UTILIZATION OF HYPERSPECTRAL REMOTE SENSING IMAGERY FOR IMPROVING BURNT AREA MAPPING ACCURACY

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1. MANUSCRIPT

1.1 Introduction

Disastrous wildfires, such as the ones occurring in New South Wales / Australia in 2019/20 or in California / USA in 2020, have gained wide recognition in the global media. Besides obvious effects, such as the loss of lives and property, wildfires also affect the global climate through carbon dioxide (CO_2) emissions. Monitoring wildfires using satellite-based Earth Observation (EO) imagery has become an essential tool for wildfire management and mitigation.

The assessment of burnt areas through remote sensing imagery is usually based on a combination of information of either the red / NIR (near infrared) or the NIR / SWIR (short wave infrared) domain. This is done by utilizing a normalized difference index such as the NDVI (Normalized difference vegetation index), or the NBR (Normalized Burn Ratio), often in their differential variants. The wavelengths of the available spectral bands are, however, determined by the utilized sensor, and may not be optimal for the specific task of burnt area derivation. Hyperspectral data, however, allows the utilization of specific wavelengths best suited for a given task. The presented study analyses to what extent an automatic burnt area processing chain can profit from the additional spectral information available in data of the DESIS hyperspectral instrument.

1.2 Methodology

As the DESIS sensor provides wavelength data from 402 nm to 1000 nm, we focus our investigation on the optimal combination of red and NIR bands for mapping burnt areas. The method of this study follows a comprehensive approach, sometimes referred to as “brute-force”. Every possible band combination from the red / NIR domain is used for calculating the differential NDVI in order to derive burnt areas. We focus on the 4-bin DESIS product. More sensitive indices regarding the mapping of burnt areas, such as the NBR, cannot be applied, as DESIS provides data up to a maximum wavelength of 1000 nm.

As reference dataset for the investigation of the accuracy of the DESIS burnt area mapping regarding differing band combinations, we use the result of a fully automated burnt area mapping processor based on mid-resolution Sentinel-3 data (Nolde et al. 2020). This processor, operated at the German Aerospace Center (DLR), utilizes data of the Ocean and Land Colour Instrument (OLCI) onboard the European satellites Sentinel-3A and Sentinel-3B.

The algorithm uses auxiliary active fire data from the MODIS (Moderate-resolution Imaging Spectroradiometer) and VIIRS (Visible Infrared Imaging Radiometer Suite) in combination with a region growing step to define areas of interest within the source scene. Depending on whether pre-information is available, the analysis is either based on the differential NDVI or just the $NDVI_{post}$. Each region is consecutively segmented using a dynamically growing curve through a morphologic active contour approach.

The thematic and spatial accuracy of the DESIS burnt area mapping results is assessed using the Kohen’s Kappa metric by comparison with the reference dataset. The analysed band combinations are presented in the order of their suitability for burnt area assessment.

REFERENCES

Nolde, M.; Plank, S.; Riedlinger, T. An Adaptive and Extensible System for Satellite-Based, Large Scale Burnt Area Monitoring in Near-Real Time., 2020. *Remote Sens.*, *12*, 2162. https://doi.org/10.3390/rs12132162

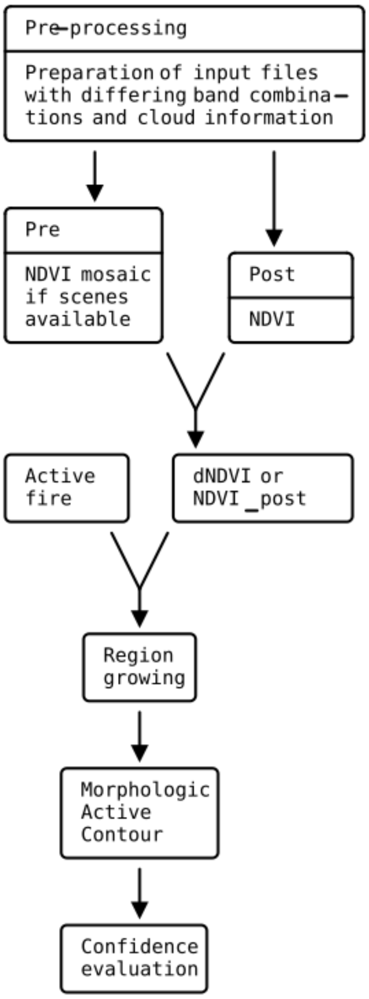

Figure 1: Schematic workflow for the burnt area derivation