

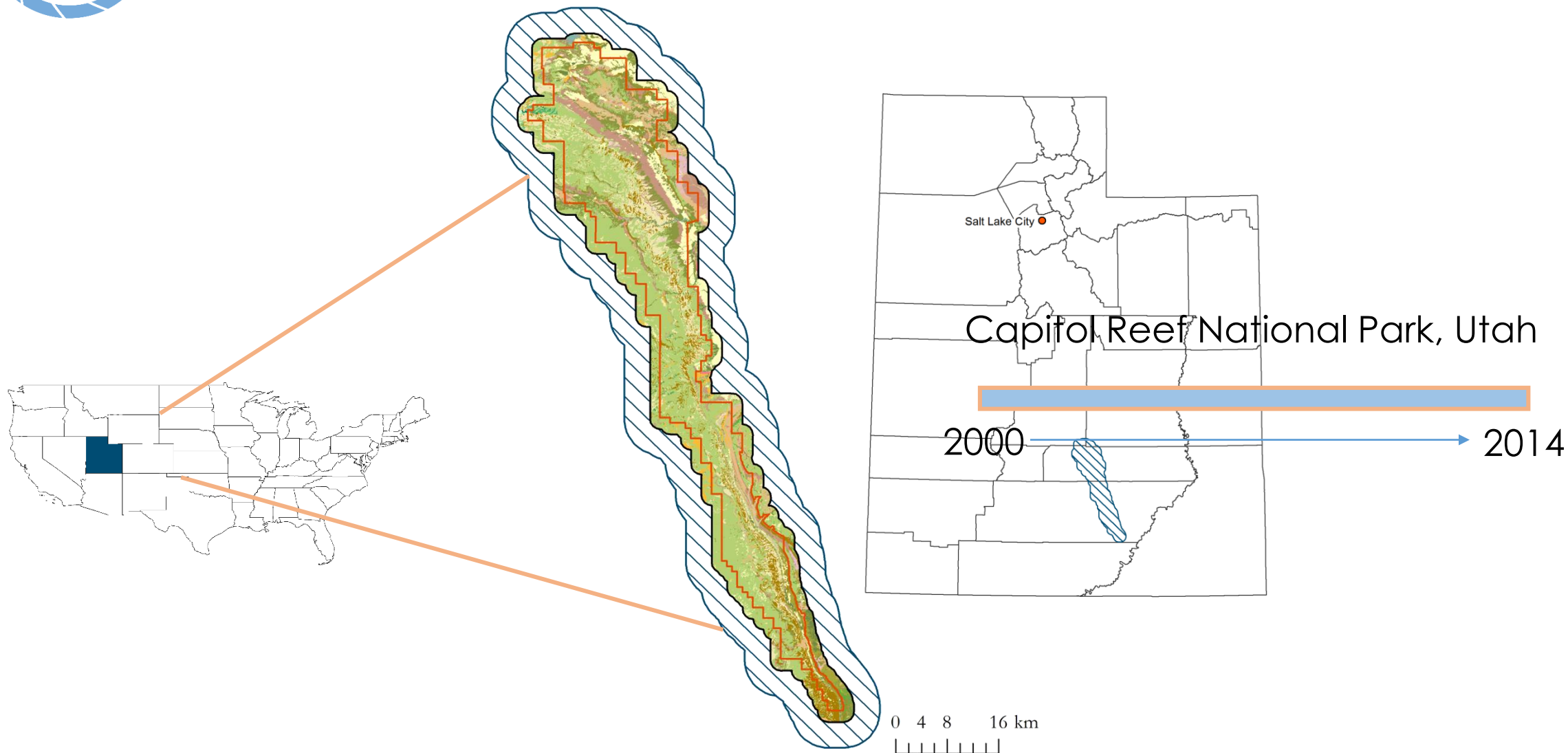
Western US Water Resources

Assessing Landscape Vulnerability to
Drought and Climate Change in National
Parks of the Western United States

