



Operational Wildfire Intelligence Systems

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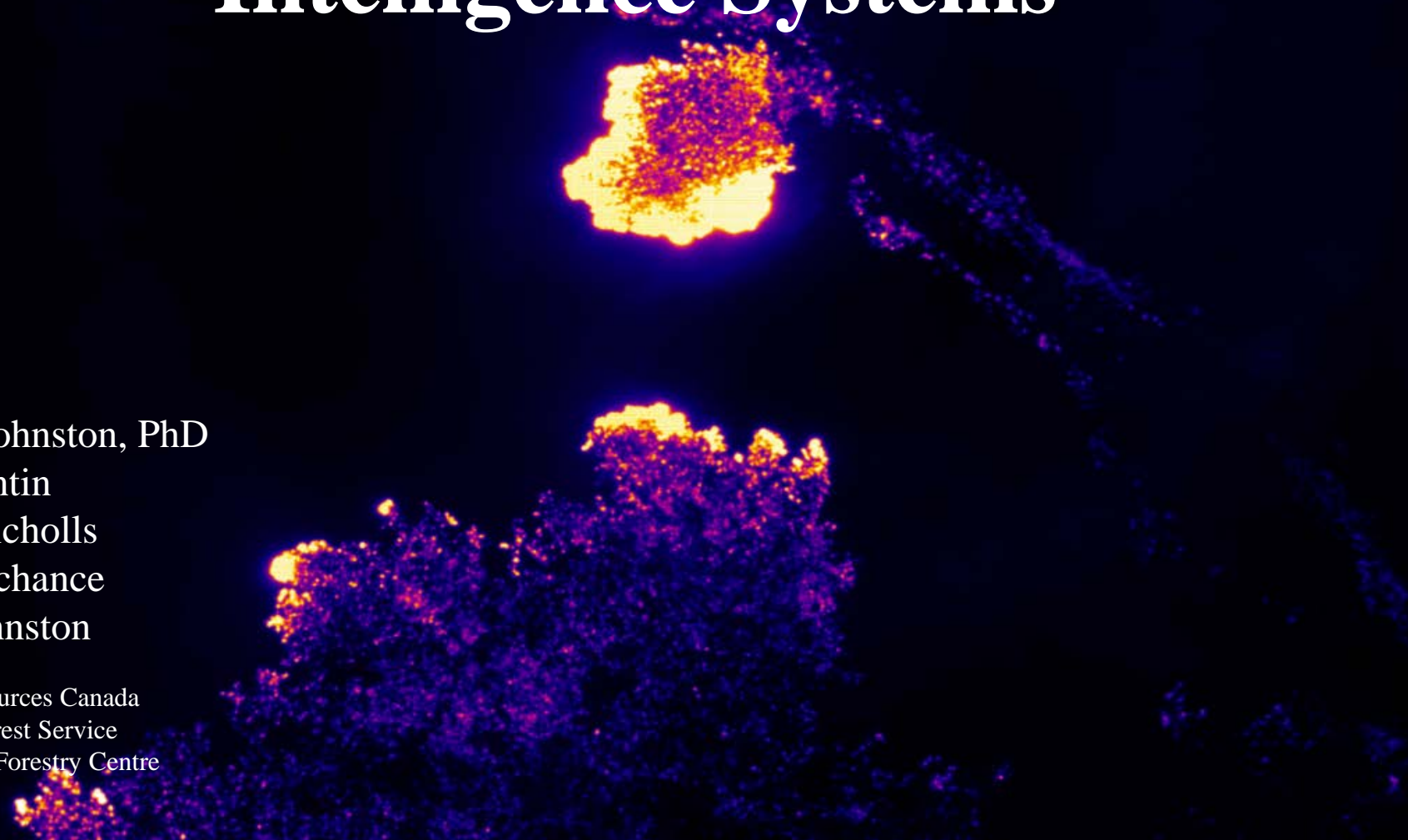
Marc Lachance

Lynn Johnston

Natural Resources Canada

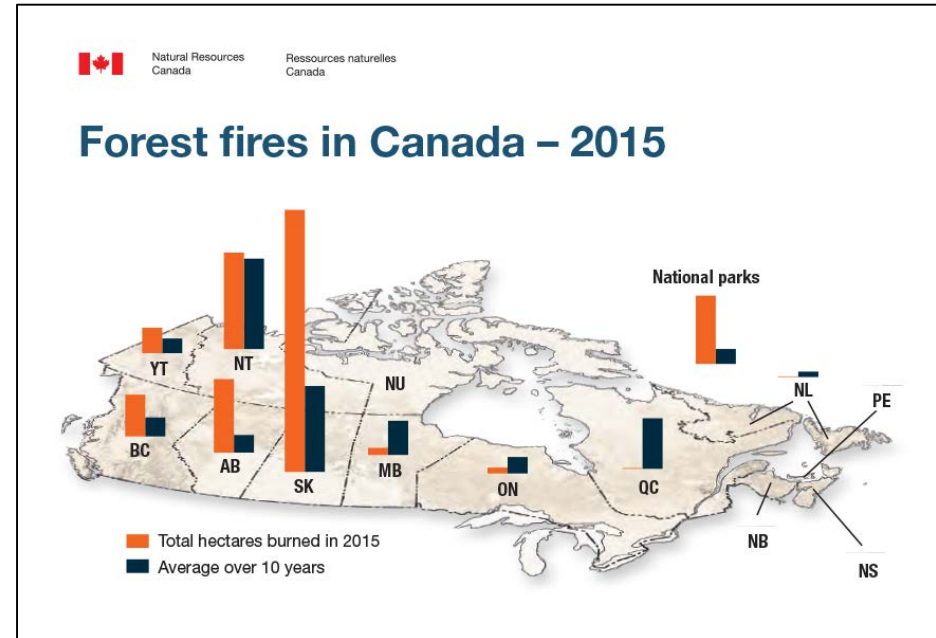
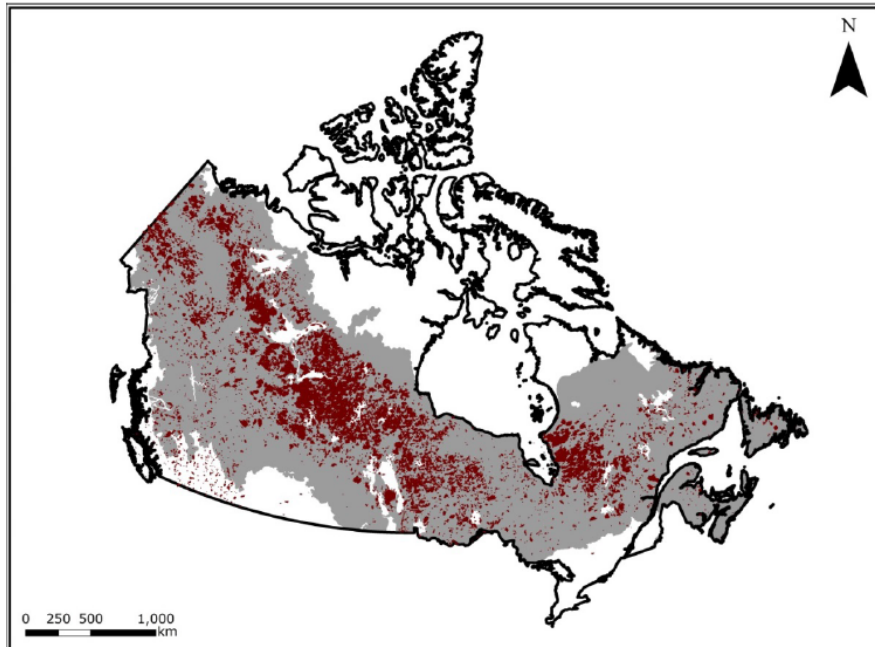
Canadian Forest Service

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).

