

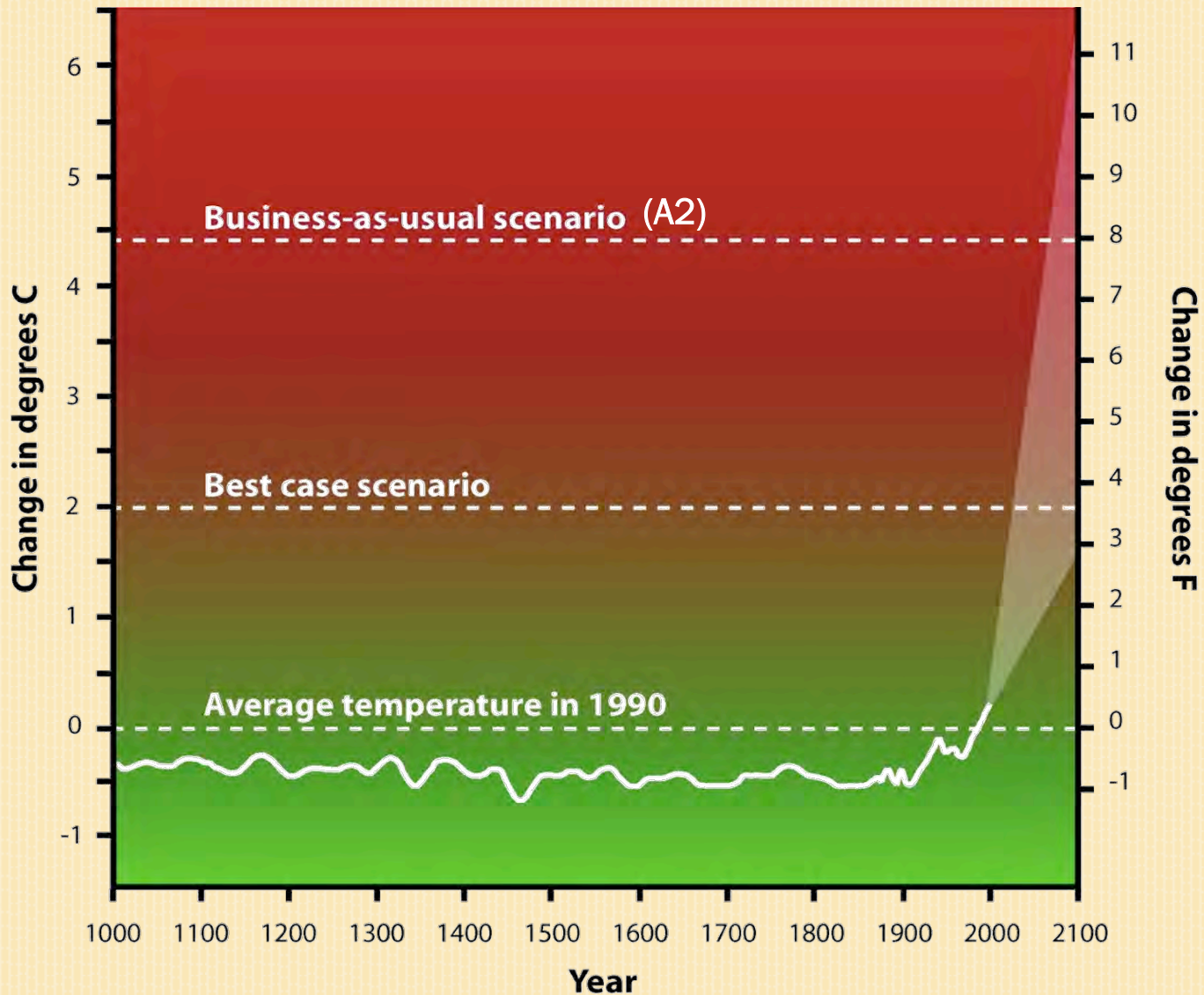


CLIMATE CHANGE TRENDS IN THE SIERRA NEVADA

Marni Koopman, Climate Change Scientist

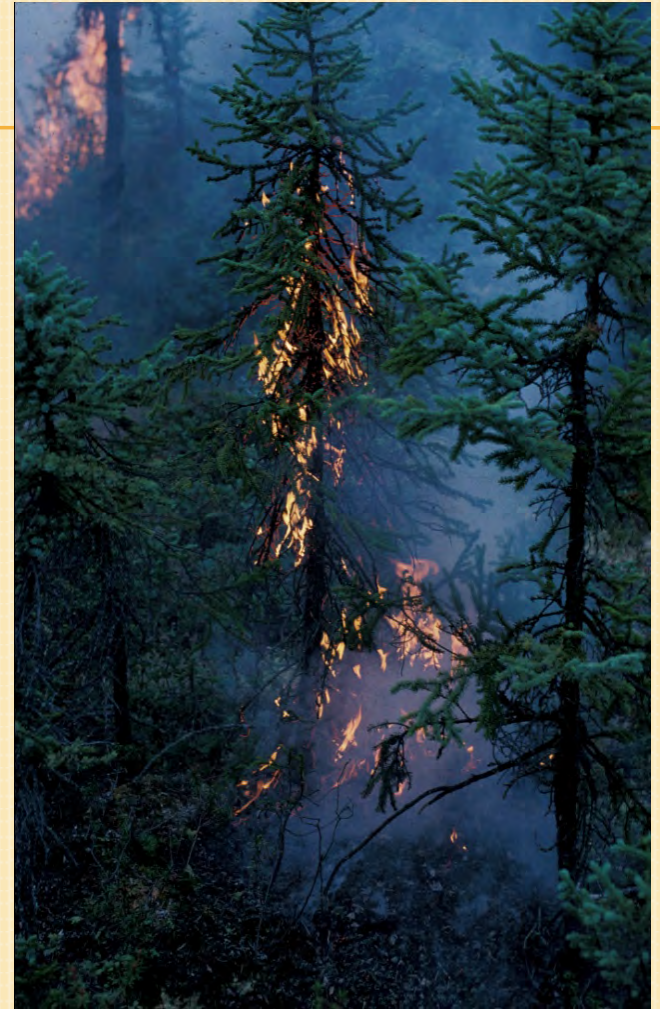
Geos Institute

AVERAGE GLOBAL TEMPERATURE



GLOBAL TRENDS

- ✘ Increase in avg. temp
- ✘ Increase in sea level
- ✘ Melting of ice/snow
- ✘ Fewer frost days
- ✘ More severe heat
- ✘ More wildfire
- ✘ More frequent floods, severe storms