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Molly Spater
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Grant Jaccoud



Study Area and Period



Community Concerns



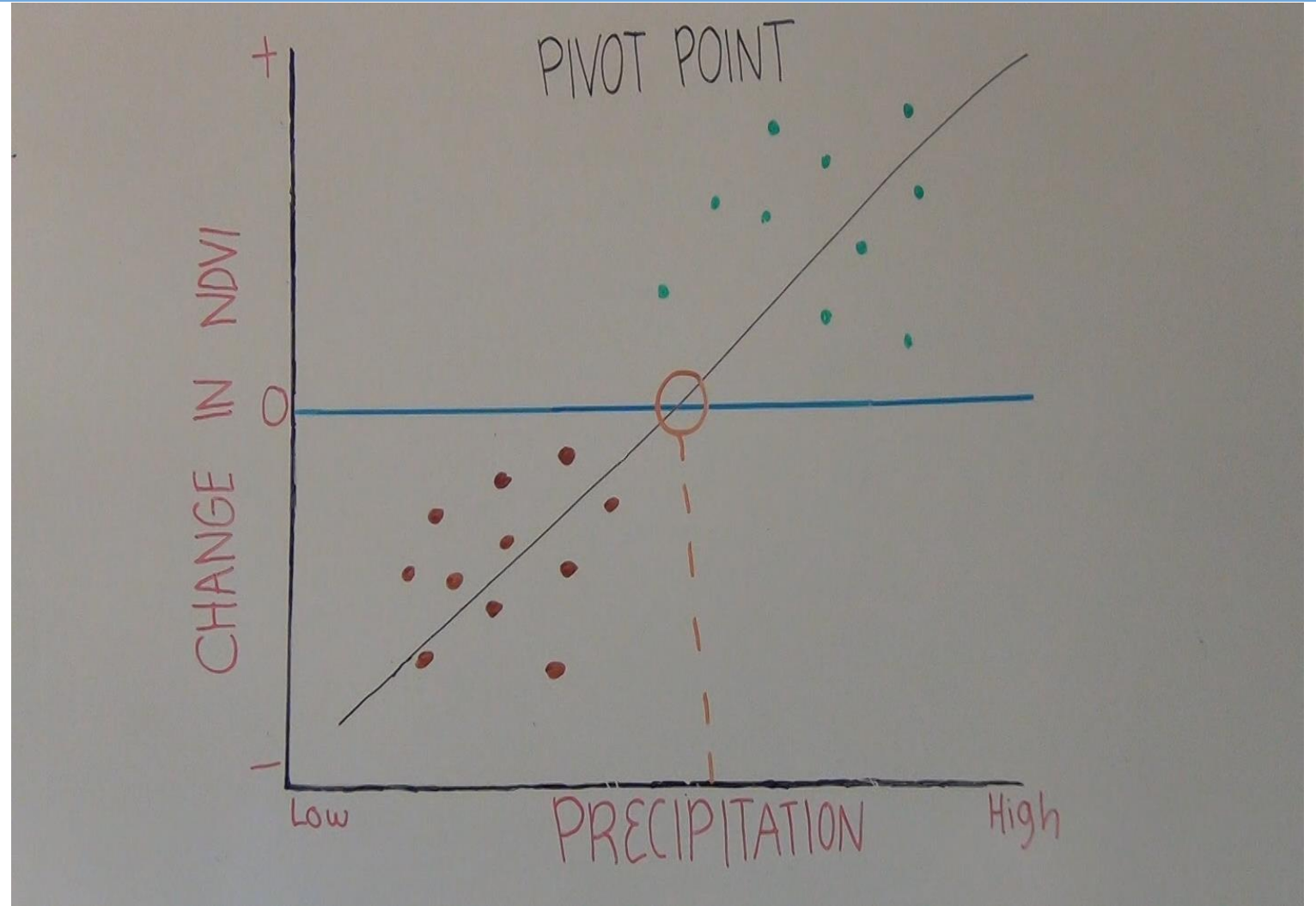
- ▶ The West has been experiencing drought for over a decade
- ▶ Much of the vegetation in the American West is water limited
- ▶ Vegetation shifts are the early warning signs of: ***Environmental thresholds***