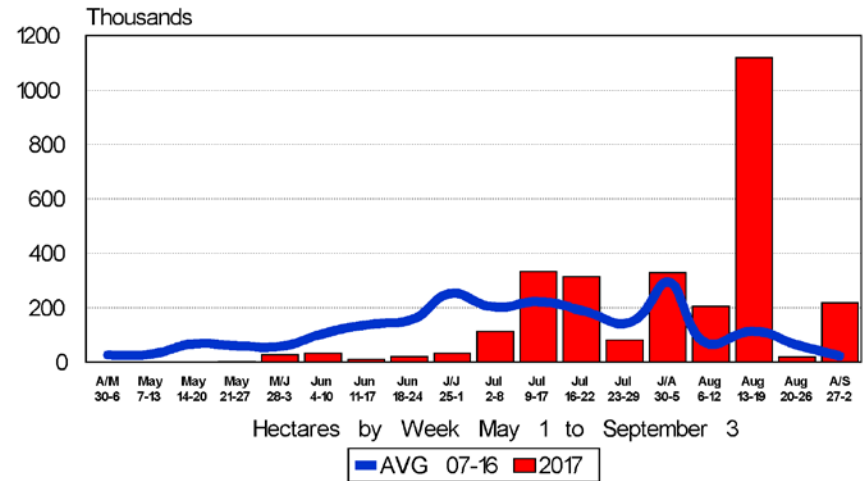
(Johnston, 2016)



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





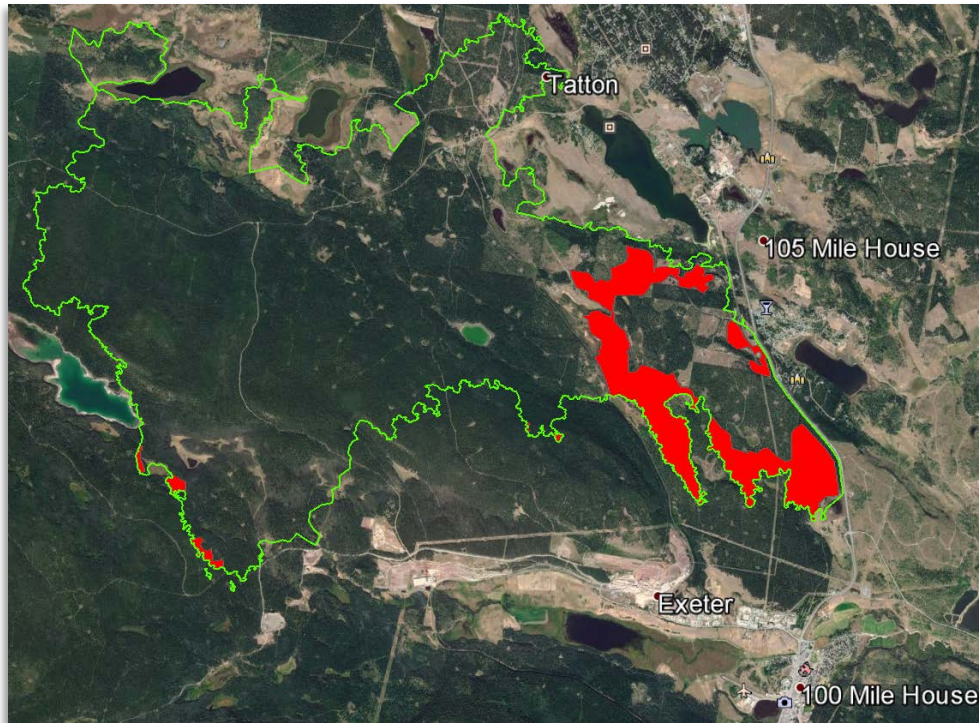
Torchlight: Automating the art of tactical wildfire mapping

- 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



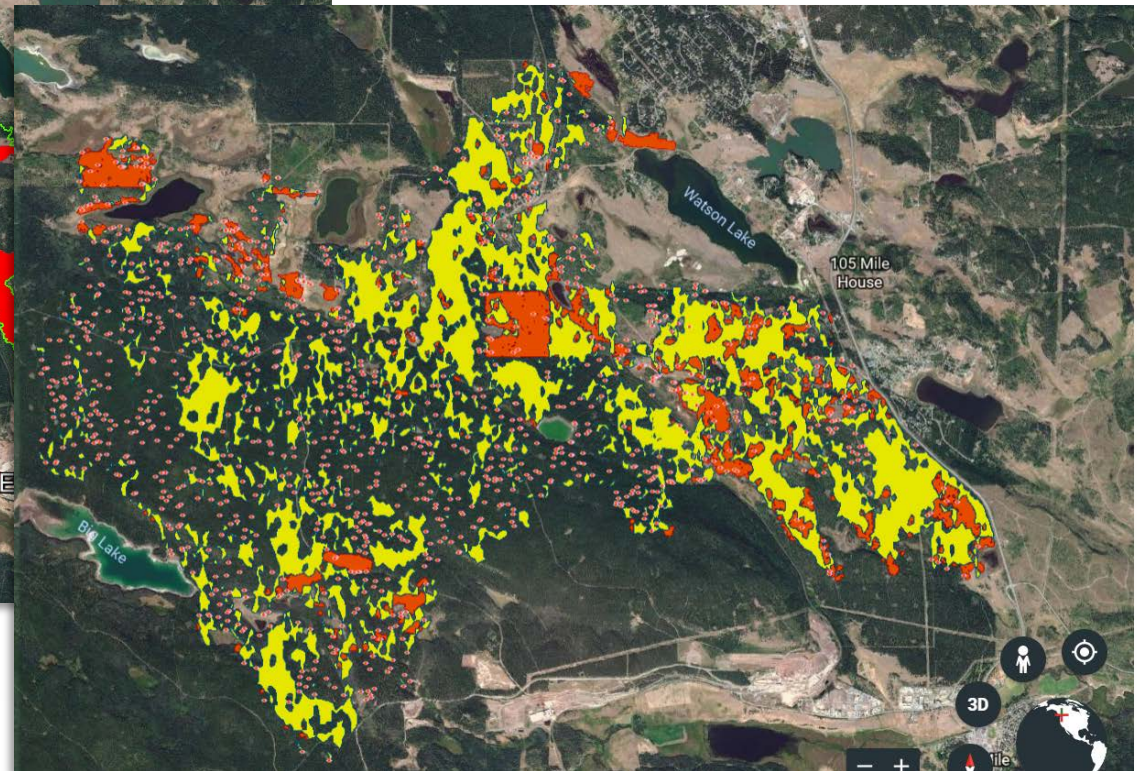
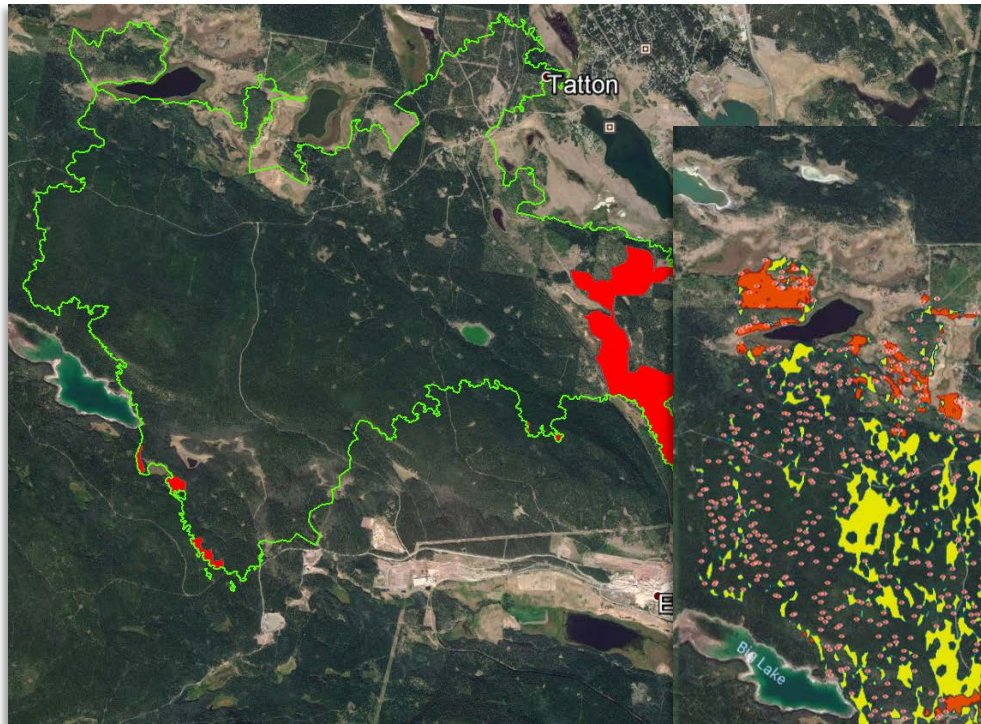


