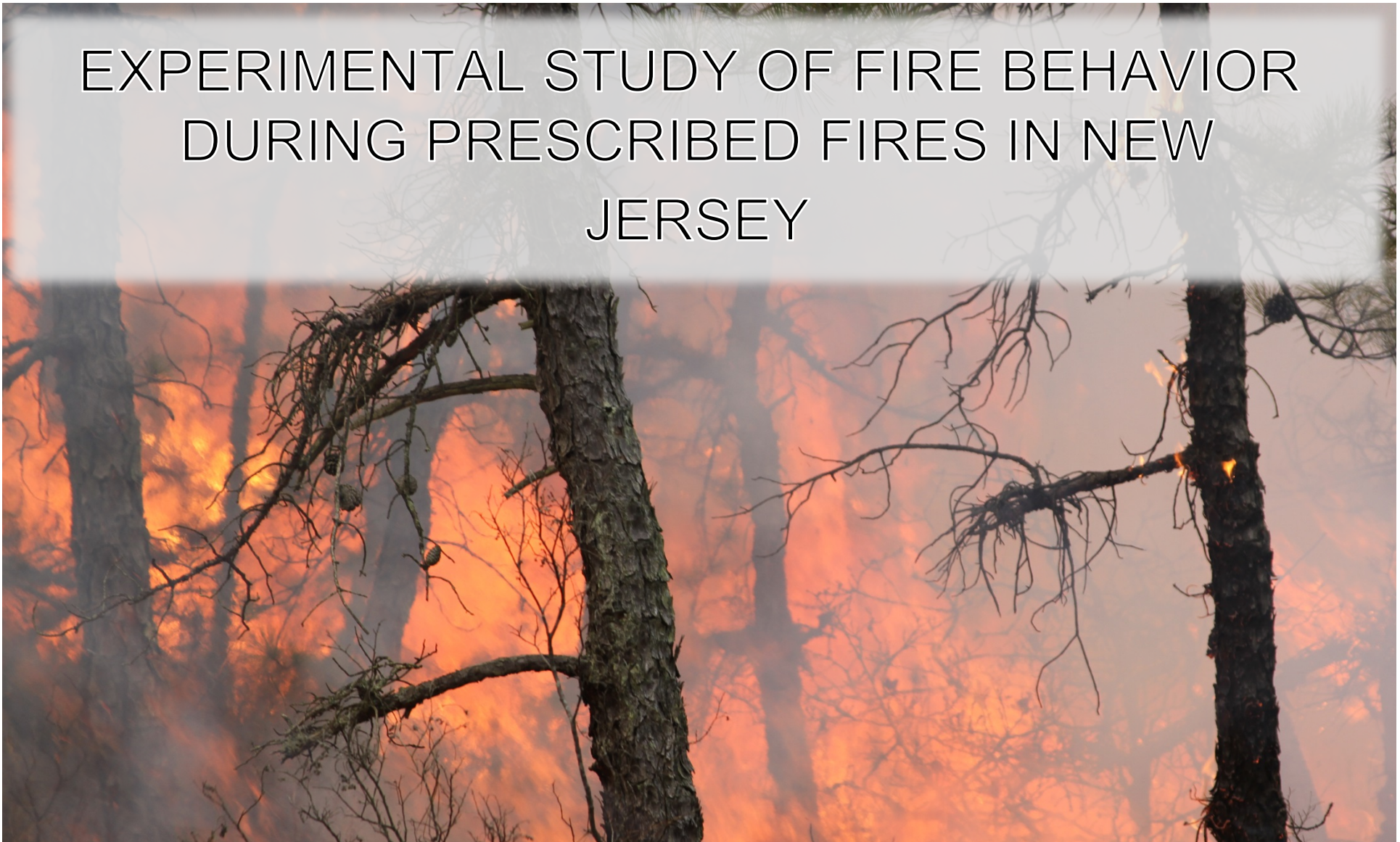


# EXPERIMENTAL STUDY OF FIRE BEHAVIOR DURING PRESCRIBED FIRES IN NEW JERSEY



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R·I·T

NATIONAL RESEARCH  
Tomsk  
State  
University



# Project Overview

- 3-year goal – Effectiveness of fuel treatment
- Long-term goal – Improved understanding of wildland fire behavior
- 2 field experiments to date



Courtesy of Wikimedia Commons



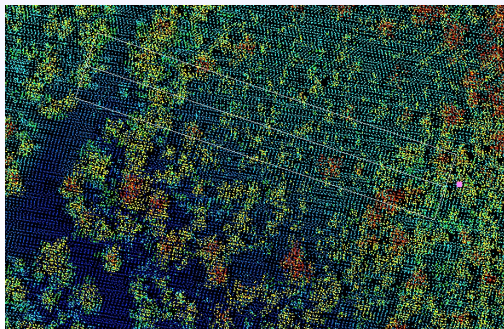
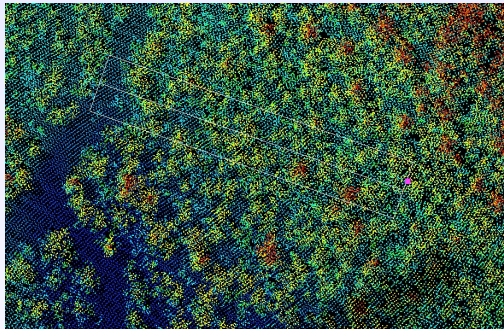
**New Jersey Pinelands National Reserve**  
1.1 million acres ~23% of NJ

