Climate Variability and Drought: An Overview for Local Drought Impact Groups

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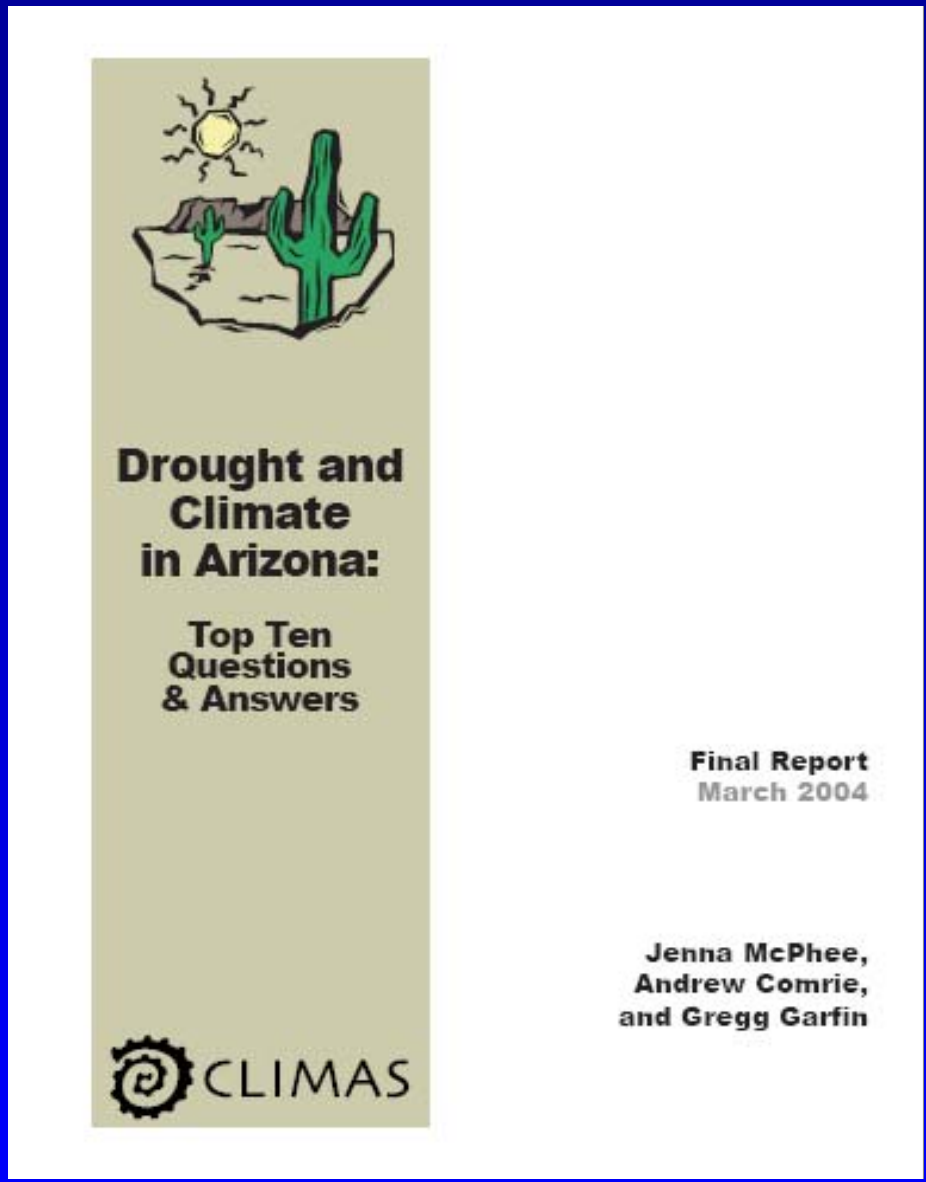
Presentation Overview

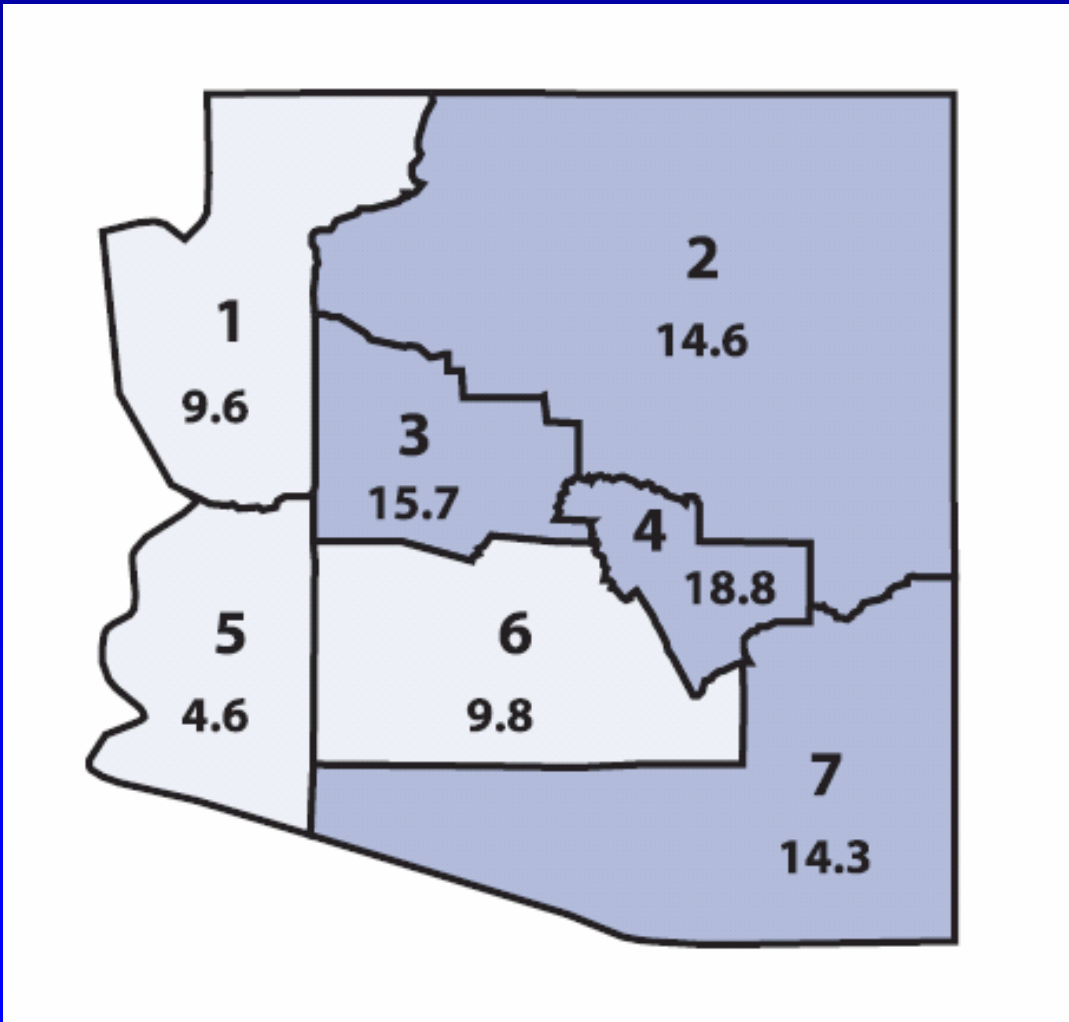
- Background on Central AZ Climate and Drought
- Atmospheric Controls on AZ Climate
- Seasonality of Precipitation
- Interannual Climate Variability

Background on Central AZ Climate



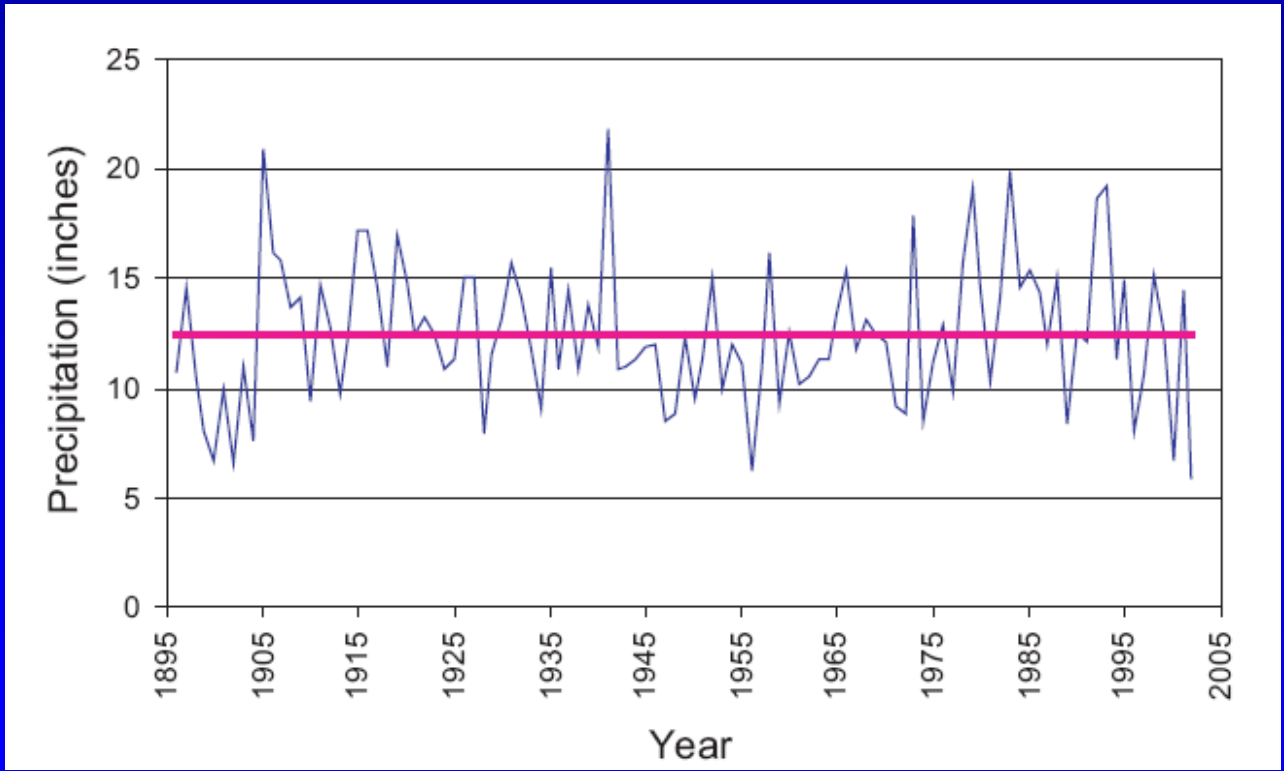
- http://www.ispe.arizona.edu/climas/pubs/DroughtQ&A.pdf

