DETERMINING CLIMATE CHANGE SCENARIOS AND PROJECTIONS

A significant amount of climate data are available:

- It can be time-consuming to manage and interpret the vast amount of climate data available
- The USACE methodology is to consider all relevant, available data for the purpose of revealing as much of the quantified uncertainty as possible; that way, the conclusions about climate effects and impacts to water resources will be robust to a range of possible futures

This presentation describes one approach widely used now.

- Methods are in development to make this a manageable exercise that fits in the SMART Planning framework.
- In the meantime, while these new methods are still being developed, a plausible approach to follow is shown here.

INTRODUCTION

ONE APPROACH TO DETERMINING CLIMATE CHANGE SCENARIOS AND PROJECTIONS

The World Meteorological Organization (WMO) Coupled Model Intercomparison Project (CMIP):

- Phase 3 (CMIP3) included more than 20 global climate models (GCMs)
- 6 emissions forcing scenarios from the IPCC Special Report on Emissions Scenarios (SRES)
- Phase 5 (CMIP5) included more GCMs and a different set of 4 forcing scenarios (RCPs)

Archive of Downscaled CMIP3 + CMIP5 Climatology Outputs:

- CMIP3 and CMIP5 outputs were downscaled using empirical-statistical techniques and a restricted set of combinations of GCMs and emissions scenarios to 0.125 degree (~12 km) on a grid side
- This archive now houses >200 transient-through-time climatologies using the models and emissions scenarios from CMIP3 and CMIP5
- That total is unwieldy for analysis of water resources impacts, so several methods have been developed to sample from this restricted uncertainty space
- The method shown here is common and widely used
- However, using quadrants of projected T and P (warmer+wetter, colder+drier, etc.) to select 4 or 5 combinations of GCMs and emissions scenarios leaves us with unexamined risk in the impacts analysis because not all of the uncertainty space represented with the downscaled outputs has been sampled

5 REPRESENTATIVE CLIMATE CHANGE SCENARIOS BASED ON TRENDS FROM THE FULL SET OF 112 CLIMATE CHANGE PROJECTIONS

Change in 30-Year Mean of Mean Annual Temperature: A total of 112 simulations were run for temperature. A mean was identified for each simulation within the historical base 30-year period and a mean was identified for each simulation within the future base 30-year period. By subtracting those values, a change in mean between the historical base period and future base period was identified. The values range from 0.9 to 2.4 and are plotted along the y-axis.

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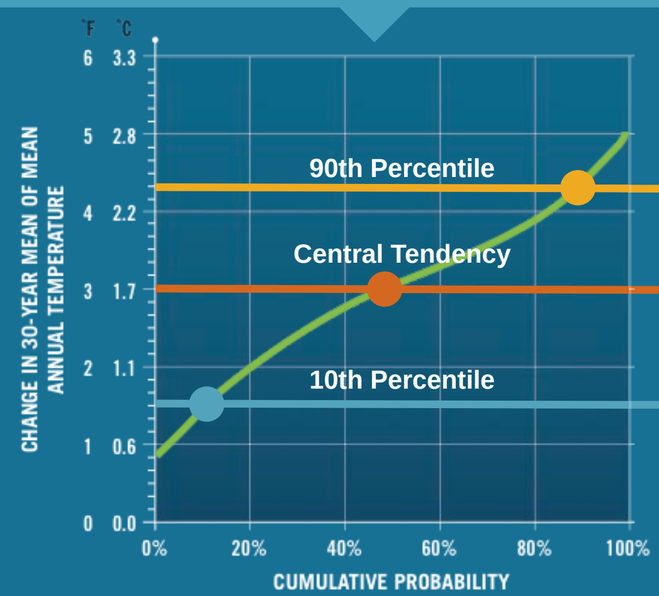


