

Advancements in GIS-based fire modeling applications



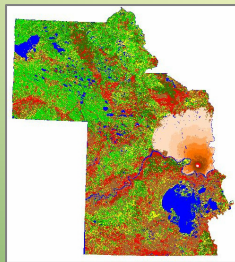
Advanced fire modeling applications
Advanced fire modeling applications



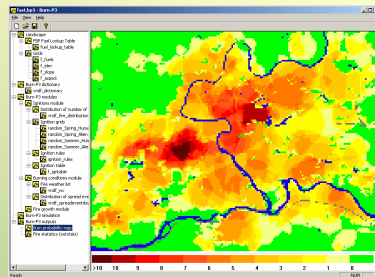


Fire Information Systems

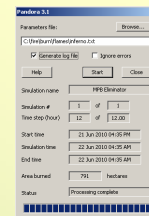
- Fire growth modelling (PFAS, Burn-P3, Pandora, Pegasus, Bigfoot)
- Fire danger mapping (SFMS)



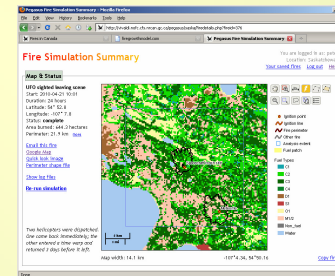
PFAS



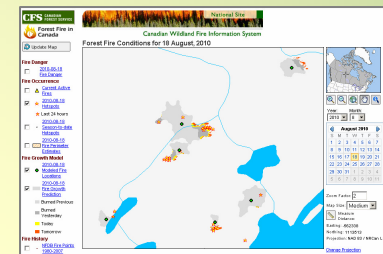
Burn-P3



Pandora



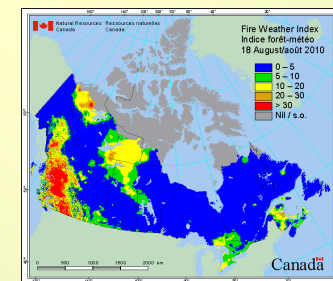
Pegasus



Bigfoot

CFS Fire Information Systems group:

Kerry Anderson, Richard Carr, Peter Englefield,
John Little, Marc Parisien, Rod Suddaby



SFMS



Fire Growth Modelling

- Long-range / probabilistic (PFAS)
- Burn probability (Burn-P3)
- Batch / no user interface (Pandora)
- Simple / on the web (Pegasus)
- Automated (Bigfoot)



Fire Growth Modelling Applications



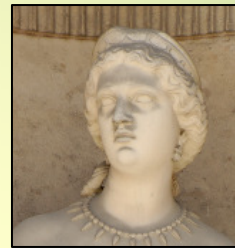
Prometheus



Pegasus



Bigfoot



Pandora



PFAS



Burn-P3

Short range

Tactical

Operational

Deterministic

Long range

Strategic

Planning

Probabilistic



Prometheus - Dogrib-1.fgm

[FBP Fuel: Scenario1] Project: Dogrib-1.fgm

[Clock: Scenari...]

[Wind Vector...]

fast.bp

Pegasus Fire Simulation Summary - Mozilla Firefox

http://vivaldi.nofc.cfs.nrcan.gc.ca/pegasus/saska/firedetails.php?fireid=376

Fires in Canada firegrowthmodel.com Pegasus Fire Simulation Summary

Fire Simulation Summary

You are logged in as: peter
Location: Saskatchewan
[Your saved fires](#) [Log out](#) [Help](#)

Map & Status

UFO sighted leaving scene
Start: 2010-04-21 10:01
Duration: 24 hours
Latitude: 54° 52.8
Longitude: -107° 7.8
Status: **complete**
Area burned: 644.3 hectares
Perimeter: 21.9 km [more](#)

[Email this fire](#)
[Google Map](#)
[Quick look image](#)
[Perimeter shape file](#)

[Show log files](#)

[Re-run simulation](#)

Two helicopters were dispatched. One came back immediately; the other entered a time warp and returned 3 days before it left.

Map width: 14.1 km -107°4.34, 54°50.16 [Copy fire](#)

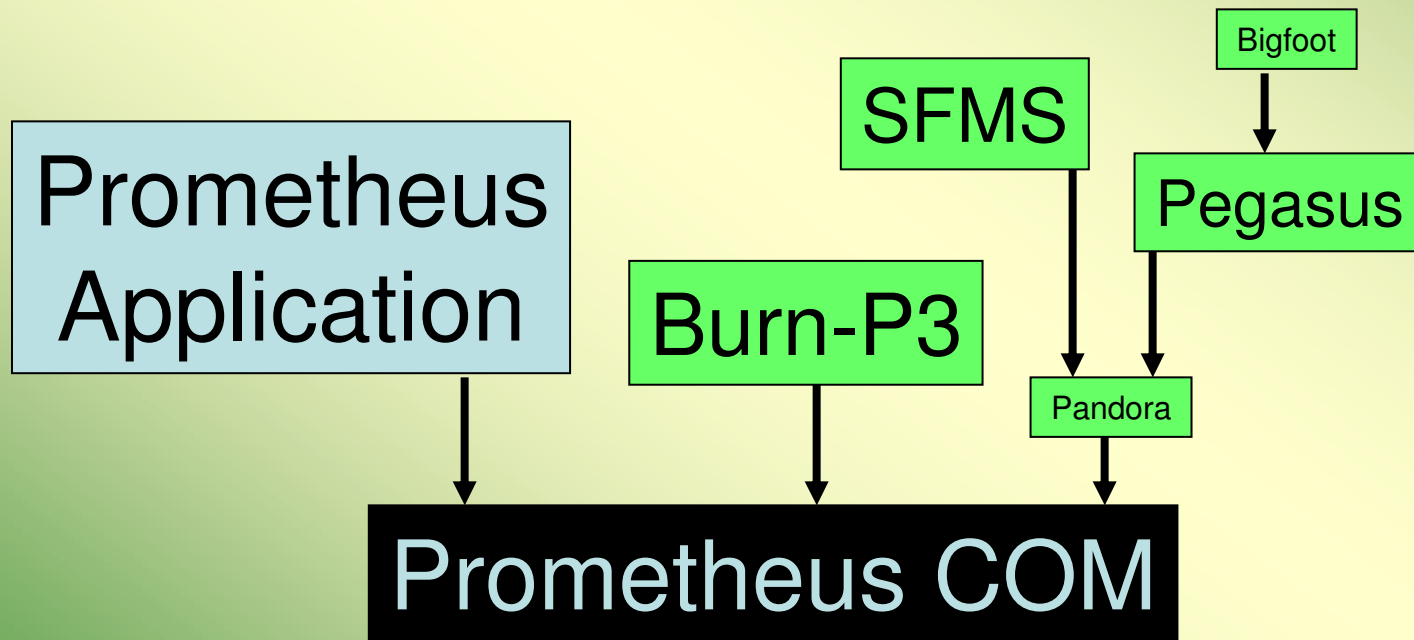
- Ignition point
- Ignition line
- Fire perimeter
- Other fire
- Analysis extent
- Fuel patch

Fuel Types

- C1
- C2
- C3
- C4
- D1
- S1
- O1
- M1/2
- Non_fuel
- Water



Prometheus Applications





Pandora

Accessing Prometheus through the back door

- "Batch Prometheus"
- Run one or many simulations sequentially
- All input parameters specified in text file
- Minimal user interface (optional)
- Help file
- Progress window displays status, simulation time, and area burned

Pandora

Parameters file:

Generate log file Ignore errors

Simulation name:

Simulation #: of

Time step (hour): of

Start time:

Simulation time:

End time:

Area burned: hectares

Status:

Pandora Help

File Edit Bookmark Options Help

Contents Index Back Print

Pandora
A Prometheus Batch Tool

[About Pandora](#)
[Input File Specifications](#)
[Starting Pandora](#)
[Sample Input File](#)



Pegasus

- "Prometheus on the web"
- Minimal set of input parameters

New Fire

| | | |
|--|---|---------------------|
| Fire Name: <input type="text" value="Paul started this one"/> | Latitude: <input type="text" value="54.88"/> | Easting: 425715 m |
| Start date and time: <input type="text" value="2008-07-17 13:06"/> | Longitude: <input type="text" value="-107.13"/> | Northing: 5970545 m |
| Duration of Simulation (hours): <input type="text" value="12"/> | Extent (km): <input type="text" value="10"/> | |

- Data stored and prepared by server
- No client-side data or software needed
- User can modify weather, fuels, ignitions
- Simulations done on server via Pandora
- Fire perimeter displayed using map server
- Developed in collaboration with Saskatchewan FMFP



Pegasus

Prometheus on the web

Pegasus Fire Simulation Summary - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://vivaldi.nofc.cfs.nrcan.gc.ca/pegasus/saska/firedetails.php?fireid=376

Fires in Canada firegrowthmodel.com Pegasus Fire Simulation Summary

Fire Simulation Summary

You are logged in as: peter
Location: Saskatchewan
[Your saved fires](#) [Log out](#) [Help](#)

Map & Status

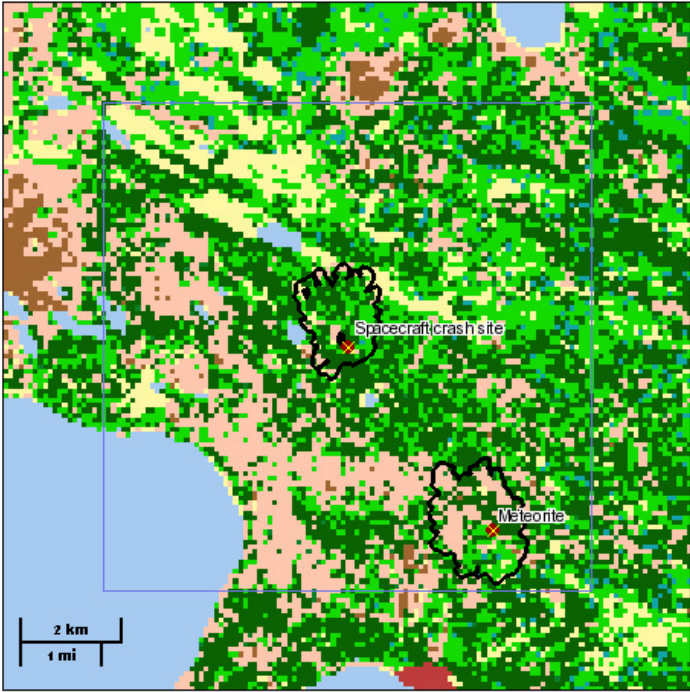
UFO sighted leaving scene
Start: 2010-04-21 10:01
Duration: 24 hours
Latitude: 54° 52.8
Longitude: -107° 7.8
Status: **complete**
Area burned: 644.3 hectares
Perimeter: 21.9 km [more](#)

[Email this fire](#)
[Google Map](#)
[Quick look image](#)
[Perimeter shape file](#)

[Show log files](#)

[Re-run simulation](#)

Two helicopters were dispatched. One came back immediately; the other entered a time warp and returned 3 days before it left.



