Developing a Global Early Warning System for Wildland Fire

Michael Brady, Natural Resources Canada

International Workshop on Agrometeorological Risk Management: Challenges and Opportunities 28-29 October 2006, New Delhi
Co-Authors

• William J. de Groot & Tim J. Lynham, Natural Resources Canada, Canadian Forest Service
• Johann G. Goldammer, Global Fire Monitoring Center, Germany
• Tom Keenan, Bureau of Meteorology Research Centre, Australia
• Christopher O. Justice and Ivan A. Csiszar, University of Maryland, USA
• Kevin O’Loughlin, Bushfire Cooperative Research Centre, Australia
Outline

• Wildland fire issues
• Fire danger rating
• Development steps for a global early warning system
• Sustainability
Development of a Global Early Warning System for Wildland Fire within the Global Multi-Hazard Early Warning System

Global and monthly variation of wildland fires
Development of a Global Early Warning System for Wildland Fire

Fire causes: land-use fires, carelessness, arson, natural wildfire

Some uncontrolled fires become large disastrous events
Development of a Global Early Warning System for Wildland Fire

There are many negative economic, social, and environmental impacts of uncontrolled wildland fire.
Development of a Global Early Warning System for Wildland Fire

Global Burnt Area: African subset 'percentage of the total surface area of each 1/2 degree cell burned - year 2000'
Objectives

1. Develop a global early warning system for a 0-10 day prediction of wildland fire danger based on existing and demonstrated science and technologies;

2. Develop an information network to quickly disseminate early warning of wildland fire danger that reaches global to local communities;

3. Develop an historical record of regional and global fire danger information for early warning product enhancement, validation and strategic planning purposes; and

4. Design and implement a technology transfer program to provide the following training for global, regional, national, and local community applications.
Fire Danger Rating

• Fire Danger is a general term used to describe conditions of the fire environment including:
  – ease of ignition
  – rate of spread
  – difficulty of control
  – fire impact

• Fire Danger Rating:
  An assessment of the potential for a fire to start, spread and do damage

• Fuel is any vegetation that will burn
Fire Weather Index

Inputs
- Wind speed
- RH
- Rainfall
- Temperature

Moisture Codes
- FFMC
- DMC
- DC

Behavior indices
- ISI
- BUI
- FWI
Activities: Early Warning System Development

1. Review and summarize literature and data on global fire activity to assess risk to global communities and areas of priority.
2. Adapt a current risk monitoring system for global application, using the Canadian Forest Fire Weather Index System in a prototype.
3. Develop protocols for utilizing state of the art (0-10 day) global weather forecasting models for fire danger prediction.
4. With latest numerical weather prediction ensemble prediction techniques, adapt FWI System to operate in a forecasting mode providing probability of event characteristics.
5. Utilize historical satellite detected hotspot and archived numerical analysis of FWI to further calibrate the system.
6. Studies to assess form and utility of products with end users and their social and economic impact.
Basic structure of the early warning system for wildland fire (EWS-Fire)

Solid lines indicate daily procedures; dashed lines indicate periodic recalibration of fire danger levels based on updated databases.
Why Ensemble Techniques:
Single Weather Model Run suffers from

• Uncertainty in Initial Conditions
• Atmospheric Predictability
• Uncertainty in Forecast
• Model Representations

Multiple model runs, based on slightly different initial conditions or using slightly different model configurations and/or parameterizations.

