

Matching seed to site by climate similarity: Tools to prioritize plant materials development and use

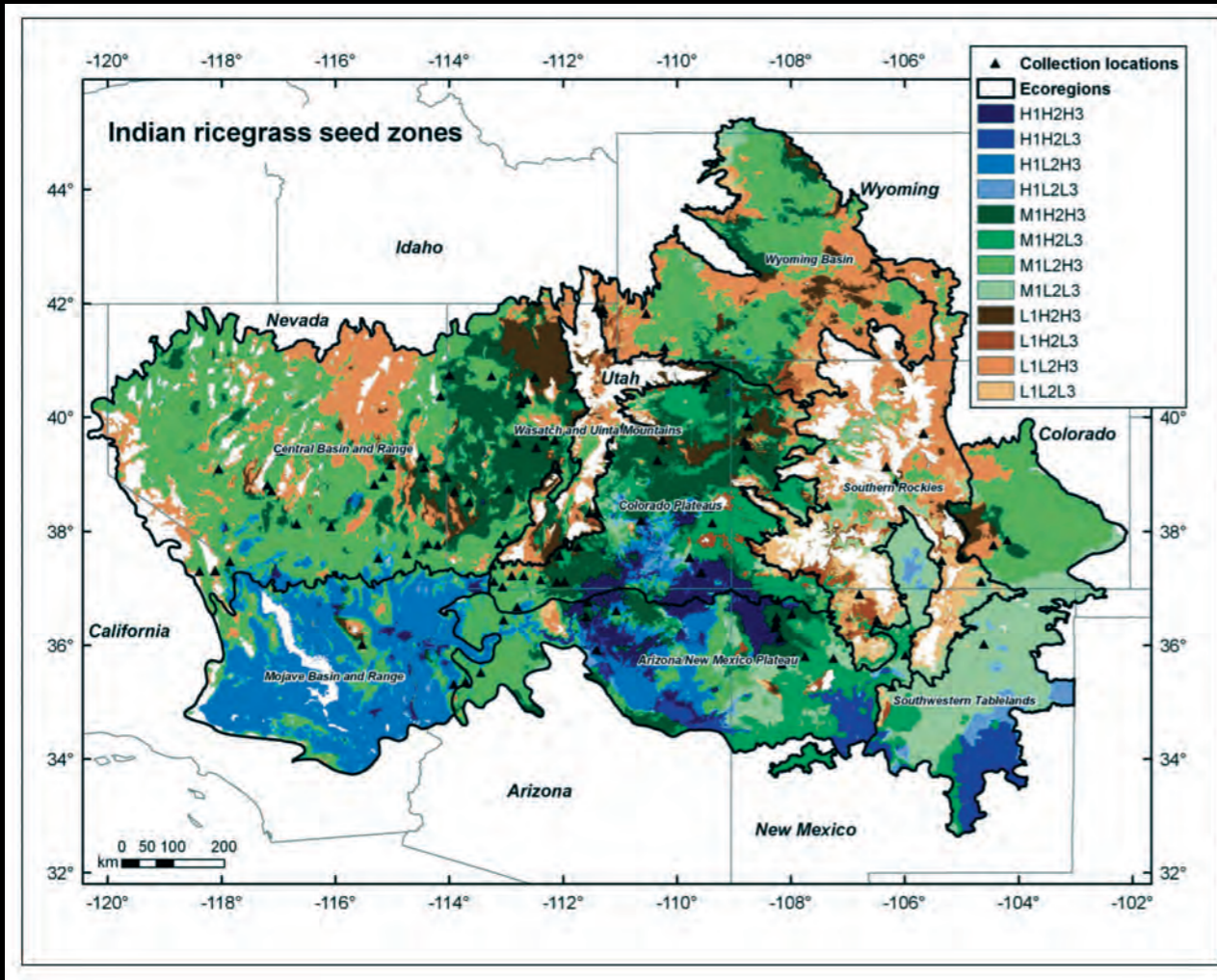


Kyle Doherty
Troy Wood
Bradley Butterfield

Seed Transfer Frameworks

- Which seeds are appropriate where?
- Where should we be collecting to diversify our plant materials?

Seed Zones



Johnson et al 2012



Bower et al 2014

Climate Similarity

ECOLOGICAL APPLICATIONS
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Article


Matching seed to site by climate similarity: Techniques to prioritize plant materials development and use in restoration

[Kyle D. Doherty](#) , [Bradley J. Butterfield](#), [Troy E. Wood](#)

Accepted manuscript online: 23 January 2017 [Full publication history](#)

DOI: 10.1002/eap.1505 [View/save citation](#)

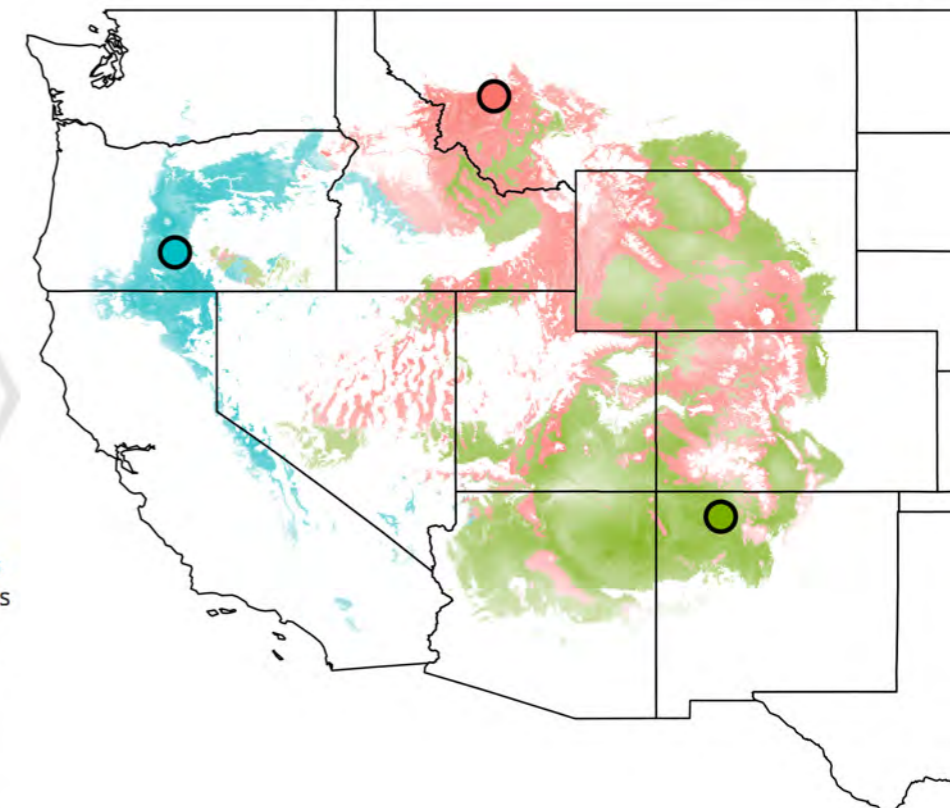
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Tool #1: Seed Selector

Which seeds to use?

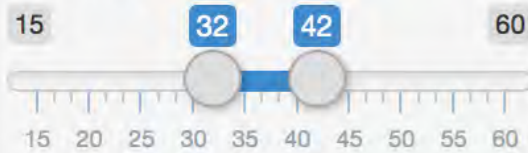
https://seedmapper.shinyapps.io/seed_selector/

App takes ~15 seconds to initialize, please wait.

How would you like to define your area of interest?

Lat/long slider bars ▾

Latitude Extent



Longitude Extent



id	x	y
custom id 1	-107.46667	35.88333
custom id 2	-108.64655	40.11694

Now upload a .csv of your accession data (maximum of 50 accessions) in the format pictured above (id, long, lat):

Choose File no file selected

Match Seed to Climate

Download Data

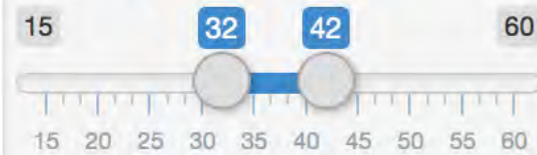
Click above to download underlying rasters and summary data. Note that clicking will open a new tab.

App takes ~15 seconds to initialize, please wait.

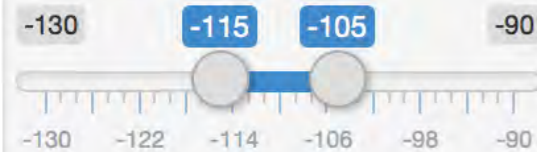
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Latitude Extent



Longitude Extent



id	x	y
custom id 1	-107.46667	35.88333
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Match Seed to Climate

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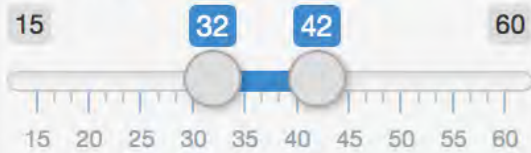
Click above to download underlying rasters and summary data. Note that clicking will open a new tab.

App takes ~15 seconds to initialize, please wait.

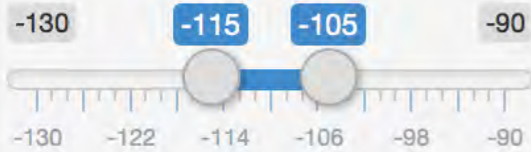
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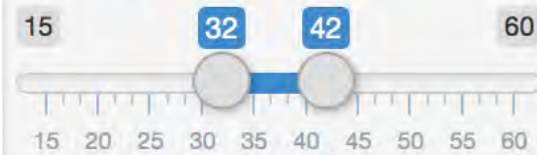
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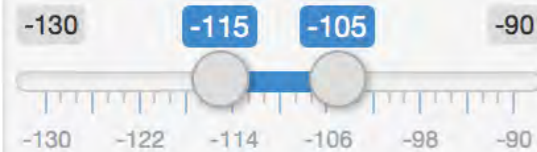
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Map

Accession Climate Data

Accession Assignment Distributions

Background and Use

App takes ~15 seconds to initialize, please wait.

How would you like to define your area of interest?

Lat/long slider bars ▲

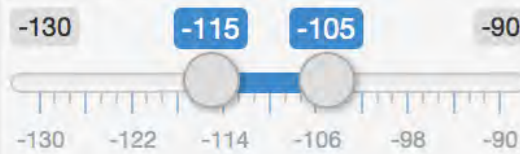
Lat/long slider bars

Spatial polygon

Raster

Species Distribution Model

Longitude Extent



id	x	y
custom id 1	-107.46667	35.88333
custom id 2	-108.64655	40.11694

Now upload a .csv of your accession data (maximum of 50 accessions) in the format pictured above (id, long, lat):

Choose File no file selected

Match Seed to Climate

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App takes ~15 seconds to initialize, please wait.

How would you like to define your area of interest?

