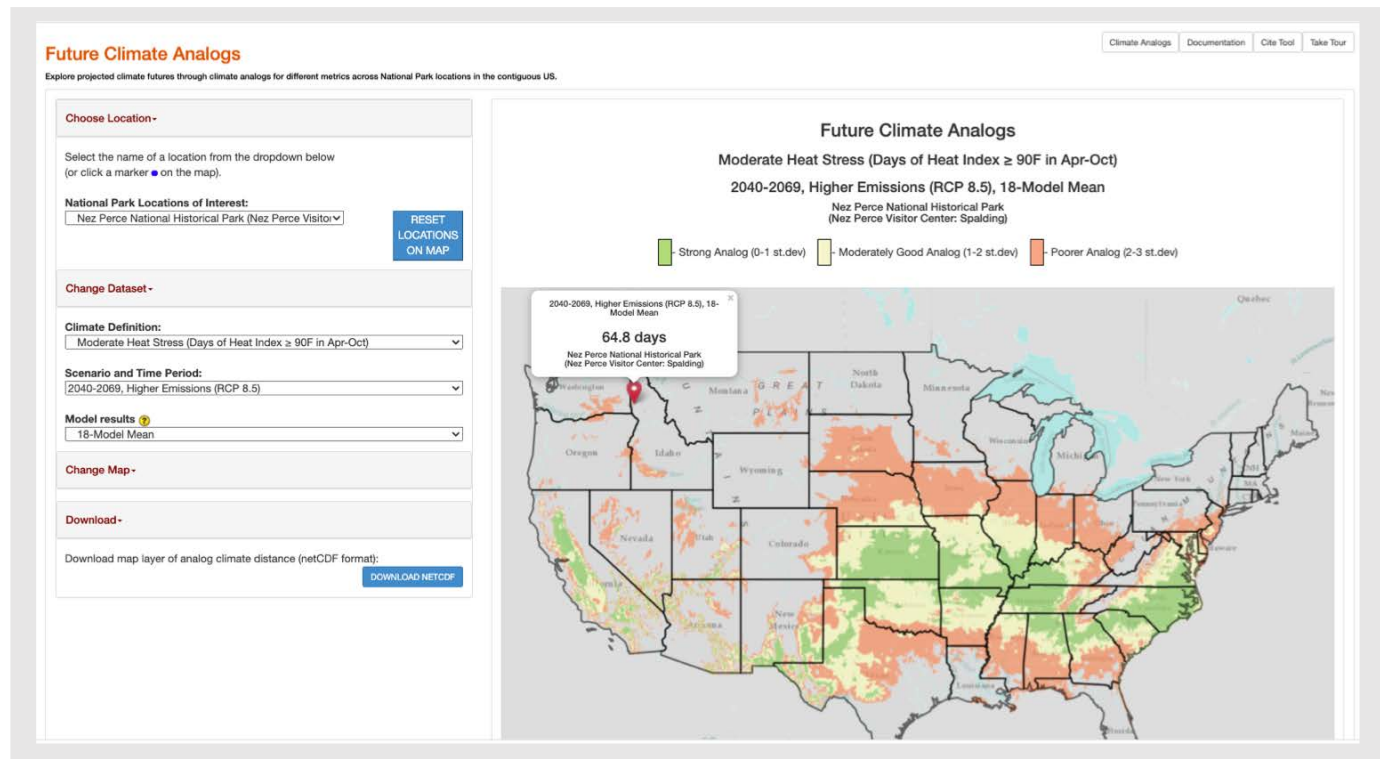


# The Future Climate Analogs Tool in the Climate Toolbox

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John Gross, *National Park Service*



UNIVERSITY OF CALIFORNIA  
**MERCED**

 **National  
Park Service**

 **CIRC**  
Climate Impacts Research Consortium  
A NOAA RISA TEAM



**RISA**  
Regional Integrated Sciences  
and Assessments

# Motivation

National parks are often found in extreme or unique climate environments.



