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Firefighter Survival Zones

Greg Baxter
Senior Researcher

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Survival Zones - Outline

- Background
- Research Group
- Study Areas
- Field Work
- Preliminary results to date

Background

- An incident in Alberta raised interest in firefighter travel rates and survival clearing size requirements when faced with entrapment and, or burn-over event.

- A ‘survival zone’ **IS** different than a safety zone.

- Due to the seriousness of this topic we have taken a very cautious approach.

****This research is based on the concept that survival zones should only apply when all other safety protocol has been exhausted.****

Project Objectives

To determine the characteristics of a survival zone that increase the probability of survival by:

1. Determining the radiation produced spatially and temporally
2. Collection of temperature and air quality data
3. Understanding the role of PPE.
4. Compilation of data from previous entrapments

This is Exploratory Research at this time.

Research Team

- Marty Alexander, University of Alberta, Department of Renewable Resources. Literature Review.
- Mark Ackerman. U of A Mechanical Engineering. Fire Intensity, clothing.
- Rob Thorburn, SRD. CO limits.
- Gary Dakin, Consultant. Fire logistics.
- Greg Baxter, FPInnovations.

Research Areas

- Literature Review – of fire entrapments focusing on opening size, fire behaviour and fuel type.
- Human Survivability – radiation influence on clothing and skin.
- Air Quality – Carbon Monoxide levels experienced in survival zones and super-heated air.
- Experimental fires.

Survival Zones –
which opening would you hunker in?

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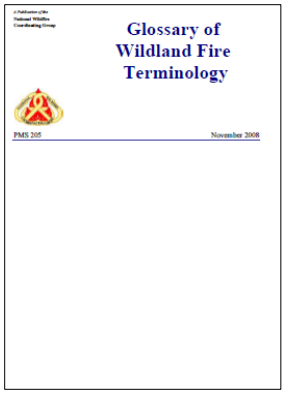
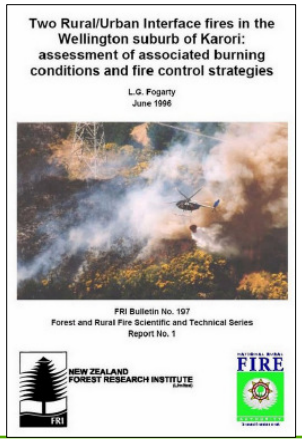
Literature Review - sources

- Historical and current operational wildland firefighter safety guidelines and glossaries produced by wildland fire management agencies worldwide



- Relevant technical and scientific articles produced by wildland fire research globally

- Case studies of wildland fire entrapments and burn-over's in Canada, U.S. (dating back to 1910), New Zealand, Australia, South Africa, Argentina, Spain, Portugal, and Croatia.



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Literature Review - findings

- Existing definitions and concepts of safety and survival zones do not seem applicable or relevant to the Canadian wildland fire scene.
- No definitive models or guidelines exist in the scientific and technical literature with respect to the wildland firefighter safety and survival zones.
- The literature (especially individual case studies of wildland fire entrapments and burn-over's), provide insights into the nature of the issues and problems (e.g., tolerance to heat varies amongst individuals).
- Heat from the flames is not the only variable to consider (e.g., smoke).

