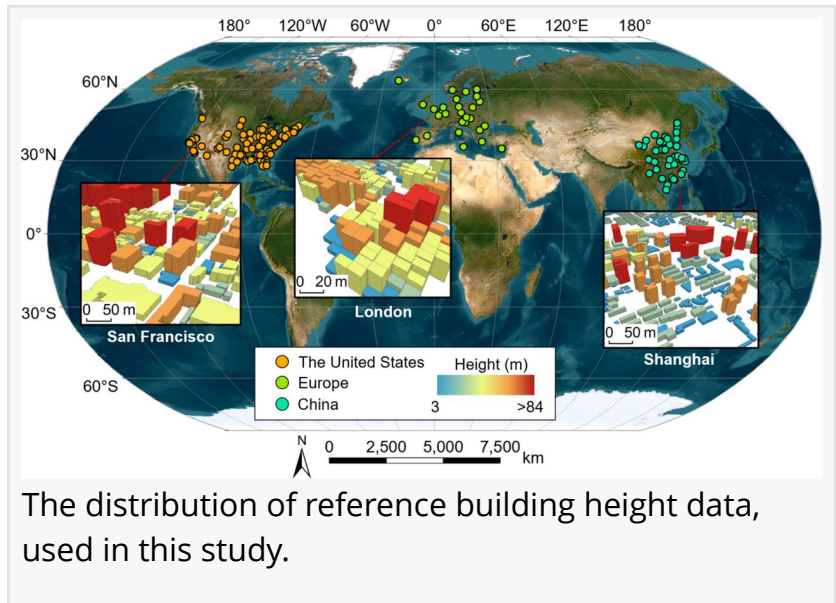


# Radar maps cities rising worldwide

GA, UNITED STATES, April 28, 2026 /EINPresswire.com/ -- Cities are growing not only outward, but upward—and now researchers have shown that this vertical transformation can be tracked worldwide over time. Using calibrated [radar](#) records from multiple satellite systems, the team reconstructed annual global built-up height and volume from 1995 to 2018. The study offers a new way to understand how urban form evolves, providing insights that could improve urban planning, energy-use estimates, and carbon-emission assessments.



Urban expansion is usually measured by how much land cities occupy, but this two-dimensional view misses a crucial part of the story: height. Built-up height and volume affect land-use efficiency, urban heat, air quality, infrastructure demand, energy consumption, and carbon emissions. Yet long-term global records of vertical urban growth have remained scarce. Existing building-height datasets often cover only short periods, depend on limited sensor types, or are difficult to compare across time because different satellite systems produce inconsistent observations. Because of these challenges, deeper research is needed to track global built-up height dynamics over long time spans.

Researchers from China Agricultural University, Tsinghua University, the University of Hong Kong, Curtin University, the University of California, Berkeley, Sun Yat-Sen University, and Southwest Jiaotong University published (DOI: 10.34133/remotesensing.1033) the study in *Journal of Remote Sensing* on March 4, 2026. The team set out to solve a major urban science problem: how to monitor not just where cities spread, but how they rise vertically over decades using globally consistent satellite data.

The researchers generated annual global built-up height and volume estimates from 1995 to 2018 at 5.5-km resolution. Their results showed that estimated built-up heights, ranging from 0 to 6.5 meters, closely matched reference datasets, with an RMSE of 0.32 m and an  $R^2$  of 0.69. By 2018, global built-up volume had reached 931.17 km<sup>3</sup>, up from 273.09 km<sup>3</sup> in 1995—an increase

of about 2.4 times. Asia experienced the fastest rise in built-up volume, and the relative growth rate of built-up volume in the Global South was approximately double that of the Global North. By shifting attention from horizontal sprawl to three-dimensional growth, the study reveals a fuller picture of urban evolution and development intensity.

To make long-term observations comparable, the team calibrated radar records from three satellite systems—ERS, QSCAT, and ASCAT—into a temporally consistent series. Because QSCAT used a different radar band from the other two systems, the researchers applied a second-order regression model using overlapping years of observation. This calibration improved average temporal consistency across 24 world regions from 0.87 to 0.97. They then combined the calibrated radar data with annual impervious-surface information from the GAIA dataset and reference building-height data from 155 cities in Europe, the United States, and China. The model adjusted radar backscatter using impervious-surface area to reduce interference from non-built-up surfaces such as vegetation. In validation tests, the ISA-adjusted model achieved  $R^2 = 0.89$  and  $RMSE = 0.21$ , outperforming the non-adjusted version. Final estimated heights also showed good agreement with reference heights, with  $RMSE = 1.42$  m and  $MAE = 0.86$  m. Cross-product comparison with global datasets such as GBH and GUH3D showed similarly close agreement, with  $RMSE$  values between 0.32 and 0.37 m.

The study suggests that urban change should be understood in three dimensions rather than through land expansion alone. By capturing vertical growth over time, the dataset can help explain regional differences in development, improve understanding of urban density, and provide a stronger basis for studying how city form shapes energy demand and carbon emissions. The study combined annual GAIA impervious-surface data with microwave radar time series from ERS, QSCAT, and ASCAT, along with reference building-height data from 155 cities. QSCAT data were calibrated against ERS and ASCAT using overlapping periods and a second-order regression model. The researchers then used ISA-adjusted radar backscatter and a built-up height estimation model to reconstruct annual height and volume dynamics at the global scale.

The authors say long-term built-up height datasets could strengthen urban growth modeling, improve estimates of energy use and carbon emissions, and support climate-related applications such as urban heat-island assessment and cooling strategies. They also note that future improvements will depend on finer spatial resolution and broader validation data, especially in data-scarce regions. As global urbanization continues, especially across the Global South, tools that capture both horizontal and vertical growth may become essential for more sustainable and equitable city planning.

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