Long-term average annual precipitation (1896-2002)

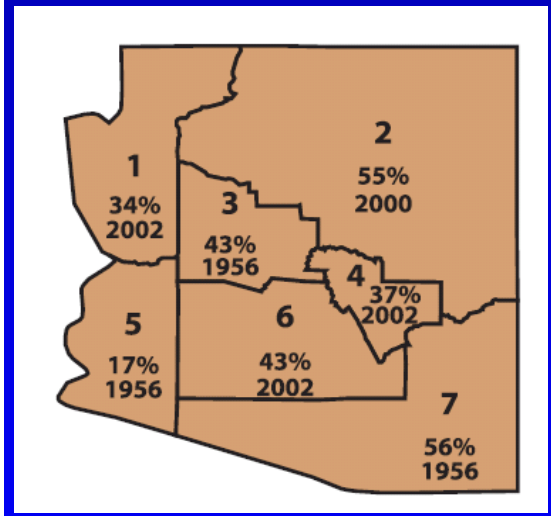


McPhee et al. 2004

Statewide Annual Average Precipitation

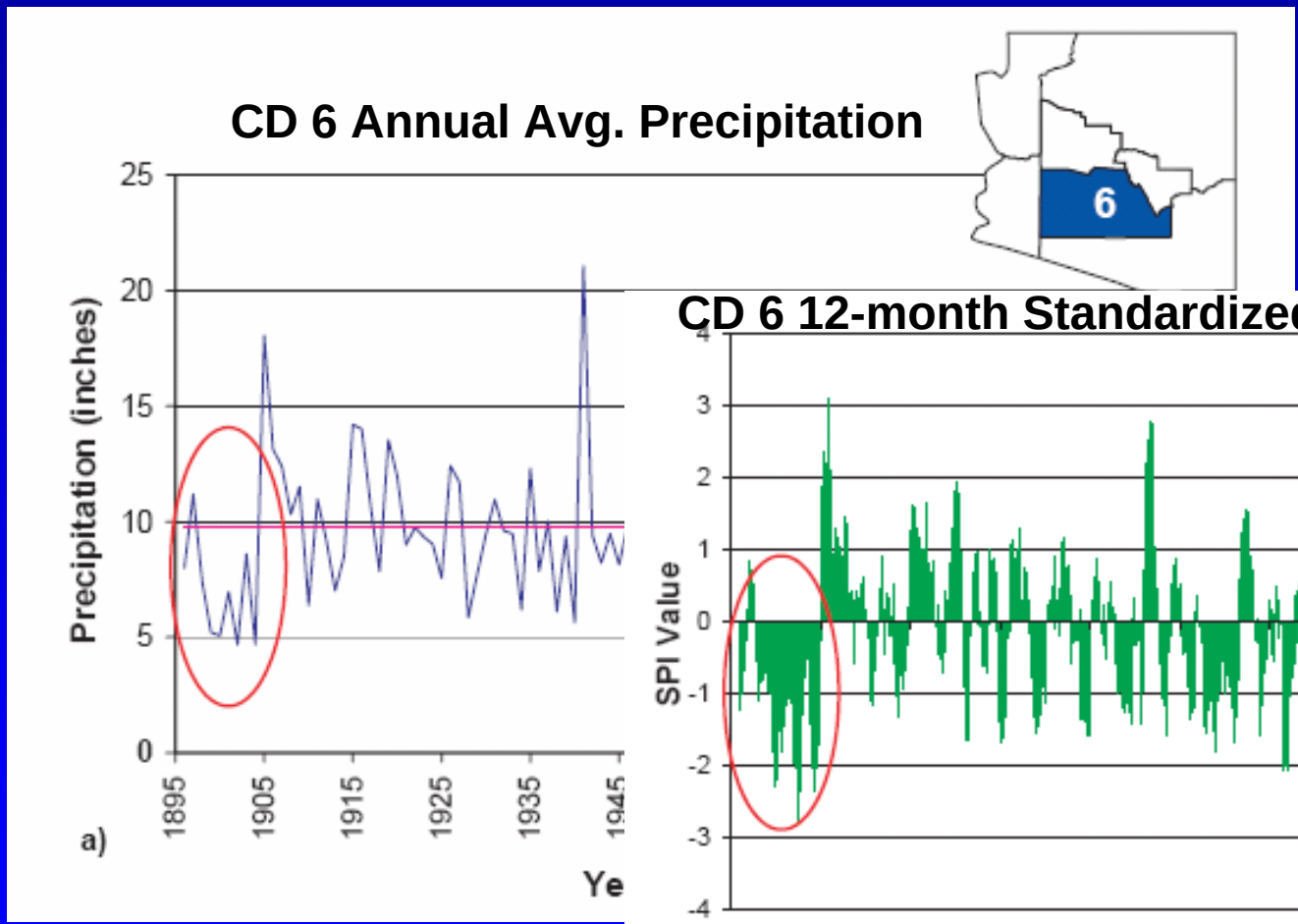


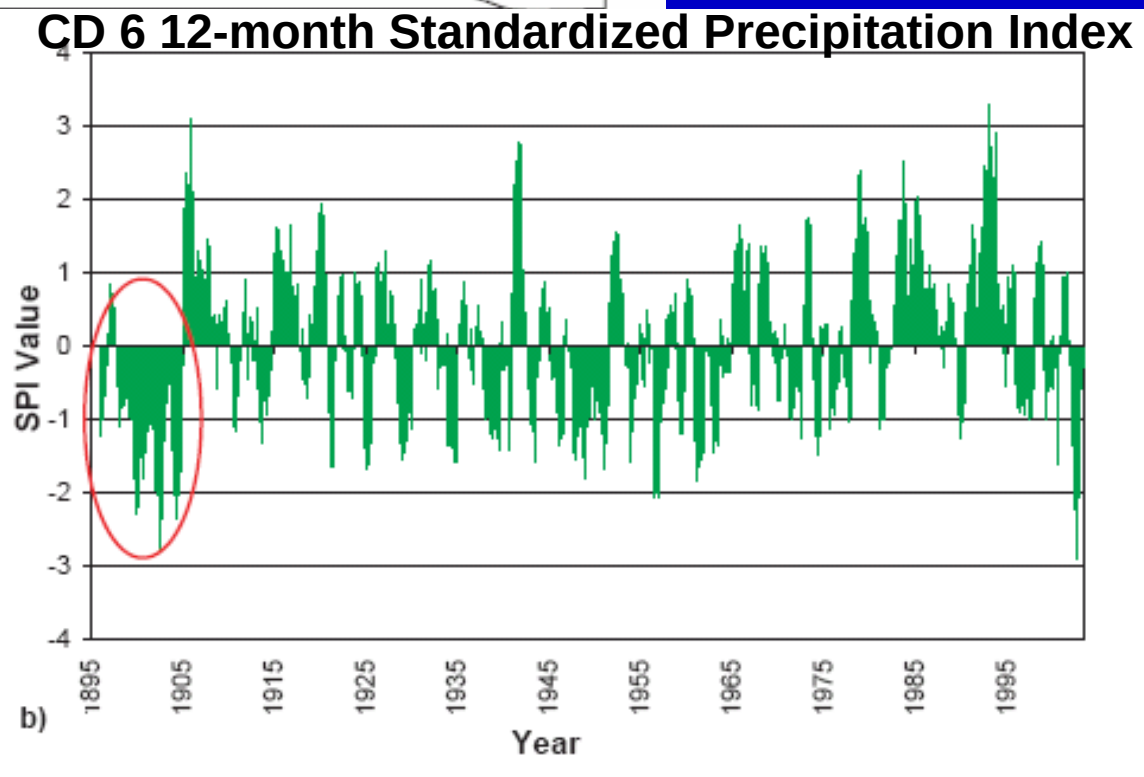
McPhee et al. 2004



Driest year & Percent of Ann. Avg.