Mount Rainier National Park



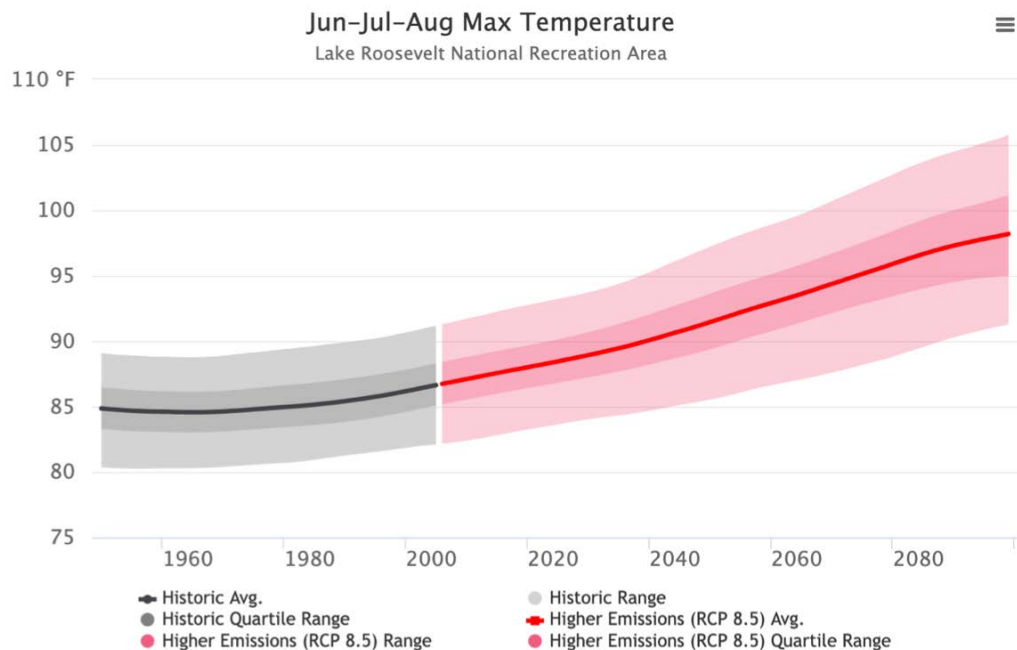
Death Valley National Park



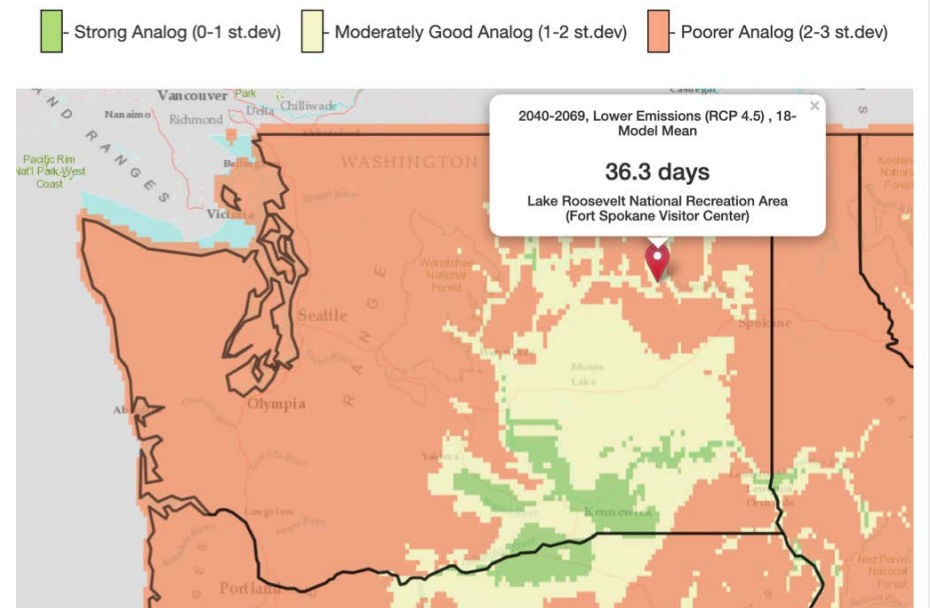
Everglades National Park

# Motivation

## Future Climate Projections



## Future Climate Analogs



Climate impacts in analog locations provide a potential glimpse into the future.

# Future Climate Analogs

What future?

2040-2069?, 2070-2099? Greenhouse Gas Emissions?

Tool: select future scenarios from global climate models \*

\*MACA downscaling of CMIP5 daily outputs for 1950-2099, RCP4.5 and RCP 8.5 (Abatzoglou, 2012)

# Future Climate Analogs

What's the climate of a location?

Temperature      Rain      Snow      Humidity      Winds

Tool: select specific metrics to define climate

## Some Clarifying Questions

### Future Climate Analogs

What does it mean for two climates to be similar?

The two climates are 'close'.

Tool: shows distance between two climates

# Current Climate Analogs

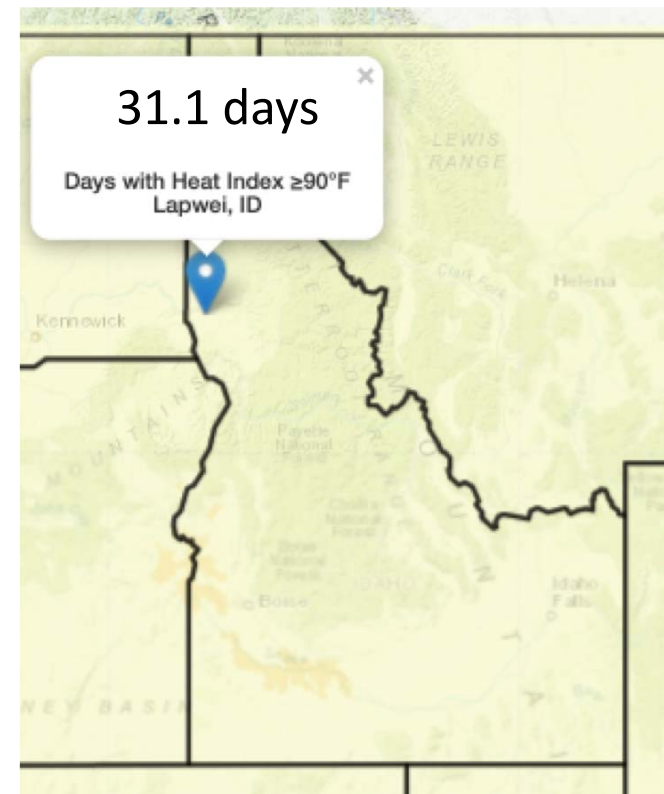
Where do we find a climate today that resembles the **current climate** of a location?

