



AIAA SCITECH

Flight Test Exploration of Integrated Wildfire Response Operations with Crewed and Uncrewed Air Assets

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Risk

Wildland fires are larger and more frequent, leading to increasingly negative impacts on the economy, public health, and natural ecosystems



Damage

Five of the largest fire seasons on record have occurred within the last 10 years (with over 9M acres burned)

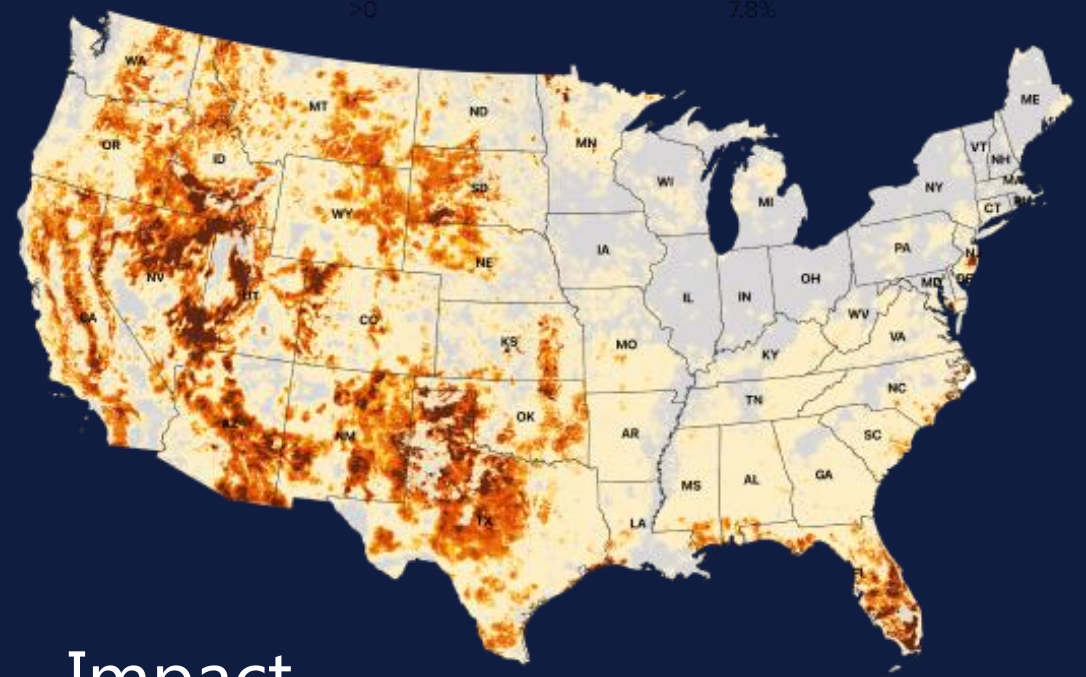


Image credit: First Street Foundation

Impact

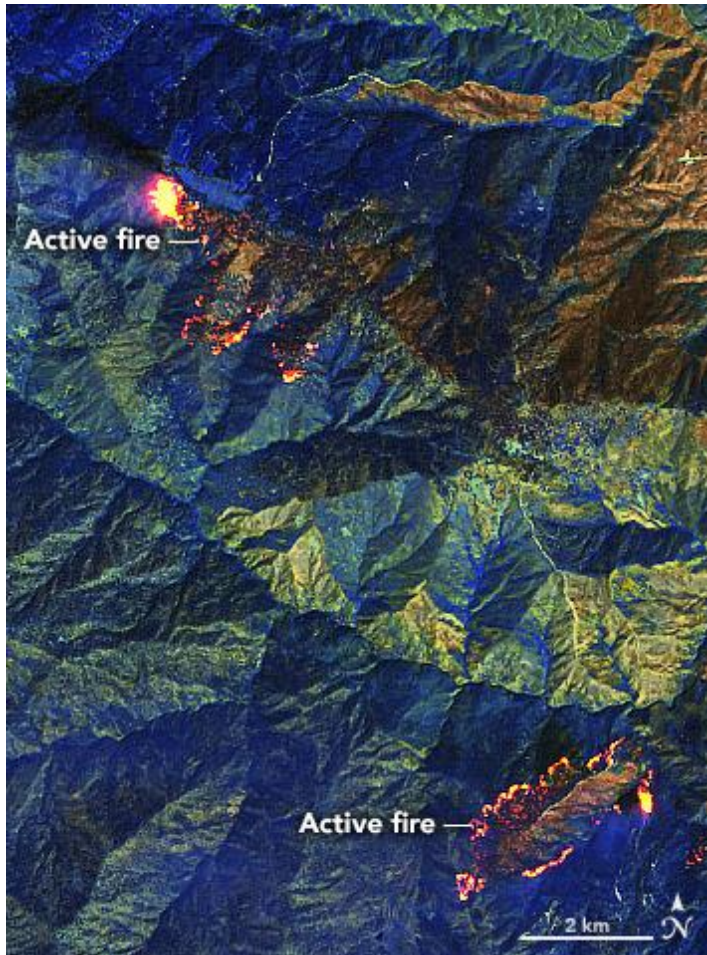
- Climate change affects wildfire risk
- Wildfires affect Climate (e.g., CO₂, black/brown carbon)
- Wildfires are costly to US economy
- Wildfires are increasingly impacting where people live

Integrating New Tools to Address a Rising Challenge

- Aircraft are essential for efficient disaster response
- The emergency response community would benefit from an increased usage of Uncrewed Aircraft System (UAS)
- Currently, concurrent UAS and crewed aircraft operations are limited by safe airspace integration needs



