USE OF REMOTE SENSING IN EDC: OPPORTUNITIES AND CHALLENGES

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ABSTRACT

Energy Development Corporation (EDC) has been exploring, developing, and harnessing clean and renewable energy resources in the Philippines for the last three decades. Being a pioneer in the country's renewable energy industry, EDC continues to grow and adapt applicable technologies as they come out and reckoned useful to the company's energy resource development and management objectives. One of the technologies that have seen increased use, especially in the Geosciences and Reservoir Engineering Group (GREG) of the company, is remote sensing. This paper details the rationale and perceived usefulness of remote sensing in geothermal energy exploration and management. The current uses, limitations, challenges, opportunities, and projected future uses of remote sensing data in EDC are also shared. It is foreseen that with the increased use of remote sensing data, EDC will continue to be at par with the current trends and best practices in the field of geothermal energy.

Keywords: Remote Sensing, Geomatics, GIS, Land Surveying

1. INTRODUCTION

With the deployment of numerous sensors and platforms with multitudes of spatial, temporal, radiometric, and spectral resolutions, the use of remotely-sensed data for various environmental and resource mapping applications has seen considerable increase in the last decades (Melesse, et al. 2007). Example fields that have used remote sensing data in an operational manner are agriculture, forestry, water resources, land use/cover, geology, environmental management, disaster monitoring and mitigation, and coastal/marine resource management (Navalgund, Jayaraman and Roy 2007).

Together with this, there has also been an increased global attention to climate change, environmental protection, and sustainable development in the past years. This in turn augmented interest in renewable energy sources and less dependence on fossil fuels (Wang 2010). Example of renewable energy sources are solar, wind, hydro, biomass, and geothermal (Pascual, et al. 2008).

The Philippines is in tune to all of these global developments, especially in the field of renewable geothermal energy, starting geothermal resource exploration as early as 1964 and pilot plant development on 1967 (Fronda 2010). Though there is currently no solid record when remote sensing was first used in the Philippines, the technology already has a large base of users (albeit uncoordinated), with the earliest remote-sensing related institute established also during the 1960's (Umali and Esconde 2003).

In the course of characterizing commercially productive geothermal systems, extensive and costly resource exploration and management strategies are needed. Hence in order to reduce risks and outlay in developing sustainable geothermal energy production fields, strategic exploration and management technologies are used and one of these is remote sensing (Phillips, et al. 2013).

The aim of this paper is to share the current and projected future uses of remote sensing technology of EDC in its various geothermal resource exploration and management activities.

2. MOTIVATIONS IN USING REMOTE SENSING

Remote sensing has long been used as an invaluable operational tool in geothermal resource exploration and development in many different countries. For example, remote sensing was used in the US to define surface indicators (i.e. indicative minerals, hydrothermal alterations, and/or geothermal deposits) of geothermal resources and used the gathered data to determine the potential of the identified sites (Calvin, Coolbaugh and Kratt 2005, Littlefield 2010). Remote sensing was also used in Iceland to determine the best locations for drill sites and site locations for proposed power plants (Noorollahi 2005) and to determine environmental changes in land cover and soil characteristics brought about by geothermal activities around their study area (Oladottir

2012). Remote sensing was also used in Japan to generate structural lineaments (Yamaguchi, Hase and Ogawa 1992) and in Mongolia and China to create Land Surface Temperature/thermal maps useful for geothermal prospecting (Peng, et al. 2013).

Due to the many proven researches about the applicability of remote sensing in geothermal resource exploration and management and because of the many technological advances made on this technology in recent years, remote sensing has now become a pervasive tool in the geothermal industry (Taylor 2007). In fact, remote sensing is identified as one of the four critical disciplines (Fig. 1) needed in modern and strategic geothermal resource exploration activities in the US (Phillips, et al. 2013). The other critical disciplines are the traditional sciences used in geothermal exploration which are geology, geophysics, and geochemistry.

