Surprise in Plymouth as flood floods floodplain in flooding season, 28 Feb 2017 (taken from Twitter)

Projecting Future Changes in Flooding Across New England: More Challenging than You Might Think

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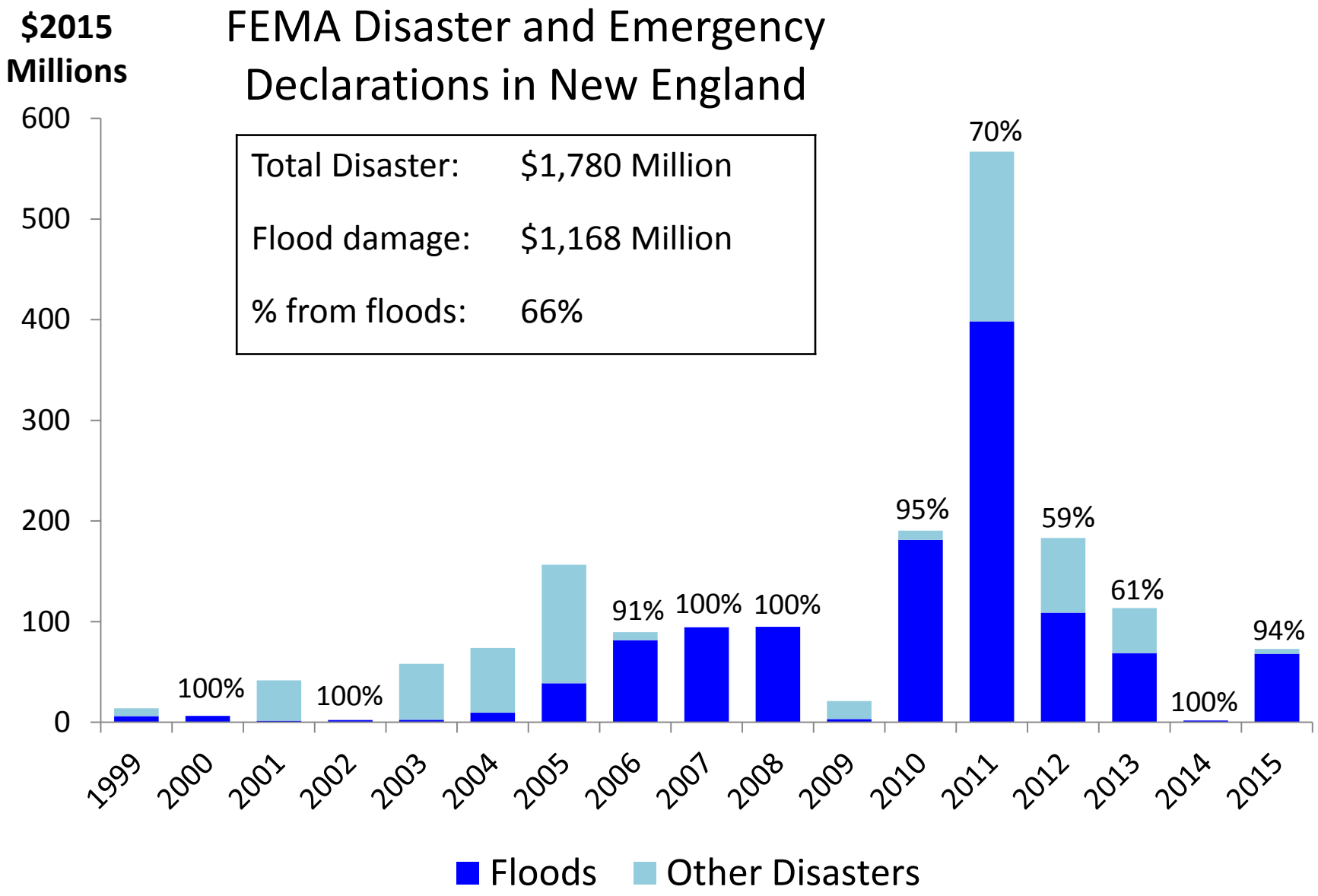
2017 NH Water & Watershed Conference
Past and Future Challenges of Water Resource Management in NH
24 March 2017, Plymouth State University

University of New Hampshire

Floods are important in New England



Outline

1. Overview of challenges

1. Historical analysis: Flooding in New England
   Rainfall vs Runoff
   Rainfall probability vs runoff probability

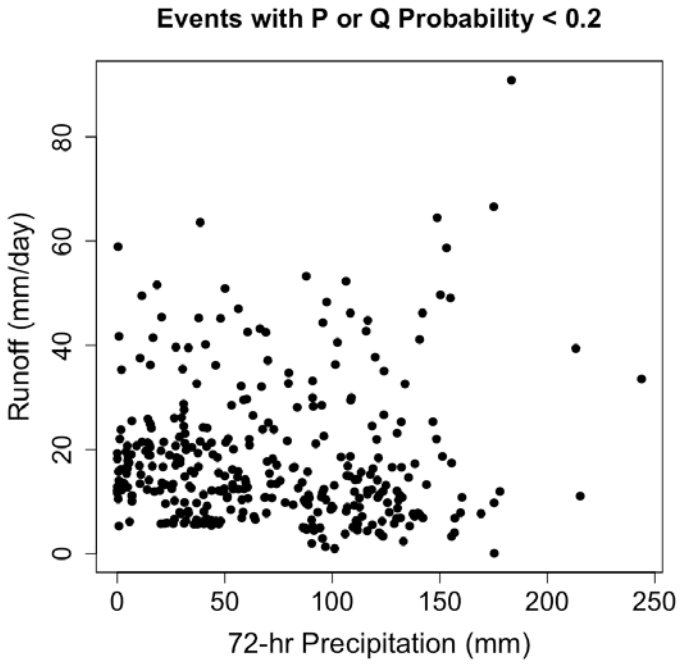
2. Estimating future changes in flooding