JAXA–NASA Disaster Response Collaboration

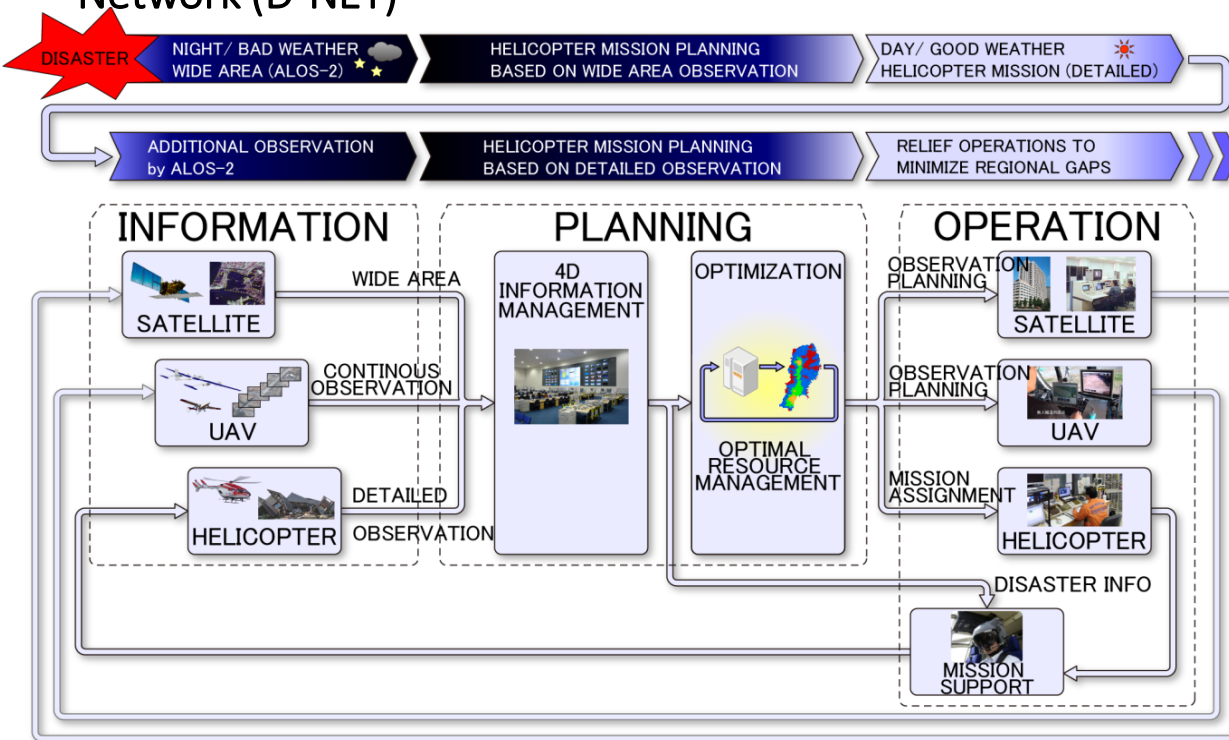


Goal: Use [mission planning](#), [situation awareness](#), and [traffic management technologies](#) to coordinated between crewed and uncrewed operations

- Since 2016, JAXA and NASA have partnered to investigate the safe and efficient integration of UAS in disaster relief operations.
- In October 2018, a flight test, which occurred as part of a large-scale disaster drill in Ehime