Climate Change, Water, and Texas

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Global Surface Temperature Anomalies (°C)
Base Period: 1980-1999

- HadCRUT surface
- GISTEMP surface
- NGT surface
- BEST surface
- RCP8.5 avg
Future Climate

• What will be in the atmosphere?
• What else will drive global changes?
• How much will that affect the global climate system?
• What are the local consequences?
• What else will happen locally?
Components of Radiative Forcing

- **CO₂**
- **CH₄**
- **N₂O**
- **HaloCarbons**
- **HFCs–PFCs–SF₆**
- **CO**
- **NMVOC**
- **NOₓ**
- **Nitrate**
- **Sulphate**
- **NH₃**
- **SO₂**
- **Fossil and Biofuel**
- **Biomass Burning**
- **ERFaci**
- **Contrails**
- **Surface Albedo**
- **Land Use**
- **Solar Irradiance**

Radiative Forcing (W m⁻²)

IPCC AR5 WG1
Fig. 8.17
Global Surface Temperature Anomalies (°C)
Base Period: 1980-1999

IPCC range
Lewis & Curry

- HadCRUT surface
- GISTEMP surface
- NGT surface
- BEST surface
- RCP8.5 avg
Marsicek et al, 2018, Nature

IPCC range, 20-40 years from now
Edwards Plateau Seasonal Temperature Anomalies
Tmax "+" & solid, Tmin "-" & dotted

Difference from 20th Century Average (°F)


DJF MAM JJA SON DJF MAM JJA SON DJF MAM JJA SON
Average Number of 100 °F Days per Year

Urban 1950-2018
Semi-Urban 1950-2018
Rural 1950-2018
Urban 1975-2018
Semi-Urban 1975-2018
Rural 1975-2018
Change (%) in annual total precip by mid 21st century
Climate Change and Precipitation

- Within a given storm, where rain is being produced:
  - Higher temperatures $\rightarrow$
  - Greater water vapor content
- For a given updraft velocity:
  - Greater water vapor content $\rightarrow$
  - Greater precipitation
- Change: 4% more per °F
Fig. 1. The global annual mean Earth’s energy budget for the Mar 2000 to May 2004 period (W m\(^{-2}\)). The broad arrows indicate the schematic flow of energy in proportion to their importance.
Climate Change and Precipitation

• Precipitation happens when lots of energy needs to be transferred upward into the atmosphere
  – Condensation adds heat (evaporation cools)

• Total global precipitation changes are driven by global energy changes
  – Enhanced greenhouse effect $\rightarrow$ 1% more per °F
Change, 24-hour rainfall amount, 100-y event, NOAA Atlas 14
Why 100-year events matter

- NOAA determines 100-year rainfall
- Hydrologists use models to determine 100-year flood
- People within floodplain must buy flood insurance
- What happens when floodplain changes?
Change, 24-hour rainfall amount, 100-y event, NOAA Atlas 14
(d) average annual 3-day precip extreme

(f) GHCN-D 13 stations, Return period

3-Day Rainfall Total (inches)

Return period [yr]

GEV scale fit 1900
GEV scale fit 2017
Houston 2017
3-Day Rainfall Total (inches)

(f) GHCN-D 13 stations, Return period

Current 100-yr estimate

2017: 60-yr

1900: 175-yr

GEV scale fit 1900
GEV scale fit 2017
Houston 2017
Implications

• Water affects just about everything
• What do you care about?
• Possibilities:
  – Floods
  – Agriculture
  – Reservoirs
  – Springs
  – Coasts
  – …
Projections (RCP 8.5, 2050-2099 CE)  

(Cook et al. 2015)

Maps showing soil moisture projections for (SM-30cm) and (SM-2m) with graphs illustrating PDSI, SM-2m, SM-30cm, and NADA over the years 1400 to 2100.
Contact Information

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