3. Addressing challenges:
   Antecedent conditions
   Building resilience

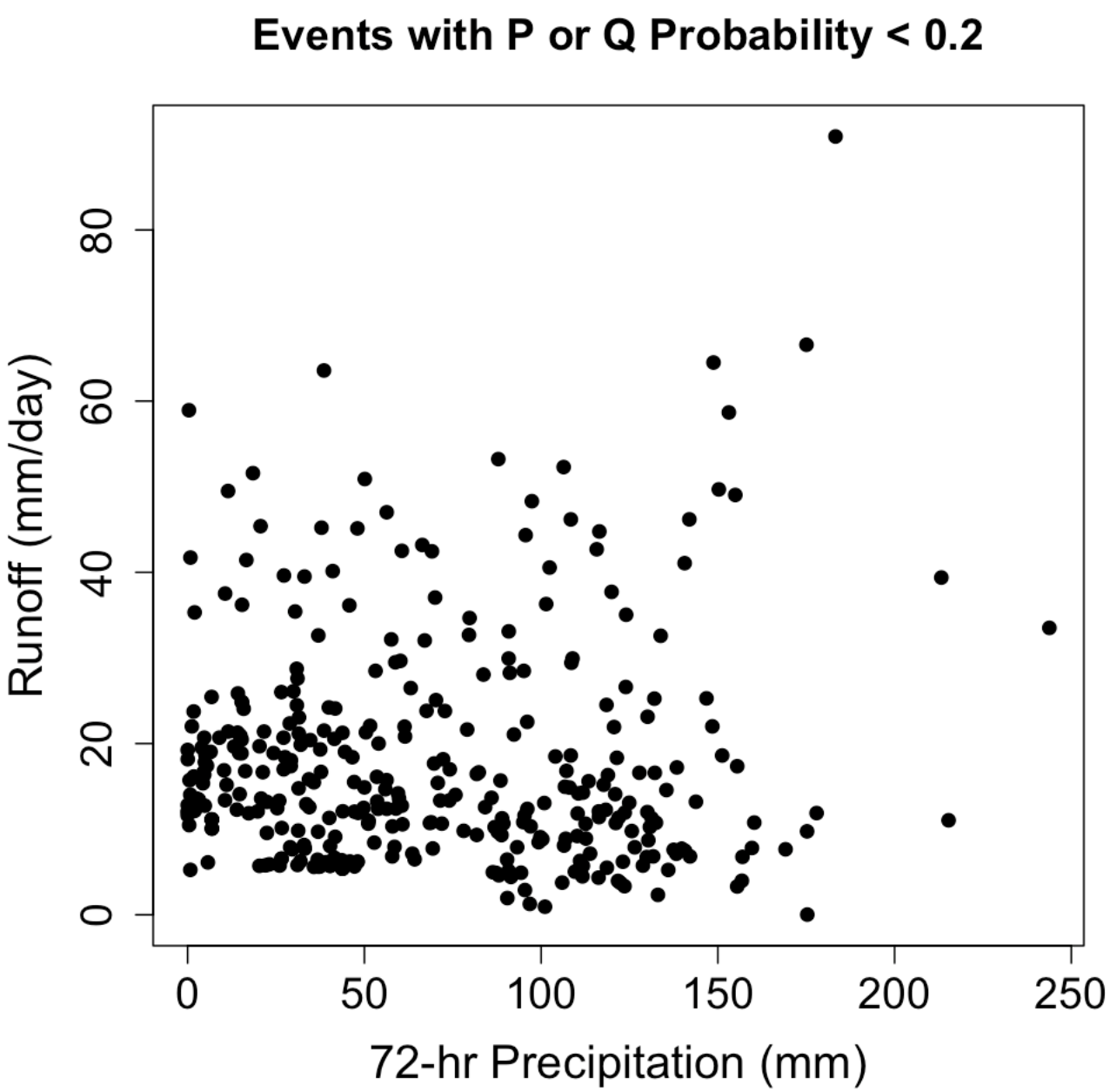
Derry, NH
Mother's Day Flood, 2006
Allegra Boverman, eagletribune.com

Overview: Challenges in future flood projections

- Scenario uncertainty:
  - Climate trajectory (RCPs)
  - Land use change
  - Population change
- GCM: challenges in simulating changes in precipitation
- Bias-correction and downscaling uncertainty
- **Rainfall-runoff relationship**
- Runoff-social cost relationship



Historical analysis: **Rainfall-runoff relationship**



USGS HUC 01

Data:

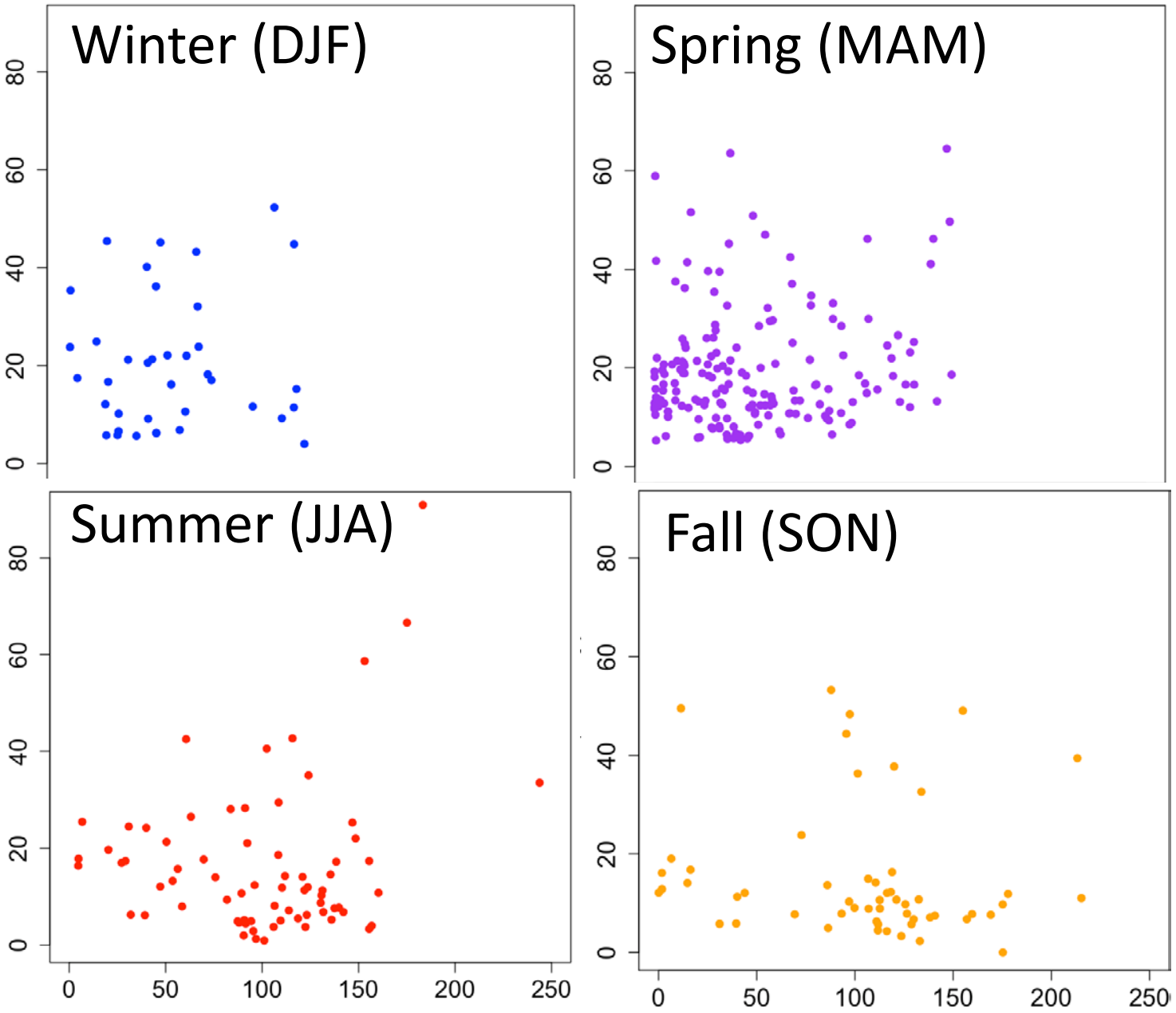
- 145 USGS gages with records ≥ 30 years long
- Watershed > 16 km^2 (based on precip data resolution)
- PRISM gridded precipitation data, selected upstream area for each USGS station.

