# Drones as a Tool for Modeling Wildfire Risk:
# Measuring the effectiveness of forest fuel reduction treatment in Flagstaff, AZ


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Flagstaff Watershed Protection Project

## Background

In the southwest U.S., historic land use and fire suppression have created forest conditions highly susceptible to catastrophic wildfire (Covington & Moore, 1994). In response to increasing wildfire risk, land managers have been conducting forest fuel reduction projects to reduce the likelihood of catastrophic fires (Graham et al., 2005, Agee & Skinner, 2005).

In November 2012, residents of Flagstaff, AZ voted on a $10 million fuel reduction treatment to help protect the city from wildfire, and subsequent flooding, which could damage key areas of the city and its water supply (Mottek Lucas, 2015). This project is known as the Flagstaff Watershed Protection Project (FWPP).

## Problem

According to the FWPP Monitoring Plan (2014), voters would like project monitoring to evaluate the following question:

***"Did the investment effectively reduce the risk of catastrophic fire?"***

Current methods used to answer this question include extensive field work that can be costly to forest land managers. The LANDFIRE database can also be used, but is coarse in spatial and temporal resolution, and often relies on field work to correct data inaccuracies.

## Objectives

This research aims to help answer the voter question using innovative remote sensing techniques via unmanned aerial vehicles (UAVs) to measure changes in forest structure from forest fuel reduction treatment. The forest structure measurements will be used to model pre- and post-treatment crown fire potential and evaluate the fuel reduction treatment effects on potential fire behavior.

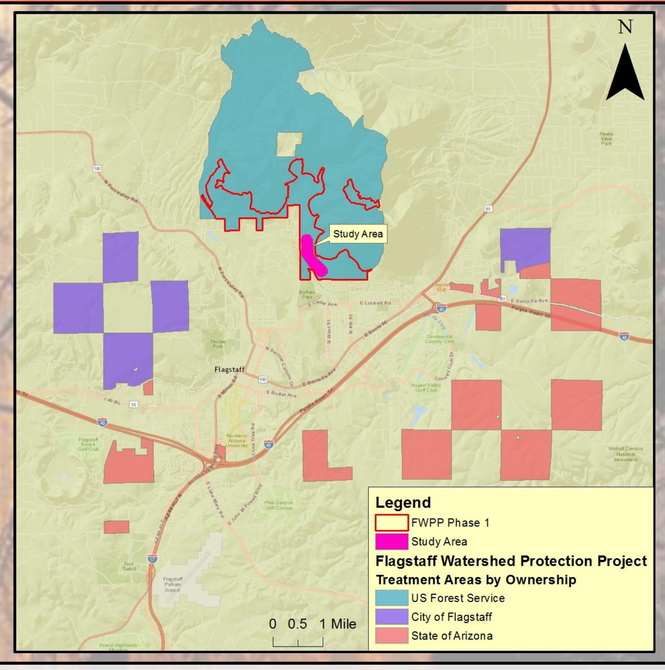
## Management Implications

The methodology and findings from this study can assist forest land managers with integrating UAV technology in their land management decisions.

By utilizing UAVs as a tool for modelling wildfire risk, managers could plan fuel reduction treatments on a fine-scale that would be difficult to do with current methods. It would also allow managers to quickly evaluate ongoing treatments and conduct rapid adaptive management to achieve desired conditions. In general, UAVs could be an efficient alternative/supplement to traditional field surveys.

The methods proposed in this study could also be applied to aerial light detection and ranging (LiDAR) datasets to measure forest structure and model fire behavior at a larger scale.

## Study Area




The study area is about 100 acres in size and located just north of Flagstaff, AZ. It is within Phase 1 of the Dry Lake Hills treatment area of the FWPP that is scheduled to be treated Summer and Fall 2017.

