

The Role of Building Roofs in Pluvial Urban Flood Modeling

Giulio Paradiso¹, Daniele Ganora¹ and Giuseppe Mascaro²

¹Polytechnic of Turin

²Arizona State University

Corresponding: giulio.paradiso@studenti.polito.it

Pluvial floods occur in small urban catchments when intense rainfall exceeds the stormwater drainage capacity. These events have been happening more frequently and with increasing impacts due to ongoing urbanization and the intensification of sub daily precipitation extremes. Modeling these fast-evolving phenomena at very high spatial resolutions (1-5 m) is crucial to understand their dynamics and mitigate the impacts. In this work, we focus on better quantifying the role of building rooftops in the rainfall-runoff transformation involved in pluvial flooding. We adopted a modeling framework based on the LISFLOOD-FP rain-on-grid hydrodynamic model forced with gridded inputs of net precipitation, which accounts for the roof effects. A significant challenge in incorporating roofs lies in accurately representing how the distinct effects of construction type, slope, surface material, and drainage systems affect rainfall losses, runoff delays, and, ultimately, water depths on the streets. We evaluate two methodologies inspired by recent research. The first involves categorizing buildings assigning a runoff coefficient based on roof typologies and the second considers the distribution of downspouts to take into account the spatial variability in flood water discharged from the roofs. We test these methods in an urban catchment of Brooklyn in New York City, basing the modeling on a real event of precipitation that on September 2023 lead to many flood events that have caused a lot of diseases to the borough. This work provides useful insights into the role of roof runoff in urban flooding, contributing to increase the knowledge about the micro-topography's importance on flood dynamics' and to improve flood management strategies in highly urbanized areas like New York City facing similar challenges of increased pluvial flooding due to climate change.