Product factsheet

Ecosystem Functional Types Map

Problem description

Land cover change analysis stands as the predominant approach for monitoring land degradation [6-8]. Nevertheless, its utility as an early warning system is constrained by inherent limitations. The identification of changes heavily relies on predefined categories, often omitting degraded covers such as forests or shrubs. Essentially, once changes are discerned using this method, it likely indicates that the ecosystem has surpassed a critical threshold, rendering interventions for restoration financially burdensome and the changes are potentially irreversible. Detecting ecosystem transitions that indicate an impending critical threshold could enhance mitigation efforts against degradation, potentially reducing associated economic

Proposed solution

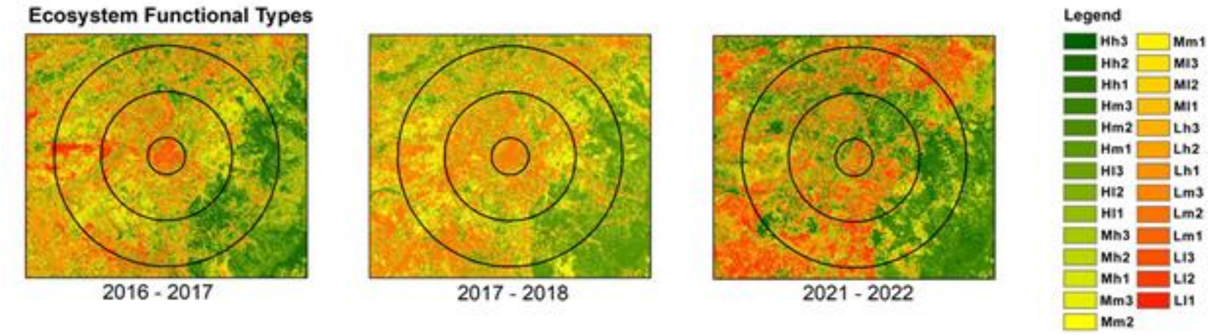

Fig 1. An example of EFT maps calculated for Mtendeli Refugee Camp surrounding for three vegetation seasons: August 2016 – July 2017; August 2017 – July 2018; August 2021 – July 2022. (source: Jenerowicz-Sanikowska, M., et al., 2023).

Remotely sensed Ecosystem Functional Attributes (EFAs) have been recognized as comprehensive indicators of change, providing an early indication of vegetation performance in response to environmental factors and human influences [1].

The Ecosystem Functional Types analysis is performed within the joint research initiative of H2020 EOTiST and ARICA projects in order to better understand the ecosystem conditions around refugee camps.

Ecosystem Functional Attributes (EFAs) serve as quantitative descriptors of the exchanges of matter and energy between biotic and abiotic environmental components. These attributes encompass various indicators such as productivity, seasonality, and phenology of carbon gains, offering a swift response to change compared to structural or compositional attributes like land use/cover [2]. Leveraging remote sensing data, EFAs have been recognized as informative metrics for assessing vegetation change and promptly responding to ground conditions, including human-induced environmental pressures [1]. Moreover, Ecosystem Functional Types (EFTs), derived from EFAs, categorize ecosystems based on their functions without prior knowledge of vegetation types or spatial structure [3]. The temporal analysis of both EFAs and EFTs provides valuable insights into changes in ecosystem functioning, facilitating the early detection of landscape degradation [3,4,5].

Project coordinated by CBK PAN and founded by Grant Agreement 952111 H2020 WIDESPREAD-05-2020 (Twinning)
https://eotist.cbk.waw.pl/

Main features

Ecosystem Functional Types are derived from the 3 Ecosystem Functional Attributes, metrics of the NDVI seasonal curve:

- the annual productivity (NDVImean);
- the NDVI seasonal coefficient of variation (sCV) as a descriptor of seasonality (NDVI sCV);
- and the date of the maximum NDVI as indicator of phenology (NDVIDmax).

For the final classification of EFTs a coding system is applied using 3 letters (H/h - high, *M/m* - medium and *L/l* - low) and a number (1, 2 or 3). The first uppercase letter denotes the level of productivity (NDVImean) being *H*, high productivity, *M*, medium and *L*, low productivity. The second lowercase letter corresponds to seasonality (NDVI sCV) being *h* high, *m* medium and *l* low seasonality. Finally, the numerical value corresponds to the phenological indicator of the maximum growing season (NDVIDmax) where 1 represents wet season, 2 post-wet season and 3 dry season (in case of Tanzania, Figure 1) and 1 for wet season and 2 for dry season (in case of Bangladesh).

Acknowledgements

This work was supported by European Union's Horizon 2020 research and innovation programme under EOTIST project, grant agreement No 952111, and the Norway Grants POLNOR2019 programme co-financed from the state budget Applied Research under ARICA project, grant agreement No NOR/POLNOR/ARICA/0022/2019-00.

References

[1] Alcaraz-Segura, D., Lomba, A., Sousa-Silva, R., Nieto-Lugilde, D., Alves, P., Georges, D., Vicente, J. R. and Honrado, J. P., "Potential of satellite-derived ecosystem functional attributes to anticipate species range shifts," International Journal of Applied Earth Observation and Geoinformation 57, 86–92 (2017).

[2] Mouillot, D., Graham, N. A. J., Villéger, S., Mason, N. W. H. and Bellwood, D. R., "A functional approach reveals community responses to disturbances," Trends in Ecology & Evolution 28(3), 167–177 (2013).

[3] Ivits, E., Cherlet, M., Horion, S. and Fensholt, R., "Global Biogeographical Pattern of Ecosystem Functional Types Derived From Earth Observation Data," 7, Remote Sensing 5(7), 3305–3330 (2013).

[4] Huang, Y., Yin, X., Ye, G., Lin, J., Huang, R., Wang, N., Wang, L. and Sun, Y., "Spatio-temporal variation of landscape heterogeneity under influence of human activities in Xiamen City of China in recent decade," Chin. Geogr. Sci. 23(2), 227–236 (2013).

[5] Jenerowicz-Sanikowska, M., Domingo-Marimon, C., Pesquer Mayos, L., Woźniak, E., Ruciński, M., Foks-Ryznar, A., Krupiński, M., Aleksandrowicz, S., Chułek, M., SobczakSzelc, K., Espegren, A., Haarpaintner, J., Starczewski, D., Developing early warning systems for land degradation around refugee camps: a preliminary approach," Proc. SPIE 12734, Earth Resources and Environmental Remote Sensing/GIS Applications XIV, 127340H (19 October 2023) https://doi.org/10.1117/12.2683928; [Full paper]

[6] Bappa, S. A., Malaker, T., Mia, M. R. and Islam, M. D., "Spatio-temporal variation of land use and land cover changes and their impact on land surface temperature: A case of Kutupalong Refugee Camp, Bangladesh," Heliyon 8(9) (2022).

[7] Hassan, M. M., Duveneck, M. and Southworth, J., "The role of the refugee crises in driving forest cover change and fragmentation in Teknaf, Bangladesh," Ecological Informatics 74, 101966 (2023).

[8] Sakamoto, M., Ullah, S. M. A. and Tani, M., "Land Cover Changes after the Massive Rohingya Refugee Influx in Bangladesh: Neo-Classic Unsupervised Approach," 24, Remote Sensing 13(24), 5056 (2021).