

Landscape 'transition zones' may influence where tornadoes strike

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Credit: Lyndon State College from VORTEX2

(Phys.org) —Areas where landscape shifts from urban to rural or forest to farmland may have a higher likelihood of severe weather and tornado touchdowns, a Purdue University study says.

An examination of more than 60 years of Indiana tornado climatology data from the National Weather Service's Storm Prediction Center

showed that a majority of tornado touchdowns occurred near areas where dramatically different landscapes meet - for example, where a city fades into farmland or a forest meets a plain.

Forecasters and city planners may need to pay closer attention to these "transition zones" to better understand tornado risks, said Olivia Kellner, doctoral student in the Department of Earth, Atmospheric and Planetary Sciences and first author of the study.

"There are still many unanswered questions about tornado climatology, but what we're finding is that there may be a relationship between the Earth's surface and the atmosphere that contributes to where [tornadoes](#) tend to touch down," Kellner said.

An analysis of locations where tornadoes touched down between 1950 and 2012 revealed that 61 percent of tornado touchdowns occurred within 1 kilometer (about 0.62 mile) of urban areas while 43 percent of touchdowns fell within 1 kilometer of forest. Some tornadoes touched down in close proximity to both cities and forests.

Although highly populated urban areas can increase the number of tornado reports, the analysis showed a large percentage of touchdowns also occurred in low-population regions with significant changes in surface features.

Kellner said the percentages suggest that certain locations may enhance the likelihood of tornado touchdowns. Increased "surface roughness" - an abrupt change in the height of [land surface](#) features - can stretch or squash a column of air, increasing the air's rate of spin, which could contribute to the formation of severe storms.

Dev Niyogi, Indiana's state climatologist and co-author of the study, said the possibility that land surface could affect the development of severe

weather deserves further scrutiny.

"Forecasting and preparing for severe weather risks such as tornadoes are difficult and societally important tasks," he said. "We might need to pay more attention to areas where land surface features transition from rough to smooth, flat to sloped, or wet to dry. These changes in landscape may provide triggers for severe weather."

The study also found that tornado touchdowns in [urban areas](#) tend to occur at about 1 and 10 miles from the city center.

Kellner said these "rings" of increased tornado activity could be related to how cities are developed.

"Cities impact the surrounding climate in terms of regional airflow and temperature," she said. "The size of cities, what they're made of and the heat they produce are factors that could affect the microclimate."

Niyogi cautioned that every storm is unique and that a variety of factors influence storm intensity and the potential for severe weather. Identifying areas of high risk, however, could lead to city designs that would reduce the conditions associated with producing severe weather hazards such as tornadoes.

"As we continue to modify our landscapes, there will be many environmental and societal changes," he said. "But perhaps we have the potential to engineer cities to be more resilient to [severe weather](#) by thinking holistically about the way cities can be developed and how they affect local climate conditions."

According to the study, Indiana has a distinct spring tornado season with a majority of tornadoes occurring in June, May and July, respectively. Strong tornadoes with estimated wind speeds of more than 158 miles per

hour occur most frequently in April and June. The total number of tornado days per year - days on which at least one tornado report is made - has not increased over time.

The study also found that drought conditions and climate variations such as El Niño have some impact on Indiana tornado climatology.

More information: The paper "Land-surface Heterogeneity Signature in Tornado Climatology? An Illustrative Analysis over Indiana 1950-2012" was published in the American Meteorological Society's *Earth Interactions* journal and is available at journals.ametsoc.org/doi/abs/10.1175/2013EI000548.1

Provided by Purdue University

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