

INFERNIS

INTELLIGENCE FORGED IN FIRE

A Machine Learning Engine for Wildfire Prediction in British Columbia

White Paper — Version 1.0

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Executive Summary

INFERNIS is a machine learning engine purpose-built to predict wildfire occurrence and spatial risk across British Columbia. By combining gradient-boosted decision trees with convolutional neural networks in a regionally calibrated ensemble, INFERNIS ingests 21 open data sources – spanning satellite imagery, reanalysis weather grids, multi-depth soil moisture profiles, vegetation indices, and historical fire records – to produce calibrated daily fire occurrence probabilities at 1 km grid resolution across the entire province.

The problem INFERNIS addresses is both urgent and structurally underserved. British Columbia has experienced three of its worst wildfire seasons in recorded history within the last decade, with cumulative damages exceeding tens of billions of dollars and hundreds of thousands of residents displaced. Existing fire danger systems, while scientifically rigorous, remain station-based and reactive. They were not designed to deliver the granular, probabilistic, machine-learning-enhanced predictions that modern fire management, insurance underwriting, and infrastructure planning demand. INFERNIS closes that gap: it transforms Canada's world-class open data ecosystem into actionable, API-delivered wildfire intelligence.

Key differentiators include BC-specific model calibration across 14 biogeoclimatic zones, a hybrid ensemble architecture validated through walk-forward temporal backtesting, automated daily ingestion of open data sources requiring zero manual intervention, and a REST API designed for integration by government agencies, insurers, utilities, and application developers. INFERNIS is built entirely on freely available Canadian and international open data.

The Problem: Wildfire Risk in British Columbia

British Columbia is in a wildfire crisis that is accelerating, not stabilizing. The 2017 fire season burned 1.2 million hectares and was declared the worst in provincial history. That record fell the very next year when 2018 saw 1.35 million hectares consumed. Both were eclipsed by the 2023 season, which burned 2.84 million hectares in BC alone – more than double the previous provincial record. Nationally, the 2023 season burned approximately 15 million hectares across Canada, making it the worst wildfire season in Canadian history. This is not cyclical variation. It is a structural shift driven by climate change, fuel accumulation from decades of fire suppression, and expanding human-wildland interface.

The economic toll is staggering. The 2023 season is expected to have caused multi-billion-dollar losses when accounting for wildfire management expenditures (approximately \$1 billion CAD in BC alone), insured property losses, infrastructure damage, public health impacts from smoke exposure, and economic disruption from evacuations that displaced nearly 50,000 residents. Insurance losses from wildfire are now a material line item in Canadian reinsurance portfolios, and multiple insurers have begun restricting coverage in high-risk BC communities.

Current wildfire danger assessment in Canada relies on the Canadian Forest Fire Danger Rating System (CFFDRS), a scientifically rigorous framework developed over decades by the Canadian Forest Service. The CFFDRS and its Fire Weather Index (FWI) System remain the most widely adopted fire danger rating system in the world, used operationally across Canada, the EU (via EFFIS), and dozens of other countries. However, the system was designed for an era of manual weather station readings and human interpretation. It is historically station-based, though gridded FWI products derived from ERA5-style reanalysis inputs now exist in research contexts. The core operational system does not incorporate machine learning or multi-depth soil moisture reanalysis. CWFIS does use MODIS NDVI operationally for fuel type classification (greenup mapping) and satellite sensors for hotspot detection, but these are not used as continuous predictive features in the FWI danger rating calculation itself. The Canadian Wildland Fire Information System (CWFIS) publishes daily and forecast fire danger maps and exposes data layers via OGC web services (WMS/WFS/WCS) that support GeoJSON output, but it does not provide a purpose-built developer REST API with documentation, authentication, or onboarding. Its interfaces are oriented toward government fire management workflows and GIS professionals rather than commercial developers, insurers, or application builders.

The gap between what the science makes possible and what the operational systems deliver – a gap acknowledged by Canada's own Blueprint for Wildland Fire Science 2019–2029 – represents both a public safety risk and a commercial opportunity.

