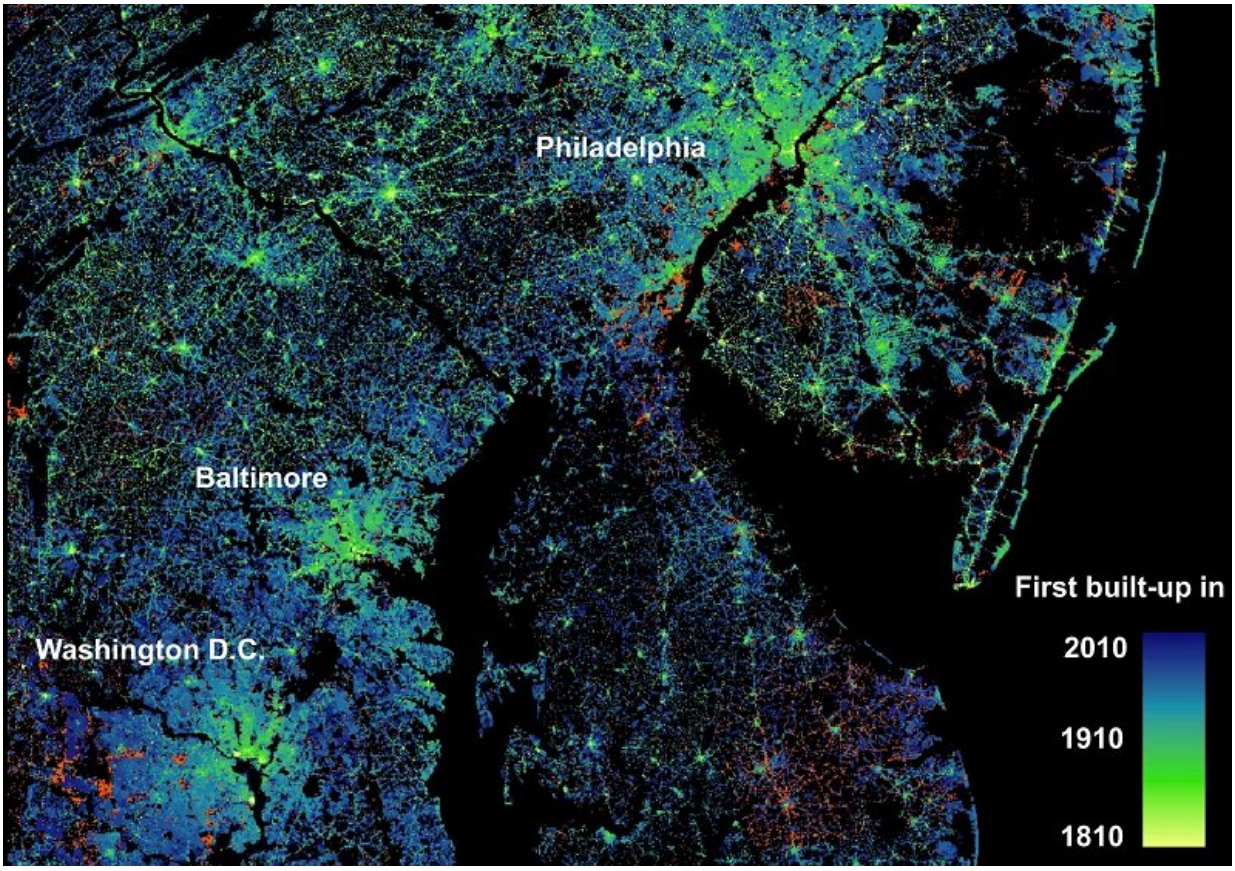
Scholars reveal the changing nature of US cities

January 28 2021, by Cay Leytham-Powell



Washington, D.C. and surrounding area. Credit: Johannes Uhl

Cities are not all the same, or at least their evolution isn't, according to new research from the University of Colorado Boulder.

These findings, out this week in *Nature Communications Earth and Environment* and *Earth System Science Data*, buck the historical view that most cities in the United States developed in similar ways. Using a century's worth of urban spatial data, the researchers found a long history of urban size (how big a place is) "decoupling" from urban form (the shape and structure of a city), leading to cities not all evolving the same—or even close.

The researchers hope that by providing this look at the past with this unique data set, they'll be able to glimpse the future, including the impact of population growth on cities or how cities might develop in response to environmental factors like sea level rise or wildfire risk.

"We can learn so much more about our cities about and urban development, if we know how to exploit these kinds of new data, and I think this really confirms our approach," said Stefan Leyk, a geography professor at CU Boulder and one of the authors on the papers.

"It's not just the volume of data that you take and throw into a washing machine. It's really the knowing how to make use of the data, how to integrate them, how to get the right and meaningful things out there."

It's projected that by 2050, more than two-thirds of humans will live in urban areas. What those urban areas will look like, however, is unclear, given limited knowledge of the history of urban areas, broadly speaking, prior to the 1970s.

This work and previous research, however, hopes to fill that gap by studying property-level data from the property management company, Zillow, through a property-share agreement.

