Advancements in GIS-based fire modeling applications
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Fire Information Systems

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

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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  Long range
Tactical    Strategic
Operational Planning
Deterministic Probabilistic
Fire Simulation Summary

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

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
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
Pegasus

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

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
Fire Simulation Summary

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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.
Bigfoot

• Automated fire growth simulations • Start fire growth from:
  – ignition point – fire perimeter – hotspot buffer perimeter
• 48-hour simulations • Run daily at 5:00 AM
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

Burn probability

0
0.038
Evaluating fuel treatment effectiveness

Untreated landscape

Treated landscape

Burn probability (%) 0 4.0

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

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

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

Inverse Distance Weighting (IDW)

IDW with elevation adjustment
Fire Climatology

Daily Severity Rating
Indice journalier de sévérité
85th / 85e percentile
Fire Season / Saison des feux
1971-2000

Canada
Fire Occurrence Prediction

Human-caused
- People

Lightning-caused
- Sparky
- LCFOP
Fire Growth Modeling
Fire growth ensemble modelling

Saskatchewan
3 July 98

Fire3 ensemble perimeters
- Actual
- MaxA
- MaxB
- Min

Fire3 ensemble probability grid
- 0
- 25
- 50
- 75
- 100

Fuel Types 2004
- Spruce-Lichen Woodland
- Boreal Spruce
- Mature Pine
- Immature Pine
- Ponderosa Pine - Douglas Fir
- Deciduous
- Slash
- Grass
- Mixedwood
- Non Fuel

0 1 2 3 4 Kilometers
Next Generation
Spatial Fire
Management System

SFMS
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