The Journal of the PGRSS and its significance in Philippine space technology applications

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Abstract. As early as 1970, the Philippines exploited satellite remote sensing technology to monitor weather disturbances from polar orbiting spacecraft. Not only did the country use remote sensing technology for atmospheric observations, it was also quick to realize its benefits in late 1977 to identify different forest types and for monitoring forest cover. Since then, the technology was applied to accomplish many specific objectives. Although there is an active community of practitioners in this field, there has been no local journal dedicated to remote sensing where Filipinos have their work scientifically reviewed, shared, and discussed. The launch of the Journal of the Philippine Geosciences and Remote Sensing (PGRSS), through this maiden issue, marks an era of revival in the use of space technology in the country. It is greatly motivated by the recent acquisition of LiDAR instruments, a hyperspectral imager, Doppler Radar, drones, a nationwide, IFSAR-derived Digital Elevation Model (DEM), and fabrication of Philippine-made microsatellites. Like the need for the use of local capacity and local resources for effective disaster risk reduction and prevention, this journal addresses the need to support the local community of remote sensing scientists for fast, clear, and efficient communication of scientific output. This forum, hopefully will serve its purpose to advance our understanding of complex earth processes for national development.

1 Introduction

In no other time has there been of equal vibrance in the Philippine geospatial mapping community than today. Over the past three years, geospatial mapping in the country regained vigor through the acquisition of airborne Light Detection and Ranging (LiDAR) instruments, a Compact Airborne Spectrographic Imager (CASI) for hyperspectral mapping, Doppler Radar, Drones and a 1:10,000-scale Digital Terrain Model (DTM) and Digital Surface Model (DSM) of the country derived from Interferometric Synthetic Aperture Radar (IFSAR). In addition to the already scheduled purchase of a ground receiving station for satellite imagery, the planned launch of PHL-Microssat-1 (Diwata), and PHL-Microssat-2, in 2016 and 2017, respectively, (Ranada, 2015), pushes forward the Philippines in Asia’s space race.

Philippine participation in the civilian space competition has nothing to do with leadership in the exploration of outer space but on development of a space program that aims to maximize space technology for national and economic development. Unparalleled in Philippine Remote Sensing (RS) and Geographic Information Systems (GIS) history, these advanced technologies help us efficiently manage and monitor urban areas, agriculture, forest canopy, mining activity, weather and climate, water resources, the coastal and marine environments, natural hazards, disasters and many more aspects that concern our daily lives. By obtaining high spatial-and temporal-resolution data of our habitat, we are able to better see and understand our environment. This is critical in making well-informed and sound decisions.

Clearly, with the significant Philippine investment in space technology, there is a requirement for counterpart contributions in educating more Filipinos on the use and application
of these newly acquired technologies. We will have to increase local manpower and expertise in remote sensing and GIS to meet the ever-growing needs of the private sector and government agencies, such as the Department of Environment and Natural Resources (DENR), Department of Agrarian Reform (DAR), Department of Agriculture (DA), Department of Interior and Local Government (DILG), and the Housing and Land Use Regulatory Board (HLURB). Considering the vast amount of data that is currently and potentially available, coordination of remote sensing and GIS mapping activities is worth promoting.

The Philippine Geosciences and Remote Sensing Society (PGRSS) promotes and advances the application of RS in areas of education, industry, research, and public service for the Filipino people and the country. In line with the society’s objectives, it fosters through its journal a discourse on the theory, science, and application of remotely sensed data in the Philippines, focusing on technical discussions pertaining to remote sensing of the atmosphere, its interaction with the Earth and its effects on the biosphere. Principal topics in the journal include surveying from space and land-based high-resolution mapping such as LiDAR and other advanced mapping technologies, image processing, application of remotely sensed data for development, disaster prevention and mitigation, agriculture and aquaculture monitoring.

This issue of the Journal of the PGRSS is the maiden publication of the society. It is with great hope that it will serve its purpose to provide a forum for RS and GIS experts in the Philippines and in the region for the advancement of the field for progressive and sustainable human development.

2 Brief History of Philippine Remote Sensing

2.1 Pre-World War II to the 1950’s

Early institutional interest in the observation of space and related activities goes back way to 1865 when the Jesuits (priests from the Society of Jesus religious order) established the “Observatorio Meteorológico de Manila” (OMM) to systematically observe Philippine weather. Located in Padre Faura Manila, OMM boasted of an astronomical dome, which housed a telescope to chart heavenly bodies, a venture the institution entered into in 1899 (Manila Observatory, 2015). After becoming the official Philippine institution for weather forecasting in 1884 and the Philippine Weather Bureau in 1901 (PAGASA, 2015), the facility in Padre Faura was destroyed in the Battle of Manila during the second World War. It was rebuilt by the government along with the construction in 1954 of another astronomical observation facility at the University of the Philippines, Diliman Campus.