Prefecture, Japan, successfully demonstrated that D-NET and UTM can contribute to the safe and efficient use of airspace by both manned and unmanned aircraft.
- Follow-on flight testing has occurred to look at search and rescue missions in urban Tokyo (Dec. 2019) and wildland fire operations near Mt. Fuji (Aug. 2022)

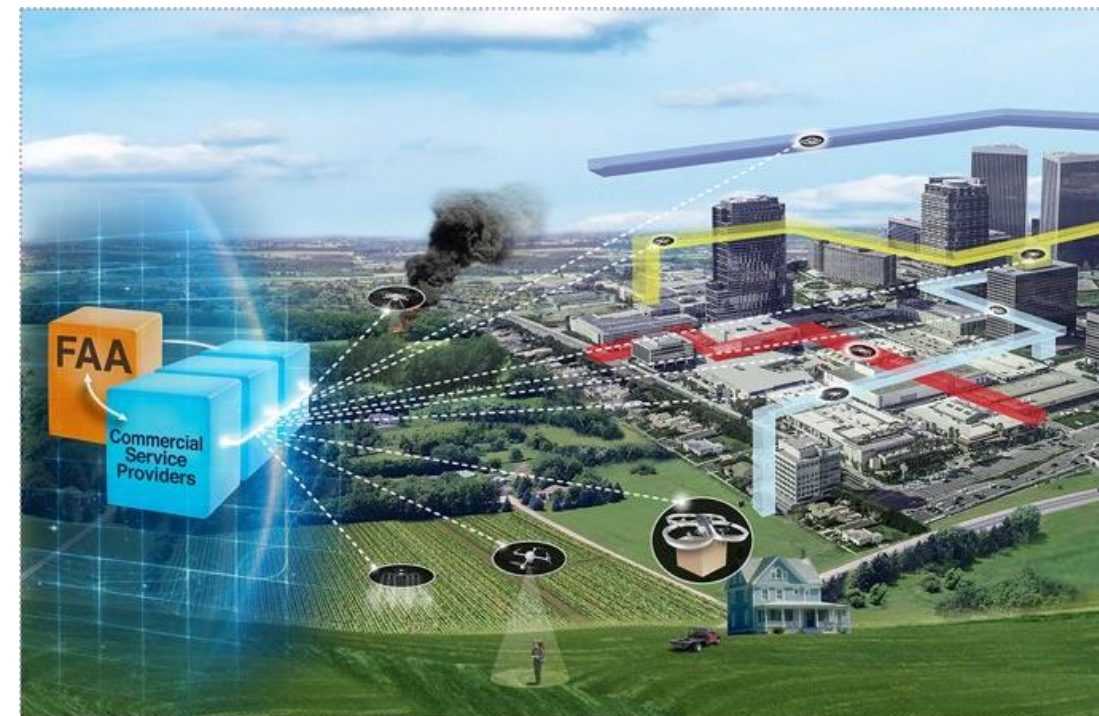
JAXA–NASA Technology Contributions

JAXA's Disaster Relief Aircraft Information Sharing Network (D-NET)



