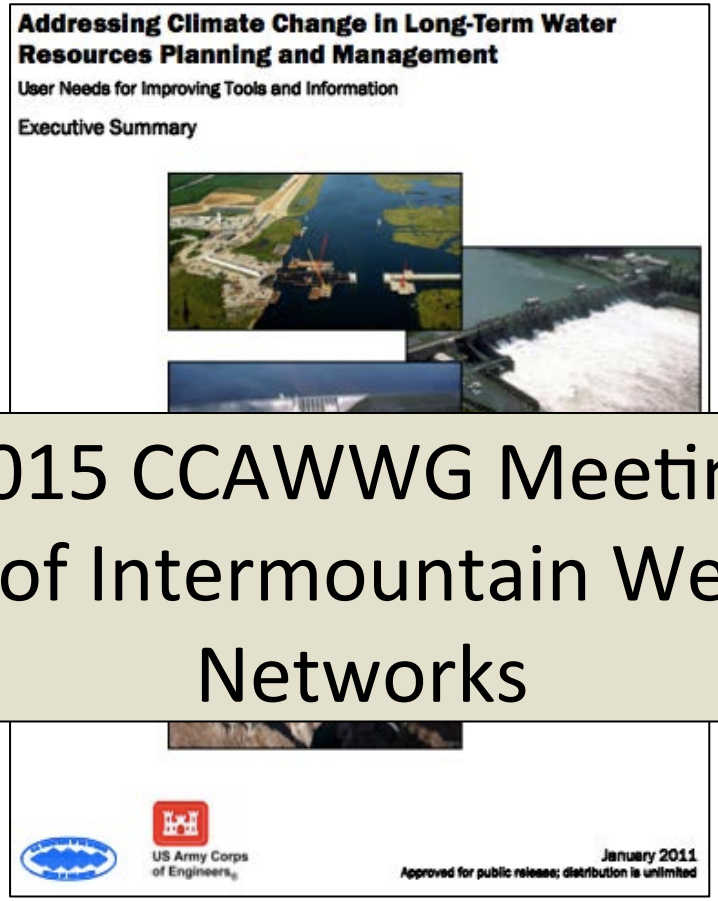


2015 CCAWWG Meeting
Summary of Intermountain West Climate Networks

Ben Livneh (ben.livneh@colorado.edu)

Representing work led by: Balaji Rajagopalan, Cameron Bracken, Lisa Dilling Jeff Lukas, Imtiaz Rangwala, and Joe Barsulgi

Western Water Assessment

CIRES Cooperative Institute for Research in Environmental Sciences

Earth System Research Laboratory
Physical Sciences Division

North Central Climate Science Center
University Consortium

Overview

- Review of existing USBR-CIRES/CU projects
  - Hydrometeorological data set development
  - Seasonal to decadal hydrometeorological extremes
- Key partners
  - Western Water Assessment
  - North Central Climate Science Center
  - NOAA-Physical Sciences Division
- Future Opportunities
  - Impacts of land cover change on hydrology
  - Characterization of extremes and how climatic drivers may improve predictability

