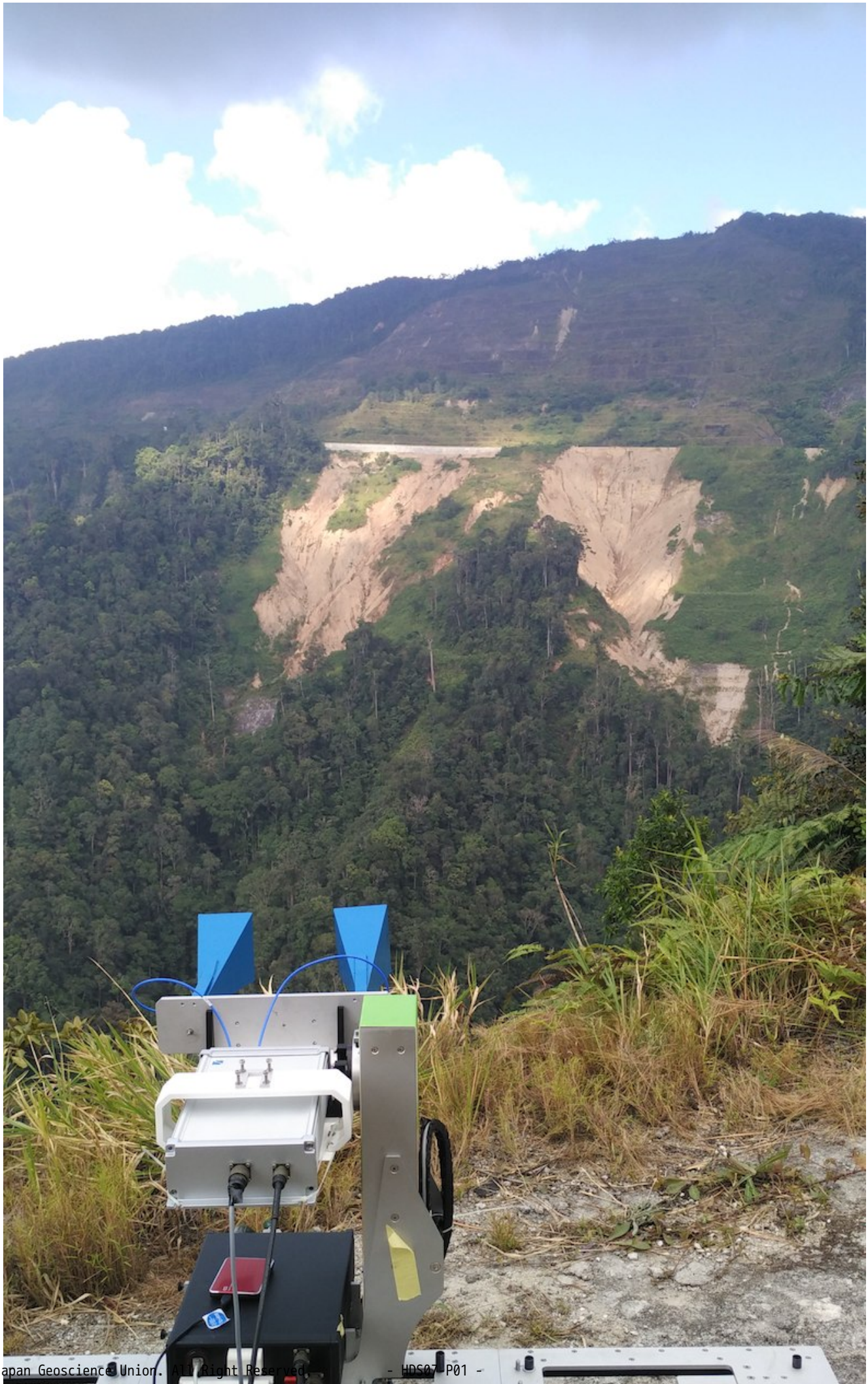
A New Ground-based SAR for Landslide Monitoring: Development and Preliminary Results

*Voon Chet KOO[1], Yee Kit CHAN[1], Bryan Chih-Yuan CHU[2]

1.Multimedia University, 2.G-AVE Technology

Every year, over one million people are exposed to weather-related landslide hazards around the world. Due to the recent climate change, it is likely that the decrease of permafrost areas, changes in precipitation patterns and increase of extreme weather events will influence the weather-related mass movement activities. This paper reports on the recent development of a ground-based synthetic aperture radar (GBSAR) for continuous monitoring of landslide-prone areas in Malaysia. It operates at Ku-band with spatial resolution of 0.5 m in range and 5.8 mrad in cross range. The system is mounted on a rail which travels along a linear guide to achieve SAR imaging. The GBSAR has been installed at a test site to provide timely information for landslide monitoring and early warning system. The paper discusses the design, development and preliminary field experiments using the new GBSAR system.