Torchlight: Automating the art of tactical wildfire mapping



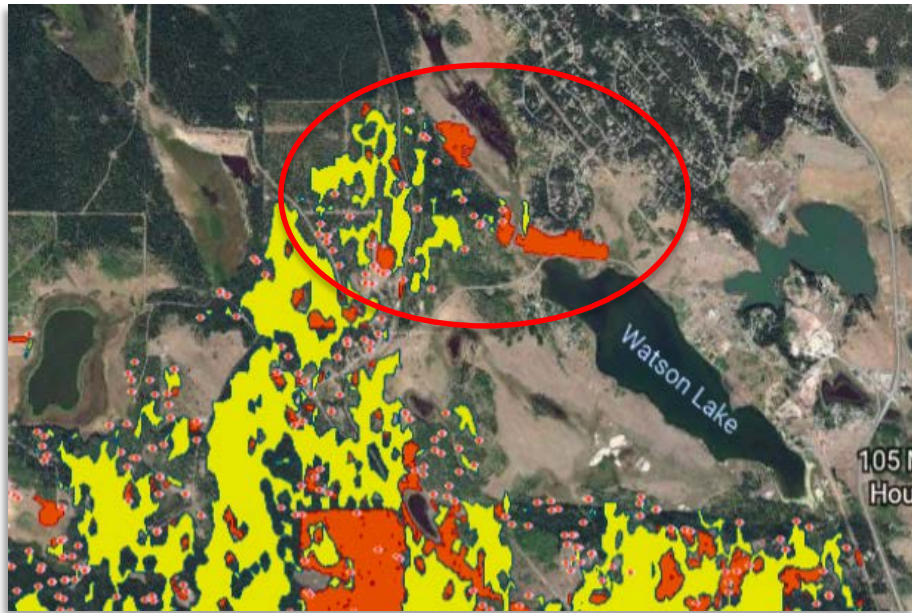


Torchlight: Automating the art of tactical wildfire mapping





Torchlight: Automating the art of tactical wildfire mapping



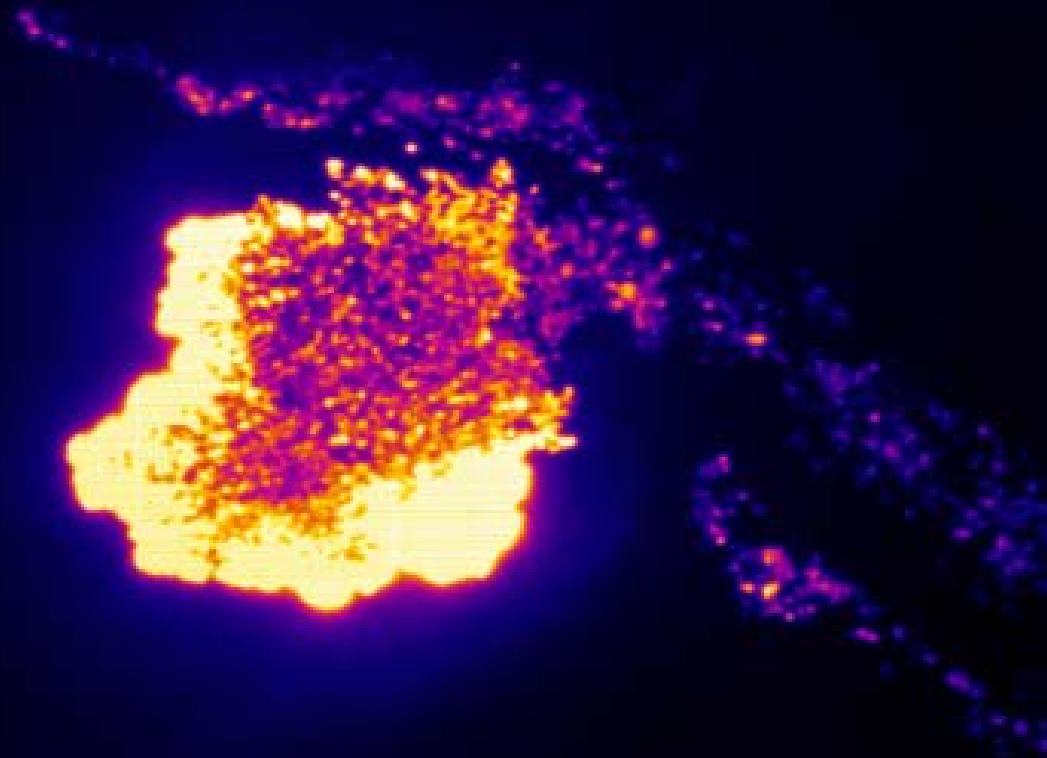


Torchlight: Automating the art of tactical wildfire mapping





