Brief Overview of Arizona Climate

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• AZ climate basics
• Observations
• Projections
Arizona Climograph

- Precip (in.):
  - Jan: 1.2
  - Feb: 1.0
  - Mar: 1.1
  - Apr: 0.7
  - May: 0.3
  - Jun: 0.2
  - Jul: 2.5
  - Aug: 2.3
  - Sep: 1.5
  - Oct: 0.9
  - Nov: 0.8
  - Dec: 1.0

- Temp (F):
  - Jan: 40°F
  - Feb: 50°F
  - Mar: 60°F
  - Apr: 70°F
  - May: 80°F
  - Jun: 90°F
  - Jul: 100°F
  - Aug: 90°F
  - Sep: 80°F
  - Oct: 70°F
  - Nov: 60°F
  - Dec: 50°F

Legend:
- Blue: Precip (in.)
- Red: Temp (F)
El Niño-Southern Oscillation (ENSO)

Slide courtesy of Greg McCabe, USGS
El Niño-Southern Oscillation (ENSO)
Drought Frequency % (25 = expected)

McCabe et al., 2004 Proceedings of the National Academy of Sciences

high drought frequency
low drought frequency
Areal drought coverage: 1900-2010
Extreme precipitation events: 1900-2010
Arizona:
- Outpaced all other states

2001-2010
- Fewer cold waves
- More heat waves
Mean Temperature for Colorado Basin (above Lake Mead)
12 month period ending in September

Total Precipitation for Colorado Basin (above Lake Mead)
12 month period ending in September

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Reclamation – SECURE WATER Act Report, 2011
Changes in Streamflow Timing:
2000-2010 vs. 1950-2000
Areal drought coverage: 1900-2010
Increased temperatures, decreased soil moisture, result in greater stress, longer insect breeding cycles. Once a threshold is crossed massive mortality occurs.
Temperature is a hydrologic variable
Climate Change Projections
Climate Modeling
Global Temperature Change °F

- B1
- A1B
- A2
- Historical
- Observations

Year

1960 1980 2000 2020 2040 2060 2080 2100

• Big spatial scales
• Temperature
• Not predictions
Hotter
Sta0s0cally
downscaled
precipita0on
changes (%)
for
high
emission
scenario

High
Emissions
Scenario

Drier?
La Niña = YES!

High Emissions Scenario

Change (%)
• Less Snow
• Less Water in Arizona streams
Upper Colorado River Basin

Reclamation – Westwide Climate Risk Assessments, 2011
Colorado River at Lees Ferry

Percentage Change

Annual  Winter  Spring-Summer

Less Streamflow

Reclamation – SECURE WATER Act Report, 2011
Colorado River at Lees Ferry

Percentage Change

Early Snowmelt

2020s 2050s 2070s

Annual Winter Spring-Summer

Reclamation – SECURE WATER Act Report, 2011
Colorado River at Lees Ferry

Less Water When We Need It

Annual  Winter  Spring-Summer

Percentage Change

2020s  2050s  2070s

Reclamation – SECURE WATER Act Report, 2011
Projected Annual Temperatures in Tucson

- Low (B1)*: 1.9°F in 2010-2040, 3.2°F in 2041-2070, 4.3°F in 2071-2099
- High (A2)*: 2.1°F in 2010-2040, 4.3°F in 2041-2070, 7.5°F in 2071-2099

G. Garfin based on work performed by J. Weiss, University of Arizona (Geosciences)
Projected temperature Extremes for Tucson, AZ
Preliminary analysis by Carlos Carrillo and Gregg Garfin, Univ. of Arizona
Not peer-reviewed
Max Water Use and Precipitation In Tucson
Timing and amount of river flow

Temperature is a hydrologically variable component of river flows.

Changes in water resource system operations

Sea level rise

Cowin, CDWR, 2008
http://southwestclimatechange.org/

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Disaster

Have to Pee
Have to Sneeze
Losses of 30-60% Snow Water Equivalent

USDA-NRCS National Water and Climate Center
http://www.wcc.nrcs.usda.gov/wsf/
Raffa et al., 2008
Hotter Means Drier: 2011 Drought

Analysis courtesy of Jeremy Weiss, Jonathon Overpeck, and Julie Cole, Univ. AZ, 2012
Trend Since 1895