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Estimation of Soil Nutrient Content Using Google Earth and Pleiades Satellite Imagery for Small Farms

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Abstract : Precision Agriculture has long being benefited from crop fields' aerial imagery. This important tool has allowed identifying patterns in crop fields, generating useful information to the production management. Reflectance intensity data in different ranges from the electromagnetic spectrum may indicate presence or absence of nutrients in the soil of an area. Different relations between the different light bands may generate even more detailed information. The knowledge of the nutrients content in the soil or in the crop during its growth is a valuable asset to the farmer that seeks to optimize its yield. However, small farmers in Brazil often lack the resources to access this kind information, and, even when they do, it is not presented in a comprehensive and/or objective way. So, the challenges of implementing this technology ranges from the sampling of the imagery, using aerial platforms, building of a mosaic with the images to cover the entire crop field, extracting the reflectance information from it and analyzing its relationship with the parameters of interest, to the display of the results in a manner that the farmer may take the necessary decisions more objectively. In this work, it's proposed an analysis of soil nutrient contents based on image processing of satellite imagery and comparing its outtakes with commercial laboratory's chemical analysis. Also, sources of satellite imagery are compared, to assess the feasibility of using Google Earth data in this application, and the impacts of doing so, versus the application of imagery from satellites like Landsat-8 and Pleiades. Furthermore, an algorithm for building mosaics is implemented using Google Earth imagery and finally, the possibility of using unmanned aerial vehicles is analyzed. From the data obtained, some soil parameters are estimated, namely, the content of Potassium, Phosphorus, Boron, Manganese, among others. The suitability of Google Earth Imagery for this application is verified within a reasonable margin, when compared to Pleiades Satellite imagery and to the current commercial model. It is also verified that the mosaic construction method has little or no influence on the estimation results. Variability maps are created over the covered area and the impacts of the image resolution and sample time frame are discussed, allowing easy assessments of the results. The final results show that easy and cheaper remote sensing and analysis methods are possible and feasible alternatives for the small farmer, with little access to technological and/or financial resources, to make more accurate decisions about soil nutrient management.

Keywords : remote sensing, precision agriculture, mosaic, soil, nutrient content, satellite imagery, aerial imagery
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