PROCEEDINGS

8th International Workshop on Remote Sensing for Disaster Management

Campus Innovation Center
Tokyo Institute of Technology
Tokyo, Japan
September 30 to October 1, 2010

Workshop Sponsors:

U.S. Geological Survey
Tokyo Institute of Technology
Earthquake Engineering Research Institute
MCEER
ImageCat, Inc.

Group Photo of Workshop Participants

February 15, 2011

Acknowledgments

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Workshop Summary

The following observations were recorded over the two-day period:

1) The 8th International Workshop on Remote Sensing for Disaster Management which was held at the Campus Innovation Center at the Tokyo Institute of Technology, Tokyo, Japan between September 30 and October 1, 2010 was one of the most diverse workshops to date. Over 30 participants from nine different countries delivered 28 presentations on a broad set of topics dealing with *recent worldwide earthquakes, tsunami effects, earthquake effects, hurricane effects, damage detection methodologies, building inventory development, and new and emerging technologies for disaster response.* In addition, because of the devastating effects caused by two recent earthquakes – the Haiti and Chile earthquakes – three special sessions were organized in this workshop in order to learn from these events. A common conclusion from the discussions is that the role of remote sensing has expanded significantly in the last several years, and in fact, recent events have clearly defined a new direction and paradigm for post-disaster damage assessment, one which includes remote sensing technologies.
2) A highlight of the workshop was an invited presentation by Professor Masanobu Shinozuka of the University of California at Irvine on "*Remote Sensing for Spatially-Distributed System Modeling and Calibration*." Professor Shinozuka discussed the importance of evaluating the vulnerability of critical services by examining these services as systems, i.e., an interconnected network of components. He also encouraged the group to view another paradigm of damage assessment where sensors on structures are used to collect post-earthquake data that is telemetrically sent back to a central site for analysis. This approach is likely to provide more detailed and accurate information on facility performance that can be correlated with other datasets, e.g., remotely-sensed assessments.
3) Another highlight of the workshop was an invited presentation by Dr. Makoto Kawai from the Satellite Applications and Promotion Center of the Japan Aerospace Exploration Agency (JAXA). Dr. Kawai discussed an initiative called *Sentinel Asia* which

was established in 2005 as an international collaboration between space and disaster management agencies to apply remote sensing and Web-GIS to assist disaster management in the Asia-Pacific region. A step-by-step approach for Sentinel Asia was presented in this workshop.

4) In order to help focus discussions on the future direction of remote sensing in disaster management, a special panel session that included worldwide remote sensing experts (Fumio Yamazaki, Fabio Dell'acqua, Chris Renschler, and Norman Kerle) was organized. The discussions covered insights and opinions on the following questions: a) What events or achievements have impressed you the most with regard to the integration of remote sensing into disaster management? b) What has not occurred or been achieved that you feel strongly should have by now to improve the use of remote sensing in disaster management? c) If you had complete control over one item or activity (such data availability, image resolution, or research direction), what would that be and what would you like to see happen?

5) A new thrust for damage studies is using remotely-sensed images/data for the purpose of developing damage or fragility models. This was especially evident in several studies of tsunami damage (2010 Chile earthquake, 2009 Samoa earthquake, and the 2004 Indian Ocean earthquake) where probabilistic models relating building failure to inundation height, wave velocity, and hydrodynamic pressure were produced from empirical data from these events.

6) Another new direction for the use of remotely-sensed data is in measuring, monitoring and evaluating post-disaster recovery. High-resolution imagery datasets offer a unique opportunity for tracking the progress of recovery and rebuilding after a major disaster. This ability is important in assessing whether recovery is progressing as planned. A major thrust of this research remains defining metrics that adequately represent recovery progress.

7) Remotely-sensed data are now being used to characterize the built environment; great interest was observed in methods that can be applied to large urban areas in a semi-automated way.

8) There were many examples of where remote sensing damage methodologies developed from one hazard type were successfully applied to other hazard types, e.g., storm surge to tsunami, or vice-a-versa.

9) Other research topics included: 1) advances in building inventory development, 2) integration of imagery datasets of different resolutions, 3) disaster preparedness and integration with modeling, 4) hurricanes, windstorms and tsunamis, 5) earthquakes effects, 6) advances in analytical techniques, and 7) disaster recovery.

