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ENVIRONMENT

Expanding Paved Areas Has an Outsize Effect on Urban Flooding

Researchers have finally been able to pinpoint just how much impervious surfaces exacerbate flood levels

By Erica Gies on May 15, 2020



Floodwater rips down Main Street during a torrential storm in Ellicott City, Md., on May 27, 2018. Credit: Katherine Frey Getty Images

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Blockbuster flooding events such as Hurricane Harvey grab headlines, but urban flooding is a routine—and growing—problem: in a 2018 report, 83 percent of municipal stormwater and flood managers surveyed in the U.S. reported such inundation in their areas. Though heavier downpours fueled by climate change are a factor, the expansion of pavement and other impervious surfaces is making the situation worse because it prevents the land from absorbing these torrents of water. On that broad point, researchers largely agree. What they have not agreed on is how much worse.

Now a study published in March in *Geophysical Research Letters* has found that, on average across the U.S., every time a city expands roads, sidewalks or parking lots by one percentage point, the annual flood magnitude in nearby waterways increases by 3.3 percent. (Some of the floodwater that the ground cannot absorb runs into nearby rivers and streams, so measuring their levels can help track changes in flooding severity.) Hydrologist Annalise Blum and her co-authors say the mathematical model they used makes their finding more accurate than previous studies. And it could help answer other questions about human impacts on water systems—an emerging field called sociohydrology.

Blum says previous research that looked at just one or two waterways was too narrowly focused to parse how much various human interventions—such as paved surfaces, dams or levees—contribute to flooding. To untangle the role of impervious areas from the “noise” of other influences, Blum and her colleagues—including Paul Ferraro, an economist at Johns Hopkins University—used an extremely large data set covering 39 years of records from 280 stream gauges, which measure water levels in rivers and streams. They also adapted a statistical model more common to economic studies. Economists use this technique to isolate how a particular policy might alter human behavior. Blum and her team tweaked it to leverage differences among all the stream-gauge data, thus isolating the role of paving from other human modifications. “By using data in both time and space dimensions, we were able to soak up all of that noise and isolate the causal effect,” says Blum, who was a postdoc at Johns Hopkins when she conducted the new study and is now a AAAS Science & Technology Policy Fellow.

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Maura Allaire, a water economist at the University of California, Irvine, who was not involved with the new study, says the research design is “a major contribution to natural sciences and hydrology in particular.” Conducting similar analyses for other human-made contributors to flooding could help cities take targeted steps to ameliorate them. These approaches could include discouraging building in a floodplain if that was shown to be a dominant factor or increasing green infrastructure and permeable surfaces throughout a city to absorb more rainwater.

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Erica Gies writes about science and the environment from Victoria, British Columbia, and San Francisco. Her work appears in the *New York Times*, the *Guardian*, the *Economist*, and elsewhere. She is working on a book that investigates water's past so we can adapt to the future by collaborating with nature.

Credit: Nick Higgins

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