The Solution: INFERNIS

INFERNIS is a machine learning-powered fire prediction engine designed specifically for British Columbia. It operates as a daily batch prediction system, ingesting data each afternoon after noon weather observations are finalized, and producing grid-level fire occurrence probabilities and danger classifications that are served via a REST API.

The architecture employs a hybrid ensemble approach. An XGBoost gradient-boosted classifier serves as the primary occurrence prediction model, trained on approximately 298,000 labeled samples spanning ten fire seasons (2015–2024), incorporating 28 engineered features. In cross-validated evaluation on 1km grid data, it achieves an AUC-ROC of 0.974 with a Brier score of 0.036.

A FireUNet convolutional neural network (~31M parameters) operates in parallel, processing 12-channel spatial inputs across a 256x512 raster grid to generate continuous risk heatmaps that capture landscape-scale spatial patterns the cell-independent XGBoost model cannot represent (AUC-ROC 0.815).

The Risk Fuser combines both model outputs in logit space with calibration coefficients independently tuned for each of BC's 14 biogeoclimatic (BEC) zones, producing a final composite risk score mapped to a six-level danger classification.

Beyond current-day predictions, INFERNIS produces multi-day fire risk forecasts using HRDPS weather forecasts (days 1–2, 2.5km resolution) and GDPS forecasts (days 3–10, 15km resolution) from Environment and Climate Change Canada, with FWI moisture codes rolled forward day-by-day and a confidence decay factor to reflect increasing forecast uncertainty.

All data sources are open and freely available from Canadian federal agencies, provincial data portals, and international scientific repositories. INFERNIS requires no proprietary data subscriptions. Google Earth Engine is used under its non-commercial license for satellite data access during development, with a plan to transition to a commercial license once revenue is generated. The system is designed for full automation: once configured, the daily pipeline runs without human intervention, from data retrieval through model inference to API delivery.

The Science

The Fire Weather Index System

INFERNIS builds on the scientific foundation of the Canadian Fire Weather Index (FWI) System, which models fire danger through a three-tier structure of moisture codes and fire behavior indices.

At the base tier, three moisture codes track fuel drying at different time scales. The Fine Fuel Moisture Code (FFMC) represents the moisture content of surface litter and fine fuels, responding to weather changes within hours. The Duff Moisture Code (DMC) tracks moisture in loosely compacted organic layers, operating on a time scale of days to weeks. The Drought Code (DC) models deep organic soil moisture with a seasonal memory spanning weeks to months. Together, these three codes encode cumulative drying across the full spectrum of fuel layers relevant to fire ignition and behavior.

The intermediate tier combines these moisture codes into two compound indices. The Initial Spread Index (ISI) merges FFMC with wind speed to estimate the expected rate of fire spread. The Buildup Index (BUI) combines DMC and DC to represent the total fuel available for combustion.

At the top tier, the Fire Weather Index (FWI) integrates ISI and BUI into a single numeric rating of fire intensity. INFERNIS uses all six FWI components as engineered features in its ML models, preserving the decades of fire science encoded in their formulations while allowing the machine learning layer to discover nonlinear interactions and threshold effects that the linear FWI aggregation cannot capture.

Feature Engineering

Beyond the classical FWI features, INFERNIS incorporates modern data sources that were unavailable when the CFFDRS was designed. Satellite-derived vegetation indices (NDVI, LAI) from MODIS and Sentinel-2 provide direct observation of fuel condition and vegetation stress. ERA5 reanalysis provides gridded, gap-free weather and soil moisture at four depths. Topographic features derived from the Canadian Digital Elevation Model (CDEM) encode terrain characteristics at the landscape scale. Distance to the nearest road, from the BC Digital Road Atlas, captures human-wildland interface proximity. Lightning detection from the Canadian Lightning Detection Network (CLDN) captures the primary natural ignition source – lightning is responsible for roughly 60% of BC wildfire ignitions and, as in the rest of Canada, for the majority of the total area burned.

