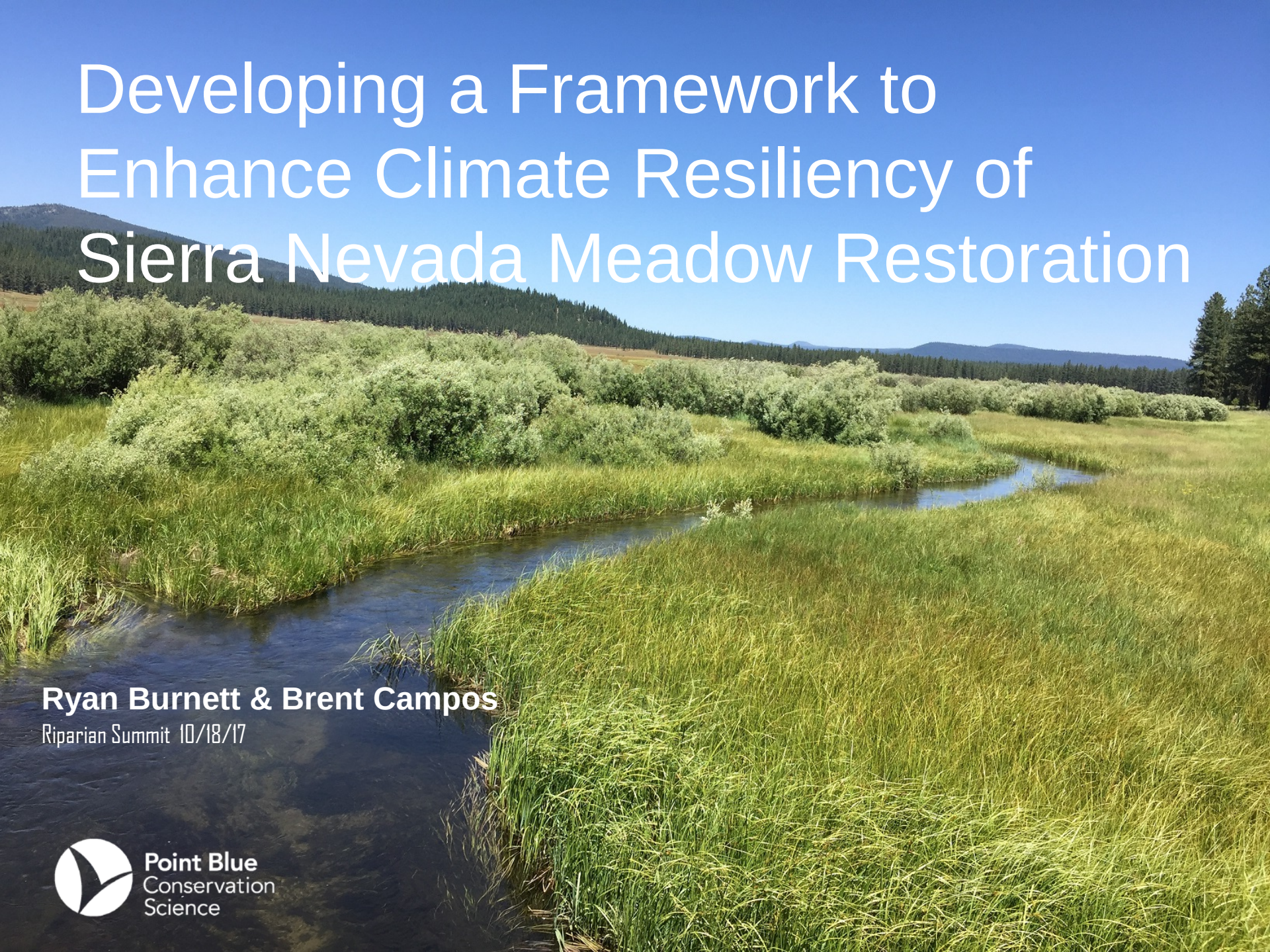
Developing a Framework to Enhance Climate Resiliency of Sierra Nevada Meadow Restoration



Ryan Burnett & Brent Campos

Riparian Summit 10/18/17

Point Blue Conservation Science


Sierra Meadow Partnership
Restore 30,000 acres by 2030 that enhance water, carbon, and biodiversity benefits

Climate-smart ecological restoration is the process of enhancing ecological function of degraded or destroyed areas in a manner that prepares them for the consequences of climate change.

Gardali et al., In review

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Climate-smart principles

1. Show your work
2. Look forward but don't ignore the past
3. Consider the broader context
4. Build ecological insurance
5. Build evolutionary resilience
6. Include the human community
7. Monitor and Experiment