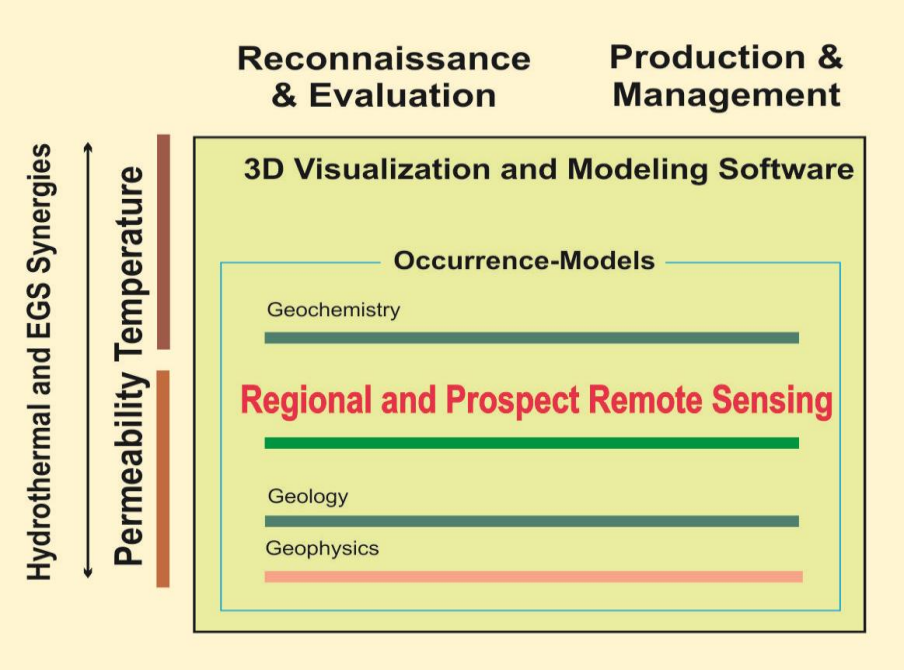

Fig. 1. A matrix showing critical technologies which includes remote sensing as a separate focus area, identified by the US Department of Energy, needed for strategic and modern geothermal resource exploration activities. Adopted from (Phillips, et al. 2013).

However in the Philippines, despite having some researches about remote sensing's applicability in the local geothermal industry, its use is not yet deployed in a fully operational manner (Dolor 2005). Probable reasons for this are the lack of prioritization, coordination, trained experts, and appropriate equipment (Umali and Esconde 2003).

3. CURRENT USES OF REMOTE SENSING IN EDC: LIMITATIONS, CHALLENGES AND OPPORTUNITIES

The Table 1 below summarizes the current uses of EDC of its various remote sensing data. It also enumerates the limitations, challenges, and opportunities that the company is facing in using the remote sensing datasets.

Examples of 2D and 3D visualization and analysis include generation of hill shades, area measurements, profiling, and volume computations. Hydrology applications include generation of watersheds and waterways directly from the DEMs. Structural mapping is the process of delineating fault lines from the DEMs and DSMs. Thermal mapping on the other hand makes use of the Thermal Infrared band of the Landsat images to compute for Land Surface Temperature (LST) at areas of interest. Feature extraction pertains to digitizing visible natural and man-made features like rivers, roads, geothermal pipelines, and built-up facilities.

Type	**Uses**	**Limitations and Challenges**	**Advantages and Opportunities**
RADAR/ DSM/ DEM/ ORI	1. 2D and 3D visualization and analysis 2. Hydrology 3. Fieldwork planning 4. Base mapping 5. Site Selection 6. Structural mapping	1. Limitations in resolution and vertical accuracy 2. Limited knowledge on RADAR analysis 3. The need for calibrating DEMs / DSMs to a local height system 4. High cost for very precise and high level data products	1. Potential to develop more geothermal-related applications 2. The ability to generated maps at different scales 3. Updated topographic maps when compared to national topomaps 4. No cloud cover
Medium Resolution	1. Regional base mapping 2. Thermal mapping	1. Cloud cover 2. Spatial resolution 3. Relatively high cost 4. No control on time of acquisition (LandSat) 5. Need for image adjustments 6. False color rendition may be confusing for users who have no remote sensing background (Spot 5)	1. Potential to develop more geothermal-related applications 2. Landsat data are free 3. New LDCM images poses new opportunities
High Resolution	1. Local base mapping 2. Heads-up feature extraction/ digitization 3. 2D and 3D visualization and analysis	1. Cloud cover 2. Very high costs especially for new acquisitions 3. Need for image adjustments	1. Potential to develop more geothermal-related applications 2. High detail because of high spatial resolution 2. Intuitive to use even for non-remote sensing experts especially if rendered in true color

Table 1. Current uses, limitations, and challenges of EDC in using satellite data. Opportunities are given in the last column.

4. CONCLUSIONS

As the world continues to be environmentally conscious and demand for green sources of energy, EDC will continue to explore new sources of clean and renewable energy sources and will continue to maintain its efficient management of its existing geothermal production fields. As seen in the discussions above, one of the key technologies that EDC is using to achieve these business objectives is remote sensing.

Also, with the current thrust of the international geothermal community to make its resource exploration and management much more cost effective and efficient, it is foreseen that the use of remote sensing in geothermal-related applications will continue to increase and mature. It is expected that EDC will catch on with these foreseen advancements as the company continues to be the premier indigenous, clean, and renewable energy developer in the country.

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