



Natural Resources
Canada

Ressources naturelles
Canada



Operational Wildfire Intelligence Systems

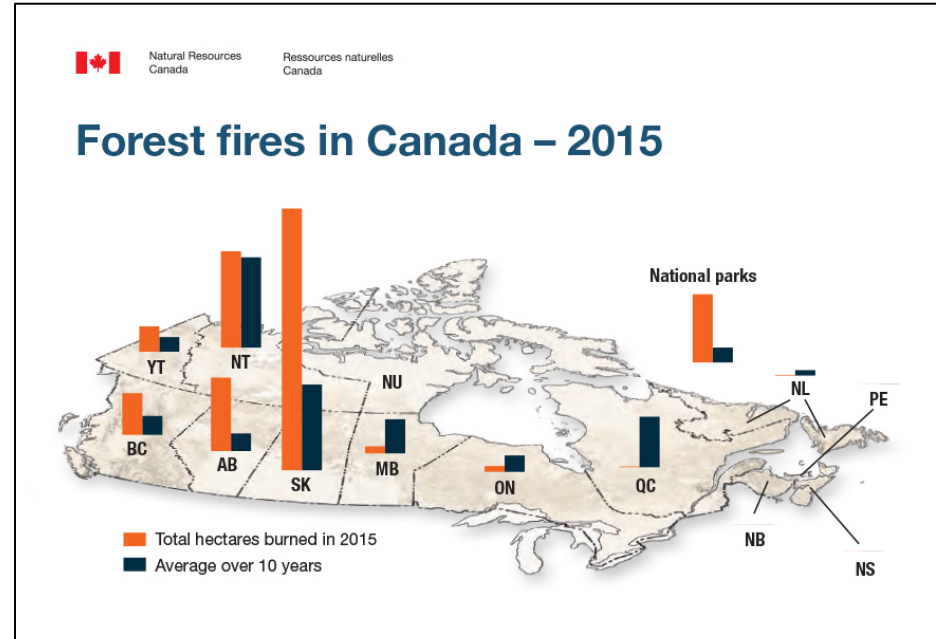
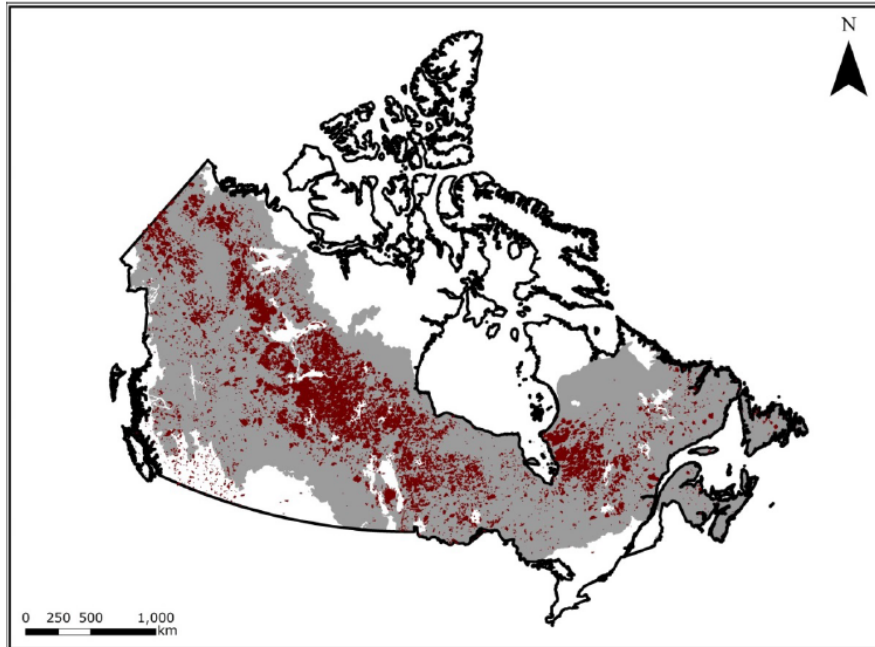
Joshua Johnston, PhD
Alan Cantin
Julian Nicholls
Marc Lachance
Lynn Johnston

Natural Resources Canada
Canadian Forest Service
Great Lakes Forestry Centre





Wildfire in Canada



Source: The State of Canada's Forests - 2016

Figure 2.1: Wildfire area burned in Canada from 1980 – 2010. Burned area (in red) represent all fires documented in the Canadian National Fire Database (CNFB; Canadian Forest Service, 2010), along with the extent of the Canadian portion of the Boreal forest (in grey; Brandt, 2009). Map provided by Natural Resources Canada, Canadian Forest Service (2015).

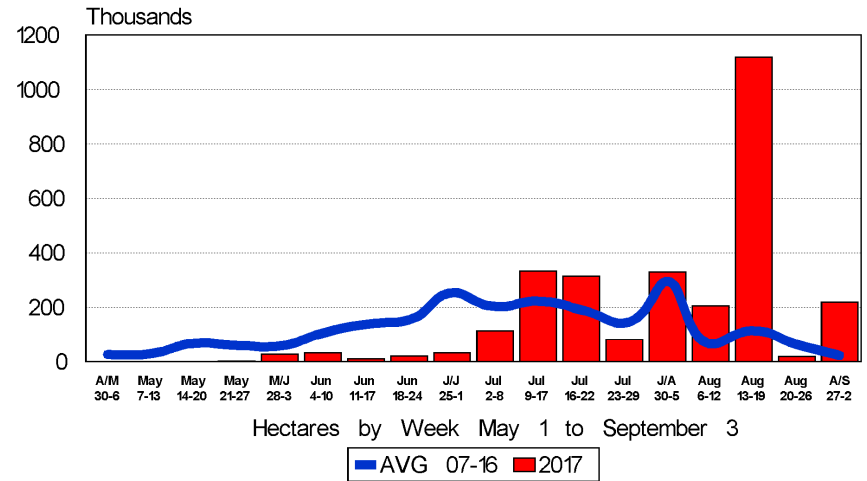
(Johnston, 2016)



The Future

- Fire activity is gradually increasing
- With as little as 15% increase in fire load resource requirements must double to maintain IA success (Wotton and Stocks, 2006)
- Its very possible there is a law of diminishing returns with resource allocation (McAlpine and Hirsch, 1998)
- Human encroachment into boreal zone will continue to increase

Hectares 2017 vs. 10 Year Average



Current as of September 2, 2017





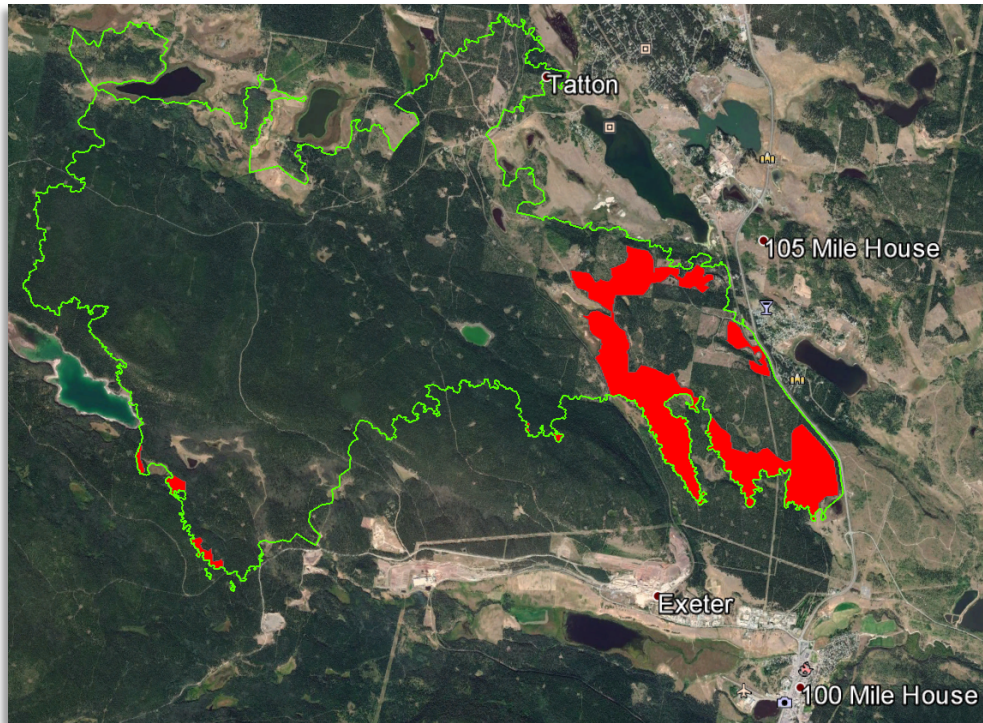
Torchlight: Automating the art of tactical wildfire mapping

