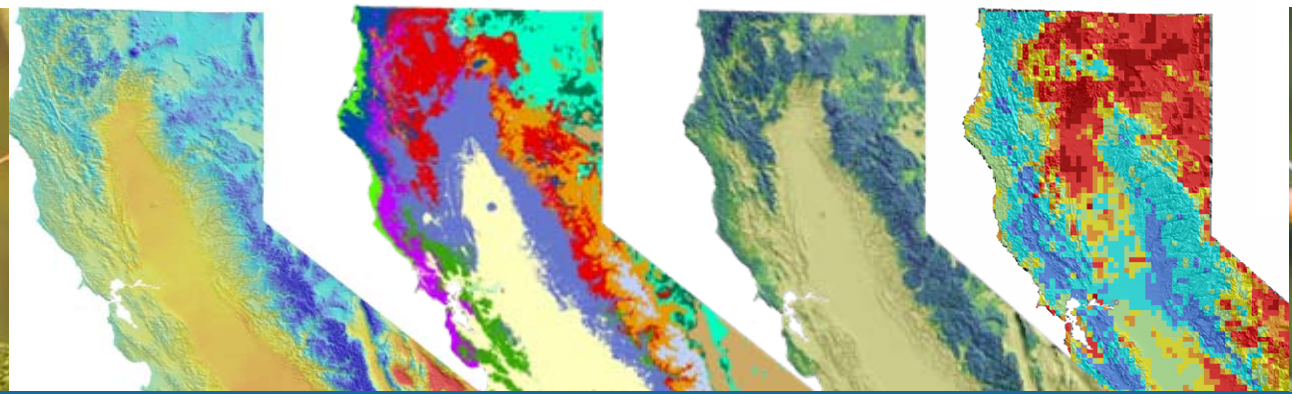
prbo

PRBO Conservation Science



Photos by Peter LaTourrette and PRBO

Projecting Effects of Climate Change on Terrestrial Birds in California

Diana Stralberg, Dennis Jongsomjit, Chrissy Howell, John Wiens

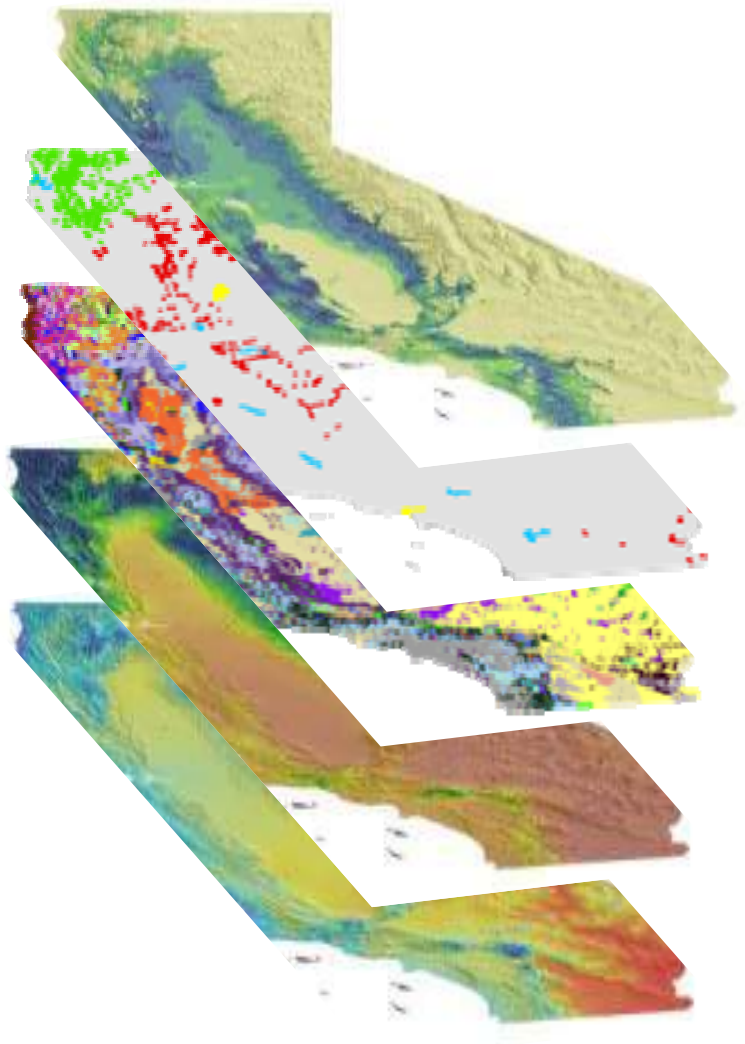
PRBO Conservation Science

Talk Outline

- **What is distribution modeling?**
- Results from PRBO's California Bird Models
- Relevance for Sonoma County

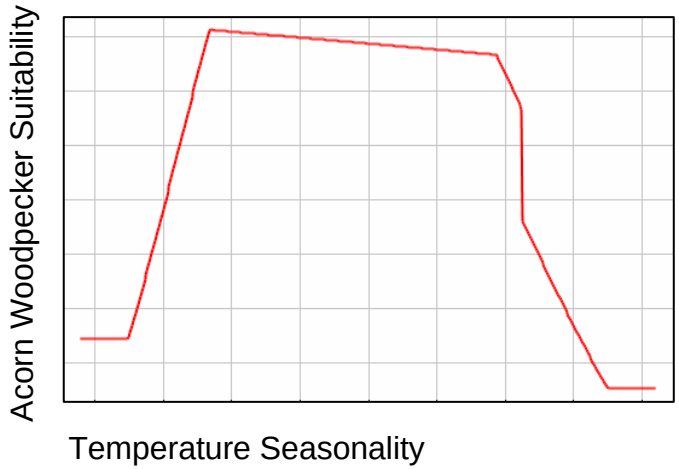
What is Species Distribution Modeling?

- AKA “niche models” or “bioclimatic models”
- Usually based on climate variables
- Often used to predict shifts due to climate change
- Generally at continental scales



What is Species Distribution Modeling?

- Species-climate relationships assumed constant



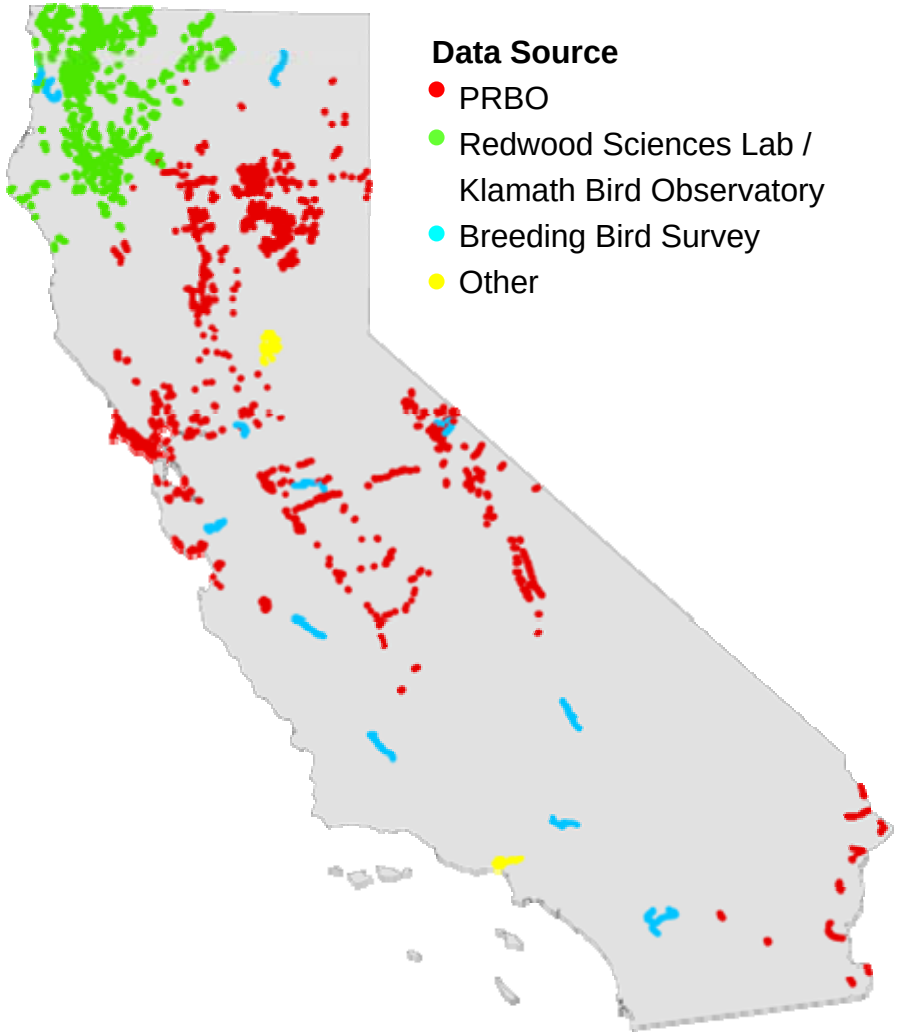
- Not included:
  - Biotic interactions
  - Dispersal

Talk Outline

- What is distribution modeling?
- **Results from PRBO's California Bird Models**
- Relevance for Sonoma County

Predicted Bird Responses to Climate Change

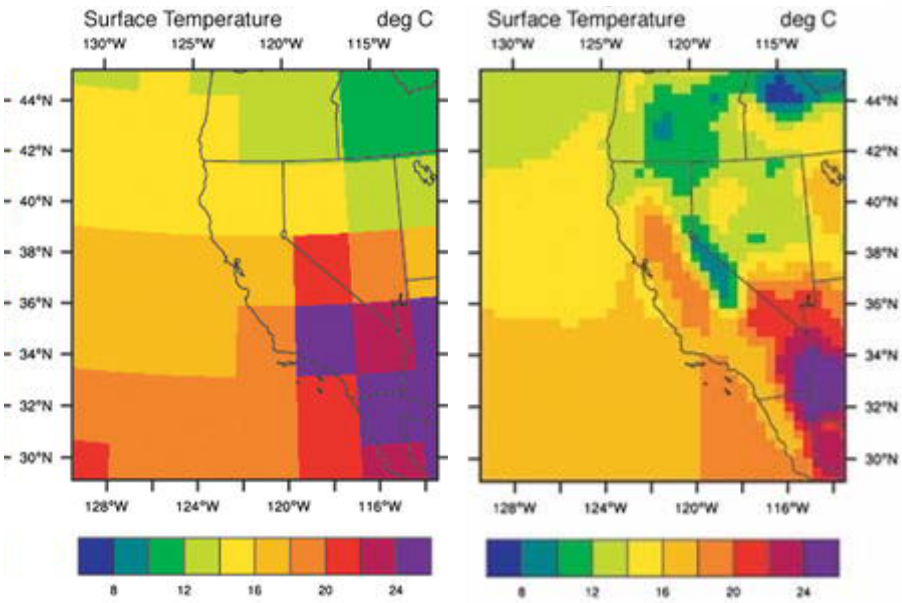
- **Terrestrial breeding birds**
- **Point count data**
- **60 focal species (California Partners in Flight) representing 5 habitats (scrub, oak, conifer, riparian, grassland)**



Regional Climate Models

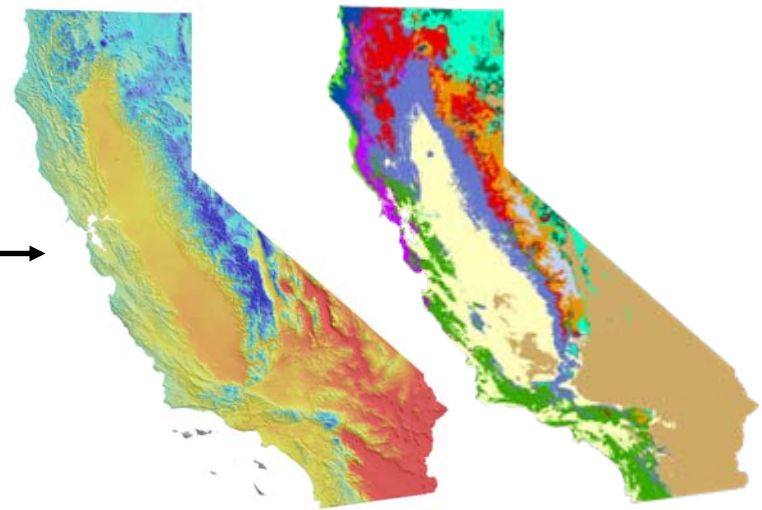
General Circulation Model (GCM)

Regional Climate Model (RCM)



From Snyder et al. 2005

Regional Climate Models: Snyder, unpublished
RegCM3 (inputs from GFDL CM2.1, NCAR CCSM3.0)



8 bioclimatic variables (based on monthly temperature and precipitation)

Vegetation type (modeled from climate, soil, topography)

~3˚ 30 km 800 m

Individual Species Predictions

Modeling Bird Distribution Responses to Climate Change:
A mapping tool to assist land managers and scientists in California

About the Maps & Data

www.prbo.org/cadc

Species Distributions

Start Over

Select a habitat type: Conifer

Select a species: Brown Creeper

Select other data:
- Current range maps (more info)
- Show locations for this species

