Global Earth Observation - Benefit Estimation: Now, Next and Emerging

GEOBENE

Assessing the economic, social and enviromental benefits of the GEO domains

The role of GEOSS in monitoring ecosystems & their services

B. Reyers[a], P. O'Farrell[a] and S. Fritz[b]

[a] Natural Resources and the Environment, CSIR, PO Box 320, Stellenbosch 7599, South Africa
[b] International Institute for Applied Systems Analysis, A-2361 Laxenburg, Austria

MONITORING ECOSYSTEM SERVICES

Global declines in ecosystems and their services, and impacts on human wellbeing, have triggered international agreements to reduce or halt these trends (MA 2005[1]). This has created a need for significant improvements in the current set of ecosystem monitoring systems with which to measure the conditions and trends of ecosystem services, and monitor progress in implementing these agreements. The Global Earth Observation System of Systems (GEOSS) is one such proposed improvement which has as one of its objectives the provision of "spatially-resolved information on ecosystem change, condition and trend, in relation to their capacity to deliver sustainable ecosystem services in sufficient quantities to meet societal needs… with sufficient resolution to support national and global decision-making" (GEO 2005).

OBJECTIVES

- Assess the benefits of the improved observations proposed by GEOSS, specifically within the area of ecosystem service monitoring.
- Compare these benefits with the costs of improved data.

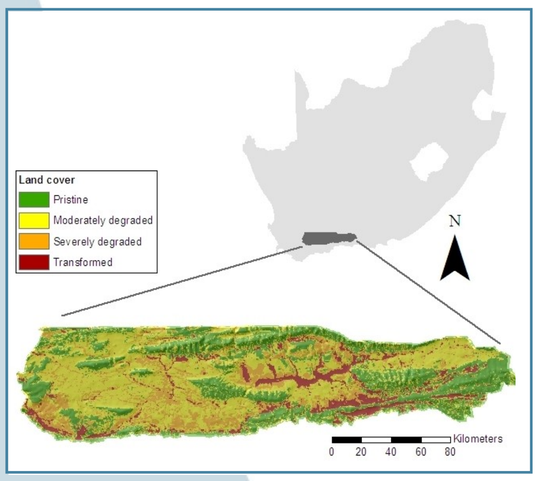

***Figure 1**: The Little Karoo of South Africa (~19 000 km²); a semi-arid, intermontane basin, where vegetation associated with three globally-recognized biodiversity hotspots intersects and intermingles.*

APPROACH

The study is based in the Little Karoo of South Africa (Fig. 1). The major form of land-use has, since the 1730s, been extensive grazing and browsing by livestock, chiefly ostriches, but also sheep and goats, leaving large areas (>50%) of degraded vegetation and soil (Fig. 2). Using data extracted from (Reyers *et al.* In Press) on the ecosystem specific impacts of land cover change on ecosystem services, the study quantified changes in ecosystem services (Fig. 3) from land cover change in the Little Karoo. These changes were quantified using two data scenarios: a GEOSS scenario (Fig. 4a) and a non-GEOSS scenario (Fig. 4b).