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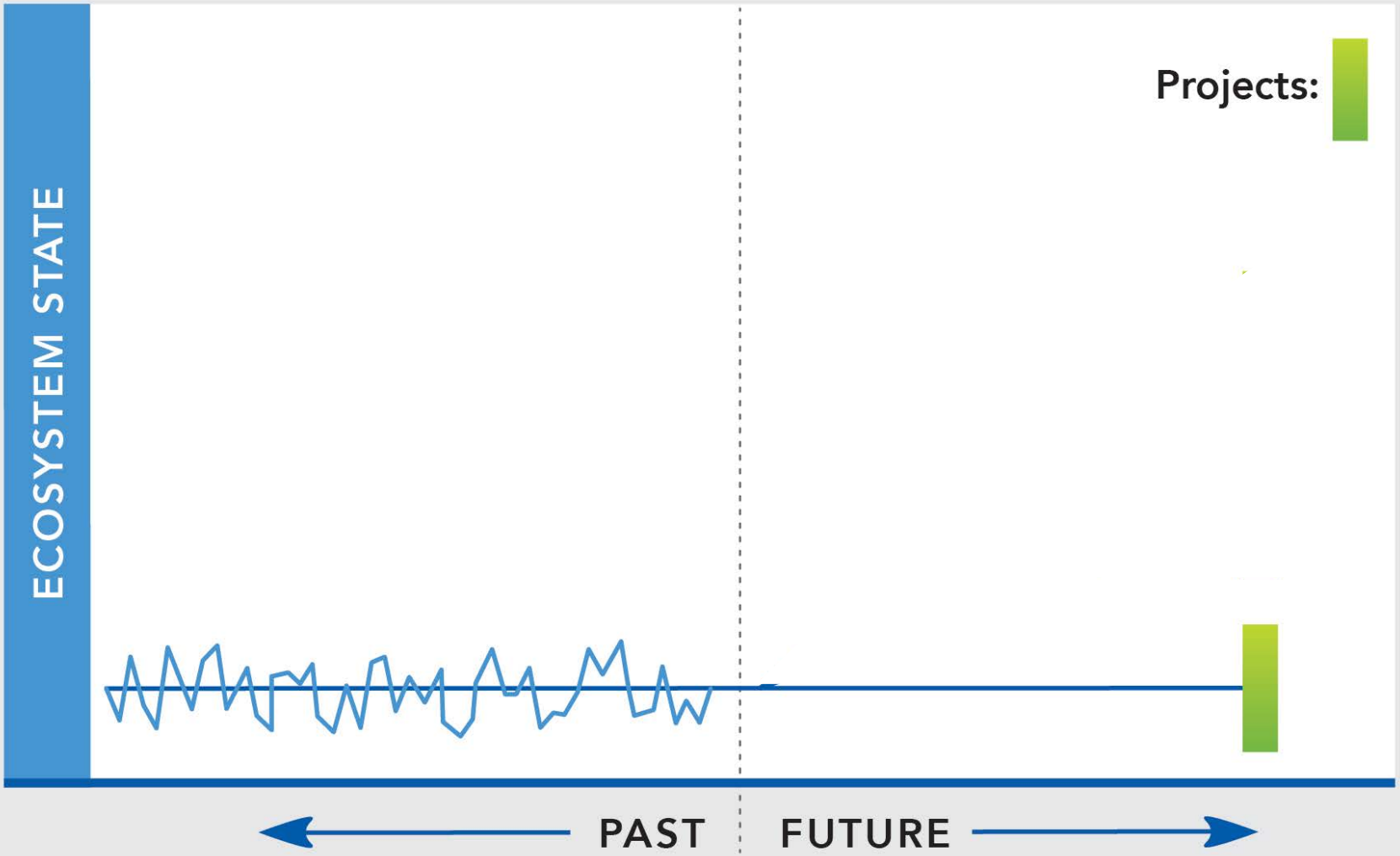
Adapted from: http://www.nwf.org/, Palmer Est. & Coasts 32, Hansen et al. Con. Bio. 24



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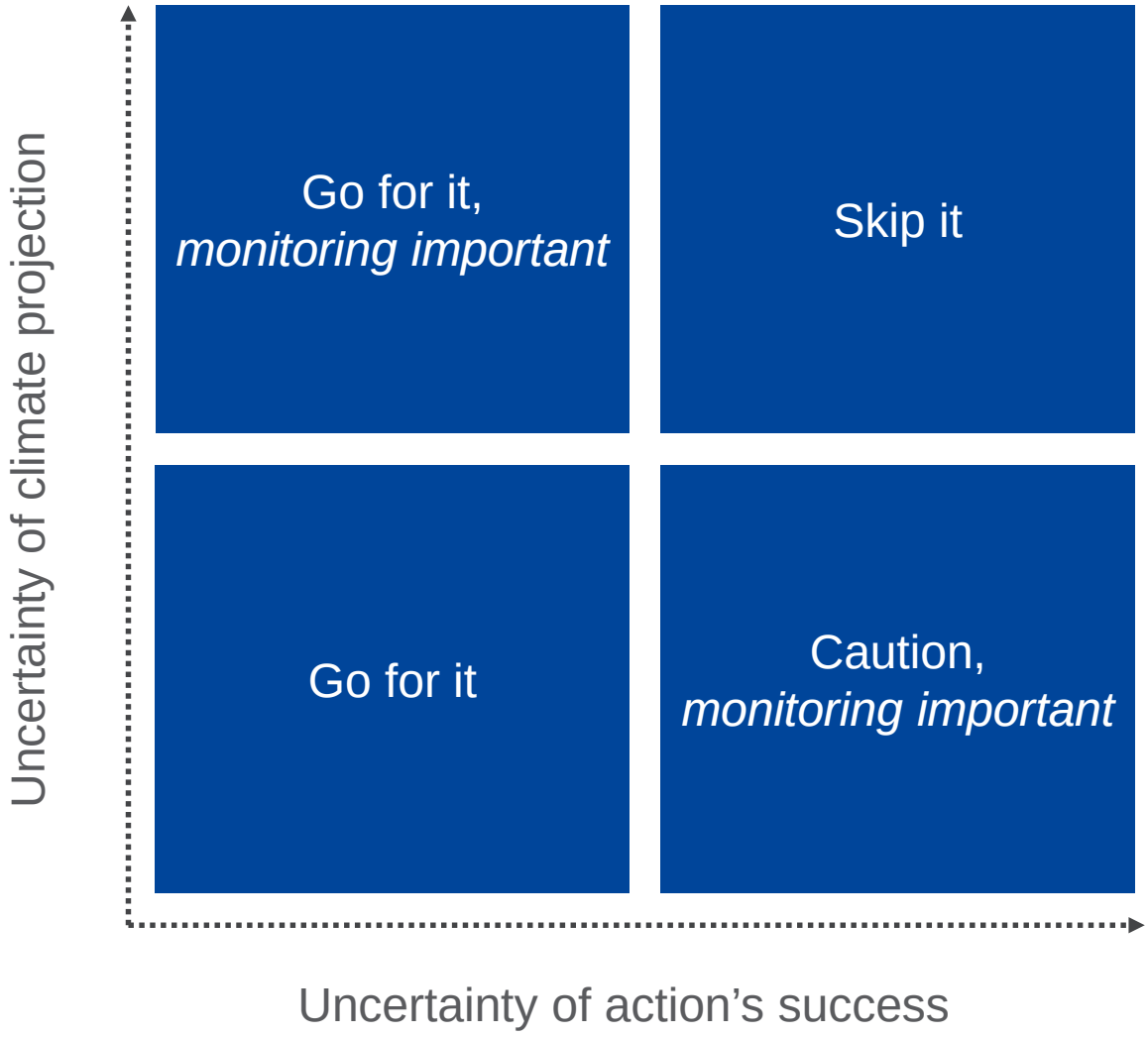
Projects should be designed to succeed under multiple scenarios.