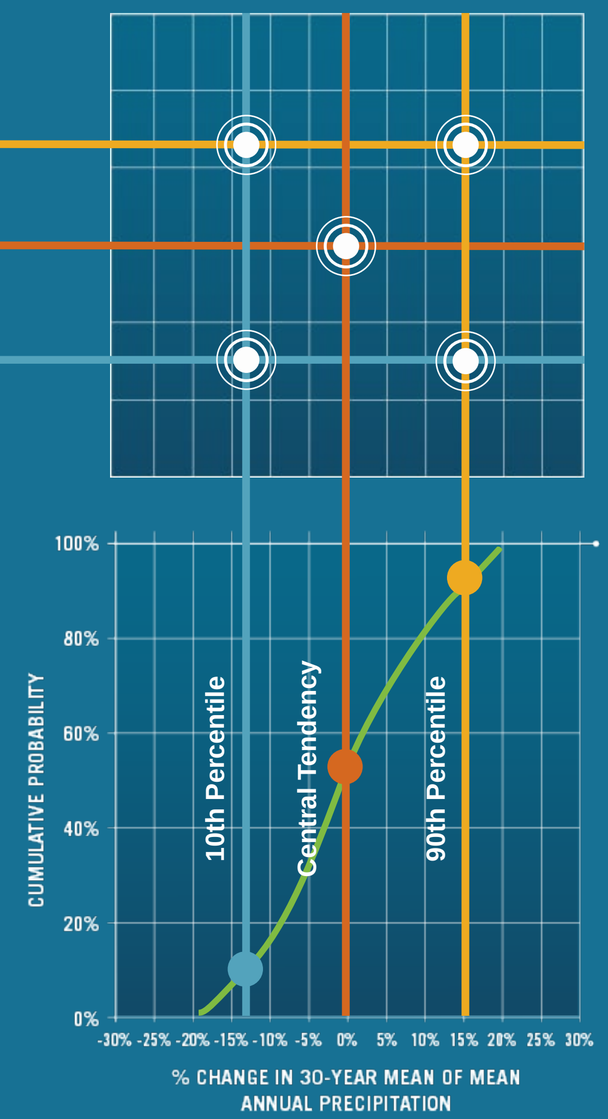
5 SCENARIOS to permit planning for a range of possible future outcomes

CUMULATIVE PROBABILITY: The probability of non-exceedance.

- **90TH PERCENTILE:** Upper Spread Limit
- **10TH PERCENTILE:** Lower Spread Limit
- **CENTRAL TENDENCY:** Based on the median value of the projections, and is used to establish whether a general trend is depicted by the data.