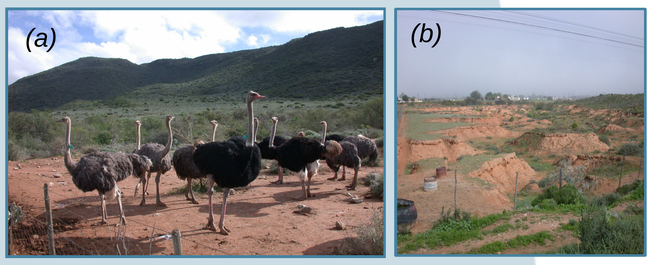

***Figure 2:** Land use in the Little Karoo (a) Ostrich camp and (b) the impact of overgrazing*

[1]Full reference list provided in proceedings

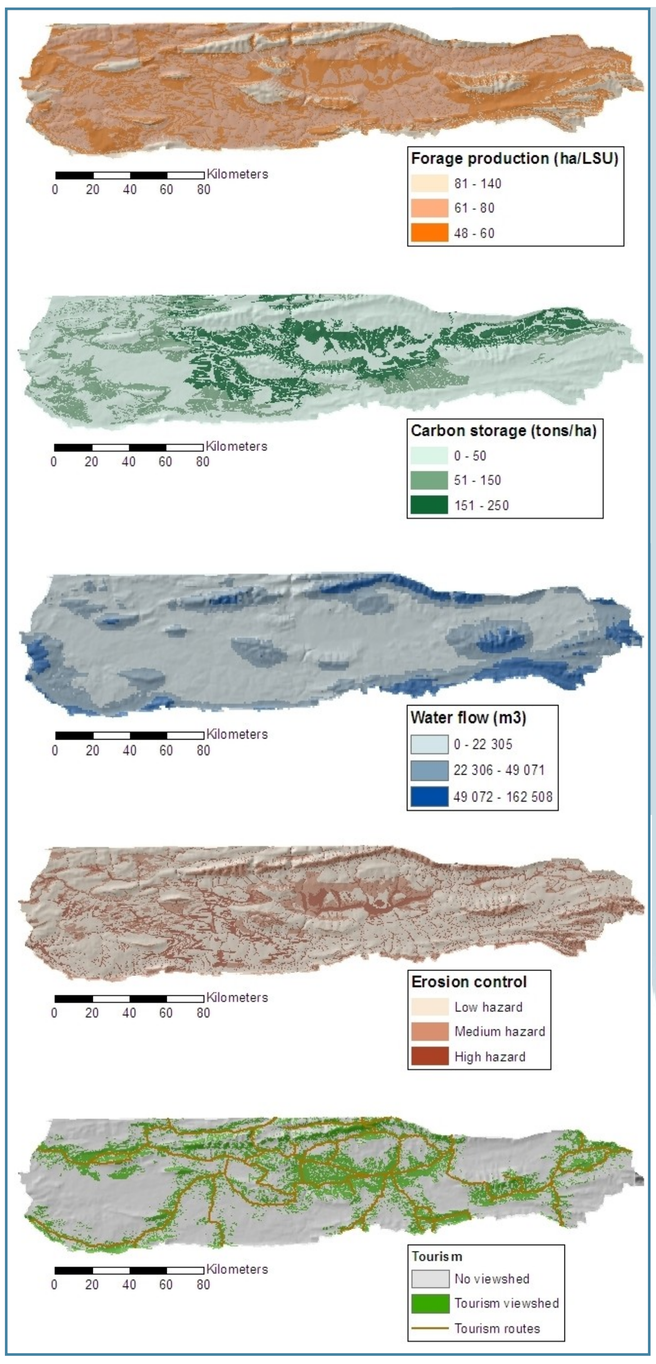

***Figure 3:** Maps of the distribution and supply of the ecosystem services of livestock grazing, water flow regulation, carbon storage, erosion control and tourism in the Little Karoo (extracted from Reyers et al. In Press).*

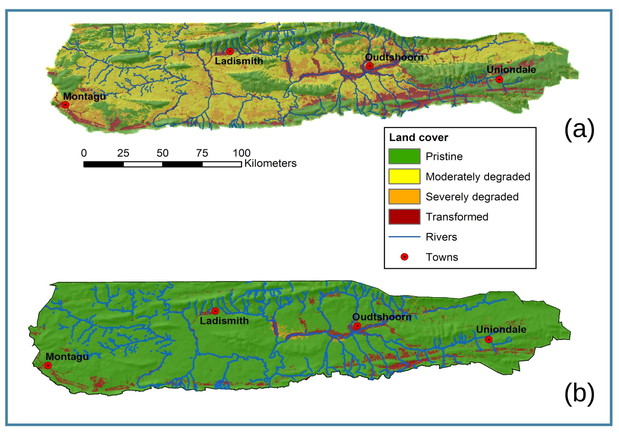

Figure 4: Landcover data used in (a) the GEOSS scenario and (b) the non-GEOSS scenario. The GEOSS scenario uses a database on land transformation and degradation mapped at a 1:50 000 scale depicting pristine vegetation and transformed (cultivated and urban) areas, but also moderately and severely degraded areas. Land degradation was quantified using a novel technique, based on intra-annual variance in NDVI values, calibrated for different vegetation units mapped at 1: 50 000 scale, and ground truthed via expert assessment (Thompson et al., In Press). The non-GEOSS scenario uses land cover data available at a national scale derived from seasonal, ortho-rectified, standardised, high resolution digital satellite imagery from Landsat 7 Enhanced Thematic Mapper

RESULTS

Figures 4 and 5 demonstrate the large discrepancy in land cover composition of the Little Karoo, where the GEOSS scenario shows large tracts of moderately (37%) and severely degraded (14%) land missed by the non-GEOSS scenario. The latter also underestimates the extent of transformation. Figure 6 translates these differences into differences in ecosystem service condition illustrating the large declines found in the GEOSS scenario, while the non GEOSS scenario finds < 10% declines in most ecosystem services.

