ID.59313: GRASSLAND DEGRADATION DETECTION AND ASSESSMENT BY REMOTE SENSING

The Potential for Using Image Fusion to Monitor Grassland Degradation

Grasslands are vital ecosystems, standing out for their complexity and significant role in supporting biodiversity, aiding in carbon sequestration, and offering livelihoods for various communities. The globe is covered by about 41% of grasslands that are home to more than 38% of people, mostly from low and medium-income countries. Overgrazing is considered the most significant cause of arid and semi-arid grassland degradation and desertification.

Existing research has made progress in using spectral indices to analyse critical features such as above-ground biomass, which is an important health indicator for grassland ecosystems. However, these studies do not adequately account for the multidimensional character of environmental degradation. A thorough assessment of grassland degradation, for example, would benefit from considering a broader range of sources and other physical indicators, such as soil degradation and microclimatic conditions, which interact with each other. This study proposes image fusion to achieve a comprehensive evaluation of grassland degradation, marking a pivotal advancement in environmental monitoring.

Image fusion involves the combination of various data types, such as optical and SAR imagery, enhancing our understanding of ecosystem health. For example, including SAR data, could potentially solve some of the constraints by offering new insights into the physical structure of the vegetation and soil moisture conditions and cloud-related issues. At the same time, optical sources provide information on the reflective and emissive characteristics of the surface. Moreover, Light Detection and Ranging (LIDAR) data sensors can capture the three-dimensional arrangement of vegetation canopies and the terrain beneath them, resulting in rich topographic maps and precise assessments of vegetation height, coverage, and canopy structure.

Recent research has taken a multi-level fusion approach to leverage the combined strengths of pixel-level and feature-level methods. This allowed for obtaining meaningful insights from remote sensing sources representing a comprehensive method for mapping vegetation degradation and soil degradation. The field remains underdeveloped with few dedicated studies, highlighting significant research opportunities. This also highlights that some significant ecosystem attributes might be overlooked and suggests a more comprehensive approach for matching sensor and phenomena characteristics.

To address these limitations, this study is devising a novel integration of area-focused and object-focused fusion to meet the challenge of assessing land degradation on both smaller and larger scales. Area-focused fusion leveraging sensors with wide coverage to produce a

comprehensive view of grassland degradation. This captures expansive phenomena patterns without compromising the spectral integrity of the data. Object-focused fusion presents a detailed analysis of identified patterns that employs feature extraction and object-based image analysis techniques to segment images into discrete, identifiable objects. The integration of area-focused and object-focused fusion is a significant development in environmental monitoring. By connecting sensor properties with environmental hazards, such as the sensor/bands' sensitivity to soil moisture, biomass, and vegetation structure, a thorough understanding of grassland degradation can be achieved.