Bi-Hourly Wildfire Behaviour Monitoring: A Canadian Solution to a Global Problem

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GOFC-Fire Nov. 2016, Santiago, Chile
Problems Caused by Wildfire (Canada)

- More than 1 billion $ yearly cost to manage,
- Significant health hazards (degraded air quality),
- Carbon release into the atmosphere,
- $Billions in damage and indirect costs:
  - Destruction of communities, industrial sites, national and provincial parks,
  - Evacuations and health costs,
  - Insurance losses (Ft McMurray 2016 - $3.8B)
  - Loss or revenues:
    - Timber, Energy, Farming, Tourism.
- The amount of wildfire is growing on a yearly basis.
Area Affected by Smoke from Fort McMurray
### Facts about wildland fires in Canada

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Average # of forest fires per year:</td>
<td>7,500</td>
</tr>
<tr>
<td>Total area burned annually:</td>
<td>2.3 million hectares</td>
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<td>3% of the fires account for 97% of total area burned</td>
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Wildfire Occurrence - Canada 1918-2015

The graph shows the annual burned area in hectares for Canada from 1915 to 2035. The data is plotted against the year, with a peak around 1985 and a notable increase towards the end of the graph. The red line represents the 10-year average burned area.
Canadian Direct Carbon Emissions

![Graph showing Canadian Direct Carbon Emissions from 1958 to 2000. The graph compares emissions from fossil fuels and fires. The sources for the data are:

Fossil fuels: www.nrcan.gc.ca/es/ceo/update.htm
Prioritization of Fires

- Limited resources available for fire suppression;
- Only subset of all fires can be tackled;

**Which fires to choose for attack?**

- Goal: reduce the number of large escape fires
  - i.e. the 3% of fires that cause most damage;

**Save drastically on overall cost**
Fire Danger Rating (FDR)

Fire Hazard (amount, type orientation…)

Ignition Risk from people & lightning

Fire Danger Rating

[Diagram showing ratings: red, orange, yellow, green]
Fire Behaviour Prediction

- Weather
- Fuel type
- Topography

Fire Behaviour Prediction
Fire Behaviour Prediction

- Location
- Weather
- Fuel type
- Topography

Fire Behaviour Prediction
Fire Behaviour Prediction

- Location
- Fire Temperature
- Fire Energy
- Weather
- Fuel type
- Topography

Currently missing

Fire Behaviour Prediction
What we are Missing

- Fire characterization data:
  - Every 2 – 3 hours;
  - Of every point in Canada;
  - For fires as small as 15 m by 15 m;
  - Available within 30 min. after data acquisition.

Only possible from space
With a constellation of satellites
Affordable with low-cost satellites
**Systems Currently Available**

- Have insufficient:
  - Temporal or spatial resolution;
  - Data latency;
  - Measurement performance (saturation issues);
- Do not provide the necessary coverage of Canadian forests;
- Come from *cooled* Infra-Red detectors;
  - High-cost payload technology;
  - High mass, volume and power demands lead to *costly* satellites that are not suitable for a multi-sat constellation.
Canadian industry developed a novel infrared sensor called a microbolometer.

Contrary to infrared sensors used in other missions, the microbolometer does not require cooling.

This allows for a relatively low-cost mission with both high spatial resolution as well as high temporal resolution (large swath).

**Result:**

- **High Revisit:**
  - Multiple sensors packed in one satellite → large swath;
  - Low-cost microsatellite → makes constellation of satellites affordable.

- **Short Data Latency:**
  - Use of Canadian Ground Stations;
  - Maximum 30 min. latency.

- **Routinely Scanning of the whole of Canada:**
  - Low power needs allow for long-duration scanning.
Canadian Wildland Fire Monitoring System (CWFMS)

Number of Accesses with a 9-sat Operational CWFMS Constellation:

During the burning period of one day (09:00 – 21:00 local time)

During the PEAK burning period of one day (15:00 – 19:00 local time)
Additional Benefits from a Canadian Wildland Fire Monitoring System

- Enabling ecologically beneficial fires to burn on the landscape;
- Accurate fire statistics for the whole of Canada for future optimization and research;
- Accurate estimations of fire carbon emissions;
- Accurate prediction of Smoke and Air Quality;
- Industrial innovation/growth in Canada
  - space technology, remote sensing, data service;
- Benefits not limited to Canada → global coverage.
Contact Information

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