Most of the topographic activities in the Philippines from 1901 to 1942 were done by the U.S. Coast and Geodetic Survey. Mapping activities were superseded by the Army map service at the outbreak of World War II. Wartime topographic field units of the U.S. Engineers and the Australian Service Corps carried out mapping in the Southwest Pacific Area, generally based on aerial photography, which made use of stereocomparator methods or multiplex methods and radial-line plotting (US Army Department, 1956). At the height of the war, the primary source of aerial photographs and visual intelligence for the southwest pacific was from the 91st photographic wing (Maurer, 1983; AFHRA, 2007). During the Japanese occupation of the Philippines, 1944 series aerial photographs, pre-war charts, and ground surveys were used to generate 1:50,000 and 1:100,000 topographic maps. Since 1948, the 64th engineer Base Topographic Battalion compiled map sheets of 1:50,000 scale based on aerial photographs. After the war, the Philippine Coast and Geodetic Survey became the official agency of the Philippines for cartographic matters (US Army Department, 1956).

2.2 1960-70

The first Philippine weather surveillance radar was installed in 1963, until it was damaged by fire in 1978 (PAGASA, 2015). In 1964, Certeza provided commercial services for aerial photography in the Philippines. Two years later, the Philippine Communication Satellite Corporation (PhilCOM-SAT) ventured into the satellite communications industry through the lease of satellite circuits from international carriers (Santos, 1999). In the international scene, the first United Nations Conference on the Exploration and Peaceful Uses of Outer Space was held in Vienna in 1968. Since then, the world has witnessed unparalleled growth and development in space exploration, as well as in space science and technology applications (United Nations, 2000).

2.3 1970-1979

The Philippine Weather Bureau performed the functions of atmospheric observations and weather forecasting meteorological observations for almost 6 decades, until former President Ferdinand E. Marcos signed Presidential Decree No. 78 on 8 December 1972, establishing the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA) (Malacanang, 1972). By 1970, the use of satellite technology came of age with the use of an Automatic Picture Transmission (APT) system (Wamsteker et al., 2004) to intercept photo-transmission of polar satellite observations (Santos, 1999) in the upper atmosphere (Figure 1). The use of the APT was stopped in 1978 due to its interference with other communication facilities of government. In the following year, five new radar stations were installed as part of the Weather Bureau’s radar surveillance network. In 1983, the first Geostationary Meteorological Satellite (GMS) ground station, a Canadian built receiver (McDonald Detwiller and Associates - MDA), was installed in PAGASA (Holiday, 1988), heralding a new era on the use of space technology in the Philippines. Through this facility, large-scale images of the atmosphere provided data over the Pacific Ocean and
helped improve PAGASA’s weather forecasting capabilities. The system was upgraded in 1988 to receive hourly high-resolution images from the Japanese GMS-series of satellites.

In late 1977, the Philippines was not only using remote sensing technology for atmospheric observation, but also for terrestrial applications. Using sophisticated processing equipment such as the Image-100 (Santos, 1999), the then Natural Resource Management Center introduced satellite imagery (Landsat) as an additional source of data for conducting forest inventory and mapping. This mapping activity was conducted in cooperation with the General Electric Company of the United States. Thirty Landsat computer compatible tapes taken between 1972 to 1976 were digitally processed, and geographical distribution of the different forest types in the country was identified. This exercise did not have the official status of a nationwide forest inventory. It, however, tended to confirm the unofficial trends indicated in the 1965-69 inventory of forest cover in the Philippines (FRDS, 2007).

2.4 1980-1989

A year before PAGASA upgraded its receivers, the Philippine government by virtue of Executive Order No. 192 established the National Mapping and Resource Information Agency (NAMRIA) to manage water, coastal, and agricultural resources. In the late 80’s, remote sensing was used in the RP-German Forest Resources Inventory (FRI) projects to produce forest resource condition maps using Landsat and SPOT data and aerial photographs. This was followed by the World Bank-SSC-NRMC/NAMRIA project on Mapping of Natural Conditions of the Philippines using SPOT data (Rasch et al., 1987). The aim of the study was to supply the World Bank with input information to their Forestry, Fisheries, and Agricultural Resources Management (FFARM) study for the Philippines. It was financed by BIT’s, the Swedish Agency for International Technical and Economic Cooperation and DENR was SSC’s co-operating agency. The project was started in April 1987 and completed 12 months later in April 1988 (Rasch et al., 1987, 2015). The project produced 43 landcover maps at scale 1:250,000 (Figure 2), covering approximately 98% of the country (Fajardo, 2001; Moltz, 2011; Rasch et al., 2015).