Human heat stress

Apr-Oct days with heat index > 90F

**Nez Perce Visitor Center (Lapwei, ID)**

Current (1971-2000): 31.1 days





# Future Climate Analogs

Where do we find a climate today that will resemble the **future climate** of a location?

Human heat stress

Apr-Oct days with heat index > 90F

**Nez Perce Visitor Center (Lapwai, ID)**

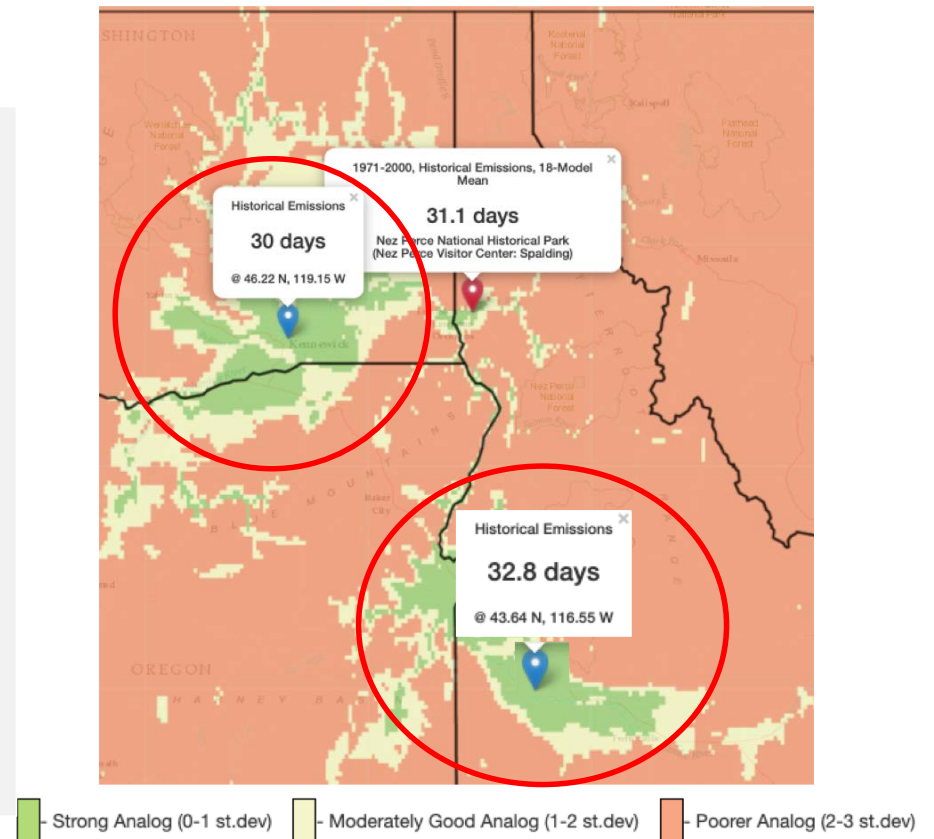
Current (1971-2000): 31.1 days

**Kennewick, WA (Tri-Cities)**

Current (1971-2000): 30.0 days

**Meridian, ID (Treasure Valley)**

Current (1971-2000): 32.8 days





# Future Climate Analogs

Where do we find a climate today that will resemble the **future climate** of a location?

Human heat stress

Apr-Oct days with heat index > 90F

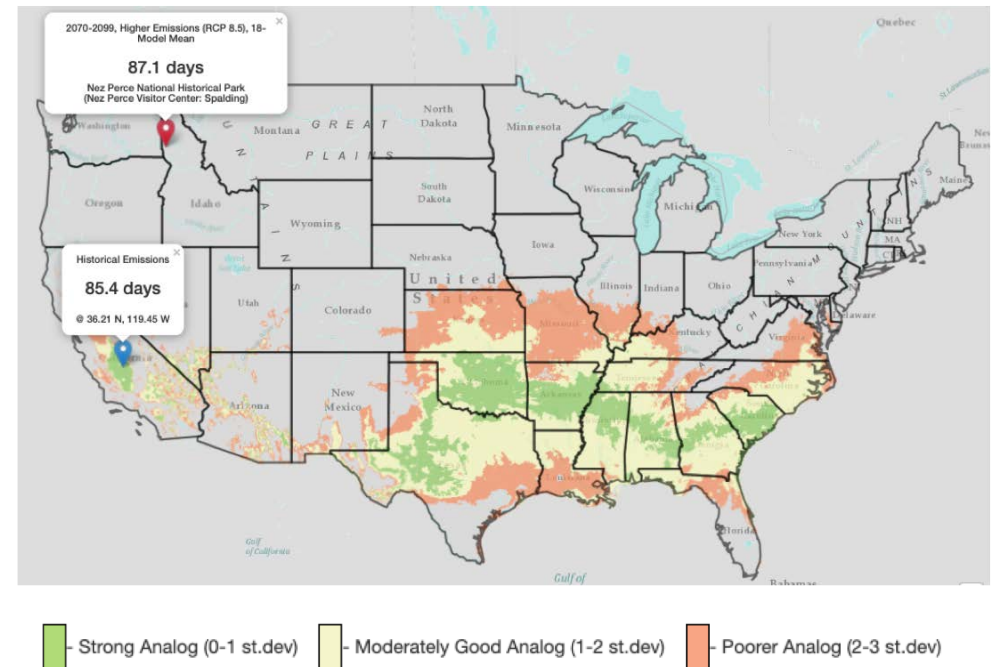
**Nez Perce Visitor Center (Lapwei, ID)**

