

CSA Microsat Program

Canadian Wildland Fire Monitoring System (CWFMS)



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Government
of Canada

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du Canada

The Wildfire Problem

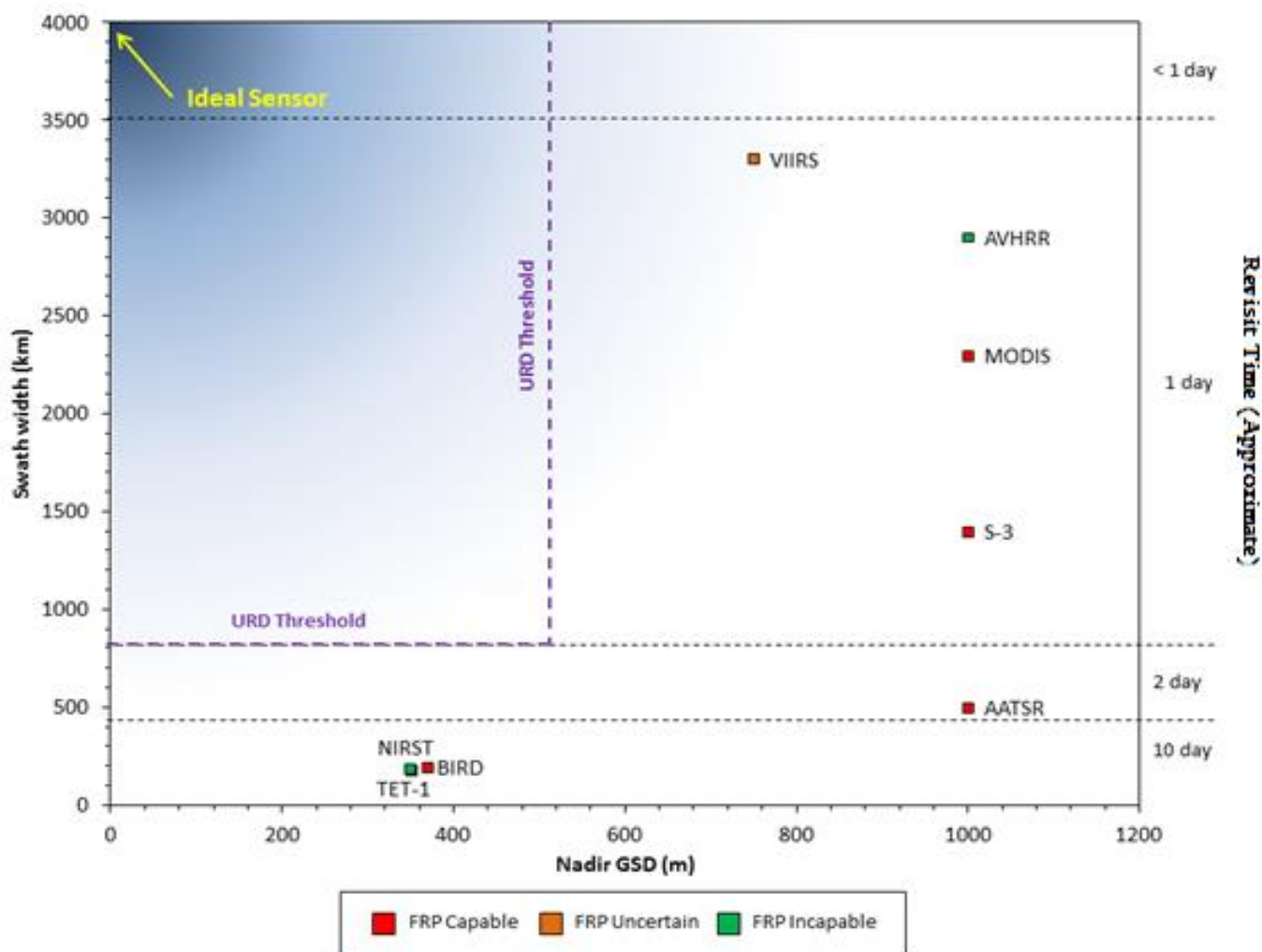
- Canada contains 10% of the world's forests, which cover nearly half of the country;
- Canadian forests have intense, fast-spreading wildfires that have a large impact on the Canadian economy and the well-being of Canadians:
 - The annual burned area from wildfires is growing (**doubled** since 1970);
 - Significant health and safety hazards to Canadians:
 - Through the **destruction** of communities and industrial activities;
 - From smoke that can travel great distances and severely **degrade** air quality;
 - More than **\$1 billion** yearly to manage.



The Gap

- The detection and monitoring infrastructure currently in place (including land, space and air assets) does not provide the level of data that is required to improve:
 - I. Real-time monitoring for Fire management;
 - II. Smoke and air quality forecasting;
 - III. Wildfire carbon emissions reporting.
- Remote-sensing is the only viable option for a country as vast as Canada;
- Satellite remote sensing data currently available/planned for wildfire monitoring and detection:
 - Has insufficient temporal and spatial resolution;
 - Has insufficient data latency;
 - Does not provide the necessary coverage of Canadian forests.

Available Remote-Sensing Data from Polar-Orbiters



The Solution – Canadian Technology

- Canadian industry developed a novel infrared sensor called a Microbolometer that does not require cooling;
- This allows for a relatively low-cost mission with both high spatial resolution as well as high temporal resolution.