5 POSSIBLE CLIMATE CHANGE SCENARIOS

*USACE selected 93 projections from the full set of 112

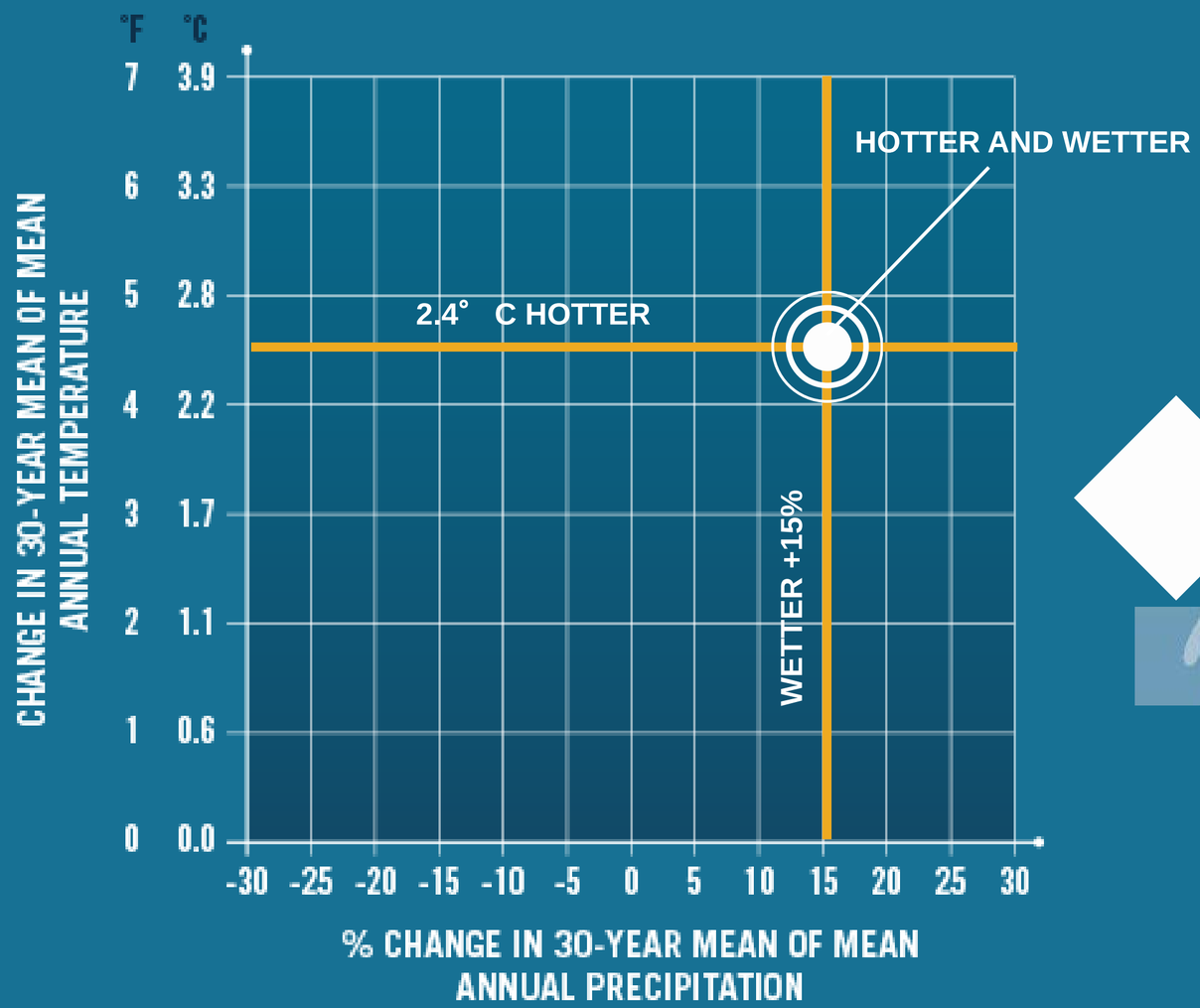


% Change in 30-Year Mean of Mean Annual Precipitation: A total of 112 simulations were run for precipitation. A mean was identified for each simulation within the historical base 30-year period and within the future base 30-year period. By subtracting the historical base mean from the future base mean, a change in mean was identified for each simulation.

5 REPRESENTATIVE CLIMATE CHANGE SCENARIOS

1. **HOTTER AND WETTER**
2. **WARMER AND WETTER**
3. **WARMER AND DRIER**
4. **HOTTER AND DRIER**
5. **CENTRAL TENDENCY**