10) A brief review of last year's workshop in Austin revealed that demonstrable progress has been made on almost all resolutions:

    - Social networking or "crowd-sourcing" was an important element of the Haiti earthquake damage assessment. For the first time, remote sensing technology was

used as the primary means of performing the post-event damage assessment for use in the Post Disaster Needs Assessment (PDNA) for the Haiti Earthquake.

- Some progress has been made in creating a damage scale for earthquake effects using remotely-sensed images – examples from the 2010 Haiti and the 2009 Samoa earthquakes provide proof of progress in this area.
- We continue to make progress in expanding worldwide participation in this workshop series with participants from Japan, US, UK, Italy, Peru, Thailand, the Netherlands, Iran and Sweden.
- The workshop focused on several recent disasters in order to keep the application of remote sensing technologies current. Presentations on recent events were highlighted in several talks: 2010 Haiti earthquake, 2010 Chile earthquake.
- The workshop has yet to attract more end-users to this workshop series. A more active participation of this group is considered critical if remote sensing technologies are to be a common tool in an emergency responder's toolbox.

Workshop Resolutions

The following resolutions were agreed upon by all workshop participants:

1) The **9th International Workshop on Remote Sensing for Disaster Management** will be held at Stanford University, USA on September 15-16, 2011.
2) The workshop participants enthusiastically supported the idea of exploring the notion of a remote sensing conference to be held once every two years to take the place of the current workshop series. The basis for this "graduation" is to open up the participation of this meeting to a much larger group that would include not only leading researchers in remote-sensing studies on disasters, but to the large group of end-users who have been largely absent from this workshop series. In order to adequately plan for this larger meeting, a longer planning period is required. In addition, a longer planning period will allow for more time in soliciting financial and organizational support for the conference.
3) During this workshop, an invitation from the Cambridge University Press to publish a book on Remote Sensing and its Impact on Disaster Planning, Response and Recovery was received early this year. Arleen Hill has agreed to serve as the Coordinator of this effort and will be chairing a small working group to 1) develop a detailed outline of the book, 2) identify and select chapter coordinators, and 3) select an editorial board to follow-through with the production of the first and subsequent drafts and the book.
4) One of the key impediments to damage detection that was discussed in this workshop was the lack of very high resolution (VHR) aerial imagery before an event occurs. In the past, comparisons between pre- and post-event imagery to detect damage have generally relied on comparing pre-event satellite imagery (generally 60 cm) with post-event aerial imagery (as fine as 15 cm). While there are procedures for performing these comparisons, another approach would be to ensure that VHR aerial imagery is collected before a major disaster for major at-risk cities throughout the world.

Therefore, the workshop participants support the notion of a global imagery fund that can be used to 1) develop building exposure data for high-risk cities; and 2) for use in damage detection studies after an event. In order to ensure transparency and meet critical priorities, the criteria for selecting imagery datasets must be clear. An important consideration for justifying an imagery fund is to demonstrate the value of the data in past events.

5) As a group, emphasize the importance of ground truth or survey data in validating the efficacy of remote sensing analyses, especially to affected countries or regions that have collected such data.
6) The notion of standardized damage scales for buildings, lifelines and the environment based primarily on using remote sensing data is still considered a high priority by the workshop participants. It was noted that having such a scale will help consolidate and analyze large datasets, i.e., ensuring that parallel damage assessment efforts are producing datasets that can be combined and integrated. A first step in creating these standardized damage scales may be defining the process of establishing the scales.
7) Expanding the emphasis of the workshop beyond just earthquakes was noted by participants.
8) A backward evaluation of past studies – especially in facilitating key response and recovery decisions - should be considered in helping to benchmark progress towards an assessment of the value of remote sensing in disaster management.
9) A priority for the next workshop continues to be to reach out to regions that have not been actively engaged with this workshop, e.g., Latin America, Africa, and other Asian countries.
10) Copies of all papers and presentations will be put up on the Tokyo Institute of Technology workshop website. Access to this website will also be possible through the MCEER website so that the general research community can also have access to the products from this year's workshop as well as previous workshops.

