

## Comment on bg-2021-289

Matthias Forkel (Referee)

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Referee comment on "Monitoring post-fire recovery of various vegetation biomes using multi-wavelength satellite remote sensing" by Emma Bousquet et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-289-RC2>, 2022

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### **Review of the manuscript „SMOS L-VOD shows that post-fire recovery of dense forests is slower than what is depicted with X- and C-VOD and optical indices“ by Bousquet et al. 2021**

The study investigates the temporal anomalies of different remotely-sensed climate variables and vegetation properties before and after fire. The main finding is that L-VOD recovery slower after fire than X-VOD, C-VOD or optical vegetation indices. The study provides an important contribution to the research on the understanding of VOD data in different wavelengths and on the use of VOD to study fire. The text is written in an easy to understand language, however some sentences are written too simple and are unspecific and by this make partly wrong statements (see specific comments).

Fire is both driven by fuel loads and fuel moisture (Chuvieco et al., 2014) and VOD is sensitive both to biomass and fuel moisture content (FMC), or vegetation water content (VWC) (Konings et al., 2019). Especially, X-VOD is more sensitive to FMC than other microwave-derived surface properties (Fan et al., 2018). Hence VOD was already successfully used in data-driven fire models (Forkel et al., 2017; Kuhn-Régnier et al., 2021). However, it is not yet clear how the different VOD bands are sensitive to either biomass or FMC and hence of the biomass- or moisture-“component” of VOD is more important for fire prediction. The same question is true for post-fire recovery: Does VOD measure really a recovery of biomass or a recovery of the fuel moisture? Note that different changes in VOD and optical indices and their relation with land cover trends have been also investigated in Andela et al. (2013). Those sensitivities of VOD to biomass and moisture are important to consider in the context of this study, however, those lines of thought were not included in the introduction and/or discussion. Hence, the objective of the study is also not entirely clear. Are you aiming to use VOD as a proxy for post-fire biomass recovery? If yes, how could you disentangle the moisture effect? The role of biomass and moisture on VOD should be introduced in chapter 1 and discussed in the

discussion.

Like the second referee, I am puzzled about the selection of fires for the analysis (Fig. 4a). Globally, fire activity is strongest in the African Savannahs (mostly in the Sahel), in northern Australia and South America (Giglio et al., 2013; Andela et al., 2019). However, the Sahel and Australia (and the Mediterranean) are almost completely missing in the selection of fires. What are the reasons? Does it make sense to not consider some of the most fire-prone regions in the analysis? You need to revise this (or clarify it).

### **Specific comments**

L 34: „Authors found“ – unclear which authors are meant

L 94-95: The sentence is not clear and wrong. L-band was already used in conjunction with other VOD data. See for example (Fan et al., 2018)

L 96: Using the abbreviation “VV” for vegetation variables in a study that makes use of microwave remote sensing data is not ideal because VV stands for vertically polarized sensed and received radiation. In order to avoid confusion, I recommend using another abbreviation.

L 208-209: What is the size of those fires relative to the spatial resolution of the SMOS data? How many pixels are included in those fires? Did you apply any threshold for minimum fire sizes in order to select the case studies?

L 256: Here a caption for a sub-chapter is missing because the chapter is still about the Santarem case study and not about the data analysis.

L 274: I don't understand the point iii – You excluded entire Australia from the global analysis? Why? Can you improve this description.

L 280-285: How was the anomaly computation done if a pixel experienced multiple fires?

L 413: Those time lags between fire and fuel availability were also recently reported here (Kuhn-Régnier et al., 2021).

L 419: What does L-VOD “measure” in grasslands and savannahs? L-VOD should be close to zero in grasslands as the L-band microwave penetrate the grass layer. Can you provide some more explanation and references about the sensitivity of L-VOD in grasslands?

L 425-426: Note that there are much more differences in fire regimes between North American and Siberian boreal forests (Rogers et al., 2015). In your analysis, different signals might be mixed and hence it would be better to investigate the two regions separately.

L 439: “It can be explained” – It is not clear to what “it” refers. I assume “it” refers to “L-VOD” from the previous sentence but then the sentence does not make sense. Please revise.

L 502-503: I doubt this statement as it is written. You come to this statement by averaging over many fire events from several continents but for most individual fires, it will be likely very hard to see an effect in L-VOD because most fires are much smaller than the spatial resolution of L-VOD. You need to revise the sentence in a way that it is specific to the results of your study.

Fig. 3: Some of the colours are almost impossible to see, especially the pale red and pale green of fires and L-VOD, respectively. What means “Fire nb” in the axis label?

Fig. 4: The time series plots are too small and the labels are not sharp.

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