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Remote Diagnosis of Early Desertification with Panchromatic, High-spatial Resolution Images. A Feasible Solution for Sustainable Use of Shrublands.

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Abstract

Rationale. Shrublands are fragile ecosystems covering about a third of the world terrestrial area, because of the impact of domestic grazing, anthropogenic fires and conversion to marginal agriculture. In Argentina, shrublands occupy extensive areas of the Monte and northern Patagonian regions, covering most of the central and southern country. Shrubland sustainable management requires the development of monitoring criteria to detect early signs of desertification in those areas where this process is not yet severe.

Objective. Explore the utility of panchromatic images of high spatial resolution to detect subtle changes in the structure of the vegetation of shrublands that would be meaningful indicators of early stages of desertification.

Methods. We obtained panchromatic images along an E-W low-altitude (600 m) flight transect in the southern Argentinian Monte (from -65.2 °W to -65.6 °W, at -42.64 °S, ≅ 30 km) in an area with early signs of desertification (reduction of shrub-perennial grass cover, increase in wind and animal "streets", etc.). Images were obtained according to a systematic design comprising an equal proportion of areas with high, medium and low intensity of grazing use at three different paddocks, and were digitized to a spatial resolution of one pixel = 0.3 x 0.3 m. Fourier signatures (S/N ratio) were calculated on randomly located transects over them. Computer code was prepared in order to load image binary files and compute the corresponding Fourier signatures.

Results. The frequency distributions of Fourier S/N ratios corresponding to images of areas under low or medium grazing pressure were significantly different from those under high grazing pressure. No areas characterized by high S/N ratios were found under high grazing pressure, irrespective of water runoff or wind erosion impact.

Conclusions. Fourier signatures in digitized panchromatic images of high spatial resolution can be used to detect early signs of desertification processes in semiarid shrublands. The technique is amenable for extensive land monitoring in areas were the land productivity would not support other techniques of remote sensing that would require intensive capital (satellite imagery) or manpower investment (land surveys), and constitutes a sustainable alternative for the conservation of these ecosystems.

Keywords: Applied remote sensing, shrubland desertification