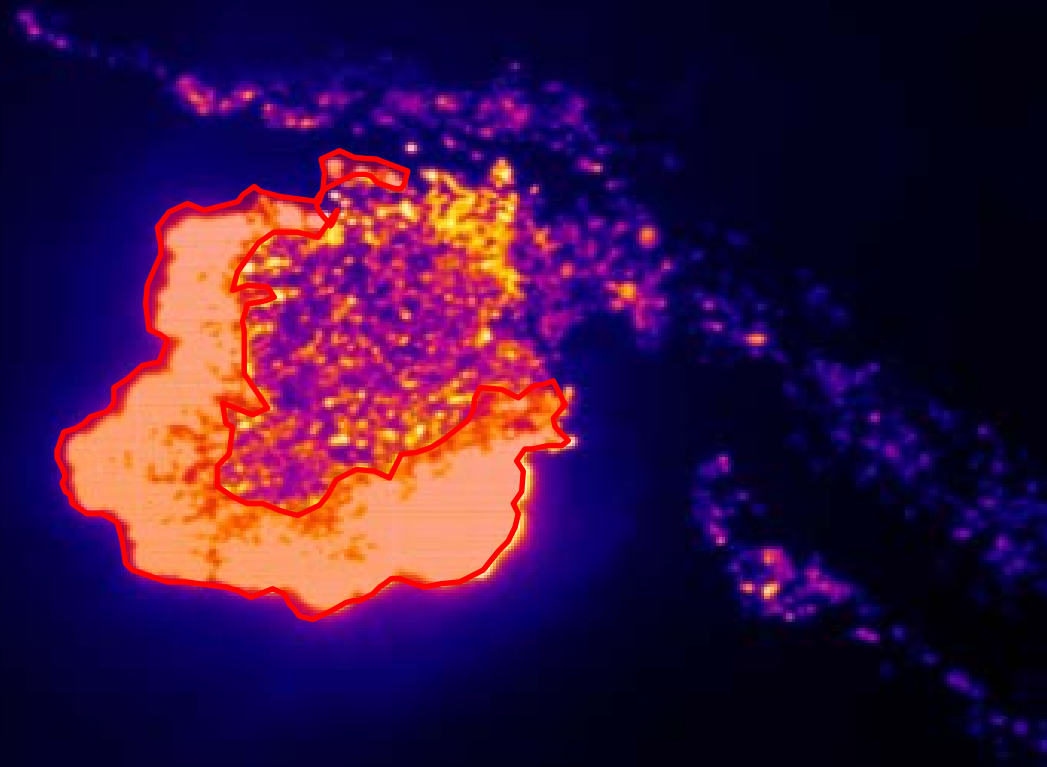
Information NOT Imagery





Information NOT Imagery

Intense Heat = flaming combustion

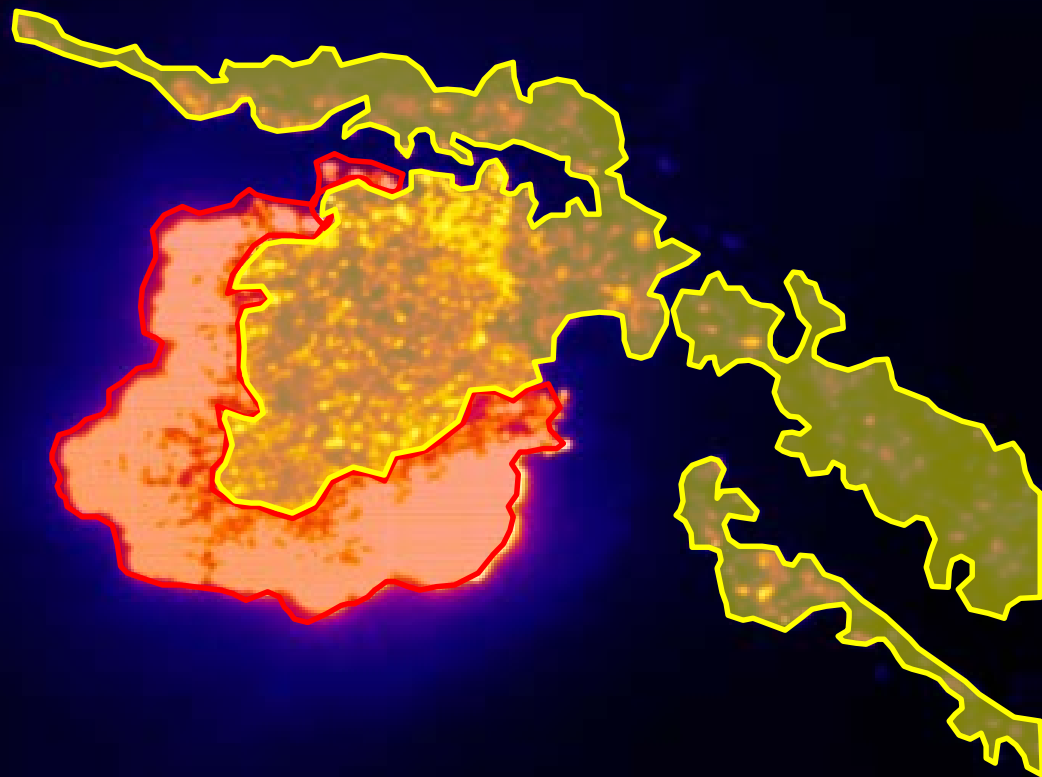




Information NOT Imagery

Intense Heat = flaming combustion

Scattered Heat = smoldering combustion



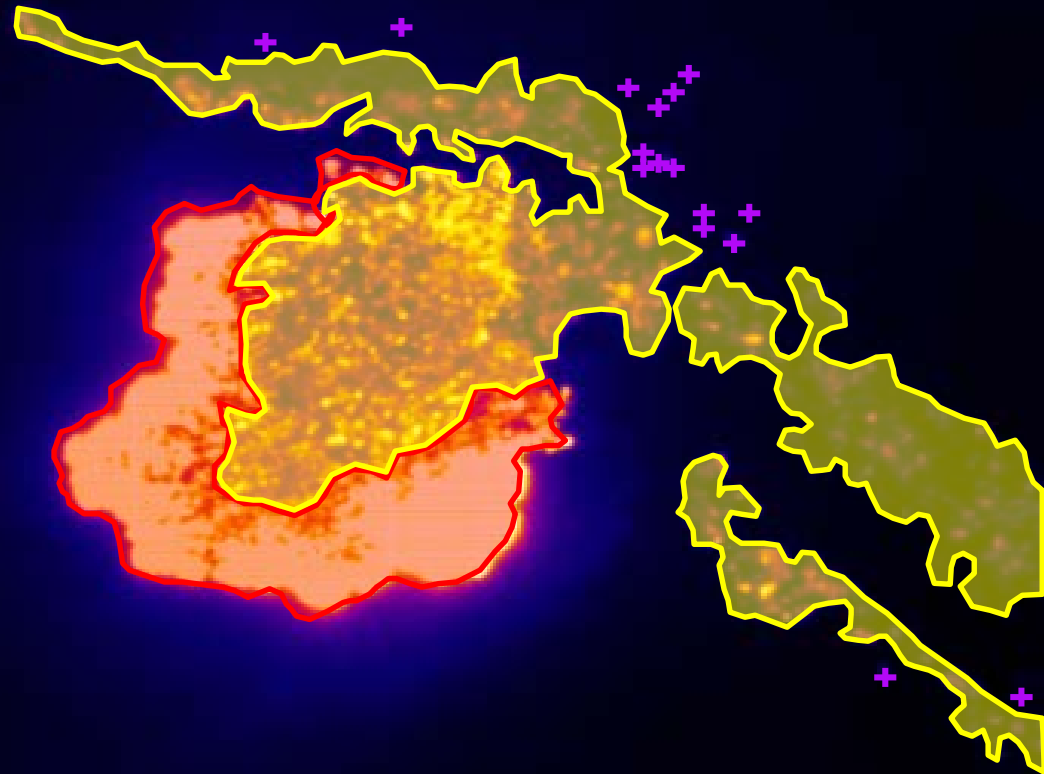


