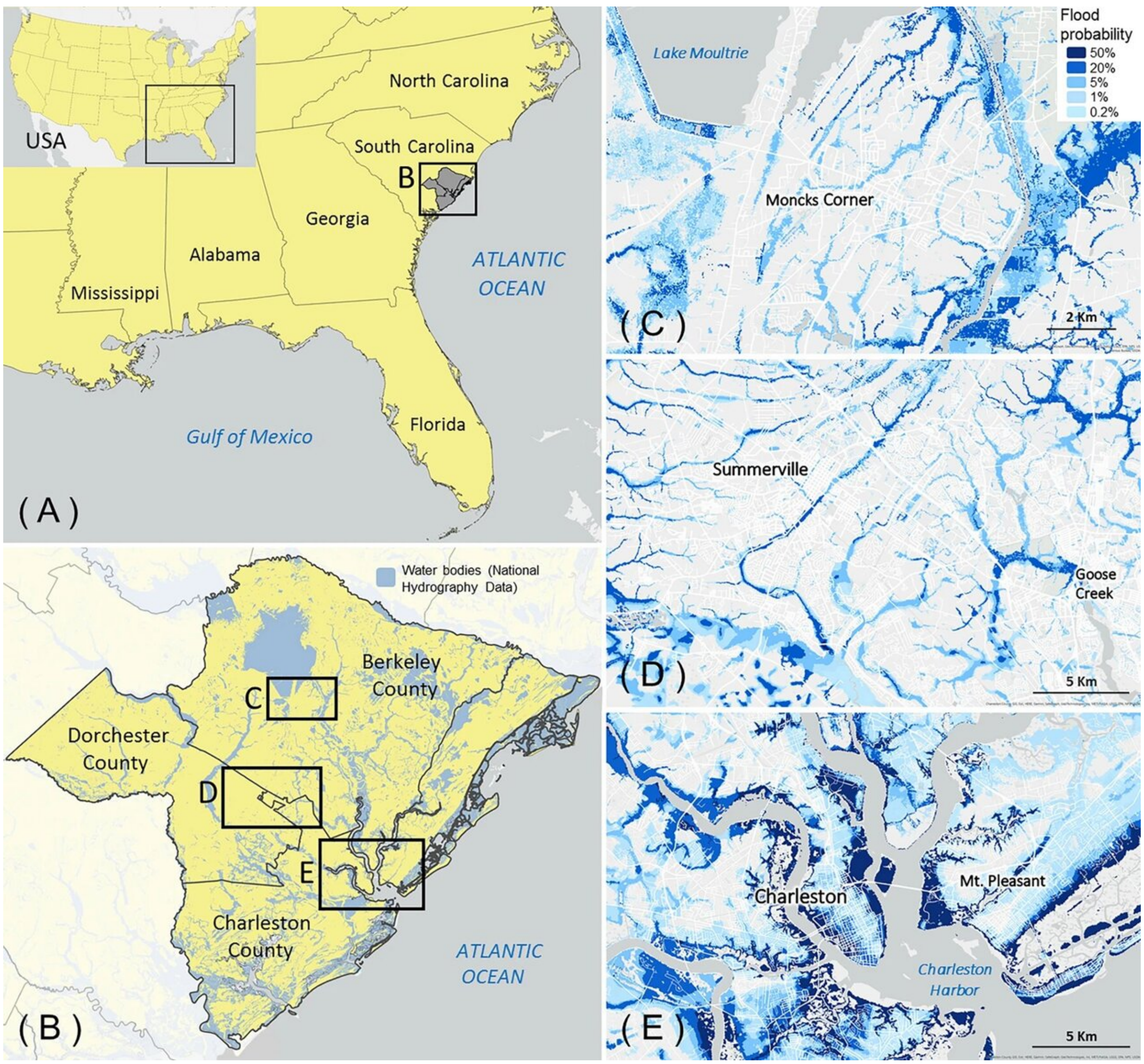
New model adds human reactions to flood risk assessment

November 6 2023, by Tracey Peake



Test case location in the Southeast U.S. (**A**) comprising three coastal plain counties in the Lowcountry of South Carolina (**B**) with detailed maps of annual flood probability in the Towns of Moncks Corner (**C**) and Summerville (**D**) and the City of Charleston (**E**). Detail maps (**C**, **D**, **E**) display anticipated flood hazard due to fluvial, pluvial, and coastal flooding under a moderate greenhouse gas emissions scenario (Representative Concentration Pathway [RCP] 4.5) by 2050. Credit: *Scientific Reports* (2023). DOI: 10.1038/s41598-023-46195-9

Researchers at North Carolina State University have created a land change model that simulates interactions between urban growth, increased flooding and how humans adapt in response. The new model could offer a more realistic assessment of risk for urban planners, natural resource managers and other local government stakeholders.

"Traditional risk assessment typically involves overlaying inundation layers—areas that may flood—onto existing development or population distribution to identify areas and communities at risk," says Georgina Sanchez, research scholar in NC State's Center for Geospatial Analytics and corresponding author of the work. "Yet this approach only provides a partial picture.

"Urban planners and residents are increasingly aware of the growing flood risks from climate change and are ready to respond and adapt when able," Sanchez says. "It's crucial for models to consider our collective adaptation efforts—like elevating buildings or moving away from high-risk zones. Our model provides deeper insights, helping us understand adaptive capacities and identify communities with limited resources—essentially characterizing the geography of impact and response."

The model, FUTURES 3.0 (FUTure Urban-Regional Environment Simulation), is an open-source, scalable model that includes three components of flood risk: exposure, which refers to urban development patterns; hazard, which includes increases in flooding due to climate change; and vulnerability, or the adaptive response of people living in the area. The model incorporates climate data as well as demographic, socio-economic and flood-damage data.

The researchers used the greater Charleston (S.C.) metropolitan area as their test case. Charleston is a rapidly developing urban area located in a low-lying region bordered by the Atlantic Ocean and numerous rivers.

By comparing land change projections for 2035 and 2050 against a 2020 baseline and across various policy intervention and response scenarios, they envisioned possible demographic and population shifts and identified which scenarios resulted in the least exposure to future flooding, as well as where flood risk remained highest across the landscape.

"The study underscores the importance of incorporating human adaptive response alongside demographic shifts and urban expansion for accurate exposure and risk assessment," Sanchez says. "Not all residents or communities will have the means or capacity to build protective measures. Visualizing potential 'what-if' scenarios help us consider the where and when of impact and understand who is being affected and how."

The researchers' next steps are to engage with communities to discuss potential interventions. They are also expanding their studies at a regional scale.

"Through scenario-based modeling," Sanchez says, "we explore questions like: how will communities respond to damage, who has the means to adapt, and what challenges do those with limited resources for protection face?

"Additionally, these scenarios let us visualize the long-term consequences of our current development choices," Sanchez continues. "If we anticipate that 30 years from now a newly developed community may face the decision to retreat, why not think about protecting that area now?"

The work appears in *Scientific Reports*.

More information: Georgina M. Sanchez et al, Spatially interactive modeling of land change identifies location-specific adaptations most likely to lower future flood risk, *Scientific Reports* (2023). DOI: 10.1038/s41598-023-46195-9

Provided by North Carolina State University