Through Executive Order No. 624, then President Marcos created the National Committee on Geological Sciences, which defined the scope of Geological Sciences as the group of disciplines in the natural sciences dealing with the earth, its composition, physics, structure, and evolution. These disciplines included Remote Sensing in Geology. In the mid-80’s, the Geology Department of the University of the Philippines had a project which used remote sensing to identify vegetative cover and characterize the geobotanical Indicators of mineralized regions. The project was conducted in a science laboratory headed by Dr. Teodoro Santos, the first Director of the National Institute of Geological Sciences.

The International Rice Research Institute (IRRI) began using GIS in 1985 (Huke, et al. 1985). The interest progressed when one of its researchers participated in the GIS training at the Asian Institute of Technology. IRRI, at the start, purchased two IBM P52 model 55sx-061s networked to the VAX8350, Macintosh computer, one digitizer capable of handling input maps measuring up to 48” x 60”, one digitizer half that size, scanner, inkjet printer, and ARC/INFO software and aerial photos and satellite images of Barangay San Bartolome, Municipality of Mayantoc, Tarlac. This area was chosen because it had been the object of several studies by IRRI teams over 2 decades prior to the GIS application (Reyes, 2009).

Because of the 1987 Australian-assisted project entitled “National Resource Management and Development Project”, NAMRIA was able to complete, through the use of satellite-based position technology or GPS, the First-Order Geodetic Control Network of the Philippines. This resulted in the creation of the Philippine Reference System (PRS ’92), mandated by Executive Order No. 45 of President Fidel Ramos’ administration, which adopts the geodetic control network of NAMRIA. PRS92, or the Philippine Reference System of 1992, is a homogeneous national network of geodetic control points (GCPs), marked by survey monuments or monuments, that was established using Global Positioning System (GPS) technology, which is an all-weather, high precision, global satellite positioning system that revolutionized navigation and surveying operations (NAMRIA, 2009, 2015). PRS92 serves as the country’s standard coordinate reference

Figure 1: ITLOS satellite image of Category 4 super typhoon Yoling, 14 November–22 November 1970. Source: NOAA - Mariners Weather Log, July 1971, pg. 201. Photo is in the public domain.
2.5 1990-1999

In this decade, remote sensing technology was developing rapidly and being fully utilized by various government agencies and universities. Various applications covering the fields of forestry, land resource evaluation, coastal and marine resources, and disaster mitigation and preparedness were among the projects funded or assisted by different international groups such as JAFTA, JICA, AIDAB, ASEAN, and UNESCO (Fajardo, 2001).

NAMRIA and PAGASA's remote sensing capabilities were upgraded in 1990 with funding from the Australian International Development Assistance Bureau (AIDAB). Dubbed as the joint Philippine-Australian Remote Sensing Project, the program provided necessary hardware and software as well as training to agency personnel leading to the creation of the National Remote Sensing Center (NRSC) within NAMRIA (Moltz, 2011). The NRSC now serves as the country’s archiving, processing, and applications center of remotely sensed data (Fajardo, 2001). As part of the AIDAB funded project, a Master’s and Diploma program

Figure 2: A map sheet of the Land Cover Map in 1:250,000 reduced to 1:1,000,000. 24 different classes were discriminated in the multispectral SPOT images (Rasch et al., 2015).
for remote sensing and GIS was established in June 1992 at the University of the Philippines, UP Geodetic Engineering Department. The institutionalization of short training programs and graduate courses ensured a steady development of a pool of skilled professionals with expertise in remote sensing technology and applications (Fajardo, 2001). To add to the pool of Philippine experts in remote sensing and GIS, Filipinos enrolled in universities abroad (e.g., in Australia, Europe, US, and Japan) where they earned M.S. or Ph.D degrees.

By 1991, PAGASA, through development assistance from the Australian Government, installed a ground station to receive space-born imagery from the polar-orbiting satellite of the National Oceanic and Atmospheric Administration (NOAA), complementing data received from GMS satellite platforms. In the next two years, additional ground receivers were installed at the Ninoy Aquino International Airport, Cagayan de Oro City, Mactan, and Cebu (PAGASA, 2015). Using NOAA and GMS data, non-meteorological applications were also explored to assist agroclimatological, volcanic ash detection, vegetation mapping, and low-cloud detection (Marshall et al., 1995). Facilities included a GMS/S-VISSR receiving and processing system, a NOAA High Resolution Picture Resolution (HRPT) receiving station for the Advanced Very High Resolution Radiometer (AVHRR) and the TIROS Operational Vertical Sounder (TOVS) data, and four GMS WEFAX systems (Marshall et al., 1995; Santos, 1999). Today, PAGASA uses the multi-functional transport satellite (MTSAT) images in its weather forecasting. These imageries are received every 30 minutes and post-processed for public awareness of weather disturbances (Flores, 2007).