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APPENDIX A: Workshop Schedule

8th International Workshop on Remote Sensing for Disaster Management		
9/30 (Thu.)		
10:00-10:10	Opening	
	Saburoh Midorikawa	
10:10-12:30	The 2010 Chile earthquake & Tsunami	Title
	Shunichi Koshimura and Masashi Matsuoka	Searching Tsunami Affected Area by The 2010 Chilean Earthquake Tsunami by Integration of Tsunami Numerical Model and Satellite Images
	Yutaka Hayashi, Norihisa Usui, Masafumi Kamachi and Shunichi Koshimura	Detection of The 2010 Chile Earthquake Tsunami from Satellite Altimery
	Masashi Matsuoka and Shunichi Koshimura	Tsunami Damage Area Estimation for the 2010 Maule,Chile Earthquake Using Satellite SAR Imagery and DEM
	Hideomi Gokon, Shunichi Koshimura and Masashi Matsuoka	Developing Tsunami Fragility Curves for Structural Destruction in American Samoa
	Anawat Suppasro, Shunichi Koshimura and Fumihiko Imamura	Tsunami Fragility Curves and Structural Performance of Building along The Thailand Coast
	Daroonwan Kamthonkiat, Aneak Saiwanrunrkul, Shunichi Koshimura and Masashi Matsuoka	Shoreline Anomaly Mapping Using Multi-Temporal Remote Sensing-The Recent Updates after the December 2004 Tsunami in Phang Nga, Thailanad
	Tuong-Thuy Vu and Shunichi Koshimura	Object-Based Image Analysis to Support Numerical Tsunami Modelling
12:30-13:30	Lunch	
13:30-15:30	Damage Detection	Title
	Pralhae Uprety and Fumio Yamazaki	Damage Detection Using High Resolution TerraSAR-X Imagery in The 2009 L'Aquila Earthquake
	Hiroyuki Miura, Saburoh Midorikawa, Norman Kerle	Building Damage Distribution of the 2006 Central Java, Indonesia, Earthquake Detected from Satellite Optical Images
	Yoshihisa Maruyama, Akira Tashiro and Fumio Yamazaki	Construction of Digital Surface Model Using Digital Aerial Images to Detect Collapsed Buildings due to the Earthquake
	Thomas Oommen, Laurie G Baise, Rudiger Gens, Anupma Prakash and Ravi P Gupta	Documenting Liquefaction Failures Using Satellite Remote Sensing
	Tapas R. Martha and Norman Kerle	Object-Oriented and Cognitive Detection and Characterisation of Landslides
	Stuart M. Adams, Carol J. Friedland and Marc L. Levitan	Unmanned Aerial Vehicle Data Acquisition for Damage Assessment in Hurricane Events
15:30-16:00	Break	
16:00-17:00	Keynote Lecture	Title
	Masanobu Shinozuka,	Remote Sensing for Spatially Distributed System Modeling and Calibration
18:00-	Banquet (JAL City Hotel TAMACHI)	
10/1 (Fri.)		
10:00-12:00	The 2010 Haiti earthquake	Title
	Shinobu Ando and Hiroshi Ueno	The Crustal Deformation and the Damage area Caused by the M7.0 Earthquake in Haiti detected by ALOS/PALSAR
	Diego Aldo Polli, Fabio Dell'acqua, Paolo Gamba and Gianni Lisini	Earthquake Damage Assessment from Post-Event Only Radar Satellite Data.
	Markus Gerke and Norman Kerle	Use of Oblique Airborne Images for Automatic Structural Damage Assessment
	Babak Mansouri, Alaa Bahrami and Masanobu Shinozuka	Fuzzy Classification of Urban Damage in 2010 Haiti Earthquake An object-based approach using VHR optical data
	Keiko Saito, Robin Spence, Edmund Booth, Gopal Madabhushi, Ron, Eguchi, and Stuart Gill	Damage Assessment of Port au Prince Using Pictometry
	Ronald T. Eguchi, Stuart Gill,Shubharoop Ghosh, Walter Svekla, Beverley J. Adams, Galen Evans and Joaquin Toro	A Comprehensive Assessment of Building Damage after the January 12, 2010 Haiti Earthquake
12:00-13:00	Lunch	
13:00-14:40	Building Inventory & Sentinel Asia	Title
	Miguel Estrara	TBD
	Pooya Sarabandi	Advancements and Challenges in Building Inventory Campilation -An Integrated GIS and Remote Sensing Approach
	Wen Liu and Fumio Yamazaki	Urban Monitoring and Change Detection of Central Tokyo Using TerraSAR-X Images
	Babak Mansouri, Masanobu Shinozuka, Iman Entezari and Mahdi Motagh	Fully Polarimetric SAR Parameters and Correlation with Target Sensor Orientation
	Daniel Brown, John Bevington, Steve Platt, Keiko Saito, Beverley Adams, Torwong Chenvidyakarn, Robin Spence,Ratana Chuenpagdee, Amir Khan and Emily So	Monitoring and Evaluating Post-Disaster Recovery Using High-Resolution Satellite Imagery - Towards Standardised Indicators for Post-Disaster Recovery
14:50-15:20	Makoto Kawai, Kazuya Kaku, Shinya Tanaka, Atsushi Ono and Takafumi Horiuchi	SENTINEL ASIA - International Cooperation for Disaster Management in the Asia-Pacific Region-
15:20-15:30	Break	
15:30-17:00	Panel Discussion	
	Coordinated by Ron Eguchi	Towards International Network of Remote Sensing Technology dor Disaster Management