Integrated operations of crewed and uncrewed aircraft, and satellites with optimized allocations of available resources

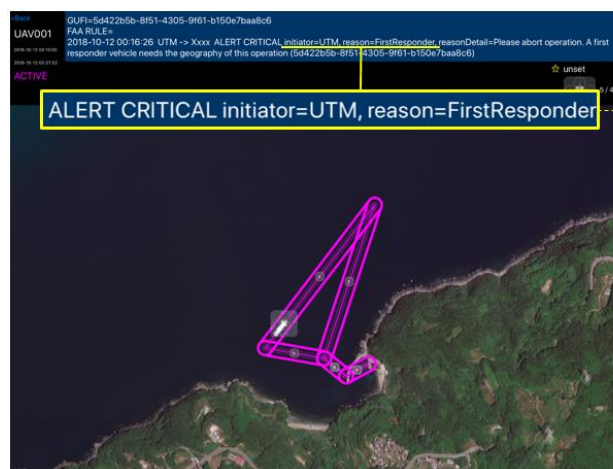
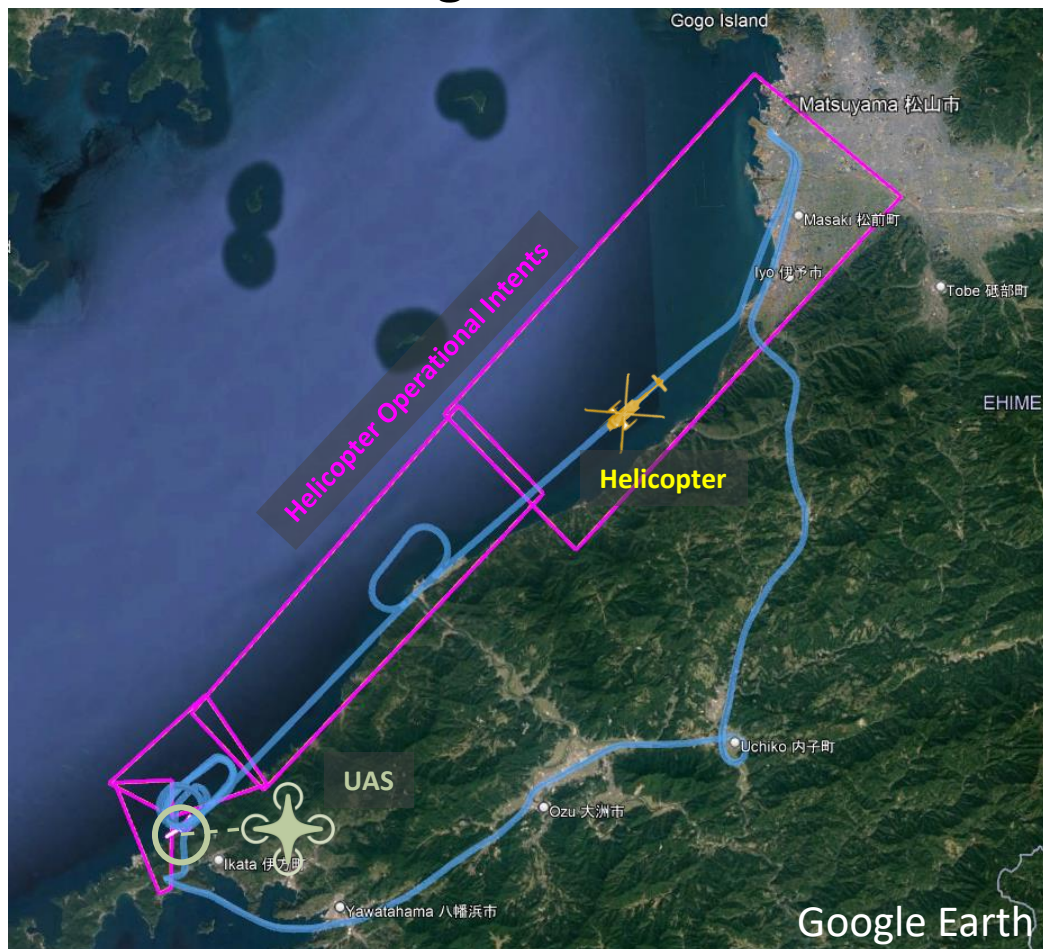
NASA's UAS Traffic Management (UTM)