Lat/long slider bars ▲

Lat/long slider bars

Spatial polygon

Raster

Species Distribution Model

Longitude Extent



id	x	y
custom id 1	-107.46667	35.88333
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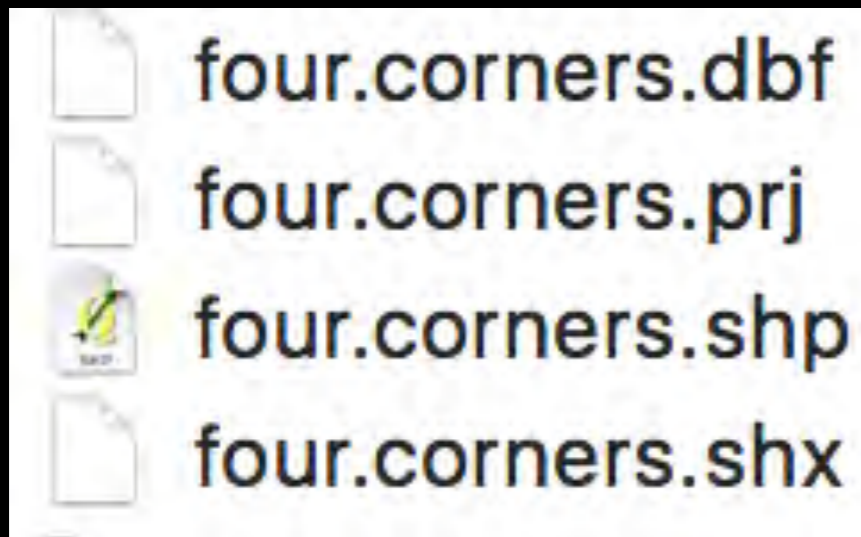
Choose File no file selected

Match Seed to Climate

Download Data

Click above to download underlying rasters and summary data. Note that clicking will open a new tab.

Compress spatial polygon files



Upload to app

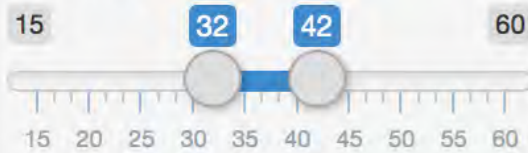


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Latitude Extent



Longitude Extent



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Choose File no file selected

Match Seed to Climate

Download Data

Click above to download underlying rasters and summary data. Note that clicking will open a new tab.

Our accession data (maximum of 50)

	A	B	C	D	E
1	id	x	y		
2	northern az	-108.09938	35.9556217		
3	southern az	-109.71437	33.8565727		
4	utah	-109.53858	38.1214428		
5	colorado	-107.42921	38.1041548		
6	new mexico	-107.06666	34.836193		
7					
8					
9					
10					

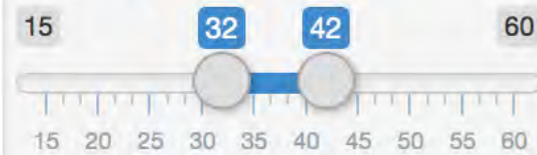
Save as **.CSV**

App takes ~15 seconds to initialize, please wait.

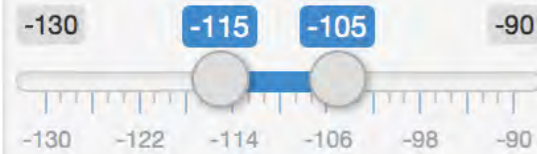
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Lat/long slider bars ▾

Latitude Extent



Longitude Extent



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Choose File no file selected

Match Seed to Climate

Download Data

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App ready!

How would you like to define your area of interest?

Spatial polygon

Upload spatial polygon files (.shp, .shx, .prj, and .dbf) compressed into a .zip format:

Choose File four.corners.zip
Upload complete

id	x	y
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custom id 2	-108.64655	40.11694

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Choose File exampl...s.csv
Upload complete

Match Seed to Climate

Download Data

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Mapping climate similarity
Calculating maximum climate
Extracting climate data for user extent

**Calculations underway,
larger extents take longer.
Have a coffee, check email,
come back in ~3 to 5 mins.**

App ready!

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Map

Accession Climate Data

Accession Assignment Distributions

Background and Use

+

-

Light Basemap

Terrain

Assignments

Accessions

Click for:

Rankings

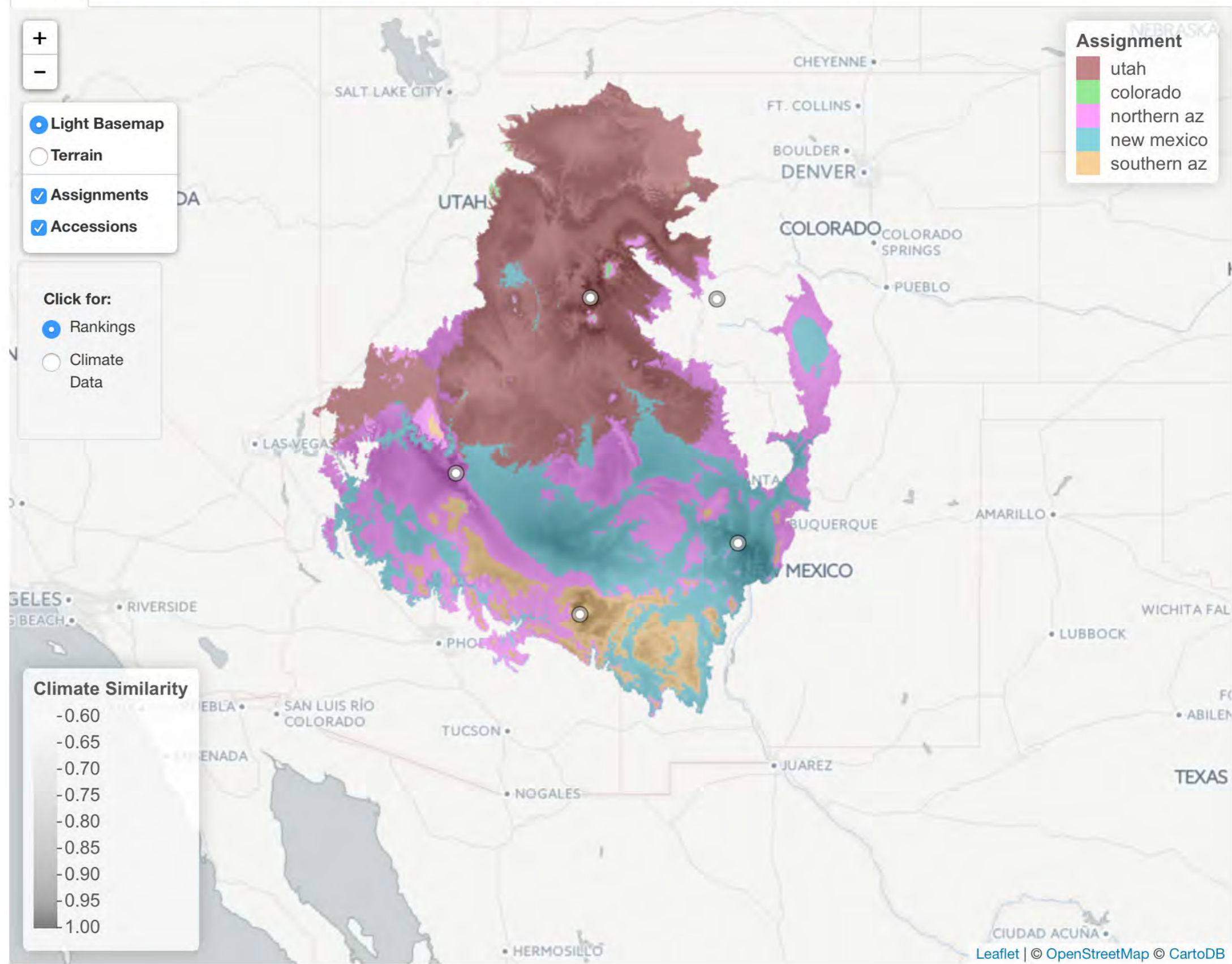
Climate Data

Climate Similarity

-0.60
-0.65
-0.70
-0.75
-0.80
-0.85
-0.90
-0.95
1.00

Assignment

utah
colorado
northern az
new mexico
southern az



App ready!

