Final Report

Collection of Best Practices on the use of geospatial information for disaster risk reduction

UN-GGIM-AP WG2

October 2017
Contents

1. Overview of the Best Practice survey ........................................ 1
2. Key findings of the Best Practice cases ..................................... 1
3. Conclusion ............................................................................... 2
4. Summary list of Best Practices introduced .............................. 3
5. Best Practice cases .................................................................. 4
1. Overview of the Best Practice survey

(1) A Best Practice survey was conducted as a part of UN-GGIM-AP (United Nations Global Geospatial Information Management for Asia and the Pacific) WG2 (Disaster Risk Management, hereinafter WG2) (2015-2018) activities.

(2) NGIAs (National Geospatial Information Authorities) of Member States of UN-GGIM-AP were requested to submit at least one best practice, in conjunction with the questionnaire survey which was simultaneously conducted by WG2. Best Practice cases were invited twice on December 2015 and February 2017 from Member States.

(3) As of October 2017, 18 Best Practice cases have been collected from ten Member States.

2. Key findings of the Best Practice cases

(1) NGIAs in Asia Pacific region have already significantly committed to disaster risk reduction through implementing various kinds of activities.

(2) Kinds of disasters addressed reflect each Member State’s circumstances.

(3) Best practices mainly focus on responses during the occurrence of disaster. On the other hand, a few practices focus on before the occurrence of disaster or after the occurrence of disaster.

(4) Geospatial information produced and provided according to each disaster phase is:

1) Before the occurrence of disaster: hazard maps or hazard-related geospatial information provided to stakeholders and citizens to enlighten disaster risk of a particular area. (No.2, 10, 13, 14)

2) During the occurrence of disaster: aerial photos, satellite imagery, UAV images, topographic maps showing damage situation, evacuation sitemap of victimised people, and geodetic data. (No. 1, 3, 4, 6, 7, 8, 9, 11, 12, 16, 17, 18)

3) After the occurrence of disaster: DEM data to consider relocation of victimised people and topographical survey after landslides. (No.5, 15)

(5) Outcomes of the best practice reported are recognized as follows:

1) NGIAs’ data were used as a material for decision-making by government organizations and decision makers. (No.1, 2, 3, 4, 5, 7, 8, 11, 12, 15, 17, 18)
2) Some cases indicated that data were provided to citizens and residents via the internet to facilitate evacuation activities. (No. 6, 9, 14, 16)

3) Promotion of geospatial information application, enlightenment and capacity building of local governments were also reported. (No. 10, 13, 14)

4) A geospatial information catalogue for the provision in case of a disaster to help stakeholder quickly request required information to the NGIA. (No. 10)

5) Provision of geospatial platforms (such as geoportal) enabling stakeholder and people to view the situation spatially and to overlay their particular information. (No. 14)

(6) The future efforts mentioned are as follows:

1) Use of UAV which enables flexible and quick provision of information during disaster. (No. 2, 5, 11, 18)

2) Quick dissemination of geospatial products (No. 3, 11)

3) Development of geospatial information about the people vulnerable to disasters. (No. 4)

4) Enrichment of data in coordination with other organizations (No. 6, 16)

5) Densification of CORS network (No. 12, 17)

3. Conclusion

A variety of examples of Best Practices suggest that the collection be a valuable material for NGIAs in Asia and the Pacific to learn how to take a better action for Disaster Risk Reduction effectively.
## 4. Summary list of Best Practices introduced