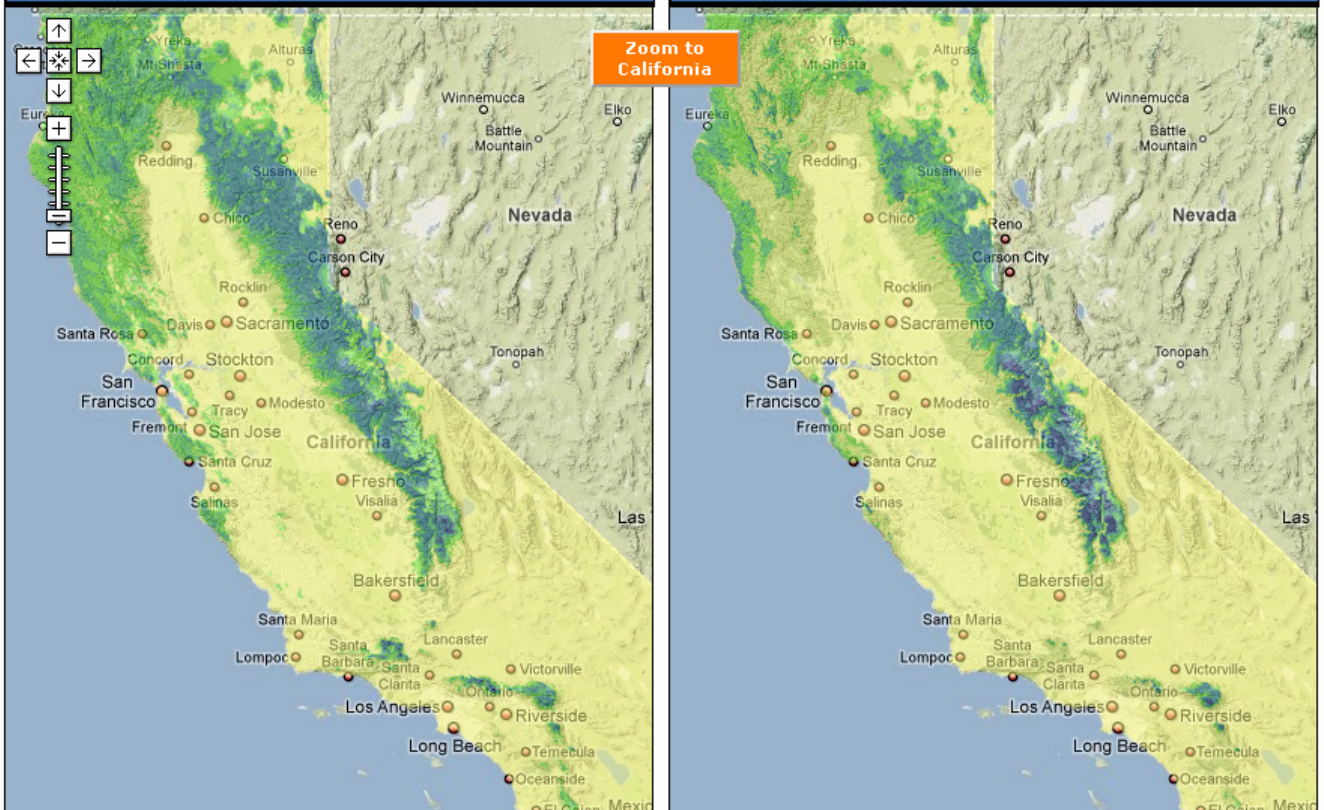
Results from GFDL CM2.1 climate model
and Maxent algorithm

Probability of occurrence: 0-20% | 20-40% | 40-60% | 60-80% | 80-100%

Projected Current Distribution

Projected Future Distribution

Zoom to California



Brown Creeper

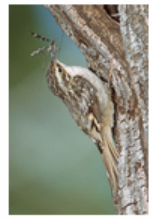


Photo (c) Peter LaTourrette

Learn more about the **Brown Creeper** at All About Birds or read the Partners In Flight species account

Variables in order of Importance

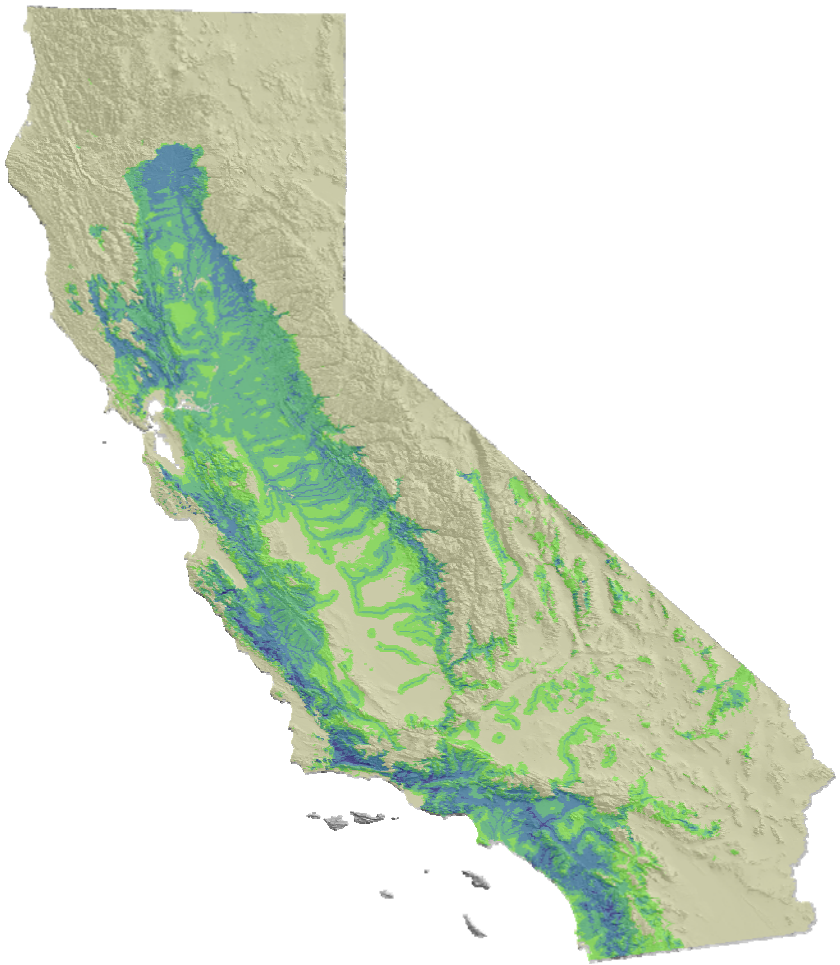
1. Vegetation
2. Annual precipitation
3. Precipitation of driest quarter
4. Isothermality
5. Mean temperature of the warmest quarter
6. Distance to stream
7. Precipitation seasonality
8. Mean diurnal range
9. Temperature seasonality
10. Annual mean temperature

