Disaster Monitoring with Remote Sensing at CRISP, NUS

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CRISP Ground Station

**Satellite Data CRISP received since 1995:**

1. **SPOT 1,2,4 (France, Sep 1995) – 1,110,000 scenes**
2. **ERS 1,2 (Europe, Mar 1996) – 26,500 scenes**
3. **RADARSAT 1 (Canada, Apr 1997 till 1999) – 12,000 scenes**
4. **SeaWiFS (USA, Sep 1999)**
5. **TERRA MODIS (USA, March 2001)**
6. **IKONOS (USA, August 2001)**
7. **EROS (Israel, October 2001) – suspended due to ground equipment failure**
8. **AQUA MODIS (USA, July 2002)**
9. **SPOT 5 (October 2002) – 360,000 scenes**
Forest Fire Monitoring
Planning of SPOT Pass
Fires in 2006

- The yearly vegetation fires in Sumatra and Kalimantan were made worse in 2006 by the onset of a mild El-Nino event.
- This brought drier weather at the tail end of the fire season (September and October) to South Sumatra and Kalimantan.
- The fires in South Sumatra and Kalimantan in this period were the most severe in recent years. The PSI in Singapore (on Oct 7) also hit the highest level since 1997.
High resolution satellite imagery: South Sumatra
Red regions – recent burning activities (ground still very hot)
Systems of Canals, indicating intention of converting to plantations
Some Observations of the spatial and temporal patterns of fires detected by high resolution SPOT images
Comparison of hotspots in September

Hotspots, 2nd half of September 2005

Hotspots, 2nd half of September 2006
Comparison of hotspots in October

Hotspots, 1st half of October 2005

Hotspots, 1st half of October 2006
Monthly Fire Count & Monthly Rainfall (Sumatra)

Average Monthly Fire Count (Sumatra, 1999 - 2004)

Climatological Mean Monthly Rainfall (Pekan Baru)
Monthly Fire Count (Sumatra)
2006 vs. 1999 – 2005 mean
Validation of MODIS Hotspots Using High Resolution SPOT Images

Validation of MODIS Hotspots

- Use high resolution SPOT multispectral images as the reference data
- The reference SPOT data are acquired almost simultaneously as the MODIS data
- Detection of fires in SPOT images
  - Use visible smoke plumes to locate fires
  - The locations of the active fires are determined from the points of origin of the individual smoke plumes.
  - Intense fires with efficient combustion may not produce sufficient smoke plumes and would not be detected. Such fires are not very common in the humid tropics, due to the high humidity.
- Detection of MODIS hotspots
  - Use standard NASA v4 algorithm
An example:
19 Aug 2002 Central Kalimantan

SPOT acquisition: 02:58 UTC
MODIS acquisition 03:15 UTC

Yellow dots are locations of fires detected in SPOT
Green dots are locations of MODIS hotspots
## Results

<table>
<thead>
<tr>
<th>MODIS Hotspots</th>
<th>SPOT Fires</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Validated by SPOT</td>
<td>180</td>
<td>Detected by MODIS</td>
</tr>
<tr>
<td>False Alarms</td>
<td>66</td>
<td>Not Detected</td>
</tr>
<tr>
<td>Total</td>
<td>246</td>
<td>Total</td>
</tr>
<tr>
<td>Commission Error Rate</td>
<td>26.8%</td>
<td>Omission Error Rate</td>
</tr>
</tbody>
</table>
Comparison with a study conducted in Southern Africa

<table>
<thead>
<tr>
<th>MODIS Hotspots</th>
<th>ASTER fires</th>
</tr>
</thead>
<tbody>
<tr>
<td>Validated by ASTER</td>
<td>Detected by MODIS</td>
</tr>
<tr>
<td></td>
<td>33</td>
</tr>
<tr>
<td>False alarms</td>
<td>Undetected fires</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>131</td>
</tr>
<tr>
<td>Commission Error Rate</td>
<td>Omission Error Rate</td>
</tr>
<tr>
<td>0.8%</td>
<td>74.8%</td>
</tr>
</tbody>
</table>

South Asia Tsunami
Subduction of India plate under Sunda plate

26 December 2004, 00:58 am (UTC), 07:58 am (local time)
Lhoknga
Java Mudflow
(August 2006)
Other Natural Disasters
Village of Guinsaugon on 2 Sept 2004
Village of Guinsaugon on 1 Mar 2006
IKONOS Image of PADANG (8 Mar 07)
IKONOS Image of Bukit Tinggi (08 Mar 07)
(Showing Landslides possibly results of Earthquake)
Sentinel Asia
(Fire Hotspots)
Implementation Progress

- CRISP Hotspot server to host our hotspots is ready; updated after every MODIS pass.
- CRISP server implemented with opensource Mapserver software originally developed by the University of Minnesota in 1994 (http://mapserver.gis.umn.edu/)
- URL to access CRISP Webgis:
  - http://crisp.nus.edu.sg
Thank You