

Best Practices for Small Unmanned Aerial Systems for Floods

Based on 2015-16 Texas & Louisiana Floods, Hurricane Harvey see more at https://youtu.be/uPA1Xe_K70E

Before The Flood

- Get elevation maps of critical areas before flooding; requires path planning and photogrammetric software
- Monitor initial flooding and confirm flood inundation maps; usually have drainage expert directing flight because there's always some surprise

Recommendations and Considerations

- **Exploit low cost UAVs flying visual line of sight** such as DJI Mavic Pro. Flights will normally be visual line of sight for safety reasons and have a short duration of 8-12 minutes as experts quickly see what they need.
- **Send agency experts (and social workers) with sUAS team.** Even if you can stream over 4G, have a county or agency rep with each UAS team conducting surveys to answer questions from citizens and diffuse any public perception issues. Preprogrammed mapping flights may not get the right viewpoints for structural inspection, investigation of causes of flooding, or overwatch types of missions; real-time streaming may not work
- **Have a sUAS expert work directly with the Air Operations Branch.** This simplifies airspace coordination. Route requests through ICS where the air branch can be assigned to manned or unmanned assets; e.g., some missions could be better executed by the Civil Air Patrol than a sUAS
- **Have a dedicated data management policy and manager.** GIS team won't be able to handle the additional workload and high resolution imagery from a single 20 minute flight can run around 2GB, so prepare. The policy should enforce chain of custody procedures.
- **If you want a single image of a neighborhood, consider options such as Hangar 360** rather than do a preprogrammed flight over the area. Hangar 360 has the sUAS fly straight up, rotate and take pictures, then constructs a 360 panorama on the web-
- Be aware that **Part 107 volunteers may not be adequately prepared for disaster response**, either in terms of familiarity with regulations, personal safety, or advanced flight skills

Most Common Missions During Flooding

- **Detailed Inspection and structural inspection**
 - Inspect road, railroad bridges, levees, standing water on the side of roads (which may prevent utility crews from working), and other critical infrastructure.
- **Debris/Damage/Flood estimation**
 - Documentation of flood inundation and determination of causes (e.g., a fallen tree acting as a dam). *Be aware that UAS haven't been as helpful for documenting waterline on houses and buildings because of viewing angle of UAV and trees blocking houses*
 - Document land use and drainage issues to be resolved later
 - Use for volumetric estimations of debris after the flood recedes
- **Strategic Situation Awareness, Reconnaissance, Survey**
 - Inform the Public about the flood, the impact on them or their relatives; why the evacuation order is in place; Put videos on YouTube
 - Hazards alert: What's that sheen on the water- diesel? Chemical? Sewage? and where is it coming from? Are those propane tanks floating away?
- **Tactical Situation Awareness**
 - Embed with ESF1, 8, 9... for tactical situation awareness-- Transportation, US&R, and other field teams can carry very small UAS to pop up and look to see if roads are passable or alternative routes

Less Frequent Missions and Methods

- Mapping. Photogrammetric mapping is most commonly done during the recovery phase, not the immediate life saving and mitigation response phase. During response, field experts use sUAS to look and analyze in real-time. Maps may be noisy because flowing water interferes with stitching.
- Other: Identify stranded livestock, Provide oversight or spotting for swift water rescue, Carry water bottles to trapped people but this can be dangerous since UAS aren't designed for delivery.