Method:

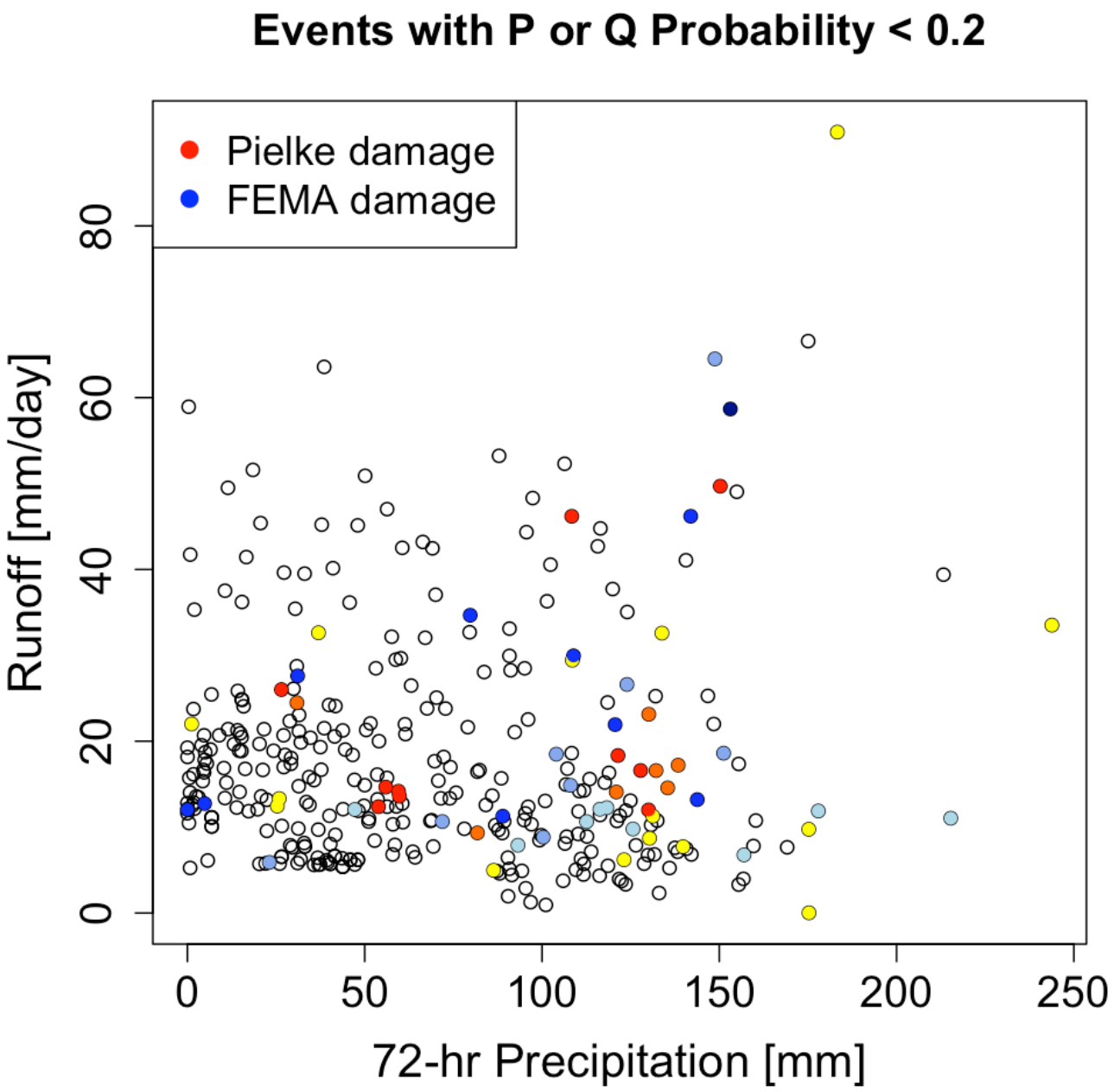
Frequency analysis

- Log-Pearson Type III distribution fit to annual peak discharge.

Historical analysis: **Rainfall-runoff relationship by Season**



Historical analysis: **Rainfall-runoff relationship → Social damage**



Data:

- FEMA flood damage payouts for identified flood events
- Pielke, 2009

Pielke Damage*

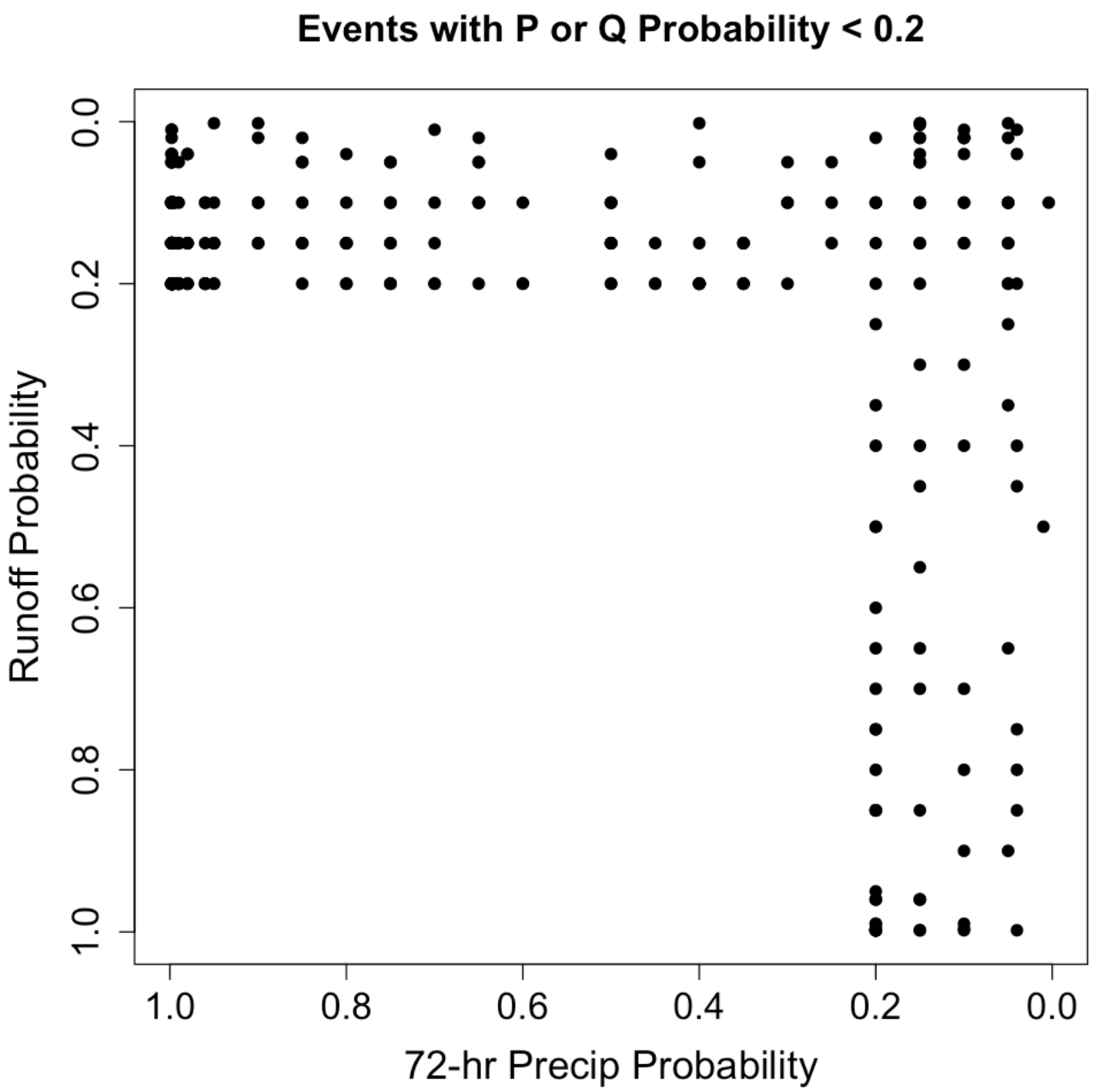
$10 M → $145 M

FEMA Damage*

$10 M → $350 M

**Damage data sources not directly comparable*

Historical analysis: **Rainfall-runoff relationship: Probability**

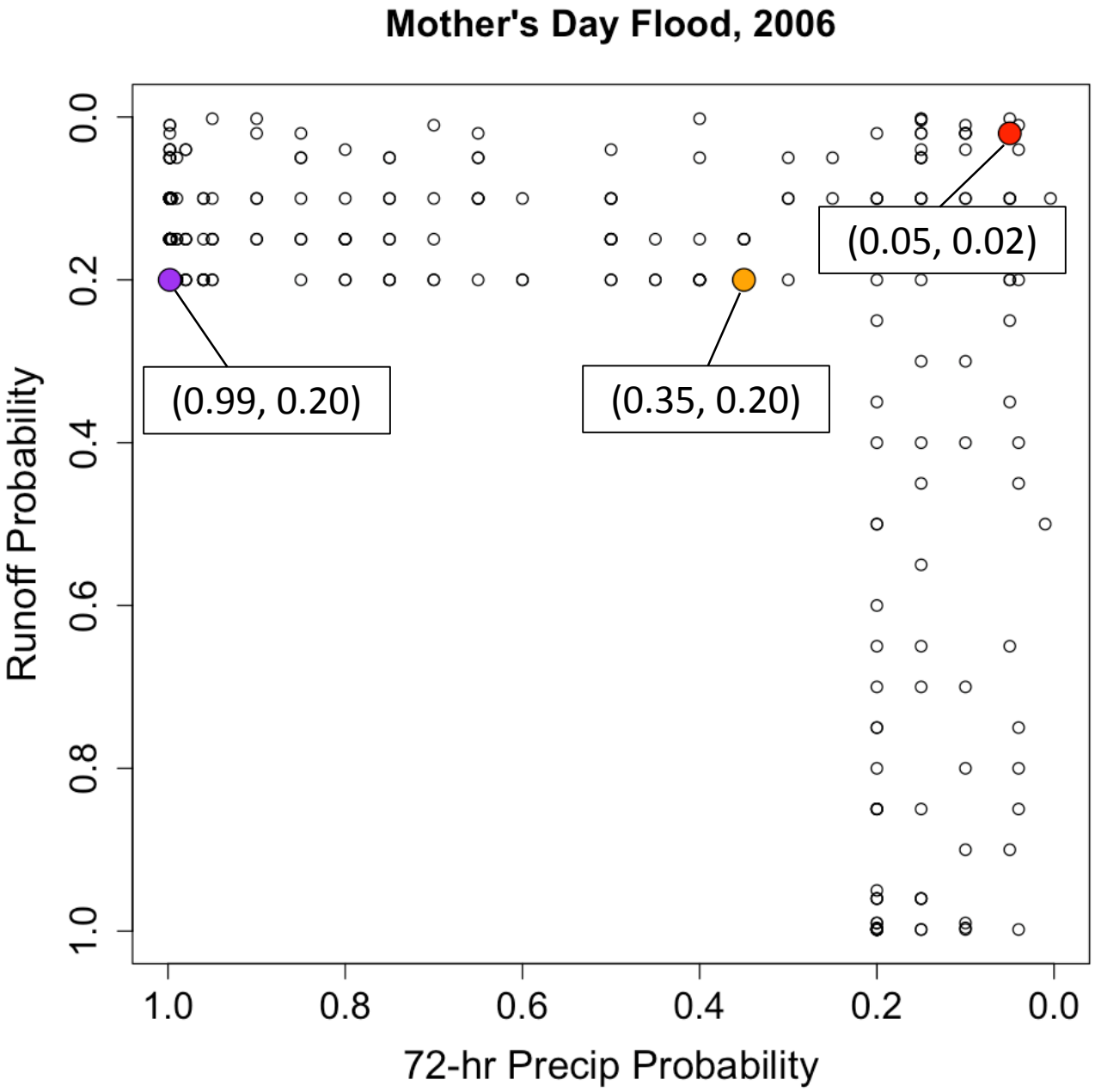


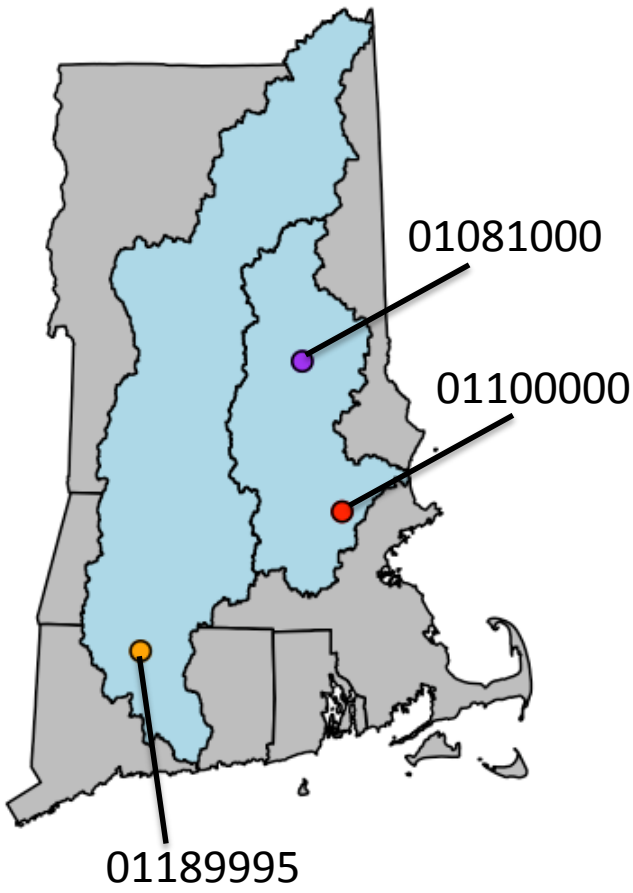
Methods:

- Event probabilities are binned
- Minimum probability: 0.002

(500-year return interval)