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APPENDIX C
Summary/Notes of Individual Sessions

The 2010 Chile Earthquake
Thursday, 30 September 2010
Chair: Keiko Saito

S. Koshimura and M. Matsuoka.
Searching Tsunami Affected Area by the 2010 Chilean Earthquake Tsunami by Integration of Tsunami Numerical Model and Satellite Images.

How can we determine the affected area of tsunami within a short period of time? Preliminary findings from implementation of numerical models and satellite images in a four component approach (hazard, exposure/vulnerability, damage estimation, and damage detection) to establish affected area of the Chilean earthquake were presented. Findings suggest that integrating numerical model of tsunami propagation and inundation, GIS analysis, and remote sensing data and techniques provides a robust method for quickly establishing impact areas for tsunami.

Y. Hayashi, N. Usui, M. Kamachi, and S. Koshimura.
Detection of the 2010 Chile Earthquake Tsunami for Satellite Altimetry.

Is it possible to monitor a tsunami from space, can we extract the tsunami from sea-surface-height measurements from satellite altimetry? Yes, despite technical issues associated with real-time analysis, it is possible to extract tsunami sea surface anomalies from satellite altimetry, for example the 2004 Indian Ocean tsunami. From a monitoring standpoint, it can take months to extract the tsunami signals for an event the size of the 2010 Chilean earthquake which presents a challenge for implementing the method in near-real-time/detection.

M. Matsuoka and S. Koshimura.
Tsunami Damage Area Estimation for the 2010 Maule, Chile Earthquake Using ASTER DEM and PALSAR Images on the GEO Grid.

A damage area detection scheme applied to the tsunami associated with the 2010 Chile earthquake was presented. Damage estimation determined by tsunami inundation susceptibility based on a DEM derived from pre-tsunami ASTER and post-tsunami assessment with PALSAR was described and evaluated. Results of damage detection scheme were compared with optical sensor images and field survey data /ground truth photographs. An automated approach to damage estimation remains case-by-case and requires additional datasets to be realized.

Tsunami
Thursday, 30 September 2010
Chair: Masashi Matsuoka

Title: Developing Tsunami Fragility Curves for Structural Destruction in American Samoa
Presenter: Hideomi Gokon

The goal of this study is to develop tsunami fragility curves in order to estimate damage probability of a disaster area. The American Samoa tsunami data is used to propose two types of fragility curves. One based on inundation height and the other based on flow velocity. These curves achieve damage probabilities as a function of hydrodynamic features of the tsunami. Numerical simulation of pre and post-event nadir satellite imagery is processed and the need for oblique/ground surveys is noted.

Title: Tsunami Fragility Curves and Structural Performance of Building along the Thailand Coast
Presenter: Anawat Suppasri

The goal of this study is to develop tsunami fragility curves in order to estimate damage probability of a disaster area. The Thailand tsunami data is used to propose three types of fragility curves. One based on inundation height, another on current velocity, and the other on hydrodynamic pressure. These curves achieve damage probabilities as a function of hydrodynamic features of the tsunami. Building occupation based on building area, construction types and roughness coefficients based on land use data is considered. Numerical simulation of pre and post-event nadir satellite imagery is processed for Thailand and compared with Japan and Indonesia.

