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Spatiotemporal trends in burn severity in the last two decades for mainland Portugal

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Abstract

Wildfires can pose severe threats to human lives and assets as well as to biodiversity on a global scale. Due to climate, land-use changes, and often inadequate forest management, wildfire regimes are also in transition. In particular, increasing fire severity causes slower post-fire recovery times and depletion in the resistance and resilience of ecosystems.
Satellite remote sensing (SRS) Earth Observations (EO) allow us to characterize the ecological impacts of wildfires and assess spatiotemporal trends in fire severity. The SeverusPT project is currently pursuing the objective of harnessing SRS/EO time series to characterize wildfire severity. Our primary objectives of this exploratory research paper are two-fold: (i) assess national and regional spatiotemporal trends in fire severity and burnt area, and (ii) evaluate if fire severity regionally scales up with the total burnt area.
Satellite image time series (SITS) were obtained to calculate fire severity through the Normalized Burn Ratio (NBR) and the difference between pre- and post-fire (ΔNBR). Trend analyses were employed to quantify fire severity and burned area spatiotemporal patterns. Linear regression assessed the association between total burnt area by year/region (predictor) and fire severity (response).

Preliminary results show that at a national level, from 2001 until ca. 2008 - 2009 there was a general decrease in fire severity, followed by a reversal of this trend. This turning point has led to a general increase, with new severity highs formed in 2017 and 2020. We also found wide variation in fire severity at the regional level (NUTS-III), and trend analysis displayed that most regions increased both in burned area and severity.
Linear regression showed that burned area and fire severity are correlated despite this association being highly structured at the regional level, forming a continuous spectrum from highly area-severity coupled regions (e.g., AM Porto, Médio Tejo, Viseu, Coimbra, Alto-Minho) to less coupled ones (e.g., Cávado, Trás-os-Montes, Alentejo). These results may support that the increasing amount and size of the burnt area will scale up into higher fire severity for specific regions.
These preliminary results show that satellite image time series allow assessing the spatial variation and the temporal trends of fire severity in a standardized fashion. Mapping fire severity, its spatiotemporal variation and addressing its environmental drivers are now more crucial than ever to understand its dynamics and support fire management and prevention.

Keywords: Fire severity, Burnt area, Spatiotemporal trends, Remote Sensing, Earth Observation

References

Bowman D et al., Fire in the Earth system., Science, vol. 324, no. 5926, pp. 481–4, Apr. 2009, doi: 10.1126/science.1163886. Cardil, A., B. Mola-Yudego, Á. Blázquez-Casado, and J. R. González-Olabarria, Fire and burn severity assessment: Calibration of Relative Differenced Normalized Burn Ratio (RdNBR) with field data, J. Environ. Manage., vol. 235, pp. 342–349, Apr. 2019, doi: 10.1016/j.jenvman.2019.01.077. Gorelick, N., M. Hancher, M. Dixon, S. Ilyushchenko, D. Thau, and R. Moore. 2017. Google Earth Engine: Planetary-scale geospatial analysis for everyone. Remote Sensing of Environment 202:18-27. Hijmans, R.J. 2022. terra: Spatial Data Analysis. R package version 1.5-21. https://CRAN.R-project.org/package=terra ICNF, 2022. Territórios ardidos (National Burnt Area Database for mainland Portugal 1975-2020). Creation date: 28/04/2020, Updated in: 26/01/2022, Visit date: Feb-2022. URL: https://sig.icnf.pt/portal/home/item.html?id=983c4e6c4d5b4666b258a3ad5f3ea5af Koutsias, N, B. Allgöwer, K. Kalabokidis, G. Mallinis, P. Balatsos, and J. G. Goldammer, Fire occurrence zoning from local to global scale in the European Mediterranean basin: Implications for multi-scale fire management and policy, IForest, vol. 9, no. APR2016, pp. 195–204, Apr. 2016, doi: 10.3832/ifor1513-008. Marcos, B., J. Gonçalves, D. Alcaraz-Segura, M. Cunha, and J. P. Honrado. 2019. Improving the detection of wildfire disturbances in space and time based on indicators extracted from MODIS data: a case study in northern Portugal. International Journal of Applied Earth Observation and Geoinformation 78:77-85. Marcos, B., J. Gonçalves, D. Alcaraz-Segura, M. Cunha, and J. P. Honrado. 2021. A Framework for Multi-Dimensional Assessment of Wildfire Disturbance Severity from Remotely Sensed Ecosystem Functioning Attributes. Remote Sensing 13. Santos, X., J. Belliure, J. Gonçalves, and J. G. Pausas. 2022. Resilience of reptiles to megafires. Ecological Applications 32:e2518. Tedim, F, R. Remelgado, C. Borges, S. Carvalho, and J. Martins, Exploring the occurrence of mega-fires in Portugal, For. Ecol. Manage., vol. 294, pp. 86–96, Apr. 2013, doi: 10.1016/j.foreco.2012.07.031 Torres, J., Gonçalves, J., Marcos, B., and Honrado, J. 2018. Indicator-based assessment of post-fire recovery dynamics using satellite NDVI time-series. Ecological Indicators 89:199-212.

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