The complete 28-feature vector per grid cell per day comprises: 6 FWI components (FFMC, DMC, DC, ISI, BUI, FWI), 10 weather variables (temperature, relative humidity, wind speed, wind direction, 24h precipitation, soil moisture at four depths, evapotranspiration), 3 vegetation indices (NDVI, snow cover fraction, leaf area index), 5 topographic and infrastructure features (elevation, slope, aspect, hillshade, distance to nearest road), 2 temporal encodings (day-of-year sine and cosine), and 2 lightning features (24h and 72h flash density).

Training Data Construction

Labels are derived from the Canadian National Fire Database (CNFDB) point-of-origin records and BC Wildfire Service perimeter data. A grid cell is labeled positive for a given day if a fire ignition point falls within its 1km cell boundary during that day. Negative samples are drawn from fire-free cells with spatiotemporal exclusion:

negatives must be at least 10km and 7 days from any fire event, preventing contamination from near-miss conditions that are functionally fire-prone. The negative-to-positive ratio is 10:1 (271,460 negatives to 27,146 positives in the 1km training set), sampled with stratification across years and BEC zones to prevent temporal or geographic bias from dominating the training signal.

This label construction means that INFERNIS predicts fire occurrence conditions at the grid cell level. The spatiotemporal exclusion zone serves as a data leakage prevention mechanism: by excluding near-fire cells from the negative pool, the model cannot learn trivially from spatial autocorrelation of adjacent fire/non-fire cells.

Feature Importance

Training on the 1km grid across ten BC fire seasons with the full 28-feature vector reveals the following feature importance ranking by mean |SHAP| value:

RA NK	FEATURE	MEAN SHAP	CATEGORY
1	NDVI (vegetation greenness)	1.25	Vegetation
2	Elevation	1.03	Topography
3	DMC (duff moisture code)	0.88	FWI
4	DC (drought code)	0.74	FWI
5	Soil moisture	0.49	Weather
6	Day-of-year	0.44	Temporal
7	FFMC (fine fuel moisture code)	0.42	FWI
8	Temperature	0.31	Weather
9	Wind speed	0.28	Weather

Vegetation condition (NDVI) remains the single most important predictor. Elevation ranks second, demonstrating that topographic context materially improves prediction at 1km resolution. Three FWI components (DMC, DC, FFMC) appear in the top nine, confirming the value of the classical fire weather indices as ML features. Soil moisture ranks fifth, capturing landscape-level dryness that integrates weeks of precipitation and evapotranspiration history.

Several features contribute zero marginal SHAP value: 24-hour precipitation, evapotranspiration, slope, aspect, hillshade, and both lightning density features. Their information appears captured by correlated features (e.g., precipitation effects absorbed by FWI moisture codes; slope/aspect absorbed by elevation). The zero lightning SHAP is notable given lightning's role as the dominant natural ignition source – this likely reflects limitations in available lightning data resolution or temporal alignment rather than the irrelevance of lightning as a fire driver.

Validation

The approach is validated by a growing body of peer-reviewed research. Recent machine learning studies on regional wildfire prediction using gradient-boosted models with ERA5 and FWI feature sets report AUCs in the 0.8–0.9 range, depending on region, task definition, and evaluation protocol. The BCWildfire benchmark dataset, which evaluates deep learning models at 1km resolution across British Columbia, reports that recent architectures (e.g., S-Mamba) achieve F1 scores above 0.85 and PR-AUC close to 0.95 in boreal wildfire risk prediction.

INFERNIS achieves an AUC-ROC of 0.974 and average precision of 0.794 in 5-fold stratified cross-validation on its 1km, 10-year training corpus, with a Brier score of 0.036 indicating well-calibrated probability outputs. Walk-forward temporal backtesting (training on years [2015, test_year-1], testing on test_year) yields AUC-ROC values of 0.90–0.93 across six held-out fire seasons (2019–2024), confirming that model performance generalizes across years and is not an artifact of random cross-validation splits.