Risk



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Developing a Climate Smart Framework

Goal: Ensure all meadow restoration in the Sierra Nevada is Climate Smart

Objectives:

Pilot with restoration partners to refine

Tested framework at Van Norden & Rock Creek Meadows in 2017

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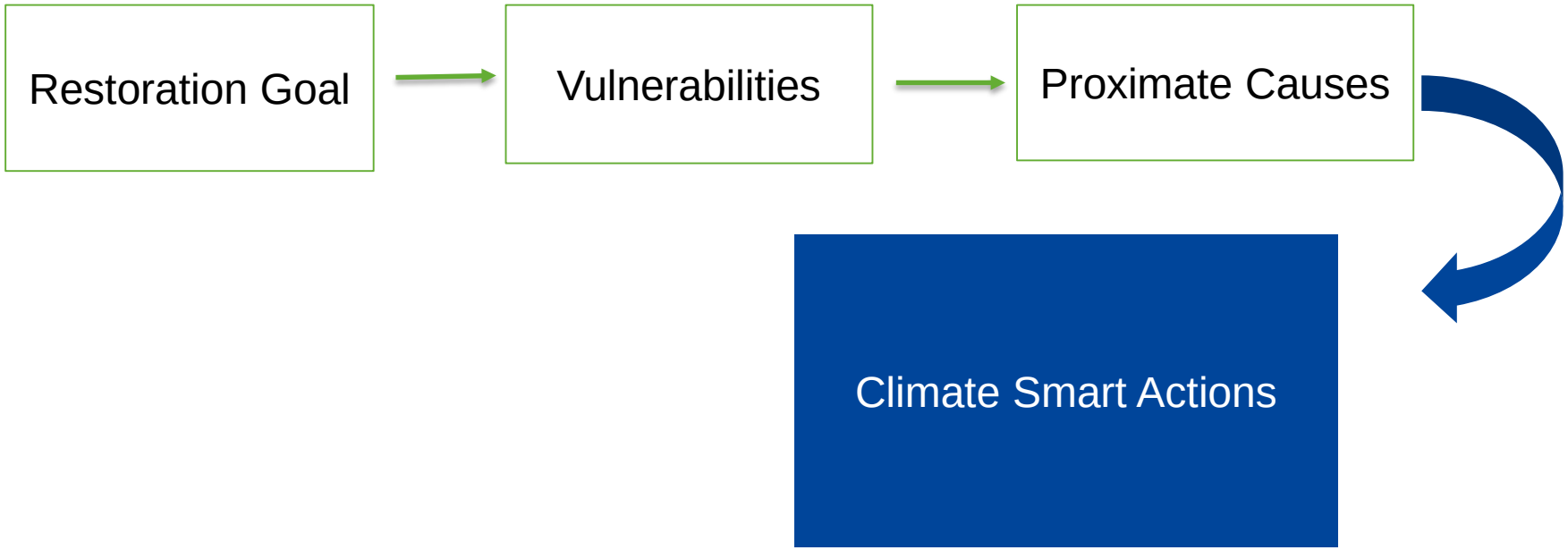
Workshop Approach

Identify Restoration Project Goals

Synthesize climate projections & frame future climate conditions

Provide Guidance on Uncertainty and No-regrets actions



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Van Norden Meadow –
Headwaters South Fork Yuba
River