- Emergency use only, hard criteria will be announced soon
- Generally (to be confirmed):
 - Threatening a community or critical value
 - Distance to interface zone ~ 50 km
 - OR has caused evacuation
 - OR has caused State of Emergency
 - OR (TBC) is assigned a Type-1 IMT
- For R&D we are seeking approval to deploy whenever a researcher is attached to the IMT



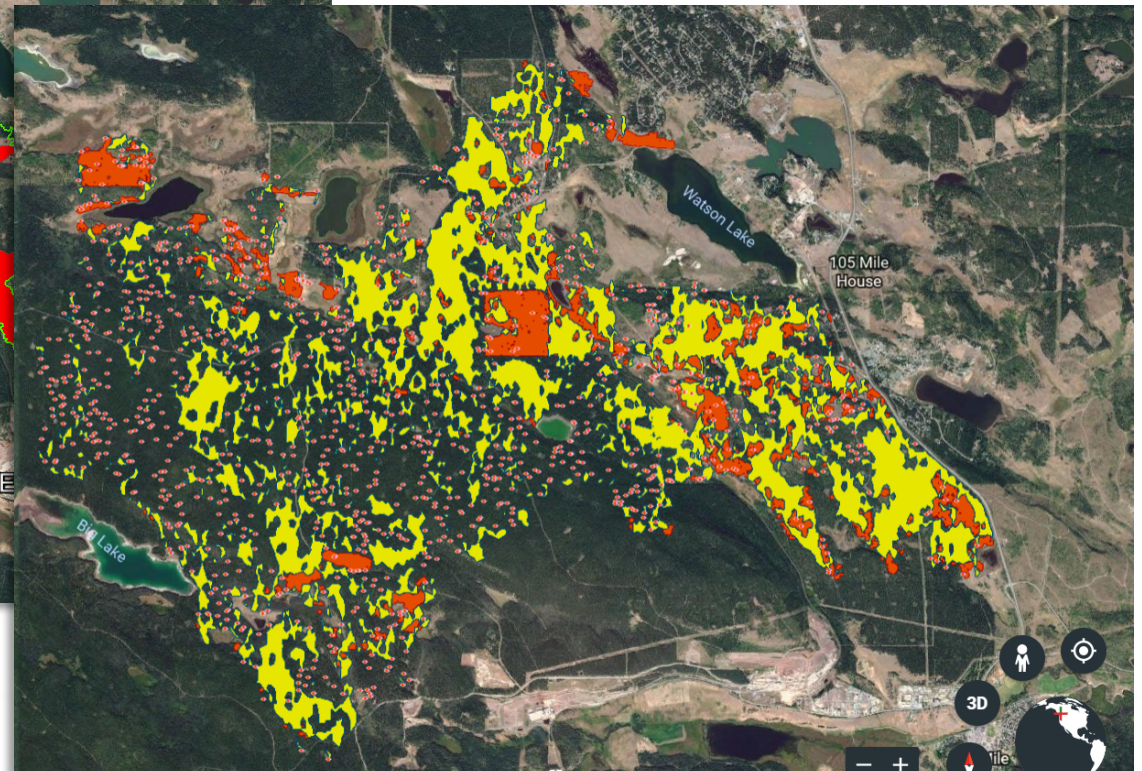
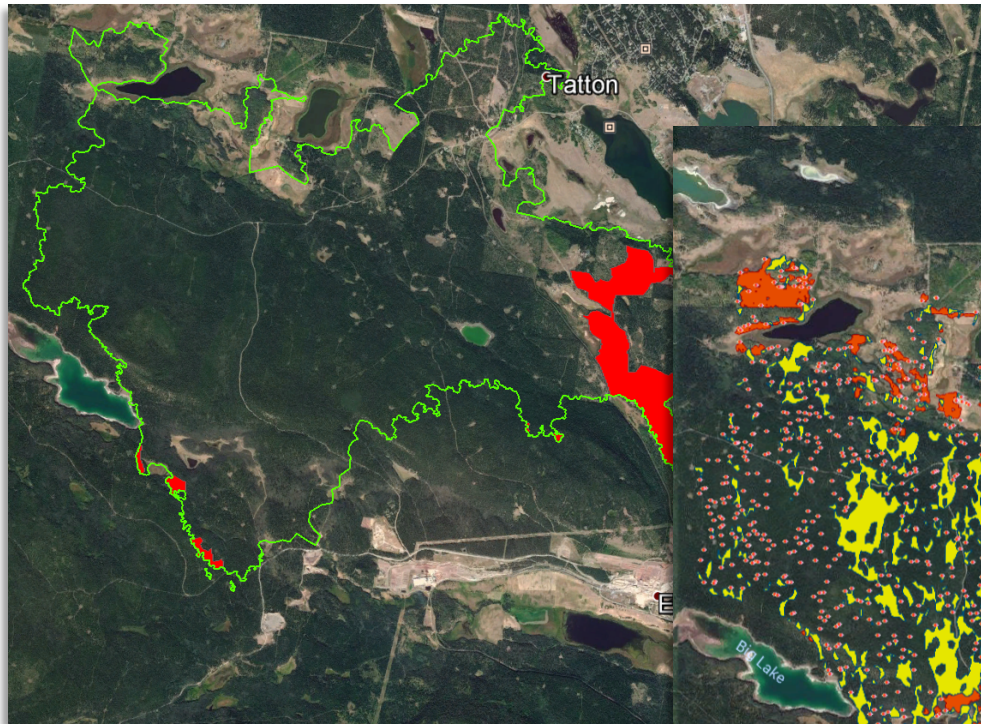


