ADDRESSING REGIONAL DIFFERENCES IN NON-STATIONARITY

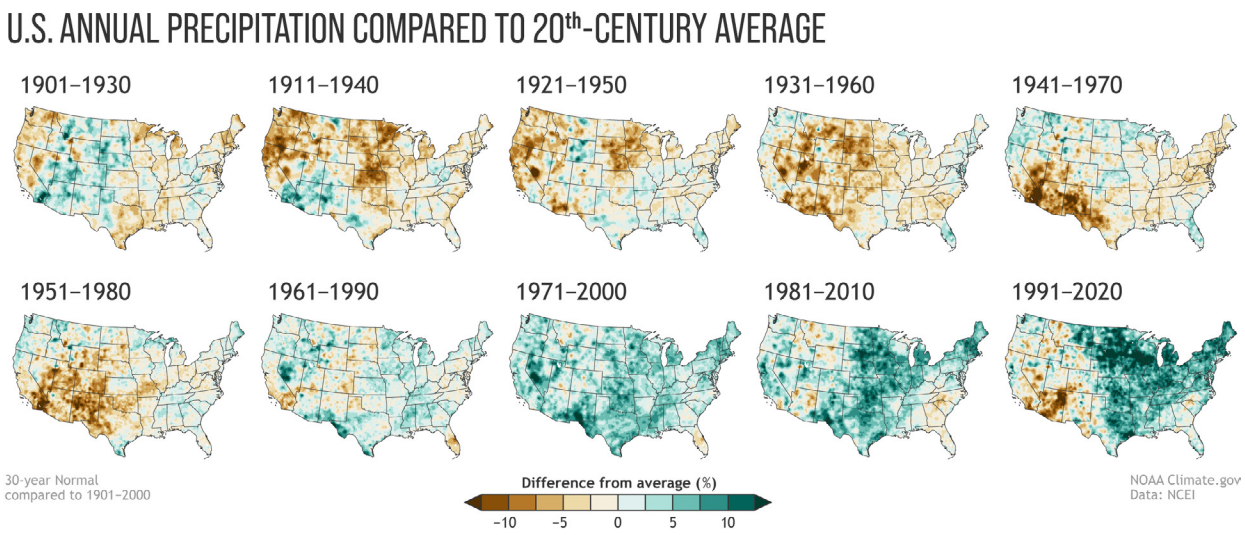
Climate change manifests differently across space and time and affects different regions in unequal ways. Two opposite examples in the United States are the Southwest, which is trending warmer and drier, and the Northeast, which is trending warmer and wetter. When assessing national trends, these two regional trends counter each other. Another example is when the Northern Plains states are grouped together to look at long-term trends. Since the early 20th century, the Eastern Plains (i.e., the Dakotas) have become wetter, while the Western Plains (i.e., Montana and Wyoming) have become drier. When looking at the Northern Plains as a combined region, these two different trends are diluted (Easterling et al., 2017). There needs to be an acknowledgement and systematic accounting for regional to sub-regional differences in non-stationarity when applying drought indicators and assessing drought and drought impacts. Climate change might affect current drought indices in similar or different ways, requiring better scientific understanding of spatial-temporal sensitivities. Defining the regions[3] at which drought is monitored and assessed is critical to account for the unique physical and climatological attributes of different parts of the United States. Regionalization requires an understanding of the interplay between indicators, where some might be more dominant by location and/or season, especially under climate change, and how indicators could be weighted to improve drought assessment. Regionalization also addresses the challenge that economic sectors, cultural practices, ecosystems, and habitats differ from region to region, and therefore experience different drought impacts.

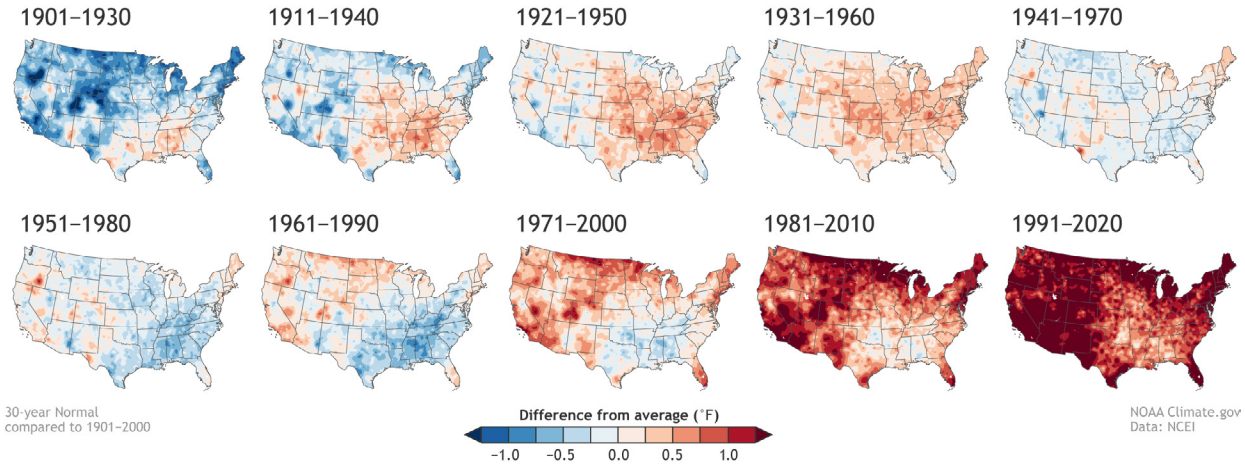
Priority Actions:

1. Expand on current efforts to develop drought assessment scales from global to continental to regional, acknowledging the pros and cons of each scale of assessment and the needs to fully fund these efforts.
2. Evaluate and compare current drought indicators to determine if they depict drought conditions appropriately and effectively given non-stationarity. Also, identify what indicators are most applicable at the regional scale, while also recognizing that these regions might also be responding to climate change in unique ways.
3. Synthesize research on existing and emerging issues and/or weaknesses in current means of drought assessment by region, as it pertains to non-stationarity.

3 "Regional" should be defined based on the requirements of the assessment. These can include: climate divisions, watersheds, states, eco-regions, agricultural systems or any other area—of various sizes—with shared attributes.

4. Represent and clearly communicate uncertainty and/or confidence in drought assessment to inform the application of the information in regional decision-making. Recognize regional differences in drought and non-stationarity, consider expanding the incorporation of regional information into national drought assessment products.
5. Develop and strengthen partnerships with regional and local communities and drought experts to ensure regional differences (including differences in resource allocation) are well understood and considered in state and federal assessment.





U.S. Annual Temperature and Precipitation Compared to 20th Century Average. Source: NOAA's Climate.gov/National Centers for Environmental Information (NCEI)

Research Questions:

1. How can a drought index/drought category be contextualized to account for large-scale climate oscillations (Jiang et al., 2019) relevant to various regions?
2. What are the optimal time scales to calculate percentiles or standardized anomalies for application in drought indices?
3. What is the climate sensitivity of drought categories to the period of record by region?
4. How sensitive are drought metric percentiles to period of record and approach (e.g., moving window, quantile regression approach, general additive model with time, general additive models with time and climate teleconnections) and drought type (i.e., as was done for flooding in Jain & Lall, 2001)?
5. What are the regional and sub-regional characteristics of non-stationarity, and how can these be used to understand the nature of droughts and other extreme events?
6. How is regional variability of drought indicators changing over time and with climate change?
7. How does changing variability affect the indicator-impact relationship in each region?