- Averages 1300 wildfires per year (2003-2013)
- Large crown-fire event every 5-10 years
- High level of WUI
- RxB conducted on 12,000 acres per year



# Measurement Techniques - Fuel

- 36 pre- and post-fire clip plots (3 per understory tower)
- Fuels sampled by size class
  - Forest floor: fine, repro., 1hr, 10hr, 100hr
  - Shrub and Oak layer: 1hr, 10hr (live and dead)

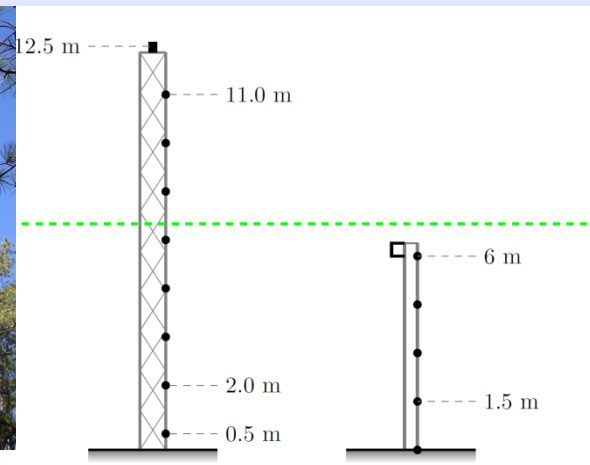
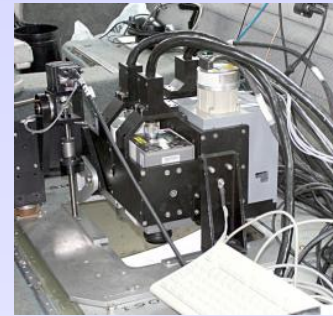


- Pre- and post-fire Airborne Laser Scanning data (400 kHz, pulse density 5.12 pts/m<sup>2</sup>)
- Provides canopy height and bulk densities (calibrated by upward sensing LiDAR)
- Resolution of 10 x 10 x 1 m



