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## Characterising vegetation fuel moisture conditions from microwave satellite observations for fire danger prediction at continental to global scales

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Spatial patterns and temporal changes in live fuel moisture content (LFMC) have been intensively estimated from satellite observations in the optical domain of the electromagnetic spectrum. Such estimates are valuable to predict regional to local variations in fire danger (Yebra et al., 2018). However, optical satellite measurements saturate fast in dense canopies and are generally hampered during cloud cover. Microwave satellite observations can penetrate clouds and the canopy (dependent on the wavelength) and hence have been intensively used to derive surface soil moisture (SSM) or vegetation optical depth (VOD), which is a proxy for vegetation water content (Moesinger et al., 2019). However, the relationship of microwave VOD to LFMC and the predictive capabilities of VOD for fire dynamics have not yet been investigated at large scales. Here we aim to assess how VOD reflects changes in LFMC and the sensitivity of VOD to different properties of fire dynamics such as fire occurrence, size, burned area, and fire radiative power.

We compared VOD in different microwave bands (Ku-, X-, and C-band) from the VODCA dataset (Moesinger et al., 2019) with LFMC from MODIS retrievals (Yebra et al., 2018). Our results demonstrate that VOD and LFMC are moderately to highly correlated but the strength and shape of the relationship depends on land cover type. In a preliminary analysis, we then predicted the probability of fire occurrence (Andela et al., 2019) and fire radiative power (Kaiser et al., 2012) from VOD, SSM, and climate data using the random forest machine learning approach. The initial results show that VOD is a skilful predictor for continental-scale fire dynamics. Furthermore, our results suggest that the combination of LFMC from optical satellites with microwave SSM and VOD might allow to comprehensively estimate ecosystem fuel moisture conditions. Hence microwave satellite observations will be valuable for the development of integrated fire danger prediction systems.

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