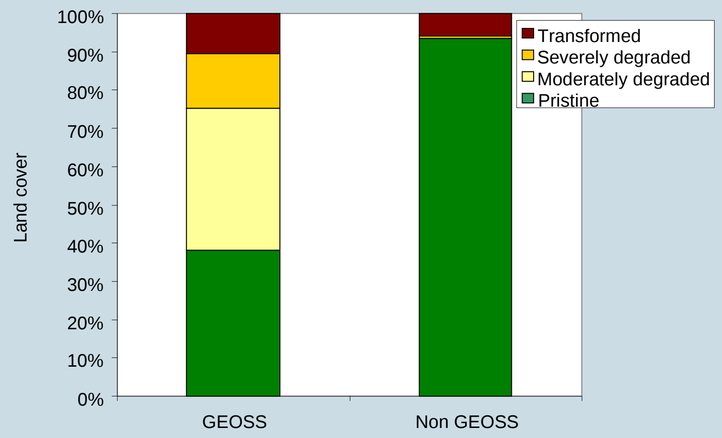

***Figure 5**: Land cover of the GEOSS & non-GEOSS assessments*

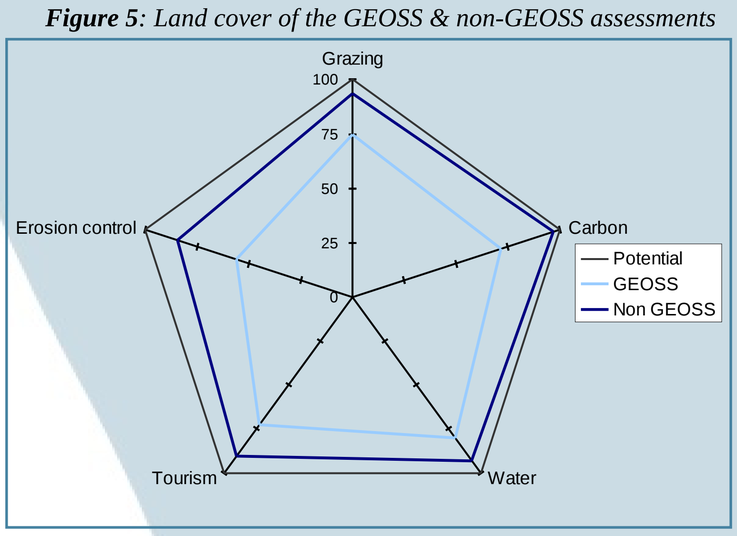

***Figure 6:** Changes in ecosystem service supply in the Little Karoo based on GEOSS and non GEOSS scenario databases. Change is reflected as a percentage of the potential supply (nominally that of the pre-colonial period).*

A ROLE FOR GEOSS

The use of accurate fit-for-purpose data (GEOSS scenario) provides accurate information on the current degraded state of the Little Karoo's ecosystems and emphasizes the need to make careful land use decisions in the future. The results of the non GEOSS assessment tell a very different story of relatively intact ecosystems with ecosystem service levels very similar to what they were during pre-colonial times. It contradicts many studies in the region which highlight the significant declines in ecosystem health and human wellbeing in the region (e.g. Le Maitre *et al.* 2007; O'Farrell *et al.* 2008). It is difficult to compare the costs of the GEOSS scenario's improved data (€9000; Rouget *et al.* 2006) with the benefits of more accurate information on ecosystem state. However, costs of €2000/ha to restore overgrazed and degraded land (Herling *et al.* In Press); and costs of €35.3 million in flood related agriculture and infrastructure damage provide an indication of the benefits of improved data for management of human land uses.

CONCLUSION

Strategic investments in earth observation systems can have disproportionately large effects on our ability to manage ecosystems and their services. Determining optimal investment in such systems is clouded by our inability to quantify the benefits of improved ecosystem management.

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