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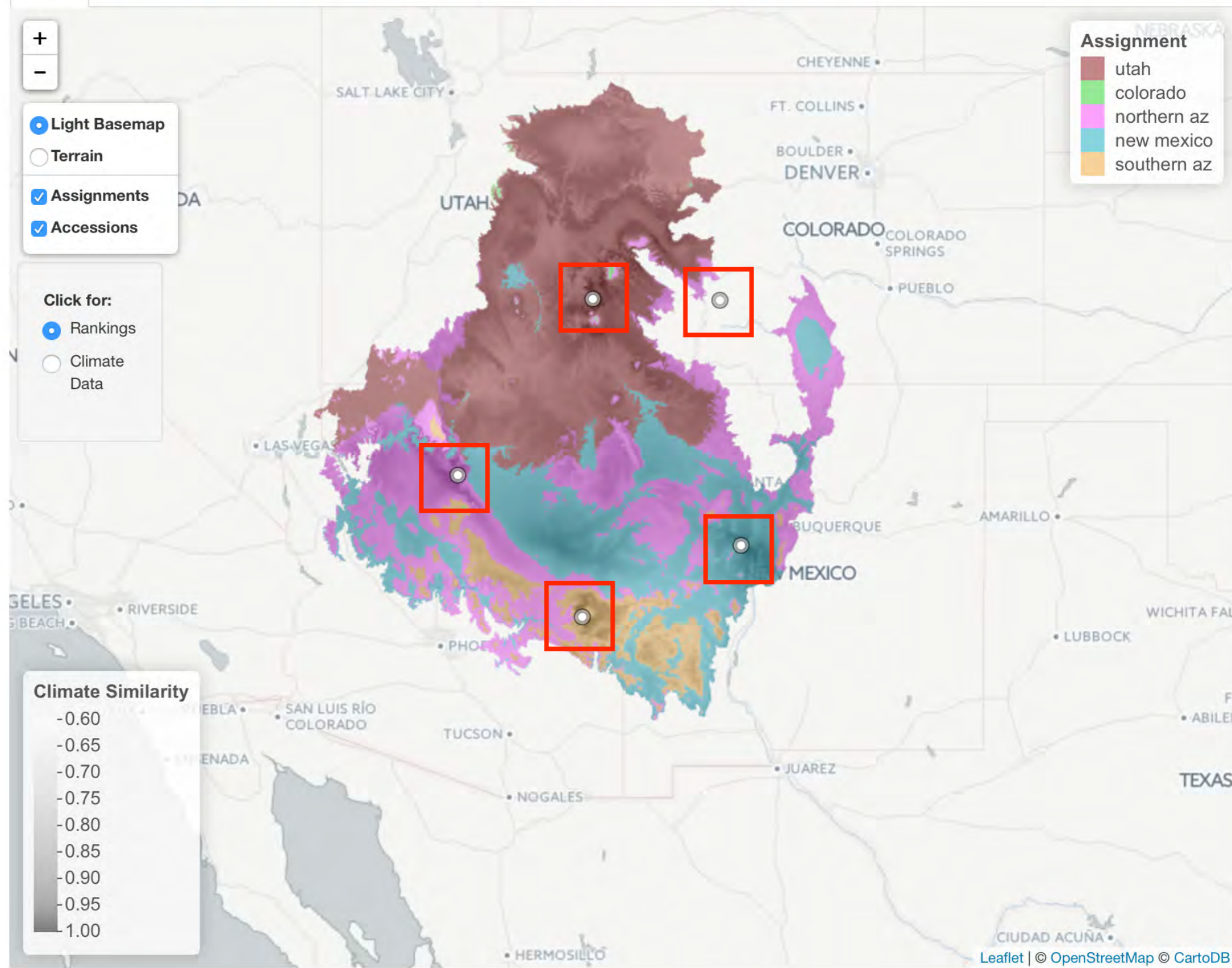
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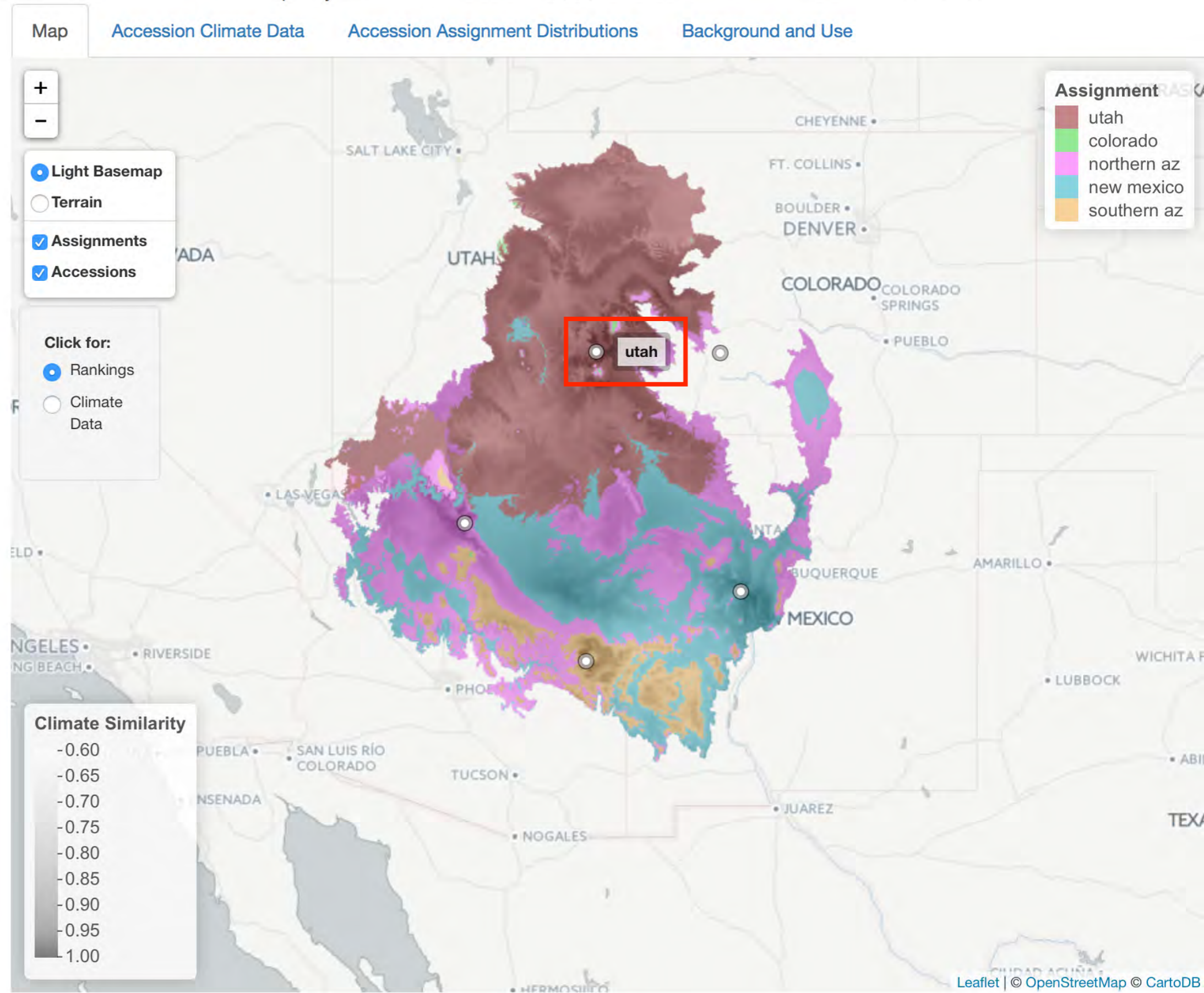
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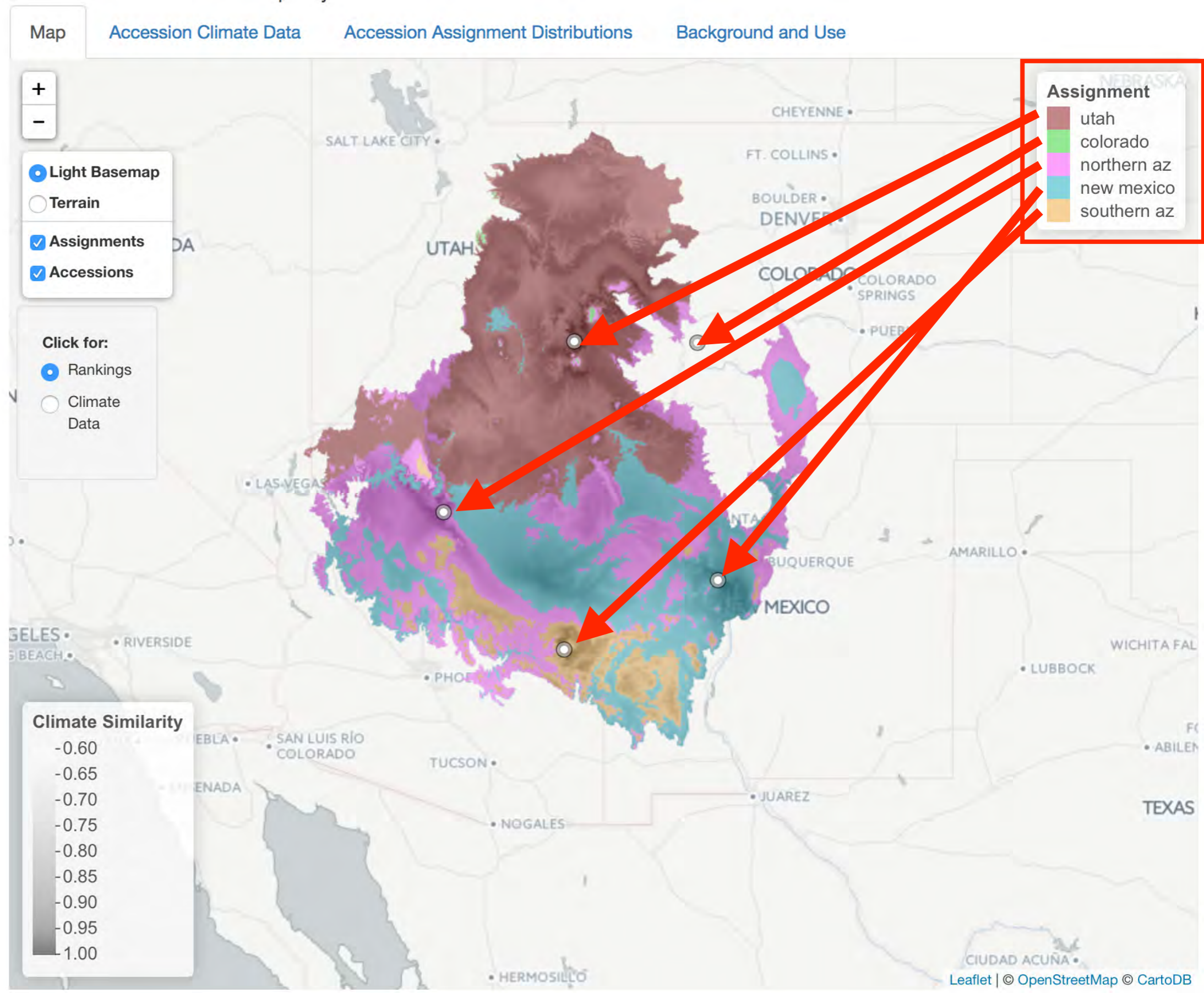
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Map

Accession Climate Data

Accession Assignment Distributions

Background and Use

+

-

Light Basemap

Terrain

Assignments

Accessions

Click for:

Rankings

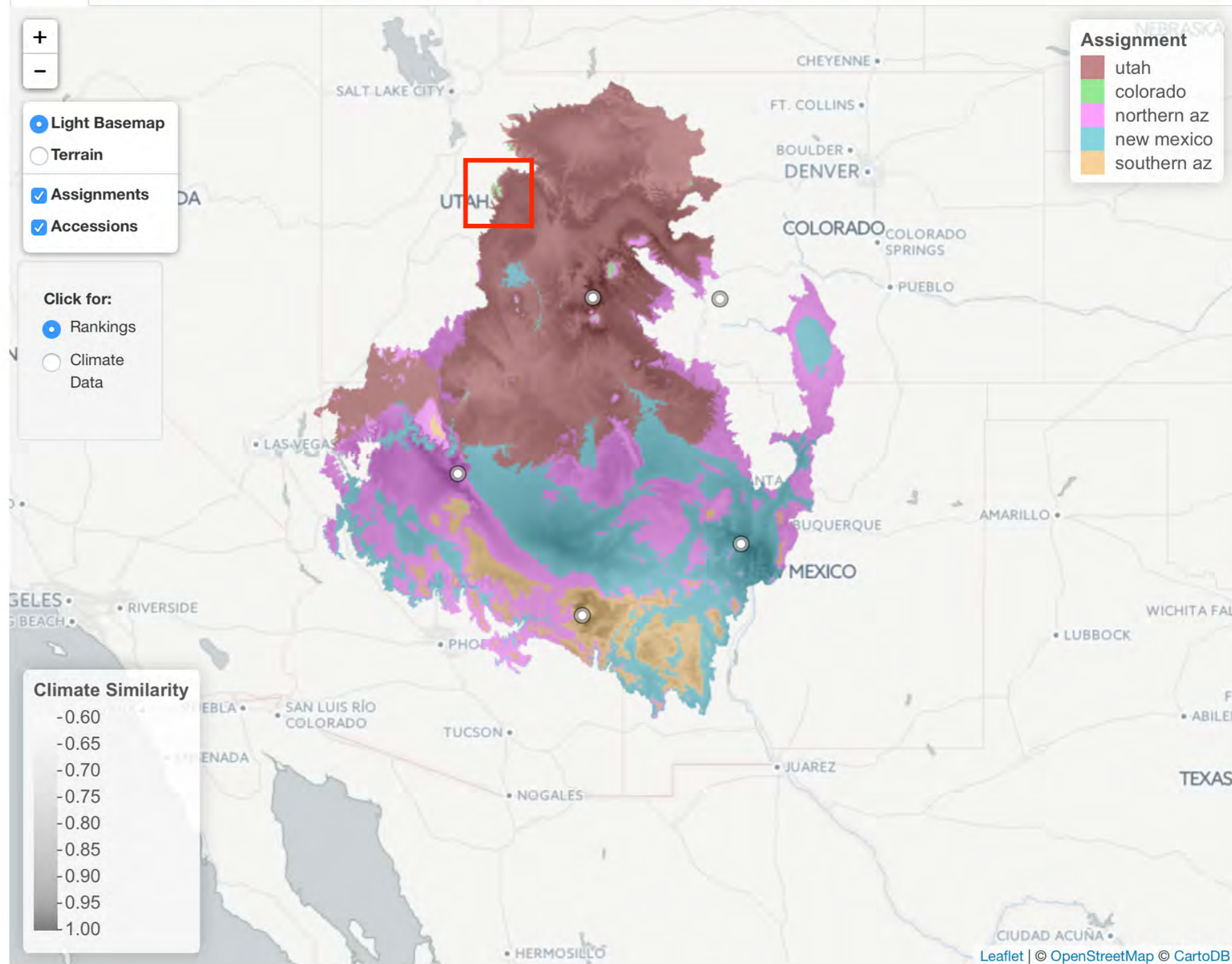
Climate Data

Climate Similarity

-0.60
-0.65
-0.70
-0.75
-0.80
-0.85
-0.90
-0.95
1.00

Assignment

utah
colorado
northern az
new mexico
southern az




App ready!