Title: Shoreline Anomaly Mapping Using Multi-Temporal Remote Sensing- The Recent Updates after the December 2004 Tsunami in Phang Nga, Thailand
Presenter: Daroonwan Kamthonkiat

This study uses multi-temporal Remote Sensing and GIS information to map the shoreline of Thailand following the December 2004 tsunami. Satellite imagery and shoreline surveys are reviewed to determine the shoreline conditions pre-event, two years following the event (2006), and four years after the event (2010). The tsunami carried sediments from the shore (~70% to 100%); however, in 2006 recovery from erosion was evident. The 2010 survey indicated that the shoreline, specifically the sand dune area, changed shape in comparison to 2003. Most locations have partially recovered (over 50%) and a few areas have extended. Future works include high accuracy and shoreline height measurements.

Object-Based Image Analysis to Support Numerical Tsunami Modeling
Presenter: Tuong-Thuy Vu

The study aims to develop an object-based image analysis tool to extract building footprints from high resolution satellite imagery. The focus of this study is on building structures with occupational rates considered. A data analysis timeframe of less than 24 hours coupled with automated procedures achieved a greater than 70% accuracy rate from nadir imagery.

Damage Detection
Thursday, 30 September 2010
Chair: Pooya Sarabandi

Damage Detection Using High Resolution TerraSAR-X Imagery in the 2009 L'Aquila Earthquake
By Pralhad Uprety and Fumio Yamazaki (Chiba University)

Combined radar (TerraSAR-X) and optical (QuickBird) remote sensing approach using pre- and post event imagery was developed for the rapid damage assessment after an earthquake. Correlation and backscatter differences were used to detect changes in imagery. Correlation (r) is low and backscatter signals were high for same site indicating damaged buildings. Low NDVI and low r indicated damaged buildings (also indicates green spaces as false positives). High backscattering values indicate damaged buildings as well and thus a combination of both increases the detection of damaged buildings.

Building Damage Distribution of the 2006 Central Java, Indonesia Earthquake detected from Satellite Optical Images
By Hiroyuki Miura, Saburoh Midorikawa (both University of Tokyo) and Norman Kerle (ITC)

Damage assessment with high-resolution optical imagery requires a lot of time. Pixel-based damage detections based on pre-and post-event FORMOSAT-2 imagery is proposed that uses only build up areas previously extracted (vegetated and bare earth areas were excluded). A 200 m mesh allows a percentage estimate of number of pixels with likely damaged building and a statistical approach can be used to assess the damage. The validation of the approach was compared with GIS data or building damage data collected by University of Gadjar Mada (UGM) with three damage classes – heavy, medium, low damage - showed that the new approach works well for heavily damaged buildings, but pixels with surrounding dense vegetation were underestimated.

Construction of Digital Surface Model Using Digital Aerial Images to Detect Collapsed Buildings due to the Earthquake
By Yoshihisa Maruyama, Akira Tashiro and Fumio Yamazaki (Chiba University)

It is difficult to detect collapsed building by only assessing top view imagery. Collapsed buildings were detected by using digital surface models (DSM) of pre- (3 months before the EQ)

and post data sets (3 days after EQ). In the latter, DSM was created without ground-based GPS reference. Stereo-pairs of digital imagery allowed automatic photogrammetric extraction of DSM assessment of terrain and buildings but created differences due to lack of ground-based GPS support in the post-event DSM. Additional ground-based reference points improved post-event DSM. Visual qualitative comparison of DSM allowed better detection of differences in DSMs (quantification is still pending).

Object-Oriented and Cognitive Detection and Characterization of Landslides
By Tapas R. Martha and Norman Kerle

Create a landslide inventory after events based on object-oriented and cognitive detection methods going beyond pixel-based analysis. Resourcesat-1 and cartosat-1 imagery allowed deriving DEMs for two study sites in the Indian Himalaya allowing applying an elaborate series of algorithms based on reflectance values as well as terrain parameters to detect landslides automatically with very good results (~70-75% detection rates). However, the solution of remaining problems requires a high complex rule sets and trial & error image segmentation to further improve results. To improve guiding series of image segmentations and sub-segmentations of image portions allowed the removal of impurities and include process understanding of landslides to assess various origins, ages and processes in the types of landslides.

