Using Landsat ETM+ and ASTER DEM in mapping geothermal Potential area around Olkaria

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Abstract

Olkaria field is licensed by the Kenyan Government to harvest geothermal energy since 1950s where wells have been drilled in various fields and power generated. GIS and Remote Sensing technology was explored as a tool for mapping geothermal potential area using freely available datasets to minimise cost of exploration and provide prior guided information to geoscientist. A model was developed using four main datasets; environmental suitability map which was processed from ASTER DEM, land use/cover suitability map which was derived from Landsat imagery for the year 2003, Land Surface Temperature derived from the thermal band of Landsat imagery, NDVI, emissivity and vegetation fraction and last Terrestrial Emittance derived from Landsat imagery by computation of emissivity, broad bans surface emittance and downwelling atmospheric transmittance. The results showed satisfactory estimations of geothermal potential map with limitations due to effects of albedo and solar radiation. Landsat data and DEM provide valuable information in mapping geothermal potential areas. The method described in this research could be improved by correcting albedo and solar radiation effects.

Key Words: Geothermal, Land Surface Temperature, Olkaria, Terrestrial emittance

Introduction

Kenya and Ethiopia are part of the East African Rift System which is endowed with significant geothermal resources (Pürschel et al., 2013). The rift system is volcano-tectonically active. According to geothermal power generation report, Kenya has increased the capacity of their power plant installations by more than 50% with respect to the year 2005 (GEA, 2012).

The Olkaria geothermal field is inside a major volcaniccomplex associated with Quaternary volcanism. The field is a high-temperature geothermal system located within the Kenya Rift Valley with numerous volcanic domes(Omenda, 1998).. Geothermal energy manifests itself on the surface as hot-spring, steam jets, geysers, mudpools, altered grounds, sulphur deposit, silica sinters, geothermal grass, young lava flows caldera and fumaroles along the Kenyan Rift after which geophysics, geochemistry and geological exploration methods are used for citing the wells for drilling (GEA, 2012).

One of the main challenges associated with geothermal harvest is the large upfront cost of geothermal exploration and development in adition to high risks associated with resource exploration and power development (Omenda, 2012). The kenyan Government has recognized geothermal energy as a viable solution for electricity generation and energy mix. Kenya is one of the leading countries globally with significant geothermal resources with rich geothermal potential sites being along the Rift Valley and a few outside the rift (Mibei, 2013). In Kenya today, there is a lot of awareness and emphasis toward clean, green and renewable energy, geothermal being one of them. Geothermal energy offers a great potential source with the capability of producing over 10000 MW of energy in Kenya. Geothermal energy contributes about 284MW into the national grid, but plans to increase this to 5000MW by the year 2030 is what the government, GDC and KenGen and other private sectors are targeting (Mibei, 2013). Projected electricity demand in Kenya is more than 23,000 MW by 2030 (Omenda, 2012).