

Climate and Hydrologic Cycles and Trends in PNW Basin & Range

Understanding Changing Patterns of Water Availability

Harney Basin Study Advisory Committee

October 17, 2017

Burns Oregon



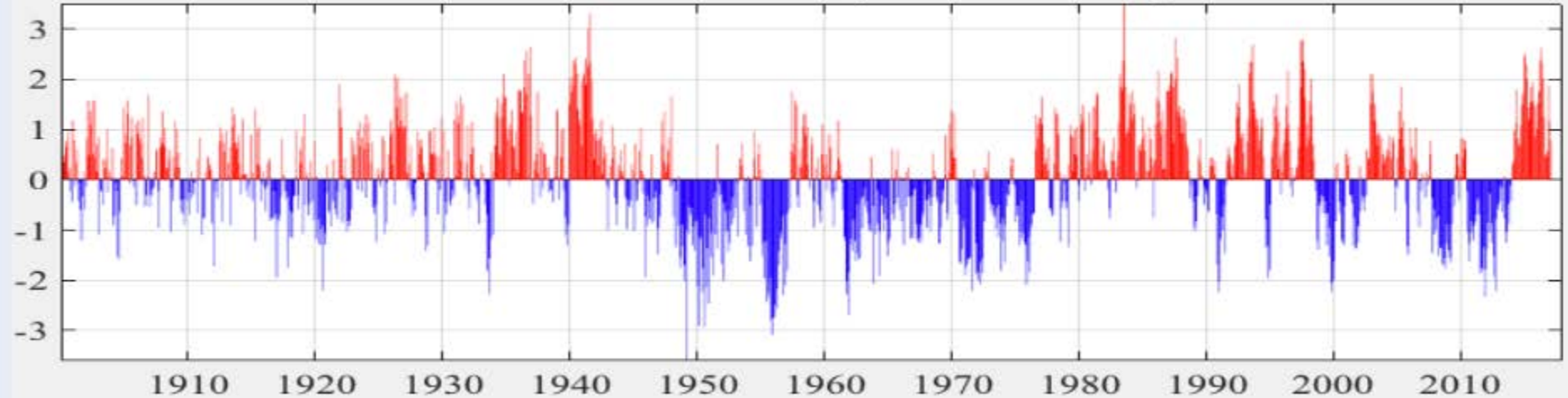
PNW Basin and Range

Climate Setting and Variability

- Climate setting
- Two periodic global-scale climate phenomenon that influence PNW weather and climate variability



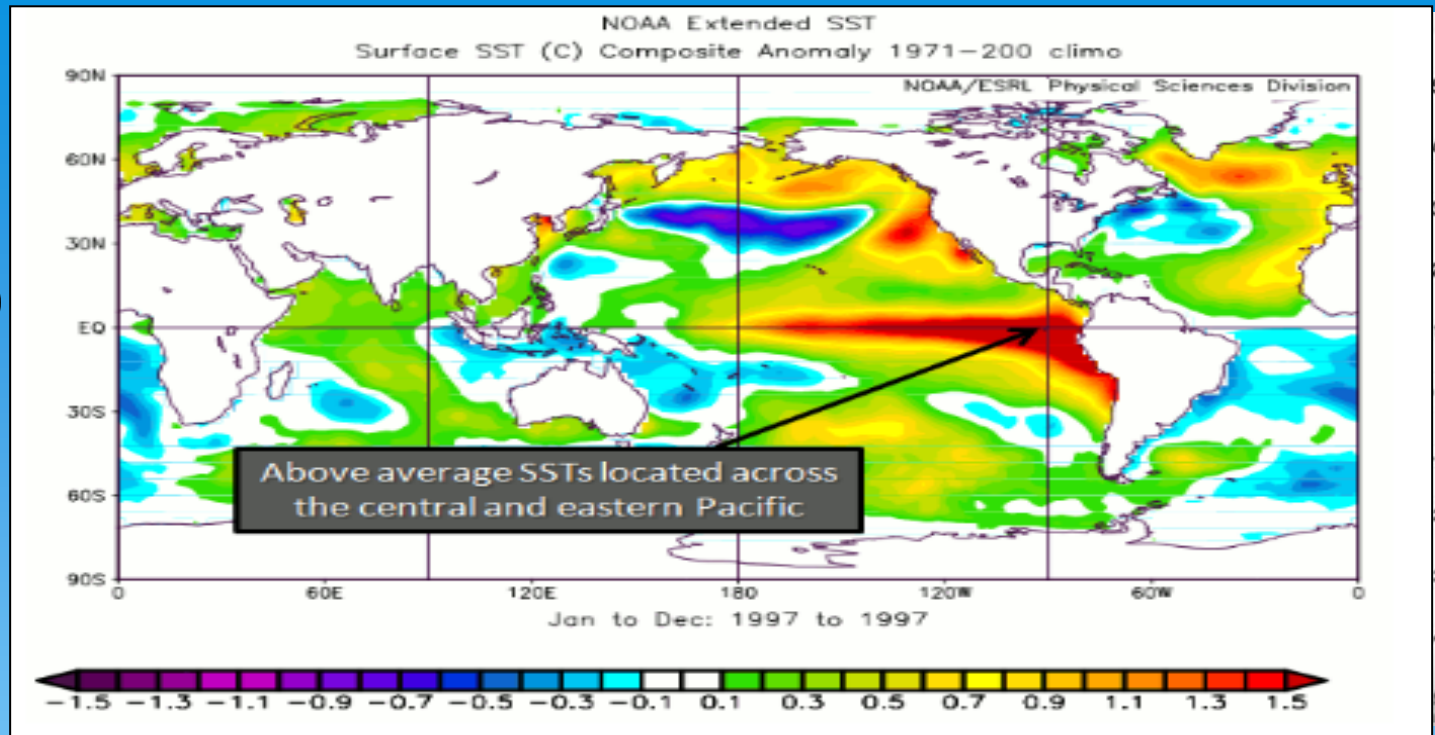
PDO index values: January 1900 - January 2017



- Long term fluctuation of SST in the North Pacific Ocean.
- PDO phases
 - 1890-1924 cool phase
 - 1925-1946 warm phase
 - 1947-1976 cool phase
 - 1977-1996 warm phase
 - 2000s- variable
- Phases
 - Warm: winter temperatures, less precipitation in PNW
 - Cool: Reversed

