SH-SSP 2018 EXECUTIVE SUMMARY

DISASTER MANAGEMENT

SPACE BASED SOLUTIONS FOR DEVELOPING NATIONS

SOUTHERN HEMISPHERE SPACE STUDIES PROGRAM 2018

University of South Australia

EXECUTIVE SUMMARY

SH - SSP 2018

OUR MISSION

"To identify and enhance the use of current and emerging space-based PNT technologies and services in developing nations' disaster management systems."

The Southern Hemisphere Space Studies Program is jointly organized by the International Space University (ISU) and the University of South Australia. The program provides a unique opportunity for professionals, graduate researchers, and undergraduate students to understand multidisciplinary aspects of space-related issues under the ISU's renowned educational philosophy: International, Intercultural, and Interdisciplinary.

This report is the result of the collaboration of 25 participants from nine different countries. The team was tasked to explore the integration of satellite position, navigation, and timing (PNT) technologies and services with disaster management systems of developing nations, and to recommend areas for future enhancement of the use of these services in the disaster management cycle.

What is PNT?

Position is the accurate and precise location of the end user.

PNT satellite information is provided to local devices independently of fixed ground stations, and can be vital in many aspects of the disaster management cycle (Kafi and Gibril, 2016).

Navigation relates the current position to the desired position and applies corrections to course, orientation, and speed.

Timing ensures that position and navigation are consistently maintained for the end user (US Department of Transportation, 2017).

The disaster management cycle is a framework for governments and agencies to actively reduce the impact of disasters. Continuously moving through the four stages of the cycle - mitigation, preparedness, response, and recovery - ensures that communities build disaster management capability and reduce their vulnerability.

CASE STUDIES

Case studies comparing multiple recent earthquakes in Indonesia and Chile revealed vulnerabilities in communications systems, evacuation plans, and warning systems in these developing countries.

In the Indonesian case study of the 2004 Boxing Day earthquake and subsequent tsunami, the primary issues identified were an insufficient warning system and a lack of functional emergency response procedures (Muhari, 2007).

The Chilean case study reviews two earthquakes over a magnitude of 7.0. Issues with loss of communication and poor evacuation strategies were identified (Gonzalez-Muzzio and Henriquez, 2015; ONEMI, 2014).

ISSUES & RECOMMENDATIONS

ISSUE #1

NETWORK UNAVAILABLE

The case studies of Indonesia and Chile revealed that disaster events result in infrastructure damage that can eliminate communication capabilities. Remote and disadvantaged communities without access to internet and cell phones miss out on crucial emergency information.

RECOMMENDATION#1

We recommend that developing nations build the capacity to deploy mobile communication vehicles such as stratospheric balloon networks, Unmanned Aerial Vehicles (UAVs), and Millimeter Wave (Mi-Wave) products in the emergency response phase. Considering developing nations' economic constraints, they could seek partnerships to access these resources from nations that have these technologies.
Internet connectivity and mobile networks can be made available for emergency responders in unconnected areas by using balloon based projects such as Loon Project and SkySite.

Issue #2{
In times of panic, there can be an overload of cellular networks in the affected location when members of the public try to contact friends and family. This results in a delay of communicating with emergency response teams and providing early warning to those in highest-risk areas.
}

RECOMMENDATION(#2){
Developing nations can combine open-access location data from the Global Navigation Satellite System (GNSS) with Internet of Things (IoT) devices and Artificial Intelligence (AI) to define critically vulnerable areas in disaster zones to prioritize incoming alert messages and outgoing distress messages or calls.
//Use an AI notification service algorithm to prioritize alerts based on location;
//Use mobile bluetooth technology for text messages in the disaster areas;
//Update national regulations and policy to include message prioritization;
}

ISSUE #3

Developing countries face issues with the lack of prompt information distribution from the government to the population after a disaster occurs, i.e., an earthquake followed by a tsunami (Hormazábal, 2012). The collapse of communication systems, including phones, and landlines becomes an issue in providing evacuation information and updates.