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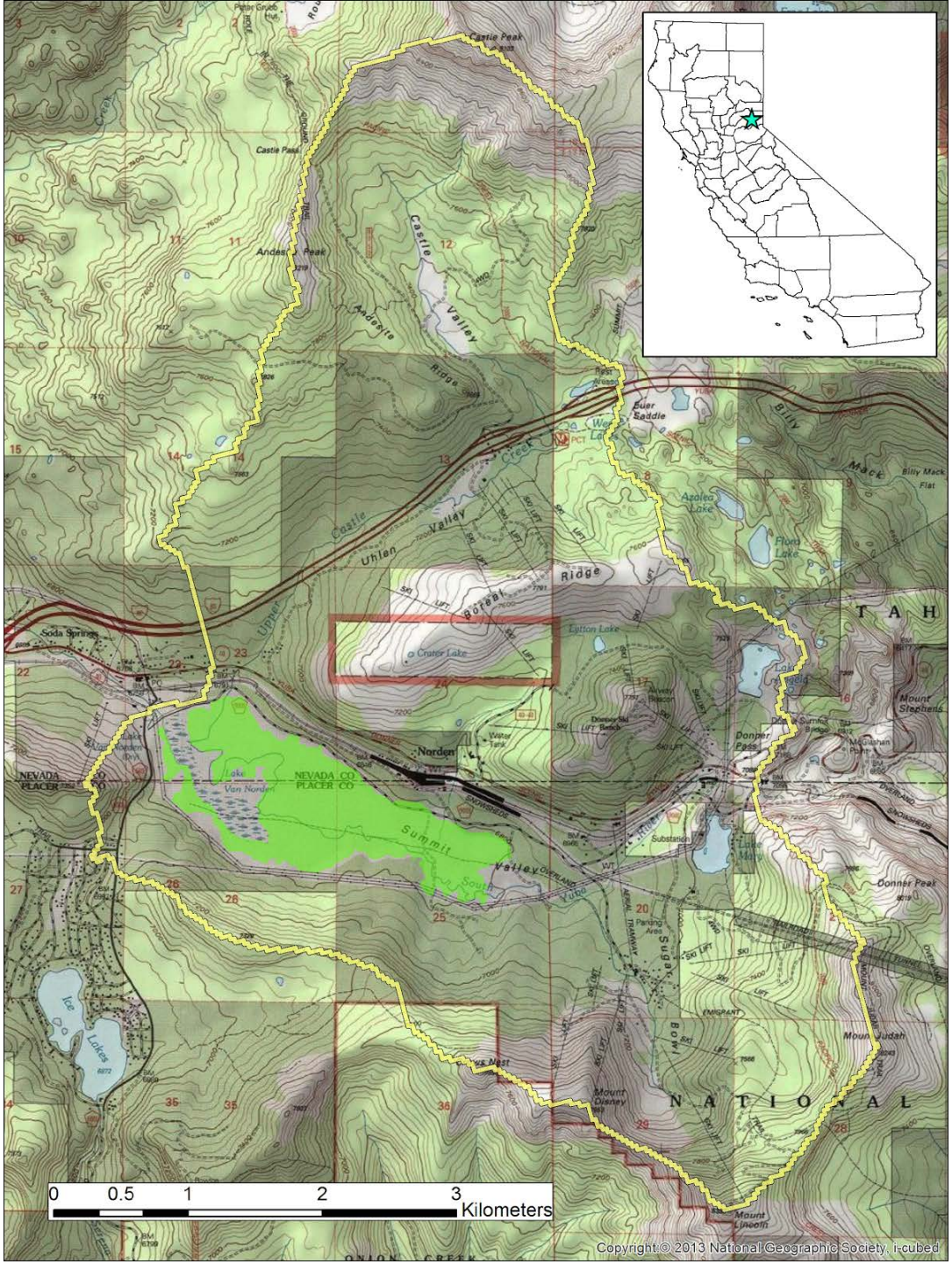
Castle Peak
Castle Pass
Andesite Peak
Castle Valley
Andesite Ridge
Basin
Saddle
Billy Mack Flat
Azalea Lake
Flora Lake
Upper Castle Valley
Uhlen Ridge
Forest
Soda Springs
Crater Lake
Lake Field
Mount Stephens
Donner Pass
Norden
Van Norden
NEVADA CO
PLACER CO
Summit
Valley
Substation
Donner Peak
Ice Lakes
Mount Judah
Mount Disney
Mount Lincoln
N A T I O N A L
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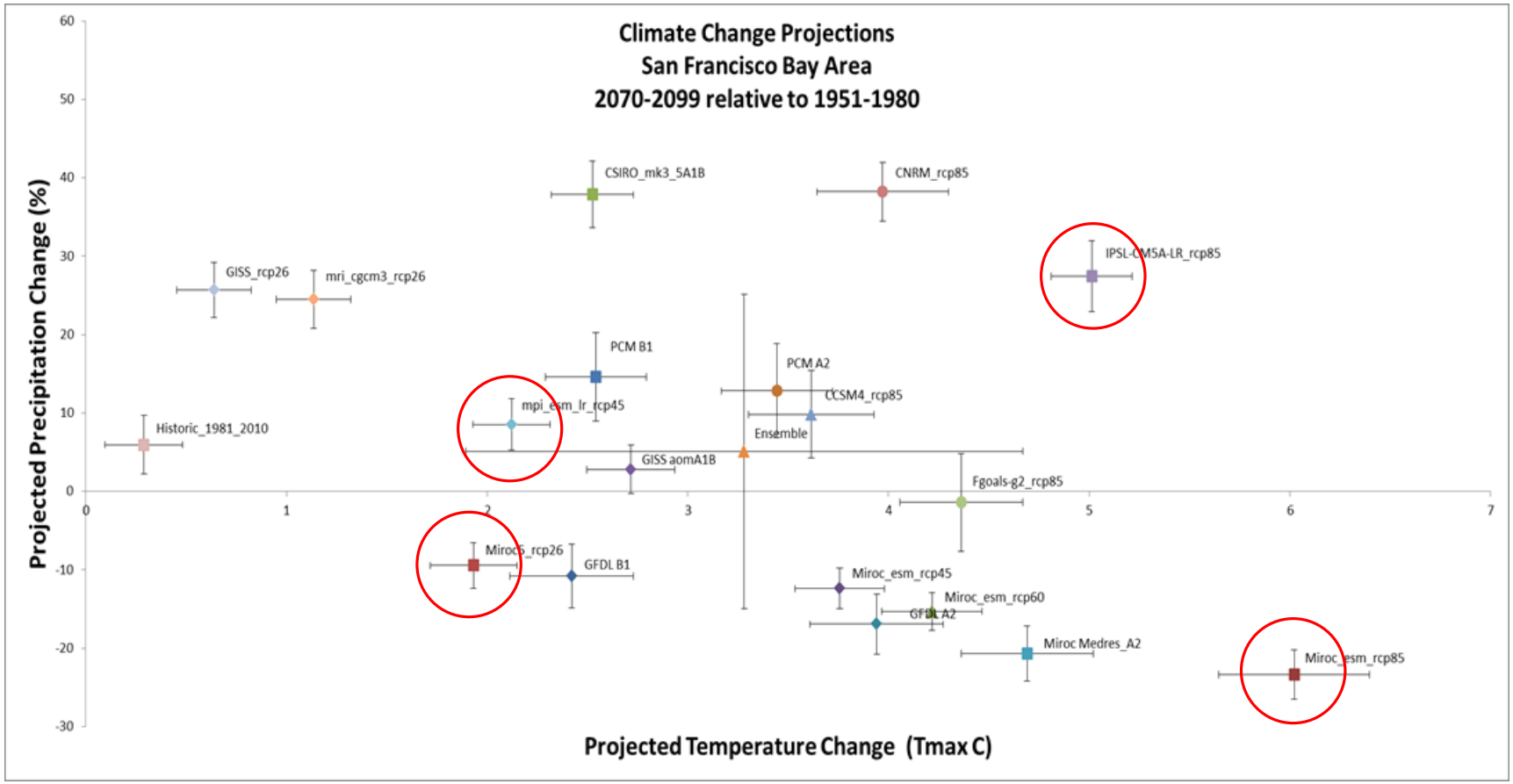
Climate Projections