Current (1971-2000): 31.1 days

Future (2040-2069): 87.1 days

**Fresno, CA (Central Valley)**

Current (1971-2000): 85.4 days



# Future Climate Analogs Tool



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## Future Climate Analogs

Explore projected climate futures through climate analogs for different metrics across National Park locations in the contiguous US.

[Climate Analogs](#) [Documentation](#) [Cite Tool](#) [Take Tour](#)

Choose Location

Select the name of a location from the dropdown below (or click a marker ● on the map).

National Park Locations of Interest:  
--Select a Point of Interest --

RESET LOCATIONS ON MAP

Change Dataset

Climate Definition:  
Moderate Heat Stress (Days of Heat Index  $\geq$  90F in Apr-Oct)

Scenario and Time Period:  
2070-2099, Higher Emissions (RCP 8.5)

Model results ?  
18-Model Mean

Change Map

Layers  
☒ US States  
☐ US Counties

Base Map:  
World Light Gray Map w/ Cities & Rivers

National Park Locations of Interest

# Climate Definitions

## HUMAN COMFORT



- Max temperature of hottest month
- Min temperature of coldest month
- Days of hot nights ( $T_{min} > 70F$ )
- Days of heat index  $> 90F, 100F, 105F$

## WATER



- Annual precipitation
- Days of high precipitation ( $p > 0.25''$ )
- Total actual evapotranspiration
- Maximum annual snow cover

## GROWING CONDITIONS



- Temperature degrees for
  - cool season growing ( $T > 32F$ )
  - warm season growing ( $T > 50F$ )

## FIRE DANGER/DROUGHT STRESS



- 3-month mean vapor pressure deficit
- Annual total water deficit

## ENERGY



- Temperature degrees for
  - cooling ( $T > 65F$ )
  - heating ( $T < 65F$ )

# Climate Definitions

## Multiple metrics for defining 'climate'

2 VARIABLE  
TEMPERATURE COMBO



2 VARIABLE  
WATER COMBO



4 VARIABLE  
TEMPERATURE/WATER COMBO



Coldest temperature of coldest month



Hottest temperature of hottest month



Annual water deficit



Actual evapotranspiration

# Example: 2 vs 4 variable combos

## 2 Variable Temperature Combination Lapwei, ID analogs

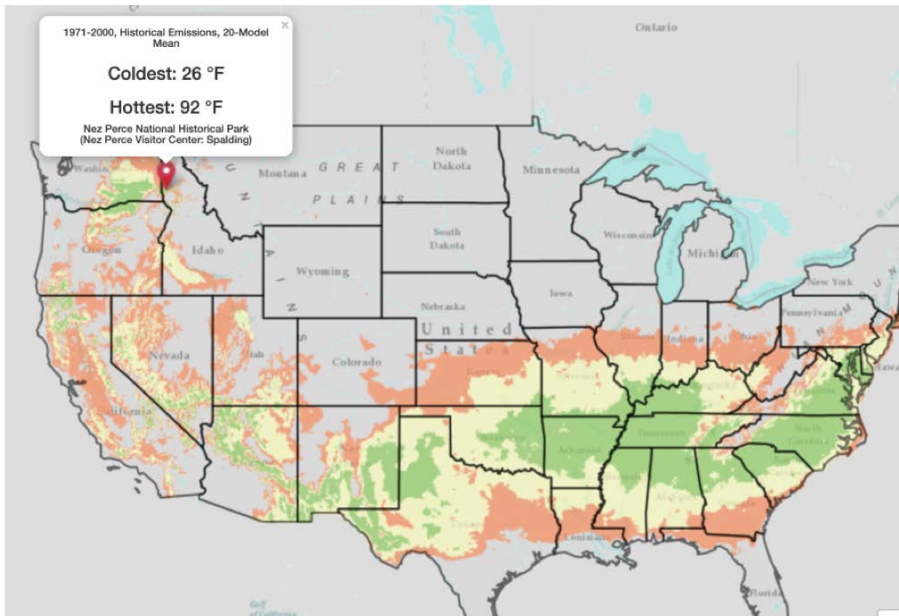
### Current Climate Analogs

Average Temperature of Hottest Month, Average Temperature of Coldest Month (2 variable combination)