Historical analysis: **Rainfall-runoff relationship: Probability**

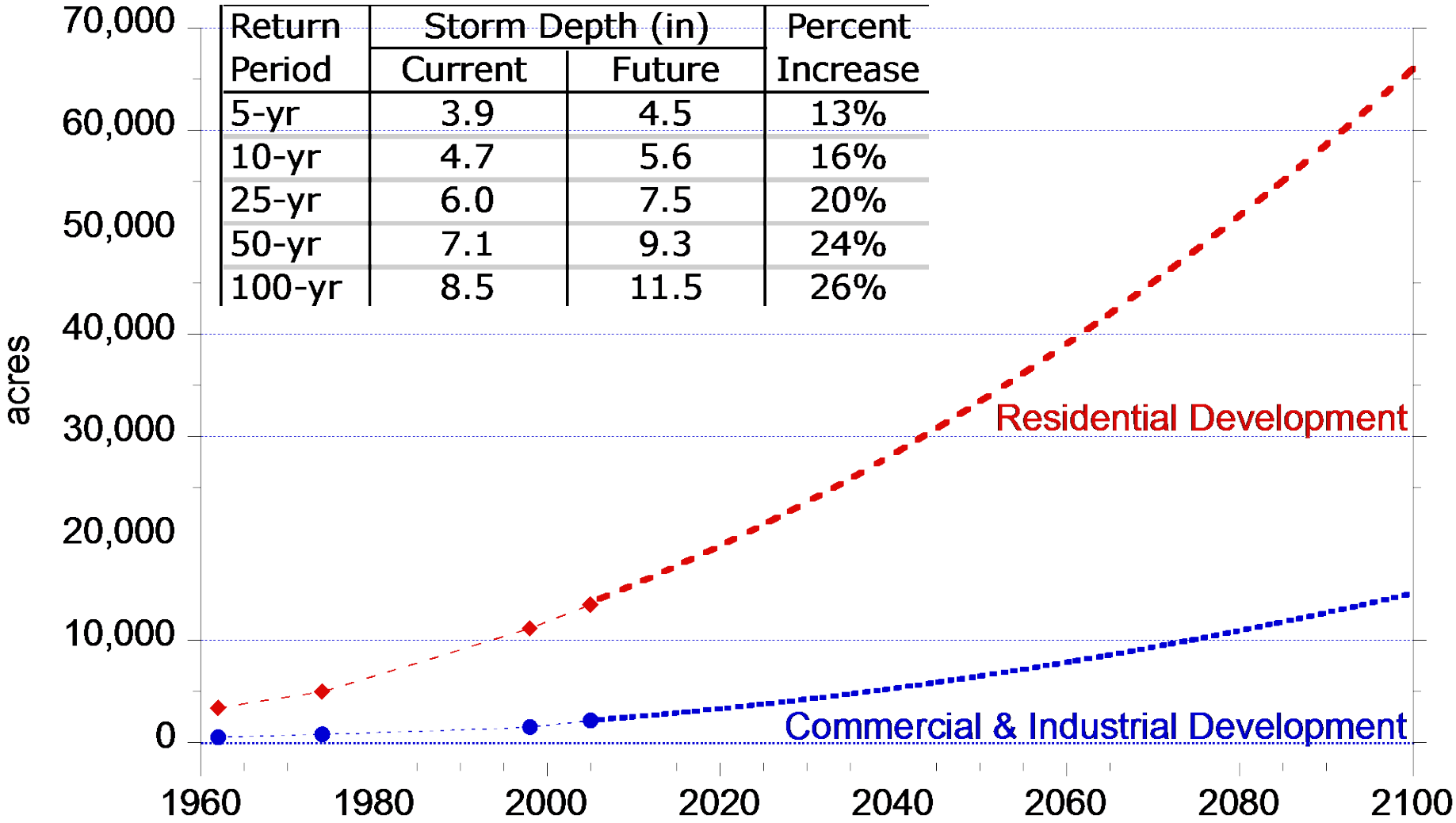




Estimating Future Changes in Flooding: Lamprey River Watershed

Build Out & 24-hr Storm Depth Scenarios

Return Period	Storm Depth (in)		Percent Increase
	Current	Future	
5-yr	3.9	4.5	13%
10-yr	4.7	5.6	16%
25-yr	6.0	7.5	20%
50-yr	7.1	9.3	24%
100-yr	8.5	11.5	26%



Estimating Future Changes in Flooding: Lamprey River Watershed

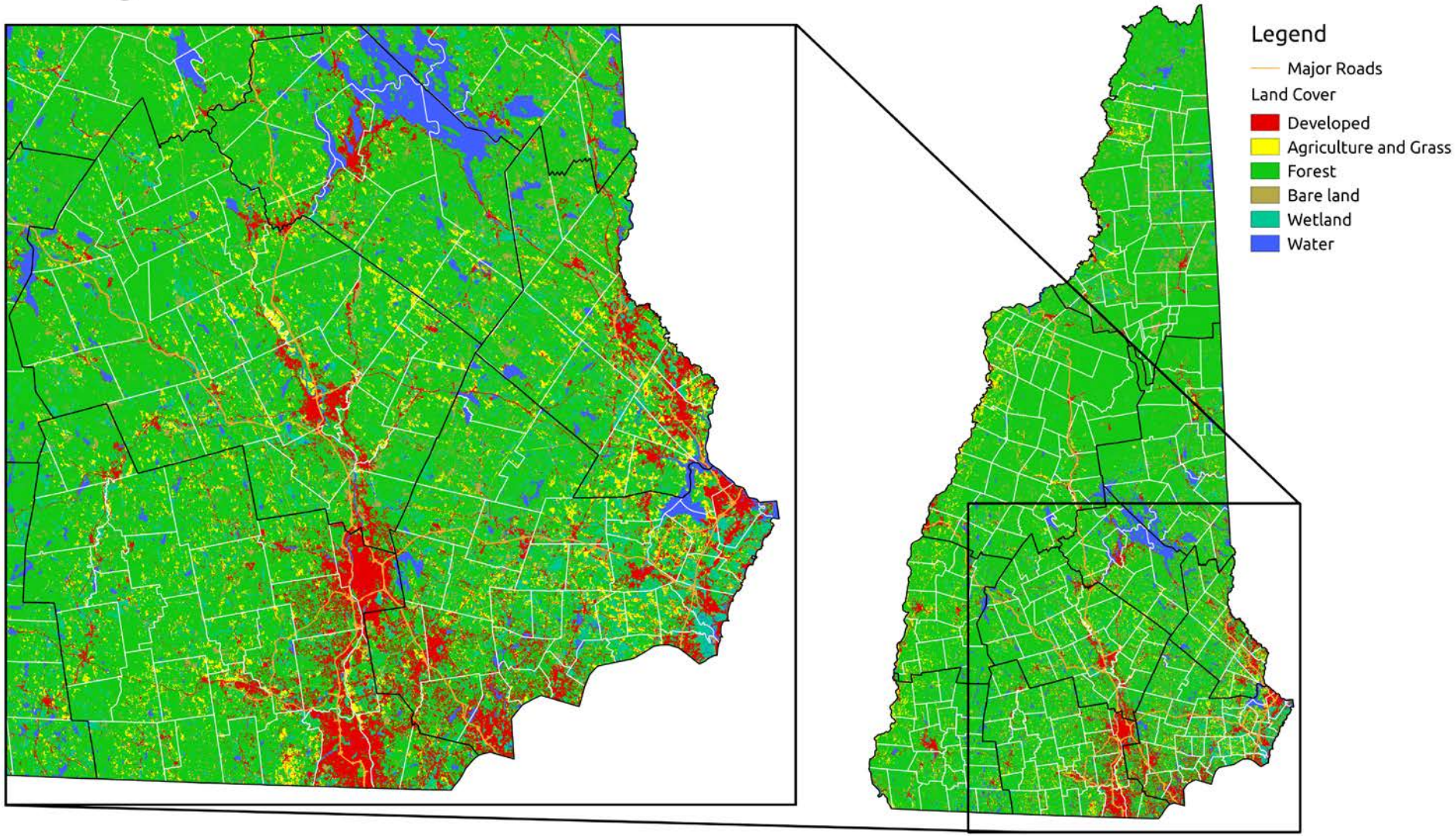
Discharge at Packer's Falls, Lamprey River

