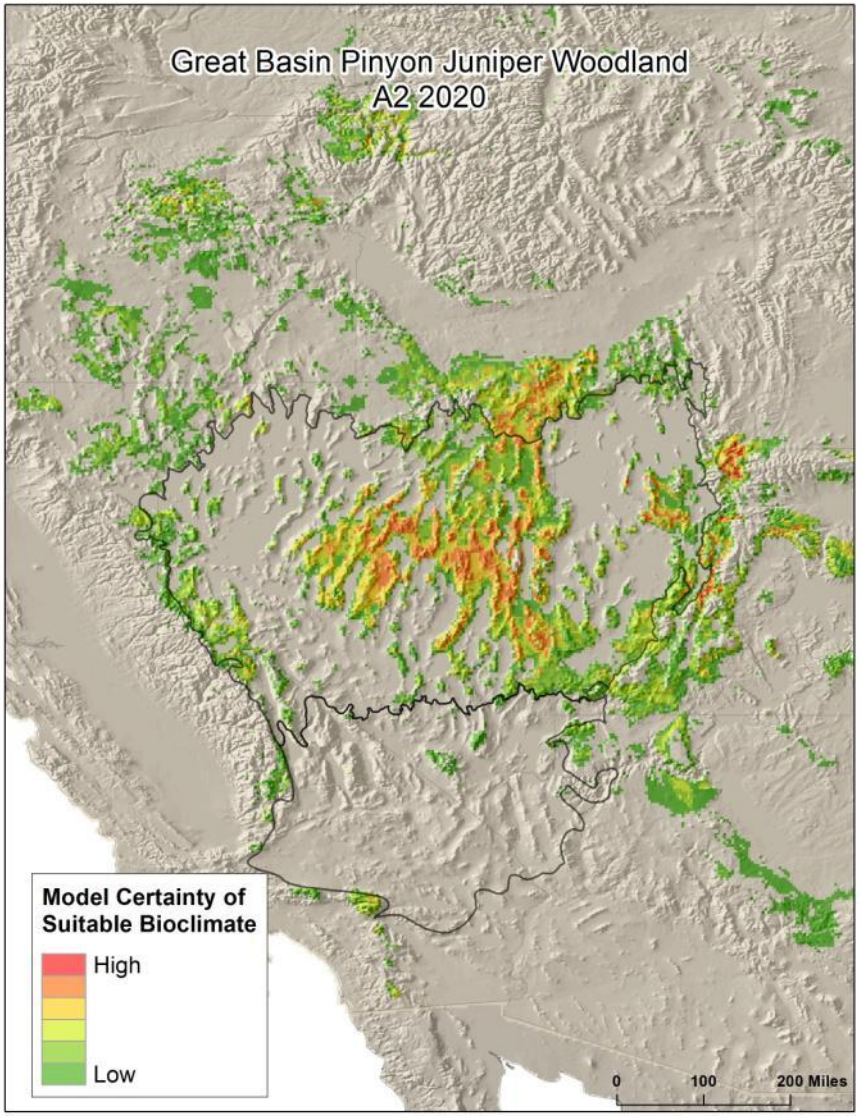

Great Basin Pinyon-Juniper Woodland
Point locality
Modeled Current Niche

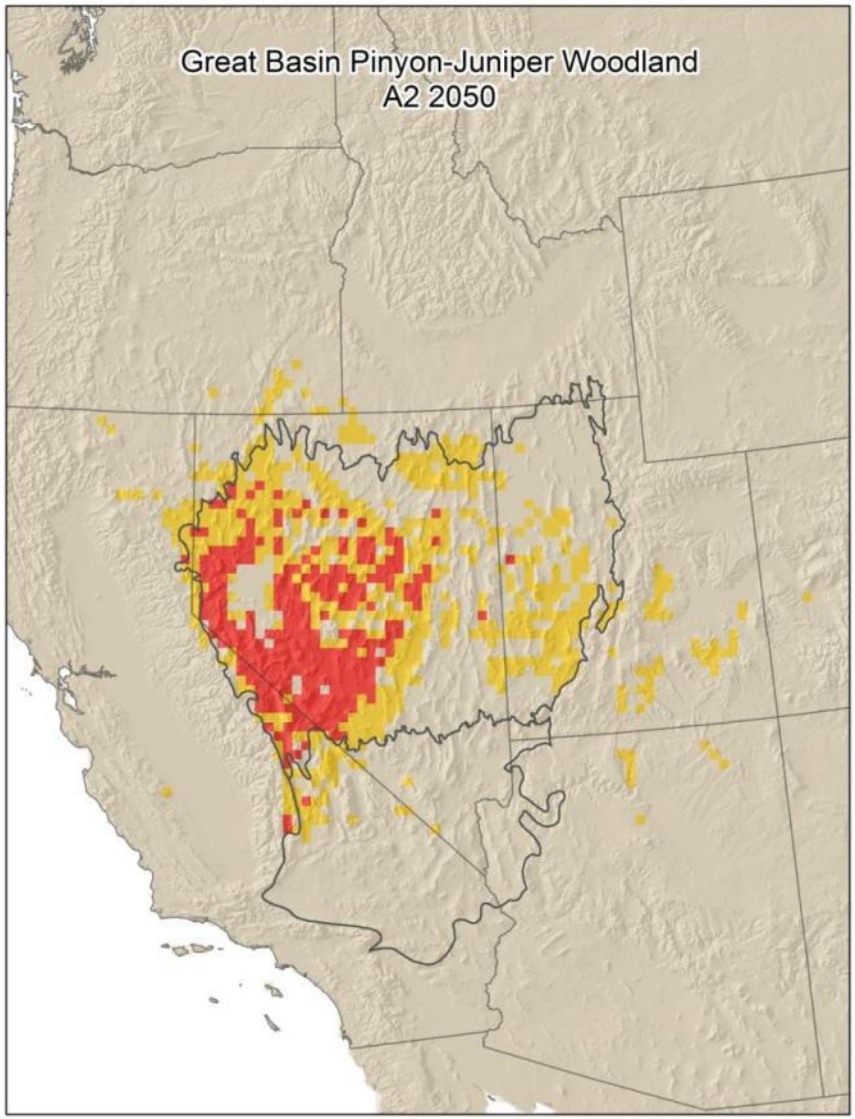

Great Basin Pinyon Juniper Woodland
Current Modeled Bioclimatic Niche
Point locality
Modeled Current Niche
0
100
200 Miles

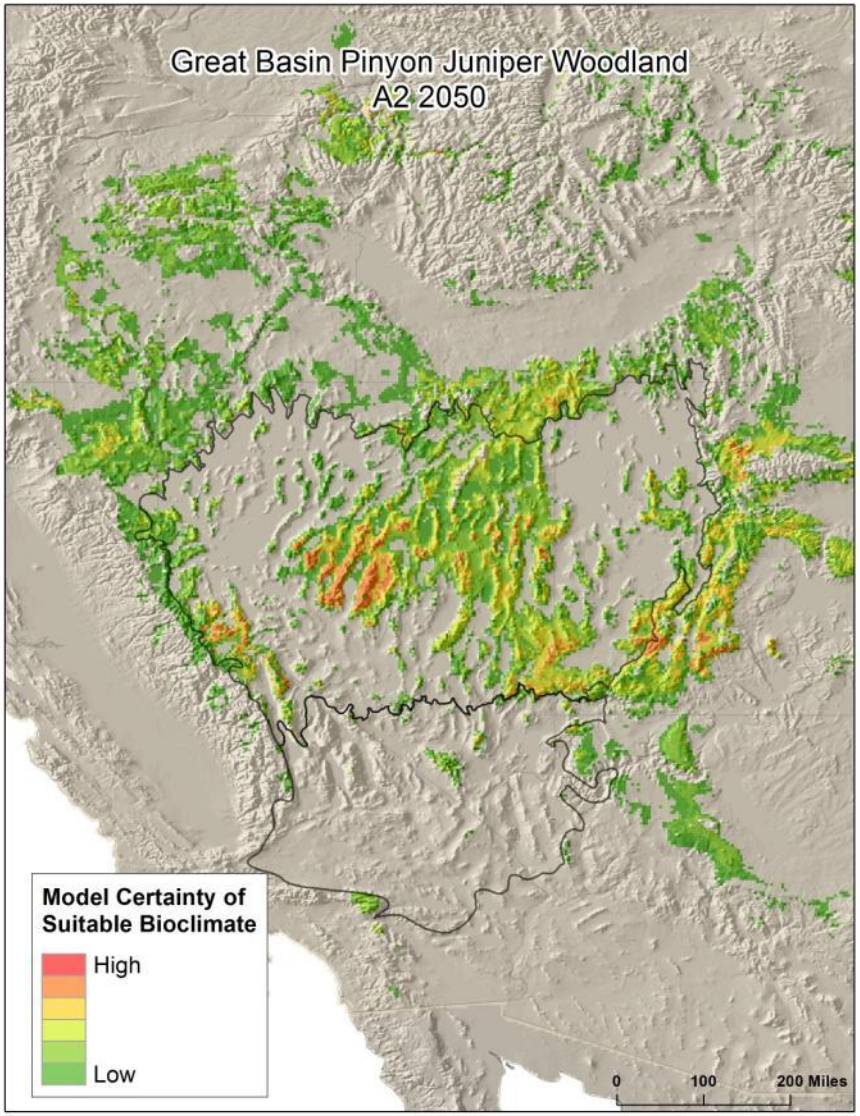

Great Basin Pinyon-Juniper Woodland
Point locality
Modeled Current Niche

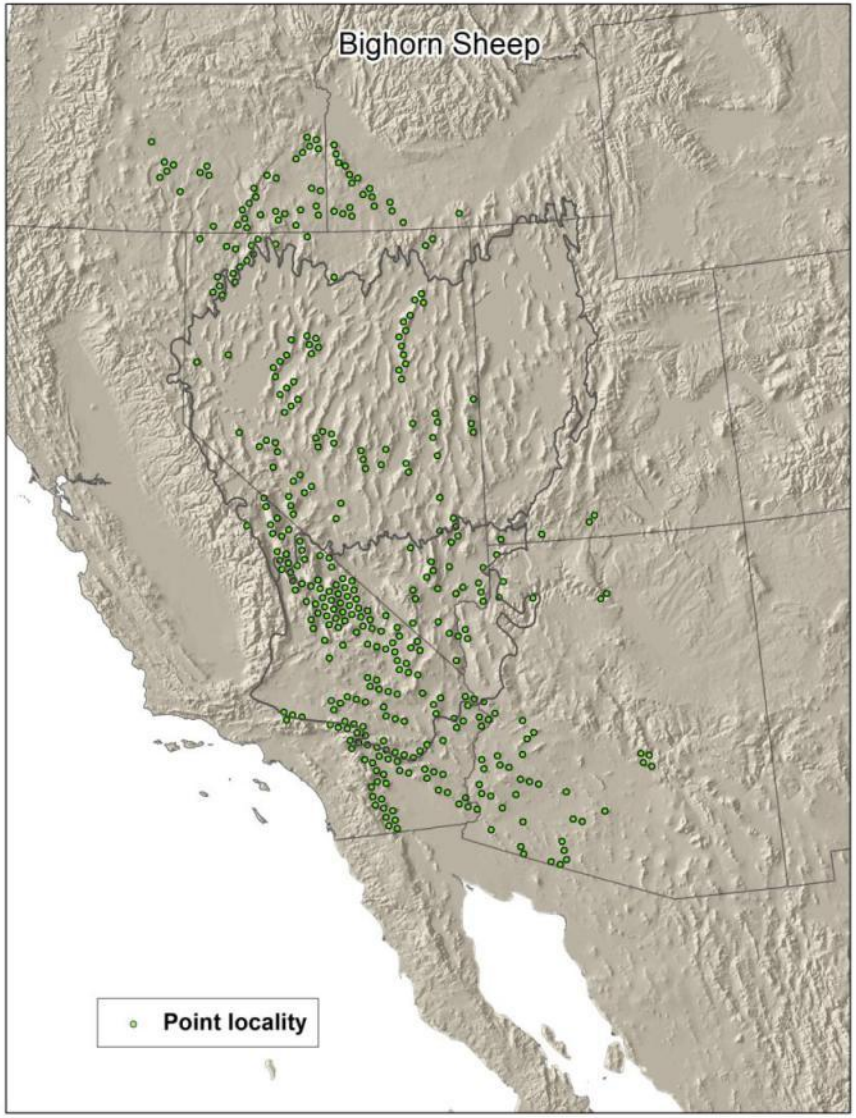

Great Basin Pinyon Juniper Woodland
Current Modeled Bioclimatic Niche
Known distribution
(National Vegetation Map, NatureServe)
Modeled Current Niche
0
100
200 Miles

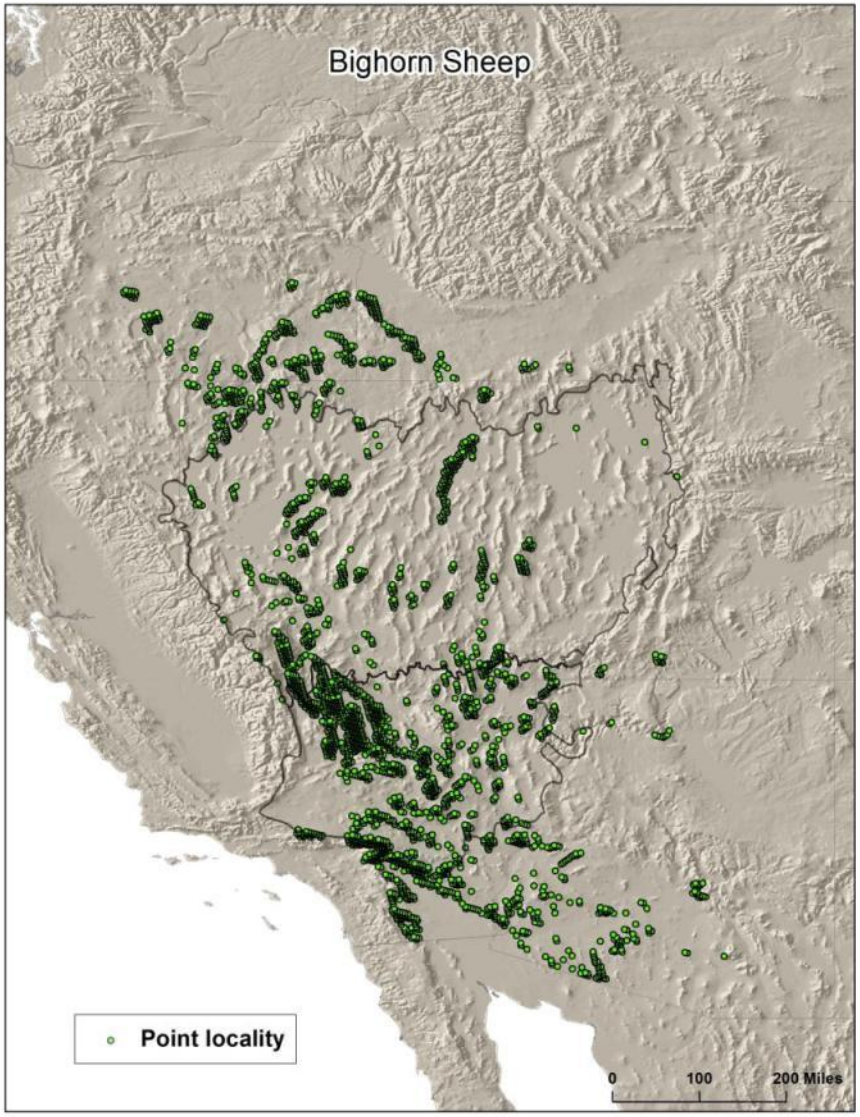

Great Basin Pinyon-Juniper Woodland
A2 2020

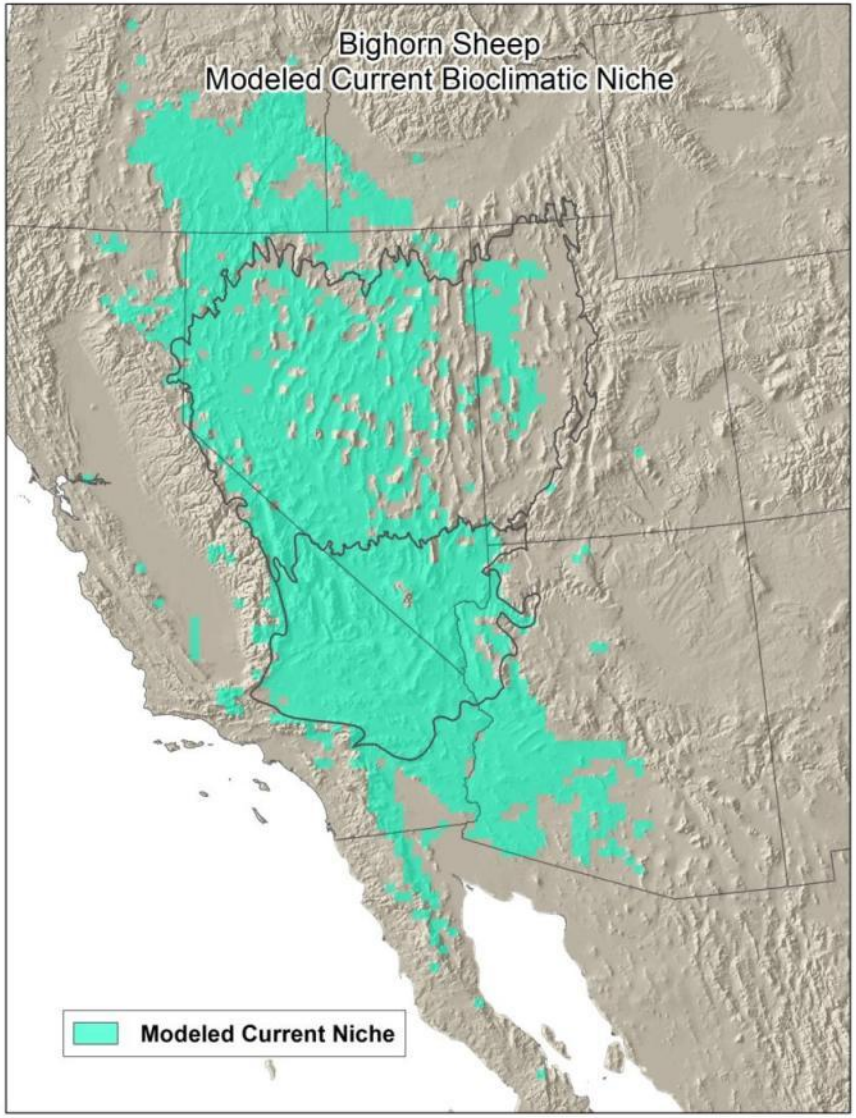

Great Basin Pinyon Juniper Woodland
A2 2020
Model Certainty of Suitable Bioclimate
High
Low
0
100
200 Miles

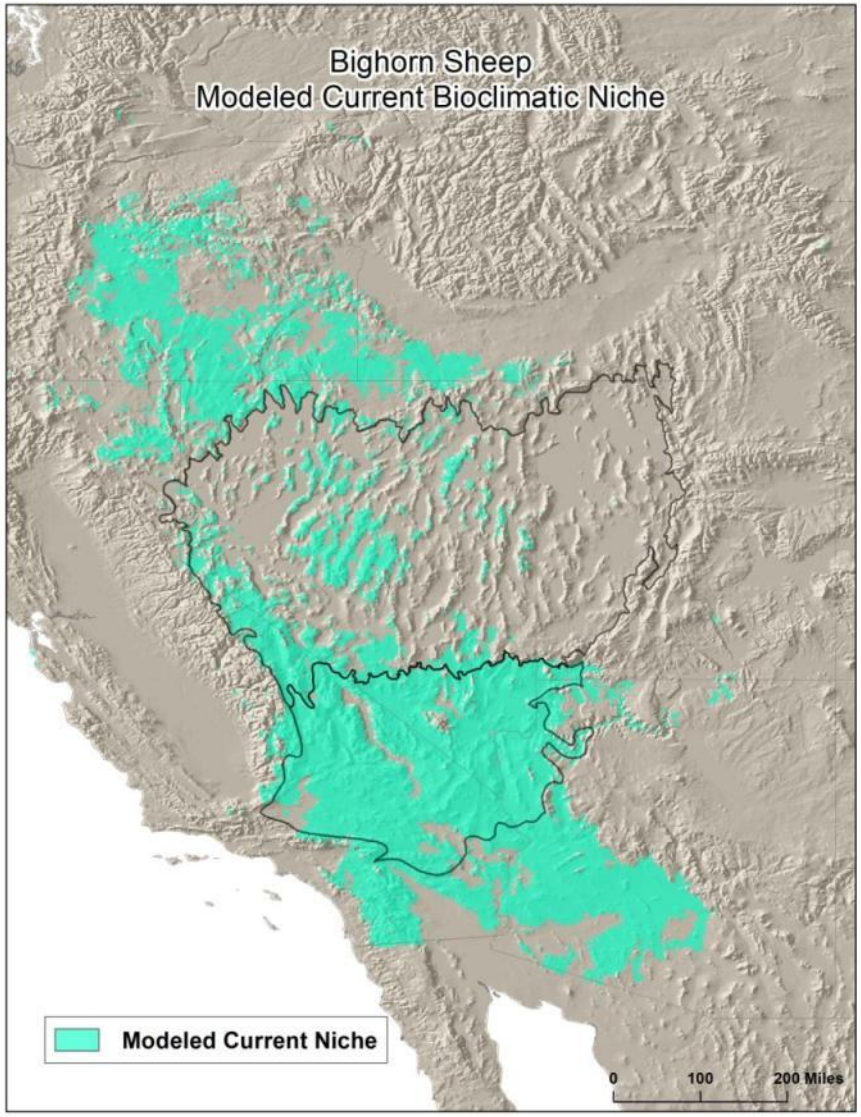

Great Basin Pinyon-Juniper Woodland
A2 2050

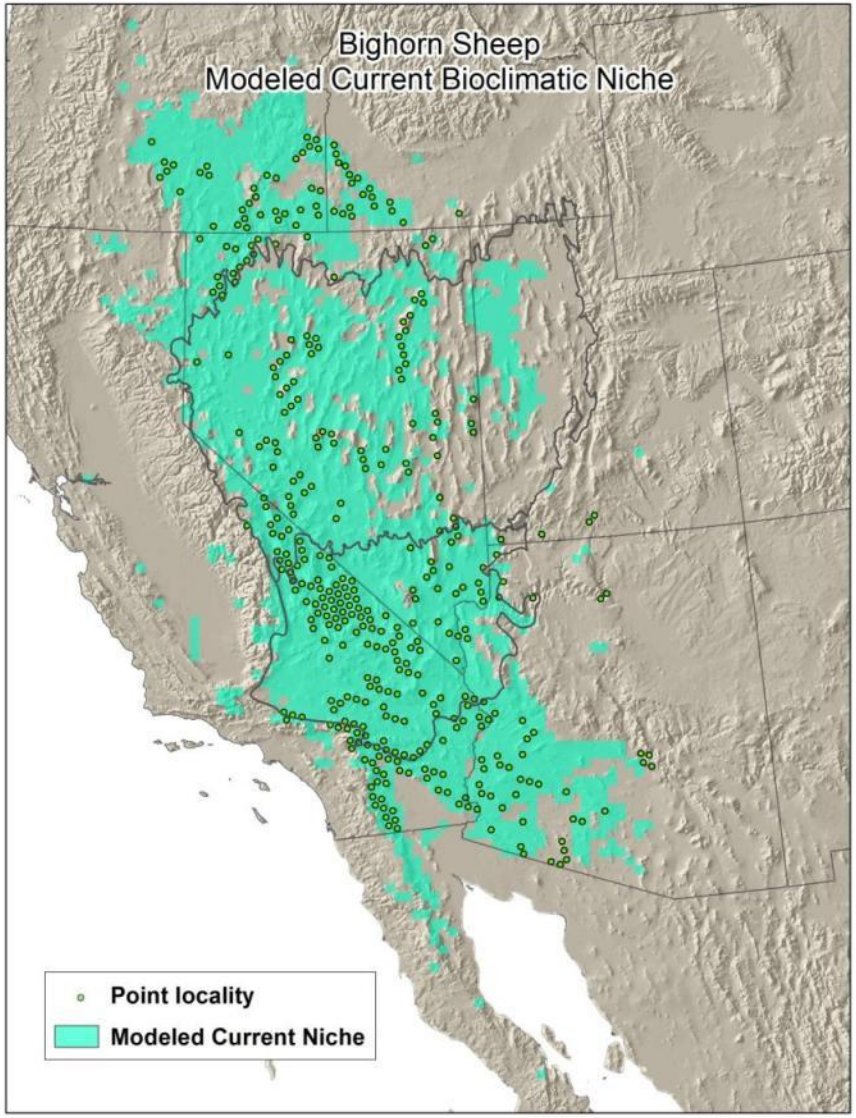

Great Basin Pinyon Juniper Woodland
A2 2050
Model Certainty of Suitable Bioclimate
High
Low
0
100
200 Miles

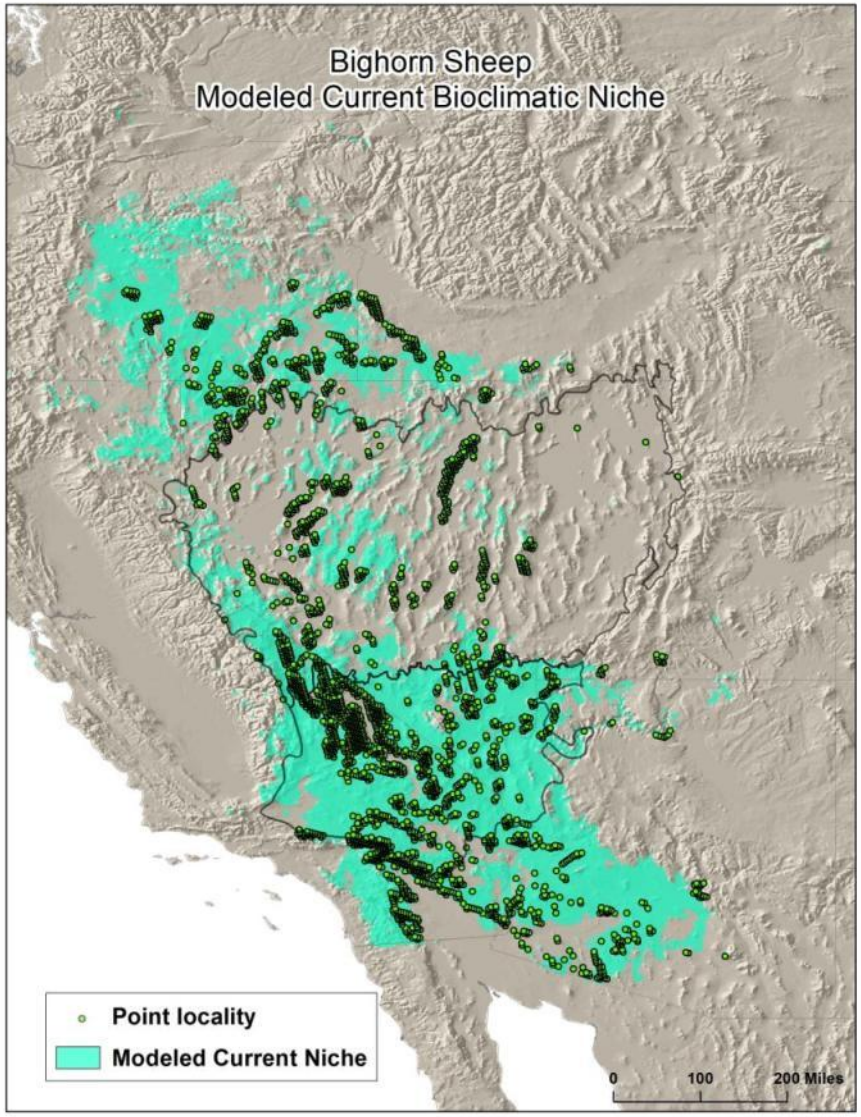

Bighorn Sheep
Point locality

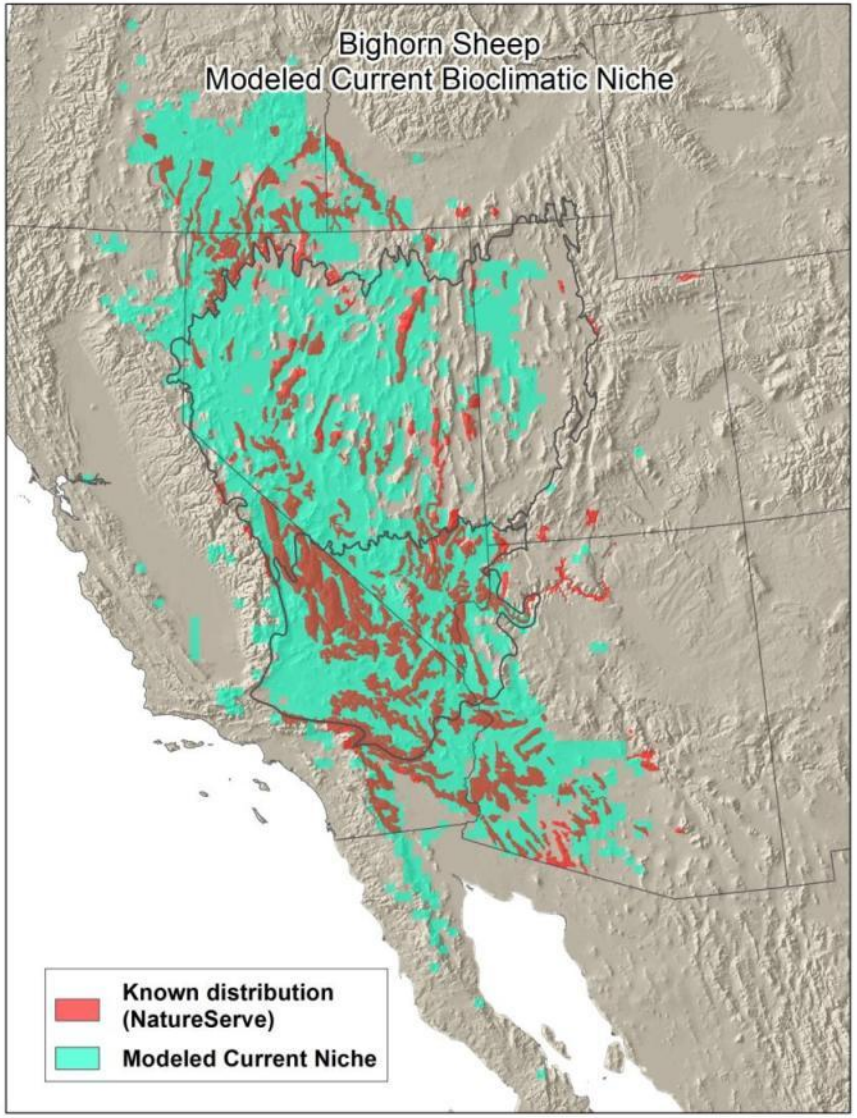

Bighorn Sheep
Point locality
0
100
200 Miles

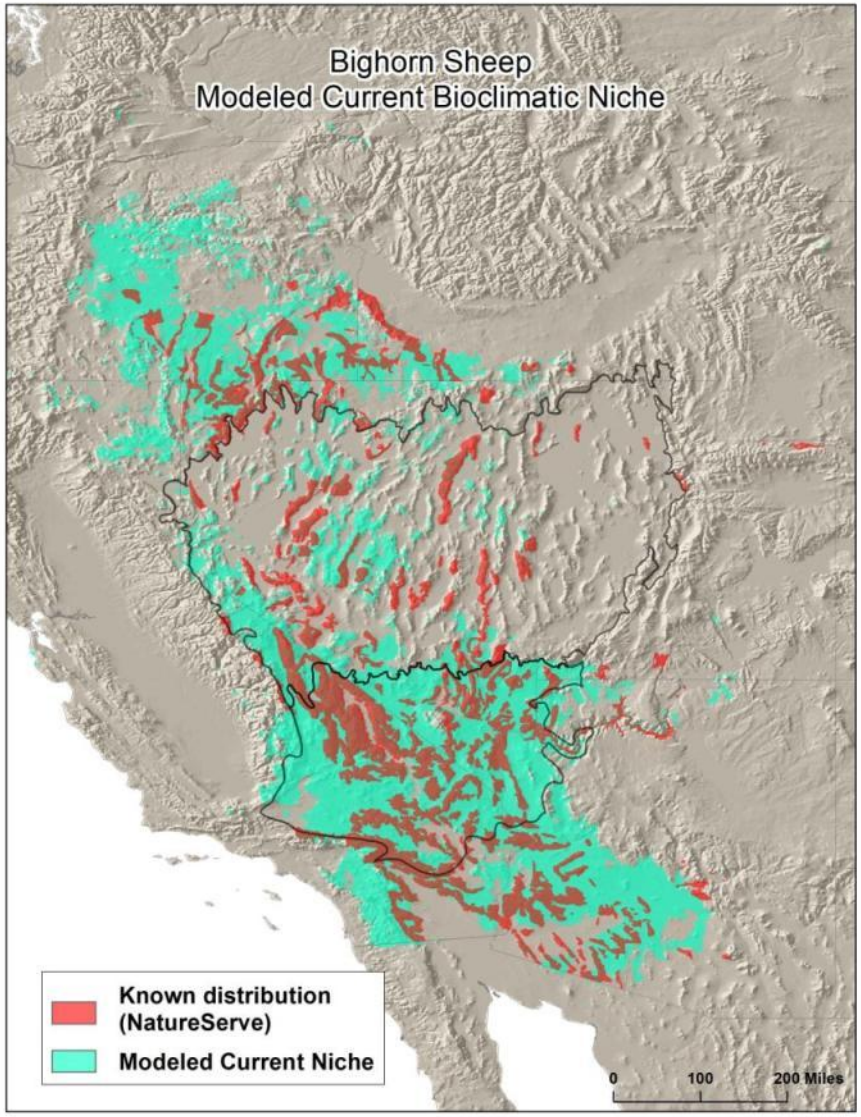

Bighorn Sheep
Modeled Current Bioclimatic Niche
Modeled Current Niche

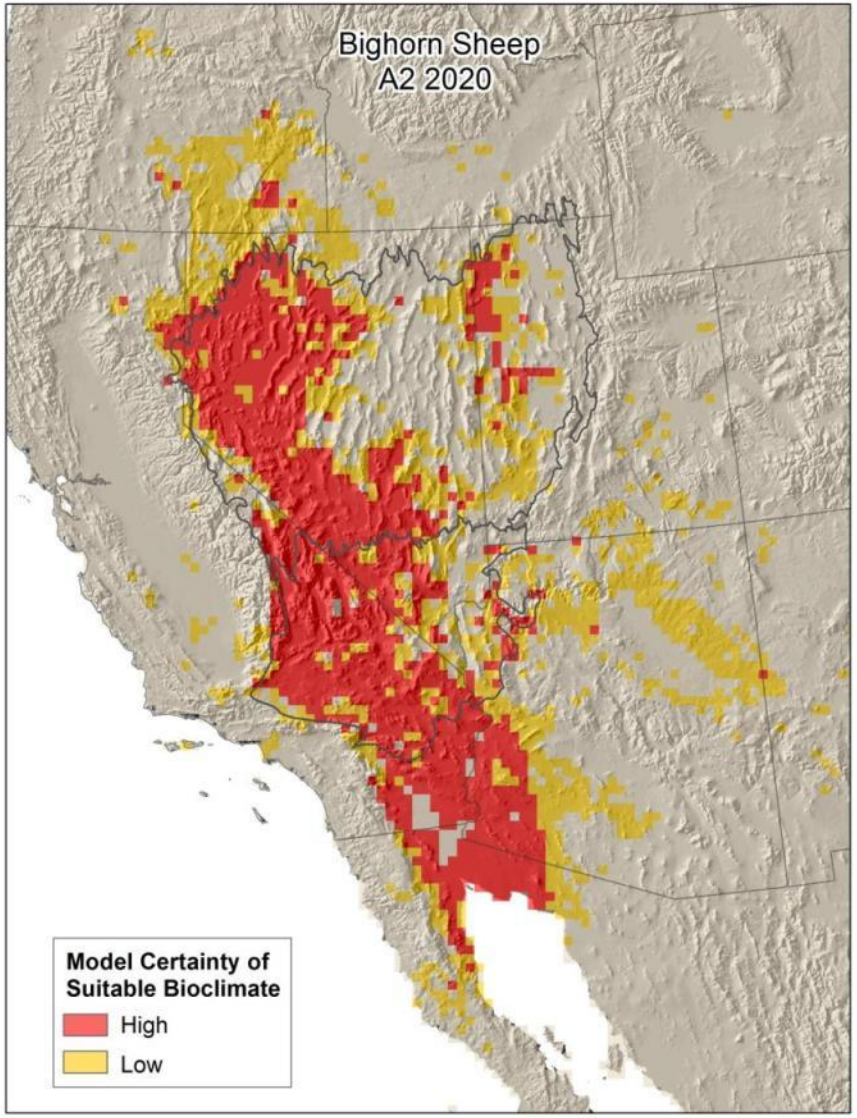

Bighorn Sheep
Modeled Current Bioclimatic Niche
Modeled Current Niche
0
100
200 Miles

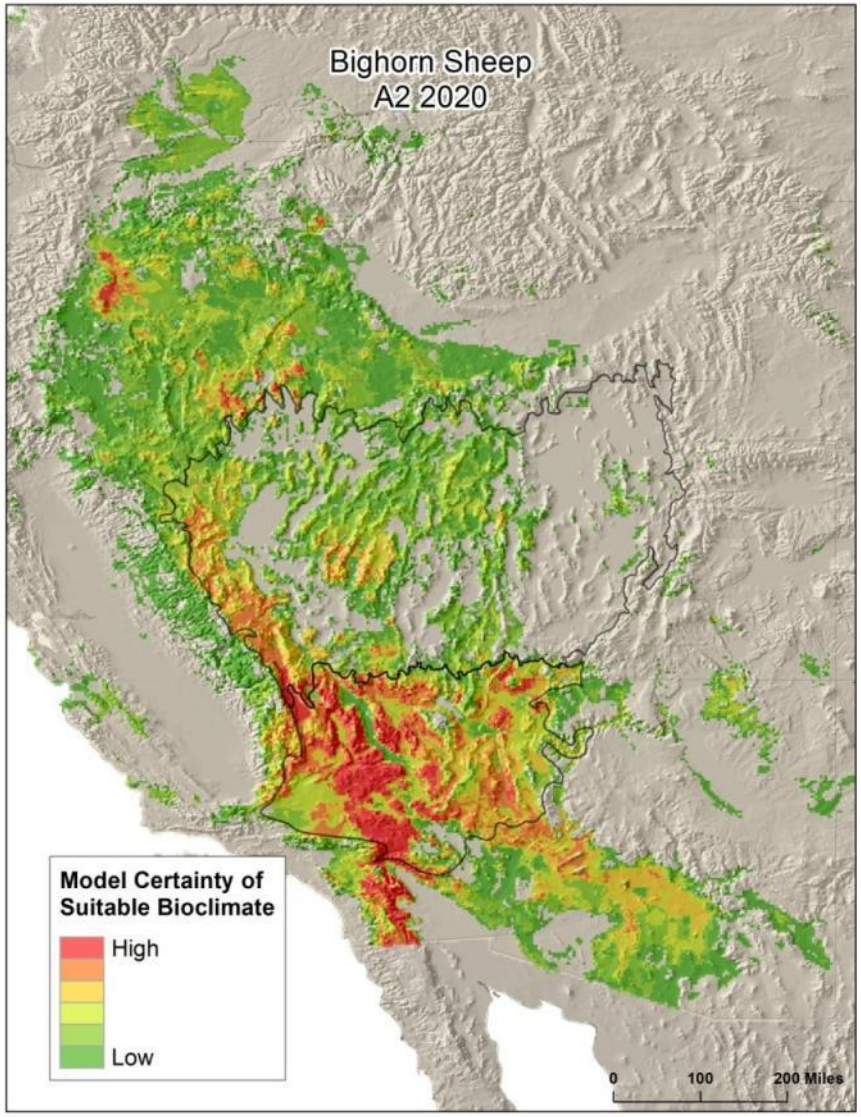

Bighorn Sheep
Modeled Current Bioclimatic Niche
Point locality
Modeled Current Niche

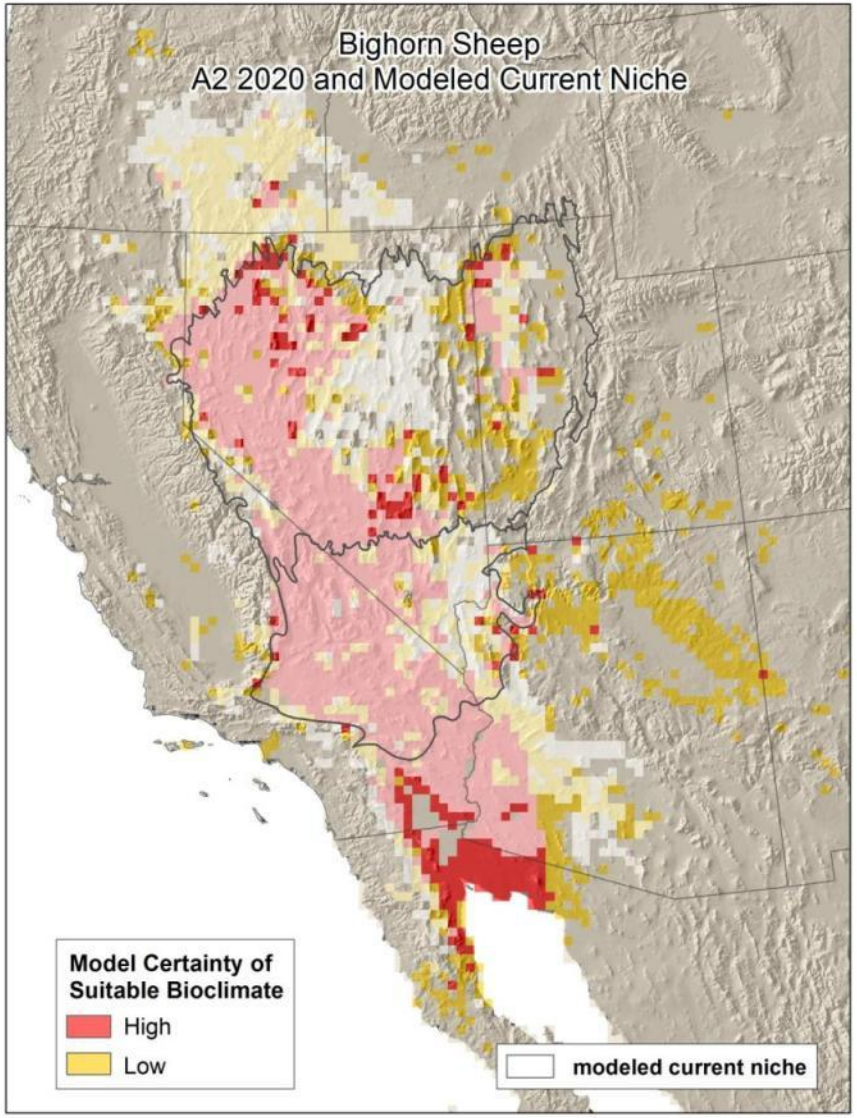

Bighorn Sheep
Modeled Current Bioclimatic Niche
Point locality
Modeled Current Niche
0
100
200 Miles

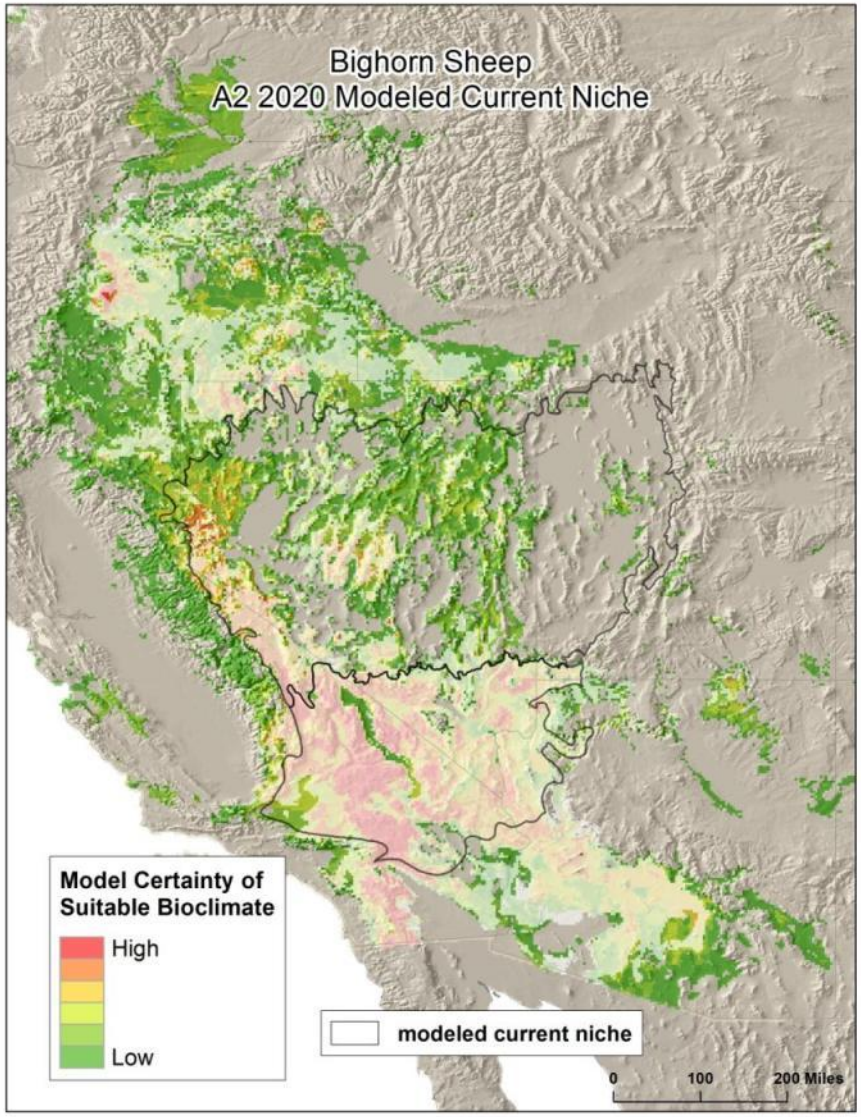

Bighorn Sheep
Modeled Current Bioclimatic Niche
Known distribution (NatureServe)
Modeled Current Niche

