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Regionalization Concepts

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Streamflow Characteristics

- 100-year flood
- Average annual streamflow
- Average streamflow for August
- 7-day, 10-year low flow (7Q10)
- 90-percent duration flow
- …

Estimation of streamflow under some condition

Streamflow Characteristics: Uses

- Engineering Design
- Water Resources Management
- Water Quality Regulation
- Floodplain Mapping and Land Use Planning

Streamflow Characteristics: Gaged Sites

- Use statistical analysis of historic flows to compute streamflow characteristics at a gaged site.

- USGS applications
  - PeakFQ
  - SWStat

Streamflow Characteristics: Ungaged Sites

- Determine streamflow characteristics at ungaged sites using:
  - Regression Equations
  - Drainage-area Ratio Method
  - Hydrologic and/or Hydraulic Models
- USGS regression applications
  - GLSNet
  - WREG
  - NFF / NSS
  - StreamStats

Regression Equations

- Developed by statistically relating the flow characteristics to the physical and climatic characteristics of the watersheds for a group of gaging stations within a region.
- Enable the transfer of flow characteristics from gaging stations to ungaged sites simply by determining the watershed and climatic characteristics for the ungaged site and using the regression equation.

Regression equations

- Ordinary Least Squares (OLS)
- Weighted Least Squares (WLS)
  - Adjusts for varying length of record
  - Different levels of uncertainty
- Generalized Least Squares (GLS)
  - Accounts for time-sampling differences
  - Accounts for overlapping records

Regression & Regionalization

- Equations are used to link flow characteristics to basin characteristics through curve fitting
- Equations are developed for geographic regions that are designed to meet certain criteria
- Allows us to overcome spatial scarcity of the data and to “extend” data through time by pooling information from several sites

Example Regression Equation

$$Q_{100} = 18.7\ A^{0.812}\ P^{1.060}\ (F + 1.0)^{-0.664}$$

Where:

- Q_{100} - 100-year flood flow, cfs
- A - drainage area, square miles
- P - mean annual precipitation, inches
- F - percentage of forested land

Basin Characteristics

Descriptive attributes – values must be readily available or easily measured at both gaged and ungaged basins.

- **Physical**
  - **Area**
  - **Slope**
  - **Soil Types**
- **Climatic**
  - **Precipitation Amounts or Intensity**
  - **Temperature**

Selecting Basin Characteristics

- Hydrologic judgment
- Physical sense
- Significant at regional or local levels
- Fewer characteristics implies relative ease of use but less accuracy
- Try to avoid using basin characteristics that are closely related to one another (e.g. drainage area and length)

What makes a good Characteristic?

- measureable (determinable)
- variability
- direct or indirect influence on statistic of interest
- reproducible

Basin Characteristics

How do we know which characteristics are important and which are not?

- **Statistically test the significance of each to see whether (or how much) they explain the variability of the flow and discard those that don't meet a threshold.**

How good are the equations?

- Statistical Measures of Fit
  - Standard error
  - Standard error of prediction
  - R^2

Weighting of Estimates

- Often the best estimate of a flow statistic is a weighted, combined estimate of the regression equation estimate and other estimates (from gaged records or other equations.)

- The weighting techniques are generally described in the regional report.

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Questions

U.S. Department of the Interior
U.S. Geological Survey