Return Period	Discharge (cfs)		Percent Increase
	Current	2050 CON	
5-yr	3,276	4,567	28%
10-yr	4,447	6,459	31%
25-yr	6,525	10,007	35%
50-yr	8,169	13,598	40%
100-yr	11,291	18,185	38%

Geosyntec Consultants, 2016; 100yearfloods.org

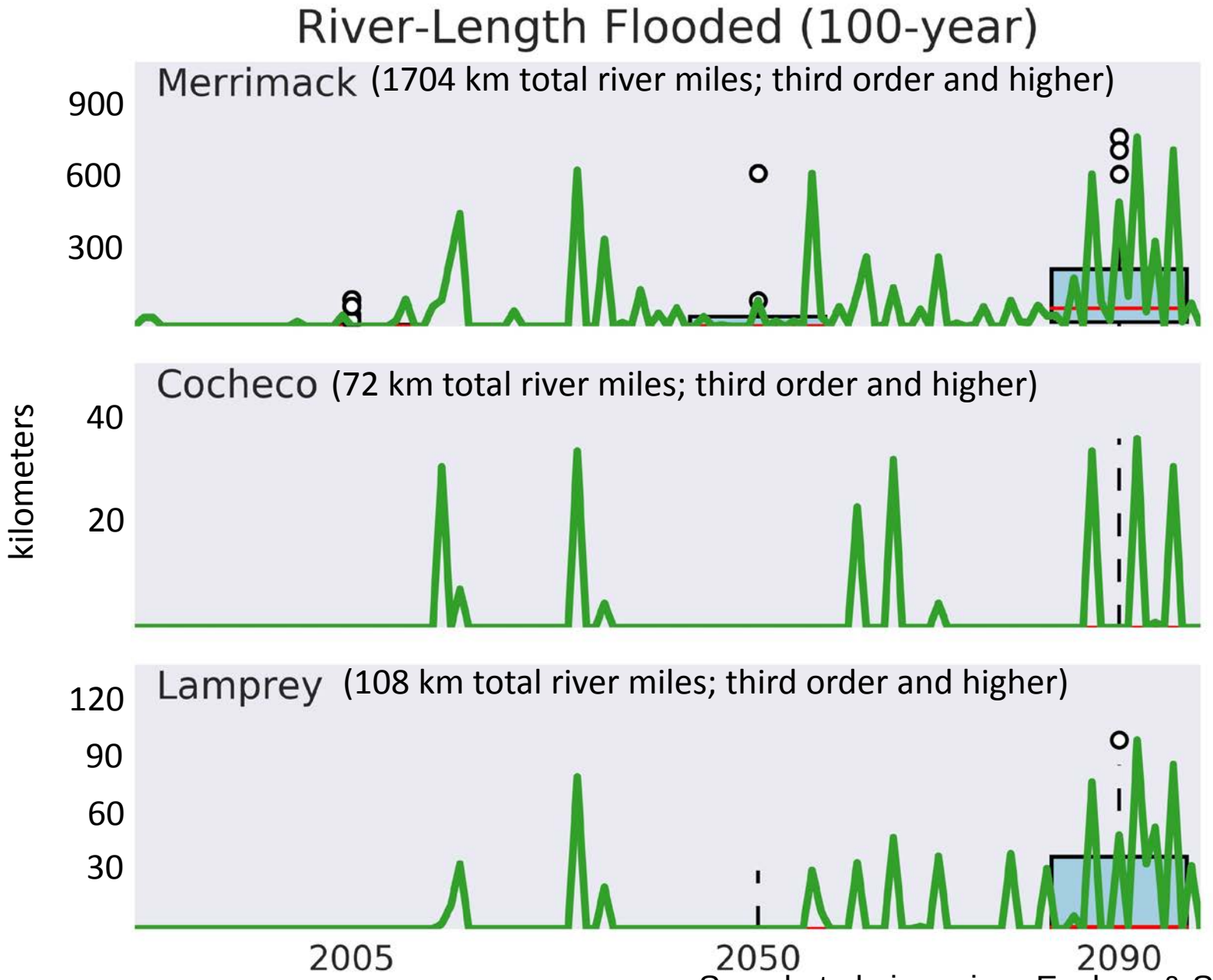
Estimating Future Changes in Flooding: New Hampshire

Backyard Amenities: 2010



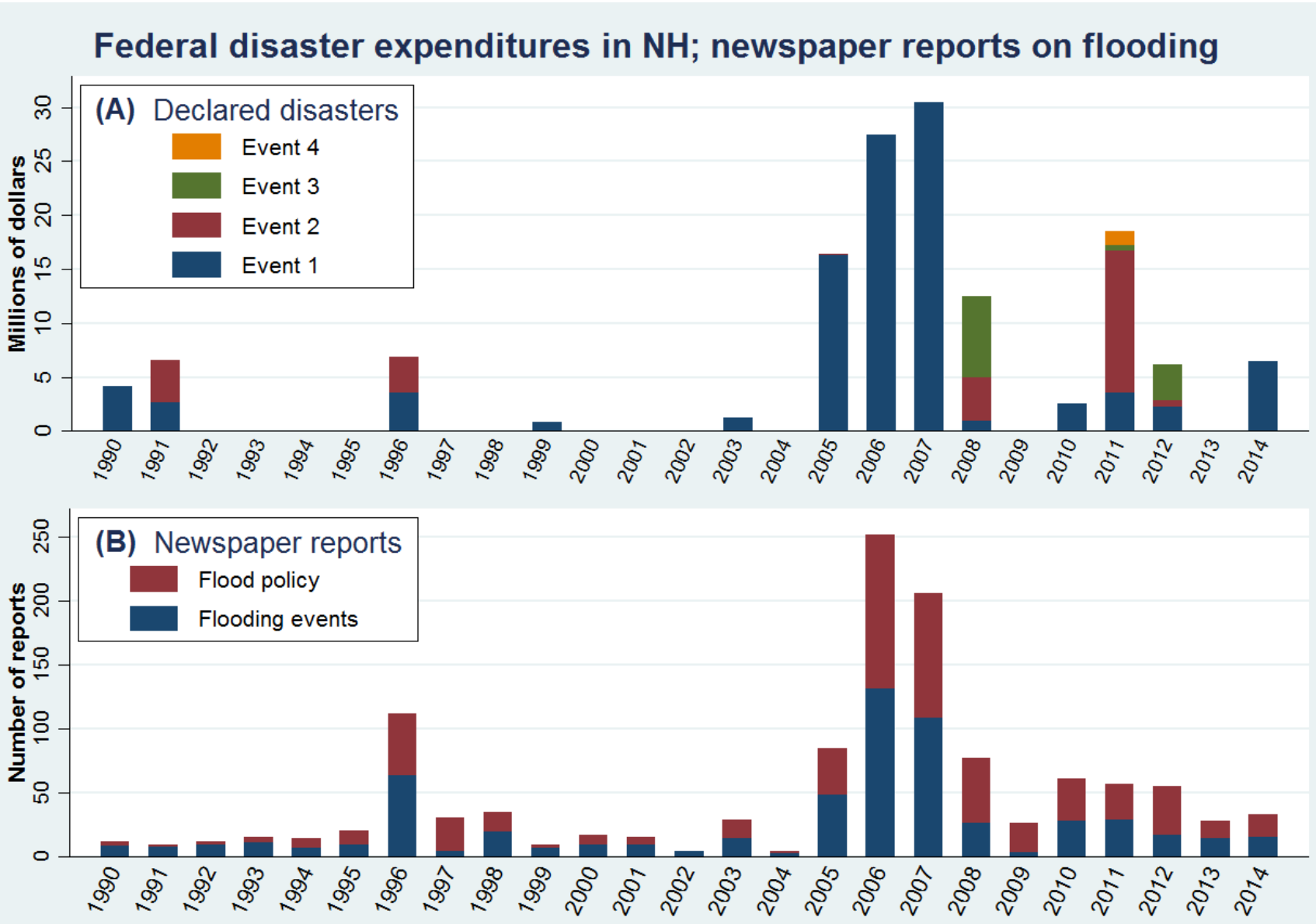
Thorn et al., in review, Ecology & Society; UNH Data Discovery Center: https://ddc.unh.edu

