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Interactive comment on "The high sensitivity of SMOS L-Band vegetation optical depth to biomass" *by* Nemesio J. Rodríguez-Fernández et al.

Anonymous Referee #3

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The paper provides evidence that the vegetation optical depth VOD derived from passive microwave satellite data at L-band frequency has strong correlation with the above-ground biomass and can be used to monitor vegetation status. The paper is well-written and the methodology and results are sound and at the same intriguing, suggesting VOD as a potential satellite derived parameter to explore in future studies. I recommend the paper for publication but I have few suggestions and recommendations that may help improve the interpretation of the results before final publication of the paper.

1. The paper does not provide a strong motivation of what VOD can be used for. Veg-

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etation aboveground biomass is one of the most important global ecosystem variable for carbon cycle and climate mitigation. However, the strong correlation of VOD with biomass does not necessarily mean VOD from passive microwave at approximately 0.5-degree resolution is useful for biomass estimation or monitoring. VOD can be used to monitor vegetation water content at regional scales given its coarse resolution and frequent observation. I would like to suggest that although the authors correlate the result with biomass, they emphasize the use of VOD for monitoring vegetation water content. Biomass and water content are similar in magnitude with biomass being more static and water content more dynamic. 2. The method says: "The main evaluation strategy used in this study is to spatially compare L-VOD to the evaluation data set." Although the pixel values are extracted from all the data sets to compare. However, this is not a spatial analysis because the spatial information almost disappears in the correlation studies. Unless a specific spatial correlation model was used to capture the pattern. Some of the vegetation classes are separated that can help with spatial variation of the data sets but again this is only a simple correlation study and does not include spatial analysis of data sets. 3. Figure 2. The density scatter plots with multiple parameters show that there is a strong relationship between VOD and all the parameters. Some of the most interesting ones are the optical data and precipitation showing a strong saturation with respect to VOD suggesting that VOD can be used as a complementary measurement to look at the vegetation. Wavelength is probably the most powerful aspect of the VOD measurements compared to optical data. If VOD correlated with EVI and NDVI over the entire range, then the interpretation of VOD could've been more difficult. I recommend the authors discuss this in the paper. 4. The relationship between VOD and biomass from different products are interesting. The fact that L-band VOD does not show a clear saturation with biomass may be due to: a. 1. At very coarse resolution (40-50 km), the variations of forest biomass on the landscape is dominated with the landscape heterogeneity. Larger heterogeneity (e.g. forest/non-forest mixture) will improve the relationship of VOD with biomass. This may mean that the VOD is also co-varying with the vegetation cover. In fact, the straighter

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relationship with Baccini data is the artifact of this effect. Baccini biomass is strongly correlated with MODIS VCF (vegetation continuous field) data and therefore causes a more linear relationship. Whereas other maps and including the vegetation height from Simard do not show this linear relationship. There is no reason for VOD and biomass to have a linear relationship. I recommend the authors discuss this point and may even include the MODIS VCF product as a layer similar to NDVI in the mix. b. At coarse resolution, the global biomass values are much smaller on the average. Biomass at 1-ha can reach a very large number at some ecosystems. However, at 40 km as it is mixed with the heterogeneity the average is almost smaller. This is one more reason for better sensitivity to biomass. However, it would be interesting to focus on different range of biomass with VOD. c. Over Africa, all dense tropical forests are clustered around 300 Mg/ha of biomass on the graphs in figure 2. If the goal of the paper is sensitivity to biomass, it may not be a bad idea to separate areas of up to 150 Mg/ha that includes the first cluster from the second cluster and study it separately. The binary feature of biomass in Africa, from woodlands to dense humid tropical forests in area may introduce a false strong correlation with biomass that need to be discovered further. Figure 3 is supposed to show this effect. However, the authors mix this up with precipitation and NDVI and only show the result from Bouvet. It would be good to show this for all biomass maps so the variations of the relationships are discussed. d. Although the paper is written for the biogeoscience community, it would be important for the authors to provide some explanation of why L-band data from passive measurements may have better relations with biomass compared to active measurements at the same frequency. e. How different are the relationships between VOD and different biomass maps and how can the difference be interpreted? f. In table 1, there are three metrics to show the relations between VOD and biomass and other parameters. However, only Baccini result is highlighted in the abstract. Why? The table does not necessarily support this. Furthermore, there is not physical reason that the scattering or emissivity has to be linearly related to biomass. 5. Figure 4 is a bit difficult to understand. The colors and what the legend provide cannot be easily deciphered. It seems

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one should the see the saturation of NDVI and a much linear relationship with VOD but I am not sure the figure explicitly shows this. I recommend either making the figure a bit simple or provide more information in the caption and change colors so the points are clear.

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