Keywords: Synthetic Aperture Radar, Interferometry, Landslide Monitoring



An idea to create a satellite with the capability to rescue

*Phuong Viet Vu

Until now, satellite is considered by many to be an untouchable system once launched into space. That means we are unable to physically expand, repair or replace any component or sub-system, etc… once a satellite is operating in orbit. That is why satellites have been developed under very stringent design & production process using high-reliability hardware and qualification test to ensure them being able to work smoothly in harsh space environment for a long time without failure. The thing is, people can't manage all risks in space.
This paper suggests a solution which may help to repair a part of hardware problems or fulfil a request for system expansion after launching.
Any satellite is proposed to simply be equipped with a wireless connection port which supports inter-satellite link once requested. The main idea is how to apply it and design the satellite orbit. With this configuration, once this satellite needs:
to add more functions (networking, relay communication…) or increase capacity (adding more memory, data exchange with other satellites…); or
to replace the failed hardware such as data storage; downlink system (for example: space debris damaging the downlink antenna, or problem with the transmitter)…
We will launch a "rescue" satellite for instance a micro-satellite which is able to support the request system or the faulty system. This "rescue" satellite will connect to the "request" satellite via the inter-satellite link.
Here are some technical supports for this solution:
The "rescue" satellite will be launched into the same orbit, maybe as close as possible with the "request" satellite in order to reduce as much as possible the power of transmission of both satellites. That also means a simple and small antenna system is required (we can even use omnidirectional antenna). By the way, the distance and pointing direction between the two satellites is almost unchanged therefore the Doppler's effect is removed and the satellite pointing is easy. It also allows any wireless transmission technology such as that from Ka, Ku band and even optical communication to be easily applied, too.
Nowadays, many satellites have applied the SpaceWire standard due to its advantage of standardized interface, network protocol, link management…, as well as plug and play function. That means no new, expensive technology is required and standard system can be applied easily. It may just request some add-in protocols for this standard.
With this solution, my dream is that one day, satellites will be equipped with a small sub-system just like a PC equipped with a Wi-Fi or USB ports. Such inexpensive investment may create huge advantages to help the mission adapt to unforeseen requirements from a dynamic economy or increase the opportunity to recover from some serious satellite failures.

Keywords: micro satellite, repair and service in space, novel/pioneering mission

The diversity of land surface temperatures in the Greater Lyon (France): preliminary characterization with Landsat 8 TIRS to monitor heat waves impacts