Map width: 14.1 km -107°4.34, 54°50.16 [Copy fire](#)

Legend:


- Ignition point
- Ignition line
- Fire perimeter
- Other fire
- Analysis extent
- Fuel patch

Fuel Types:

- C1
- C2
- C3
- C4
- D1
- S1
- O1
- M1/2
- Non_fuel
- Water



Bigfoot



Forest Fire in Canada

Update Map

Fire Danger

[2010-08-18 Fire Danger](#)

Fire Occurrence

[Season-to-date Hotspots](#)

[2010-08-18 Fire Perimeter Estimates](#)

Fire Growth Model

[2010-08-18 Modeled Fire Locations](#)

[2010-08-18 Fire Growth Prediction](#)

Burned Previous


Burned Yesterday

Today

Tomorrow

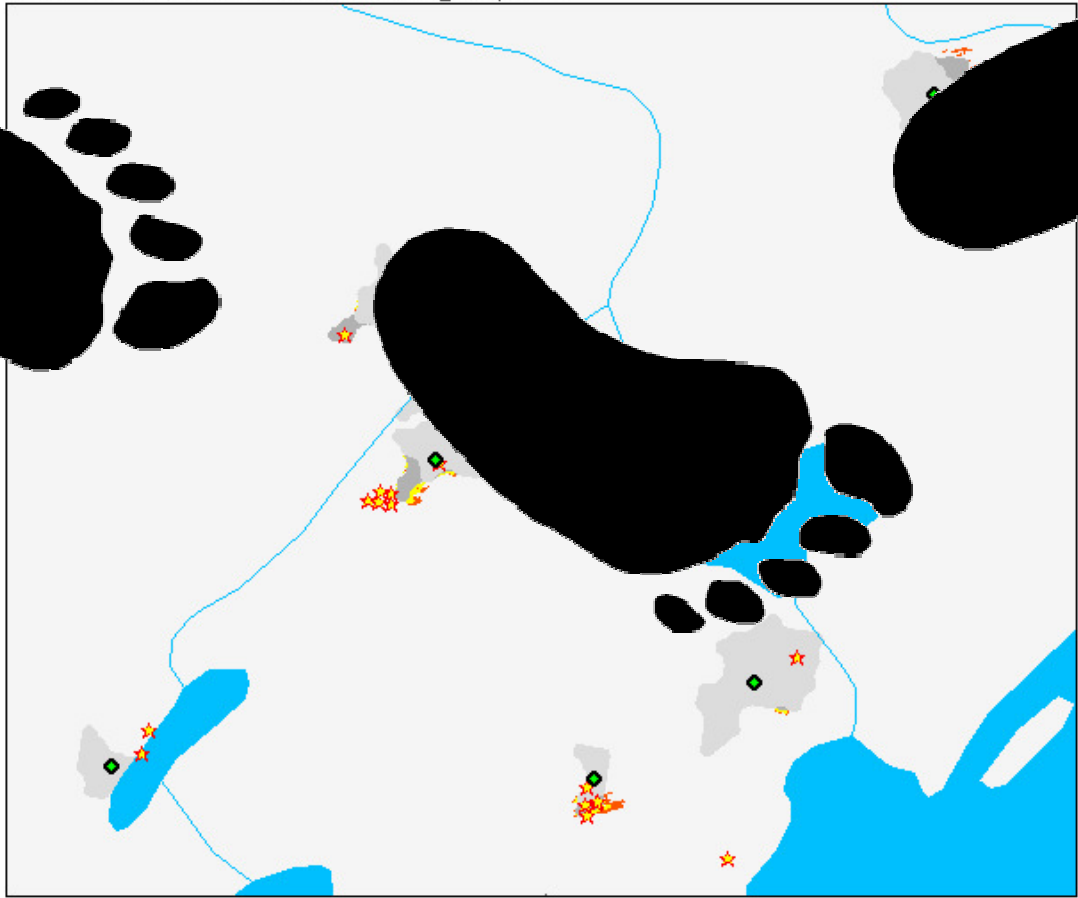
Fire History

[NFDB Fire Points 1980-2007](#)



Canadian Wildland Fire Information System

Forest Fire Conditions for 18 August, 2010



Year: 2010 Month: 8

| August 2010 | | | | | | |
|-------------|----|----|----|----|----|----|
| S | M | T | W | T | F | S |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | 31 | 1 | 2 | 3 | 4 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Zoom Factor: 2

Map Size: Medium

Measure Distance:

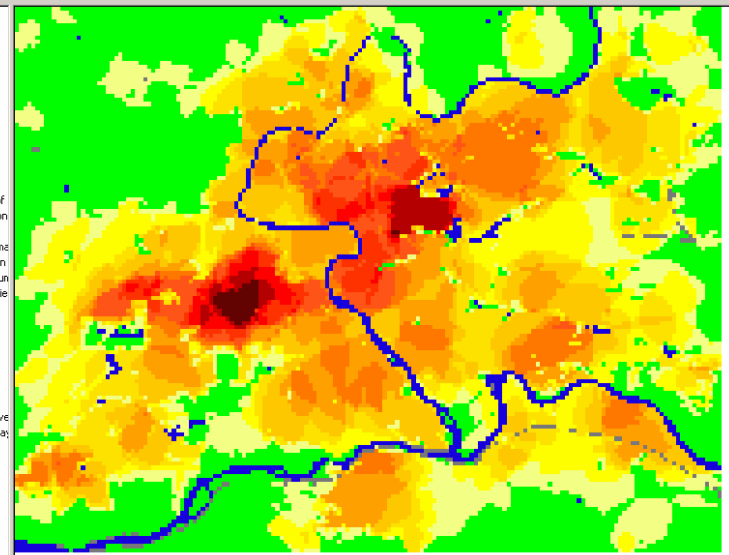
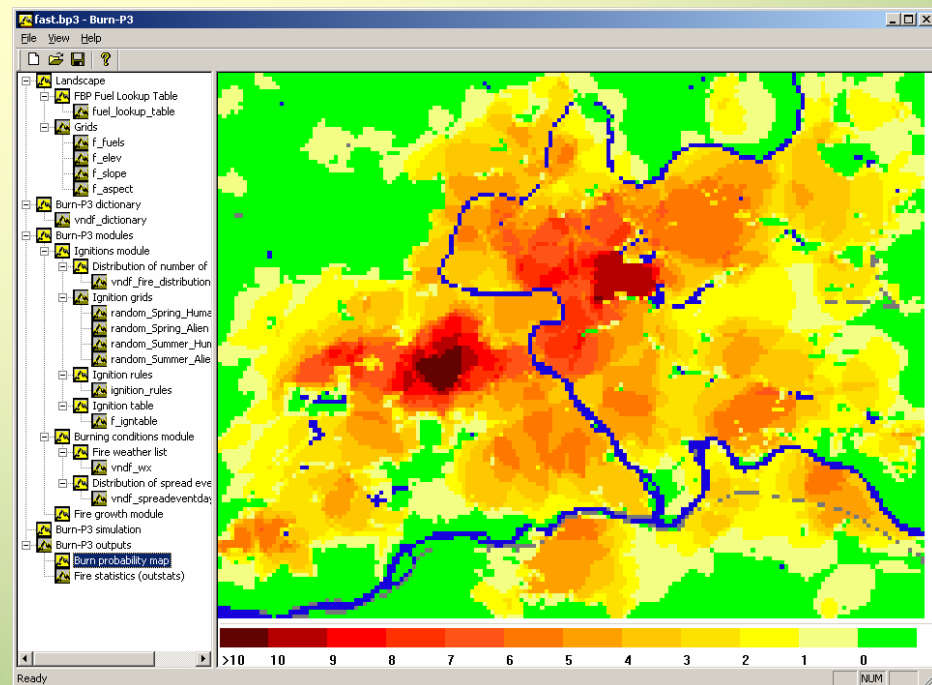
Easting: -562338
 Northing: 1113513
 Projection: NAD 83 / NRCan LCC

[Change Projection](#)



Burn-P3

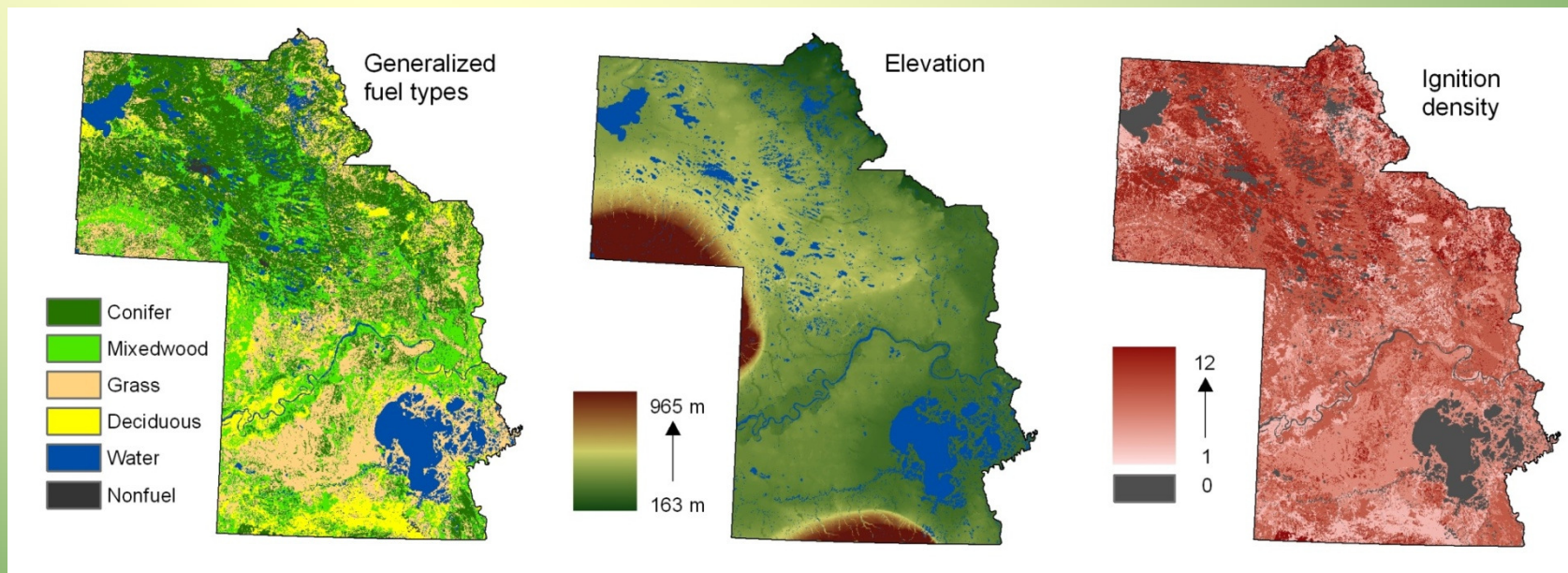
- Burn Probability, Prediction, and Planning
- Multiple simulations
- Ignition and weather based on historical data
- Prometheus COM





