COMPARISON OF ASTER GDEM AND A PHOTOGRAMMETRICALLY DERIVED SPOT-5 DEM FOR ALLUVIAL LANDFORM MODELING APPLICATIONS IN CENTRAL AND WESTERN AFRICA

Peter G. Chirico

United States Geological Survey (USGS), Earth Surface Processes Team, Reston VA 20192, USA, pchirico@usgs.gov

1. INTRODUCTION

The relatively flat area along rivers and streams where the gradient changes and the velocity is below that which is required to continue the transport of materials yields the natural deposition of sediments. Alluvial placer deposits of sand, gravel, gold, platinum, and gemstones, such as diamonds, form on bends of rivers, point bars, and within potholes on the weathered bedrock surfaces that rivers and streams form. Placer deposits are often mined by artisans or informal miners. The artisanal mining sector employs hundreds of thousands across Africa and is an important part of the economy in many developing nations.

Traditional geomorphologic mapping techniques have long been advocated and integrated into the mapping and prospecting of alluvial placer deposits [1], [2]. Geographic information systems (GIS) integrated with the use of satellite imagery offer improved methods for analyzing and mapping alluvial placer deposits. The quantitative study of topography or digital terrain modeling has been facilitated by the advancing science of finer resolution and increasing accuracy of digital elevation models (DEMs) [3]. However, the use of optical remote sensing techniques to map alluvial deposits and to monitor artisanal mining is hampered by perennial cloud cover and dense vegetation in tropical regions. Since 1999, ASTER has been used as a source for the development of individual DEMs of 30m resolution for geoscience applications [4]. ASTER's visible along track sensor still posed challenges to acquisition of imagery and DEMs in areas of perennial cloud cover. The development of the ASTER Global DEM (GDEM) represents a new and potentially more precise elevation model source appropriate for mapping alluvial deposits at 30m spatial resolution and at map scales of up to 1:50,000. GDEM overcomes the cloud cover problems by integrating all ASTER scenes over a particular area and merging them together using a cloud mask function.

The purpose of this study is to compare morphometric variables of alluvial placer deposits in western Africa from ASTER GDEM and from a DEM derived from SPOT-5 stereo imagery and GPS field observations.

2. STUDY AREA

The study area for this study is Kenieba, Mali. Kenieba is located approximately 350 kilometers west of the capital Bamako and 190 kilometers south of the city of Kayes. It is located between the Falemé river on the western border of Mali with neighboring Senegal and the Tamboura escarpment which lay to the east. The mean high temperature is 35° -40° C (95° -104° F) and the

mean low temperature is 16° - 21°C (61° - 71°F) with an annual precipitation value of 1152 mm (46.8 inches). The climate is considered to be arid savanna and the low and sparse vegetation reflects the dry climate. The topography is generally flat with the Tamboura escarpment rising abruptly 400m in elevation above the surrounding topography. Kenieba is a central district for mining of gold and some diamonds both through primary deposits mined in open pit mines and placer deposits mined locally by artisans with simple tools.

3. METHODOLOGY

This paper presents a methodology whereby the ASTER GDEM 30m resolution digital elevation model (DEM) and the SPOT-5 10m resolution DEM are processed for geomorphic variables First, primary topographic attributes of elevation, planform and profile curvature, slope, and relief are derived using raster GIS techniques. Secondarily, a Compound Topographic Index (CTI) and a Potential Drainage Density Index (PDD) are derived for the study area. A Fuzzy K-Means unsupervised classification is used to produce the landform classification for alluvial flats and active channel deposits, low terraces, and high terraces. A set of 80 GPS field observations will be used to develop an absolute accuracy measure for both sources of DEM data. Image differencing techniques will be used to evaluate and compare the SPOT-5 DEM with the ASTER GDEM for the primary and secondary attributes as well as the landform classification results.

4. REFERENCES

[1] R.M. Teeuw, M.F. Thomas, M.B. Thorp, "Geomorphology applied to exploration for tropical placer deposits" in *Alluvial Mining*, Institution of Mining and Metallurgy, Elsevier Applied Science, London, New York, pp. 458 - 480. 1991.

[2] M. F. Thomas, M. B. Thorp, and R. Teeuw, "Palaeogeomorphology and the occurrence of diamondiferous deposits in Koidu, Sierra Leone", *J geol Soc London,* 142, 789–802. 1985.

[3] R. J. Pike, "Geomorphometry; diversity in quantitative surface analysis", *Progress in Physical Geography*, vol. 24, pp.1-20, March 2000.

[4] T. Toutin, "ASTER DEMs for geomatic and geoscientific applications: a review", *International Journal of Remote Sensing*, vol. 29, pp. 1855 – 1875, April 2008.