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WildFireSat e-Bulletin

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New publications

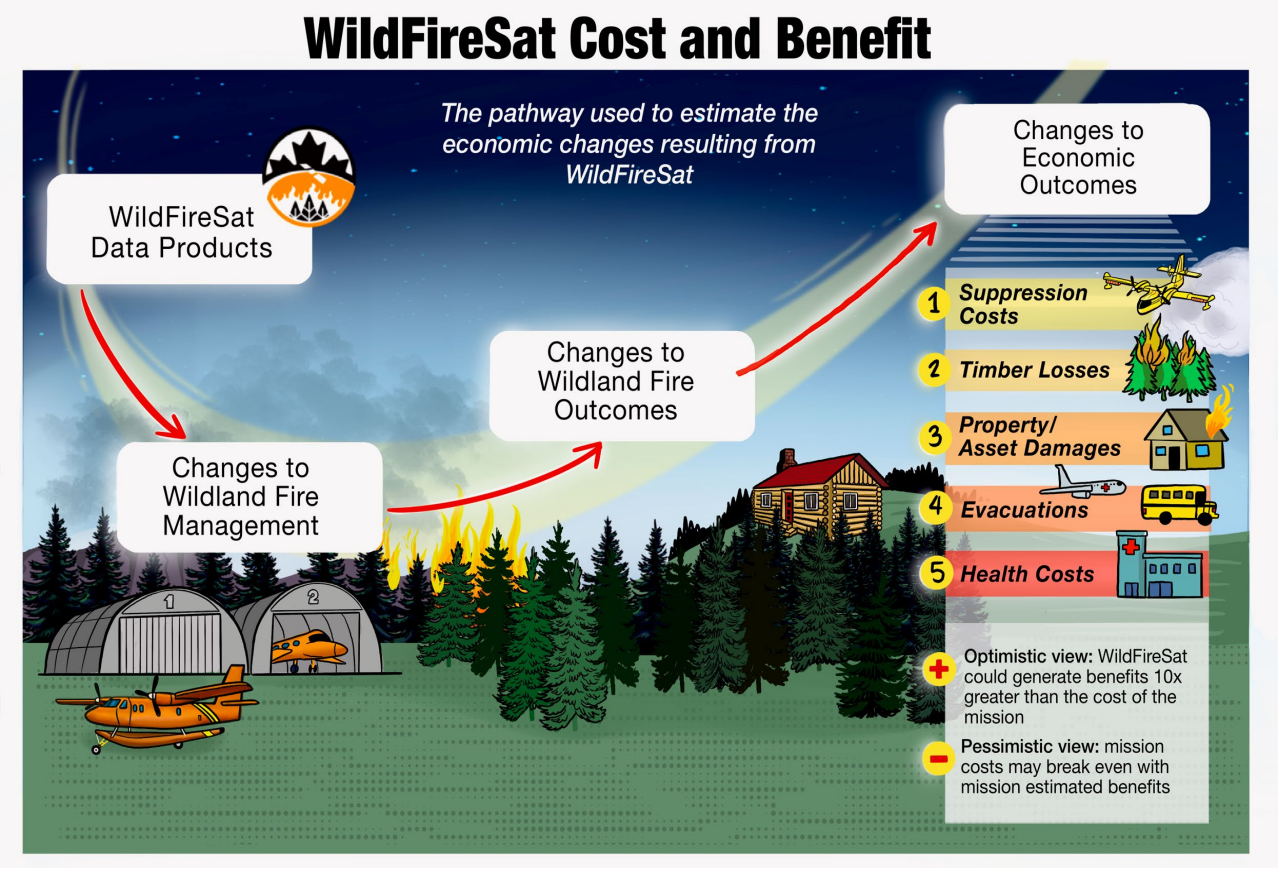
The costs and benefits of WildFireSat

A new study compares the costs and benefits of the WildFireSat mission. An optimistic view finds that it could generate economic benefits 10 times greater than the mission costs. However, a pessimistic view suggests that the costs might break even with the benefits.

Estimating the costs of a future satellite mission is relatively easy; costs are assumed to be like existing satellite missions. Estimating the economic benefits of the same future mission is difficult. Despite this difficulty, comparing the costs with the benefits of satellite missions is an important step for the governments and agencies sponsoring the endeavour. In the context of WildFireSat, understanding how the mission will impact fire management and generate economic benefits is key for ensuring continued investments. Once operational, the WildFireSat mission will provide a range of data products to wildland fire management agencies. However, the impact these products will have on wildfire management will depend on the successful uptake of these products (see Canadian Fire Management Agency Readiness for WildFireSat: Assessment and Strategies for Enhanced Preparedness.)