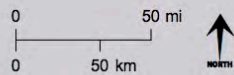
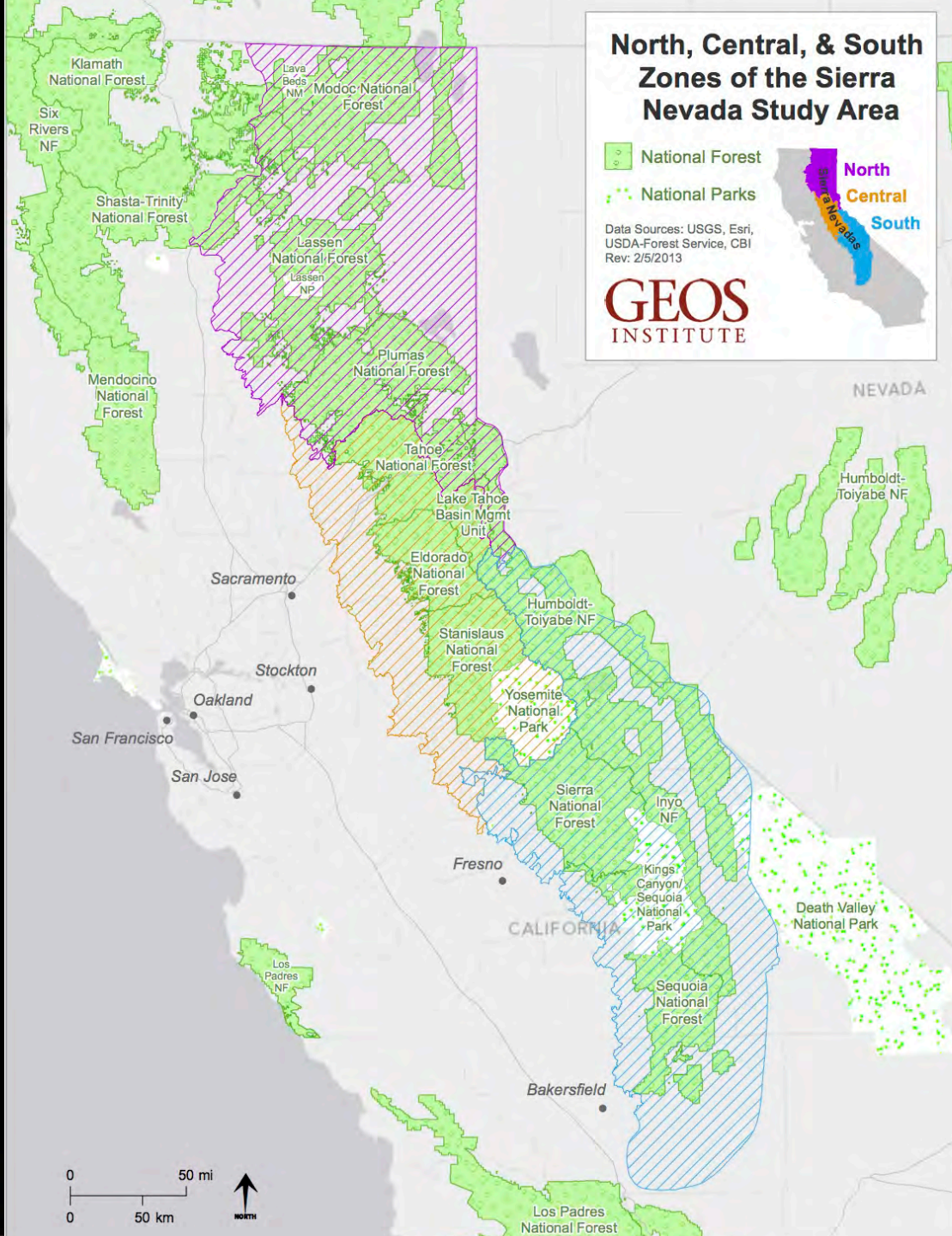
North, Central, & South Zones of the Sierra Nevada Study Area

 National Forest

 National Parks

Data Sources: USGS, Esri,
USDA-Forest Service, CBI
Rev: 2/5/2013

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MODELS/EMISSIONS SCENARIOS

- ✘ PCM (NCAR)
- ✘ GFDL (Geophysical Fluid Dynamics Lab)
- ✘ A2 emissions scenario



SIERRA NEVADA PROJECTIONS

- ✘ Temperature (annual, seasonal)
- ✘ Precipitation (annual, seasonal)
- ✘ Hydrology – runoff, snowpack, water deficit
- ✘ Vegetation – MC1 projections
- ✘ Wildfire – particulate matter and area burned

HISTORIC TRENDS IN CALIFORNIA

- ✘ Temperature increase (air and water)
- ✘ Shifts from snow to rain
- ✘ Declines in streamflow
- ✘ Increased frequency of heavy precip and flood
- ✘ Earlier spring runoff
- ✘ Change in vegetation (not always upslope)
- ✘ Longer fire season

TEMPERATURE

	Historic	2030-49	2060-79
North	47.4° F	+3° F	+5° – +5.5° F
Central	51.3° F	+3° F	+5° – +5.5° F
South	48.4° F	+3° F	+5° – +6° F
Summer			
North	63.2° F	+3° – +4° F	+5° – +7° F
Central	66.1° F	+3° – +4° F	+4° – +6° F
South	64.3° F	+3° – +4° F	+4° – +7° F
Winter			
North	33.2° F	+2° – +3° F	+4 – +5° F
Central	38.4° F	+2° – +3° F	+4° F
South	34.6° F	+2° – +3° F	+5 F

PRECIPITATION

	Historic	2030-49	2060-79
North	770mm	+3° F	+5° - 5.5° F
Central	1119mm	+3° F	+5° - 5.5° F
South	528mm	+3° F	+5° - 6° F
Spring			
North	65mm	-10% - +19%	+4% - +24%
Central	98mm	-15% - +16%	0% - +20%
South	47mm	-16% - +15%	-5% - +21%
Fall			
North	61mm	0% - +2%	-14% - -27%
Central	86mm	+3% - 9%	-5% - -25%
South	33mm	+9%	-1% - -13%

WHAT CAN WE EXPECT?

- ✘ Higher temperatures
- ✘ Drier conditions
- ✘ More wildfire
- ✘ More drought
- ✘ More floods
- ✘ Shift from snow to rain
- ✘ Longer, hotter summers
- ✘ Lower late summer streamflow
- ✘ Higher, earlier peak flow
- ✘ Species redistribution