<table>
<thead>
<tr>
<th>No.</th>
<th>Member state</th>
<th>Disaster Type</th>
<th>Information and Service</th>
<th>Title</th>
<th>Activity Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Australia: Geoscience Australia(GA)</td>
<td>Overall disaster</td>
<td>Location data</td>
<td>Real Time Crisis Response Mapping for Government Officials</td>
<td>Provided by Geoscience Australia to Government Emergency Crisis Coordination Centre and used by the government as a material for decision-making during disasters.</td>
</tr>
<tr>
<td>2</td>
<td>Bangladesh: Survey of Bangladesh(SOB)</td>
<td>Typhoon, Cyclone, Earthquake, etc.</td>
<td>Thematic map</td>
<td>Use of Geospatial information for DRR in Asia and the Pacific Region</td>
<td>Provided by Survey of Bangladesh to government organizations, and by integrating and sharing geospatial information in the government, contributed to mitigating disaster risks and saving of resources.</td>
</tr>
<tr>
<td>3</td>
<td>China: Satellite Surveying and Mapping Application Center (SASMAC)</td>
<td>Earthquake</td>
<td>Geospatial information</td>
<td>Earthquake</td>
<td>Used for emergency response during disasters.</td>
</tr>
<tr>
<td>5</td>
<td>Hong Kong Special Administrative Region (HKSAR): Lands Department</td>
<td>Landslide</td>
<td>Location data</td>
<td>Contingency Plan for Natural Disasters</td>
<td>Provided by the system of the website and used to identify the location at the occurrence of landslides and for recovery activities after the occurrence.</td>
</tr>
<tr>
<td>6</td>
<td>Indonesia: Geospatial Information Agency(BIG)</td>
<td>Volcano</td>
<td>Topographic map</td>
<td>Rapid Mapping of Kelud Mountain</td>
<td>By releasing evacuation routines and distribution of volcanic ash on the topographic map on the Internet, provided the people living around the volcano a material to make decision for evacuation.</td>
</tr>
<tr>
<td>7</td>
<td>Japan: Geospatial Information Authority of Japan(GSI)</td>
<td>Flood</td>
<td>Aerial photo, inundated area map</td>
<td>Floods as a Result of Heavy Rain</td>
<td>Swiftly disclosing the situation that specifies the inundation range on the Internet, contributed to initial restoration operations (placement of police, the numbers of semper trucks and workers, placement positions and determining work hours). Government and media used the data provided by GSI as trustworthy official information for disaster response and for news coverage.</td>
</tr>
<tr>
<td>8</td>
<td>Japan: Geospatial Information Authority of Japan(GSI)</td>
<td>Tsunami</td>
<td>Aerial photo, inundated area map</td>
<td>2011 Great East Japan Earthquake 2011 Great East Japan Earthquake</td>
<td>Immediately after the disaster, GSI created figures to provide related organizations with the general situation of the inundation range, conducted emergency shots of aerial photograph, and these resources were utilized in a wide range of fields, such as making the base map for disaster recovery planning. All of them are released on the Internet.</td>
</tr>
<tr>
<td>9</td>
<td>Japan: Geospatial Information Authority of Japan(GSI)</td>
<td>Overall Disaster</td>
<td>Thematic map</td>
<td>Evacuation Center Map for 2016 Kumamoto Earthquake</td>
<td>Creating Evacuation Center Map enabled on-site disaster response headquarters to understand information on evacuation centers and to support activities like providing supply goods to evacuation centers.</td>
</tr>
<tr>
<td>10</td>
<td>Japan: Geospatial Information Authority of Japan(GSI)</td>
<td>Overall Disaster</td>
<td>Creation of Disaster Geoinformation Catalog</td>
<td>Creation of Disaster Geoinformation Catalog</td>
<td>The national and local governments referred to the Catalog and understood what type of geospatial information GSI developed and owned. This preparation helped GSI meet their requests rapidly.</td>
</tr>
<tr>
<td>11</td>
<td>Malaysia: Department of Survey and Mapping Malaysia (DSMM)</td>
<td>Flood</td>
<td>Video by UAV</td>
<td>The Use of Unmanned Aerial Vehicle (UAV) to Monitor the Flood and Its Impact in Malaysia</td>
<td>By releasing evacuation routes and distribution of volcanic ash related organizations with the general situation of the inundation range on the Internet, contributed to initial restoration operations (placement of police, the numbers of semper trucks and workers, placement positions and determining work hours). Government and media used the data provided by GSI as trustworthy official information for disaster response and for news coverage.</td>
</tr>
<tr>
<td>12</td>
<td>Malaysia: Department of Survey and Mapping Malaysia (DSMM)</td>
<td>Earthquake</td>
<td>GNSS data</td>
<td>Earthquake Struck Ranai in Sabah, Malaysia</td>
<td>By analyzing GNSS data before and after earthquakes and releasing them on the early warning system of earthquake, contributed to the citizen for an early planning.</td>
</tr>
<tr>
<td>13</td>
<td>Philippines: National Mapping and Resource Information Authority (NAMRIA)</td>
<td>Hydromet* and Seismic**</td>
<td>Hazard map</td>
<td>Multi-Hazard Mapping of 28 Priority Provinces and the Greater Metro Manila Area</td>
<td>By providing local government organizations with hazard maps on the Internet, used as a material for decision-making of the area at the time of disasters.</td>
</tr>
<tr>
<td>14</td>
<td>Philippines: National Mapping and Resource Information Authority (NAMRIA)</td>
<td>Hydromet and Seismic</td>
<td>Hazard map</td>
<td>The Philippine Geoportal</td>
<td>By providing hazard maps on the Internet, contributed to the citizen in visually identifying risk areas.</td>
</tr>
<tr>
<td>15</td>
<td>Philippines: National Mapping and Resource Information Authority (NAMRIA)</td>
<td>Typhoon</td>
<td>Digital topographic map data, Ortho image</td>
<td>Recovery and Rehabilitation after Typhoon Haiyan</td>
<td>Used by the government to determine the status of disaster-affected areas and to identify safe and risk zones.</td>
</tr>
<tr>
<td>16</td>
<td>Philippines: National Mapping and Resource Information Authority (NAMRIA)</td>
<td>Typhoon</td>
<td>Hazard map</td>
<td>Mapping of Track of Typhoon Lawin (International Name: Haiyan) and Affected Areas and Population</td>
<td>The track of the typhoon was visualized by obtaining information from meteorological and statistical organizations and creating and releasing a map layout which showed the track. Through this effort, residents in the area at high risk for the typhoon were able to prepare.</td>
</tr>
<tr>
<td>17</td>
<td>Philippines: National Mapping and Resource Information Authority (NAMRIA)</td>
<td>Earthquake</td>
<td>GNSS data</td>
<td>Philippine Active Geodetic Network (PageNet) - Surigao Earthquake</td>
<td>GNSS enabled to acquire data of crustal displacement before and after the earthquake. Collaboration of observation system with other organization was achieved by continuous observation.</td>
</tr>
<tr>
<td>18</td>
<td>Sri Lanka: Survey Department</td>
<td>Tsunami</td>
<td>Digital topographic map data, and by</td>
<td>Expressing disaster-prone areas on the topographic map can make swift relief operations.</td>
<td></td>
</tr>
</tbody>
</table>

