Effect of Spatial Resolution on Remotely-Sensed Rangeland Vegetation Indices

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Effect of spatial resolution on remotely-sensed rangeland vegetation indices

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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 $MSAVI_2$ 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 $MSAVI_2$ 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) .

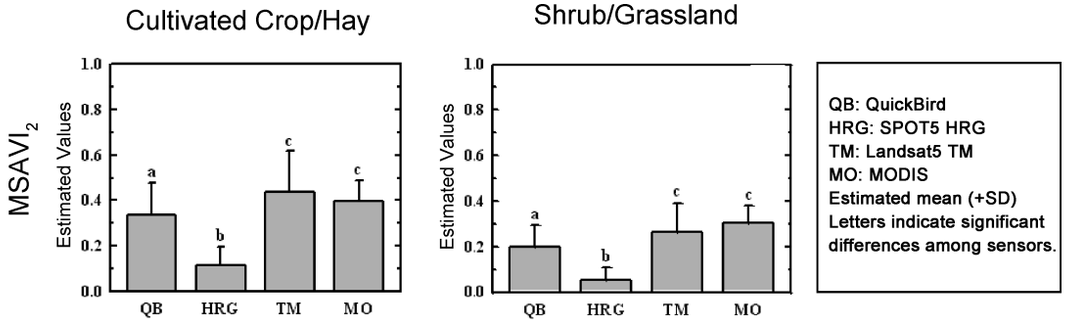

Figure 1 *Vegetation Indices (only $MSAVI_2$ is presented here) comparison among sensors .*

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 $MSAVI_2$ 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 theses 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 .