PRBO Conservation Science

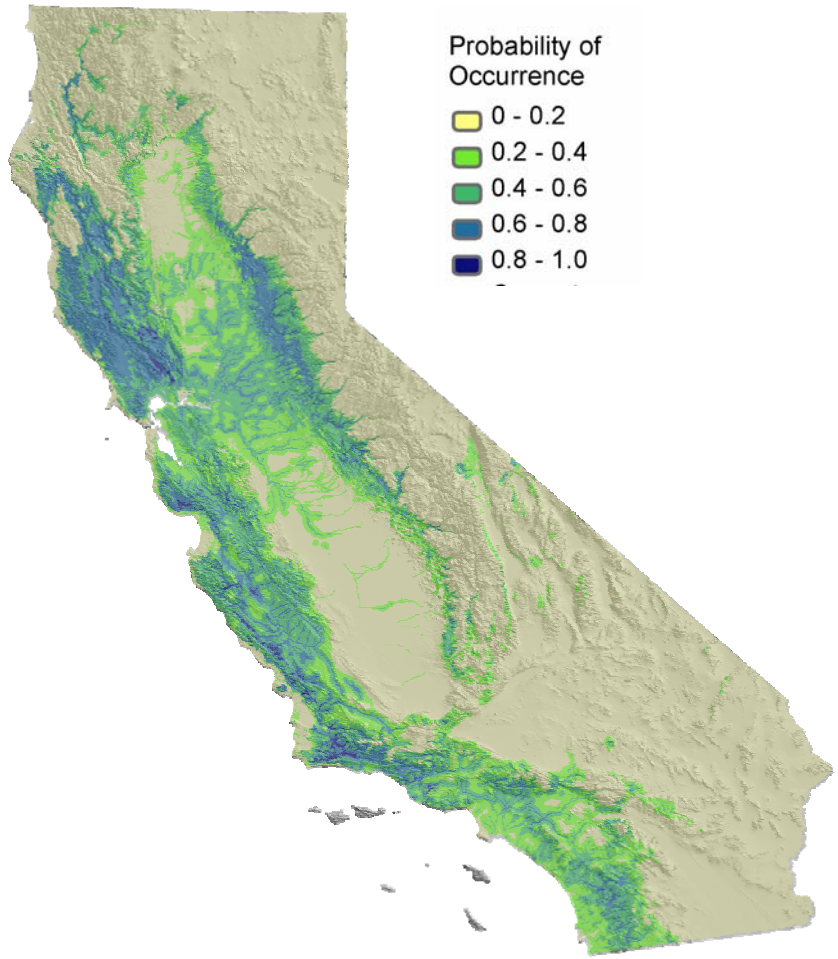
Nuttall's Woodpecker


Peter LaTourrette

Year 2000



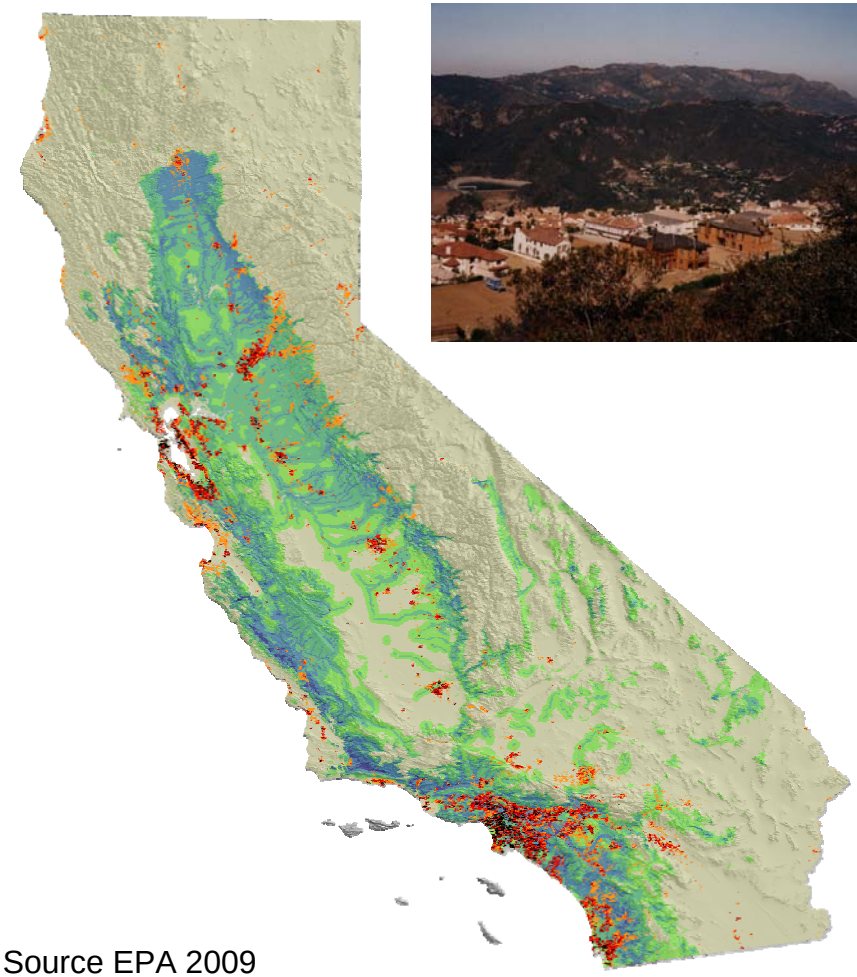
Year 2070

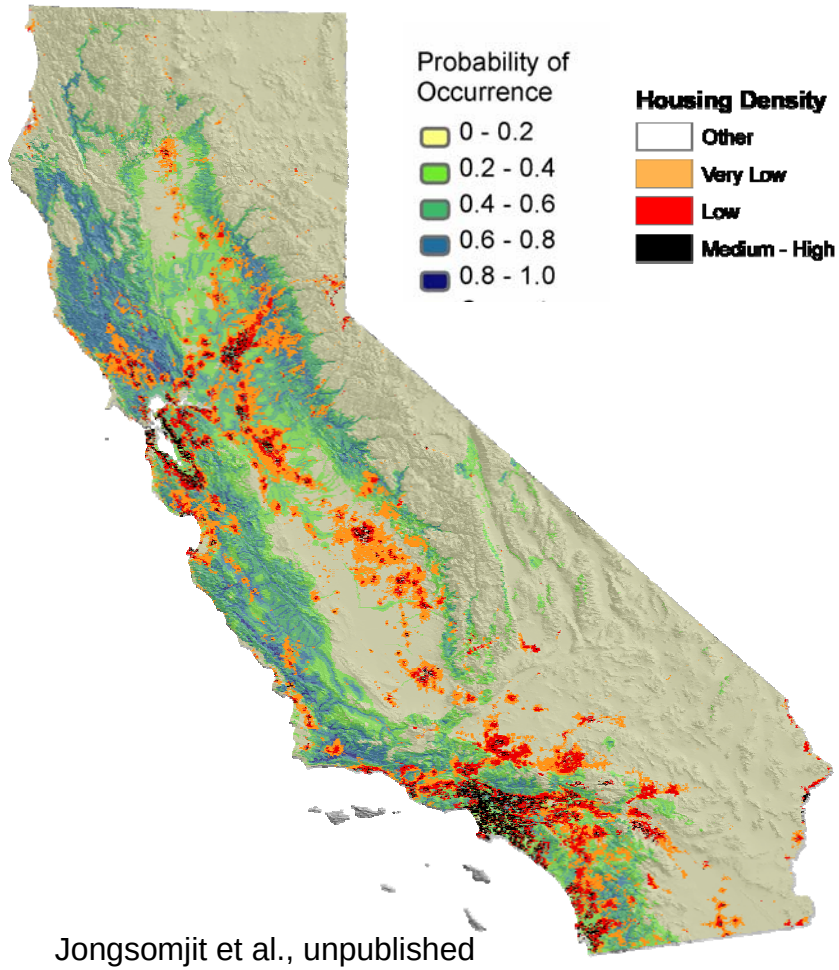


Climate Change + Urbanization

Year 2000

Year 2070

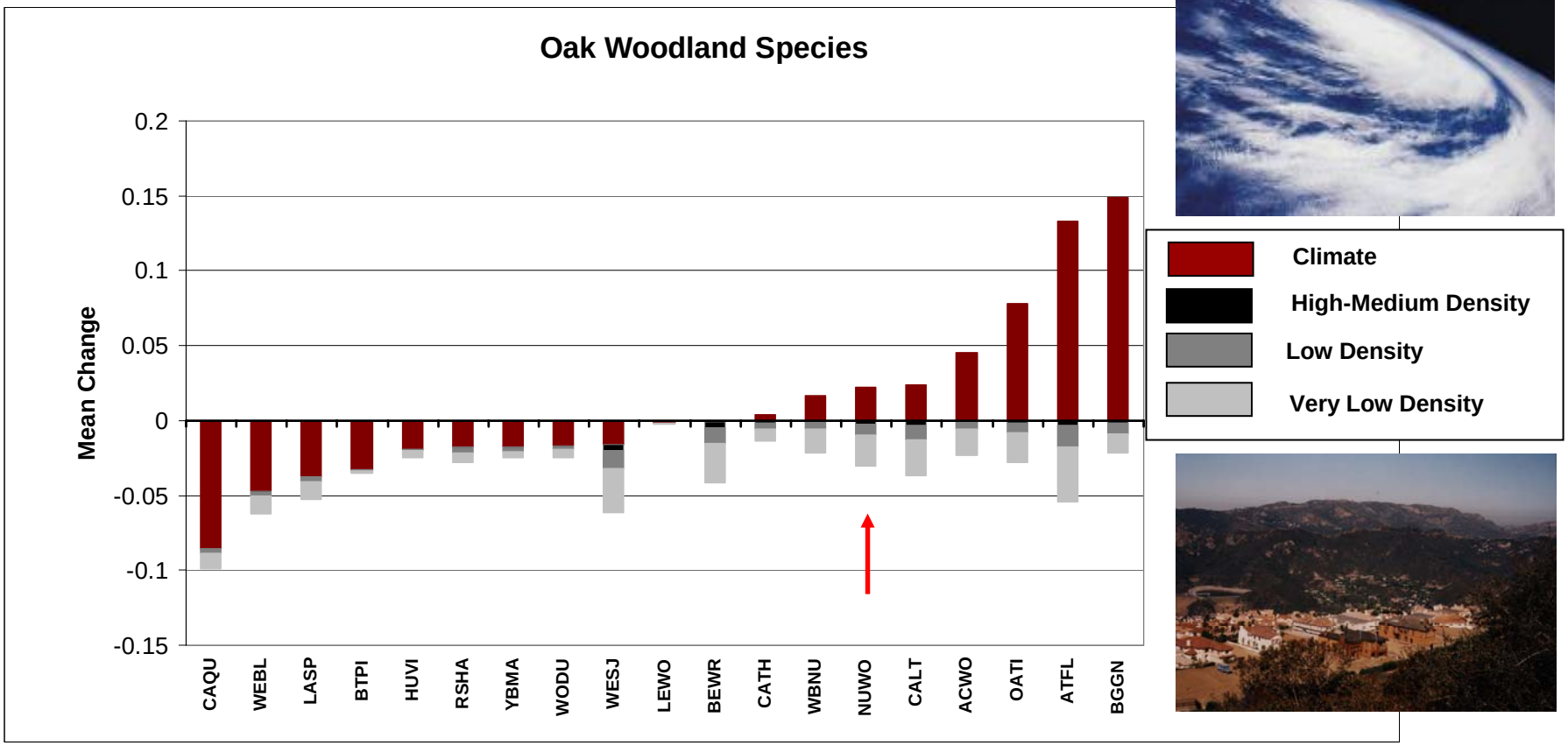


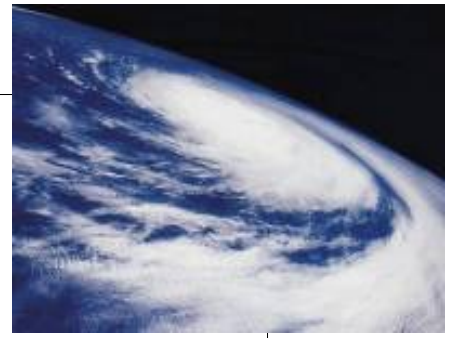


Source EPA 2009

Jongsomjit et al., unpublished

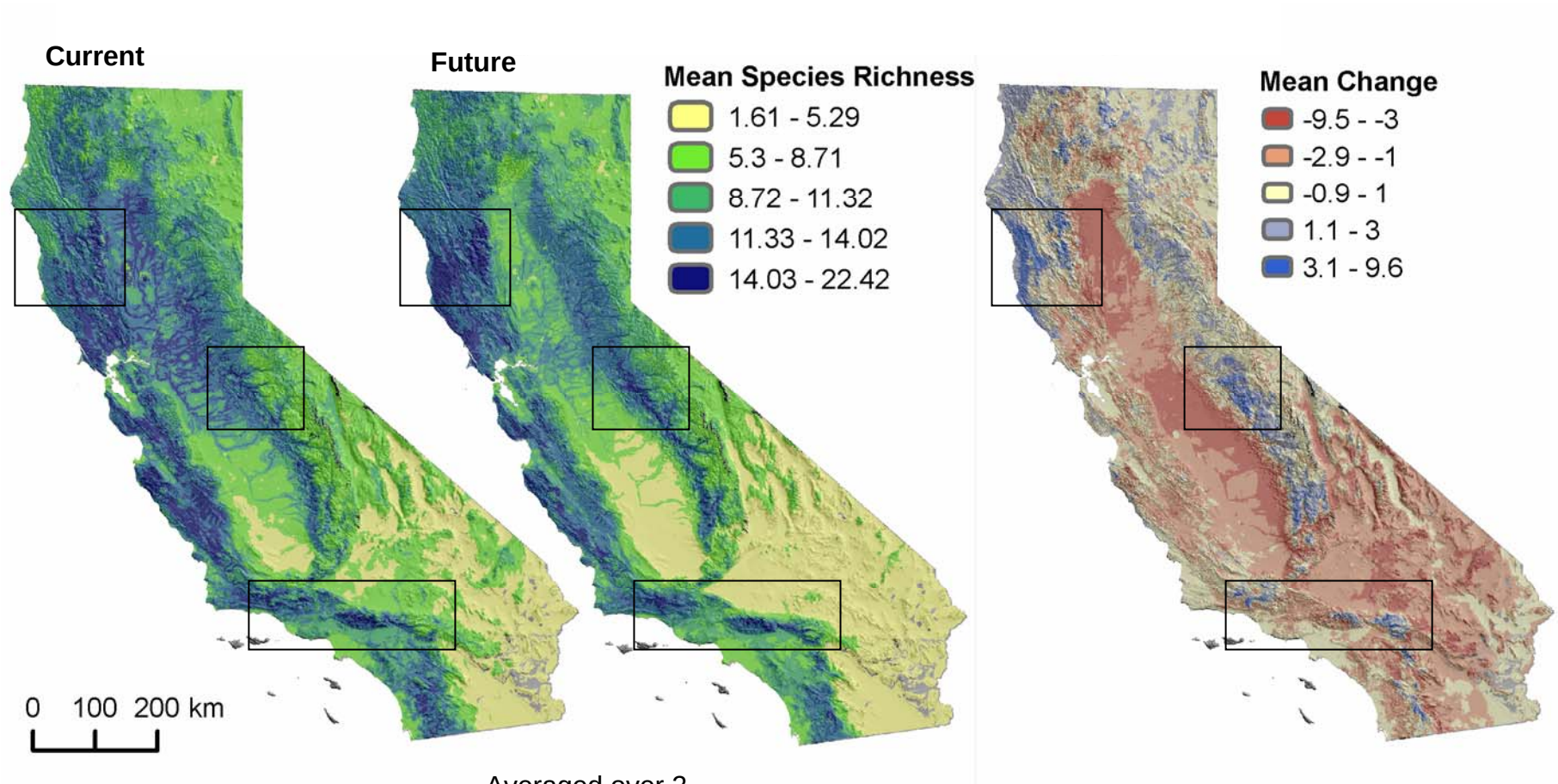
Climate Change + Urbanization





Jongsomjit et al., unpublished

Future Diversity Hotspots

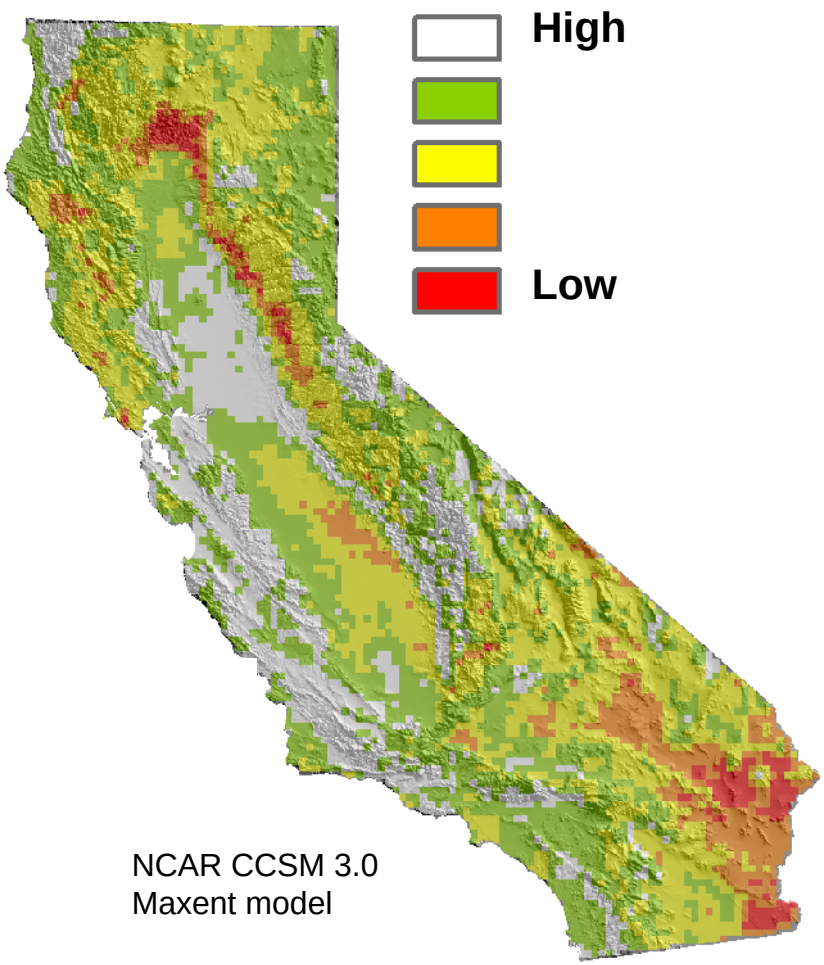


Averaged over 2 climate models and 2 distribution models

Wiens et al. 2009, PNAS