Burn-P3 fire simulation modeling inputs

Wood Buffalo National Park



Spatial inputs:

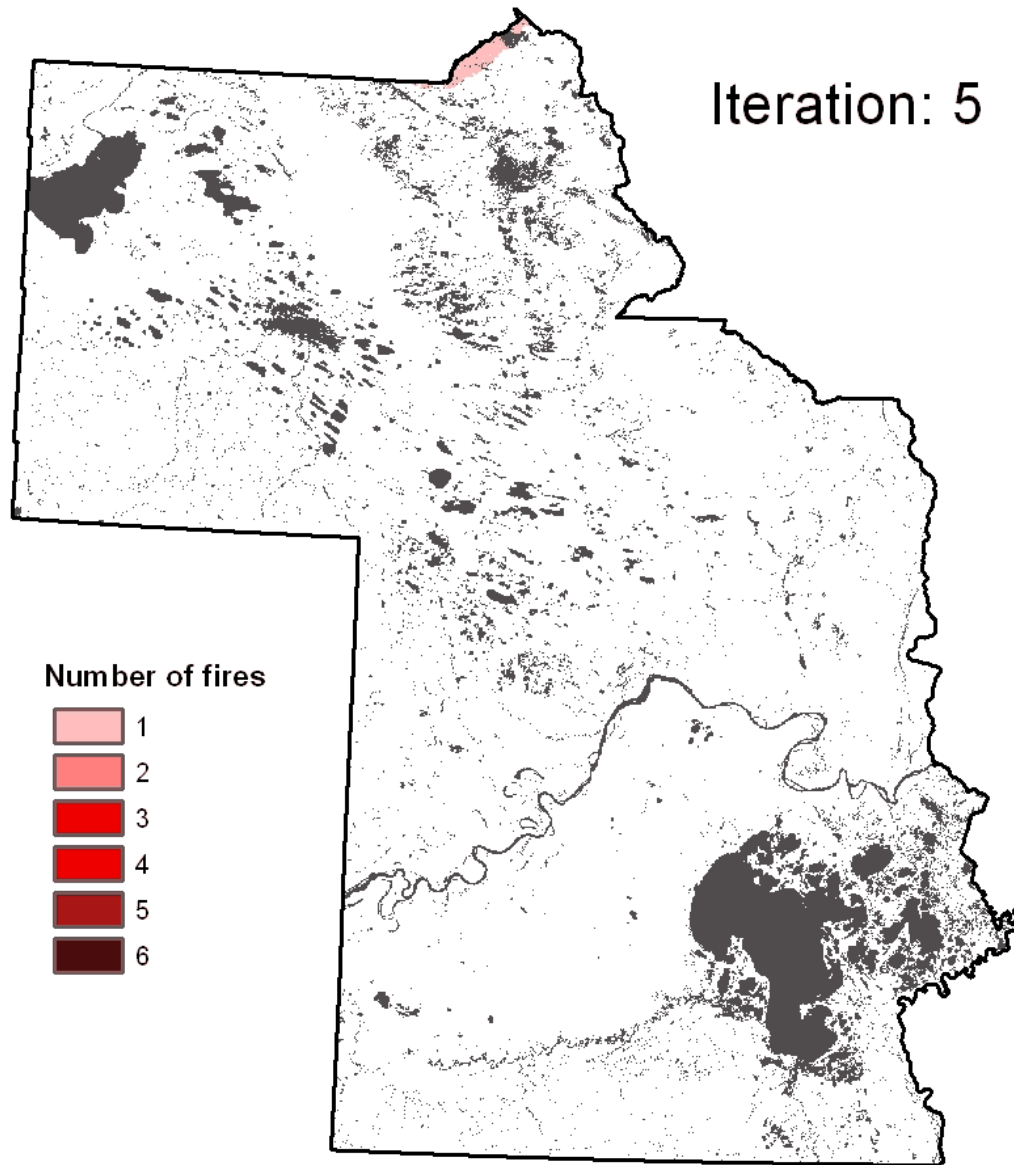
- Fuels
- Topography
- Ignition patterns

Non-spatial inputs:

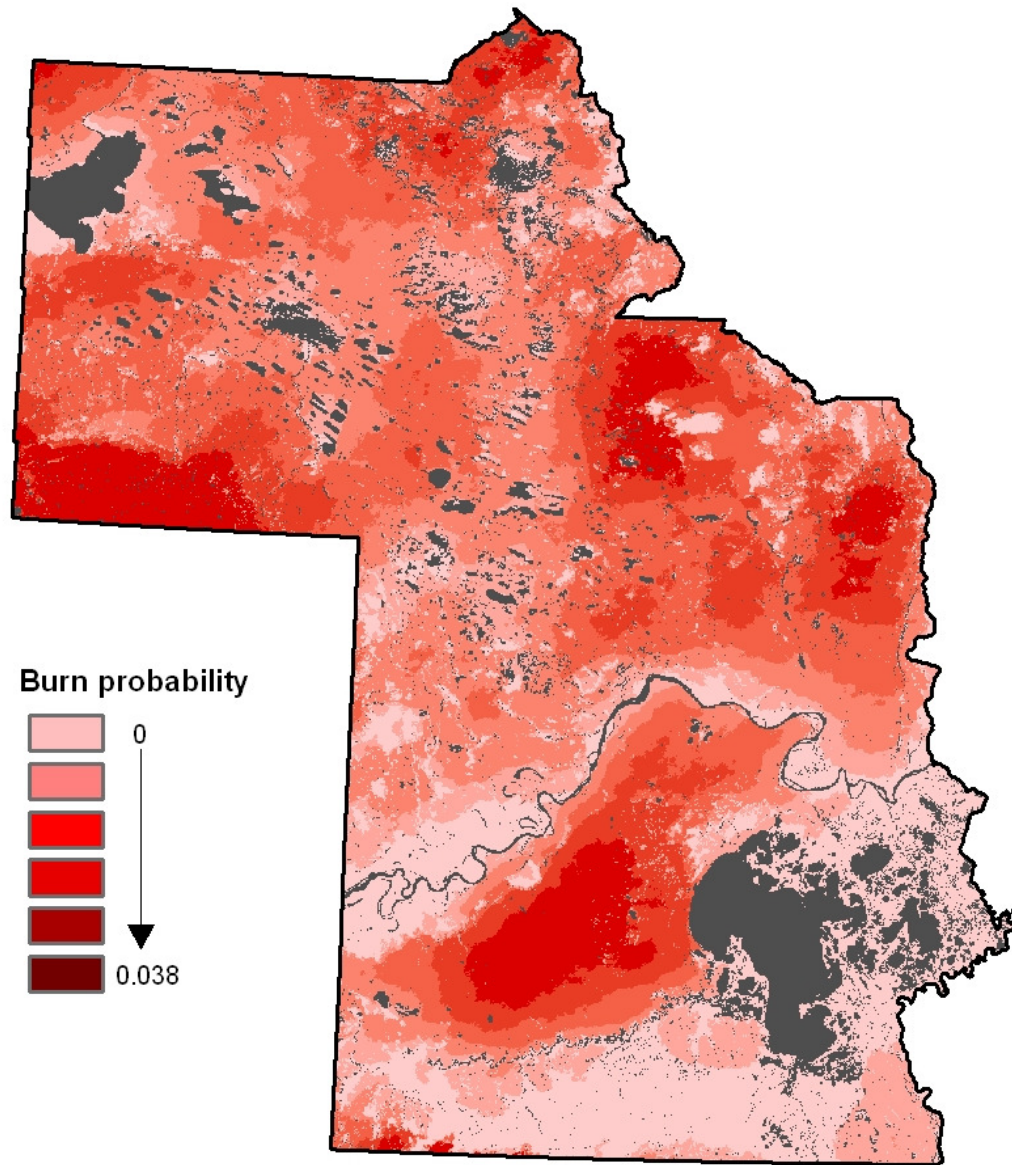
- Number of fires per year
- Weather conditions
- Duration of burning