The cataclysmic eruption of Pinatubo eruption in 1991 generated worldwide interest and many remote sensing projects using optical and radar sensing platforms were used to study Pinatubo and other active volcanoes of the Philippines. The Geological Application of Remote Sensing (GARS) Asia Project was one of the numerous international projects with the Philippine Institute of Volcanology for volcano hazards mitigation (Bannert, 2000). Another is the project on the use of Advanced Earth Observing Satellite (ADEOS) for monitoring the deadly lahars of Pinatubo volcano (Santos, 1998).

Meanwhile, in the international scene, the Congress of the United States of America enacted a law in 1992 called the Land Remote Sensing Policy Act to maximize the value of the Landsat program to the American public, unenhanced Landsat 4 through 6 data were made available, at a minimum, to United States Government agencies, to global environmental change researchers, and to other researchers who are financially supported by the United States Government, at the cost of fulfilling user requests. Unenhanced Landsat 7 data were made available to all users at the cost of fulfilling user requests (Landsat, 2015). This allowed Philippine remote sensing and environmental researchers, who had links with U.S. Universities, to access valuable Landsat imageries.

Soon after the establishment of the NRSC, the National Coordinating Council of Remote Sensing was founded and was upgraded in 1995 into the Science and Technology Coordinating Council’s Committee on Space Technology Applications (STCC-COSTA) by virtue of STCC Resolution No. 4 (United Nations, 2000). This body serves as the national coordinating organization for space and the point of contact for cooperation with foreign space programs such as NASA and JAXA Moltz (2011). Through STCC-COSTA, participating agencies are made aware of the benefits of sharing remotely-sensed data, resources, facilities, expertise and information exchange (Santos, 1998, 1999). Lastly, it is mandated to support training, education and other manpower development activities in remote sensing and space technology applications (Santos, 1999; United Nations, 2000).

There was a giant leap in the Philippine use of space technology when private telecommunications and broadcasting firms launched the Agila I and II satellites into orbit to address the demand of the telecommunications and commercial broadcast industries in the Philippines. Agila I was ill-fated, but Agila II’s launch on 20 August 1997 at 1:50 a.m. local time, aboard a Long March 3B rocket from the Xichang Satellite Launch Centre, was a success (Figure 3). As part of the contract, Space Systems/Loral (SS/L), the company that built the Agila II satellite, procured the launch vehicle, built a satellite control ground station in Subic Bay, Philippines, and trained Agila II personnel to operate the satellite (Skyrocket, 2015). The spacecraft was launched on a CZ-3B rocket (Astronautica, 2015). Agila II is one of the most formidable satellites of its class in the region and the first high-powered telecommunications satellite. The Agila II satellite has a large ground footprint, and access by neighbouring countries is possible from the Philippines to Hawaii, India, Pakistan, and Bangladesh (Skyrocket, 2015). The high-powered spacecraft allowed the Mabuhay Philippines Satellite Corporation to transmit more than 190 channels of high-fidelity digital programming to cable companies and home satellite dishes and to handle more than 50,000 simultaneous two-way telephone conversations (United Nations, 2000). The satellite was acquired by Asia Broadcast Satellite and renamed Agila 2 / ABS 5 in late 2009. In late 2011 it was repositioned to 3° West and renamed ABS 3 (Skyrocket, 2015).

The Ministerial Conference on Space Applications for Development in Asia and the Pacific was held in Beijing from 19 to 24 September 1994, where the Regional Space Applications Programme for Sustainable Development (RESAP) was launched. This was made possible through the adoption of the Beijing Declaration on Space Technology Applications for Environmentally Sound and Sustainable Development in Asia and the Pacific, the Strategy for Regional Cooperation in Space Applications for Sustainable Development, and the Action Plan on Space Applications for Sustain-
able Development in Asia and the Pacific. These actions and strategies provided a general policy instrument for cooperation and coordination on space applications at both the national and regional levels and for the implementation of the RESAP. It also outlines national and regional mechanisms for building the capacity of member countries to use space technology applications for natural resource accounting, environmental management, disaster monitoring, poverty alleviation, and sustainable development planning and lays down the framework for execution of RESAP through a regional approach. (United Nations, 2000).

