Supplementary Material for

A Probabilistic Approach for Characterization of Sub-Annual Socioeconomic Drought Intensity-Duration-Frequency (IDF) Relationships in a Changing Environment

Hadi Heidari [1,*], Mazdak Arabi [1], Mahshid Ghanbari [1], and Travis Warziniack [2]
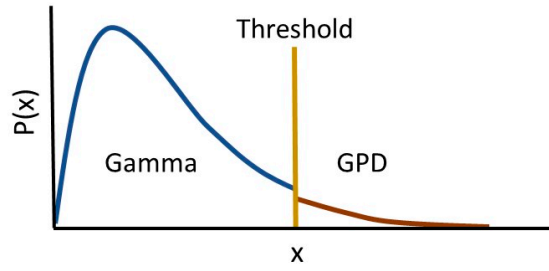
[1] Department of Civil and Environmental Engineering, Colorado State University, 1372 Campus Delivery, Fort Collins, CO 80523-1372, United States
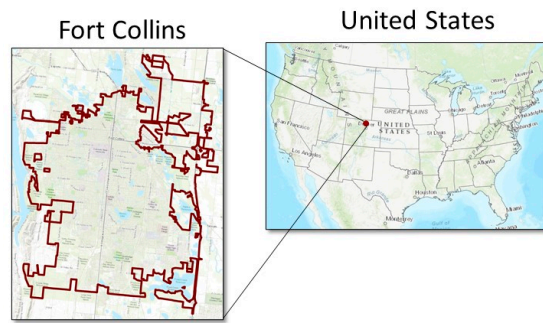
[2] Rocky Mountain Research Station, U. S. Forest Service, Fort Collins, CO 80526, United States
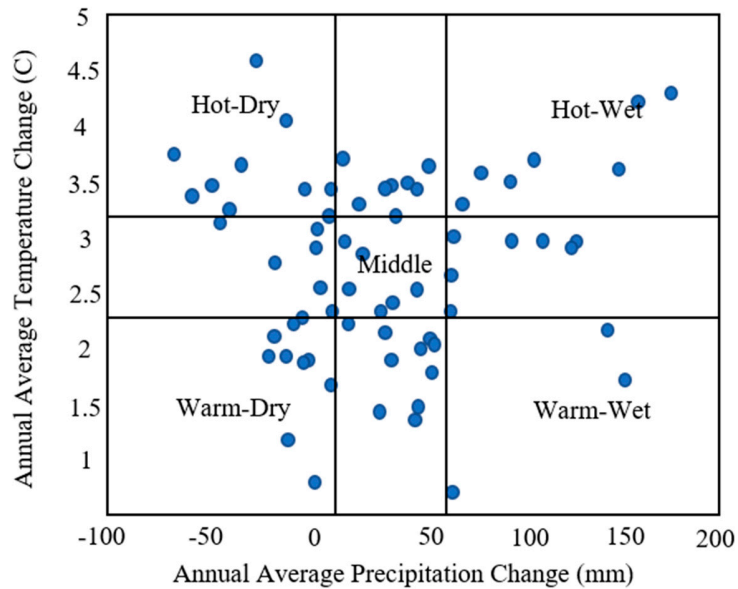
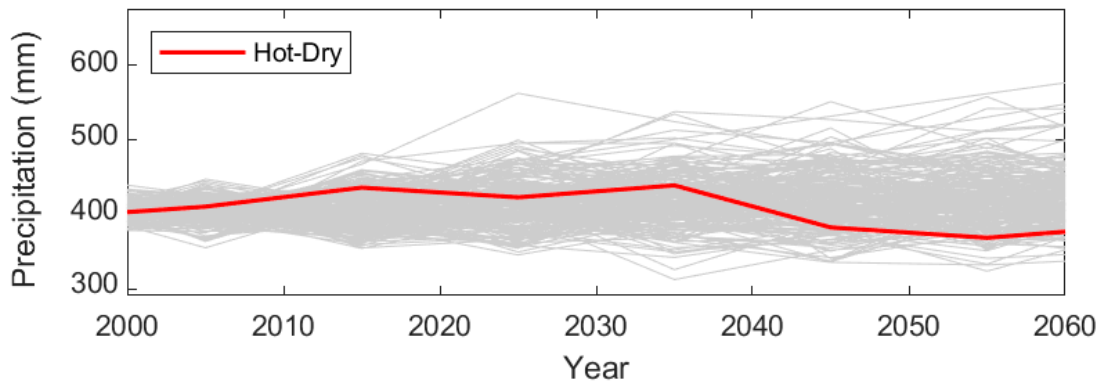Corresponding author: Hadi Heidari (Hadi.Heidari@colostate.edu)

