Supplement of Biogeosciences, 15, 4627–4645, 2018
https://doi.org/10.5194/bg-15-4627-2018-supplement

Biogeosciences
Open Access
EGU

Supplement of

An evaluation of SMOS L-band vegetation optical depth (L-VOD) data sets: high sensitivity of L-VOD to above-ground biomass in Africa

Nemesio J. Rodríguez-Fernández et al.

Correspondence to: Nemesio J. Rodríguez-Fernández (nemesio.rodriguez@cesbio.cnes.fr)

Correlation computation

To get a quantitative assessment of the correlation and the dispersion of L-VOD versus the evaluation datasets, three correlation coefficients were computed. First, the Pearson correlation coefficient R of two variables $x_1,...x_n$ and $y_1...y_n$ was computed as:

$$R = \frac{\sum_{i=1}^{n}(x_i - \overline{x})(y_i - \overline{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \overline{x})^2}\sqrt{\sum_{i=1}^{n}(y_i - \overline{y})^2} \quad \text{(S1)}$$

where, $\overline{x}$ and $\overline{y}$ are the means of each variable. R is a measure of the linear correlation between two variables. If the relationship linking these variables is linear with no dispersion, R equals 1 (both variables increase together) or -1 (one variable increases when the other decreases).

However, the relationships between L-VOD and the evaluation data are not expected to be linear in most of the cases. Therefore, two rank correlations were also computed to quantify monotonic relationships whether linear or not. The Spearman's correlation coefficient ρ is the Pearson correlation coefficient R computed on the rank of the two variables instead of the variables themselves. If there are no repeated data values, a perfect Spearman correlation of +1/-1 occurs when each of the variables is a perfect monotonic function of the other. In addition, Kendall's rank correlation was also computed. Kendall's correlation coefficient τ is given by:

$$\tau = \frac{n_{\text{concordant}} - n_{\text{discordant}}}{n(n-1)/2} \quad \text{(S2)}$$

where $n_{\text{concordant}}$ and $n_{\text{discordant}}$ are the number of concordant and discordant pairs, respectively. Given a pair of observations (x_i, y_i) and (x_j, y_j), they are said to be concordant if $y_j > y_i$ for $x_j > x_i$ or $y_j < y_i$ for $x_j < x_i$. Otherwise, the pair is said to be discordant. The denominator is the total number of pair combinations, so τ is in the range [-1,1].

