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Comparing the efficiency of RADAR and optical remote sensing in mapping burnt areas within a grassland biome

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Abstract:

Wildfires are unintentional fires that damage natural environments but do also contribute to ecological sustainability. Monitoring wildfires is therefore a vital component in the management of natural ecosystems. Remote sensing techniques such as burn indices derived from optical data have been used widely to monitor wildfires. The most prevalent focus within the literature of remote sensing of wildfires is on wildfires that occur in large plant forms such as forests and savannas (e.g., Xulu et al., 2021; Shekede et al., 2021). Many studies have applied remote sensing in the mapping of wildfires in South Africa; however, most of these studies focused on the use of a ingle type of remotely sensed data, mainly optical data (e.g., Ngadze et al., 2020; Urban et al., 2020; Belenguer-Plomer et al., 2021). The use of optical data is limited to convenient seasons since technology works optimally in cloud free conditions. In contrast, RADAR has the ability to penetrate clouds, and therefore there is a need to explore the utility of RADAR to map fire burns.

The present study compared the efficiency of RADAR and optical remote sensing in the mapping burnt areas in the Mangaung Municipality, Free State (South Africa). Sentinel-2 multispectral (optical) image and Sentinel-1 RADAR data acquired around mid-July of 2021 were used in the study. The images were classified using Random Forest (RF) and Support Vector Machine (SVM) classifiers. The optical data returned high producer's (PA) and user's (UA) accuracies using the RF and the SVM (Table 1). In contrast, the RADAR data had low PA and UA for both the RF and SVM classifiers. Lastly, the combination of RADAR and optical data improved the classification marginally over the optical data alone.

	Optical		RADAR		Combination	
	UA	PA	UA	PA	UA	PA
RF	98,4%	93,0%	7,7%	38,3%	100,0%	94,0%
SVM	98,9%	91,5%	6,5%	37,3%	100,0%	93,0%

Table 1: Accuracy (UA, PA) results of burnt area identification using RADAR, Optical, and Combined datasets by applying RF and SVM classification algorithms

Figure 1 shows the distributions of burnt areas produced using the three datasets and the two algorithms. The RADAR data overestimated burnt areas significantly followed by the optical data that showed slight difference from the combined dataset. The findings of the study clearly show the efficiency of optical data in mapping burnt areas. However, by combining RADAR and optical data, the accuracy of mapping burnt areas can potentially be maintained even during cloudy seasons when optical data alone suffers.

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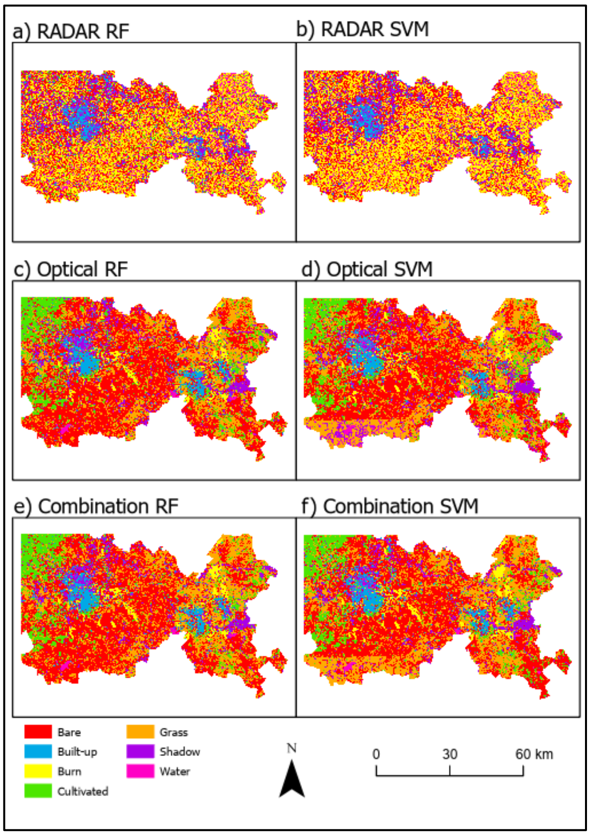

Figure 1. Map of land cover types including burnt areas produced using different data and classification algorithms

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