*Hydromet: flood, storm surge, rain-induced landslide,* **Seismic: ground rupture, ground shaking, tsunami, earthquake-induced landslide, liquefaction
5. Best Practice cases

No.1

<table>
<thead>
<tr>
<th>Country</th>
<th>Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Australia</td>
</tr>
<tr>
<td></td>
<td>Geoscience Australia(GA)</td>
</tr>
<tr>
<td>Title</td>
<td>Real Time Crisis Response Mapping for Government Officials</td>
</tr>
<tr>
<td>Outline of the subject natural disaster</td>
<td>Spatially enabling federal government to enhance decision making.</td>
</tr>
</tbody>
</table>

Response

- Geoscience Australia is supporting the Attorney-General's Department’s · Australian Government Crisis Coordination Centre · establish a spatial mapping capability as part of its crisis centre. Geoscience Australia also integrates fundamental and synthesised spatial data with statistical information for a given area of interest to estimate exposure. This information is provided in report form on request to the Australian Government Crisis Coordination Centre.

Effect

The collaboration between GA and AGD is supporting the ability of executive decision makers in government to make informed decisions on the coordination of the Australian Government’s response to domestic disaster events, using location based data.

Future

Continuous development and improvement of the capability supporting a joint mission across agencies.
<table>
<thead>
<tr>
<th><strong>Country</strong></th>
<th><strong>Bangladesh</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organization</strong></td>
<td>Survey of Bangladesh (SOB)</td>
</tr>
<tr>
<td><strong>Title</strong></td>
<td>Use of Geospatial information for DRR in Asia and the Pacific region</td>
</tr>
<tr>
<td><strong>Outline of the subject</strong></td>
<td>Floods, Storm surge, Drought, Tornado, Landslide and Cyclone are the main disaster. Beside these, country is in the risk of Earthquake and Sea Level Rise.</td>
</tr>
<tr>
<td><strong>Response</strong></td>
<td>Survey of Bangladesh is preparing thematic maps for the whole Bangladesh. Thematic maps will help the country to prepare an integrated, comprehensive and coordinated plan which is already underway.</td>
</tr>
<tr>
<td><strong>Effect</strong></td>
<td>By supplying geospatial information to the relevant agencies, the Government will be able to mitigate the natural disaster and can save our valuable resources.</td>
</tr>
<tr>
<td><strong>Future</strong></td>
<td>Our organization is planning to use UAV for capturing aerial photographs and making available live high resolution satellite images just after the disaster to prepare an integrated, comprehensive and coordinated post disaster plan.</td>
</tr>
</tbody>
</table>
No.3