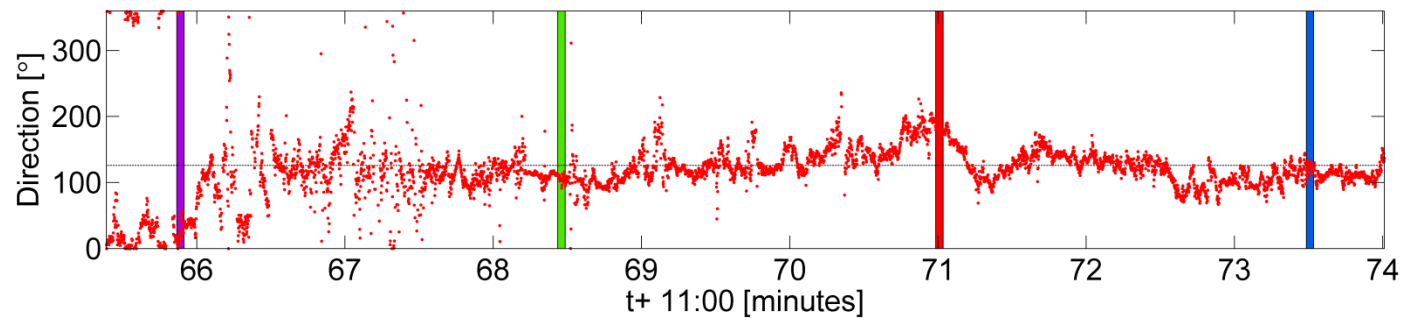
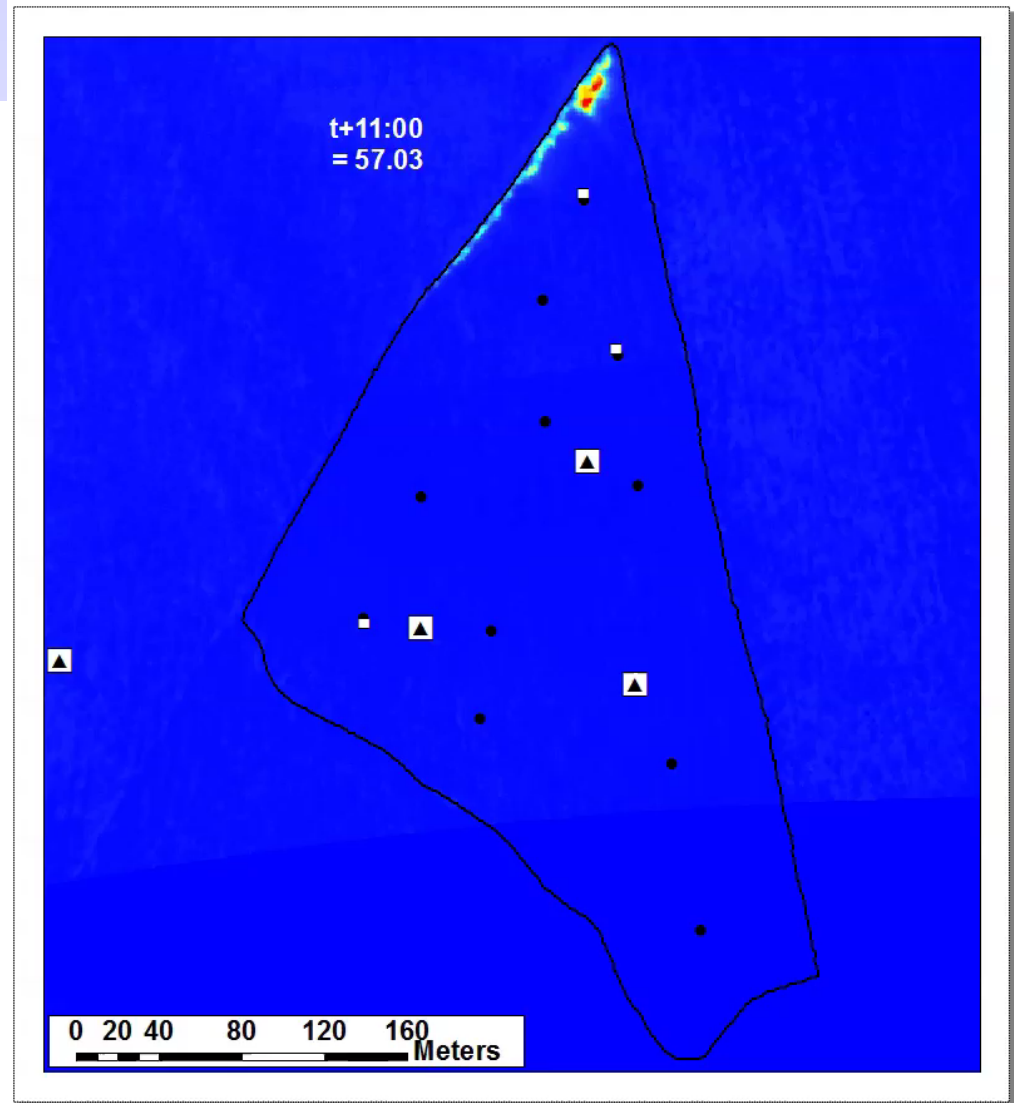
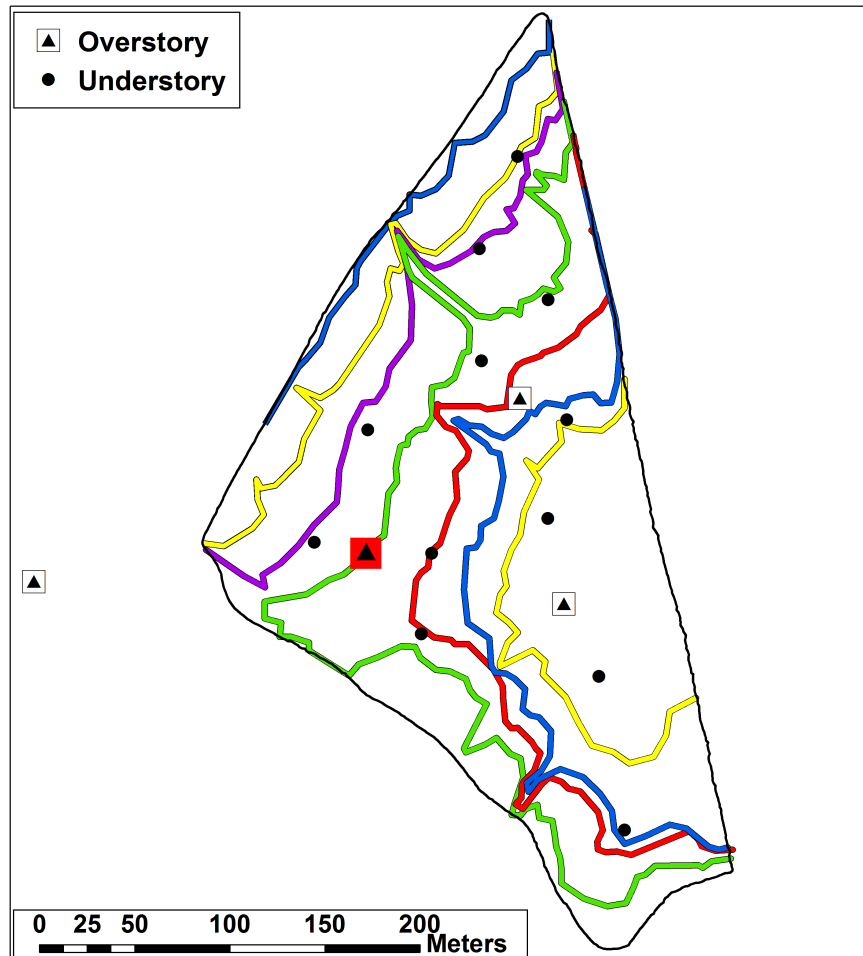
# Measurement Techniques - Fire

- Aerial imagery: Series of georeferenced stills taken using RIT's Wildfire Airborne Sensor Program (WASP)
- Towers: overstory (8 thermocouples and 1 3D Sonic Anemometer) and understory (5 thermocouples, 1 vertical flow sensor, 1 vertical dual-band radiometer)
- Fire behaviour packages: 4 thermocouples, 6 thin-skin calorimeters (total heat flux), 3D flow velocity