Data Foundation

INFERNIS draws from 21 open data sources spanning eight major categories. A comprehensive catalog is maintained in the project's DATA_SOURCES.md document; the following summarizes the key inputs.

Historical Fires

The Canadian National Fire Database (CNFDB) provides point-of-origin records for fires dating back decades. BC Wildfire Service perimeter data supplies polygon boundaries for all significant fires, enabling both point-based classification training and spatial burn-area modeling.

Weather

ERA5 reanalysis from the European Centre for Medium-Range Weather Forecasts (ECMWF) provides hourly, gridded, gap-free atmospheric variables at approximately 31km native resolution, globally, from 1940 to present with a five-day lag. INFERNIS ingests 2m temperature, dewpoint, 10m wind components, total precipitation, and potential evapotranspiration.

Satellite Imagery

MODIS and Sentinel-2 imagery, accessed via Google Earth Engine, provides vegetation indices (NDVI), active fire detections (MODIS Thermal Anomalies), and burn severity assessments.

Soil Moisture

ERA5-Land soil moisture layers at four depth levels (0–7cm, 7–28cm, 28–100cm, 100–289cm) provide gridded subsurface water content critical for predicting deep organic fuel drying. All four layers are ingested as model features, capturing moisture gradients from surface litter through to deep root zones.

Vegetation and Fuel

NDVI and Leaf Area Index (LAI) time series characterize vegetation phenology, canopy density, and stress. CFFDRS Fuel Behaviour Prediction (FBP) system fuel type maps classify the landscape into standardized fuel categories.

Topography

The Canadian Digital Elevation Model (CDEM) at approximately 23m resolution provides elevation, from which slope gradient, aspect angle, and hillshade illumination index are derived.

Infrastructure

The BC Digital Road Atlas provides road network geometry used to compute distance-to-nearest-road for each grid cell, capturing human-wildland interface proximity relevant to both ignition probability and suppression accessibility.

Lightning

The Canadian Lightning Detection Network (CLDN) provides lightning strike locations and polarity, as lightning is responsible for roughly 60% of BC wildfire ignitions and, as in the rest of Canada, for the majority of the total

area burned.

All data is sourced from Canadian federal agencies, the Government of British Columbia, ECMWF, NASA, and ESA. No proprietary data subscriptions are required.

System Architecture

INFERNIS is organized into six core subsystems that execute as a coordinated daily pipeline.

DATA FORGE

DATA FORGE is the automated ingestion layer. It retrieves, validates, and standardizes data from all sources on a daily schedule, handling format conversions, coordinate reprojection, temporal alignment, and quality control. Data Forge maintains a local mirror of key datasets and performs incremental updates to minimize bandwidth and processing time.

FIRE CORE

FIRE CORE is the primary prediction engine. It operates on the structured 28-feature matrix with one row per grid cell per day. The XGBoost model produces well-calibrated occurrence probabilities for each of the 2,113,524 cells in the 1km grid.

HEATMAP ENGINE

HEATMAP ENGINE processes 12-channel spatial inputs covering the full BC extent to generate continuous spatial risk surfaces. The CNN captures landscape-scale patterns, spatial gradients, and neighborhood effects that the cell-independent XGBoost model cannot represent.

RISK FUSER

RISK FUSER combines outputs from FIRE CORE and HEATMAP ENGINE in logit space with per-BEC-zone calibration. The fuser applies zone-specific linear calibration and maps the resulting probabilities to a six-level danger classification. In current calibration, XGBoost dominates the ensemble weighting – the CNN receives minimal weight across most zones, indicating that cell-level predictions already capture most of the predictive signal at 1km resolution. The CNN architecture remains as an active pipeline component; future work on higher-resolution inputs and training may unlock additional ensemble value.

