568L & 568C

FLOOD MAGNIFICATION FACTOR

USACE CLIMATE PREPAREDNESS AND RESILIENCE

Background

- The flood magnification factor represents how flood flow (i.e., the monthly flow exceeded 10% of the time) is predicted to change in the future.
  - In watersheds with indicator values greater than 1, flood flow is predicted to increase.
  - In watersheds with indicator values less than 1, flood flow is predicted to decrease.
- Increases in flood flow can have adverse effects on species not adapted to such changes. For example, increased flood flow levels can lead to river bed scour, which reduces egg-to-fry survival rates of salmon in the Pacific Northwest.[1]
- Increased flood flow levels may also result in energy spills at hydropower plants, when there is neither sufficient storage capacity nor turbine capacity. Energy spills may be especially prevalent in winter and early spring, when increased flood flow levels may occur.[2]
- Higher values suggest higher vulnerability relative to other watersheds.

THIS INDICATOR MEASURES THE CHANGE IN FLOOD RUNOFF, I.E., THE RATIO OF INDICATOR 571L/C (MONTHLY LOCAL OR CUMULATIVE RUNOFF EXCEEDED 10 PERCENT OF THE TIME,) TO 571L/C IN THE BASE PERIOD.

Local vs. Cumulative

- The interpretation of flow-based indicators depends on where the flow originates.
- The vulnerability assessment tool uses two versions of this indicator:
  - Local (568L): Reflects flow generated only within one 4-digit hydrologic code (HUC-4) watershed.
  - Cumulative (568C): Reflects all flow generated within a HUC-4 watershed and any upstream watersheds.

Data Sources

Data Source	Description	Spatial Resolution	Temporal Resolution
Coupled Model Intercomparison Project (CMIP-5) output[3]	Local runoff within HUC-4 watersheds	HUC-4 watersheds	2035-2064 and 2070-2099

These Indicators Were Used to Assess the Vulnerability of Some of USACE's Eight Business Lines

Indicator	Business Line	Importance Weight (Varies from 1 to 2 for USACE)	Indicator	Business Line	Importance Weight (Varies from 1 to 2 for USACE)
568L	Flood Risk	1.4	568C	Flood Risk	1.8
	Ecosystem Restoration	1		Navigation	2
	Hydropower	1		Ecosystem Restoration	1.5
	Recreation	1		Hydropower	1.4
	Regulatory	1.1		Recreation	1.4
				Regulatory	1.6
				Emergency Management	1.9

Calculation

- Use local runoff values from 47 CMIP-5 climate model traces specific to each future scenario.[4]
- Calculate the flood runoff for the base period (1950-2004), and a future scenario (2035-2064 or 2070-2099).
  - For indicator 568L, use local flood runoff values (indicator 571L) in the base and future periods.
  - For indicator 568C, use cumulative flood runoff values (indicator 571C) in the base and future periods.
- Divide the future value of flood runoff by the base period value to obtain the flood magnification factor.

[1] Mantua, N., I. Tohver, and A. Hamlet. 2010. Climate Change Impacts on Streamflow Extremes and Summertime Stream Temperature and Their Possible Consequences for Freshwater Salmon Habitat in Washington State. Climatic Change. 102(1-2): 187-223.
[2] Madani, K., and J. R. Lund. 2010. Estimated Impacts of Climate Warming on California's High-Elevation Hydropower. Climatic Change. 102(3-4): 521-538.
[3] CMIP-5 output is available for download online at: http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html
[4] 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

Watersheds with high indicator values may have an increased risk of flooding or damage to property in the future.

The photo shows the 2011 flood of the Souris River in North Dakota, when 500-year flood levels were reached or exceeded.

HIGH

Minot, ND - Courtesy of USAF