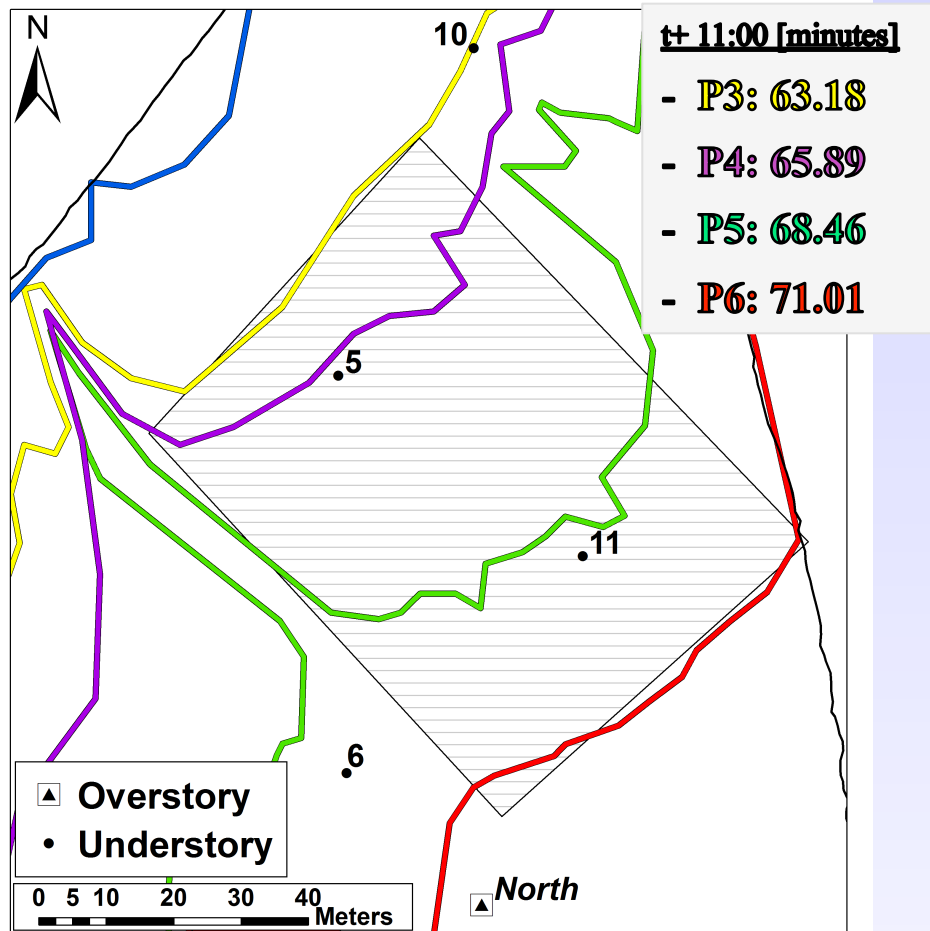




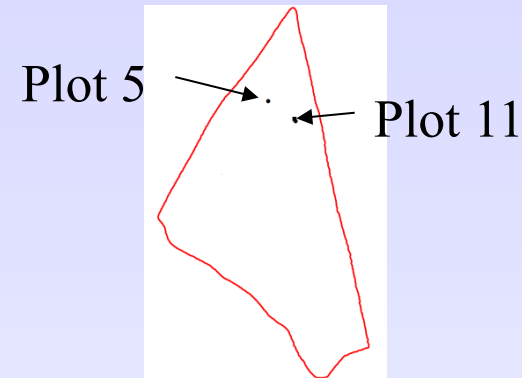
# Fire Progression







## Plot 5 & 11



### Forest floor – U5

	fine	wood 1hr	FF total
mean consumption [g·m <sup>-2</sup> ]	575.7	-0.7	<b>575.0</b>

### Shrubs and Oaks – U5

	1hr L+D
mean consumption [g·m <sup>-2</sup> ]	<b>324.0</b>

### Forest floor – U11

	fine	wood 1hr	FF total
mean consumption [g·m <sup>-2</sup> ]	507.4	391.7	<b>899.1</b>

### Shrubs and Oaks – U11

	1hr L+D
mean consumption [g·m <sup>-2</sup> ]	<b>419.7</b>

$$\text{Fireline Intensity } I_f = ROS \cdot \Delta m \cdot h$$

U5:

~1500-4100 kW·m<sup>-1</sup>

U11:

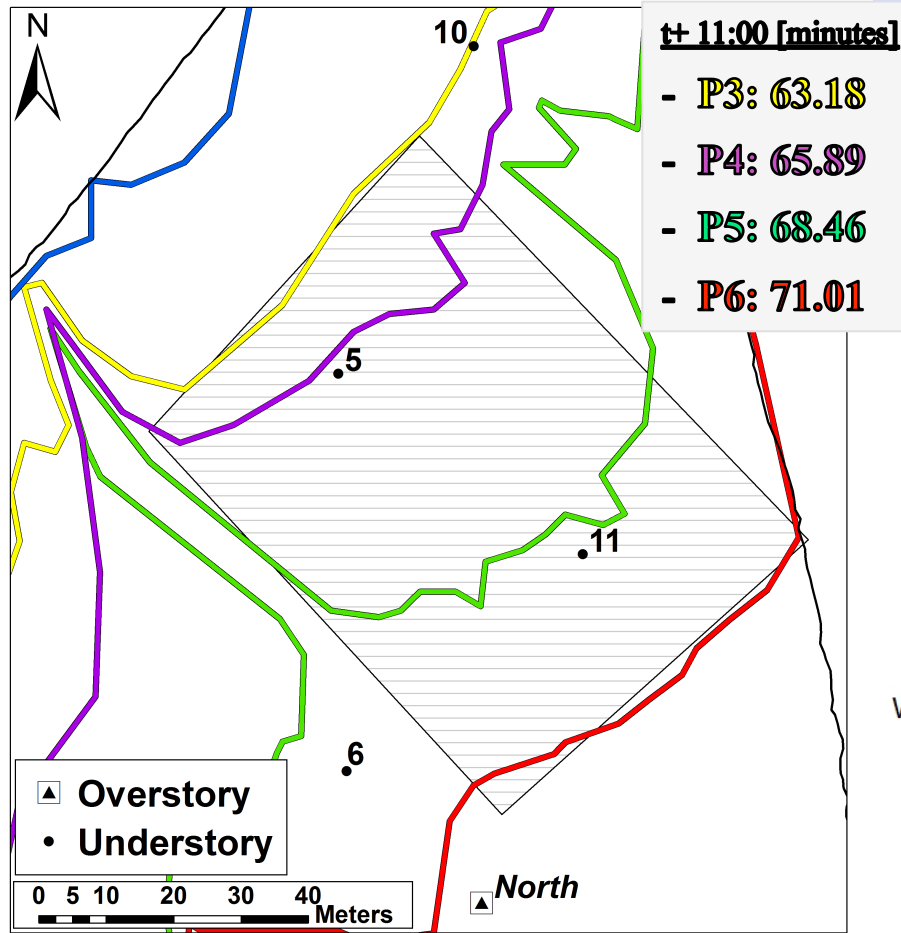
~4700-6000 kW·m<sup>-1</sup>





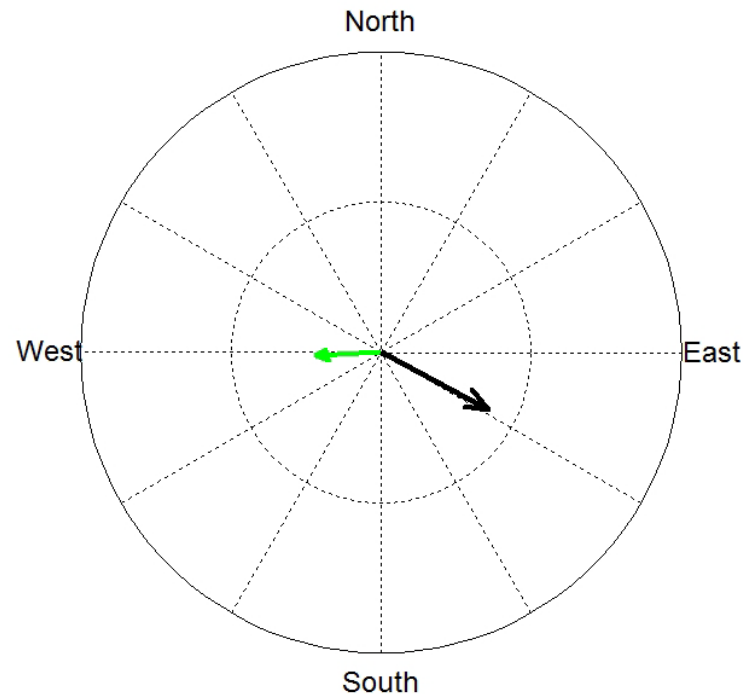


# Plot 5 & 11



t+ 11:00 [minutes]

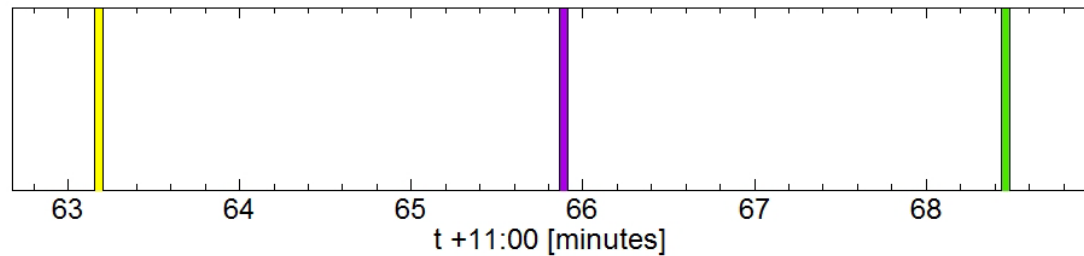
- P3: 63.18
- P4: 65.89
- P5: 68.46
- P6: 71.01



Control



North



## Preliminary Visual Results





## Preliminary Visual Results

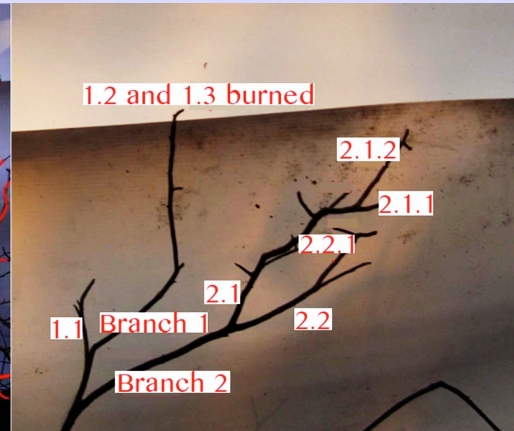
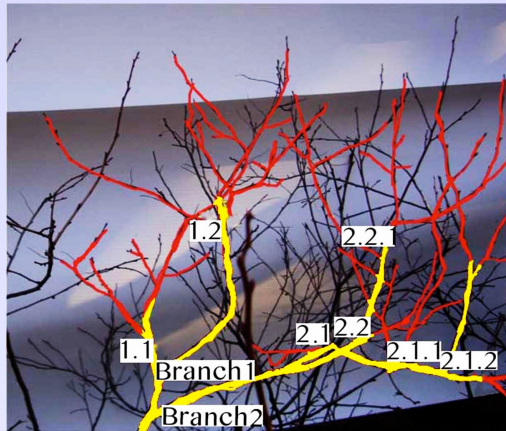