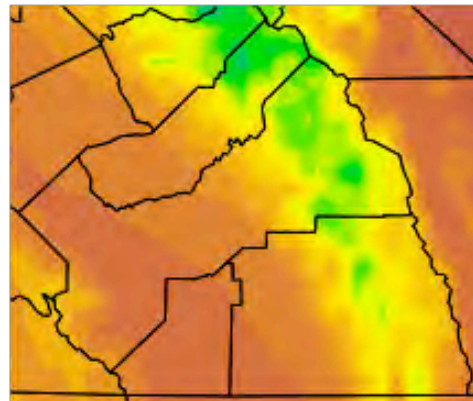


EXPOSURE

EXPOSURE

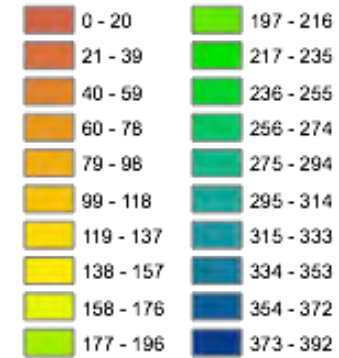
✘ Direct

Historic



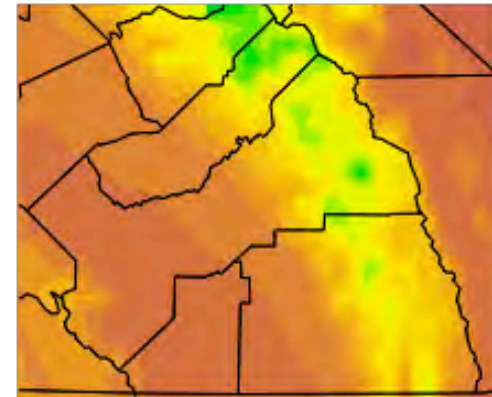
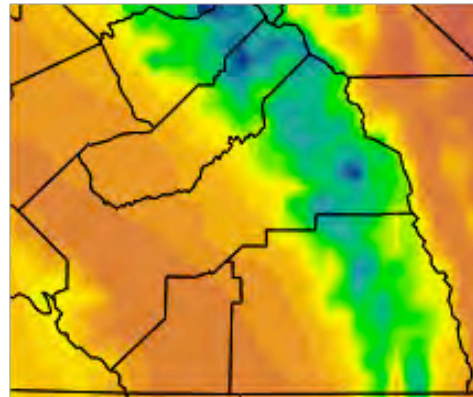
HADCM

Monthly Mean Precipitation in Millimeters

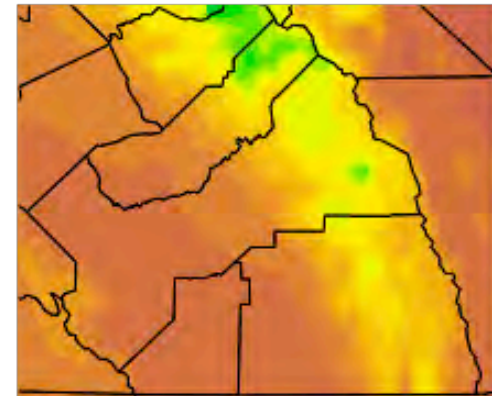
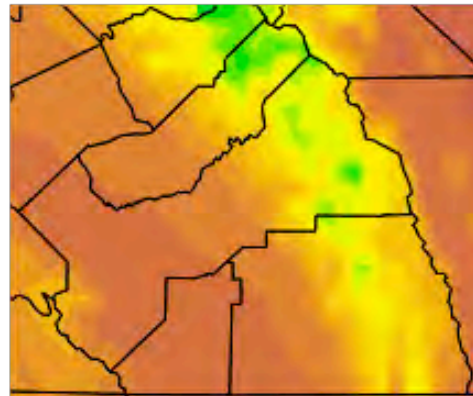


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Mid-century



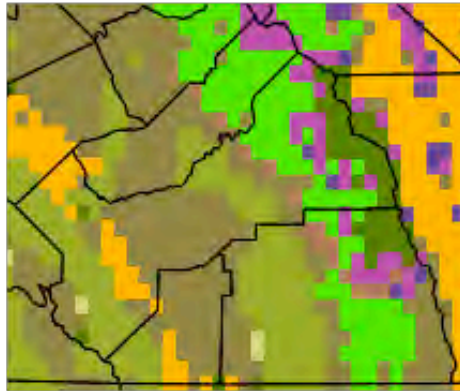
Late-century



EXPOSURE

✘ Indirect

Historic



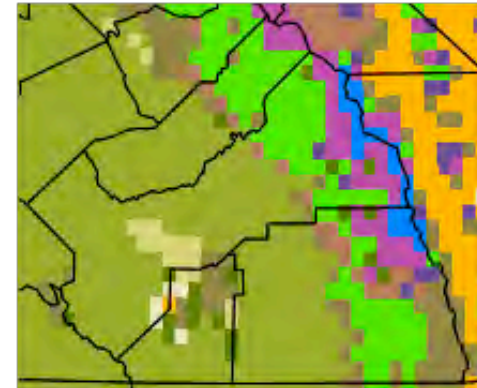
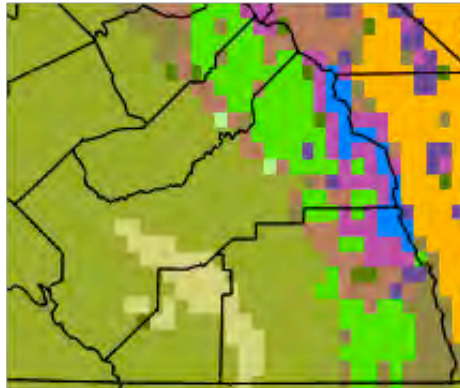
HADCM

MC1 Vegetation Classification

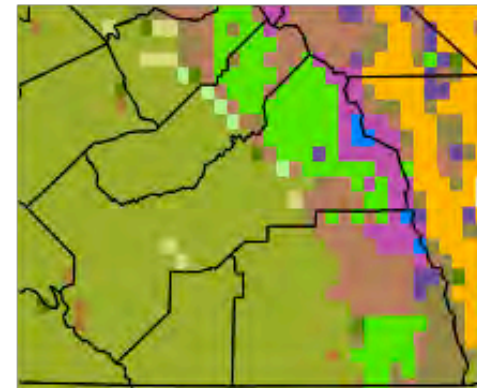
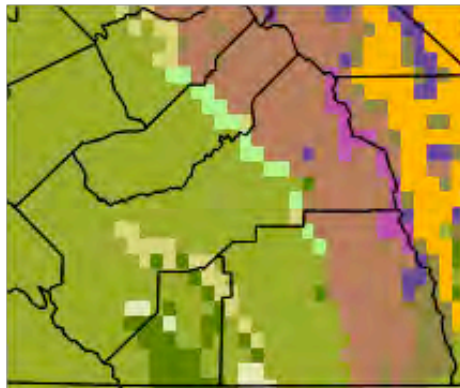
- Mixed High Elevation
- High Elevation Grasslands
- Subalpine Forest
- Maritime Evergreen Needleleaf Forest
- Temperate Evergreen Needleleaf Forest
- Temperate Evergreen Needleleaf Woodland
- Temperate Shrubland
- Temperate Grassland
- Temperate Desert
- Subtropical Mixed Forest
- Subtropical Mixed Savanna
- Subtropical Shrubland
- Subtropical Grassland
- Subtropical Desert

CSIRO

Mid-century



Late-century



Human response to climate change

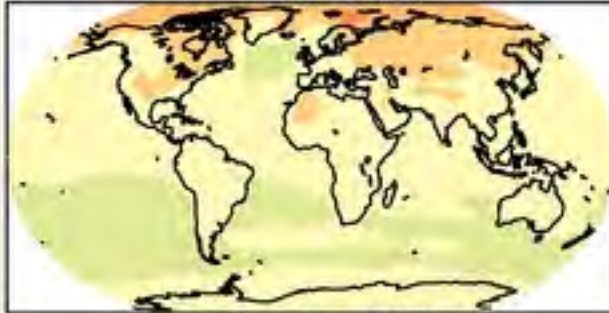


Human response to climate change

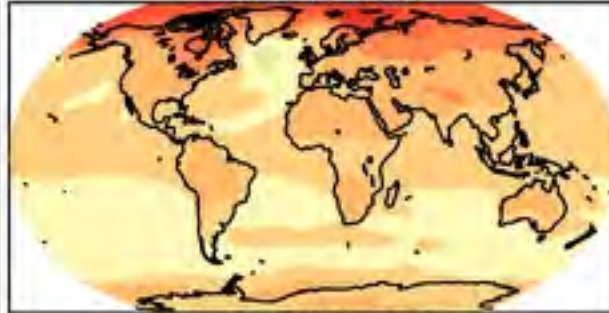


General Circulation Models (GCMs)

