11-23-2009

The International Charter and Flood Mapping

Jie Shan
Purdue University - Main Campus, jshan@purdue.edu

Follow this and additional works at: http://docs.lib.purdue.edu/gisday
Part of the Other Civil and Environmental Engineering Commons

http://docs.lib.purdue.edu/gisday/18

This document has been made available through Purdue e-Pubs, a service of the Purdue University Libraries. Please contact epubs@purdue.edu for additional information.
The International Charter and Flood Mapping

Jie Shan
Geomantics Engineering of School of Civil Engineering, Purdue University; jshan@purdue.edu, 765-494-2168
November 20, 2009
Outline & Acknowledgement

• The Charter
• 3 flood examples
• Summary of lessons

• Ejaz Hussein
• KyoHyouk Kim
International Charter
Space and Major Disasters

• Organization:
  – An International agreement among Space Agencies

• Mission:
  – to support with space-based data and information relief efforts in
    the event of emergencies caused by major disasters

• History
  – Initiative: following the UNISPACE III conference held in Vienna, Austria in June
  – CSA (Canadian Space Agency) signed the Charter on October 20, 2000.
  – Charter implementation by identifying and creating a number of functional units
    and preparing the necessary policies and plans.
  – Charter declared operational as of November 1, 2000 after formal rehearsals and
    qualification tests.

Courtesy of Brenda Jones, USGS
The Charter History (con’t)

- The US National Oceanic and Atmospheric Administration (NOAA), and the Indian Space Research Organization (ISRO) became members in September 2001.
- In July 2003, the Comision Nacional de Actividades Espaciales (CONAE) joined the Charter.
- Detailed operational procedures established and kept under document configuration control.
- In 2005, the Japanese Space Agency (JAXA) joined the Charter in February, the United States Geological Survey (USGS) in April as part of the US membership, and the Disaster Monitoring Constellation (DMC) Consortium in November.
- The China National Space Administration (CNSA) joined the Charter in May 2007.
- Two hundred and fourteen (214) disasters covered to date in various parts of the world.

Courtesy of Brenda Jones, USGS
Charter Member Agencies

Courtesy of Brenda Jones, USGS
Activation Distribution
(Floods and storms)

As of April 30, 2009

Courtesy of Brenda Jones, USGS
Data Units Used for Various Disasters
(Floods and storms)

Courtesy of Brenda Jones, USGS
Charter Operational Loop

Disaster

Authorized User (AU)

On-Duty Operator (ODO)

Emergency On-Call Officer (ECO)

Project Manager (PM)

End User (EU)

Value-Added Reseller (VAR)

CSA

ESA

ERS-2 and ENVISAT

CNES

SPOT-1, 2, 4 & 5

NOAA

NOAA-12, 14, 15, 16 & 17, POES and GOES

ISRO

IRS

SAC-C

JAXA

ALOS

USGS

Landsat

CNSA

DMC Constellation

CBERS

Courtesy of Brenda Jones, USGS
Indiana Flood June 2008
(The Charter was not directly involved)

https://engineering.purdue.edu/CE/floodmaps/main.htm
Background

- June 1 -7, 2008 about 7-10 inches of rain in Midwest
  - Clay, Owen and Greene etc Counties
- The week-long rain caused floods in Wabash and White rivers
- Average June rainfall of 8 inches, about 4 inch above normal
- Severity
  - State of emergency in 23 counties declared by State Governor
  - 39 counties declared as major disaster by the President
  - About 51 counties were affected by the floods
- Initial Estimated loss of about 126 Million to $1 Billion
- 3 (three) persons dead
• An average of about 12 feet water level increase in about 5 days
• Highest water level recorded Mt Carmel, IL June 14, 2008 - 33.24 feet (remained 8 days above flood stage)
Water Levels for White River

