

Foreword

Special Issue: Haiti 2010 Earthquake

Jie Shan, Ronald Eguchi, and Brenda Jones

This October issue of *PE&RS* is the second of two consecutive issues on the Haiti 2010 Earthquake. The first six papers were published in the September issue, while the remaining six papers appear in this October issue. The following 12 papers from engineers and scientists in 11 different countries chronicle research on detecting region-wide impacts following the 12 January 2010 Haiti earthquake. This collection of papers is significant for many reasons. Of import is that the methods of damage detection and evaluation documented in these papers are based solely on the use of remote sensing technologies. Additionally, the Haiti earthquake is an event where a broad range of sensors were available to record its effects. Because of the physical and social disruption caused by this earthquake, many of the datasets used by the authors of these papers were provided at no charge by various data providers. This support is gratefully acknowledged.

In order to fully understand the nature of this event, the reader must view the Haiti earthquake from several different perspectives. First, the impact of the earthquake was captured using a myriad of sensor platforms. The day after the earthquake, high-resolution optical satellite imagery was available through GeoEye that provided the first glimpse of the devastation. The world had just witnessed the power of the 2008 Sichuan, China earthquake; however, the extent of devastation in Haiti shocked the global community, and in response, this community responded with a technical workforce unseen in prior disasters. In addition to these early satellite images, very high-resolution aerial imagery was available to provide even more details on the damage caused by this event. The World Bank, through the Global Facility for Disaster Reduction and Recovery (GFDRR), commissioned a seven-day mission to fly over greater Port-au-Prince with very high-resolution optical and lidar sensors. These data, available within days of the flight, were made freely available to all relief organizations and research institutions responding to this event. In addition, the International Charter Space and Major Disaster provided many space agencies' satellite sensors and other organizations provided data from other aerial photography and satellite missions. Most offered their data through the U.S. Geological Survey's Hazards Data Distribution System (HDDS) to provide unprecedented views of the earthquake, views that had never before been seen on such a large-scale. Certainly, from the standpoint of milestone events, the Haiti earthquake will be viewed as one of the most widely recorded events from the perspective of high-resolution imagery.

Also noteworthy in this event are the types of output produced by the researchers above. The vast majority of the papers focus on the damaging effects to buildings. In total, 8 of the 12 papers address some aspect of building damage, e.g., counts of destroyed or collapsed structures, or quantification

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Building Extraction and Rubble Mapping for City Port-au-Prince Post 2010 Earthquake with GeoEye-1 Imagery and Lidar Data, Dr. Jie Shan *et al.*

Damage Assessment of 2010 Haiti Earthquake with Post-Earthquake Satellite Image by Support Vector Selection and Adaptation, Gulsen Taskin Kaya *et al.*

Post-event Only VHR Radar Satellite Data for Automated Damage Assessment: A Study on COSMO/SkyMed and the 2010 Haiti Earthquake, Prof. Fabio Dell'Acqua and Diego Aldo Polli

Change Detection Applying Landscape Metrics on High Remote Sensing Images, Eva Savina Malinverni

A Novel Method of Urban Road Damage Detection using Very High Resolution Satellite Imagery and Road Map, Dr. Peijun Li *et al.*

A Comprehensive Analysis of Building Damage in the January 12, 2010 Mw7 Haiti Earthquake using High-Resolution Satellite and Aerial Imagery, Christina Corbane *et al.*

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Automatic Structural Seismic Damage Assessment with Airborne Oblique Pictometry Imagery, Dr. Markus Gerke and Dr. Norman Kerle

USGS Remote Sensing Coordination for the 2010 Haiti Earthquake, Kenneth A. Duda and Brenda K. Jones

Seismic-sonation of Port-au-Prince using Pixel- and Object-based Imaging Analysis Methods on ASTER GDEM, Alan Yong *et al.*

Rapid Damage Assessment and Situation Mapping for the 2010 Port-au-Prince Earthquake, using Very High Resolution Optical Imagery, Stefan Voigt *et al.*

Damage Indication Maps for Rapid Geospatial Reporting after the Haiti Earthquake - An Automated Object-based Approach, Dirk Tiede *et al.*

Geospatial Disaster Response During the Haiti Earthquake: A Case Study Spanning Airborne Deployment, Data Collection, Transfer, Processing, and Dissemination, Dr. Jan van Aardt *et al.*

of building debris. The reader will see that different methodologies are used to estimate damage to buildings. Most of the approaches are based on comparing changes between pre- and post-earthquake images; however, at least one paper uses only post-event images to discern different damage states. In addition, one paper discusses the application of “crowdsourcing” techniques to engage with a global community of engineers and scientists (over 600) to identify severely-damaged buildings using visual interpretation methods. Other noteworthy papers include studies that evaluate the damage state of roadway systems, and analyses that resulted in more accurate seismic zone maps for Haiti.

A collective analysis of these papers reveals several important lessons from this event. First, timely access to high-resolution imagery is key to rapid damage assessment and response. Without this access, quantification of impacts – especially on a regional level – is left to ground surveys which can take weeks to months to complete. Second, while satellite imagery usually provides our first visual view of damage, these data must be supplemented by higher-resolution data that is generally afforded through aerial platforms. Furthermore, access to oblique imagery proved to be critical in discerning damage to buildings that did not collapse. Third, for many of the severely damaged areas, it was important to have reference images that clearly showed what was there before the earthquake. While pre-event satellite images were sufficient, had higher-resolution aerial photographs been available before the earthquake, most damage assessments would have been completed more quickly and accurately. Fourth, access to “free” imagery helped to spawn many efforts that would

have otherwise stalled because of the high cost associated with quality data. The activation of the International Charter was an important development; however, the decision made by many data providers who typically do not “donate” their imagery for public access was an important milestone. Efforts to expand the collection of these non-traditional datasets and to have them accessible through the International Charter should be explored. And finally, concerted efforts to standardize damage measures and metrics for future disasters should be encouraged. While the range of data products was prolific in this earthquake, the fact that many of the studies provided different views of the extent of damage caused by this event is problematic. In some cases, the methodologies used to estimate damage are different, thus it is understandable why the results may differ. In many cases, however, the measure of damage or what observations best describe damage is not generally agreed upon. Therefore, a universal effort to define and agree upon standard measures of earthquake damage would reap significant benefits and ultimately, reduce the uncertainty in post-earthquake damage evaluations.

The editors of this special issue would like to acknowledge the efforts of all the authors and reviewers. While the results demonstrate the efficacy of remote sensing technologies for post-disaster impact assessment, the more important contribution of these papers is to help the country of Haiti understand the magnitude of the effects caused by the earthquake and to use this information to effectively plan for the reconstruction and rebuilding of Haiti. For this, we dedicate this special issue to the people of Haiti and to their efforts to build a better and more disaster-resilient country.

Special Issue Editors

Jie Shan

Purdue University
jshan@ecn.purdue.edu

Ronald T. Eguchi

ImageCat, Inc.
rte@imagecatinc.com

Brenda Jones

U.S. Geological Survey
bkjones@usgs.gov