Information NOT Imagery

Intense Heat = flaming combustion

Scattered Heat = smoldering combustion

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

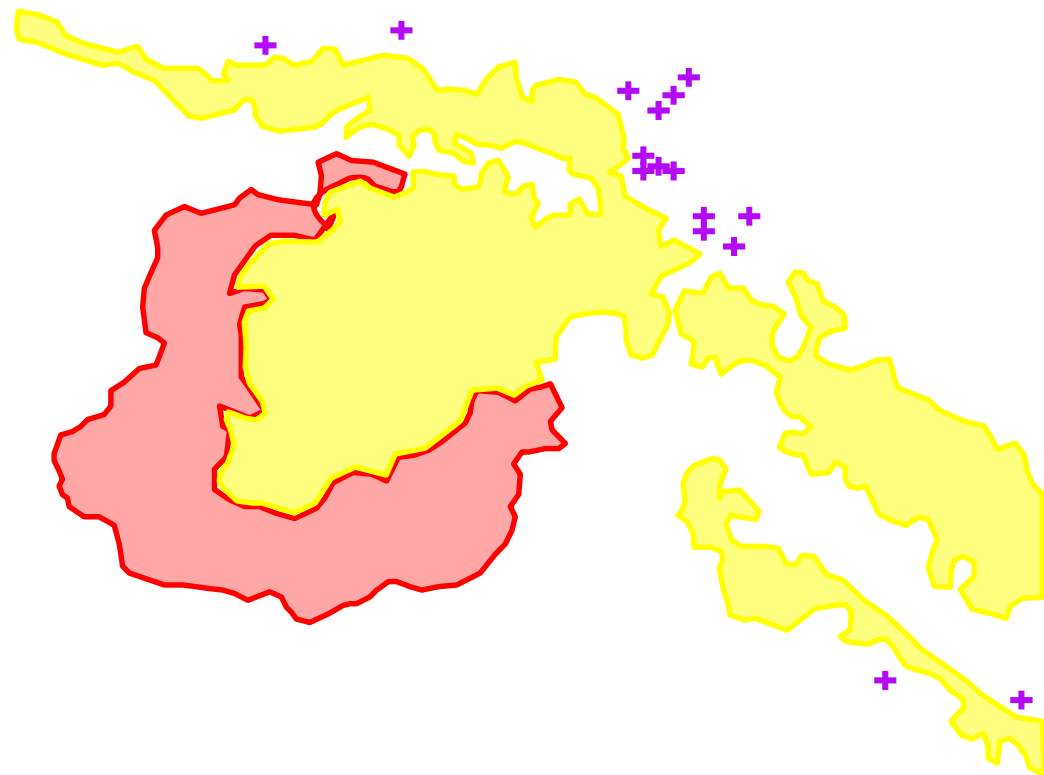




Intense Heat = flaming combustion

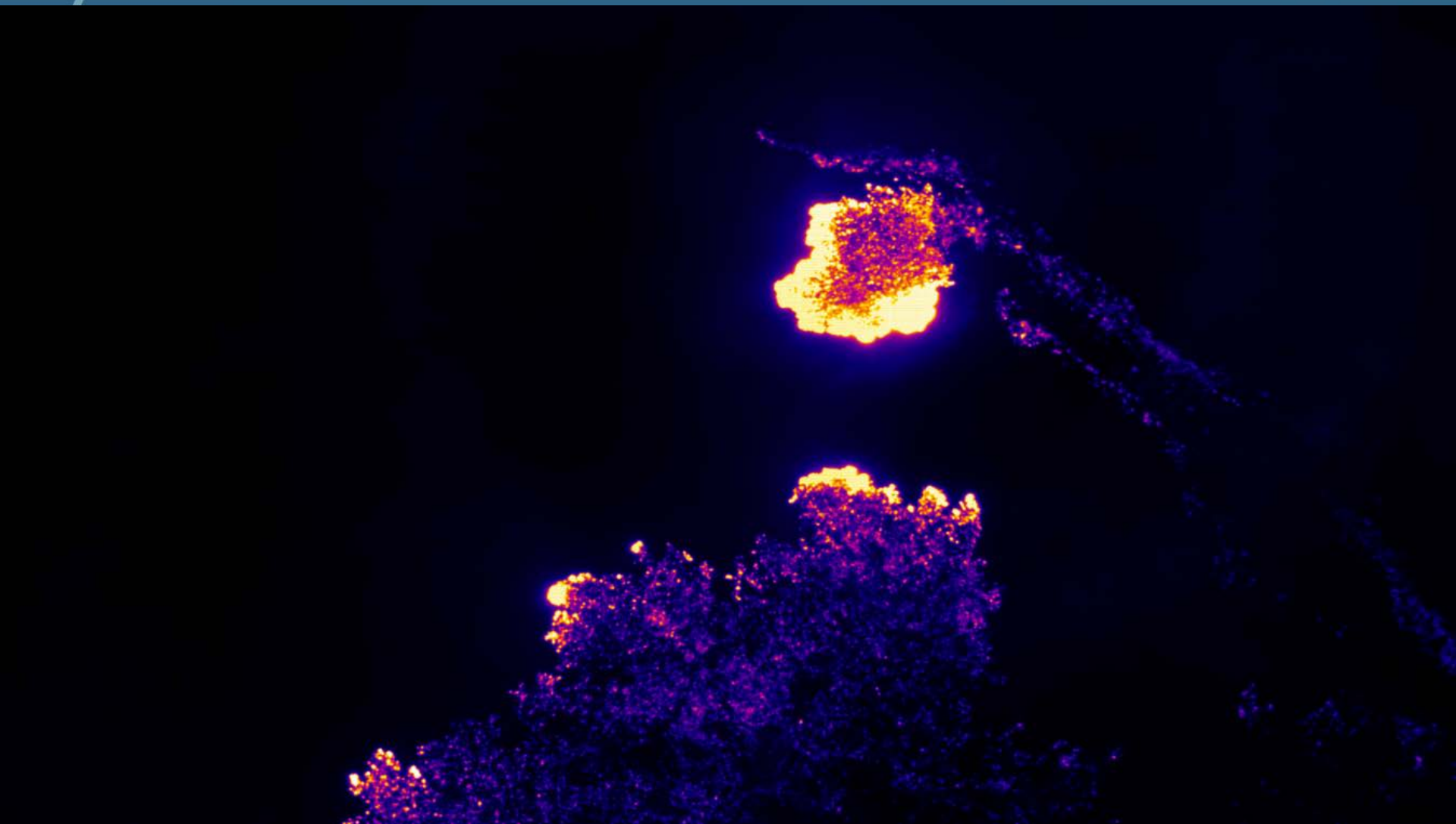
Scattered Heat = smoldering combustion