<table>
<thead>
<tr>
<th>Date</th>
<th>Station</th>
<th>Footage 2007</th>
<th>Footage 2008</th>
<th>Flood Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-Jun</td>
<td>Spencer, IN</td>
<td>4.19</td>
<td>14</td>
<td>3.63</td>
</tr>
<tr>
<td>9-Jun</td>
<td>Newberry, IN</td>
<td>3.63</td>
<td>13</td>
<td>3.66</td>
</tr>
<tr>
<td>12-Jun</td>
<td>Above Petersburg, IN</td>
<td>3.66</td>
<td>16</td>
<td>4.13</td>
</tr>
<tr>
<td>10-Jun</td>
<td>Petersburg, IN</td>
<td>4.13</td>
<td>16</td>
<td>3.66</td>
</tr>
</tbody>
</table>

Gauge Stations: Level Year 07, Level Year 08, Flood Stage

Data source: USGS
Datasets

- Landsat TM and ETM+ Images, June 9, 2007 and June 11, 2008
  - Coverage: South West Indiana
  - Resolution: 30m, 7 Bands (Used 6 bands)
  - Four scenes of the same area for each year
- MODIS Images
  - Pre flood: May 28, 29; Two scenes
  - Post flood: June 8 to June 19, 2008 – 14 scenes (7 cloud covered)
  - Resolution: 500 m, 7 Bands
- USDA cropland data layer of 2008, available in March 2009
- Indiana GIS data: county boundaries, rivers, streams and floodplains
- INDOT roads and streets data 2005
Landsat Images of the Study Area

LANDSAT TM JUNE 09, 2007

LANDSAT TM JUNE 11, 2008
Affected Crops

2008 crop data layer without (left) and with (middle) flood extent overlay, and damaged crops (right)
Crop Damages of 9 Counties

An average of about 15% of soybeans and corns affected by floods
## Crop Damages of 9 Counties

<table>
<thead>
<tr>
<th>County</th>
<th>Corn</th>
<th>Soybean</th>
<th>Wheat</th>
<th>Pasture, Hay</th>
<th>Forest, Shrubs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vigo</td>
<td>1823</td>
<td>3911</td>
<td>49</td>
<td>680</td>
<td>1675</td>
</tr>
<tr>
<td>Clay</td>
<td>1586</td>
<td>4058</td>
<td>23</td>
<td>208</td>
<td>1025</td>
</tr>
<tr>
<td>Owen</td>
<td>393</td>
<td>1336</td>
<td>31</td>
<td>510</td>
<td>1539</td>
</tr>
<tr>
<td>Sullivan</td>
<td>752</td>
<td>1994</td>
<td>18</td>
<td>647</td>
<td>1633</td>
</tr>
<tr>
<td>Greene</td>
<td>1607</td>
<td>7315</td>
<td>118</td>
<td>652</td>
<td>2061</td>
</tr>
<tr>
<td>Knox</td>
<td>1852</td>
<td>10496</td>
<td>63</td>
<td>526</td>
<td>2604</td>
</tr>
<tr>
<td>Daviess</td>
<td>1682</td>
<td>6544</td>
<td>38</td>
<td>297</td>
<td>1359</td>
</tr>
<tr>
<td>Pike</td>
<td>252</td>
<td>3265</td>
<td>2</td>
<td>249</td>
<td>1071</td>
</tr>
<tr>
<td>Gibson</td>
<td>780</td>
<td>2543</td>
<td>5</td>
<td>293</td>
<td>1362</td>
</tr>
<tr>
<td><strong>Total Area</strong></td>
<td><strong>10728</strong></td>
<td><strong>41462</strong></td>
<td><strong>347</strong></td>
<td><strong>4062</strong></td>
<td><strong>14329</strong></td>
</tr>
</tbody>
</table>
Flood Affected Roads

• INDOT 2005 roads and streets data

• Roads passing through floodplains are mostly affected

• Flood affected roads include
  
  – State Roads (SR 42, SR 246, SR 57, SR 157, SR 59)
  
  – US Highway (US 231)
  
  – County Roads and City streets
INDOT ROADS 2005

Flood Affected Roads

FLOOD AFFECTED ROADS

20  0  20  40 Miles

0  20  40 Miles

VIGO  CLAY  OWEN
SULLIVAN  GREENE
KNOX  DAVIESS
GIBSON  PIKE
Flood Affected Roads