Unmanned Aerial Vehicle Data Acquisition for Damage Assessment in Hurricane Events
By Stuart M. Adams, Carol J. Friedland and Marc L. Levitan

UAVs aerial photographs allowing a low-cost option to assist damage assessment – with or without additional satellite-borne imagery of wind, flood and storm surge after hurricane events. The direct downlink of video imagery and GPS allows the timing and control of picture taking. The current research focus is on the development of a low-cost platform allowing point mesh of roof surfaces or other structural features. The combination of meteorological measurement towers and UAVs for pre- and post-event application will allow a powerful combination of gathering process data of hurricane related hazards and the impacts for a specific location.

The 2010 Haiti EQ – Part 1
Friday, October 1, 2010
Chaired by: Fumio Yamazaki

The Crustal Deformation and Damage Area Caused by the M7.0 Earthquake in Haiti detected by ALOS/PALSAR
Shinobu Ando and Hiroshi Ueno

Measuring crustal deformation caused by Haiti earthquake using SAR data was explained in this session. Considering patterns observed from SAR data, it was concluded that the fault is a left

lateral fault. Fault plane's orientation and the amount of deformation could be identified and be measured using SAR data.

Earthquake Damage Assessment from Post-event only Radar Satellite Data
Diego Aldo Polli, Fabio Dell'acqua, Paolo Gamba and Gianni Lisini

Use of "only post-event" very high resolution radar data to estimate building damage at city-block level was discussed in this session. This methodology is particularly important when young data acquisition systems are used or in cases where there is no pre-event image is available. The methodology was first developed and tested on areas damaged by L'Aquila, Italy earthquake and then applied to Haiti earthquake. Also use of ancillary optical data, in enhancing accuracy of the post-event damage detection was investigated. Further validation will be continued in future.

Use of Oblique Airborne Images for Automatic Structural Damage Assessment
Markus Gerke and Norman Kerle

Rapid damage mapping after events using Pictometry images (optical aerial photos with multiple image acquisition directions) was investigated in this section. Number of features such as texture, color, disparity, elevation (stereo images) and etc. were selected to define building damage. An investigation is done to identify the most useful feature(s) for identifying the damage and resulted damage classification was shown. An accuracy assessment was performed and some potential areas for improvements were identified.

The 2010 Haiti EQ – Part 2
Friday, October 1, 2010
Chaired by: Fabio Dell'Acqua

Damage Assessment of Port au Prince Using Pictometry
Keiko Saito, Robin Spence, Edmund Booth, Gopal Madabhushi, Ron Eguchi, and Stuart Gill

It was explained how the three datasets in Haiti (GEOCAN, Pictometry, ground survey) can be used and integrated. Some 60 locations in Port-au-Prince were selected and over 1200 buildings assessed in Pictometry for accuracy assessment (ca. 120 investigated on the ground). Accuracies obtained in image analysis are sufficient for a rapid overview, but better operationalization in existing methods is needed. Problems were also encountered with existing damage scales, which may have to be rethought.

The January 12, 2010 Haiti Earthquake: A Comprehensive Damage Assessment Using Very High Resolution Areal Imagery
Ron Eguchi, Stuart Gill, Shubharoop Ghosh, Walter Svekla, Beverley Adams, Galen Evans, Joaquin Toro, Keiko Saito, and Robin Spence

The talk focused on the value of crowd sourcing and the value adding of international collaboration in the damage mapping process. It was stressed that the Haiti response may create high expectations for similar data availability in future events, whereas flexibility in approaches is needed to be ready for different image availability. The Haiti event was been a catalyst for a radically new type of disaster response, with focus on collaboration and also non-expert contributions.

Uncovering Community Disruption Using Remote Sensing: An Assessment of Early Recovery in Post-Earthquake Haiti
John Bevington, Sarah Pyatt, Arleen Hill, Matthew Honey, Beverley Adams, Rachel Davidson, Susan Brink, Stephanie Chang, Dilnoor Panjwani, Robin Mills, Paul Amyx, and Ron Eguchi

The research reported on focused on how to use remote sensing techniques to study early post-disaster recovery, and also on how people actually overcame damage and social impacts. While based on the GEO-CAN PDNA, a substantial focus was placed on community member interviews to learn about how people and communities perceived damage and moved on after the event. A major observation was that recovery overall was quite slow, with nearly half of all affected structures in the 7 communities studied not changing in the 4 months after the event. One major problem was that remote sensing did not always match up linearly with progress on the ground – livelihood is more complex than having an intact building.

