The operation of any city, county or state is dependent to a significant degree upon weather conditions, especially with regard to relative extremes in wind, precipitation or temperature. For example, with precipitation events, local topography and weather conditions influence water runoff and infiltration, which directly affect flooding as well as drinking water quality and availability. The operation of the distribution system of an electric utility, particularly with an overhead infrastructure, can be highly sensitive to local weather conditions, including disruption by strong winds. The impact of such events creates issues of public safety for both citizens and first responders. Therefore, the availability of highly localized weather model predictions focused on municipal public safety operations has the potential to mitigate the impact of severe weather on citizens and local infrastructure. Typically, information at such a scale is simply not available. Hence, what optimization that is applied to these processes to enable proactive efforts utilizes either historical weather data as a predictor of trends or the results of coarse-scale weather models. Neither source of information is appropriately matched to the temporal or spatial scale of many such operations. While near-real-time assessment of observations of current weather conditions may have the appropriate geographic locality, but by its very nature is only directly suitable for reactive response.

Current state-of-the-art numerical weather prediction codes operating at a cloud scale have been shown to have reasonable skill in being able to predict specific events or combination of weather conditions with sufficient spatial and temporal precision to address this scale mismatch. For example, to produce operational, 84-hour forecasts for the New York City and 48-hour forecasts for the Rio de Janeiro metropolitan areas, which are updated every twelve hours, high-resolution weather models are a prerequisite. In each case, choices of model configuration, physics, assimilation schemes, boundary data, etc. are made appropriate for the range of geography within the domain from highly urbanized to rural. However, such a model-based weather forecast is only a prerequisite to the aforementioned optimization of weather-sensitive business operations. To forecast impacts from storm-driven disruptions of an overhead electric distribution network (e.g., poles and wires), outage prediction must be approached stochastically. Historical observations from a local, relatively dense network of weather stations were analyzed along with data from a local electric utility concerning the characteristics of outage-related infrastructure damage from weather events, as well as the information about the distribution network and local environmental conditions. This has enabled the generation of forecasts of the number of jobs to be dispatched to repair storm-induced outages. This approach also incorporates uncertainties in both the weather and outage data. A prerequisite for a similar notion of a damage model due to flooding events requires a different, intermediate step. Hence, to enable a prediction and warning system, an hydrological model that operates at a street scale was developed. Using limited historical data, a simplified high resolution analytical model was implemented. It also takes into account geomorphological data. A mathematical model was implemented simulating surface flow and water accumulation using a locally conservative approach by employing the shallow water equations. It employs precipitation estimates generated by the aforementioned numerical weather prediction, which are used to analyze if a site historically prone to
flood, could receive a surface runoff flow that leads to flooding. For Rio de Janeiro, a two-dimensional version has been implemented operationally, but scaled to $O(10^9)$ cells leveraging very high-resolution terrain data (1m) for the area.

In both cases, in New York and Rio de Janeiro, the coupled model approach has enabled prediction of storm impacts on local infrastructure as well as quantification of the uncertainty associated with such forecasts. We will discuss the approach and the background research effort, some specifics of how we brought these solutions into an operational phase, and lessons that were learned through the development and deployment. The work is on-going and the model results are being evaluated. We will present how the forecast information is being used and discuss the overall effectiveness of our approach for these and related applications as well as recommendations for future work.