RECOMMENDATION #3

Developing nations can develop and introduce a smartphone application that encourages civilians to input locations of road blockages through crowdsourced data and social media during disaster response to optimize evacuation route updates. We recommend further research to ensure that the population are aware of the application and how to use it.

- Existing service 'Tomnod' uses satellite imaging and crowd sourced analytics
- Similar use of field observations and location data from affected people provide real-time updates on movements and obstacles
- Public, private, government sharing data and cooperation

ISSUE #4

Mitigation and preparedness are improved by reliable early detection systems. The Indonesian and Chilean case studies demonstrated that delayed warnings result in communities being unprepared for the impacts of an earthquake. Early prediction of an event gives additional notice to those affected, allowing them to better prepare for the impending event. Certain precursors exist that provide information on when a large scale earthquake will occur.

RECOMMENDATION #4

IDeveloping nations can investigate the development of a mobile app that encourages users to gather, self-index, and share field observations of abnormal animal behaviors to generate a model that links animal movement with prediction of seismic events.

RECOMMENDATION #5

Developing nations can seek access to electromagnetic measurements from satellites such as the China Seismo-Electromagnetic Satellite (CSES), which correlates earthquake predictions with global disaster management databases such as UN-SPIDER to improve the effectiveness of their mitigation and preparedness phases of their disaster plan.

RECOMMENDATION #6

Developing nations could monitor tectonic plate movements using Very Long Baseline Interferometry (VLBI) and IoT sensors at points of interest in an effort to predict earthquakes and communicate early warnings direct to civilian devices.

Considering developing nations economic constraints, access to these instruments and their data may be available in the future through extensions of the International Charter or other multilateral international agreements.

CONCLUSION

The more fragile infrastructure of developing nations is vulnerable to disruption during disasters. Earlier prediction of impending earthquakes, various methods to rapidly restore communications networks, and the use of electronic maps updated by crowdsourced and proximal/remote sensing data are just a few ways that services incorporating PNT can contribute to strengthening the management of disasters.

Although natural events such as earthquakes cannot be prevented, the recommendations of this report aim to help developing nations become familiar with the space-based technologies that could reduce the human, environmental, and economic impact of disasters.

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ACKNOWLEDGEMENTS

The 2018 Southern Hemisphere Space Studies program was held at the Mawson Lakes campus of the University of South Australia (UniSA), Adelaide, by the International Space University (ISU) and UniSA. The authors gratefully acknowledge the generous guidance, supportm and direction provided by the following faculty, visiting lecturers, teaching associates, program staff, advisors, and experts:

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Mr Duncan Blake	International Aerospace Law & Policy Group
Dr Gordon Cable	Australasian Society of Aerospace Medicine
Prof Iver Cairns	The University of Sydney
Mr Lih Wei Chia	BSE Space
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Mr Allan Scott	University of Canterbury
Ms Alexandra Seneta	Department of Industry Innovation and Science
Dr Michael Simpson	Secure World Foundation
Ms Flavia Tata Nardini	Launchbox
Dr Matthew Tetlow	AIAA
Dr Naomi Tsafnat	UNSW
Mr James Waldie	BAE Systems
Mrs Danielle Wood	MIT Space Enabled Research Group
Dr Soyeon Yi	KARI
Dr Christyl Johnson	NASA
Ms Kerrie Dougherty	International Space University
Mr George Dyke	Symbios Communications
Dr Brett Gooden	University of South Australia
Dr Alice Gorman	Flinders University
Mr Colin Hall	University of South Australia
Mr Chris Johnson	Secure World Foundation
Ms Eriita Jones	University of South Australia
Dr Charley Lineweaver	ANU Research School of Astronomy and Astrophysics
Mr Jack Mahoney	Lockheed Martin
Prof Tanya Monro	University of South Australia
Dr David Neudegg	Bureau of Meteorology
Mr Paddy Neumann	Neumann Space
Mr Brett Newell	Boeing
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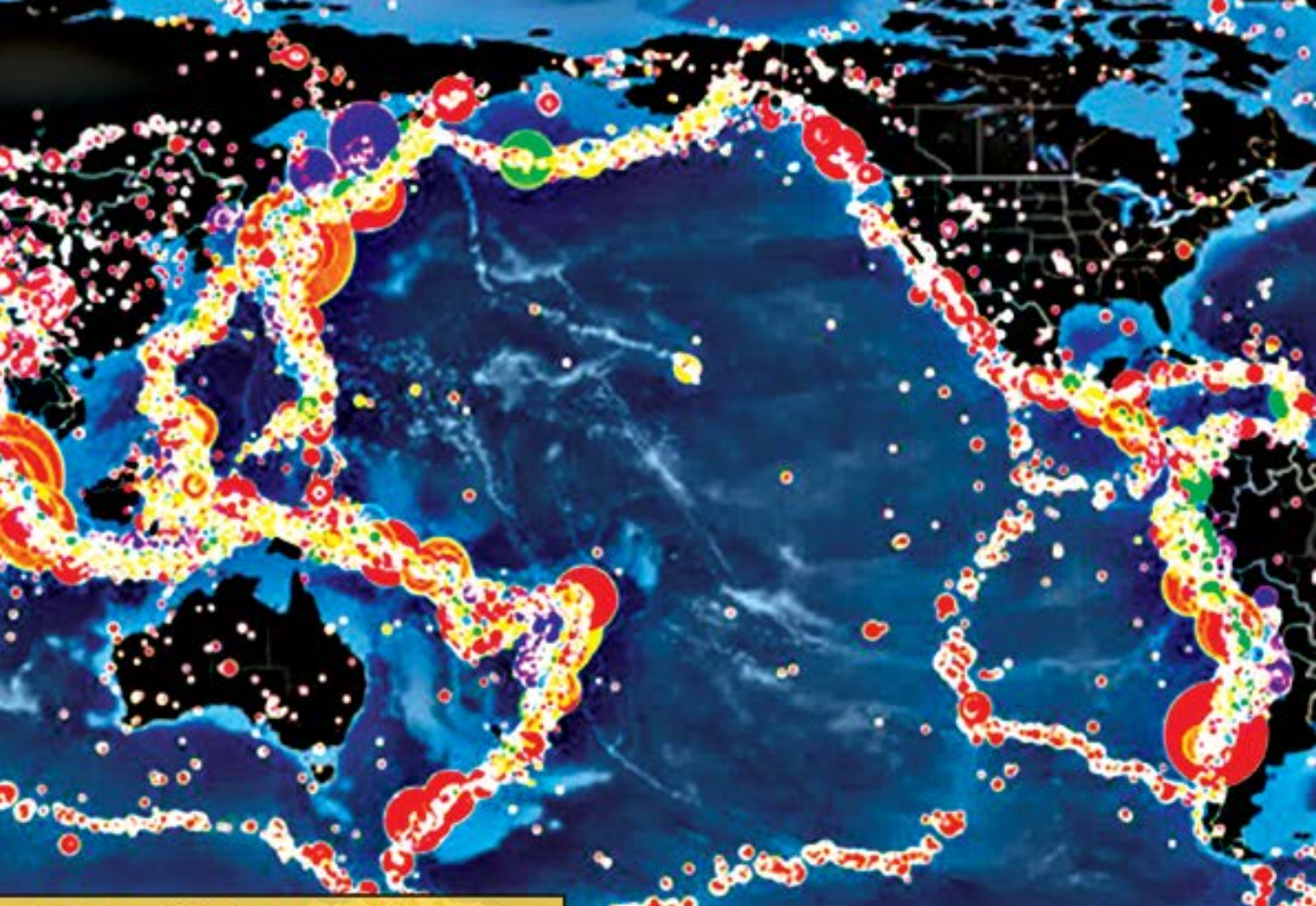

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