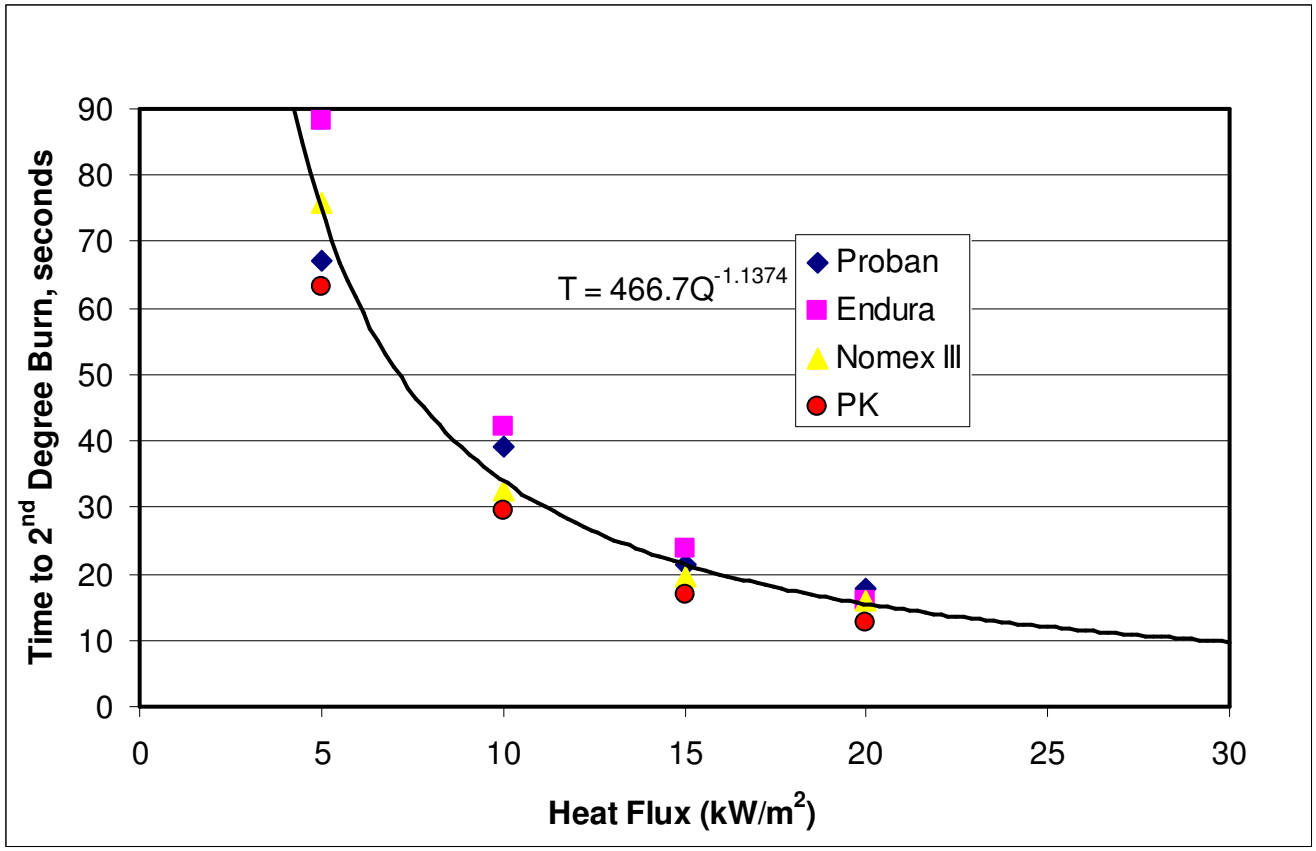
Literature Review - findings

- Ackerman and Alexander have combined to develop a modeling framework for simulating the thermal environment associated with wildland fires in and around clearings of different shapes (circular, rectangular, elliptical).

- For a given fuel type, Flame Height, Flaming Residence Time & Rate of Fire Spread need to be specified.

- On the basis of the 3 specified fire behavior characteristics, the Radiant Heat Flux is calculated for given distances from the flame front in relation to time as well as the Critical Radiant Heat Flux.

Firefighter Survivability



Grass:
30 kW/m²
10 sec

Conifer Forest:
8 kW/m²
45 sec

Slash:
5 kW/m²
90 sec

- Bare skin can tolerate 10 kW/m² for 10 seconds (Stolls curve).

