

Precipitation-Related Vehicle Crashes Under Future Climate

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INTRODUCTION

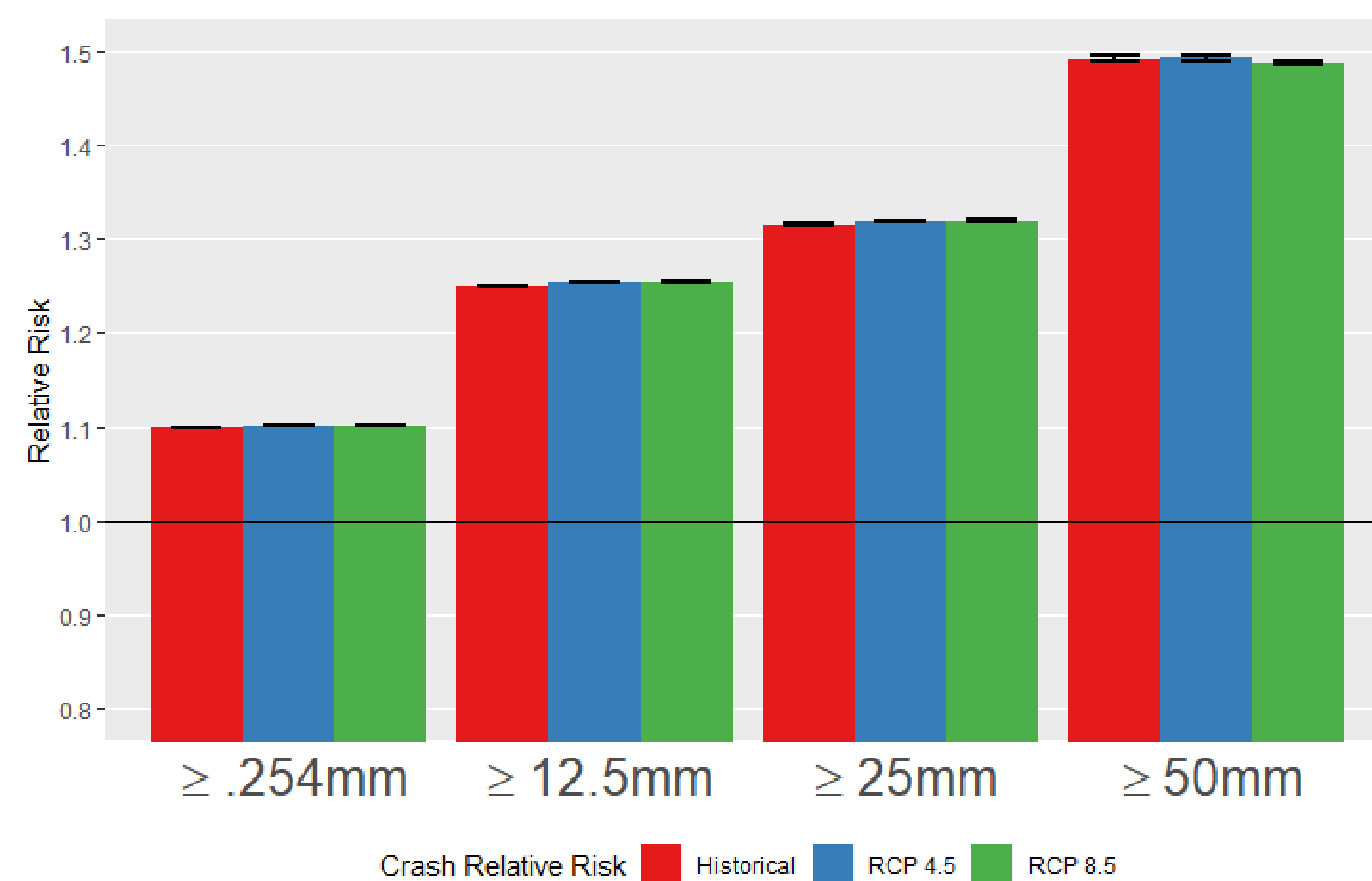
- It is well established that precipitation increases crash risk as compared to dry conditions.
- How will changes in warm-season (1 May through 30 September) precipitation under future climate impact crashes?

METHODS

1. Data on vehicle crashes, injuries, and fatalities were obtained from the National Highway Traffic Safety Administration (NHTSA) and tabulated by county for six U.S. states – Arkansas, Georgia, Illinois, Maryland, Minnesota, and Ohio.
2. Daily rainfall totals for those states were retrieved from the Climate Prediction Center (CPC) Unified Gauge-Based Daily Precipitation database.
3. Downscaled Localized Constructed Analog (LOCA) data were gathered for six U.S. States. Daily precipitation values were extracted from LOCA for the historic (1950 – 2005) and future (2045 – 2100) periods (55 yrs. each).
4. Based on the distribution of daily precipitation from LOCA, a stratified random sample was used to select days with similar precipitation characteristics from CPC data; the number of crashes, injuries, and fatalities from those days were tabulated.
5. These days were matched with a dry control day, and the change in risk was assessed using relative risk.

RESULTS

- Relative Risk of Crash for the LOCA historical and future periods under RCP 4.5 and 8.5 (below).



Changes in warm-season rainfall will lead to an additional 2,800 crashes, 1,200 injuries, and \$37,000,000 in economic losses per year by 2100 in the six study states.

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RESULTS, continued

All Rainfall	Crash Relative Risk	95% CI	
		Lower	Upper
Historical	1.0985	1.0983	1.0986
RCP 4.5	1.1016	1.1014	1.1017
RCP 8.5	1.1020	1.1018	1.1021
Rainfall ≥ 12.5 mm (0.50 inches)			
Historical	1.2501	1.2497	1.2505
RCP 4.5	1.2537	1.2533	1.2541
RCP 8.5	1.2545	1.2542	1.2549
Rainfall ≥ 25 mm (1.00 inch)			
Historical	1.3153	1.3145	1.3162
RCP 4.5	1.3191	1.3183	1.3199
RCP 8.5	1.3196	1.3188	1.3204
Rainfall ≥ 50 mm (2.00 inches)			
Historical	1.4929	1.4900	1.4957
RCP 4.5	1.4929	1.4904	1.4955
RCP 8.5	1.4878	1.4854	1.4902

At left: Relative Risk of Crash for the LOCA historical and future periods under RCP 4.5 and 8.5 for various daily precipitation thresholds.

- Crash relative risk is significantly higher in the future under both RCP 4.5 and 8.5 than in the historic period.
- While the increases in relative risk are small, they represent an additional 2,800 crashes and 1,200 injuries per year during the warm season (1 May through 30 Sept.). The costs of these crashes and injuries is estimated to be \$37,000,000. These values only consider the six states examined, so the true increase in crashes, injuries, and economic losses across the U.S. will be higher.

DISCUSSION

- The changing nature of precipitation is likely to have an impact on transportation risk in the future.
- This work only considers the change in risk due to a shifting precipitation distribution. There are many other factors that impact road safety during rainfall.
- General Circulation Models (GCMs) have difficulty in capturing the most extreme precipitation events. These events are expected to greatly increase in the future and have the most significant impact on overall crash risk.
- Future work will examine additional precipitation thresholds and downscaled model members.

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