Collaborative, automated, and federated airspace management approach that enables safe, efficient, and equitable UAS operations at scale

Prior D-NET / UTM Testing

Large-scale disaster drill in Japan with integrated UTM and D-NET systems



Flight tests conducted in Mt. Fuji area of Japan with experienced disaster response helicopter pilots

Test Goals:

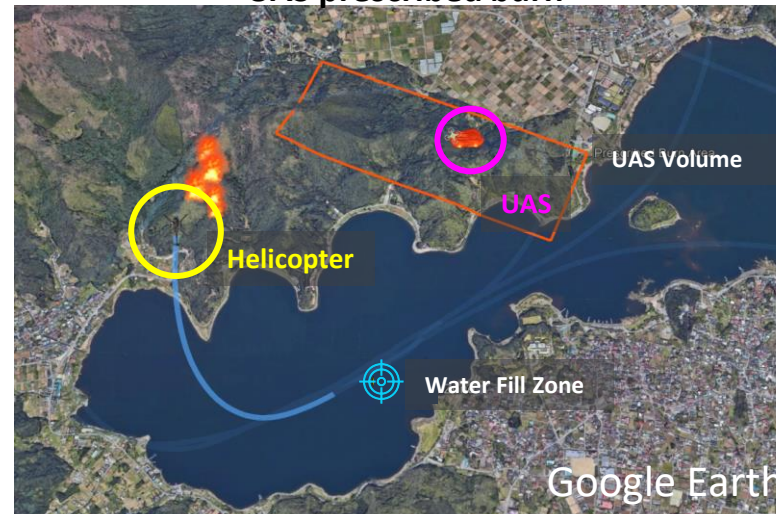
- Assess how situation awareness technology can help pilots with their flight planning and mission execution
- Use JAXA's experimental helicopter and D-NET's technology with NASA's UAS trajectory data



UAS Volume Established in Airspace



Helicopter dropping water in proximity to active UAS prescribed burn



Helicopter maintaining well clear of active UAS Volume



Test Conditions

- Condition 1: Inactive sUAS Operation Volume
- Condition 2: Active sUAS Operation Volume, oral advisory from researcher based on D-PAS displaying volume location
- Condition 3: Active sUAS Operation Volume, oral advisory from researcher based on D-PAS displaying volume location and relative helicopter position