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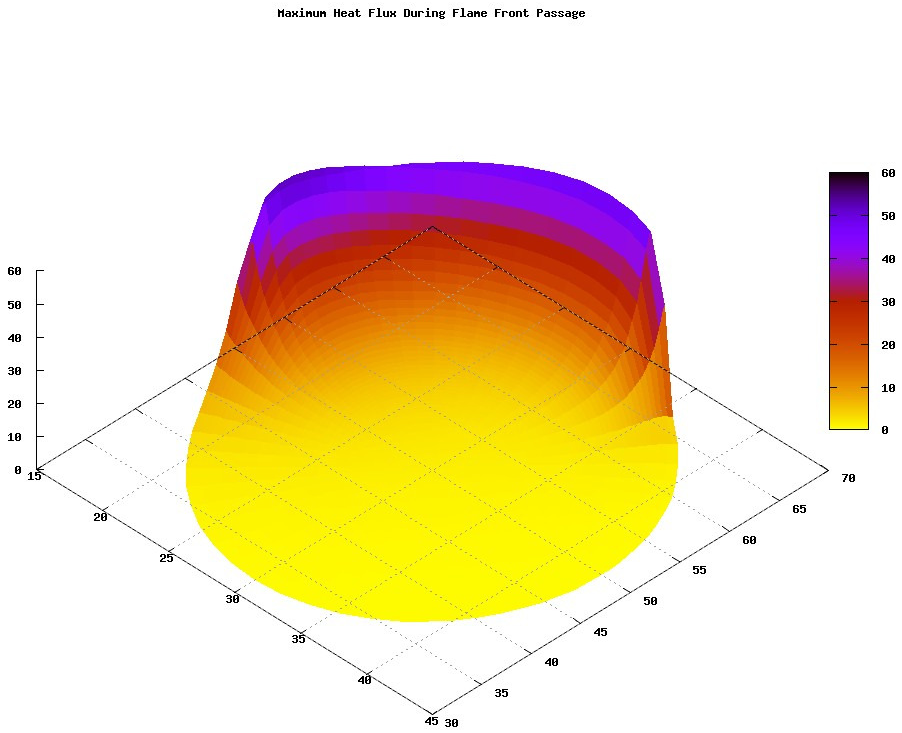
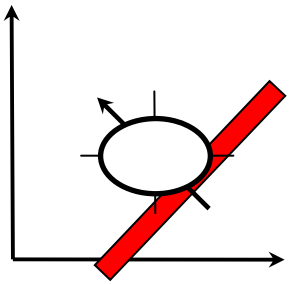
Survival Zone Modeling

- Known theoretical equations were used in simulations on various shaped survival zones surrounded by trees of various heights.