## Preliminary Visual Results

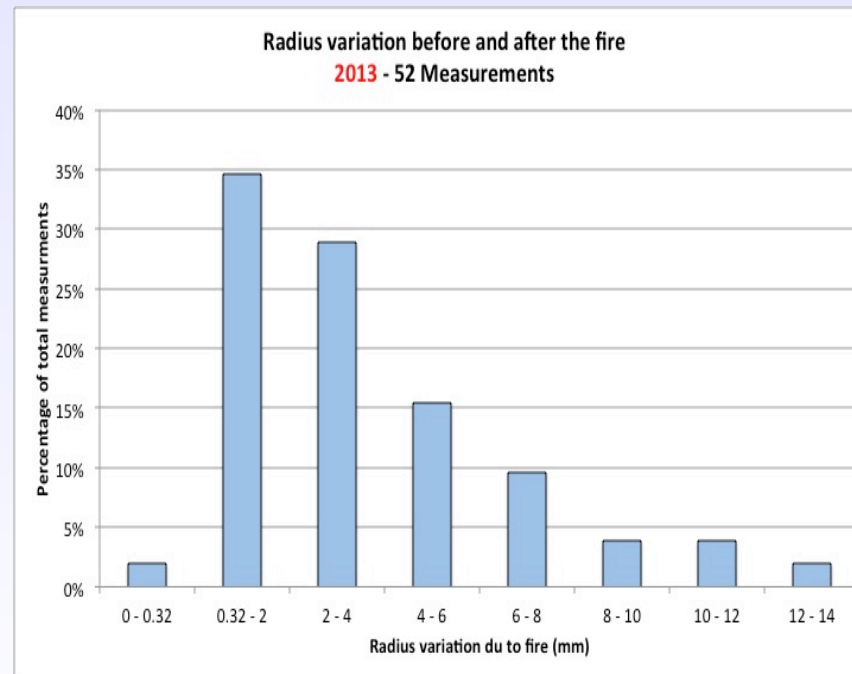




# Fuel - Branch and Bark Consumption



No more than 53% of shrub mass was consumed. 1 hour fuels:  
 $S_1 < 2$  mm;  $S_2 = 2-4$  mm;  $S_3 = 4-6.35$  mm  
 All  $S_1$  consumed but less than 50% of  $S_2$  and no  $S_3$ .