Burn-P3

Iteration: 5



Burn-P3

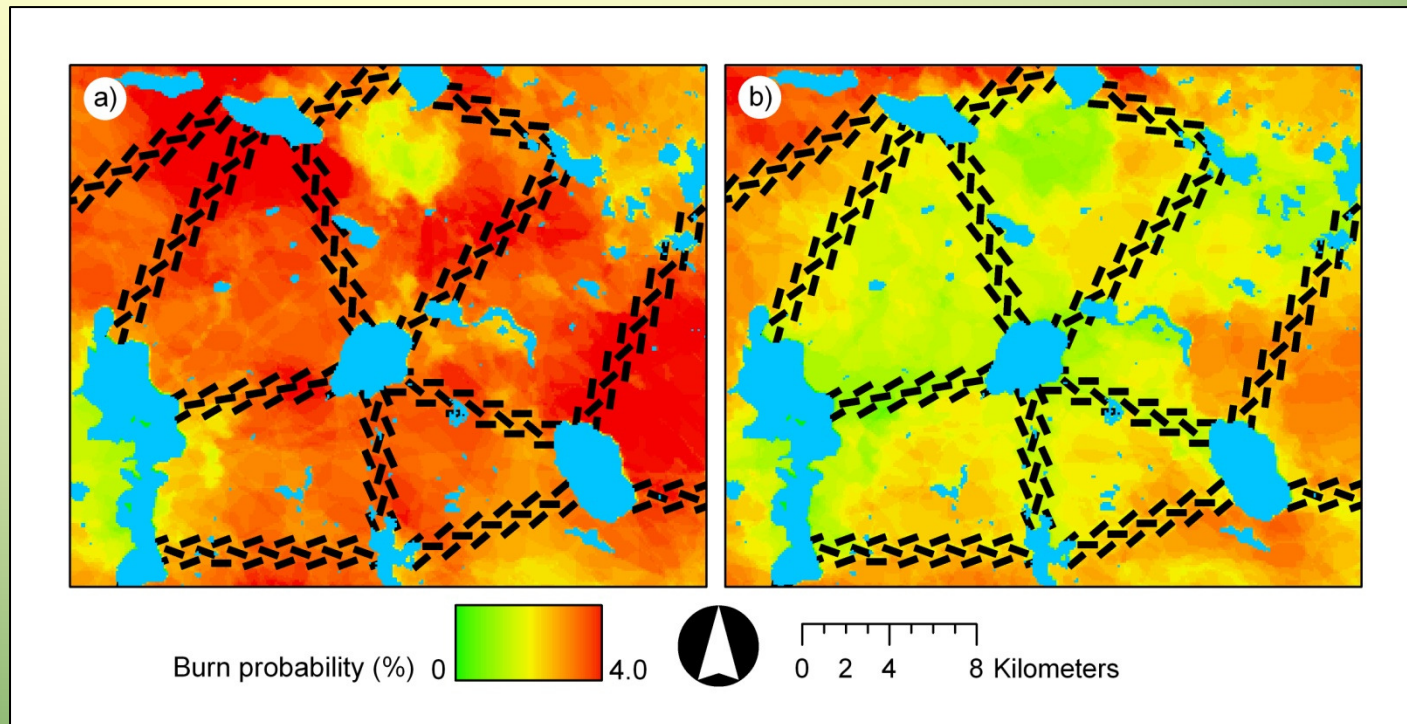




Evaluating fuel treatment effectiveness

Untreated landscape

Treated landscape

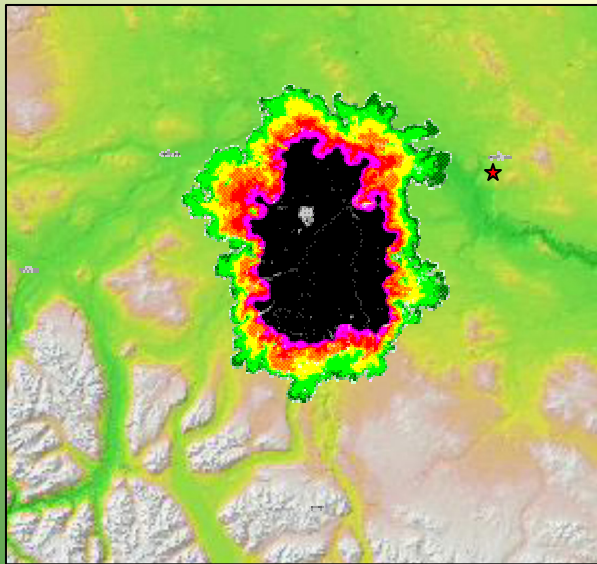


Parisien et al. (2007, Int. J. Wildland Fire)

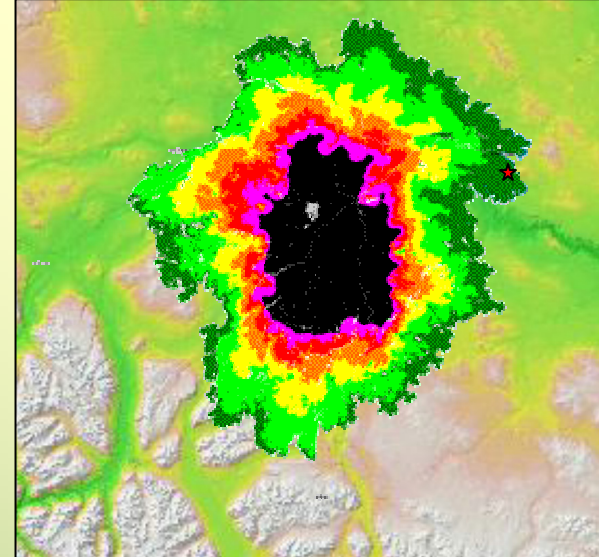


PFAS

- Prescribed Fire Analysis System
- Long-range forecast (weeks / months)
- Climatology input
- Probabilistic output



15 day

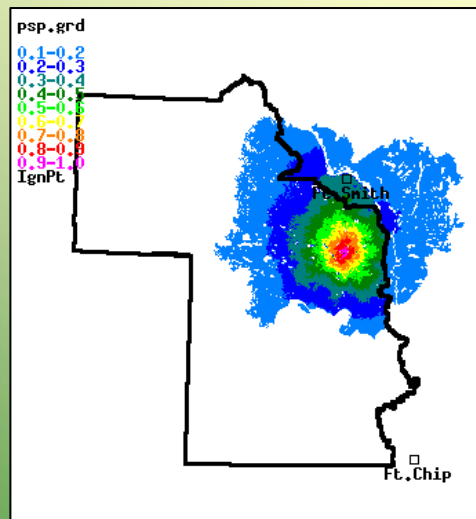


30 day

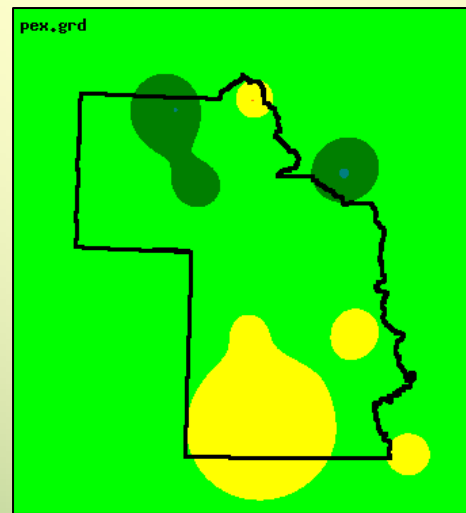


PFAS

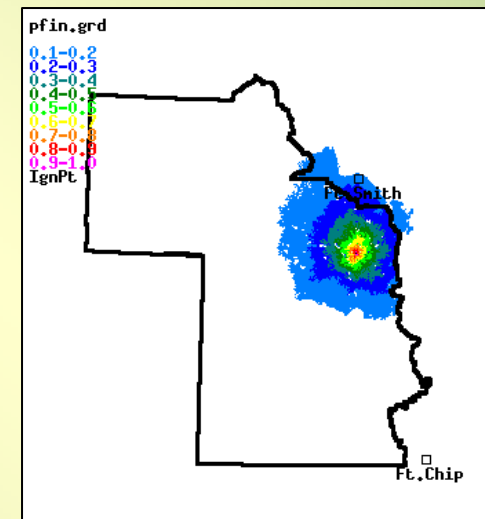
The model calculates the probabilities of spread and of survival for each grid cell based on historical weather and multiplies them to produce the probable fire extent map.



Probability of Spread



Probability of Survival



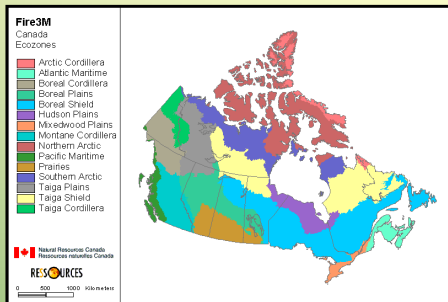
Probable Extent

Spatial Fire Management System





What is SFMS?



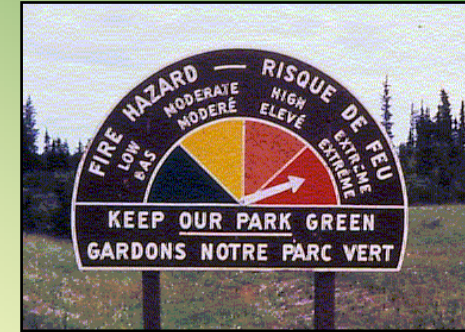
- Fire information analysis and display software
- Incorporates fire science models (CFFDRS)
- Runs on GIS platform (ArcView 3.x)
- Now being re-developed as a stand-alone application

POWERED BY
SFMS



Modules

- Weather (WX)
- Fire Weather Index (FWI)
- Fire Behaviour Prediction (FBP)
- Optimal Resource Allocation & Prepositioning (ORAP)
- Wildfire Threat Rating (WTR)
- Fire Occurrence Prediction (FOP)
- Fire Growth Modelling (FGM)

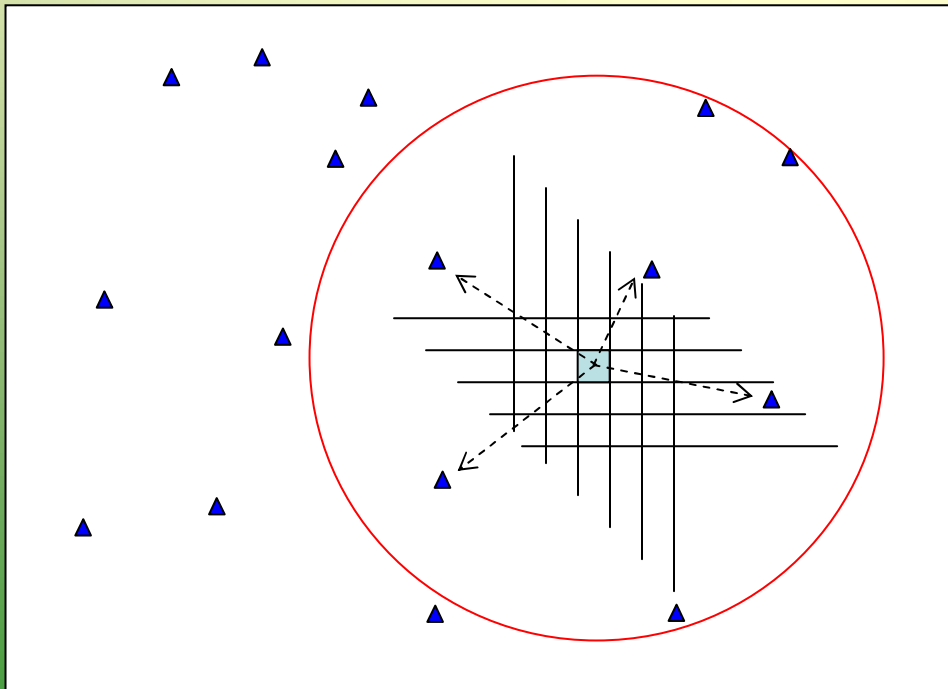


POWERED BY
SFMS



Interpolation Options

- Inverse Distance Weighting (IDW)
- Kriging
- Thin plate smoothing spline (Anusplin)



SFMS Interpolation Settings

Interpolation method: **SFMS**

IDW Kriging Anusplin

Exponent for IDW:

Kriging method:

Search distance:

Fixed Variable

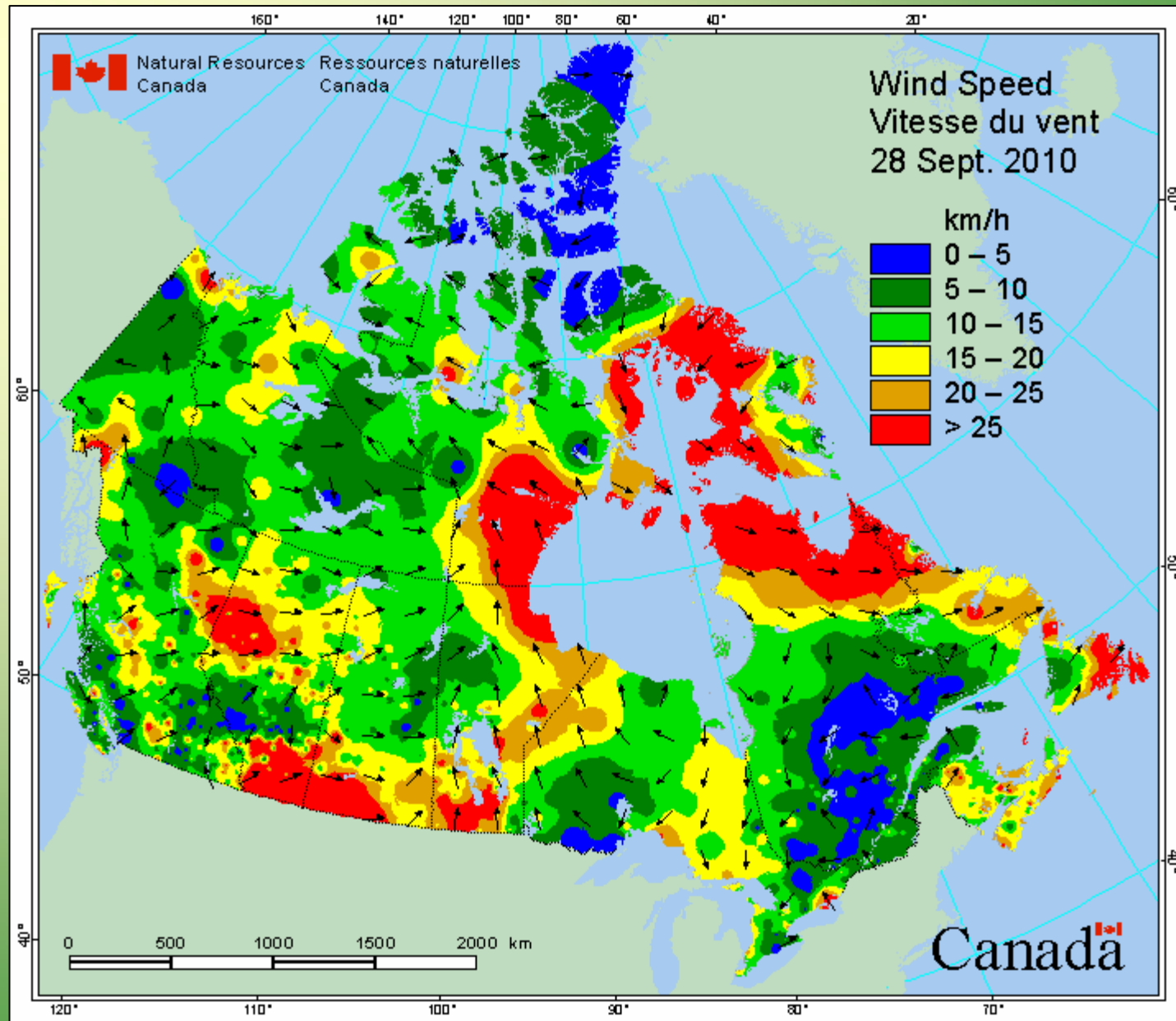
Maximum search distance (m):

Fixed number of stations:

for Anusplin

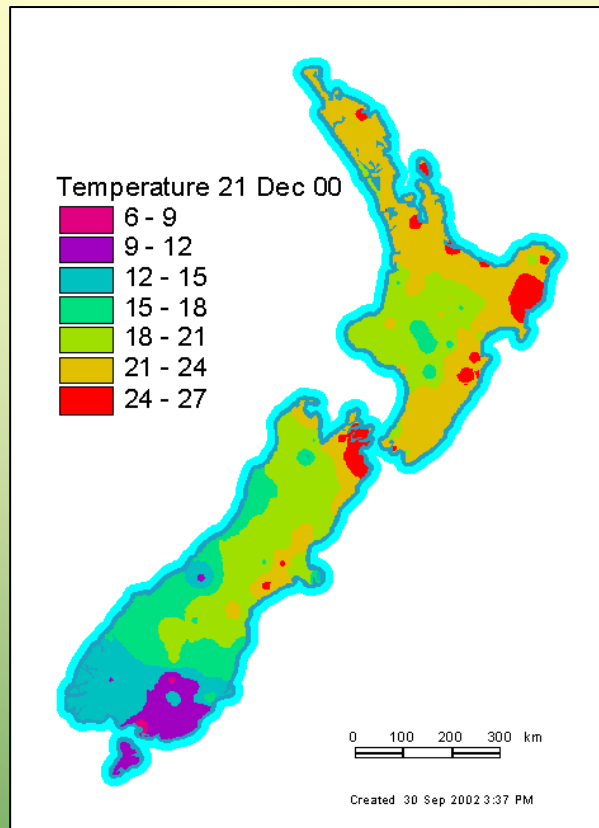
Expand sampling extents

F1=Help

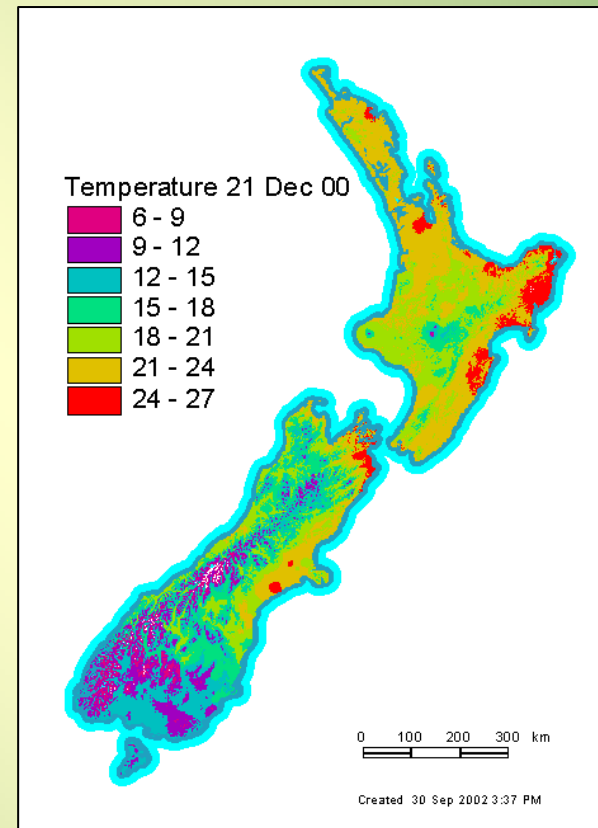




Elevation adjustment



Inverse Distance
Weighting (IDW)



IDW with elevation
adjustment



Fire Climatology

Fire Climatology Grid Builder

Start year: End year:

Component(s):
Fine Fuel Moisture Code
Duff Moisture Code
Drought Code
Initial Spread Index
Buildup Index
Fire Weather Index
DSR

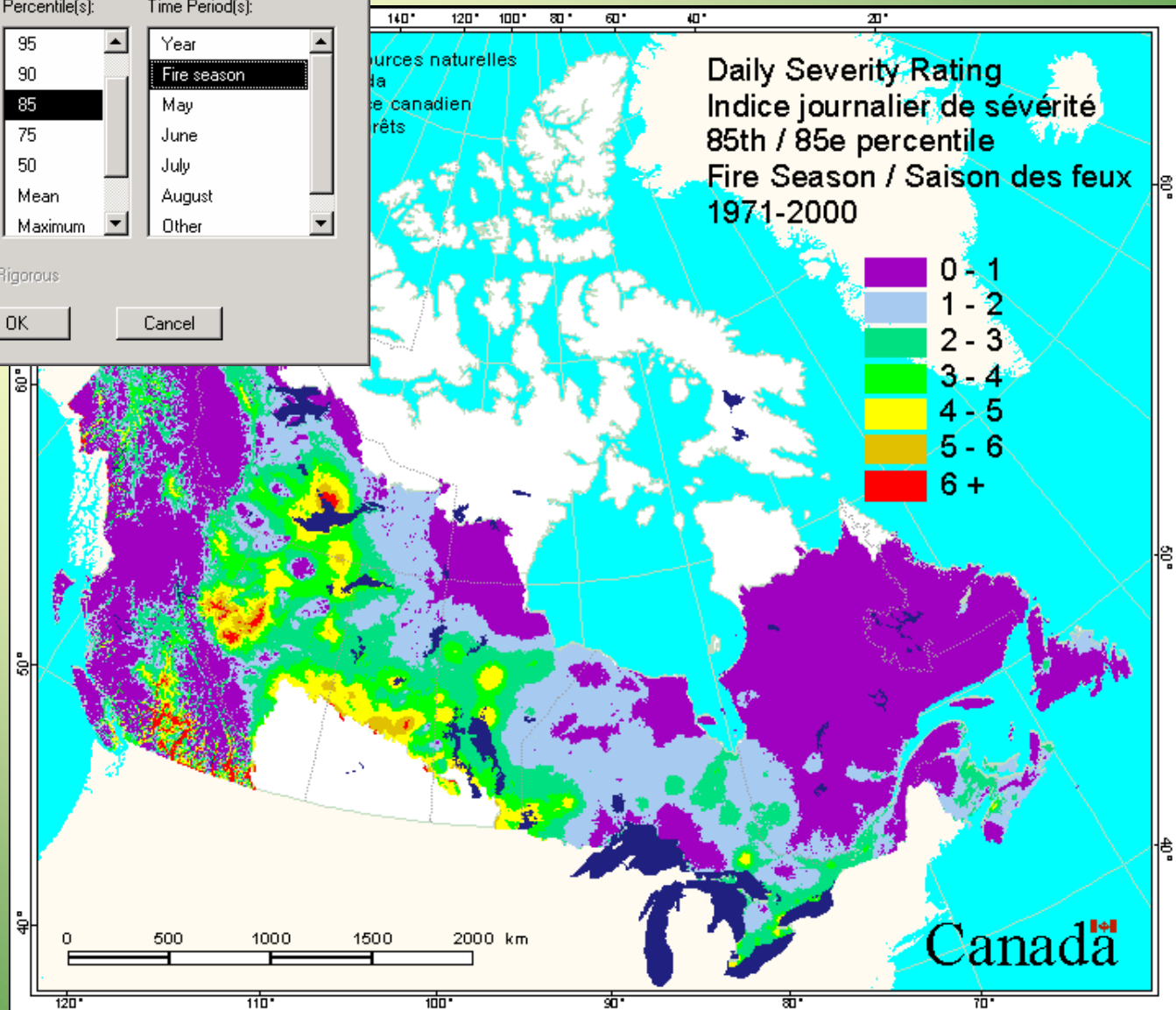
Percentile(s):
95
90
85
75
50
Mean
Maximum

