RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Mark Ruminski
Roland Draxler
Shobha Kondragunta
Jian Zeng
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

HMS GRAPHICAL OUTPUT
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

NOAA/NESDIS began fire/smoke analysis in 1998.

Massive smoke episodes have detrimental affect on health, transportation and industry.

Large wildfires pose threat to life and property. Early detection and extinction saves money.
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

- HMS Incorporates 7 satellites – 2 geostationary and 5 polar orbiting
- Over 100 looks per day in areas of overlap
- POES spacecraft provide 2 orbits/day in mid latitudes, more frequent over Alaska/Canada
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

AUTOMATED FIRE DETECTION ALGORITHMS USED

• Wildfire – Automated Biomass Burning Algorithm (WF-ABBA) for GOES

• Fire Identification, Mapping and Monitoring Algorithm (FIMMA) for NOAA AVHRR

• MODIS MOD14 for MODIS (Terra and Aqua)
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Since we employ the automated algorithms why have an analyst in the loop?
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Algorithms can mistake highly reflective clouds for fires.
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Algorithms can mistake highly reflective clouds for fires.
Sunglint off water surfaces at high sun angles can generate false detects.
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Urban heat islands and land type can appear to be fires to the algorithms under proper conditions.
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

HMS GUI with power plants and known false alarm locations
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Need to get a good handle on the fires to produce a good analysis of smoke emissions (where there’s smoke there’s fire!)

Smoke analysis consists of:

- Graphic of smoke extent
- Input to dispersion and transport model
- Text product describing smoke and blowing dust
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Individual GIS smoke plume shapefiles are tagged with observation start/end times
Analysts provide input to the HYbrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) Model

Locations of smoke emitting fires are added to file

Each point represents 1 square km

Number of points selected determined by areal coverage of hotspots and/or amount of smoke observed
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

HYSPLIT switched from using constant emission rate for all input locations to using BlueSky framework in 2005.

Most recent constant emission rate used was 15 kg/ha/hr.
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

BlueSky emissions much larger than constant rates that HYSPLIT had been using.
Variable emission duration implemented in April 2006

Start/End time of emissions indicated by analyst

Previous assumption was that fires were emitting for 24 hours with a decay rate of 75%/day

Majority of analyzed fires have no detectable smoke plume

The majority of fires that do have a smoke plume have a limited duration (much less than 24 hours)
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM
Even short duration fires with limited smoke can produce regionally significant emissions under the right atmospheric conditions and with a large number of fires.
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

HYPLIT SMOKE - DAY 1 FORECAST

<table>
<thead>
<tr>
<th>Analyzed Smoke</th>
<th>HYSPLIT Smoke (1 hr avg.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All On</td>
<td>All On</td>
</tr>
<tr>
<td>All Off</td>
<td>All Off</td>
</tr>
<tr>
<td>1130-1330Z</td>
<td>07Z</td>
</tr>
<tr>
<td>1200-1330Z</td>
<td>08Z</td>
</tr>
<tr>
<td>1245-1745Z</td>
<td>09Z</td>
</tr>
<tr>
<td>1400-1800Z</td>
<td>10Z</td>
</tr>
<tr>
<td>1415-1745Z</td>
<td>11Z</td>
</tr>
<tr>
<td>1415-1915Z</td>
<td>12Z</td>
</tr>
<tr>
<td>1600-1900Z</td>
<td>13Z</td>
</tr>
<tr>
<td>1815-2115Z</td>
<td>14Z</td>
</tr>
<tr>
<td>1845-2145Z</td>
<td>15Z</td>
</tr>
<tr>
<td>1845-2345Z</td>
<td>16Z</td>
</tr>
<tr>
<td>1915-2245Z</td>
<td>17Z</td>
</tr>
<tr>
<td>1945-2245Z</td>
<td>18Z</td>
</tr>
<tr>
<td>1945-2315Z</td>
<td>All Off</td>
</tr>
<tr>
<td>2015-2345Z</td>
<td></td>
</tr>
<tr>
<td>2045-0015Z</td>
<td></td>
</tr>
<tr>
<td>2045-2345Z</td>
<td></td>
</tr>
<tr>
<td>2115-0015Z</td>
<td></td>
</tr>
<tr>
<td>2215-0145Z</td>
<td></td>
</tr>
<tr>
<td>2245-0015Z</td>
<td></td>
</tr>
</tbody>
</table>

Contour Levels:
- 1 ug/m3
- 5 ug/m3
- 20 ug/m3
- 100 ug/m3
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Long range transport of smoke does not adhere to political or geographic boundaries

HMS analysis includes Central America during the peak burn season in that region

Responsibility for Central American analysis has very recently been transferred to the Mexican National Weather Service
Hurricane Wilma felled a vast number of trees and vegetation in the Yucatan producing fuel for potentially disastrous fires.
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

May 9, 2006

May 10, 2006
Currently we are just drawing smoke outlines

Very soon we will begin drawing contours of smoke concentration

Contours will be largely influenced by the GOES Aerosol and Smoke Product (GASP)
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Properties of GASP:

Produced ½ hourly

Fully automated

Utilizes GOES visible band brightness values

Aerosol Optical Depth (AOD) is converted to concentration using a mass extinction coefficient of 7.9 +/- 4.5 m2/g
Limitations of GASP (and analyst drawn contours):

- There is no vertical structure
- Due to dependence on visible imagery, only available during daylight
- Clouds hinder detection
- GASP does not distinguish between aerosol types – analysts attempt to
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Clouds and sun glint are difficult for GASP to resolve

Clouds mixed with smoke

Sun glint
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

• All products available on the Web at:
  www.ssd.noaa.gov/PS/FIRE/

• Includes links to
  archived products   automated algorithms
  GIS page         HYSPLIT smoke forecasts
  near real time imagery
  manual quality controlled analysis
RECENT CHANGES TO THE HAZARD MAPPING SYSTEM

Smoke plume
Additional contributors who have made the system possible

Donna McNamara  UMd/NASA MODIS fire team
George Stephens  CIMMSS GOES fire team
John Simko      Yi Song
Jamie Kibler    Ivan Csiszar
Tim Kasheta     Rob Fennimore
Po Li           Tad Franson