How would you like to define your area of interest?

Spatial polygon


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Accession Assignment Distributions

Background and Use

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Assignments

Accessions

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Rankings

Climate Data

Assignment

utah

colorado

northern az

new mexico

southern az

Climate Similarity

-0.60

-0.65

-0.70

-0.75

-0.80

-0.85

-0.90

-0.95


1.00

Zoom out **y!**

How would you like to define your area of interest?

Spatial polygon ▾


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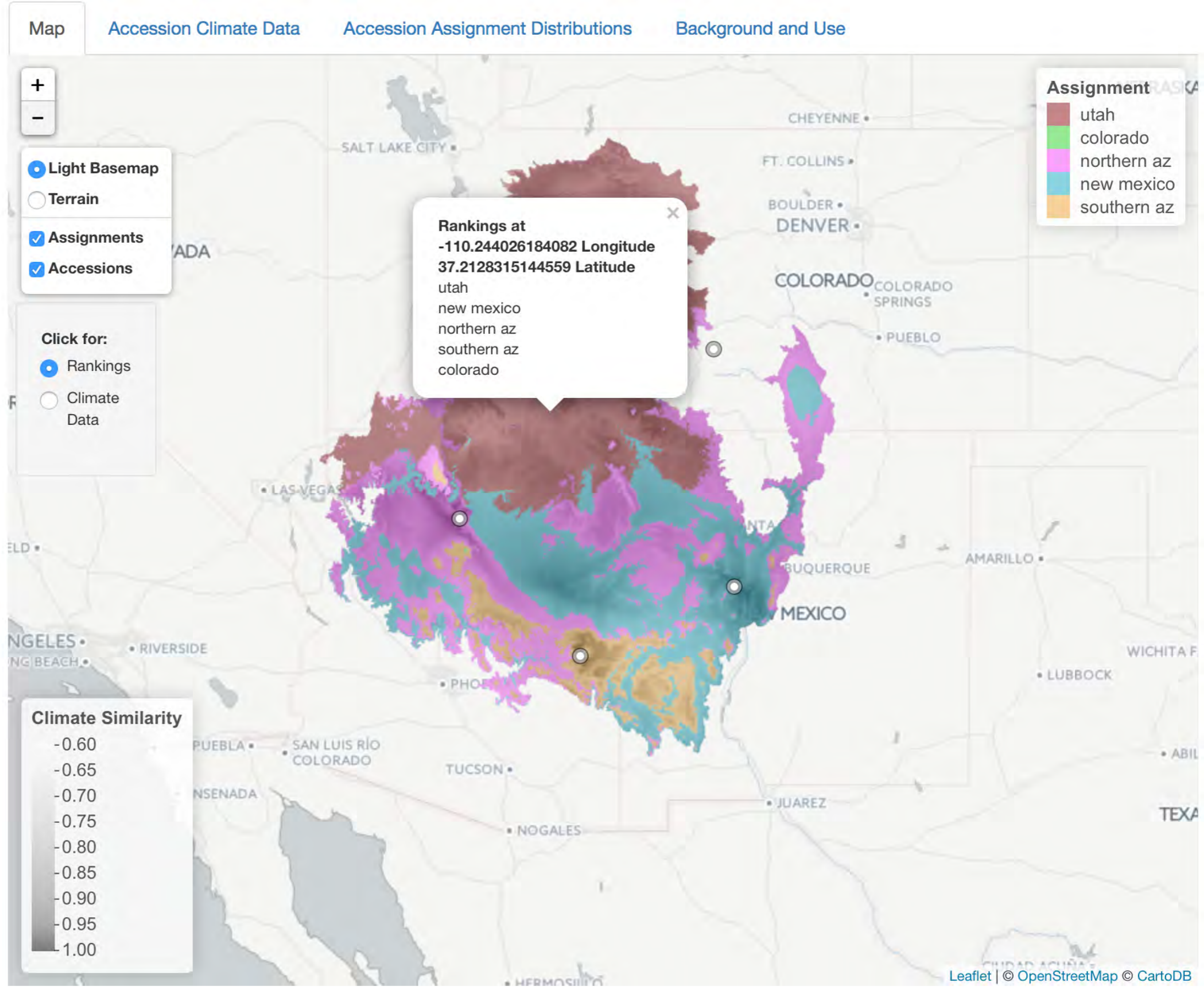
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Map

Accession Climate Data

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Rankings

Climate Data

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-0.60
-0.65
-0.70
-0.75
-0.80
-0.85
-0.90
-0.95
1.00

Assignment

utah
colorado
northern az
new mexico
southern az

Long: -110.244026184082

Lat: 37.2128315144559

Assignment : utah

MAT : 13.3

DiurnalRange : 14.4

TSeasonality : 9285

TWettestQtr : 20.1

MAP : 177

PSeasonality : 33

PWarmestQtr : 48

App ready!

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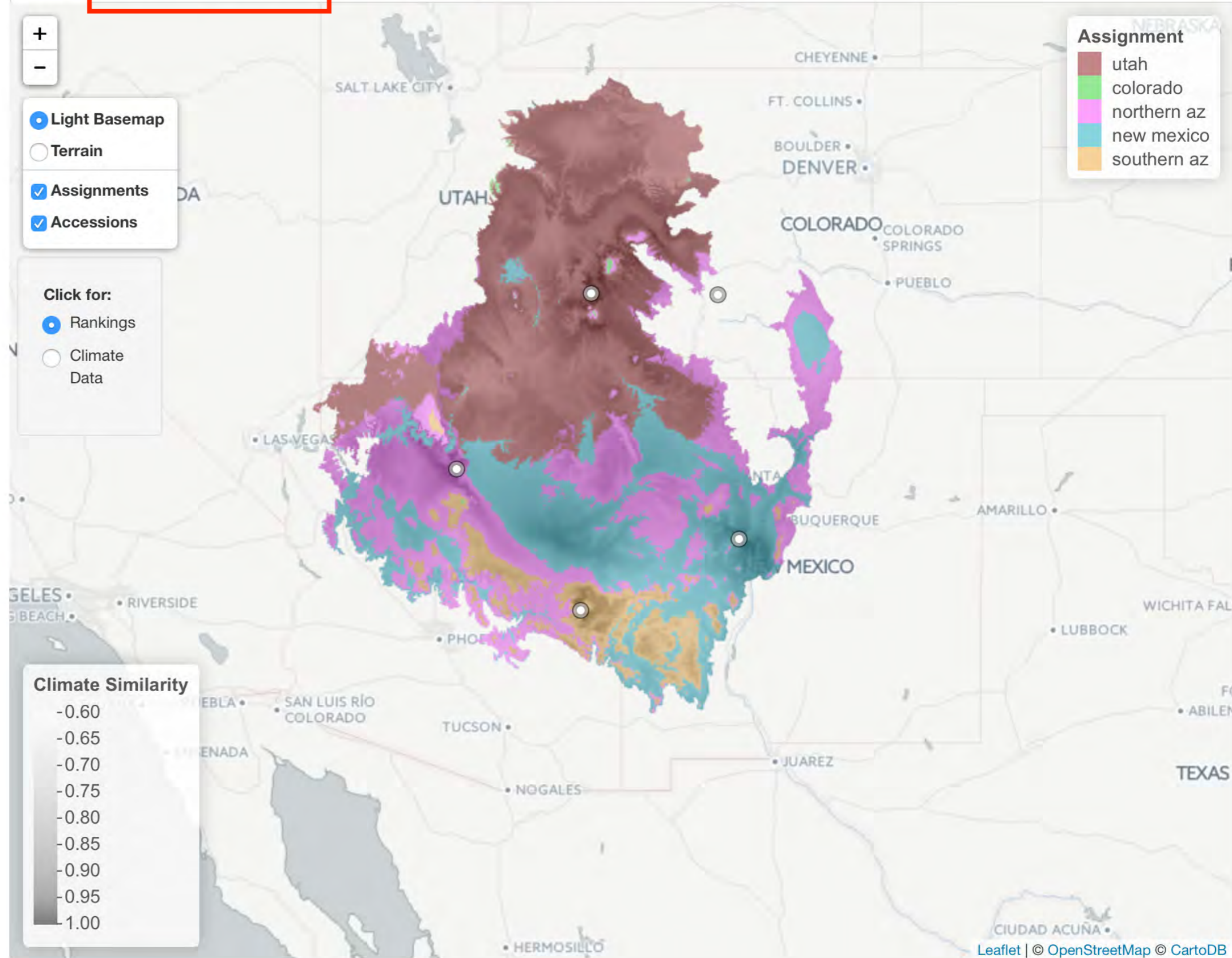
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1.00

Assignment

utah
colorado
northern az
new mexico
southern az



Map

Accession Climate Data

Accession Assignment Distributions

Background and Use

Show 25 entries

Search:

Accession	cell	x	y	MAT	DiurnalRange	TSeasonality	TWettestQtr	MAP	PSeasonality	PWarmestQtr
utah	12602456	-109.5375	38.12083	9.2	15.0	8822	15.8	327	24	82
colorado	12612309	-107.4292	38.10417	-2.4	14.6	7233	6.6	912	20	224
northern az	13950987	-111.7792	35.77917	8.8	16.0	7465	18.0	378	35	111
new mexico	14493953	-107.0625	34.83750	12.8	18.5	8109	22.4	218	60	91
southern az	15060035	-109.7125	33.85417	6.8	16.4	6451	14.7	682	49	239

Showing 1 to 5 of 5 entries

App ready!

How would you like to define your area of interest?

Spatial polygon


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Choose File  four.corners.zip

Upload complete

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Map

Accession Climate Data

Accession Assignment Distributions

Background and Use

+

-

Light Basemap

Terrain

Assignments

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Click for:

Rankings

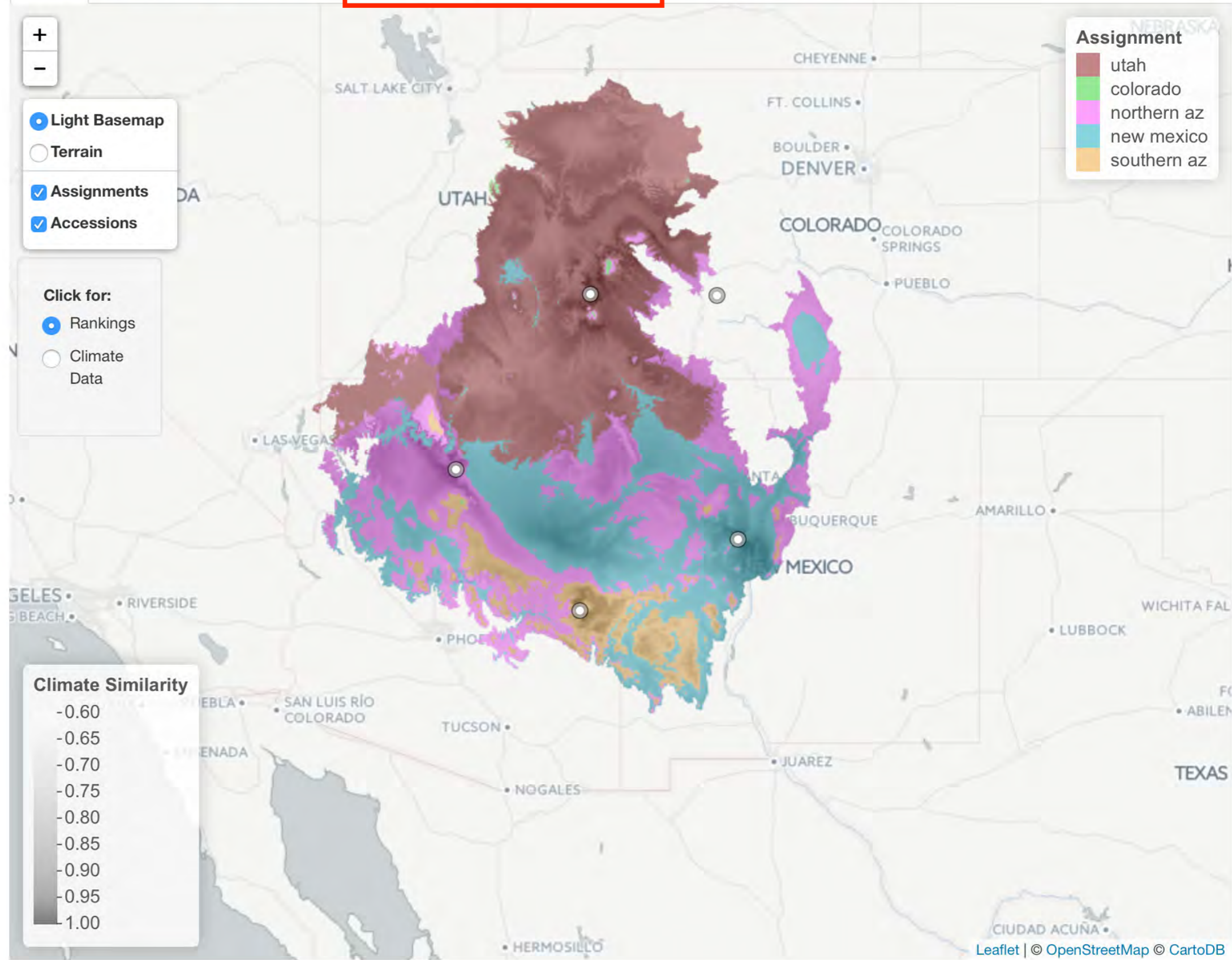
Climate Data

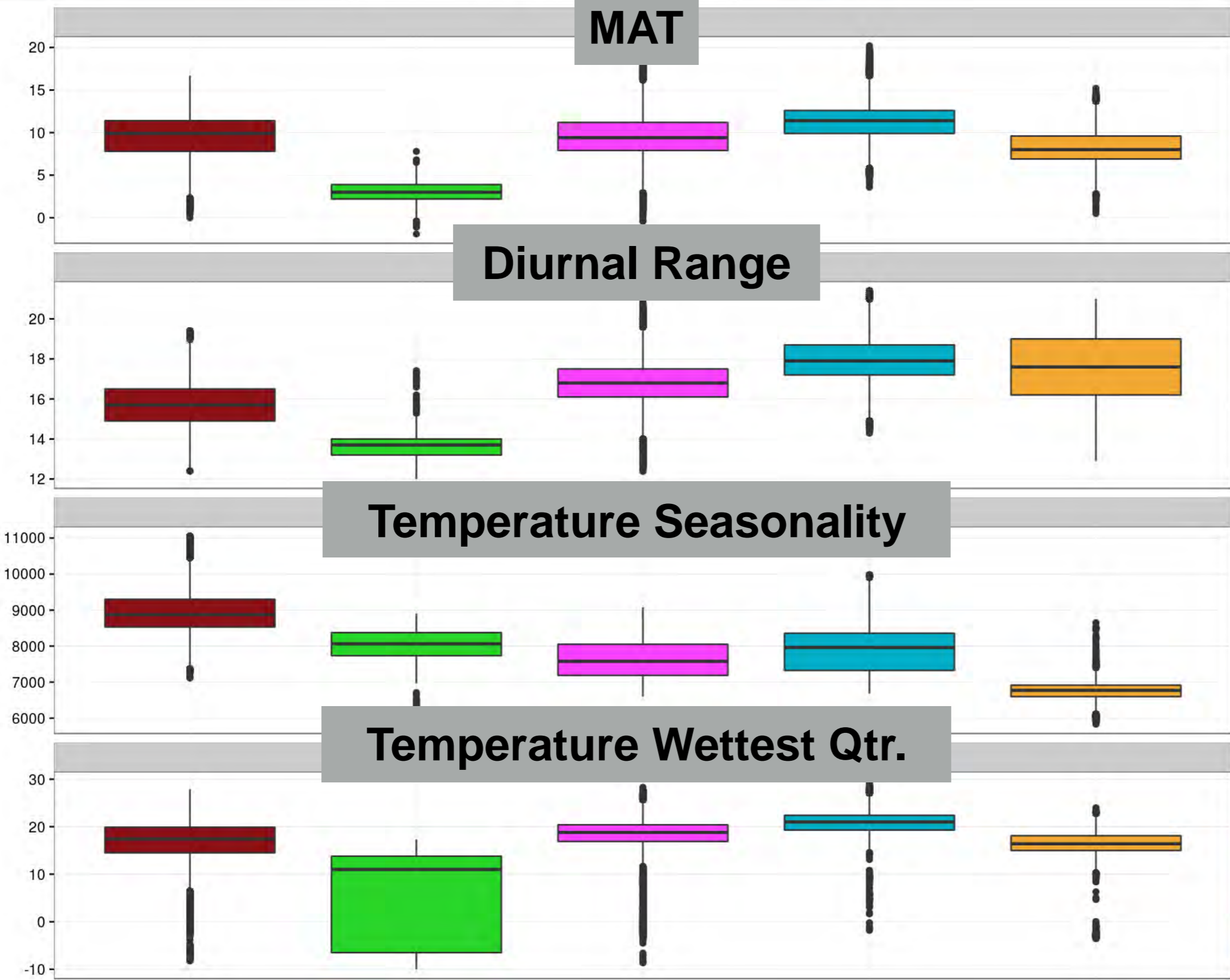
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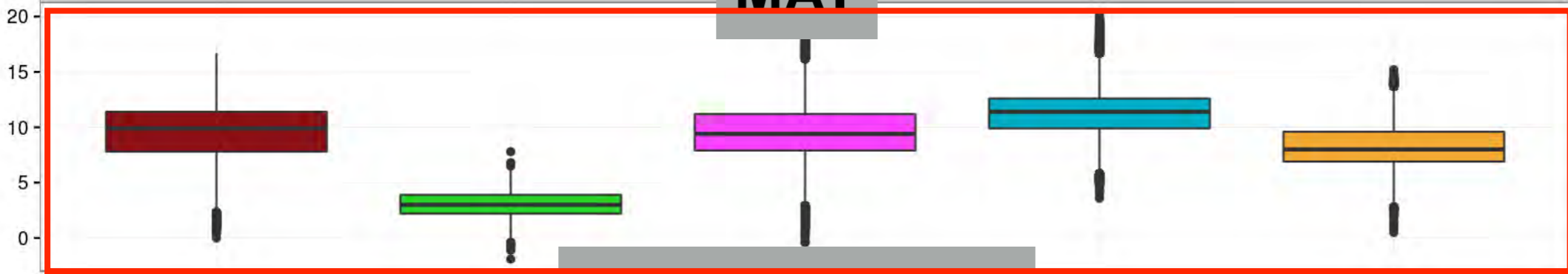




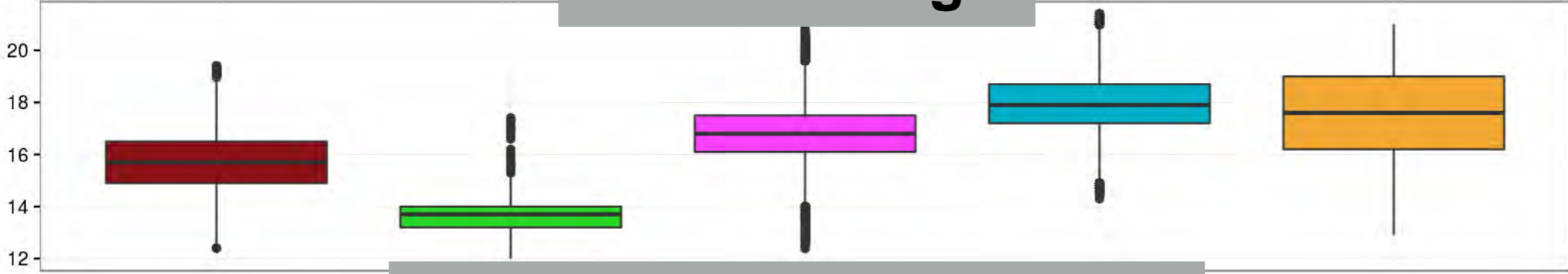
Scroll down for additional variables



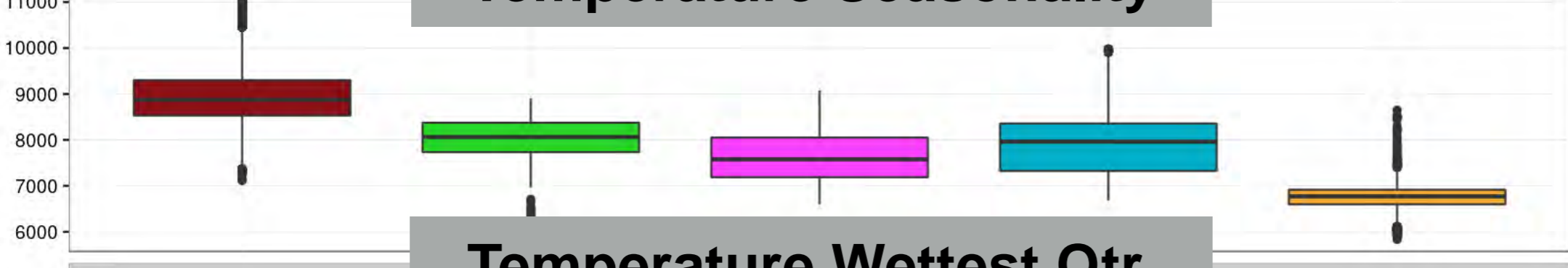
MAT



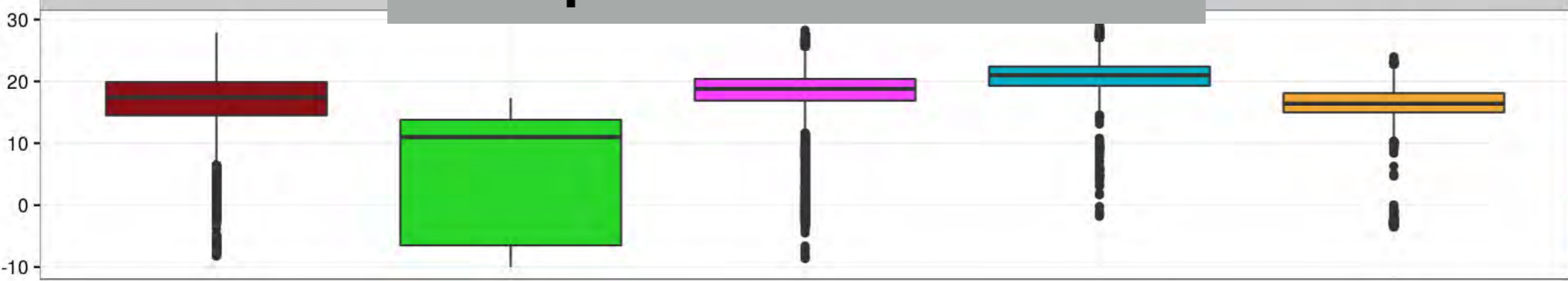
Diurnal Range



Temperature Seasonality



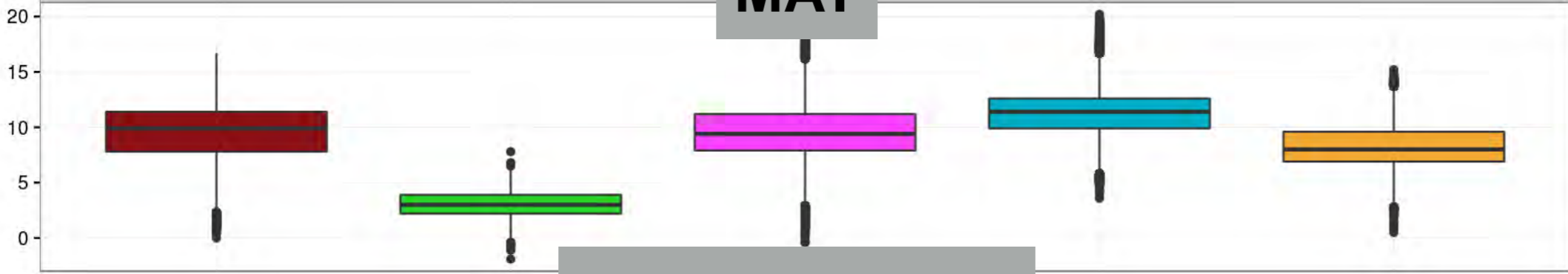
Temperature Wettest Qtr.