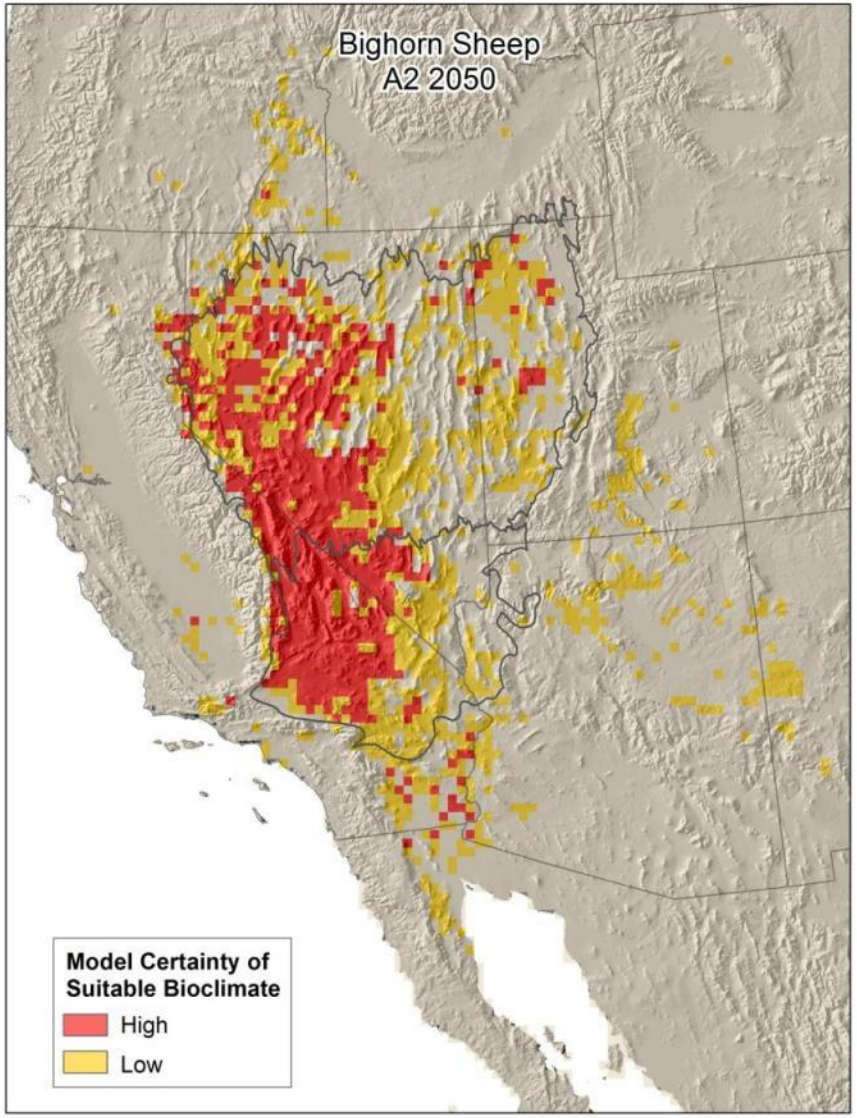

Bighorn Sheep
Modeled Current Bioclimatic Niche
Known distribution (NatureServe)
Modeled Current Niche
0
100
200 Miles

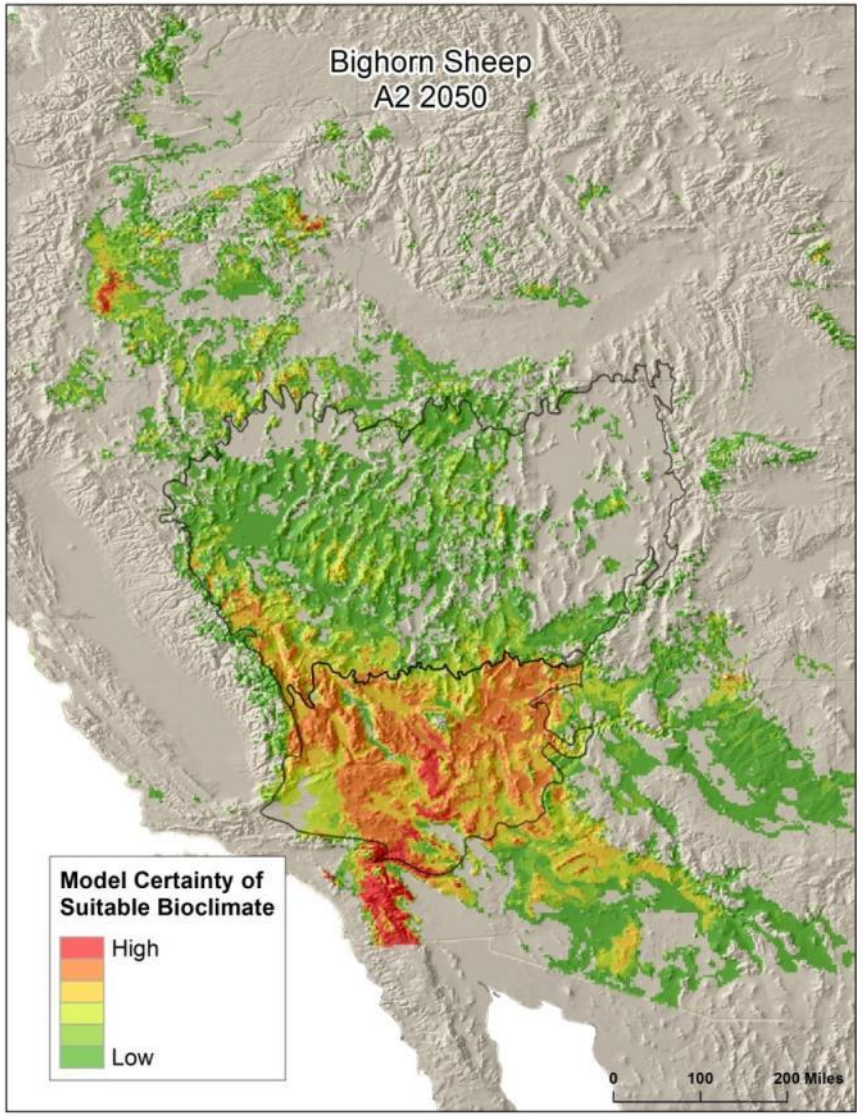

Bighorn Sheep
A2 2020
Model Certainty of
Suitable Bioclimate
High
Low

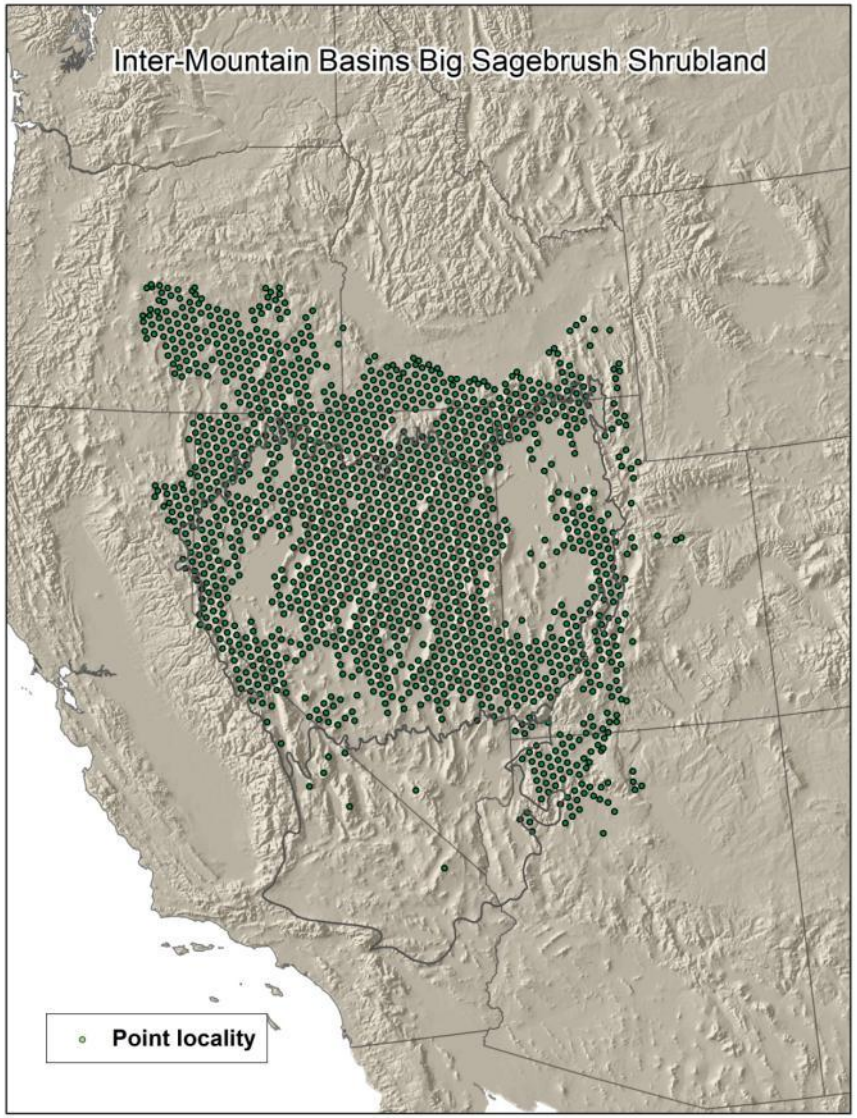

Bighorn Sheep
A2 2020
Model Certainty of
Suitable Bioclimate
High
Low
0
100
200 Miles

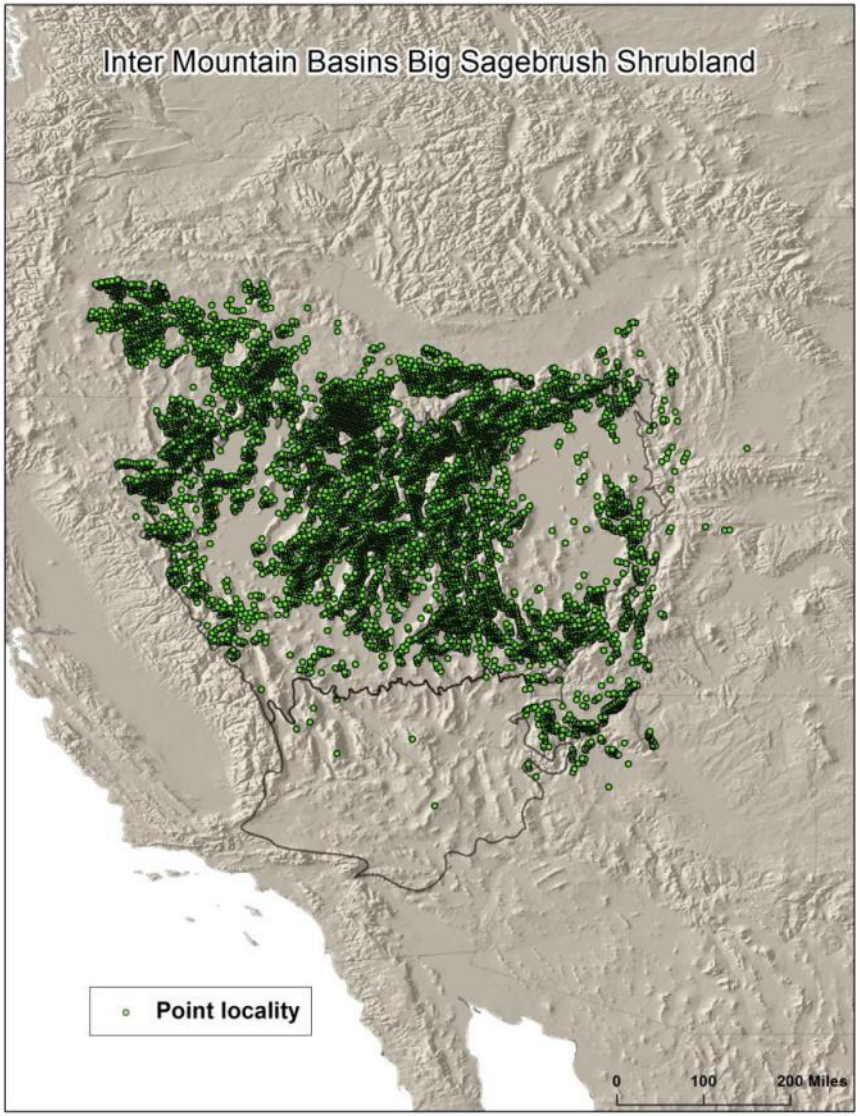

Bighorn Sheep
A2 2020 and Modeled Current Niche
Model Certainty of Suitable Bioclimate
High
Low
modeled current niche

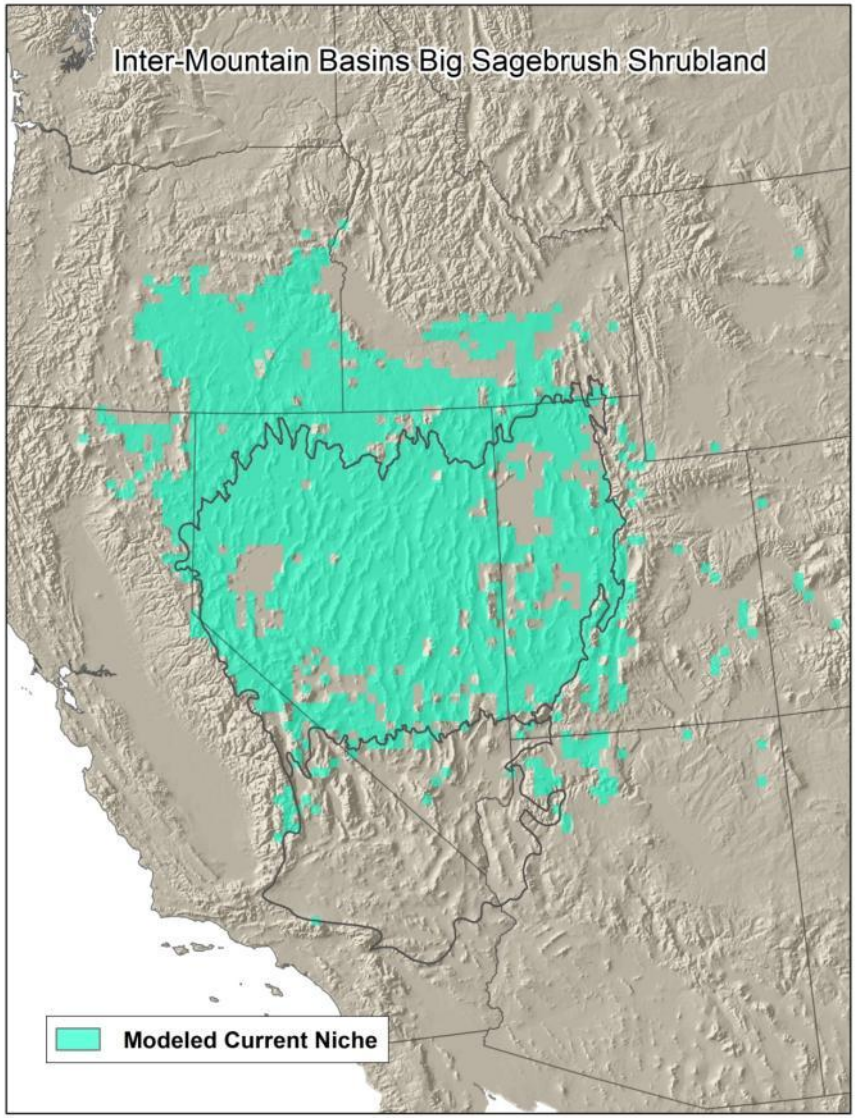

Bighorn Sheep
A2 2020 Modeled Current Niche
Model Certainty of Suitable Bioclimate
High
Low
modeled current niche
0
100
200 Miles

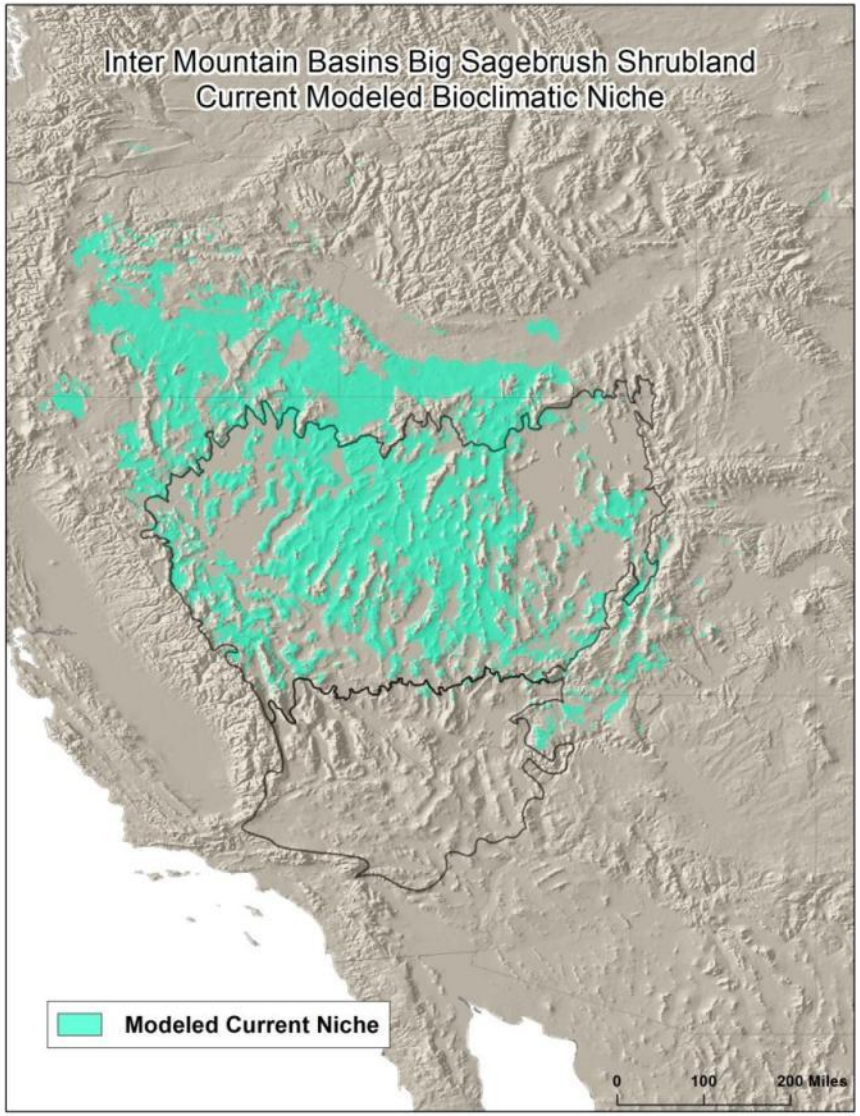

Bighorn Sheep
A2 2050
Model Certainty of
Suitable Bioclimate
High
Low


Bighorn Sheep
A2 2050
Model Certainty of
Suitable Bioclimate
High
Low
0
100
200 Miles


Inter-Mountain Basins Big Sagebrush Shrubland
Point locality

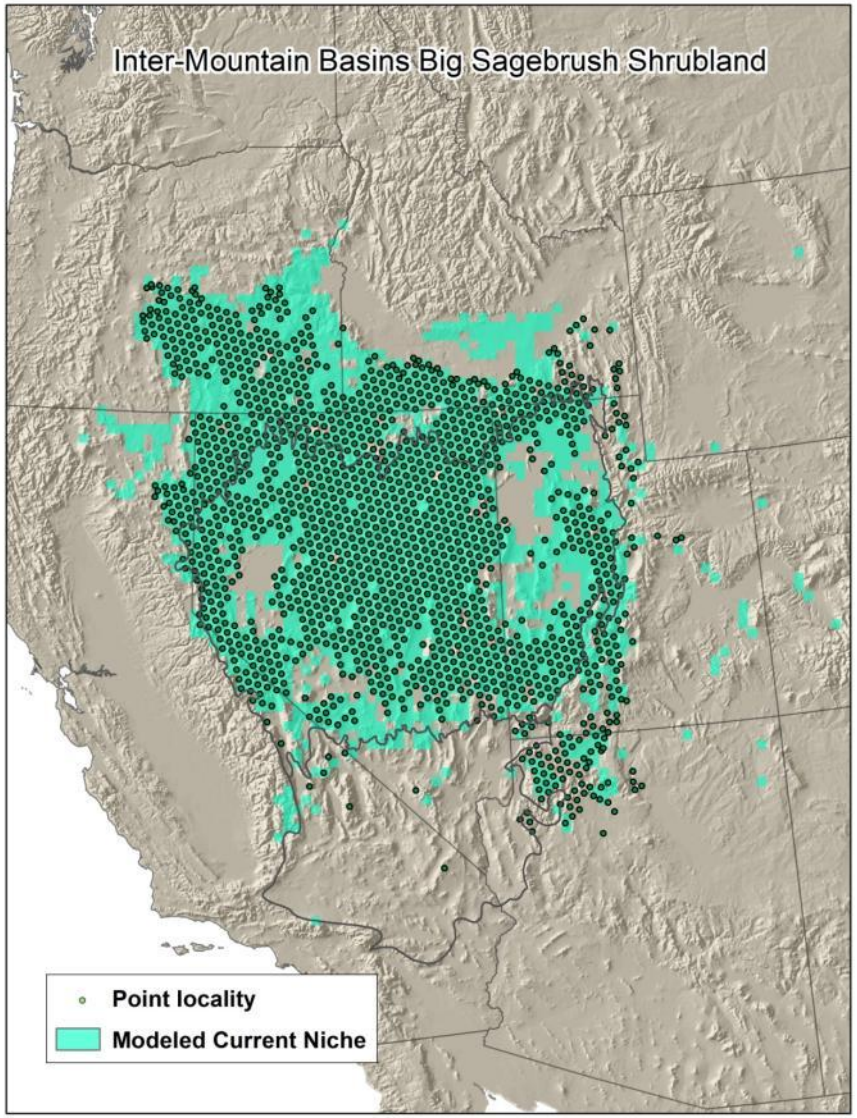

Inter Mountain Basins Big Sagebrush Shrubland
Point locality
0
100
200 Miles

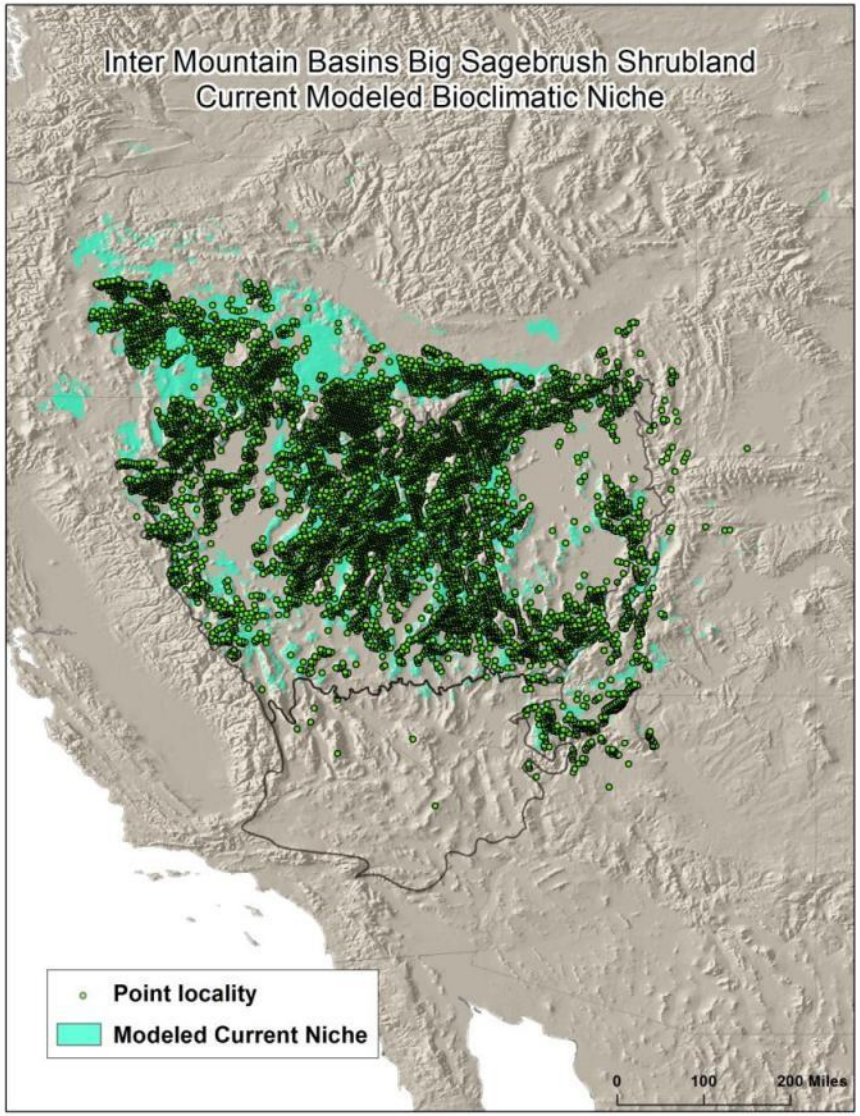


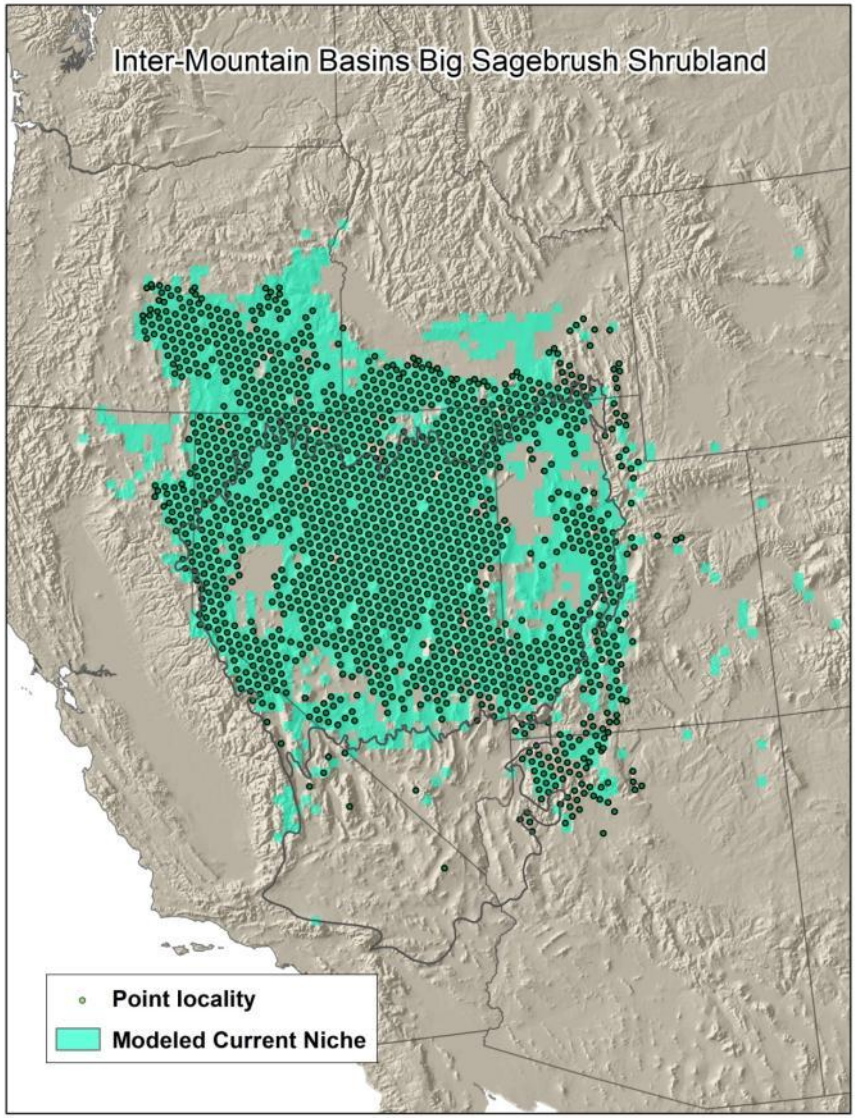


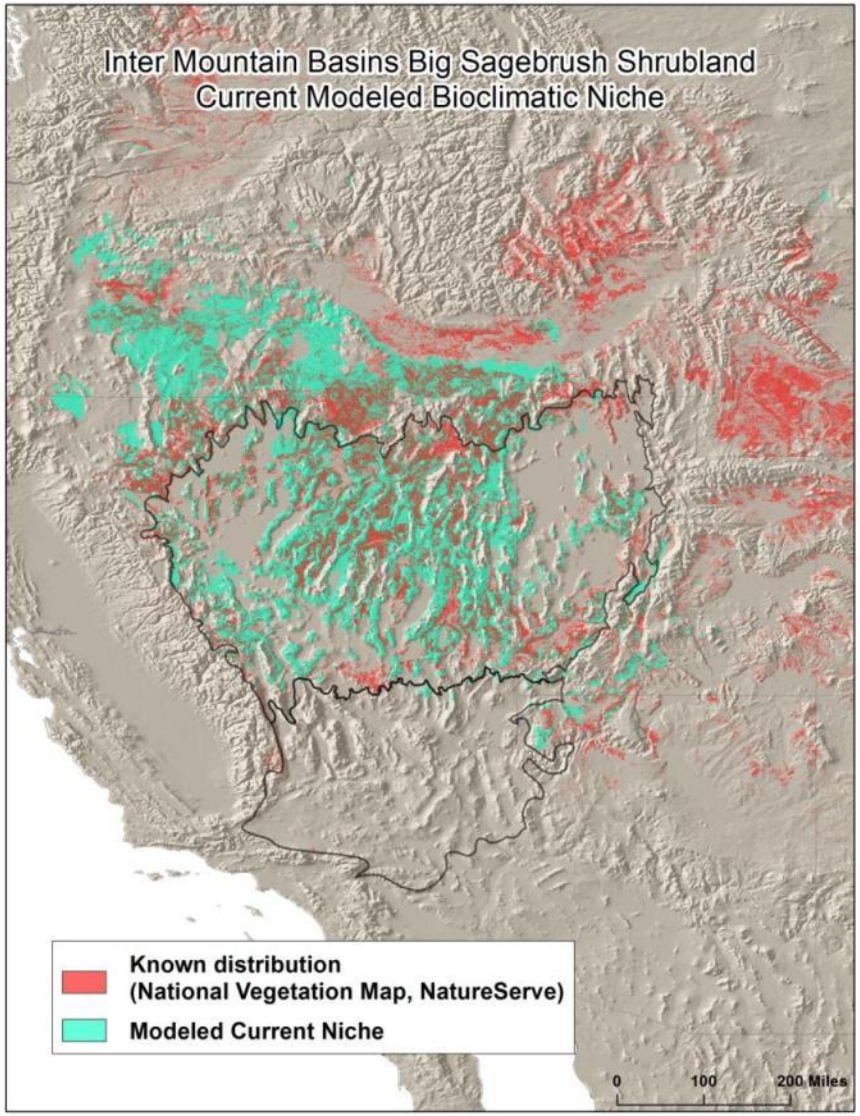
BLM

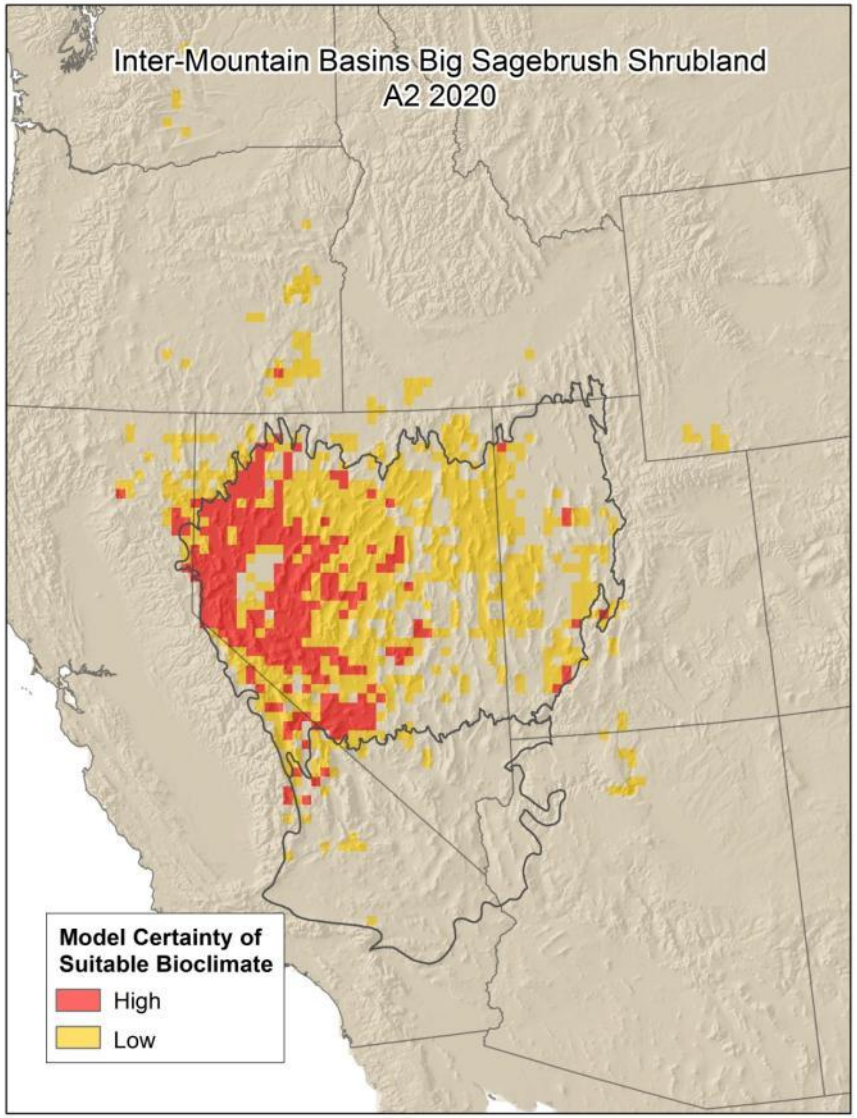
Rapid Ecoregional Assessment

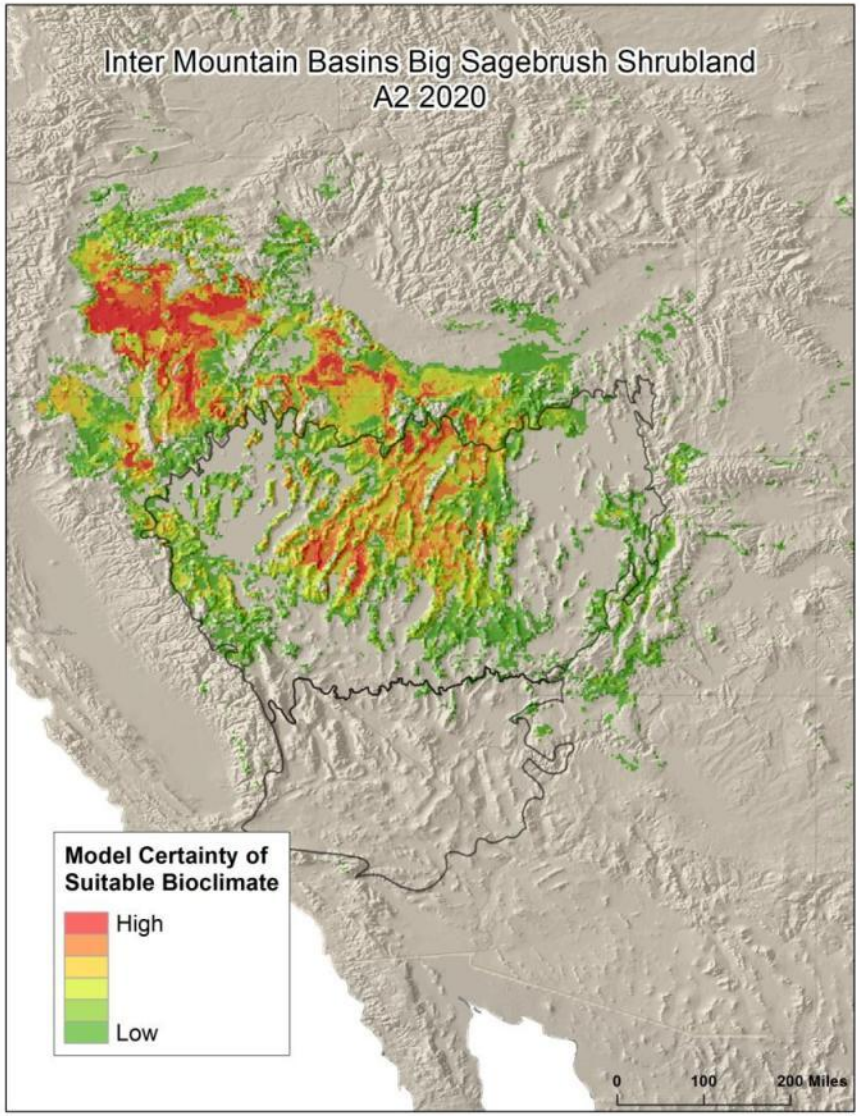

Inter-Mountain Basins Big Sagebrush Shrubland
Point locality
Modeled Current Niche


Inter Mountain Basins Big Sagebrush Shrubland
Current Modeled Bioclimatic Niche
Point locality
Modeled Current Niche
0
100
200 Miles

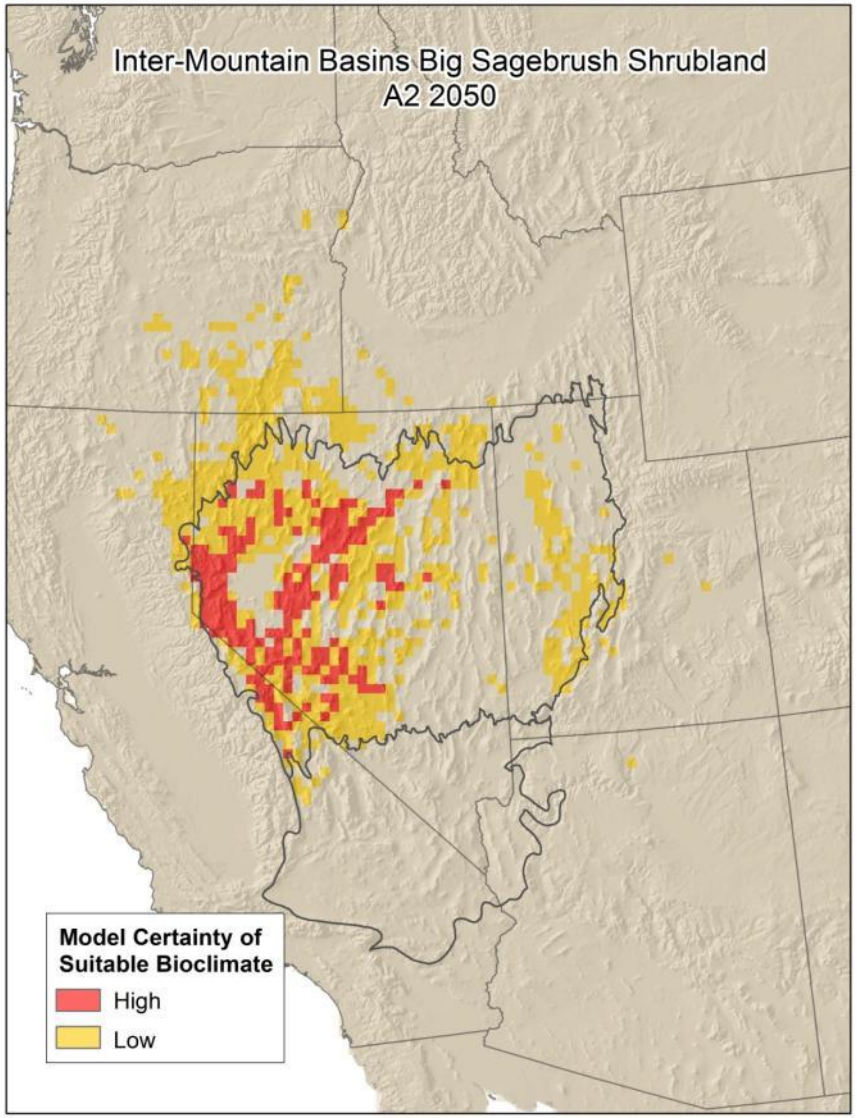

Inter-Mountain Basins Big Sagebrush Shrubland
Point locality
Modeled Current Niche

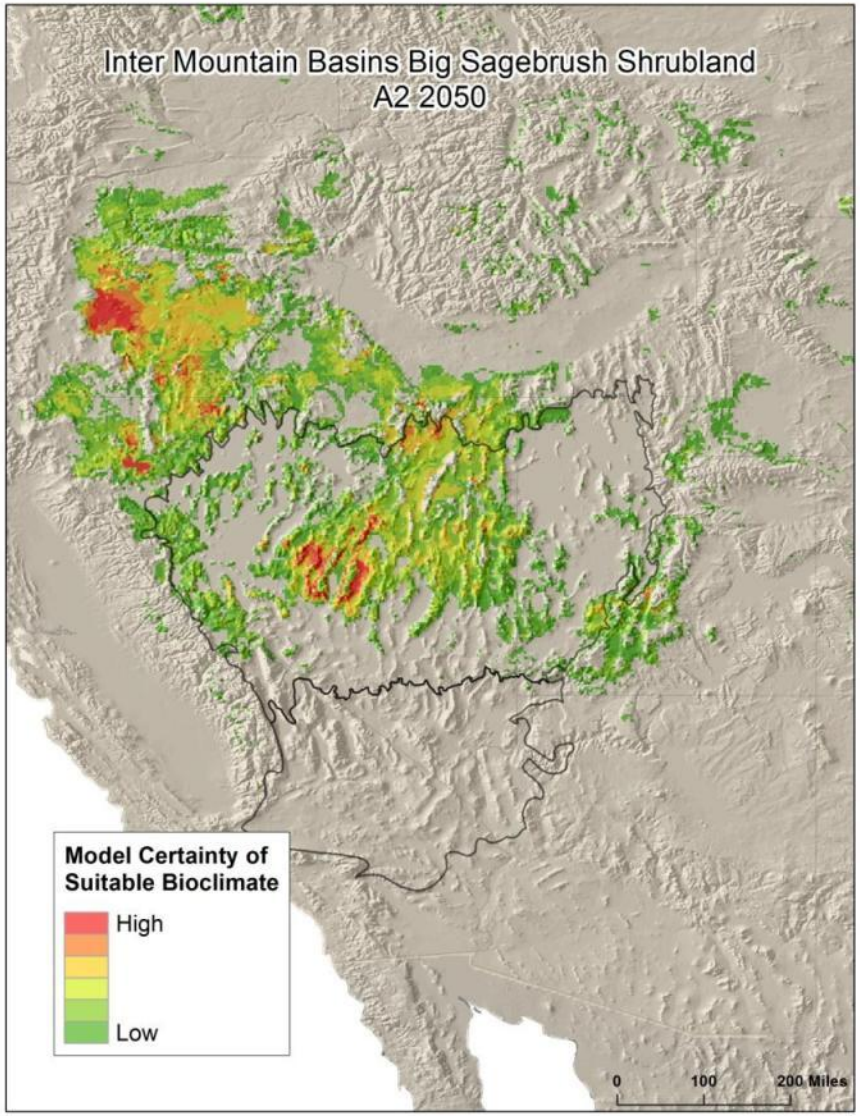

Inter Mountain Basins Big Sagebrush Shrubland
Current Modeled Bioclimatic Niche
Known distribution
(National Vegetation Map, NatureServe)
Modeled Current Niche
0
100
200 Miles





