



**Third International Conference on  
Early Warning  
27-29 March 2006, Bonn, Germany**



---

## **Global Early Warning System for Wildland Fire**

### **1. Summary of Project Proposal**

#### **Partner Organizations:**

- Global Fire Monitoring Center (GFMC), Max Planck Institute for Chemistry, c/o Freiburg University / United Nations University, Germany on behalf of the UNISDR Wildland Fire Advisory Group / Global Wildland Fire Network
- Canadian Forest Service (CFS), Edmonton, Canada
- World Meteorological Organization (WMO)
- World Weather Research Programme (WWRP)
- Bureau of Meteorology Research Centre, Melbourne, Australia
- Global Observation of Forest and Land Cover Dynamics (GOFC-GOLD) Secretariat, Edmonton, Canada
- University of Maryland, USA
- Bushfire Cooperative Research Centre (BCRC), Melbourne, Australia
- European Centre for Medium Range Weather Forecasting (ECMWF)

#### **Primary Contact:**

Johann G. Goldammer  
The Global Fire Monitoring Center (GFMC) / Fire Ecology Research Group  
Max Planck Institute for Chemistry, c/o Freiburg University  
Georges-Koehler-Allee 75, D - 79110 Freiburg GERMANY  
Tel: +49-761-808011 ; Fax: +49-761-808012  
e-mail: [johann.goldammer@fire.uni-freiburg.de](mailto:johann.goldammer@fire.uni-freiburg.de)

**Website:** <http://www.fire.uni-freiburg.de>

**Geographic Coverage:** Global

**Timeframe:** 3 years

**Approximate Funding Needs:** (in Original only)

#### **Attached Supporting Documents:**

(in Original only)

- Government of Canada, Canadian Forest Service – Letter of Support
- Global Observation of Forest and Land Cover Dynamics – Letter of Support
- Global Fire Monitoring Center – Letter of Support
- Bureau of Meteorology Research Centre, Australia – Letter of Support
- Bushfire Collaborative Research Centre, Melbourne, Australia – Letter of Support
- World Weather Research Programme of the World Meteorological Organisation – Letter of Support
- European Centre for Medium Range Weather Forecasting – Letter of Support
- German Foreign Office – Letter of Endorsement

**Attached Annexes:**  
(in Original only)

Annex I: Summary: A Global Early Warning System for Wildland Fire (July 2005)

Annex II: Summary of WWRP Fire Weather Workshop (June 2005)

Annex III: EWC-II Wildland Fire Early Warning Report (2003)

## **2. Background and Motivation**

Fire is a very prevalent disturbance on the global landscape with several hundred million hectares of vegetation burning every year. Land and forest fires (collectively referred to as wildland fires) occur annually on every continent except Antarctica, and most global fire is unmonitored and undocumented. Increasing trends in wildland fire activity have been reported in many global regions. Wildland fires have many serious negative impacts on human safety, health, regional economies and global climate change. Developed countries spend billions every year in an attempt to limit the impact of wildland fires. In contrast, developing countries spend little, if any, money to control fire, yet they are often the most susceptible to the damaging impacts of fire because of increased vulnerability of human life and property (due to limited fire suppression capability), increased risk due to high fire frequency (often caused by the cultural use of fire), and sensitive economies (tourism, transport).

To mitigate these fire-related problems, forest and land management agencies, as well as land owners and communities, require an early warning system to identify critical time periods of extreme fire danger in advance of their occurrence. Early warning of these conditions with high spatial and temporal resolution incorporating measures of uncertainty and the likelihood of extreme conditions allow fire managers to implement fire prevention, detection and pre-suppression plans before fire problems begin. Considering the fact that the majority of uncontrolled and destructive wildfires are caused by humans as a consequence of inappropriate use of fire in agriculture, pastoralism and forestry, it is crucial that international wildland fire early warning systems are developed to complement relevant national fire danger warning systems where they exist, to provide early warning where national systems do not exist, and to enhance warnings applied or generated at the local (community) level (**people-centered early warning systems** – as requested by the UN Secretary General and as laid down in the Hyogo Framework for Action 2005–2015: “Building the Resilience of Nations and Communities to Disasters”). This will ensure delivery of targeted information reflecting specific local conditions and allowing the involvement of local communities in wildland fire prevention.

Fire danger rating is a mature science and has long been used as a tool to provide early warning of the potential for serious wildfires. Fire danger rating systems (FDRS) utilize basic daily weather data to calculate wildfire potential. FDRS early warning information is often enhanced with satellite data such as hot spots for early fire detection, and spectral data on land cover and fuel conditions. Normally, these systems provide a 4-6 hour early warning of the highest fire danger for any particular day that the weather data is supplied. However, by using forecasted weather data, as much as 2 weeks of early warning can be provided, depending on the length of the forecast. Ensemble weather prediction systems through multiple realisations of forecasts provide distributions of weather forecasts and capture their inherent predictability and uncertainty associated with such forecasts. As well, FDRS indices can be calibrated with local data to provide longer term early warning, such as a 30-day early warning tool developed for SE Asia to indicate the potential for disaster-level haze events from peatland fires.