In 2020, we launched a research project to estimate the economic value of the WildFireSat mission. The research project started by identifying potential real-world changes that WildFireSat data products could motivate within wildfire management. With an optimistic view, we assumed that the use of new and improved fire information would lead to more informed decision-making, which would generate reductions in suppression costs, timber losses, property and asset losses, evacuations and health costs. However, the research also included a pessimistic view, such that WildFireSat data products could result in increased suppression costs, timber losses, property and asset losses, evacuations and health costs.

Our results suggest that WildFireSat has the potential to generate large economic benefits for Canadians. However, the degree of economic benefit depends on the variability of the wildfire seasons that could occur during the satellite's operating life. Importantly, this study does not address broader value to the Canadian economy implicit in the building of any satellite mission.



For more information see Hope et al. 2024, "A cost-benefit analysis of WildFireSat, a wildfire monitoring satellite mission for Canada."

WildFireSat products

WildFireSat product operations

The WildFireSat product operations group are tailoring data products for operational fire use through engagement with the fire management agencies.

Across Canada, fire managers have different requirements for information management and information technology (IT), which are necessary to consider for the interoperability we envision for WildFireSat. The aim of the WildFireSat product operations group is to help the science team by providing them with the software development guidance and support necessary to create the data products and serve those data products to end-users in a way that they can use them as efficiently as possible. This group is providing guidance on best practices for developing the science-level software, which includes following internationally accepted and open metadata and data standards, coding guidelines and a robust development environment.

To provide effective products our development team is also maintaining strong connections with fire managers throughout the development process. To successfully integrate these products into fire management agencies, it's key to connect with the users who will need to interpret and apply WildFireSat data products in decision-making. Connection with the IT and geographic information system (GIS) staff is also essential because they will integrate the data into the routine standard operations of the agency. One way we aim to facilitate this back-and-forth engagement is through the development of a virtual environment (a sandbox) to develop, test and demonstrate the products for both the WildFireSat team and fire managers. This

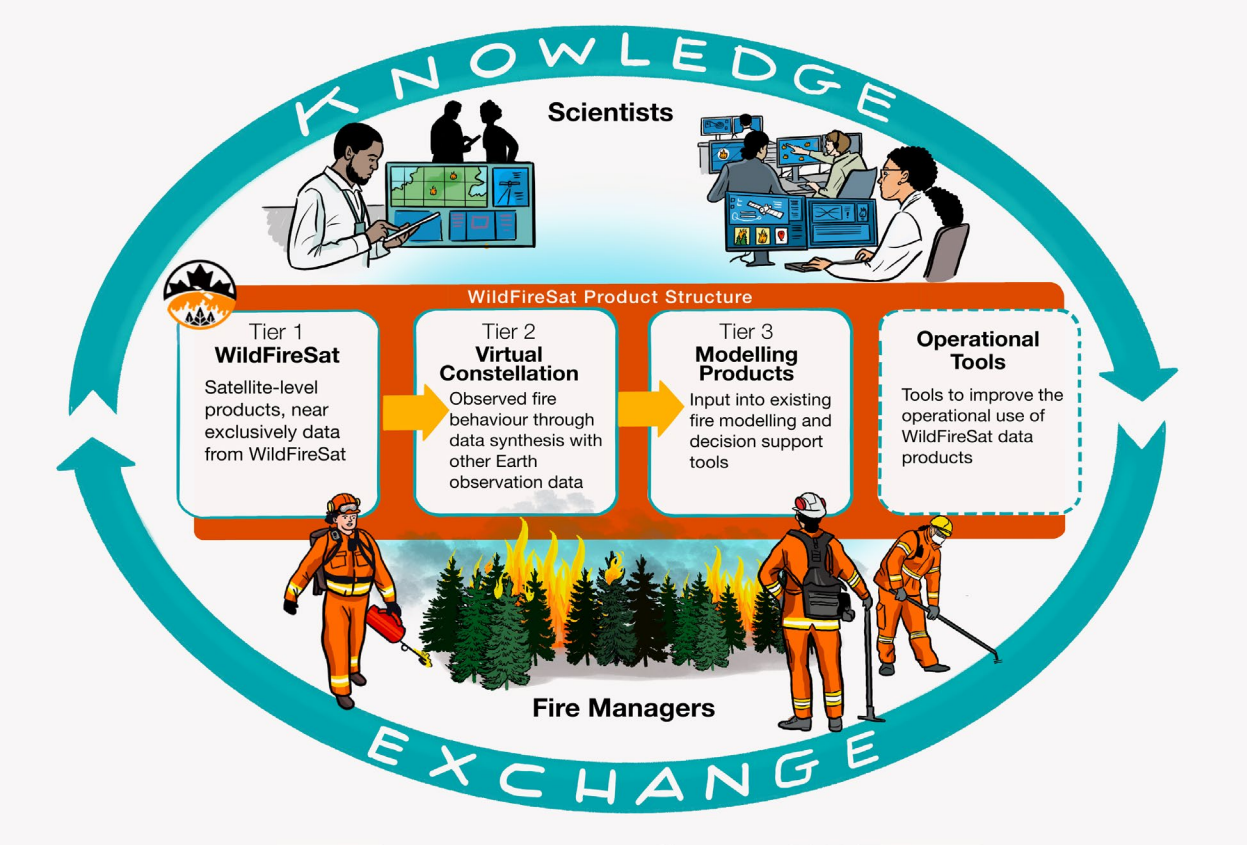
sandbox is anticipated to be initially available in 2025 for early engagement with development product releases.

