

Biogeosciences Discuss., author comment AC1  
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## Reply on RC1

Leander Moesinger et al.

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Author comment on "Monitoring Vegetation Condition using Microwave Remote Sensing: The Standardized Vegetation Optical Depth Index SVODI" by Leander Moesinger et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-360-AC1>, 2022

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### **We thank you for taking the time to write this constructive review!**

*Your comments are in italics, our answers are plain text.*

**Comment R1.1** *For the estimation, only night or descent orbits have been used. Using also ascendent orbits can increase the Spatio-temporal coverage but probably introduce lower quality data. Can you make a short comment about if introducing extra orbital data will increase/decrease de quality of the index?*

**Answer to R1.1** One of the main assumptions of LPRM, the retrieval algorithm, is a thermal equilibrium between surface and vegetation. Due to solar heating during the day, there likely is no thermal equilibrium. While technically we do have daytime LPRM VOD data (made with the assumption of a thermal equilibrium), it is still very experimental and the error magnitude unknown. We considered including the daytime observations with a corresponding quality flag and leave it to the users whether to use those observations or not. However, data sharing experiences of VODCA and our soil moisture products have taught us that even with extensive documentation, data are often not used and interpreted correctly.

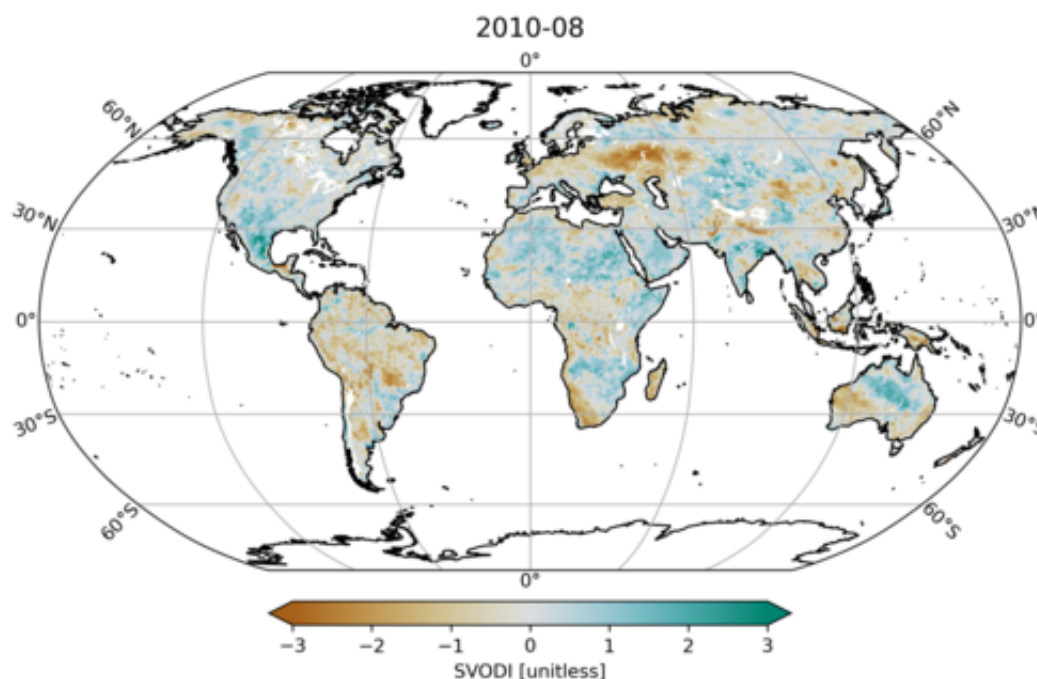
**Comment R1.2** *As you pointed out in line 206, long-term VOD trends are related to biomass changes. To extract vegetation structural changes, the data have been linearly detrended. Since the data set covers a long period, can rapid changes in biomass introduce variability into the index not related to the vegetation water content? Is the detrend enough to decouple both contributions, the biomass, and the vegetation water content? Can this mask the index sensitivity in regions with no water growth limitations as for example the peninsula of India? Make an extended comment on this.*

**Answer to R1.2** Yes, we mention that this might be a problem (line 208) and also that more powerful methods bear the high risk of removing actual vegetation condition fluctuations. But the description is indeed a bit short. Therefore, we will expand the discussion and mention that short-term biomass-fluctuations (e.g., harvest) would lead to an anomaly if they occur outside the (climatologically) expected time of year. However, the low resolution mitigates the effect of small-scale changes and therefore anomalies only become visible when they occur at large scales.

**Comment R1.3** *Question two leads to this one: SVODI appears to be sensitive to*

vegetation water content in arid regions where the vegetation growth is water-limited. The correlation analysis with SOI and DMI shows this clearly. Is SVODI also sensitive to vegetation water content during a drought? Can capture as for example the 2010 Russian drought?

**Answer to R1.3** Yes, is it also sensitive to vegetation water content in response to drought. Fig R1 shows SVODI in August 2010, at the peak of the Russian wildfires. Reaching values of less than -2 in Western Russia, SVODI suggests that the vegetation was indeed in an exceptionally poor condition. While this might make for another interesting case study, we will not add it to the paper because, as Reviewer # 2 noted, our paper lacks a bit of focus which another case study would further decrease.



**Figure R1:** Mean SVODI during August 2010

**Comment R1.4** To estimate SVODI you integrate microwave data from C-, X-, and Ku-bands from different sensors. Since the last decade, there are other microwave sensors that integrate the L-band as SMOS and SMAP. L-band is sensitive to upper layer soil moisture variability but also can be used to extract VOD measures. Have you tried to integrate this sensor? It will be great to have a short discussion in the text to clarify the decision of not taking it into account.

**Answer to R1.4** L-VOD exhibits completely different temporal characteristics than C-, X- and Ku-VOD. It is mostly susceptible to slow structural changes, which, by design, are not shown with SVODI. This susceptibility to slow changes is also one of the main reasons why most studies aggregate L-Band VOD to a very low temporal resolution (e.g yearly means) as daily L-VOD changes are mostly noise. We expanded our reasoning for not using L-VOD .

**Comment R1.5** Comparing SVODI with root moisture at different layer levels shows a good representation of ground physical processes. Can these results be reproduced using soil moisture from observational data as SMOS or SMAP upper layer soil moisture?

**Answer to R1.5** In theory, this would be possible but we regarded them as inappropriate to validate VOD products for two reasons: 1) SMOS and SMAP soil moisture is also based on microwave sensors, so they share similar errors as the VOD products in our study. 2) Such satellite products only provide surface soil moisture estimates while we wanted to differentiate the responses with respect to different rooting depths. For these two reasons,

we chose to use ERA-5.

**Thank you for bringing the minor mistakes to our attention, we will fix them!**