FDRS tools for early warning are highly adaptable and have demonstrated their application to a wide range of users, from independent remote field stations (for making local fire suppression and preparedness decisions) to global and regional fire information centres (for large-scale decision making, such as multi-national resource sharing). There are numerous examples of current operational systems utilizing GIS technology and computer modelling of

landscape level fire danger, which process and transfer early warning information very quickly via the World Wide Web.

Long-term knowledge of conditions during wildfires and the utility of fire danger forecasts are important to the immediate development of early warning systems and to undertake the planning and preparation associated with the impacts of climate change. Understanding the characteristics of extreme wild fire events is a paramount consideration. A long-term global dataset of fire danger metrics is also required to these meet requirements.

### **3. Objectives and Expected Impact**

Objectives:

1. To develop a global early warning system for wildland fire based on existing and demonstrated science and technologies.
2. To develop an information network to quickly disseminate early warning of wildland fire danger that reaches global to local communities.
3. To develop an historical record of global fire danger information for early warning product enhancement, validation and strategic planning purposes.
4. To design and implement a technology transfer program to provide the following training for global, regional, national, and local community applications:
  - Early warning system operation
  - Methods for local to global calibration of the System
  - Using the System for prevention, preparedness, detection, and, where appropriate, fire response decision-making

Expected Impacts:

1. Early warning of wildland fire danger, on a global basis, will provide international agencies, governments and 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.
2. 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.
3. Development of local expertise and capacity building in wildland fire management for system sustainability through technology transfer and training.

### **4. Planned Activities**

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 (FWI System) in a prototype.
3. Develop protocols for utilizing current weather forecasting models for fire danger prediction
4. Adapt FWI System to operate in a forecasting mode providing probability of event characteristics.
5. Integrate global hotspot databases with FWI data, presenting a current global fire status product (shows where current fire problems are, and provides basis to assess severity of forecast fire danger conditions)
6. Utilize historical hotspot and FWI data to calibrate FWI System components for early warning purposes across different geographic regions.
7. Studies to assess form and utility of products with end users and their social and economic impact

#### Operational Implementation

1. 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
  - a. Analysis and production of current fire danger assessment
  - b. Analysis and production of forecast fire danger
  - c. Dissemination of early warning information through multiple channels
2. Establish procedures with operating services to maintain and update the System as new tools and products are developed

#### Technology Transfer

1. Through the WMO framework and the United Nations University, provide training and workshops in:
  - Early Warning System operations
  - Basic understanding of fire danger and early warning
  - Calculating FWI components
  - Provision of FWI algorithms
  - Developing and implementing decision-aids based on early warning to mitigate the impacts of fire through prevention, preparedness, detection, and fire response
  - Involvement of local communities in the application of early warning information in wildland fire management (Community-Based Fire Management – CBFiM), especially in wildfire prevention, and preparedness for coping with wildland fire disasters (including smoke pollution and public health)
2. Promote the early warning system project through presentations to land and forest fire managers at conferences, professional meetings, etc.
3. Publish documents on the early warning system.

### 5. Implementing Agencies and Division of Labour

**Global Fire Monitoring Center (GFMC)**, Germany on behalf of the UNISDR Wildland Fire Advisory Group / Global Wildland Fire Network and the United Nations University (UNU)

1. Collection and global dissemination of FWI and associated early warning products
2. Technology transfer – through the United Nations University, facilitate the local-level implementation of a people-centered Early Warning System for wildland fire / CBFiM

**Bureau of Meteorology Research Centre (BMRC)**, Australia, with cooperation from WMO and provision of data from ECMWF.

1. Adapt Canadian Forest Fire Weather Index (FWI) System as a Numerical Weather Prediction (NWP) Suite Module to provide medium range (up to two weeks) forecasts of FWI. Approach includes:
  - A poor man's ensemble of current operational deterministic global model output e.g. National Center for Environmental Prediction (NCEP), Japanese Meteorological Agency (JMA), ECMWF, Australian Bureau of Meteorology, Canadian Meteorological Service (CMS), Deutscher Wetterdienst (DWD) etc. This activity will provide an initial globally-based FWI employing current global weather prediction systems in a manner that optimizes forecast skill. Will involve collaboration with Canadian Forest Service component of this proposal for initial product intercomparison and investigation of NWP model biases (see Canadian Forest Service activities below)
  - Development of a FWI incorporating measures of uncertainty and extreme behavior employing a Global EPS scheme. To be based on up to fifty ensemble members for up to two weeks FWI forecasts sourced from the ECMWF operational Ensemble Prediction System
  - Development of a prototype second order global ensemble FWI using ensemble of ensemble techniques. This additional year three phase to be undertaken as part of the WMO THORPEX Interactive Grand Global Ensemble (TIGGE) program (in cooperation with ECMWF)