ENSO

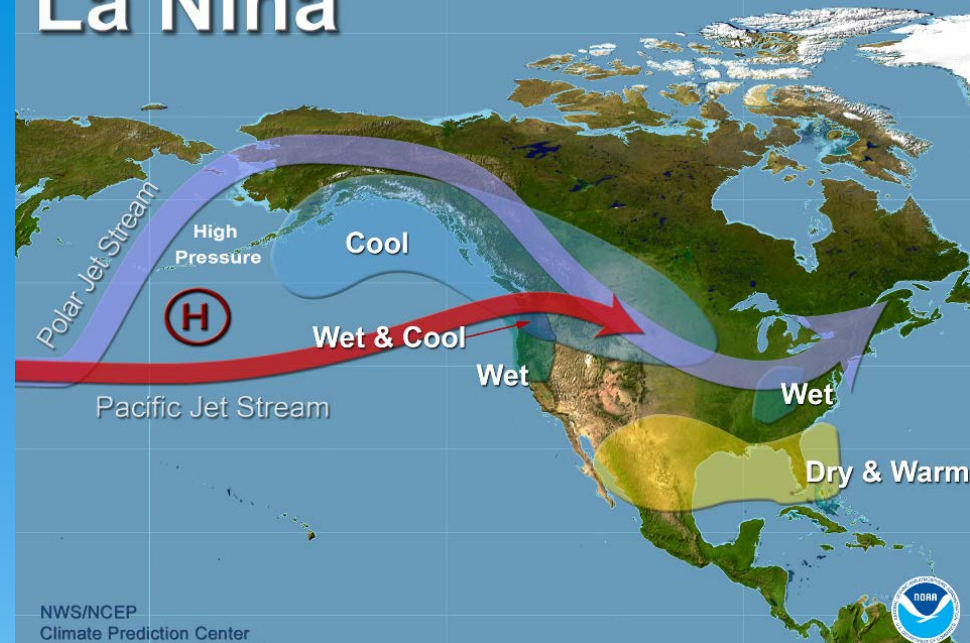
(2-7 yrs)



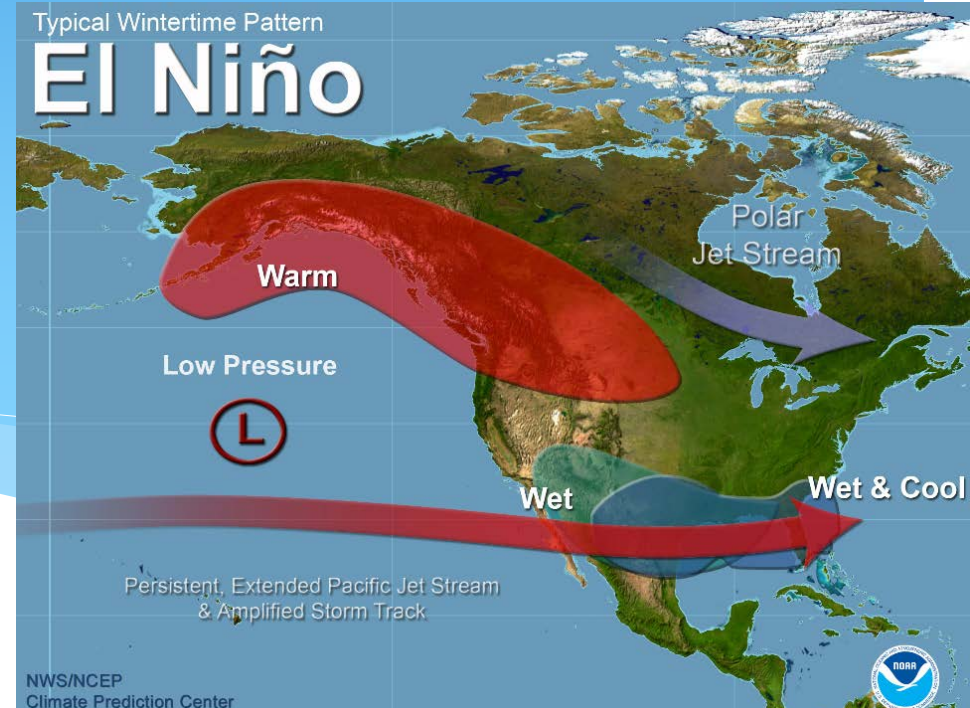
- Short term fluctuation of SST in the Equatorial Pacific
- Phases
 - Warm (El Nino): warmer temperatures, less precipitation in PNW
 - Cool (La Nina): approximately reversed
- Strongest effects on winter weather.

- Most significant impact: Position of jet streams and storm tracks
- Effects *probability* of PNW seasonal climate.
- If PDO and ENSO are in phase, impacts tend to be magnified.

La Niña



El Niño

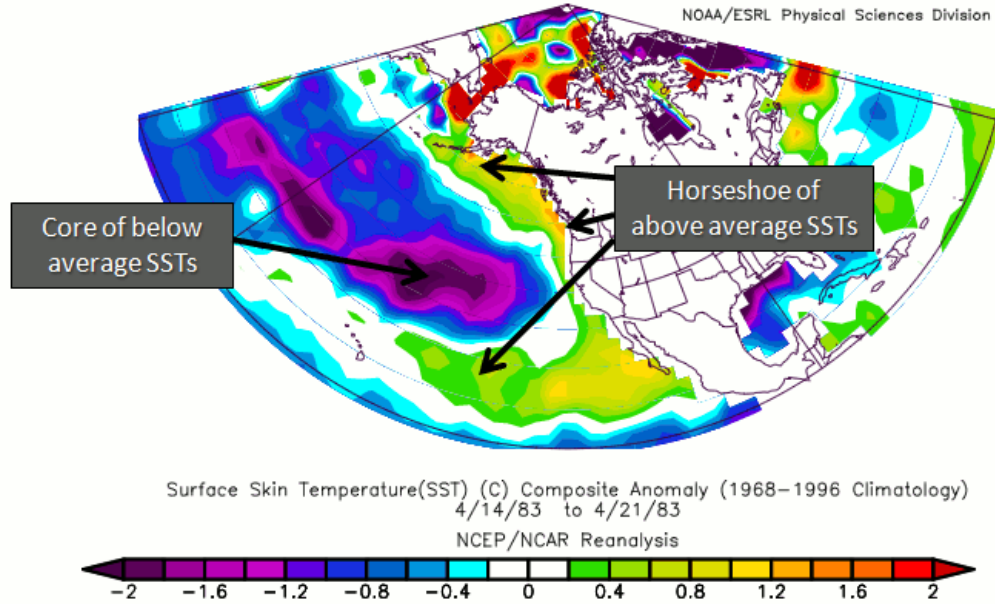


PDO (20-30 yrs)

ENSO (2-7 yrs)