D-PAS Display onboard helicopter



Test Results

Helicopter passes through *inactive* UAS area



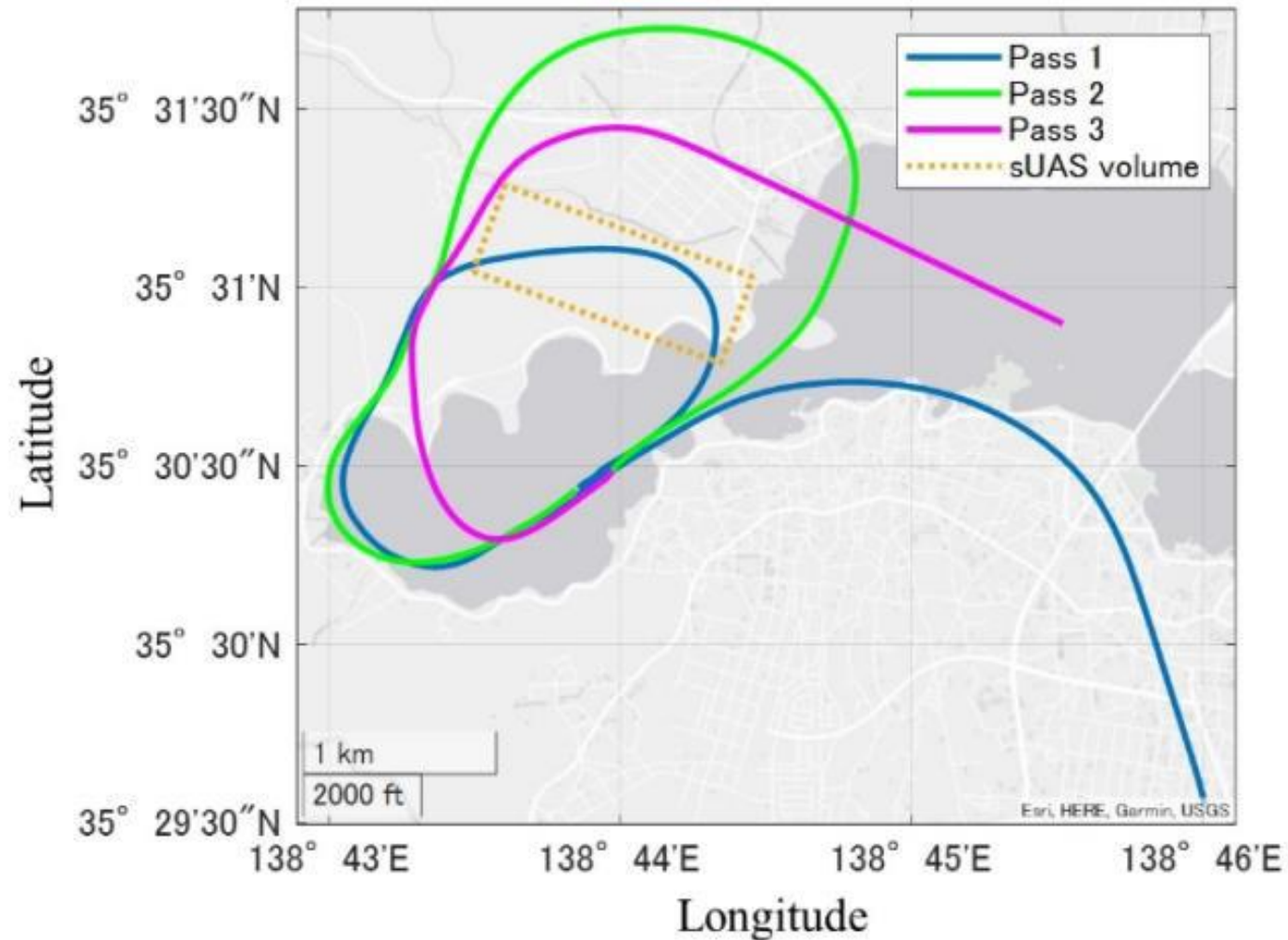
Helicopter maintains well clear of active UAS Volume through pilot awareness