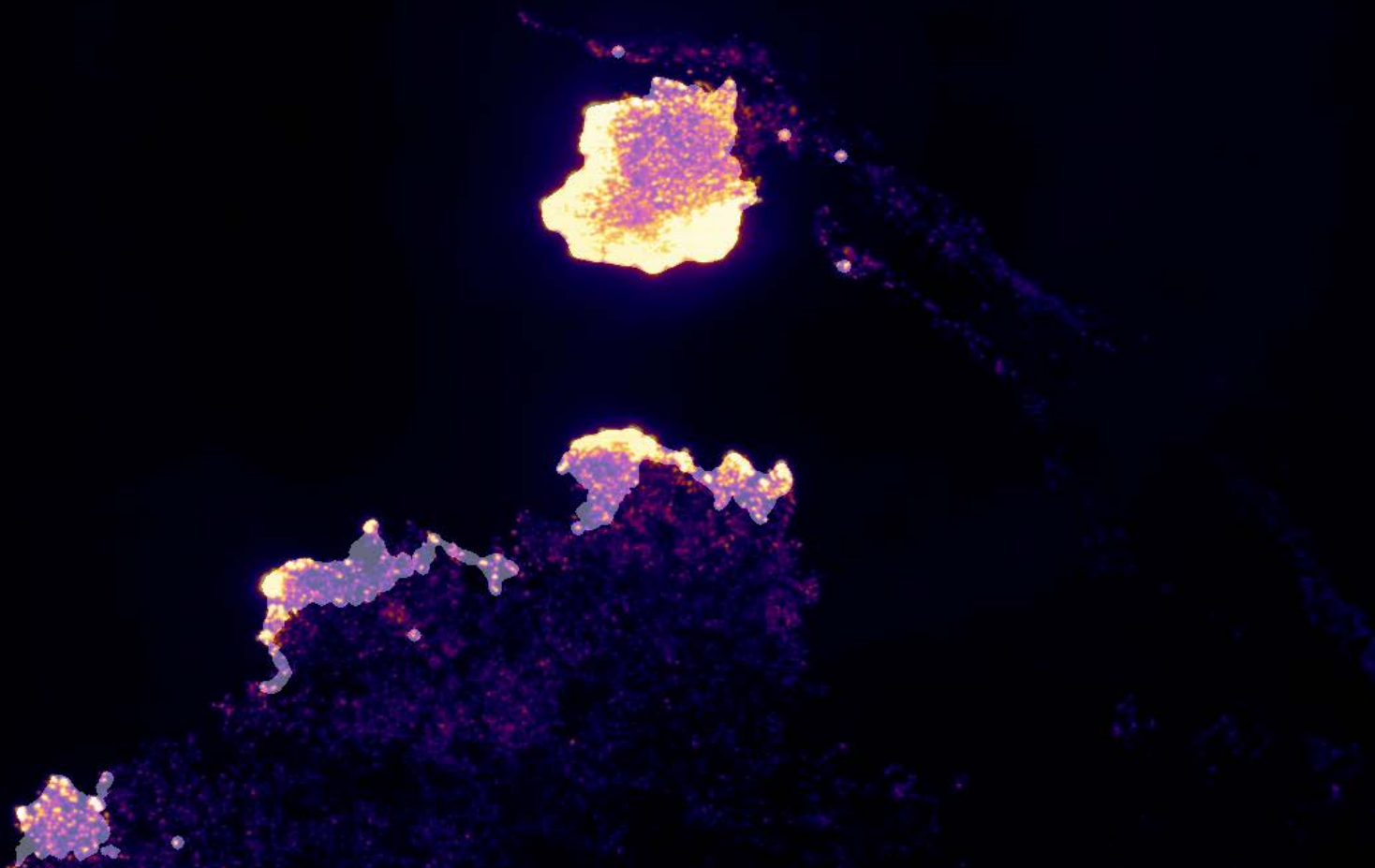
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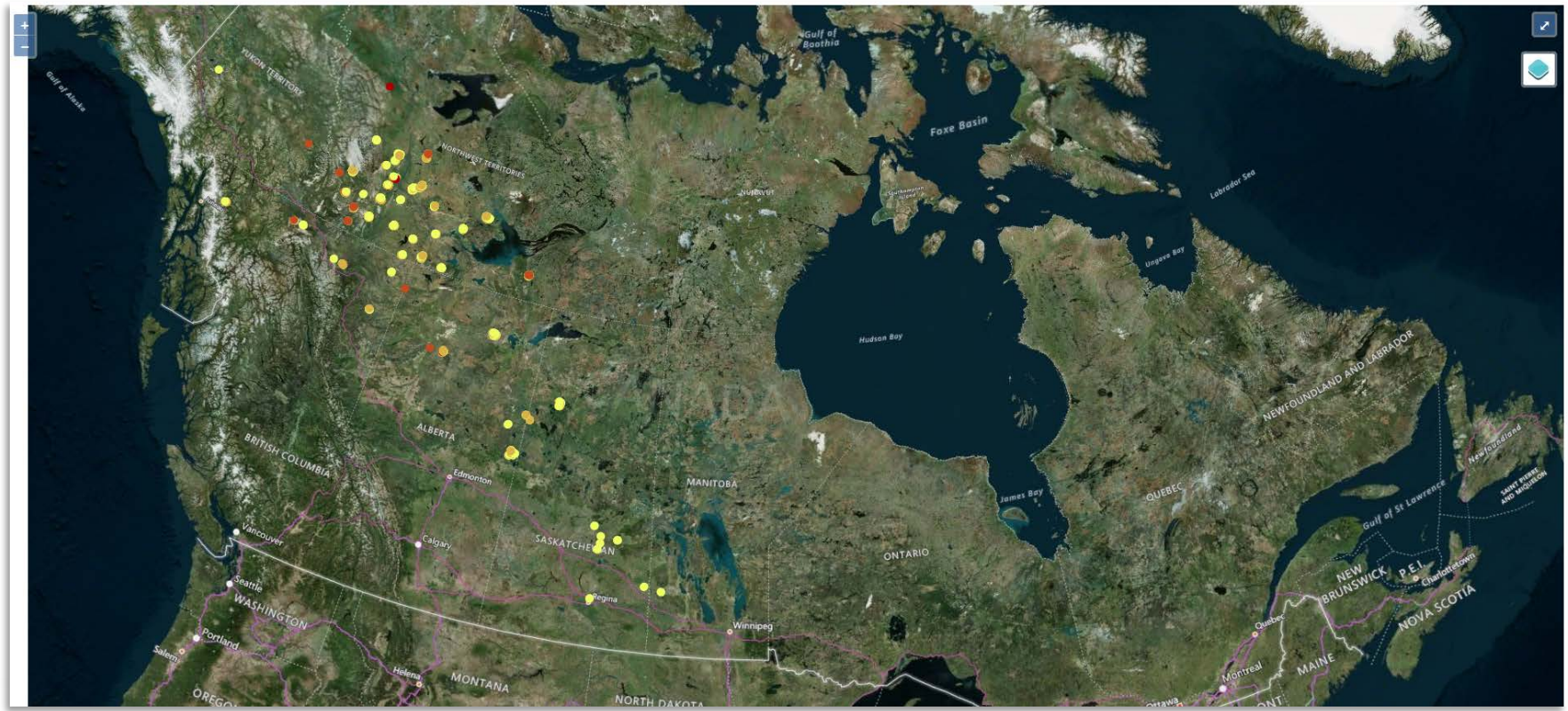








Consolidated Fire Detection and Monitoring System (CFDMS)





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

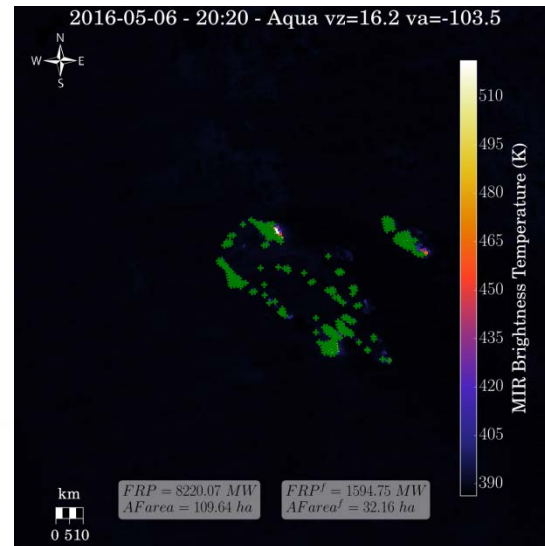
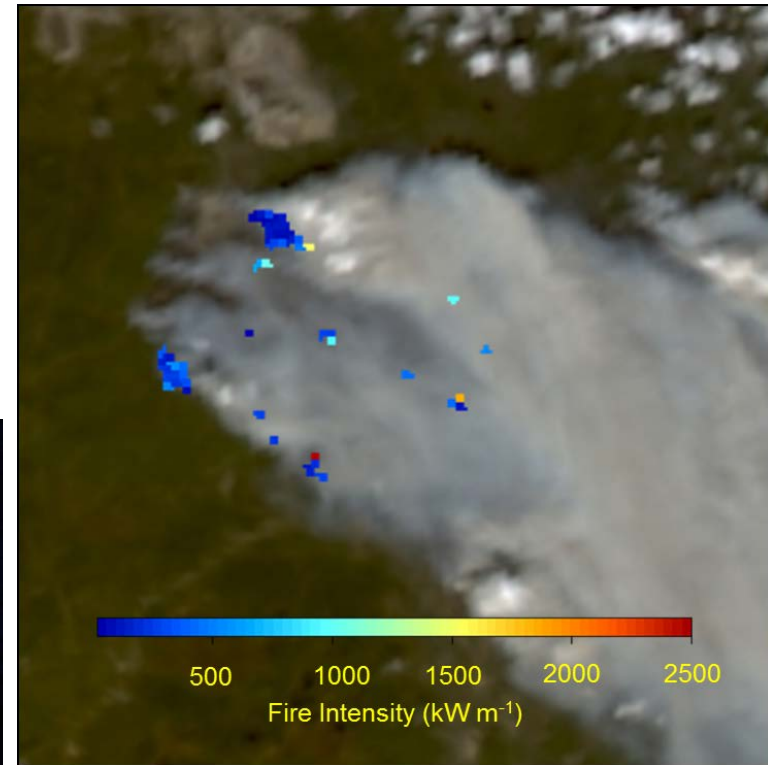