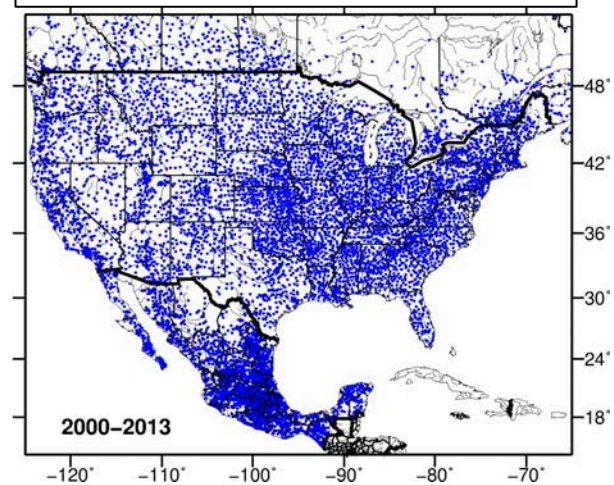
Gaps: 2.02, 3.01

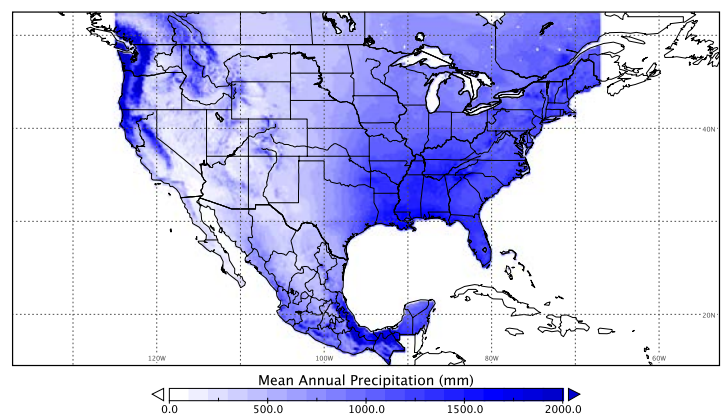
Hydrometeorological data set development

CIRES lead: Ben Livneh

- Motivation – downscaling *Localized Constructed Analogs,* LOCA (*Scripps*); Water balance studies;
- Consistent methodology relative to international boundaries—Daily 1/16° (~6km) P, T_{max}, T_{min}, 1950-2013
- Spatial extension and refinement of a previous data set (Maurer et al., 2002).

Station locations





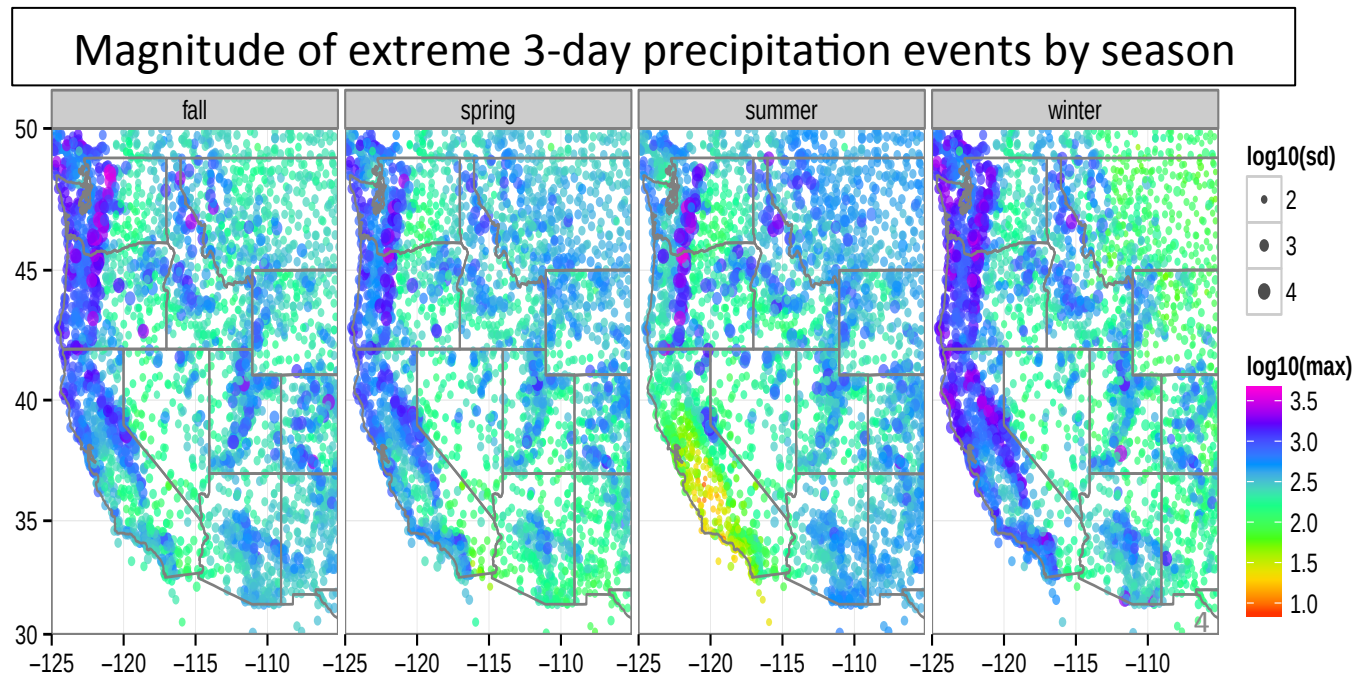
Mean Annual Precipitation (mm)

Livneh B., T.J. Bohn, D.S. Pierce, F. Munoz-Ariola, B. Nijssen, R. Vose, D. Cayan, and L.D. Brekke, 2015: **A spatially comprehensive, hydrometeorological data set for Mexico, the U.S., and southern Canada 1950-2013**, *Nature Scientific Data,* doi:10.1038/sdata.2015.42.

