ABSTRACT

Small scale farming identify farms with less than 300 acres of agricultural land and represent a large population of producers in the US, thus the interest in procedures such as Precision Agriculture Application in productivity cycles. This study compares publically available Landsat7 ETM+ imagery, at nominal 30 meters pixel resolution, and National Agricultural Imagery Program's (NAIP) imagery, at nominal 1 meter pixel resolution, to evaluate their use in Precision Agriculture (PA) applications for small-scale farming. The selected study area was determined based on crop characterization and land size criteria identified in the South Eastern part of Pittsylvania County, VA. The selected agricultural fields within the study area, 14 in total, were of varying shapes, ranging from 7.5 to 150 acres in size, and characterized by a specific crop type such as non-alfalfa hay. The methodology for this study consisted in the computation and analysis of four vegetation indices (VIs) to evaluate the effect of imagery resolution to depict vegetation maturity in the selected 14 sites. The VIs used consisted of: Ratio Vegetation Index (RVI), Normalized Difference Vegetation Index (NDVI), Green Normalized Difference Vegetation Index (GNDVI), and Soil-Adjusted Vegetation Index (SAVI). In addition to the Vis analysis, a pixel Percent Error estimate was derived from the low and high resolution VIs products to evaluate the amount of variance between Landsat7 ETM+ and NAIP data. As expected, NAIP's VIs results provided more detail about the study sites compared to the Landsat7 ETM+ VIs products. This was evident as NAIP's ability to locate and visualize vegetation and non-vegetation features within the study sites, which is of particular importance for PA applications. In contrast, Landsat7 ETM+ imagery were not able to provide adequate identification and monitoring capabilities when used in limited areal extent, specifically required for small scale farming PA applications. Spectral mixing of land features smaller than the 30 meters pixel resolution imagery were causing vegetation differences to be diluted across the fields rather than being isolated and identifiable like in the NAIP's VIs results. Results from the PE analysis confirm the VI results and show a great difference between VI values derived from the low resolution Landsat7 ETM+ and high resolution NAIP imagery. The majority of the sites contain a high percentage of pixels error above the acceptable percentage, which outline that VI values derived from low resolution imagery do not provide results comparable to the high resolution imagery. Moreover, the size of the sites do have an effect on the amount of acceptable PE within each field, with larger fields containing higher percentages of Acceptable PE than smaller sites. Therefore, due to the use of reduced size fields in small scale farming, the use of low resolution imagery might not be appropriate to adequately represent the actual ground conditions necessary for reliable PA use.