FORECAST ENGINE

FORECAST ENGINE rolls FWI moisture codes forward day-by-day using NWP weather, builds the full feature matrix for each lead day, and applies the XGBoost model to produce multi-day risk trajectories. A confidence decay factor (default 0.95 per lead day) attenuates predictions at longer lead times. Forecast weather is bilinearly interpolated from the native NWP grid to the prediction grid.

REST API

REST API serves pre-computed daily predictions and multi-day forecasts via a FastAPI application. Consumers can query fire risk by geographic coordinates, grid cell identifiers, or bounding boxes, receiving JSON responses containing occurrence probabilities, danger classifications, contributing factor breakdowns, and up to 10 days of forecast trajectories with per-day confidence scores and data source attribution (HRDPS or GDPS).

The full pipeline executes daily at 14:00 Pacific Time, after noon weather observations have been incorporated into data feeds. The daily pipeline produces current-day predictions; the forecast pipeline runs immediately

afterward, generating multi-day risk trajectories for all grid cells.

Risk Scoring Methodology

INFERNIS assigns each grid cell a composite risk score mapped to a six-level danger classification system: VERY_LOW, LOW, MODERATE, HIGH, VERY_HIGH, and EXTREME. This classification aligns with the familiar CFFDRS danger scale while incorporating ML-derived probability refinement.

Raw model outputs undergo probability calibration via Platt scaling (logistic regression on a held-out calibration set) to ensure that a predicted probability of 0.30 corresponds to an actual observed fire frequency of approximately 30% in similar conditions. This calibration is performed independently for each BEC zone to account for the dramatically different baseline fire rates across the province – the Coastal Western Hemlock zone has a fundamentally different fire regime than the Interior Douglas-fir or Boreal White and Black Spruce zones.

Danger class thresholds are set to optimize the tradeoff between false alarm rate and detection probability, with higher sensitivity in zones protecting communities and critical infrastructure.

LEVEL	SCORE RANGE	DESCRIPTION
VERY LOW	0.00 – 0.05	Negligible risk. Wet or snow-covered conditions.
LOW	0.05 – 0.15	Minor risk. Fires unlikely under current conditions.
MODERATE	0.15 – 0.35	Elevated. Fires possible with an ignition source.
HIGH	0.35 – 0.60	Significant. Fires likely to spread if ignited.
VERY HIGH	0.60 – 0.80	Severe. Aggressive fire behavior expected.
EXTREME	0.80 – 1.00	Critical. Explosive fire growth potential.

Use Cases

Government and Fire Services

Pre-positioning suppression crews and equipment based on next-day risk predictions. Proactive evacuation planning for communities in forecast high-risk zones. Optimized allocation of limited aerial suppression resources across multiple simultaneous fire starts.

Insurance

Wildfire risk underwriting at the property level, informed by location-specific historical and predicted fire probability. Portfolio exposure analysis across insured properties in BC. Dynamic risk assessment for parametric wildfire insurance products.

Utilities

BC Hydro transmission corridor risk assessment for preventive de-energization decisions. Vegetation management prioritization along power line rights-of-way. Infrastructure hardening investment planning based on long-term risk trends.

Forestry

Harvest scheduling that accounts for predicted fire risk windows. Fire guard construction and maintenance prioritization. Reforestation site selection informed by projected fire frequency.

Public and Developers

Community-level fire risk dashboards for municipal governments. Fire risk data layers for weather applications and outdoor recreation platforms. Integration into mapping tools and real-time alerting systems.