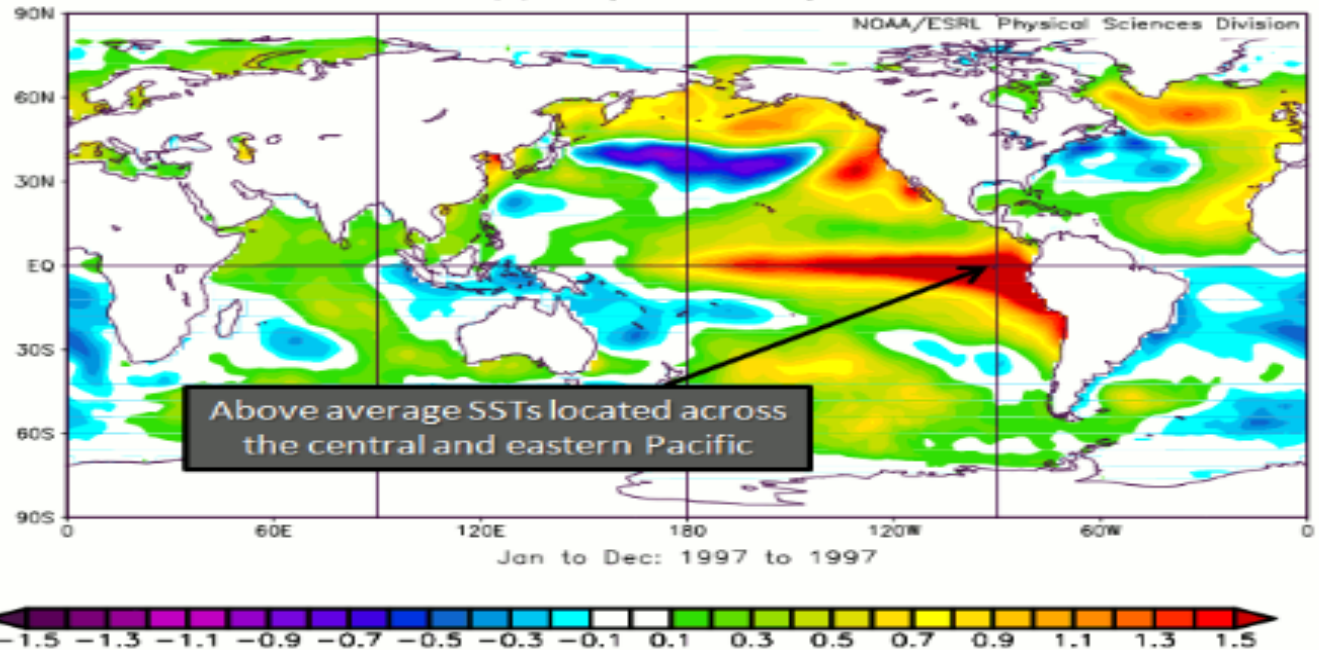
Sea Surface Temperature Anomalies During a Warm PDO Phase

NOAA/ESRL Physical Sciences Division

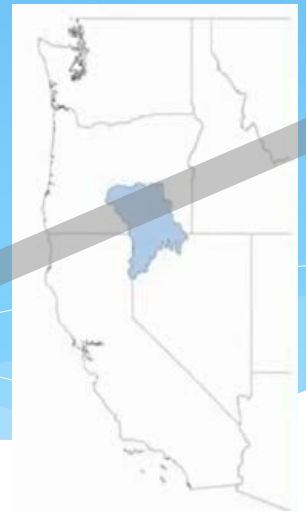


NOAA Extended SST
Surface SST (C) Composite Anomaly 1971–2000 climo

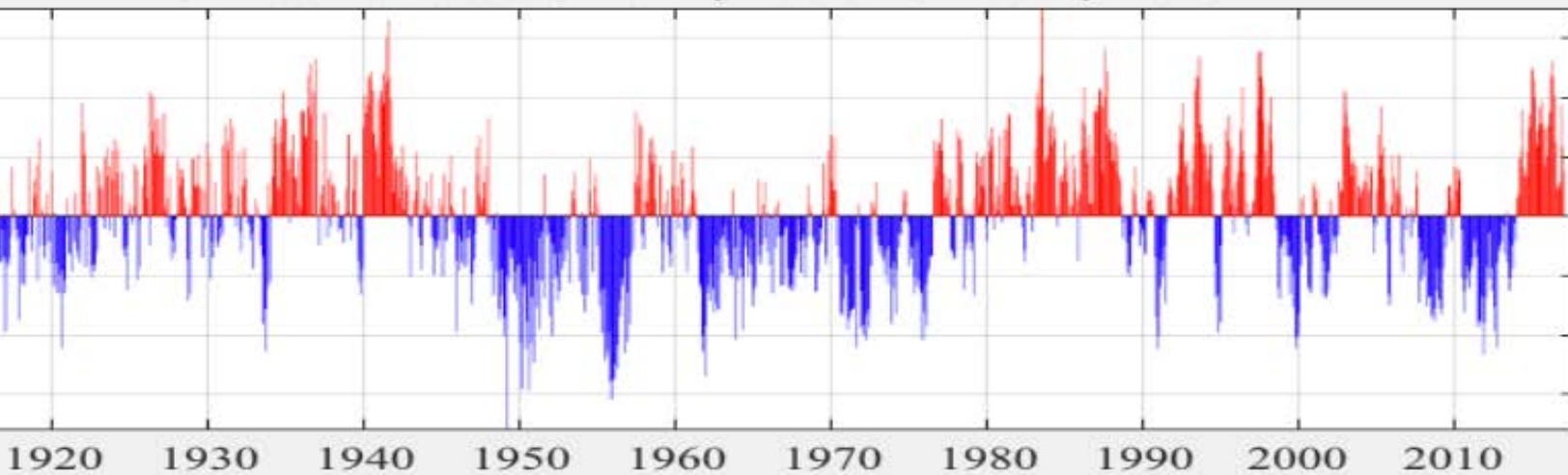
NOAA/ESRL Physical Sciences Division



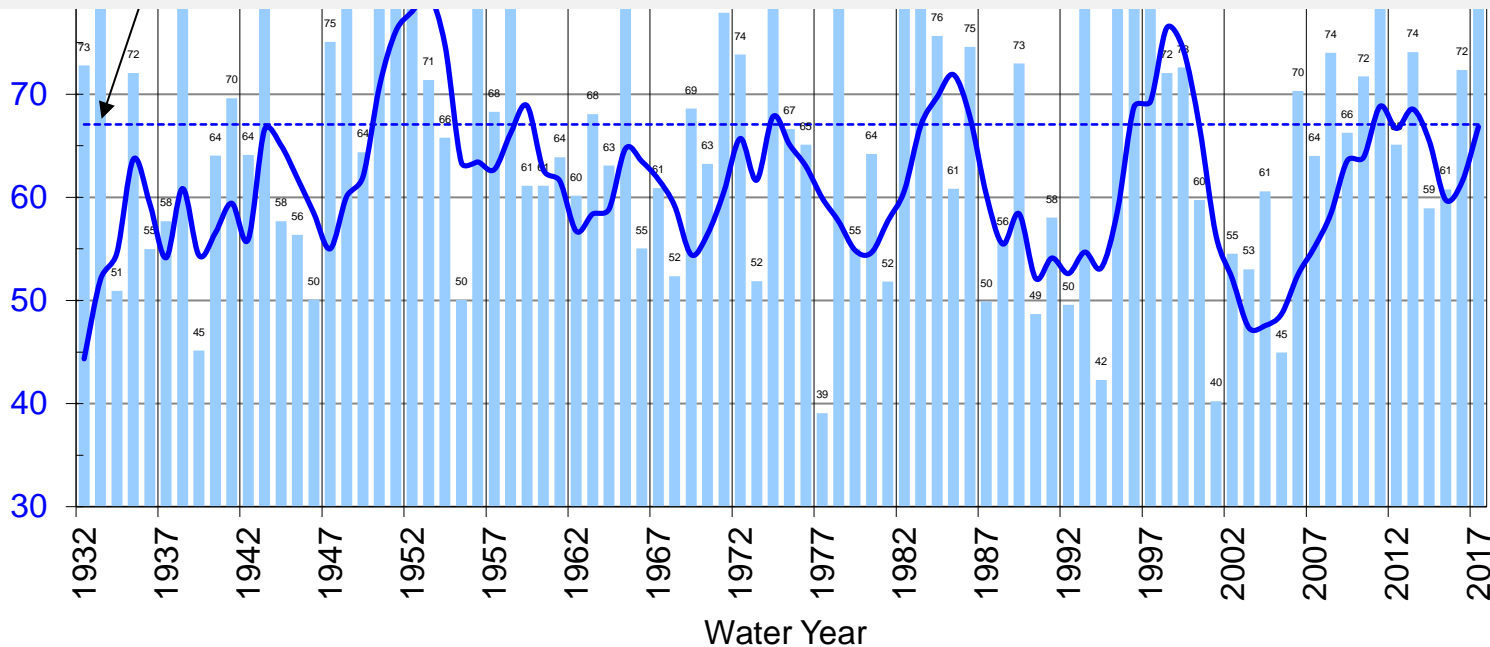
- PDO/ENSO not as predictive as we'd like.
 - ENSO ~ variability in annual streamflow
 - PDO ~ timing and magnitude of freshet
- S. Oregon/N. California transition area