Long-term Precipitation Variability

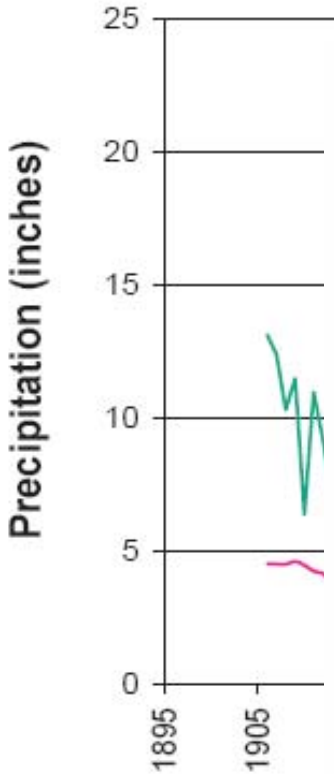




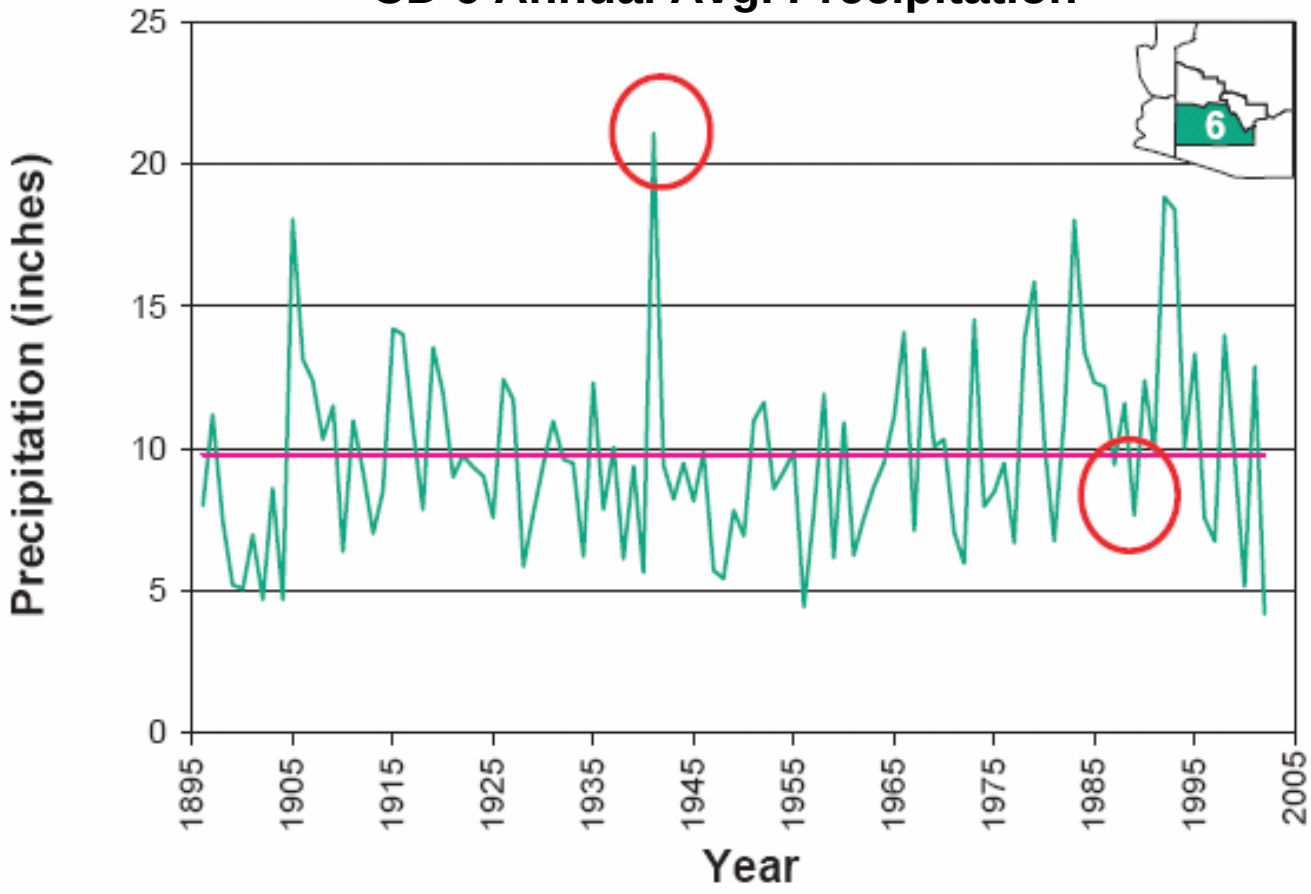
McPhee et al. 2004

Long-term Precipitation Variability

CD 6 Annual Avg. Precipitation – 21-yr running Std Dev.