1971-2000, Historical Emissions, 20-Model Mean

Nez Perce National Historical Park  
(Nez Perce Visitor Center: Spalding)

Strong Analog (0-1 st.dev)   Moderately Good Analog (1-2 st.dev)   Poorer Analog (2-3 st.dev)



## 2 Variable Water Combination Lapwei, ID analogs

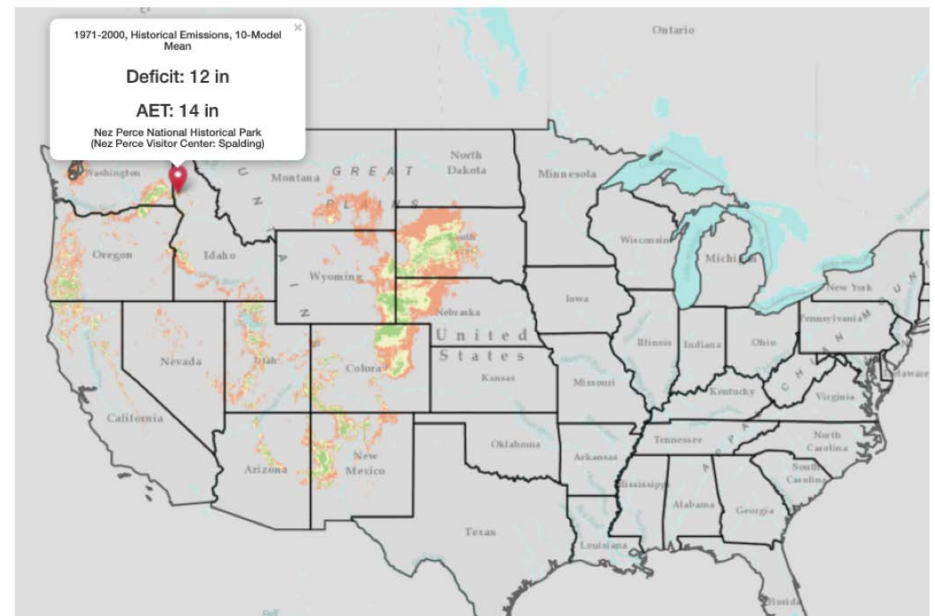
### Current Climate Analogs

Annual Water Deficit, Annual Actual Evapotranspiration (2 variable combination)

1971-2000, Historical Emissions, 10-Model Mean

Nez Perce National Historical Park  
(Nez Perce Visitor Center: Spalding)

Strong Analog (0-1 st.dev)   Moderately Good Analog (1-2 st.dev)   Poorer Analog (2-3 st.dev)



# Example: 2 vs 4 variable combos

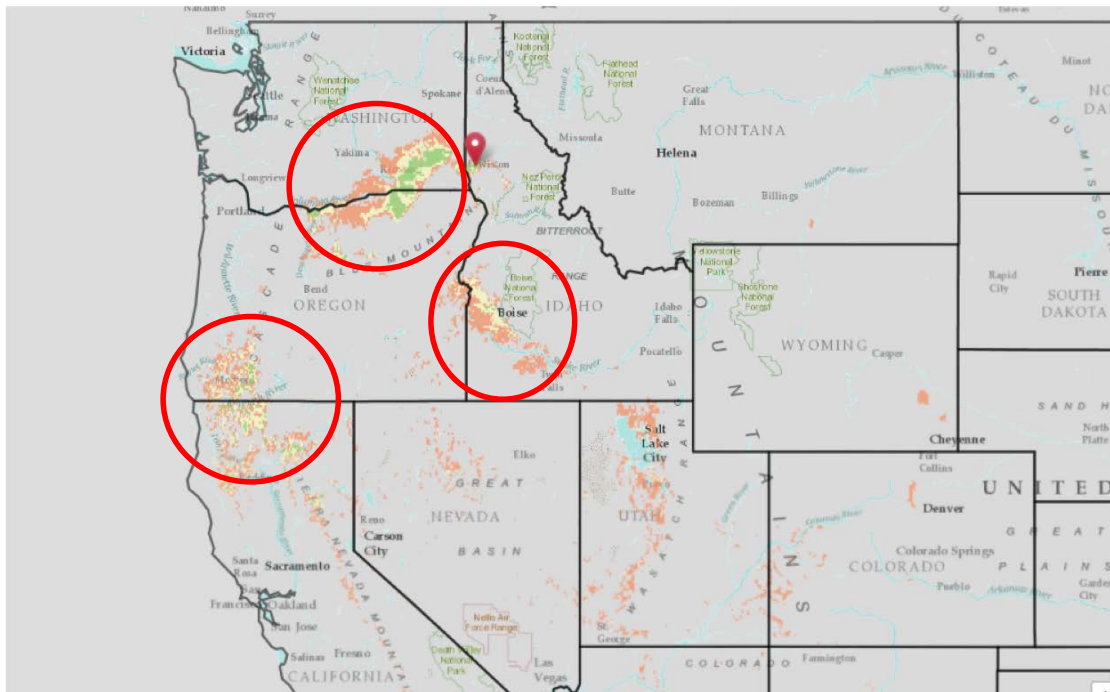
## Current Climate Analogs

Average Temperature of Hottest Month, Average Temperature of Coldest Month, Annual Water Deficit, Annual Actual Evapotranspiration(4 variable combination)