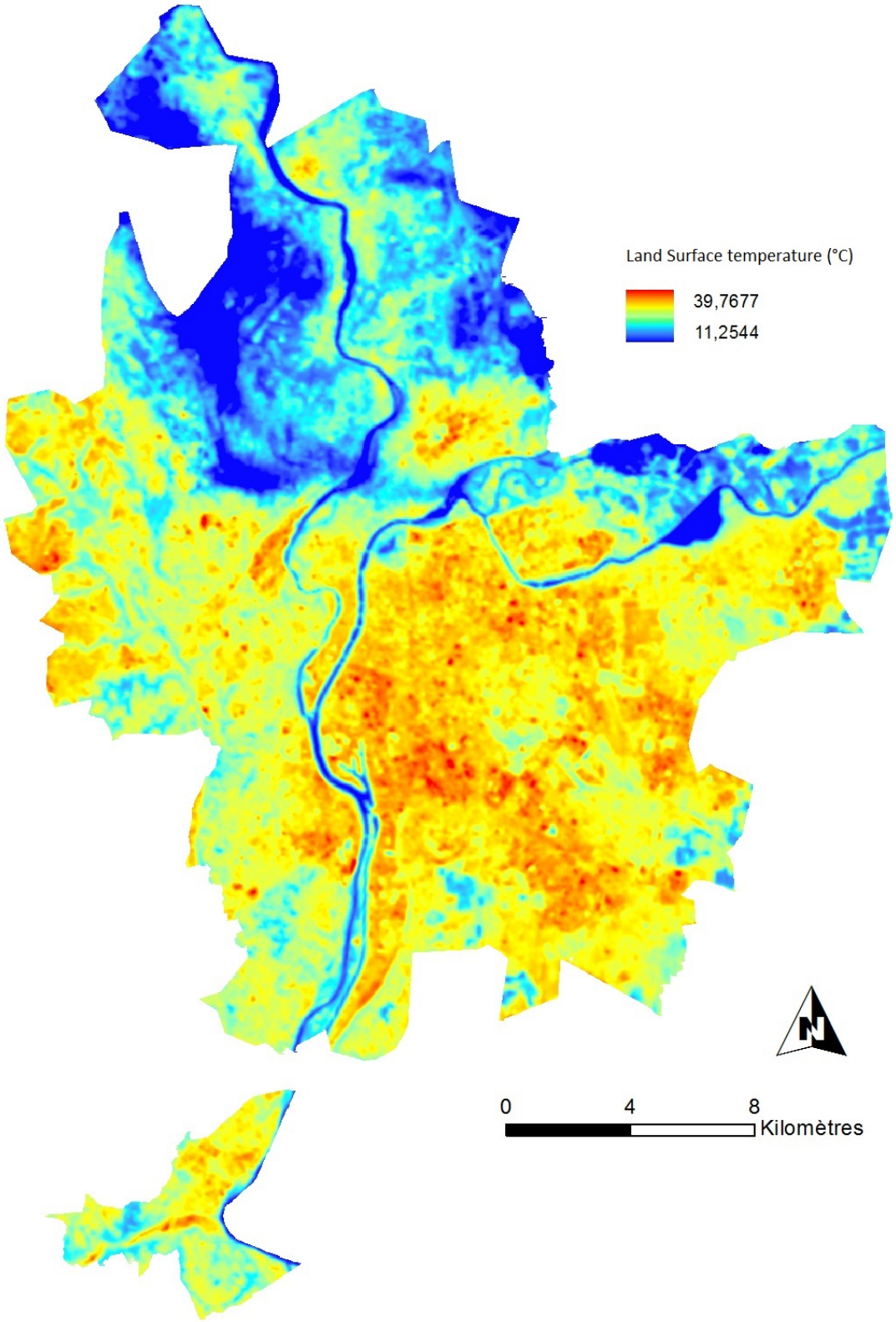
*Florent Renard[1], Didier Soto[2]

1.University Jean Moulin Lyon 3, UMR 5600 CNRS Environment City Society, 2.LABEX IMU, UMR 5600 CNRS Environment City Society

The health impacts of heat waves are a 21st century challenge facing the world and France in particular. Measures have to be taken to avoid disasters like those of 2003, 2006 and 2015 that respectively caused 15,000, 1400 and 3300 deaths, according to the International Disaster Database EM-DAT (Guha-Sapir et al., 2016). The victims were mainly recorded in large cities because of rising temperatures due to global climate change are amplified by the effect of urban heat island (UHI). This study aims to characterize the phenomenon of UHI on the Greater Lyon area. Located in the southeastern part of France, it focuses 1.3 million people about 500 km^2, with a high rate of elderly. A parallel study identified the sectors with the most vulnerable populations in terms of health criteria, such as age or physical condition (Renard et al., 2015). The aim of this study is to determine the most frequently hot areas of the city and to compare them with the places where people are the most vulnerable, in order to target priority areas for mitigation and adaptation to this risk.
The method is based on remote sensing. The bands 10 and 11 of the landsat-8 thermal infrared sensor (TIRS) are to calculate the land surface temperature (LST). This temperature estimation procedure follows the ones established by Jimenez-Munoz and Sobrino (2003), Sobrino et al., 2004 and Cristobal et al., 2009. This implies to convert in a first step the Landsat thermal band to at-sensor spectral radiance and then to at-sensor brightness temperature. In second time, the land surface emissivity is estimated using the NDVI threshold methods, according to Sobrino et al., 1990 and 2008. Finally, the land surface temperature (LST) is obtained thanks to the single-channel algorithm (Jimenez-Munoz and Sobrino (2003), Sobrino et al., 2004 and Cristobal et al., 2009) and the results are converted from degrees Kelvin to Celsius.
The results show strong LST spatial disparities in the Greater Lyon. Indeed, variations of several tens of degrees in just a few kilometers are found between rural and urban territory, as for the 4 th of July, 2015 (fig. 1). The warmest part of the city is located into the ancient town center and the industrial areas. However, the most sensitive persons are located into the town center, where air conditioning is not frequently used. Consequently, strategies of mitigation and adaptation should be quickly focused on these precise areas.
Cristóbal, J., Jiménez-Muñoz, J.C., Sobrino, J.A., Ninyerola, M., Pons, X., 2009. Improvements in land surface temperature retrieval from the Landsat series thermal band using water vapor and air temperature. J. Geophys. Res. Atmospheres 114, 1-16
Guha-Sapir D. , R. Below, Ph. Hoyois, 2016. EM-DAT: The CRED/OFDA International Disaster Database –www.emdat.be –Université Catholique de Louvain –Brussels –Belgium.
Jiménez-Muñoz, J.C., Sobrino, J.A., 2003. A generalized single-channel method for retrieving land surface temperature from remote sensing data. J. Geophys. Res. Atmospheres 108, 1-9
Renard F., Soto D., Alonso L., 2015. Identification et répartition spatiale des personnes vulné rables àla chaleur dans la métropole de Lyon. Congrès annuel de la Société Française de Santé et d'Environnement (SFSE), Paris, p. 61
Sobrino, J.A., Caselles, V., Becker, F., 1990. Significance of the remotely sensed thermal infrared measurements obtained over a citrus orchard. ISPRS J. Photogramm. Remote Sens. 44, 343–354
Sobrino, J.A., Jiménez-Muñoz, J.C., Paolini, L., 2004. Land surface temperature retrieval from