PDO index values: January 1900 - January 2017



Water Year
Precipitation (Incl)



Precipitation at Crater Lake
 POR average



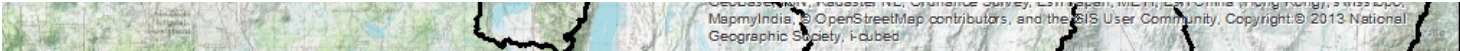
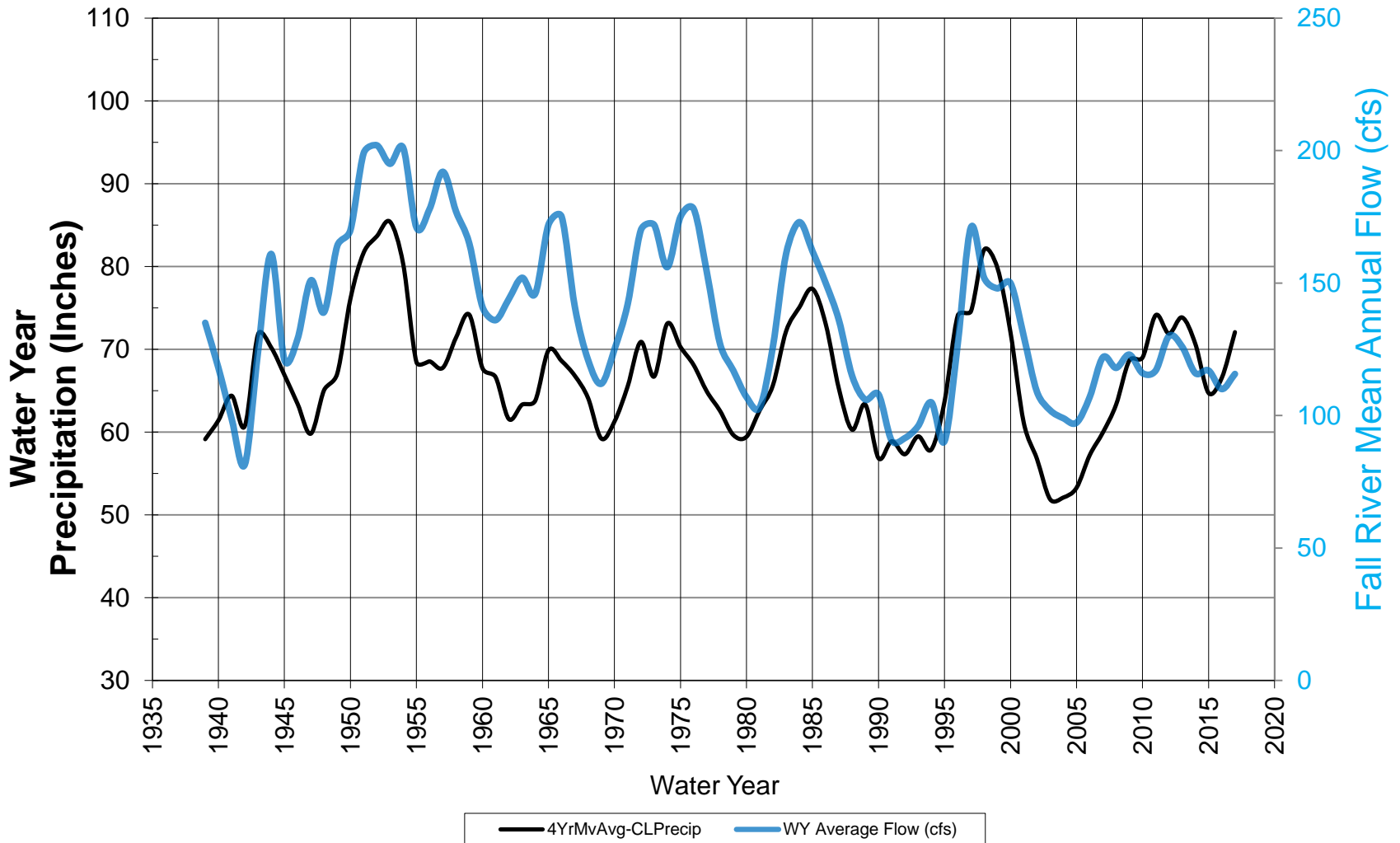
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBC, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), Swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community, Copyright © 2013 National Geographic Society, i-cubed

Observed precipitation/ streamflow

Note: WY 1943-1946 data estimated from other sites.

WY 2013 September precipitation was 9.1 inches, the maximum September value for the POR

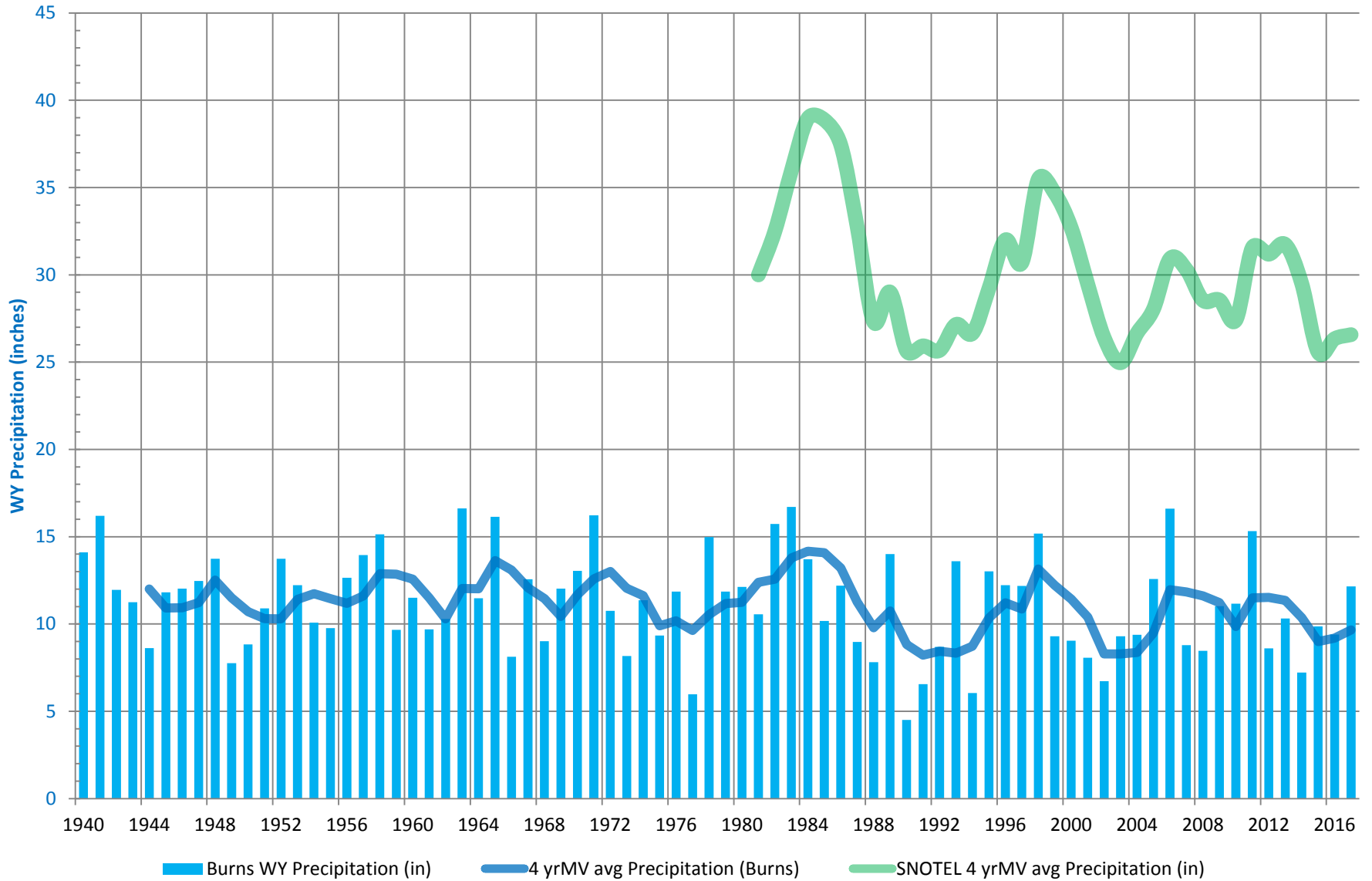
Water Year Precipitation and Fall River MAF