Torchlight: Automating the art of tactical wildfire mapping



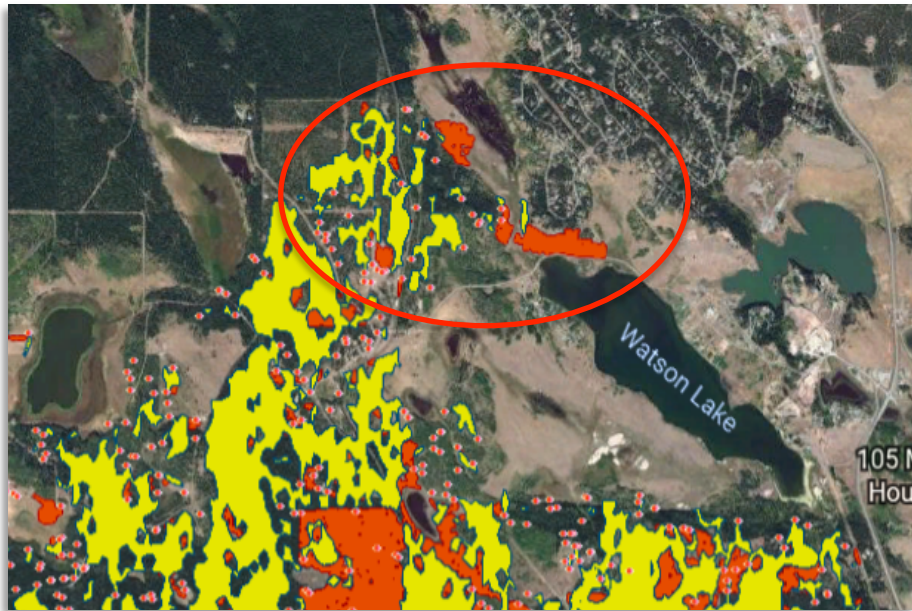


Torchlight: Automating the art of tactical wildfire mapping





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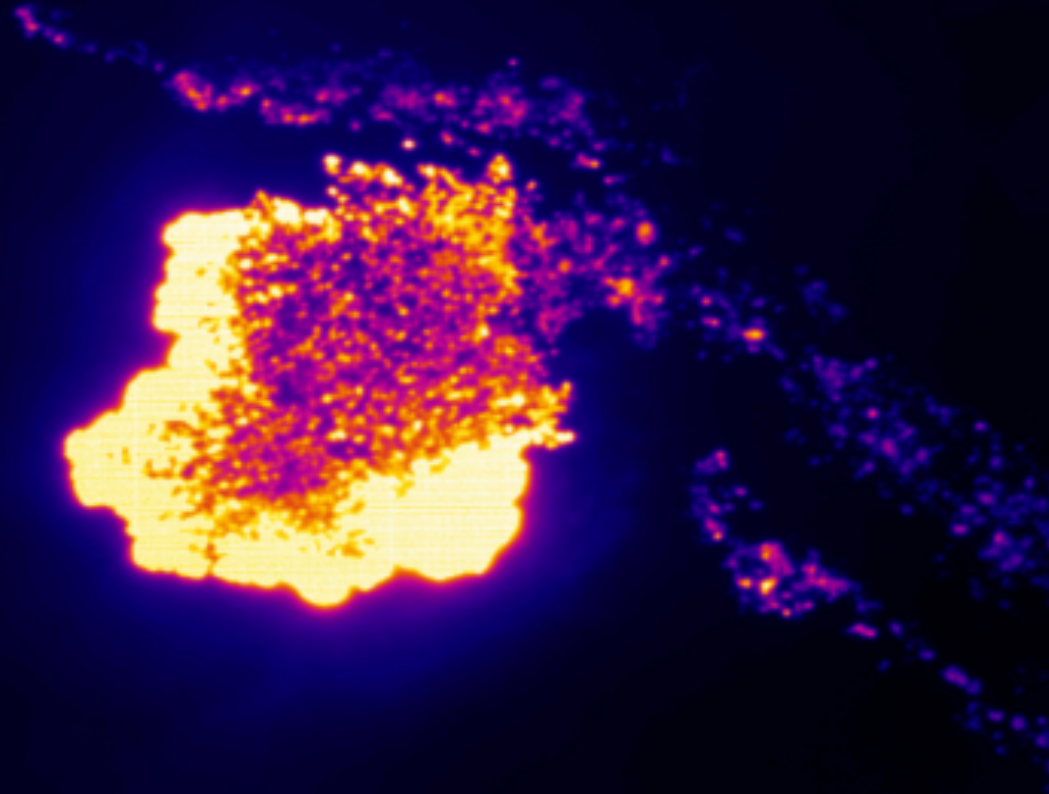


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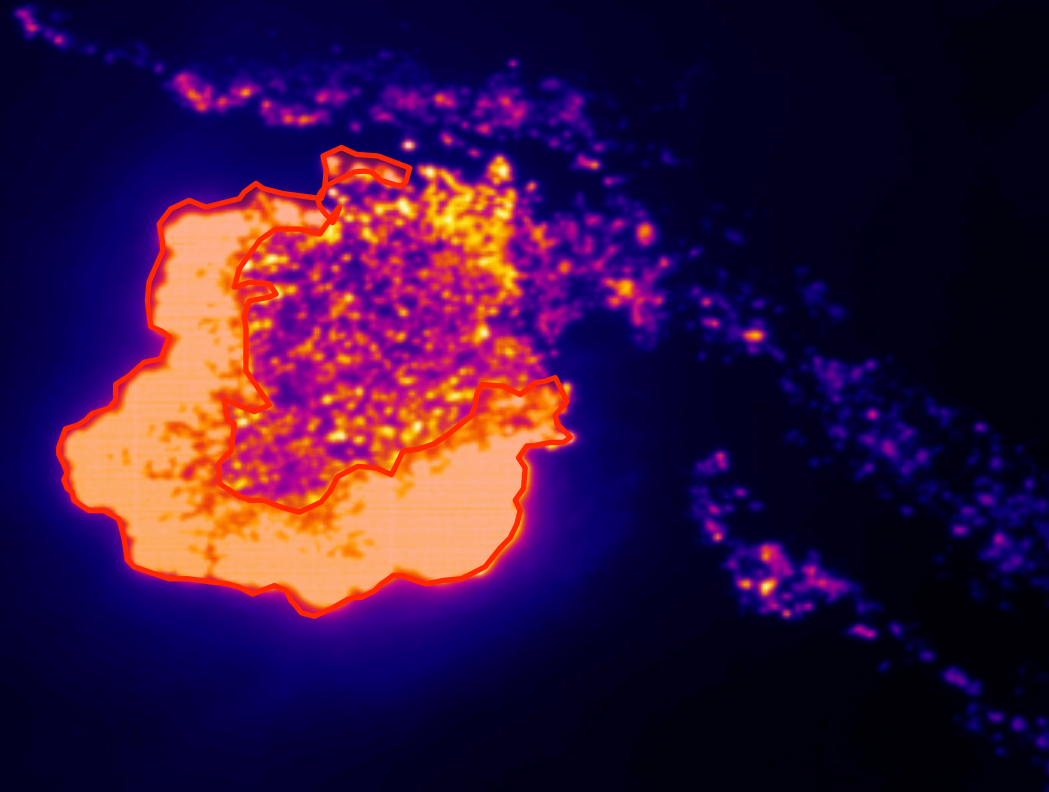
Information NOT Imagery