In 1996, the AIRSAR radar surveyed the Pacific rim countries, including the Philippines. AIRSAR is a multifrequency, polarimetric, and interferometric radar flown on a DC-8 aircraft operated by NASA. Two survey campaigns were conducted by the AIRSAR team, the first, from 28-29 November 1996 and the second, from 23-27 September 2000 (NASA, 2015). Various agencies in the Philippines, coordinated by the Department of Science and Technology (DOST) and the National Mapping and Resource Information Authority of the Philippines (NAMRIA), selected sites in the Philippines for the AIRSAR PacRim surveys with principal science objectives related to geology, coastal zone studies, solid moisture, topography, agriculture, forestry, and natural hazards. The sites covered by AIRSAR and the dates of the surveys are listed in Table 1.

On 17 March 1998, former President Ramos signed Executive Order 467, entitled “Providing for a national policy on the operation and use of international satellite communications in the country”. The promulgation of the policy is in response to the need to broaden access by authorized entities to international fixed and mobile satellite systems and services in order to accelerate the attainment of the development thrusts for the local telecommunications sector. Some of the salient features of the executive order are as follows: (a) Direct access to all international fixed and mobile satellite systems by all international telecom carriers; (b) Direct access to international satellite systems by broadcasters and operation of satellite news gathering Earth stations owned or operated by foreign news media organizations, for a limited period of time as defined by the National Telecommunications Commission; and (c) Access to global mobile personal communications by satellite (GMPCS) (United Nations, 2000).

Also towards the end of the 90’s, computers were becoming more powerful and affordable enough for remote sensing software to run in desktops or stand-alone workstations. In 1997, a high-resolution Digital Elevation Model of Iriga volcano and vicinities (Figure 4) was created from Digital Photogrammetry of more than 20 aerial photographs, courtesy of NAMRIA (Lagmay et al., 2000). This effort was the forerunner of helicopter-borne and airborne digital photogrammetry (Lagmay et al., 2007) used to generate high-resolution DEMs over small areas. At around this time NAMRIA, acquired a digital photogrammetric workstation that generated new

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Table 1: AIRSAR surveys in the Philippines (NASA, 2015)

<table>
<thead>
<tr>
<th>Date of Survey</th>
<th>Location of AIRSAR Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>29-Nov-1996</td>
<td>Magat, Luzon, Philippines; Manila, Luzon, Philippines; Mayon Volcano, Philippines; Taal Volcano, Philippines</td>
</tr>
<tr>
<td>28-Nov-1996</td>
<td>Cebu, Philippines; Iloilo, Panay, Philippines; Kanlaon Volcano, Philippines; Visayas, Panay, Philippines</td>
</tr>
<tr>
<td>27-Sep-2000</td>
<td>Central Taiwan; Ken Ting, Taiwan; Polillo Islands, Philippines; Santa Rosa, Philippines; South Taiwan; West Taiwan</td>
</tr>
<tr>
<td>25-Sep-2000</td>
<td>Cebu, Philippines; Lingayen Gulf, Philippines; Manila, Philippines; Marikina, Philippines; Mt. Pinatubo, Philippines; Santa Rosa, Philippines; Taal, Luzon, Philippines</td>
</tr>
<tr>
<td>24-Sep-2000</td>
<td>Balayan Bay, Philippines; Lingayen Gulf, Philippines</td>
</tr>
<tr>
<td>23-Sep-2000</td>
<td>Cebu, Philippines; Davao, Mindanao, Philippines; Parker Volcano, Mindanao, Philippines</td>
</tr>
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Figure 3: Artist’s rendition of the Agila II satellite designed for Development in Asia and the Pacific. These actions and strategies provided a general policy instrument for cooperation and coordination on space applications at both the national and regional levels and for the implementation of the RESAP. It also outlines national and regional mechanisms for building the capacity of member countries to use space technology applications for natural resource accounting, environmental management, disaster monitoring, poverty alleviation, and sustainable development planning and lays down the framework for execution of RESAP through a regional approach. (United Nations, 2000).

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The 1990’s was dominated by two five-year technical cooperation agreements with the Japan International Cooperation Agency (JICA) which improved the capability of BSWM to provide soil analytical data, and ushered a computer-assisted map digitization and spatial analyses through the establishment of Geographic Information System (GIS) and Remote Sensing laboratories. The JICA technical cooperation extended for another five years until 2005 (Carating et al., 2014).
product lines, including: digital orthophoto maps, Digital El-

evational Models (DEM) and other by products derived from

Digital Photogrammetry. Due to the growing demand for dig-

tial geographic data to support revision of cartographic prod-

cuts and various GIS applications, four (4) private surveying

and mapping contractors invested in Digital Photogramme-

try equipment. These firms also have their own aircraft and

aerial survey camera for aerial photography (Fajardo, 2001).