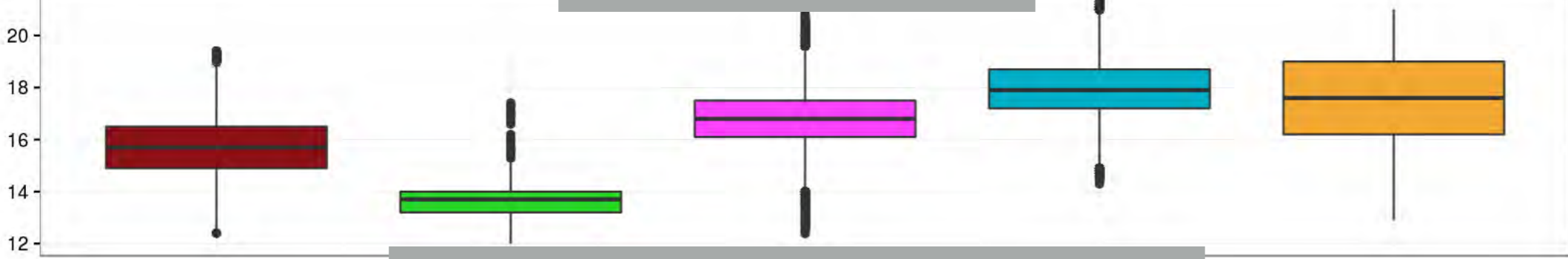
Accession Assignment

-  utah
-  colorado
-  northern az
-  new mexico
-  southern az

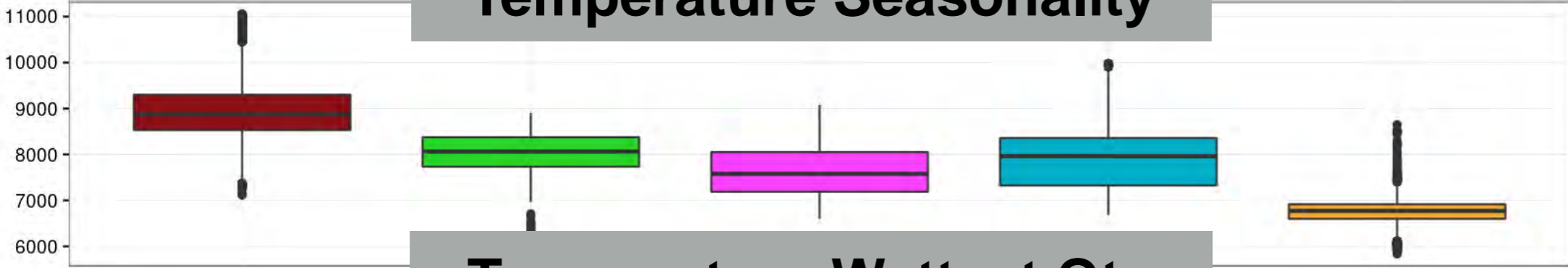
MAT



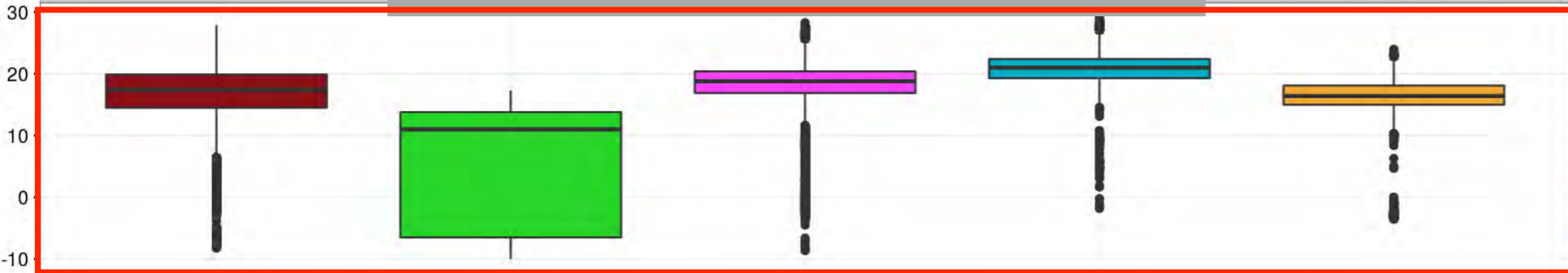
Diurnal Range



Temperature Seasonality



Temperature Wettest Qtr.



Accession Assignment

-  utah
-  colorado
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Choose File  exampl...s.csv

Upload complete

Match Seed to Climate

 Download Data

Click above to download underlying rasters and summary data. Note that clicking will open a new tab.

Map

Accession Climate Data

Accession Assignment Distributions

Background and Use

+

-

Light Basemap

Terrain

Assignments

Accessions

Click for:

Rankings

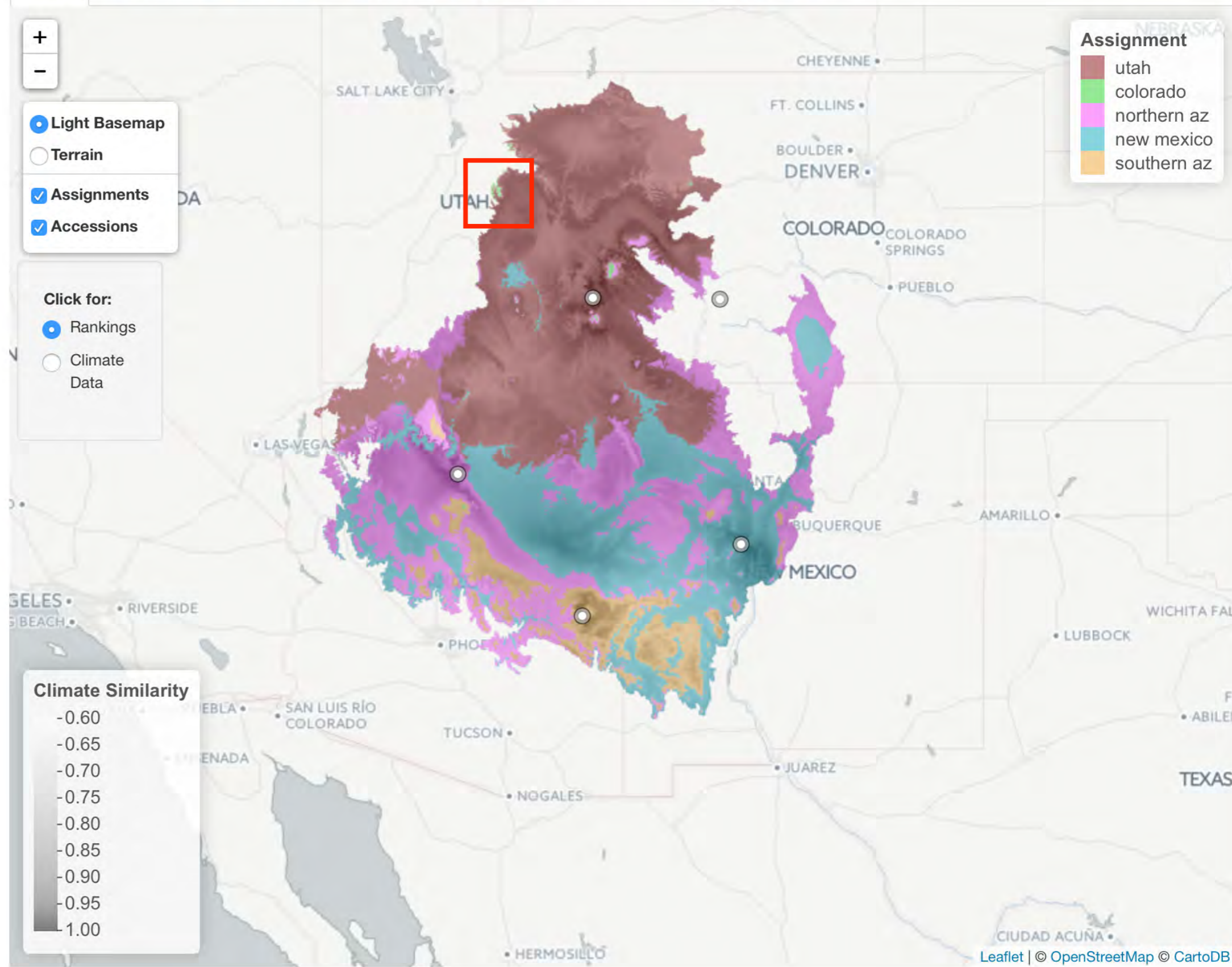
Climate Data

Climate Similarity

-0.60
-0.65
-0.70
-0.75
-0.80
-0.85
-0.90
-0.95
1.00

Assignment

utah
colorado
northern az
new mexico
southern az



App ready!

How would you like to define your area of interest?

Spatial polygon


Upload spatial polygon files (.shp, .shx, .prj, and .dbf) compressed into a .zip format:

Choose File  four.corners.zip

Upload complete

id	x	y
custom id 1	-107.46667	35.88333
custom id 2	-108.64655	40.11694

Now upload a .csv of your accession data (maximum of 50 accessions) in the format pictured above (id, long, lat):

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Climate Data

Assignment

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Climate Data

Assignment

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colorado

northern az

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-0.65

-0.70

-0.75

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-0.90

-0.95

1.00

**Tool #2: Climate Partitioner
collection / sampling guidance**

https://seedmapper.shinyapps.io/climate_partitioning_app/

Map

Climate Center Data

Within-Assignment Distributions

Background and Use

App ready!

How would you like to define your area of interest?

Spatial polygon ▼

Upload spatial polygon files (.shp, .shx, .prj, and .dbf) compressed into a .zip format:

Choose File  four.corners.zip

Upload complete

Specify how many climate partions you want (1 to 50):

10

Partition and Map

 Download Data

Click above to download underlying rasters and summary data. Note that clicking will open a new tab.