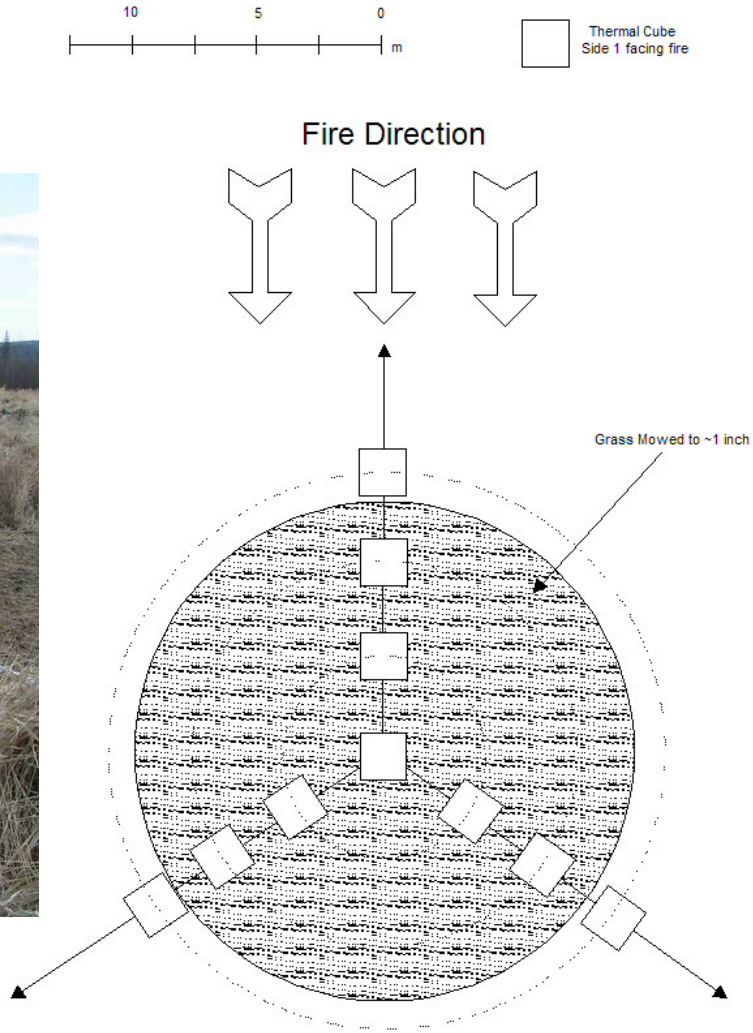


Experimental Fires

Experimental Fires

- Plots initially in grass fuels to develop a methodology. It is easy to work in and allows faster replications.
- Working closely with Vanderwell Contractors 1971 Ltd. we found a site where we are able to build a number of plots each year.
- Burn in spring when grass is cured. Burn same sites each year.
- Have completed 9 burns to date.

Experimental Fires – Plot layout



Experimental Fires – fire behaviour

- Plot size roughly 50 x 40 m.
- Opening 10 m across
- Fuel loading: 5 t/ha
- Flame length: 1 – 2.5 m
- ROS: 20-40 m/min
- Up to 3000 kW/m