- Vigo: 110 km (INDOT), 2684 km
- Clay: 78 km (INDOT), 1825 km
- Owen: 34 km (INDOT), 1776 km
- Sullivan: 74 km (INDOT), 2207 km
- Greene: 147 km (INDOT), 2471 km
- Knox: 238 km (INDOT), 2481 km
- Daviess: 147 km (INDOT), 1914 km
- Gibson: 174 km (INDOT), 2565 km
- Pike: 80 km (INDOT), 1586 km

Legend:
- Black bars: Roads INDOT- 2005 (km)
- Blue bars: Roads Under Flood (km)
Evaluation of Floodplains General

FLOOD WATER IN FLOODPLAINS
93000 Hectares

FLOOD WATER OUT OF FLOODPLAINS
6000 Hectares
Evaluation of Floodplains General

2.5 km

2.5 km

2.5 km

2.5 km

Legend:
- Pink: Floodplains
- Blue: Flood water in floodplains
- Red: Flood water out of floodplains
Web Interface

https://engineering.purdue.edu/CE/Academics/Groups/Geomatics/floodmaps
Web Interface

https://engineering.purdue.edu/CE/Academics/Groups/Geomatics/floodmaps
Indiana Flood March 2009

https://engineering.purdue.edu/CE/floodmaps/main.htm
(The Charter was involved)
March 2009 Northern Indiana Flood

- Heavy rain during the 2\textsuperscript{nd} week of March, 2009
- Resulted flooding of the Tippecanoe River in the White county
- Images provided by the Charter through IDHS during and after
- This data include both the optical and Radar imagery
### Image Data through the Charter

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Resolution</th>
<th>Acq Time</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALOS-PALSAR</td>
<td>6.25 m</td>
<td>03/13/2009 04:12:52</td>
<td></td>
</tr>
<tr>
<td>SPOT-4, XS</td>
<td>20 m</td>
<td>03/15/2009</td>
<td></td>
</tr>
<tr>
<td>WorldView-1, PAN</td>
<td>0.539 m</td>
<td>03/14/2009 16:56:52.41</td>
<td>Partly cloud covered</td>
</tr>
<tr>
<td>WorldView-1, PAN</td>
<td>0.539 m</td>
<td>03/18/2009 17:02:36</td>
<td>Mostly cloud covered</td>
</tr>
</tbody>
</table>
Study Area - White and Carroll Counties, Indiana

Lake Shafer/Norway dam

Monticello

Oakdale Dam

Tippecanoe River

Wabash River
ALOS image (left), ALOS extracted water extent (middle, red) atop Indiana 2005 image, and the extracted water after geo-registration (right)
DMC & Radarsat 2 offsets

2005 Cty Ortho

DMC

17 km

21 km
ALOS Derived Water Extent

ALOS PALSAR Image

Water Extent

ALOS PALSAR Image with water extent
SPOT-4 Derived Water Extent

SPOT -4 Image (Bands 4,3,2)  Water Extent  SPOT -4 Image with water extent
WorldView

WorldView Image

Water Extent

WorldView Image with water extent
WorldView Water extent atop Google Image
WorldView  Water extent atop Google Image
Georgia Flood Sept. 2009

https://engineering.purdue.edu/CE/floodmaps/main.htm

(The Charter was involved. JS as Project Manager)
Background

- Sept 19, 2009: 3.7 inch from daybreak to 8pm
- Sept 22, project manager appointed
- The Charter activated in the same time
- Activities
- Data
  - Landsat a bit too late
  - ALOS SAR
  - Envisat
  - Radarsat 1 and 2
  - Quickbird
  - SPOT etc
Flood areas

- Y: Radarsat 2
- B: ALOS
- G: Landsat
- Priority area
- Cty boarder
- Atlanta
22 Sept 2009; DigitalGlobe; Atlanta
Sample image from DG. From Web.
Lessons Learned

• Early warning and timely targeting
• Cloud coverage
• Geometric registration
• Processing difficulty on SAR imagery
• Large data transfer
• Other data should be included for further evaluation:
  – such as DTM, DSM, water gauge, flood plain,
  – population, landuse/landcover zone etc

https://engineering.purdue.edu/CE/floodmaps/main.htm