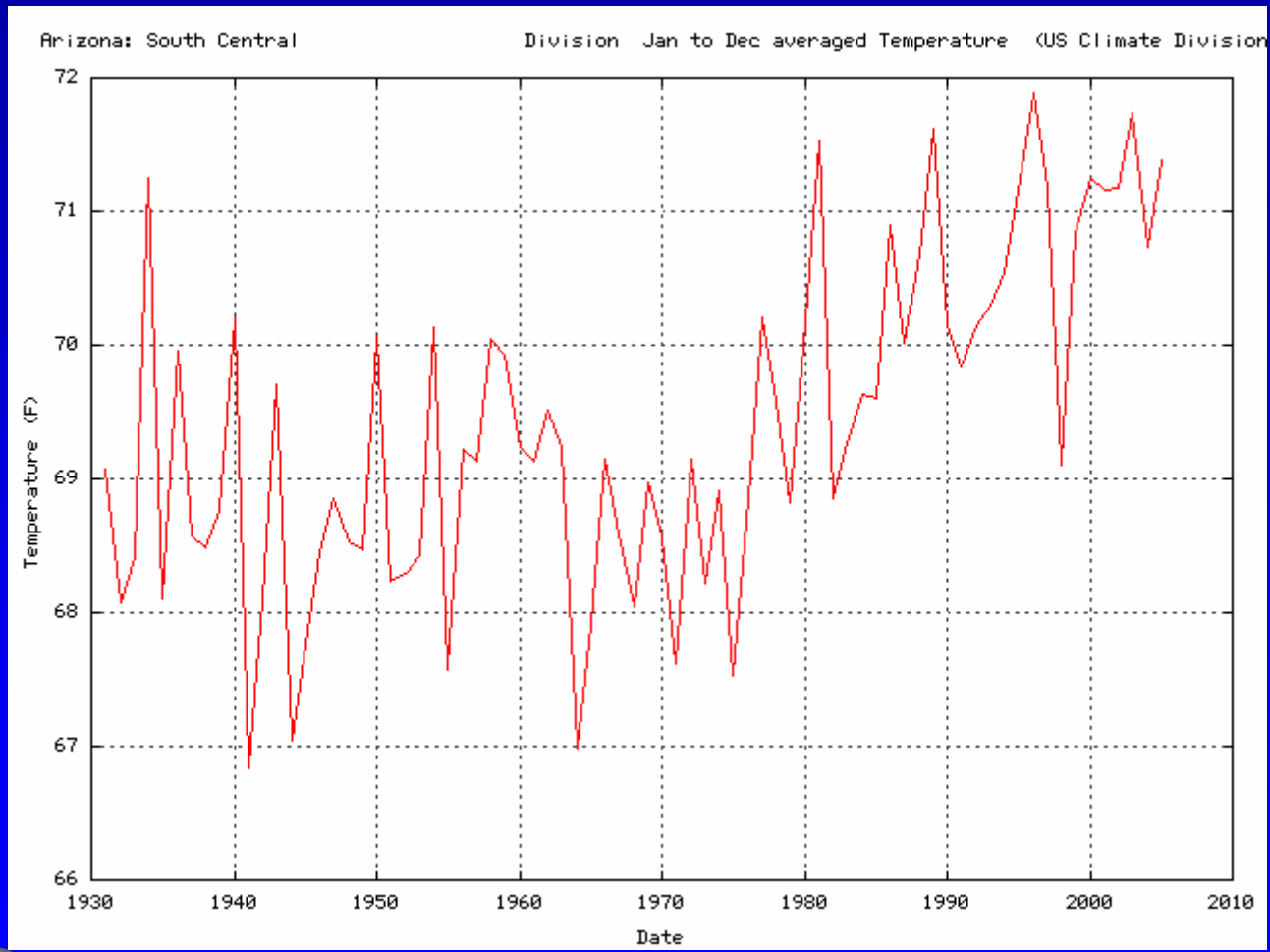


CD 6 Annual Avg. Precipitation

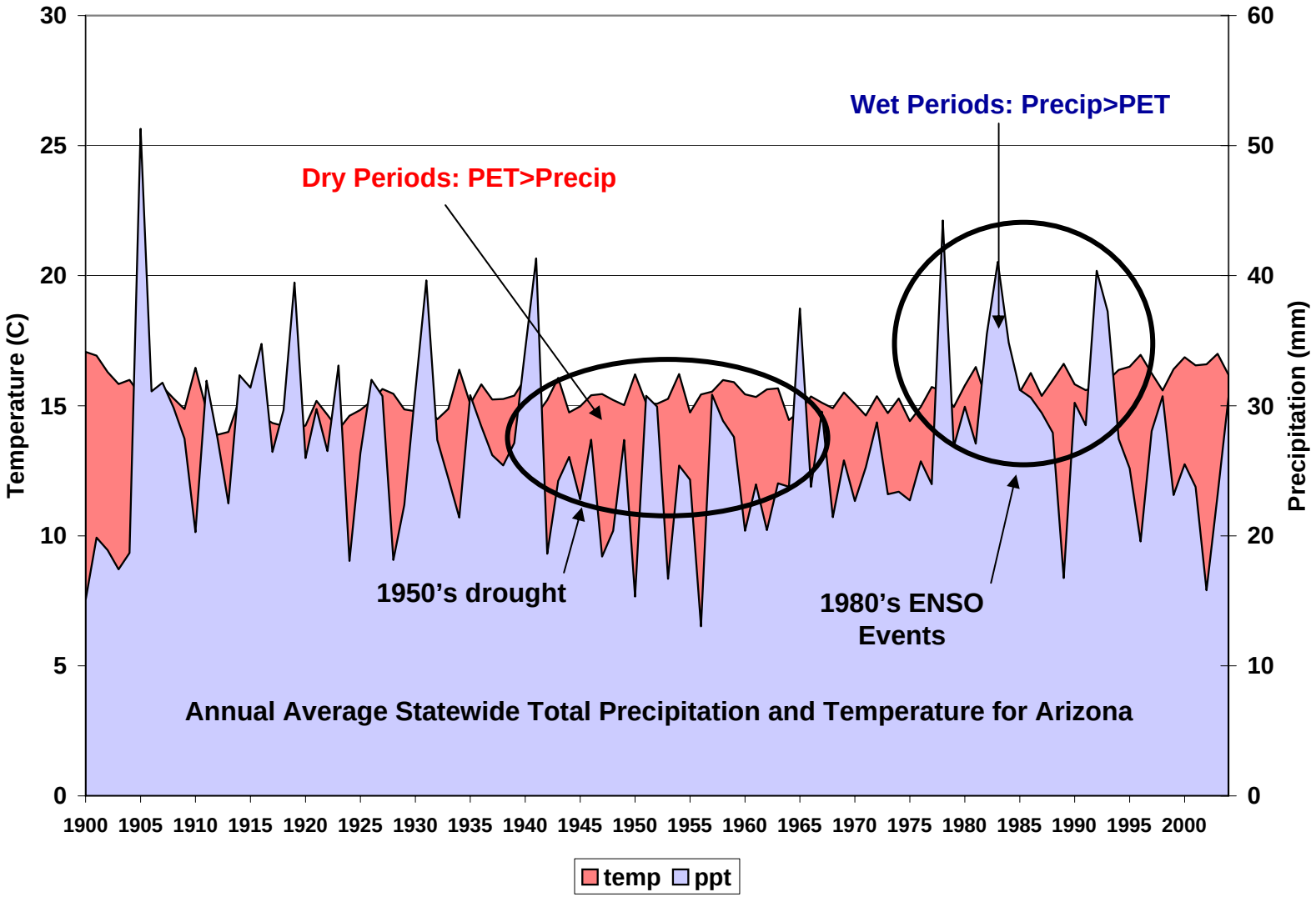


McPhee et al. 2004

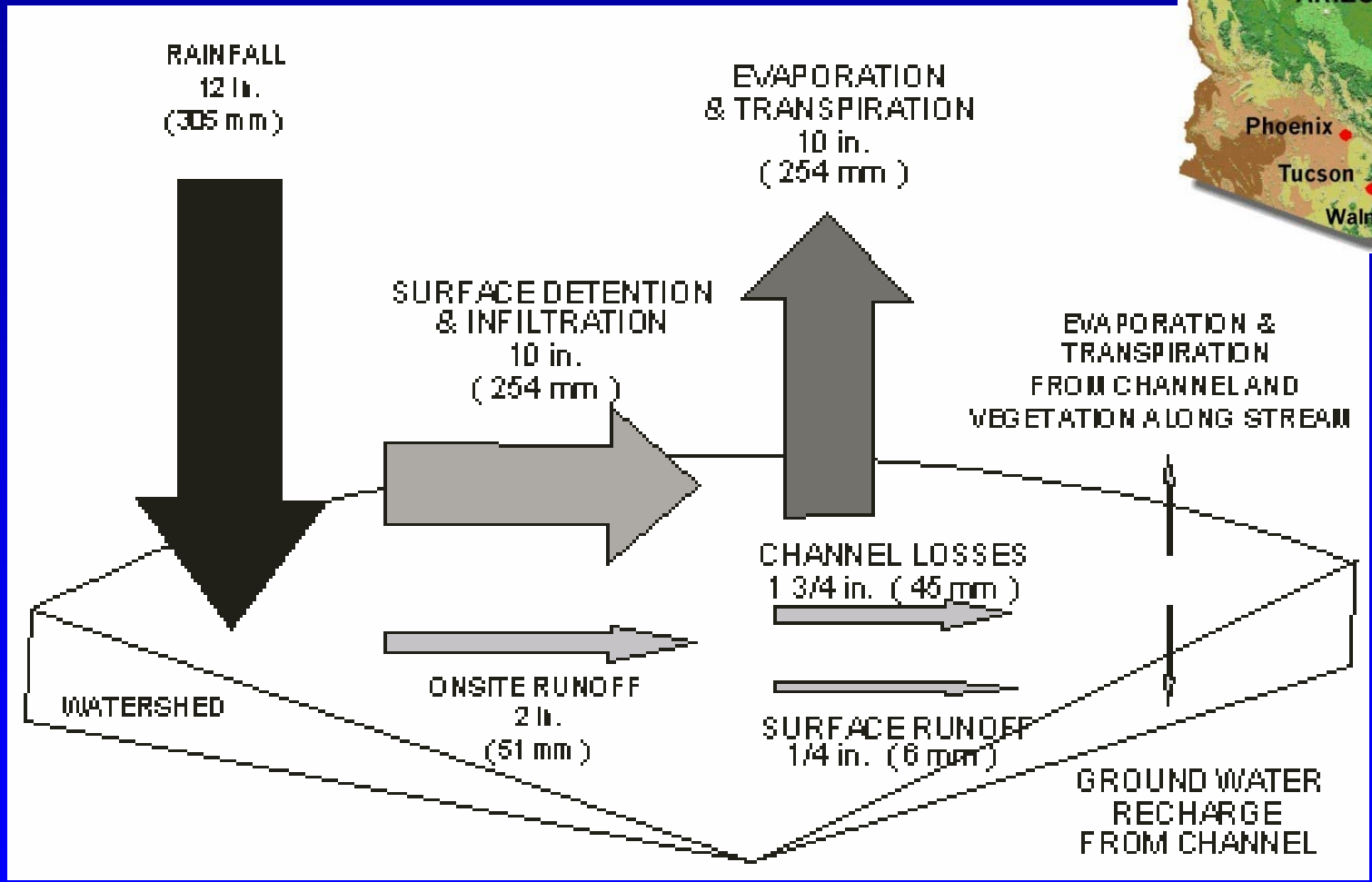
CD 6 Annual Avg. Temperatures



Evapotranspiration and Aridity



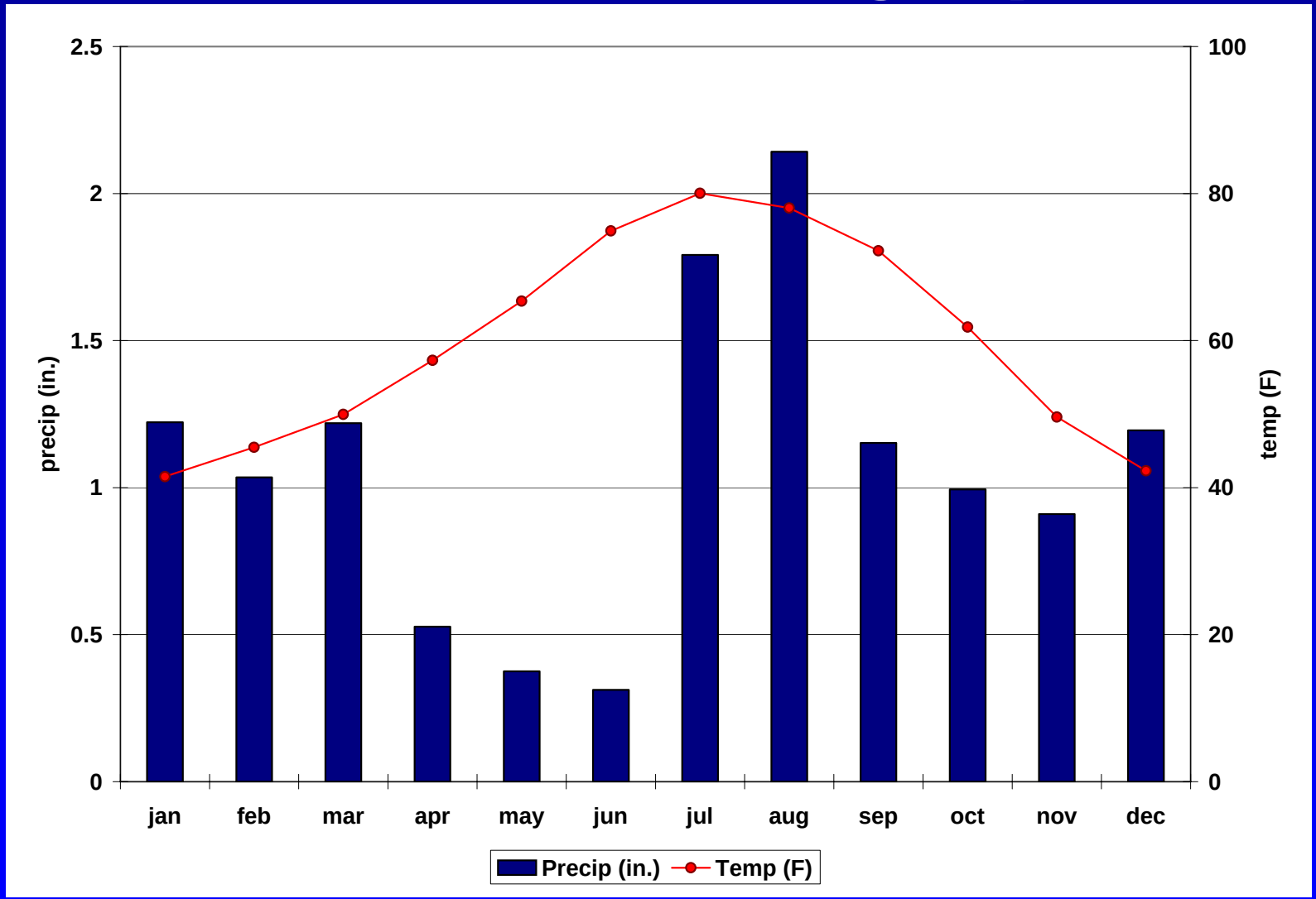
Example Water Balance: Walnut Gulch, Arizona



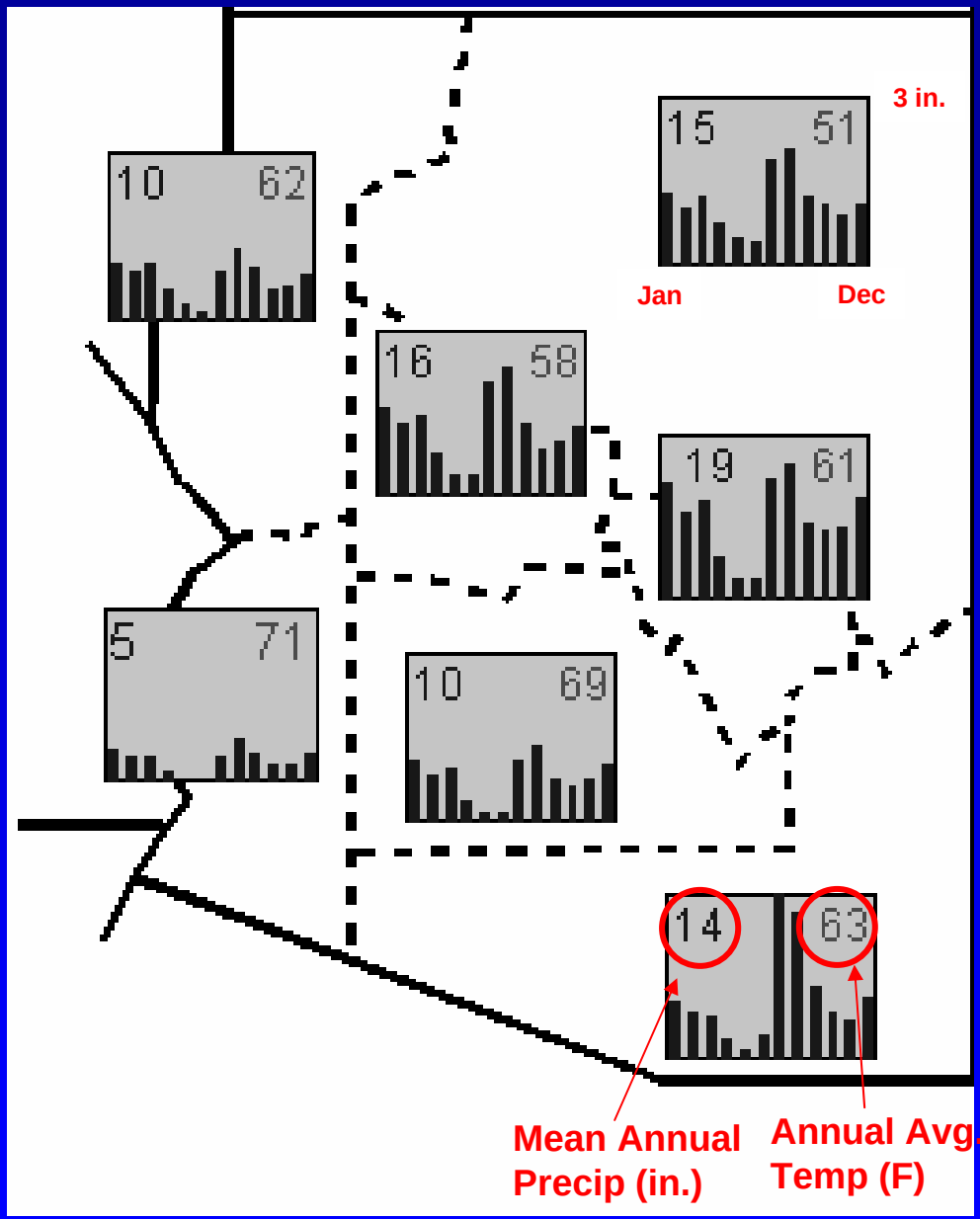
http://www.tucson.ars.ag.gov/dap/field_sites.htm