Building Inventory
Friday, October 1, 2010
Chaired by: Norman Kerle

Advancements and Challenges in Building Inventory Compilation - An Integrated GIS and Remote Sensing Approach
Pooya Sarabandi

1) Integration of GIS and RS for building inventories; 2) Using geometry of acquisition in oblique images, as well as shadow size, to establish building height; and 3) Geo-Linking: digitizing buildings is fine, but you need to link them to addresses, as most ancillary information is based on street address.

Fully Polarimetric SAR Parameters and Correlation with Target-Sensor Orientation and Building Height
Babak Mansouri, Masanobu Shinozuka, Iman Entezari and Mahdi Motagh

1) Determining building height and orientation based on (fully-pol)SAR data parameters; 2) Inverting the relation between polarimetric parameters (especially Pauli beta) and angle of physical building orientation; and 3) Building height and orientation are correlated with

polarimetric parameters, but at the resolution of PALSAR you may only retrieve the leading orientation of a city block.

Inventory Development of Metropolitan Lima for Earthquake Risk Assessment Based on High-Resolution Satellite Images
Miguel Estrada

1) Populating a geospatial building inventory with information relevant to social vulnerability; 2) Using new 8-band multispectral HR WorldView data for enhanced land cover classification based on a Spectral Angle Mapper classifier; and 3) Detecting and counting pool and vegetation density in urban blocks is a good proxy for social class of the neighborhood, which is in turn correlated to social vulnerability.

Classification of Fully Polarimetric SAR Satellite Data Using Genetic Algorithm and Neural Networks
Iman Entezari, Babak Mansouri and Mahdi Motagh

1) Land cover classification in urban areas using polSAR, i.e., without a sufficient knowledge of expected statistical parameters for each class; 2) Using genetic algorithm to select the best set of features for neural classification of land cover; and 3) Genetic algorithms are capable of selecting the best features, almost regardless of the classifier that is used at the following stage.

Miscellaneous
Friday, October 1, 2010
Chair: Shunichi Koshimura

Urban Monitoring and change detection of central Tokyo using TerrasarX
Wen Liu and Fumio Yamazaki

ALOS/PALSAR (L band) and TerrasarX (X band) used to carry out change detection in Tokyo. Radiometric calibration was carried out, and change detection applied to the images. Difference and correlation was combined. Application of Matsuoka's Z factor. Terrasar is affected by small changes. New builds were identified well, but buildings identified as removed were not always removed. For validation aerial photos were compared to the SAR analysis result.

Monitoring and evaluating Post-disaster recovery using high-resolution satellite imagery – towards standardized indicators for disaster recovery
Daniel Brown, John Bevington, Steve Platt, Keiko Saito, Beverley Adams, Torwong Chenvidyakarn, Robin Spence, Ratana Chuenpagdee, Amir Khan, and Emily So

Produced guideline for monitoring disaster recovery monitoring and evaluation using remote sensing. Combine use of remote sensing, ancillary data and ground surveys. Identified the

most effective method of data collection for the indicators identified. Data requirements will be different for various end users. Key is to identify these different end user needs.

Assessing community resilience: a remote sensing approach to evaluate post-disaster ecosystem recovery
Chris Renschler, Amy Frazier, and Scott Miles

Monitor change in the ecosystem/vegetation after extreme events. Resilience of systems. Resilience modeling engine by Scott Miles was used. ResilUS Agent based approach. The use of community resilience index approach allows interdisciplinary teams to continuously monitor the change in the eco systems. Assess the productivity of the ecosystem using GPP and NPP.

Sentinel Asia – international cooperation for disaster management in the Asia pacific region
Makoto Kawai, Kazuya Kaku, Shinya Tanaka, Atsushi Ono, and Takafumi Horiuchi

Led by APRSAF to assist disaster management using RS and GIS in Asia-pacific region. Assisted in 60 disasters so far. Trying to create one Data Analysis Node (DAN) in each participating country. Provides capacity building trainings. SENTINEL Asia is the coordinating body within the Asia Pacific region for disaster response mapping data provision, and is collaborating with disaster charter.

Panel Discussion
Friday, October 1, 2010
Chair: Ron Eguchi
Panelists: F. Yamazaki, F. Dell'acqua, C. Renschler, and N. Kerle

Final session of the 8th Workshop involved a four-person panel discussed to following questions:

What events or achievements have impressed you the most with regard to the integration of remote sensing into disaster management?