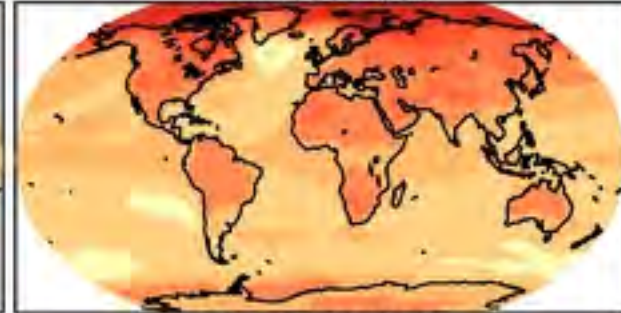
B1: 2011-2030



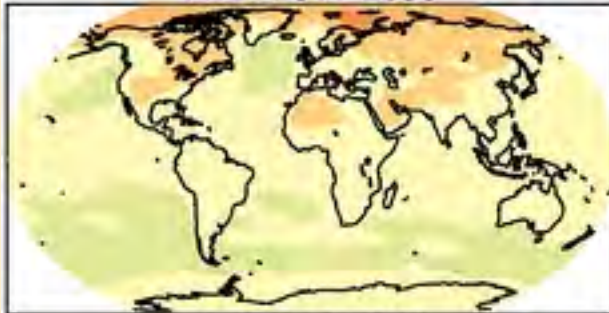
B1: 2046-2065



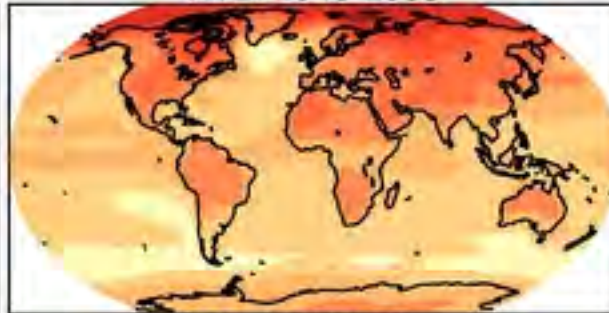
B1: 2080-2099



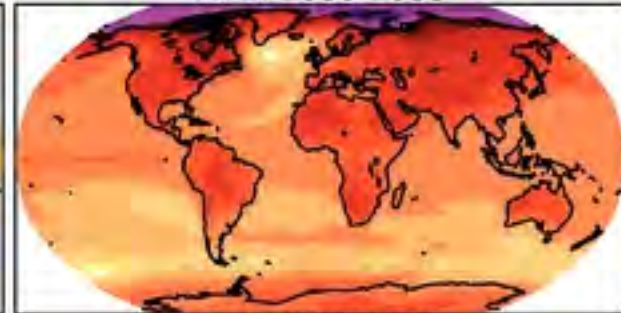
A1B: 2011-2030



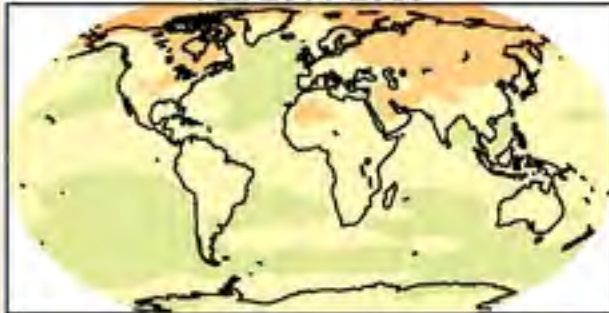
A1B: 2046-2065



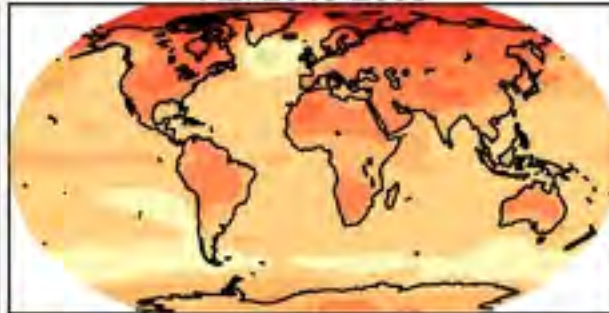