Time Period(s):
Year
Fire season
May
June
July
August
Other

Interpolate Rigorous

SPMS
F1=Help

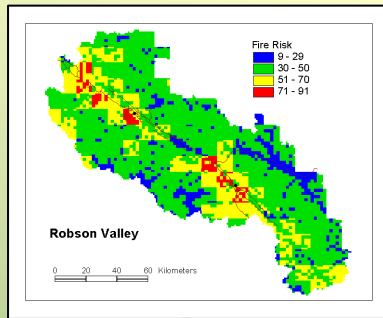
OK Cancel



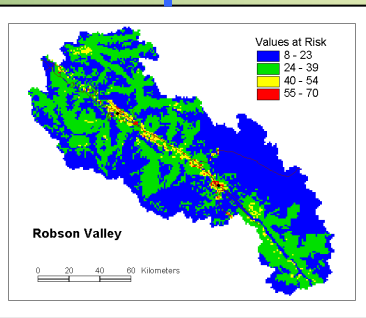
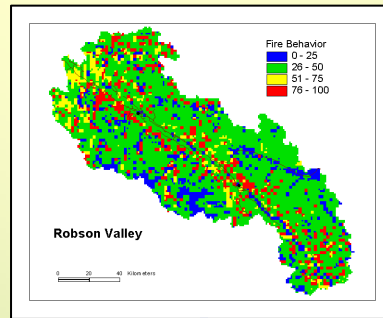


Wildfire Threat Rating

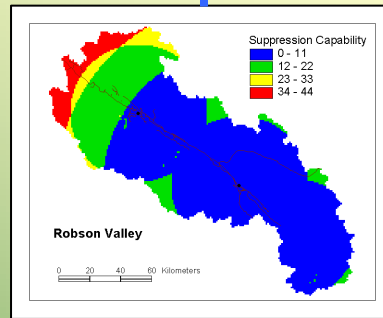
Fire Risk



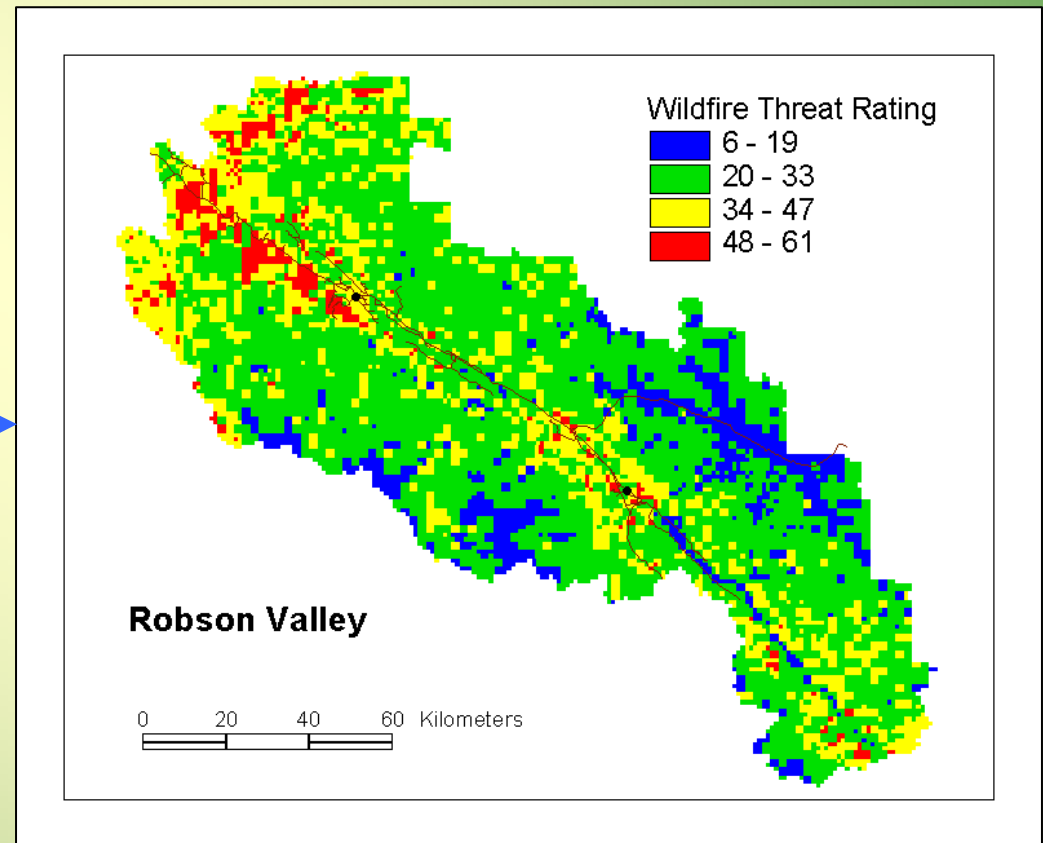
Fire Behavior



Values at Risk



Suppression Capability





Saskatchewan Primary Protection Zone

Deployment 3

- ▲ Manned
- ▲ Unmanned

Rivers

Cities

-

Initial Attack Bases

Regions

-

Weather Stations

Roads

Lakes

Coverage Assessment

- Not covered
- Partially covered
- Covered
- Exceeds req.
- Non fuel

Fuelsnorth

Deployment 3: Meadow L

| Aircraft | Status |
|------------------------|-----------|
| Bell 206LI Long Ranger | Red alert |

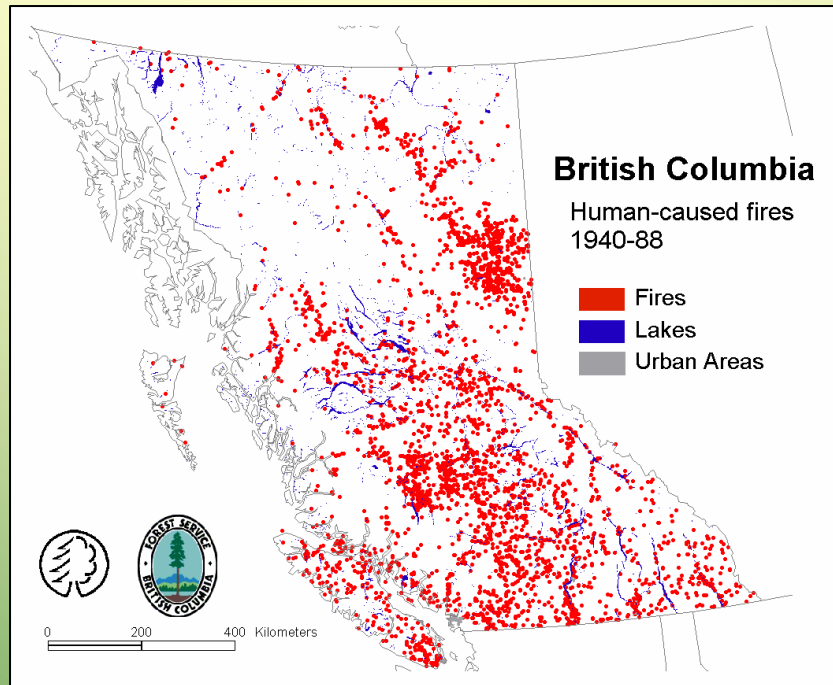
Add Aircraft to Deployment

| Aircraft | Red alert |
|------------------------|-----------|
| Bell 204B | |
| Bell 205A | 5 min |
| Bell 206B Jet Ranger | 10 min |
| Bell 206LI Long Ranger | 15 min |
| Bell 212 Twin | 30 min |
| Bell 214B | |
| Bell 222 | |
| Bell 47AJ-2 | |
| Bell 47G-2 | |
| Bell 47G-3B | |

POWERED BY
SEMS

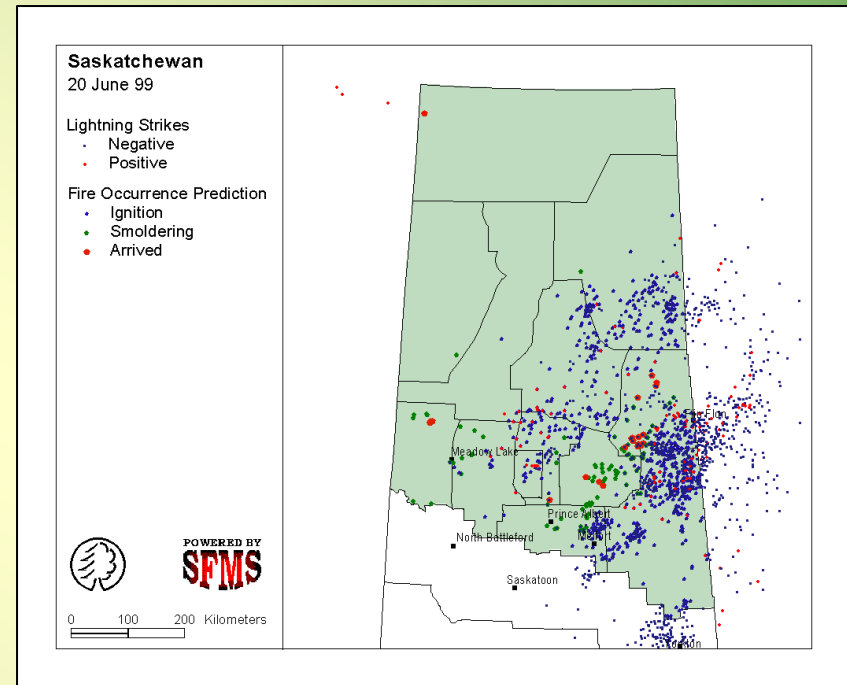


Fire Occurrence Prediction



Human-caused

- People



Lightning-caused

- Sparky
- LCFOP



Fire Growth Modeling

The screenshot displays the Fire Growth Modelling software interface. The main window, titled "Saskatchewan", shows a map with a fire simulation overlay. The fire is represented by a central yellow and orange area, surrounded by a red and orange ring, indicating the fire's extent and intensity. The map is overlaid on a grid of fuel types, color-coded according to the legend on the left.