Information NOT Imagery

Intense Heat = flaming combustion

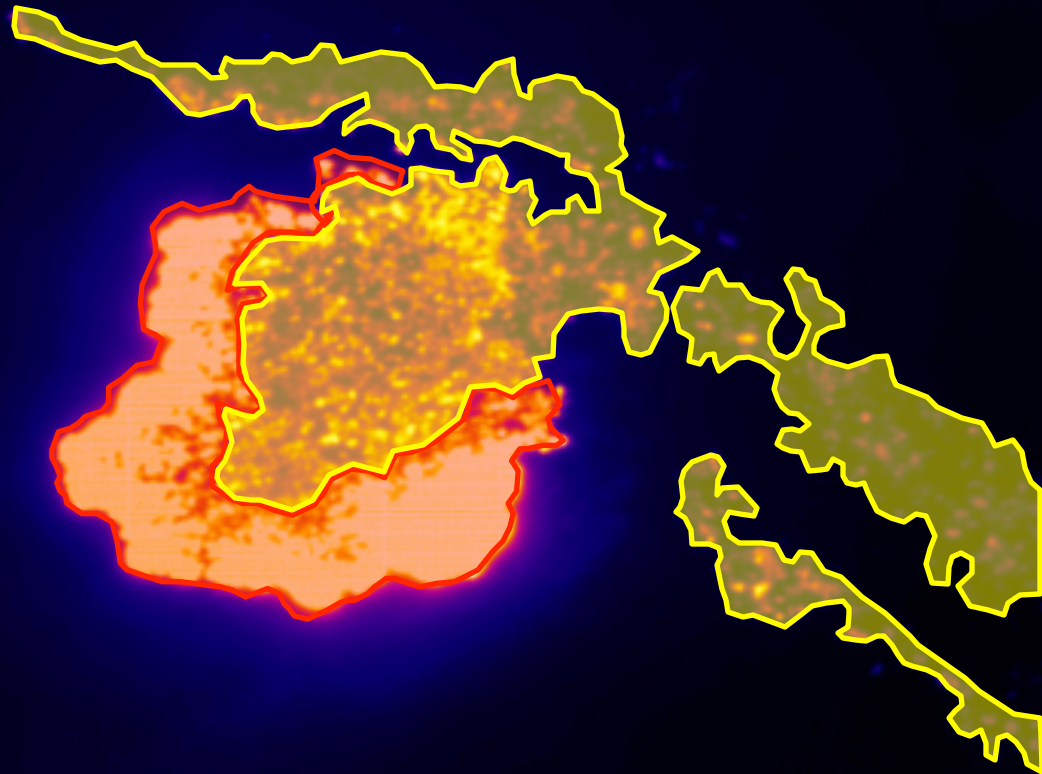




Information NOT Imagery

Intense Heat = flaming combustion

Scattered Heat = smoldering combustion



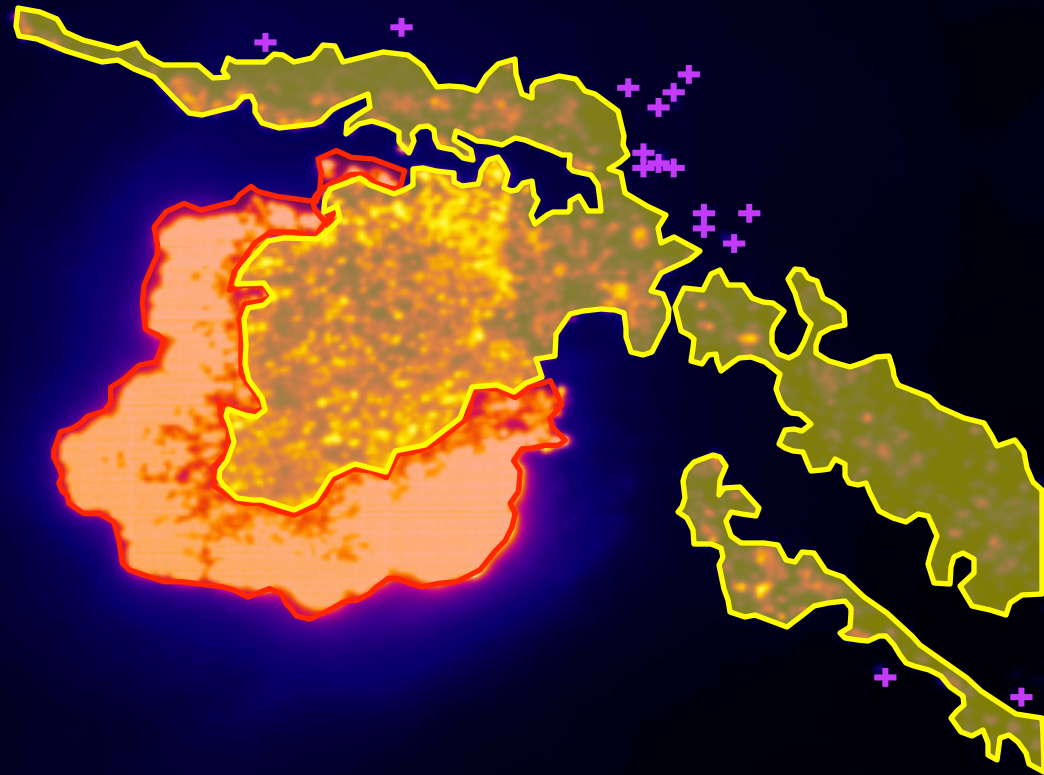


Information NOT Imagery

Intense Heat = flaming combustion

Scattered Heat = smoldering combustion

Isolated Heat = small heat clusters
at least 10m from other
clusters