Figure: Dr. Ronan Paugam



Detection

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

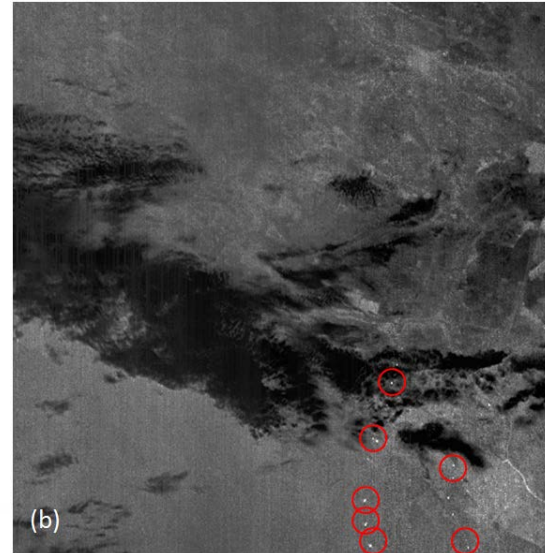
OPERATIONS

- 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

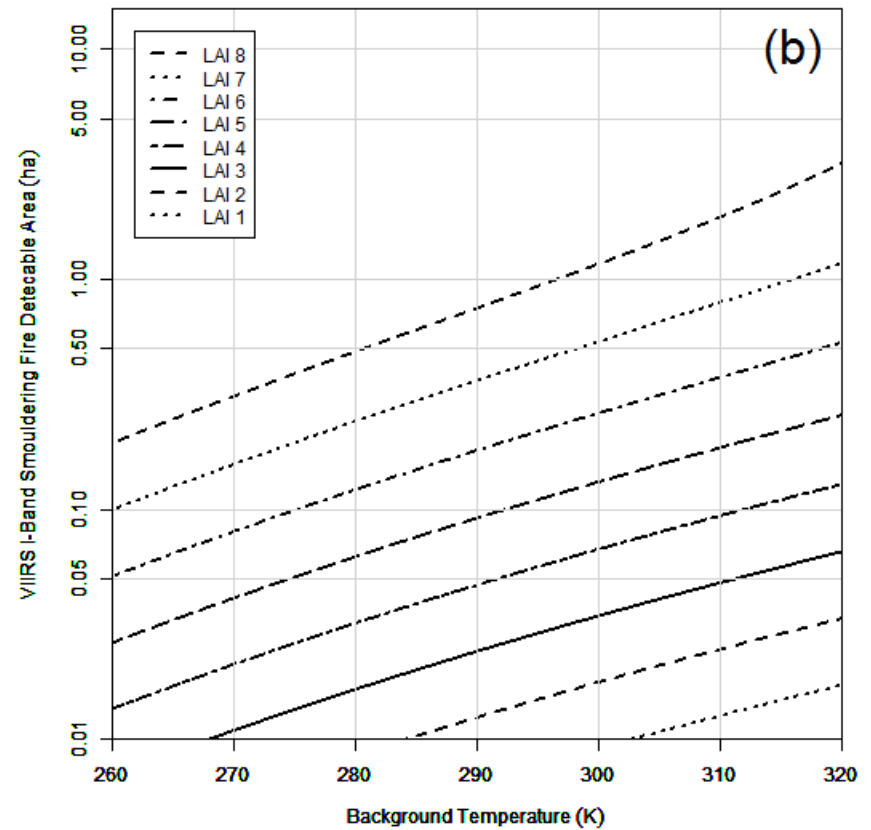
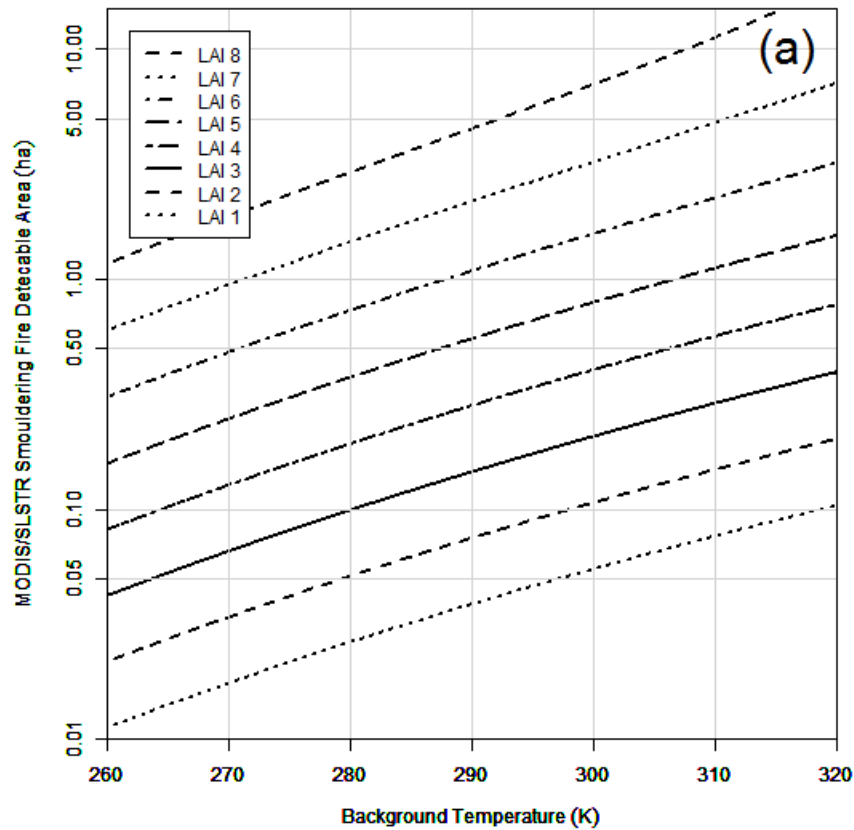
- e.g. 10 x 20 m of flaming area (~900 K) in the MWIR
- ~ 28 x 28 m (0.08 ha) of smoldering area (~675 K) in the MWIR

10 x 20

28 x 28

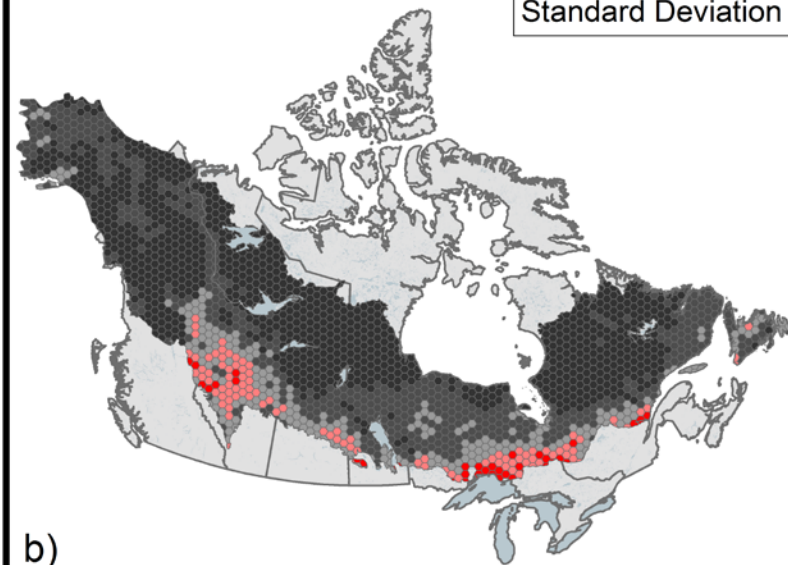
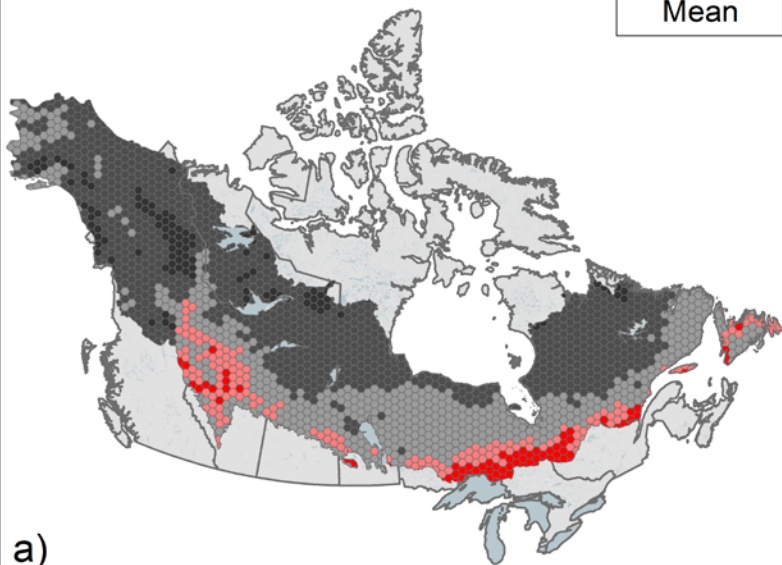