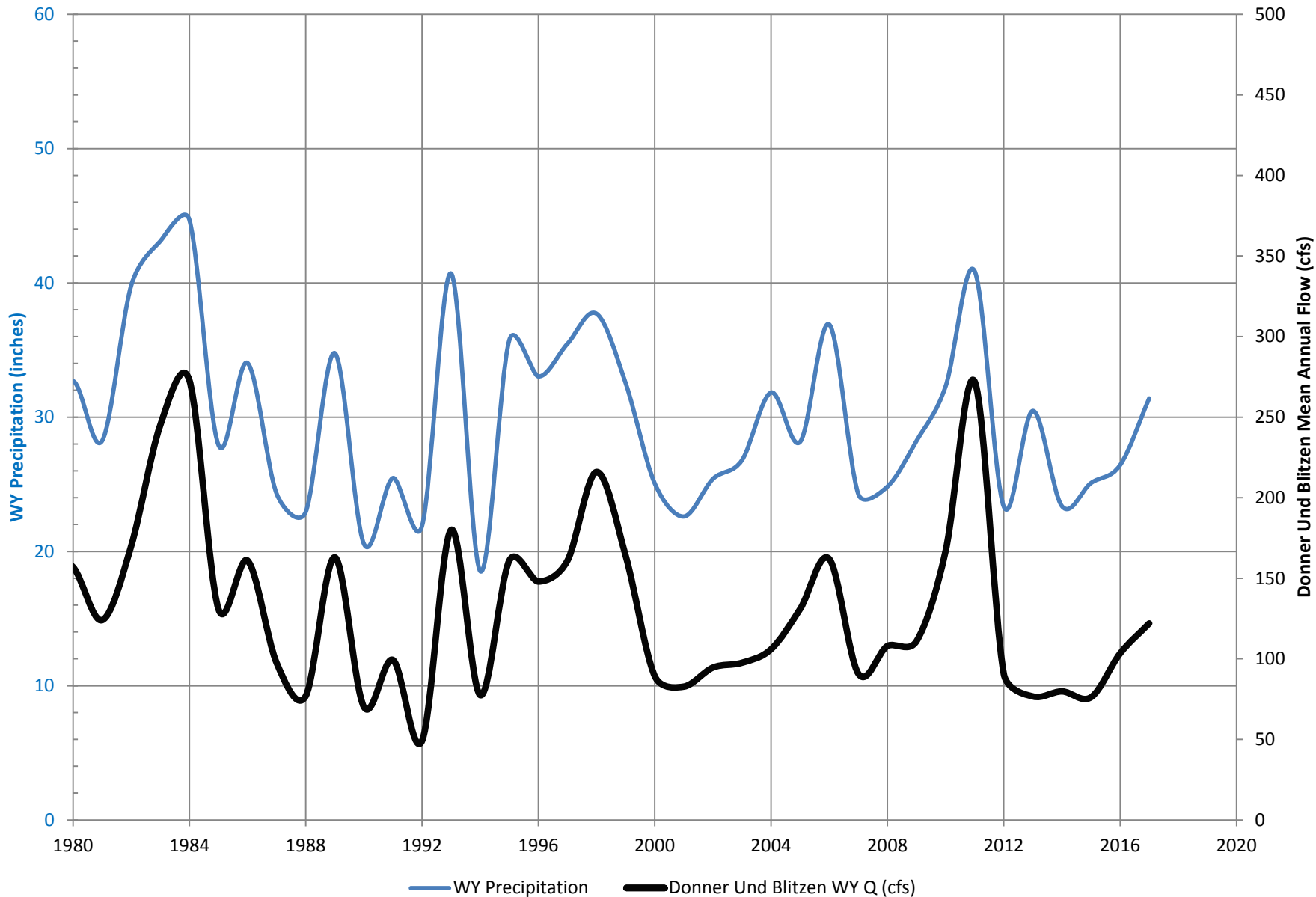
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Surface Water Hydrologic Indicators in Harney Basin

