Can We Predict Flash Flooding? Models to Estimate Flashiness in the Mid-Atlantic
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Background
• Due to climate change, heavy rainfall in the Mid-Atlantic Region is becoming more frequent and intense, contributing to the increase in flash flooding.
• The National Weather Service (NWS) currently forecasts flooding based on rainfall and soil moisture which doesn’t account for watershed characteristics that could impact the flood responses of streams.
• There is a need for more accurate multivariable flash flood predictor models.

Key Findings
• We identify 195 sites in the Mid-Atlantic (Fig 2)
  • We included eleven watershed parameters in our analysis (Imperviousness was removed due to high correlations with others).
  • PoT [1] and RBFI [2] were the flow metrics for analysis (table 1).

Statistical Analysis
R Studio 2022.02.1
We used p<0.05(*), p<0.01(**), and p<0.001(***)

Results
• When grouped by 10% development, there was a significant shift (p=0.0037) in RBFI behavior at 80% development. Thus, our urban model contained sites with percent development greater than 80% (Fig 3).
  • For all sites, urban, valley ridge and Appalachian models, 1-3 variable models were as sufficient as 4 variable (Fig 4)

Discussion
Flashiness is complex and difficult to predict, especially considering how different watershed regions vary in characteristics and climate. The key finding of our studies include that
• Regional models better predict flashiness due to varied impacts of different watershed parameters
• Wetlands are a universal buffer.
• Rural/suburban watersheds behave similarly, with a shift in flashiness behaviors at ~80% development
The results of our study can be used to more accurately predict flash flooding in the Mid-Atlantic region and can be considered with existing flooding warning systems to better warn the public of flooding events.

References

Materials

Watershed Parameters
• Hydraulic Disturbance Index
• Area
• Compactness Ration
• Development
• Soil Ratio
• Forest Cover
• Precipitation
• Wetland Cover
• Slope
• Carbonate Geology
• Drainage Density

Flow Metrics
• Richard-Baker Flashiness Index (RBFI)
• Flow exceedances of 0.25 m³/km² per water year in 12 h time frame.

Figure 1: Graphical Abstract

Figure 2: Sites and Regions

Figure 3: Flow Metrics

Figure 4: Four variable linear models.

BTW: The Mid-Atlantic Region is one of the Flashiest in the US [3]

Figure 5: Parameter values by region

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