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Editorial

Remote Sensing Advances in Fire Science: From Fire Predictors to Post-Fire Monitoring

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Fire activity has significant implications for ecological communities, biogeochemical cycles, climate, and human lives and assets. Approximately over half of the Earth's land surface is susceptible to fire, with around 3% experiencing annual burning according to coarse-resolution satellites [1], a value that is probably much higher according to recent estimates from finer satellite imagery [2]. Because of the vast extent of land burned over the world, landscape fires release approximately 23% of the global CO_2 emitted annually from fossil fuels, modify Earth's energy fluxes through changes in surface albedo, and have an enormous influence on human health and the economy [1]. Fires also have a large influence on local ecosystems, affecting the ecosystem services provided to local communities. Thus, fires are a relevant phenomenon with an enormous area of impact every year.

Because of the relevance and impact of fires across the globe, the study of this phenomenon and the assessment of its consequences cannot be addressed only by field or laboratory studies. In this sense, the exploitation of remote sensing platforms, sensors, and methods is crucial to obtain accurate and extensive spatial and spatiotemporal information on fire and its consequences. Considering fire as a natural hazard, geo-spatial studies can be organized in multiple ways, one of them being based on the temporal point on which they focus in relation to fire. Thus, we can differentiate those studies focused on a pre-fire stage: for instance, those addressing topics that can help predict fire-related risks and thus are useful for pro-active management strategies. The second stage is the moment when fires occur. At that point, remote sensing might be useful to detect active fires, or to detect burn scars as evidence of fire. The next stage is the analysis of the immediate impacts and consequences of fire. This is related, but not limited to burn severity assessments, which indicate the overall environmental change caused by fire. The assessments immediately after fire are essential for addressing post-fire emergency actions when needed. Lastly, remote sensing plays a crucial role in analyzing the evolution of burned areas over time. This can be focused on multiple elements of the ecosystem but is generally focused on soil and vegetation. The assessment of post-fire trajectories is necessary to identify the areas where post-fire recovery is not satisfactory and for the implementation of restoration strategies.

The remote sensing discipline is rapidly advancing thanks to the increasing availability of sensors, data, techniques, and processing capabilities. Thus, in this Special Issue, "Remote Sensing in Forest Fire Monitoring and Post-fire Damage Analysis", we compiled 10 studies [1–10] representing significant advances in the remote sensing of fires, with regard to the different aspects and temporal stages exposed above. In relation to the pre-fire stage, our Special Issue provides new insights into the relevant predictors of fire activity, such as live fuel moisture content [3] and surface fuel load [4], or soil moisture availability [5]. Moreover, Stoyanova et al. [5] explored the potential of land surface temperature status and dynamics as novel indicators of fire risk. In relation to the second stage, a new burned area mapping algorithm using Sentinel-2 [2] is presented, which has been revealed as the most accurate non-commercial imagery for burned area mapping. Furthermore, Park et al. [6] presented a novel approach to improve disaster responses, based on the application of deep learning to detect the multiple elements that might interact in a fire situation. Regarding the assessment of burned areas and fire impacts, our Special Issue includes the first analysis of trends in burn severity at the global scale, revealing the aggravation of fires in many forest biomes [1]. Moreover, Silva Cardoza et al. [7] proposed an improved burn severity algorithm by combining relative phenological correction with former burn severity metrics. In terms of analyzing post-fire trajectories, our Special Issue encompasses a variety of advances, providing cutting-edge information on the drivers and dynamics of post-fire regeneration [8], the performance of physical-based models to measure forest resilience to fire [9], and the identification of optimal parametrizations and wavelengths for LiDAR classifications in post-fire environments [10].

The work provided in this Special Issue contains examples of the multiple advancements in the remote sensing discipline. For instance, the presented studies demonstrate advancements using different remote sensing platforms exploiting imagery from geosynchronous orbit satellites (METEOSAT) [5], sun-synchronous polar orbit satellites (MODIS) [1,3], low-earth-orbit satellites (Sentinel-2) [2,7–9], aircrafts [4,10], or UAVs [6]. Likewise, examples are also provided of how the remote sensing and fire sciences can be advanced using different sensor types (passive [1–3,5–9] and active [4,10]) and methodological approaches (deep learning, machine learning, radiative transfer models, spectral mixture analysis, interpolation techniques, linear models, and spectral indices).

Conflicts of Interest: The authors declare no conflict of interest.

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