<table>
<thead>
<tr>
<th>Country</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization</td>
<td>Satellite Surveying and Mapping Application Center (SASMAC)</td>
</tr>
<tr>
<td>Title</td>
<td>Earthquake</td>
</tr>
<tr>
<td>Outline of the subject</td>
<td>In China, earthquakes happen quite often, In almost all earthquakes, SBSM provides the maps after earthquakes including previous, in situ, and after maps</td>
</tr>
<tr>
<td>Response</td>
<td>The response of emergency mechanism of government</td>
</tr>
<tr>
<td>Effect</td>
<td>good</td>
</tr>
<tr>
<td>Future</td>
<td>Accelerate the speed of response including all kinds of disasters such as storm, flooding. etc</td>
</tr>
<tr>
<td>No.4</td>
<td>Country</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
</tr>
<tr>
<td></td>
<td>Organization</td>
</tr>
<tr>
<td></td>
<td>Title</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Response</td>
<td>The information provided by geospatial information assists in the coordination our response.</td>
</tr>
<tr>
<td>Effect</td>
<td>It really assists in the effectiveness and efficiency of response efforts.</td>
</tr>
<tr>
<td>Future</td>
<td>• Improve geospatial information</td>
</tr>
<tr>
<td></td>
<td>• Mapping of people with disability</td>
</tr>
<tr>
<td><strong>Country</strong></td>
<td><strong>Hong Kong Special Administrative Region (HKSAR)</strong></td>
</tr>
<tr>
<td>-------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Organization</td>
<td>Lands Department</td>
</tr>
<tr>
<td>Title</td>
<td>Contingency Plan for Natural Disasters</td>
</tr>
<tr>
<td>Outline of the subject natural disaster</td>
<td>A landslip is occurred affecting life and property.</td>
</tr>
</tbody>
</table>

**Response**
Lands Department (LandsD) is responsible for emergency and urgent repair works to landslips occurring on registered man-made slopes maintained by LandsD and to landslips that occur on man-made slopes on unleased and unallocated Government land not maintained by other departments and affecting life and property. LandsD works in conjunction with the Civil Engineering and Development Department (CEDD) in determining maintenance responsibilities of registered man-made slopes. The maintenance responsibilities of slopes having been determined are contained in the Slope Maintenance Responsibility Information System (SMRIS) and publicized on the LandsD’s website (http://www.slope.landsd.gov.hk/smris/) and on CEDD’s Slope Information System (SIS) accessible from http://hkss.cedd.gov.hk. LandsD will assist as necessary in emergency situations. The Survey and Mapping Office (SMO) of LandsD is responsible for providing existing maps, plans and aerial photos of the scene in conjunction with Government Flying Services (GFS) in an emergency situation. The SMO will also conduct topographical surveys after the disaster if necessary.

**Effect**
Location and maintenance responsibility of the landslip are identified in the first instance. Geospatial information of the disaster scene is captured for investigation and restoration purposes.

**Future**
UAV will be deployed as a part of the emergency survey operation in future disaster incidents.
<table>
<thead>
<tr>
<th>No.6</th>
<th><strong>Country</strong></th>
<th><strong>Indonesia</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organization</strong></td>
<td>Geospatial Information Agency (BIG)</td>
<td></td>
</tr>
<tr>
<td><strong>Title</strong></td>
<td>Rapid Mapping of Kelud Mountain</td>
<td></td>
</tr>
<tr>
<td><strong>Outline of the subject natural disaster</strong></td>
<td>On February 13, 2014 mount Kelud erupted. The Centre of Thematic Mapping and Integration of Geospatial Information Agency (BIG) has conducted rapid mapping and analysis of Mount Kelud.</td>
<td></td>
</tr>
<tr>
<td><strong>Response</strong></td>
<td>BIG, together with some institutions and local governments, have provided the Disaster Susceptibility Map of Mount Kelud, Evacuation Sites and Routes, and Ash Distribution of Mount Kelud.</td>
<td></td>
</tr>
<tr>
<td><strong>Effect</strong></td>
<td>The above products have been published on internet so that many people in Blitar and Kediri Regencies could be saved.</td>
<td></td>
</tr>
<tr>
<td><strong>Future</strong></td>
<td>Many additional important information from ministries, local governments, and private sectors could be enriched the above maps.</td>
<td></td>
</tr>
<tr>
<td><strong>Country</strong></td>
<td><strong>Japan</strong></td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td><strong>Organization</strong></td>
<td>Geospatial Information Authority of Japan (GSI)</td>
<td></td>
</tr>
<tr>
<td><strong>Title</strong></td>
<td>Floods as a Result of Heavy Rain</td>
<td></td>
</tr>
<tr>
<td><strong>Outline of the subject natural disaster</strong></td>
<td>Due to the heavy rainfall from September 9 to 11 in 2015, the collapsing of levees, overtopping and leakage, inundation and the fracturing/breaking of levee slopes occurred in over 80 rivers. Immense damage was brought about as a result of this, including the loss of lives, injuries, and many incidents of houses being swept away and above the floor level inundation.</td>
<td></td>
</tr>
<tr>
<td><strong>Response</strong></td>
<td>Relief work and restoration activities were enforced in cooperation with related organizations after overtopping and damage occurred at the rivers. Specifically, aerial photos after the disaster were photographed, and photos before and after the disaster were provided to the government and disaster-stricken municipalities, while information was provided extensively to the nation on our homepage. By measuring the inundated area using photographic interpretations, the disaster effects and restoration situation after the disaster were monitored. Measurements of the inundated areas were updated daily and reported to the government until the inundated areas became small enough that drainage pump cars were no longer required.</td>
<td></td>
</tr>
</tbody>
</table>
### Effect
Swiftly disclosing the disaster situation that specifies the inundation range, contributed to initial restoration operations (placement of police, the numbers of pumper trucks and workers, placement positions and determining work hours).
As well, the government and media utilized the data provided by GSI as trustworthy official information in their disaster response and news coverage, reaffirming the significance of GSI.