Legend:

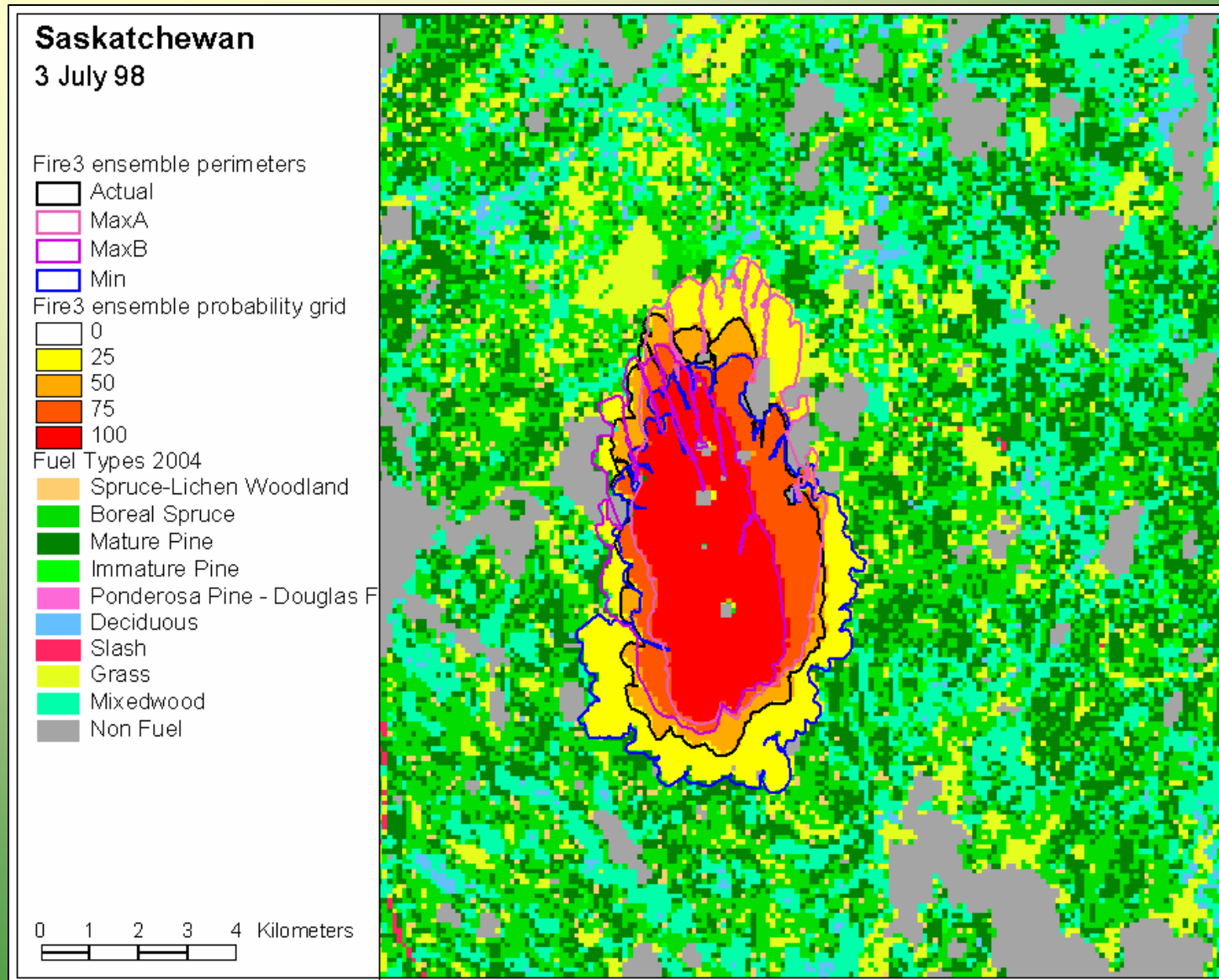
- Initial Attack Bases
- Cities
- Towns
- Super_roads.shp
- Super_rivers.shp
- Rivers
- Railways
- Roads
- Fire2 (Prometheus) 14:16
 - 1 - 3
 - 4 - 6
 - 7 - 9
 - 10 - 12
 - 13 - 15
 - 16 - 18
 - 19 - 21
 - 22 - 24
- Regions
- Super_lakes.shp
- Boundary
- Province.shp
- Lat/Lon graticule
- Lakes.shp
- Lakes
- Fuel Types 2004
 - Spruce-Lichen Woodland
 - Boreal Spruce
 - Mature Pine
 - Immature Pine
 - Red & White Pine
 - Conifer Plantation
 - Ponderosa Pine - Douglas Fir
 - Deciduous
 - Slash
 - Grass
 - Mixedwood
 - Non Fuel

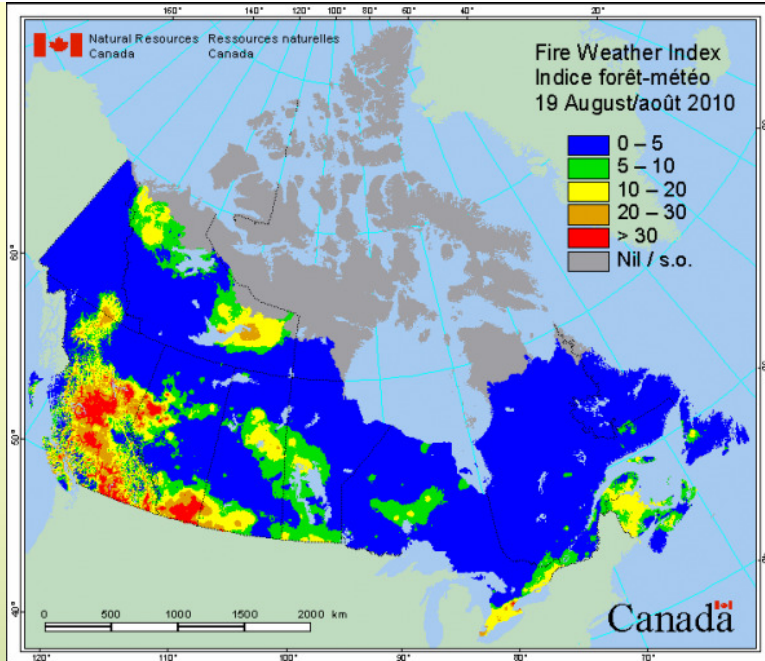
Fire Growth Modelling Dialog Box:

- Latitude: 55.5292
- Longitude: -108.458
- Cell size (m): 100
- Extents size (km): 20
- Ignition time (HHMM): 1416
- Fire name: Fire10
- Model: PFAS SAFF (P-threat)
 - Prometheus
 - Prometheus data export
- Deterministic: 1 days
- Ensemble: 5 days
- Probabilistic: 5 days
- Buttons: OK, Cancel
- Footer: F1=Help



Fire growth ensemble modelling

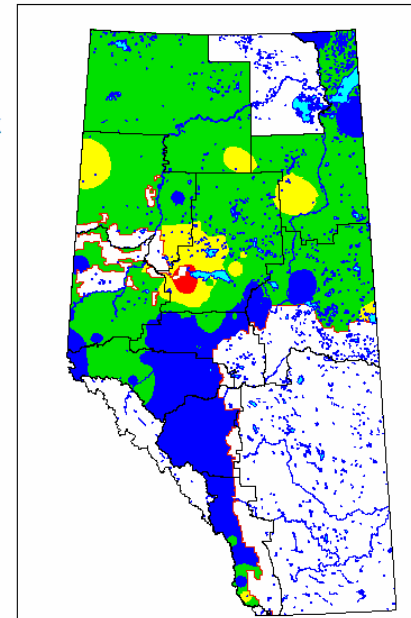




Alberta

Initial Spread Index
for 29 Sep 10

Initial Spread Index 29 Sep 10 PM

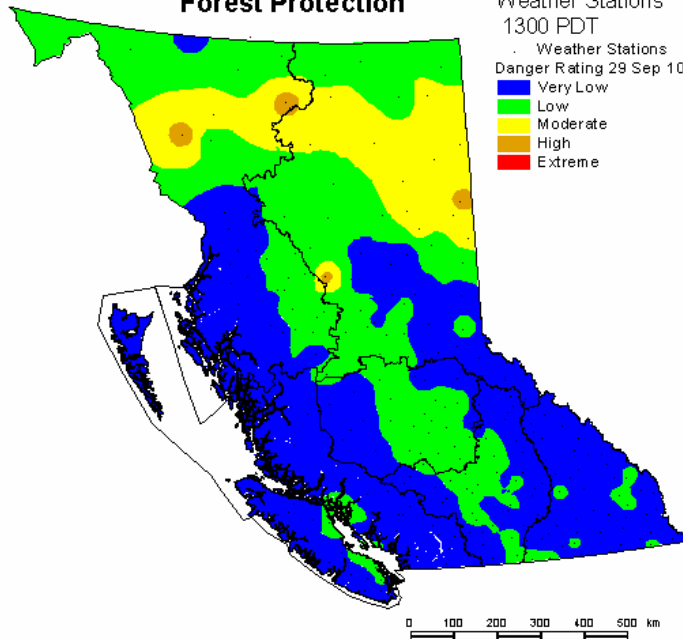


Alberta
From the To Create. Spirit To Achieve.