Community Turnover

Future Bird Community Similarity



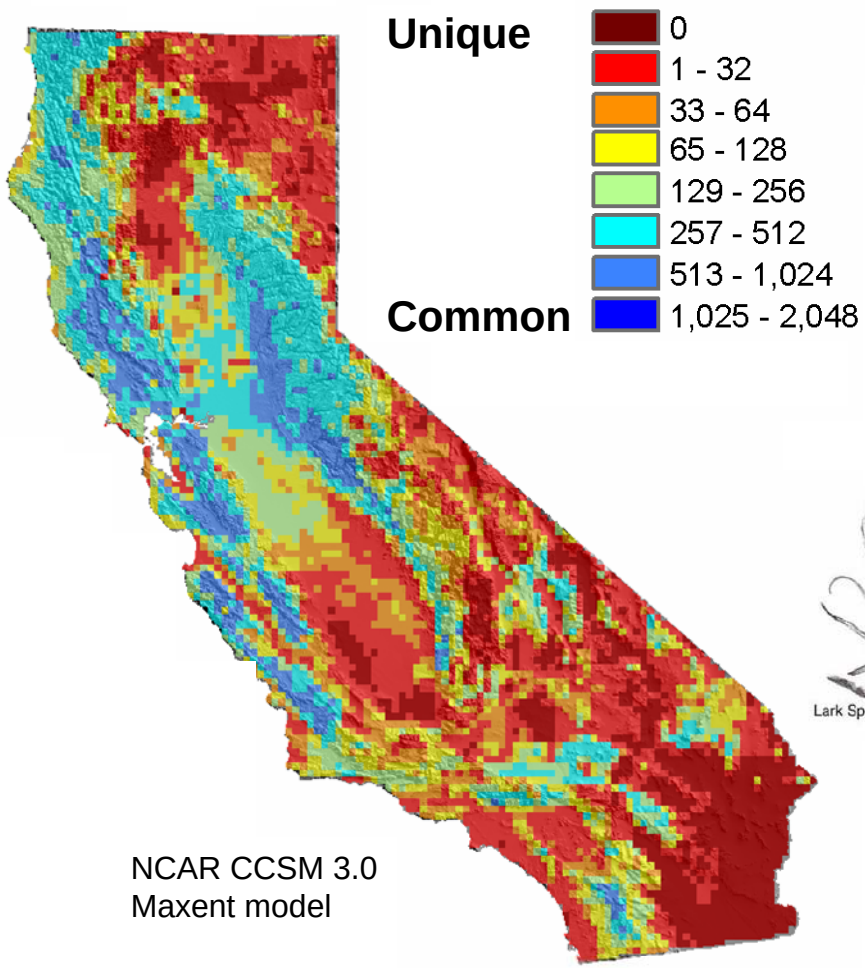
NCAR CCSM 3.0
Maxent model

© Keith Hansen

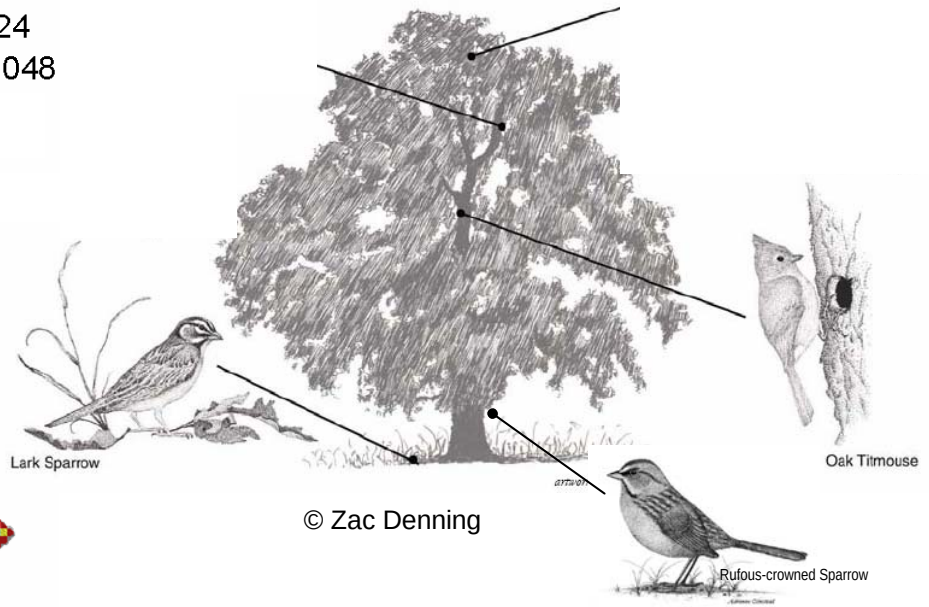
Stralberg et al. 2009, PLoS ONE

Community Reshuffling

Future Bird Communities: Number of Modern Analogs



NCAR CCSM 3.0
Maxent model

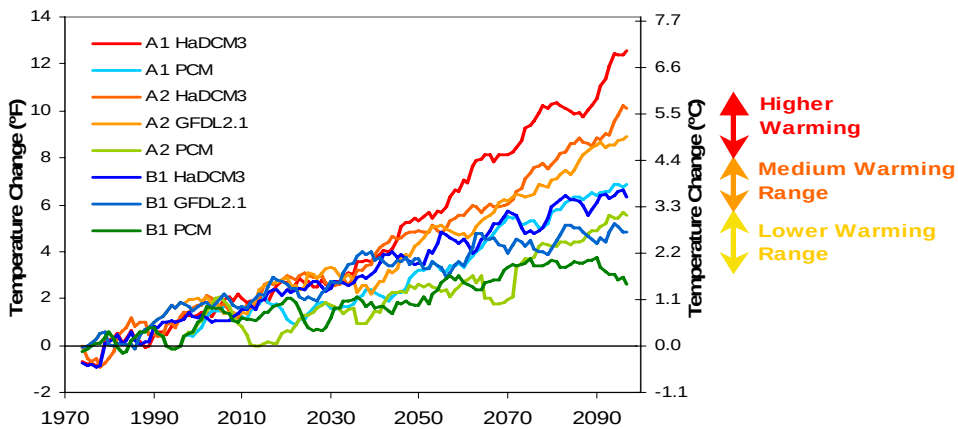


© Zac Denning

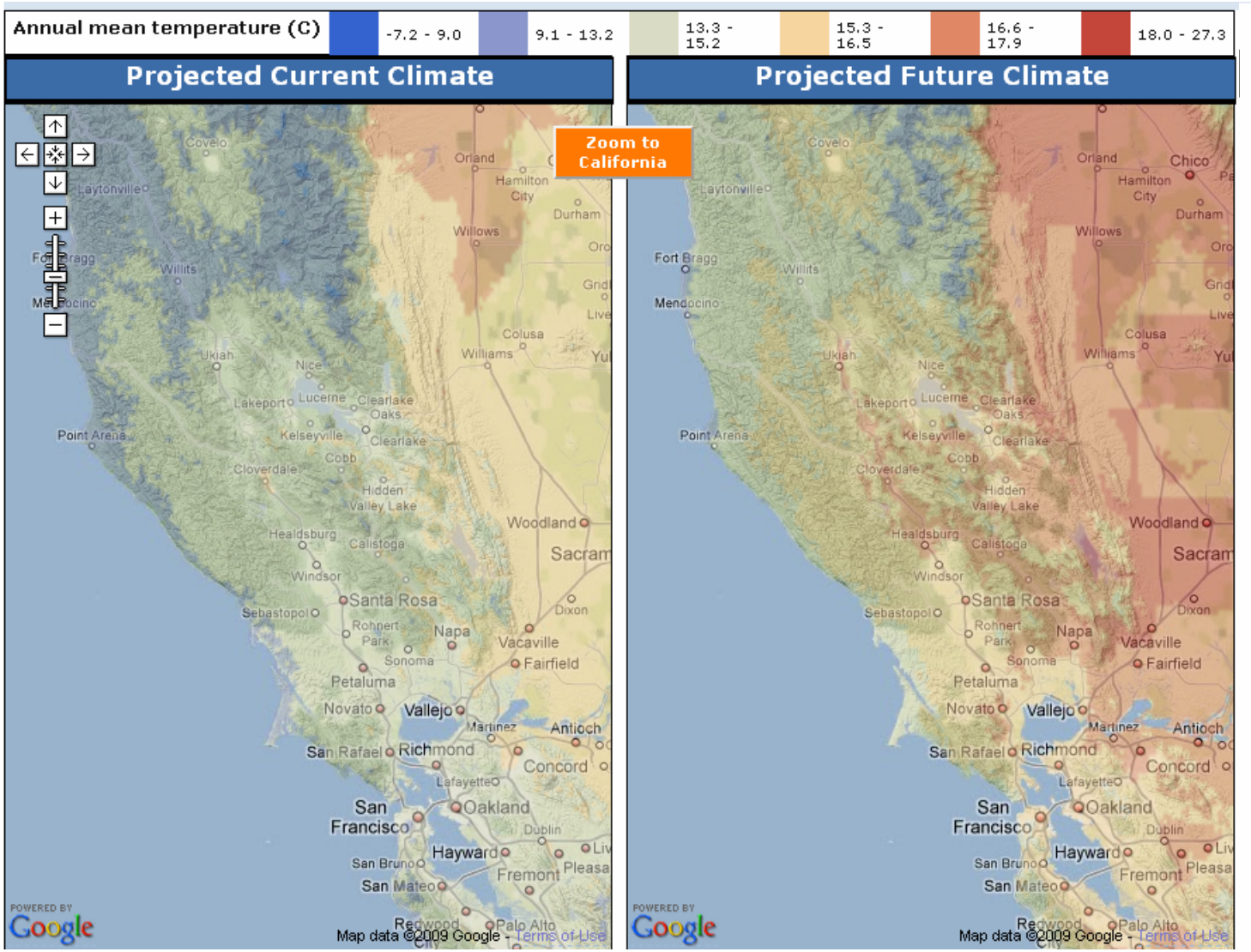
Stralberg et al. 2009, PLoS ONE

Talk Outline

- What is distribution modeling?
- Results from PRBO's California Bird Models
- **Relevance for Sonoma County**
  - **Terrestrial birds only**
  - **Uncertainty increases at local level**