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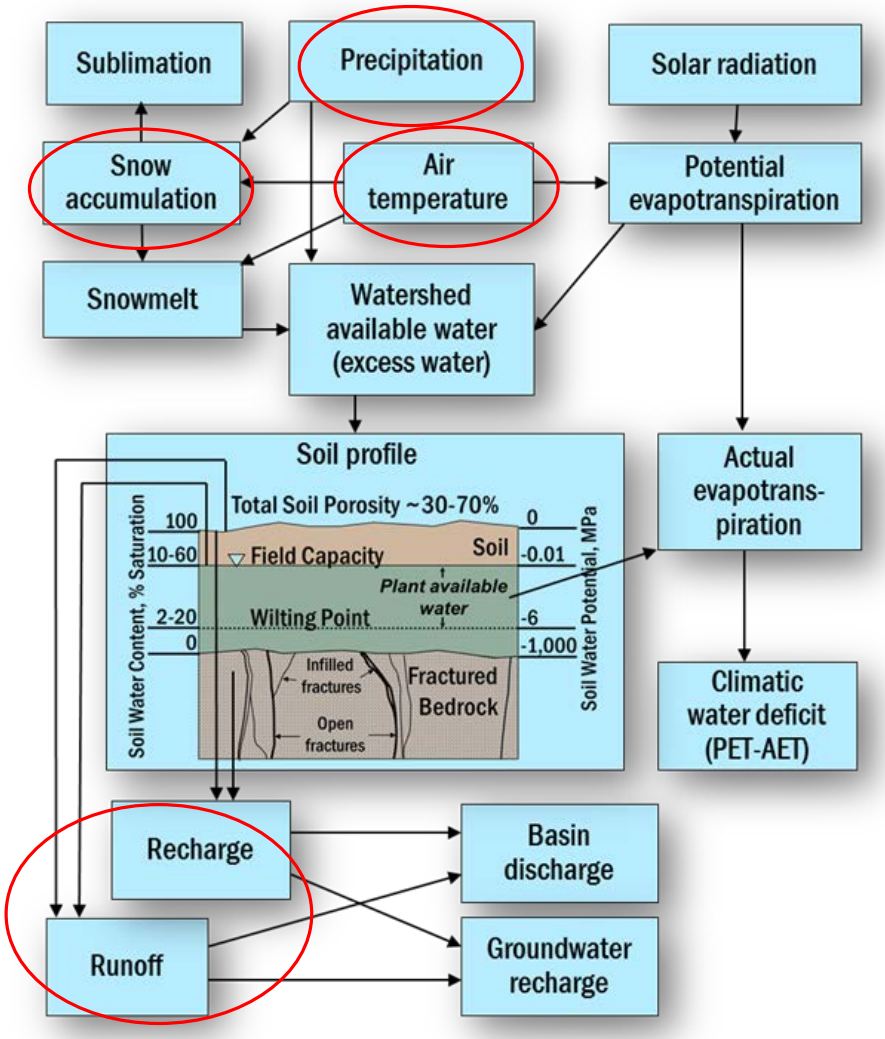
Climate Projections: Basin Characterization Model