Objectives

- ▶ Determine climate pivot points
 - ▶ Evapotranspiration
 - ▶ Precipitation
 - ▶ Temperature
- ▶ Formulate a methodology to determine vegetation response



Example of Pivot Point Extraction

Methodology



**Data acquisition
and
pre-processing**

**Multiple Linear
Regression
Model**

Data Analysis

**Pivot Point
Extraction**

MAX NDVI and Evapotranspiration



Moderate

Resolution

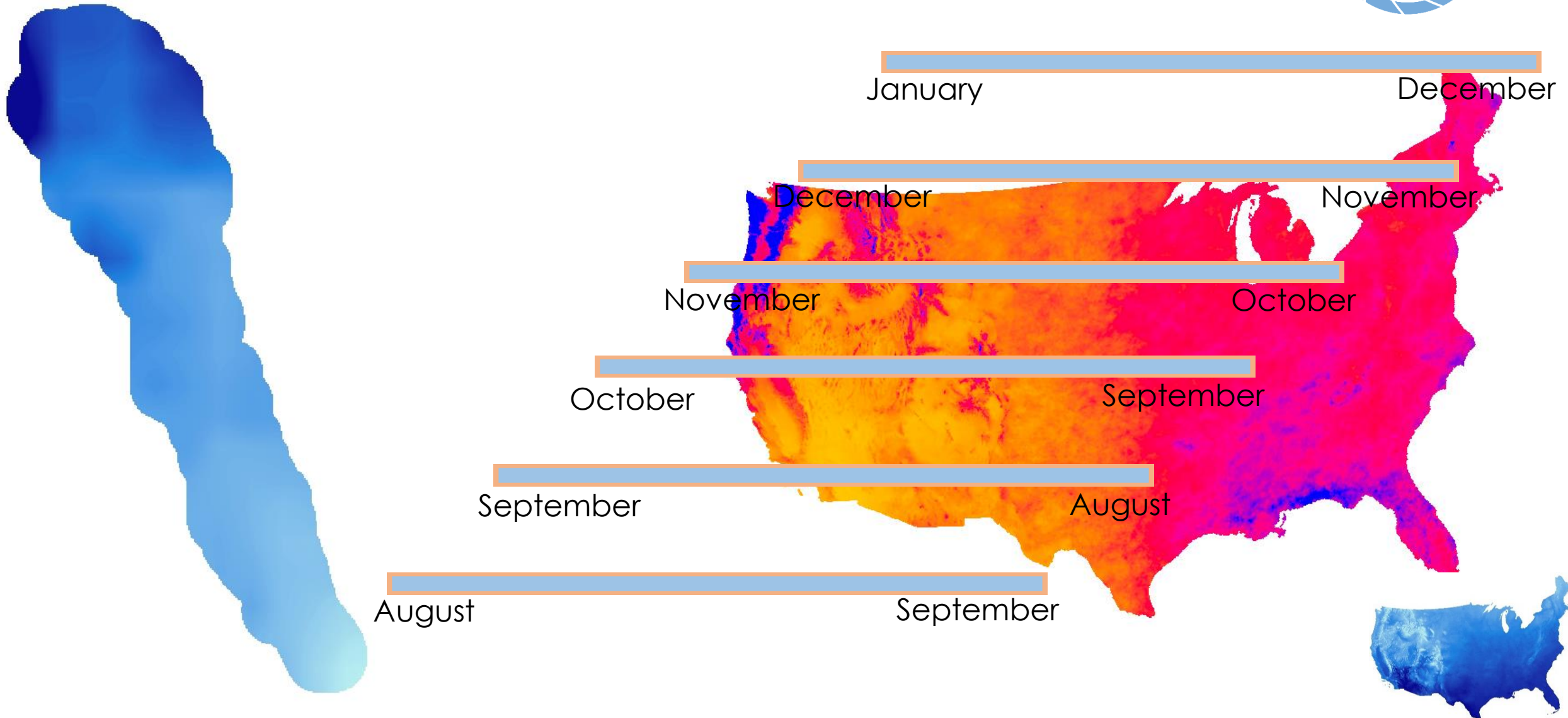
Imaging

Spectroradiometer

ForWarn

Satellite-Based Change Recognition and Tracking

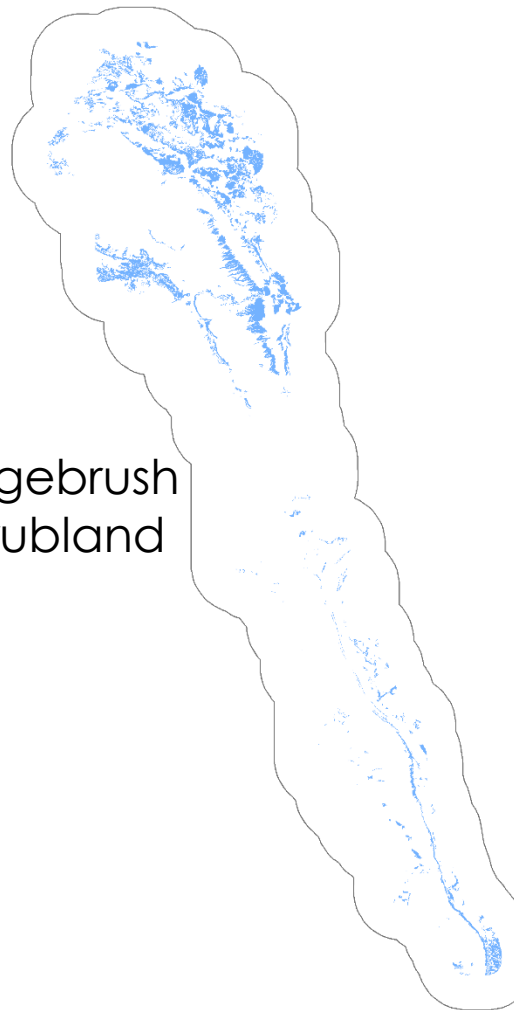
PRISM Climate Group



National Park Service Inventory & Monitoring Program



Sagebrush
Shrubland



Semi-Desert
Grassland



Capitol Reef
Vegetation Classes