### Future
It was possible to provide timely information to the government, as the government’s needs were understood through frequent interactions with various government posts on a regular basis. In other words, it is important that the required needs for policy making are grasped.
Furthermore, disaster simulations (hazard maps) of these rivers where levees broke had been released to the public until now. However, because a sense of danger was not clearly communicated to residents, it may also be believed that it didn’t lead to their swift evacuations. It is important to also raise the awareness of residents towards disaster prevention.
<table>
<thead>
<tr>
<th><strong>Country</strong></th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organization</strong></td>
<td>Geospatial Information Authority of Japan (GSI)</td>
</tr>
<tr>
<td><strong>Title</strong></td>
<td>2011 Great East Japan Earthquake</td>
</tr>
</tbody>
</table>

**Outline of the subject natural disaster**

The Great East Japan Earthquake that occurred at 14:46 on March 11 2011 with the largest Mw (moment magnitude) of 9.0 ever recorded in Japan, caused strong earthquake motions with an intensity over lower 6 on the Japanese scale of 7 in a wide area spanning eight prefectures from Iwate Prefecture to Chiba Prefecture, and triggered a powerful tsunami over 10-meters in height that hit the Pacific side of Japan’s Tohoku region, destroying an area of 561km² with its massive force, followed by an accident at the Tokyo Electric Power Company Fukushima Daiichi Nuclear Power Plant and resulting massive evacuation efforts, making it the most massive and multiple catastrophe our nation has ever experienced.

**Response**

Immediately after the disaster, Geospatial Information Authority of Japan created figures of the general situation of the inundation range, conducted emergency shoots of aerial photograph to provide to related organizations, and these resources were utilized in a wide range of fields. Specifically, figures of the general situation of the tsunami inundation and aerial photos were used for the creation of radiation dosimetry maps, the issuing duties of disaster victim certificates, and explanatory manuals for volunteer activities etc. Apart from these, the disaster recovery plan base map, provided by Geospatial Information Authority of Japan, was also utilized.

![Radiation dosimetry map (estimate)](image-url)
<table>
<thead>
<tr>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Various resources to serve restoration/recovery were created and provided using the map provided by Geospatial Information Authority of Japan as its base. For example, in areas where massive emigration was conducted, the time and cost spent on the move was significantly reduced using the results of the cadastral survey results.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td>Though most of the three months after the disaster was spent for grasping the damage situation, because the information gets complicated, the swift disclosure of “trustworthy maps” issued by the nation is indispensable for grasping damage situations towards their recovery. In the future, Geospatial Information Authority of Japan will continue to seriously maintain and provide geospatial information for restoration/recovery, and promote the utilization of information, while understanding the needs of each field.</td>
</tr>
<tr>
<td>Country</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>Organization</td>
</tr>
<tr>
<td>Title</td>
</tr>
</tbody>
</table>

**Outline of the subject natural disaster**

A Mw 6.2 earthquake occurred in Kumamoto district in southern Japan on April 14, 2016 at 21:26 (pre-shock). Subsequently, a Mw 7.0 earthquake occurred on April 16 (main shock) at 1:25. These earthquakes are referred to as “The 2016 Kumamoto Earthquake.” The earthquake left 98 people dead, 830 severely injured and 1,491 slightly injured, as well as 8,198 buildings totally collapsed, 29,761 half-collapsed and 138,102 partially damaged. The earthquake hit Kumamoto city with the population of 730 thousand and its suburban municipalities, causing 180 thousand people to be evacuated at peak period.

**Response**

- Affected people who took precautions against possible aftershocks and people whose houses were totally collapsed took shelter in evacuation centers. As a result, the number of evacuees far exceeded the capacity of evacuation centers. Additionally, some evacuation centers themselves were too damaged to use. Because of these, many people had to stay and sleep outside or in their own car.
- On April 17, the following day of the main shock, evacuees’ living conditions became worse and their fatigue peaked due to rain and disruption of relief goods supply. However, the on-site disaster response headquarters, set up by the national government, did not have enough information about the location of the evacuation centers and the number of evacuees, which made the relief goods supply extremely difficult.
- Thus, the next day, on April 18, head of the on-site disaster response headquarters directed Geospatial Information Authority of Japan (GSI) to create a distribution map which showed the locations of the evacuation centers. In response, GSI mobilized disaster response staff, organized and compiled on-site information and existing materials, and created Evacuation Center Map (Figure 1).