Estimating Future Changes in Flooding: Backyard Amenities, Lo Emission



Samal et al., in review, Ecology & Society

Objectively, NH flooding increased in past decade



Hamilton et al. (2016) "Flood realities, perceptions and the depth of divisions on climate" *Sociology*

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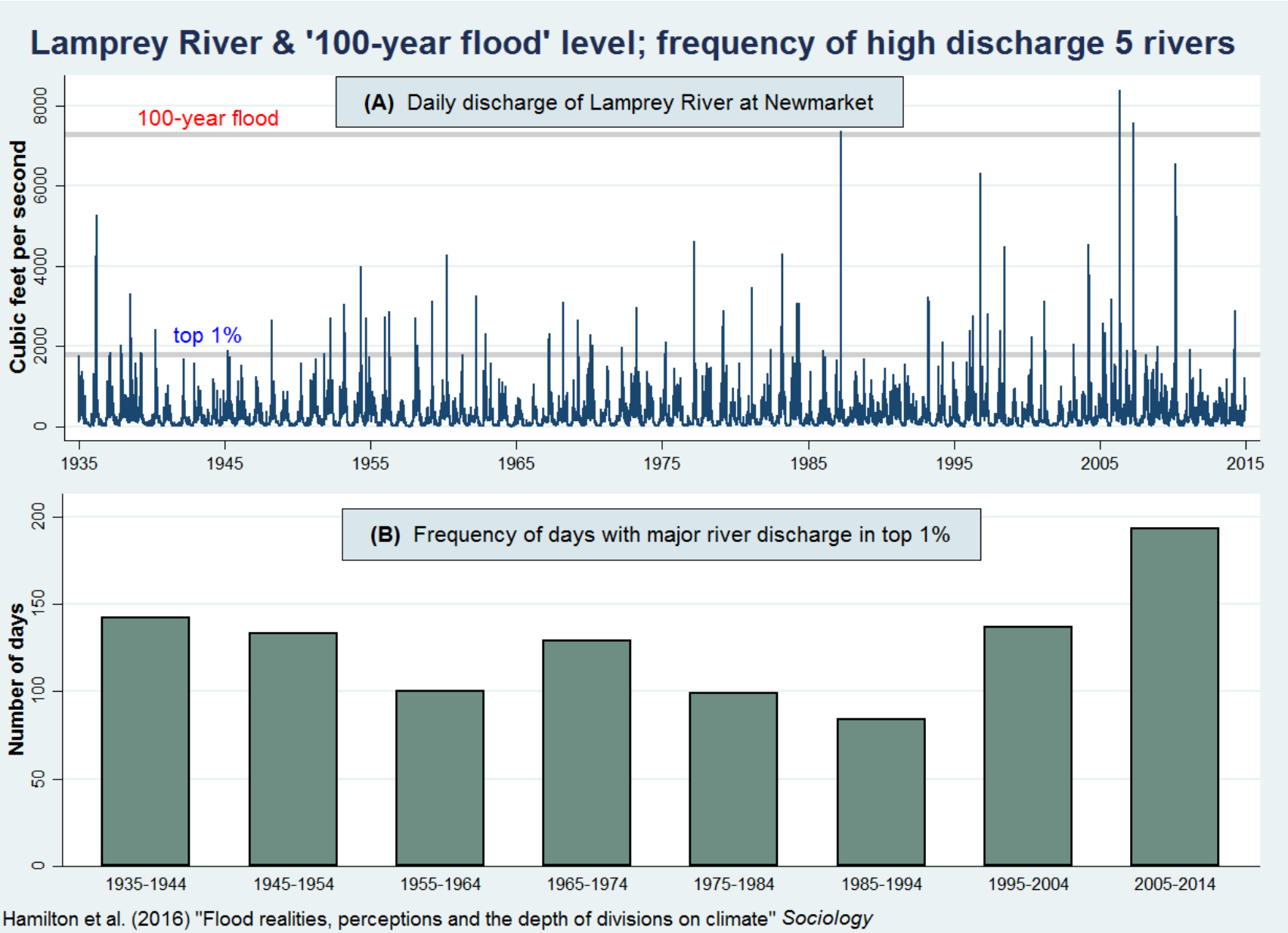