1971-2000, Historical Emissions, 10-Model Mean

Nez Perce National Historical Park  
(Nez Perce Visitor Center: Spalding)

Strong Analog (0-1 st.dev) Moderately Good Analog (1-2 st.dev) Poorer Analog (2-3 st.dev)



## 4 Variable Temperature/Water Combination

### Lapwei, ID analogs:

- Tri cities, Columbia River Gorge in Washington
- Medford area in Oregon, Forests in Northern California
- Boise area in Idaho



# Applications

## Snow cover analogs: current and future

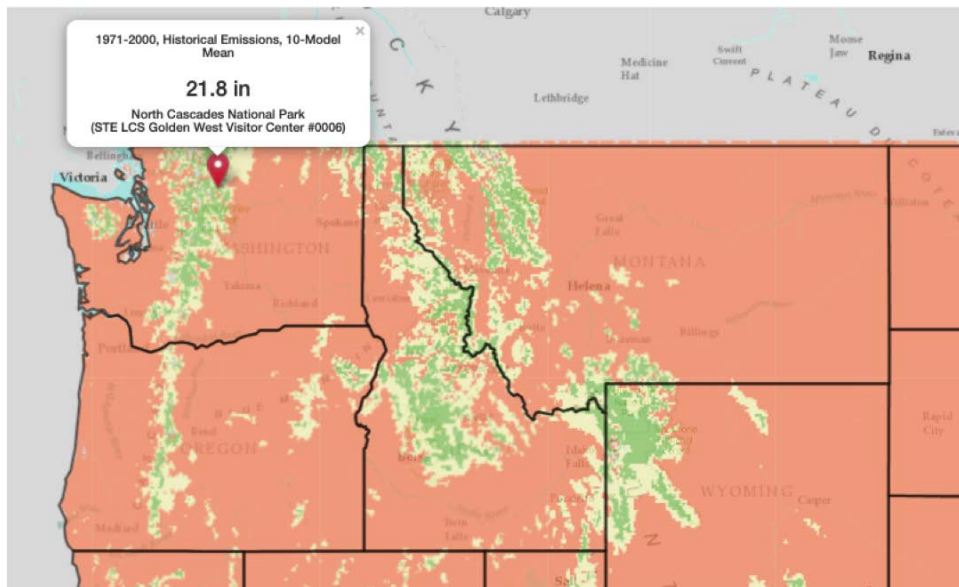
### Current Climate Analogs

Snow Cover (Maximum Annual Snow Water Equivalent)

1971-2000, Historical Emissions, 10-Model Mean

North Cascades National Park  
(STE LCS Golden West Visitor Center #0006)

Strong Analog (0-1 st.dev)   Moderately Good Analog (1-2 st.dev)   Poorer Analog (2-3 st.dev)



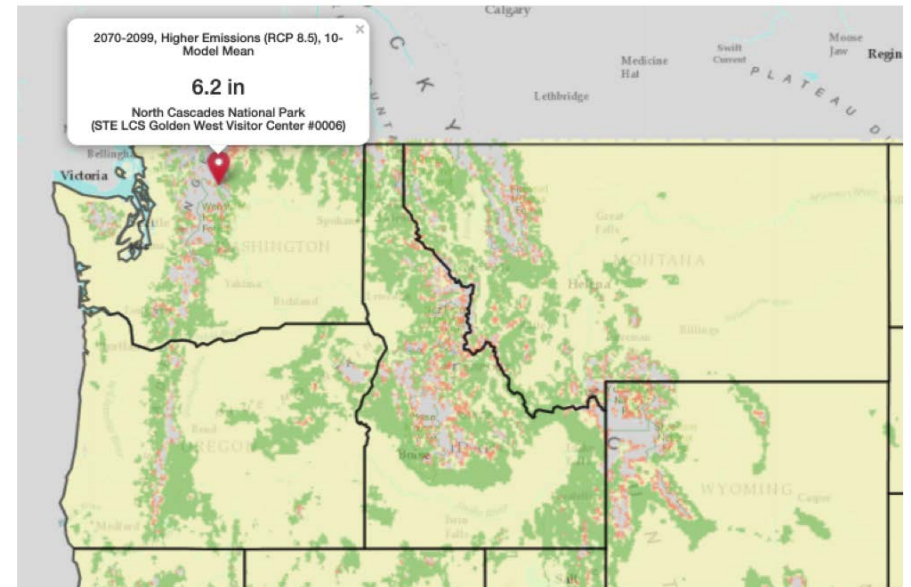
### Future Climate Analogs

Snow Cover (Maximum Annual Snow Water Equivalent)

2070-2099, Higher Emissions (RCP 8.5), 10-Model Mean

North Cascades National Park  
(STE LCS Golden West Visitor Center #0006)