Flood Frequency Variability in the Western US with Implications for Infrastructure Planning

CIRES lead: Balaji Rajagopalan

- **How are extreme flooding events manifested?** Specifically, what atmospheric and hydrologic ingredients conspire to produce extreme flood events at short (*seasonal* and below) and long (*multidecadal*) time scales?
- Developed a *Nonstationary Bayesian Hierarchical spatial model* linking precipitation (GEV) streamflow and elevation towards an improved **model of flood frequency in space and time**, flexible for a changing climate
- What are the implications for **long-term infrastructure planning** (e.g., dam safety, levee protection, etc.) and management

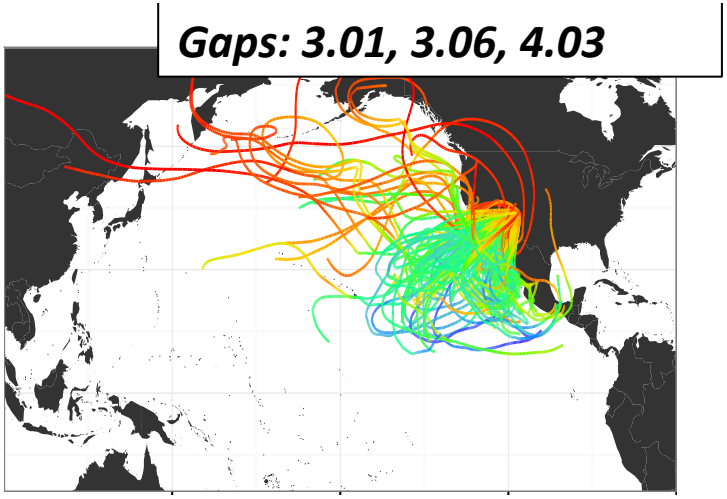


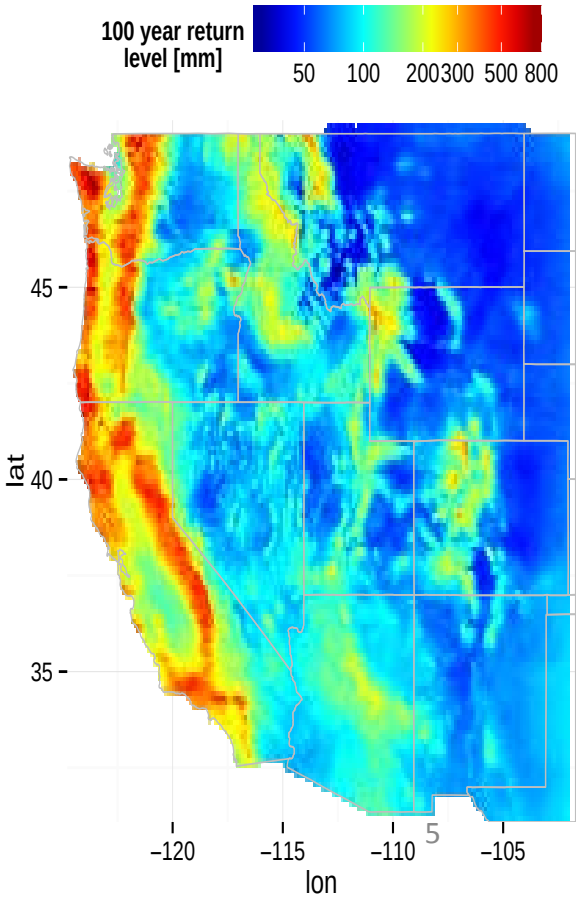
Courtesy: Cameron Bracken

Current Results

Tracking moisture sources for extreme events

Hierarchical spatial modeling of extreme precipitation return levels





Future Work

Coupled nonstationary modeling of streamflow and precipitation extremes

Suggested methodology for conducting dam safety frequency analyses

Courtesy: Cameron Bracken

Partners

Western Water Assessment (WWA) a NOAA RISA Program

CIRES leads: Lisa Dilling and Jeff Lukas

Research

- Theme 1: Vulnerability and Adaptive Capacity
- Theme 2: Extremes and Climate Risk Management
- Theme 3: Designing Organizations for Usable Science
- Leveraged projects with partners (e.g., NC CSC)

