EGU2020-9243
https://doi.org/10.5194/egusphere-egu2020-9243
EGU General Assembly 2020

Using deep learning to transfer knowledge between satellite datasets for automated agricultural land discrimination in Afghanistan

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Accurate mapping of agricultural area is essential for Afghanistan's annual opium poppy monitoring programme. Access to labelled data remains the main barrier for utilising deep learning from satellite imagery to automate the process of land cover classification. In this study, we aim to transfer knowledge from historical labelled data of agricultural land, from work on poppy cultivation estimates undertaken between 2007 and 2010, to classify imagery from a range of sensors using deep learning. Fully Convolutional Networks (FCNs) have been used to learn the complex features of agriculture in southern Afghanistan using their inherent spatial and spectral characteristics from satellite imagery. FCNs are trained and validated using labelled Disaster Monitoring Constellation (DMC) data (32 m) to transfer knowledge of agricultural land to classify other imagery, such as Landsat (30 m). The dependency on spatial and spectral characteristics are explored using intensity, Normalised Difference Vegetation Index (NDVI), top of atmosphere reflectance and tasselled cap transformation. The underlying spatial features associated with agriculture are found to play a significant role in agriculture discrimination. High classification performance has been achieved with over 92% overall accuracy and 0.58 intersection over union. The ability to transfer knowledge from historical datasets to new satellite sensors is an exciting prospect for future automated agricultural land discrimination in the United Nations Office on Drugs and Crime annual opium survey.