Urbanization contributed to Beijing storms

Hot air from city made rainfall heavier and more locally concentrated.

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Huge floods in Beijing this month were made worse by the city's intense urbanisation.

Intense urban development might have exacerbated the violent rainstorm that hit Beijing on 21 July, Chinese government meteorologists say.

The storm, the worst the city has seen in more than 60 years, dumped an average of 215 millimetres of rain in 16 hours. Hebeizhen, a town in the suburban district of Fangshan, saw 460 millimetres for the same period. The flash floods and collapsed buildings that followed claimed at least 77 lives and forced the evacuation of nearly 60,000 people. Direct economic losses are estimated to be around 10 billion renminbi (US$1.6 billion).

“The storm was a result of a large weather pattern over northern China,” Qiao Lin, director of the Beijing meteorology station, told the newspaper *People’s Daily*. “But Beijing was the worst hit and had the most rainfall.”

Qiao suspects that this may be because the city is close to a mountain range, where storms tend to gather, and is an 'urban heat island' — generating much more heat than the surrounding rural regions.

“This is the first time that Chinese authorities have acknowledged the effects of intense urbanization on extreme weather events,” says Fei Chen, an atmospheric scientist at the National Center for Atmospheric Research in Boulder, Colorado.

Heat pockets

An urban heat island tends to form when the natural landscape is replaced with materials such as concrete and asphalt. And pollution and heat generated by automobiles, air conditioning and industry exacerbates the effects.

A study last year by Chen and his colleagues in China showed[1] that intense urbanization had played a part in heavy rainfall in Beijing on 1 August 2006, with a maximum downpour of 55 millimetres in three hours.

Using a fine-scale computer simulation, the researchers were able to tease out how different types of land surface and urbanization could affect an approaching storm.

As they added in more urban surface and anthropogenic heating, the rainfall became heavier and more concentrated. The team also identified three ways that changes in land surface could affect an incoming storm.

Big cities continuously pump a lot of heat up into the air through their high-rise buildings. As a result, the atmospheric circulation becomes more vigorous and extra energy is available for a storm to develop above the city.

In addition, the heat can push up the clouds from an incoming storm, which produce more rain as they gain altitude. The effect is similar to that seen when clouds encounter mountains, and can also slow down the movement of the storm so the rainfall concentrates in one place. “If Beijing were less developed, the storm would probably be just a passing event, with much less rain falling in the city,” Chen says.

The Beijing floods should serve as a warning sign to other areas with intense urbanization, says Wang Xuemei, an atmospheric scientist at the Sun Yat-sen University in Guangzhou.

Wang’s modelling work has shown that rapid urban expansion of the Yangtze River Delta in eastern China and of the Pearl River Delta in southern China has changed the local climate, making it warmer and less windy with deeper and more active atmospheric mixing[2].

“This has made extreme storms even more intense,” he says.

To mitigate the effects of these strong storms, large metropolitan areas should have properly maintained drainage systems that are regularly upgraded, says Wang. Using white or reflective building materials could also help to reduce heat production. In addition, large reductions can come from increasing the area covered by green vegetation, according to local climate-modelling studies by Chen and his colleagues[3].

“We can’t prevent natural disasters,” says Wang. “But we can try to mitigate their impact.”

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References

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