Less rain in town, more on the farm: Effects of urbanization, irrigation on mid-Atlantic summer precipitation

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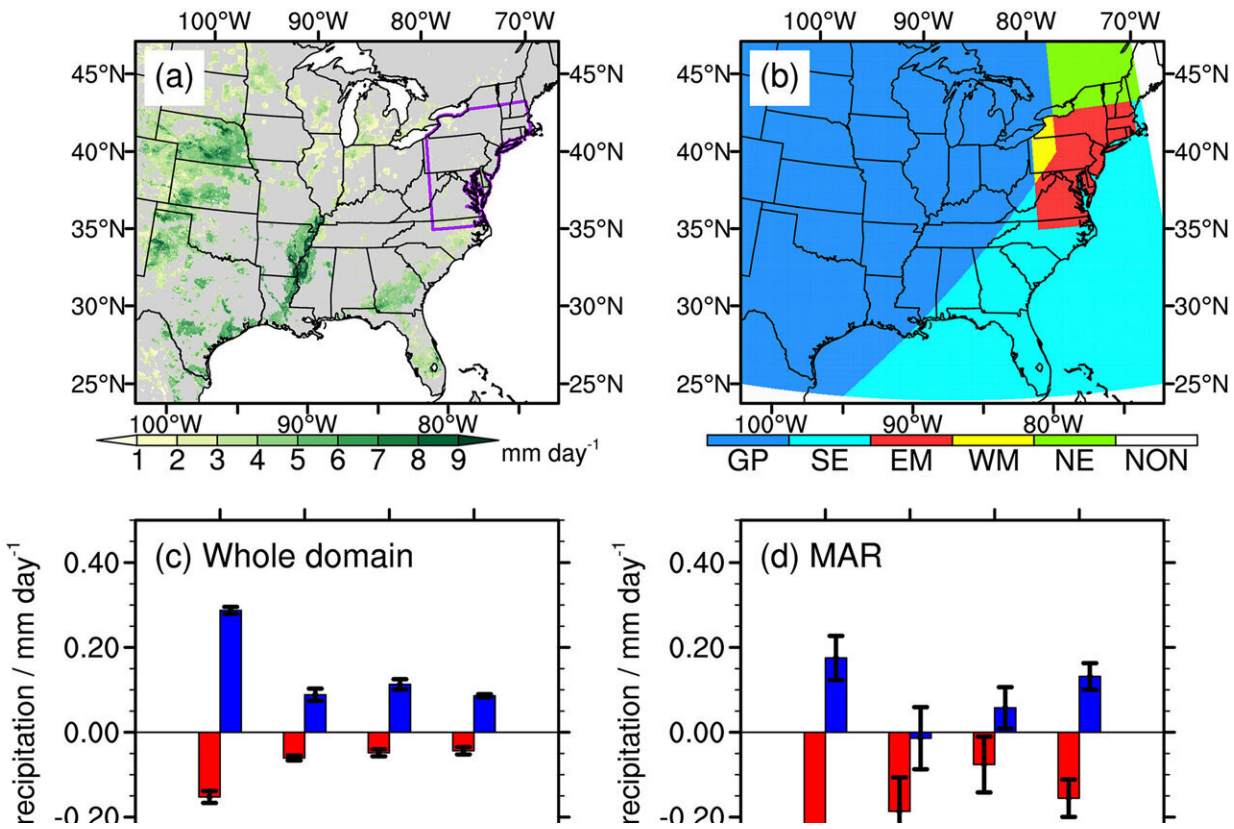

Credit: *Geophysical Research Letters* (2022). DOI: 10.1029/2022GL097845

Scientists know that urbanization and irrigation can significantly influence rainfall. However, they don't fully know how these effects vary

among different types of rain. Researchers have investigated how large-scale urbanization and irrigation in the United States affect the three dominant types of summer precipitation in the mid-Atlantic region. These include mesoscale convective system (MCS), isolated deep convection (IDC), and non-convective (NC) precipitation. MCS precipitation is from large systems of thunderstorms.

IDC precipitation is from isolated thunderstorms that result from the movement of air from the lower to the upper atmosphere. NC precipitation is rain that does not result from thunderstorms and is typically less intense but lasts longer and produces a steadier rainfall. The researchers found that urbanization suppresses all three types of precipitation. In contrast, irrigation enhances NC and IDC precipitation. Irrigation has varied influences on the mid-Atlantic precipitation produced by MCSs. The specific influence depends on whether an MCS formed locally or remotely.

The research findings are published in *Geophysical Research Letters*.

The contrasting influences of large-scale irrigation on locally and remotely initiated MCS precipitation highlight the complexity of precipitation. The findings also show the range of effects that changes in land use and land cover can have on precipitation. Finally, this study highlights the importance of understanding the diverse effects of human activities on precipitation. In regions such as the mid-Atlantic, many types of rain contribute to summer rainfall. This means that changes in total rain amount and the contributions of different rain types have important implications for water resources and their management.

The researchers, from Pacific Northwest National Laboratory and the Indian Institute of Technology–Madras, conducted convection-permitting regional model simulations with and without urbanization or irrigation. They used the simulations to investigate how large-scale

urbanization and irrigation in the United States east of the Rocky Mountains affect summer precipitation in the highly populated mid-Atlantic region. They applied a feature tracking algorithm to classify three types of precipitation (MCS, IDC, and NC) and examined the effects of large-scale urbanization and irrigation on each rain type.

The team found that urbanization suppresses all three types of precipitation in the mid-Atlantic region by reducing water vapor and atmospheric instability. In contrast, irrigation enhances IDC, NC, and locally initiated MCS precipitation. The irrigation also suppresses rainfall produced by MCSs initiated in the Great Plains and Midwest, producing conflicting effects on MCS precipitation. The surface cooling due to irrigation induces a high-pressure anomaly at sea level, which is compensated by a mid-level low-pressure anomaly. The mid-level pressure anomaly then weakens the prevailing mid-level westerly wind over the Midwest and the mid-Atlantic region, which hinders the eastward movement of MCSs toward the mid-Atlantic region.

More information: Jianfeng Li et al, Impacts of Large-Scale Urbanization and Irrigation on Summer Precipitation in the Mid-Atlantic Region of the United States, *Geophysical Research Letters* (2022). DOI: 10.1029/2022GL097845

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