277 PERCENT CHANGE IN RUNOFF DIVIDED BY PERCENT CHANGE IN PRECIPITATION

USACE CLIMATE PREPAREDNESS AND RESILIENCE

Background

- This indicator is one in a group of vulnerability indicators known as "elasticities," in which the percent change in one variable is divided by the percent change in another variable that causes the change in the first variable.
- This indicator is computed from observations of streamflow and precipitation without relying on the assumptions and caveats needed in a hydrologic model.[1]
- For example, an indicator value of 2 would imply that a 1% increase in monthly precipitation would result in a 2% increase in monthly runoff.
- Higher values suggest higher vulnerability relative to other watersheds.

THIS INDICATOR MEASURES THE MEDIAN OF THE DEVIATION OF RUNOFF FROM MONTHLY MEAN TIMES AVERAGE MONTHLY PRECIPITATION, DIVIDED BY THE DEVIATION OF PRECIPITATION FROM MONTHLY MEAN TIMES AVERAGE MONTHLY RUNOFF.

Data Sources

Data Source	Description	Spatial Resolution	Temporal Resolution
Coupled Model Intercomparison Project (CMIP-5) output[2]	Local runoff and precipitation within 4-digit hydrologic code (HUC-4) watersheds	HUC-4 watersheds	2035-2064 and 2070-2099

This Indicator Was Used to Assess the Vulnerability of All of USACE's Eight Business Lines

Business Line	Importance Weight (Varies from 1 to 2 for USACE)
Flood Risk	1
Navigation	1.5
Ecosystem Restoration	1.75
Hydropower	1.5
Recreation	1
Water Supply	1.3
Regulatory	1.25
Emergency Management	1.2

Calculation

- Use local runoff and precipitation values from 47 CMIP-5 climate model traces specific to each future wet or dry scenario.[3]
- Calculate yearly precipitation, P_t, and average local runoff, Q_t, for each model trace.
- Calculate the mean annual precipitation, $\bar{P}$, and mean average local runoff, $\bar{Q}$, by averaging the yearly values.
- For each year, calculate the yearly elasticity as: $\left(\frac{Q_t - \bar{Q}}{P_t - \bar{P}}\frac{\bar{P}}{\bar{Q}}\right)$
- Rank the yearly elasticity values for each model trace from low to high, and select the 15th value. This value is a model trace's elasticity estimator.
- Rank climate model traces' elasticity estimator values from low to high, and select the 42nd value.

[1] Sankarasubramanian, A., Vogel, R.M., and J.F. Limbrunner. 2001. Climate Elasticity of Streamflow in the United States. Water Resources Research. 37(6): 1771-1781.
[2] CMIP-5 output is available for download online at: http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html
[3] Indicator values were calculated for two scenarios (a wet and a dry future) and two time periods (2035-2064 and 2070-2099).

HIGH INDICATOR VALUE
Small changes in precipitation are likely to result in large changes in runoff at this Texas site.

Brazos River, TX - Courtesy of NWS