On April 20, GSI completed and provided the first map for the on-site disaster response headquarters.

**Effects**

Evacuation Center Map significantly contributed to the on-site disaster response headquarters for accessing evacuation centers and for assisting in relief supply. Since evacuation centers were re-organized and closed according to the change of number of evacuees, GSI had updated the map once a week for four months since the earthquake, until August 2016. The map played an important role in the operation and environmental management of the evacuation centers.

**Future**

The Basic Act on Disaster Control Measures of Japan (revised in 2013) stipulates that mayors of municipalities designate the emergency evacuation areas and evacuation centers. Public facilities such as schools are often designated as such evacuation facilities. Since designation of the facilities is subject to change as appropriate, their location information needs to be updated on a regular basis. GSI prepared the location information of emergency evacuation areas by establishing a framework of cooperation with Cabinet Office and Fire and Disaster Management Agency, as well as collaborating with prefectures, municipalities and the like. The location information of emergency evacuation areas became publicly available on GSI web map in February 2017, and GSI will continue to update the information (Figure 2).

*1 Emergency evacuation area: A place to evacuate residents and other people at immediate risk caused by tsunami, flood or other disasters, in order to secure safety of their lives
*2 Evacuation center: Facilities to accommodate residents and other people who have escaped from disaster up until there is no further disaster risk, or to temporally accommodate those who cannot return home due to disaster.
Figure 1: Evacuation Center Map (east of Kumamoto city) provided by GSI and utilized by on-site disaster response headquarters

Figure 2: Emergency evacuation area provided in web map (Kumamoto city and its vicinity)
<table>
<thead>
<tr>
<th>No.10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Country</strong></td>
</tr>
<tr>
<td><strong>Organization</strong></td>
</tr>
<tr>
<td><strong>Title</strong></td>
</tr>
<tr>
<td><strong>Outline of the response to natural disaster</strong></td>
</tr>
<tr>
<td><strong>Response</strong></td>
</tr>
<tr>
<td><strong>Effects</strong></td>
</tr>
<tr>
<td><strong>Future</strong></td>
</tr>
</tbody>
</table>
Disaster Geoinformation Catalog (excerpt)

Cover Page

No.5 Volcanic land condition map

No.12 Crustal displacement map

No.16 Unmanned aerial vehicle

(Available Disaster Geoinformation to be provided by GSI at disaster occasions)

(Disaster Geoinformation Catalog)

As of 1 March 2016

(As of 1 March 2016)

平成28年3月1日作成
<table>
<thead>
<tr>
<th>No.11</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Country</strong></td>
<td>Malaysia</td>
</tr>
<tr>
<td><strong>Organization</strong></td>
<td>Department of Survey and Mapping Malaysia (DSMM)</td>
</tr>
<tr>
<td><strong>Title</strong></td>
<td>The Use of Unmanned Aerial Vehicle (UAV) to Monitor the Flood and Its Impact in Malaysia</td>
</tr>
<tr>
<td><strong>Outline of the subject</strong></td>
<td>Floods are the major natural disaster threat facing Malaysia. The 2014 year-end downpour and floods has been the worst ever in the country’s history, affecting more than half a million people. Damage to infrastructure alone was estimated RM2.851 billion. Areas that have never experienced floods before were also inundated and floodwater rose at an unprecedented level.</td>
</tr>
<tr>
<td><strong>Response</strong></td>
<td>The video and aerial photo captured using UAV have been used to provide information about the areas that were susceptible to the floods and locations where people can be evacuated to. The data have been used for making post flood damage assessments and identifying the facilities need to be repaired urgently such as roads, bridges, water treatment plant, etc.</td>
</tr>
<tr>
<td><strong>Effect</strong></td>
<td>The process to search and rescue flood victims were expedited by using the UAV data. Besides that the refurbishment and reconstruction of damaged facilities were expedited to ease the transportation links in moving people and goods to the affected area. The use of UAV also has saved the operational cost due to its flexibility and cheap flying operation with less constraint on time and human resources.</td>
</tr>
<tr>
<td><strong>Future</strong></td>
<td>To provide UAV data during and after disaster for relief and recovery purposes particularly on the remote area. Efficient dissemination of information</td>
</tr>
</tbody>
</table>
Earthquake Struck Ranau in Sabah, Malaysia

A magnitude 5.9 earthquake struck near Mount Kinabalu killing 18 and stranding more than a hundred people on the peak. The quake damaged roads and buildings, including schools and a hospital on Sabah's west coast. Geospatial information also plays a big role to monitor the crustal and surface motion by using Continuously Operating Reference Station (CORS) data.