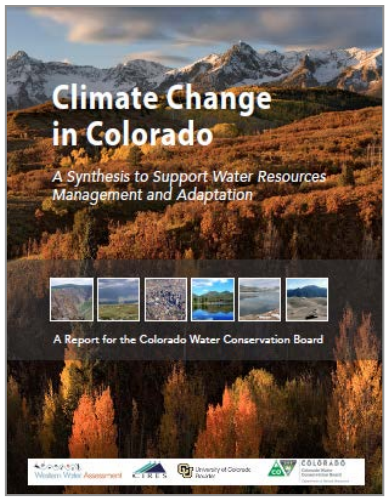
Outreach and Services

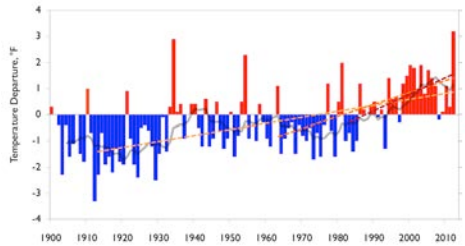
- Climate and water science literacy (talks, MOOC)
- Guidance on using climate change information in planning and assessment
- WWA Climate Dashboards
- WWA Briefings on extreme events and current conditions

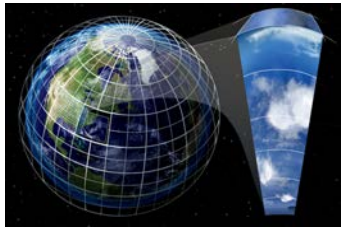
Exchange and engagement with stakeholders and research partners

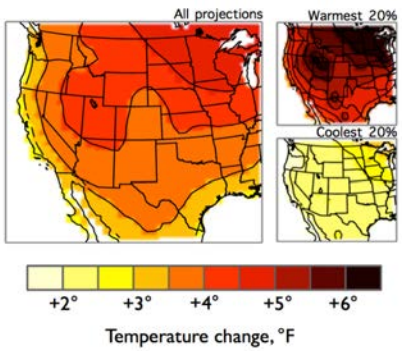
Gaps: 8.01, 8.02

Climate Change in Colorado report (2014)









- *Observed climate trends for Colorado*
- *About climate models*
- *Colorado trends in a global context*
- *Projections of Colorado's climate and water for 2050*
- *How to use this information in planning*

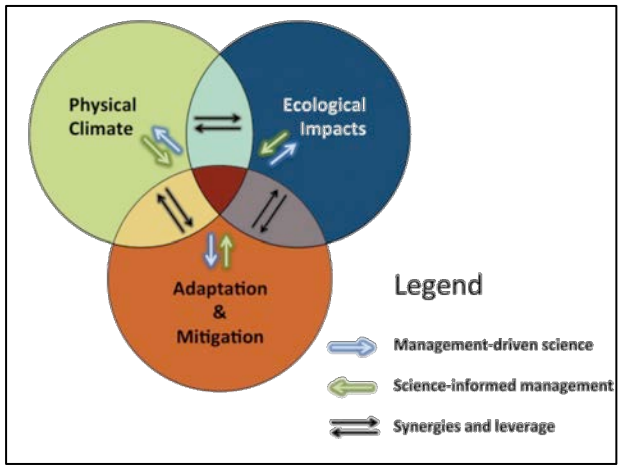
- http://wwa.colorado.edu/climate/co2014report/

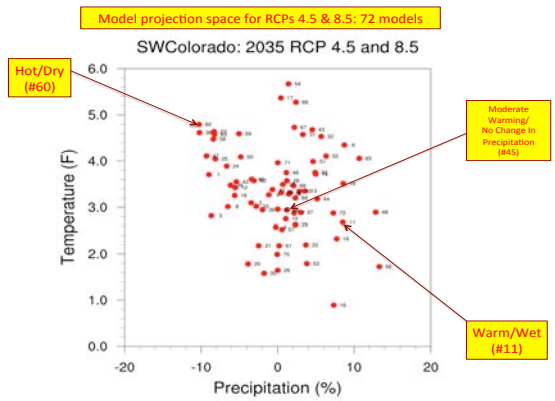
Gaps: 8.01, 8.02

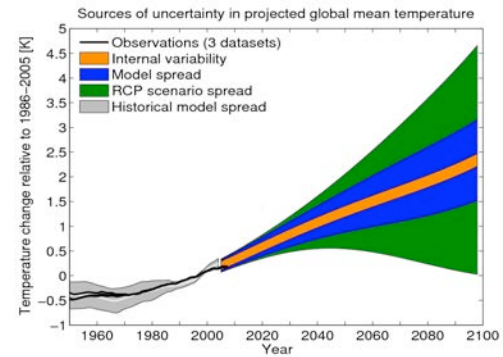
North Central Climate Science Center Partnership with CIRES

