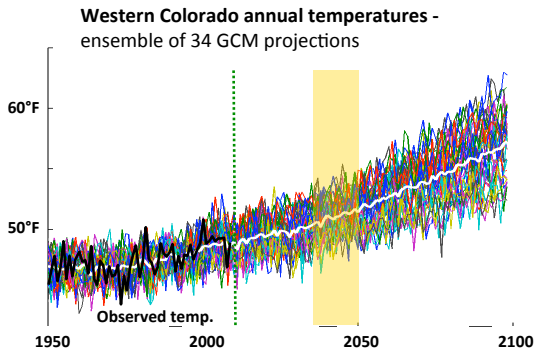
Climate change and projections of future Colorado River flows. The long perspective on Colorado River flow from tree rings Ben Livneh, CU-CIRES Western Water Assessment (ben.livneh@colorado.edu)

Where we're heading



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Full assessment of future climate risk to CRB water supply requires looking both *back* and *ahead*

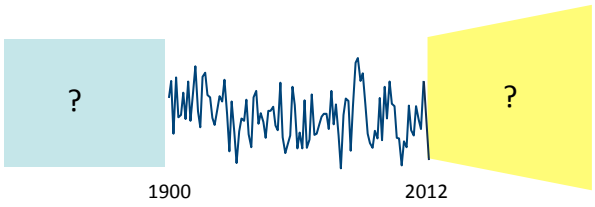

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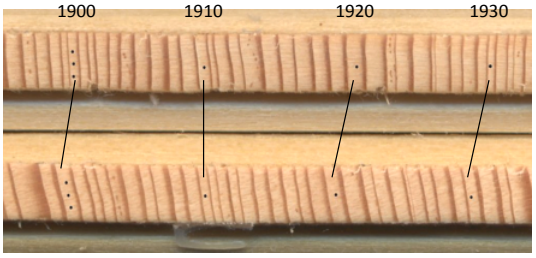
Figure 1: Temperature Projections from 16GCM runs with A1B emissions.

Same climate influences the growth of all trees at a site = **cross-dating**



Two Douglas-fir trees near Boulder, CO

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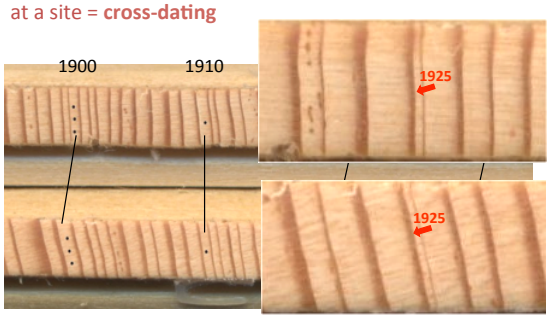

Two Douglas-fir trees near Boulder, Colorado

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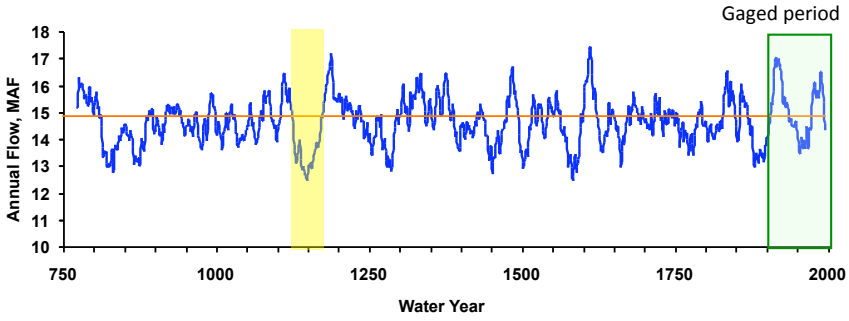
Figure 2: Cross dating tree cores, photo courtesy of Jeff Lukas, WWA

Tree-ring reconstruction of Colorado River at Lees Ferry streamflow, 762-2005, with **20-year** running mean



Meko et al. 2007. Medieval Drought in the Upper Colorado River Basin, *Geophysical Research Letters*