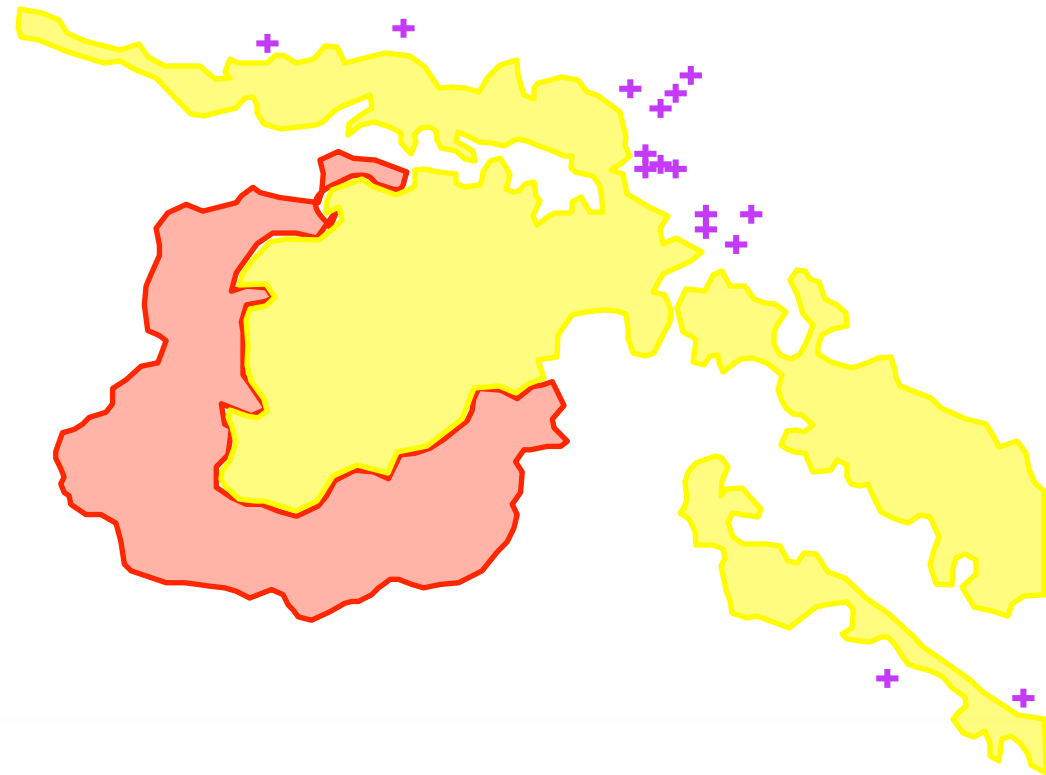




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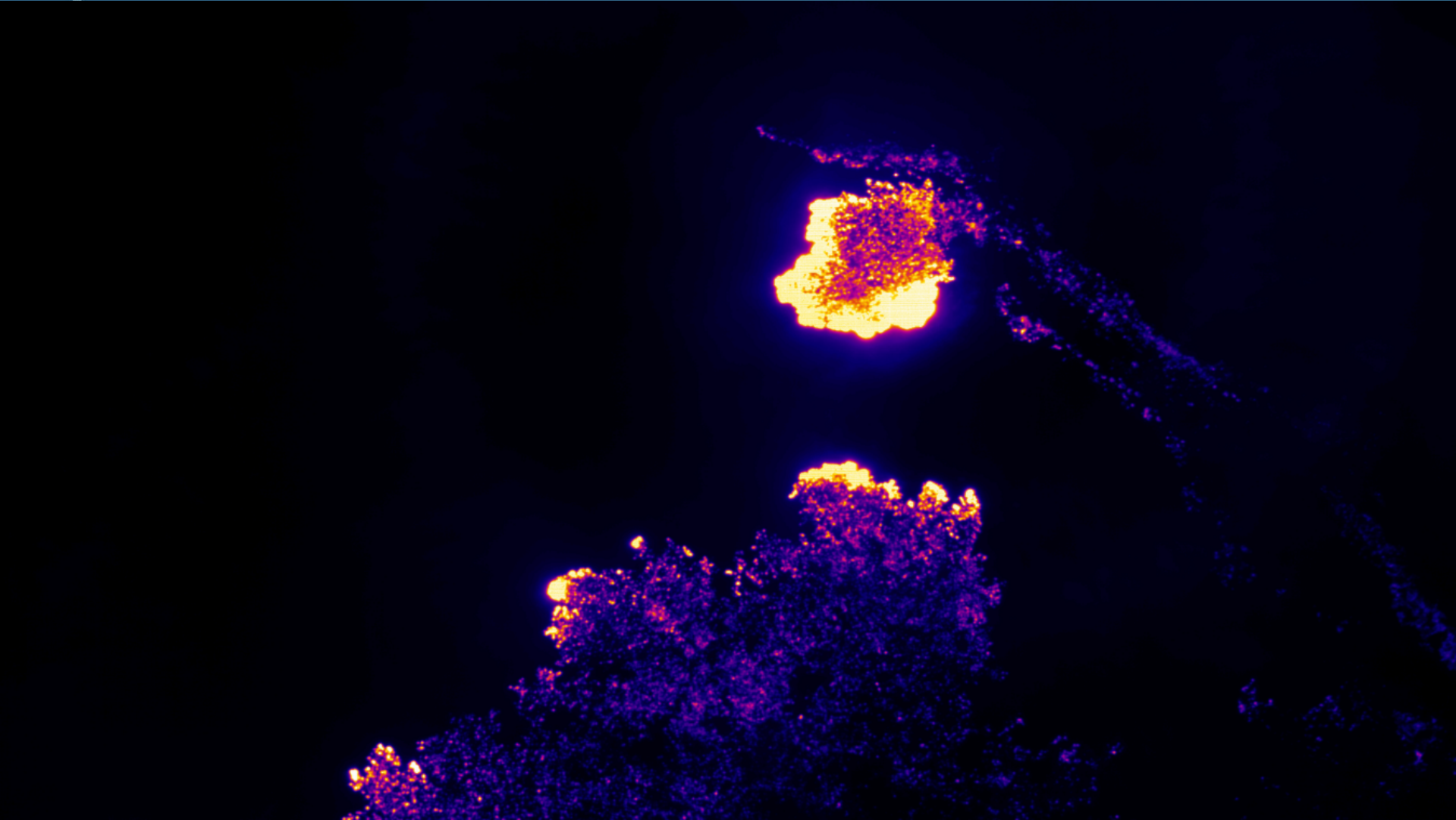
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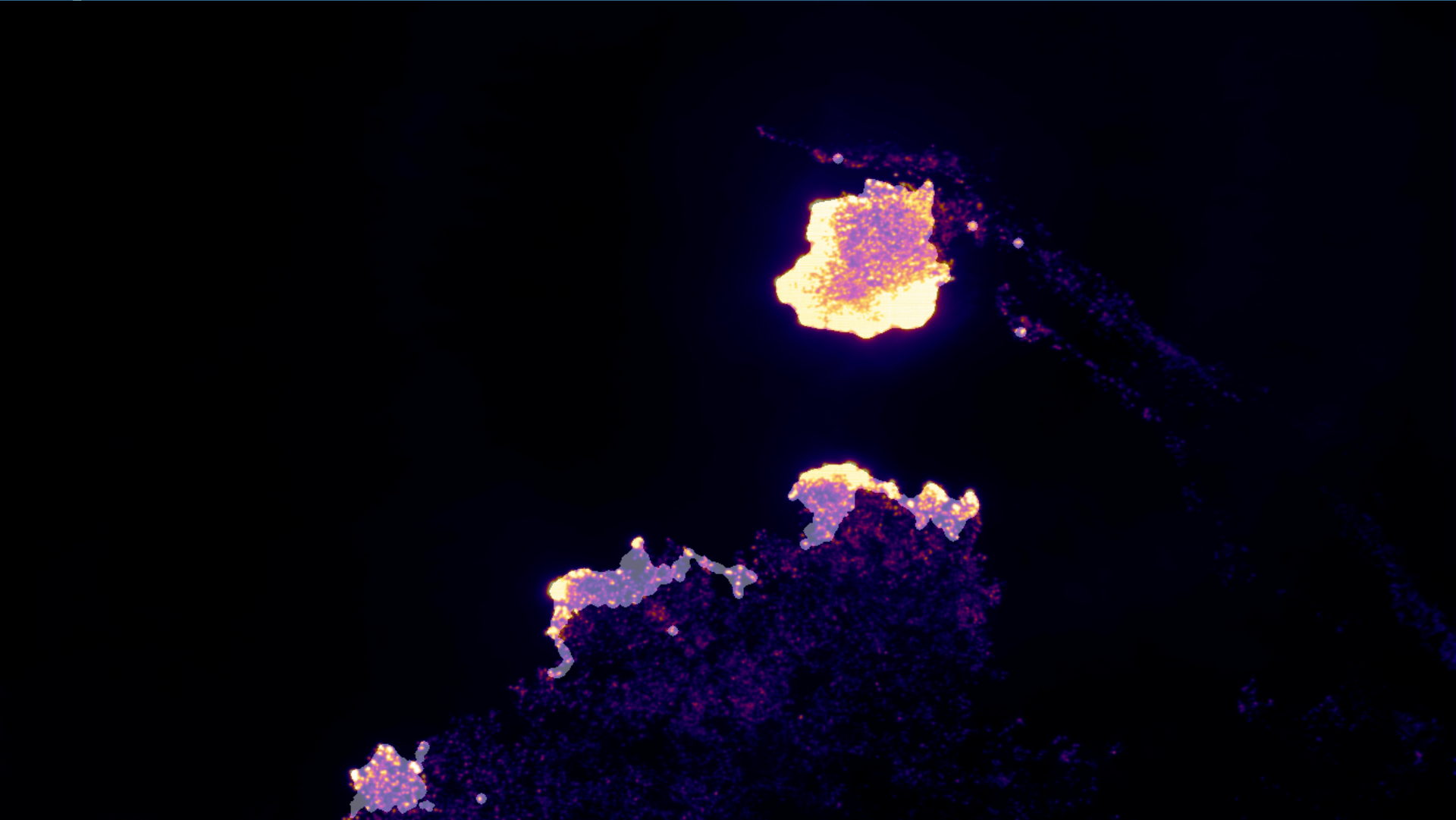
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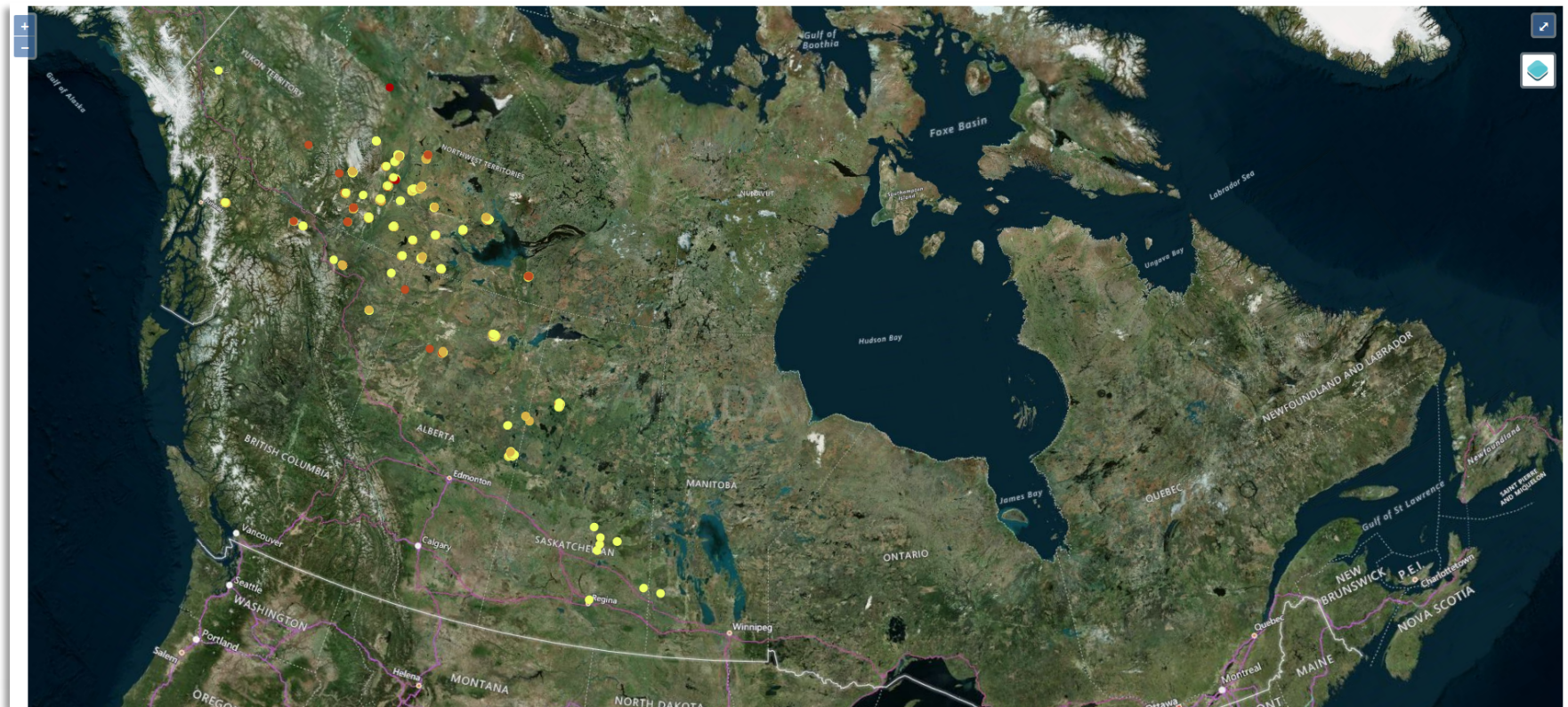
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Consolidated Fire Detection and Monitoring System (CFDMS)