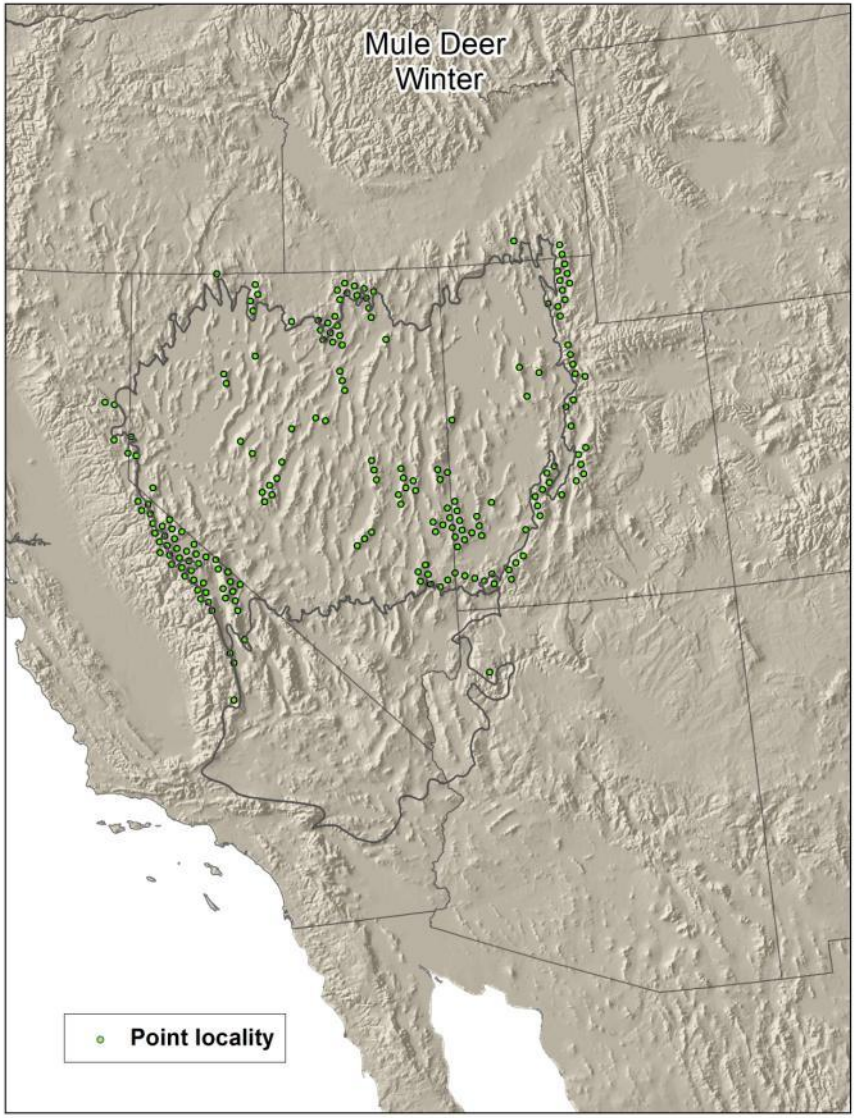
BLM
Rapid Ecoregional Assessment

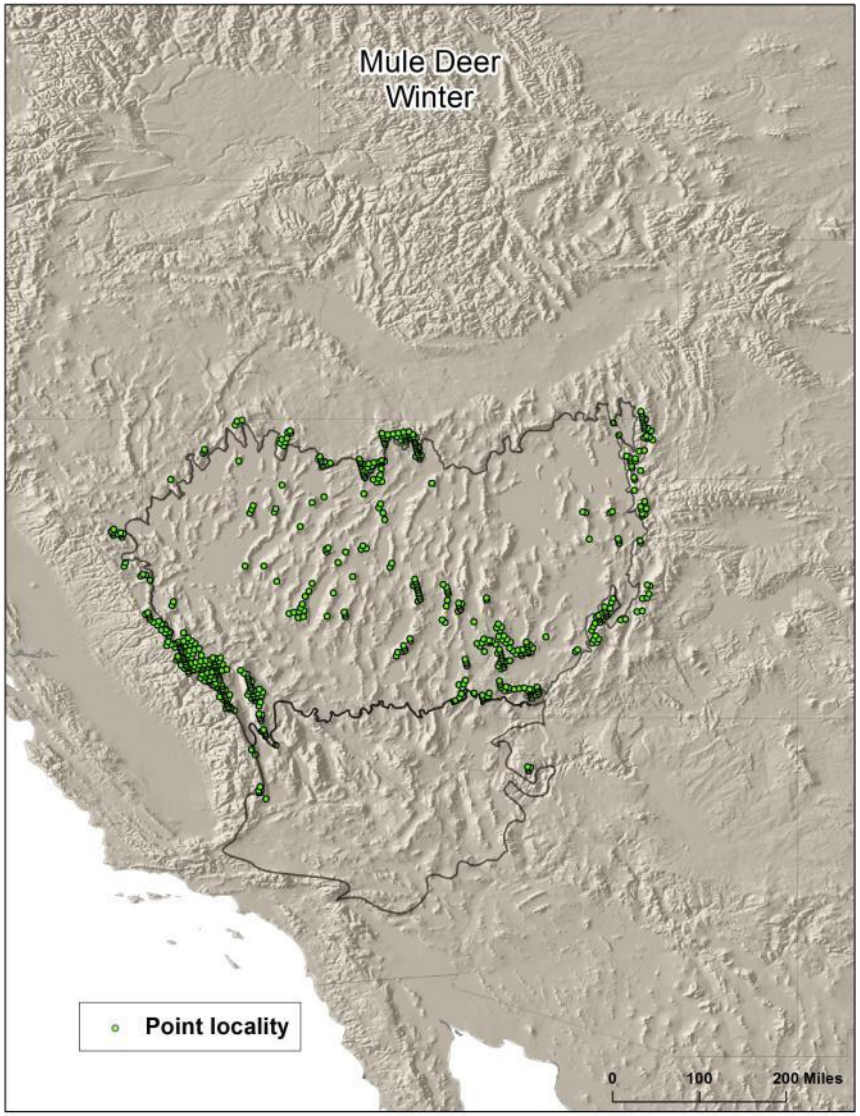


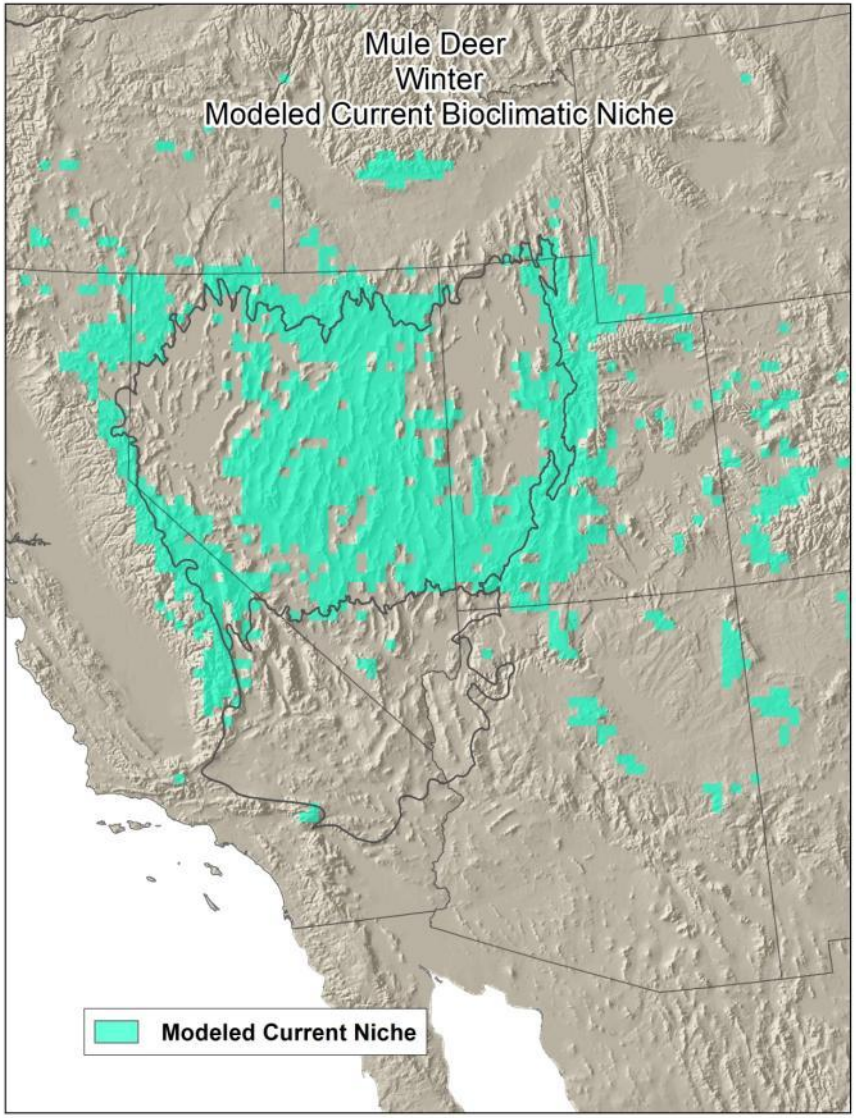


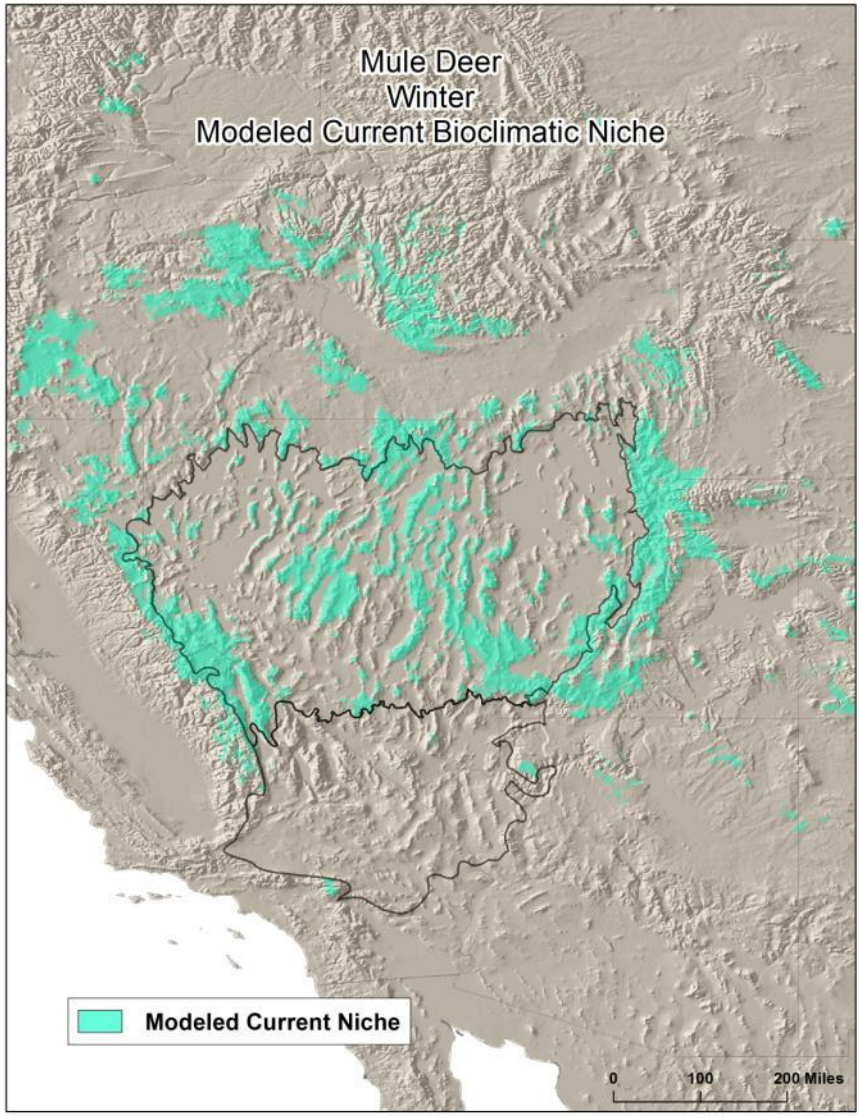
BLM

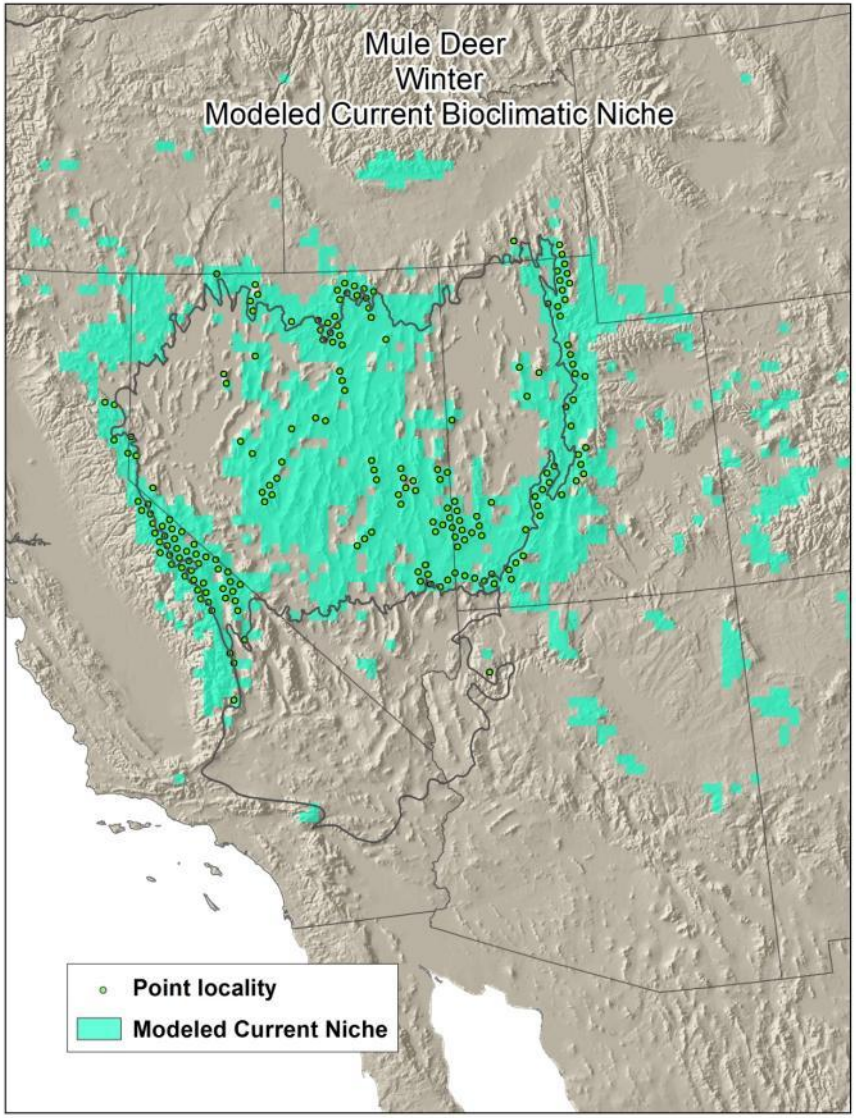
Rapid Ecoregional Assessment

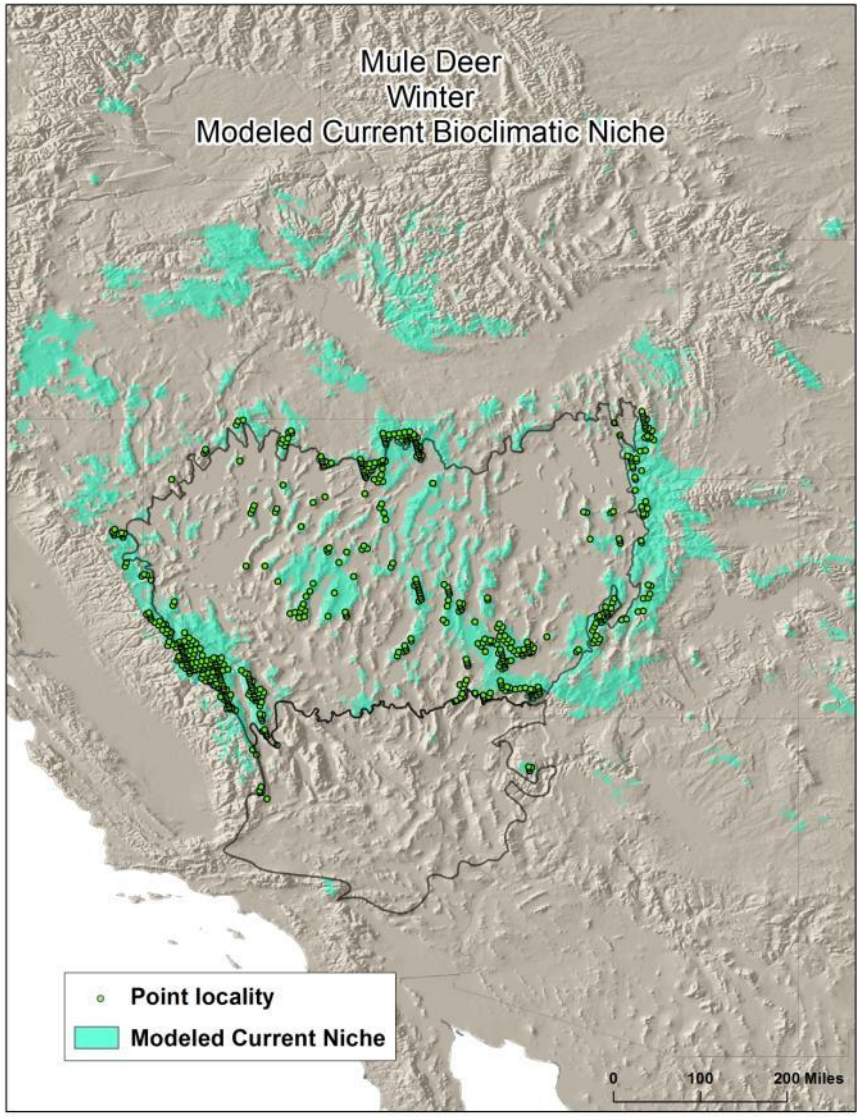

Mule Deer
Winter
Point locality

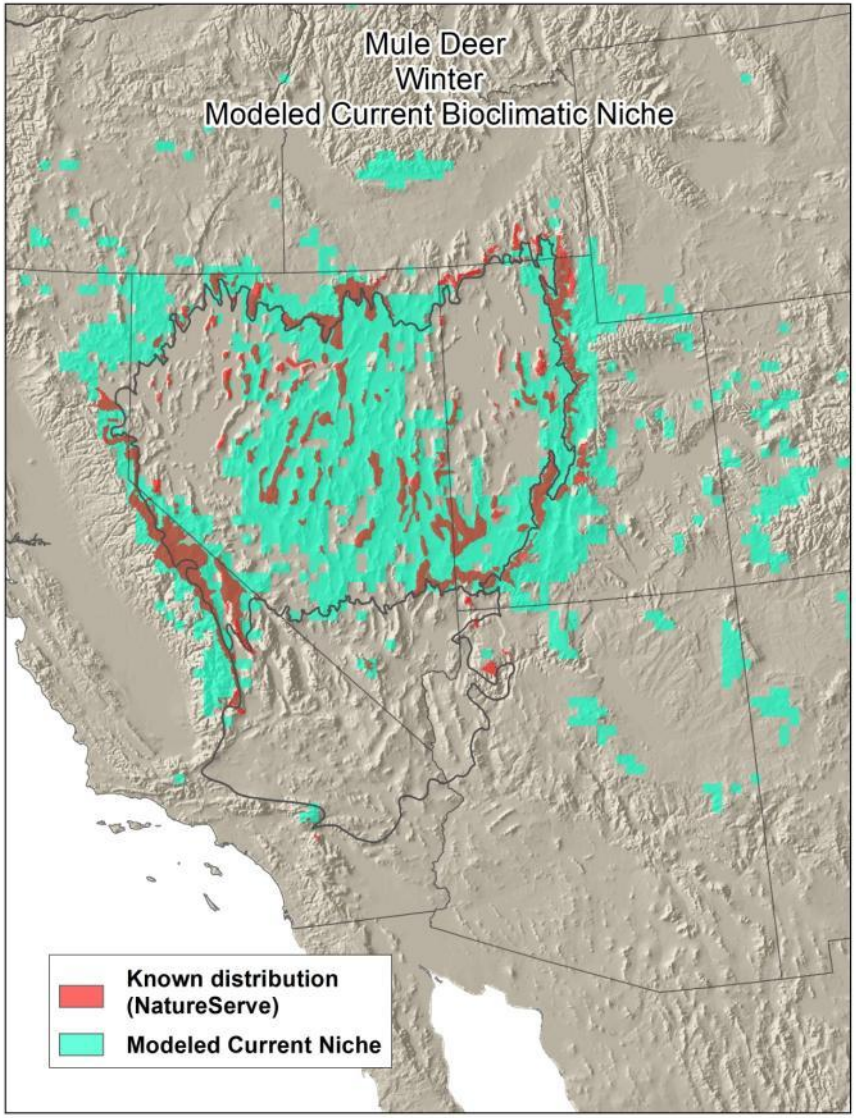

Mule Deer
Winter
Point locality
0
100
200 Miles

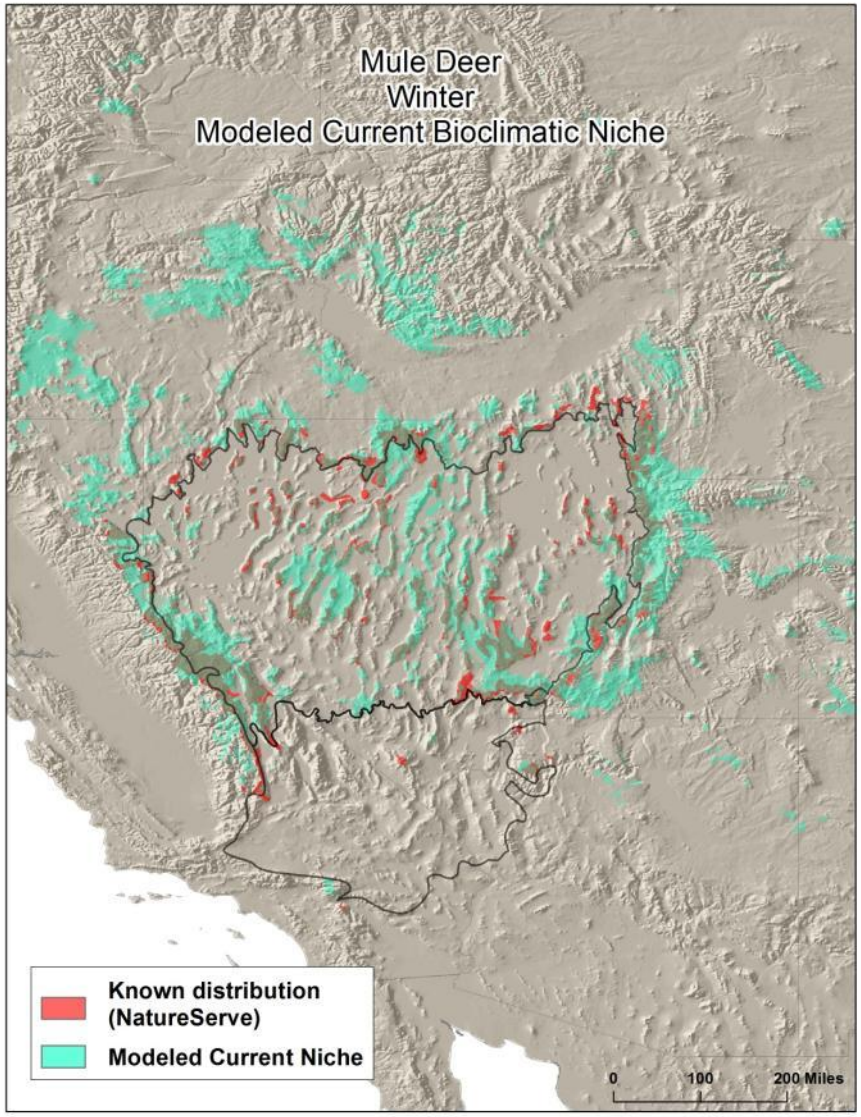

Mule Deer
Winter
Modeled Current Bioclimatic Niche
Modeled Current Niche

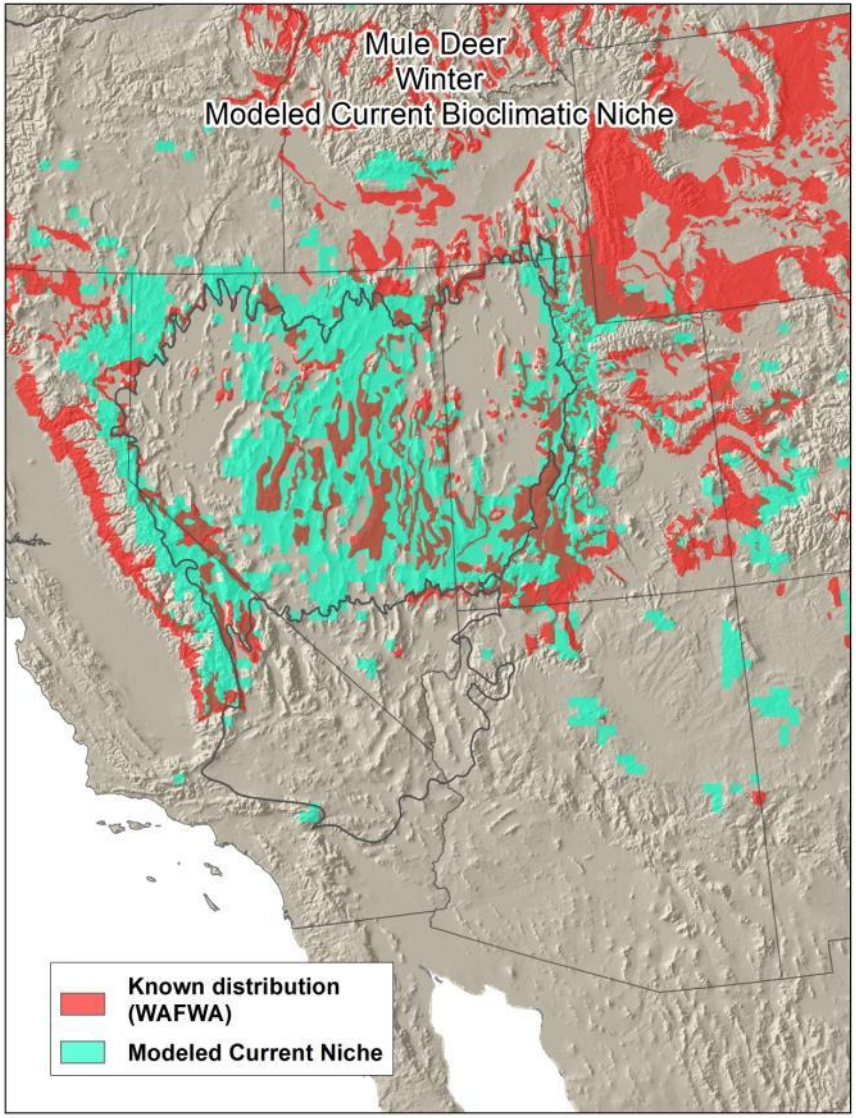

Mule Deer
Winter
Modeled Current Bioclimatic Niche
Modeled Current Niche
0
100
200 Miles

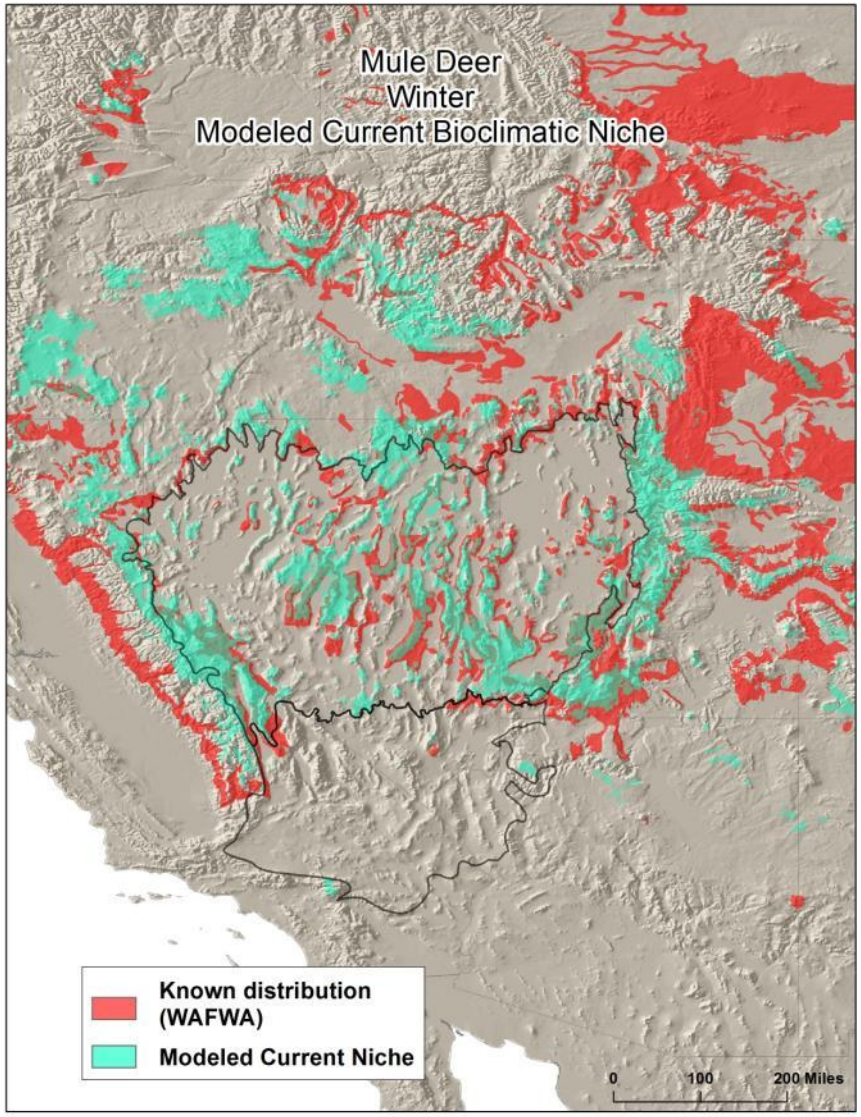

Mule Deer
Winter
Modeled Current Bioclimatic Niche
Point locality
Modeled Current Niche

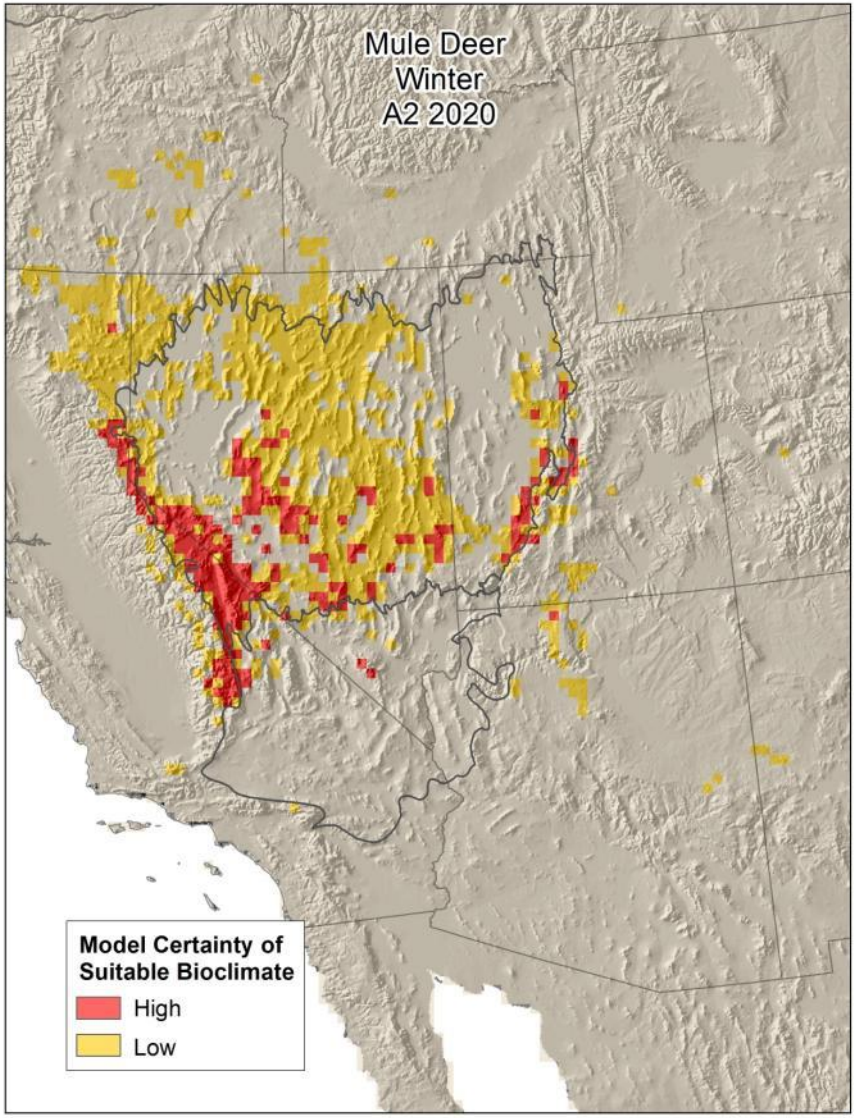

Mule Deer
Winter
Modeled Current Bioclimatic Niche
Point locality
Modeled Current Niche
0
100
200 Miles

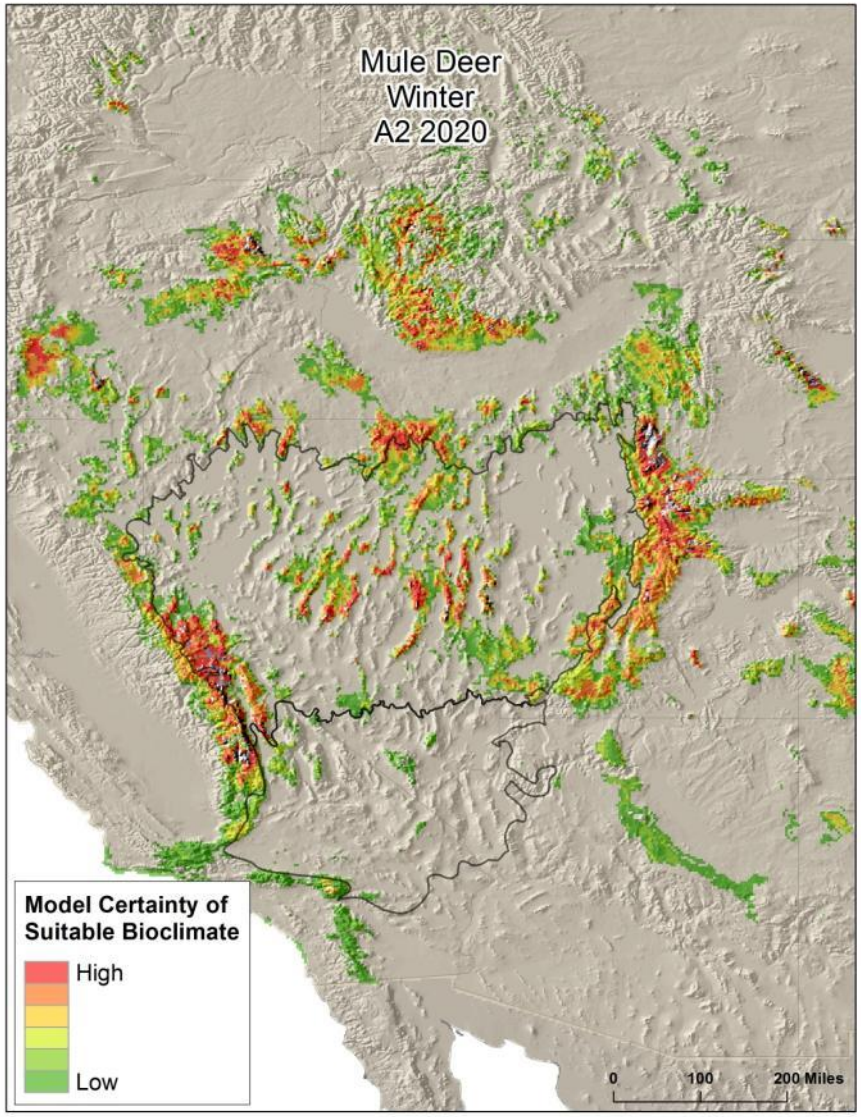

Mule Deer
Winter
Modeled Current Bioclimatic Niche
Known distribution
(NatureServe)
Modeled Current Niche

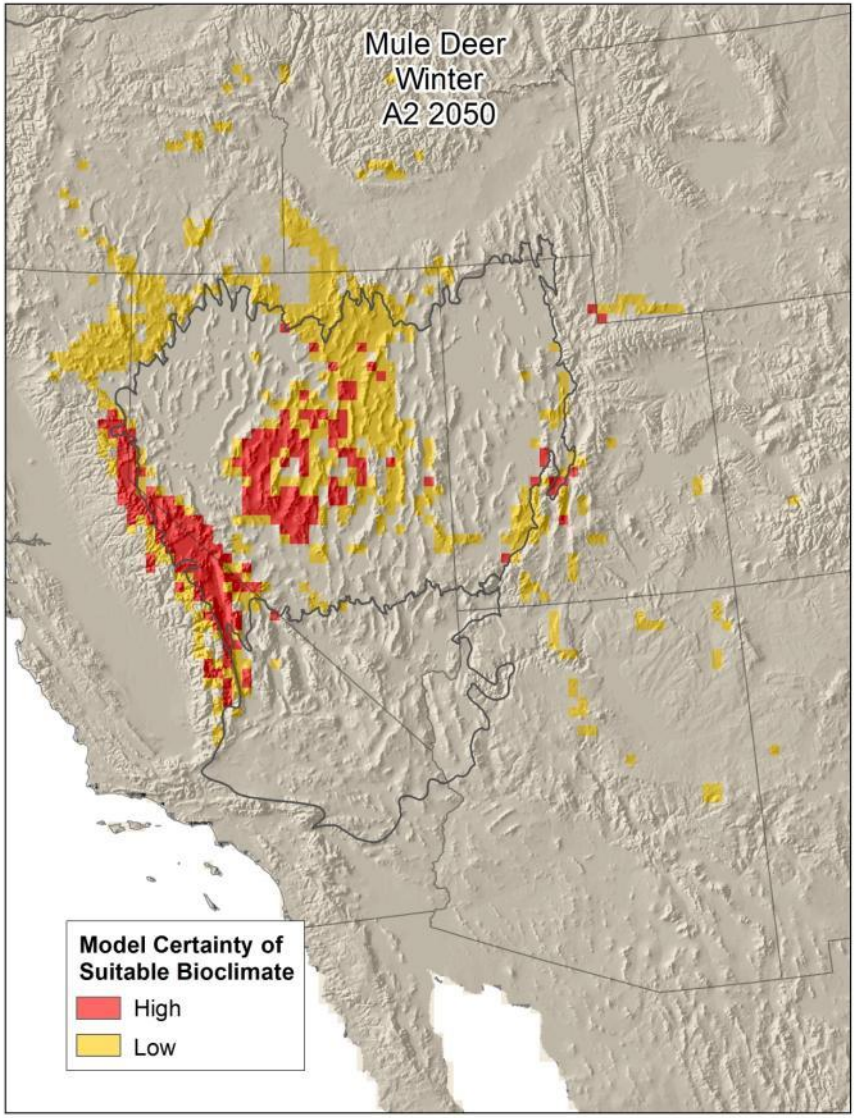

Mule Deer
Winter
Modeled Current Bioclimatic Niche
Known distribution
(NatureServe)
Modeled Current Niche
0
100
200 Miles

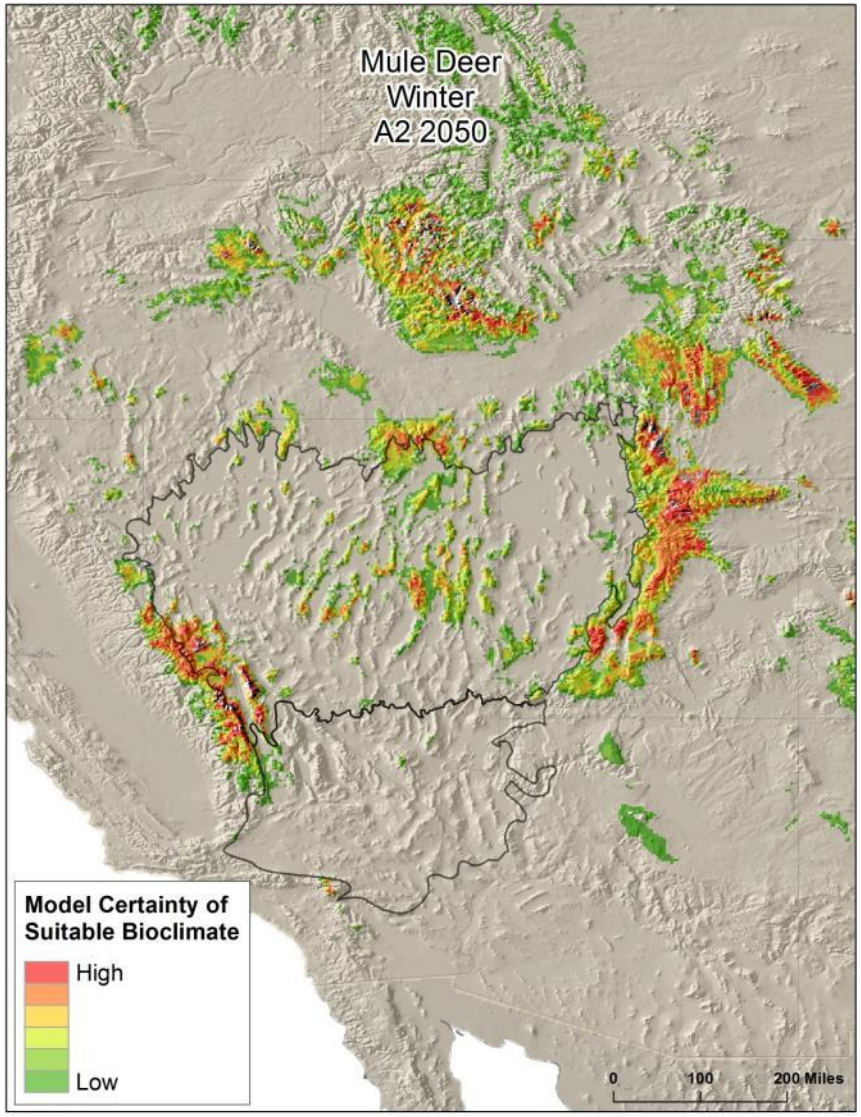

Mule Deer
Winter
Modeled Current Bioclimatic Niche
Known distribution (WAFWA)
Modeled Current Niche

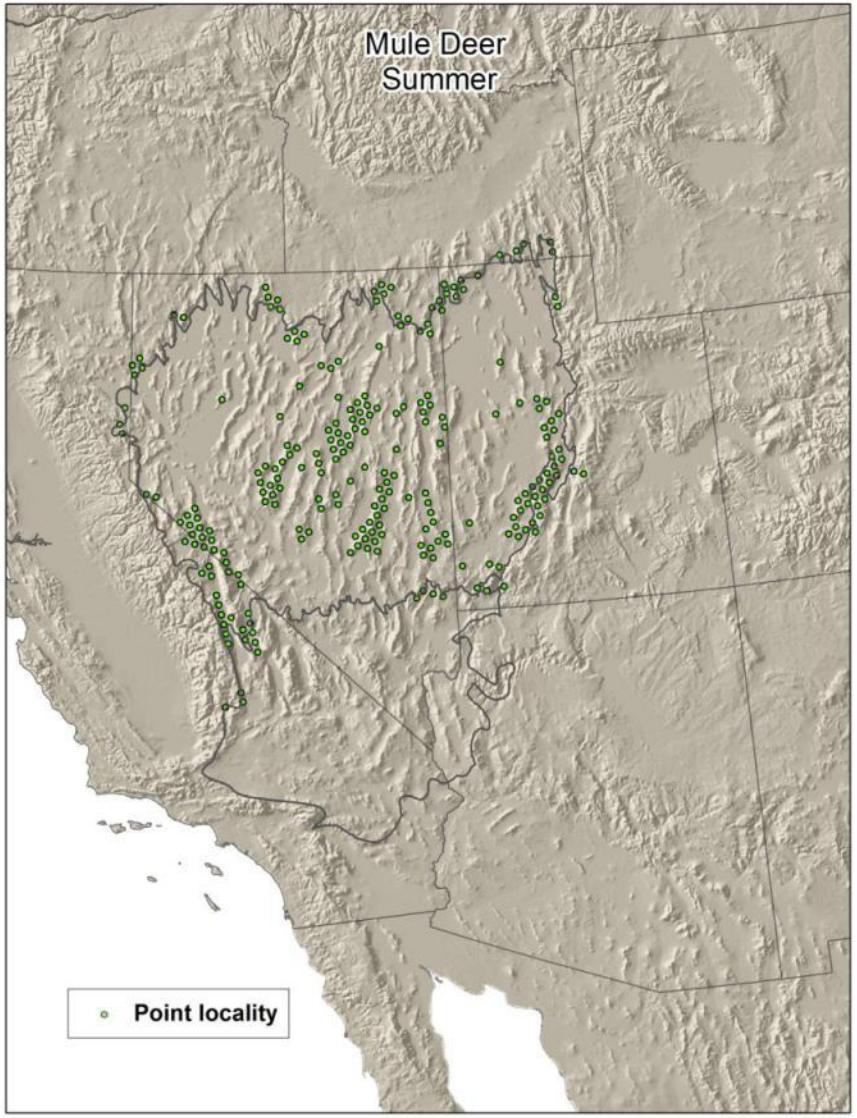

Mule Deer
Winter
Modeled Current Bioclimatic Niche
Known distribution (WAFWA)
Modeled Current Niche
0
100
200 Miles

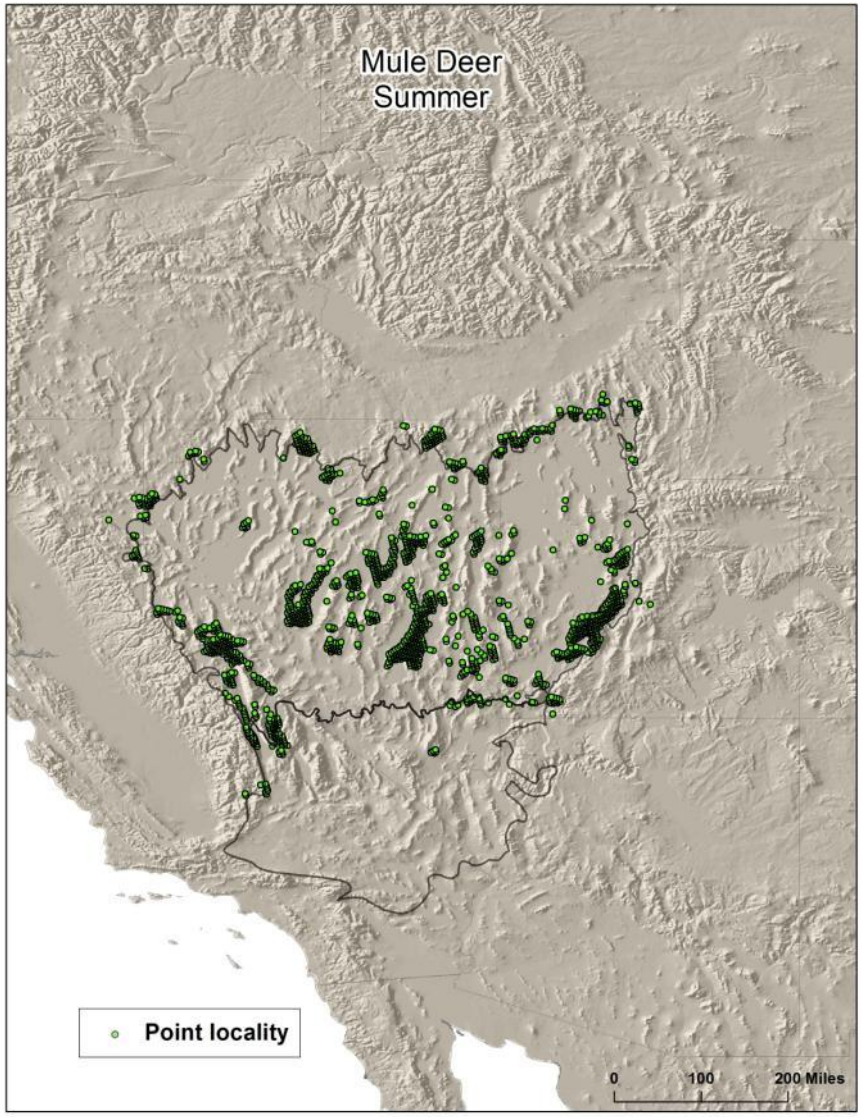

Mule Deer
Winter
A2 2020
Model Certainty of
Suitable Bioclimate
High
Low

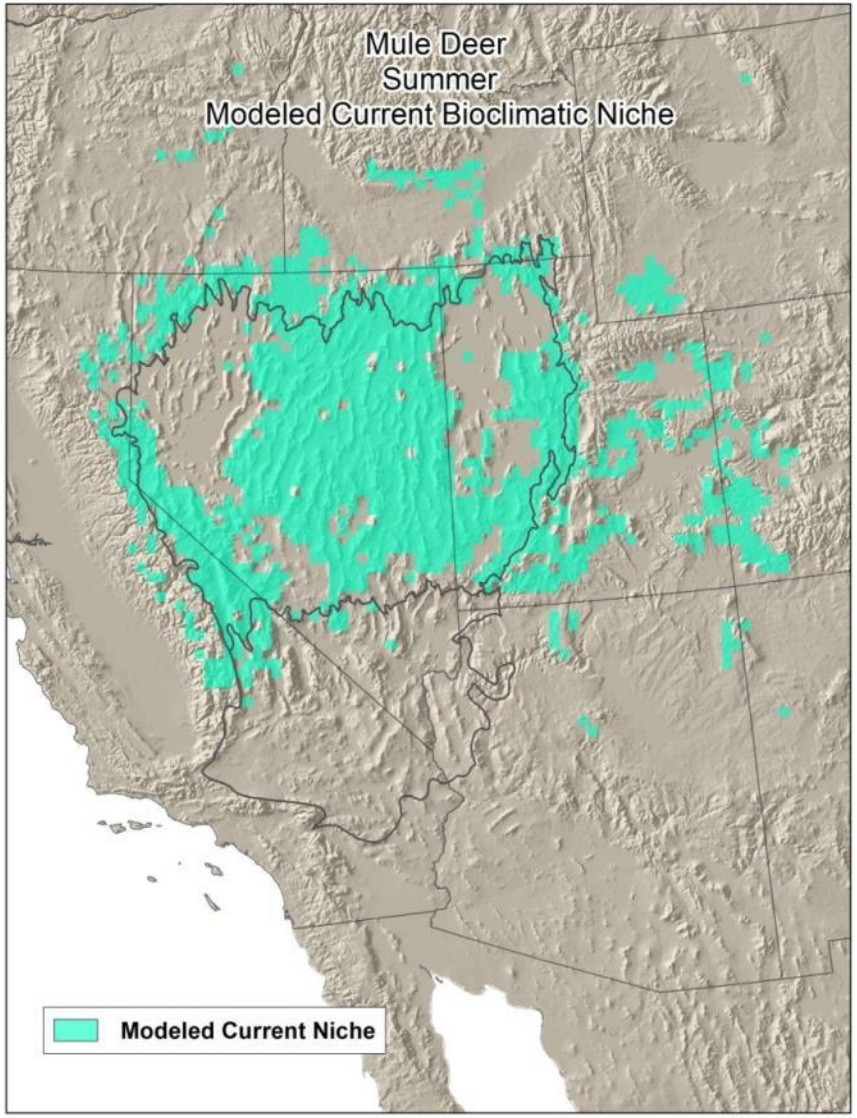

Mule Deer
Winter
A2 2020
Model Certainty of
Suitable Bioclimate
High
Low
0
100
200 Miles

