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Urban Heat Island Adaptation Strategies are not created equal: Assessment of Impacts and Tradeoffs

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Sustainable urban expansion requires an extension of contemporary approaches that focus nearly exclusively on reduction of greenhouse gas emissions. Researchers have proposed biophysical approaches to urban heat island mitigation (e.g., via deployment of cool or green roofs) but little is known how these technologies vary with place and season and what impacts are beyond those of near surface temperature. Using a suite of continuous, multi-year and multi-member continental scale numerical simulations for the United States, we examine hydroclimatic impacts for a variety of U.S. urban expansion (to the year 2100) and urban adaptation futures and compare those to contemporary urban extent. Adaptation approaches include widespread adoption of cool roofs, green roofs, and a hypothetical hybrid approach integrating properties of both cool and green roofs (i.e. reflective green roofs). Widespread adoption of adaptation strategies exhibits hydroclimatic impacts that are regionally and seasonally dependent. For some regions and seasons, urban-induced warming of 3°C can be completely offset by the adaptation approaches examined. For other regions and seasons, widespread adoption of some adaptation strategies can result in significant reduction in precipitation. Finally, implications of large-scale urbanization for seasonal energy demand will be examined.