



Background

- This indicator represents how monthly runoff varies relative to mean runoff on a yearly basis.
- Higher values represent 4-digit hydrologic unit code (HUC-4) watersheds with greater intra-annual variation of unregulated runoff. Lower values represent watersheds with less intra-annual variation.
- Shifts in temperature and precipitation may result in changes to the intra-annual variability of runoff.¹
- Higher values suggest higher vulnerability relative to other watersheds.

Local vs. Cumulative

- Flow-based indicator values depend on where the flow originates.
- The vulnerability assessment tool uses two versions of this indicator:
 - Local (221L): Reflects flow generated within only one HUC-4 watershed.
 - Cumulative (221C): Reflects flow generated within a HUC-4 watershed and any upstream watersheds.

THIS INDICATOR MEASURES SHORT-TERM VARIABILITY IN A REGION'S HYDROLOGY. IT IS THE 75TH PERCENTILE OF ANNUAL RATIOS OF THE STANDARD DEVIATION OF MONTHLY RUNOFF TO THE MEAN OF MONTHLY RUNOFF.

Data Sources

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

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

Indicator	Business Line	Importance Weight (Varies from 1 to 2 for USACE)
221L	None	N/A
221C	Navigation	1
	Ecosystem Restoration	1.75
	Hydropower	1.6
	Recreation	1.2
	Water Supply	1
	Regulatory	1.75

Calculation

- Use local runoff values from 47 CMIP-5 climate model traces specific to each future scenario.³
 - For indicator 221L, use local runoff values from each model trace.
 - For indicator 221C, use cumulative runoff values from each model trace.
- For each model trace, calculate the mean and standard deviation of the monthly runoff for each year in the time period. The coefficient of variation (CV) for each year is the ratio of the standard deviation to the mean.
- For each model trace, rank the yearly coefficients of variation from low to high. Select the CV in the 75th percentile for each model trace. This value is the model trace's short-term variability score.
- Rank short-term variability scores of all model traces from low to high, and select the 36th value.

¹ Arnell, N. W. 1999. Effects of IPCC SRES Emissions Scenarios on River Runoff: a Global Perspective. Hydrology and Earth System Sciences. 7(5): 619-641.

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

HIGH INDICATOR VALUE

Some HUCs experience high variability in monthly runoff within a year. Flash floods may occur in areas that experience frequent variation between wet and dry conditions.

Galloway, WA - Courtesy of NASA