British Columbia Forest Protection

Weather Stations
1300 PDT
Weather Stations
Danger Rating 29 Sep 10

| |
|----------|
| Very Low |
| Low |
| Moderate |
| High |
| Extreme |



Northern Saskatchewan

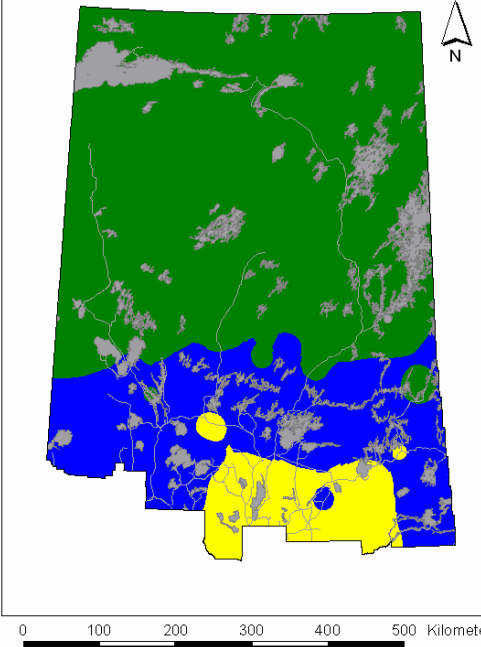
Fire Hazard

Forecast
valid for
29 Aug 2010

Major Roads
Fire Weather Index

| |
|-------------------|
| 0 - 5 / LOW |
| 6 - 16 / MODERATE |
| 17 - 30 / HIGH |
| 30 + / EXTREME |

Prepared By:
GIS Services
Fire Management and
Forest Protection Branch



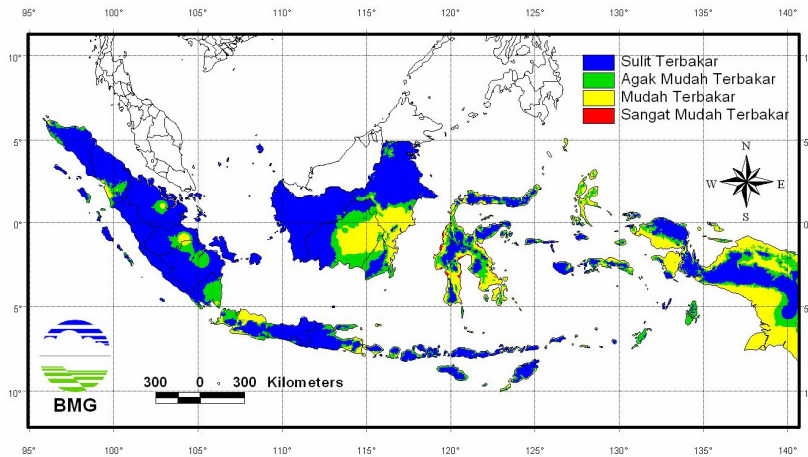
POWERED BY
SFMS



POTENSI KEMUDAHAN TERJADINYA KEBAKARAN HUTAN DAN LAHAN

Fine Fuel Moisture Code

Berlaku untuk : 03 - 04 Januari 2008; 16:00 WIB



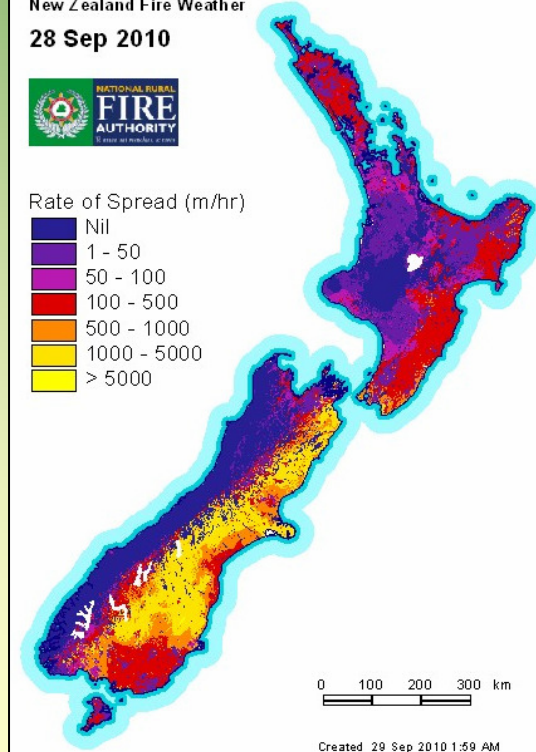
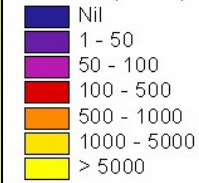
Design Layout : Tim Operasional FDRS BMG
Sumber data : Data Pakisan Symbio BMG

New Zealand Fire Weather

28 Sep 2010



Rate of Spread (m/hr)



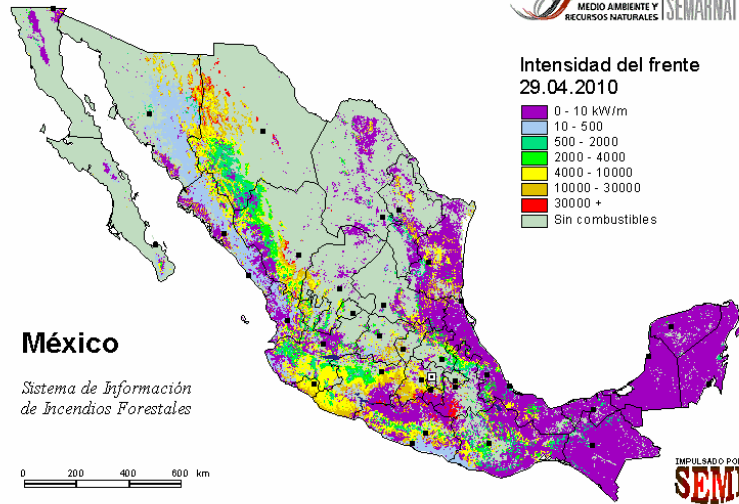
Intensidad del frente
29.04.2010



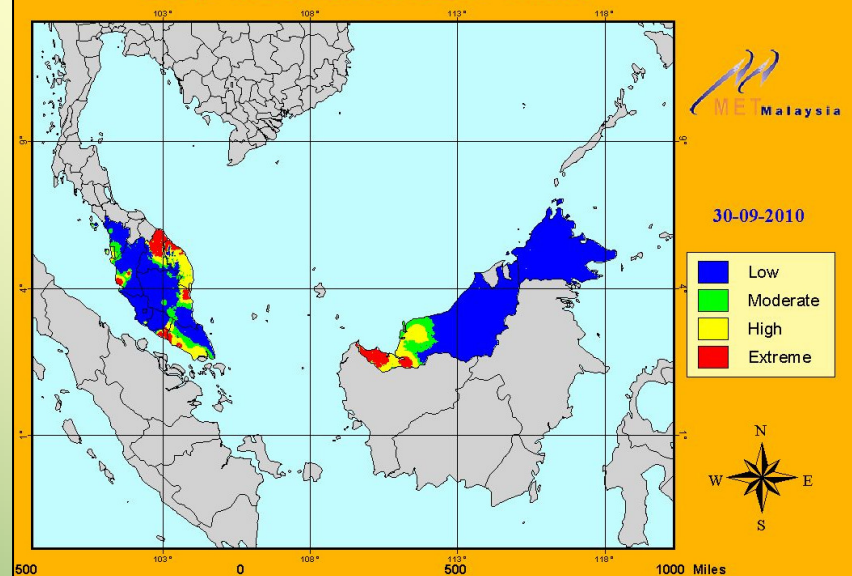
México

Sistema de Información
de Incendios Forestales

0 200 400 600 km



FINE FUEL MOISTURE CODE



POWERED BY
SFMS

*Next Generation
Spatial Fire
Management System*





SFMS re-development

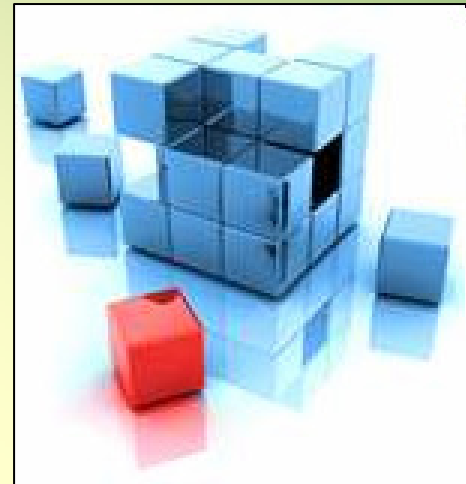
- Independent of any commercial software
- Written in C
- Can be compiled for Windows or Unix
- Run from the command line
- No GUI, at least initially
- Open Source approach allowing for collaboration and minimizing obstacles to implementation
- GeoTIFF grid format allowing for easy file management and compatibility with various GIS/mapping platforms
- ODBC for retrieving weather data





SFMS re-development

- Modular design
- Core modules:
 - Initialization
 - Database
 - Weather
 - FWI
 - FBP
- MapServer to render map images
- Run in daily or hourly mode





SFMS re-development

Fire Weather

This module produces maps of FWI components by interpolation or cell-by-cell calculation.

Parameters: startup procedures, daily/hourly FFMC

Fire Behavior

Cell-by-cell calculation of ROS, HFI, TFC, etc.

Input grids: Fuel type, elevation, slope, aspect

Parameters: curing, greenup

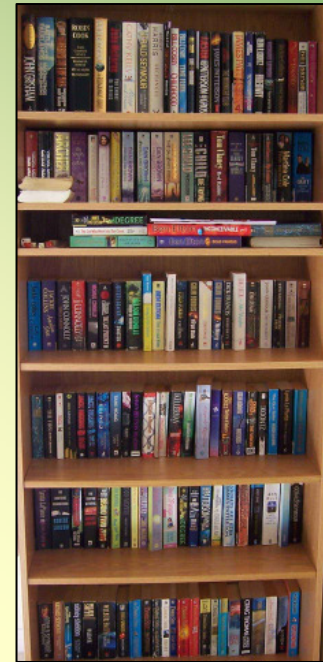




SFMS re-development

Open source libraries used:

- GDAL (for reading and writing grids)
- PROJ4 (for projecting coordinates)
- MapServer (for creating map images)
- XML2 (for managing initialization files)



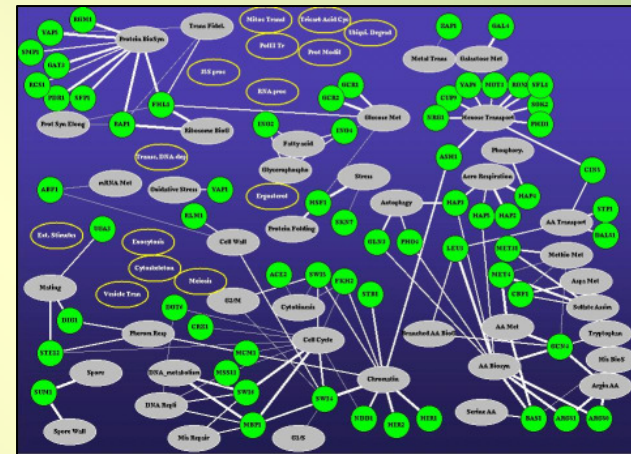
SFMS will also be open source, allowing for agency additions and customization. These customizations can be shared and incorporated into SFMS.



SFMS re-development

Additional modules to be included after the completion of the SFMS core system, depending on user demand:

- Web-based user interface
- Fire growth modelling
- Fire occurrence prediction
- Wildfire threat rating
- Optimal resource allocation and prepositioning
- Fire climatology





KHAN'S TALLY