“Poor Man’s Ensemble
ECMWF
TIGGE

FIRE RISK FORECASTS 0-10 days
40 y CLIMATE SUMMARY
Activities: Operational Implementation

- Develop procedures within the robust framework of the World Weather Watch (global network of operational meteorological services) to run the early warning system on a daily operational basis
- Analysis and production of current fire danger assessment
- Analysis and production of forecasted fire danger
- Dissemination of early warning information through multiple channels
- Establish procedures with operating services to maintain and update the System as new tools and products are developed
Global Observing System

Global Telecommunication System

Global Data-processing and Forecasting Systems

National Meteorological Services
Provide meteorological, hydrological and related services

- Protection of life and property
- Safeguarding the environment
- Contributing to national security and development
- Promotion of capacity building
- Meet international and regional commitments including support to WMO’s Programmes and activities
- Contributing to international and regional cooperation

NMHS’s routinely involved in services for multi-hazards and have established mechanisms for coordination and treatment dealing with responsible authorities, public etc. Provides an effective end-to-end process.
1. Collect noon weather observations from WMO centres

2. Transfer data

3. Extract and decode weather data; interpolate conditions to build grid layers in a GIS; produce daily early warning maps

4. Map products displaying current fire danger are distributed via WWW

Typical data flow
Activities: Technology transfer

• Through the WMO framework and the United Nations University, provide training and workshops.
• Promote the early warning system project through presentations to land and forest fire managers at conferences, professional meetings, etc.
• Publish documents on the early warning system.
Development of a Global Early Warning System for Wildland Fire

Training in early warning system operation and practical application to fire management.
Development of a Global Early Warning System for Wildland Fire

Technology transfer aimed at the local level is critical to community-based implementation of an early warning system.
Expected Impacts

• Early warning of wildland fire danger will, on a global basis, provide local communities with an opportunity to mitigate fire damage by assessing threat likelihood and possibility of extreme behaviour enabling implementation of appropriate fire prevention, detection, preparedness, and fire response plans before wildfire problems begin.

• A globally robust operational early warning framework with an applied system that will provide the foundation with which to build resource-sharing agreements between nations during times of extreme fire danger.

• Development of local expertise and capacity building in wildland fire management for system sustainability through technology transfer and training.
Development of a Global Early Warning System for Wildland Fire

DEFINING THE CURRENT STATE AND RISK

The necessary science and technology exists, but a globally coordinated effort by multiple international partners is required.
Global Partnership

- Global Fire Monitoring Center (GFMC), c/o Freiburg University / United Nations University, Germany on behalf of the UNISDR Wildland Fire Advisory Group / Global Wildland Fire Network - Information dissemination and technology transfer
- Canadian Forest Service (CFS), Canada - Fire Weather Index monitoring system, decision tools, outreach
- Bushfire CRC, Australia - End user products and evaluation
- Global Observation of Forest and Land Cover Dynamics (GOFC-GOLD) Secretariat, Canada - Outreach, Support, product evaluation
- University of Maryland (UMD), USA - Remote sensing hotspot detection and vegetation specification
- World Meteorological Organization (WMO) - Operational Framework and Development Support
  - World Weather Research Programme (WWRP)
- Bureau of Meteorology Research Centre (BMRC), Melbourne, Australia - Ensemble/Deterministic Weather and Climate Global Fire Products
- European Centre for Medium Range Weather Forecasting (ECMWF) - Ensemble/Deterministic Weather and Climate Global Fire Products

Natural Resources Canada
Ressources naturelles Canada

GOFC-GOLD
Global Observation of Forest and Land Cover Dynamics

University of Maryland
Instituto Nacional de Meteorología

Australian Government
Bureau of Meteorology

World Weather Research Programme (WWRP)

ECMWF

Bushfire CRC
Sustainability

Case Studies in EWS-Fire Development

1. Canada
2. Southeast Asia
1-Day Forecasted Fire Danger at National Level
Real Time Fire Danger at Regional Level: Case Study
FDRS in Southeast Asia

• Project Period 1999-2004
• Purpose:
  to enhance the capacity of resource management organizations in Southeast Asia to manage land and forest fires, and associated haze.
• Systems operating in Indonesia, West Kalimantan, Riau, Malaysia, Sabah and ASEAN
FDRS Outcomes

ASEAN
- FDRS is used on Fire Monitoring website
- Fire Science Network established
- FDRS incorporated into regional haze agreement
- FDRS adapted for regional haze forecasting
- Extensive fire science database
Based on FDRS reading, all fine fuels will easily ignite, potentially resulting in many fires in most parts of Thailand, most parts of Lao PDR, most parts of Viet Nam, parts of Peninsular Malaysia, most parts of Sumatra and southern Borneo.