Climate

CIRES leads: Imtiaz Rangwala, Joe Barsugli





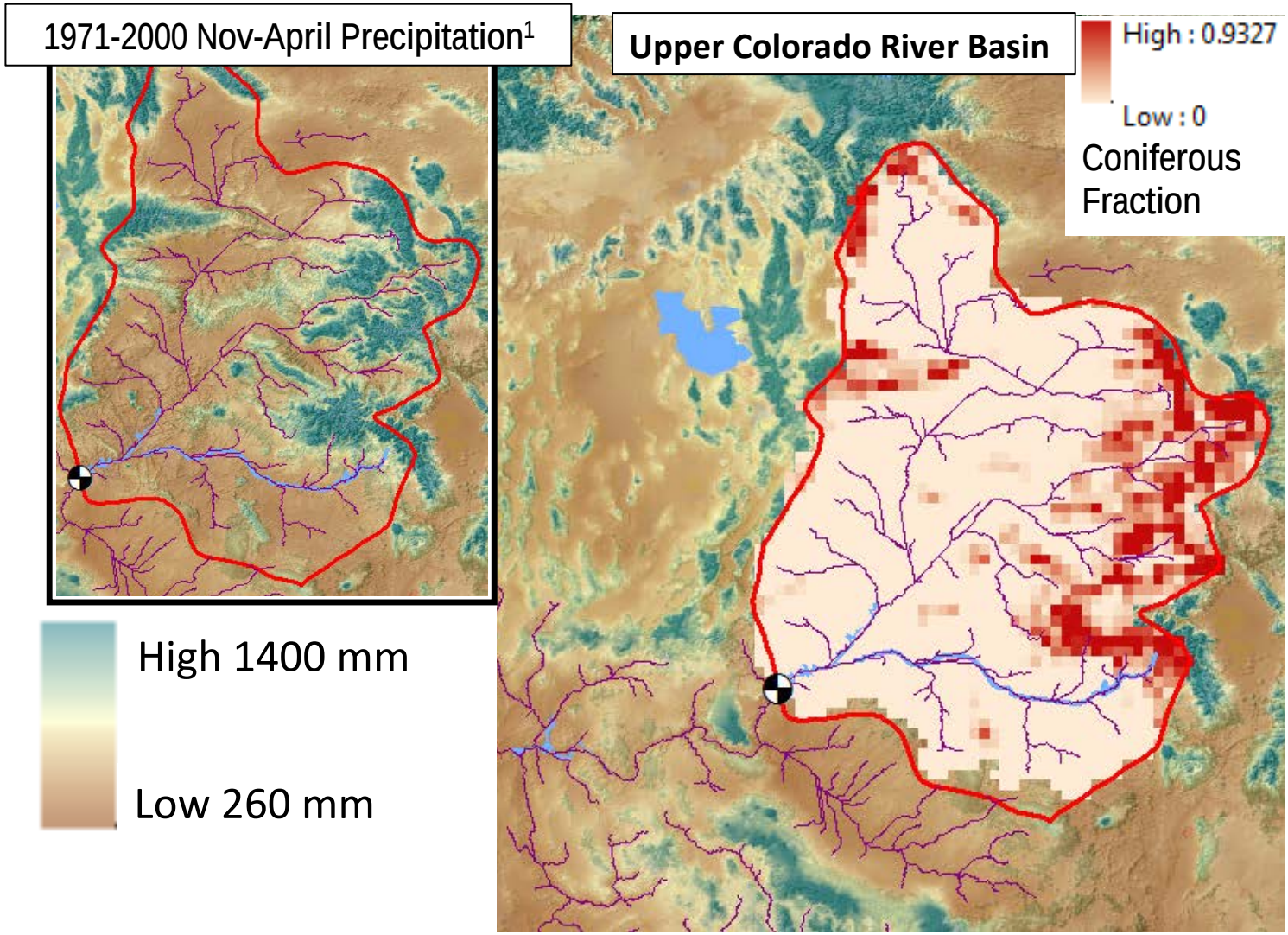


- ✧ Primary Research into Drivers of Hydro-Climatic Trends and Extremes in the North Central Region across Multiple Timescales
  - Droughts
  - Drivers of Evapotranspiration
  - Extreme Precipitation
  - Effects of landuse