Atmospheric Controls on Arizona Climate

Arizona Climograph



Seasonal Distribution of Precipitation

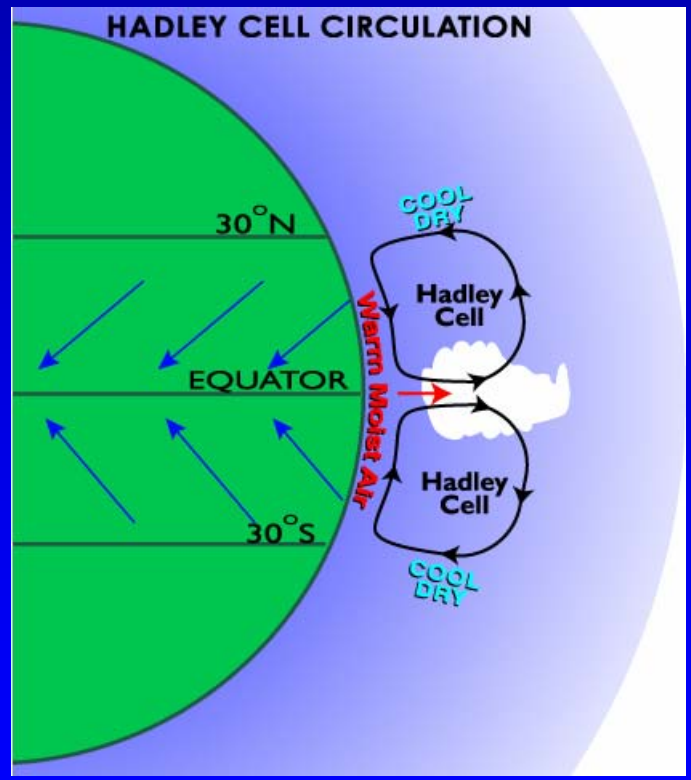


- More winter precip in northern AZ
- Stronger monsoon signal in southeast AZ (more summer precip)

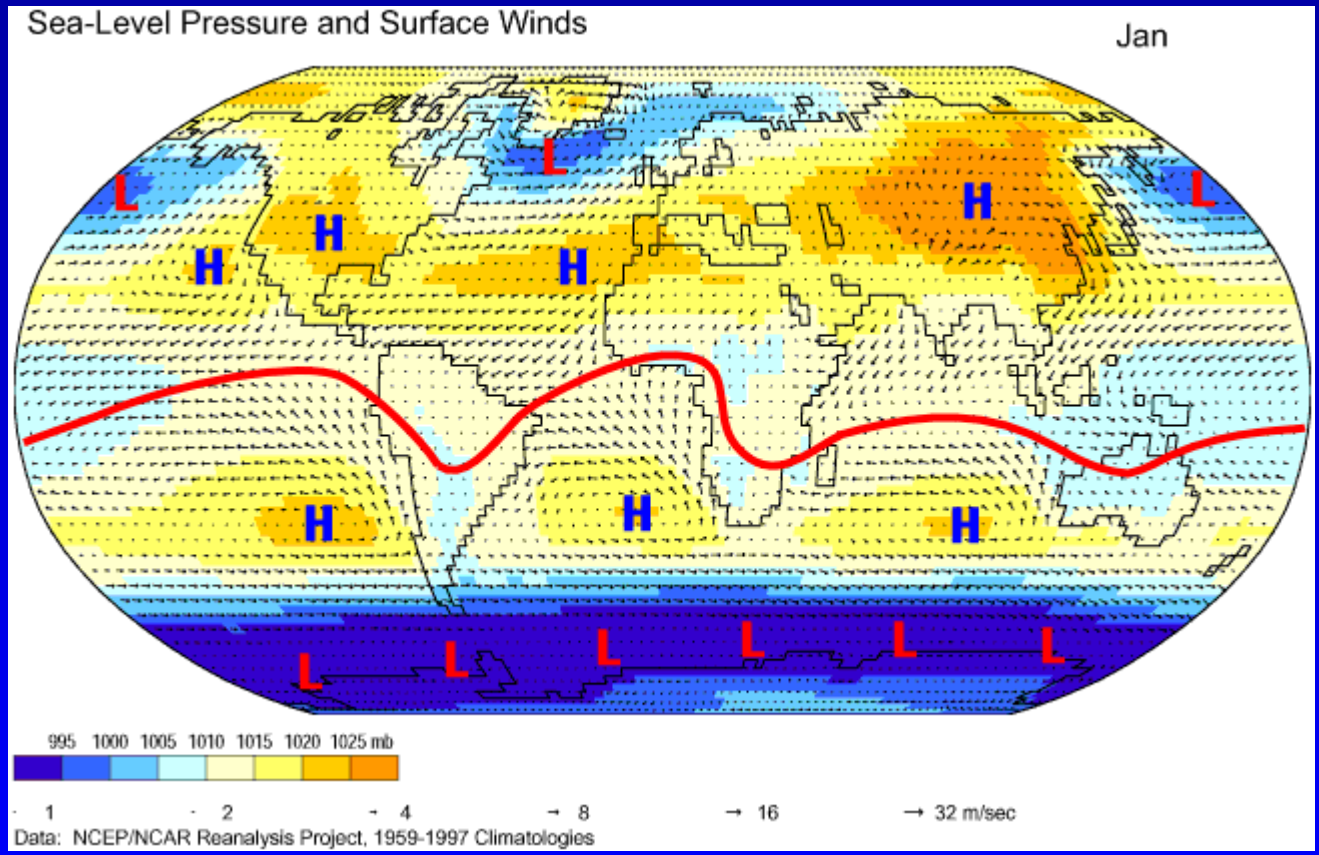
(graphic from Sheppard, et al. 2000)

Atmospheric Circulation and Arizona Climate

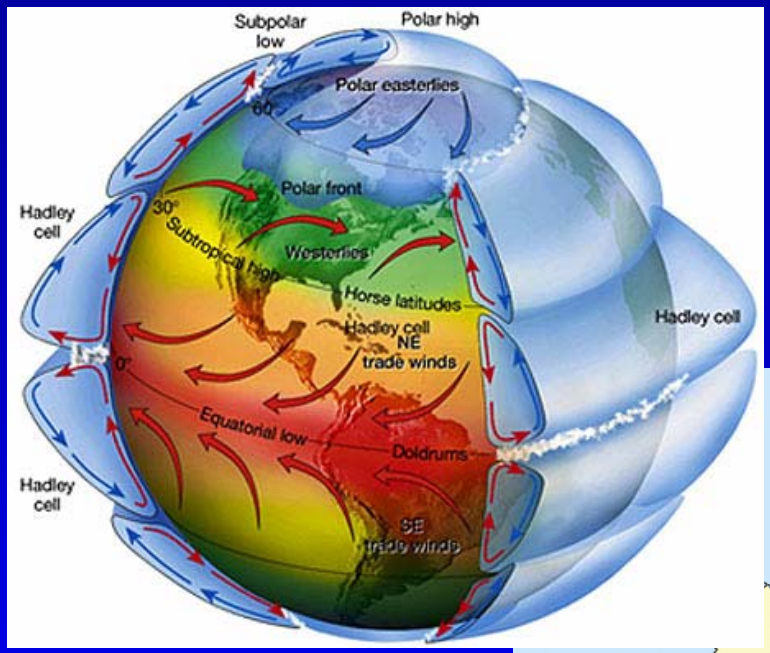
- Large-scale circulation patterns are an important determinant of local climate
- Arizona has a unique geographic position in northern hemisphere
  - Latitude of global belt of subtropical highs
  - Interacts with both mid-latitude westerlies in winter and subtropical high in summer
- Circulation patterns are tied to global ocean sea surface temperatures
- Patterns can persist for years and even decades