The earthquake that occurred in Ranau on 5th June 2015 which is near to Mount Kinabalu had caused massive landslides around the mountain and nearby area as well. The data before and after earthquake from CORS stations (MyRTKnet) and 11 GNSS monuments were analysed and has indicated the surface motion on the area is between 36 to 53 cm. The output reflected the benefit to monitor the progress of motion so that the early warning for earthquake can be disseminated to alert the surrounding people.

The data from CORS stations (MyRTKnet) and 11 GNSS monuments has contributed significant information for an early warning system for earthquake in order to expedite the necessary evacuation of people from the hazard area. Also important in the following cases:

- Overall picture and extent of damage caused
- Indication of ground displacement
- Planning and distribution of aids

To densify the CORS stations (MyRTKnet) throughout the country
No.13

<table>
<thead>
<tr>
<th>Country</th>
<th>Republic of the Philippines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization</td>
<td>National Mapping and Resource Information Authority (NAMRIA)</td>
</tr>
<tr>
<td>Title</td>
<td>Multi-Hazard Mapping of 28 Priority Provinces and the Greater Metro Manila Area</td>
</tr>
</tbody>
</table>

**Outline of the subject natural disaster**

The Philippines is consistently visited by tropical disturbances exposing communities to hydrometeorological hazards such as strong winds, storm surge floods/flashfloods, and rain-induced landslides. The country, being located in the Pacific ring of fire, is likewise exposed to seismological hazards such as ground shaking, ground rupture, earthquake-induced landslide, and liquefaction.

Aiming to have a safer and disaster resilient communities, multi-hazard mapping of the 28 high risk provinces was implemented to map out areas exposed to natural hazards. The output of this activity will facilitate evidence-based decision-making by local and national authorities.

**Response**

The Agency provided base maps, capacitated LGUs on the use of GIS technology, engaged technical staff in the integration of hazard maps for use by the local government units and national government agencies, and participated in the conduct of information and education campaign (IEC) in the communities primarily exposed to hazards.

**Effect**

1. Raised awareness on the impending hazards confronting the exposed communities in the provinces.
2. Hazard maps are increasingly used in the formulation of land use and physical development plans.
3. Hazard maps used in the formulation of local DRRM plans.
4. Increasing number of LGUs expressing interest in the use of GIS for DRRM

**Future**
<table>
<thead>
<tr>
<th>Country</th>
<th>Republic of the Philippines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization</td>
<td>National Mapping and Resource Information Authority (NAMRIA)</td>
</tr>
<tr>
<td>Title</td>
<td>The Philippine Geoportal</td>
</tr>
<tr>
<td>Outline of the subject natural disaster</td>
<td>The Philippine Geoportal is envisioned to provide a comprehensive and consistent geospatial information of the country. It aims to support the geospatial information needs of users in various disciplines by providing access to such information. In the aftermath of Tropical Storm Ketsana (Ondoy) which left Metro Manila and 30% of the provinces in the Philippines under state of calamity, geohazard maps were prepared for the 28 high risk areas in the country. These maps were made accessible to the public through the Philippine Geoportal.</td>
</tr>
<tr>
<td>Response</td>
<td>Developed in the Philippine Geoportal is a DRRM application which provides a visual appreciation of the hydrometeorological and seismological hazards in the high risk areas of the country.</td>
</tr>
</tbody>
</table>
| Effect                | 1. Increased awareness of the public on the hazards faced by the community.  
2. Hazard maps are increasingly used in the formulation of land use and physical development plans.  
3. Hazard maps used in the formulation of local DRRM plans. |
<p>| Future                | |</p>
<table>
<thead>
<tr>
<th>Country</th>
<th>Republic of the Philippines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization</td>
<td>National Mapping and Resource Information Authority (NAMRIA)</td>
</tr>
<tr>
<td>Title</td>
<td>Recovery and Rehabilitation after Typhoon Haiyan</td>
</tr>
<tr>
<td>Outline of the subject natural disaster</td>
<td>The harrowing impact of typhoon Haiyan left about 4 million people homeless. This prompted the Philippine government to ensure the safety of the affected communities, moving them away from the seashore to more suitable relocation sites. In focusing on the recovery and rehabilitation phase, the immediate objective is to identify areas suitable for relocation of those left homeless by the typhoon.</td>
</tr>
<tr>
<td>Response</td>
<td>NAMRIA provided technical assistance with the provision of IfSAR data which includes digital terrain models (DTM), digital surface models (DSM), and orthorectified images used in the identification of suitable relocation sites for the affected communities.</td>
</tr>
<tr>
<td>Effect</td>
<td>The government was able to advance and fast track the identification of safe and unsafe zones in the Haiyan-affected areas.</td>
</tr>
<tr>
<td>Future</td>
<td></td>
</tr>
</tbody>
</table>

