

Utilizing Uncrewed Systems (UxS) for Storm Damage and Hydrology Surveys in Southern Indiana and Central Kentucky

Article and Figures Provided By Dan McKemy (NWS)



Figure 1: Tornado damage March 2, 2012, in Henryville, Indiana. Damage assessment and area access will benefit from the use of drones once implemented (Credit: NWS Louisville Storm Survey Team).

Future river flood and storm damage surveys will look a little different going forward with the National Weather Service (NWS) in Louisville, Kentucky, for the next several years! NWS Louisville was the recipient of a grant from the Office of Marine and Aviation Operations (OMAO) Uncrewed Systems Operation Center (UxSOC) that provided funds to acquire uncrewed aircraft (drones) for use on river flood and storm damage surveys across southern Indiana and central Kentucky. Drones will allow NWS forecasters to fly over hazardous debris and power lines to get better perspectives of storm damage while keeping the staff safe (Figure 1). Project funding and operations began in June of 2020, and since the start of the project, the drones and necessary equipment to fly them have been acquired and several staff members have been trained to use them during storm and flood damage surveys.

The primary focus of this project will be using the drones for hydrology surveys during times of river flooding. The main river of focus will be the Licking River (Figure 2), located in central and eastern Kentucky, as it remains one of the harder rivers to forecast and model across the region. Other rivers across southern Indiana and central Kentucky also will be surveyed during times of flooding, including the Ohio, Green, and Kentucky Rivers. Imagery collected from the drones will be transformed into orthomosaic maps and 3D models that will give researchers and scientists additional datasets to improve river flood forecasts and models (Figure 3). Additionally, this imagery may lead to the creation of flood inundation maps for specific river points across portions of the region. An interactive inundation map already exists for one of the river points in NWS Louisville's region ([Kentucky River at Frankfort Lock, KY \(FFTK2\)](#)). The goal is to be able to create more of these enhanced types of maps with the imagery that is collected.

River flood warning statements will also see an improvement in their accuracy. When a river flood warning is put out for a specific river point, it highlights the impacts the flood waters will cause when they get to a certain level (e.g., when the river rises to 30 feet, certain roads or fields will become flooded). Some of these river warning impact statements have not been verified in recent years, and it is possible that due to changes in the river basin structure from erosion or land-use, some of the current river warning impact statements may be incorrect. The orthomosaic maps created from these data will allow forecasters more easily to determine what impacts are occurring across portions of the region when the river is at certain levels.

A secondary focus for the project will be storm damage surveys with drones. For decades, the NWS has conducted storm damage surveys by foot, but aerial imagery from drones will provide several benefits to the surveyors. First, storm damage surveys will be able to be completed much more efficiently and quickly as aerial imagery will allow the surveyors to quickly assess the damage and pinpoint the hardest hit areas. Second, aerial imagery will lead to more accurate tornado damage length and width estimates. This is especially true with tornado lengths, as tornadic damage in southern Indiana and central Kentucky often occurs in areas with terrain and trees that make it difficult visually to observe any great distance from the ground. Drones will allow surveyors to quickly assess a tornado path from the air and observe how far it goes. Georeferenced imagery can then be used to accurately measure tornado length and width.

Last but not least, drones will provide safety benefits to staff during storm damage surveys. After a tornado impacts a town or city, there are often power lines down and debris scattered all about. Traversing through that debris can be dangerous at times and may prevent surveyors from getting to certain structures that need to be observed.

Drones will allow surveyors to fly over any dangerous debris that may be on the ground and assess damage from a safe distance.

The staff at NWS Louisville are excited about incorporating drone technology into hydrology and storm damage surveys going forward (Figure 4). The impact and societal benefits from this study will enhance products that support NOAA's critical missions. The intention is that imagery from NWS Louisville surveys will be shared shortly after they are completed via their webpage (linked below). More technical results from their surveys will be published over the next several years at various conferences and potentially in journal articles.

Link to NWS Louisville's home webpage: <https://www.weather.gov/lmk/>.