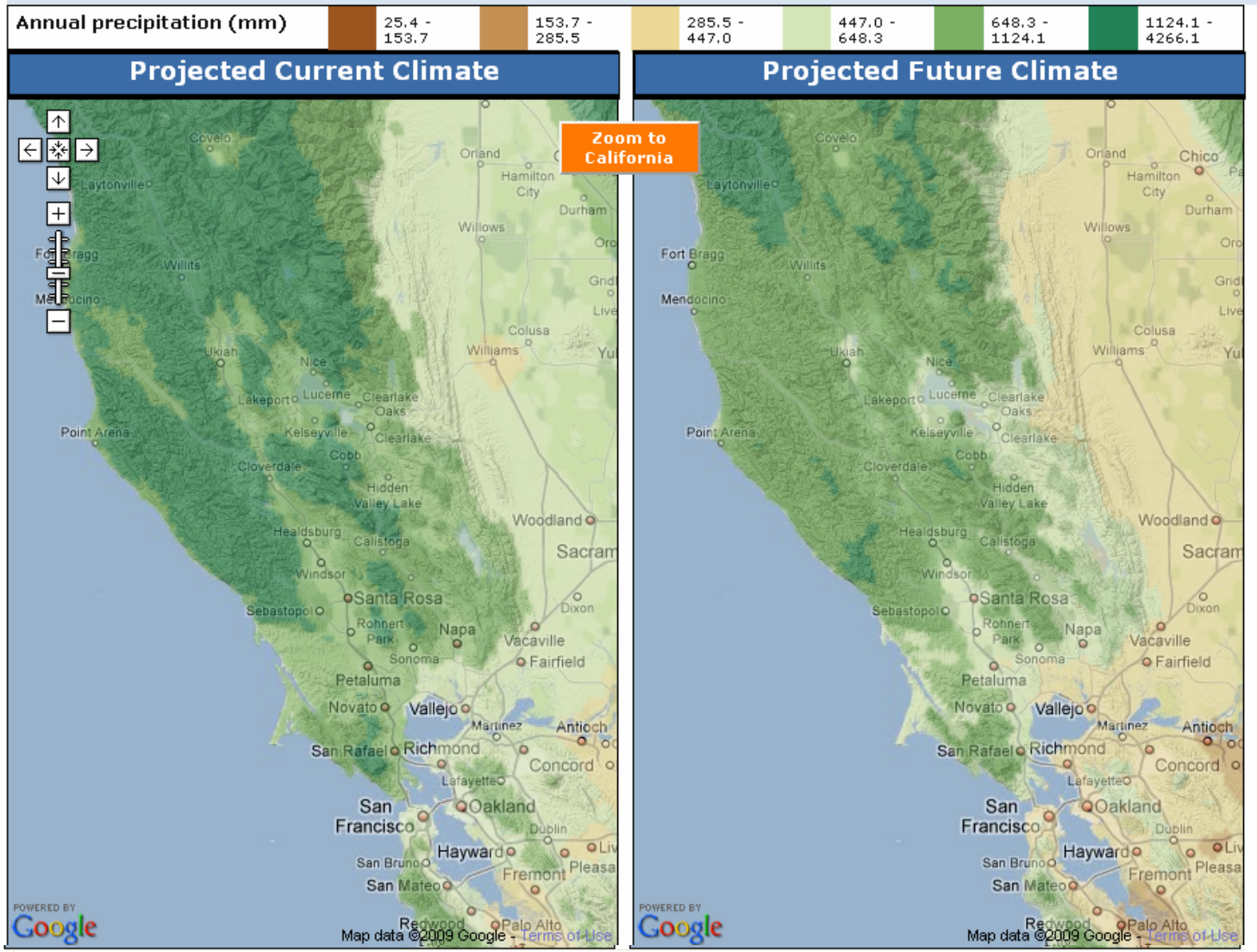


Annual Mean Temperature



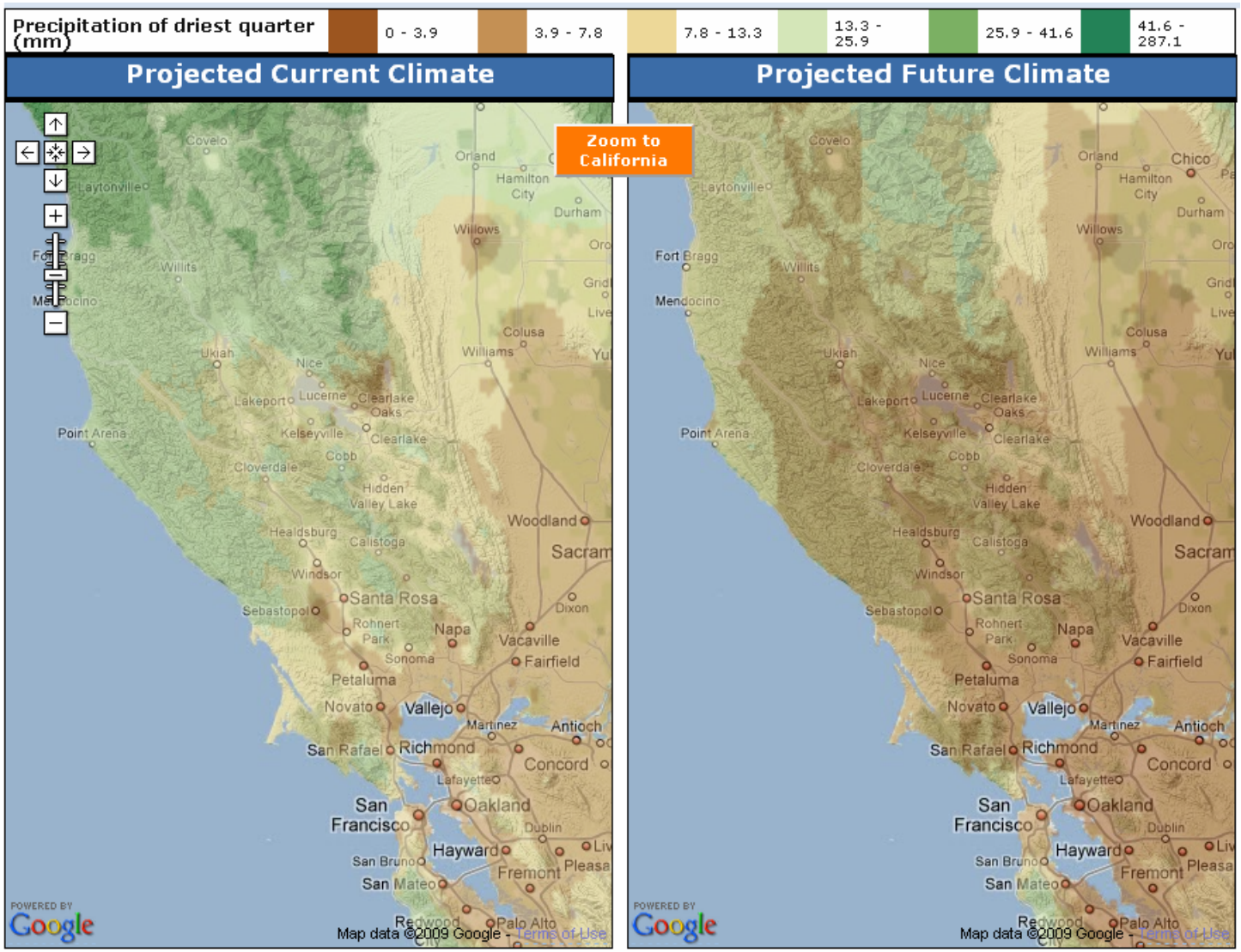
NCAR
CCSM 3.0

Annual Precipitation



NCAR
CCSM 3.0

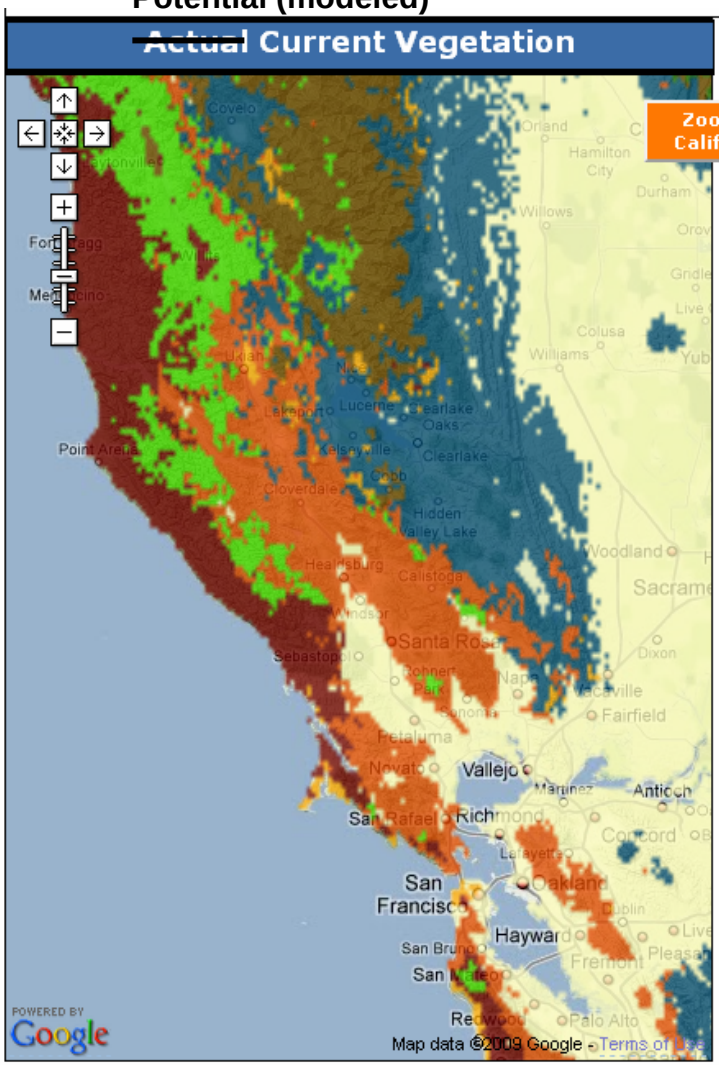
Precipitation of the Driest Quarter

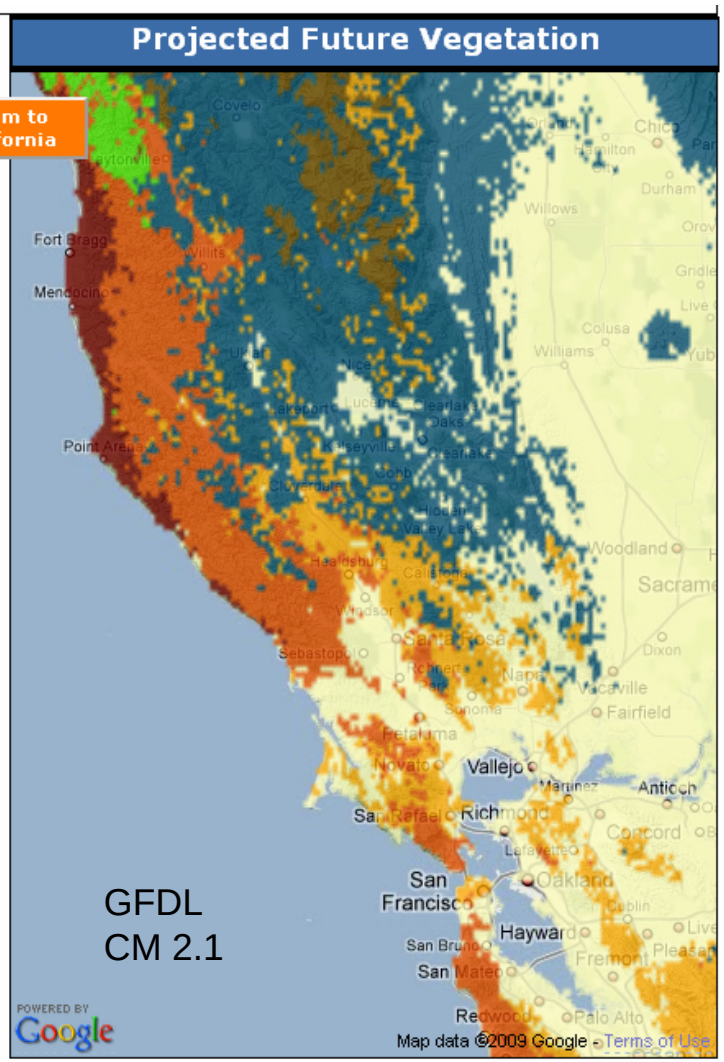


NCAR
CCSM 3.0

Vegetation

Potential (modeled)





Vegetation legend

- Annual Grassland (AGS), Perennial Grassland (PGS)
- Blue Oak Woodland (BOW), Blue Oak-Foothill Pine (BOP)
- Desert Scrub (DSC), Alkali Desert Scrub (ASC), Desert Succulent Shrub (DSS)
- Eastside Pine (EPN), Juniper (JUN), Pinyon-Juniper (PJN)
- Mixed Chaparral (MCH), Chamise-Redshank Chaparral (CRC), Coastal Scrub (CSC)
- Montane Hardwood-Conifer (MHC), Douglas Fir (DFR)
- Montane Hardwood (MHW), Coastal Oak Woodland (COW)
- Ponderosa Pine (PPN), Klamath Mixed Conifer (KMC)
- Redwood (RWD), Closed-Cone Pine Cypress (CPC)
- Red Fir (RFR), Lodgepole Pine (LPN), Subalpine Conifer (SCN)
- Sagebrush (SGB), Bitterbrush (BBR), Low Sage (LSG)
- Sierran Mixed Conifer (SMC), White Fir (WFR), Jeffrey Pine (JPN)

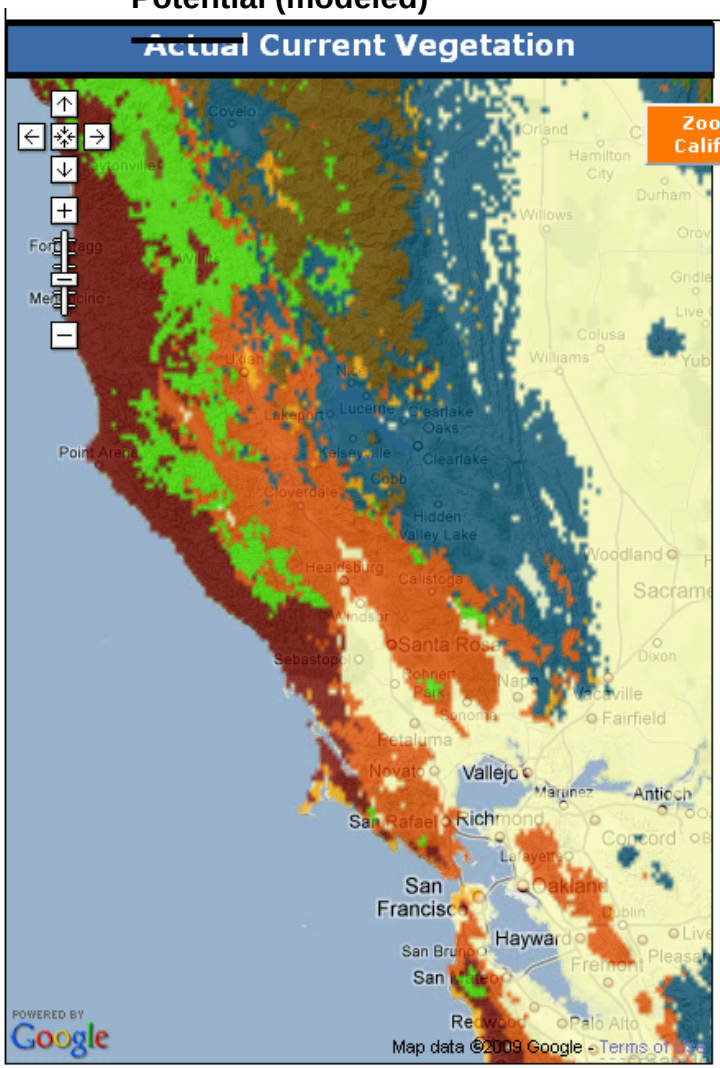
Variables in order of Importance

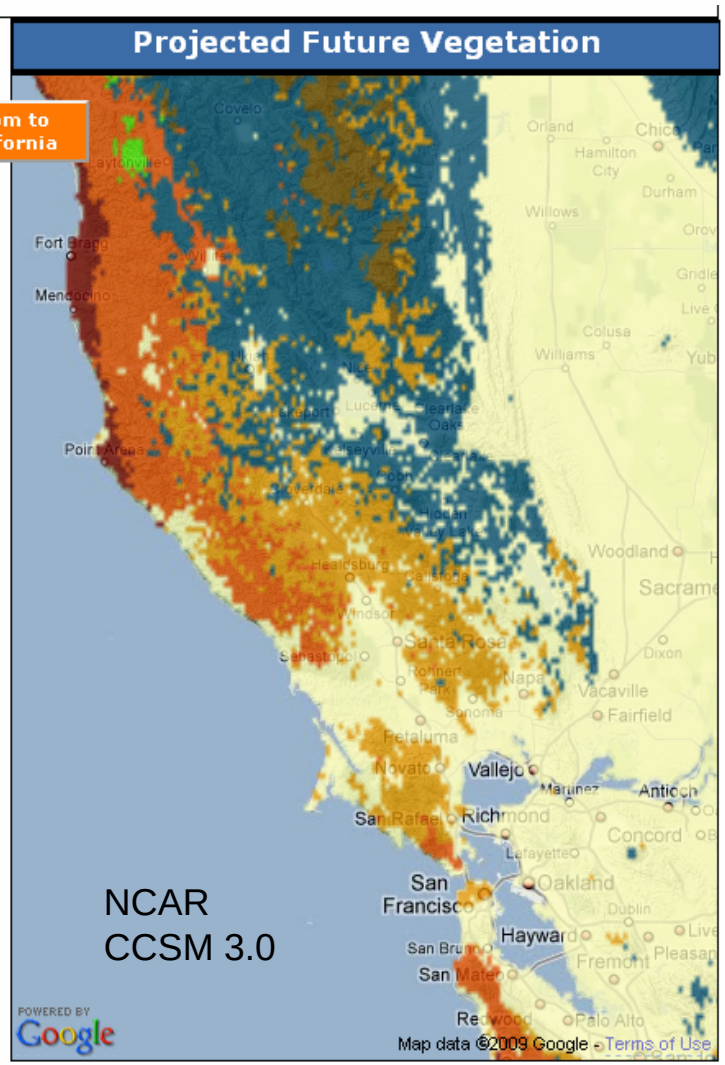
1. Annual precipitation
2. Annual mean temperature
3. Temperature seasonality
4. Soil available water capacity (AWC)
5. Mean temperature of the warmest quarter
6. Precipitation seasonality
7. Slope
8. Precipitation of driest quarter
9. Solar radiation
10. Isothermality
11. Soil permeability
12. Soil pH

? - variable definitions

Vegetation

Potential (modeled)





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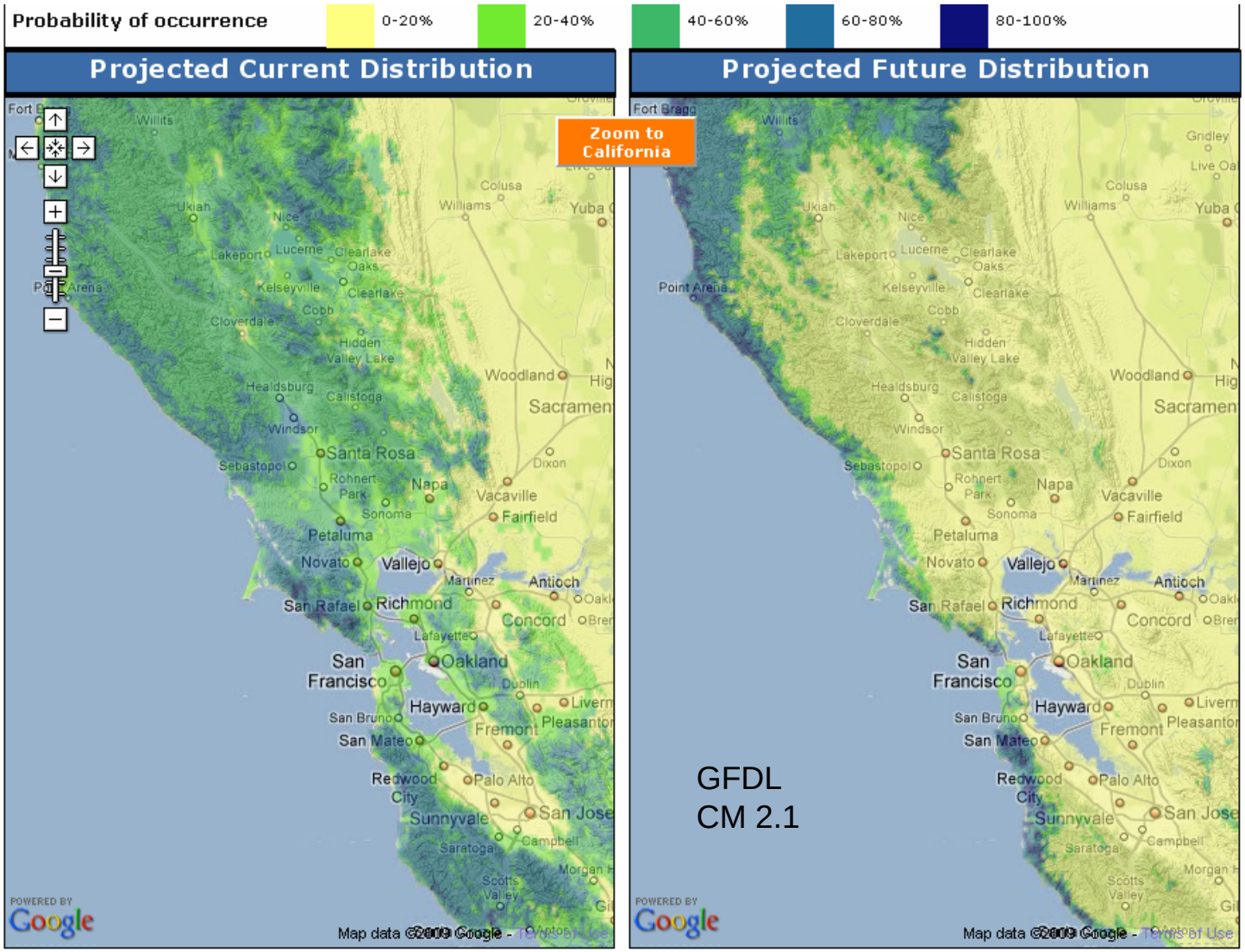
? – variable definitions

