Satellite-Derived Bathymetry Modelling in Shallow Water: A Case Study of Lighthouse Creek, Lagos

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INTRODUCTION

Bathymetry (the measurement of the depths of water bodies from the water surface) is the marine equivalent to topography. Bathymetric surveys are generally conducted with a transducer which transmits a sound pulse from the water surface (usually attached to a boat) and records that same signal when it bounces from the bottom of the water body. An echo sounder attached to the transducer filters and records the travel time of the pulse. At the same time that the pulse occurs, a GPS unit can record the location of the reading. After many of these readings are taken, corrections are made based on fluctuations in the water surface elevation that may have occurred during the survey. There is great demand for accurate and high-resolution seafloor topography data. However, present availability of such data remains spatially incomplete and limited. Traditional bathymetric charts are based on individual soundings accumulated during decades of ship-borne surveying operations. Ship-borne surveys with single- or multi-beam echo sounders can operate to depths in excess of 500m by sensing and tracking acoustic pulses. Single-beam SONAR (Sound Navigation and Ranging) systems have been used since the 1950s by survey vessels to measure water depths along transect lines, but these lines are generally sparsely distributed. Since the 1980s, more accurate multi-beam echo sounders have been widely used in bathymetric surveys. However, ship-borne surveys are time consuming, costly, particularly in relatively shallow coastal waters where survey swaths are narrow (Su et al, 2008). Also, it may not be feasible to survey shallower waters because of sound saturation and/or inaccessibility of survey vessels. In sufficiently shallow and clear waters, the magnitude and spectral quality of light reflected from the seafloor can be interpreted from remotely sensed ocean colour. Using passive ocean colour, bathymetry has been mapped with high spatial resolution from aircrafts (Dierssen et al, 2003) to regional and global scales from satellites orbiting the earth.

Moreover, bathymetry in particular can change rapidly in response to storm surges, sea level rise, changes in river conditions, and engineering activity such as dredging. Because of the expense and time involved with traditional, though very accurate, bathymetric methods, remote sensing imagery-derived measurement is often used as a technique for in-fill or rapid response to bathymetry-changing events. While imagery-based bathymetry has been in use for many decades, the techniques and imaging platforms have both evolved and improved over the years. It should be noted however that no single technique is ideal for measuring the diversity and complexity of the underwater landscape because limitations are inherent in all these methods. The preference for each method is usually determined in terms of scale of feature observed, accuracy, and water depth that can be sensed.

Landsat imagery, with its high spectral capability, revisit time, and global coverage, is an important step forward in updating underwater morphology maps and extending them into less well-known coastal and inland waters. The generation of bathymetric maps is founded on analytical modelling