2.6 2000-2009

After Y2K (year 2000), powerful desktop computers were

common and remote sensing work was accessible to people

more than ever. By this time, open source remote-sensing and

GIS software and satellite image datasets have become avail-

able, including the visible and thermal ASTER imageries

(Tiangco et al., 2008). Because of accessibility to these tools,

projects and activities related to remote sensing flourished

like mushrooms after rain. There are too many that can be

mentioned, but we list here a few of the projects during this
time:

1. Establishment of a National Spatial Data Infrastructure

(NSDI) by NAMRIA and ASTI (dubbed as FedGIS)

through a DOST-GIA funded project (Aban, 2007). This

initiative is later to be known as the Philippine Geoportal.

2. Between 5 and 7 November 2008, a multicast experi-

ment with overseas ground stations (sending data to

pre-designated multiple places at the same time) was

held using the Wideband Internetworking Engineering

Test and Demonstration Satellite “KIZUNA.” The mul-

ticast transmissions were successfully performed using

KIZUNA’s high speed data transmission. High definition

images of the moon’s surface and the earth taken by the on-

board High Definition TV camera of the lunar explorer “KAGUYA” was multicast to the NECTEC

(National Electronics and Computer Technology Cen-

ter of Thailand) and the ASTI (Advanced Science and

Technology Institute of the Philippines) to introduce

JAXA’s space development activities to those taking

part in the experiment overseas (JAXA, 2015).

3. Sentinel Asia Project, a voluntary, grass-roots, and

best-efforts-based collaboration between regional space

agencies and disaster management agencies for regional

humanitarian purposes, applying remote sensing and

Web-GIS technologies to assist disaster management in

the Asia-Pacific region (Kaku and Held, 2013)

4. Intelligent decision system for environmental hazards

management (PCARRD, 2008)

5. GIS-based furniture and handicraft raw materials re-

source inventory maps (Reyes, 2009)

6. Effects of basement structural and stratigraphic her-

itages on volcano behaviour and implications for hu-

man activities (the UNESCO/IUGS/IGCP project 455)

(Tibaldi et al., 2005)

7. Satellite and Field Detection and Analysis of Ground

Subsidence in KAMANA V A, Metro Manila, and Other

Coastal Areas Such as Hagonoy and Obando, Bulacan

(PCIEERD, 2010)

Amidst rapid global developments in remote sensing and

GIS technology, the IATGF made an attempt through the as-

sistance of the World Bank to formulate a framework propos-

ing the development of a National Geographic Information

Infrastructure (NGII), a national initiative to provide better

access for all Filipinos to essential geographic information. The primary objective of the NGII is to ensure that users

of geographic information, who require a national cover-

age, are able to acquire complete and consistent datasets to

meet their requirements, even though the data is collected

and maintained by different agencies. The NGII helps en-

sure all such agencies concern themselves with the national

interest, thereby maximizing government’s return on invest-

ment in data collection and maintenance. The NGII will help

achieve better outcomes for the nation through better eco-

nomic, social, and environmental decision-making (IATGF,

2000).

Also at the beginning of the new millenium, a remarkable

feat that changed the landscape of the global remote sens-

ing community was achieved - for 11 days in February 2000,

the Shuttle Radar Topography Mission (SRTM) successfully
recorded by interferometric synthetic aperture radar (InSAR) data of the entire land mass of the earth between 60°N and 57°S. The data acquired in C- and X-bands were processed into the first global digital elevation models (DEMs) at 1 arc sec resolution, by NASA-JPL and German aerospace center (DLR) respectively. These elevation model datasets were made available for free at 1 arc second resolution for the United States and its territories and at 3-arc second resolution for other countries and was largely used by researchers locally and worldwide (Farr and Korbick, 2000; Werner, 2001; Rabus et al., 2003). Another dataset, which provided topography as well on a global scale, was the ASTER GDEM. Although the topography was 30-m per pixel and higher in resolution than the lower-resolution 90-m per pixel SRTM product, the radar-derived space shuttle product was superior (Nikolakopoulosa et al., 2006; Hirta et al., 2010).