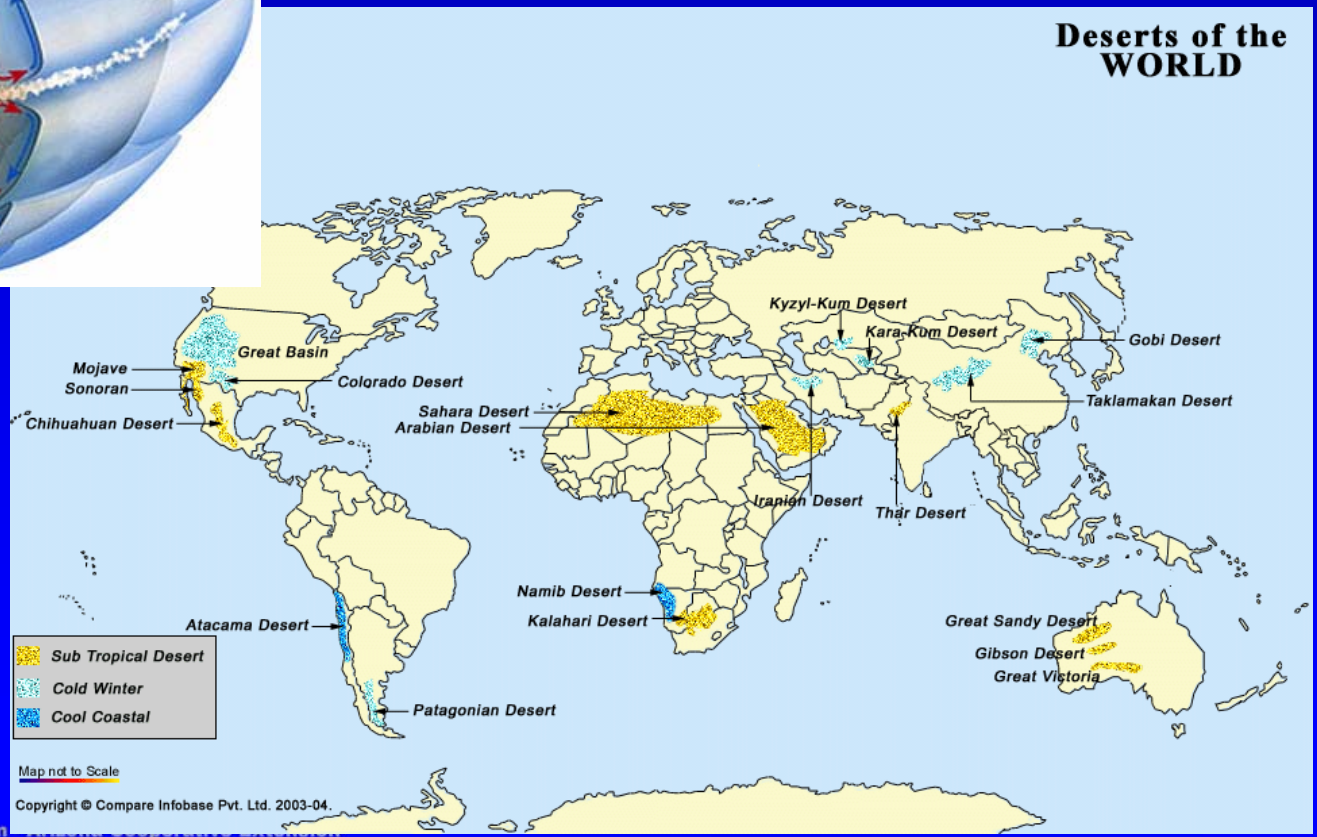


Seasonality of Circulation Patterns

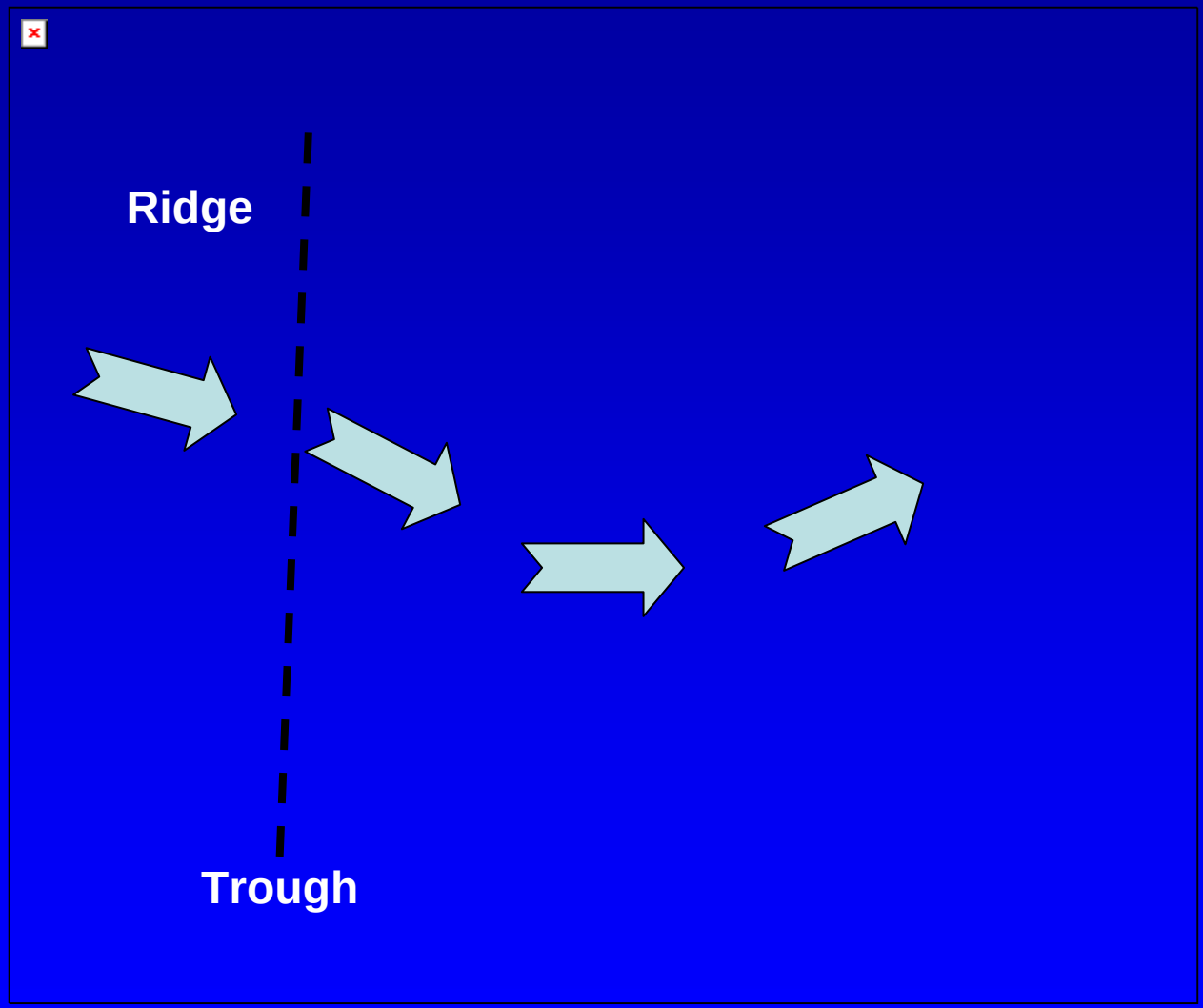


Global Circulations and Aridity

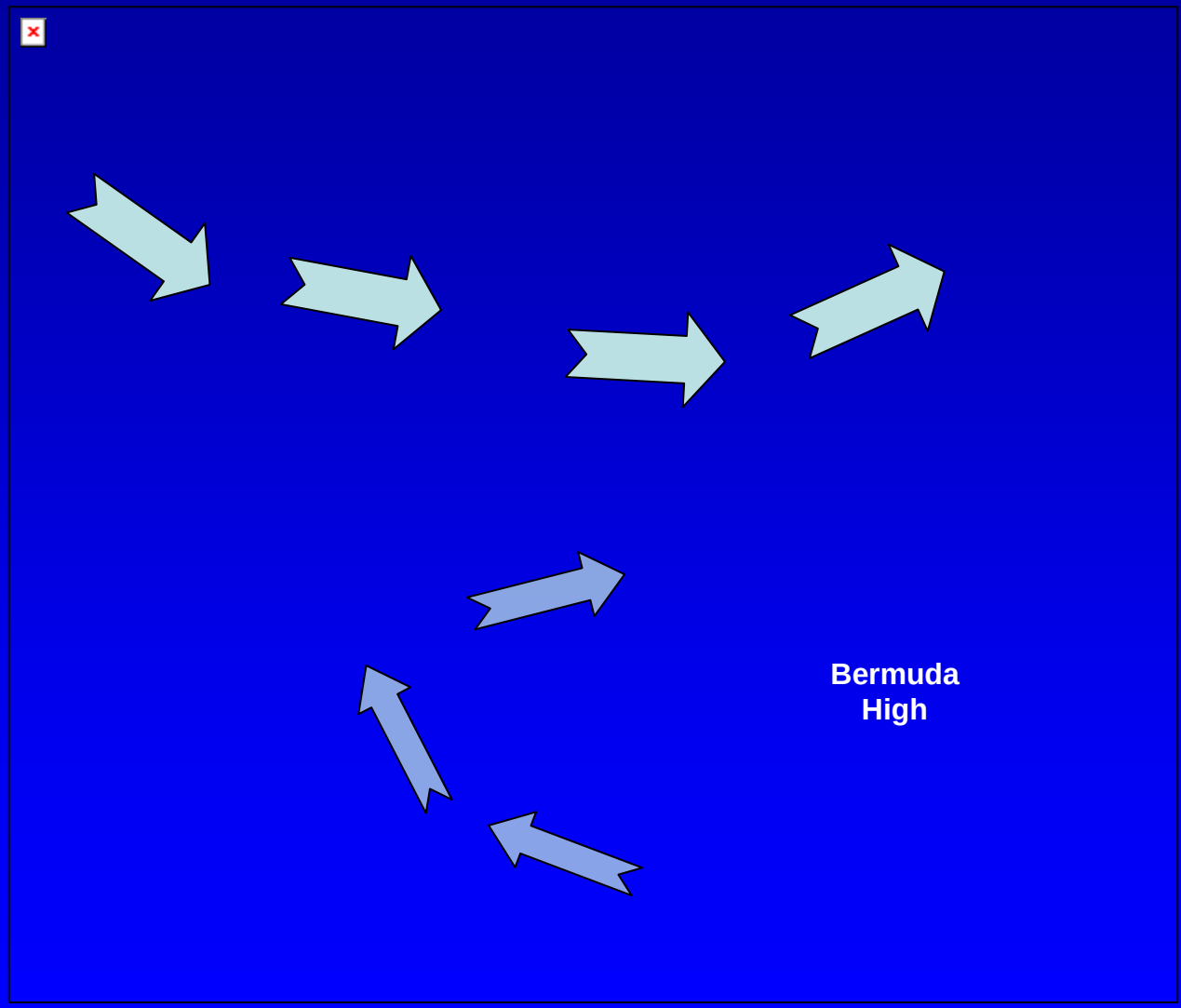




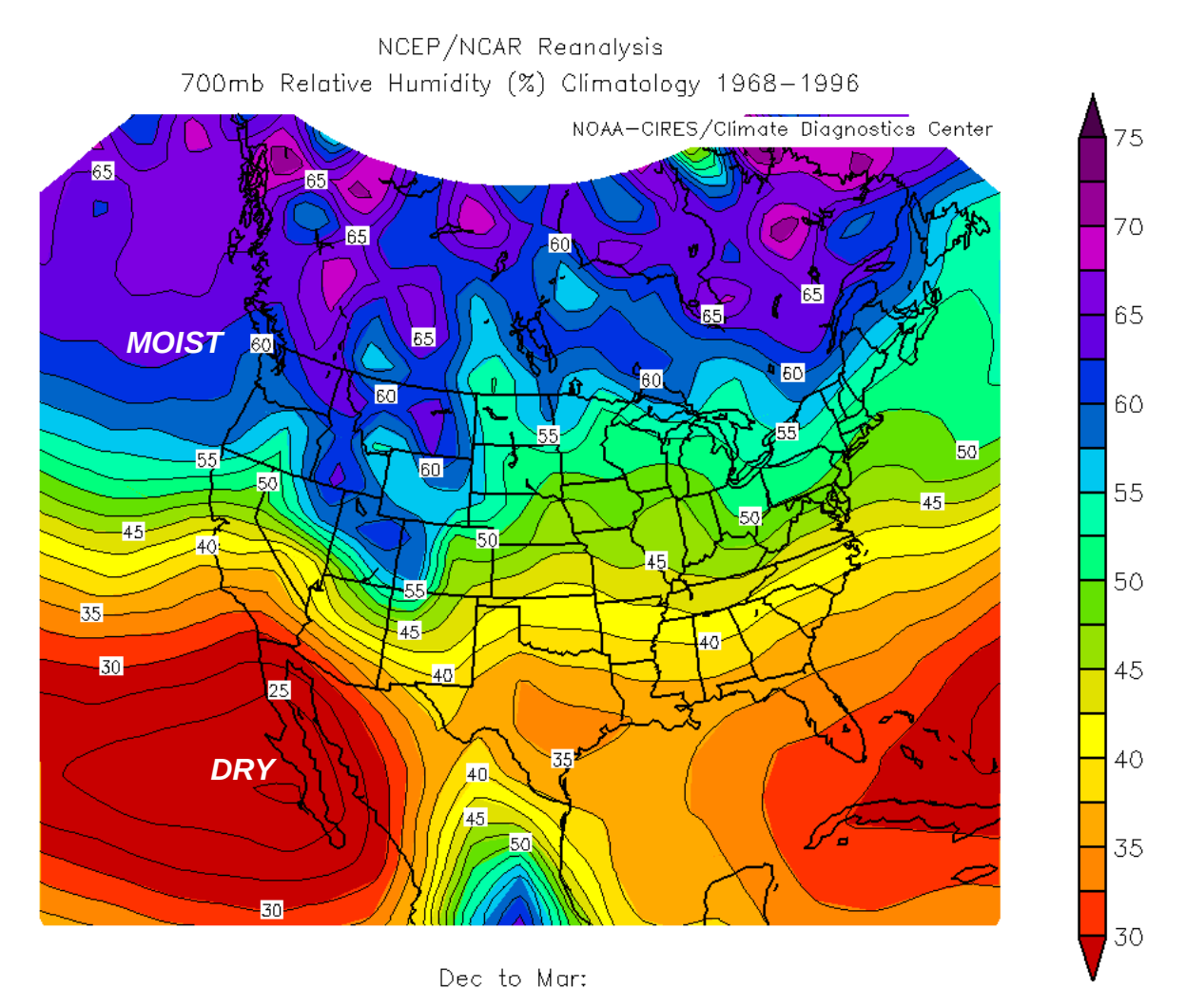
Atmospheric Circulation: Winter



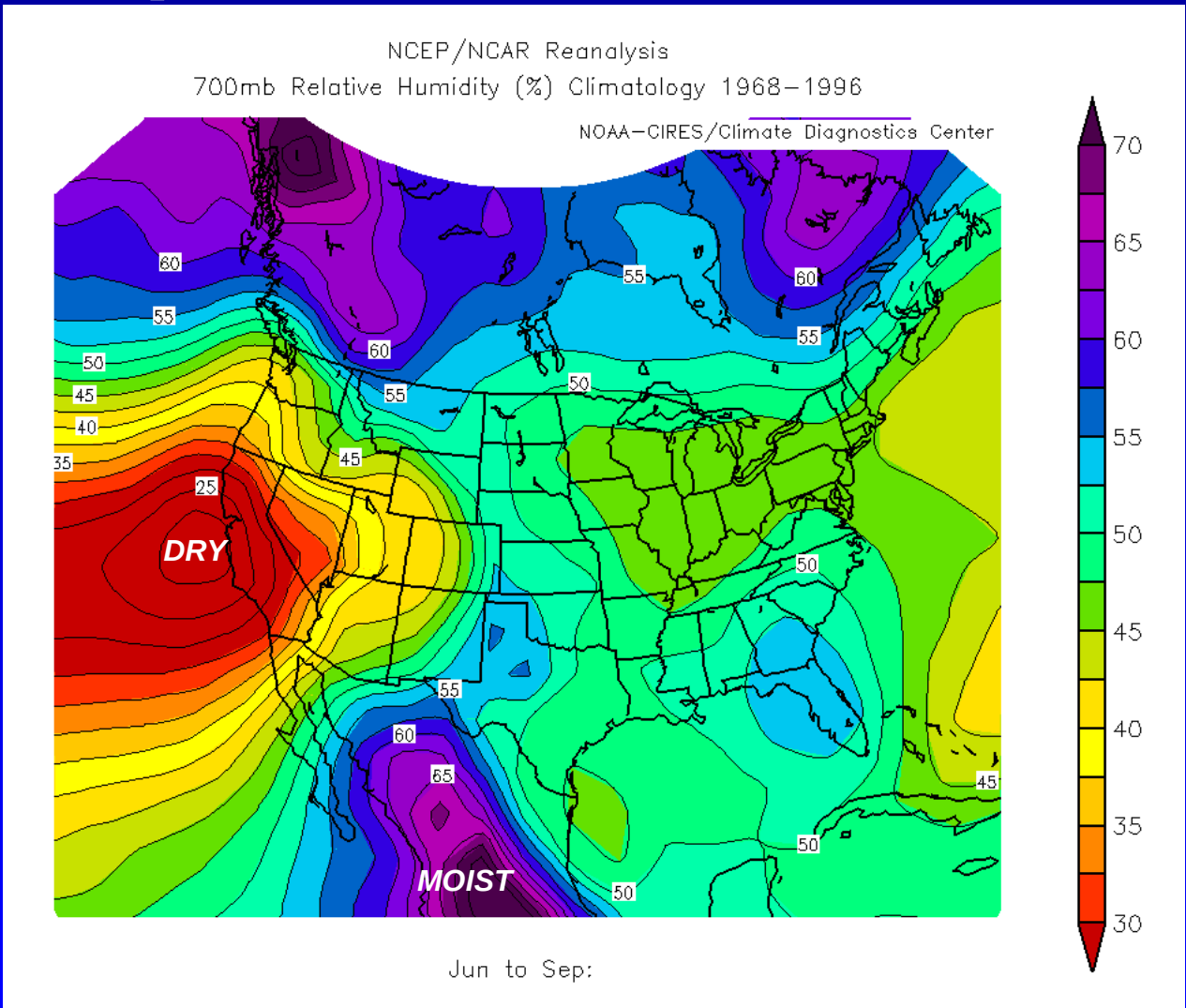
Atmospheric Circulation: Summer



Atmospheric Moisture: Winter

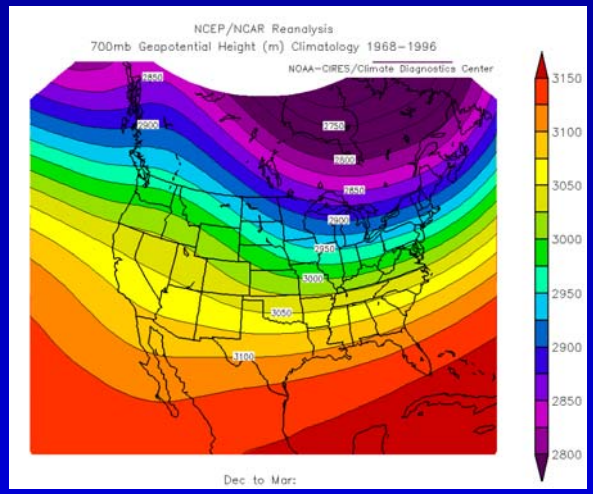


Atmospheric Moisture: Summer



Seasonal Atmospheric Changes

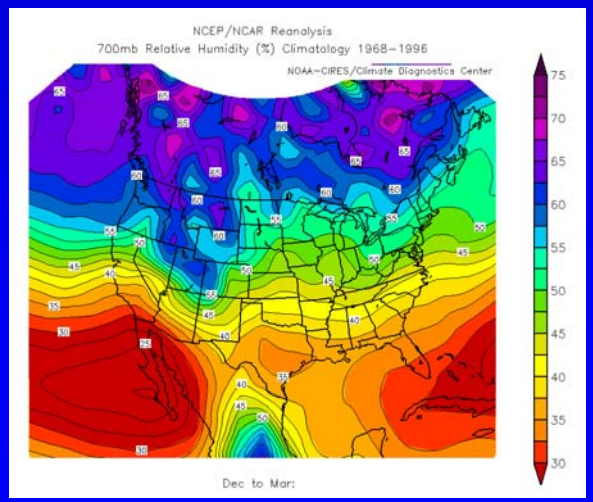
Flow

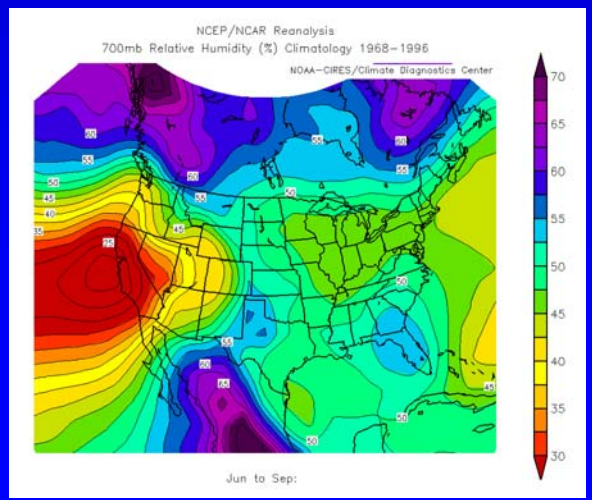


Winter

Summer

Moisture





Seasonality of Precipitation:CD 6

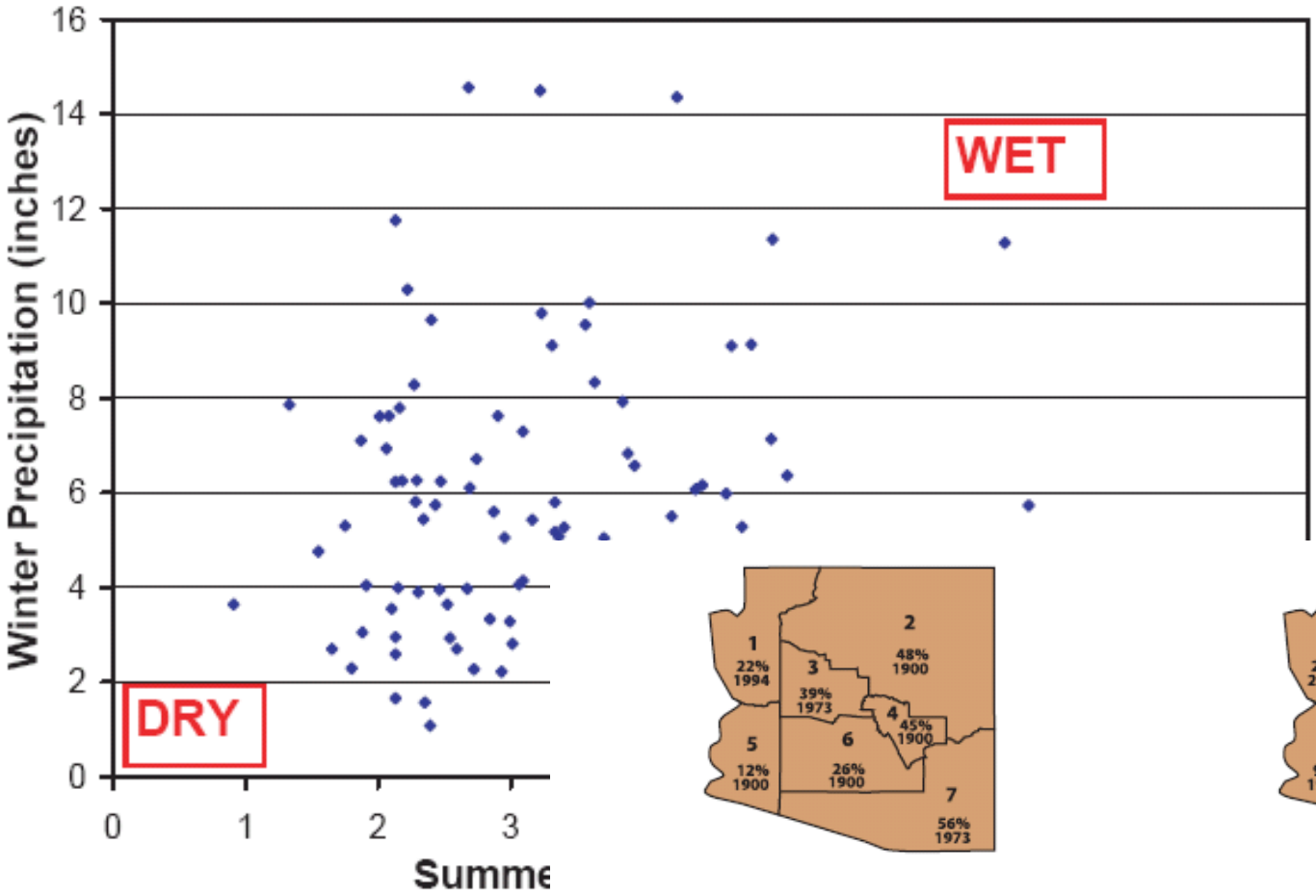