Consolidated Fire Detection and Monitoring System (CFDMS)

- Frame work for real time data delivery to fire mangers
- Capable of delivering raw data (bent pipe) or visualized data (web service)
- To be implemented operationally March 2018 (approx)





Limitation of Hotspots

May 6, 2016

Satellite: Aqua

Time: 14:20 MDT

VZ: 16.2°

GSD_{mean}: 1.06 km

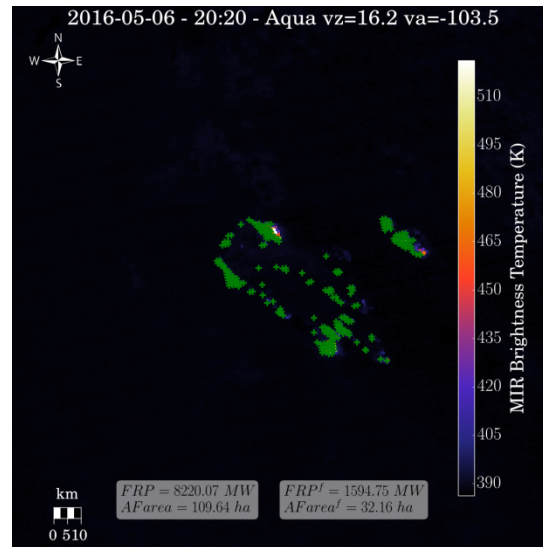
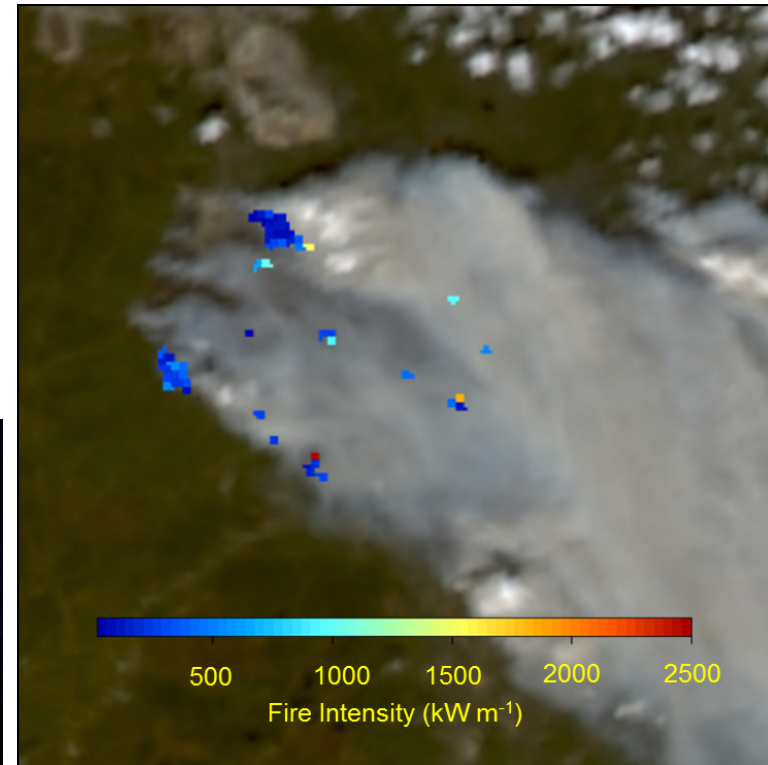


Figure: Dr. Ronan Paugam



Detection

(finding a fire) **VS** (being the first to find a fire) **VS** (being the first to report a fire)

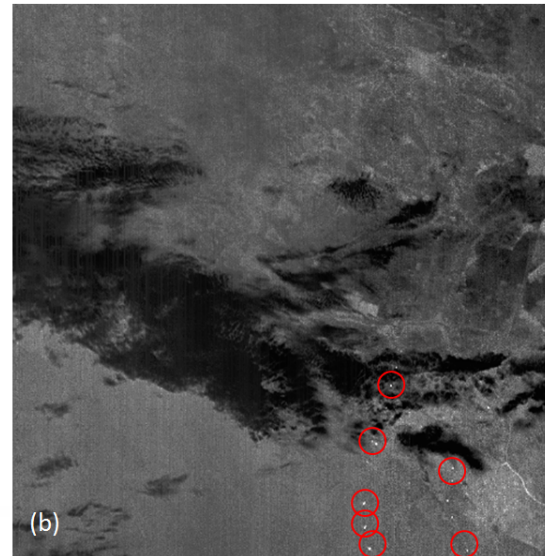
OPERATIONS

- EARLY detection
- Locating smoldering fires below a forest canopy



REMOTE SENSING

- Identifying a fire pixel
- Detectable fire size often stated as a flaming area (e.g. 10 x 20 m)





Detection

OPERATIONS

- EARLY detection
- ~ 90% of fires are detected at < 1 ha
*in response zones
- Typically sub-canopy