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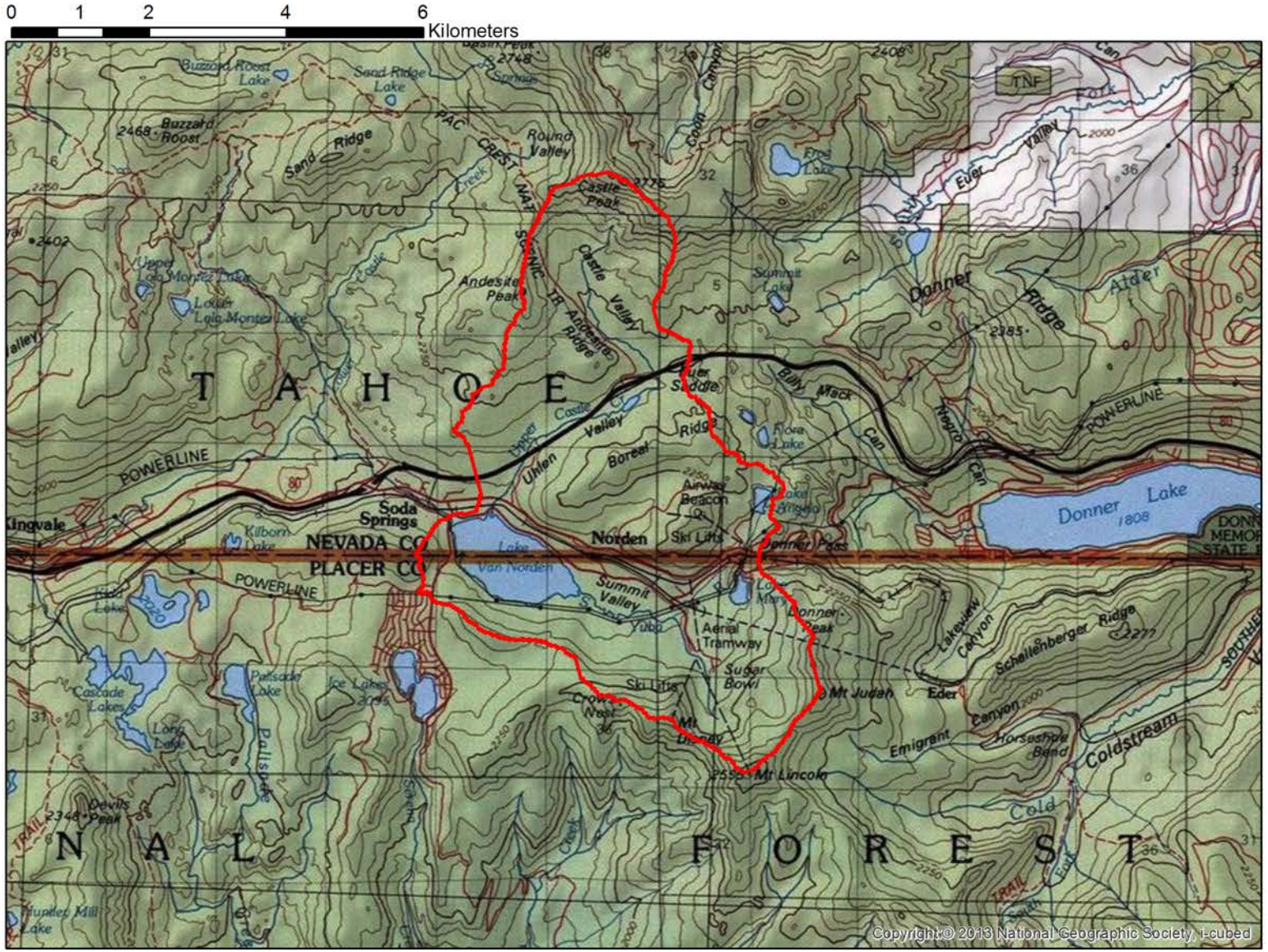
Flint, L.E. and Flint, A.L., 2014, California Basin Characterization Model: A Dataset of Historical and Future Hydrologic Response to Climate Change, U.S. Geological Survey Data Release, doi:10.5066/F76T0JPB

6700 acres (27.1 sq km) elevation range 6770-9104’



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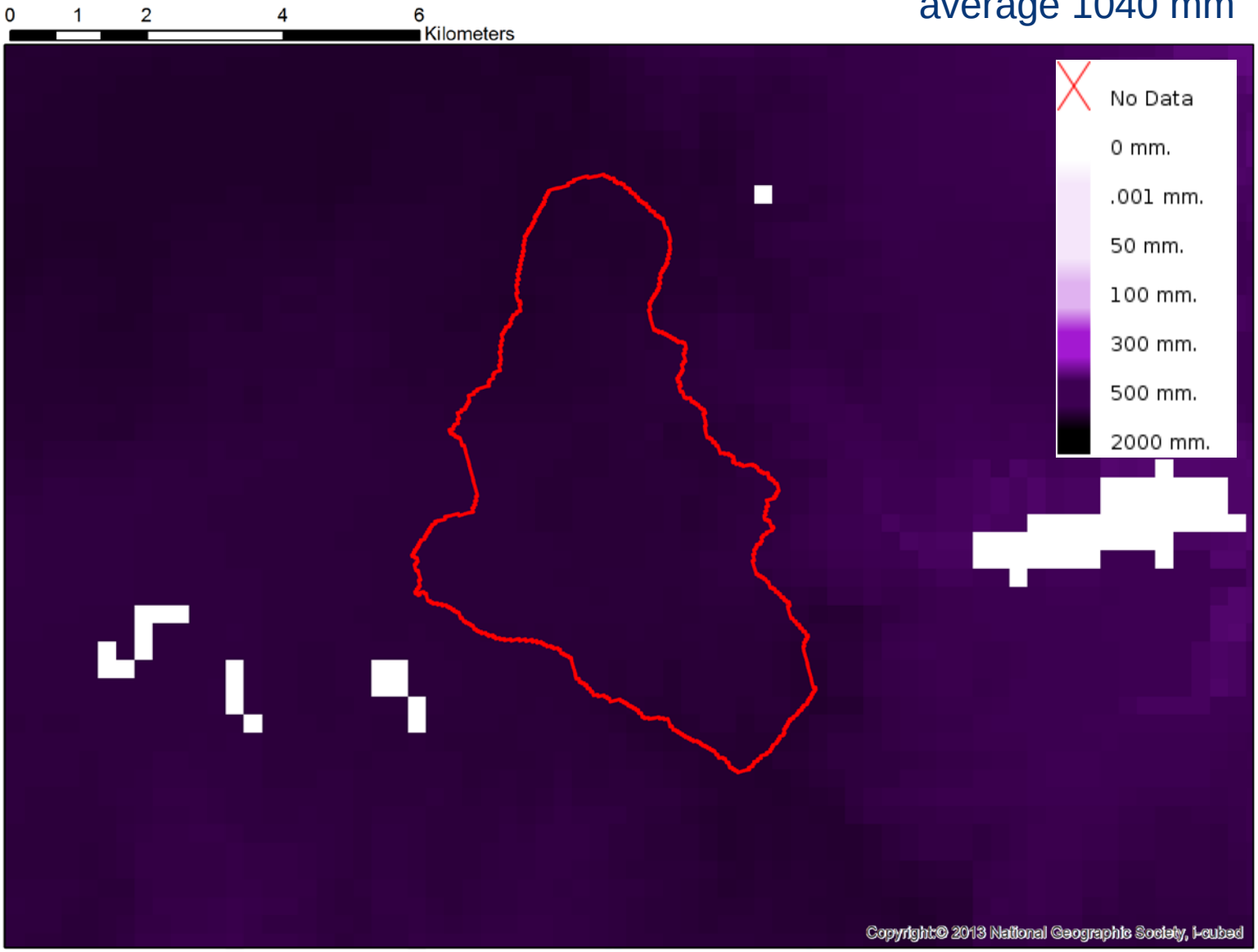
Average April 1 SWE 1981-2010

