Flood Frequency Estimation for Alaska: Updated Data and Methods



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Streamflow statistics

- Streamflow statistics are metrics determined from hydrologic data
- Used for water management and engineering
- Computed for gaged streams, estimated for ungaged streams from regressions with basin characteristics

Examples

- 1% chance flood (100-yr flood)
- mean annual flow
- 98%
 exceedance
- 7010



Estimating flood frequency at ungaged streams

- Empirical model relates streamflow statistic to basin characteristics
- Input Data: Hydrology
 - Flood frequency statistics
 - Computed from annual series of maximum instantaneous peak flows (largest 15-minute value of the year)
- Input Data: Basin Characteristics
 - Physical, climate, or other variables
 - Averaged across the drainage area



Annual series of peak streamflow used for flood frequency analysis



Figure 3. Maximum, mean, and minimum daily mean discharge and annual maximum instantaneous discharge and calendar day of occurrence during the period of record for the Matanuska River at Palmer, Alaska, USGS gaging station 15284000.



Example of flood frequency curve





Skew = 0.50

Example of flood frequency curve





Skew = 0.50

Streamgages available for flood frequency regression analysis

Streamgages in Alaska (USGS) and Canada (Water Survey of Canada) with at least 10 years of record as of 2012



Alaska gage records

- Plot shows years of record for Alaska gages used in regional regression (nonredundant sites with min. 10 yrs of record)
- Plotted by site ID (roughly south to north)





Basin characteristics tested as explanatory variables

- Obtained from drainage area boundaries and digital datasets
 - Drainage area boundaries for streamgages were merged with the Watershed Boundary Dataset
- Included climate, physical, hydrologic, vegetation, and cold climate variables

Drainage area Latitude Mean basin elevation Mean annual precipitation Mean minimum January temperature Percent lakes and ponds Percent glaciers Percent forest, percent broadleaf Percent permafrost



Substitute mean annual precipitation as proxy for Curran and others (2003) Streamflow Analysis Regions





Mean annual precipitation for 1970-2000 (Alaska) from PRISM data

Output

- Equations for estimating flood frequency statistics for ungaged streams under presentday conditions
- Regression equations were developed for the 50-, 20-, 10-, 4-, 2-, 1-, 0.5-, and 0.2 percent annual exceedance probability discharge



Form of new regression equations for estimating streamflow in Alaska

P-percent annual exceedance probability flow = constant DRNAREA^b PRECPRIS00^c

DRNAREA is the drainage area, in square miles *PRECPRIS00* is the basin mean annual precipitation for 1970-2000 from PRISM, in inches

 Uses drainage area and basin-average PRISM precipitation data as input, produces a flood frequency statistic as output



Estimating Flood Frequency in Alaska, 2016

- Recent update of Curran et al. (2003) provides simplified regression equations for estimating flood frequency statistics at ungaged streams statewide
- Developed from USGS gage data and PRISM precipitation data





Updated USGS Alaska flood frequency report released in March 2016

Insights from flood frequency study

 Regional boundaries in Curran et al. (2003) are valid but ambiguous. The most hydrologically defensible regional distinction was between Gulf of Alaska coastal areas (Southeast Alaska to about Kodiak Island) and the rest of the state.



Regional skew for Alaska

- Bayesian GLS analysis using basin characteristics
- New regional skews are constants
 - RSA 1: 0.50
 - RSA 2: 0.18
 - No regional skew in exclusion area





Limitations

- Basin characteristics must be within the range of basin characteristics used to develop the equations
- Basin characteristics must come from the same dataset as those used to develop the equations (use PRISM 1970-2000 dataset for mean annual precipitation)



Accessing Data

- USGS flood frequency report online

 Spreadsheet applications tool
 GIS of basin characteristics
- StreamStats online



- Pre-computed statistics available statewide
- Live basin delineation and computation of statistics available for Cook Inlet Basin only
- Alaska Streamflow Statistics website http://alaska.usgs.gov/science/program.php?pid=30



What is StreamStats?

http://water.usgs.gov/osw/streamstats/





 Public domain, web-based GIS application

- Simplifies access to streamflow statistics for gaged and ungaged streams
- Nationwide program developed by USGS and ESRI
- State-specific applications developed with cooperators

Functions of StreamStats

 For gaged site (available everywhere)

 Provides previously computed basin characteristics and streamflow statistics





Functions of StreamStats

- For ungaged site (available only where geospatial data has been enhanced for hydrologic function)
 - Delineates drainage area
 - Determines drainage-basin characteristics
 - Computes estimates of streamflow using regional regression equation and basin characteristics



Select location on StreamStats stream grid -Mystery Creek





StreamStats

Mystery Creek basin delineated in StreamStats



Click to compute basin characteristics



Alaska StreamStats limited functions now available

- StreamStats shows streamgages across the state.
- A Statistics shown as of April pre-date Curran and others (2003) and should not be used for critical applications. Stay tuned for updates.
- See Basin delineation and basin characteristics computation available within Cook Inlet Basin now.
 - New statistics for streamgages and tool for computation of equations will be available soon.



FAQ – flood frequency and climate change

• What about climate change?

- This study screened for trends at individual gages but was not designed to detect the effects of climate change
- Records with a median length of 28 years scattered about a 60 yr period but clustered around the 1970s make trend detection difficult
- The links between changing climate and the magnitude and frequency of floods should include consideration of changes to flood drivers, not just mean annual precipitation



More information

- StreamStats website

 click State Applications

 USGS Alaska Streamflow Statistics website

 http://alaska.usgs.gov/science/program.php?pid=30

 AWRA pre-conference workshop April 24
- Contact USGS
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