Improved seagrass change detection using linear spectral unmixing

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Background/Question/Methods

Seagrass beds serve as habitat, refuge, and foraging grounds for many important fishery species but accurate classification of these critical habitats is challenging. In North Carolina, seagrass landscapes are strongly influenced by tidal currents and waves resulting in bed forms ranging from continuous meadows to patchy mounds often no more than a meter or two across. These patches frequently go undetected when low resolution (30 meter) multi-spectral imagery is used for mapping. For this reason, visual interpretation and manual delineation from higher resolution (≤ 2.5 meter) aerial photography remains the most widely adopted approach for seagrass mapping although these methods often include unvegetated gaps, overestimating seagrass acreage and skewing results of change analysis. I developed a linear spectral unmixing technique for seagrass in which a set of representative image elements (endmembers: seagrass, sand, water) was chosen by the analyst and the unmixing process reported the fraction of each element in each pixel. I analyzed identical 8 km^2 areas of Core Sound, North Carolina from two high resolution images, a 1992 aerial photograph (1.4 meter) and a 2012 WorldView-1 image (2.4 meter), to calculate differences between change analysis via manual delineation and automated sub-pixel classification.

Results/Conclusions

The linear spectral unmixing technique produced overall accuracies of 86% and 83% for the1992 and 2012 images, respectively. Manual delineation indicated an ~70% increase in seagrass acreage from 1992 to 2012 while unmixing of the same images indicated a slight decrease (5.9%). Seagrass classified via unmixing represented only 50.8% and 26.3% of the area encompassed by the visually-interpreted1992 and 2012 seagrass maps, respectively. Very few attempts have been made to use spectral information from aerial photographs for classification purposes. I have shown that linear spectral unmixing can be readily applied to aerial photography as well as high resolution satellite imagery for classification of seagrass in shallow, coastal waters of North Carolina and that manual delineation can over-estimate seagrass acreage. Linear spectral unmixing can improve seagrass maps providing fisheries managers with more realistic representations of seagrass extent and acreage available for use by commercial species. A distinct advantage of unmixing is the ability to identify subtle differences in landscape composition through quantitative classification of pixels as proportions of representative image elements. This technique may be useful in other systems, coastal or terrestrial, where the landscape is composed of a mixture of highly contrasted cover types or cover types having sparse representation.

Keywords: spectral unmixing, seagrass mapping, remote sensing, aerial photography, WorldView