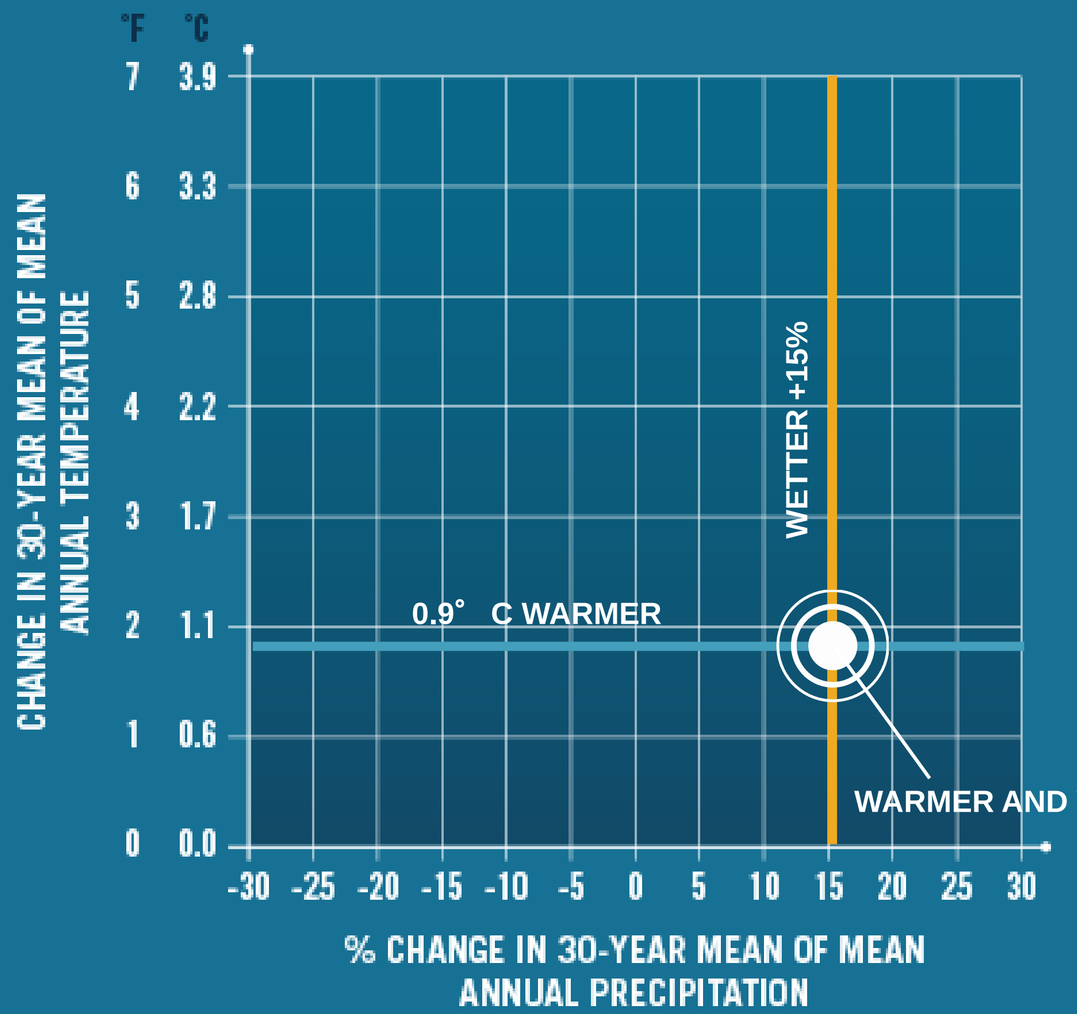
SCENARIO 1: HOTTER AND WETTER

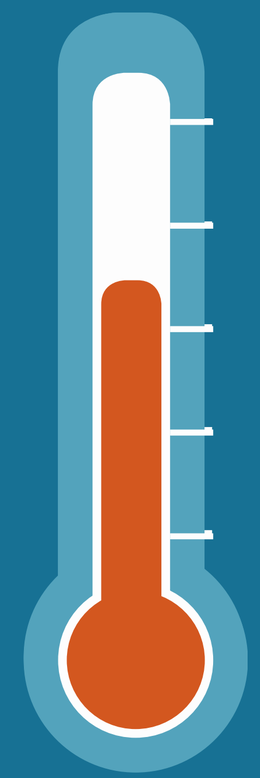


TEMPERATURE
2.4° C

PRECIPITATION
+15%

SCENARIO 2: WARMER AND WETTER

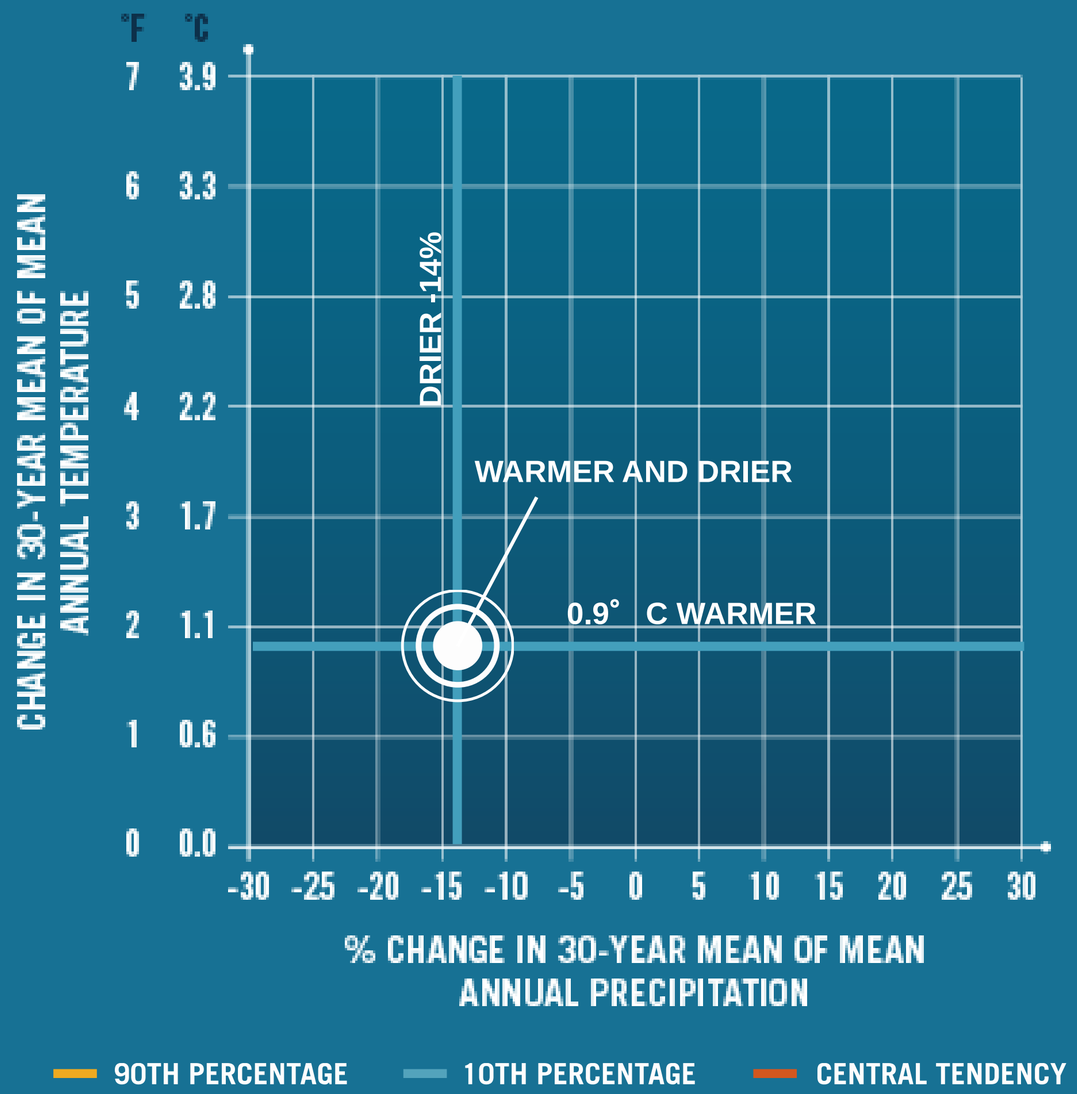


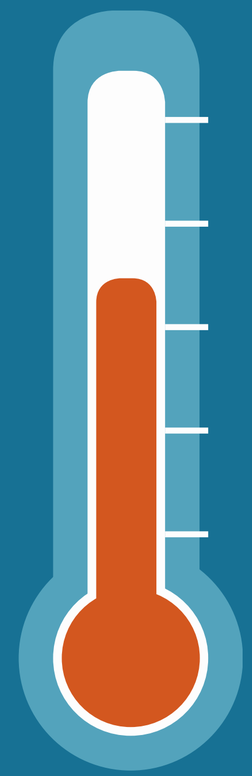


TEMPERATURE
0.9° C

PRECIPITATION
+15%