Towards the end of this decade, a landmark policy decision was announced in the Group on Earth Observations(GEO)-V plenary meeting in Bucharest, Romania, that will forever change our view of Planet Earth. USGS Director Mark Myers disclosed to the group that scientists and decision-makers will soon have unrestricted global access at no charge to the USGS Landsat archive, the world’s most extensive collection of continuously-acquired land imagery (USGS, 2008). Years after this announcement, several studies reported the value of releasing the Landsat archive as readily accessible and free data, otherwise known as Open Data. The results of different studies conducted by the National Research Council, American Society of Photogrammetry, and USGS all show the stunning return on public investment (Campbell, 2015). It was demonstrated that since the archive was released free-of-charge to the public, over 22 million Landsat scenes have been downloaded through the USGS-EROS website, the rate of downloads is still increasing (Figure 5). The report stated that Landsat applications alone produced savings of $350 million to over $436 million per year for Federal and State governments, NGO’s, and the private sector. Further annual savings, societal benefits, and commercial applications are described in the Landsat Advisory Group report (Campbell, 2015).

2.7 2010-present

After the series of landslide and flood disasters that plagued the Philippines in the first decade of the new millenium, it became obvious that higher-resolution hazard maps was a necessary tool to effectively manage risks from natural hazards (Lagmay and Arcilla, 2010). Regional scale hazard maps did not suffice, and maps that provided detailed views and different scenarios of hazards were deemed essential. Such high-resolution maps at 1:10,000-scale or higher could not be produced if the available base maps were 1:50,000 scale. Most of the topographic base maps of the country prior to 2010 were of 1:50,000 scale

NAMRIA responded to the call for more detailed topographic maps by surveying the entire country using airborne Interferometric Synthetic Aperture (IFSAR) in 2012. In less than a year, the survey generated Digital Surface Models (DSMs) and Digital Terrain Models (DTMs, or bare earth digital representations of the landscape) on a nationwide scale at 5 m per pixel horizontal resolution and ≤ 0.5 m vertical accuracy. The same survey also produced Orthorectified radar images at 1 x 1 m pixel resolution.

The Collective Strengthening on Community Awareness on Natural Disasters group or CSCAND agencies was the first to employ Light Detection and Ranging (LiDAR) technology to generate higher-resolution digital elevation models (DEMs). With funding from the Australian Government, through its agencies AusAID and Geoscience Australia, 3D-LiDAR maps surveyed by a commercial company were officially turned over to the Philippine Government in September 2011 and was used for disaster risk mapping by the CSCAND agencies (Australian-Embassy, 2011).

In response to calls for the use of local capacity and resources as a strategy for effective disaster risk reduction, the DOST embarked on an ambitious program to map out the country’s 18 major river basins prone to flooding, using LiDAR. Implemented by the Disaster Risk and Exposure Assessment for Mitigation (DREAM) team at the UP Geodetic Engineering under the lead of Dr. Enrico Paringit and with technical assistance from the U.K Environmental Agency, LiDAR mapping of the Philippines using local expertise began in 2012. DREAM is now capable of mapping the Philippines using LiDAR at a rate of 300 square kilometers per day.
The DREAM program is funded by the Department of Budget and Management (DBM) through a multi-billion master budget plan, earmarked for the period (2011-2017) under the Nationwide Operational Assessment of Hazards (NOAH) program. This program is unique in Philippine history in the sense that it is the first instance for a big-ticket government project to be funded locally and not through Overseas Development Assistance (ODA).

The establishment of NOAH was the response of DOST Secretary Mario Montejo to the instructions of President Benigno Aquino III after the Sendong disaster in 2011, to put in place a responsive program for disaster prevention and mitigation. Specifically, it seeks to equip the Philippines’ warning agencies with the capacity to provide a 6-hour lead-time warning to vulnerable communities against impending floods and to use advanced technology to enhance current geo-hazard vulnerability maps.

NOAH’s mission is to undertake disaster science research and development, advance the use of cutting edge technologies, and recommend innovative information services in government’s disaster prevention and mitigation efforts. Through the use of science and technology and in partnership with the academe and other stakeholders, the DOST is taking a multi-disciplinary approach in developing systems, tools, and other technologies that could be operationalized by government to help prevent and mitigate disasters.