A1B: 2080-2099



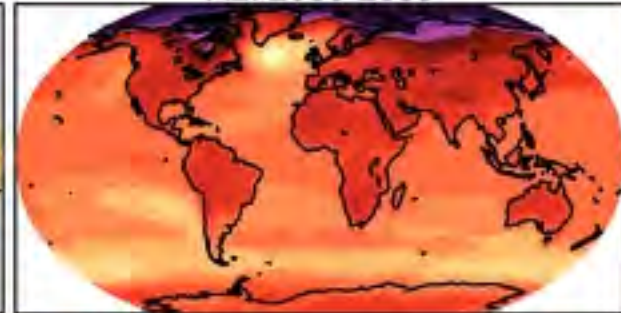
A2: 2011-2030



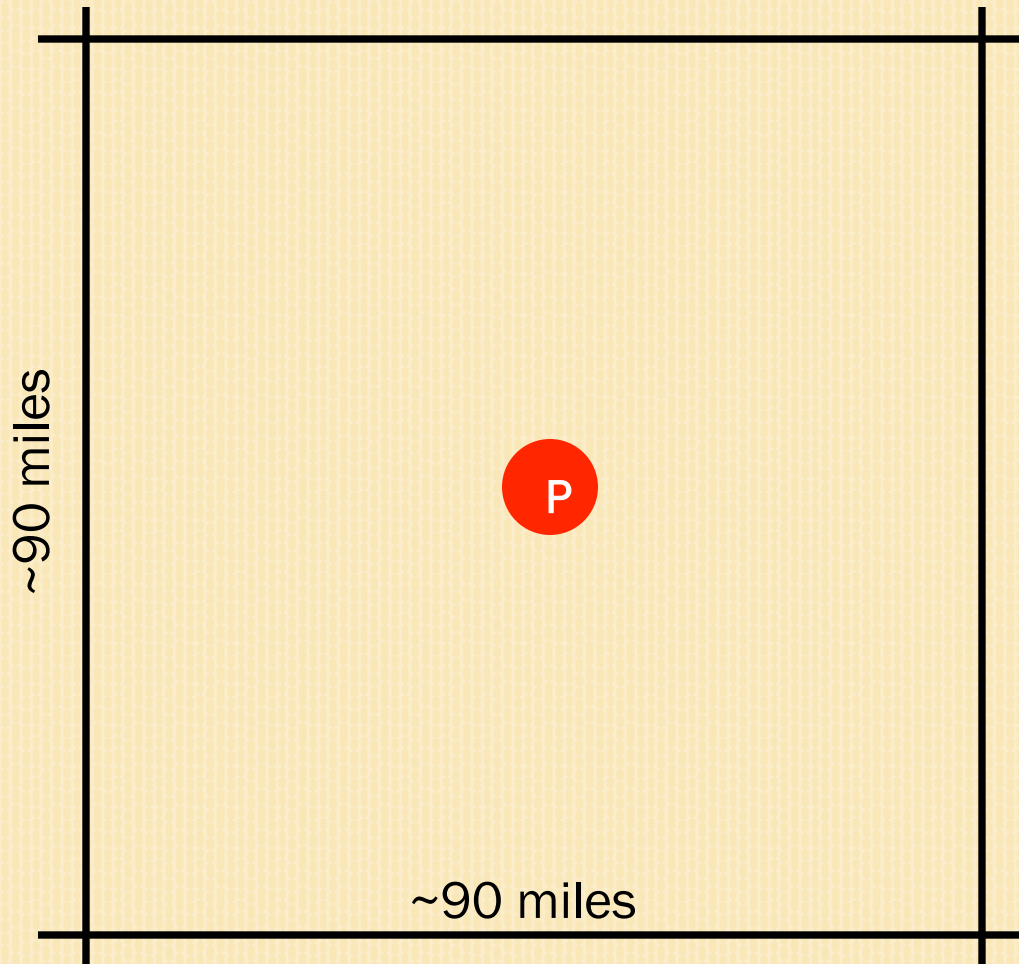
A2: 2046-2065

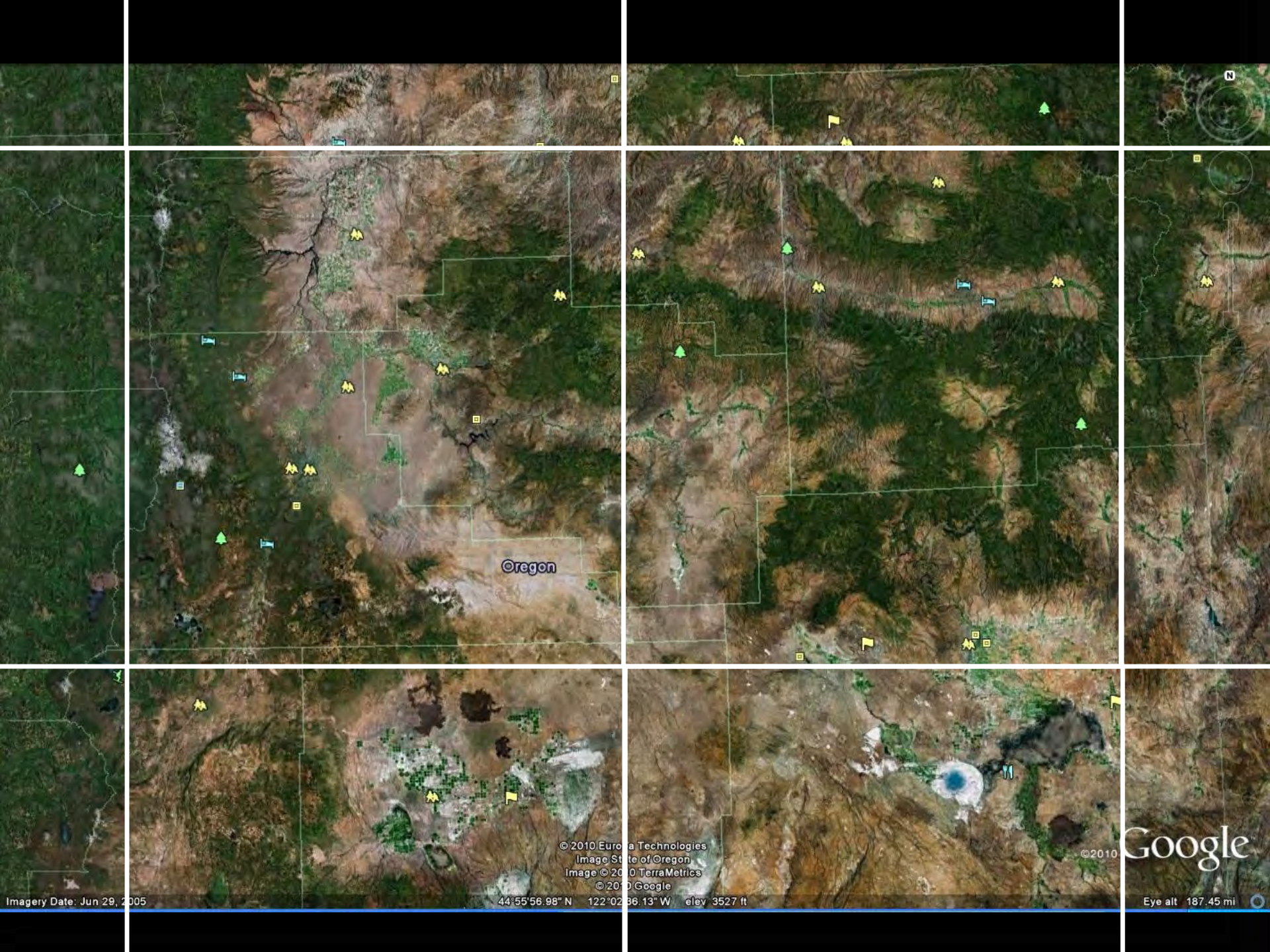


A2: 2080-2099



DOWNSCALING





Oregon

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Image State of Oregon
Image © 2010 TerraMetrics
© 2010 Google