Competitive Landscape

SYSTEM	COVERAGE	RESOLUTION	ML-ENHANCED	FORECAST	API ACCESS	BC-OPTIMIZED
CWFIS	Canada	Station-based	No	Yes (FWI/FBP)	OGC GIS (GeoJSON via WFS)	No
Technosylva	Global (ent.)	High	Yes	Yes	Enterprise only	No
Ambee Wildfire	N. America	500m–1km	Yes	4-week	Yes	No
AISIX Wildfire 3.0	Canada	Property	Yes	Climate proj.	Yes	No (national)
OpenWeatherMap	Global	500m–2km	No (FWI)	No	Yes (REST/JSON)	No
INFERNIS	BC	5km / 1km	Yes	10-day	Yes (REST/JSON)	Yes

The Canadian Wildland Fire Information System (CWFIS) is the incumbent government system. It is scientifically authoritative, publishes gridded FWI maps and multi-day fire danger products, and exposes data layers via OGC web services (WMS/WFS/WCS) that support GeoJSON output. However, it is not ML-enhanced and does not provide a purpose-built developer REST API with documentation, authentication, or onboarding. Technosylva's Wildfire Analyst is a sophisticated enterprise platform used by fire agencies across 9 countries including Canada, but it carries significant licensing costs and is not calibrated to BC's biogeoclimatic zones. Ambee provides wildfire risk forecasts for North America but without regional calibration. AISIX Solutions (Vancouver) offers a Wildfire 3.0 API focused on long-term climate-projection risk, serving a different use case than daily operational prediction. OpenWeatherMap provides a global FWI-based Fire Index API without ML enhancement or regional calibration.

INFERNIS occupies a distinct position: it is the only system offering daily operational fire occurrence prediction with per-BEC-zone calibration specifically for British Columbia, ML-enhanced prediction built on the FWI scientific foundation, exclusive use of open data sources, and a REST/JSON API designed for diverse consumers from government agencies to mobile application developers.

Roadmap

Phase 1 – MVP (Complete)

XGBoost occurrence prediction on a 5km grid covering 84,535 cells across all of British Columbia. 24-feature model trained on 10 years of data. Core REST API with geographic query support. Firebase-authenticated self-service dashboard with API key provisioning, usage tracking, and tiered access. Automated daily prediction pipeline from data ingestion through model inference to API delivery.

Phase 2 – Spatial Intelligence (Complete)

FireUNet CNN generating continuous spatial risk heatmaps. Per-BEC-zone calibration via logistic regression across all 14 zones. Risk Fuser ensemble combining XGBoost and CNN outputs in logit space. Feature set expanded from 24 to 28 features with four-depth soil moisture, LAI, and distance-to-road.

Phase 3 – High Resolution & Forecasting (Complete)

1km grid (2,113,524 cells) with vectorized BEC zone assignment. Multi-day forecast pipeline (HRDPS + GDPS) with FWI roll-forward and confidence decay. Vectorized data processing for efficient computation at 2M-cell scale. Walk-forward historical backtesting framework with temporal cross-validation and per-BEC-zone breakdowns. End-to-end 1km retraining pipeline.

Technical Specifications

COMPONENT	TECHNOLOGY
Language	Python 3.11+
API Framework	FastAPI
Primary ML Model	XGBoost
Spatial ML Model	PyTorch (U-Net)
Database	PostgreSQL 16+ with PostGIS 3.4
Cache Layer	Redis
Satellite Data Access	Google Earth Engine
Deployment	Railway
Grid Resolution	5km (84K cells, hosted API), 1km (2.1M cells, self-hosted / custom)
Grid Coverage	2,113,524 cells at 1km; 84,535 cells at 5km
Forecast Horizon	Up to 10 days (HRDPS days 1–2, GDPS days 3–10)
Backtesting	Walk-forward temporal CV (AUC 0.90–0.93), per-BEC-zone breakdowns
Training Corpus	298,606 labeled samples (10:1 neg:pos ratio), 2015–2024
Model Features	28 (6 FWI + 10 weather + 3 vegetation + 5 topo/infrastructure + 2 temporal + 2 lightning)
CNN Architecture	FireUNet, 12 input channels, ~31M parameters, 256x512 raster, AUC 0.815
Regional Calibration	Per-BEC-zone logistic regression across 14 zones
XGBoost AUC-ROC	0.974
Average Precision	0.794
Brier Score	0.036
Authentication	Firebase Auth (Google + email/password)
Prediction Frequency	Daily at 14:00 PT + 10-day forecast
API Format	REST/JSON

Limitations and Uncertainties

INFERNIS is a research-grade system transitioning toward operational deployment. The following limitations should inform interpretation of its outputs and assessment of its current capabilities.