Figure 15. Driest summer (Jul–Sept) for the period 1896-2002.

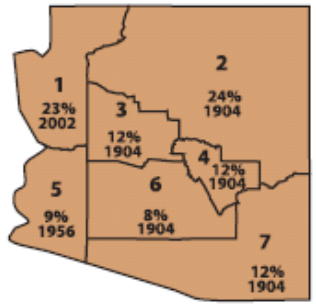
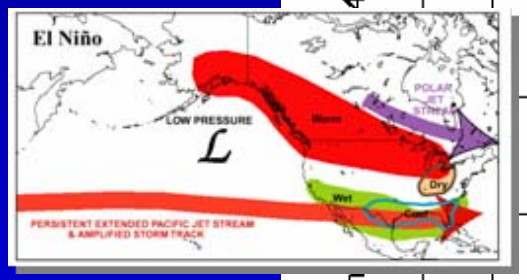


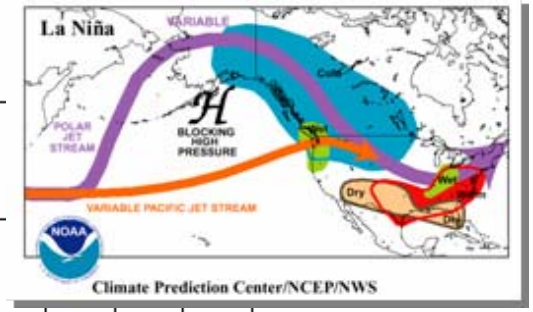
Figure 16. Driest winter (Nov–Apr) for the period 1896-2003.

McPhee et al. 2004

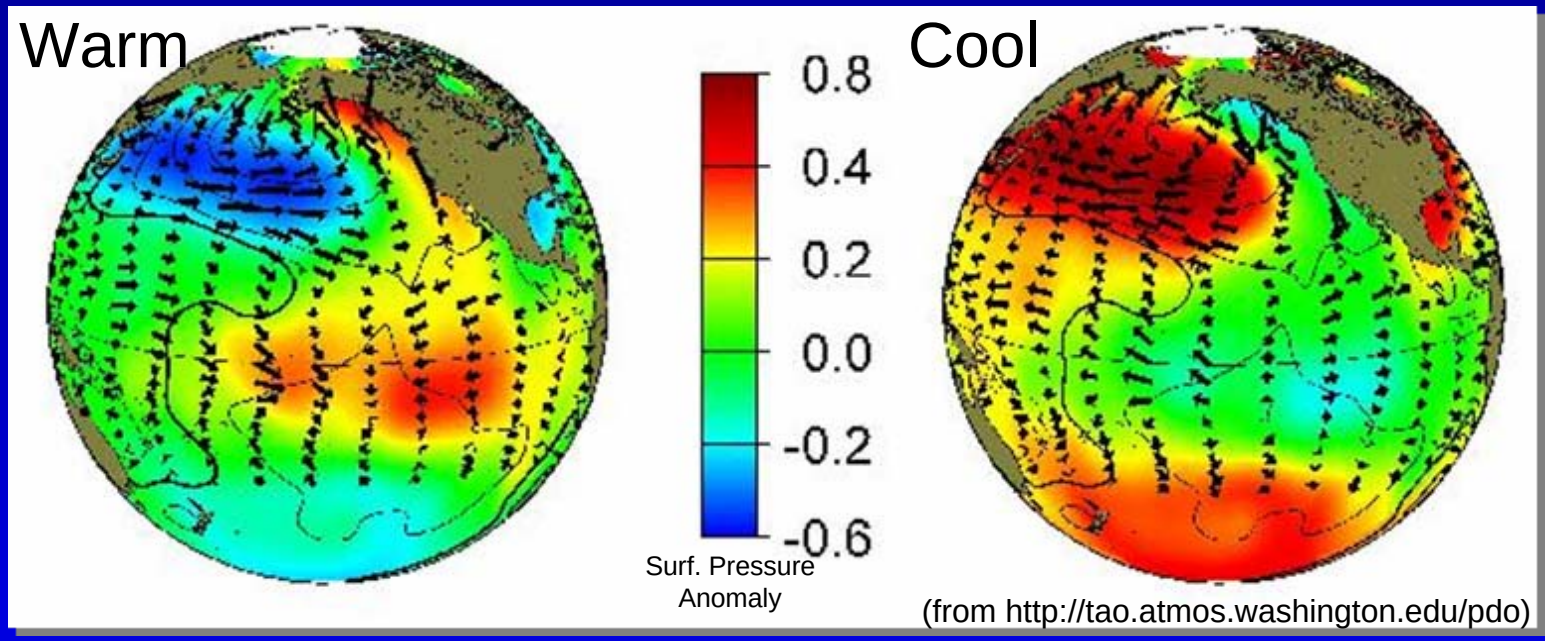
Interannual Climate Variability

El Nino and AZ Precipitation

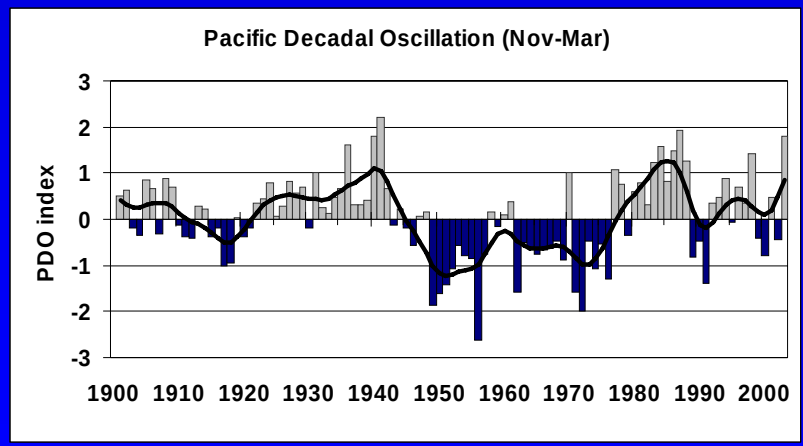




Pacific Decadal Oscillation



Period	North Pacific SSTs	Southwest Winters
1920s-1940s	Cold	Wetter
1940s-1970s	Warm	Drier
1970s-20??	Cold	Wetter
20??-????	Warm	Drier?



(from Pagano 1999)

Closing Points

- Arizona is Arid! (1980's wet period is not a good reference point)
- Precipitation inputs are generally small and highly variable
- Long-term wet/dry cycles occur over 3-30 year cycles in concert with ocean sea-surface temperature patterns
- Increasing aridity with increasing temperatures is a real concern

Resources

- Climate Assessment for the Southwest (http://www.ispe.arizona.edu/climas)
- National Weather Service
- (http://www.weather.gov)
- Climate Prediction Center (http://www.cpc.noaa.gov/)
- Western Regional Climate Center (http://wrcc.dri.edu/)
- National Drought Monitor (http://www.drought.unl.edu/dm/index.html)
- **Climate Science Applications Program (http://cals.arizona.edu/climate)**