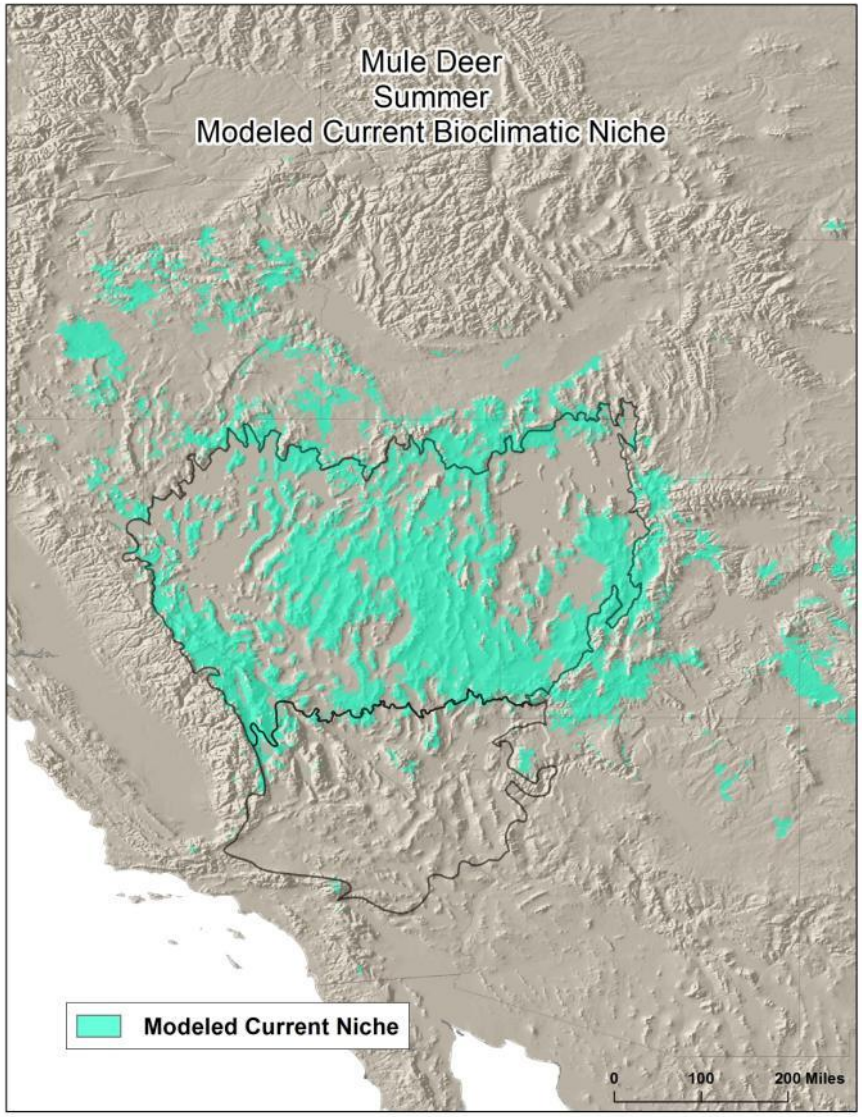

Mule Deer
Winter
A2 2050
Model Certainty of
Suitable Bioclimate
High
Low

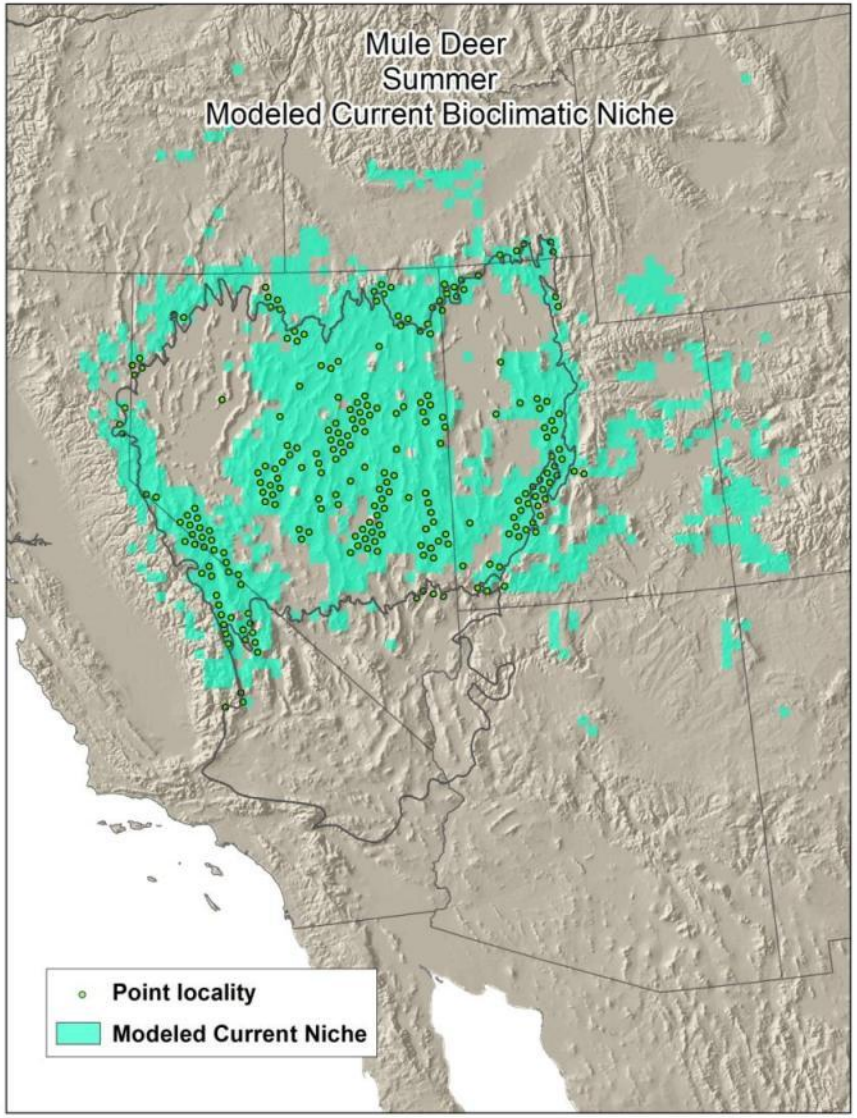

Mule Deer
Winter
A2 2050
Model Certainty of
Suitable Bioclimate
High
Low
0
100
200 Miles

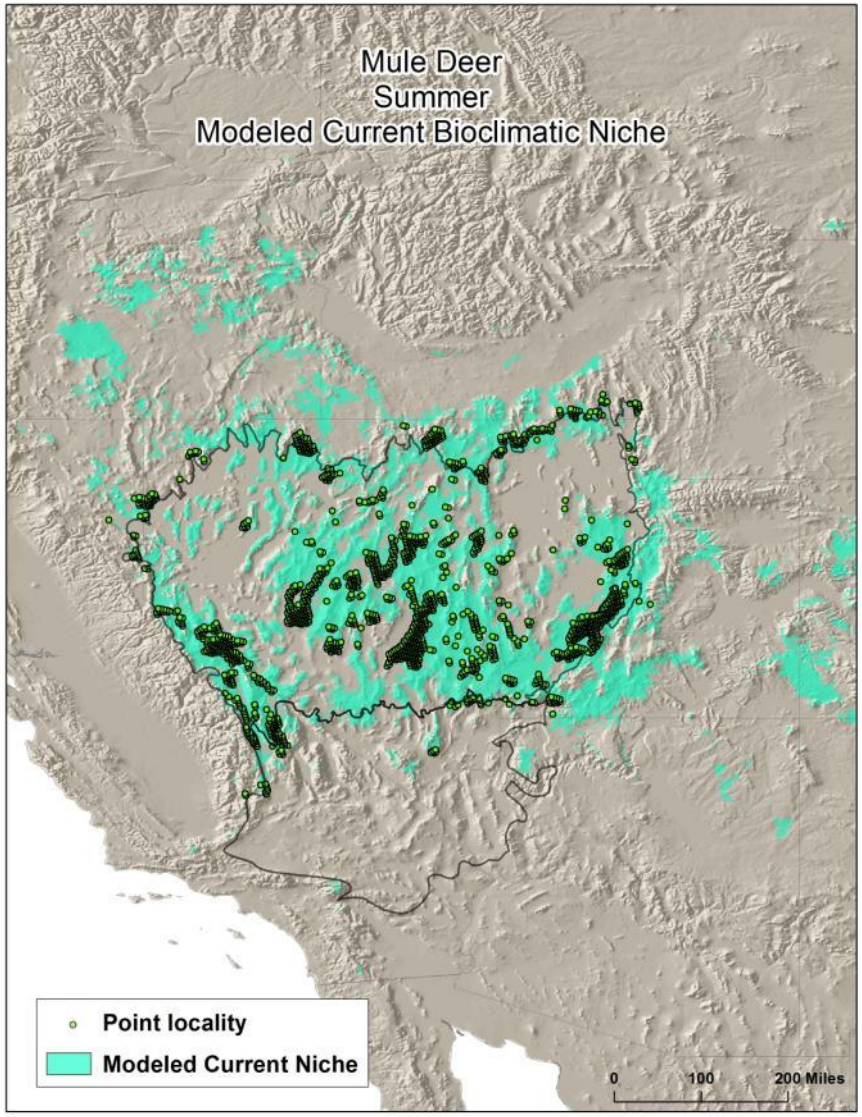

Mule Deer
Summer
Point locality

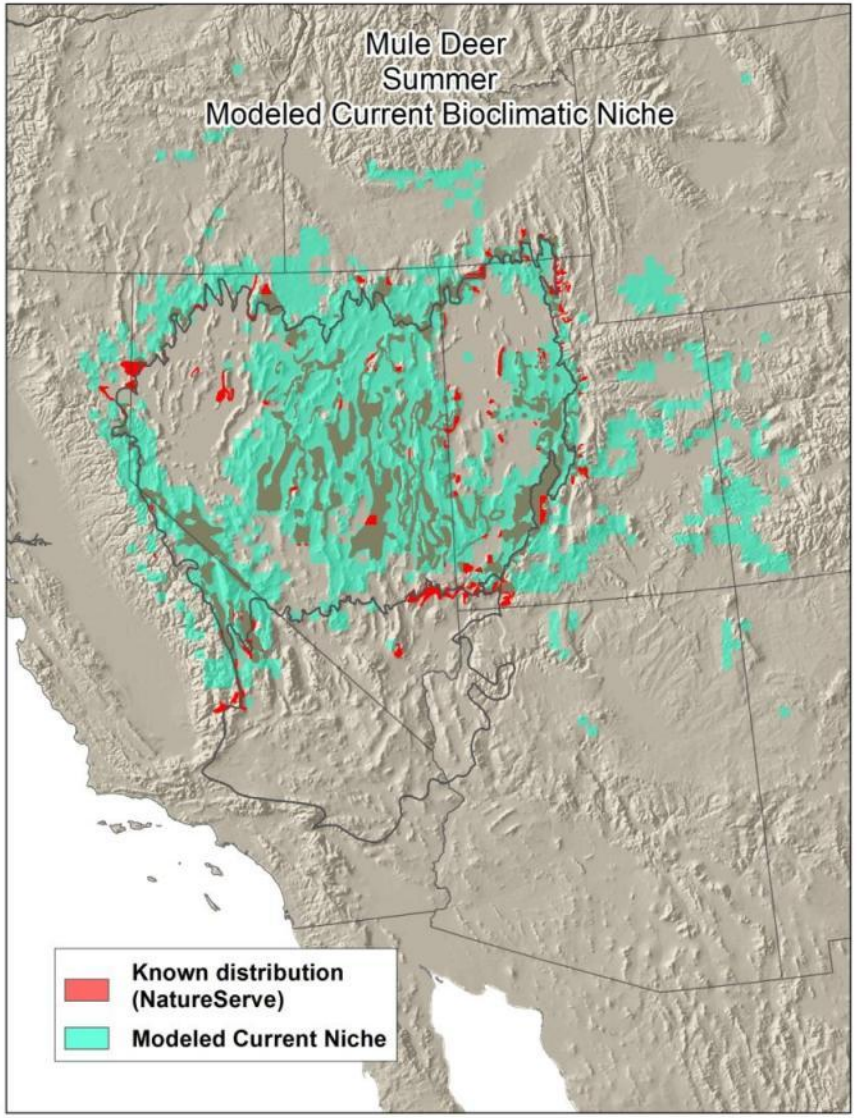

Mule Deer
Summer
Point locality
0
100
200 Miles

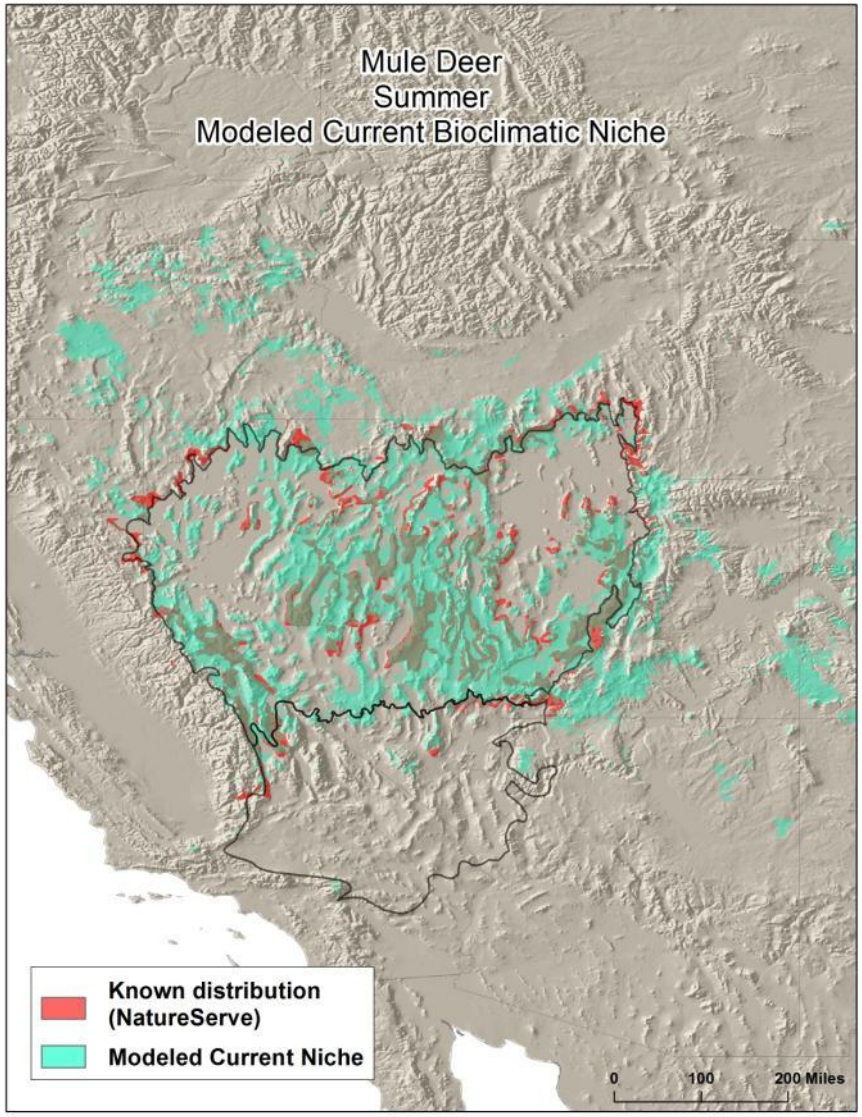

Mule Deer
Summer
Modeled Current Bioclimatic Niche
Modeled Current Niche

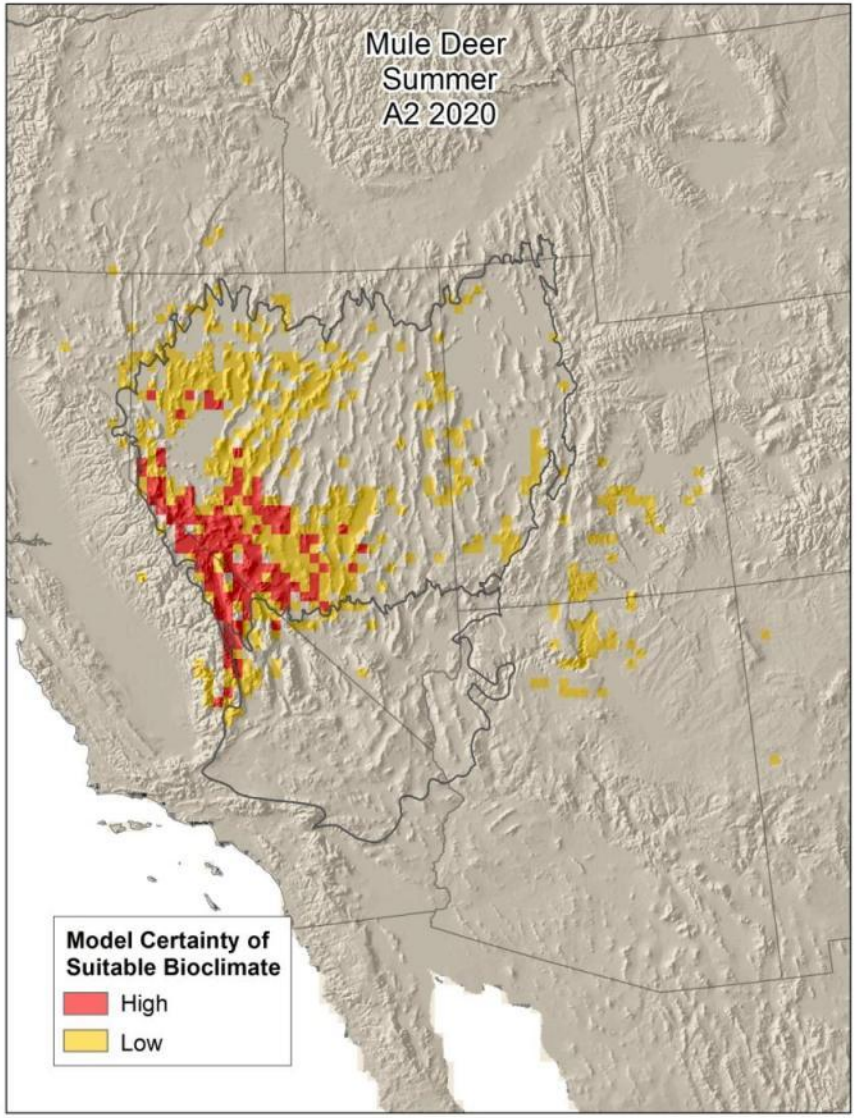

Mule Deer
Summer
Modeled Current Bioclimatic Niche
Modeled Current Niche
0
100
200 Miles

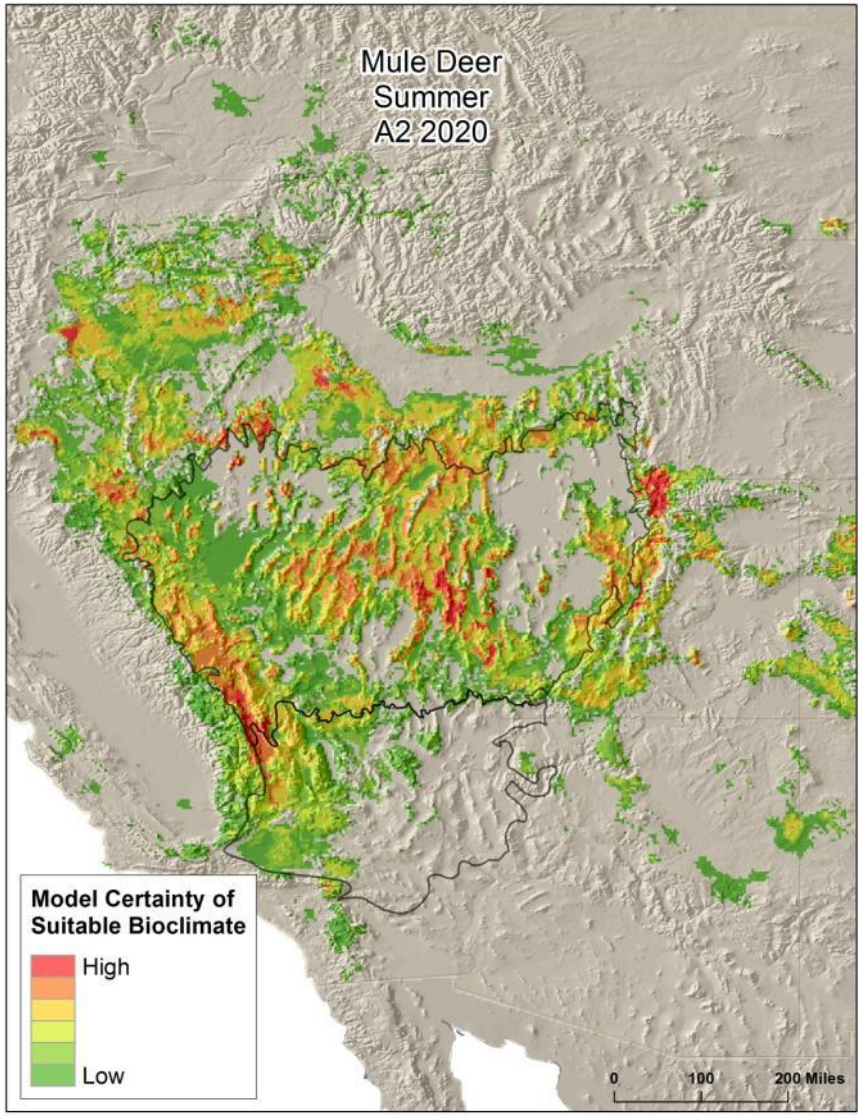

Mule Deer
Summer
Modeled Current Bioclimatic Niche
Point locality
Modeled Current Niche

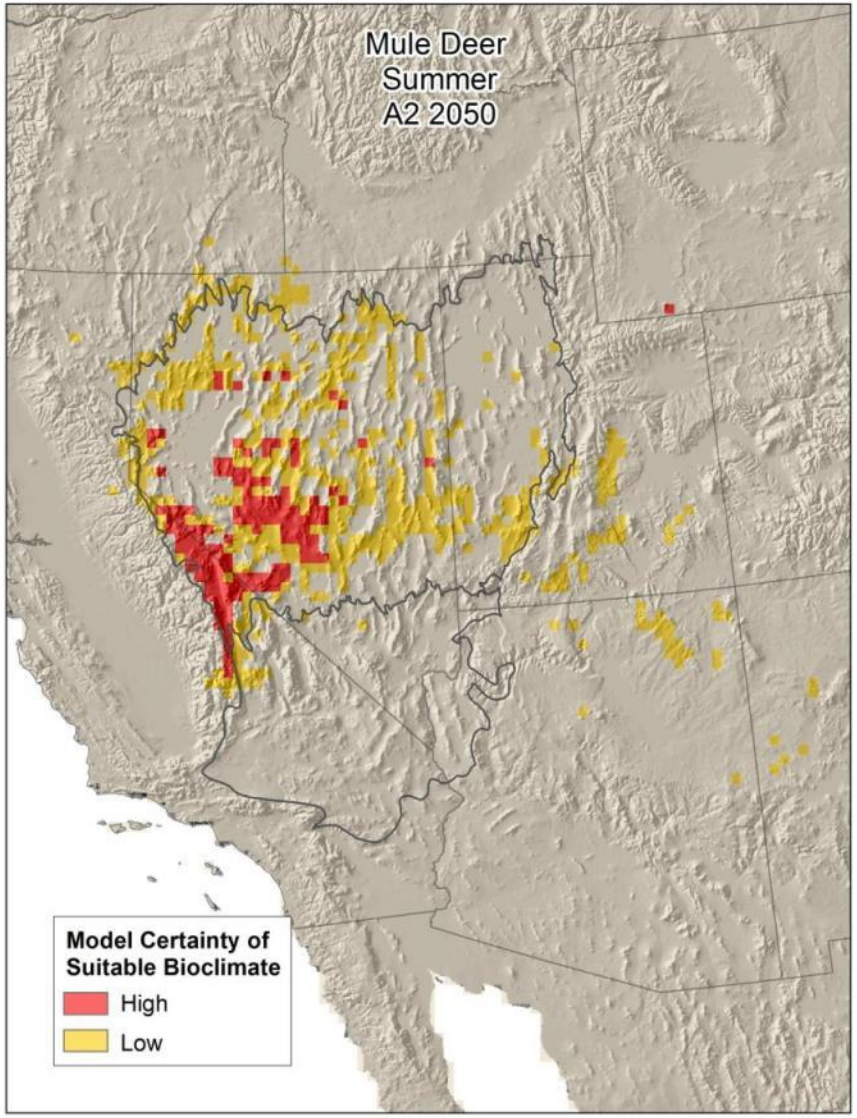

Mule Deer
Summer
Modeled Current Bioclimatic Niche
Point locality
Modeled Current Niche
0
100
200 Miles

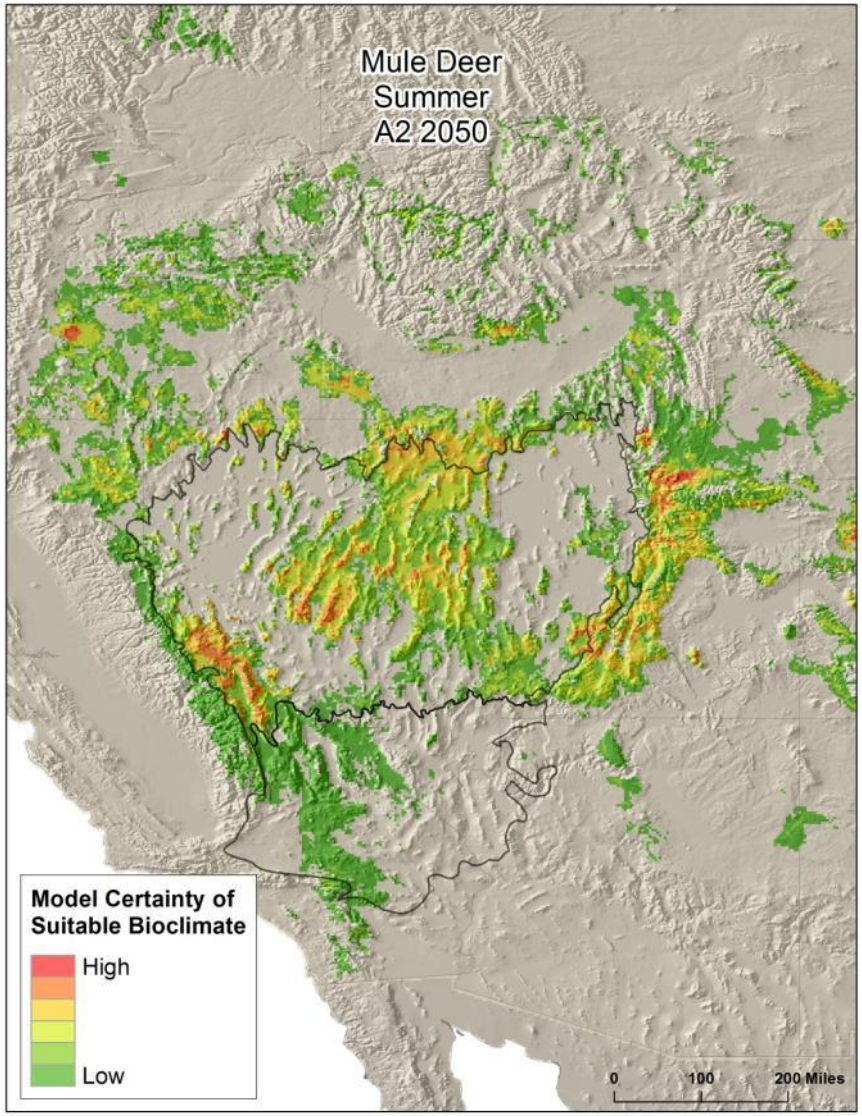

Mule Deer
Summer
Modeled Current Bioclimatic Niche
Known distribution
(NatureServe)
Modeled Current Niche

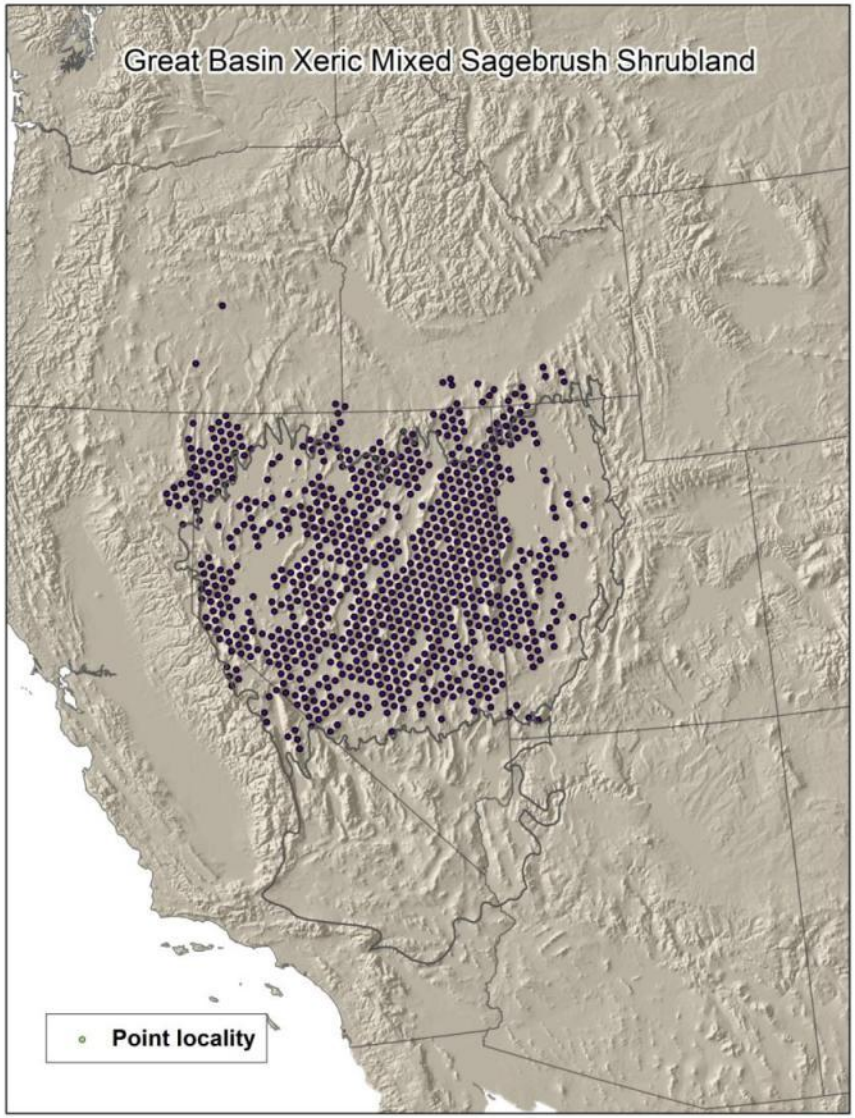

Mule Deer
Summer
Modeled Current Bioclimatic Niche
Known distribution
(NatureServe)
Modeled Current Niche
0
100
200 Miles

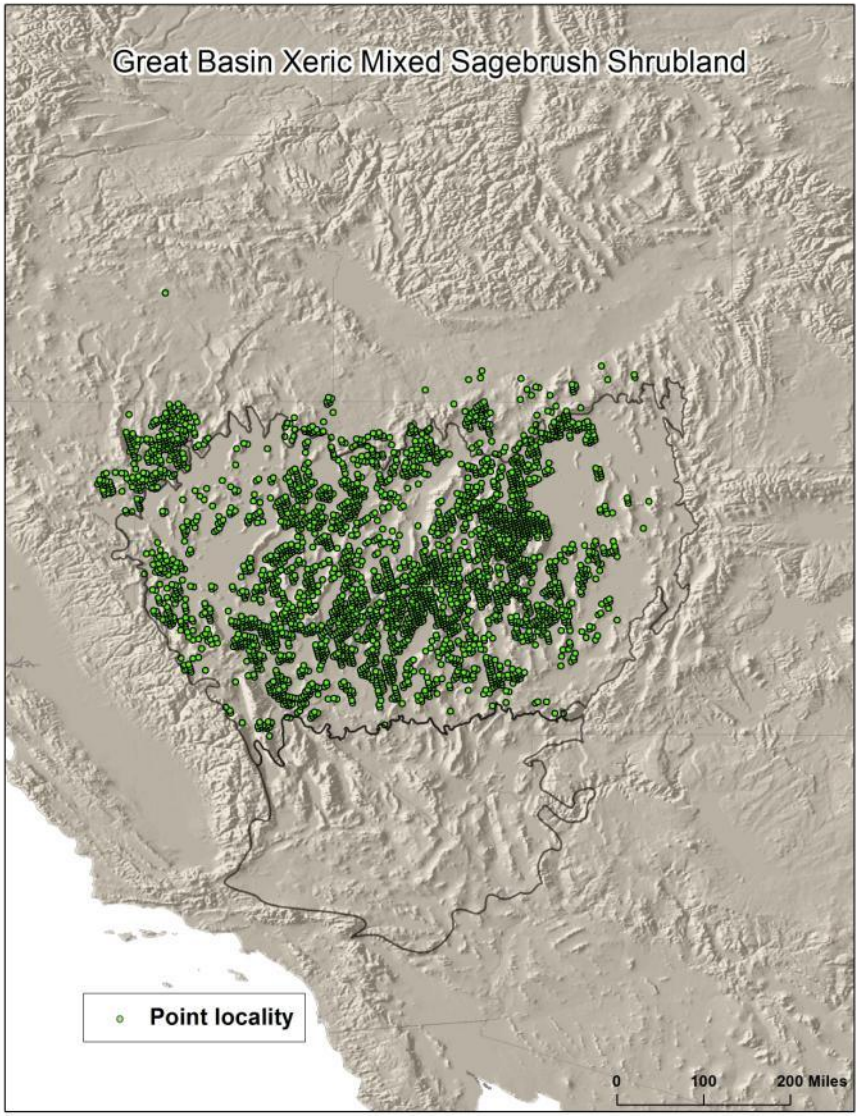

Mule Deer
Summer
A2 2020
Model Certainty of
Suitable Bioclimate
High
Low

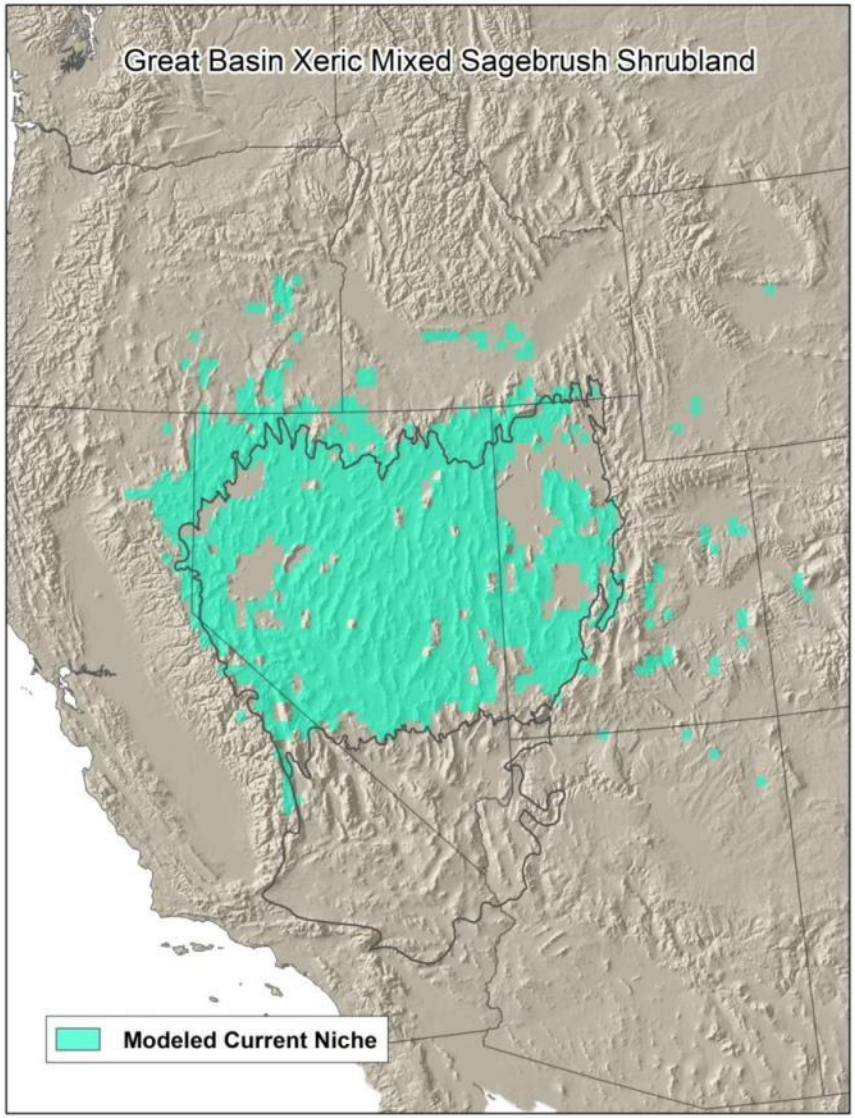

Mule Deer
Summer
A2 2020
Model Certainty of
Suitable Bioclimate
High
Low
0
100
200 Miles

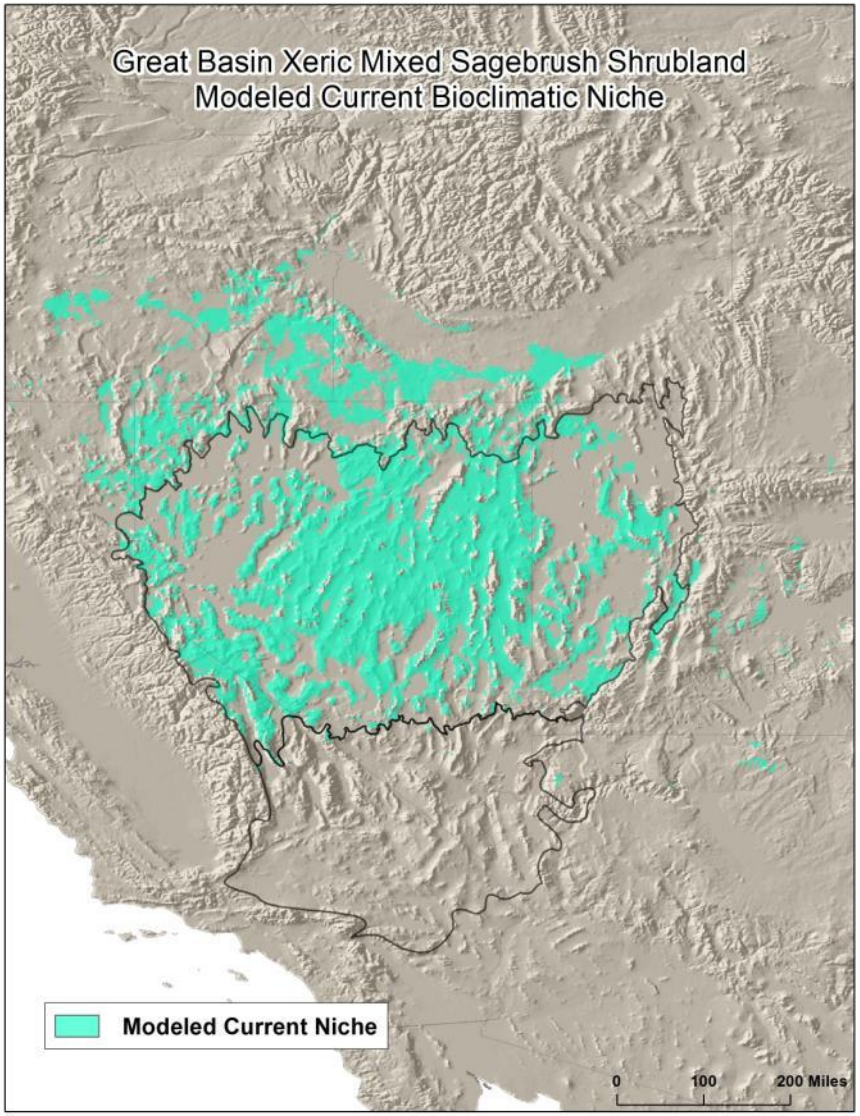

Mule Deer
Summer
A2 2050
Model Certainty of
Suitable Bioclimate
High
Low

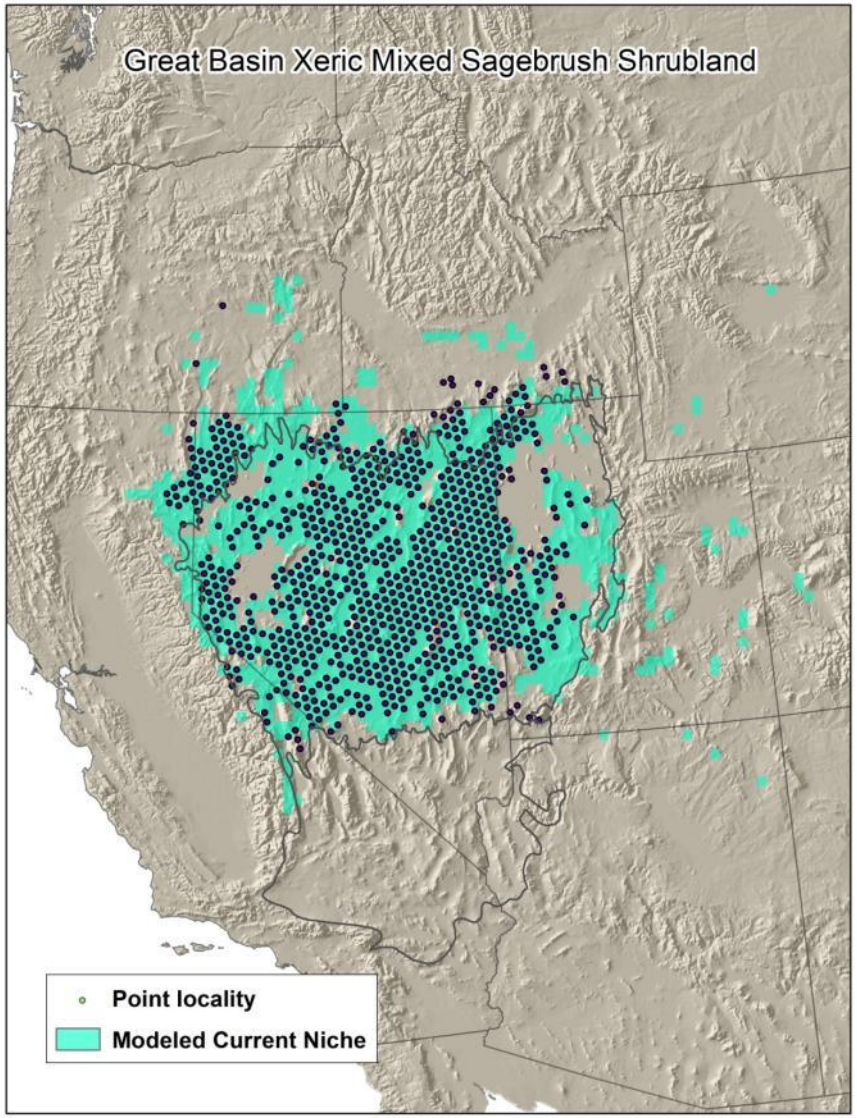

Mule Deer
Summer
A2 2050
Model Certainty of
Suitable Bioclimate
High
Low
0
100
200 Miles