Figure 3

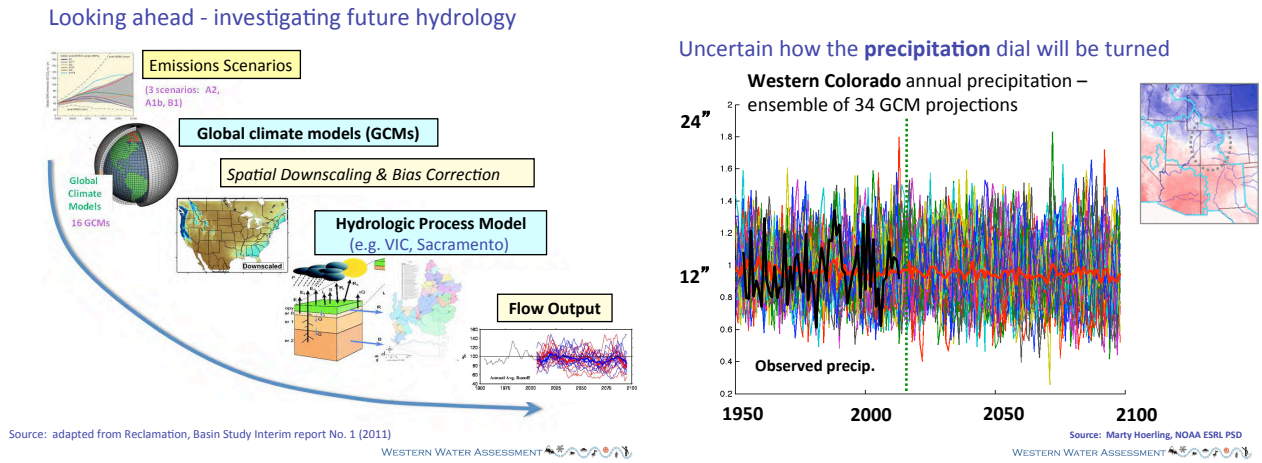


Figure 4: Conceptual diagrams of future hydrology projections and precipitation projections from 16GCMs with A1B emissions.

Projected mean UCRB streamflow changes by ~2050 from GCM-based studies: overall negative (-) outlook

Study	Hydro model	Temp Change	Precip Change	Runoff Change
Christensen et al. (2004)	VIC	+3.1ºF	-6%	-18%
Milly et al. (2005)	GCMs	na	na	-16%
Christensen and Lettenmaier (2006)	VIC	+4.5ºF	-1%	-6%
CWCB CRWAS Phase 1 (2010)	VIC	+3.6ºF (2040) +5.8ºF (2070)	-1.5% -1.9%	-7% -22%
Reclamation WWCRA - Colorado Basin Study (2011)	VIC	+3.8ºF	-0.3%	-9%
Joint Front Range CCVS (2011)	Sac. & WEAP	+3.4ºF (2040) +5.6ºF (2070)	+1.1% +2.0%	-4% -10%

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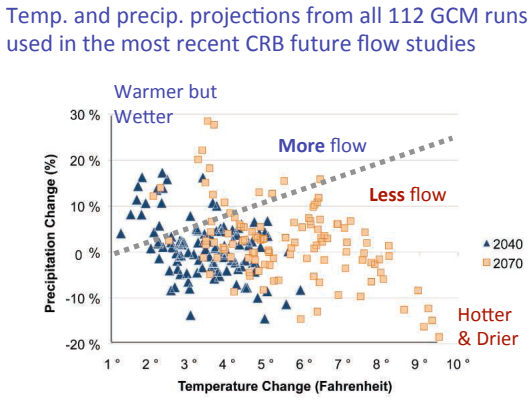
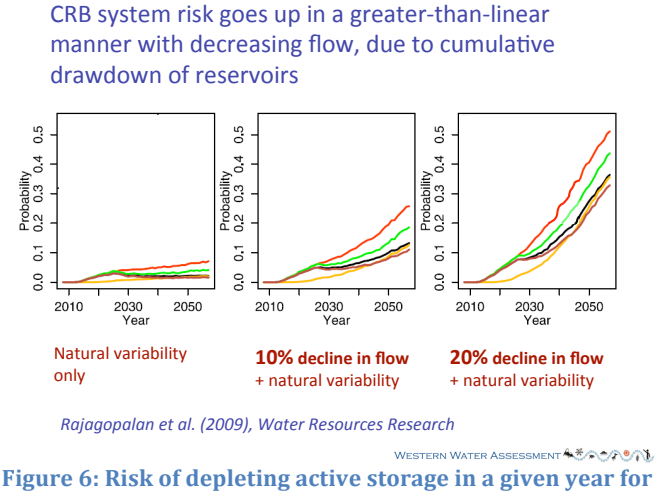


Figure 5: Literature summary of projected changes to Colorado River flow and 2040 and 2070 precipitation and temperature projections for north central Colorado.



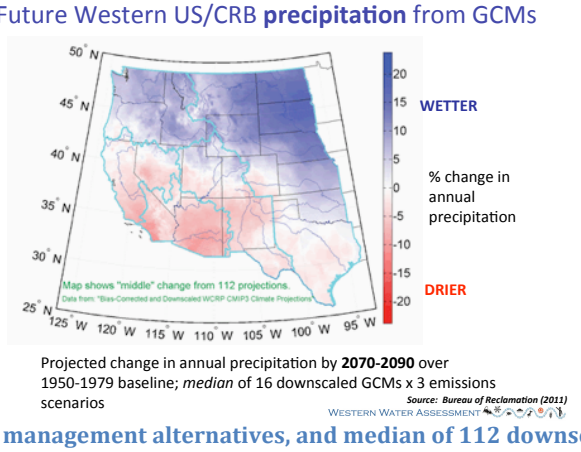


Figure 6: Risk of depleting active storage in a given year for five management alternatives, and median of 112 downscaled projections of 2070 – 2090 precipitation changes.