Limitation of Hotspots



Mean

Standard Deviation

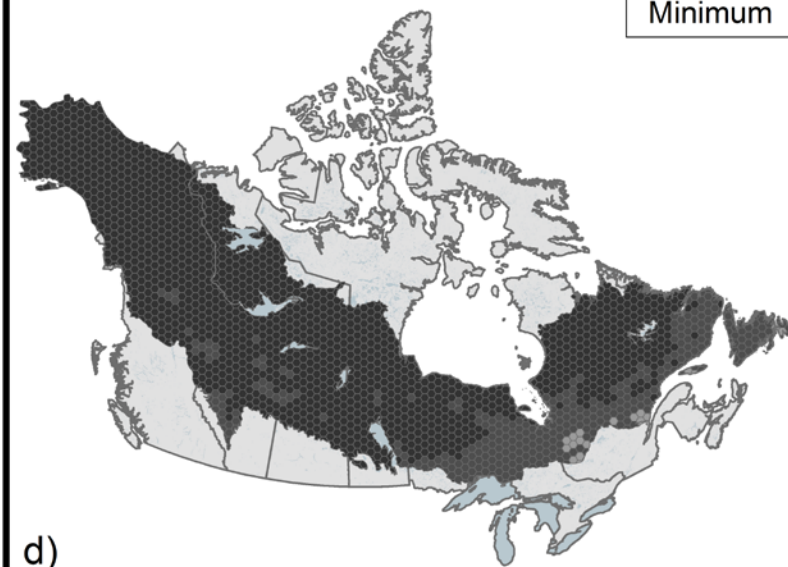
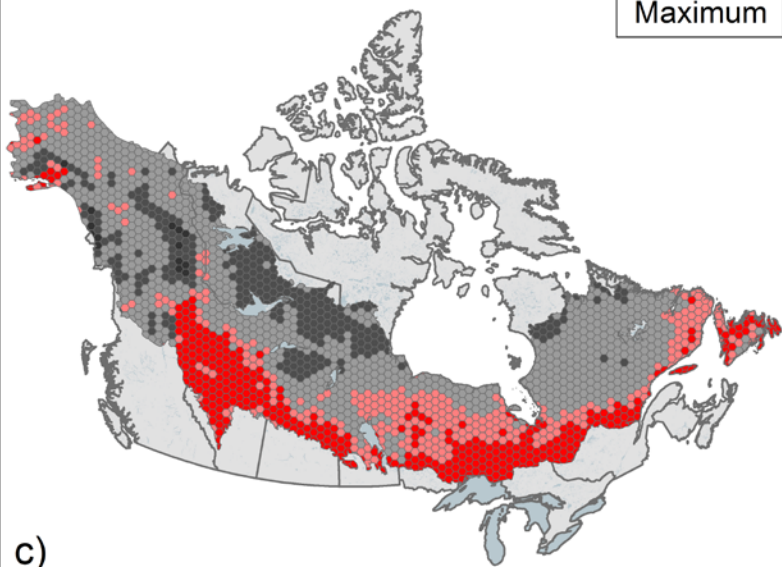


a)

b)

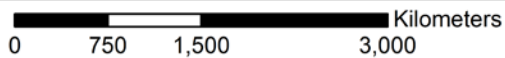
Maximum

Minimum

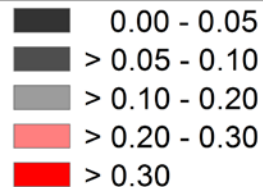


c)

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

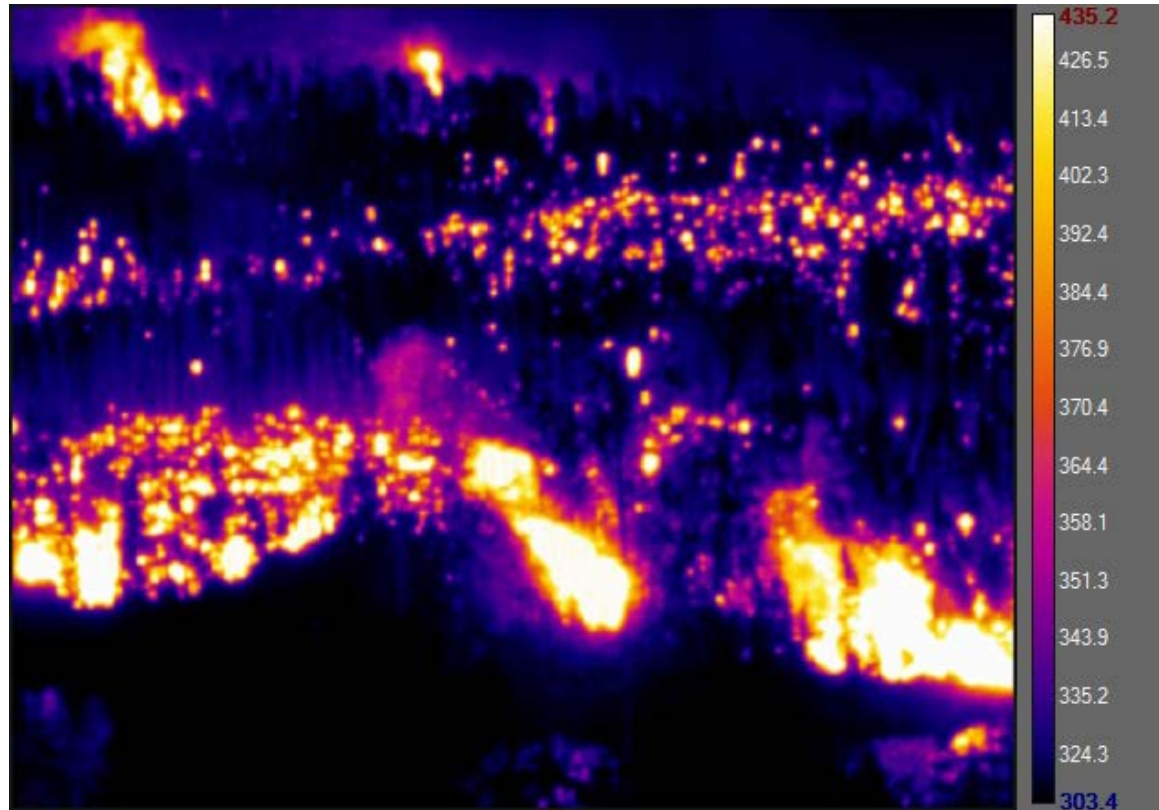


High Temporal Infrared Research





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 forested area on the left. To the right, a winding river flows through a valley. The sky is filled with a thick layer of white clouds. The text "Thank you" and "Questions?" is overlaid in the center in a yellow, serif font.

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.