Using Unmanned Aerial Systems for Monitoring Prescribed Fire

Valentijn Hoff, University of Montana, valentijn.hoff@firecenter.umt.edu
Lloyd Queen, University of Montana
Carl Seielstad, University of Montana
Chris Moran, University of Montana
Tim Wallace, University of Montana
Matt Cunningham, University of Montana
Dan Jimenez, US Forest Service, Rocky Mtn Research Station

Main Questions or Issues That You Addressed

Unmanned Aerial Systems (UAS), or unmanned aerial vehicles or drones, are being considered for many different uses in natural resource management. Often people get excited about using UAS as it is a relatively new, high profile technology. Members of the DroneFire project, part of the National Center for Landscape Fire Analysis at the University of Montana, investigated the utility of these versatile tools for monitoring prescribed fire, both for research and management applications. We used UAS for pre-fire, post-fire, and during-fire observations and data collection. We sought to evaluate operational capability, identify and overcome technical issues, collaborate with stakeholders, and establish addressable research questions.

Location and Ecosystem Investigated

We flew UAS missions in Longleaf pine forests in Georgia and Florida, mixed conifer forests in Montana and mixed conifer forests and grasslands in Oregon. Most flights were over prescribed fires on lands managed by The Nature Conservancy, Tall Timbers Research Station, and the University of Montana.

Key Findings of Your Research

UAS have shown a lot of promise for monitoring prescribed fires, but UAS operations carry considerable risk. Forested environments pose a significant challenge for UAS pilots. Quad-copters are better suited for these environments with vertical take-offs and landings and high agility. Fixed-wing platforms can cover more ground but require open take-off and landing zones. High wind speed, air temperature extremes, precipitation, and complex topography have significant negative influences on UAS operations. Flight preparation and execution cannot be rushed or the chance of crashes, mishaps, incomplete missions, and poor data rises quickly. Picking the right platform, sensor, flight planning software, and data processing software are all critical as well. GPS is required for navigation and geo-rectification of data but often has low accuracy under forest canopy. Ground control plots with accurate location information can overcome this issue for data collection. Saturation, ghosting, shadowing, and image smear are significant issues that require solutions for data to be useful. Post-processing cannot supplant optimal flight parameters for high quality data collection. Once challenges are overcome, UAS provides a flexible platform with a unique perspective. We are able to collect high resolution

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spatial (as low as 2 mm) and temporal (as high as 1 Hz) data not previously available. We can fly immediately prior to and post fire, as well as during fires, and collect data at the exact time and location of our choice. Overhead video is a powerful tool for public information and training. The regulatory environment is just as important as the physical environment. The Federal Aviation Authority and many land management agencies have a plethora of rules to follow, which can make mission planning challenging. Preparation and frequent practice are imperative for a UAS program to be successful.

How Did You Answer the Main Questions or Inform the Issues?

We flew many different mission profiles in a variety of ecosystems, under a variety of weather conditions with many different platforms. We collected data at many resolutions. We used both visual and infrared sensors for data collection. We processed data into geo-referenced ortho-mosaics, structure-from–motion (SfM) derived 3D point-clouds, 1 Hz time-lapse photo series and videos, using a variety of software packages.

How Might/Will It Influence Fire Management Decisions or Practices?

Fire managers will be able to add UAS derived data to a monitoring workflow. For example, green (area unburned) versus black (area burned) data will be more accurate and comprehensive than traditional ground-based estimates. Fire managers can increase their situational awareness by using UAS to keep track of fire progression, smoke dispersion, or to find hot spots outside the burn area. Fire researchers use the high-resolution data to measure fire effects, fuels, and fire behavior. Public information officers can create goodwill and understanding with the general public by making interesting fire footage available.

Who Is the Main End-user of Your Research?

UAS are useful tools for fire and land managers, regardless of the ecosystem they manage. The data produced by UAS can be useful for managers, scientists, students, and the general public. For more information please visit www.firecenter.umt.edu. Image Caption: Pre-fire and post-fire image mosaics of surface fuels in a pine plantation in Georgia at 2.23 mm spatial resolution. UAS provide high resolution data, but only over a limited spatial extent.

Congress Session

Prescribed Fire Science: An Interdisciplinary Focus on Fire We Use, Kevin Hiers