This massive dataset, called the Zillow Transaction and Assessment Dataset or ZTRAX, contains about 374 million data records that include

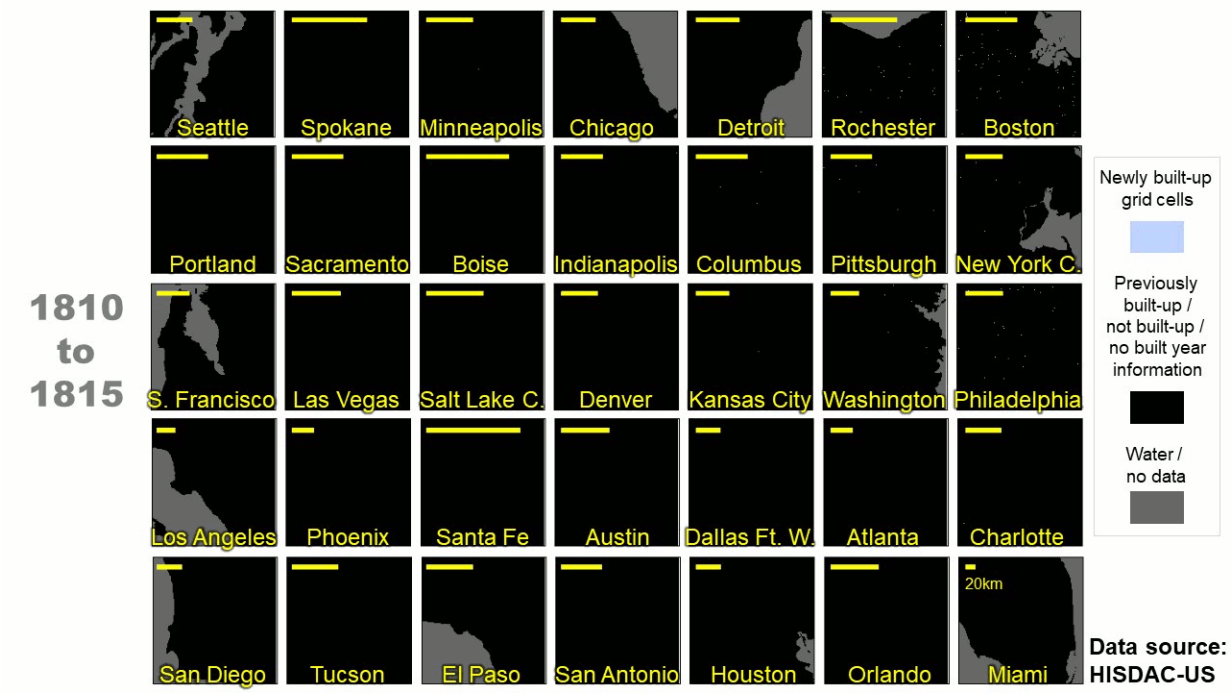
the built year of existing buildings going back over 100 years. Previously, the researchers then used these data to create the Historical Settlement Data Compilation for the United States (HISDAC-US), a set of unique time series data set that's freely available for anyone to use.

For this new research, which were funded by the National Science Foundation, the Institute of Behavioral Sciences and Earth Lab, the researchers applied statistical methods and data mining algorithms to the data, trying to glean all available information on the nature of settlement development, particularly for metropolitan statistical areas, or high-density geographic regions.

What they found is that not only were they able to learn more about how to measure urban size, shape and structure (or form), including the number of built-up locations and their structures, they were also able to see very clear trends in the evolution of these distinct categories of urban development.

In particular, the researchers found that urban form and urban size do not develop the same as previously thought. While size generally moves in a single direction, especially in large cities, form can ebb and flow depending on constraints, such as the geography of places as well as environmental and technological factors.

"This (the categorization) is something that is really novel about that paper because this could not be done prior to that because these data were just not available," said Johannes Uhl, the lead author of the paper and a research associate at CU Boulder.



Credit: University of Colorado at Boulder

It's remarkable, according to the researchers, that the two articles are being published by different high-impact journals on the same day. While the *Nature Communications Earth and Environment* piece discusses the substantive application of the data, the *Earth System Science Data* discusses the data themselves, the methods to create them, and the limitations with them.

"There's so much potential in this current data revolution, as we call it," Leyk commented. "The growth of so-called data journals is a good trend because it's becoming more and more systematic to publish formal descriptions of the data, to learn where the data can be found, and to inform the community what kind of publications are based on these data products. So, I like this trend and we try and make use of it."

This research, however, is still far from finished. Next, the researchers hope to further examine the categories, and, in particular, the different groups of cities that emerged in the process of this research to hopefully determine a classification system for urban evolution, while also applying the data approach to more rural settings.

"The findings are interesting, but they can of course be expanded into greater detail," Uhl said.

The researchers are also working with other researchers in different fields across the university to explore the applications of these data on topics as far reaching as urban fuel models for nuclear war scenarios, the exposure of the built environment to wildfire risk, and settlement vulnerability from sea level rise.

"The context is a little different in each of these fields, but really interesting," Leyk said. "You realize how important that kind of new data, new information, can become for so many unexpected topics."

More information: Johannes H. Uhl et al, A century of decoupling size and structure of urban spaces in the United States, *Communications Earth & Environment* (2021). DOI: 10.1038/s43247-020-00082-7

Johannes H. Uhl et al. Fine-grained, spatiotemporal datasets measuring 200 years of land development in the United States, *Earth System Science Data* (2021). DOI: 10.5194/essd-13-119-2021

Provided by University of Colorado at Boulder