



FLOOD REGIMES IN CANADA: LEARNING FROM THE PAST AND PREPARING FOR THE FUTURE

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Outline

- Introduction
- Extreme events
- Quantile estimates
- Analysis of changes
- Flood manual and software
- Path forward

Introduction

- Floods are arguably the most common natural disaster
 - Considerable social, economic and environmental consequences
- Damages from floods can include:
 - Property loss;
 - Destruction of infrastructure;
 - Loss of life;
 - Social and economic disruption from evacuations; and
 - Environmental degradation.

Introduction

- The frequency, magnitude and economic damages from floods are rising in recent years as a result of:
 - Increased human exposure to flood-prone areas
 - The impacts of climate change
- It is important to understand the relative contributions to the changes from these two origins

Extreme Events

- The over-arching goal is to enhance the management of floods and extreme events
- The research program will advance our knowledge of flood regimes in Canada (past, present and projected future) and provide guidelines for infrastructure design

Learning from the past and preparing for the future



Extreme Events

- The three interrelated components of the research seek to:
 - i. Provide updated estimates for flood and extreme rainfall quantiles for locations across Canada as well as a unified procedure for applying frequency analysis;
 - ii. Identify geographic regions in Canada in which water resources infrastructure might be prone to high risk of severe rainfall or flooding; and
 - iii. Develop a manual with best practices for flood frequency analysis and statistical tools that implement the methodology that can be made available to practitioners.

Quantile Estimates

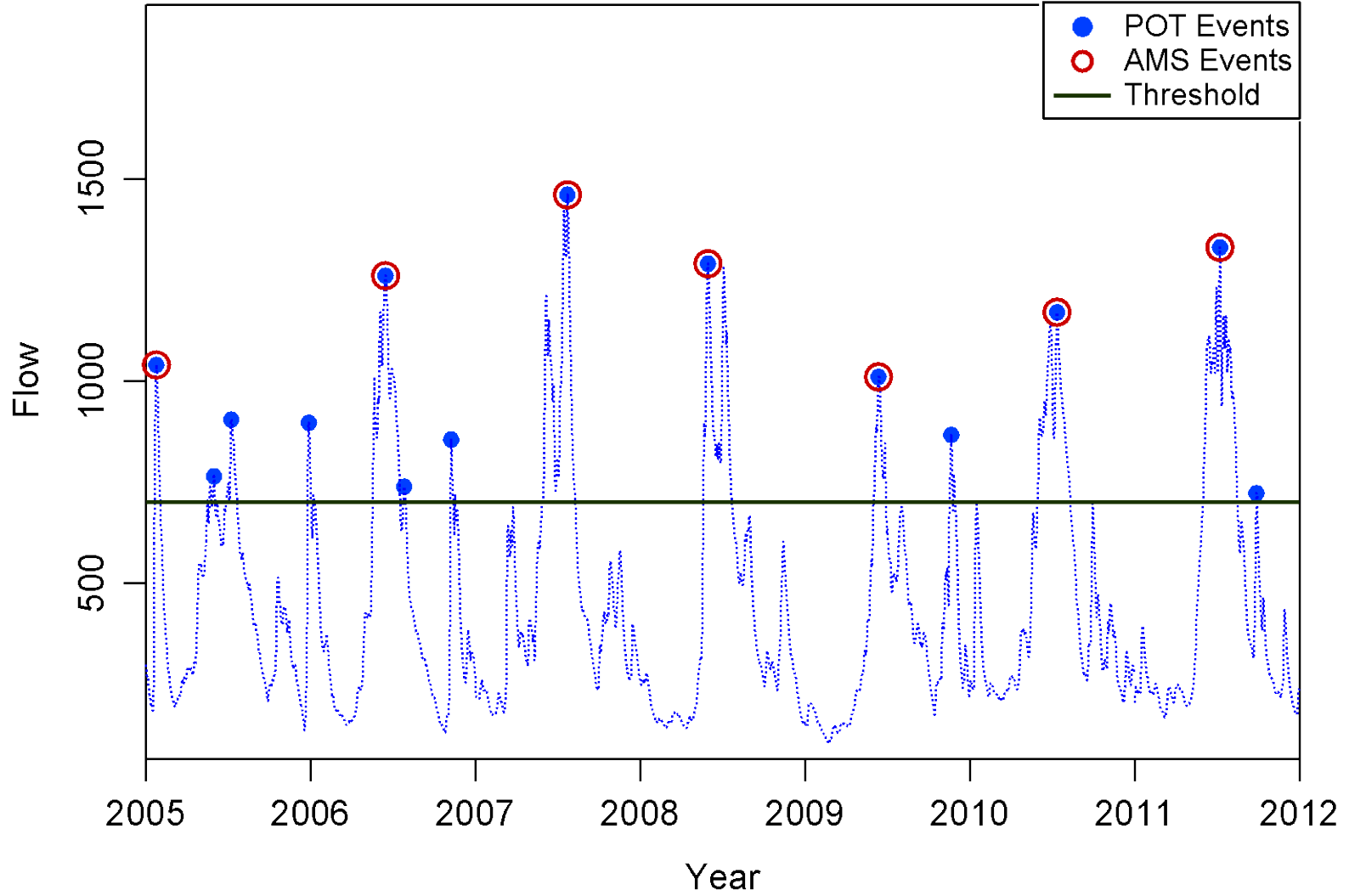
- Develop and apply a standardized approach to the estimation of extreme event quantiles
 - Based on the regional (or pooled) frequency analysis approach
- The approach will be flexible to allow for the unique characteristics of individual sites to be reflected in the implementation of the procedure at a specific location

