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Burned Areas Segmentation with Convolutional Neural Networks

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Abstract. In recent years, a novel non-linear approach based on convolutional neural networks allowed to improve the state-of-the-art of many computer vision classification and regression problems. Image segmentation places among them, and the aim is to label pixels on an image belonging to the same category. Several model architectures have been proposed to deal with this problem including U-nets that have been widely applied for this task. In this work we trained a U-net model, with a pretrained Resnet34 as the encoder, with the aim of labelling burned/unburned pixels, using remote sensing imagery derived from the Visible Infrared Imaging Radiometer Suite (VIIRS) as inputs and the Modis burned area product (MCD64A1 Collection 6) as targets. The data used covers selected regions of Portugal, California, Mozambique, Northern Australia and Brazil for the period spanning 2012 to 2018. The input data consist of 3-channel images with 0.01º spatial resolution consisting of i) monthly composites of minimum W, i.e. a near and middle-infrared based index optimized for burned area discrimination (Libonati *et al.*, 2011); ii) the difference between the minimum W of two consecutive months; and iii) hotspots obtained from the VIIRS 375m active fires product, interpolated to the working grid. Cross-validation results show that the model performs well in most scenes, with an average Dice coefficient of 0.69, 0.79, 0.60, 0.77 and 0.68, respectively for Portugal, California, Mozambique, Australia and Brazil, when using the Modis product as the reference map. Test results for 2018, performed with an ensemble of 6 cross-validation models, show improvements over a single model. We further show that the trained model can be applied to monthly composites of minimum Near-Infrared (NIR), derived from the Advanced Very High Resolution Radiometer (AVHRR) aboard Metop satellite. This is achieved by fine-tuning the pretrained model, even if with a very small training set. Finally, we discuss the advantages, limitations and future perspectives of this methodology for the burned area segmentation problem.

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