Purple Finch



Purple Finch

Photo (c) Peter LaTourrette

Learn more about the **Purple Finch** at All About Birds or read the Partners In Flight species account

Variables in order of Importance

1. Vegetation
2. Annual precipitation
3. Distance to stream
4. Annual mean temperature
5. Precipitation seasonality
6. Precipitation of driest quarter
7. Temperature seasonality
8. Mean temperature of the warmest quarter
9. Mean diurnal range
10. Isothermality

? - variable definitions

Purple Finch

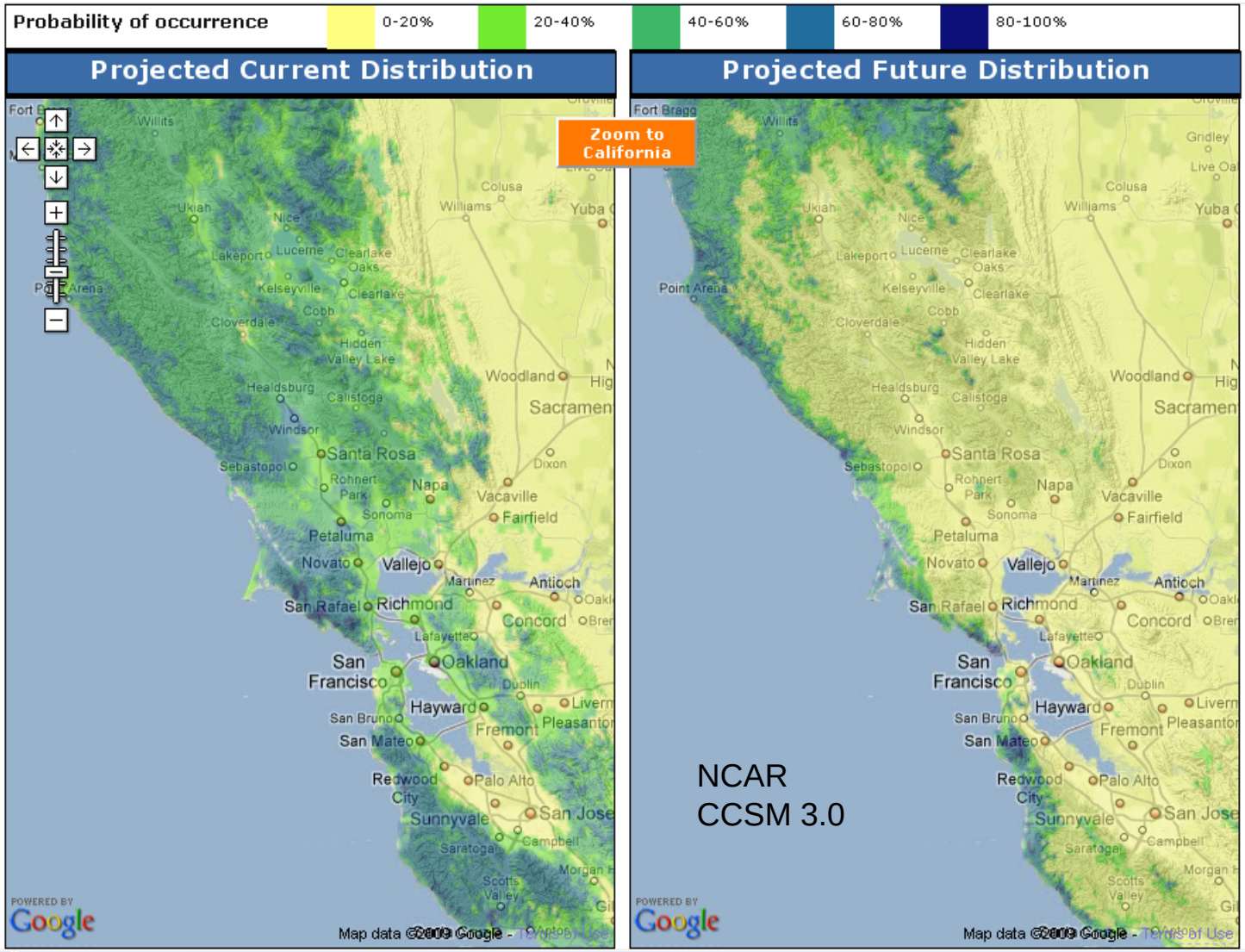


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Photo (c) Peter LaTourrette

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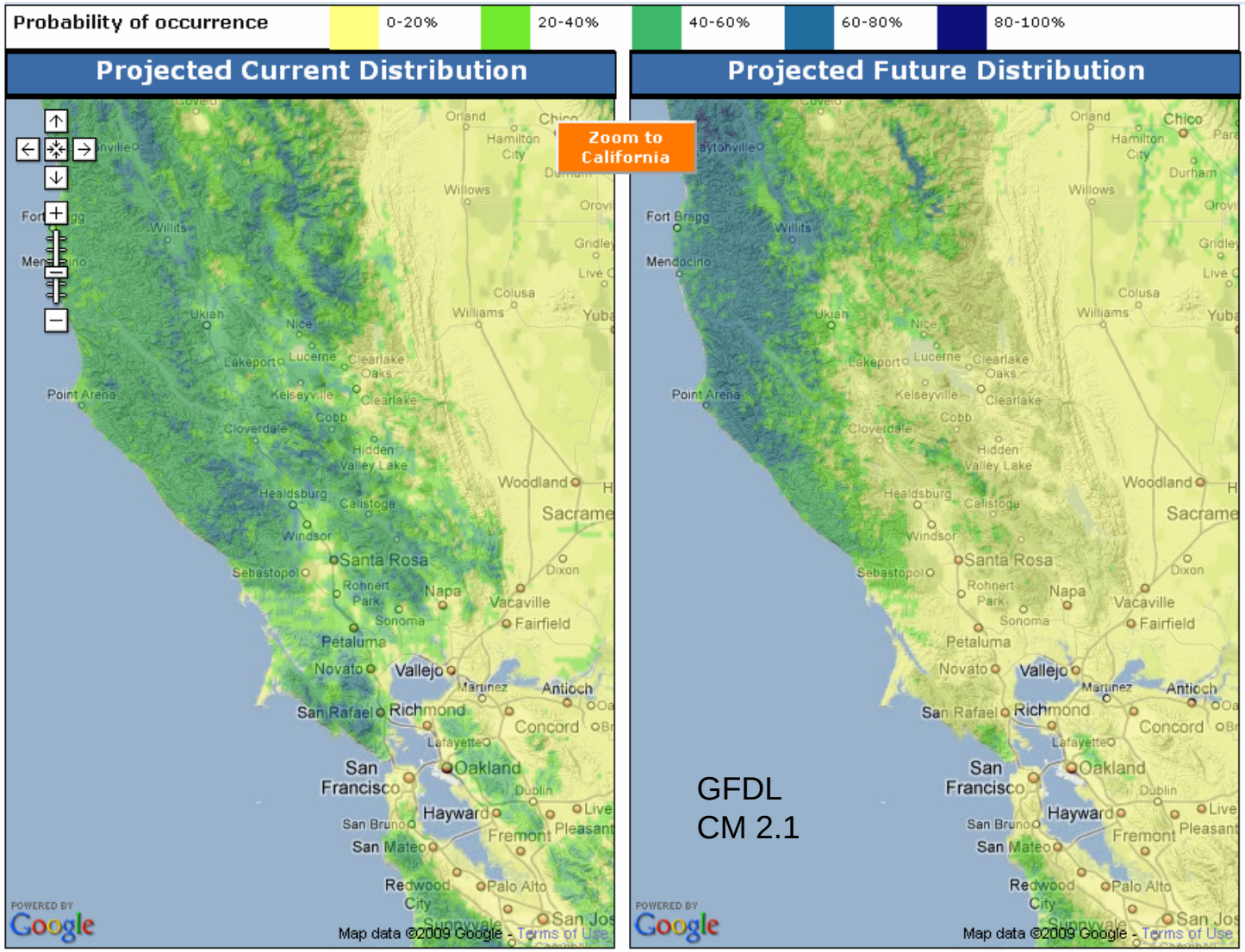
? - variable definitions

Warbling Vireo



Warbling Vireo

Photo (c) Peter LaTourrette

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Variables in order of Importance

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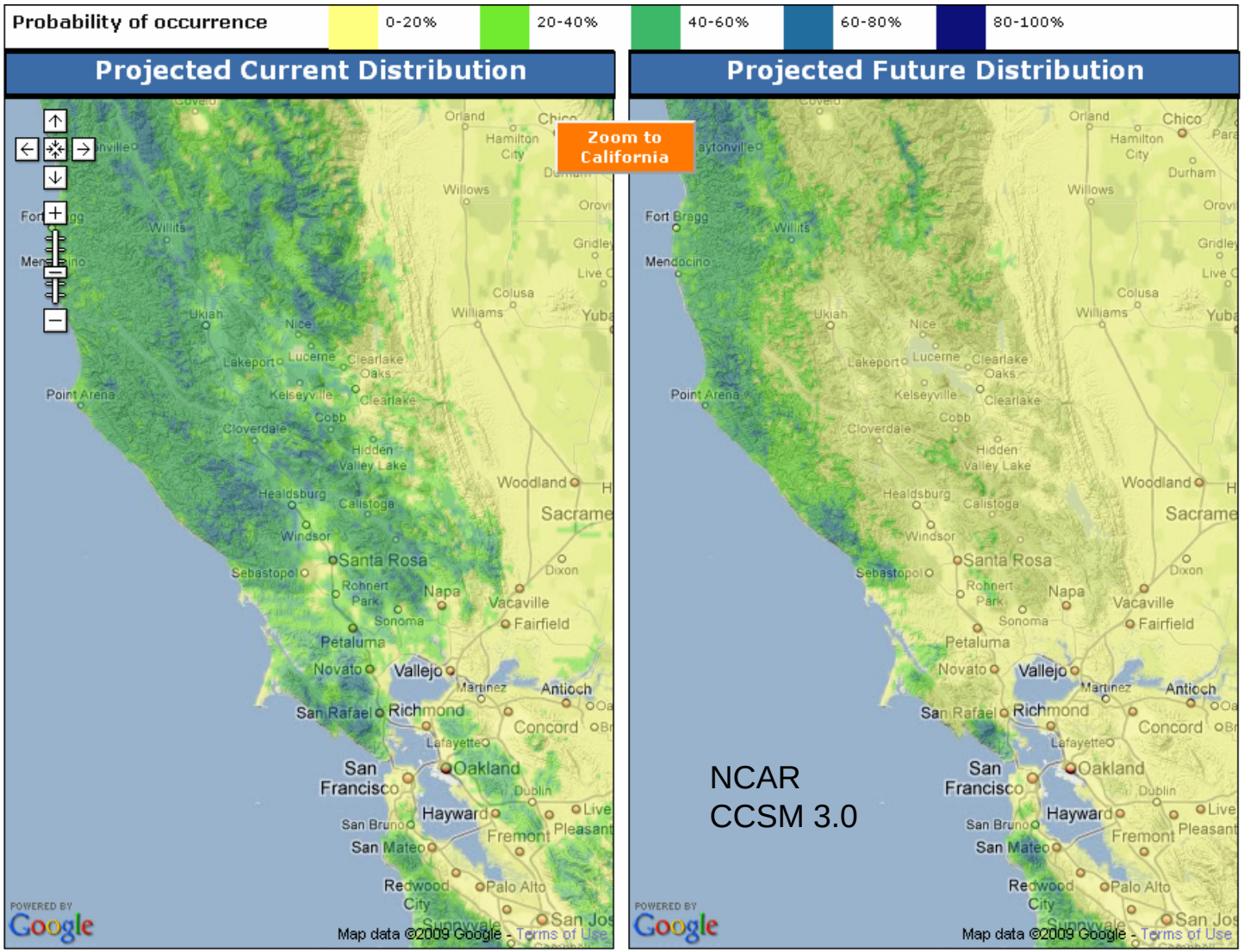
? - variable definitions

Warbling Vireo



Warbling Vireo

Photo (c) Peter LaTourrette

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Variables in order of Importance