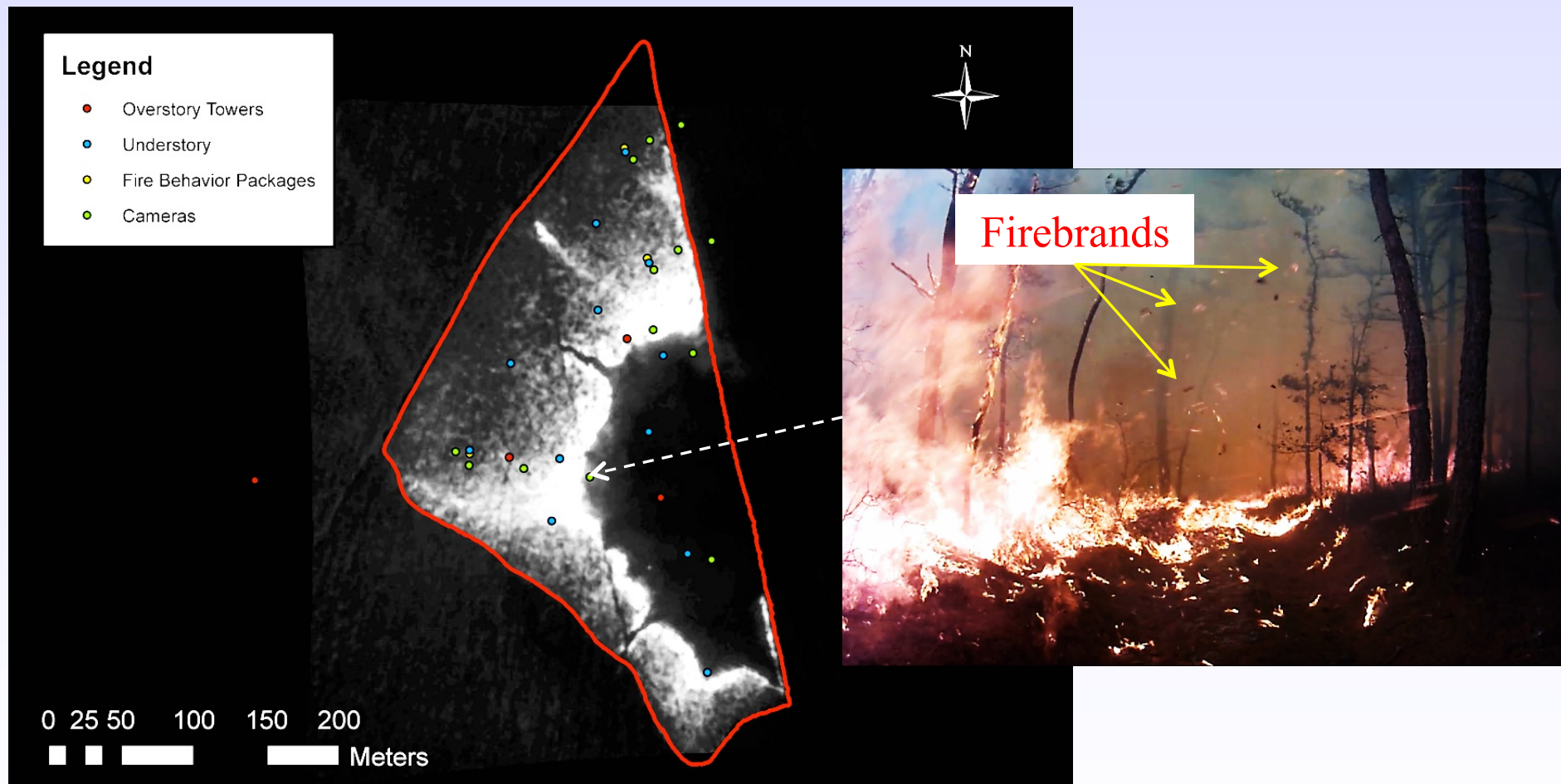


- Most Radius variations between 0.32 and 6 mm.
- Same thickness as the bark collected in pans.

# Firebrands

First attempt to quantify firebrand

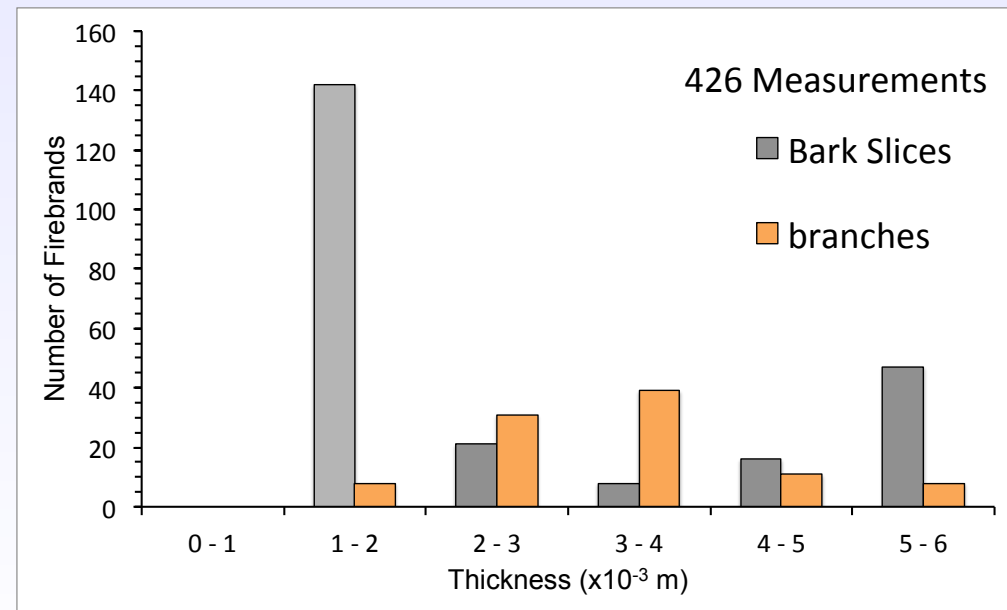
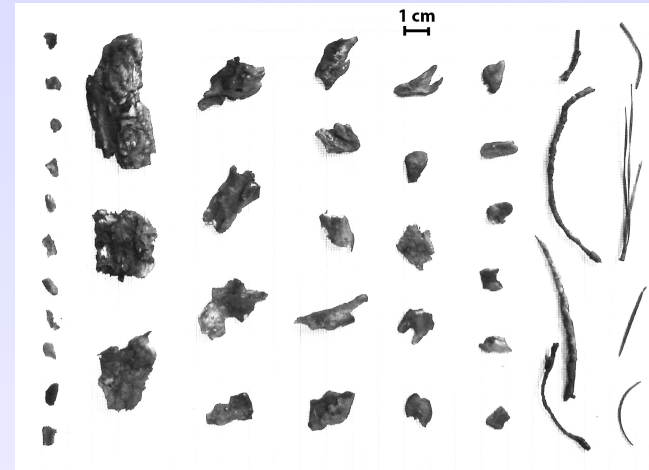
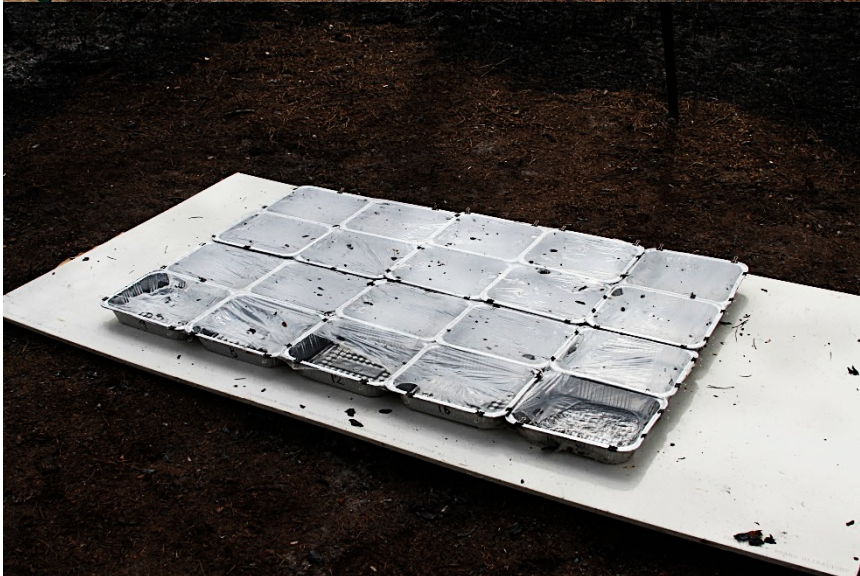
Firebrands allowed a surface fire to cross easily a narrow fuel break