App ready!

How would you like to define your area of interest?

Spatial polygon ▼

Upload spatial polygon files (.shp, .shx, .prj, and .dbf) compressed into a .zip format:

Choose File  four.corners.zip

Upload complete

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10

Partition and Map

Download Data

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Partition and Map

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Upload spatial polygon files (.shp, .shx, .prj, and .dbf) compressed into a .zip format:


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Partition and Map

Download Data

Click above to download underlying rasters and summary data. Note that clicking will open a new tab.

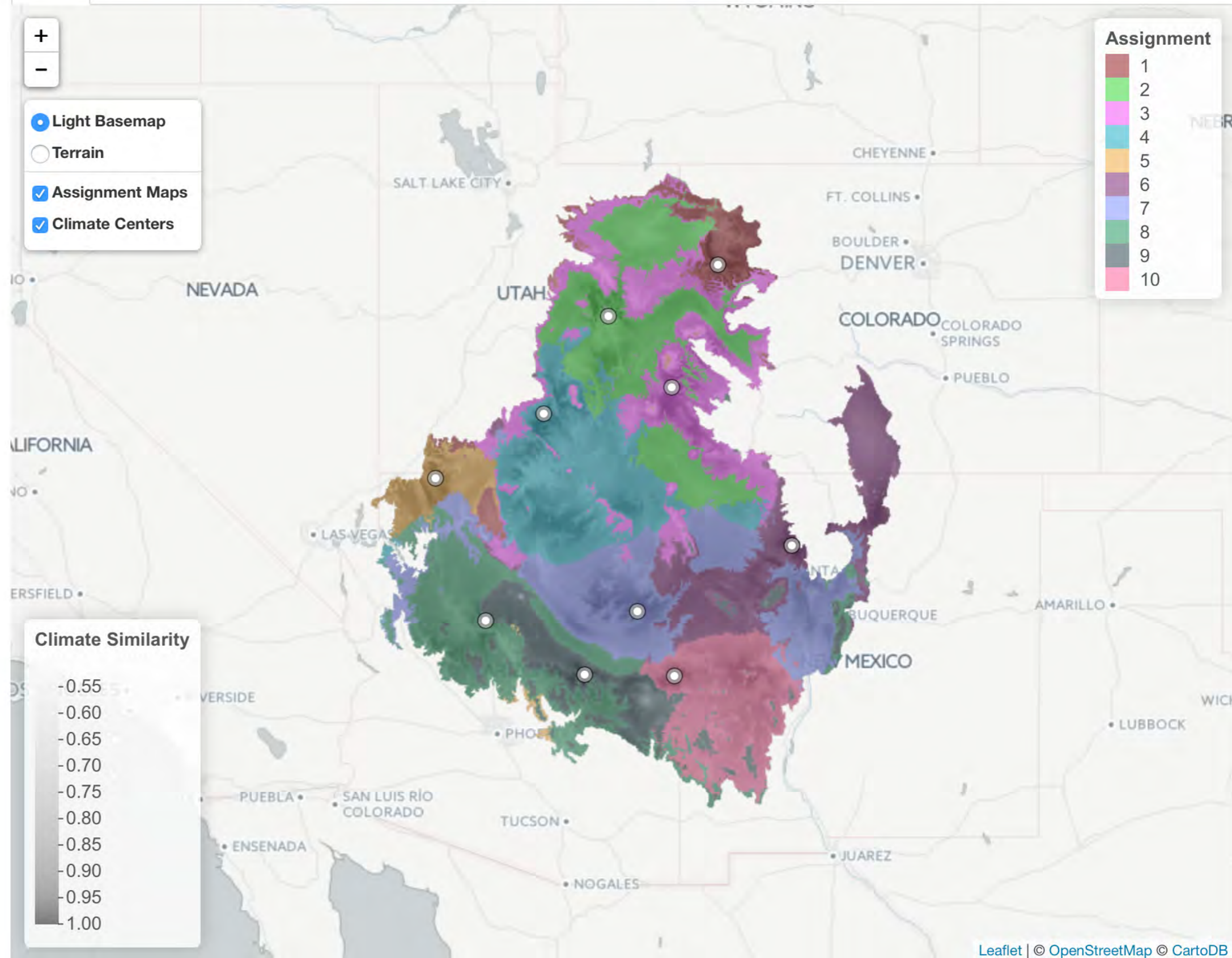
Map Climate Center Data Within-Assignment Distributions Background and Use

+
-

- Light Basemap
- Terrain
- Assignment Maps
- Climate Centers

Assignment

1
2
3
4
5
6
7
8
9
10



App ready!

How would you like to define your area of interest?

Spatial polygon

Upload spatial polygon files (.shp, .shx, .prj, and .dbf) compressed into a .zip format:

Choose File four.corners.zip

Upload complete

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Partition and Map

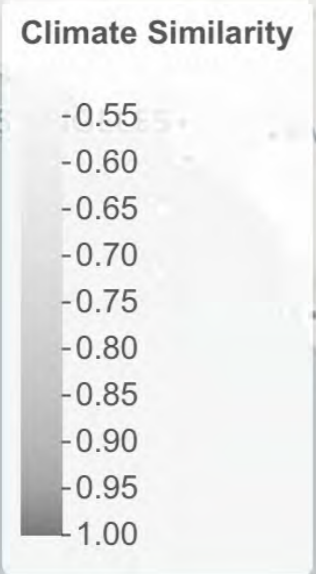
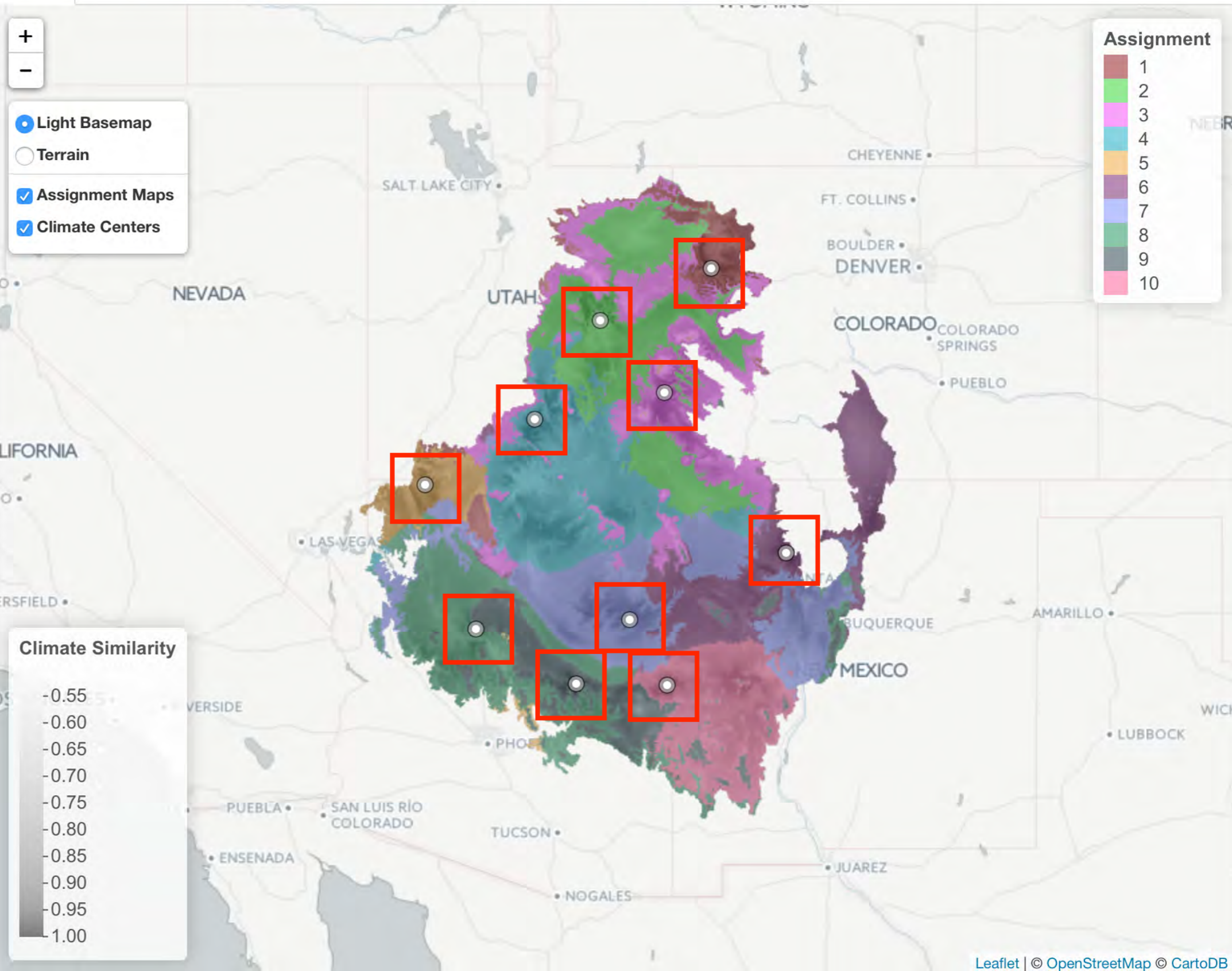
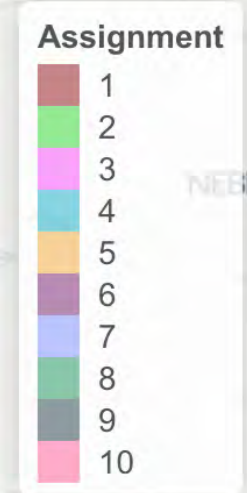
Download Data

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Map Climate Center Data Within-Assignment Distributions Background and Use