2. Validation and evaluation of initial Ensemble Prediction System (EPS)-based FWI. Employ satellite based hotspot data and ground-truthing where available (BMRC, CFS)
3. Development of a forty year FWI history based on the ERA 40 or NCEP Re- Analysis product (BMRC with WMO operational weather prediction center)
4. Development of EPS FWI products for web (BMRC, CFS, GFMC)
5. Prototype dissemination of EPS global-based FWI (BMRC)
6. Provide FWI module to WMO members as required for global, regional, national and local implementation within the World Weather Watch operational framework (BMRC)
7. Regional training and evaluation (WMO)

#### **Canadian Forest Service (CFS)**

Provide scientific, technical and fire management systems expertise in an advisory role for the project (with BMRC, GFMC, BCRC, UMD and GOFC-GOLD) to:

1. Expand current international fire danger (FWI) monitoring system to full global coverage (presently monitoring approx. 1/3 global area for current daily conditions). Requires adapting the spatial Fire Management System (sFMS) to display global products.
2. Adapt spatial Fire Management System (sFMS) software to combine global hotspot data with FWI data as an early warning product.
3. Adapt FWI System to operate in a forecasting mode.
4. Develop criteria to classify FWI data in terms of fire danger for early warning purposes (e.g., conditions that define Low, Moderate, High, and Extreme fire danger)
5. Develop practical decision-aid tools based on early warning for fire prevention, preparedness, detection, and fire response (e.g., when fire danger is High, open burning restrictions are imposed, tower detection is implemented, fire fighting staff and equipment are ready for immediate dispatch, etc.)
6. Prepare and assist in delivering a technology transfer program to train early warning system users in the following:
  - Understanding of basic fire behaviour, fire danger, the FWI System, and early warning
  - Training and tools to calculate the FWI System for local use including the collection of simple weather data, and use of either a PC-based FWI program or use of the FWI Tables where computer use is not feasible
  - Use of the World Wide Web to access FWI and early warning products
  - Methods to calibrate FWI and early warning products for local use.
  - Workshops to assist in the development of national and local early warning decision-aids (e.g., what activities should a prevention program include, and at what fire danger/early warning level should those activities be implemented?)

Note: CFS is currently preparing an internal proposal, which may allow greater participation in the EWS project. Completion of proposal review is anticipated by April 1, 2006.

#### **Bushfire Cooperative Research Centre, Australia**

1. Validation and intercomparison of FWI with other wild fire indices. Employ satellite based hotspot data and ground truthing where available (co-operatively with BMRC, ECMWF, CFS)
2. User Evaluation and Optimisation of EPS Global FWI products (with BMRC, ECMWF, CFS).

#### **University of Maryland (UMD), USA, acting on behalf of GOFC/GOLD**

1. Provision of global MODIS hotspot data from the daytime and night-time orbits of the Terra and Aqua satellites. The data will be provided in ASCII textfile format, including the center location of MODIS pixels flagged as "fire" by the standard global MODIS fire detection algorithm and auxiliary information about detection conditions and confidence.
2. Provision of global MODIS Normalized Difference Vegetation Index (NDVI) data, aimed at the assessment of vegetation condition, based on deviations from optimal and average conditions.

**Global Observation of Forest and Land Cover Dynamics (GOFC-GOLD)** Secretariat,  
Edmonton, Canada

Administrative support through the GOFC Project Office to:

1. assist the coordination and outreach mechanism for observations and products.
2. support the utilization and evaluation of products and assist in system implementation through early warning system application within the GOFC-GOLD and UN regional networks.

## **6. Monitoring and Evaluation**

A joint management group consisting of at least one member of all partner agencies (and others as the parties may determine) will manage the overall activities defined under this arrangement. This management group will define and monitor activities, set priorities for these activities and provide a mechanism to resolve any technical, scientific, implementation and support issues. The management group will make recommendations to both the contributing agencies relating to any additional tasks deemed appropriate including financial support. The Management Group will meet once per year for a detailed review of the project.

Through the Management Group, full and accurate reporting will be maintained at 3-monthly intervals. These reports shall include progress, activities undertaken, difficulties encountered, achievements made and recommendations for the next year's activities.

## **7. Sustainability**

The sustainability will be secured through the long-term scope of the research agendas of the participating institutions. All institutions have demonstrated and will continue to have an interest in a coordinated and collective approach in dedicated research and capacity building, notably through the existing and expanding networking activities. The UNISDR Global Wildland Fire Network and the GOFC-GOLD Regional Fire Implementation Teams and Networks will jointly work in:

- Technology transfer and training for development of local expertise and capacity building in wildland fire management
- Involvement of the United Nations University through the new partnership agreement signed on 7 October 2005 (GFMC is now functioning as an UNU Associated Institute)

The letters of support clearly indicate the commitments of the institutions involved.

\*\*\*

For Details on all proposals for early warning systems of natural hazards see:

<http://www.ewc3.org/>