No.15
<table>
<thead>
<tr>
<th>Country</th>
<th>Philippines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization</td>
<td>National Mapping and Resource Information Authority (NAMRIA)</td>
</tr>
<tr>
<td>Title</td>
<td>Mapping of Track of Typhoon Lawin (International Name: Haima) and Affected Areas and Population</td>
</tr>
<tr>
<td>Outline of the subject natural disaster</td>
<td>In 19 October 2016, Typhoon Lawin (Haima) classified as extremely dangerous by the state’s weather agency affected the provinces in the northern part of the country. As it intensified into a super typhoon, destructive floods and massive landslides were expected to be brought by moderate to heavy rains within its 800-km diameter.</td>
</tr>
<tr>
<td>Response</td>
<td>NAMRIA prepared a map layout showing the track of Typhoon Lawin (Haima), the likely affected provinces and population. NAMRIA integrated data from various sources such as Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) and the Philippine Statistics Authority (PSA). The map was made public via NAMRIA’s website for download by other DRR agencies, local government units, and other interested parties.</td>
</tr>
<tr>
<td>Effects</td>
<td>The public is able to visualize the track of the typhoon and is made aware of the areas and population likely to be affected by it. This increased awareness of the residents in the likely affected areas to prepare for the impending typhoon.</td>
</tr>
<tr>
<td>Future</td>
<td>Strengthen coordination with DRR and other agencies providing statistical data relevant to disaster preparedness.</td>
</tr>
</tbody>
</table>
Map showing the track of Typhoon Lawin and likely affected areas. The map was made available for public download at NAMRIA’s website.
<table>
<thead>
<tr>
<th>No.17</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Country</strong></td>
</tr>
<tr>
<td><strong>Organization</strong></td>
</tr>
<tr>
<td><strong>Title</strong></td>
</tr>
<tr>
<td><strong>Outline of the subject natural disaster</strong></td>
</tr>
<tr>
<td><strong>Response</strong></td>
</tr>
<tr>
<td><strong>Effects</strong></td>
</tr>
<tr>
<td><strong>Future</strong></td>
</tr>
</tbody>
</table>

\(^1\) Coordinates in the International Terrestrial Reference Frame (ITRF) 2008
Figure 1. PageNET active geodetic stations monitored (in red)
Figure 2. 2D Displacement (9 to 11 February 2017 = 12.9 cm, north-west)

Figure 3. Northing Displacement (9 to 11 February 2017 = 10.1 cm, north)
Notes:

1. Date format: dd.mm.yy, e.g. 1.02.17 = 1 February 2017
2. Each data point corresponds to one daily solution processed from Bernese
3. Displacements measured is difference of each daily coordinates from PageNET AGS’ reference ITRF2008 coordinates (epoch 15 May 2015). For example, in Figure 3, PSUR Northing has moved ~0.04 m (N) on 29 January 2017 from its 15 May 2015 coordinates.

Figure 4. Easting Displacement (9 to 11 February 2017 = 8.0 cm, west)

Figure 5. Height Displacement (9 to 11 February 2017 = 2.8 cm, down)
<table>
<thead>
<tr>
<th><strong>Country</strong></th>
<th><strong>Sri Lanka</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization</td>
<td>Survey Department</td>
</tr>
<tr>
<td>Title</td>
<td>Surveyor General</td>
</tr>
<tr>
<td>Outline of the subject natural disaster</td>
<td>Tsunami – 2004 December 26</td>
</tr>
<tr>
<td><strong>Response</strong></td>
<td>Providing available digital data / maps and technical support to map the disaster prone areas / damages</td>
</tr>
<tr>
<td></td>
<td>Identify available resources for relief activities</td>
</tr>
<tr>
<td><strong>Effect</strong></td>
<td>Help quick dispatch of support</td>
</tr>
<tr>
<td></td>
<td>Relief providing activities</td>
</tr>
<tr>
<td></td>
<td>Locations for relief camps</td>
</tr>
<tr>
<td></td>
<td>Medical support availability information</td>
</tr>
<tr>
<td><strong>Future</strong></td>
<td>Fully pledged database on topographic information / resources available which is shared with stakeholders / allowing them to add / update information</td>
</tr>
<tr>
<td></td>
<td>Quick mapping with UAV when required</td>
</tr>
<tr>
<td></td>
<td>Provide accurate digital elevation model</td>
</tr>
</tbody>
</table>