average 1040 mm



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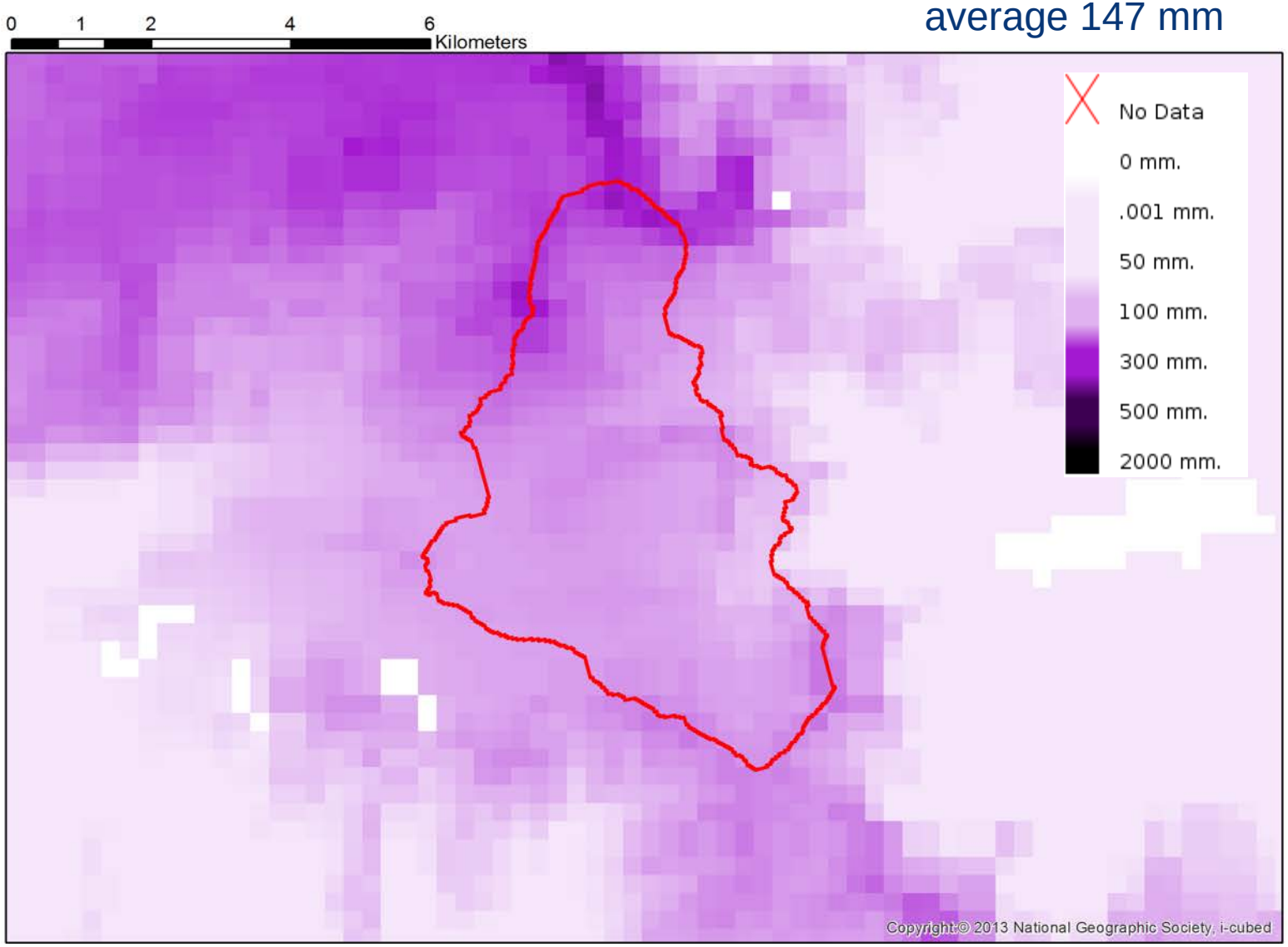
Average April 1 SWE 2070-2099 MIROC RCP8.5

average 147 mm



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Van Norden Range of Climate Projections

2070-2099

- 14–82% of historical April 1 SWE in watershed
- 64–131% of historical upstream runoff + recharge
- Jun/Jul/Aug avg max daily temperature of 72 F jumps to 75 F (Big Bend, 5745’) – 85 F (Rucker Cr, 3609’)
- Increase in proportion of precipitation as rain
- Increase in rain-on-snow events, at least through mid-century
- Increase in multi-year droughts
- Increased probability of high severity fire

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Restoration Goals

1. Increase ground water storage
2. Reduce and delay peak flows on the South Yuba River and Upper Castle Creek
3. Reduce turbidity and water temperature
4. Protect and improve high elevation meadow habitat, which acts as refugia for species during periods of drought which are predicted to be more common under climate change
5. Increase the growth of native wetland vegetation

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Assessed Vulnerabilities to Goal

Goal:

Protect and improve high elevation meadow habitat for fish and wildlife..