The WildFireSat product operations development is led by Alan Cantin, a fire research project leader with a background in computer science and Wildfire modelling. The product operations team also includes Jackie Oliver, an IT analyst who has a background in English, computer science and fire science, and Segun Oladipo, an IT analyst with a background in computer science and environmental science.

WildFireSat product structure

WildFireSat research and products are being developed through an interconnected tier structure, with each tier building upon the last.

WildFireSat research and products



Tier 1 – Fire detection and characterization

Tier 1 of WildFireSat development aims to identify where fires are actively burning on the landscape (hotspots) and provide information about their characteristics, using satellite imagery.

If you are an existing user of Earth Observation active fire data, the Tier 1 WildFireSat products should look familiar to you as our fire products are informed by a long legacy of similar products generated from existing sensors (for example, Visible Infrared Imaging Radiometer Suite [VIIRS], Moderate Resolution Imaging Spectroradiometer [MODIS]). Tier 1 products will include a point-based hotspot dataset like those available from the National Aeronautics and Space Administration Fire Information for Resource Management System (NASA FIRMS), as well as a more detailed "fire mask" that provides additional fire environment information (for example, location of clouds and waterbodies) from the raw imagery. As a bespoke fire-monitoring mission, WildFireSat products should provide improvements over products from other sensors, including improved fire radiative power (FRP) estimates, a lower false alarm rate and contextual information to aid fire management decision-making.

WildFireSat Tier 1 product development is led by Mark de Jong, a fire research scientist specialising in active fire detection, and Matthew Ansell, a forest fire modelling specialist with a background in computer science.

Tier 2 – Virtual constellation and value-added products

Tier 2 of WildFireSat development aims to leverage other Earth observation data to create products from a virtual constellation.

The objective of WildFireSat's Tier 2 stage of research and development is to create value-added Earth observation–based products through data synthesis with other satellites. WildFireSat Tier 2 virtual constellation products will be available as multi-source fire events that use active fire hotspot data from WildFireSat, VIIRS and other reliable inputs to cluster and delineate fire perimeters of growing fires. These multi-source events will inform a gridded arrival time product that will provide the first and last detection of burning pixels. Building upon previously developed fire behaviour research, we will also apply empirical approaches to estimate satellite-derived rate and direction of spread and fireline intensity products in Tier 2.

Virtual constellations are a novel realm of Earth observation development, and few satellite missions have built upon this structure to develop value-added products. The virtual constellation approach of WildFireSat will support harmonizing data from multiple complementary satellite sources to increase temporal and spatial resolutions. Tier 2's synthesis framework approach will support more near real-time monitoring of active fires and their behaviour across Canada.

WildFireSat Tier 2 algorithm and product development is led by Morgan Crowley, a forest fire research scientist with expertise in Earth observation data synthesis and fire progression monitoring, and Julia Harvie, a forest fire modelling specialist with a background in artificial intelligence and image processing.

Tier 3 – Tools for fire managers

Tier 3 of WildFireSat development aims to provide straightforward insights to fire managers about fire characteristics and behaviour.

Traditional active wildfire remote sensing focuses on providing the best "dots on a map." WildFireSat Tier 3 breaks the mould by building upon Tier 2 products. Tier 3 adds information from outside the realm of satellites to paint a better picture of how large and fast-moving fires are growing. By providing straightforward and insightful data insights to busy fire managers, Tier 3 products aim to reduce the mental workload when tracking and managing numerous large active fires on the landscape. Products include leveraging weather models to provide a forecast of cloud cover over known active fires to better inform if satellite detections and mapping will be sufficient or if aircraft will be required to monitor fire spread under heavy cloud.

New hotspot detections will be scrutinized for their underlying fire weather and observed fire intensity. A "first detection best guess" algorithm will categorize newly discovered hotspots as either wildfires or as sources of detected heat, such as the responsible use of low-intensity fire by landowners and users. Existing large fire perimeters will be better mapped and catalogued, flagging areas both inactive and very active to more realistically model future fire growth. Lastly, the observed fire spread distances from Tier 2 will be compared with nationally accepted and industry-standard fire growth models to highlight for fire managers which wildfires are spreading meaningfully faster or slower than anticipated.

WildFireSat Tier 3 product development is led by Dr. Dan Thompson, a fire research scientist specialising in fire behaviour modelling, and Geoff Goetz, a forest fire modelling specialist with a background in applied mathematics and experience as a wildland firefighter and fire investigator.

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