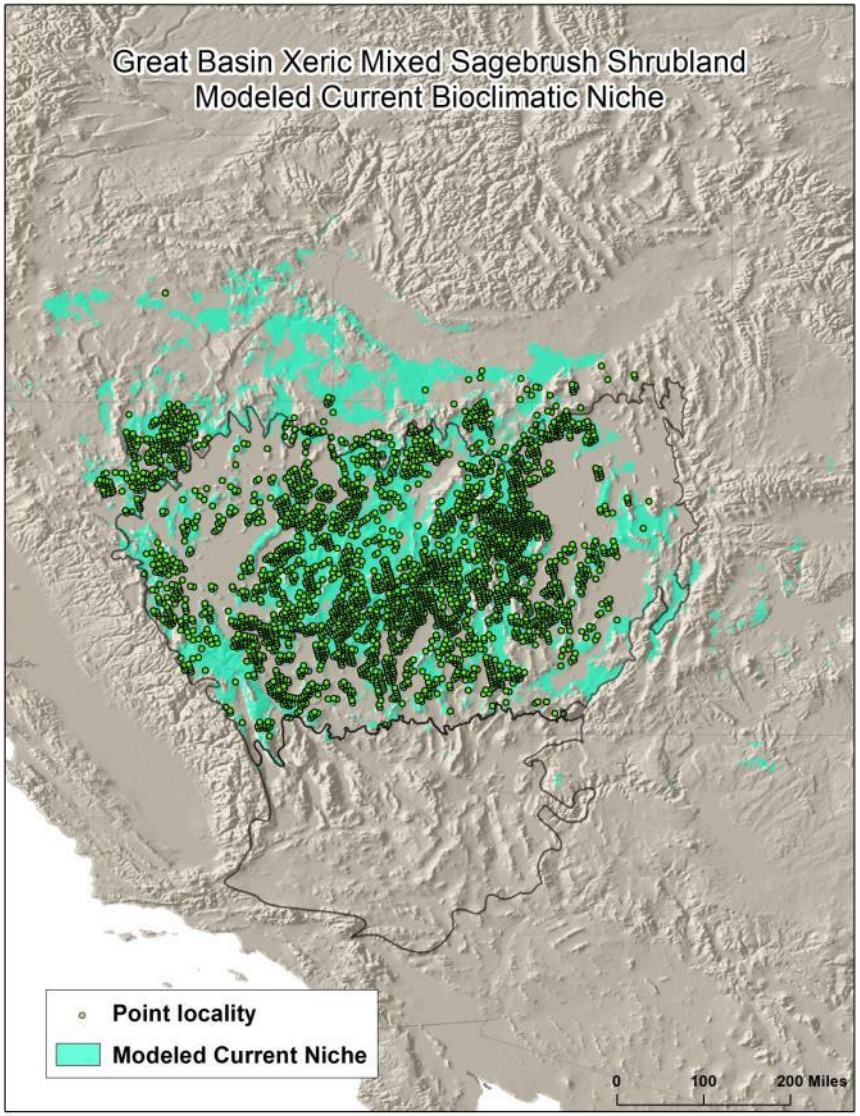

Great Basin Xeric Mixed Sagebrush Shrubland
Point locality

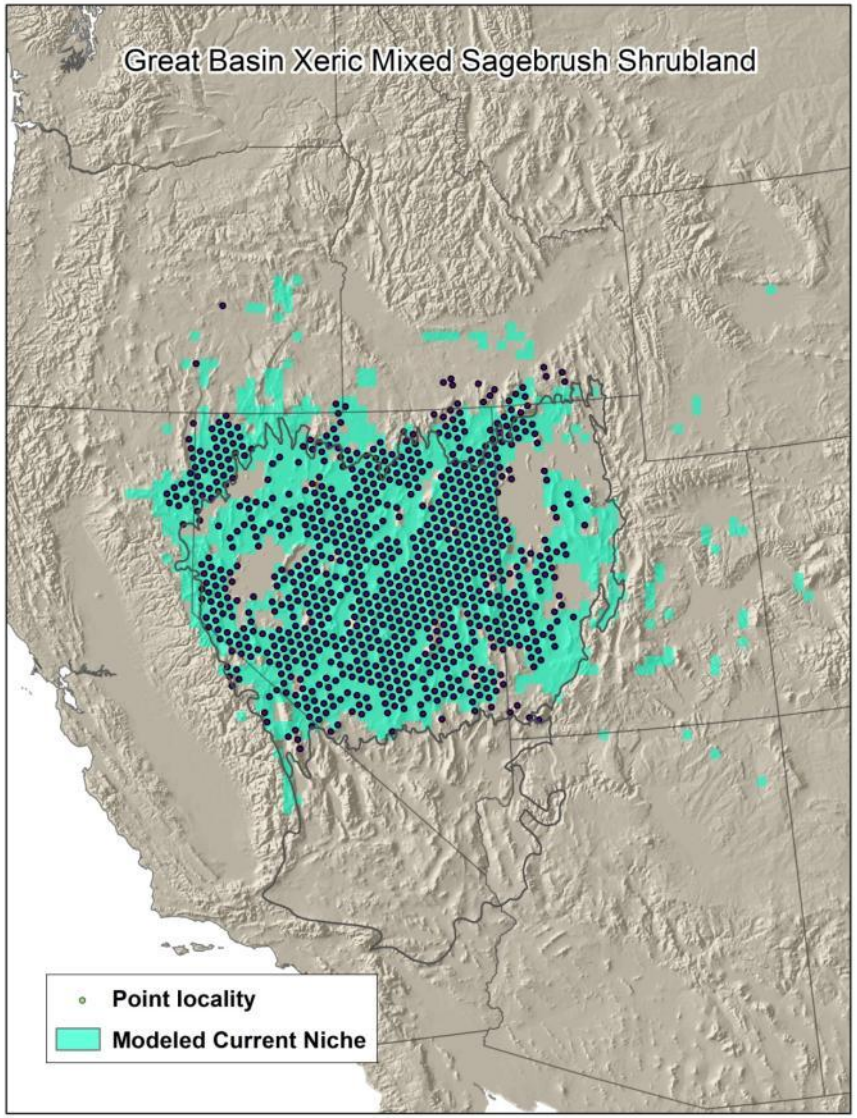

Great Basin Xeric Mixed Sagebrush Shrubland
Point locality
0
100
200 Miles

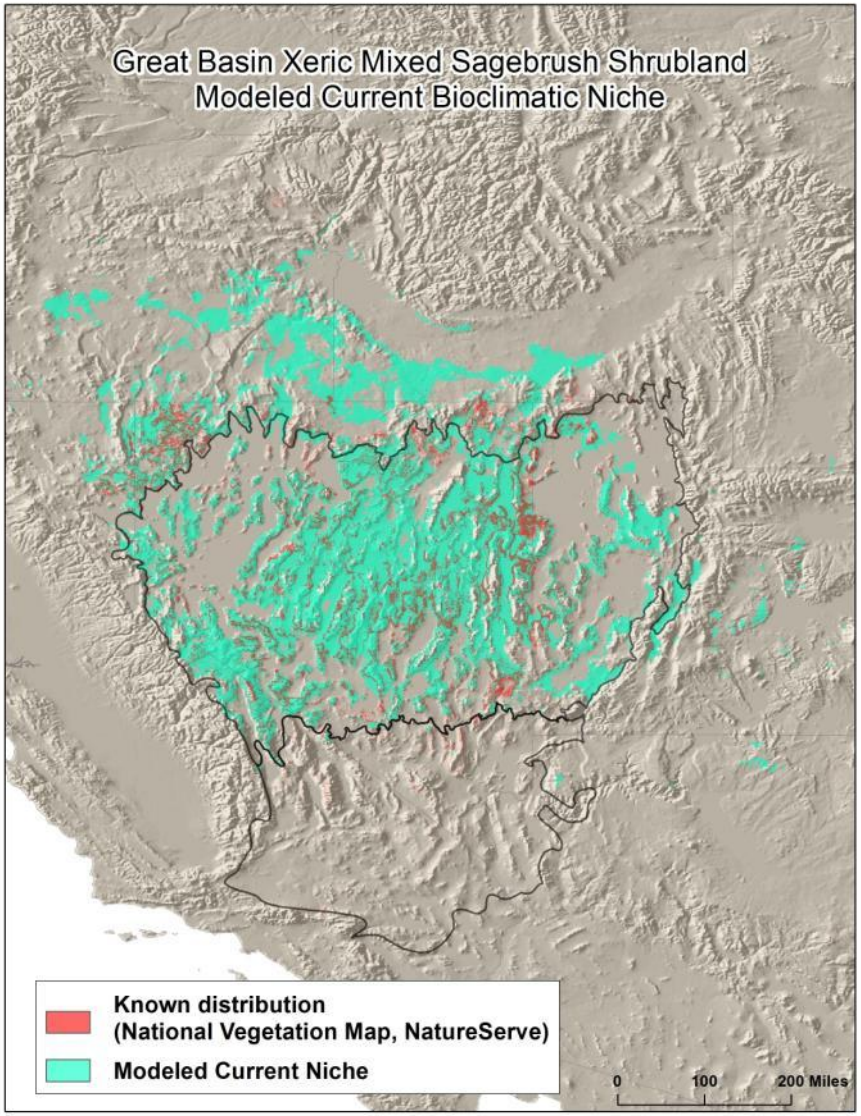

Great Basin Xeric Mixed Sagebrush Shrubland
Modeled Current Niche

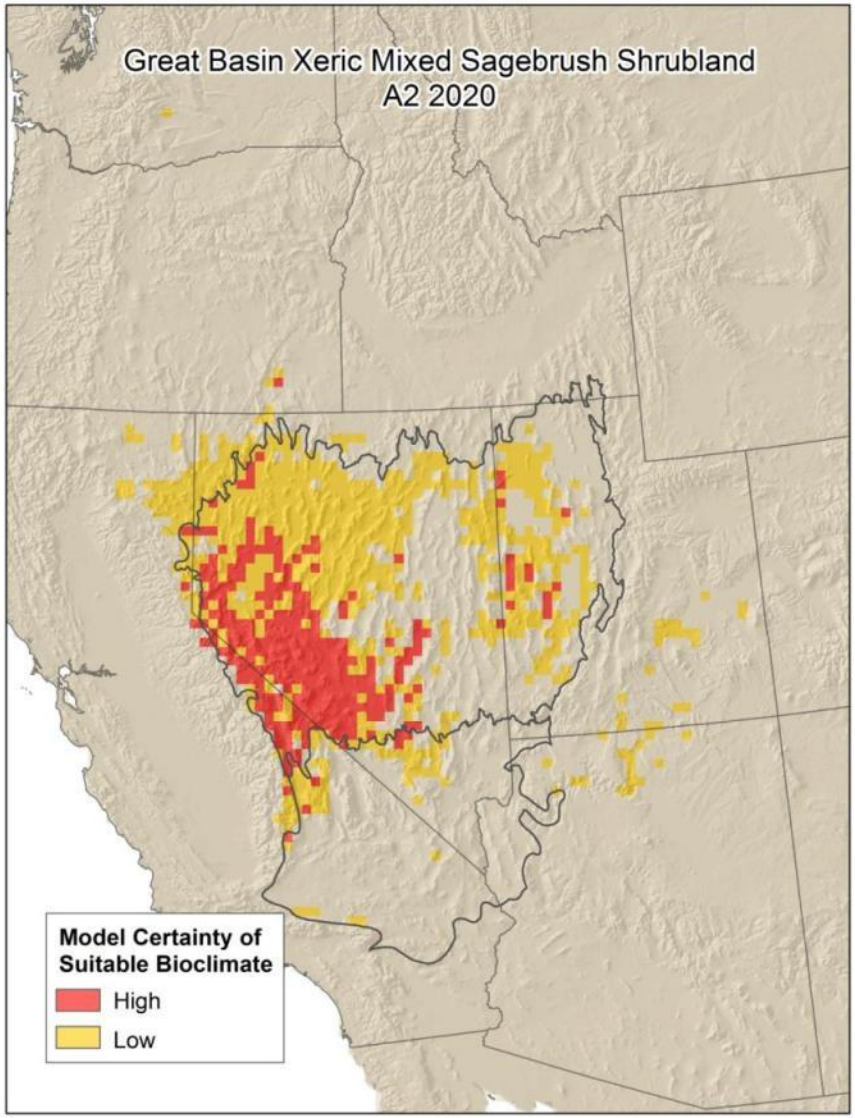

Great Basin Xeric Mixed Sagebrush Shrubland
Modeled Current Bioclimatic Niche
Modeled Current Niche
0
100
200 Miles

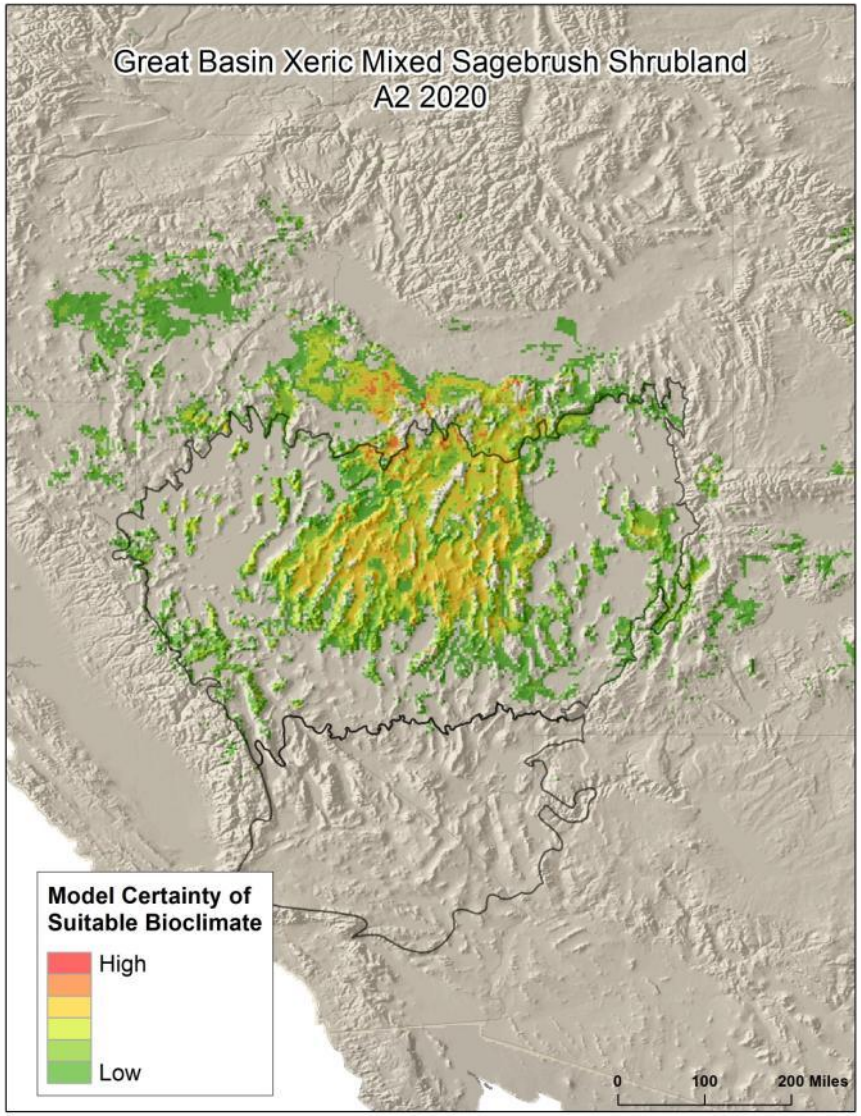

Great Basin Xeric Mixed Sagebrush Shrubland
Point locality
Modeled Current Niche

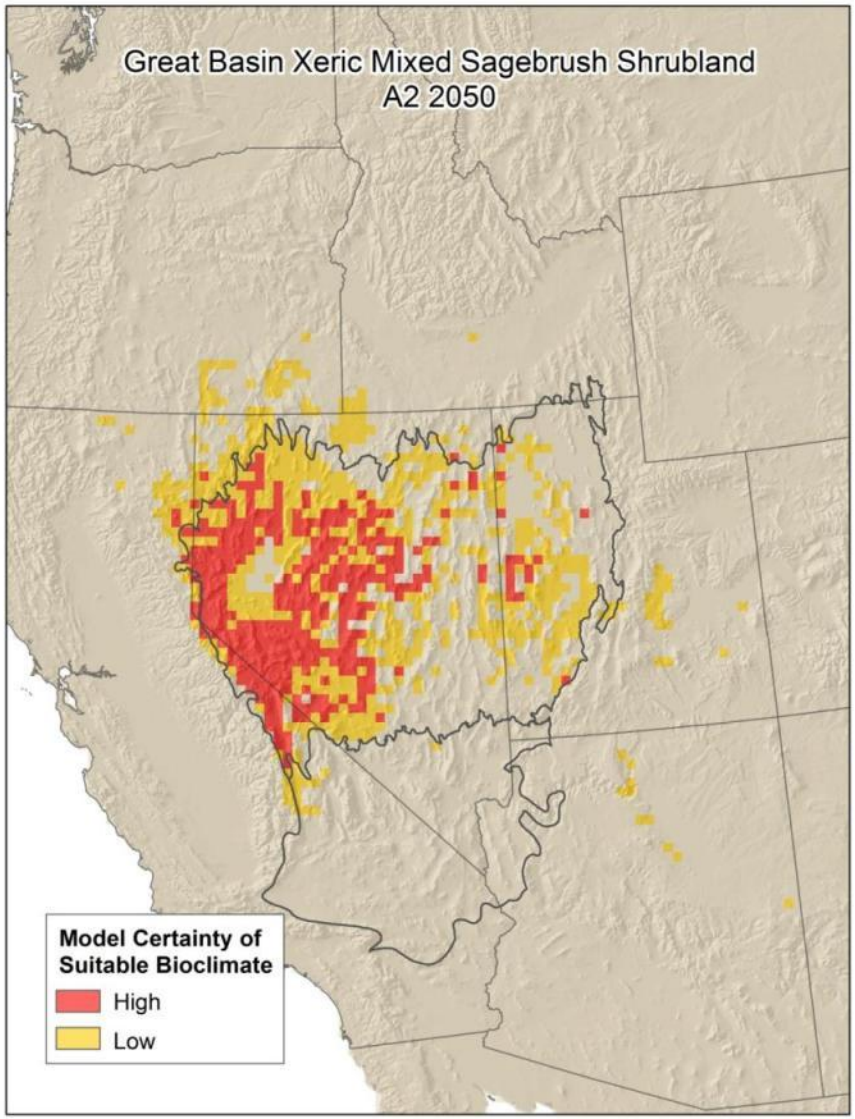

Great Basin Xeric Mixed Sagebrush Shrubland
Modeled Current Bioclimatic Niche
Point locality
Modeled Current Niche
0
100
200 Miles

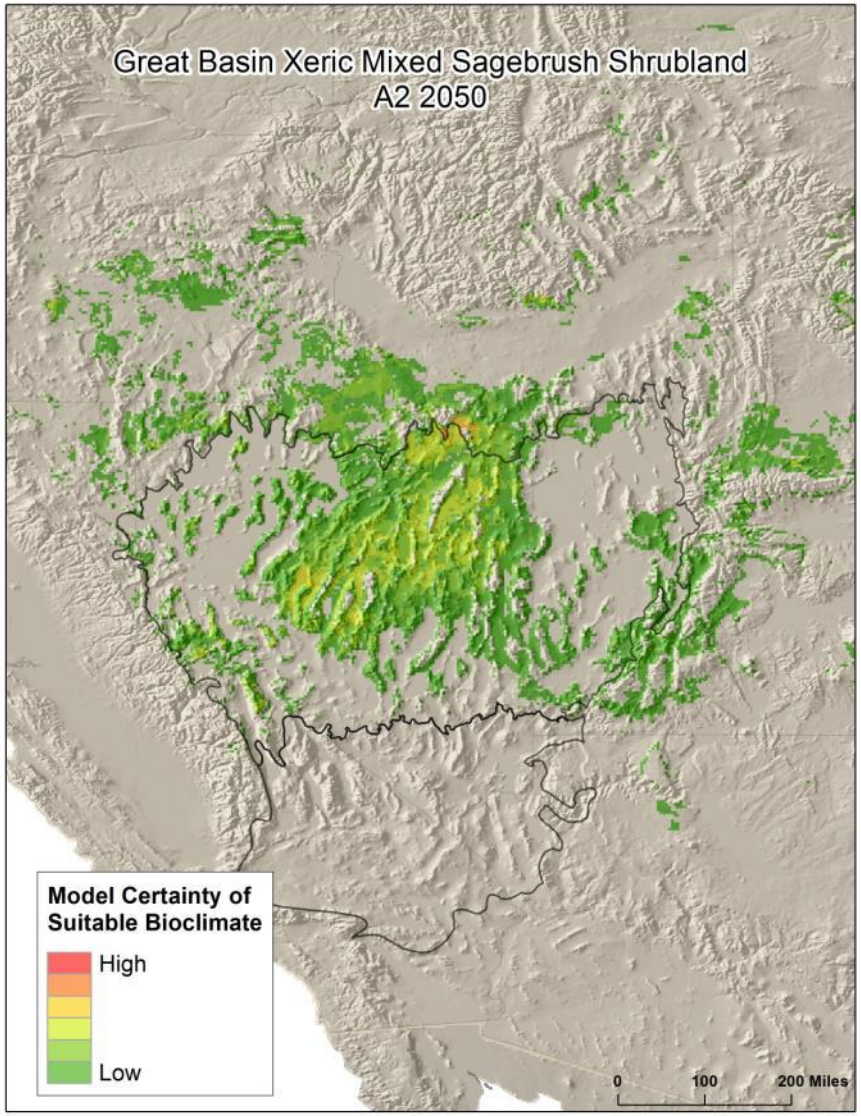

Great Basin Xeric Mixed Sagebrush Shrubland
Point locality
Modeled Current Niche

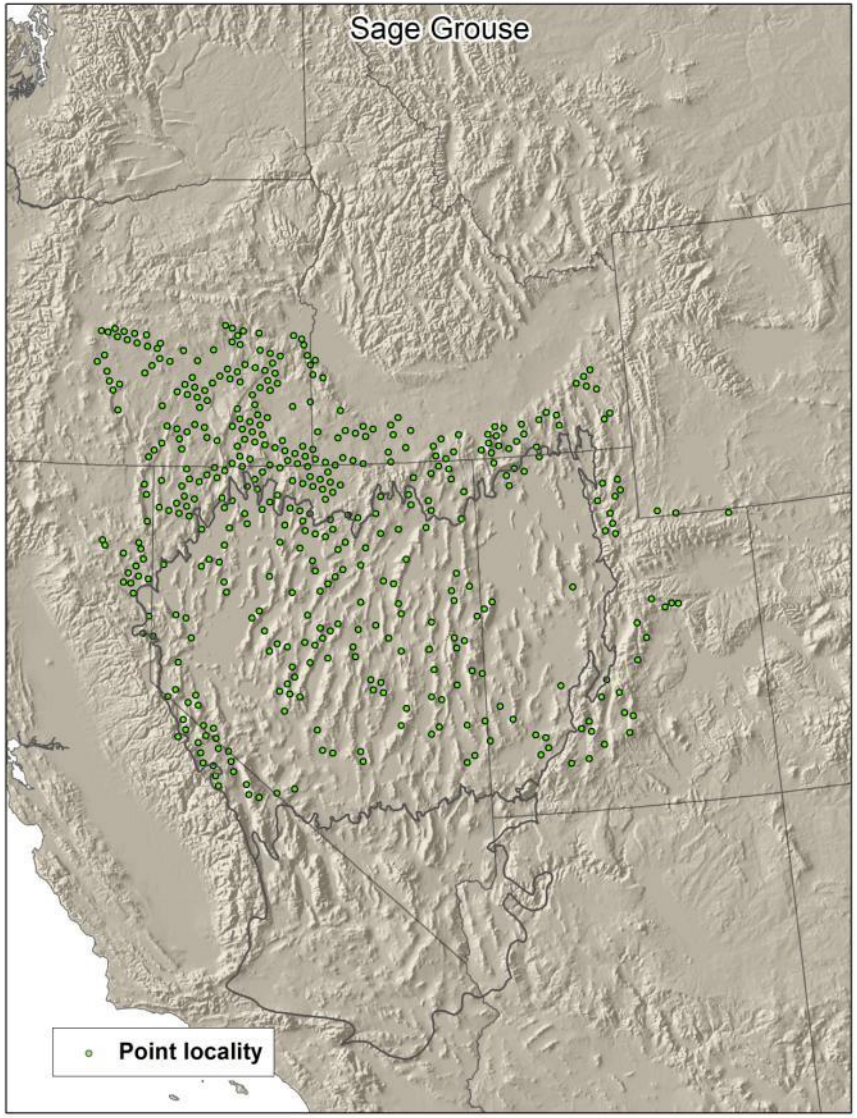

Great Basin Xeric Mixed Sagebrush Shrubland
Modeled Current Bioclimatic Niche
Known distribution
(National Vegetation Map, NatureServe)
Modeled Current Niche
0
100
200 Miles

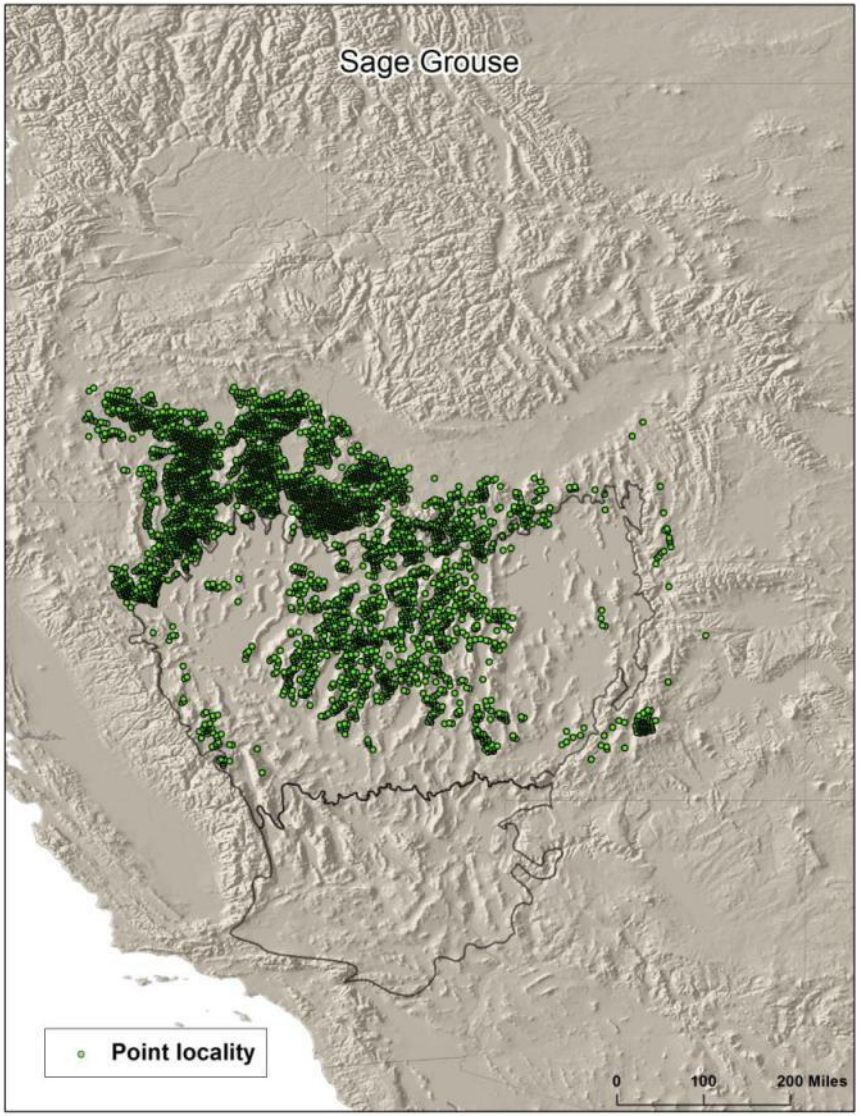

Great Basin Xeric Mixed Sagebrush Shrubland
A2 2020
Model Certainty of Suitable Bioclimate
High
Low

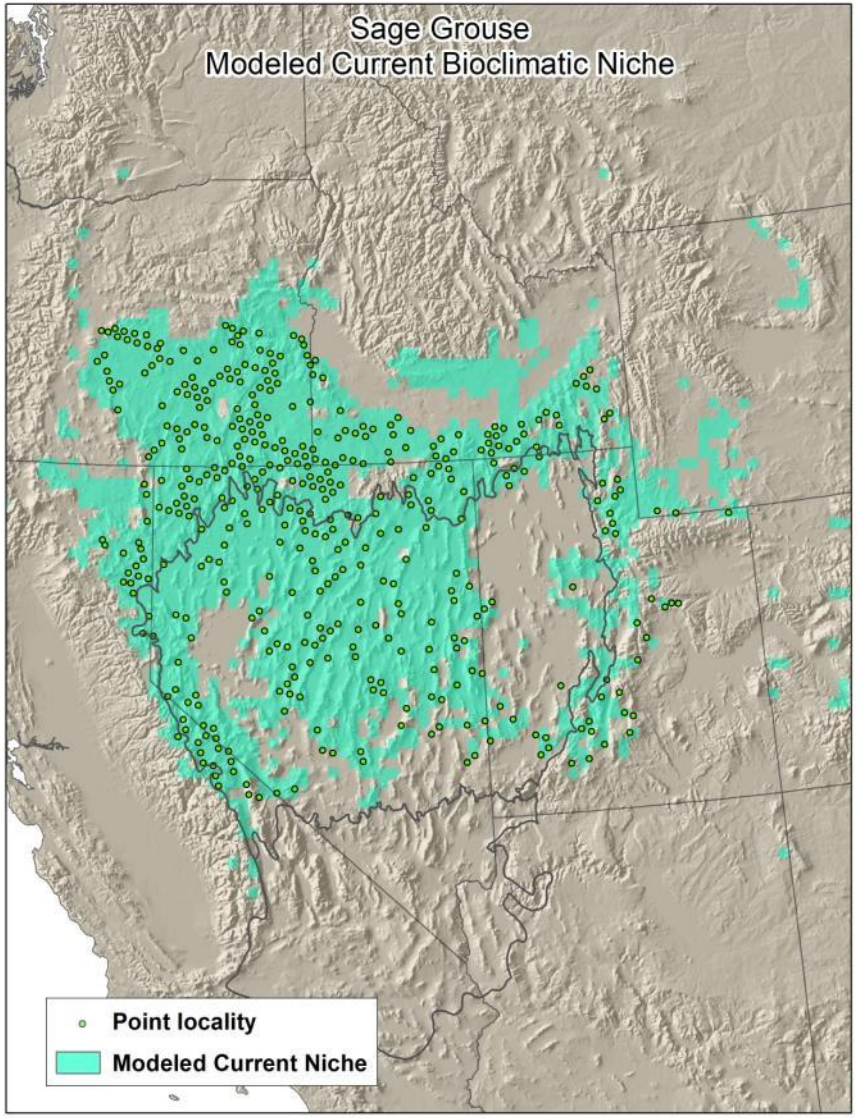

Great Basin Xeric Mixed Sagebrush Shrubland
A2 2020
Model Certainty of Suitable Bioclimate
High
Low
0
100
200 Miles

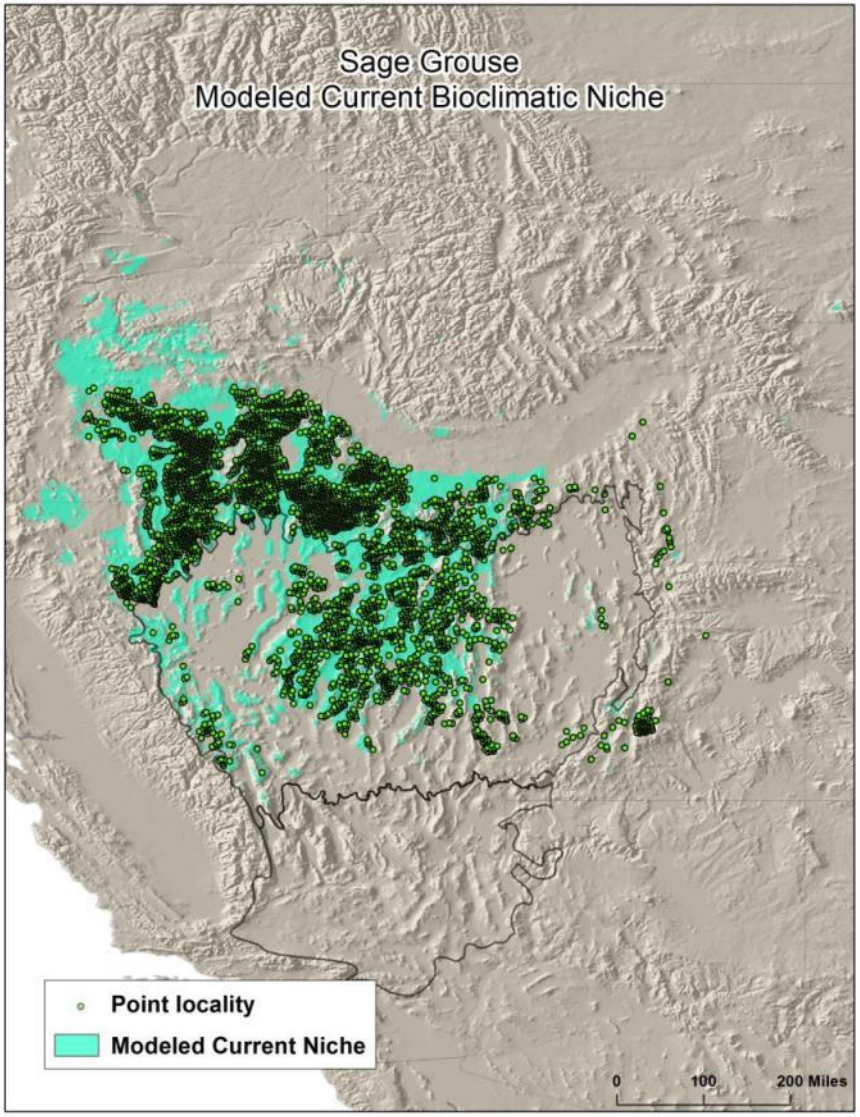

Great Basin Xeric Mixed Sagebrush Shrubland
A2 2050
Model Certainty of Suitable Bioclimate
High
Low

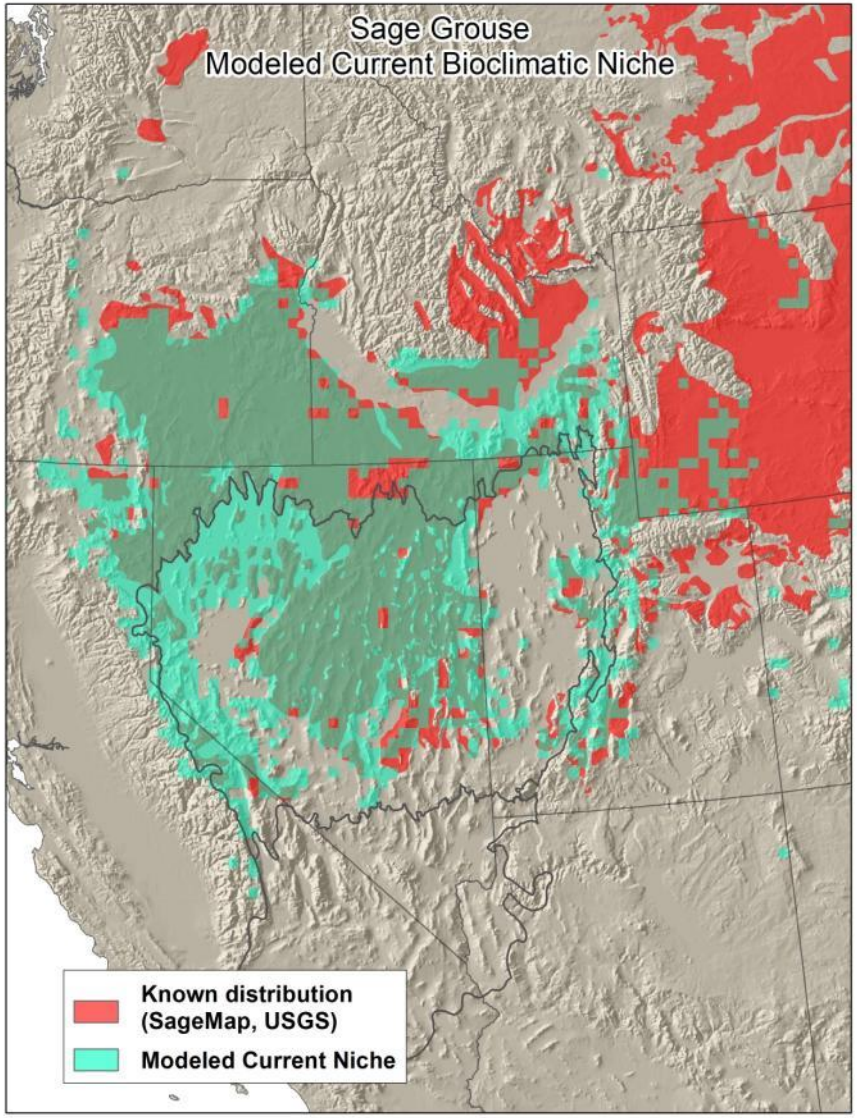

Great Basin Xeric Mixed Sagebrush Shrubland
A2 2050
Model Certainty of Suitable Bioclimate
High
Low
0
100
200 Miles

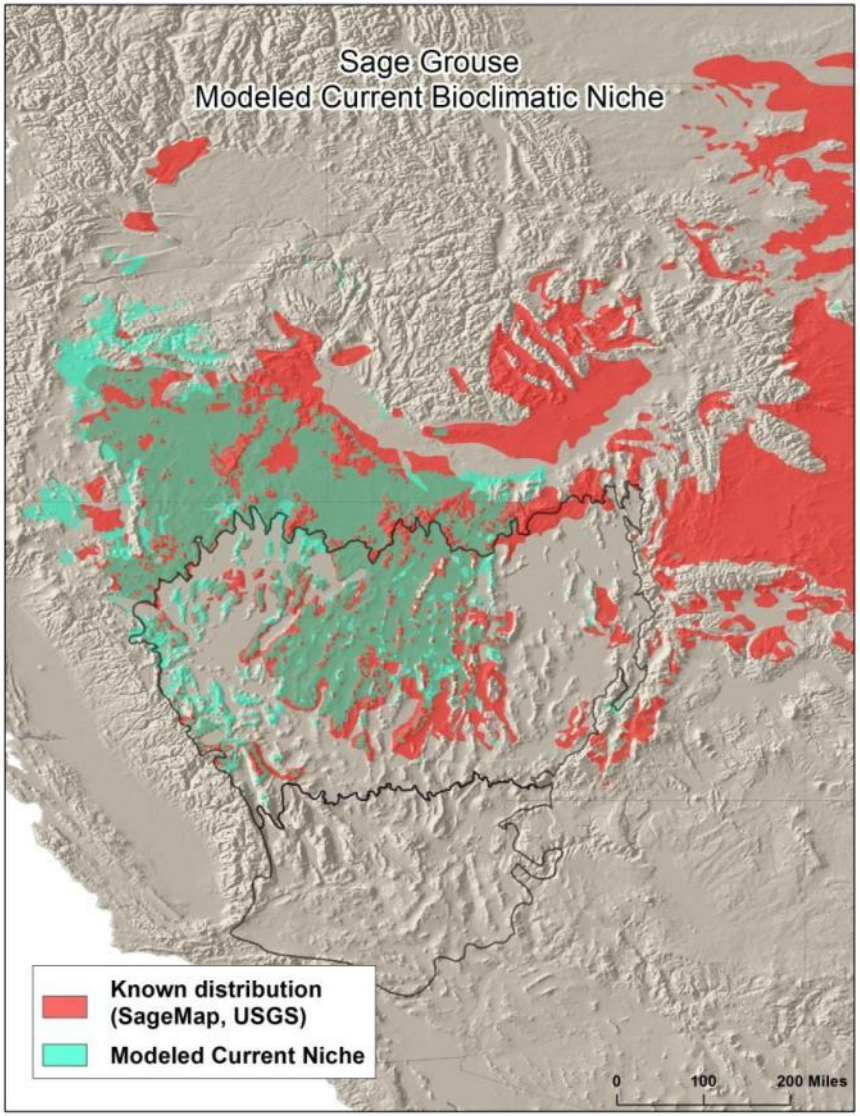

Sage Grouse
Point locality

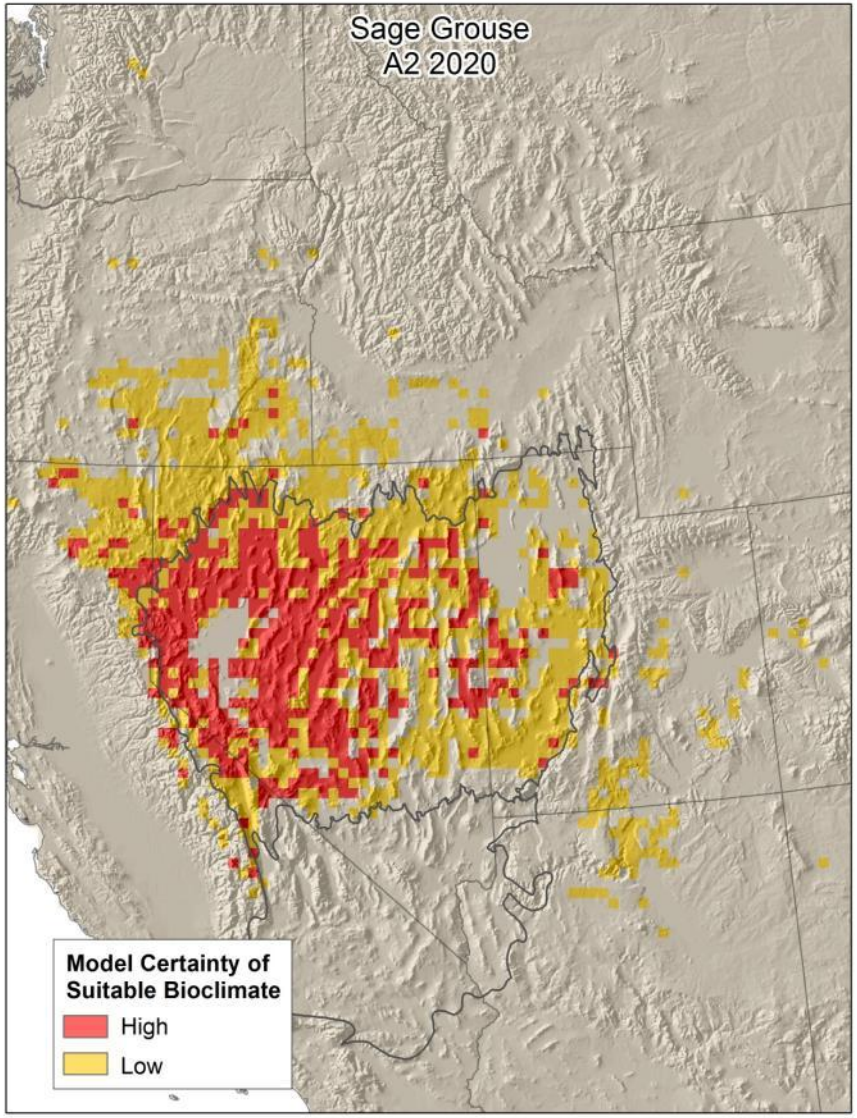

Sage Grouse
Point locality
0
100
200 Miles

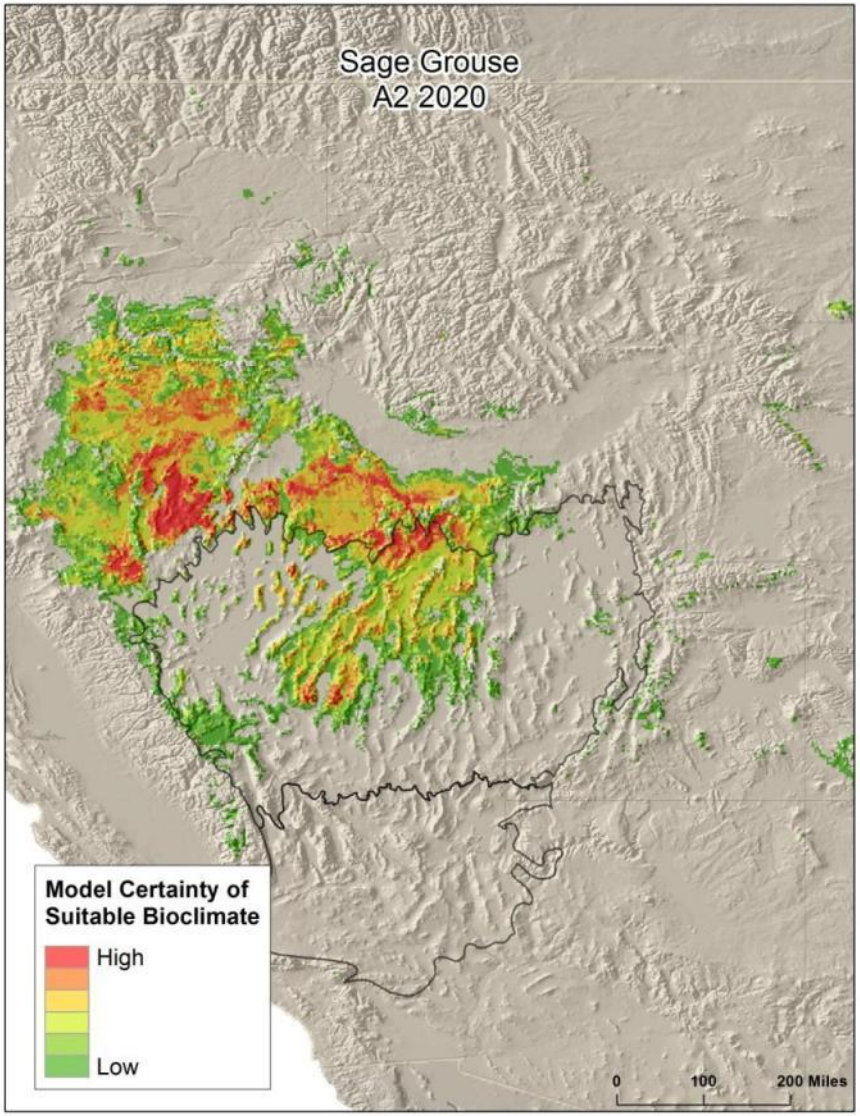

Sage Grouse
Modeled Current Bioclimatic Niche
Point locality
Modeled Current Niche