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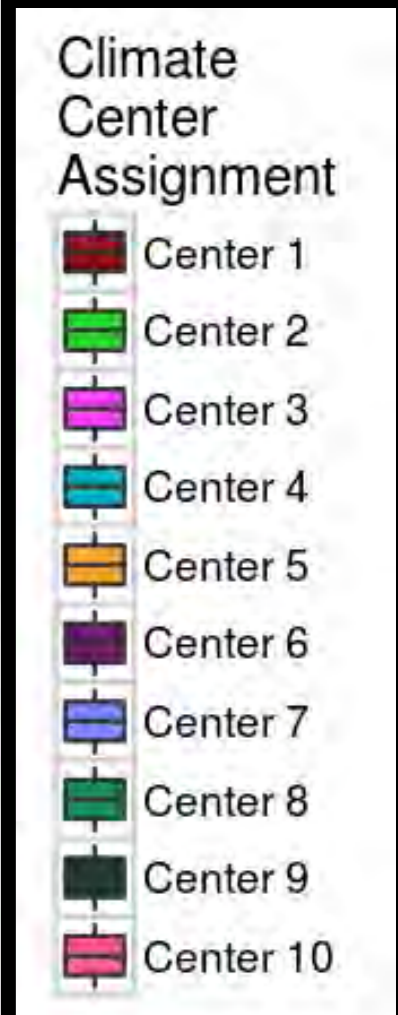
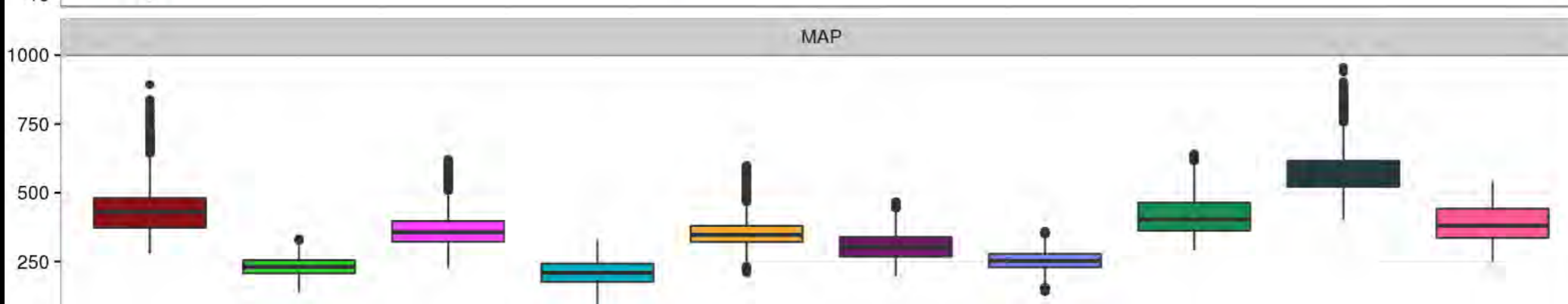
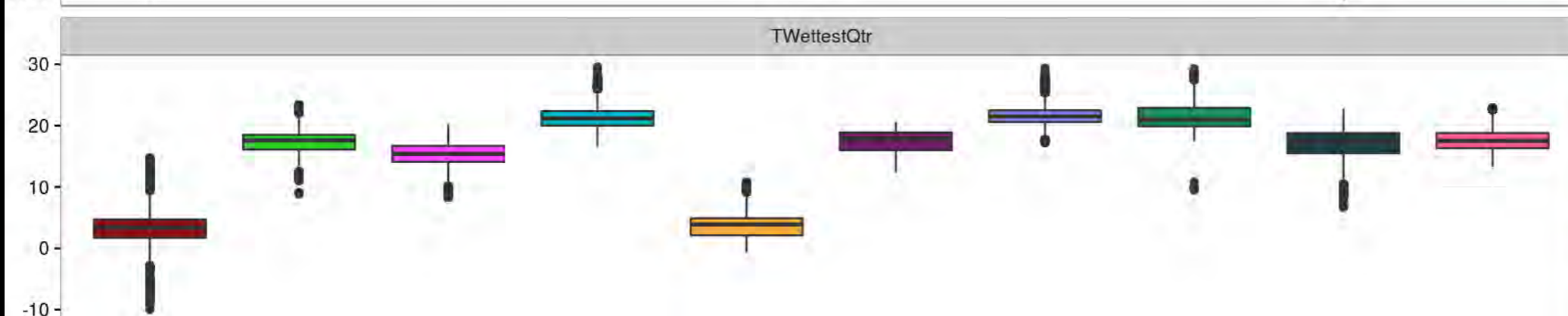
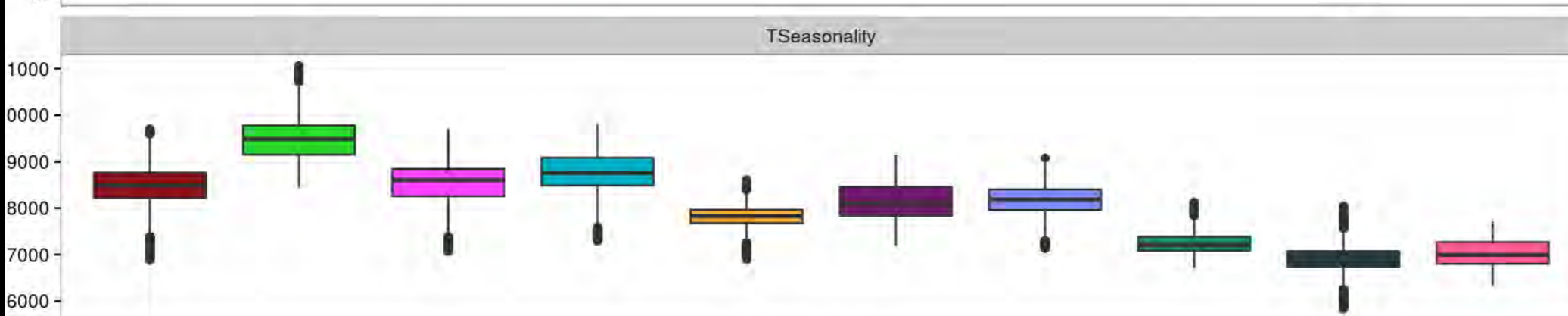
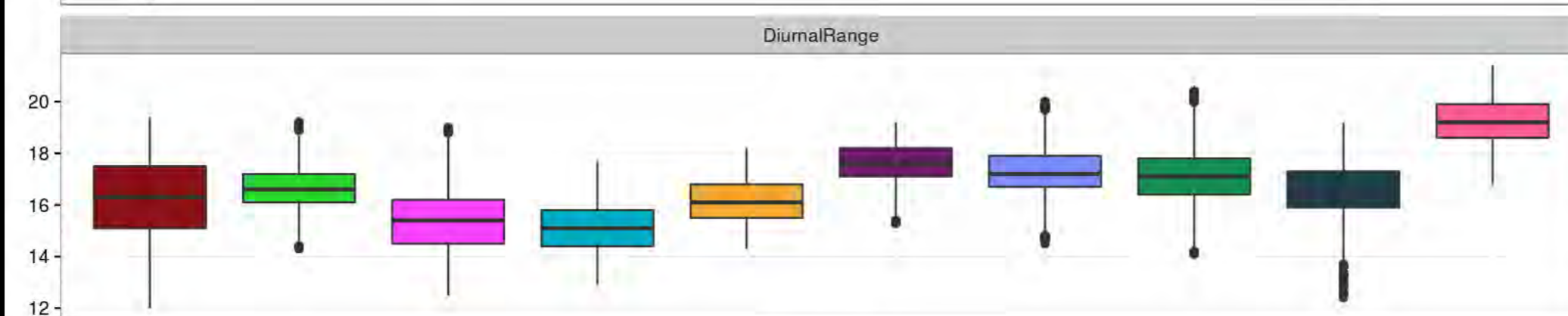
- Light Basemap
- Terrain
- Assignment Maps
- Climate Centers



Show entries

Search:

Climate Center	cell	x	y	MAT	DiurnalRange	TSeasonality	TWettestQtr	MAP	PSeasonality	PWarmestQtr
Center 1	11676193	-108.3958	39.72917	5.1	16.4	8515	3.9	443	14	108
Center 2	12059975	-110.2125	39.06250	9.9	16.4	9640	16.9	213	26	59
Center 3	12592902	-109.1542	38.13750	7.7	15.4	8624	14.4	377	24	96
Center 4	12794245	-111.2958	37.78750	11.2	15.1	8820	21.8	195	32	59
Center 5	13283628	-113.1042	36.93750	12.1	16.0	7845	3.8	352	30	84
Center 6	13807541	-107.1625	36.02917	7.8	17.6	8242	17.8	310	51	121
Center 7	14316033	-109.7292	35.14583	11.6	17.3	8155	21.6	252	49	89
Center 8	14392530	-112.2542	35.01250	12.6	17.1	7268	21.7	416	45	139
Center 9	14824726	-110.6208	34.26250	8.6	16.6	6970	17.3	579	47	189
Center 10	14829706	-109.1208	34.25417	8.4	19.1	7006	17.1	363	70	163





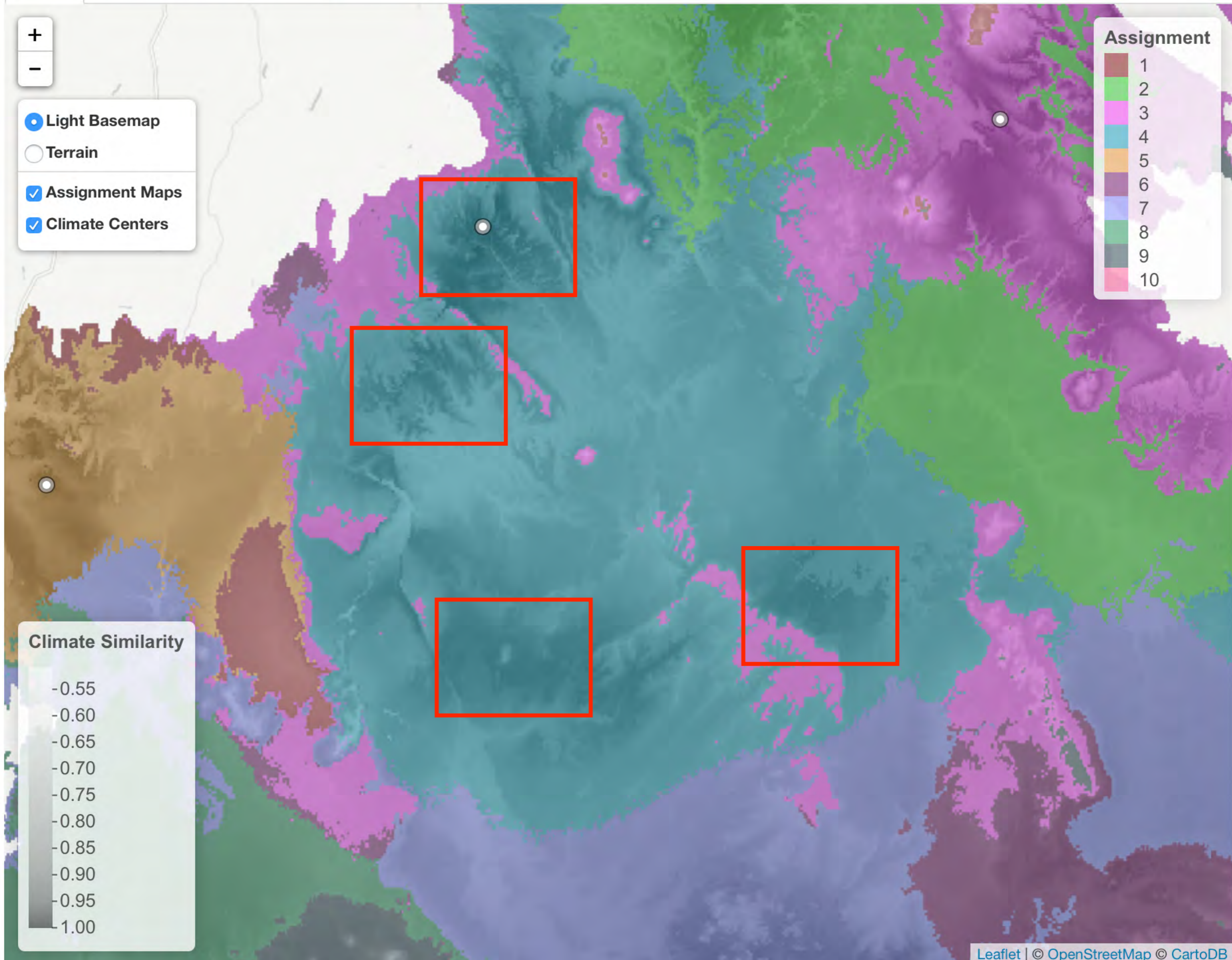
- Light Basemap
- Terrain
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Assignment

1	2	3	4	5	6	7	8	9	10
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Climate Similarity

-0.55
-0.60
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Potential Applications

- Seed banking
- Collection for common garden
- Establishing a common garden array
- Establishing transects



Future Directions

- Incorporating soil variables
- Links to available seed database
- Expansion of extent (currently limited to western US)
- Improving stability and performance
- Manipulation of variable weights



Acknowledgements