REMOTE SENSING

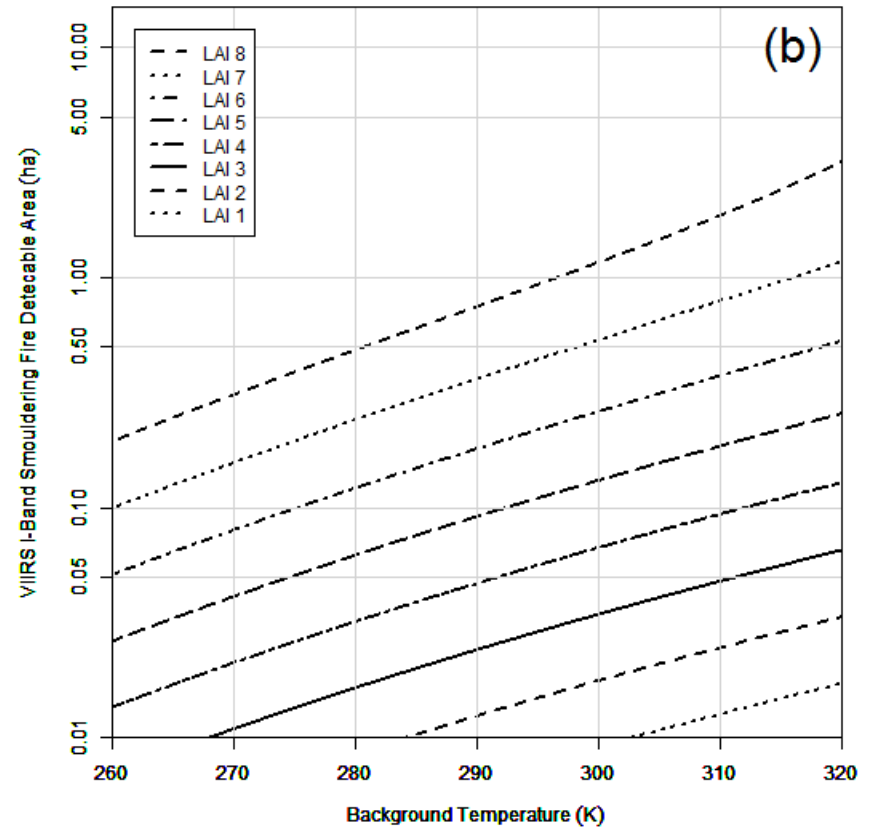
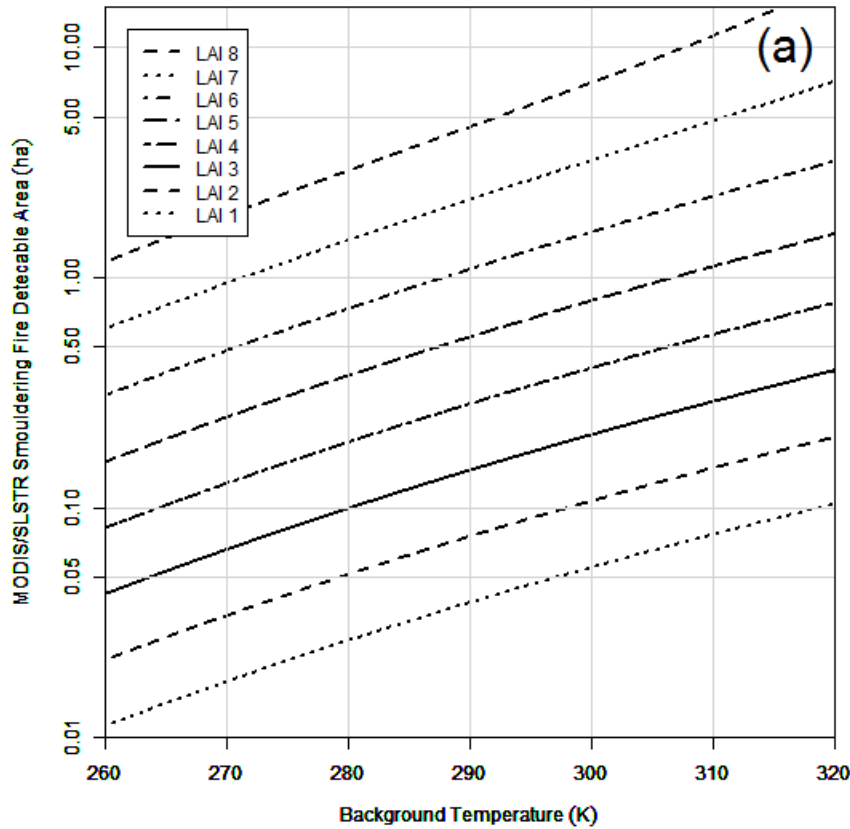
- e.g. 10 x 20 m of flaming area
(~900 K) in the MWIR
- ~ 28 x 28 m (0.08 ha) of smoldering area
(~675 K) in the MWIR

10 x 20

28 x 28

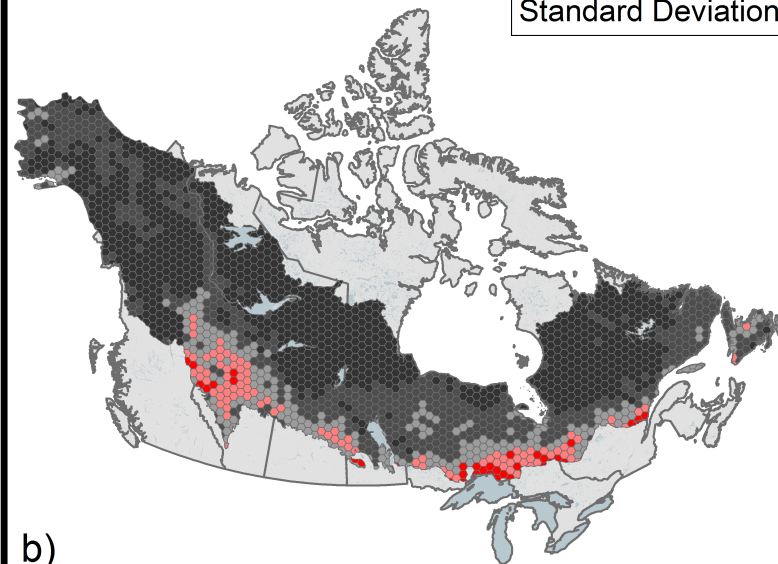
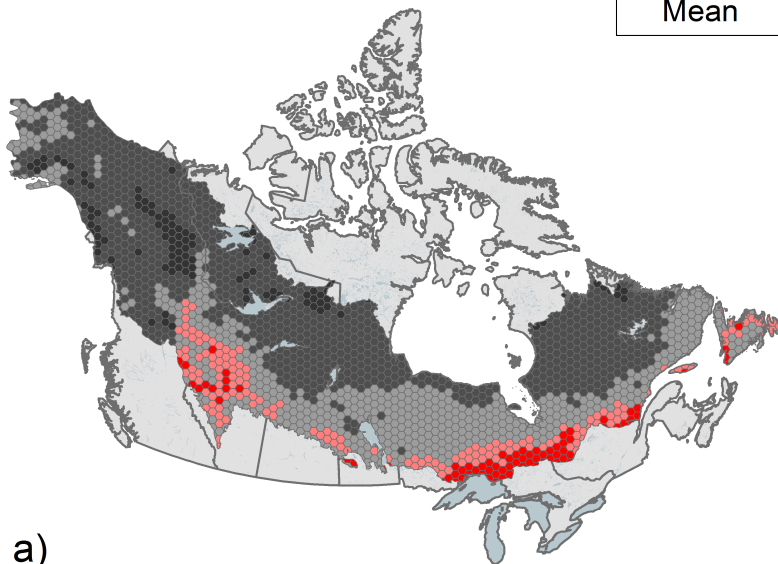