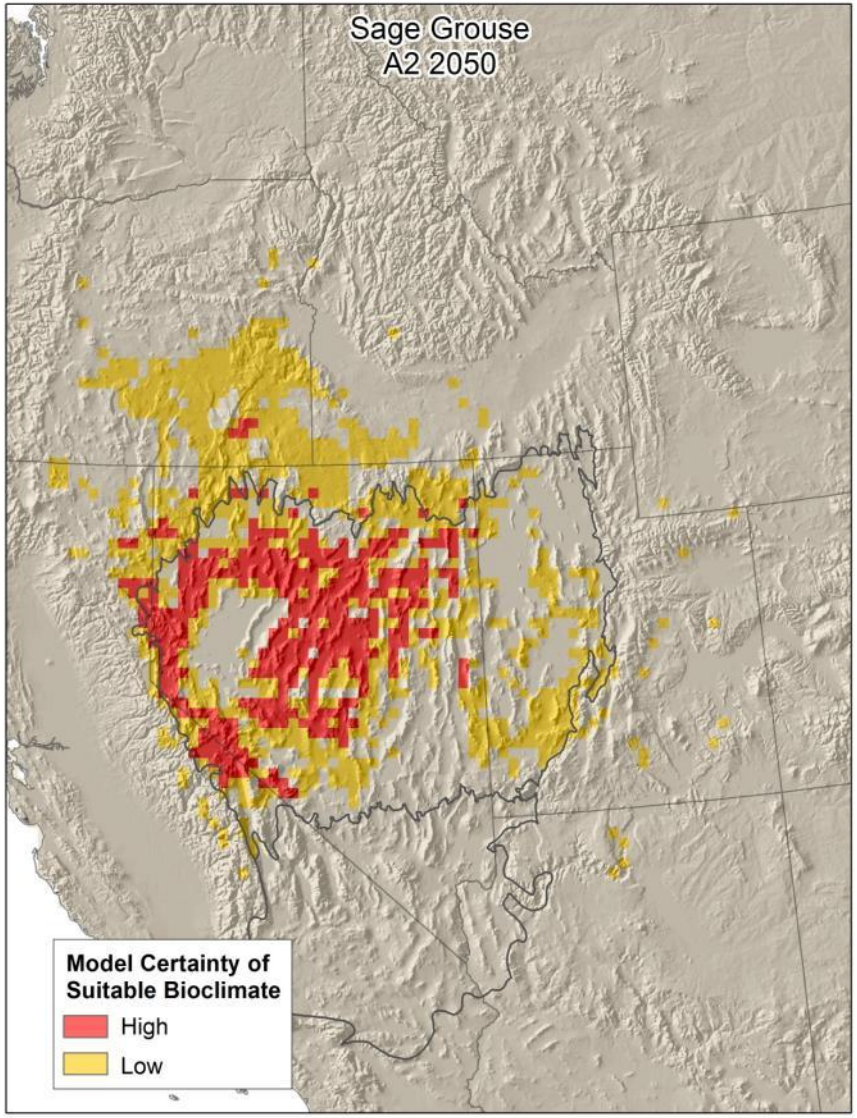

Sage Grouse
Modeled Current Bioclimatic Niche
Point locality
Modeled Current Niche
0
100
200 Miles

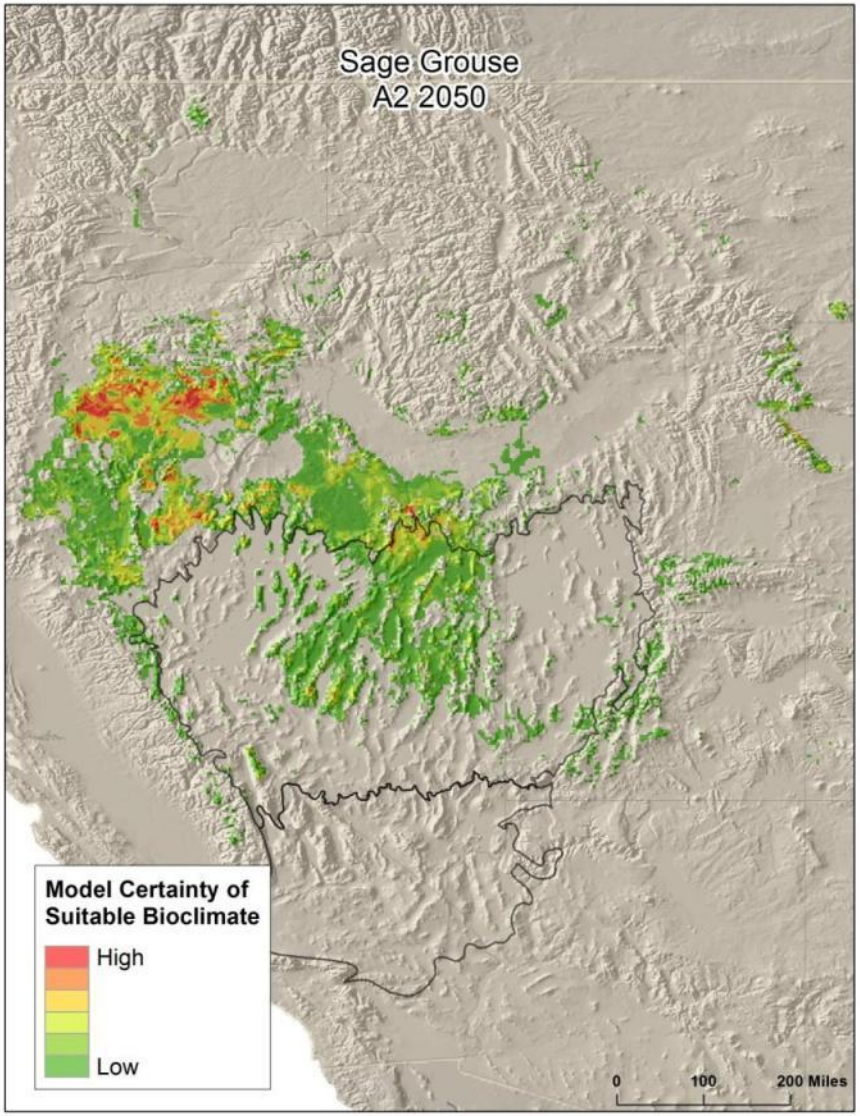

Sage Grouse
Modeled Current Bioclimatic Niche
Known distribution
(SageMap, USGS)
Modeled Current Niche

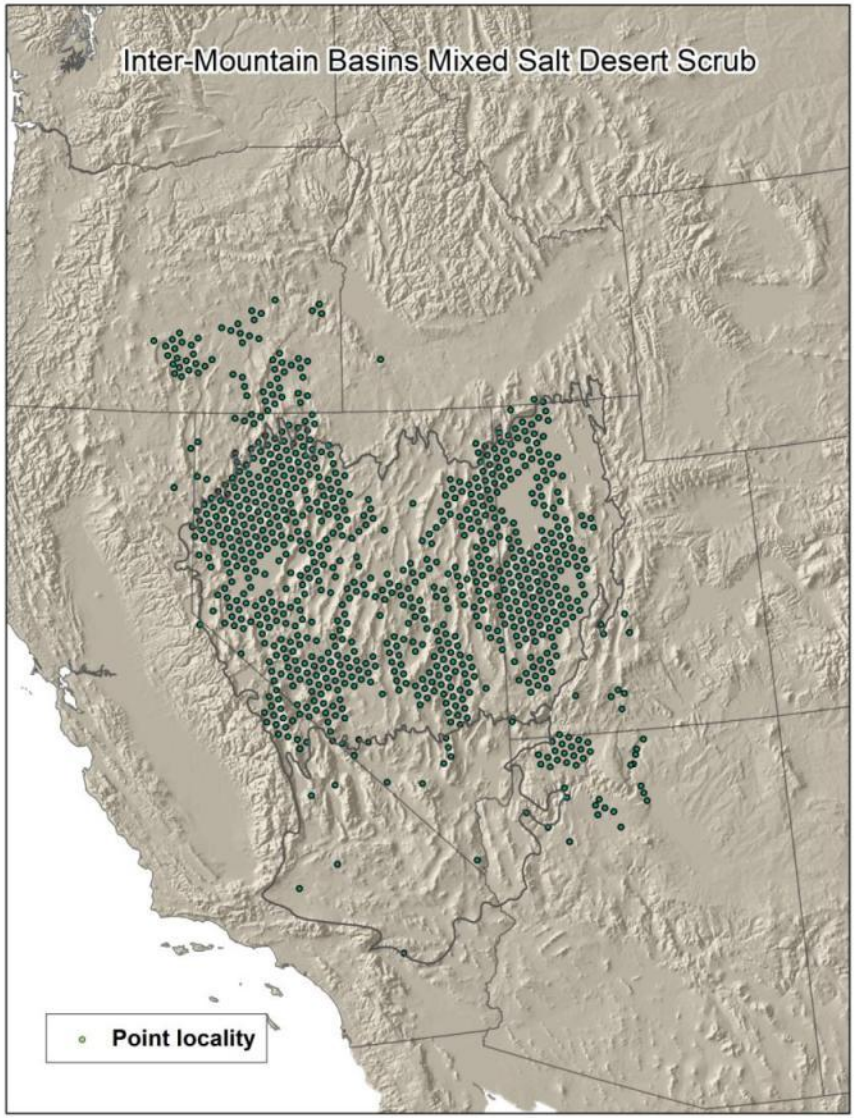

Sage Grouse
Modeled Current Bioclimatic Niche
Known distribution
(SageMap, USGS)
Modeled Current Niche
0
100
200 Miles

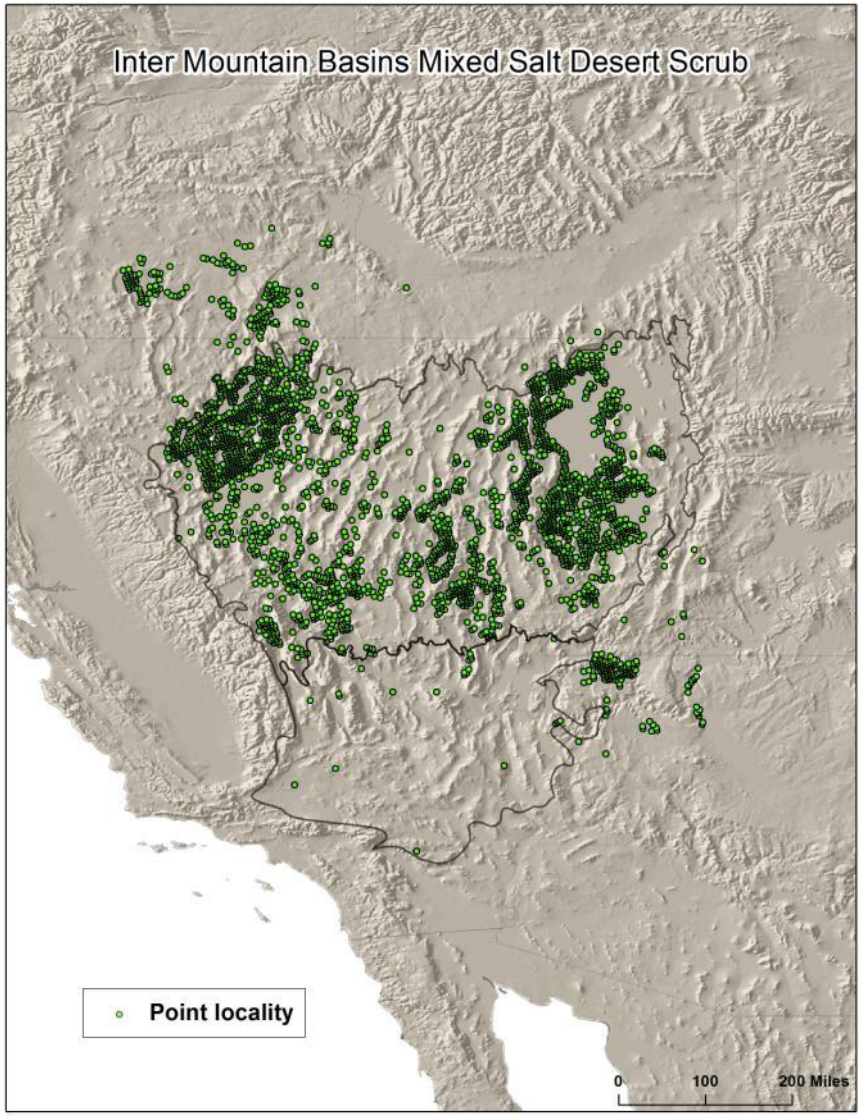

Sage Grouse
A2 2020
Model Certainty of
Suitable Bioclimate
High
Low

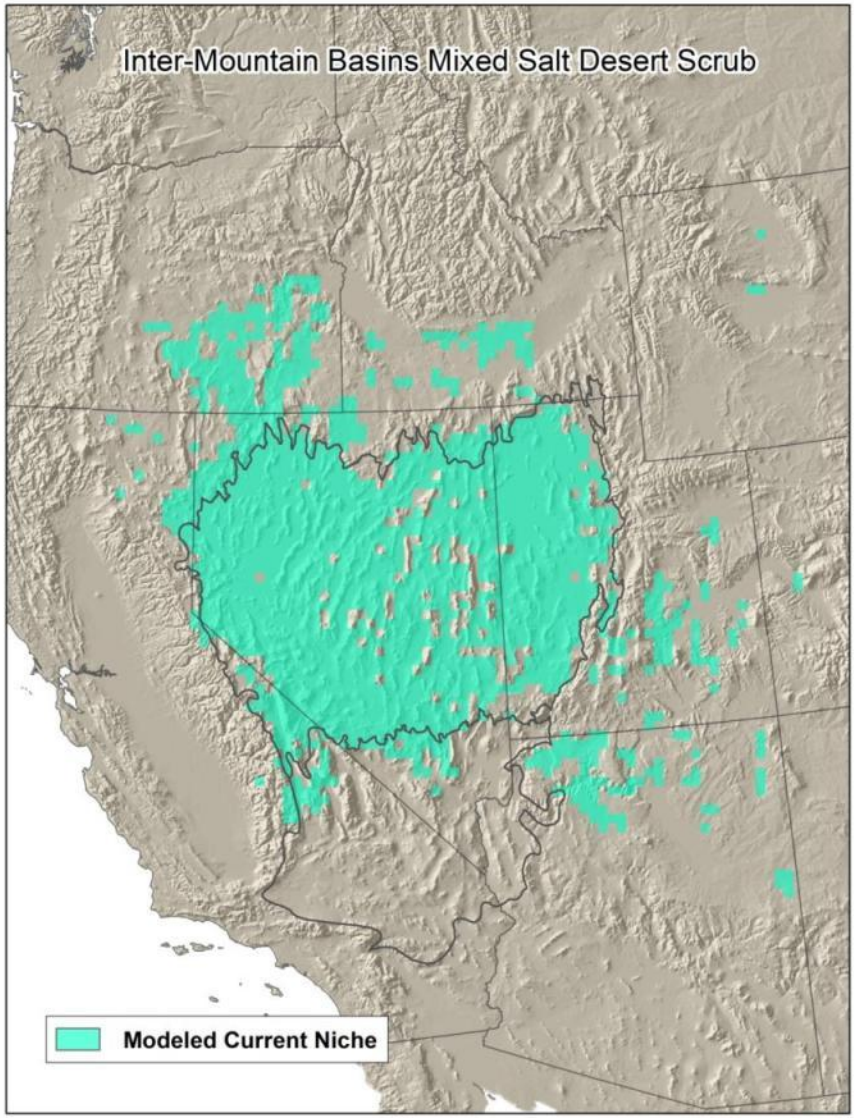

Sage Grouse
A2 2020
Model Certainty of
Suitable Bioclimate
High
Low
0
100
200 Miles

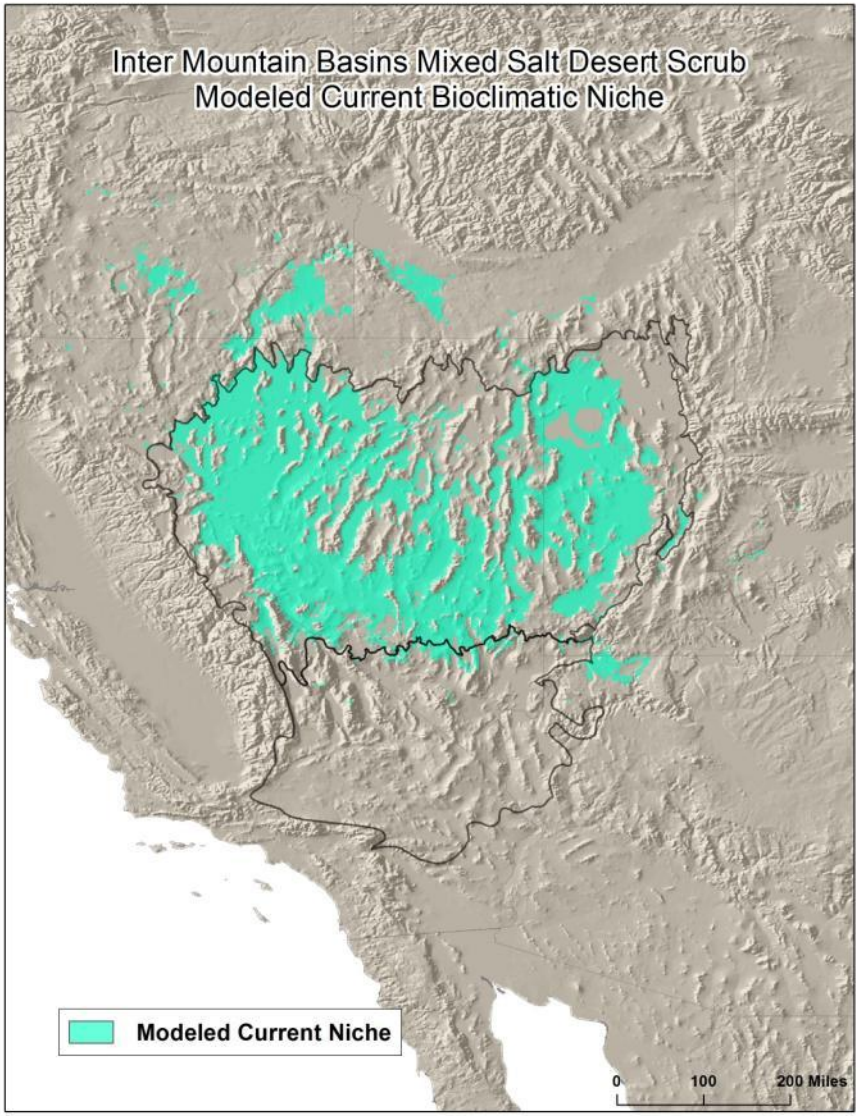

Sage Grouse
A2 2050
Model Certainty of
Suitable Bioclimate
High
Low

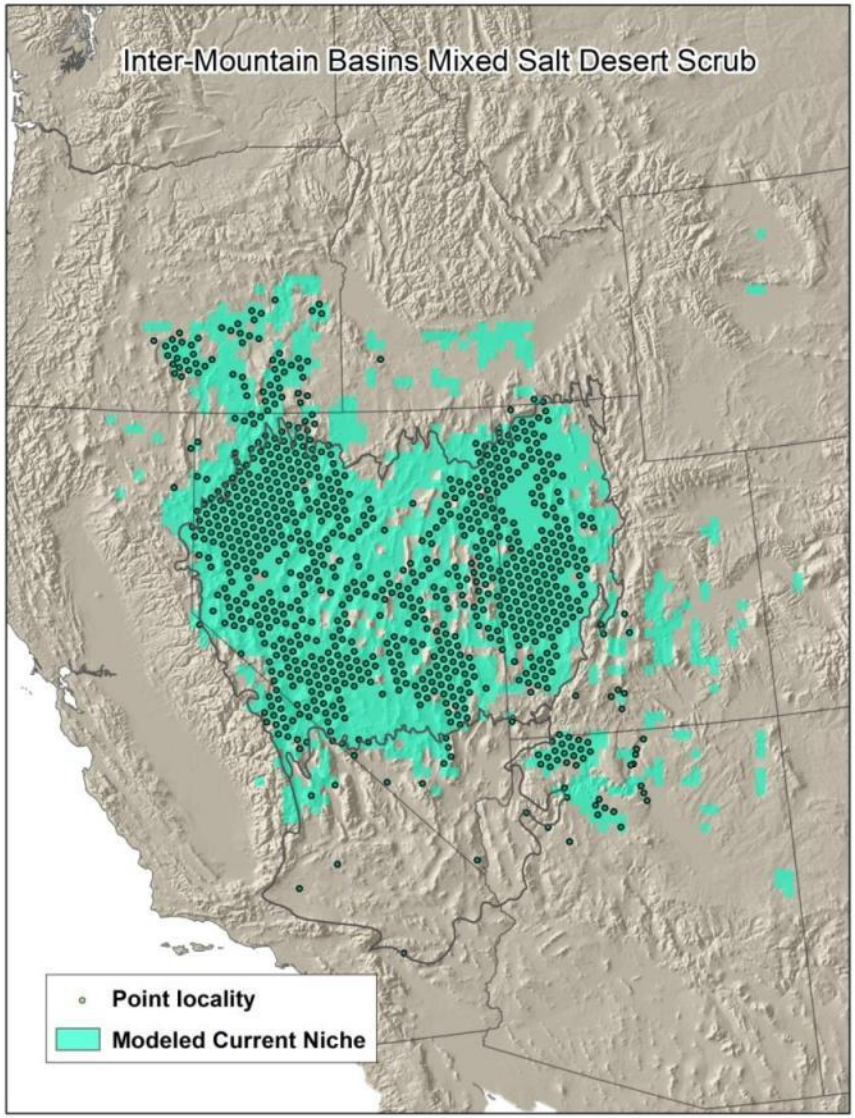

Sage Grouse
A2 2050
Model Certainty of
Suitable Bioclimate
High
Low
0
100
200 Miles

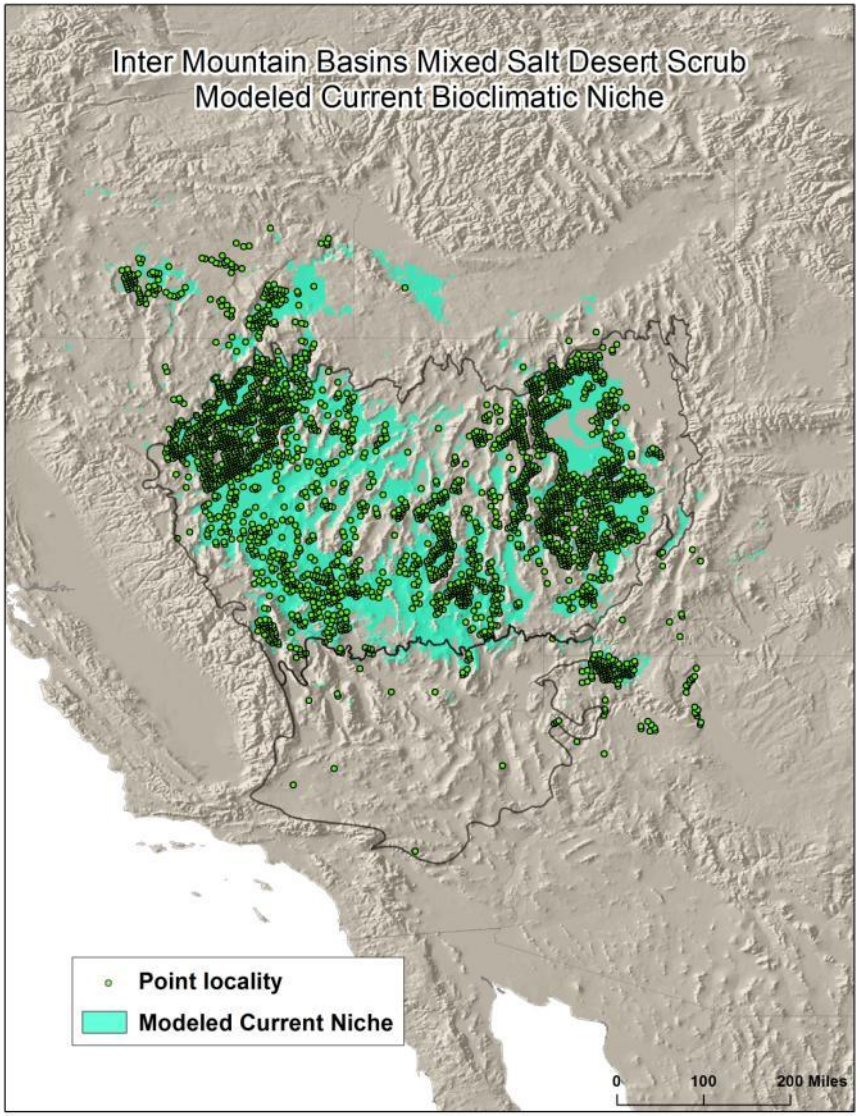

Inter-Mountain Basins Mixed Salt Desert Scrub
Point locality

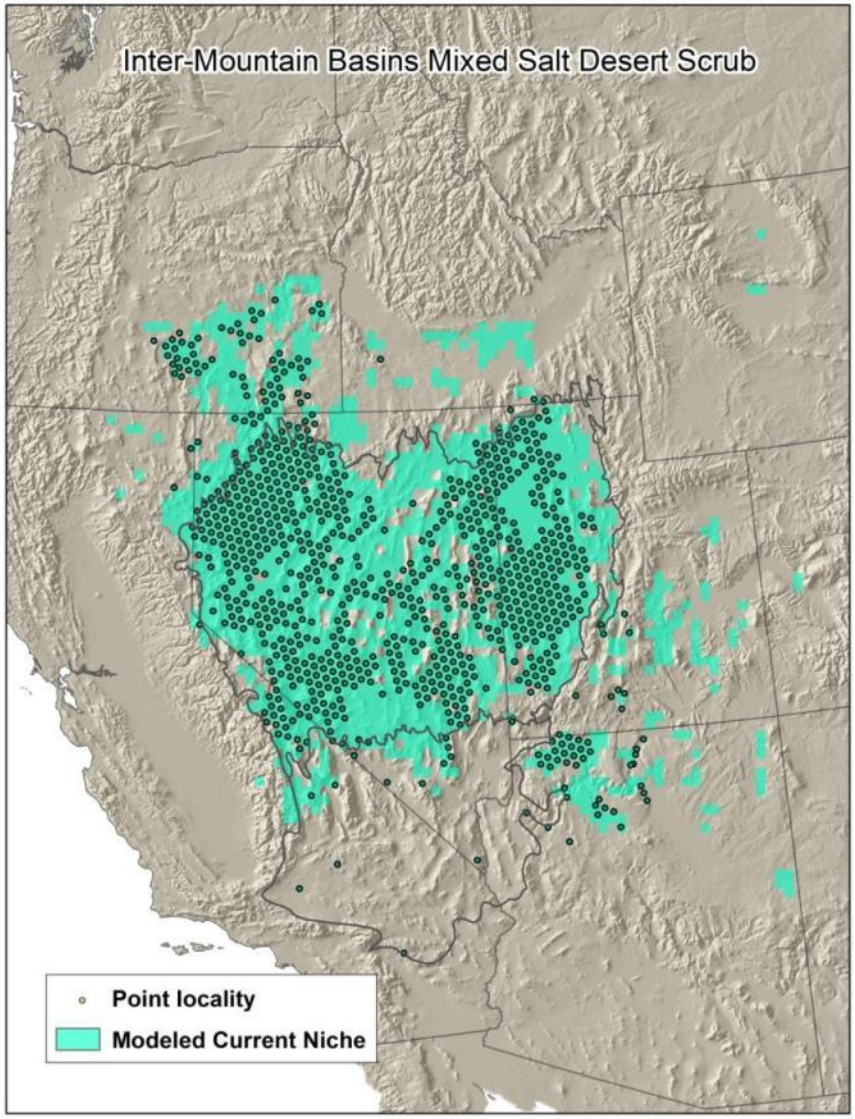

Inter Mountain Basins Mixed Salt Desert Scrub
Point locality
0
100
200 Miles

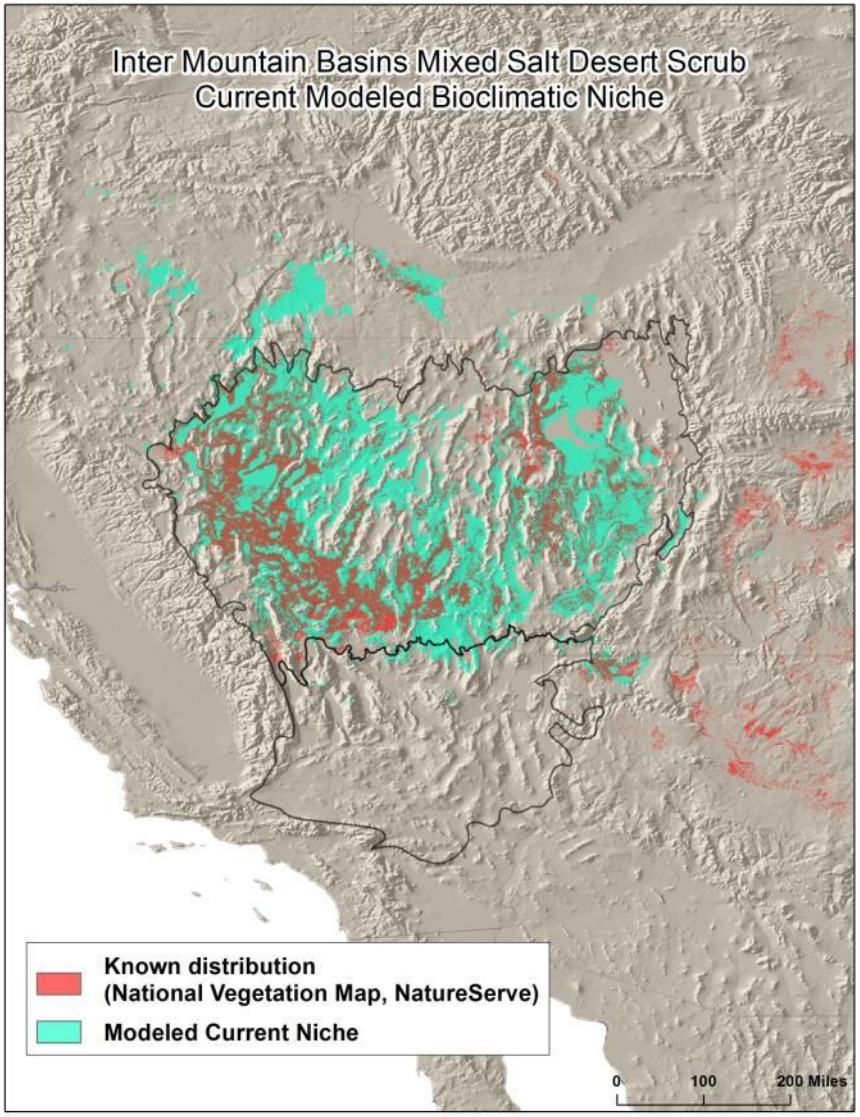

Inter-Mountain Basins Mixed Salt Desert Scrub
Modeled Current Niche

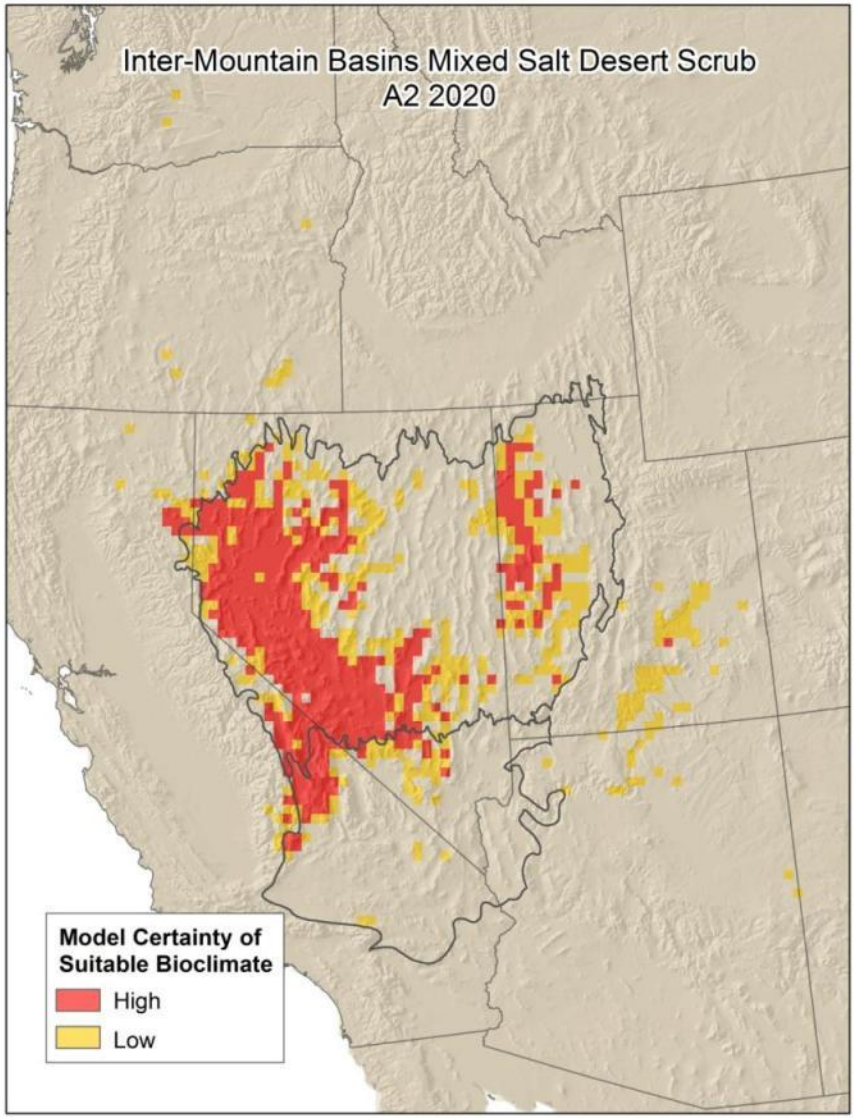

Inter Mountain Basins Mixed Salt Desert Scrub
Modeled Current Bioclimatic Niche
Modeled Current Niche
0
100
200 Miles

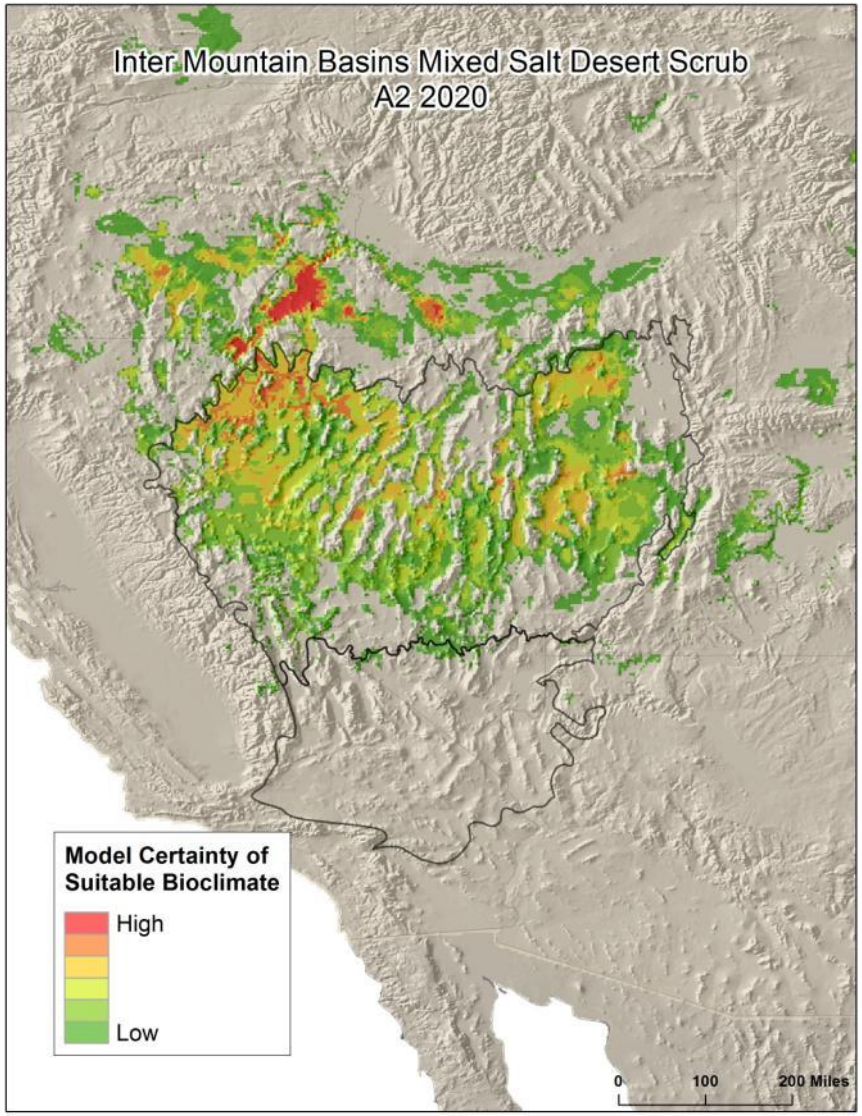

Inter-Mountain Basins Mixed Salt Desert Scrub
Point locality
Modeled Current Niche


Inter Mountain Basins Mixed Salt Desert Scrub
Modeled Current Bioclimatic Niche
Point locality
Modeled Current Niche
0
100
200 Miles


Inter-Mountain Basins Mixed Salt Desert Scrub
Point locality
Modeled Current Niche


Inter Mountain Basins Mixed Salt Desert Scrub
Current Modeled Bioclimatic Niche
Known distribution
(National Vegetation Map, NatureServe)
Modeled Current Niche
0
100
200 Miles





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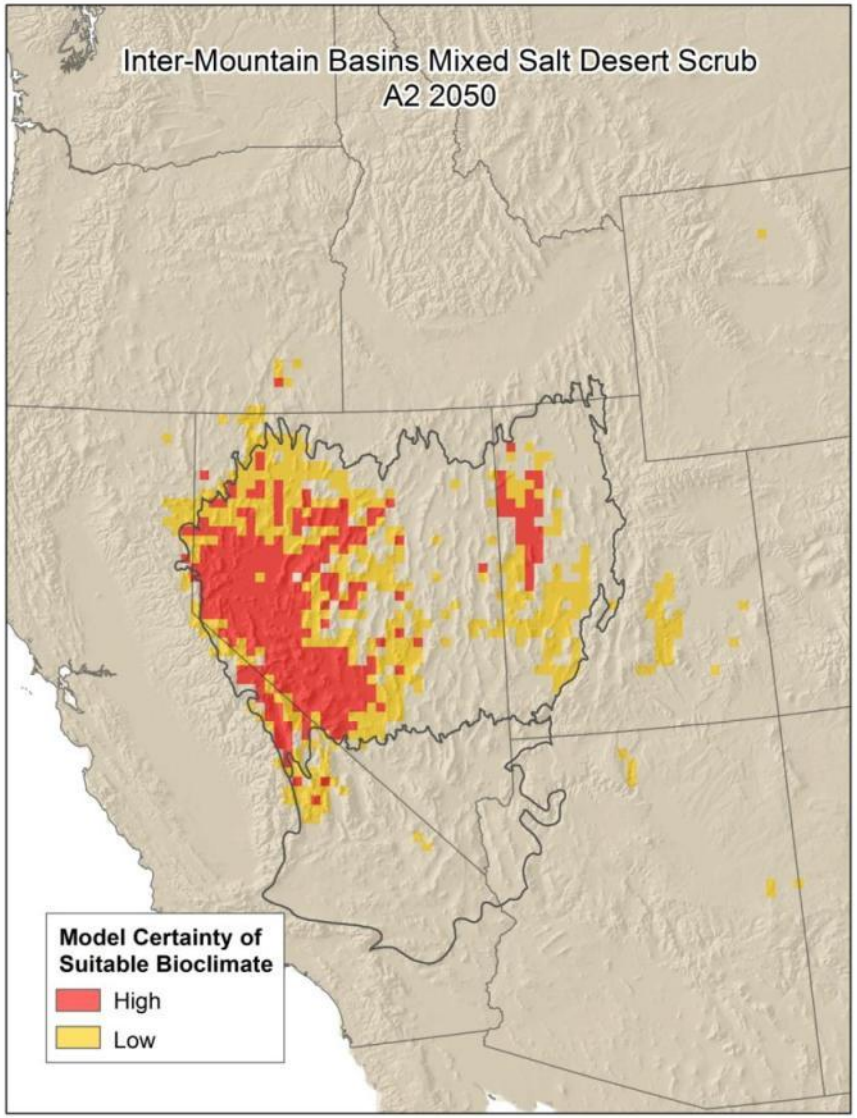
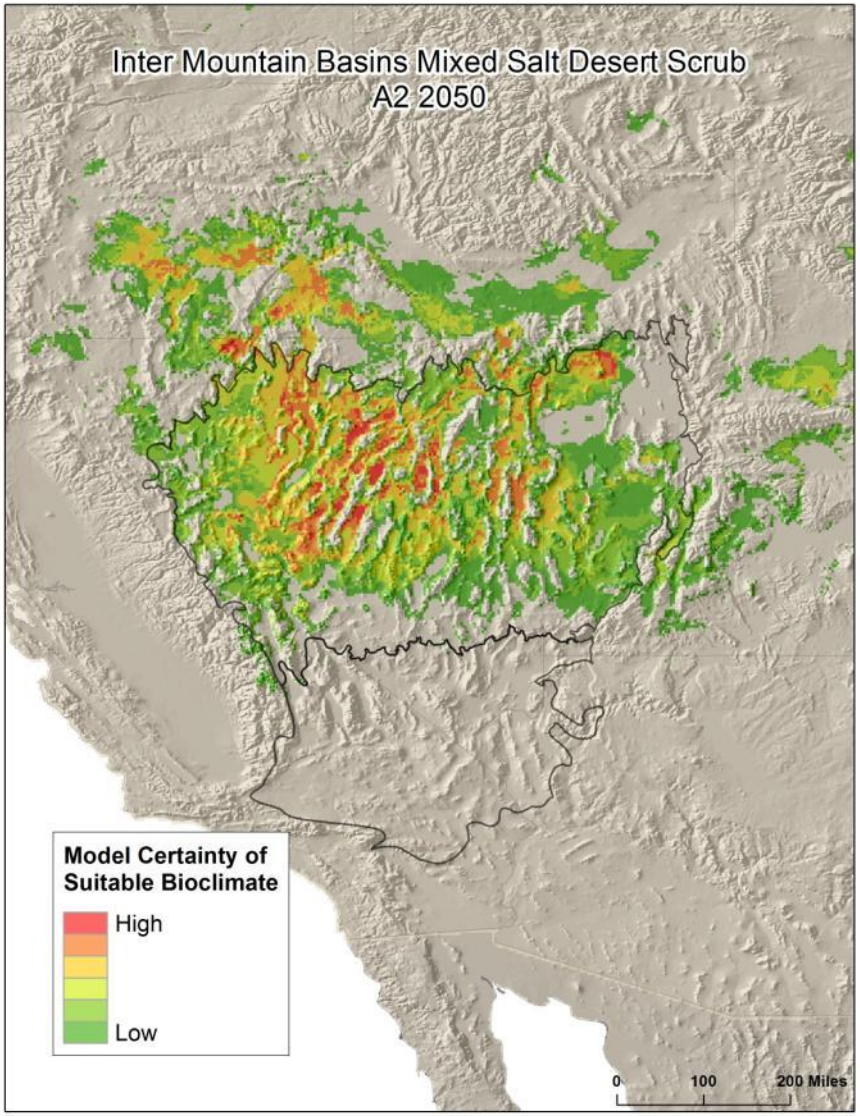
Rapid Ecoregional Assessment