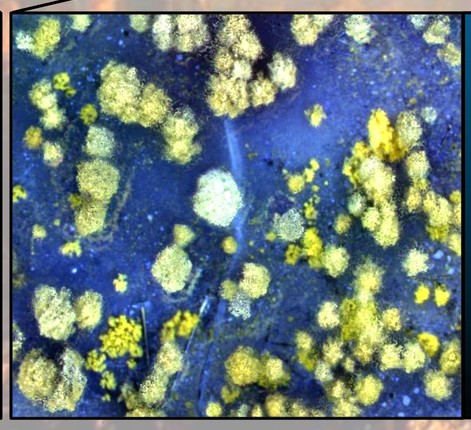
## Methods

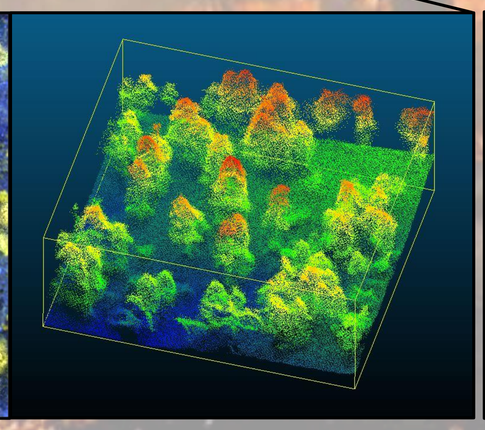
**Collect UAV imagery:**
- eBee fixed wing UAV
- MultiSpec 4C multispectral sensor

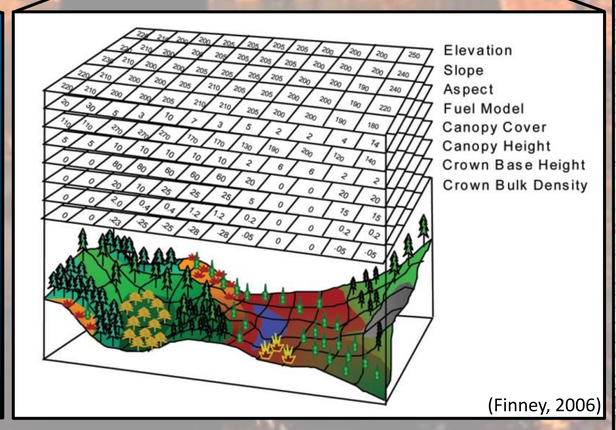
**Create 2D and 3D forest models:**
- Multispectral orthomosaic photo
- Structure-from-Motion pointcloud

**Make measurements with 2D and 3D models:**
- Measure canopy fuels
- Measure topography
- Create layers needed for FlamMap software

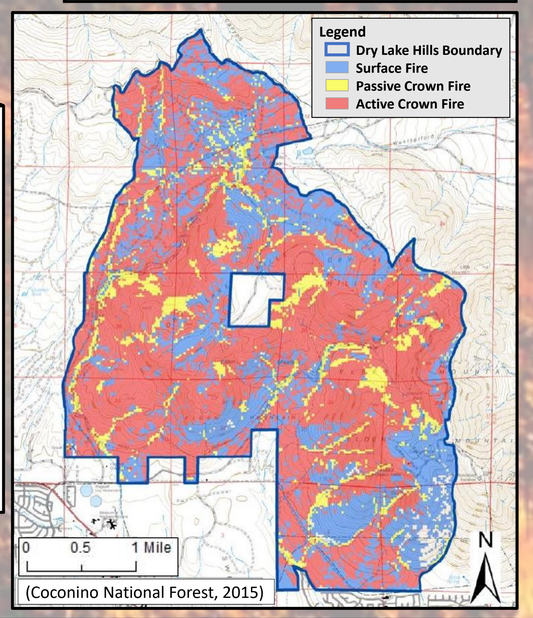
**Model pre- and post-treatment crown fire potential:**
- FlamMap Fire Behavior software
- Help to answer question: *Did treatment reduce the risk of fire?*








(Finney, 2006)




(Coconino National Forest, 2015)

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Poster background image: http://www.wallpapers-web.com/data/out/82/4460390-forest-fire-wallpapers.jpg


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