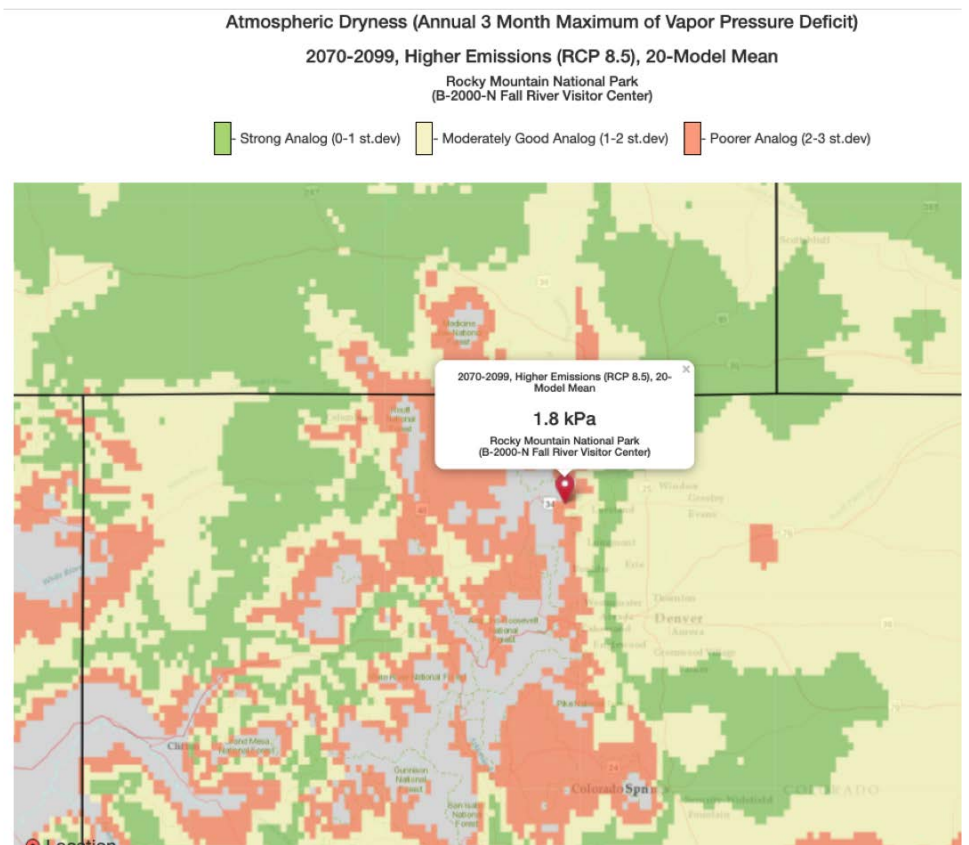
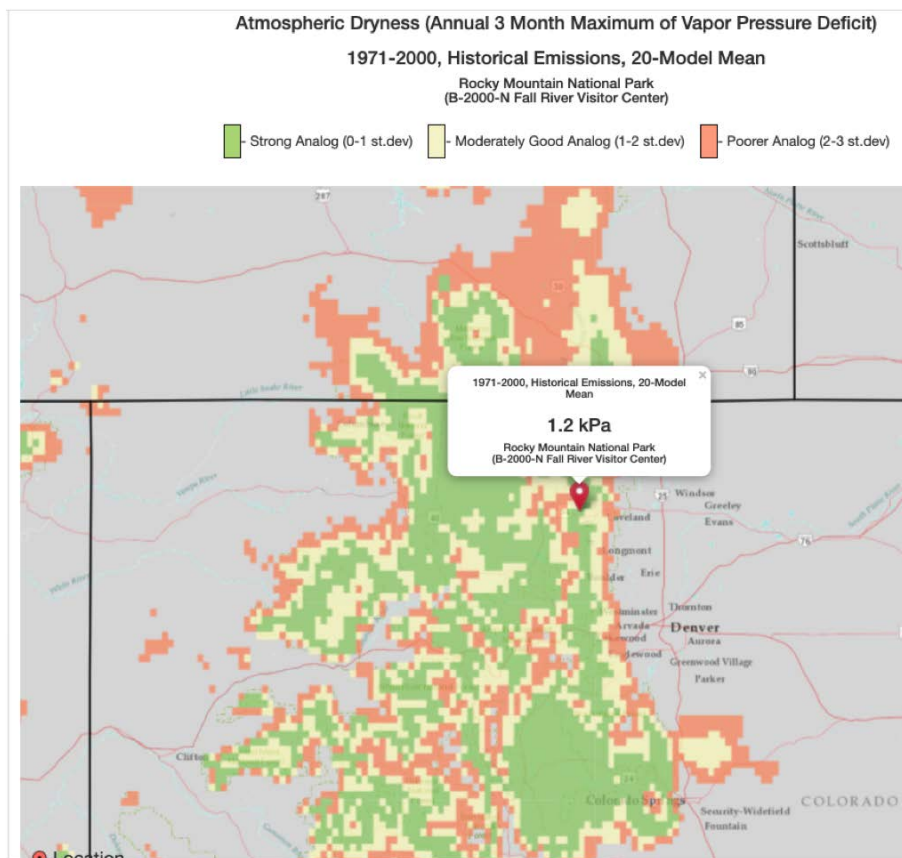
Strong Analog (0-1 st.dev)   Moderately Good Analog (1-2 st.dev)   Poorer Analog (2-3 st.dev)