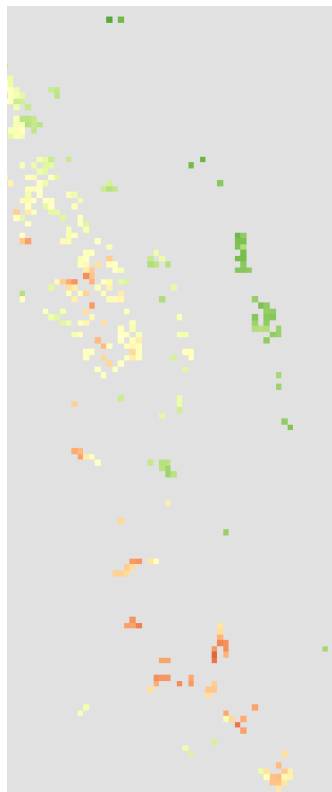
Pinyon-Juniper
Woodland





Methodology

Part 2: Data Analysis



Observed



Theoretical



Delta NDVI





Methodology

Part 3: Multiple Linear Regression

```
Call:
lm(formula = NDVI ~ Temp + Precip, data = please)

Residuals:
    Min       1Q   Median       3Q      Max
-245.53  -71.05  -15.66   55.46  686.99

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  1008.02172   100.13060    10.07  <2e-16 ***
Temp         -57.60263     4.73645   -12.16  <2e-16 ***
Precip         0.75754     0.07259    10.44  <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 112.2 on 470 degrees of freedom
Multiple R-squared:  0.4155,    Adjusted R-squared:  0.413
F-statistic: 167 on 2 and 470 DF,  p-value: < 2.2e-16
```