WY Precipitation at Burns and Basin SNOTel Sites

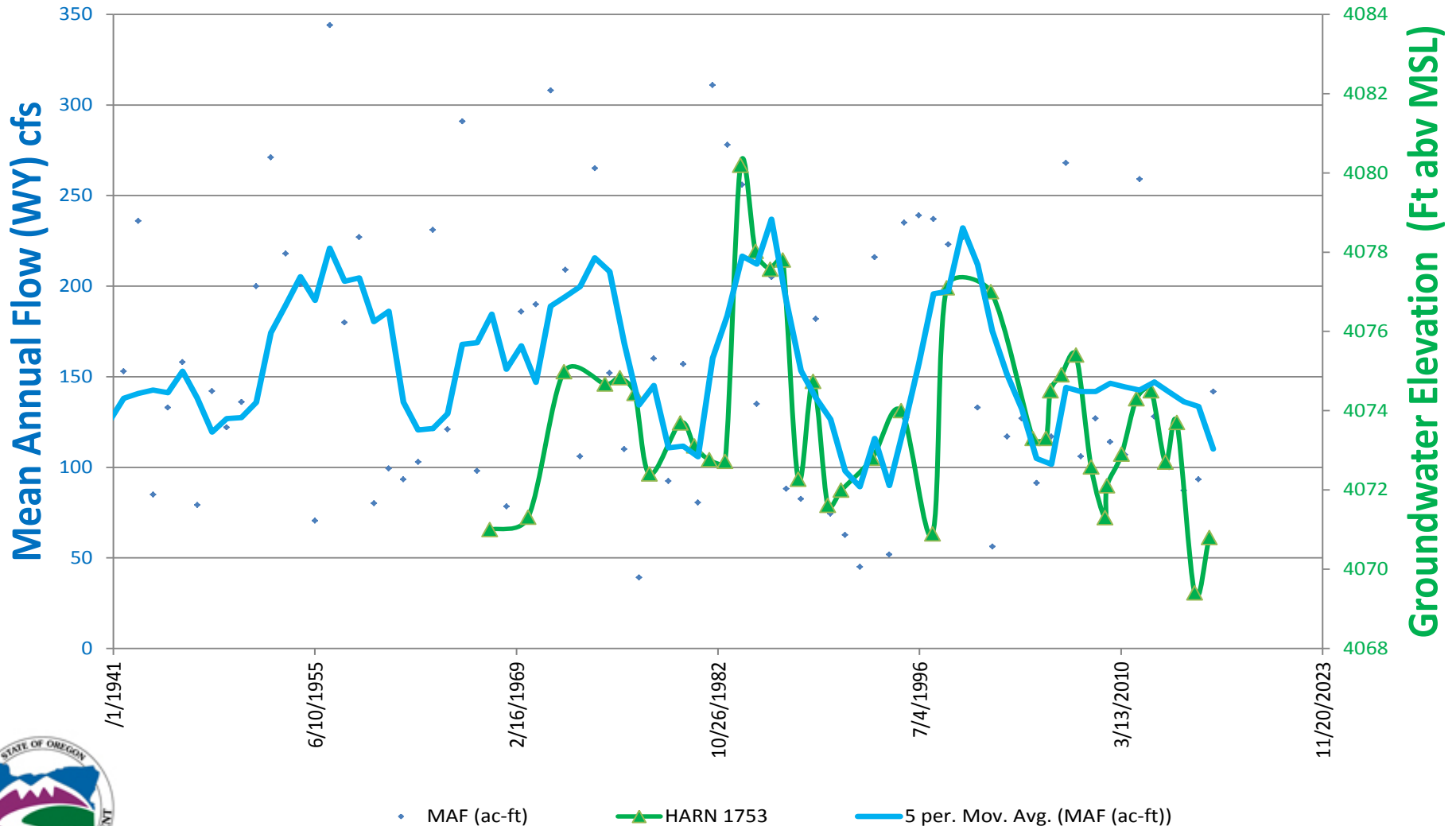


Surface Water Hydrologic Indicators in Harney Basin



Streamflow & GW response

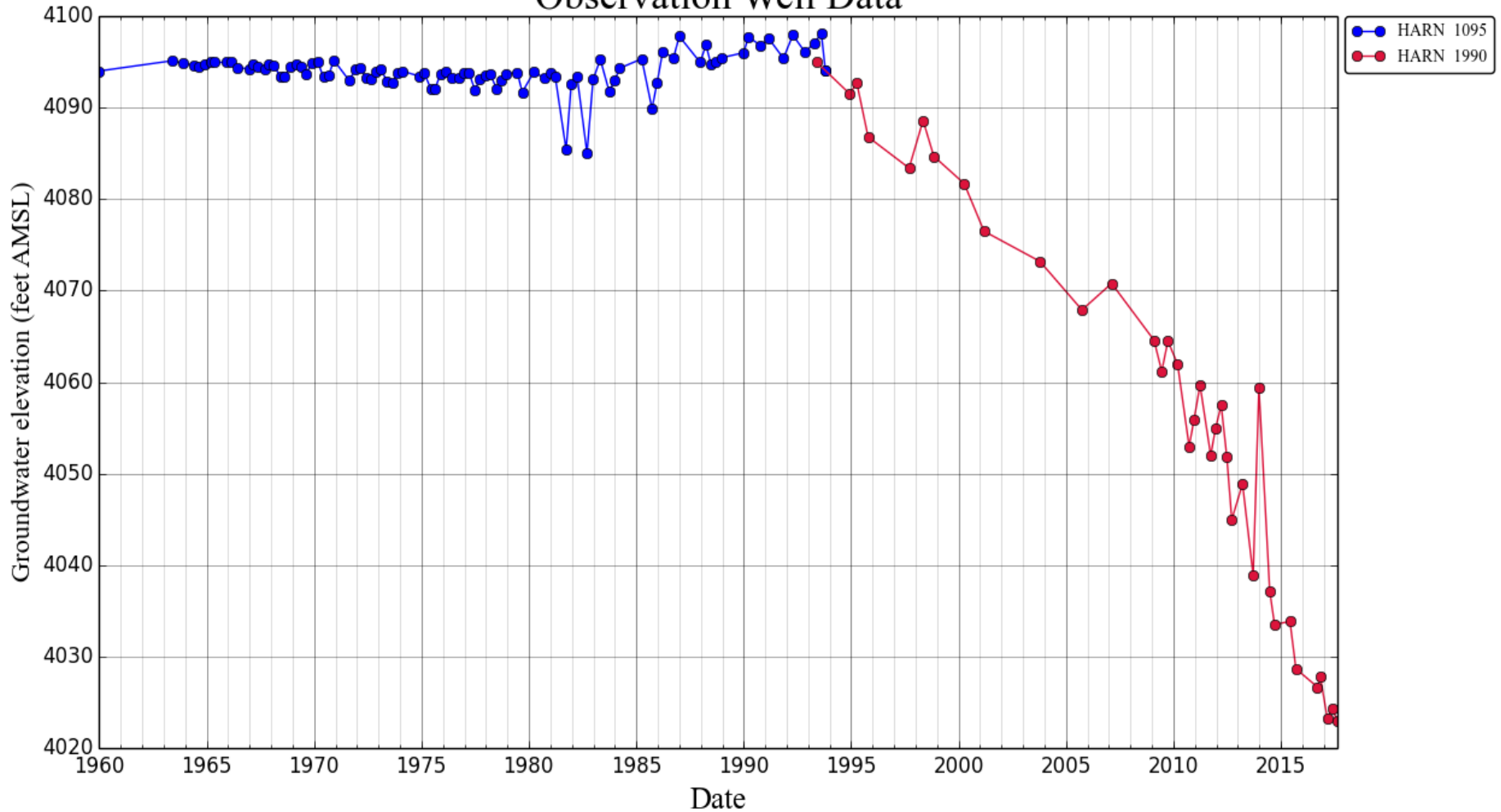
Chewaucan Streamflow GW Levels at HARN 1753