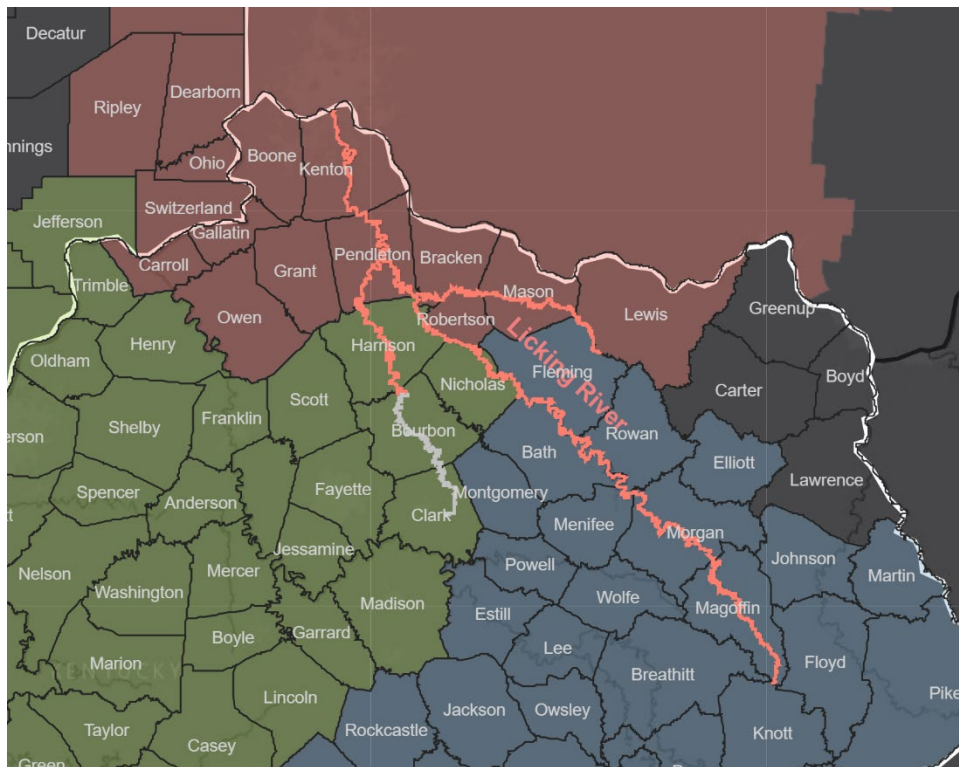


Figure 2: The Licking River (highlighted in orange) will be surveyed across central and eastern Kentucky. The river stretches across three National Weather Service County Warning Areas (Green: WFO Louisville, KY... Red: WFO Wilmington, OH... Blue: WFO Jackson, KY).

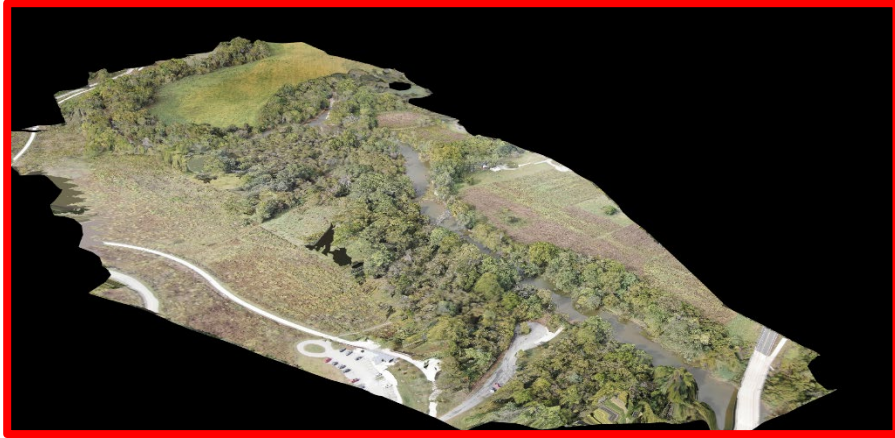


Figure 3: Orthomosaic map (top image) and 3D model (bottom image) of a river captured during a mock survey near Louisville, Kentucky, in September 2020.



Figure 4: NWS Louisville Meteorologist Dan McKemy flies one of the drones used for hydrology and storm damage surveys.