NOAH’s immediate task is to integrate current disaster science research and development projects and initiate new efforts within the DOST to achieve this objective. Currently, there are nine (9) component projects under the NOAH program, namely:

1. Hydromet Sensors Development
2. DREAM-LiDAR 3D Mapping
3. Flood NET – Flood Information Network
4. Strategic Communication
5. Disaster Management using WebGIS
6. Enhancing Geohazard Mapping through LiDAR and High-resolution Imagery
7. Doppler System Development
8. Landslide Sensors Development Project
9. Storm Surge Inundation Mapping Project
10. Weather Information Integration for System Enhancement (WISE)

Another investment of DOST is the PHL-MICROSAT program, a research and development project that aims to build, launch, and utilize the Philippines’ first microsatellite for multi-spectral, high precision earth observation. There are five component projects to the PHL-MICROSAT program: 1) Microsatellite Bus Development; 2) Ground Receiving Station for the Philippine Microsatellite Program; 3) Development of a data processing, archiving, and distribution subsystem for the Ground Receiving Station of the Philippine Scientific Earth Observation Satellite; 4) Calibration and validation of remote sensing Instruments; and 5) development of remote sensing products (DGE, 2014). Hokkaido University and Tohoku University of Japan provide technical expertise and training for the design and manufacture of the microsatellites, which is an affordable option for the Philippines to enter the space age. Images collected from space would be used for disaster risk response and management, agriculture, forestry, and marine and weather monitoring applications. The decision to send a Fil-Japanese-made microsatellite came after an earlier proposal made by Dr. Josefino Comiso of NASA and Dr. Gay Perez of UP IESM, which was to build an imaging sensor named Philippine Universities Satellite Observer or PUSO, to be linked with the International Space Station. The name PUSO was also the battlecry of Filipino basketball fans during the successive winning games of Gilas Pilipinas in the 2013 FIBA games, which generated national pride.

After the Haiyan disaster in 2013, the commitment to open data in disaster efforts was made by Ambassador Cecilia Rebong, the Ambassador and Permanent Representative of the Philippines to the United Nations, in her statement delivered during the GEO ministerial summit (Rebong, 2014). GEO is the same international organization where the USGS Director first announced free access of Landsat data to the international community. Ambassador Rebong said, “Considering these characteristics of our country, the Philippines recognizes the value of Earth observations in addressing such challenges as climate change adaptation, resilience to natural hazards, as well as food security, energy security, and water security... Indeed, access to timely, integrated, and actionable data and information about the Earth system is vital in order to respond to our societal needs and challenges. We are pleased to note GEO’s intent to assist developing countries in raising our capacities to acquire, share, store, maintain, and utilize space-based, air-borne, and in situ Earth observation data that is available on a full and open basis. We look forward to better access to timely and reliable data, the building of our capacity in this sphere, as well as the development of our information infrastructure... Among others, the Philippines will continue to play its role in biodiversity monitoring, through the ASEAN Center for Biodiversity which we host, and through the Asia-Pacific Biodiversity Observation Network. Being a member of the Asian Water Cycle Initiative (AWCI), the Philippines will also continue to work with the other members of the GEOSS/AWCI and participate in its various activities including its capacity-building programs.” (Rebong, 2014) This statement is consistent with the Open Data policy of the Philippine government.

3 Discussion and Conclusions

The recent investments allotted to space technologies by the Philippine government can be argued by some as insensitive
to the needs of millions of poor Filipinos. On the other hand, those who decided and supported these relatively costly programs argue that these programs are the technological solutions to alleviate poverty. The remote sensing and GIS community can either transform the cost of these projects into fruitful investments or waste it by arguing better options that could have been pursued. Dwelling on the latter would only lose valuable time in preparing for the multitudes of possible applications of these systems. Through informed decisions, wiser and less costly choices are made; and the more that science is used to one’s advantage, the bigger the chances are to elevate the country’s economy.

Furthermore, the role of local researchers and practitioners of remote sensing and GIS is to put added value to the investments the government has made. The availability of the space technology infrastructure allows Philippine scientists to conduct work without constraints encountered in the past, such as the purchase of expensive foreign datasets, unavailability of high-resolution spatial images, and paucity of detailed time-series data. Many of these limitations are eradicated with remote sensing platforms now in place. It is now just a matter of how its use is maximized to its full potential to get a better return of investment.

It is clear from the history of remote sensing that the Philippines quickly realized the benefits of space technology applications. The country, for a long time, did not lead the region, but it significantly applied remote sensing tools to accomplish many specific objectives. With all the recent developments in space technology applications, the Philippines is positioning itself as a leader in the region, especially in the use of advanced technologies in mitigating the impacts of hazards. However, in all that has been accomplished in this field over the past 5 decades and even with current advances, there is no local journal where Filipino practitioners can have their work scientifically reviewed, shared, and discussed. This is the objective of the Journal of the Philippine Geosciences and Remote Sensing Society (PGRSS). Like the need for the use of local capacity and local resources for effective disaster risk reduction and prevention, this journal addresses the need to support the local community of remote sensing and GIS practitioners for fast, clear, and efficient communication of scientific output. Its editorial board and staff encourages the Philippine remote sensing and GIS community to participate and make this journal a success.

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