Spatial Resolution vs. Input Resolution

INFERNIS produces predictions at 1km grid resolution, but several key input variables originate at coarser native resolutions. ERA5 reanalysis weather data is natively ~31km; ERA5-Land soil moisture is ~9km. These are bilinearly interpolated to the 1km prediction grid, meaning neighboring cells share substantially similar weather and moisture inputs. The 1km resolution is genuine for topographic features (CDEM at ~23m), road distance, and the prediction grid itself, but weather-driven features do not carry independent information at the 1km scale. Users should interpret the 1km output as topographically and vegetatively refined risk estimates built on ~10–30km weather inputs, not as independently measured conditions at each kilometer.

Ensemble Weighting

In current calibration on the 1km grid, the CNN receives near-zero weight across all 14 BEC zones – the ensemble is effectively XGBoost-only. The CNN architecture remains in the pipeline and may provide additional value with higher-resolution spatial inputs, more expressive training, or alternative fusion strategies.

Label Definition

Positive labels are derived from historical fire records (CNFDB point-of-origin and BC Wildfire perimeters), assigned to the nearest grid cell. Small fires (<4 hectares) are underrepresented in the historical record, and reporting consistency varies across regions and decades. The 10:1 negative sampling ratio means the training distribution differs from the true base rate of fire occurrence (approximately 0.01–0.1% of cells on any given day), and calibrated probabilities should be interpreted accordingly.

Operational Calibration

Cross-validated AUC-ROC and walk-forward backtest AUC measure discrimination – the model's ability to rank fire-prone cells above non-fire cells. They do not directly measure calibration accuracy at the extreme low base rates encountered operationally. Brier scores can be dominated by the large number of true negatives. Reliability at operational decision thresholds (e.g., the top 1% of predictions) should be evaluated with additional metrics before deployment in safety-critical applications.

Smoke and Extreme Events

Model performance during active large fire events – when smoke significantly degrades satellite imagery quality (NDVI, LAI) and atmospheric conditions deviate from reanalysis assumptions – has not been independently evaluated. The 2023 season is included in the training data, providing some exposure to extreme conditions, but systematic evaluation of prediction quality under heavy smoke is an area for future work.

Data Licensing

Google Earth Engine is currently used under its non-commercial license for satellite data access. This is appropriate for research and open-source development but must be upgraded to a commercial license before

INFERNIS generates revenue from API access. ERA5, CNFDB, CDEM, and other government data sources are freely available for commercial use.

Conclusion

Wildfire management in British Columbia stands at an inflection point. The old paradigm – reactive response guided by station-interpolated danger ratings – was built for a climate and a landscape that no longer exist. The 2023 season, which burned 2.84 million hectares in BC alone – more than the previous two record-setting years combined – demonstrated that the frequency and intensity of BC wildfires have moved beyond the envelope that legacy systems were designed to handle.

INFERNIS represents the next generation of wildfire prediction: machine learning models trained on the richest open data ecosystem in the world, validated against peer-reviewed research, calibrated to the specific biogeoclimatic diversity of British Columbia, and delivered through a modern API architecture designed for integration into the systems that governments, insurers, utilities, and communities depend on.

Canada is among the world's leaders in open environmental data publication. ERA5 reanalysis provides gap-free gridded weather back to 1940. The CNFDB catalogs decades of fire history. MODIS and Sentinel-2 observe the province daily from orbit. This data exists. The science to turn it into predictions has been published and validated. What has been missing is an engineered system that assembles these inputs, applies modern ML, and delivers actionable intelligence to the people and organizations who need it.

INFERNIS is that system – built on open data, validated through rigorous backtesting, and delivered as a modern API. Intelligence forged in fire.

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Intelligence forged in fire.

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