



## Rapid Response Using UAS to Support Alaskan River Ice Breakup Monitoring and Flood Forecasting in Alaska

NOAA UAS Program and NWS Coordinate with National and Alaskan State Partners to Conduct Unmanned Aircraft System (UAS) Operations.

The annual spring breakup of Alaskan rivers brings the threat of flooding from ice jams that dam river channels and cause water to backup and inundate communities. NOAA's National Weather Service (NWS) and the Alaska Department of Homeland Security and Emergency Management have monitored Alaskan rivers during breakup to provide advanced warning of flooding for several decades as part of the River Watch program using a fixed wing aircraft. In recent years, advancements in temporal and spatial resolution of polar orbiting satellites has improved broad scale monitoring of river ice conditions and flooding, but grid cell size of satellite imagery is often limited to the largest channels, restricted to a fixed time of satellite passage, and requires cloud free days.

In April 2016, NOAA's NWS and UAS Program Office, two Cooperative Institutes and the Alaska Center for UAS Integration (ACUASI) partnered to evaluate the use of UAS to monitor ice conditions and breakup with significantly higher temporal and spatial resolution than presently available from satellite imagery. The objectives of this proof of concept was to examine near real-time operational forecaster Decision Support Service (DSS), provide rapid response surveillance of river ice and/or flooding, and to validate and calibrate satellite derived river ice and flood products. The Yukon River at Circle City located approximately 150 miles northeast of Fairbanks was selected for the mission for several reasons: the community is on the road system; the River Watch team monitors this reach of

the Yukon River; data collection compliments other larger scale, fixed wing mapping in the area by the University of Alaska; and the community frequently experiences spring ice jam flooding. In addition, the breakup front on average take 5 days to travel from the upriver community of Eagle to Circle City. This allowed NWS to provide ACUASI with the "48-hour Alert" required for them to mobilize and setup in Circle City. The "Alert 48" was established on April 20th and executed on April 27th.

The NWS was interested in observing pre-breakup signatures in the ice surface (thermal and elevation changes) that are precursors to ice movement (breakup), to improve lead time for forecasting ice breakup, and ultimately ice jams and flooding. Multiple flights over several days were important to NWS to acquire a time series of data and observe differential changes in ice conditions. A mild winter combined with a very warm spring resulted in a thermal breakup of ice on the Yukon River, which is characterized by weak ice that melts ice in-place and multiple breakup fronts, rather than a single, dynamic breakup front moving down river. Therefore, significant changes in ice conditions were much subtler and less pronounced prior to the arrival of the breakup front.

Several hours after ACUASI arrived in Circle City on April 28th, the single rotor helicopter, the Responder, leaped into the sky to survey one of three priority transects identified by the NWS. On this first mission the Responder flew a Sony  $\alpha$  6000 camera that took still images every two seconds. Very shortly after the flight, the images were geotagged and uploaded to the Geophysical Institute server, and several hours later mosaic images were processed into a cohesive map identifying pockets of ice and opened water. Imagery was immediately uploaded to the National Arctic Environmental Response Management Application (ERMA), in order to support forecast operations at the NWS forecast office in Fairbanks and Alaska-Pacific River Forecast Center in Anchorage. The data showed solid ice covering the channel near the Circle village, two channels in the center clear of ice, and the fourth channel on the other side of the Yukon river, still frozen and intact.

Friday (April 29th), the team gave the local Circle school pupils and staff a briefing on ACUASI and NOAA join project, showcasing aircraft and sealing the morning with a group picture. That day ACUASI flew the Responder VTOL UAS four times and a fix wing aircraft the Aeromapper UAS, totaling an impressive five flights in one day. The last flight on Friday landed just before eight pm, and at nine, the ice on the river started to rumble. A few minutes after nine, the ice pushed on to the banks, stepping on a nearby bonfire, and forcing people to step away from the river crushing ice force. Soon after, the ice broke loose, and by about one in the morning the river channels were mostly clear of ice, a part of periodic ice blocks drifting with the current.

This mission brought federal, state, local, academic and industry partners together to provide a multi-mission, multi-aircraft, and multi-sensor event in support of the Alaskan River Watch.

**Is this is an issue of potential concern?**

**This item has high visibility**

**Geographic Location (Relevant region, city location)** Circle City, AK

**Partnering offices** OAR, NOAA UAS Program, Cooperative Institutes (NGI, UAF, MSU), NWS

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