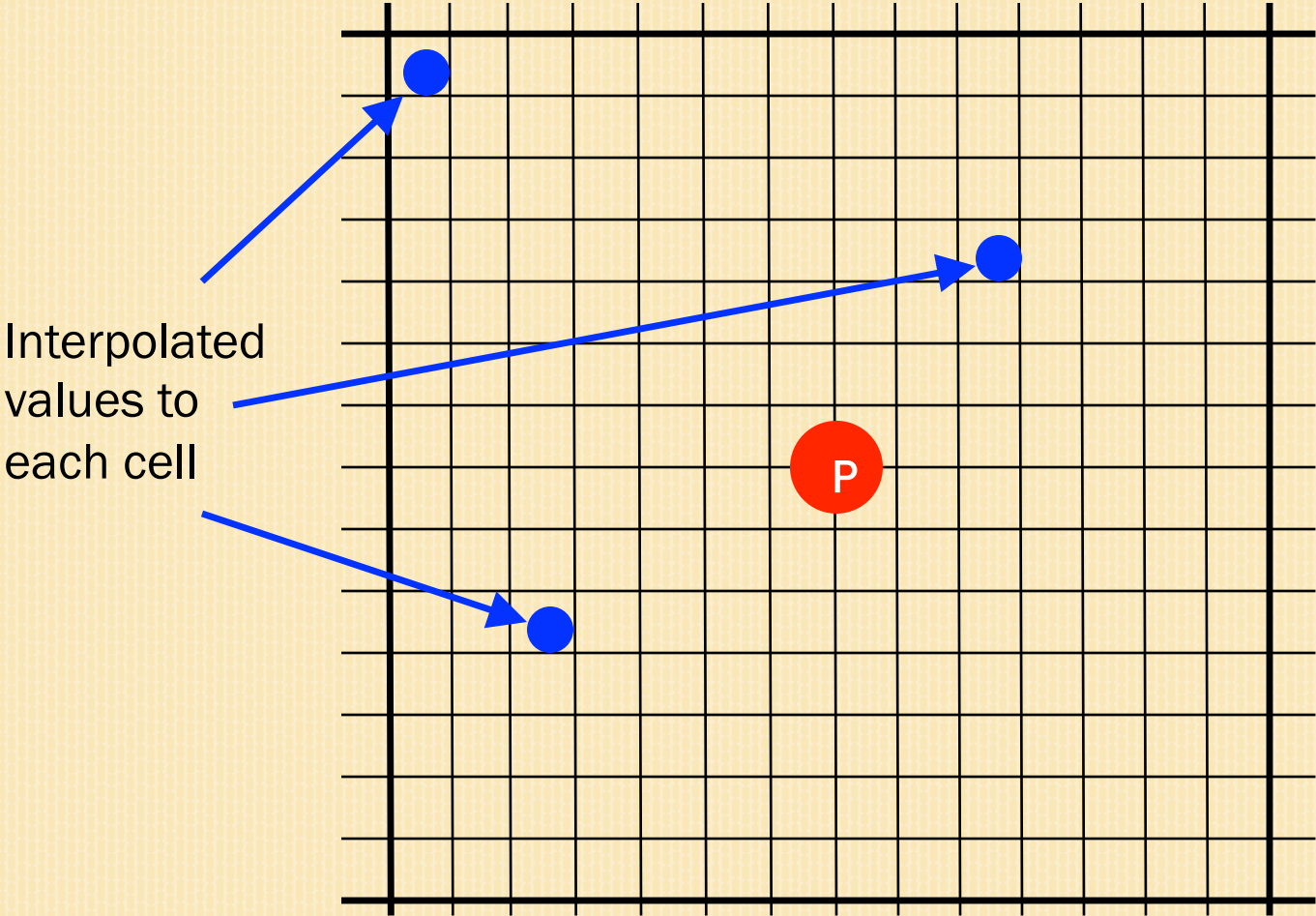
Google

Imagery Date: Jun 29, 2005

44°55'56.98" N 122°02'36.13" W elev 3527 ft

Eye alt 187.45 mi

DOWNSCALING



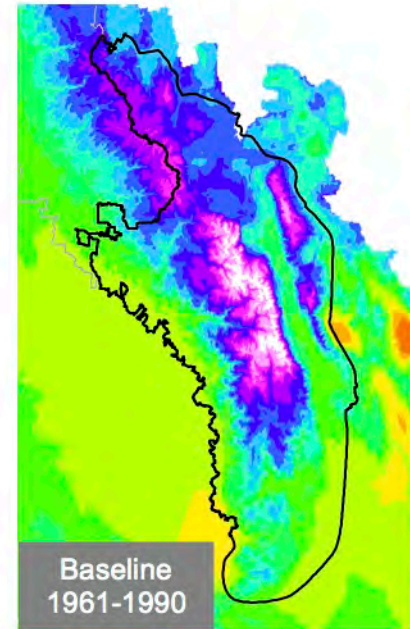
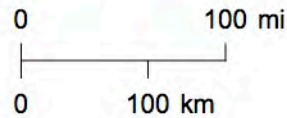
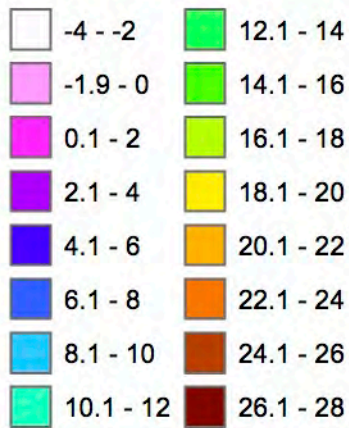
Annual Average Temperature



Southern Region
Sierra Nevada

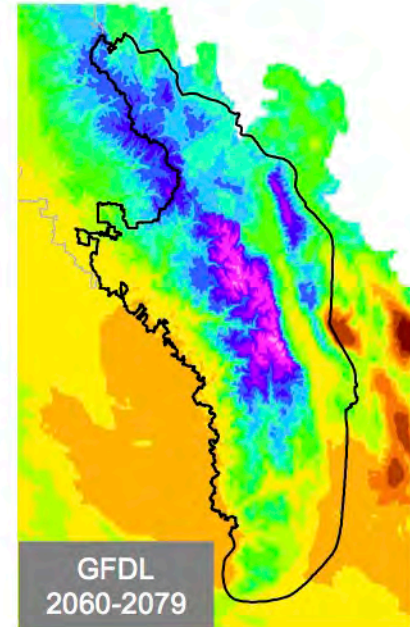
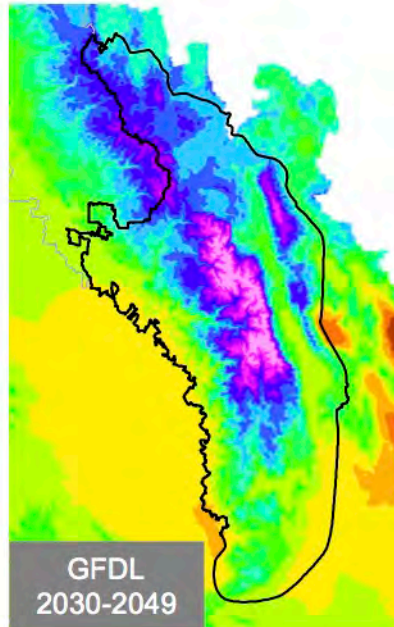
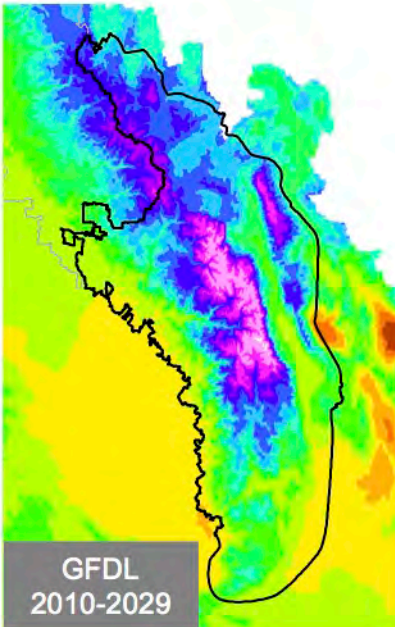
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Temperature in degrees C



Data Sources:
 Historic PRISM data (Gibson et al. 2002)⁵
 GFDL (Stouffer et al. 2006, Delworth et al. 2006)⁶,
 PCM (Washington et al. 2000)⁷,
 Downscaled following Flint and Flint (2012)⁸