**Figure 1.** Schematic of Gamma-GPD mixture model.

**Figure S2.** City of Fort Collins, Colorado, USA.

Figure S3. Classification of downscaled climate scenarios into hot-dry, hot-wet, warm-dry, warm-wet, and median categories based on the difference in current and future temperature and precipitation.
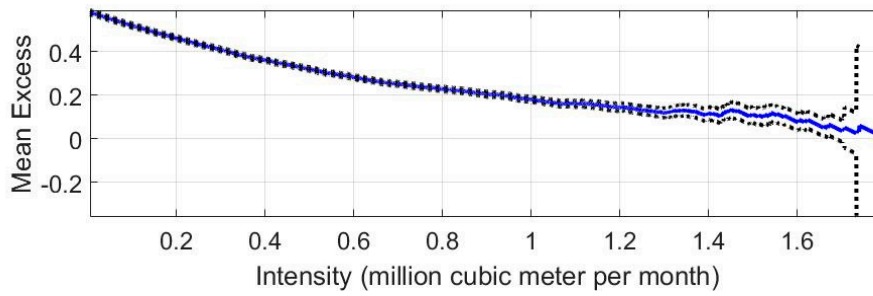
Figure S4. 30-year normal annual precipitation from the current conditions to the future
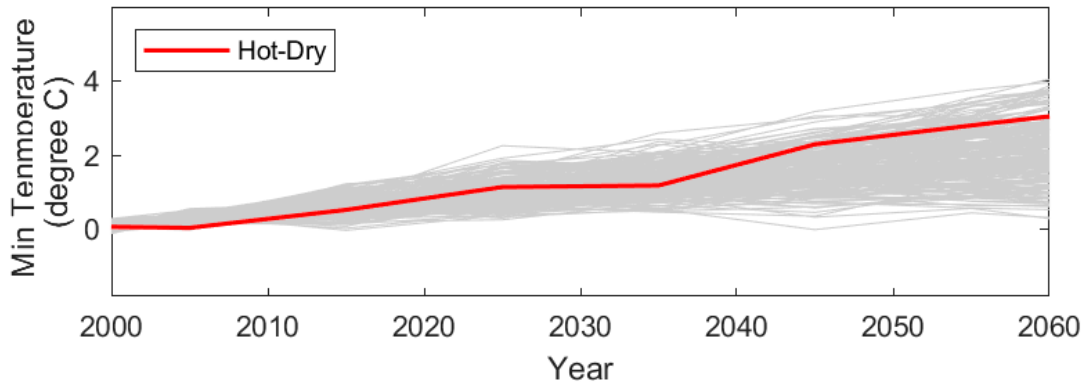
Figure S5. 30-year normal annual minimum temperature from the current conditions to the future
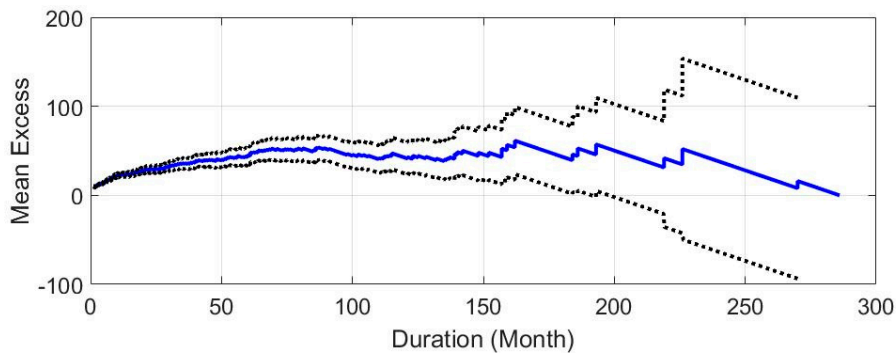
Figure S6. Mean residual life plot of drought durations

Figure S7. Mean residual life plot of drought intensities

Table S1. Boundaries of mixture model parameters

Parameter	Minimum	Maximum
GPD Shape	−0.3	0.3
GPD Scale	0.1	0.3
GPD Location	1.0	1.3
Gamma Shape	1.0	2.0
Gamma Scale	0.2	0.3

Table S2. First order sensitivity indices of mixture model parameters

	GPD			Gamma		Sum
Intensity	Shape	Scale	Location	Shape	Scale	
0.01	0.000	0.000	0.000	0.978	0.018	0.997
0.50	0.000	0.000	0.005	0.735	0.247	0.987
1.00	0.000	0.000	0.514	0.266	0.171	0.685
1.30	0.026	0.170	0.219	0.000	0.000	0.415

Table S3. Total order sensitivity indices of mixture model parameters

	GPD			Gamma		Sum
Intensity	**Shape**	**Scale**	**Location**	**Shape**	**Scale**	
0.01	0.000	0.000	0.000	0.991	0.031	1.022
0.50	0.000	0.000	0.005	0.759	0.271	1.035
1.00	0.000	0.000	0.568	0.300	0.195	1.063
1.30	0.454	0.720	0.792	0.000	0.000	1.966