Calibration of the Canadian Fire Weather Index System for SE Asia

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Fires declared a national disaster

JAKARTA (IO) — Calling the forest fires raging in Sumatra a national disaster, Environment Minister Soni Keraf yesterday said the government will summon logging firms over the burning, which has reached an emergency level.

The minister, speaking after a cabinet meeting, said forest concession holders (HPH) could lose their licenses if they are found guilty of deliberately starting the fires.

“The cabinet meeting has decided to summon the HPH businesses which have allegedly started forest fires and other activities which damage forests,” he said.

“If impropriety is found, their licenses will be revoked,” he added. Hundreds of fires are scorching

Mean annual C emissions (Tg), 1997-2006, GFED2
SE Asia FDRS Project

- **Purpose:** enhance the capacity of resource management organizations in Southeast Asia to manage land and forest fires and associated haze through the development and application of a fire danger rating system.

- **We calibrated select components of the Canadian Fire Weather Index system to conditions in Indonesia and Malaysia, focusing on:**
  - Ignition potential and difficulty of control in tall grass
  - Smoke potential

- **We used a combination of field studies, laboratory experiments, and historical analyses.**
Canadian Fire Weather Index System

- Fire weather observations:
  - Temperature, relative humidity, wind speed, rain

- Fuel moisture codes:
  - Fine Fuel Moisture Code (FFMC)
  - Duff Moisture Code (DMC)
  - Drought Code (DC)

- Fire behaviour indices:
  - Initial Spread Index (ISI)
  - Buildup Index (BUI)

- Fire Weather Index (FWI)
Ignition potential – Fine Fuel Moisture Code

- Field studies in Riau province, Sumatra
- Used to identify the relationship between fuel moisture moisture in ‘alang-alang’ grass and FFMC computed from meteorological observations.

![Graph showing the relationship between FFMC and dead grass moisture content](image-url)

- Fuel moisture decreases as FFMC increases

*de Groot et al., IJWF (2005)*
Ignition potential – Fine Fuel Moisture Code

- Laboratory studies used to identify fuel moisture threshold of 35%, below which grass becomes ignitable, corresponding to an FFMC of ~83.

![Graph showing probability of ignition vs. dead grass moisture content](image.png)

*de Groot et al., IJWF (2005)*
Ignition potential – Fine Fuel Moisture Code

- Ignition studies compared against hotspot occurrence. 78% of hotspots occurred when FFMC > 81, but this represented only 20% of all days.

<table>
<thead>
<tr>
<th>Ignition potential</th>
<th>FFMC</th>
<th>Proportion of an average year&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Proportion of fire occurrence&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>0–72</td>
<td>0.62</td>
<td>0.10</td>
<td>Low probability of fire starts</td>
</tr>
<tr>
<td>Moderate</td>
<td>73–77</td>
<td>0.08</td>
<td>0.04</td>
<td>Moderate probability of fire starts in areas of local dryness</td>
</tr>
<tr>
<td>High</td>
<td>78–82</td>
<td>0.16</td>
<td>0.13</td>
<td>Cured grass fuels becoming easily ignitable; high probability of fire starts</td>
</tr>
<tr>
<td>Extreme</td>
<td>83+</td>
<td>0.13</td>
<td>0.73</td>
<td>Cured grass fuels highly flammable; very high probability of fire starts</td>
</tr>
</tbody>
</table>
At its most severe, the haze in Indonesia is worse than the worst conditions in the world’s most polluted cities, by a factor of 5.
Smoke potential – Drought Code

• Serious smoke emissions occur when groundwater levels in peatlands drop and allow organic soils to dry below their ignition threshold.

• The Drought Code is an indicator of moisture content in deep organic soil layers, and was selected as an indicator of smoke potential.
Smoke potential - DC

- Visibility at airports was used as an indicator of haze
- Severe haze events were identified using the visibility at airports, and associated with DC > 350, compared to DC > 425 in Canada.

Palangkaraya, Central Kalimantan

Field et al., Atm. Env. (2004)
Evaluation of DC during 2006 haze event

MODIS Fire Detections

TES Total Column Carbon Monoxide

Oct 2005

Oct 2006

Source:
Univ. Maryland Web Fire Mapper

Logan et al., GRL (2008)
Precipitation over Indonesia is heavily influenced by SST anomalies in the Pacific and Indian Oceans

IOD key for Sumatra, Java

Drought is most pronounced under simultaneous ENSO and IOD conditions

ENSO key for Kalimantan, Papua

Hong et al., J. Geophys. Res. (2008)
Simple drought monitoring

- Seasonal C emissions are well-explained by rainfall totals from 1997 to 2006
- Piecewise linear regression used to estimate threshold below which severe emissions occur.

Field and Shen, J. Geophys. Res. (in press)
Long-term drought and haze

- Drought controls on haze in Kalimantan apply only since 1980s, the start of large-scale Indonesian transmigration to Central Kalimantan and accelerated deforestation.
Vegetation cover, 1950
Outlook for 2008

SST

Precipitation

Last update: Tue Jul 15 2008
Summary

• The Canadian FWI system required significant calibration to suit conditions in Indonesia and Malaysia.

• The initial FDRS implementation was designed to be as simple as possible.

• Further studies are required to better understand meteorological controls on moisture content and fire behaviour in:
  – heavier surface fuels, such as logging slash
  – open and closed forests
  – drained and un-drained peatlands

• Simple rainfall indices can be useful for interpretation of seasonal climate outlooks.


Thank you

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