1. Distance to stream
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4. Vegetation
5. Precipitation seasonality
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7. Isothermality
8. Temperature seasonality
9. Annual mean temperature
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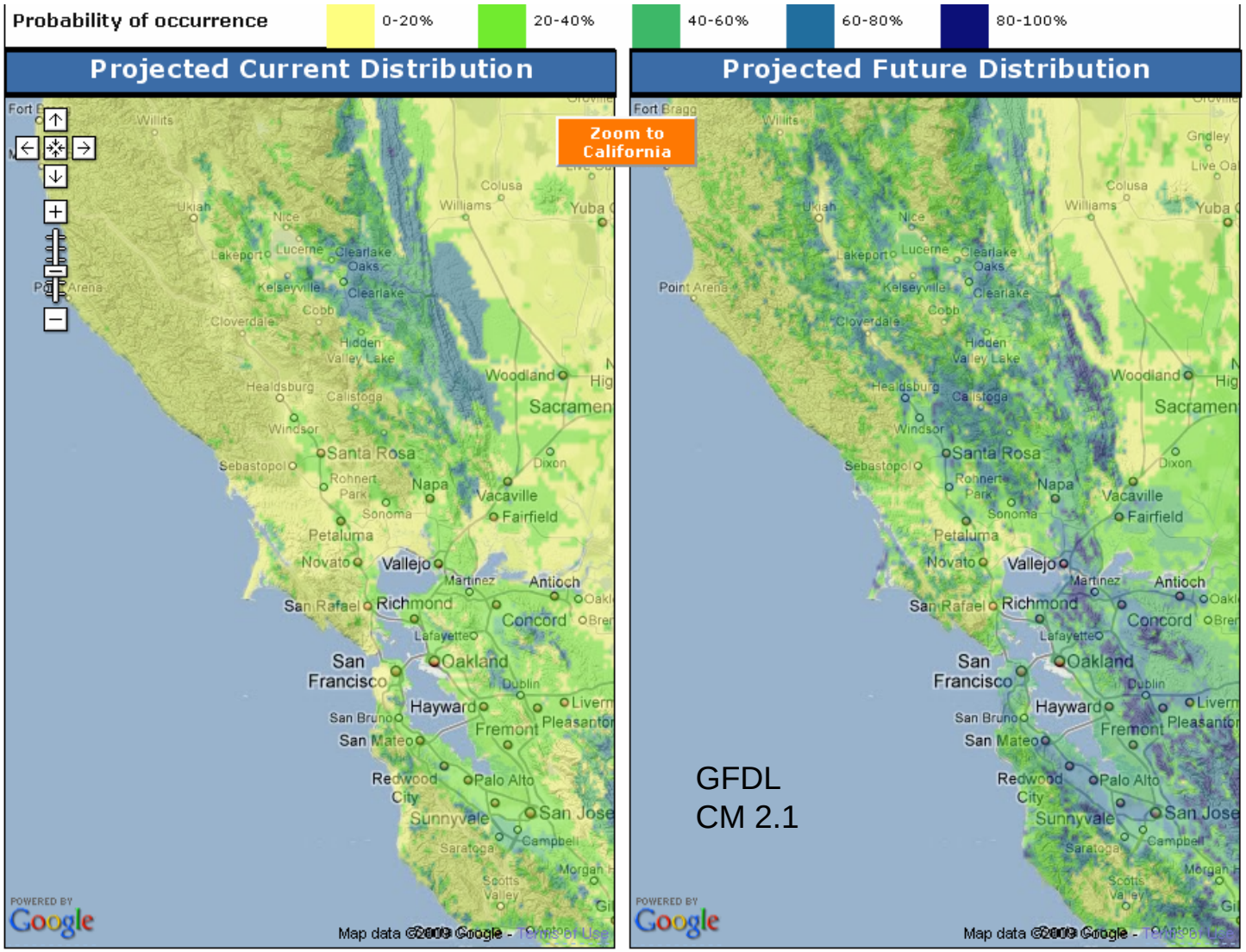
? - variable definitions

California Thrasher



California Thrasher

Photo (c) Peter LaTourrette

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Variables in order of Importance

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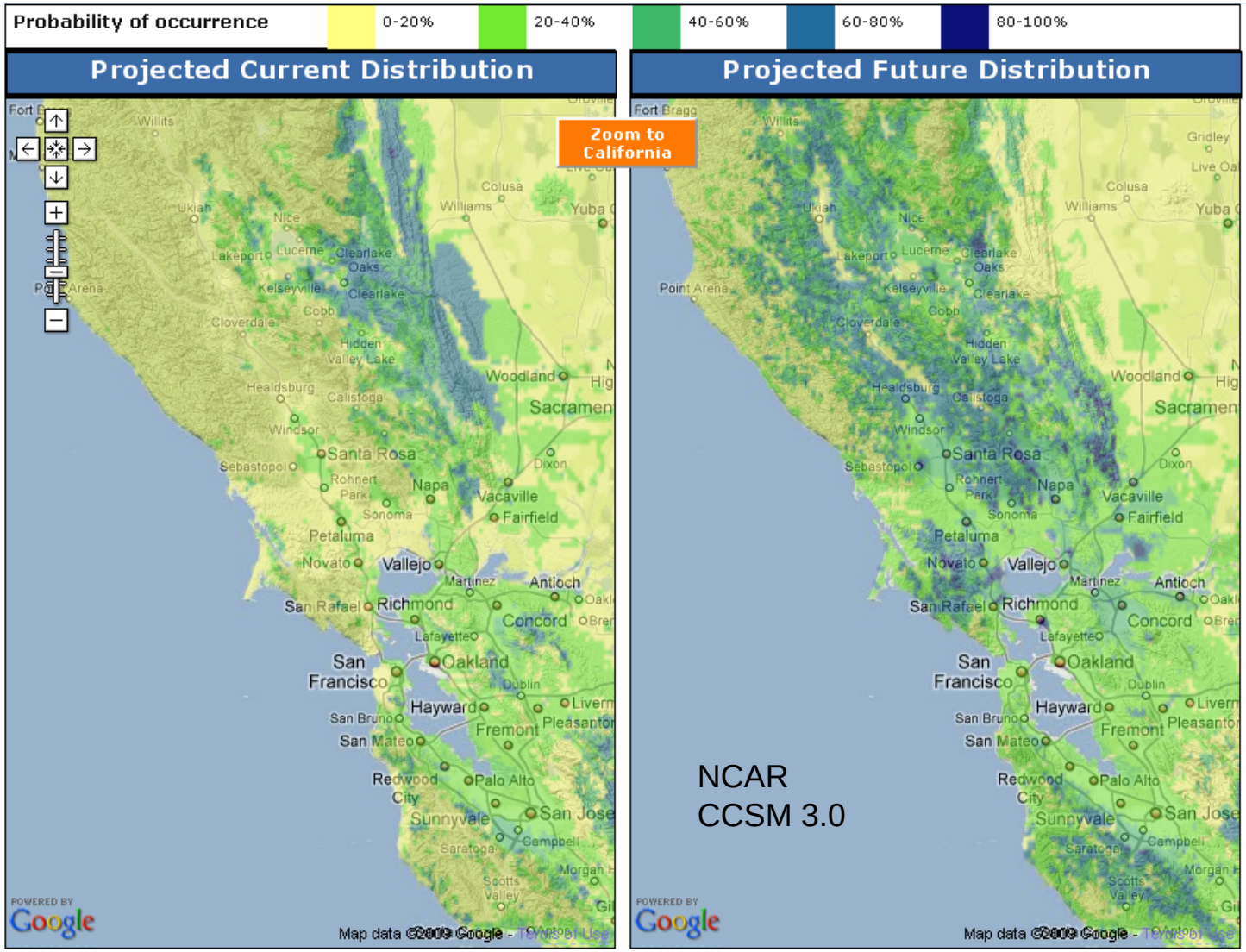
? - variable definitions

California Thrasher



California Thrasher

Photo (c) Peter LaTourrette

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Variables in order of Importance

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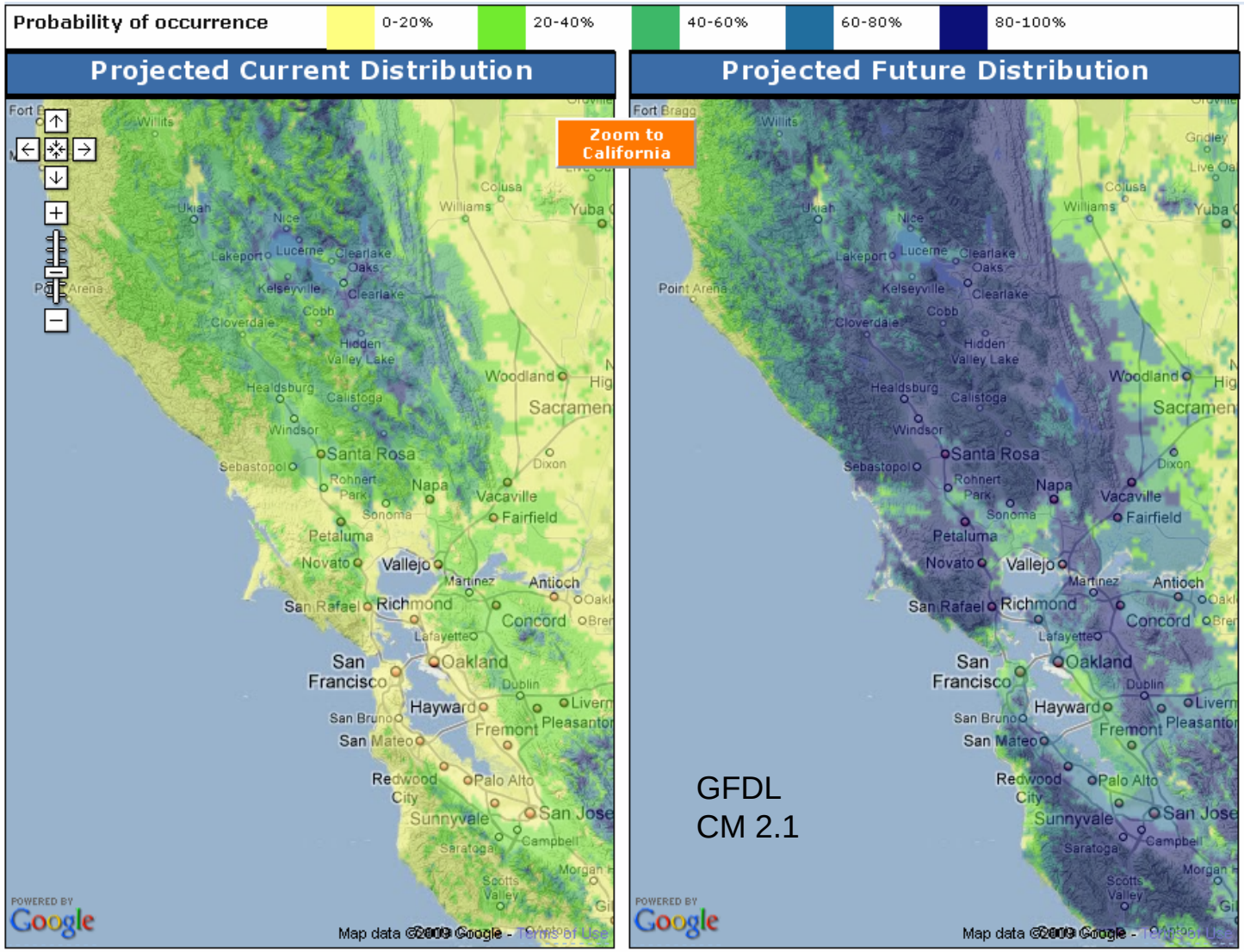
6. Precipitation of driest quarter
7. Temperature seasonality
8. Mean diurnal range
9. Distance to stream
10. Isothermality

? - variable definitions

Blue-gray Gnatcatcher



Blue-gray Gnatcatcher

Photo (c) Peter LaTourrette

Learn more about the **Blue-gray Gnatcatcher** at All About Birds or read the Partners In Flight species account

Variables in order of Importance

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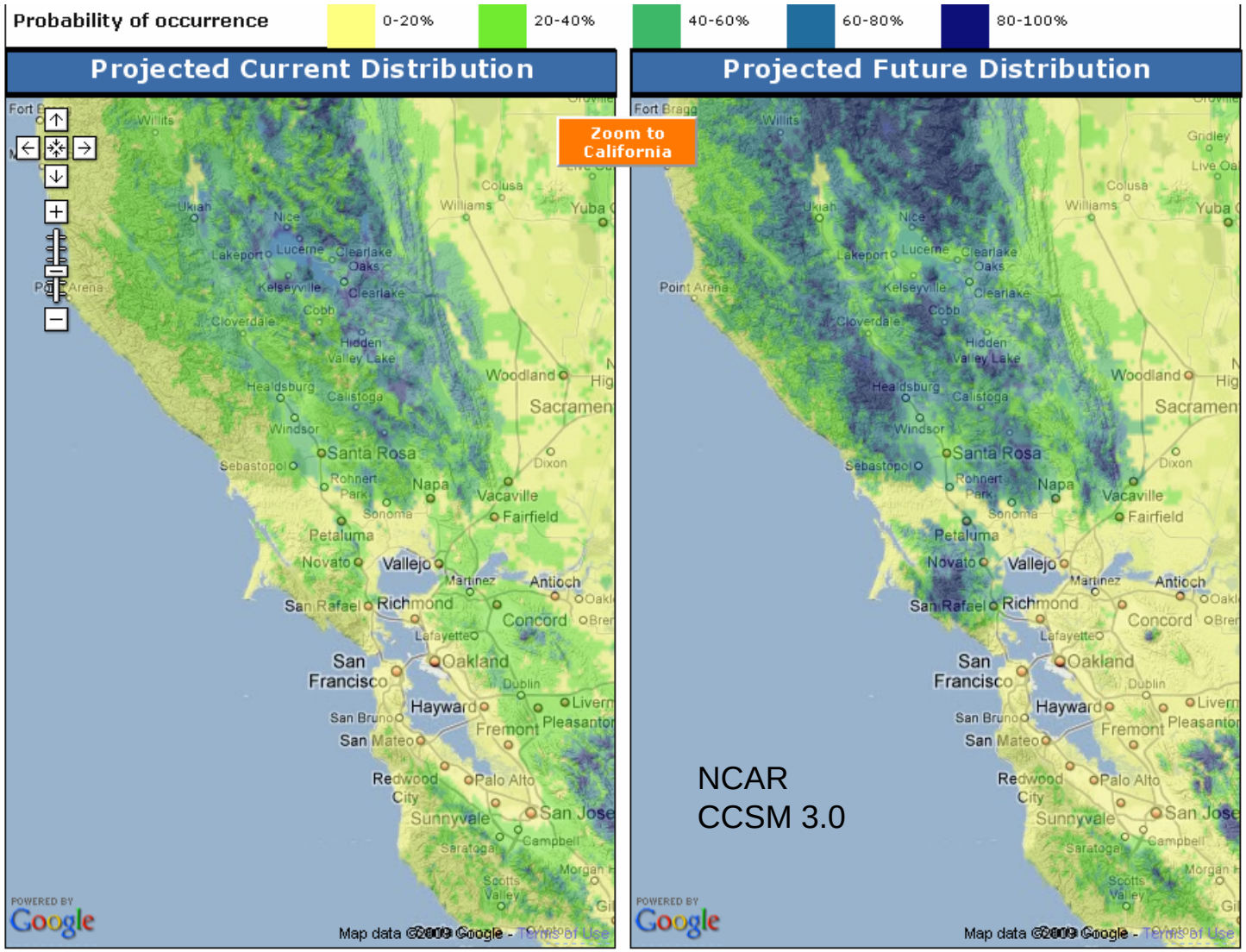
2. Precipitation seasonality
3. Precipitation of driest quarter
4. Annual precipitation
5. Isothermality
6. Distance to stream
7. Annual mean temperature
8. Mean diurnal range
9. Mean temperature of the warmest quarter
10. Temperature seasonality