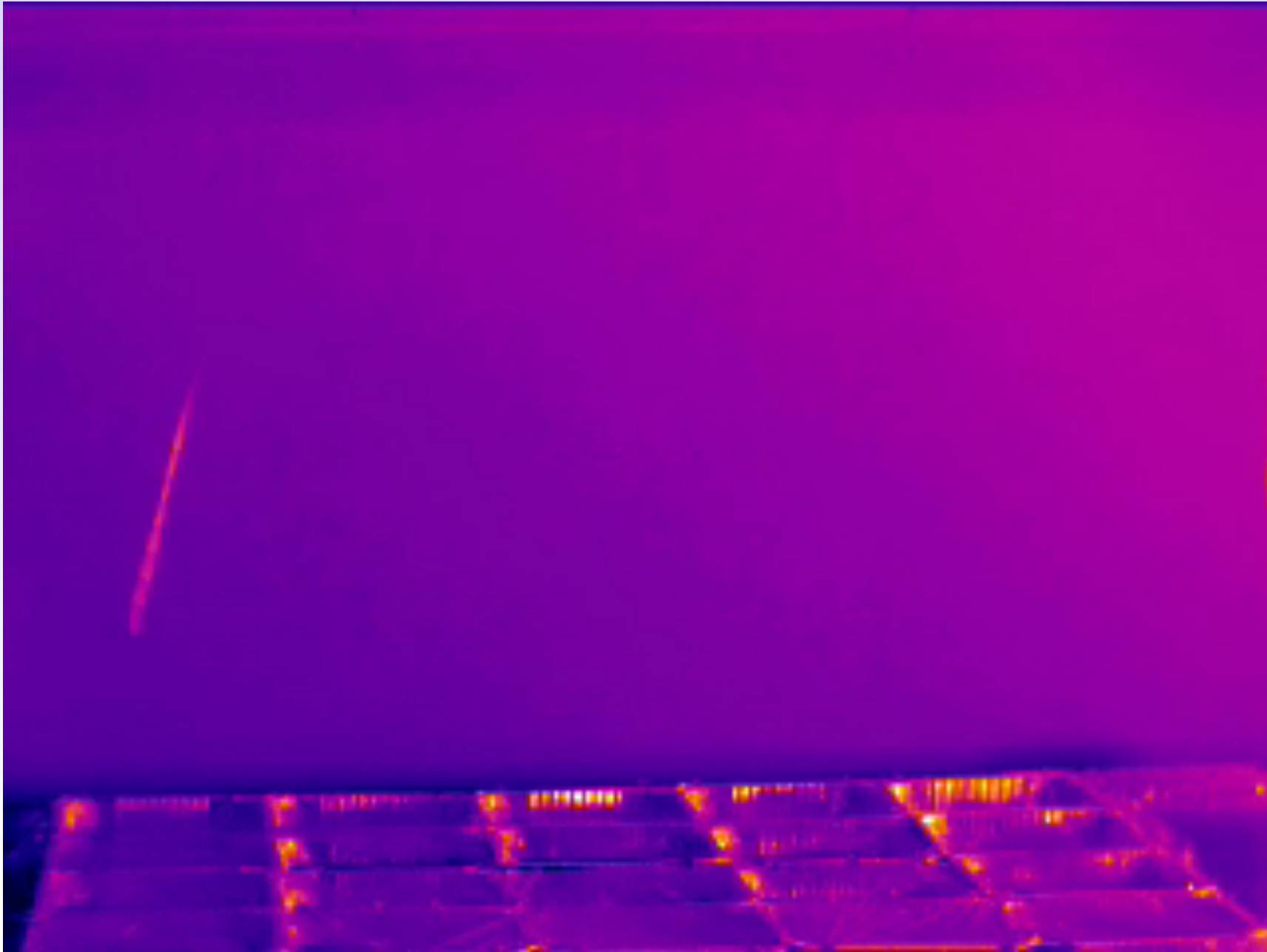


# Firebrands

The firebrand density was determined by collecting samples with and without plastic film



# Firebrands



## Conclusions

- Valuable data collected on fire behavior in a forested environment
- Both fire progression/behavior and total fuel consumption
- Estimation of fire-line intensity for different types of fire spread
- Analysis of fire behavior related to fuel distribution and wind
- Firebrand characterization (size and time)
- Much more work to be done to thoroughly analyze results from both years





# Thank you!

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