What has <u>not</u> occurred or been achieved that you feel strongly should have by now to improve the use of remote sensing in disaster management?

If you had complete control over one item or activity what would that be and what would you like to see happen?

What events or achievements have impressed you the most with regard to the integration of remote sensing into disaster management?

NK – crowd sourcing/community remote sensing - based data generation as well as damage assessment.

FY – now a more broad community sees the value and expects to access remote sensing data today … VDV, info gathering, info transfer

FD – amount of remotely sensed data made publically available in the aftermath of Haiti – really a momentum change was evident there – we now need to push agencies to meet that same level of sharing in the future; open street maps – precise, accurate, available

CR – Haiti changed the game in terms of accessibility and distribution of data, being part of the RIT and GEO-CAN – gathering data on an aerial platform and integrating that with satellite imagery – we are operating at a finer scale of details. We have arrived at the place where integration can take place and we are in a new era.

Follow-up – Haiti as a change – should we expect to have such availability as we saw in Haiti from here forward

CR – we should not, we should be flexible and focus on what info/data is crucial. Focus on accuracy assessment and supporting decision-makers.

FD – not to the same extent as Haiti, a major event that motivated resources, a trend is there but Haiti was an exceptional event not likely to be matched in the near term.

FY – we are researchers and are happy to have data – Haiti likely an exception, data providers can't provide free data all the time – we should examine the data we produced and see how products were used – usefulness assessed.

NK – Haiti was an exception, impact exceptionally large, awareness of stakeholders has increased – they are not aware of the value of remotely sensed information which in turn increases the demand for the data and therefore the imagery. Private companies such as Pictometry also have now learned of a niche area they will want to be competitive participants in.

What has <u>not</u> occurred or been achieved that you feel strongly should have by now to improve the use of remote sensing in disaster management?

CR – effective communication between users and producers of information – we can test and assess this for the Haiti case/experience and focus on time. Learning curve for researchers and practitioners. Define what we are going to do with the data after we gather it and extract it – how to we process the data. Measures of success that we identify as goals.

FD – We have homework, we must use the vase amount of data to refine our tools – it is important to have a clear definition of what we are looking for (damage assessment tools),

need to have reliable and punctual ground-truth. A clearinghouse for ground-truth data to complement a clearinghouse of remotely sensed data – to assess tool reliability and dependability. Protocol to match the opportunity that additional data … opportunity and expectations operationally … we need feedback from decision-makers. We are still guessing about what is useful.

FY – we need an archive of pre-event optical images for multiple event types, hydro-met events as well, SAR data and other platforms needed pre-event.

NK – damage assessment accuracy assessment – now that we are in a production-mode how did we get to the point of producing maps that are cartographically impressive but not assessed from a quality and accuracy standpoint; agreed upon damage-scale; map –generating proliferation and we need to look back at what we have done. Especially important in light of the escalating number of Charter activations. Disconnect between data providers/map makers and data consumers. Number of products and varying definitions may contribute to broadening the gap between providers and consumers.

If you had complete control over one item or activity what would that be and what would you like to see happen?

FY – more data, freely available. Charter doesn't apply to us …. Agencies provide data to response agencies but do response agencies have the skill/time resources to perform analyses. Research community as a welcome intermediary?

FD – more free data is helpful for scientific inquiries but we need guidance and understanding of whether we are extracting information of interest – different formats and standards of data as an impediment we can address through preparing an efficient channel between info producers and consumers/appliers. Wider use of RADAR data could address under-exploitation of the potential of this data set – helps us to do more.

CR – Data flow is a necessary step and responsibility – we can then assess a product. Usefulness of information can be accomplished and is a responsibility – we can illustrate the effectiveness of efforts. Do data we produce land in the hands of decision-makers.

NK – is information flow working out? Where are the bottle-necks. Charter – the charter is a great effort in principle, the issue is the western-domination of the charter, disconnect between organizations and the recipient nations – currently set-up is a single-direction, addition of feedback loops will propagate into mapping errors – identify from IDC alumni poll people who can be pre-deployed that we can call upon for cultural contectual information and processing – will reduce error and will promote capacity development in areas impacted by the events we respond to. Bi-directional information and data flow will be promoted and is a key missing component.

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