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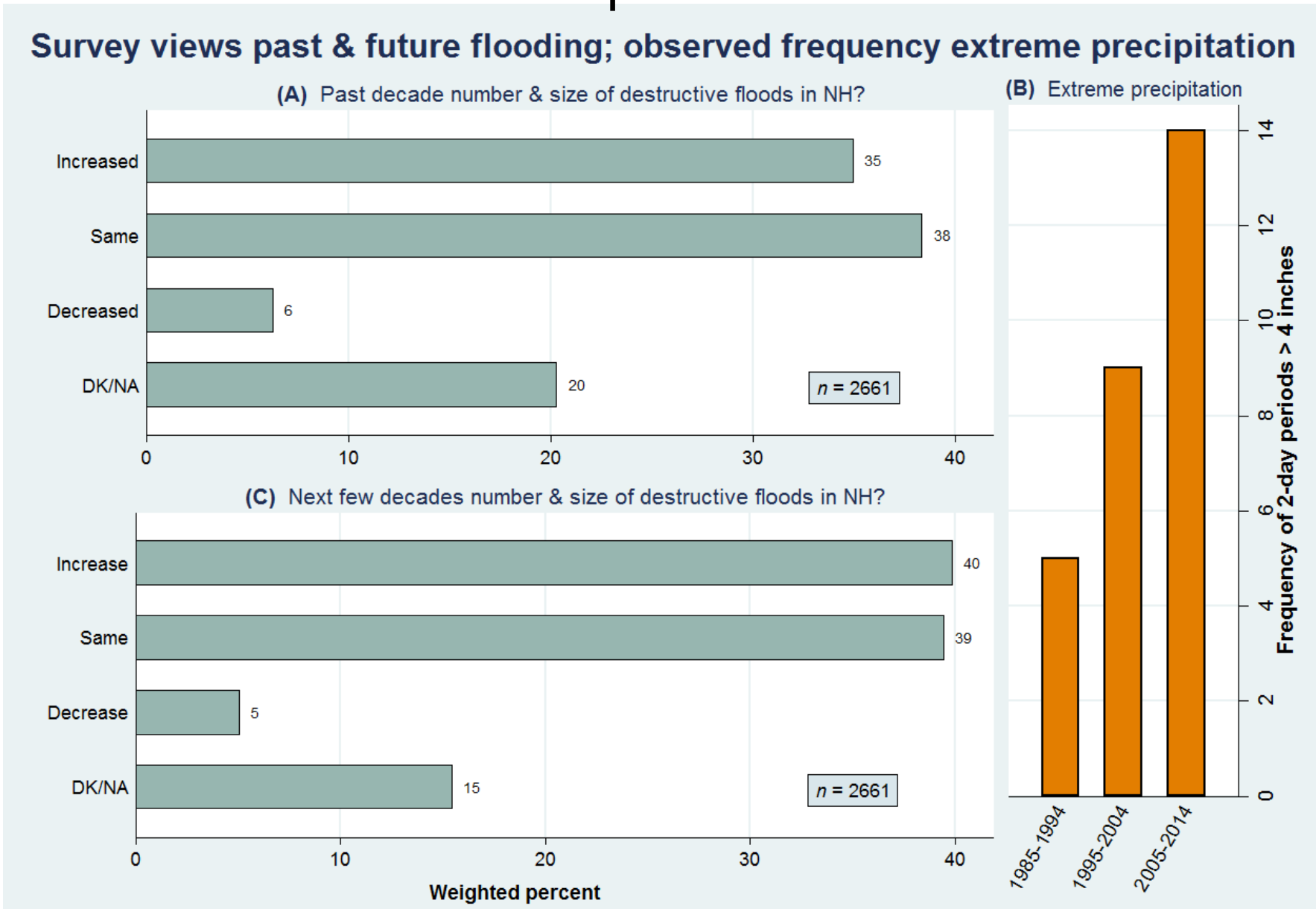
Less than half of state residents realize that flooding has increased …or expect more floods in future



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PROPOSED RESEARCH: Quantifying Risk and Risk-Reduction of Future Riverine Flooding Across New England

Enhance our understanding of:

- fundamental processes controlling flood risk
- determine the key processes responsible for the non-linearity between extreme precipitation and discharge.

Explore and quantify a suite of adaptation strategies that could reduce the severity of future flooding, especially in urban areas.

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Our Question:
Knowing that our communities flood already, and that there is likely to be more frequent and larger floods in the future, what are the best strategies to promote flood resilient communities?

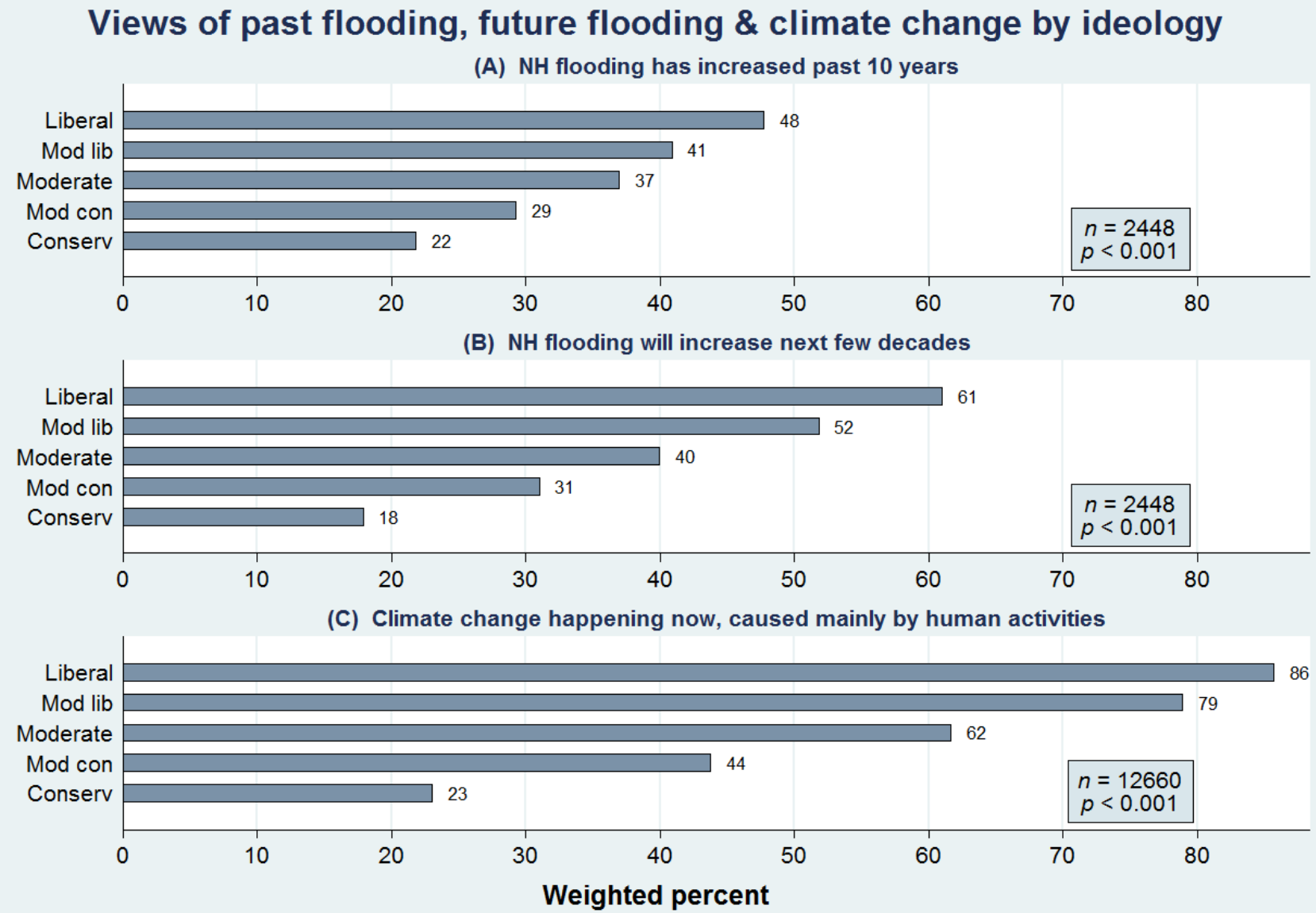
EXTRA SLIDES

Estimating Future Changes in Flooding: Lamprey River Watershed

Town	Flooded area (sq. miles)		Percent Increase
	2005	2050	
Raymond	1.5	1.7	10%
Epping	1.5	1.7	14%
Lee	1.2	1.5	17%
Newmarket	1.1	1.2	13%
Durham	0.9	1.0	11%
Total	6.2	7.0	13%

Town	Annual Damage (million $)		Percent Increase
	2005	2050	
Raymond	$15.0	$17.7	18%
Epping	$8.1	$10.2	26%
Lee	$2.8	$3.5	28%
Newmarket	$4.1	$7.0	68%
Durham	$0.9	$1.6	68%
Total	$31.0	$40.0	29%

Beliefs about past (& future) flooding depend on ideology, not geography



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Liberals & mod w/ higher ed. more likely to expect increased flooding. Conservatives w/ higher ed. are less likely.