Rev: 2/22/2013

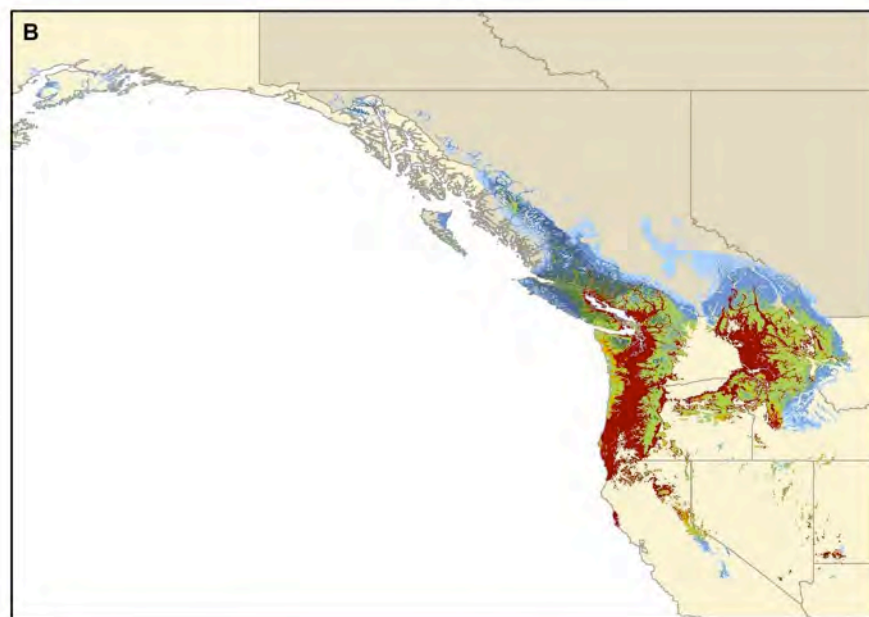
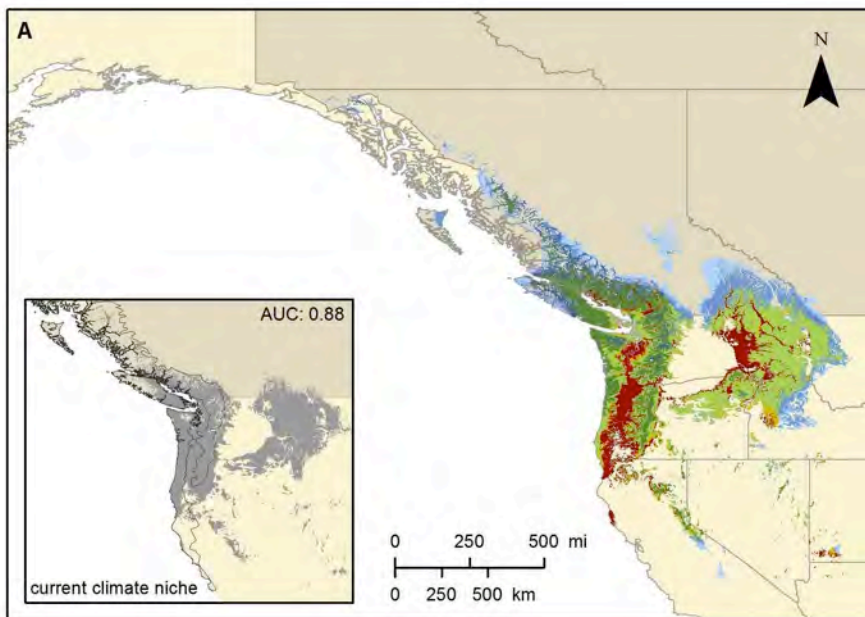


GRAND FIR

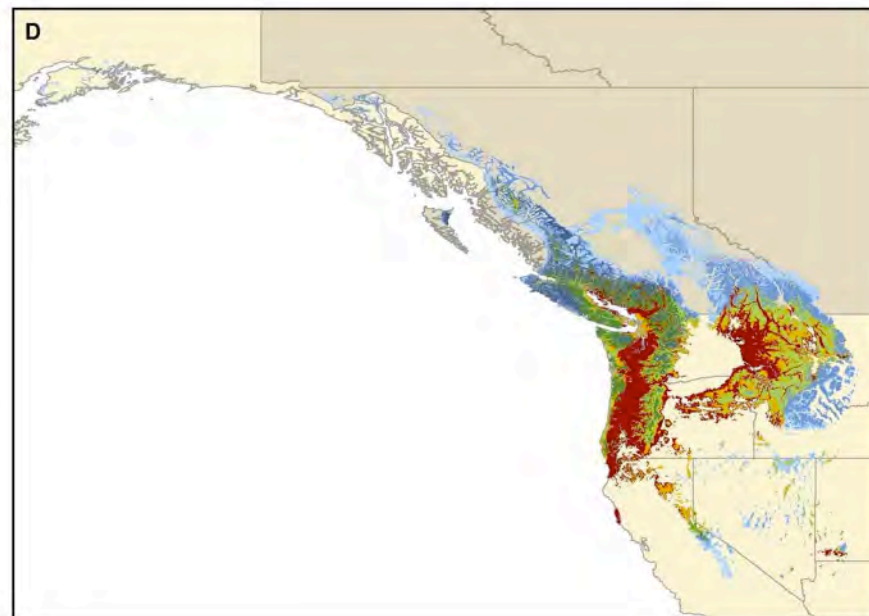
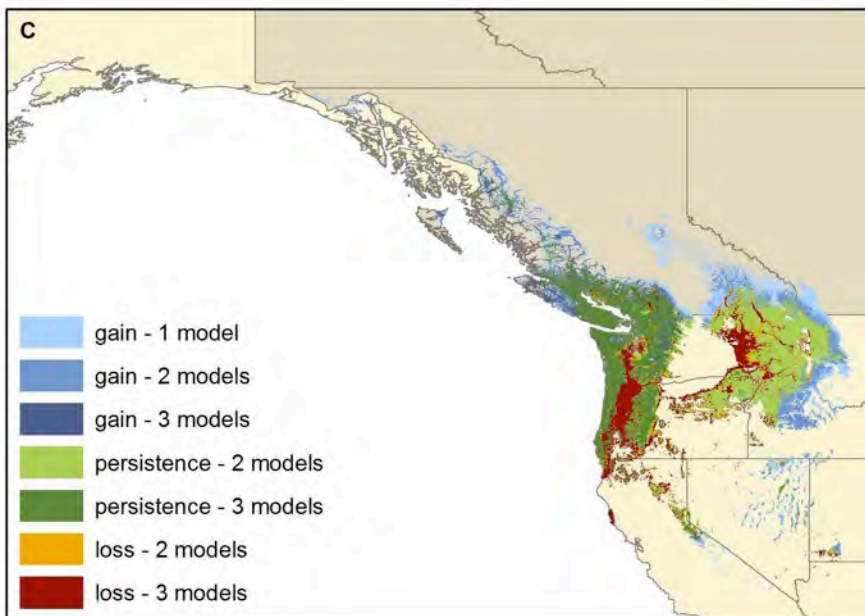
2050