Vulnerabilities:

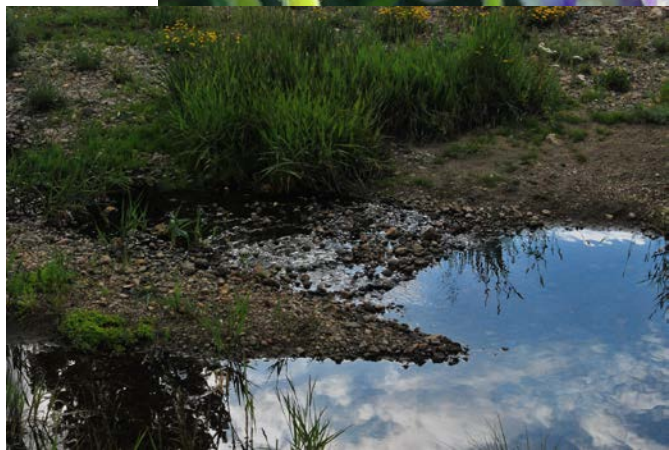
Phenological mismatches among hydrology, plants, and animals

Reduced aquatic habitat especially in dry season

Increased competition for thermal refugia

Willow defoliation/mortality

Increasing contaminant inputs



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Plausible Proximate Causes

Fruit, flowers not timed to wildlife needs (juvenile rearing, migration)

Insufficient runoff to recharge aquifer and create off channel wetland habitat

Multi-year extreme droughts

High spring and summer temperatures

Novel temperature and precipitation conditions outside of ecological tolerances

Increasing impervious surfaces/development in area

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Climate Smart Actions

- Plant full diversity of riparian shrubs that occur in vicinity, plant along moisture gradient, incorporate range of fruiting/flowering species
- Design a multi-thread low flow channel system
- Promote beaver occupancy
- Utilize remnant reservoir as aquatic refugia during extreme drought
- Plant willows from all species and many individuals
- Monitor riparian shrub vigor, if not persisting/regenerating, source material from lower elevation
- Robust monitoring plan for veg and wildlife with triggers for adaptive management

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TECHNICAL BRIEF: VAN NORDEN MEADOW CLIMATE-SMART RESTORATION

Climate-Smart Ecological Restoration is the process of enhancing ecological function of degraded, damaged, or destroyed areas in a manner that prepares them for the consequences of climate change. We applied a climate-smart restoration framework to the Van Norden Meadow restoration project. This document summarizes the results of that process, highlighting potential actions that may make the meadow more resilient to climate-driven change.

Meadow Profile

•*Meadow area*: 141.8 ha (350.4 ac); •*Meadow elevation*: 2065 m (6775 ft); •*Watershed area*: 2710 ha (6700 ac); •*Watershed elevation range*: 2065-2775 m (6775-9104 ft); •*Meadow types*: riparian low gradient (dominant), discharge slope, discharge slope peatland, lacustrine fringe, dry

Goals of the Van Norden Meadow Restoration Project

The overarching goal is to improve the resiliency of this large high elevation, headwater meadow and to protect the South Yuba headwaters from continued degradation from legacy impacts and from future pressure from a changing climate. (1) Restore 485 acres of meadow habitat; (2) Increase groundwater storage; (3) Reduce and delay peak flows on the South Yuba River; (4) Improve water quality by reducing turbidity and water temperature; (5) Protect and improve high elevation meadow habitat, including willow flycatcher; (6) Increase the growth of native wetland vegetation; (7) Increase net carbon sequestration; (8) Educate the public about the benefits of meadow restoration and provide opportunities for volunteer/citizen science participation.

Proposed Restoration Actions (1) Reconnect and fill gullied stream channels with the meadow floodplain; (2) Plant willows and sedge plugs along restored stream banks and borrow areas; (3) Remove reed canary grass along the South Yuba River degraded channel; (4) Improve a cross-meadow road; and (5) Remove at least 10 acres of conifers that are encroaching along the meadow edges.

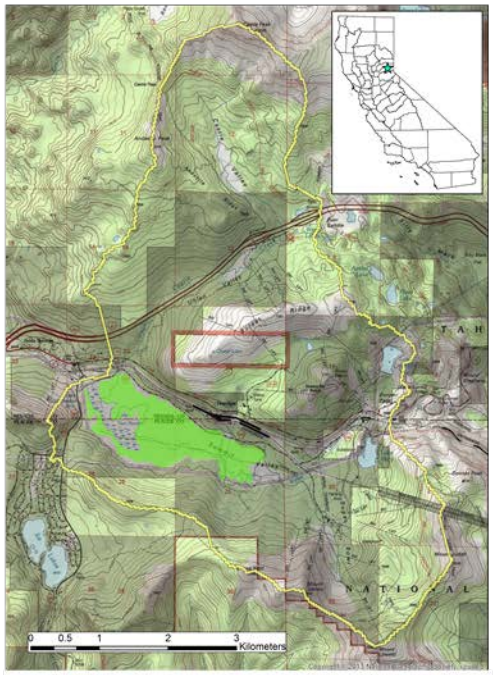

Figure 1. Location of Van Norden Meadow (green polygon) and its watershed boundary (yellow line). Green polygon does not represent area reported in text, which is an area calculated through in-the-field delineation of the meadow and includes the area covered by the reservoir.

Figure 2. Incised channel at Van Norden Meadow. Credit: Ryan Burnett

Climate Projections for 2070-2099 derived from the basin characterization model (Flint et al. 2013) and Assessment of Climate Change in the Southwest U.S. (Garfin et al 2013).

- 14–82% of April 1st snow-water-equivalent in watershed compared to 1980-2009 conditions
- 64–131% of water flowing through and under meadow compared to 1980-2009 conditions
- Average maximum daily temperature in June-August increases to 75°–85° F compared to 72° F in 1980-2009
- Increased climate water deficit in meadow
- Higher proportion of winter precipitation falling as rain
- Increase in rain-on-snow events
- Droughts will be hotter, more severe, and more frequent
- Increased probability of high severity fire

Lessons Learned & Next Steps

- Project goals variable and site specific differences in climate projections led to differences
- Beavers may be our best climate smart restoration tool
- Enough variation to warrant testing on several additional projects
- Need to continue to follow through to ensure actions manifest in restoration design

- Pilot with 2 additional restoration teams
- Finalize our meadow specific framework
- Integrate across Sierra Meadow Partnership

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