Quantile Estimates

- The pooled approach requires:
 - i. The definition of pooling groups (regions);
 - ii. The combination of extreme event information from all sites in the pooling group; and
 - iii. The estimation of extreme event quantiles using an appropriate probability distribution function.
- Issues to be explored include:
 - Identifying the most appropriate approach to defining similarity between gauging stations to form pooling groups; and
 - Tailoring the approach to the site-specific characteristics of individual locations of interest.

Quantile Estimates

- Approaches based on both annual maximum series (AMS) data and peaks over threshold (POT) data will be explored
 - The latter represent all **independent** extreme events that exceed a specified threshold while the former consist of the largest event from each year



Analysis of Changes

- Examine changes in extremes at rain gauges and hydrometric stations across Canada
- Identify significant regional or local increasing or decreasing trends
- Rates of any significant changes will be quantified
 - Trends will be related to teleconnections to large-scale atmospheric processes known to affect climatic and hydrologic conditions

Analysis of Changes

- Non-seasonal flood models are commonly used
 - Do not take into account seasonal variability in flood characteristics
- Geographical regions with distinct flood sub-populations will be identified
 - For such regions, seasonal models will be developed that are more appropriate and accurate than non-seasonal ones
 - Formal statistical tests will be used to confirm specific needs for seasonal modelling.

Analysis of Changes

- Studies will be carried out using both the AMS and the POT approach
 - POT approach incorporates more data into the analysis, and hence has the potential of providing improved flood and rainfall event estimates
- The techniques will be applied to a variety of case study locations across Canada to ensure that the unique extreme event regimes are appropriately characterized

Flood Manual and Software

- There is a clear need for a manual for flood frequency analysis
 - Canada does not have a national standard for flood frequency analysis
- This is in contrast to:
 - The United States where detailed guidelines for flood frequency analysis have been in place since 1967
 - The UK, where the Flood Estimation Handbook provides similar guidelines for practitioners

Flood Manual and Software

- Guidelines have the advantage of providing a consistent framework for design flood estimation and for handling the various subtleties that arise in most flood studies
- There is a significant amount of experience with flood frequency analysis in Canada and this work intends to capitalize on this through careful evaluation of current practices and methods

Flood Manual and Software

- The research will explore a range of issues related to flood frequency analysis, including:
 - i. Methods for selection of distributions, estimation methods, and confidence interval estimation;
 - ii. Identification and handling of outliers;
 - iii. Treatment of historical flood information;
 - iv. Estimation methods for watersheds that are ungauged or have short records; and
 - v. Estimation methods for mixed flood populations.

Flood Manual and Software

- The intent is to implement the recommended procedures in a user-friendly statistical toolbox that can be made available to Canadian users
- A manual describing the recommended practice for flood frequency analysis will be a key deliverable of this research
- The flood estimation manual and the related statistical toolbox will undergo rigorous testing by interested organizations, such as conservation authorities, provincial government departments, and other regulatory agencies

Path Forward

- A comprehensive data base that will include information for a large number of watersheds from across the country will be developed and will form the basis for the evaluation of different procedures
- The data base will include observed annual maximum floods, and physiographic and meteorological information for the watersheds

Path Forward

- Consultation with our industry and governmental partners (and interested stakeholders) will be undertaken to ensure that the needs of the user community are reflected in the products of this research



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