**Title**

Novel use of advanced scatterometer (ASCAT) for forest fire monitoring

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**Date**

2023-04-18

**Abstract**

Fire both shapes and destroys forests. Forest fires are therefore essential to ecological processes and vegetation as we know them. With climate change, forest fires are expected to increase in severity and frequency. To maintain the functioning of the forests, it is important to understand the vegetation response to and recovery from forest fires. Within this field of study, remote sensing techniques are common, and optical indices such as the NDVI are most prevalent.

With recent developments, the ASCAT variables slope and curvature have become of increasing interest in structural vegetation monitoring. These variables are a second-order Taylor polynomial’s first and second derivatives used to normalise the ASCAT backscatter-incidence angle relationship. This study explored the possibility to use these novel variables in forest fire research.
The focus was to discover to what extent the variables responded to a major forest fire.

To do so, grid points affected during the 2009 Australian Black Saturday Fires are compared to unaffected control grid points utilizing Z-scores. These control grid points have been selected based on time series similarity in the two years before the fire. Time series from 2007 to 2021 are used to investigate fire impact and recovery. The ASCAT variables are compared to a similar
NDVI time series to aid in interpreting the results.

The findings show that both slope and curvature are sensitive to the major forest fire. Both variables show an impact shortly after the fire, which can be explained by the loss of scattering elements in the vegetation due to the fire. In the following years, there is a notable recovery which can be explained by the vegetation regrowth forming new scatterers. The NDVI showed similar
behaviour but the recovery was differently timed, suggesting that the signal recovery is driven by something else or that the regrowth of leaves is different from the regrowth of the structural elements that the ASCAT variables represent.

The results help in understanding the ASCAT variables and their interpretation in terms of vegetation scatterers. Especially for the curvature, the clear change in signal deflects the discussion of whether the variable has information potential. Nevertheless, for the ASCAT variables to be applicable in forest fire research, they need to be better understood and additional research is necessary. Suggestions are for example a ground validation study or a global forest fire study, which would suit the coarse resolution of the ASCAT variables better and improve the understanding of the interaction between forest fires and the variables.

Although using the ASCAT variable for forest fire research is in its infancy, the results about its suitability are promising, both for ASCAT product development, as well as for the forest fire research field. Exploring the possibilities further is worthwhile, especially considering the fact that the slope and curvature time series cover a long continuous period starting as early as 1991. This long time series makes the ASCAT variables suitable for long-term forest fire monitoring, and the daily nature of the data might also make them interesting for short-term monitoring.