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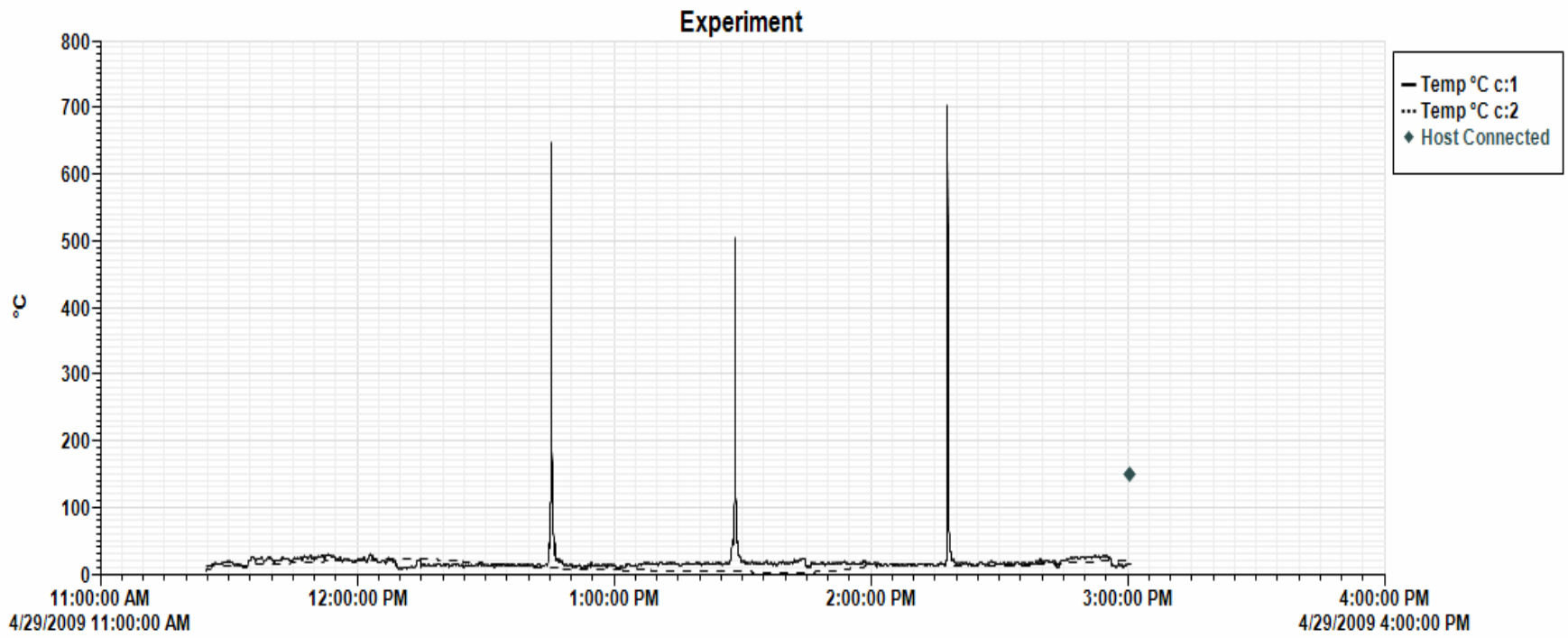
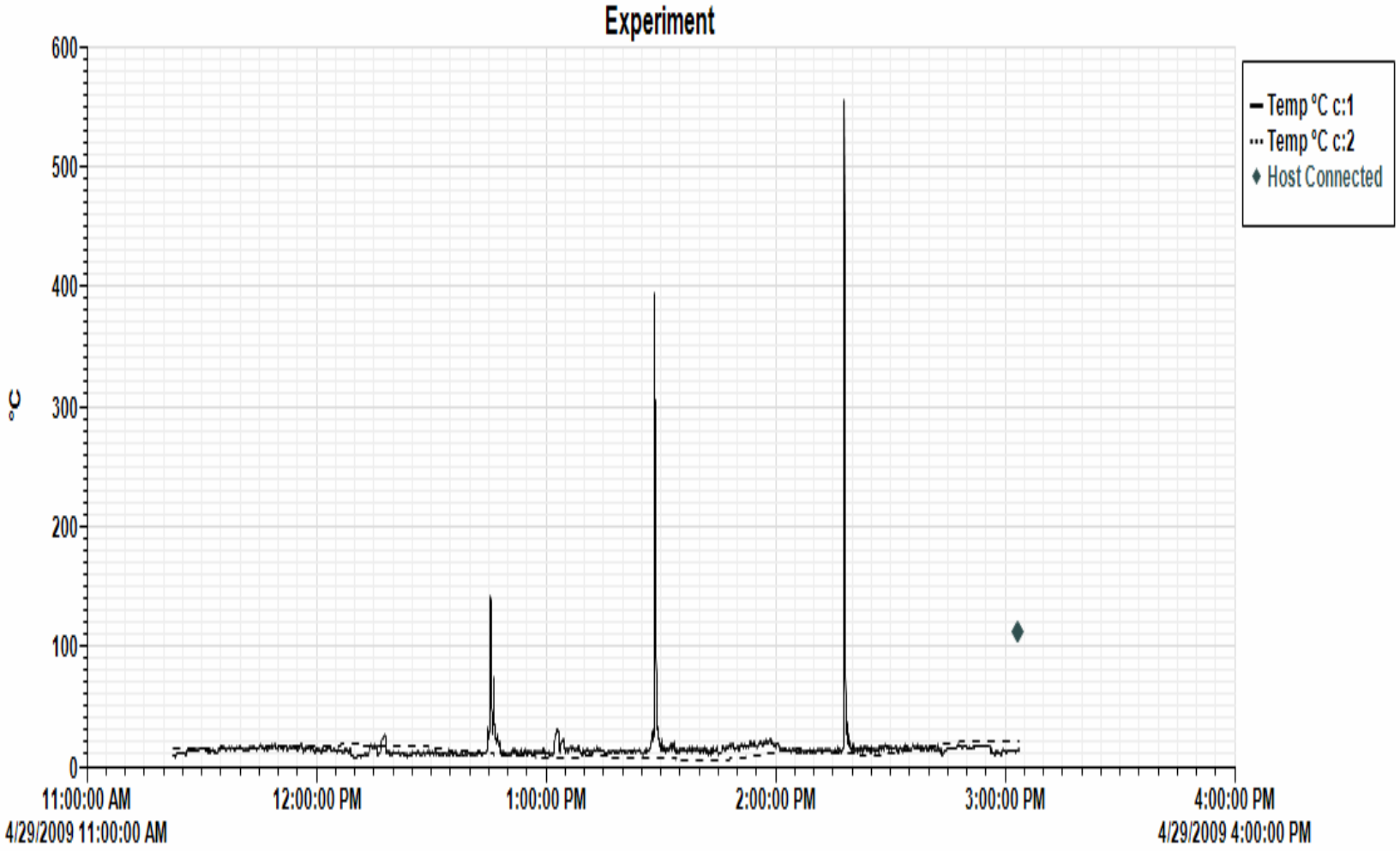
Experimental Fires – initial results. examples of data collected