The Canadian Wildland Fire Monitoring System (CWFMS) Mission



CWFMS – Organizations Involved

- Canadian User Departments:
 - Led by: Natural Resources Canada (NRCan), Canadian Forest Service (CFS);
 - Environment Canada (EC);
 - Parks Canada (PC);
 - Public Safety (PS);
 - Provincial Government Departments.
- Academic involvement:
 - University of Sherbrooke, Canada;
 - University of Alberta, Canada;
 - Kings College London, United Kingdom.
- Canadian Space Industry:
 - NGC, COMDEV, INO, SFL, MPB: involved in feasibility study.
- Canadian Space Agency



CWFMS – Mission Objectives

To develop a Canadian wildland fire monitoring system that has the ability to monitor and track wildland fires within Canada to provide to governments and commercial enterprises:

- Near real-time information in support of wildland fire management;
- Emission measurements in support of international requirements for carbon reporting and for smoke & air quality forecasting.

CWFMS – Measurements Needed

By order of priority:

1. Fire Radiative Power (FRP) Data:
 - Essential for the prototype mission;
 - Secondary objective: Fire Radiative Energy (FRE) which requires higher frequency FRP measurements (e.g. 6 hours).
2. Hotspot Data;
3. Rate of Spread and Fire Intensity Measurements;
4. Burned Area Mapping (optional).



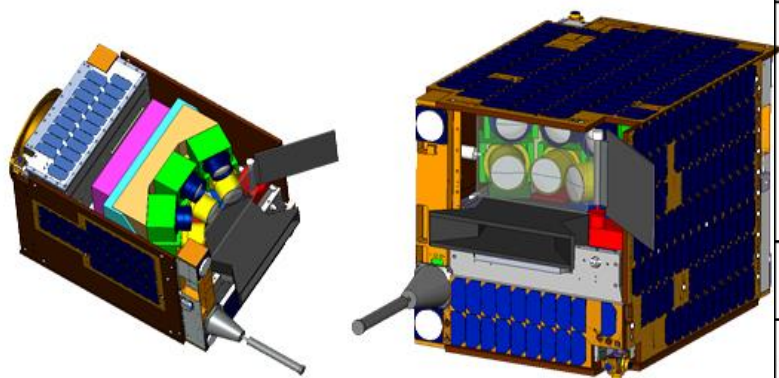
CWFMS – Mission Design

- Improved spatial resolution over existing systems (<500m);
- Daily coverage of Canada;
- Low data latency (<30 minutes for priority data);
- High accuracy geo-referencing;
- Observations during active/peak burning periods (from approximately 15:00 to 19:00 local time).
- Use Canadian Ground Receiving stations (Gatineau, Prince Albert, Inuvik)

CWFMS – Microsatellite Design Example

Mission Parameters:

Orbit Type	Sun-Synchronous, dawn-dusk (6am/6pm LTAN)
Altitude	585 km
Swath Width	1200 km
Satellite Weight	140 kg



<i>Camera</i>	<i>Spectral band (um)</i>	<i>GSD (m)</i>
Vis-NIR	0.5-0.6	200
	0.6-0.7	
	0.8-0.9	
MWIR	3.5-4.2	200
LWIR	10.4-12.4	

CWFMS – Payload Technology

- Multispectral pushbroom scanning imager;
 - Simultaneous measurement of all pixels in MWIR and LWIR bands;
 - Overlapping FPAs for wide-swath along with multiple cameras
 - Onboard radiometric calibration.
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- Notes:
 - Precursor of the Microbolometer is flying on NIRST;
 - Technology Development activities on-going as part of the CSA Space Technology Development Program (STDP).

Benefits



CWFMS – Mission Products

- Fire maps:
 - Location, extent, timing;
- Fire characteristics:
 - Fire line intensity, rate of spread, fuel consumption;
- Plume dynamics:
 - Smoke transport maps, plume heights;
- Emissions:
 - Mass of Carbon released into atmosphere.

CWFMS – Priority Applic. and Services

- Enables the use of hotspots for Rate of Spread estimates, especially for emerging fuel types (MPB & SBW mortality, peatlands) and for Fire Intensity estimates;
- Supports the Canadian Wildland Fire Information System (CWFIS) that tracks fire danger, fire behaviour and hotspots;
- Measures FRP to estimate trace gas and particulate emissions;
- Provides model inputs for improved Air Quality (Env. Canada) and smoke transport models (BlueSky).

Benefits to Canada

- Improvement of Public Health and Safety;
- Reduction of Fed. Gov costs to deal with consequences;
- Economic Benefits:
 - Reduction of industrial losses as a consequence of wildland fires;
 - New commercial opportunities for application/service industry.
- Improvement of Canada's International Reputation (e.g. carbon reporting) and International Relations;
- Positioning of the Canadian Private Industry at Forefront of Space Activities;
- Solidification of Canada as a World-Leader in Wildfire Management and Research.

Achievements to date

Dec 2013:

- Users and Science Team (U&ST) defined for each mission;
- Industrial Team selected for each mission;

2014 – 2015:

- Development of:
 - User Requirements Document (URD);
 - Draft Mission Business Case (BC);
 - Mission Requirements Document (MRD).



Next Steps...

- Engage international interest;
- Approach provincial governments;
- Build business case for commercial global operational service (constellation of microsats).



Summary

- The Canadian Wildland Fire Monitoring System (CWFMS) is a low cost single microsatellite mission;
- The CSA is carrying out a feasibility study for this mission;
- CWFMS will fulfill a need from Canadian Government User Departments and Provincial Governments;
- CWFMS will serve as a stepping-stone (proto-operational mission) towards a fully operational service (data processing, applications development).