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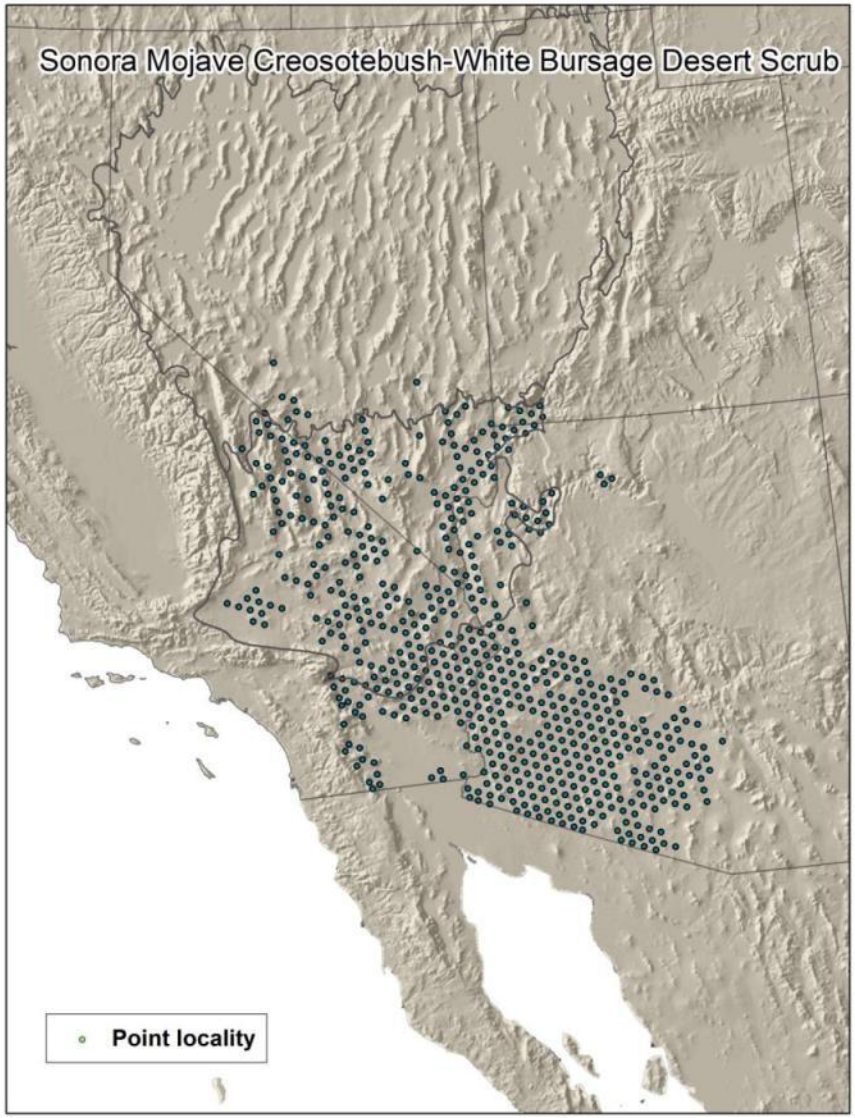
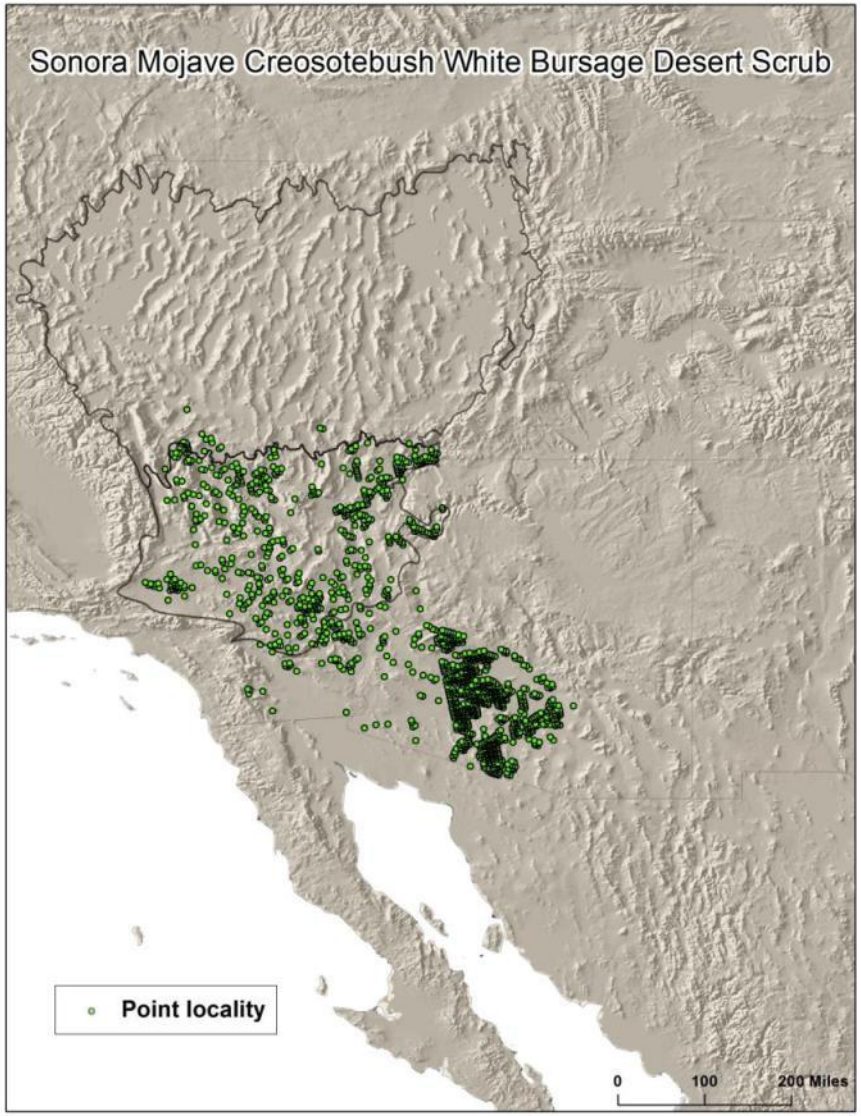
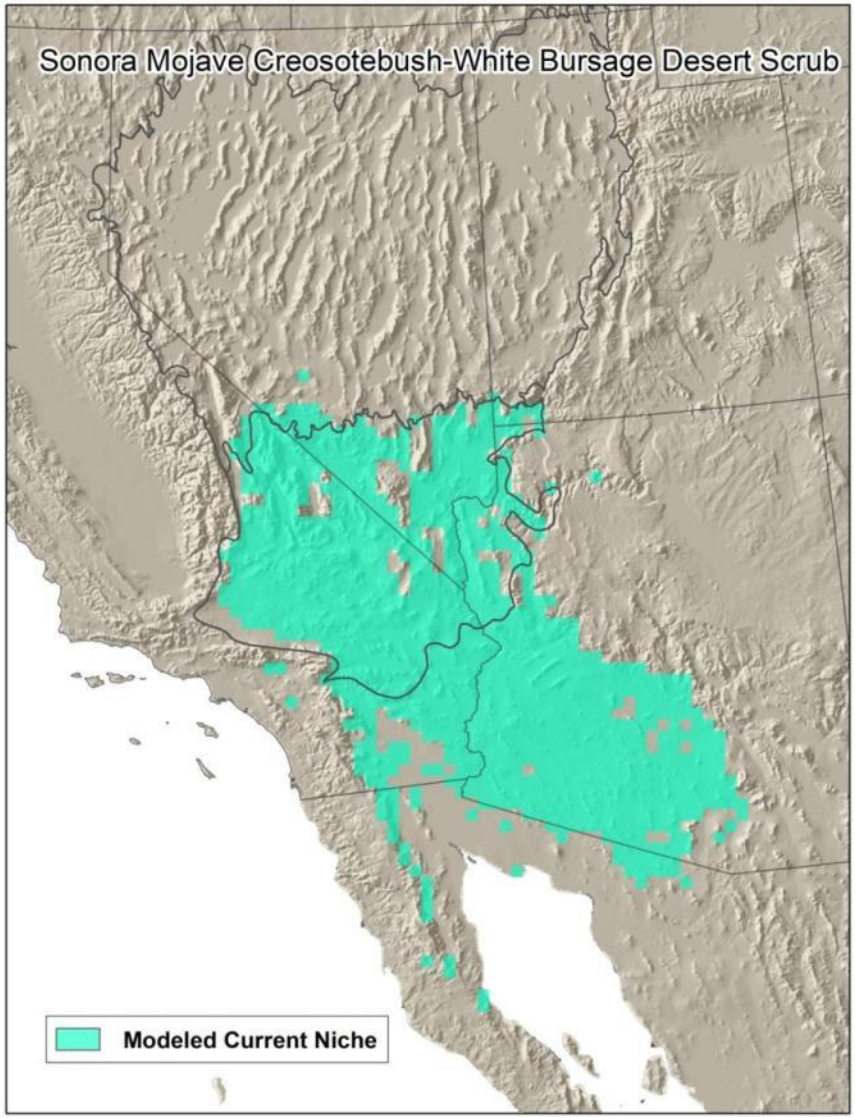
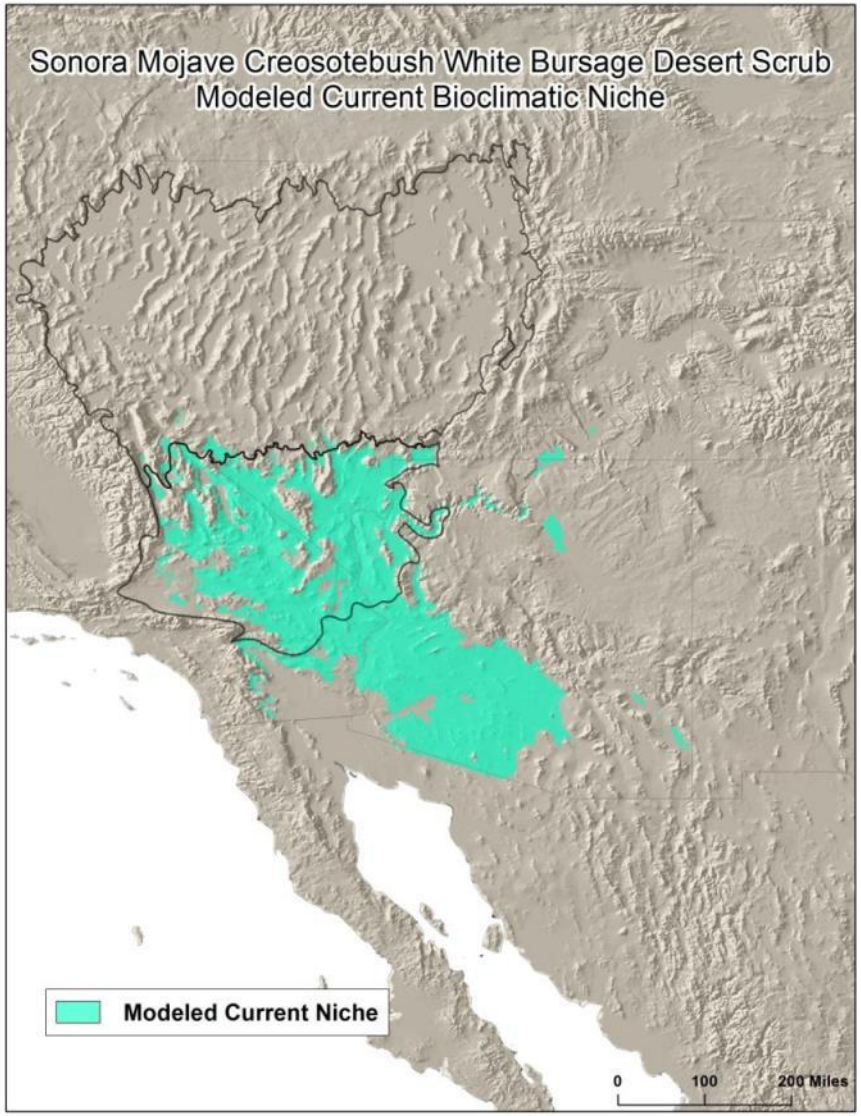
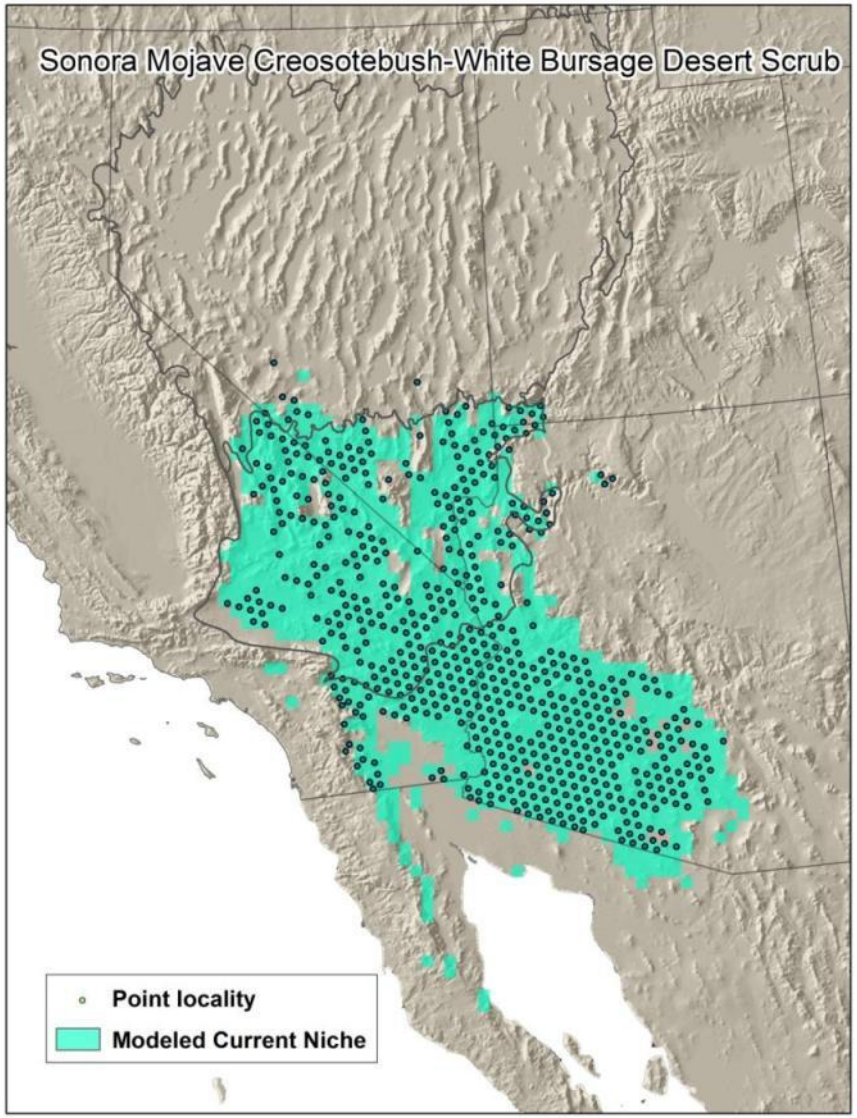
Rapid Ecoregional Assessment

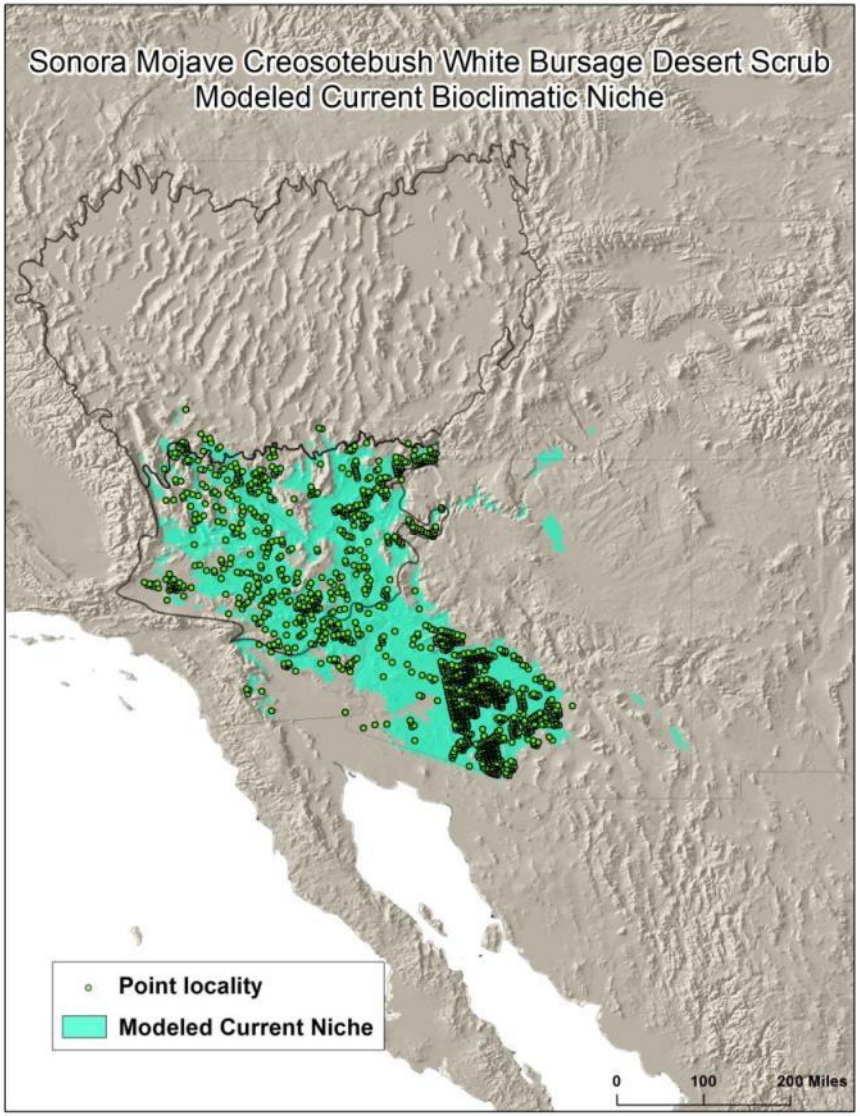

Sonora Mojave Creosotebush-White Bursage Desert Scrub
Point locality

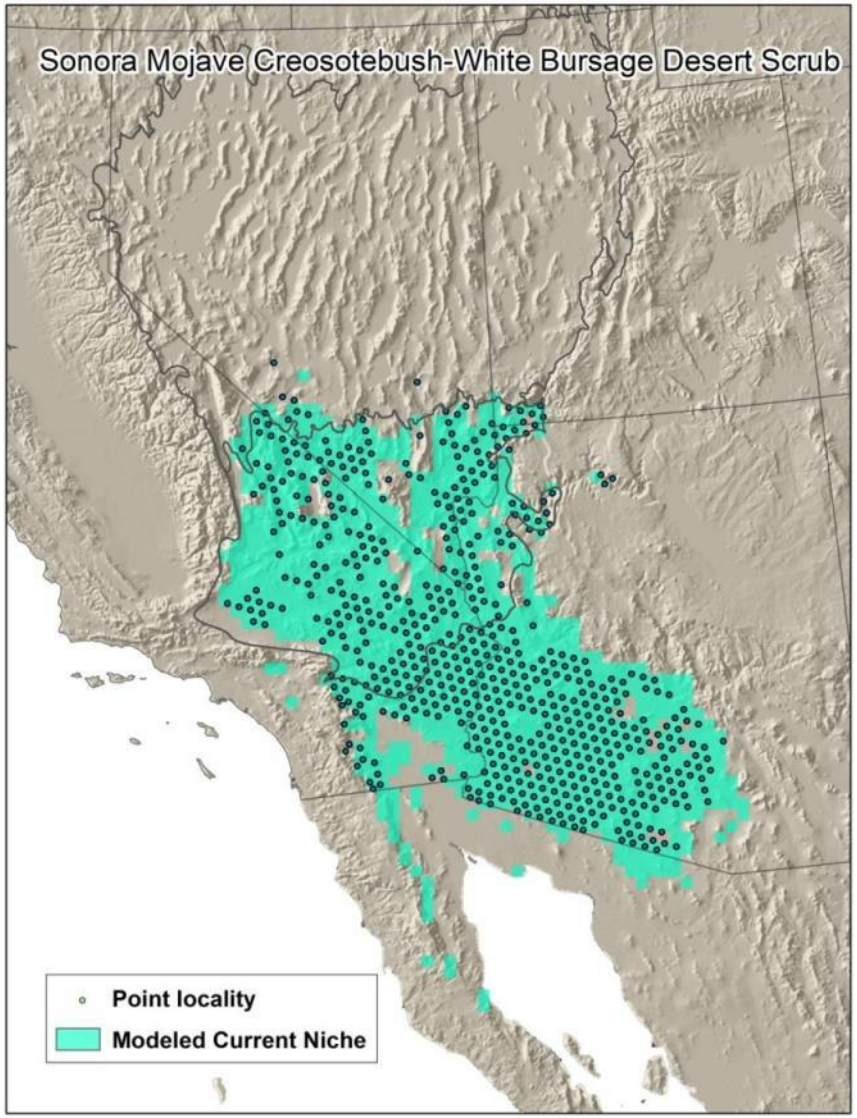

Sonora Mojave Creosotebush White Bursage Desert Scrub
Point locality
0
100
200 Miles

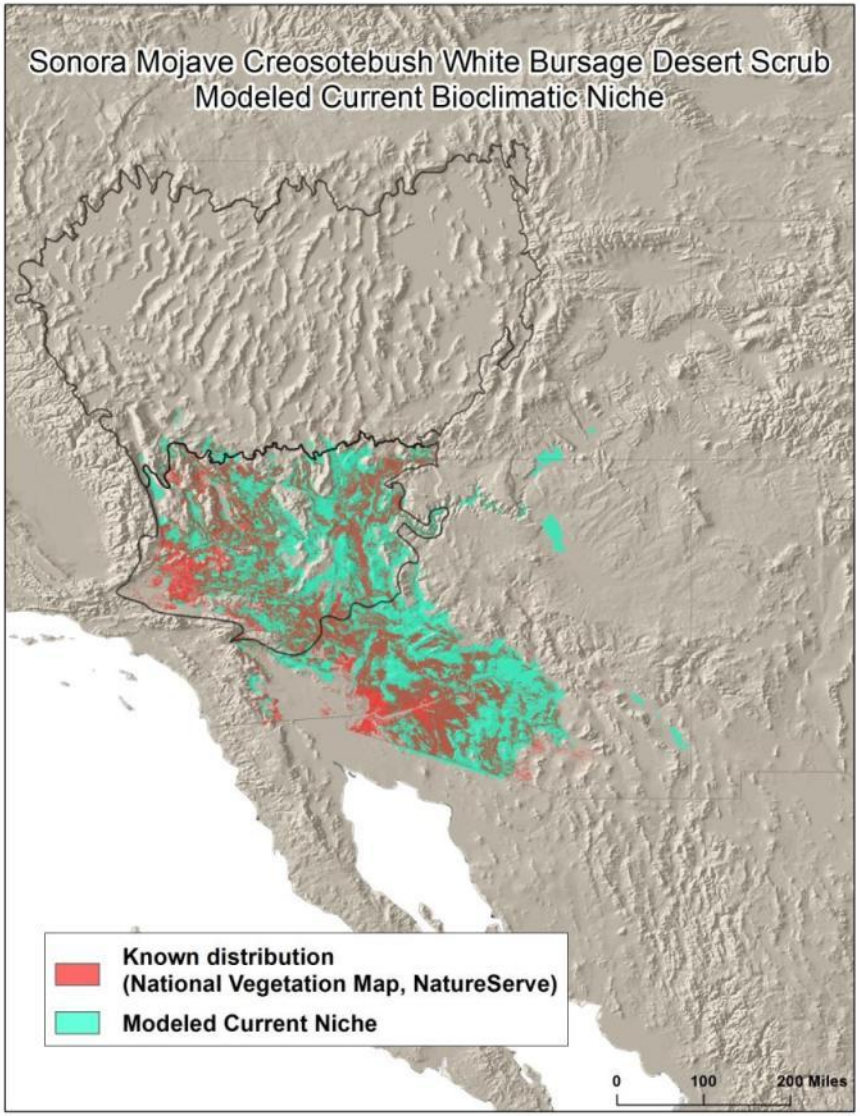

Sonora Mojave Creosotebush-White Bursage Desert Scrub
Modeled Current Niche

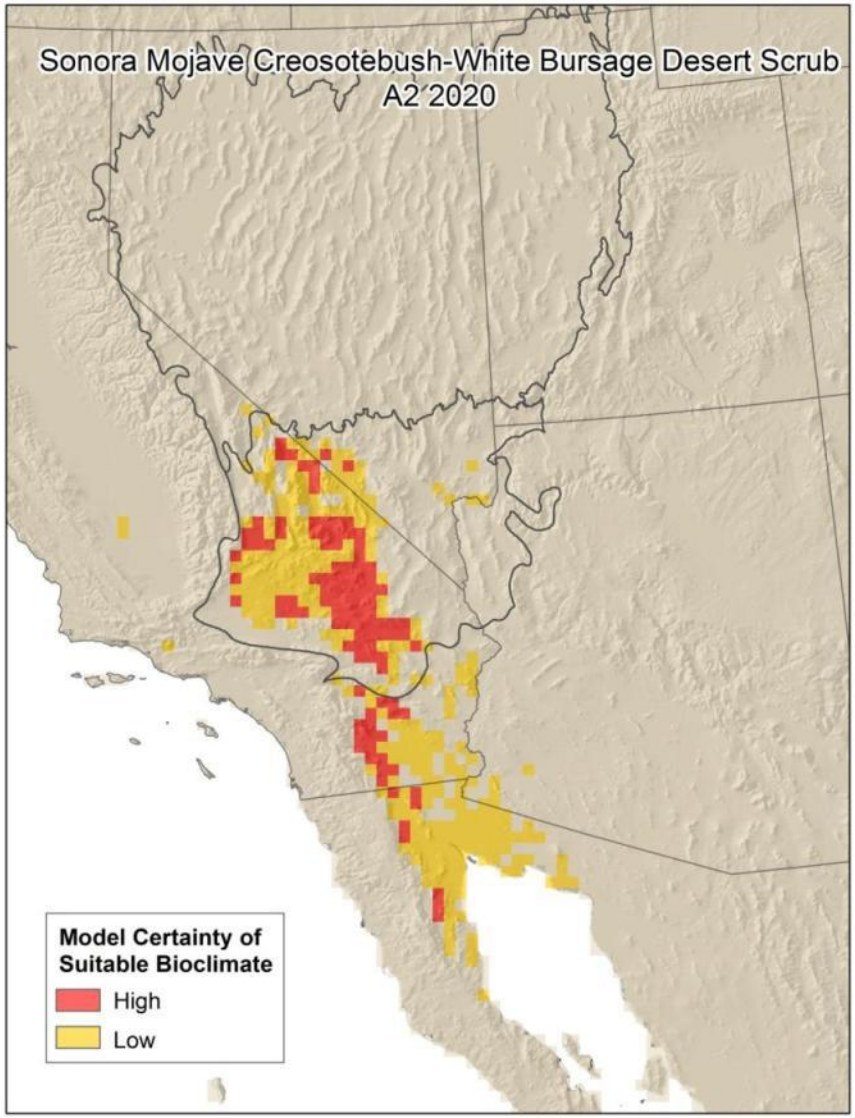

Sonora Mojave Creosotebush White Bursage Desert Scrub
Modeled Current Bioclimatic Niche
Modeled Current Niche
0
100
200 Miles

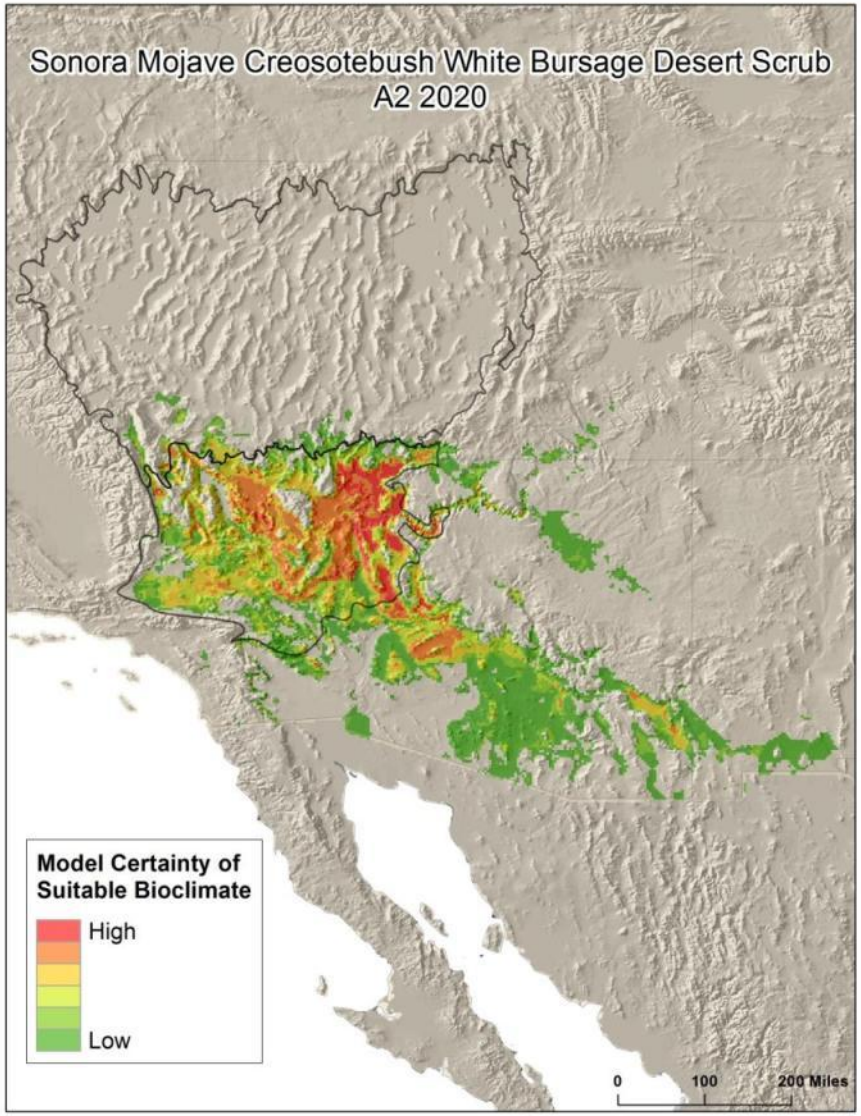

Sonora Mojave Creosotebush-White Bursage Desert Scrub
Point locality
Modeled Current Niche

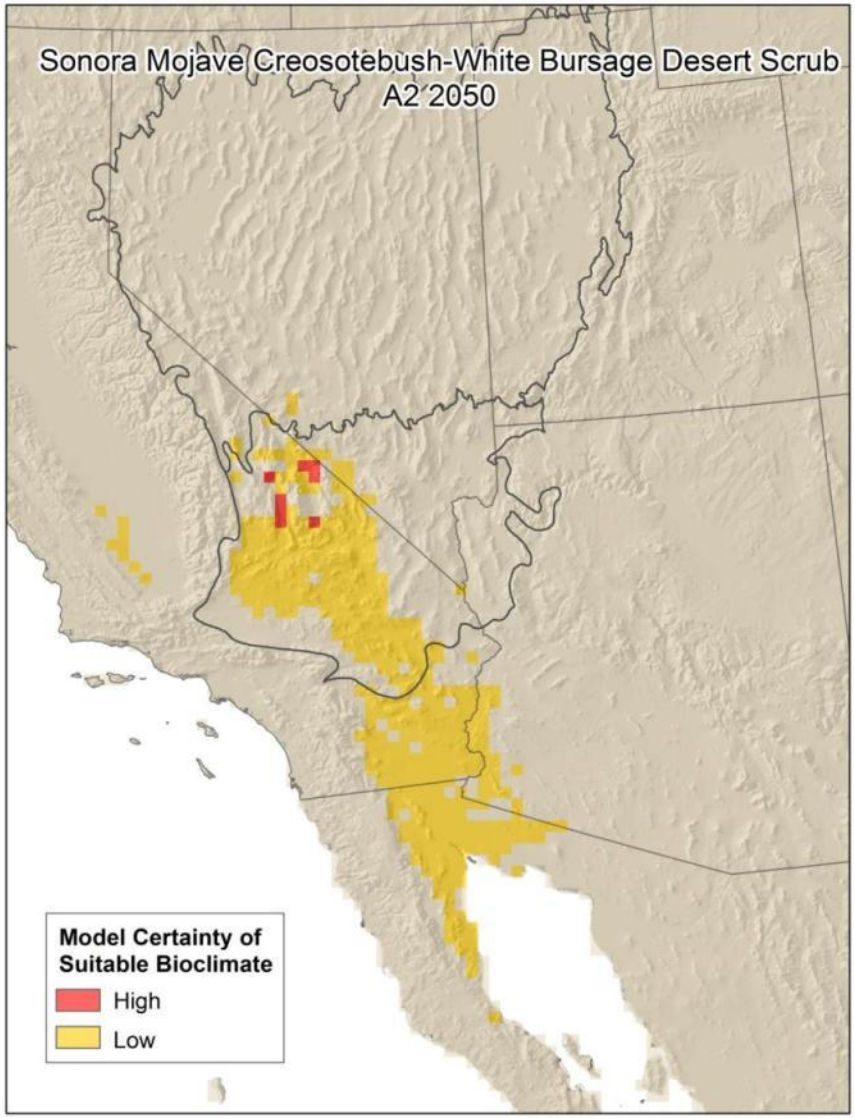

Sonora Mojave Creosotebush White Bursage Desert Scrub
Modeled Current Bioclimatic Niche
Point locality
Modeled Current Niche
0
100
200 Miles

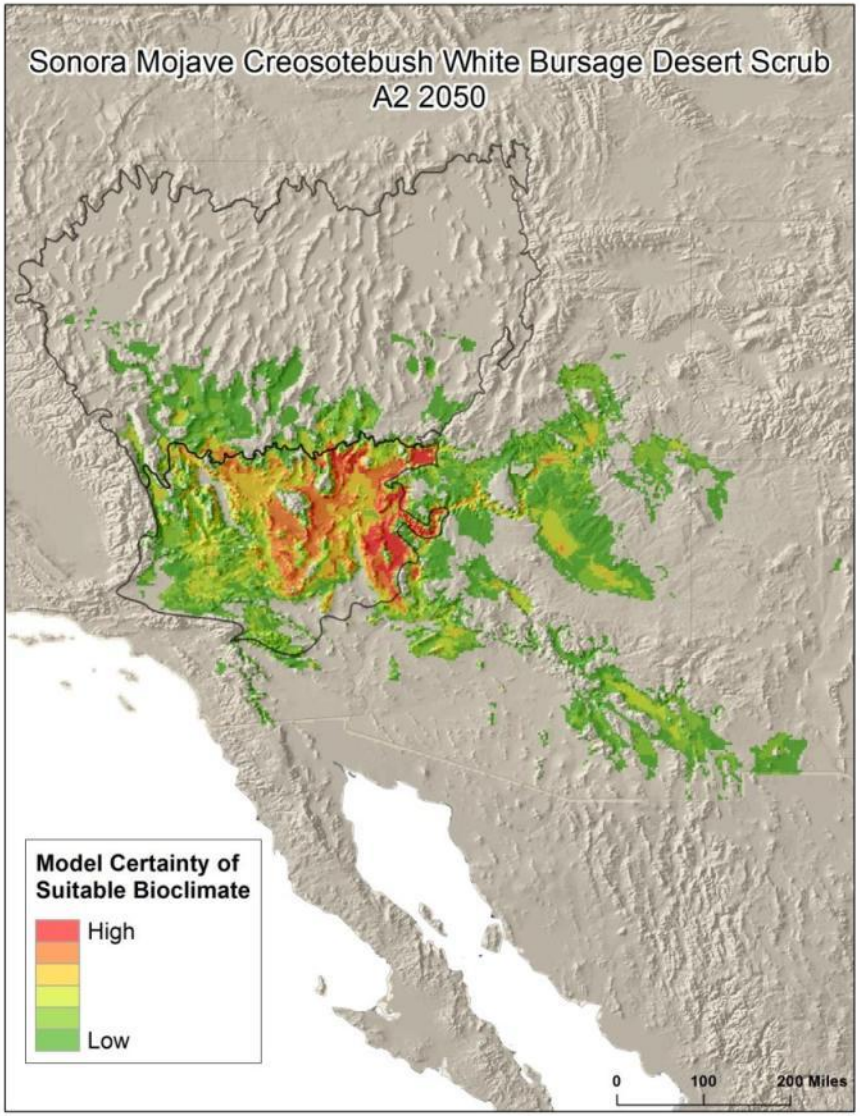

Sonora Mojave Creosotebush-White Bursage Desert Scrub
Point locality
Modeled Current Niche

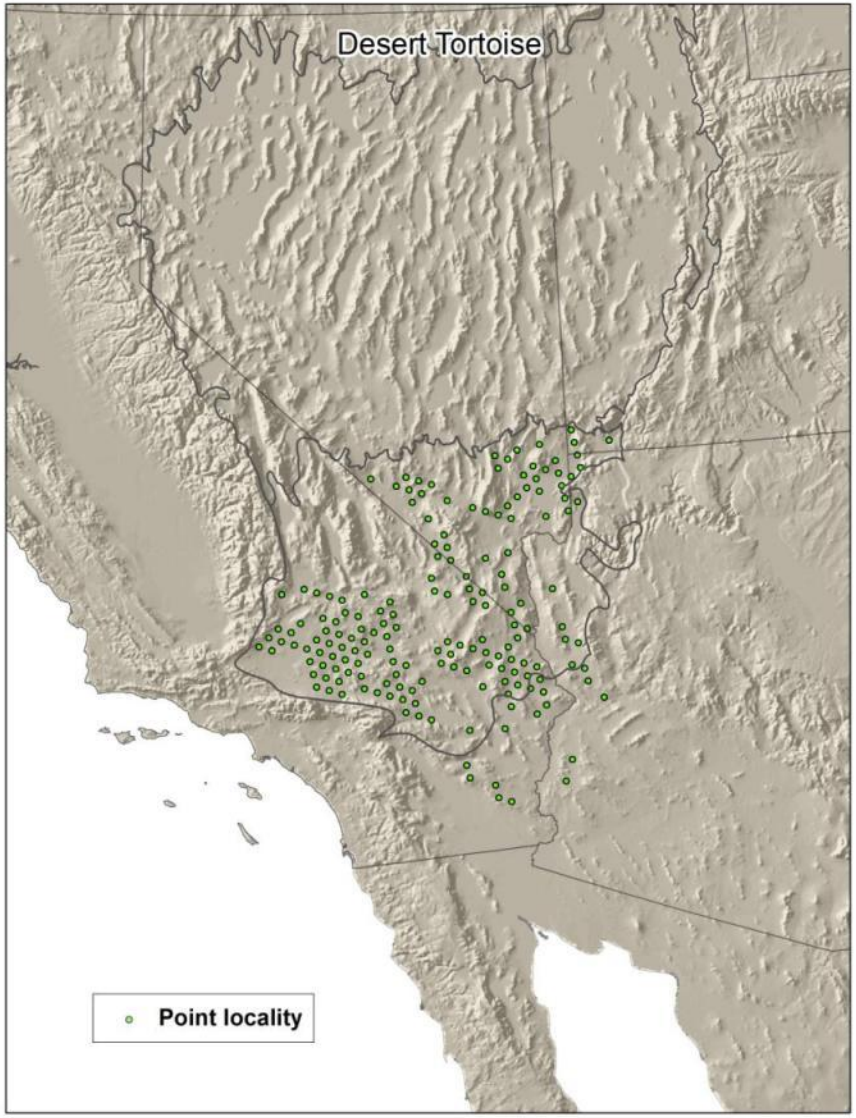

Sonora Mojave Creosotebush White Bursage Desert Scrub
Modeled Current Bioclimatic Niche
Known distribution
(National Vegetation Map, NatureServe)
Modeled Current Niche
0
100
200 Miles

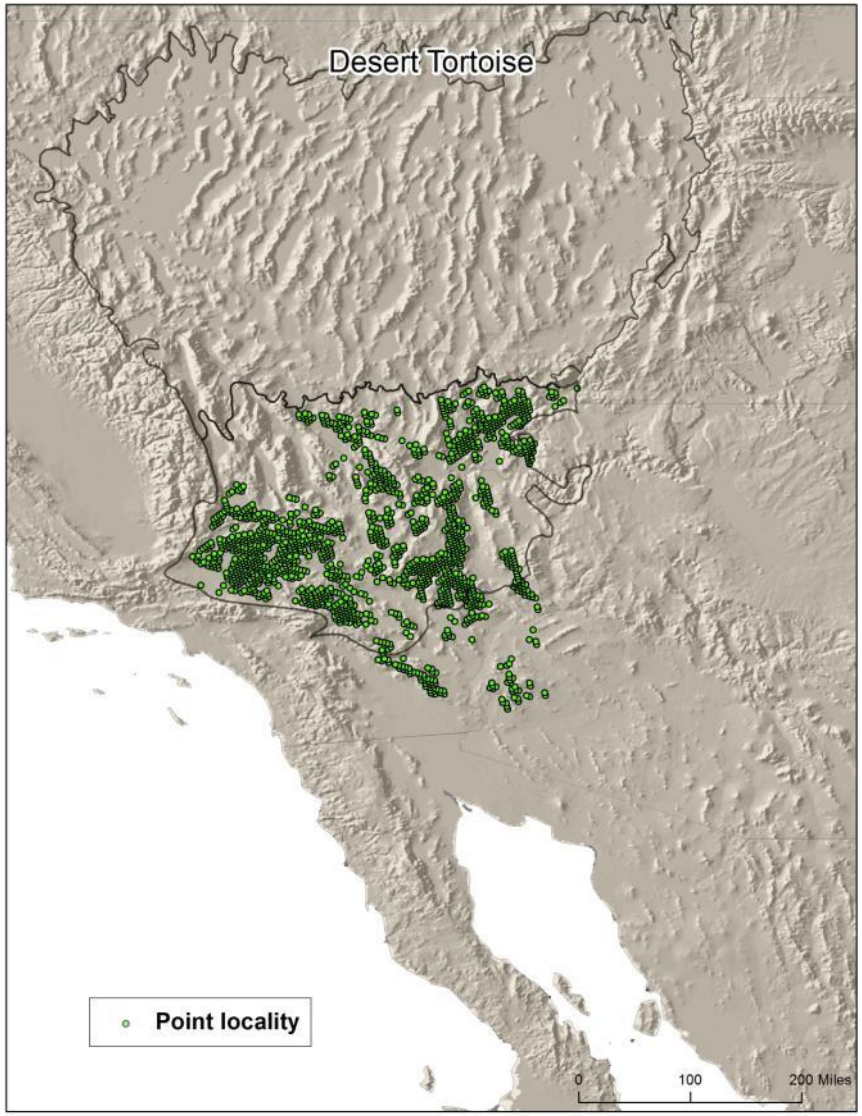

Sonora Mojave Creosotebush-White Bursage Desert Scrub
A2 2020
Model Certainty of Suitable Bioclimate
High
Low

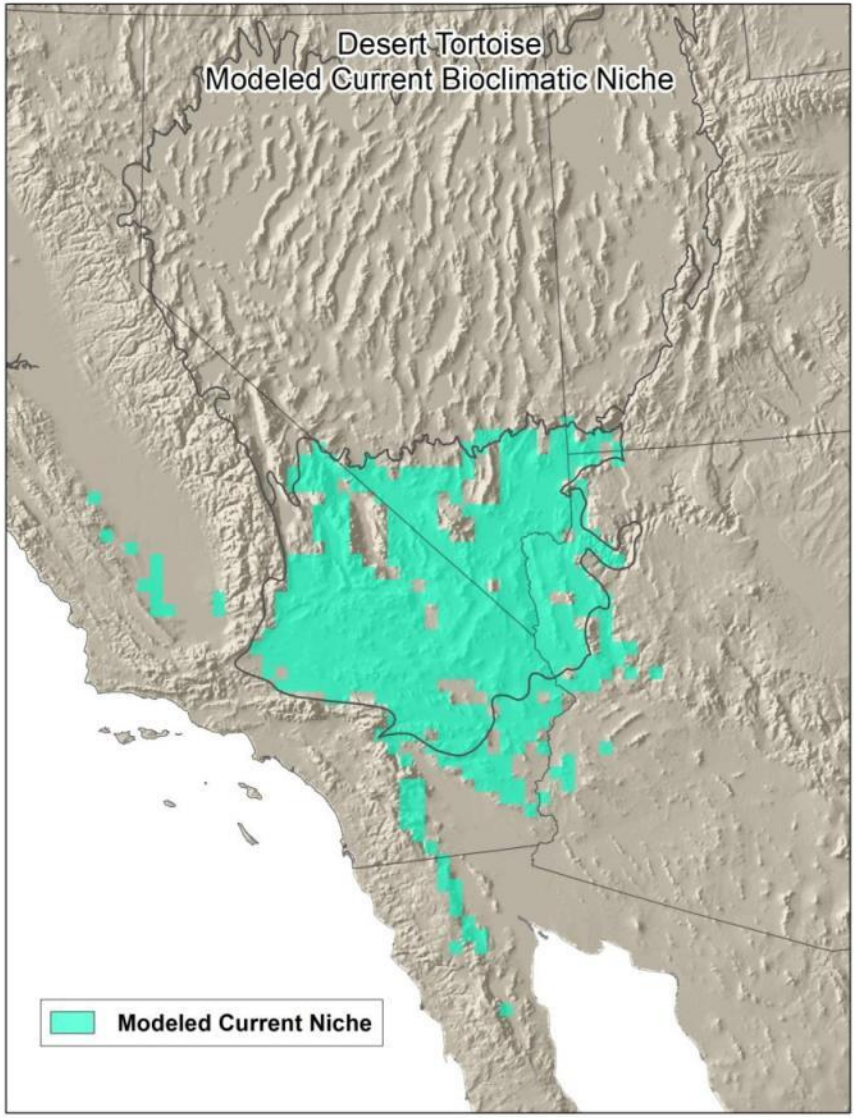

Sonora Mojave Creosotebush White Bursage Desert Scrub
A2 2020
Model Certainty of Suitable Bioclimate
High
Low
0
100
200 Miles

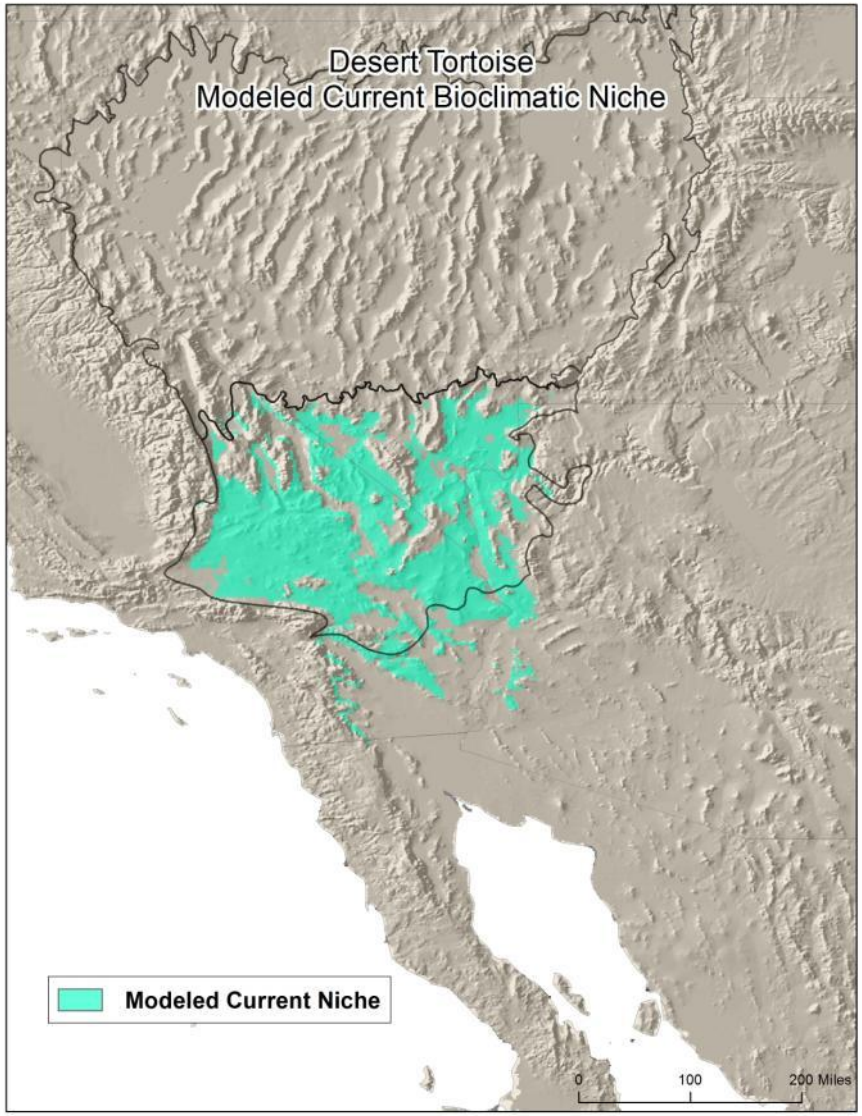

Sonora Mojave Creosotebush-White Bursage Desert Scrub
A2 2050
Model Certainty of Suitable Bioclimate
High
Low

