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Effect of spatial resolution on remotely-sensed rangeland vegetation indices

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Key words : vegetation indices, spatial resolution, semi-arid environment

Introduction Rangeland ecosystems represent a major management concern for the future due to the threats caused by growing human population and loss of biodiversity. More information on the quality and quantity of vegetation is needed to assess rangeland ecosystems. Numerous remotely-sensed vegetation indices (VIs) have been developed to detect and characterize vegetation with limited success in semi-arid environments because of the challenge in detecting low levels of biomass and sparse vegetation cover (Leprieur *et al.*, 2000). With the multiplication of image product availability, several studies have attempted to characterize vegetation in arid and semi-arid environments using VIs at different spatial scales and resolutions. However, the effects of scale on remote sensing-derived parameters are not well understood. The goal of this study was to analyze the effects of spatial resolution on VIs in a semi-arid environment.

Materials and methods The study area is located in sagebrush-steppe rangelands of southeastern Idaho, USA. Several common satellite sensors used in arid and semi-arid vegetation studies were selected and synchronous images were acquired (target date: June 26th 2006). For every image, NDVI, NRVI, SAVI, and MSAVI₂ were calculated at nominal resolutions and then aggregated at various levels of coarser spatial resolutions corresponding to the other images using an average function. Land cover types were stratified to compare the effects of scale over similar land cover types and to reduce variability. We selected two land cover types: shrub/grassland and cultivated crops/hay in which analysis were performed separately. All statistical analysis used 50 randomly selected pixel values. (1) We compared each VI from the same sensors among four different resolutions of QuickBird (i.e., 2.5, 10, 28.5, and 250 meters), three resolutions of SPOT5 HRG, and two resolutions of Landsat 5 TM. (2) We compared each VI among QuickBird, SPOT5 HRG, Landsat5 TM, and MODIS sensors using their native resolutions. One-way analysis of variance (ANOVA) with all pair-wise post-hoc comparisons were performed.

Results The different scales of QuickBird, SPOT5 HRG, and Landsat5 TM were not significant as predictor variables and no statistically significant differences were found in NDVI, NRVI, SAVI, and MSAVI₂ values among different scales of the same sensors (results not illustrated here). However, the different sensors were significant as predictor variables and the post-hoc comparisons indicated significant differences (Figure 1).

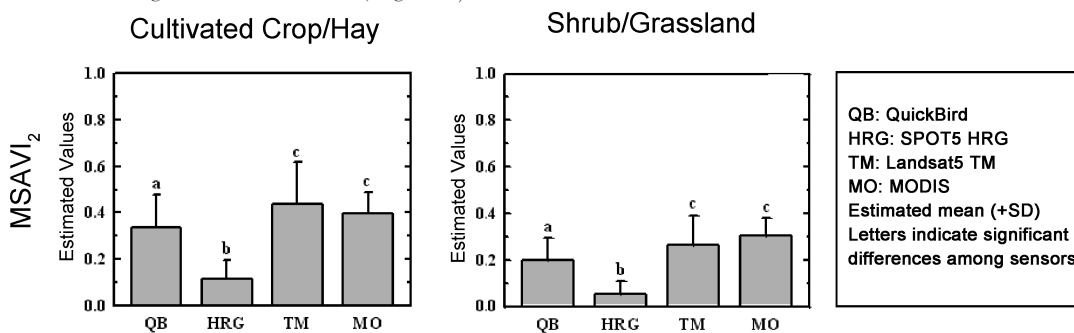


Figure 1 Vegetation Indices (only MSAVI₂ is presented here) comparison among sensors.

All VIs from both land cover types had significantly different values in most pair-wise comparisons. In many cases, VI values were not significantly different only between Landsat5 TM and MODIS sensors. As an example, we present here the MSAVI₂ values from cultivated crop/hay cover type and shrub/grassland cover type, which were significantly different in all pair-wise comparisons except the comparison between Landsat5 TM and MODIS.

Conclusions Values of VIs are not significantly different when aggregated at different spatial resolutions indicating a potential for multi-resolution comparability of VIs when derived from the same sensor. However, VI comparability between sensors is variable. In shrub/grassland land cover, Landsat5 TM and MODIS VIs values are comparable which suggests that these sensors can be used together for direct comparisons or to replace one another. However, VIs from other sensors are not comparable to one another and, therefore, direct comparisons are not recommended.

Reference

Leprieur, C., Kerr, Y.H., Mastorchio, S. & J.C. Meunier (2000). Monitoring vegetation cover across semi-arid regions: comparison of remote observations from various scales. *International Journal of Remote Sensing*, 21, 281-300.