LANDSAT TM 5. Remote Sens. Environ. 90, 434-440
Sobrino, J.A., Jiménez-Muñoz, J.C., Sòria, G., Romaguera, M., Guanter, L., Moreno, J., Plaza, A., Martínez, P., 2008. Land surface emissivity retrieval from different VNIR and TIR sensors. IEEE Trans. Geosci. Remote Sens. 46, 316-327

Keywords: land surface temperature, heat wave, Landsat 8 TIRS, adaptation, mitigation



Quantifying damages brought by tropical typhoons using remote sensing

*Kaye Kristine Vergel[1], Yukihiro Takahashi[1]

1.Graduate School of Science, Hokkaido University

Among the world's basins, the northwestern pacific ocean has the most number of tropical storm occurrence with an annual average of twenty six from 1981-2010. Many countries including China, Hong Kong, Japan, Korea, and Philippines are affected by these storms. In the Philippines alone, around eighteen to nineteen tropical typhoons enter the country’s area of responsibility and of those nine to ten make landfall. The large amount of rainfall that typhoons bring has a big impact in agriculture. According to the Climate Change Commission of the Philippines, from 1990 to 2006, the annual average damage of typhoons to the agricultural sector alone amounted to 184 million USD. Aside from damages in agriculture, strong winds brought by typhoons also result to damages in the infrastructure.
Remote sensing has been widely used in assessing damages from disasters. Compared with field survey, it is a cost effective tool. In this study we compared pre- and post-typhoon satellite images by calculating for different vegetation indices such as Normalized Vegetation Index (NDVI), Normalized Difference Infrared Index (NDII) and Enhanced Vegetation Index (EVI). We found that the largest change is calculated using NDII. We analyzed satellite images from Landsat 8 for tropical storms that passed by the Philippines and Japan. We also correlated the rainfall volume measured by rain gauges to the damages measured by the satellite images.

Keywords: remote sensing, typhoons, damage assessment

Study on early detection of thunderstorm based on electromagnetic measurement in ELF-VLF band

*Kozo Yamashita[1], Yuki Kubono[2], Yukihiro Takahashi[3], Jun-ichi Hamada[4], Jun Matsumoto[4]

1.Salesian Polytechnic., 2.Kyushu Institute of Technology, 3.Hokkaido Univ., 4.Tokyo Metropolitan University

Recently, heavy rain, tornado and lightning discharge associated with thunderstorm become a representative of severe weather in urban region. Well-established methodology for early detection and nowcast of thunderstorm activity is essential to protect and sustain urban function. Main objective in this study is to verify practical effectiveness of early detection of thunderstorm generation based on lightning observation. Receiver for lightning observation is designed to measure electromagnetic wave radiated from lightning discharge in ELF (Extremely Low Frequency, less than 3 kHz) and VLF (Very Low Frequency, 3-30kHz) band and installed around the Tokyo metropolitan region. Radio wave in ELF-VLF bands can propagates long distance (more than several hundreds kilometers) and makes it possible to detect lightning discharge with high sensitivity with few observation sites.
In this presentation, lightning observation for thundercloud generated above Ebina city, Kanagawa at September 6th, 2014 is summarized as an initial result. First detection of lightning signal in ELF-VLF observation is 30 minutes earlier than that in existing network for observation of cloud-to-ground (CG) lightning discharge. This result indicates the possibility that not only CG lightning discharge but also intracloud (IC) lightning discharge whose electromagnetic radiation is weaker than that from CG could be detected by our network. The IC lightning dominated over CG lightning in the early stages of thunderstorm. Detection of IC in ELF-VLF observation enables us to monitor thunderstorm generation without high-spatial density observation.