Streamflow & GW response



Observation Well Data



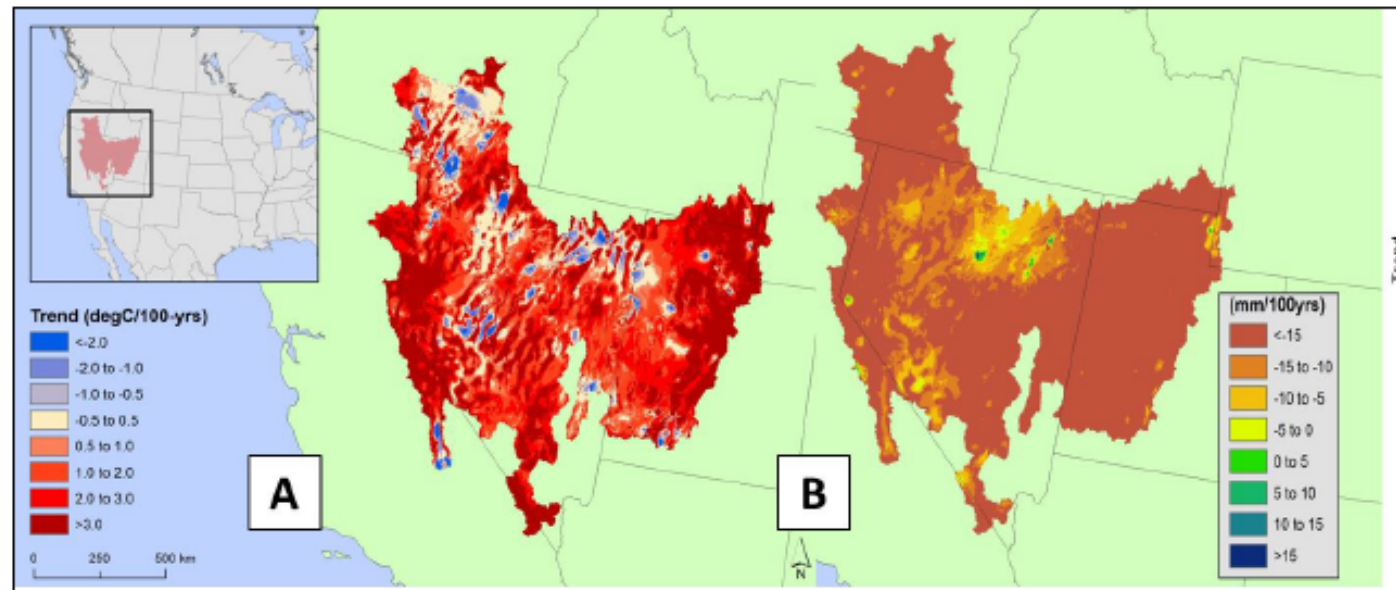
Climate Trends

Oregon State
UNIVERSITY

COLORADO STATE UNIVERSITY

USGS
science for a changing world

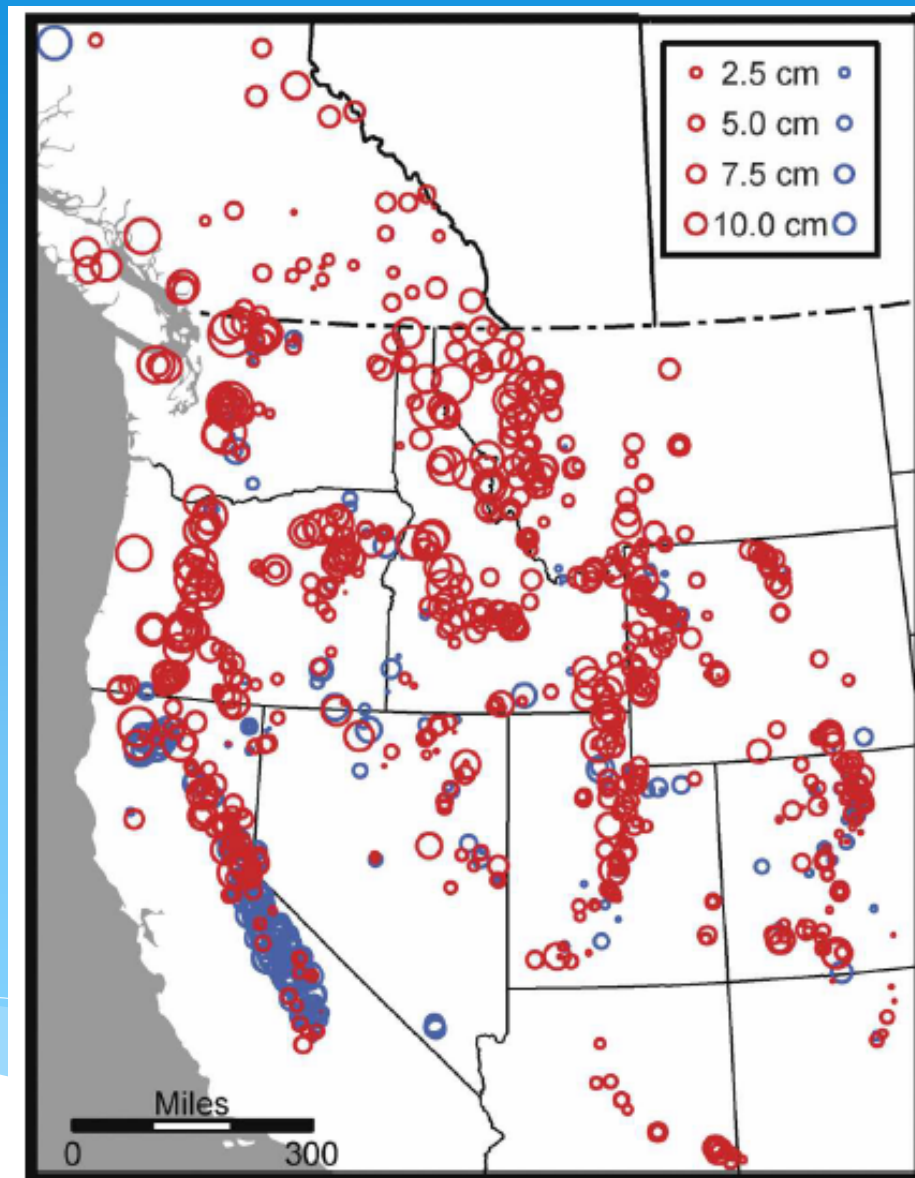
Figure 2: Trends in (A) surface atmospheric temperature ($^{\circ}\text{C}/100\text{-years}$), (B) annual precipitation ($\text{mm}/100\text{-years}$), the hydrographic Great Basin of North America (1980-2008).