In mixed fuels, severe drought conditions and high-intensify fires can occur in southern Sumatra and parts of southern Borneo.

Both moderate- and high-intensity fires can be very common in parts of Thailand. Moderate intensity fires can occur in parts of Thailand, parts of Lao PDR and parts of Peninsular Malaysia.

Peat areas will produce widespread and severe haze from deep and long-burning fires in southern Sumatra and parts of southern Borneo.

Drought conditions in peat areas and high-intensity fires are possible in parts of Viet Nam, parts of southern Sumatra and parts of southern Borneo. Smouldering in drained peat areas is possible in Thailand, Lao PDR, parts of Viet Nam, Peninsular Malaysia, parts of Sumatra and parts of Borneo.
FDRS Outcomes

Indonesia

- System operated by BMG
- Legislation incorporates FDRS
- Standard Operating Procedures
- Interdepartmental agreement
- Routine budgets in place
FDRS Outcomes

Malaysia

– System operated by MMS
– Standard Operating Procedures established
– 22 Officers from Bomba state and national fire and rescue stations received advanced training
FDRS Outcomes

Sumatra

- BMG Medan office operating electronic FDRS
- Kampar District, Riau operating weather station and manual FDRS
- District SOP produced
Analysis of Historical Weather Data
Characterize the fire climate in terms of fire season onset, severity and duration.
FDRS Outcomes

West Kalimantan
- System operated by Prov. Forestry office
- 5 fire brigades established
- Provincial SOPs formalized
- Provincial FDRS multi-agency committee
- Local team providing FDRS training courses

<table>
<thead>
<tr>
<th>CLASS</th>
<th>FIRE CHARACTERISTICS</th>
<th>POLICY</th>
<th>OPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW</td>
<td>Fuels contain sufficient moisture to prevent spread of fires.</td>
<td>Fires may be permitted.</td>
<td>Fires can be controlled with hand tools.</td>
</tr>
<tr>
<td>MODERATE</td>
<td>Surface of smoldering fires will spread.</td>
<td>Fires may be permitted with more rigorous control measures.</td>
<td>Fires can be controlled with hand tools and fuel breaks.</td>
</tr>
<tr>
<td>HIGH</td>
<td>Fuels are dry and easily ignited. Fires will spread vigorously, and large amounts of smoke may be produced.</td>
<td>Fires should not be permitted.</td>
<td>Fires are very difficult to control. Patrols should be watching for fires and putting them out as quickly as possible.</td>
</tr>
<tr>
<td>EXTREME</td>
<td>Fire spreads rapidly and releases a lot of heat and smoke.</td>
<td>Fires should not be permitted.</td>
<td>Fires are very difficult to control. Patrols should be watching for fires and putting them out as quickly as possible. Extensive mop up required.</td>
</tr>
</tbody>
</table>
EWS-Fire Proposal

1. Recommendations of the UN World Conference on Disaster Reduction (WCDR) in Kobe, Japan, January 2005

2. Proposal of the UN Secretary General to develop a Global Multi-Hazard Early Warning System

3. 3rd International Conference on Early Warning (EWC-III) (27–29 March 2006, Bonn, Germany), sponsored by the United Nations International Strategy for Disaster Reduction and Germany

Links:

• Task in the 2006–2007 work plan of the Global Earth Observation System of Systems (GEOSS)

• Conference on Promoting Partnerships for the Implementation of the ASEAN Agreement on Transboundary Haze Pollution, 11–13 May 2006 in Hanoi, Vietnam

• International Workshop on Agrometeorological Risk Management: Challenges and Opportunities 28-29 October 2006, New Delhi

• V International Conference on Forest Fire Research (November 24th to December 1st, 2006, Figueira da Foz, Portugal)
Thank You

mbrady@nrcan.gc.ca