Ongoing Work and Future Opportunities

Forest Disturbance: Coniferous forests are in the hydrologically important *basin headwaters*

- Susceptible forests coincide with areas of high precipitation

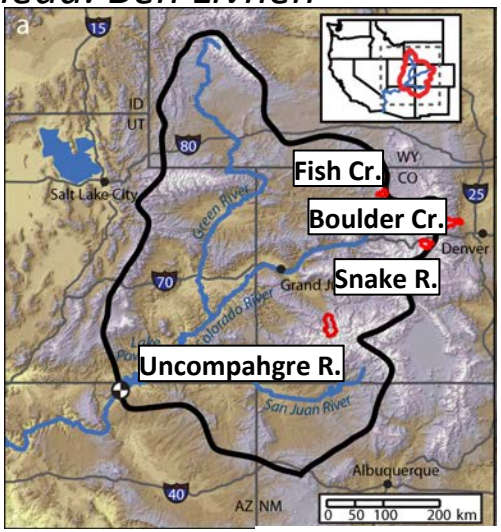


[1]PRISM:Daly C., Neilson, R.P., and Phillips, D.L. (1994) **A statistical–topographic model for mapping climatological precipitation over mountainous terrain**, *Journal of Applied Meteorology*, **33**, 140–158.

Catchment-scale modeling suggests increases in overall water-yield and changes to runoff timing