2080

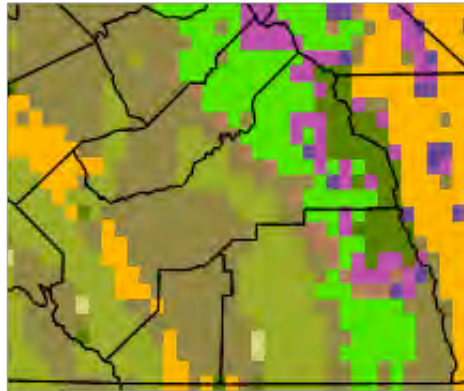
A1B



A2A



Historic

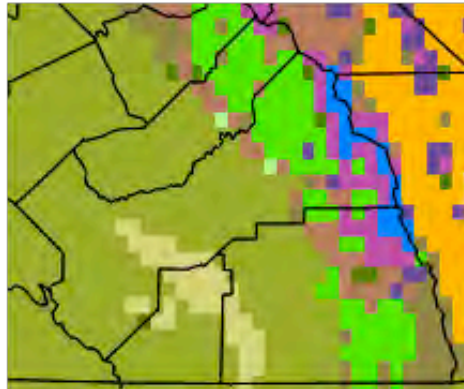


HADCM

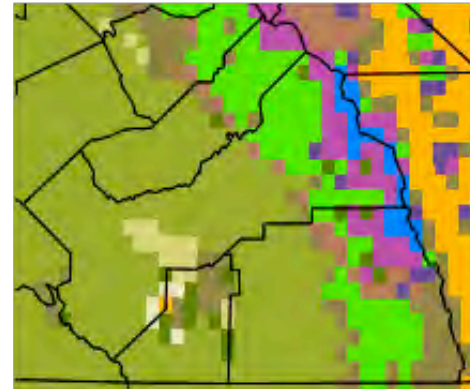
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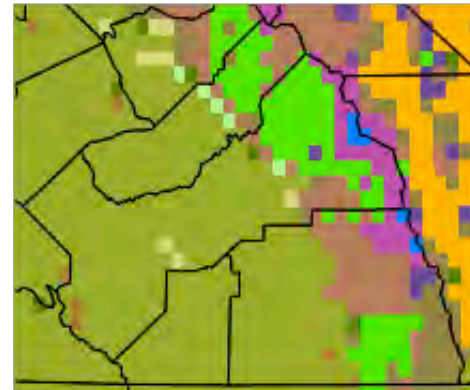
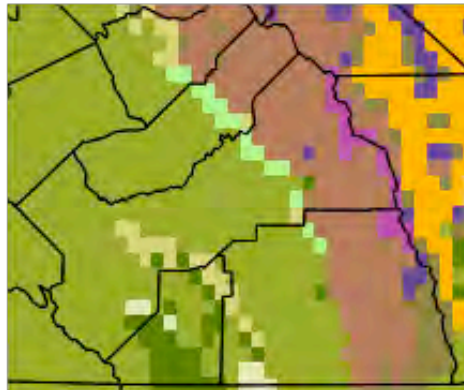
Mid-century

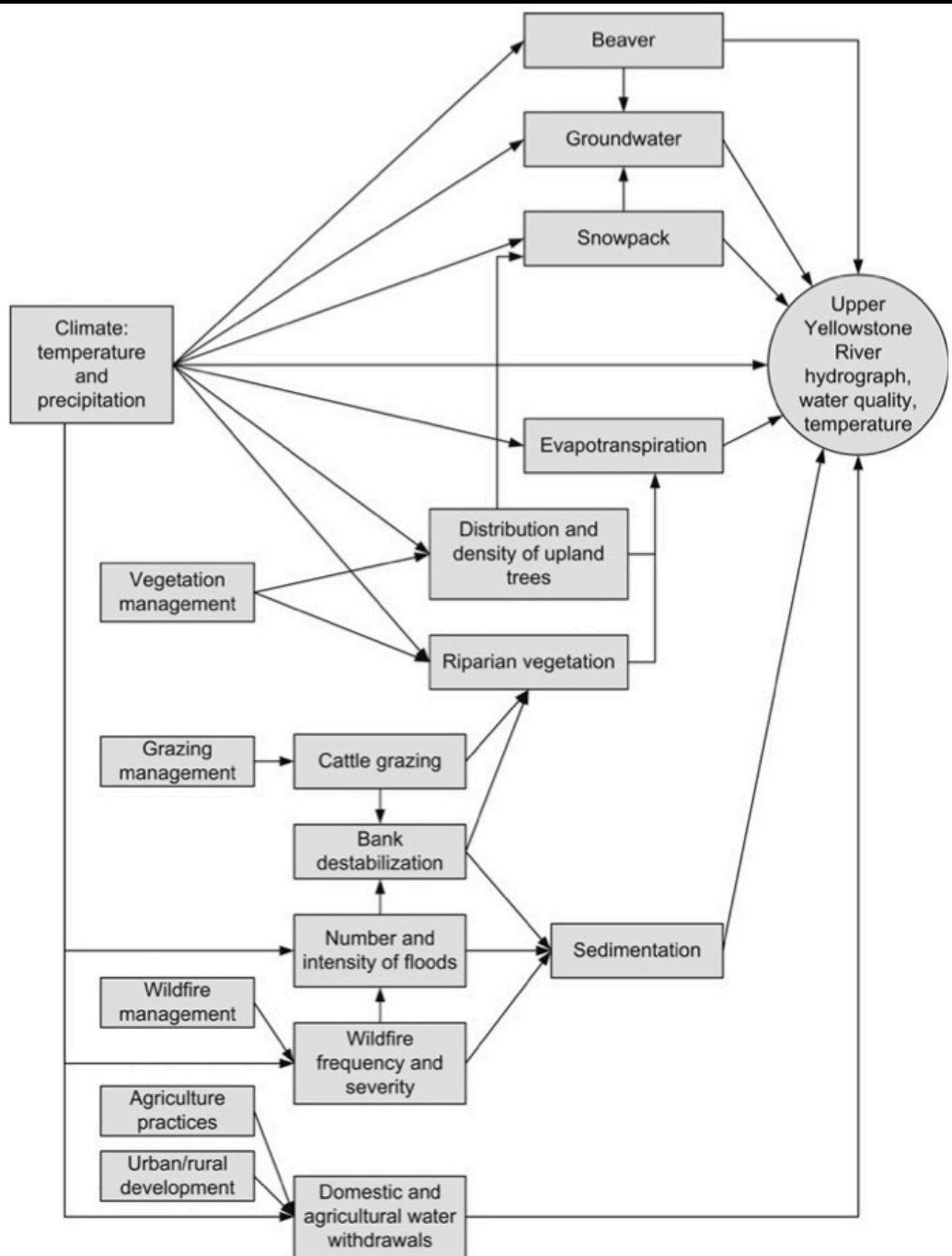


CSIRO



Late-century





EXPERT OPINION