From: Susan Haig (USGS) and Others

SWE Trends

Trends in April 1st SWE



From: Mote 2006

Runoff Trends

Stewart and others
2005

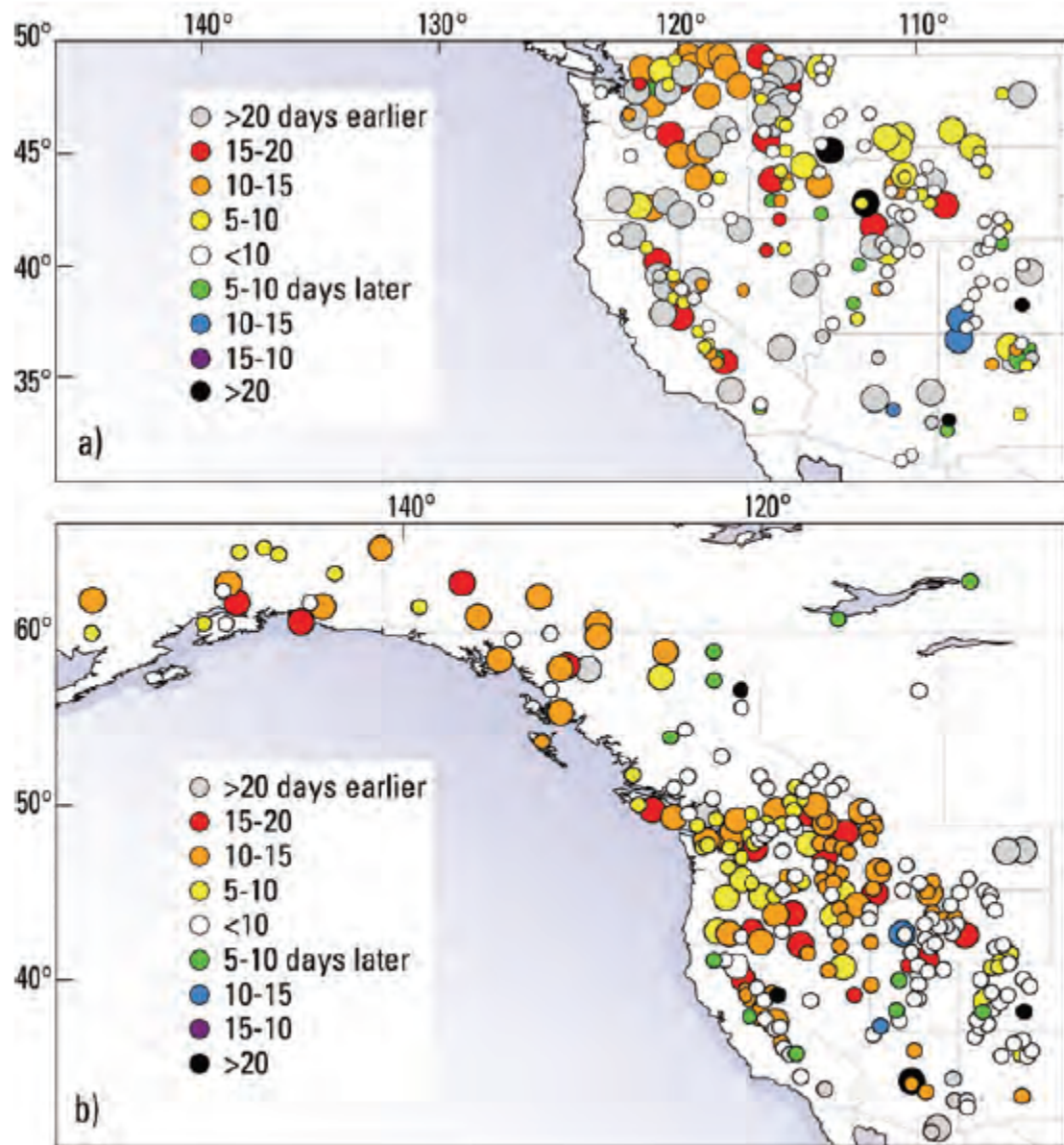
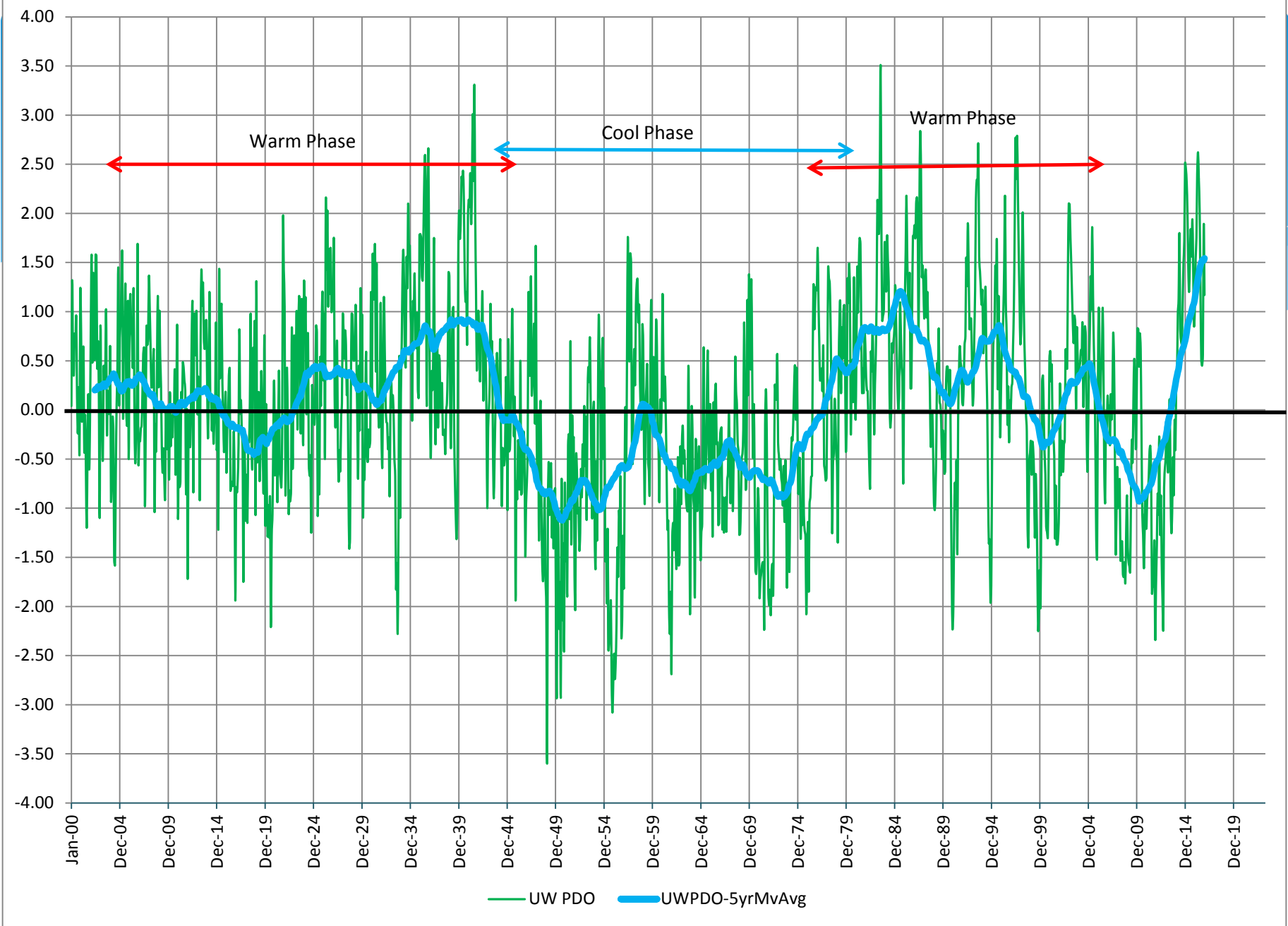


Figure 4. Trends in (a) yearly dates of spring snowmelt onset and (b) centers of volume of yearly streamflow hydrographs in rivers throughout western North America, based on U.S. Geological Survey streamgages in the United States and an equivalent Canadian streamflow network. Large circles indicate sites with trends that differ significantly from zero at a 90-percent confidence level; small circles are not confidently identified.

Climate Variability Impacts on Water Availability

- Decreased precipitation*
- Declining annual streamflow & GW*
- Cyclic wet / dry cycles
- Increased temperature
- Reduced SWE (2015 harbinger?)
- Earlier snowmelt and runoff

Questions?



Stationarity