- Data was collected on temperature, intensity and CO levels (2010).

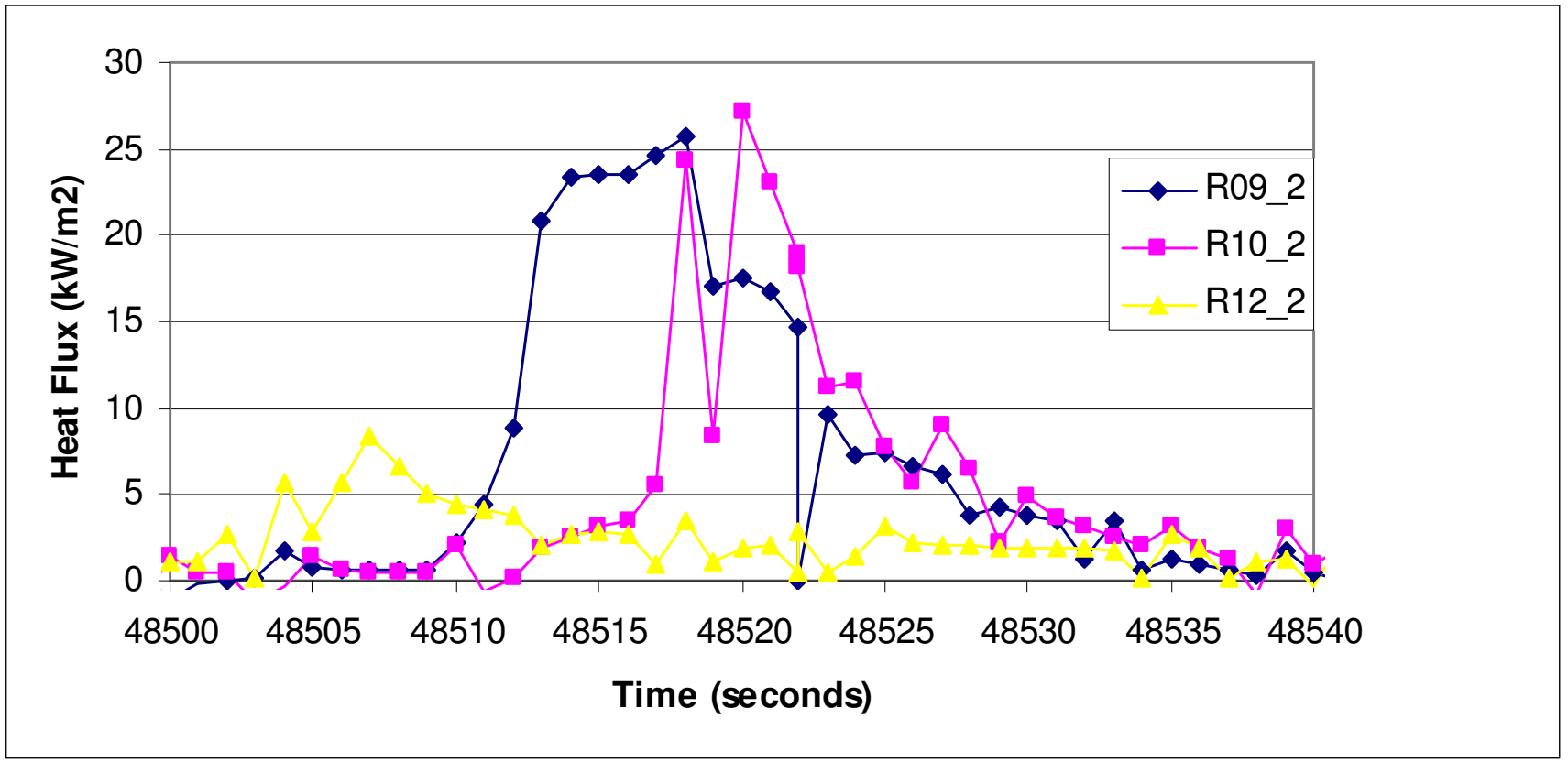
Temperature



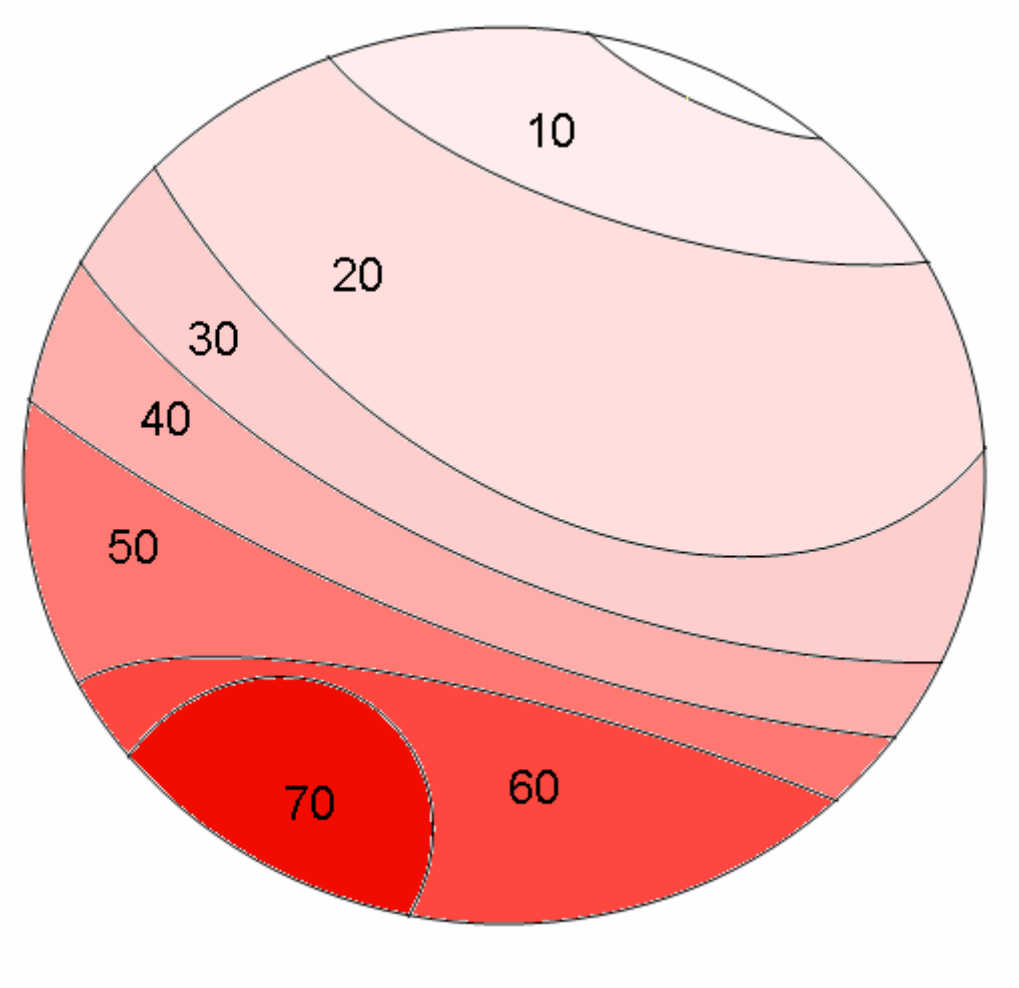
Experimental Fires - Temperature



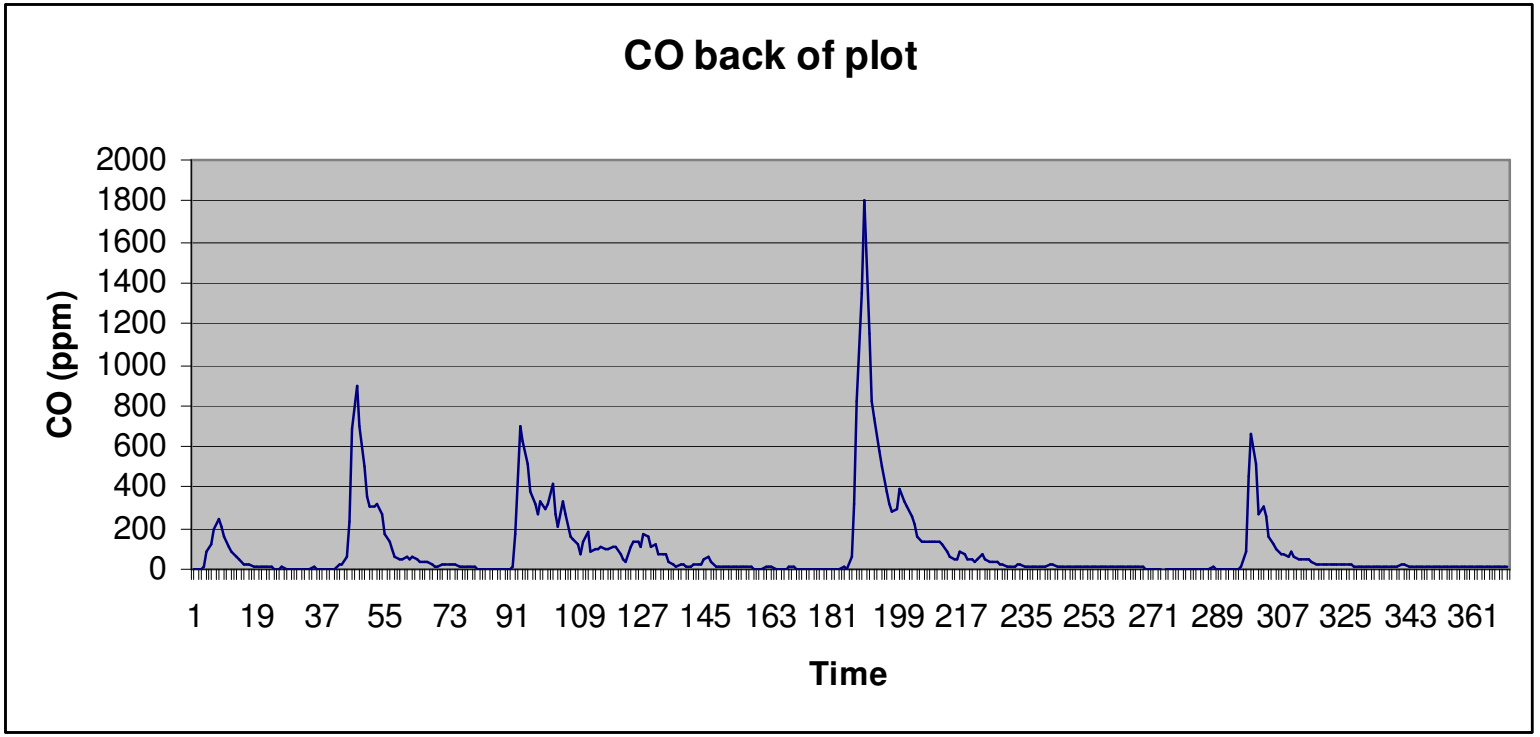
Experimental Fires - Radiation



Radiation map – mean of 5 fires in kW/m^2



Experimental Fires – Carbon Monoxide levels



Experimental Fires – an observation

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Future Burns

- NWT: 2 plots 50 m across.

- ASRD Mt. Buller PB

4 sites on slope

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Survival Zone Research

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