# Applications

## Fire danger analogs: current and future



# Applications

## Cooling energy analogs: current and future

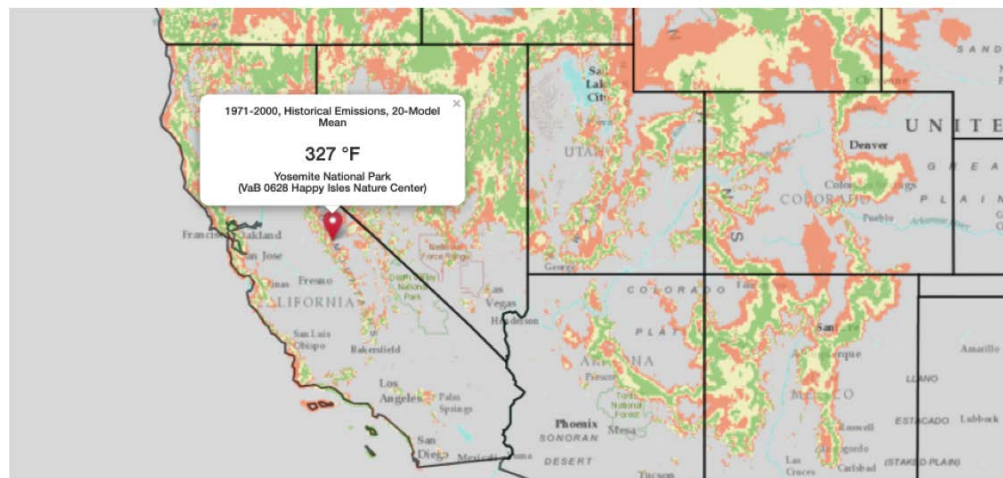
### Current Climate Analogs

Temperature Degrees for Cooling (Annual Cooling Degrees Days  $\geq 65^\circ\text{F}$ )

1971-2000, Historical Emissions, 20-Model Mean

Yosemite National Park  
(VaB 0628 Happy Isles Nature Center)

Strong Analog (0-1 st.dev)   Moderately Good Analog (1-2 st.dev)   Poorer Analog (2-3 st.dev)



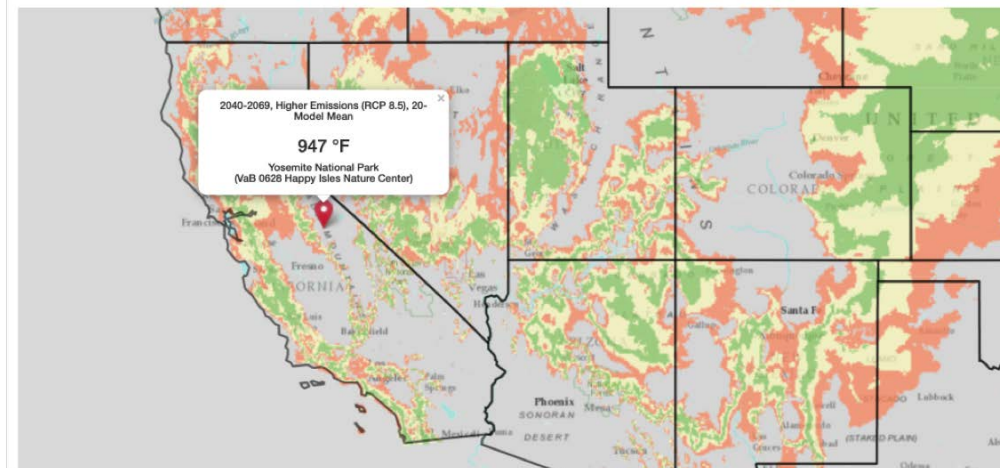
### Future Climate Analogs

Temperature Degrees for Cooling (Annual Cooling Degrees Days  $\geq 65^\circ\text{F}$ )

2040-2069, Higher Emissions (RCP 8.5), 20-Model Mean

Yosemite National Park  
(VaB 0628 Happy Isles Nature Center)

Strong Analog (0-1 st.dev)   Moderately Good Analog (1-2 st.dev)   Poorer Analog (2-3 st.dev)



# Summary

- The Future Analogs Tool allows you to see both current and future climate analogs for 540 National Park locations.
- The tool has many climate definitions for human comfort, water, growing conditions, fire danger/drought stress and energy.
- The tool lets you visualize climate analogs from the contiguous US .
- The tool lets you choose some multiple variable climate definitions to better describe the climate of a place.
- The tool has lots of applications to the understanding human comfort, mountain snow pack, fire danger, cooling energy and more.

Future Climate Analogs Tool at

<https://climatetoolbox.org/tool/future-climate-analogs>