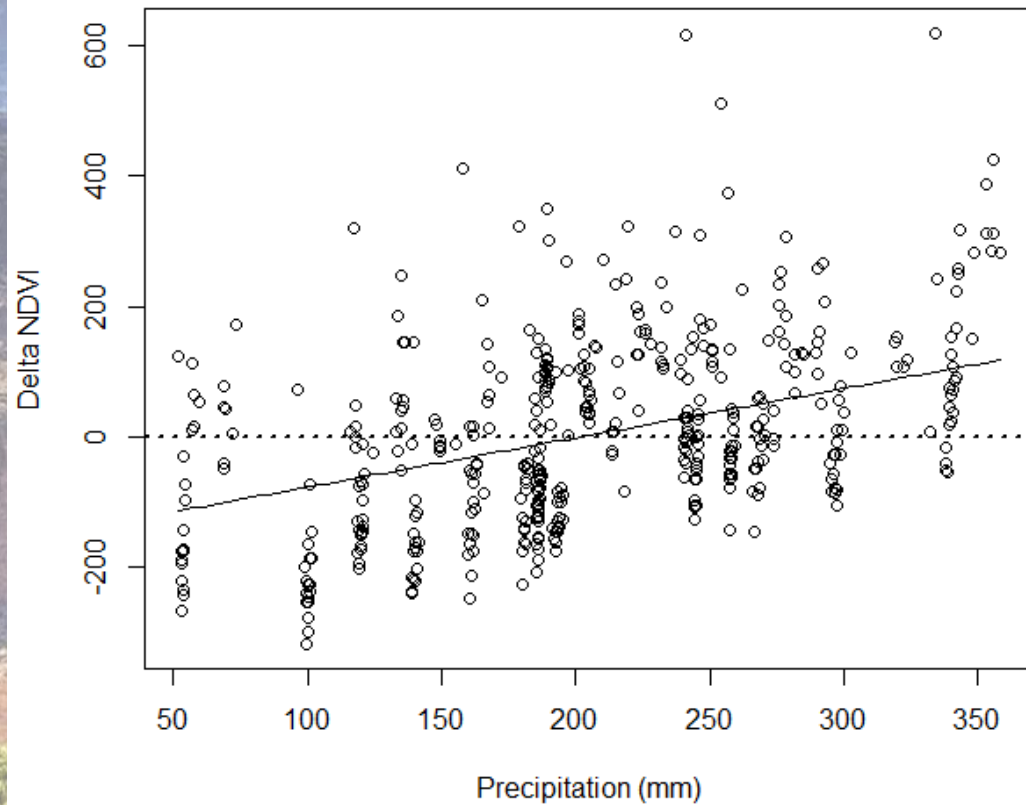



Methodology

Image Credit: Travel Around USA

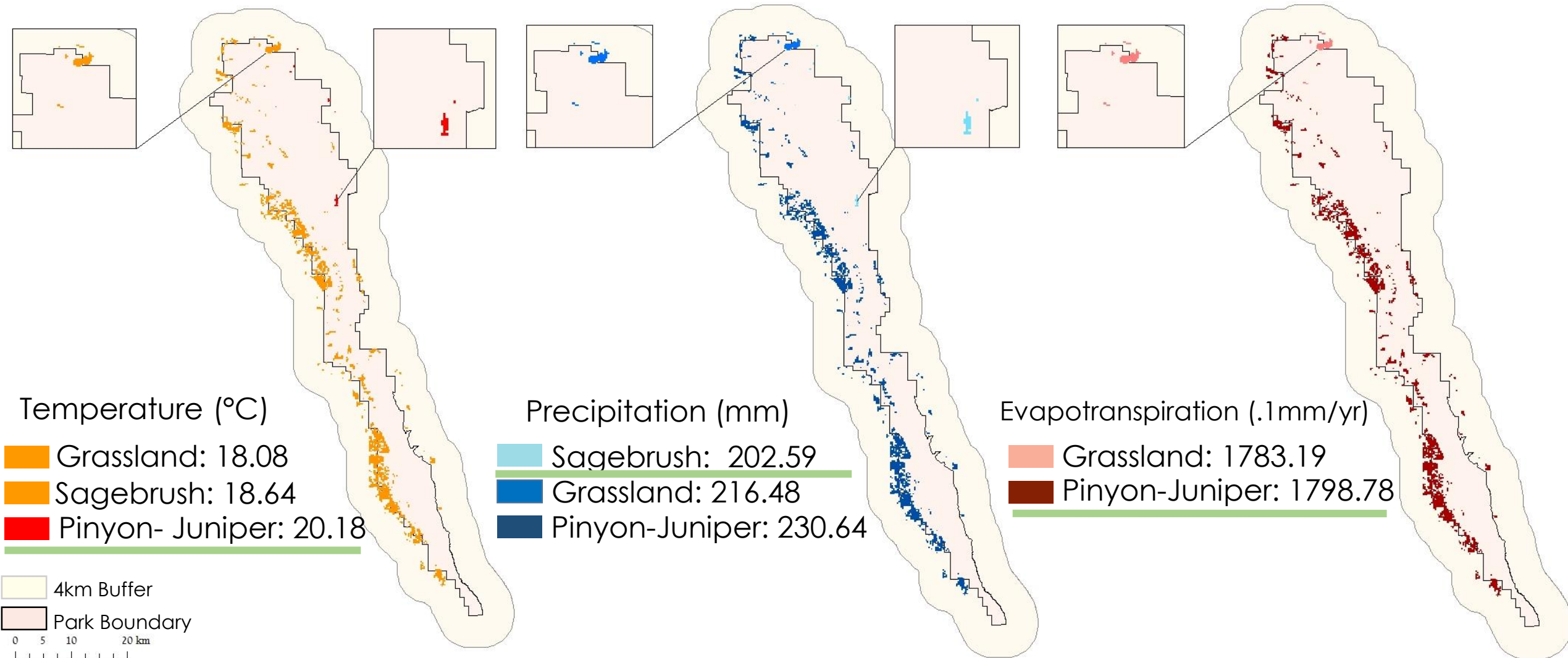
Part 4: Pivot Points

Partial Regression Plot
Precipitation vs. Delta NDVI



	Adjusted R-squared	Equation
Sagebrush Shrubland	0.413	$y = 0.75754(P) - 57.60263(T) + 1008.02172$
Semi-Desert Grassland	0.3882	$y = 2.246(P) + 113.8(T) + .03747(E) - 3217$
Pinyon-Juniper Woodland	0.1924	$y = -1.10513(P) - 232.50463(T) + 0.35845(E) + 3979.4436$

Results



Limitations



- ▶ Possible vegetation shifts
- ▶ Resampling
- ▶ Adjusted r-squared value for Pinyon Juniper Woodland