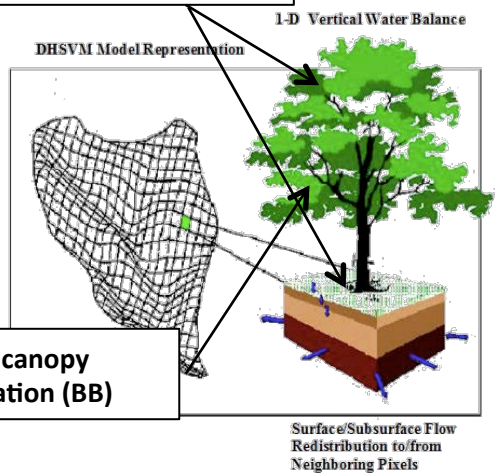
Gaps: 4.12, 4.07

CIRES lead: Ben Livneh

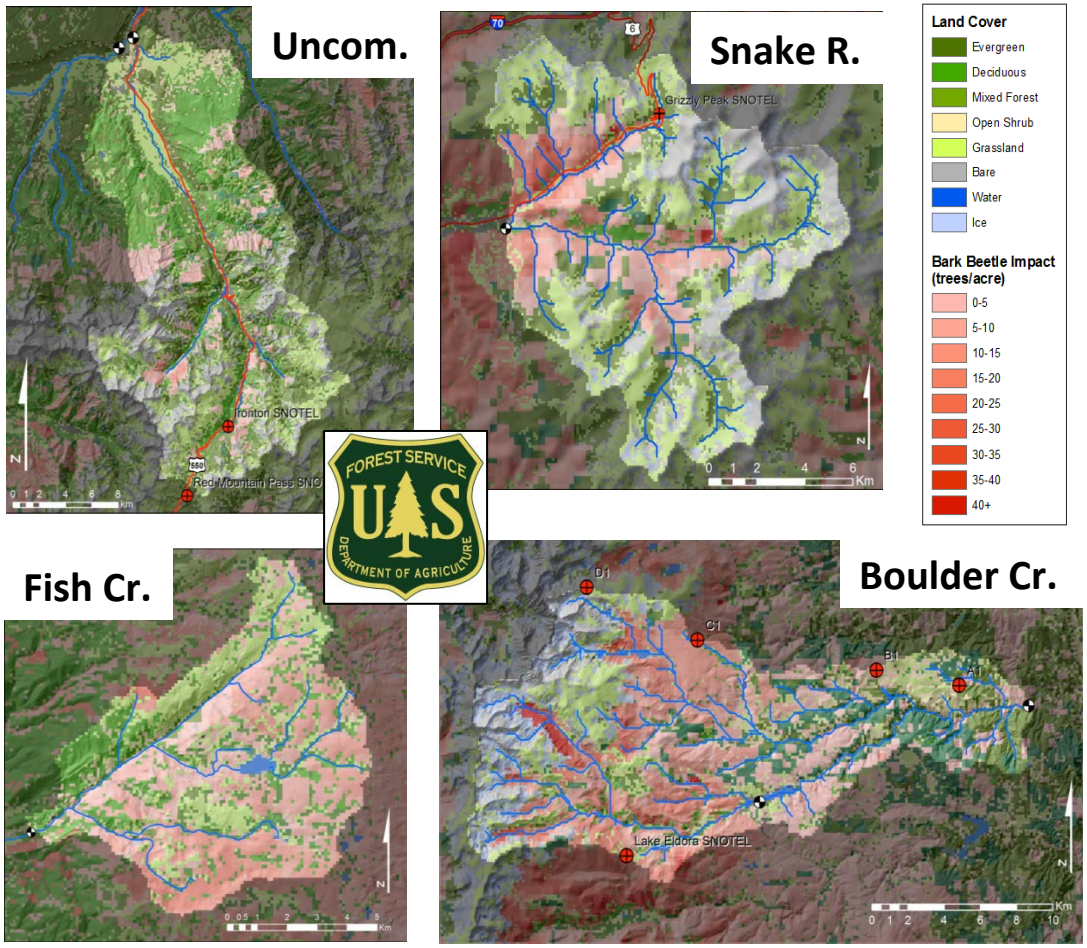


Catchment scale modeling (DHSVM)

Independent canopy and understory layers



Turn-off canopy transpiration (BB)



Aerial Surveys by the U.S. Forest Service. Annual maps of Bark Beetle related-tree deaths

Livneh B., J.S. Deems, B. Buma, J.J. Barsugli, D. Schneider, N.P. Molotch, K. Wolter, and C.A. Wessman, **2015**: **Catchment Response to Bark Beetle Outbreak in the Upper Colorado River Basin**, *Journal of Hydrology* 523,196–210.

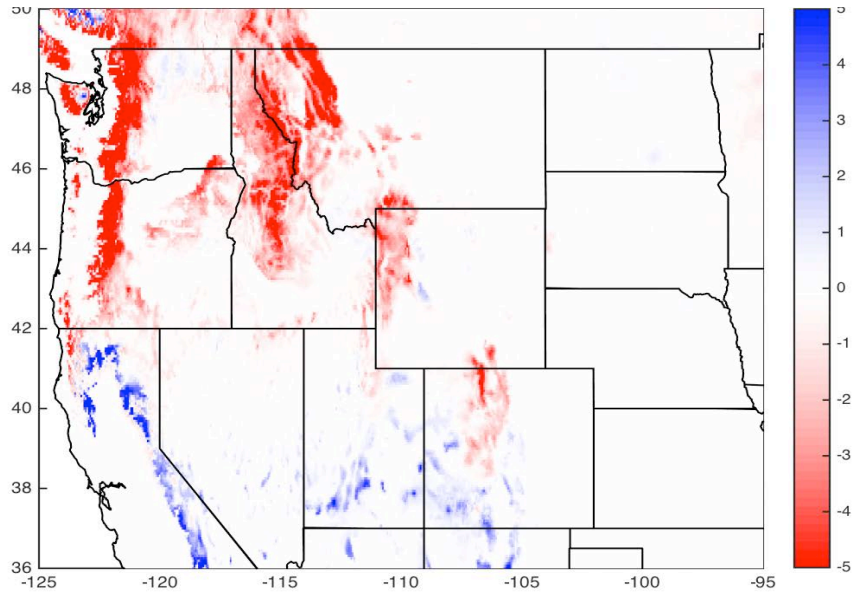
Gaps: 3.01, 4.02

Exploring ENSO connections with western U.S. SWE

CIRES lead: Joe Barsugli
NOAA Physical Sciences Division

- Linking ENSO to key water supply variables
- Preliminary work
- How may linkages change under future warming?

March 1 Snow Water Equivalent anomaly (inches) for moderate and strong El Nino years



Snowpack simulated with VIC hydrology model from historic gridded precipitation and temperature observations (Livneh 2013 dataset).
Diminished northwest storm track; enhanced southwest storm track.

Thank you

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Western Water Assessment

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