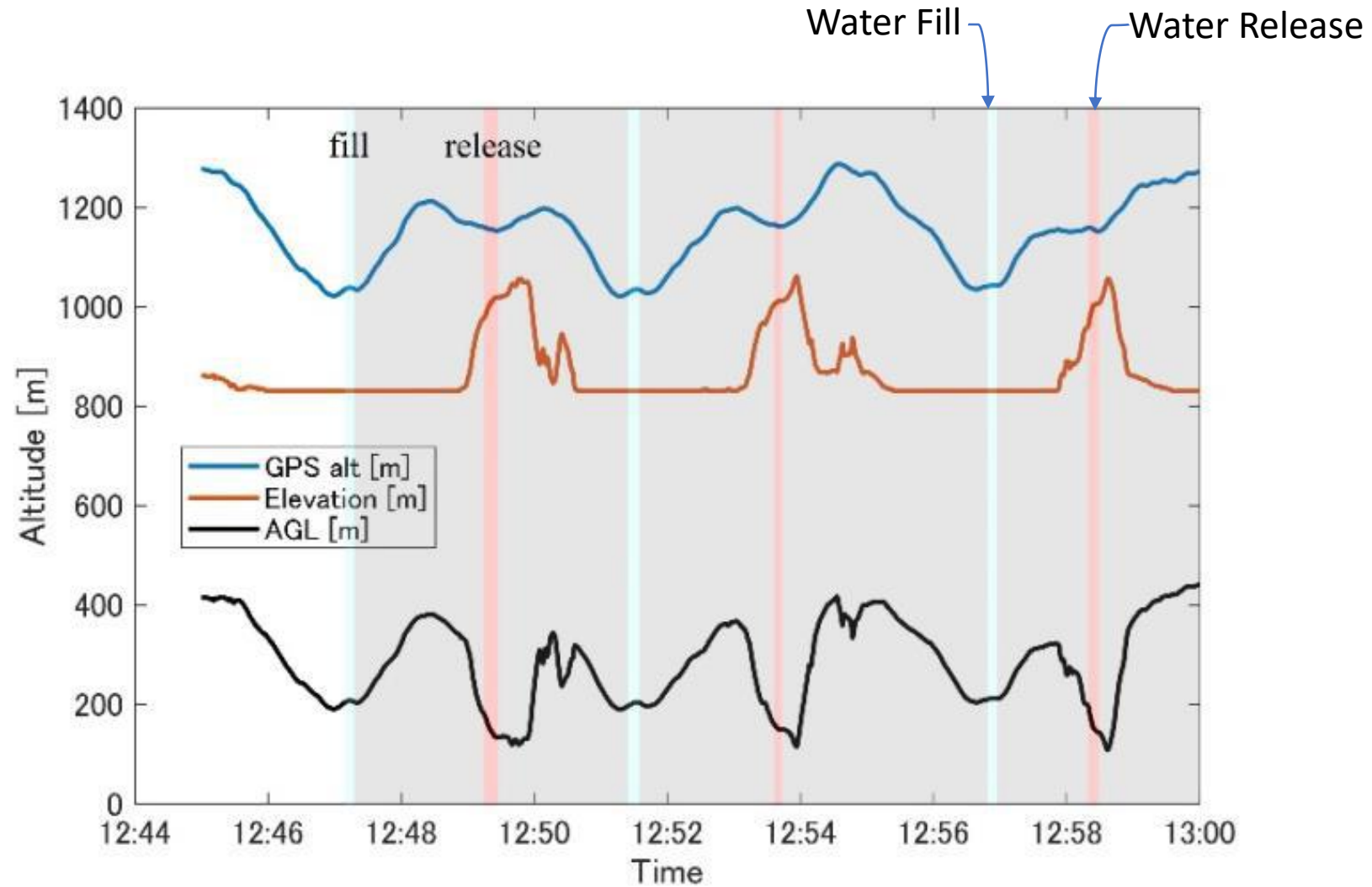
Helicopter maintains well clear with closer proximity to active UAS Volume



Test Results: Lateral Assessment



Test Results: Altitude Assessment



Test Results: Pilot Feedback

- Pilots noted that having awareness of the sUAS flight area, i.e., their operation volume, improved their overall situation awareness.
- Shared information on the sUAS operation volume contributes to shared common operating picture among sUAS operators and helicopter pilots.
- Pilots confirmed that they would not enter the sUAS operation volume when they are aware of the airspace assignments, however, they would try to visually confirm the presence of the sUAS in their operation volume and verify the number of sUAS.
- The information on planned operations is to be obtained prior to flight and by the aid of the portable mission support device onboard the vehicle, in this case JAXA's D-PAS.
- Pilots prefer to see the operation volume rather than the sUAS position if the sUAS is performing operations in an area, and only want to see sUAS position if that aircraft is transiting through the area

Concluding Thoughts

- Disasters are a growing global issue and UAS technologies offer an opportunity to bring new tools to address the growing challenges facing emergency responders
- JAXA and NASA have been conducting joint research since 2016 to better understand how UAS can be more effectively integrated in emergency response operations
- The flight tests have examined concepts for the raised situation awareness of manned and unmanned integration in disaster response environment by an integrated D-NET and UTM system.
- Test results suggest that the approach taken to operation planning may have helped the pilots maintain situation awareness of other operators in the area.

Thank You