Limitation of Hotspots



Mean

Standard Deviation

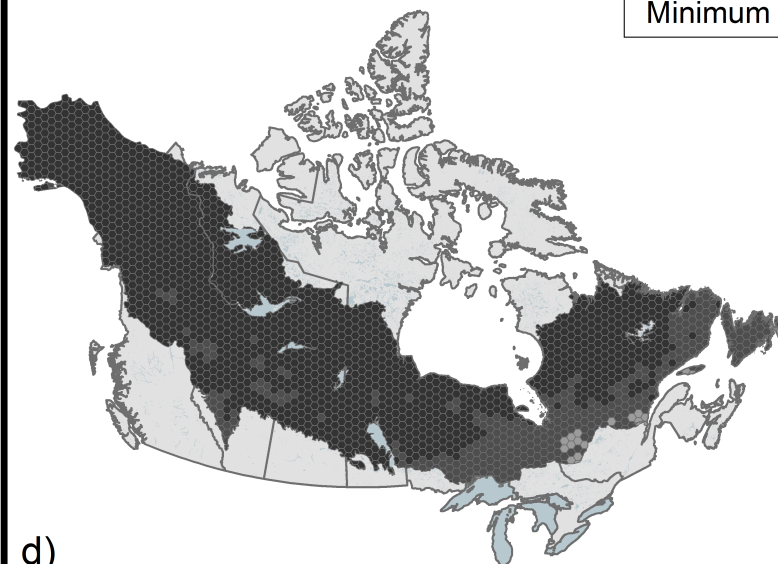
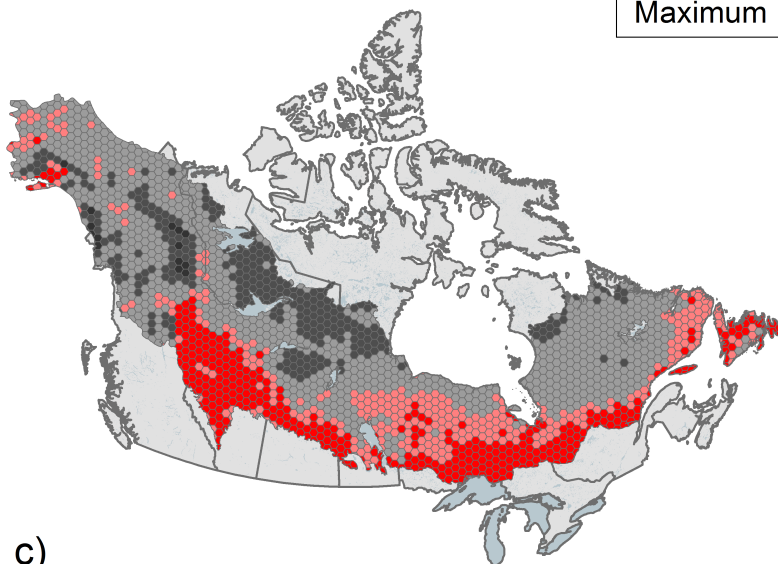


a)

b)

Maximum

Minimum

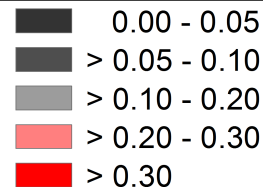


c)

d)



Minimum detectable
sub-canopy
smoldering area (ha):



Coordinate System: WGS 1984 North Pole LAEA Canada
 Projection: Lambert Azimuthal Equal Area
 Datum: WGS 1984
 False Easting: 0.0000
 False Northing: 0.0000
 Central Meridian: -100.0000
 Latitude Of Origin: 90.0000
 Date: 2018
 Producer: Natural Resources Canada

MODIS



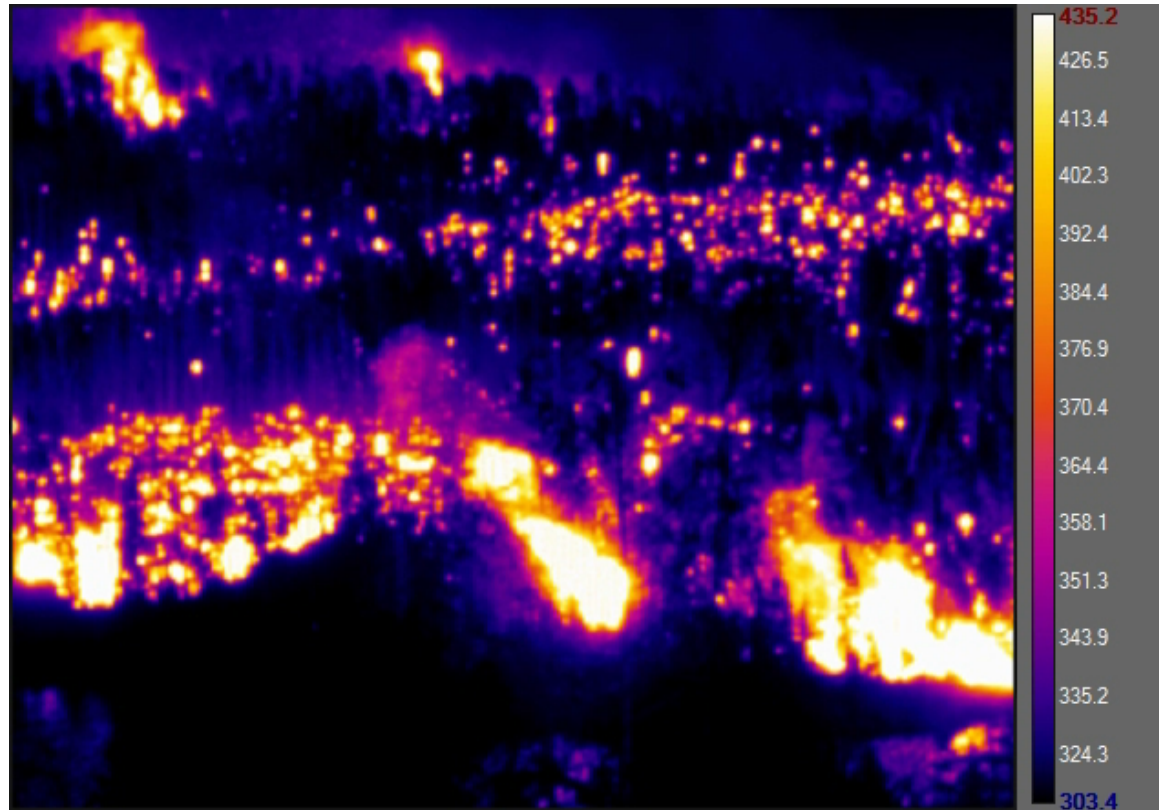


High Temporal Infrared Research





High Temporal Infrared Research



MWIR 3.9 μ m; 308-423 K; 400 Hz

An aerial photograph showing a volcanic eruption. A large plume of white and grey smoke rises from a central point, spreading across the sky. Below the smoke, a winding river flows through a valley with dense green forest. The landscape is rugged and mountainous. The text "Thank you Questions?" is overlaid in a yellow serif font in the lower center of the image.

Thank you
Questions?



REFERENCES

Johnston, J. M. (2016). *Infrared Remote Sensing of Fire Behaviour in Canadian Wildland Forest Fuels*. (Doctor of Philosophy), King's College London.

McAlpine, R. S., & Hirsch, K. G. (1998). LEOPARDS—Level of Protection Analysis Software. *The Forestry Chronicle*, 75(4), 615-621.

Wotton, B. M., & Stocks, B. J. (2006). Fire management in Canada: vulnerability and risk trends. In K. Hirsch & P. Fuglem (Eds.), *Canadian Wildland Fire Strategy: Background Synthesis, Analysis, and Perspectives* (pp. 49-55). Canadian Council of Forest Ministers, Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre: Edmonton, AB.