Conclusions

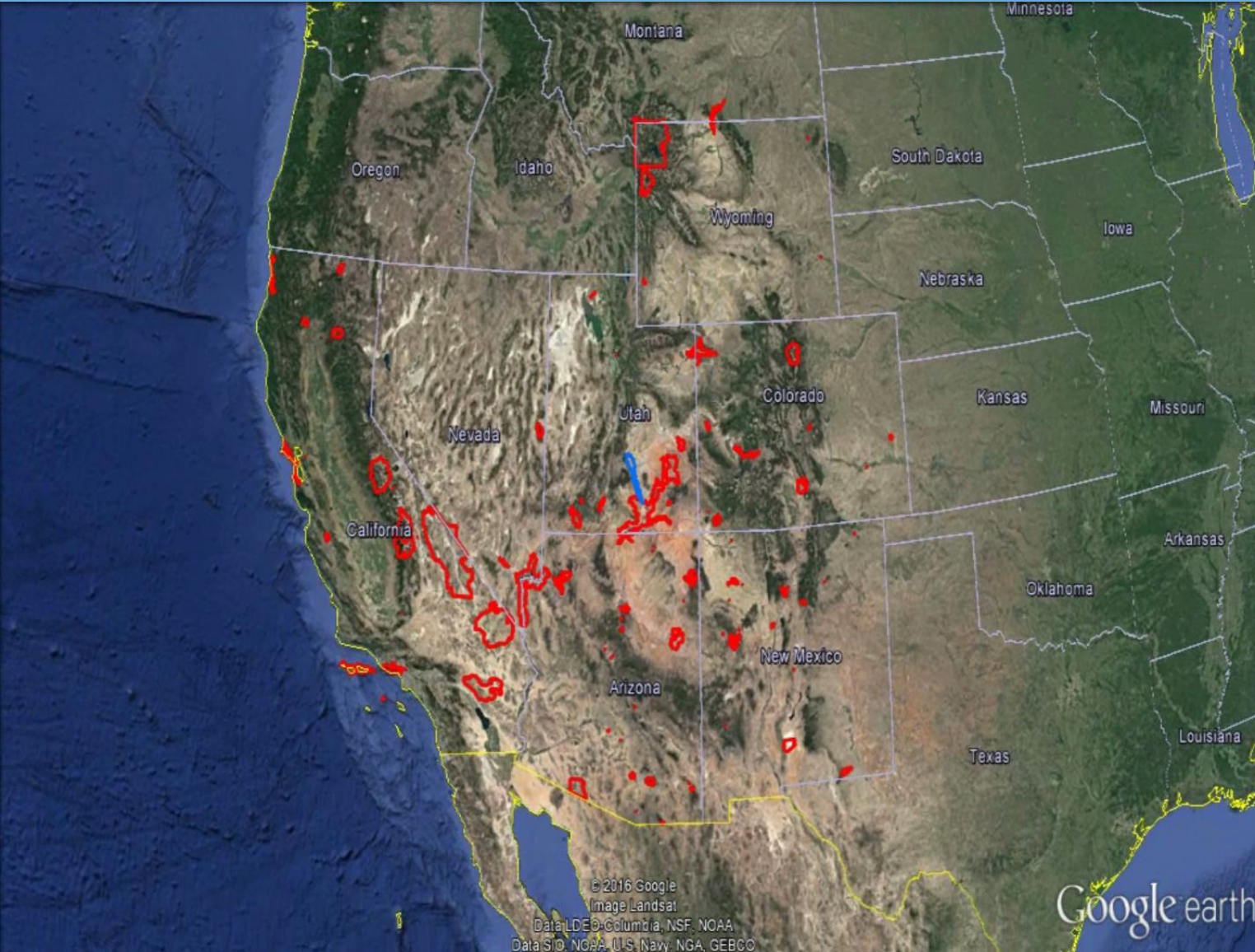


- ▶ Precipitation and temperature significantly correlated with Delta NDVI
- ▶ Sagebrush Shrublands more resilient to higher temperatures and lower precipitation



Image Source: BLM

Future Work



- ▶ Alternative vegetation index
- ▶ Additional parks
- ▶ Additional climate variables
- ▶ Different calculations of delta NDVI
- ▶ Creating our own vegetation classifications using remote sensing
- ▶ Exploring the use of higher resolution imagery
- ▶ Removing disturbed areas using the Normalized Burn Ratio

Acknowledgements



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