Fire in the Earth System Abstracts
Vol. 1 FES-Fire and soil organic matter-41
Valencia, Spain, 3-7 November, 2021

UAS-bared near infrared imagery as a new fire severity metric

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Abstract

Ash and char are known as broad indicators for evaluating the impacts of fire on nutrient cycling and ecosystem recovery. Numerous studies suggested assessing fire severity by changes in ash characteristics. Traditional methods for fire severity are based on in situ observations which are time-consuming and subjective. These measures are mostly reflecting the level of consumption of organic layers, the deposition of ash, particularly its depth and colour, and fire-induced changes in the soil. Recent studies on fire severity suggested using remote sensing combined with field observations via machine learning and spectral induces approaches to obtain applicable tools for assessing the fire effects on ecosystems. While index thresholding can be easily implemented, its effectiveness over large areas is limited pattern coverage of forest type and fire regimes. The machine learning algorithms allow multivariate classifications, but in the case of space-time series, it becomes complex. Therefore, there is no complete agreement on a quantitative index that determines the severity metric. This study indicates that there is potential for low-cost multispectral imagery across visible and near-infrared regions collected by the unmanned aerial systems to determine fire severity according to the colour and chemical properties of vegetation ash. The use of multispectral imagery data might reduce impreciseness caused by manual colour matching and produce a vast and accurate spatial-temporal severity map. The suggested severity map is based on spectral information used to evaluate chemical changes in fuels by deep learning algorithms. These methods quantify losses of carbon and assessing the corresponding fire intensity that is required to form a particular residue. By designing three different learning algorithms (PLS-DA, ANN, and 1-D CNN) for two datasets (RGB images and Munsell colour versus UAS-based multispectral imagery) the multispectral prediction results show an excellent performance (optimal correction coefficient R2 > 0.95 for 1-D CNN), which, therefore, shows that the deep network-based near-infrared remote sensing technology has a future potential to become an alternative and reliable fire severity monitoring method.

Keywords: Vegetation ash, severity, near infrared spectra, UAS, remote sensing, machine learning

Acknowledgments: This research was supported by Grant 2014299 from the United States-Israel

Binational Science Foundation (BSF)