? - variable definitions

Blue-gray Gnatcatcher



Blue-gray Gnatcatcher

Photo (c) Peter LaTourrette

Learn more about the **Blue-gray Gnatcatcher** at All About Birds or read the Partners In Flight species account

Variables in order of Importance

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2. Precipitation seasonality
3. Precipitation of driest quarter
4. Annual precipitation
5. Isothermality
6. Distance to stream
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8. Mean diurnal range
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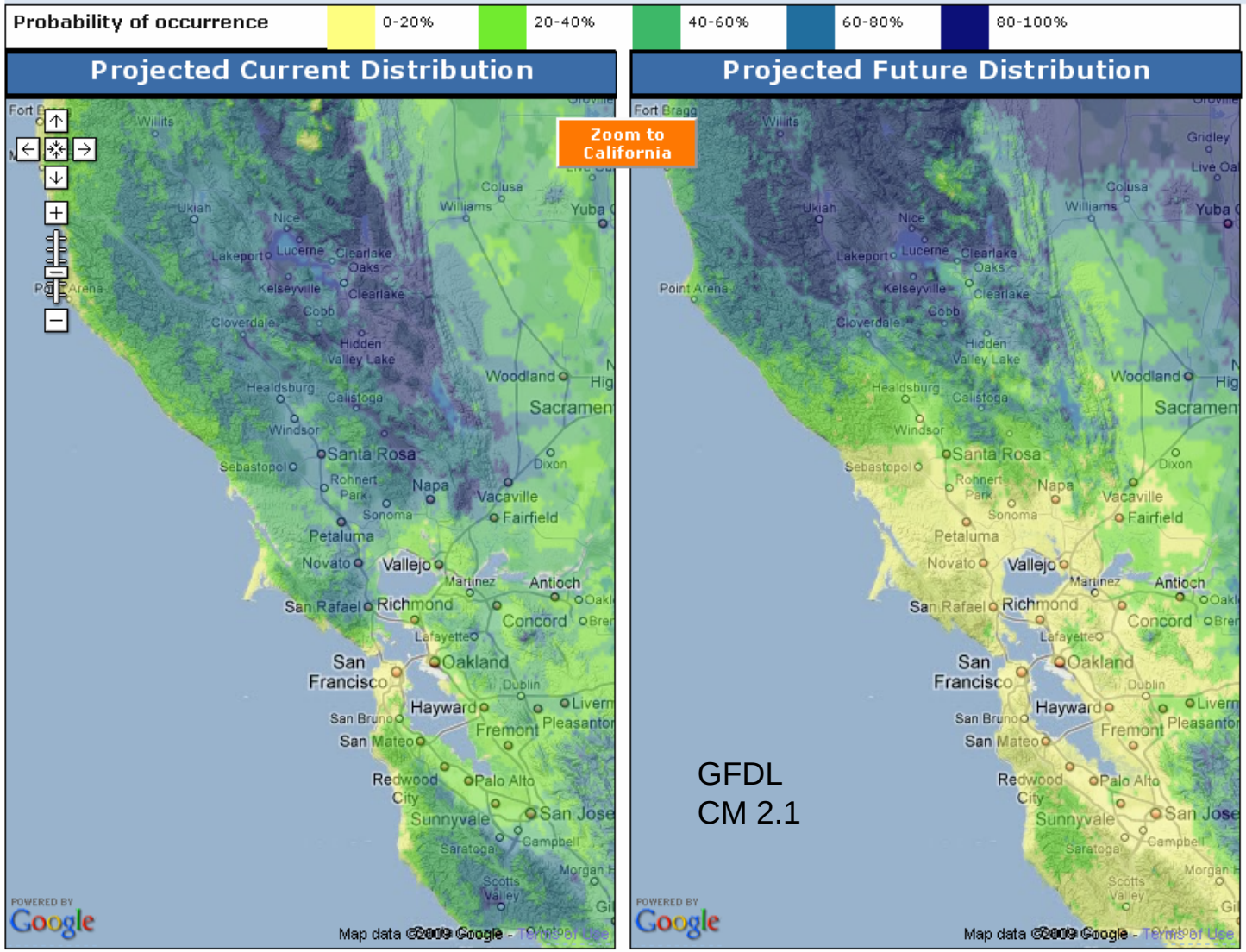
10. Temperature seasonality

? - variable definitions

Acorn Woodpecker



Acorn Woodpecker

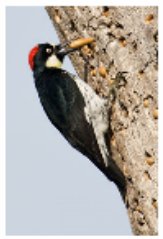


Photo (c) Peter LaTourrette

Learn more about the **Acorn Woodpecker** at All About Birds or read the Partners In Flight species account

Variables in order of Importance

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4. Precipitation seasonality
5. Distance to stream
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7. Isothermality
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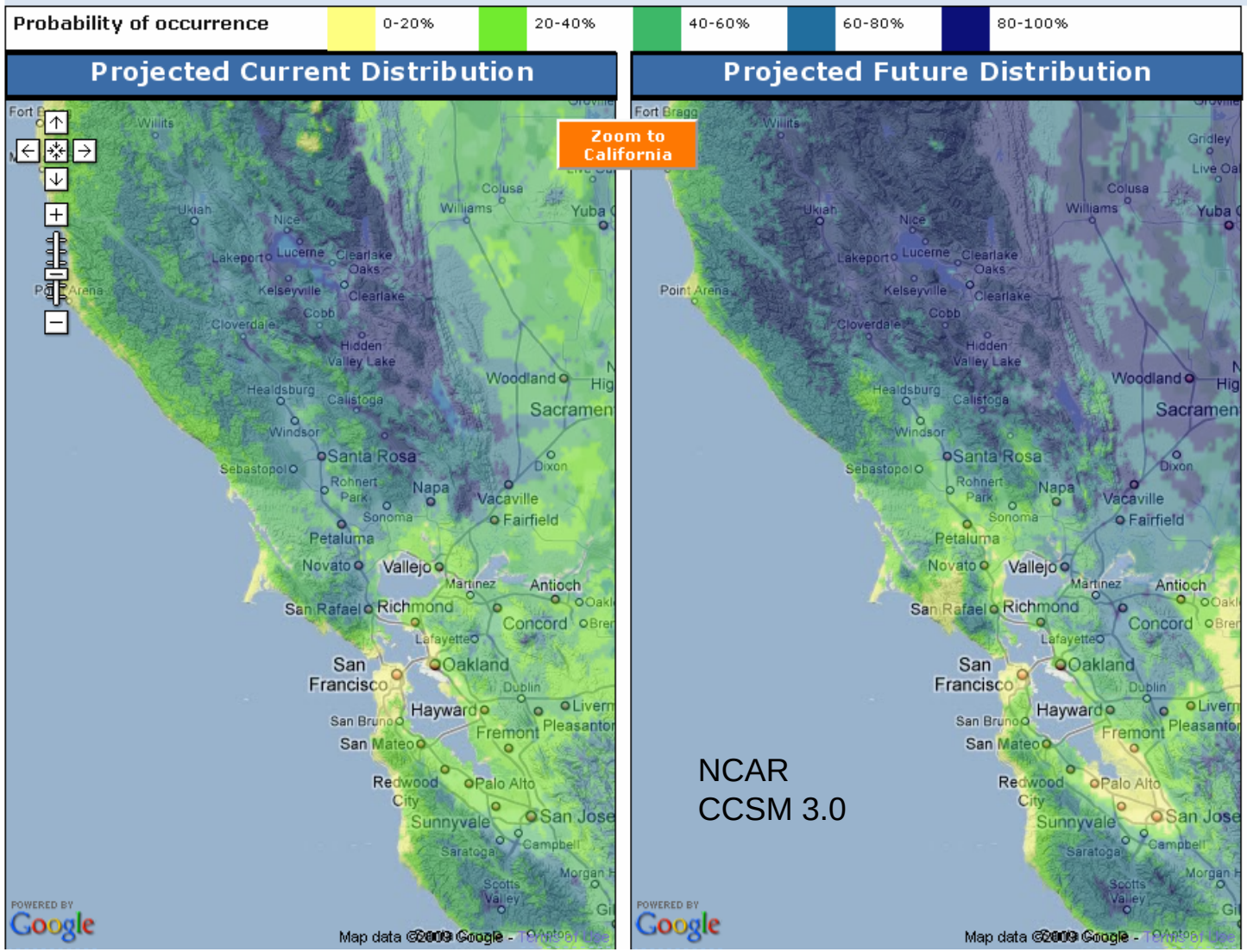
9. Mean temperature of the warmest quarter
10. Precipitation of driest quarter

? - variable definitions

Acorn Woodpecker



Acorn Woodpecker

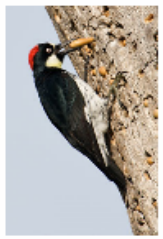


Photo (c) Peter LaTourrette

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Variables in order of Importance

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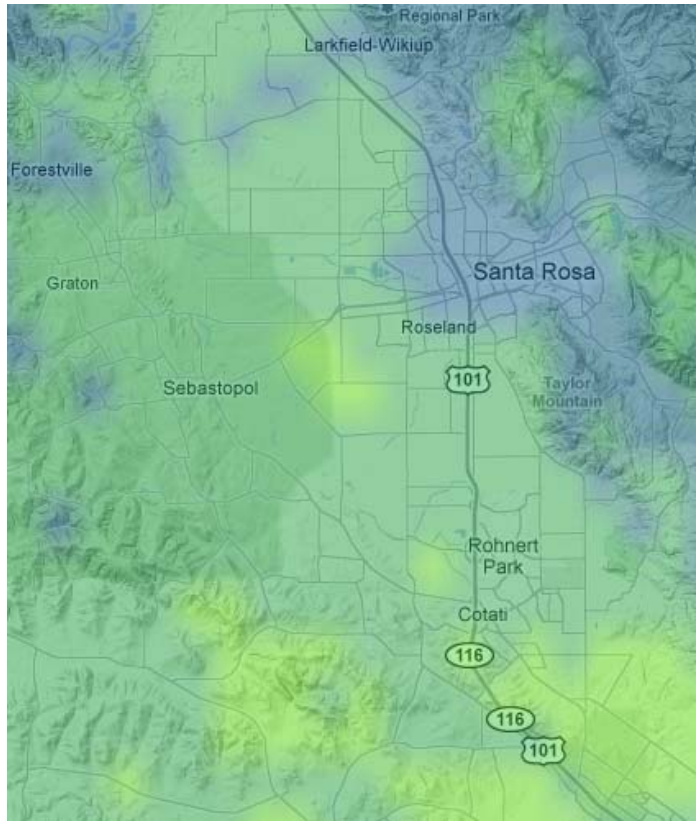
9. Mean temperature of the warmest quarter
10. Precipitation of driest quarter

? - variable definitions

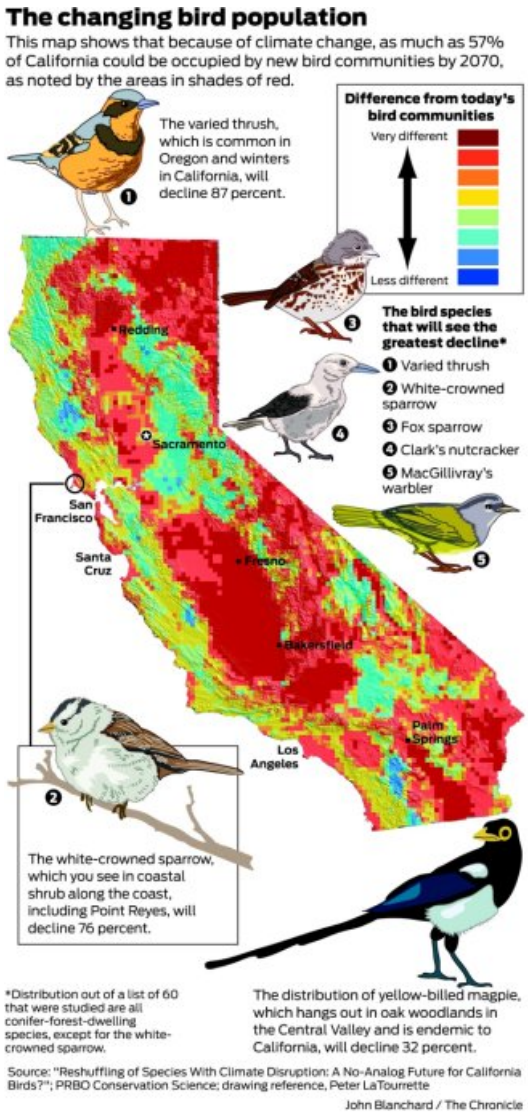
Scaling Down to the Watershed

- Limited by climate model downscaling (temperature / precipitation)
- Wetland and riparian systems not included (need hydrologic projections)
- Interpret with caution (treat as hypothesis)



Summary of Findings

- California will have climate change “winners” and “losers”
- Land-use development compounds climate change effects
- Species richness likely to increase in north coast and mountain regions
- “No-analog” assemblages (community reshuffling) likely



Source:
SF Chronicle

Take-home Messages

- Distribution models tell big-picture story
- Use projections with caution at local scales
- Flexibility is key
- Predictions will change; no static answers!
- Need more interaction between scientists and managers

Acknowledgments

www.prbo.org/cadc

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