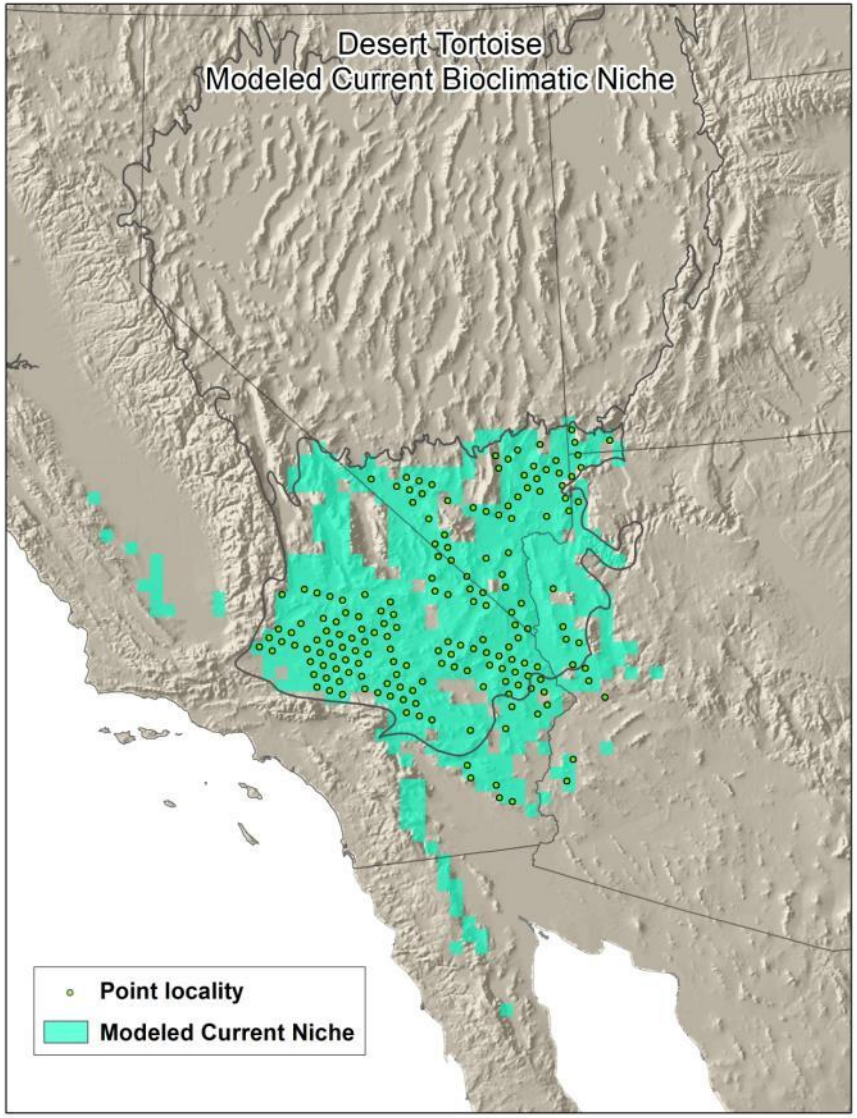

Sonora Mojave Creosotebush White Bursage Desert Scrub
A2 2050
Model Certainty of Suitable Bioclimate
High
Low
0
100
200 Miles

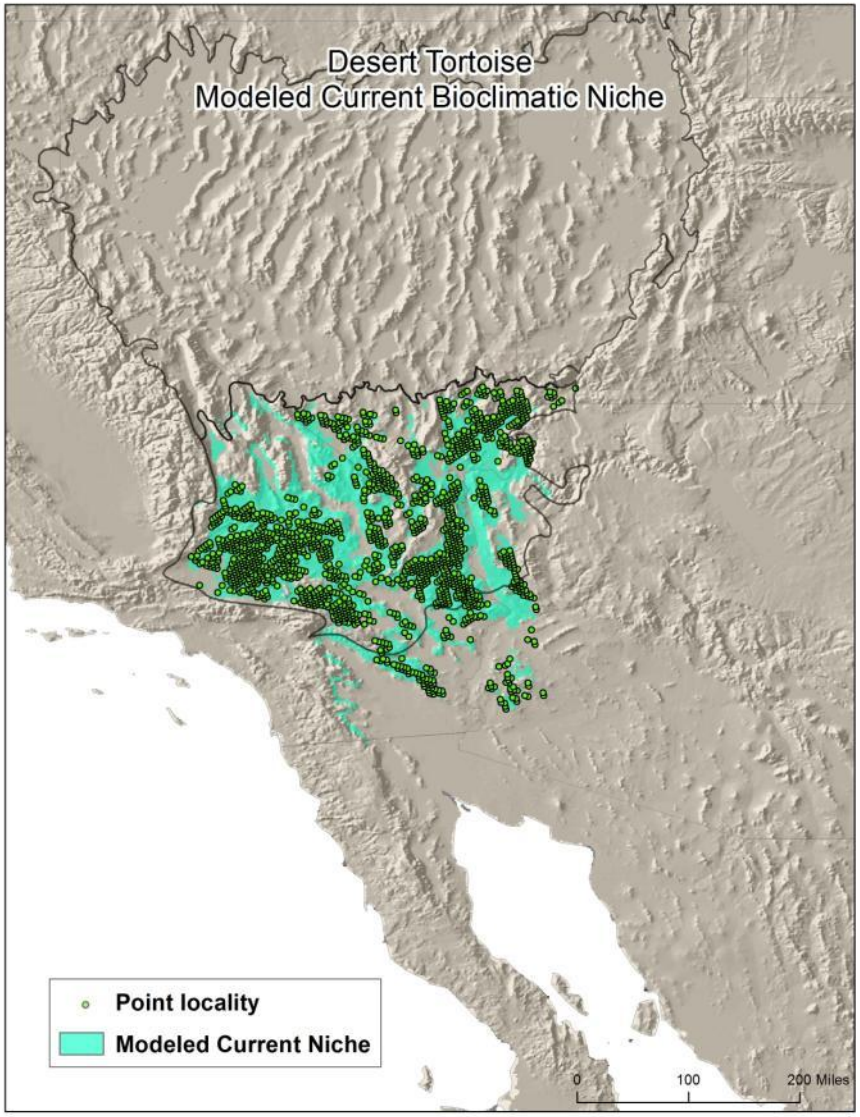

Desert Tortoise
Point locality


Desert Tortoise
Point locality
0
100
200 Miles


Desert Tortoise
Modeled Current Bioclimatic Niche
Modeled Current Niche

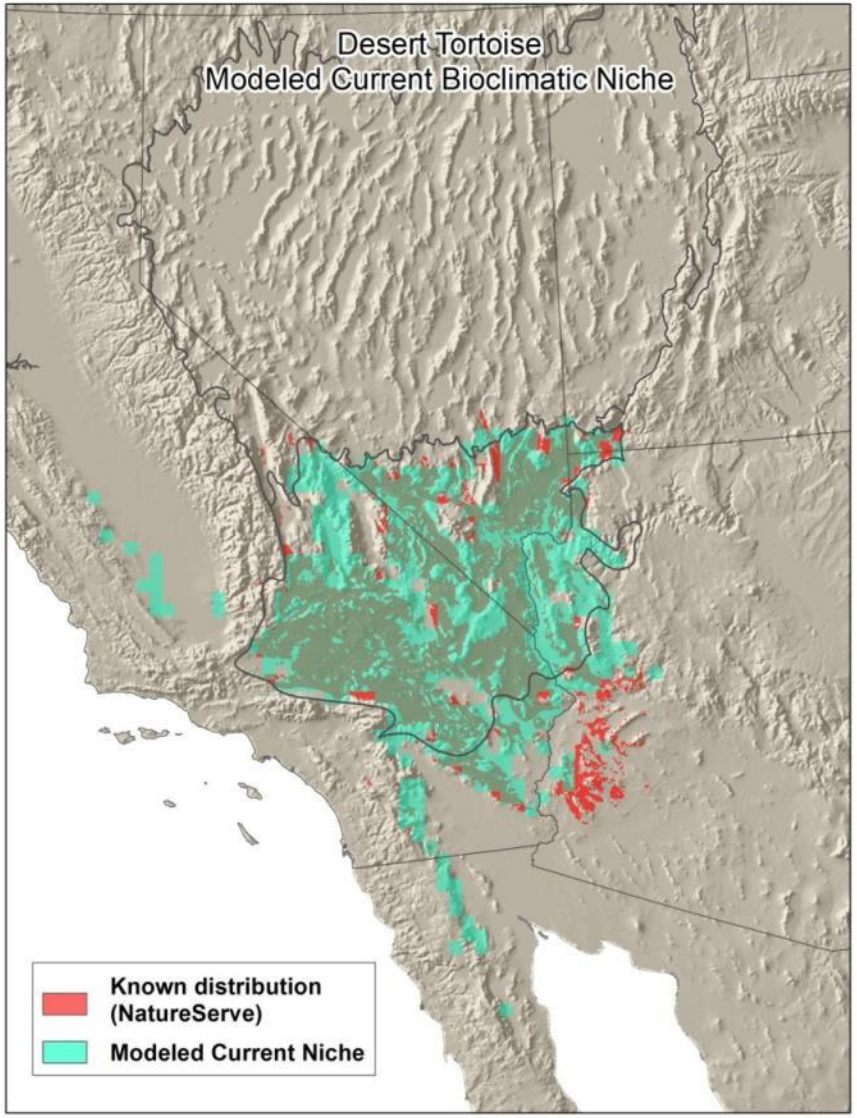

Desert Tortoise
Modeled Current Bioclimatic Niche
Modeled Current Niche
0
100
200 Miles

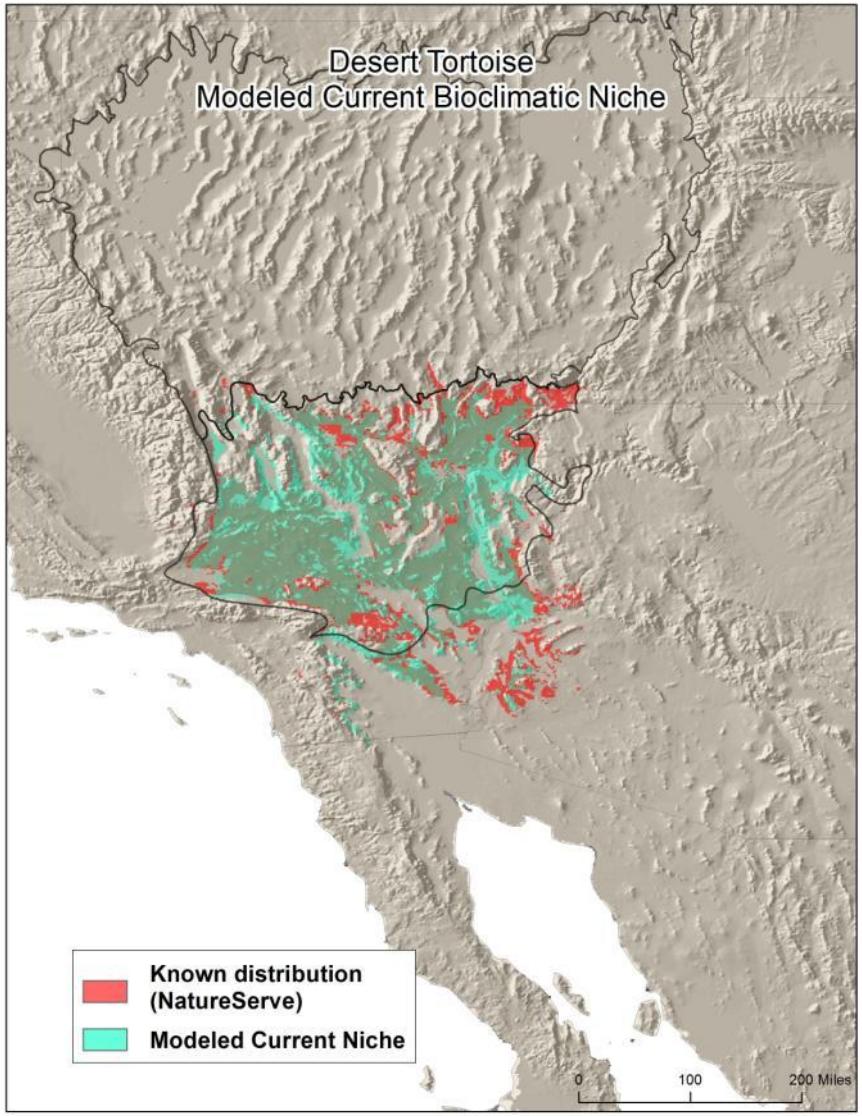


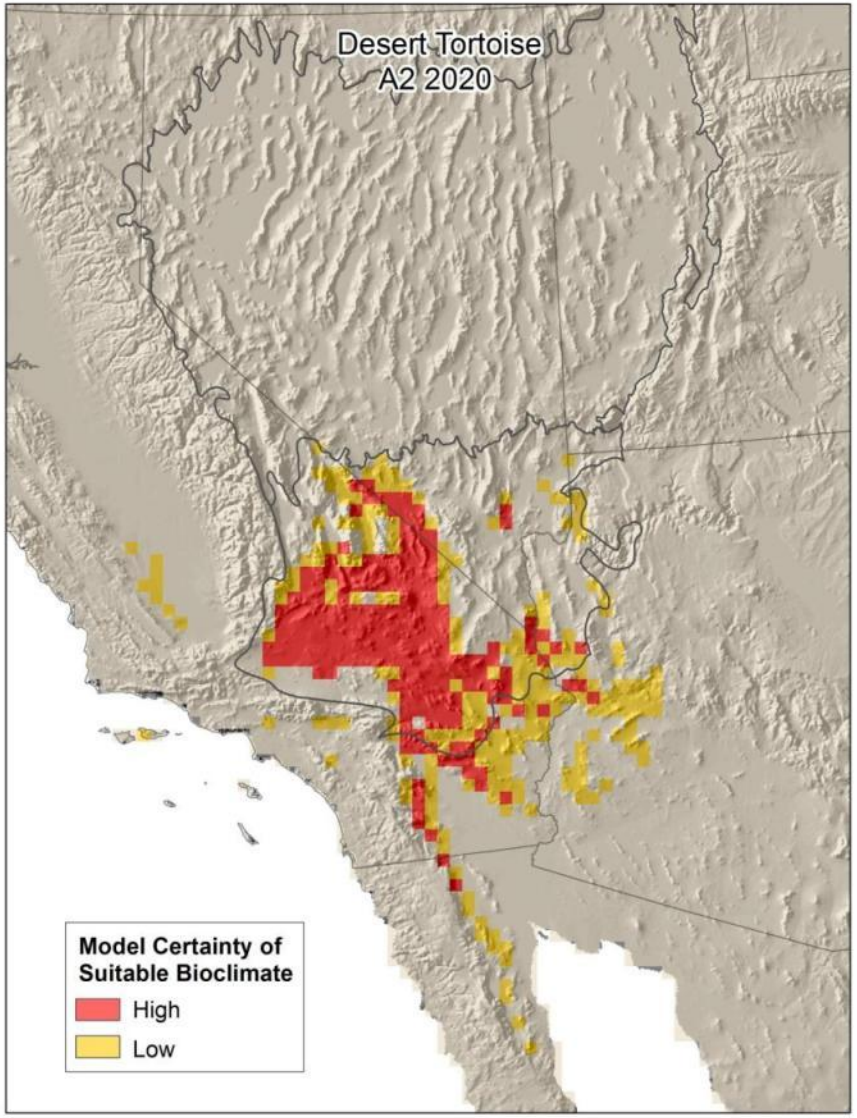


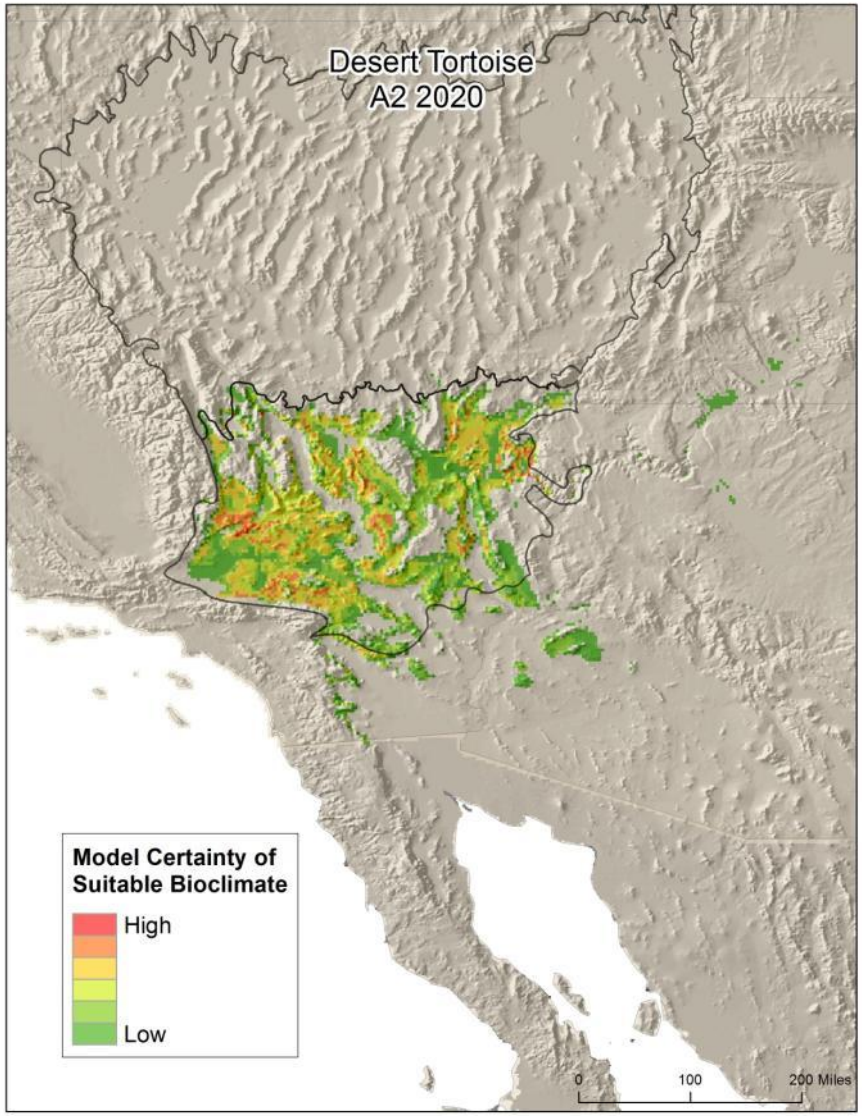
BLM

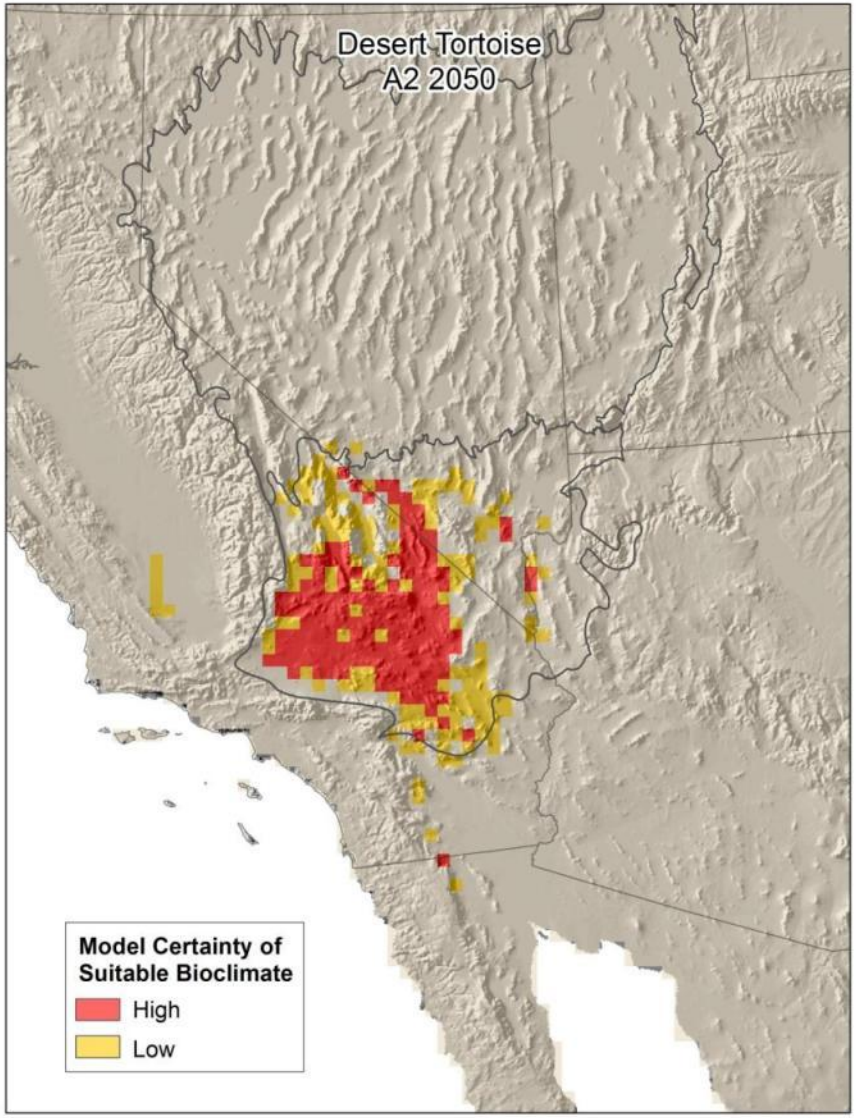
Rapid Ecoregional Assessment

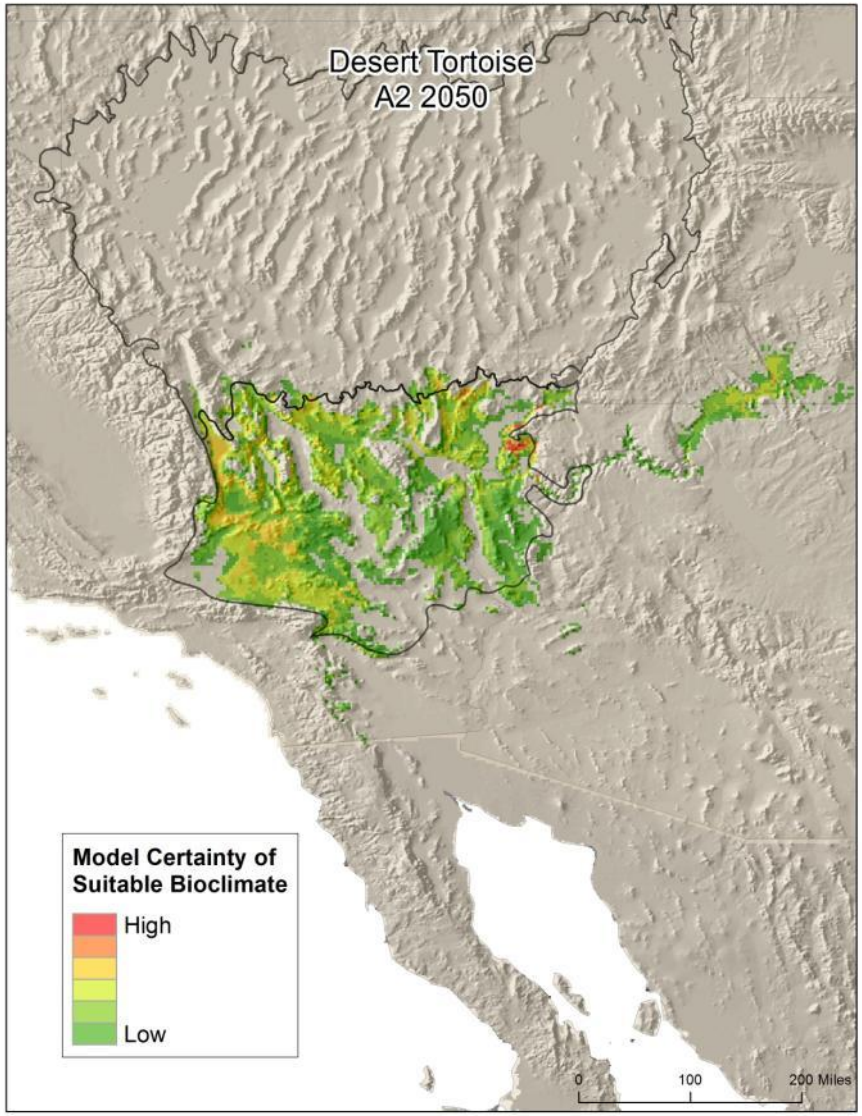

Desert Tortoise
Modeled Current Bioclimatic Niche
Known distribution (NatureServe)
Modeled Current Niche


Desert Tortoise
Modeled Current Bioclimatic Niche
Known distribution (NatureServe)
Modeled Current Niche
0
100
200 Miles


Desert Tortoise
A2 2020
Model Certainty of
Suitable Bioclimate
High
Low

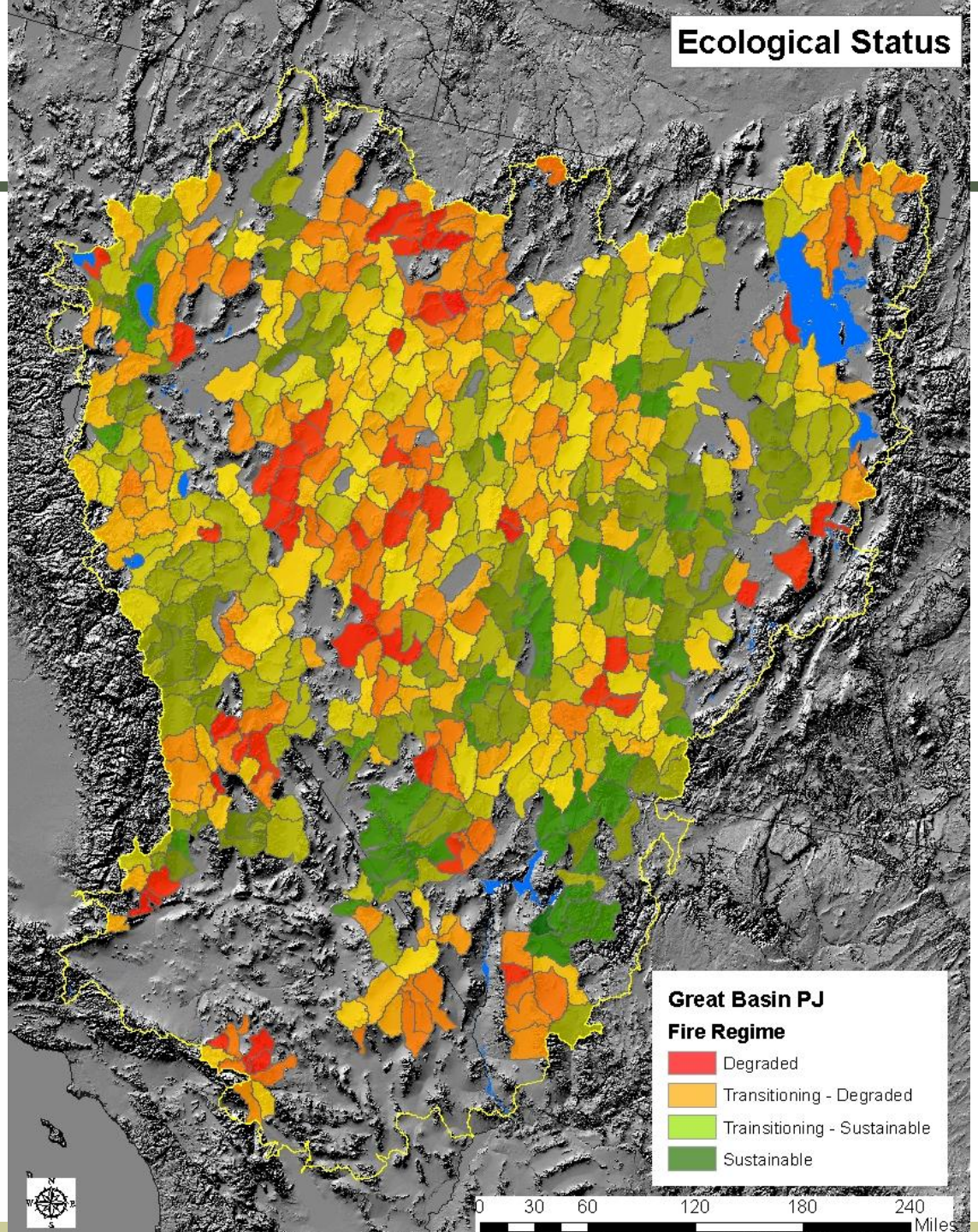

Desert Tortoise
A2 2020
Model Certainty of
Suitable Bioclimate
High
Low
0
100
200 Miles


Desert Tortoise
A2 2050
Model Certainty of
Suitable Bioclimate
High
Low


Desert Tortoise
A2 2050
Model Certainty of
Suitable Bioclimate
High
Low
0
100
200 Miles

Fire Regime

- Current Departure, by HUC
  - Modeled Historic Range of Variation (HRV) for each of the 29 veg types
  - Calculated Area of each Sclass for each veg type within each HUC
  - Calculated Departure, for each veg type, within each HUC
  - Calculated a weighted Mean Departure for each HUC. Weights were based on the relative spatial extent of each veg type



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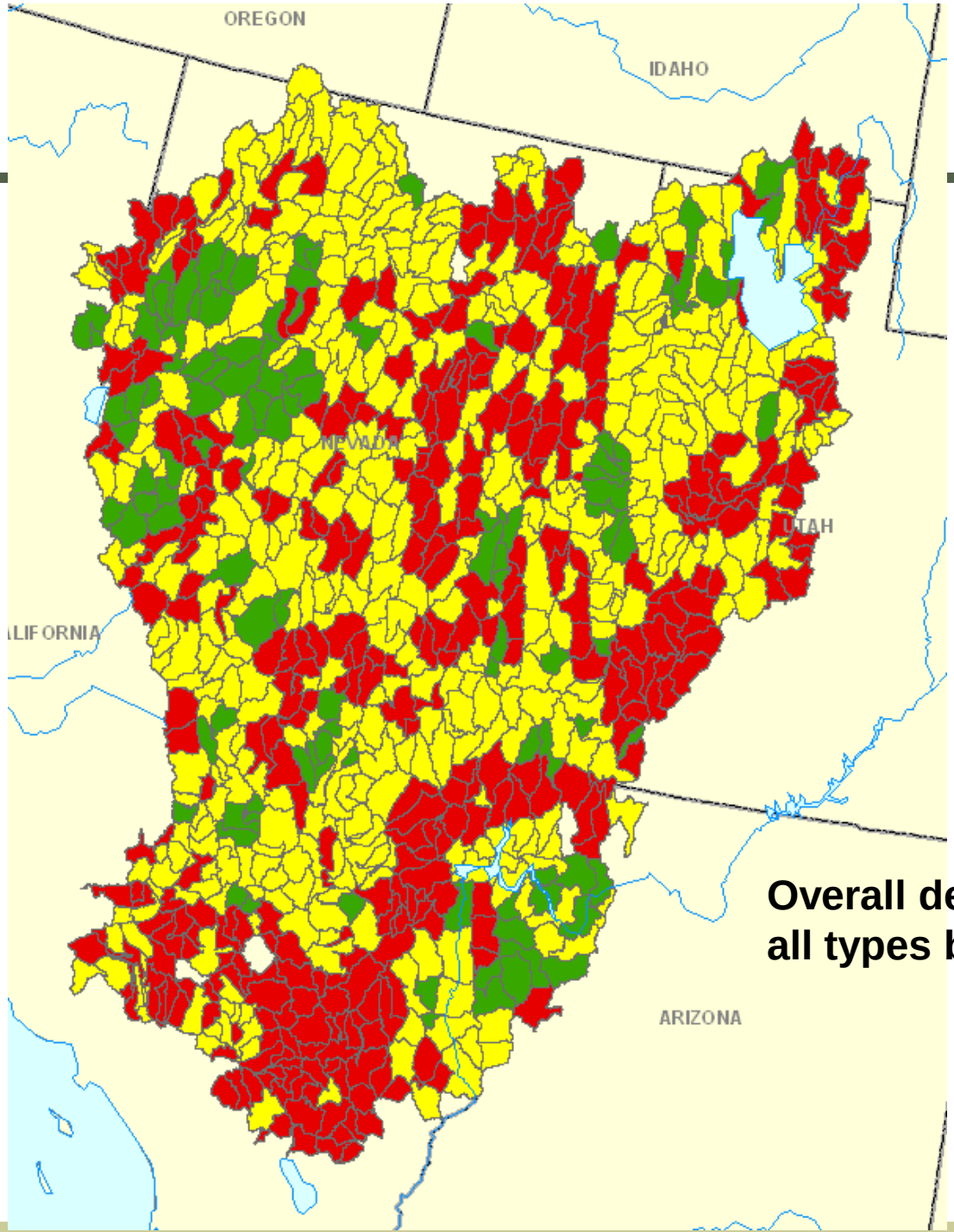
Rapid Ecoregional Assessment



Overall departure for all types by HUC

Fire Regime forecasts

- Too many watersheds X types for individual forecasts (11,828)
- Use of FRCC departure index (0-10) to characterize range by type across ecoregion (e.g., all fall into categories 2-6)
- Based on actual distributions, run 3 characteristic forecasts per type
- Report forecast results by watershed based on 3-5 forecast models per type

Fire Regime forecasts

Current Departure Class (1-3)

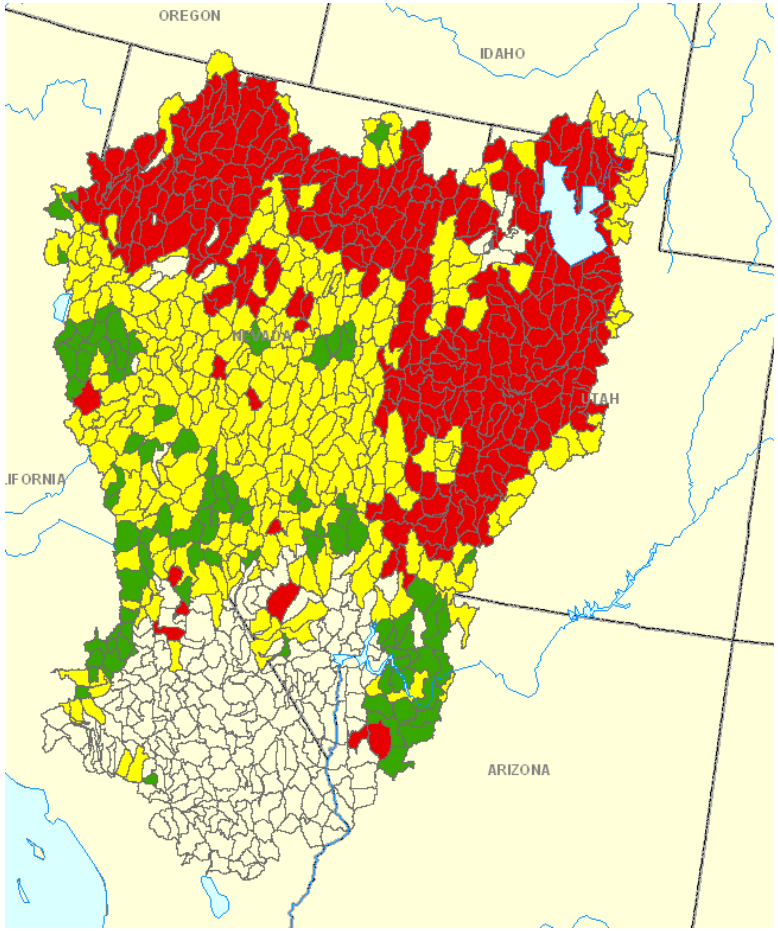
Average of SClass extent for each veg type in each Departure class

Run models for each Departure Class With initial conditions as average Sclass extent for each Departure class

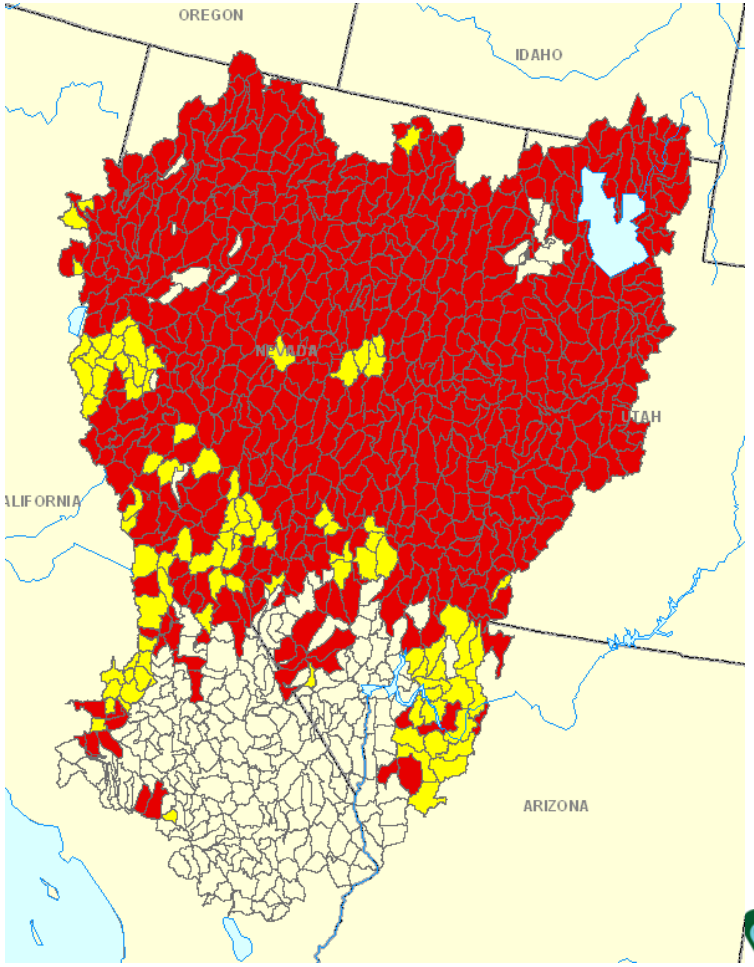
Assign Future Sclass for each veg type Within each HUC based on model results

Fire Regime forecasts

Inter-Mountain Basins Big Sagebrush Shrubland



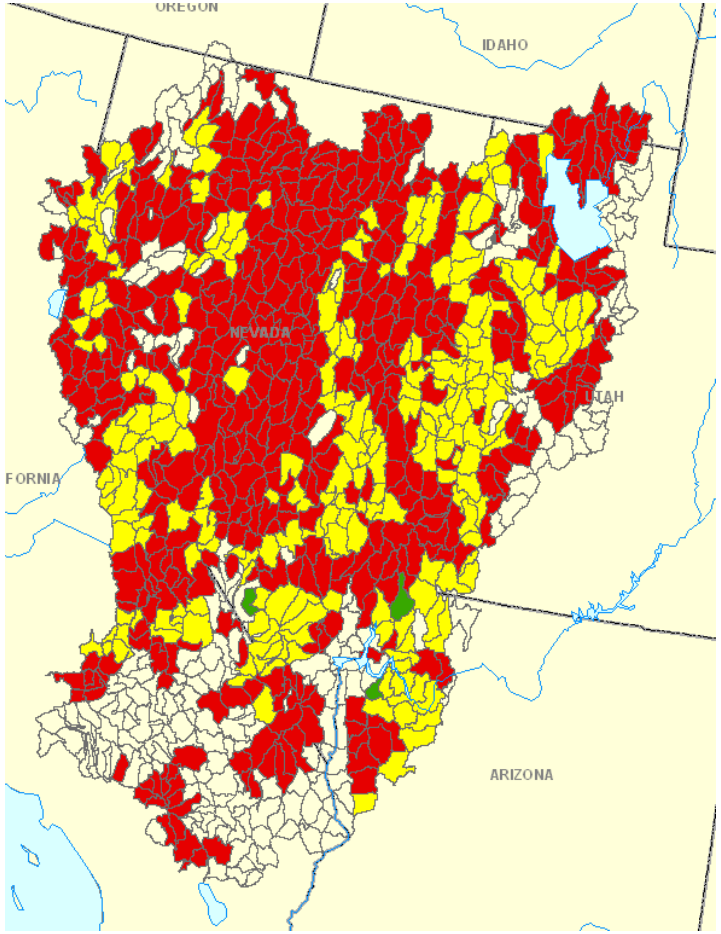
Current



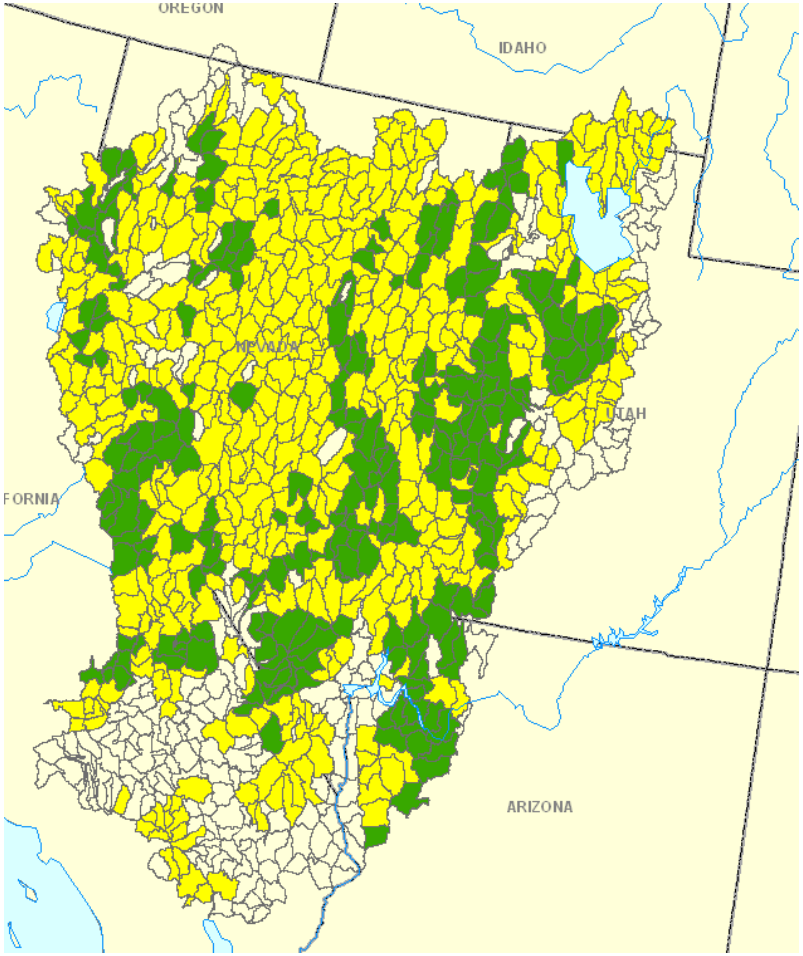
2060

Fire Regime forecasts

Great Basin Pinyon-Juniper Woodland



Current



2060

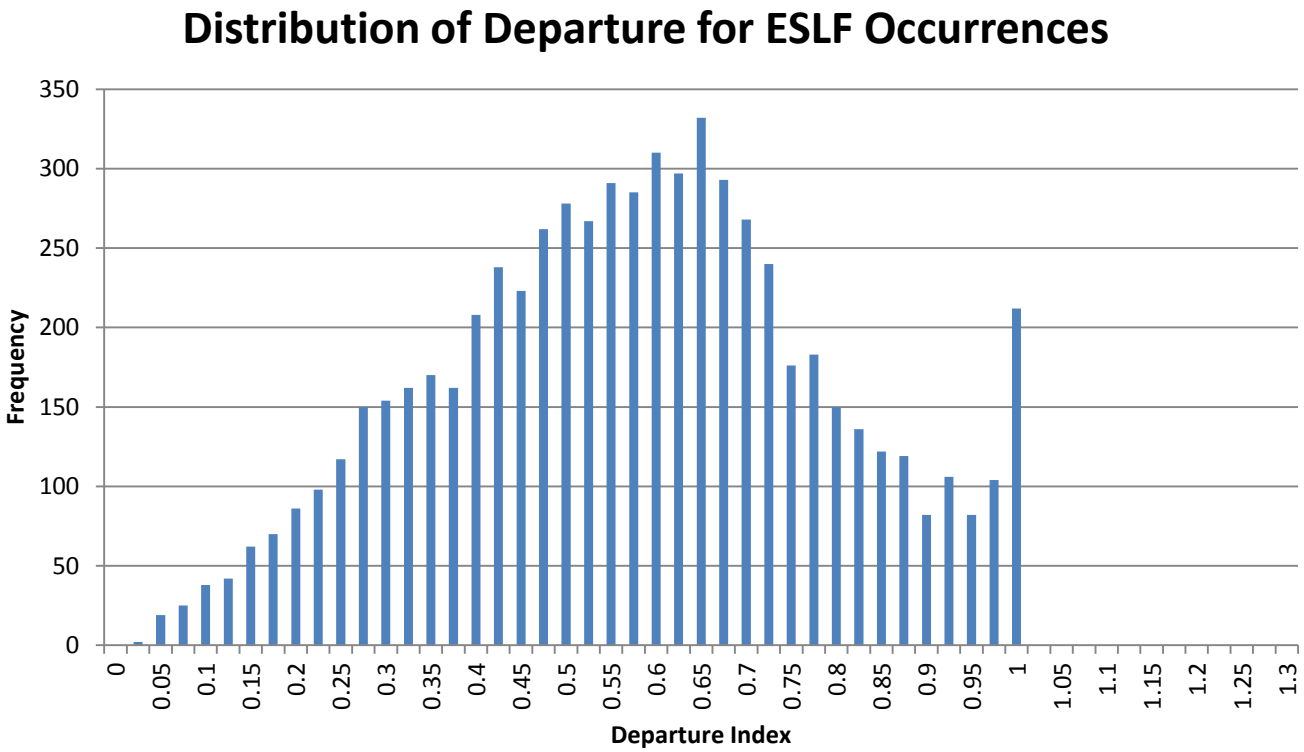
BLM
Rapid Ecoregional Assessment

Forecasting 2060 w/Climate Change

- Climate change translated into fire probabilities within VDDT models
- In general, stand-replacing fires are so infrequent that changes in departure from CC effects do not manifest by 2025 and only begin effecting change by 2060
- An area for future research…

Reporting issues and options

- Number of Classes



Reporting issues and options

- Reporting by veg type v. HUC
- Including Current Land Use

Break

Final report outline/product formats (Ford)

Discussion, recap parking lot items, & identify new agenda items for day 3

Adjourn Day 2
Dinner on your own