SCENARIO 3: WARMER AND DRIER

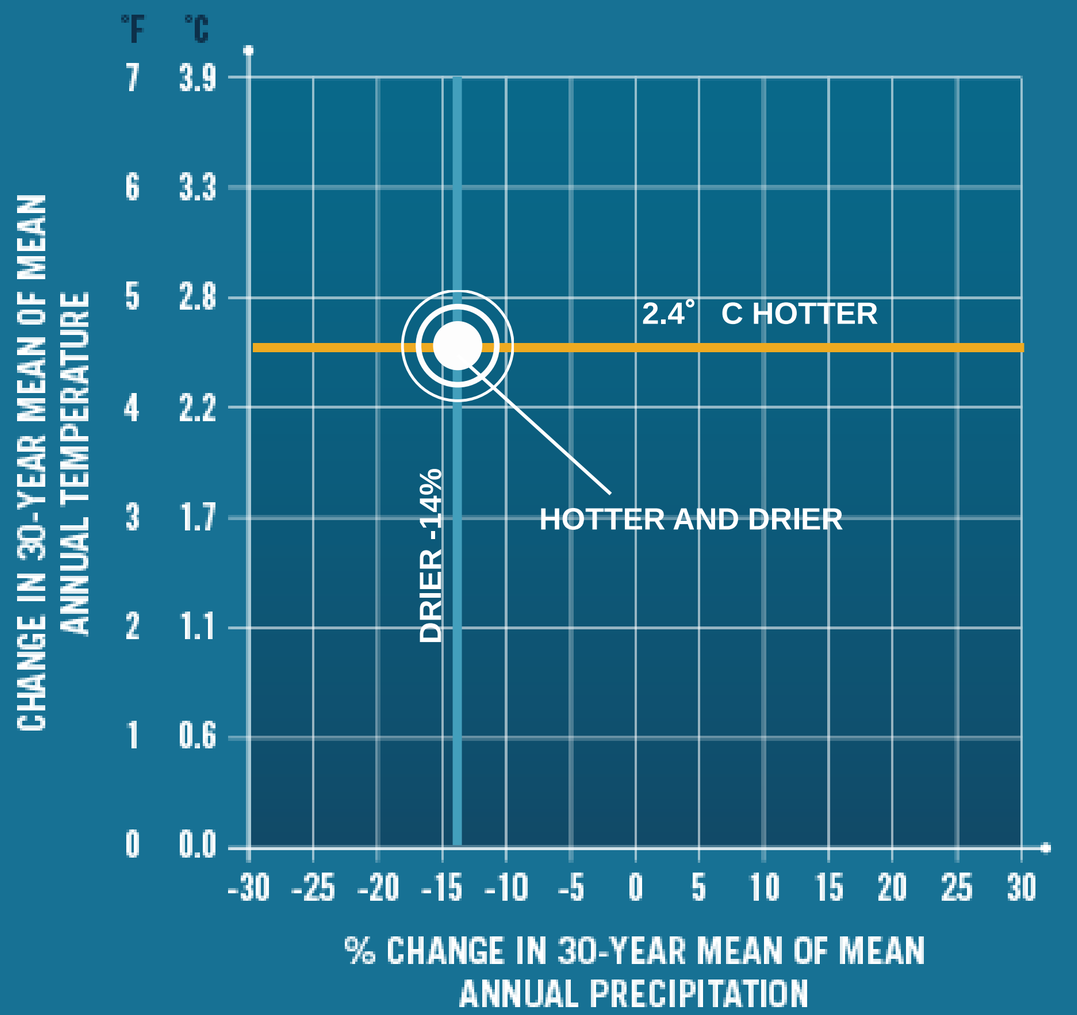


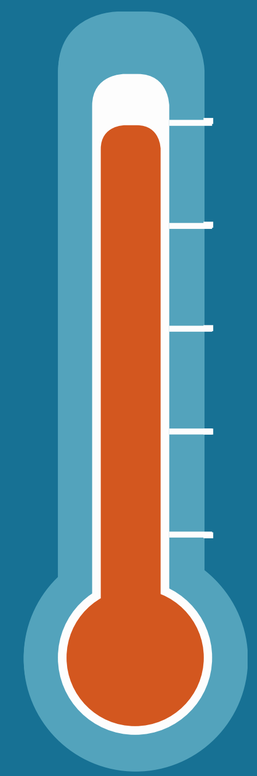


TEMPERATURE
0.9° C

PRECIPITATION
-14%

SCENARIO 4: HOTTER AND DRIER

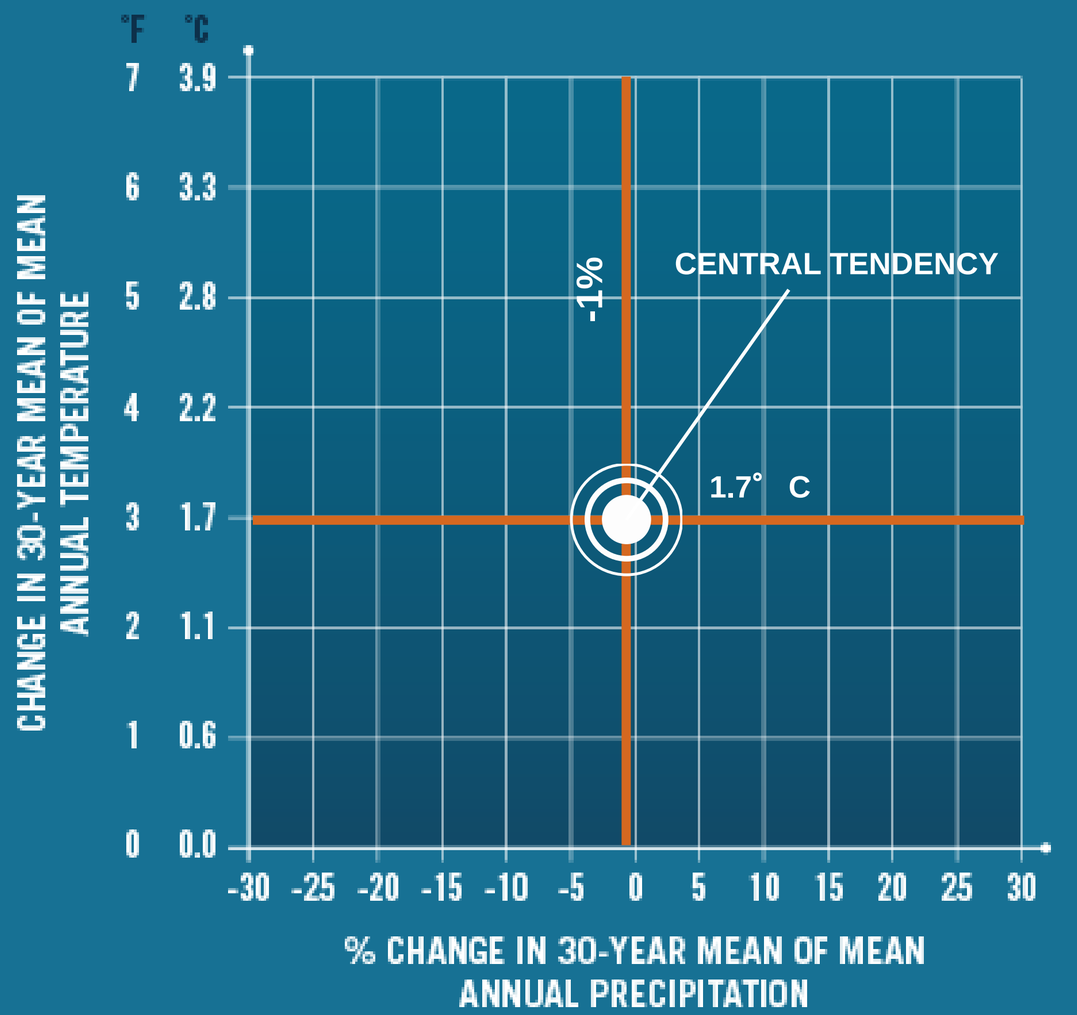


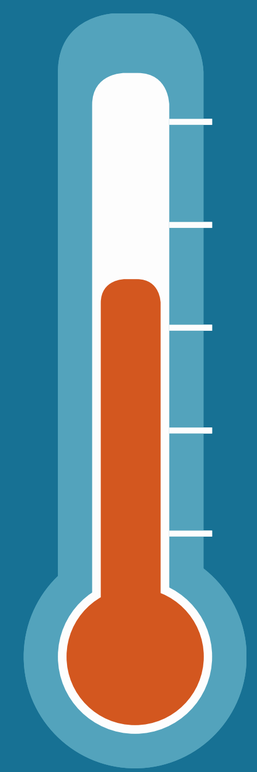


TEMPERATURE
2.4° C

PRECIPITATION
+15%

SCENARIO 5: CENTRAL TENDENCY





TEMPERATURE
1.7° C

PRECIPITATION
-1%

CONCLUSION

MOVING TO A MORE OBJECTIVE TECHNIQUE FOR USING CLIMATE CHANGE SCENARIOS AND PROJECTIONS

USACE is developing new data and methods for sampling a much larger area of the uncertainty space covered by the GCMs in the CMIP experiments by:

- **Using the whole distribution of the model projections for variables and combinations of variables relevant to water resources impacts studies**
- **This method is not complete as of September 2015**
- **Additional information about this alternative method will be made available as work progresses**