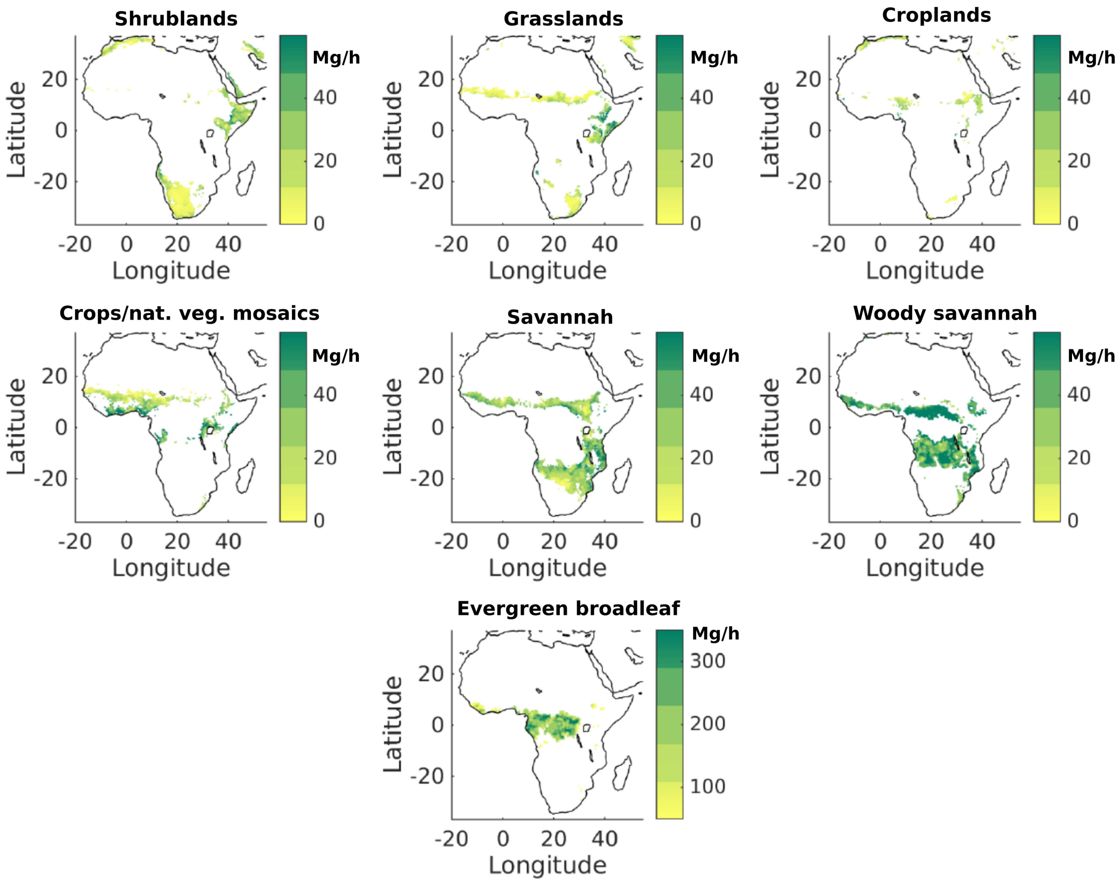

Figure S1. Spatial distribution of the IGBP land cover classes used in this study (Table S2) shown in the Bouvet-Mermoz AGB map.

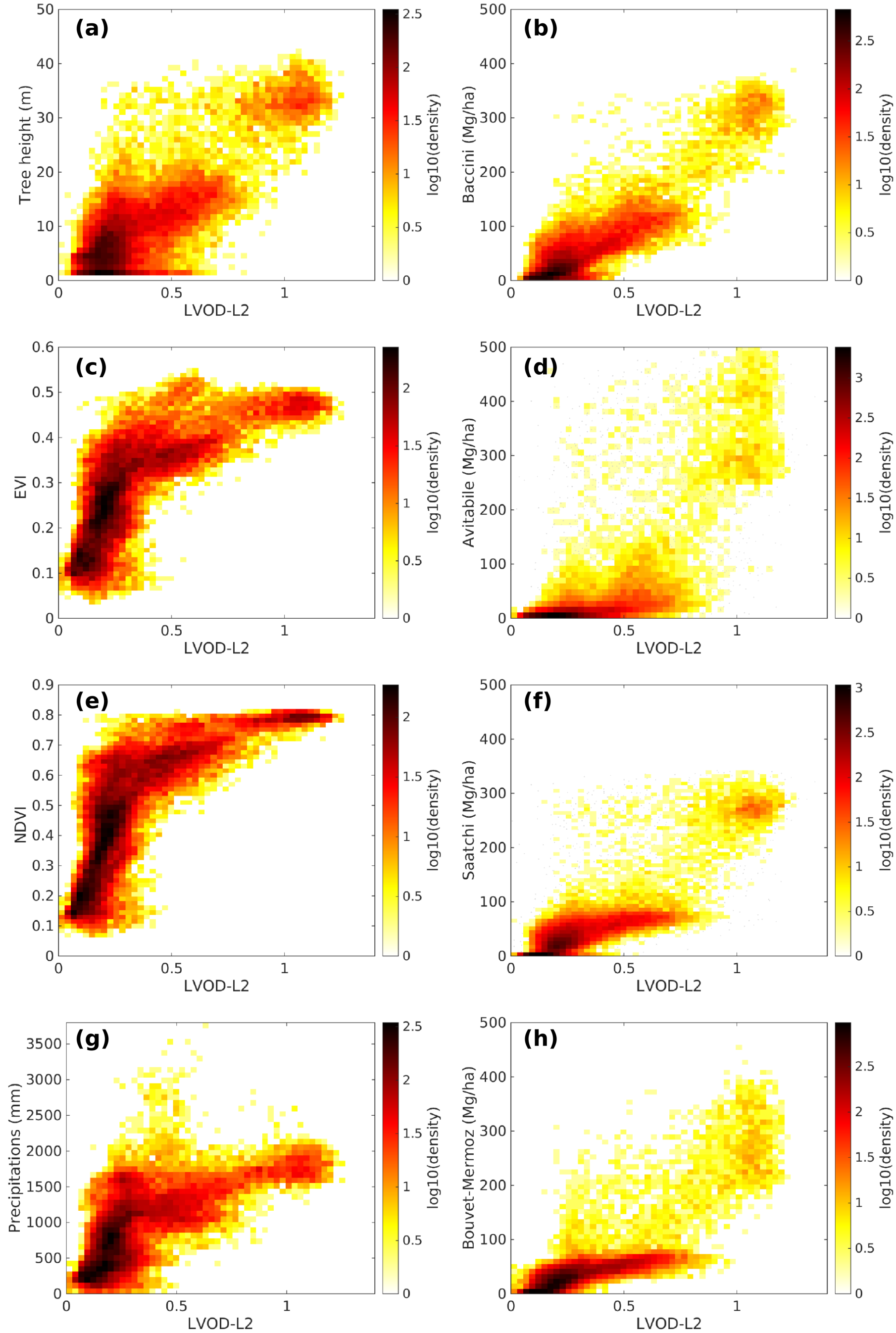

Figure S2. Density scatter plots of the 2011 annual mean of SMOS iL2 L-VOD respect to (from top to bottom and from left to right): tree height, EVI, NDVI, cumulated precipitation, Baccini et al. (2012), Avitabile et al. (2016), Saatchi et al. (2011) and Bouvet-Mermoz AGB datasets.

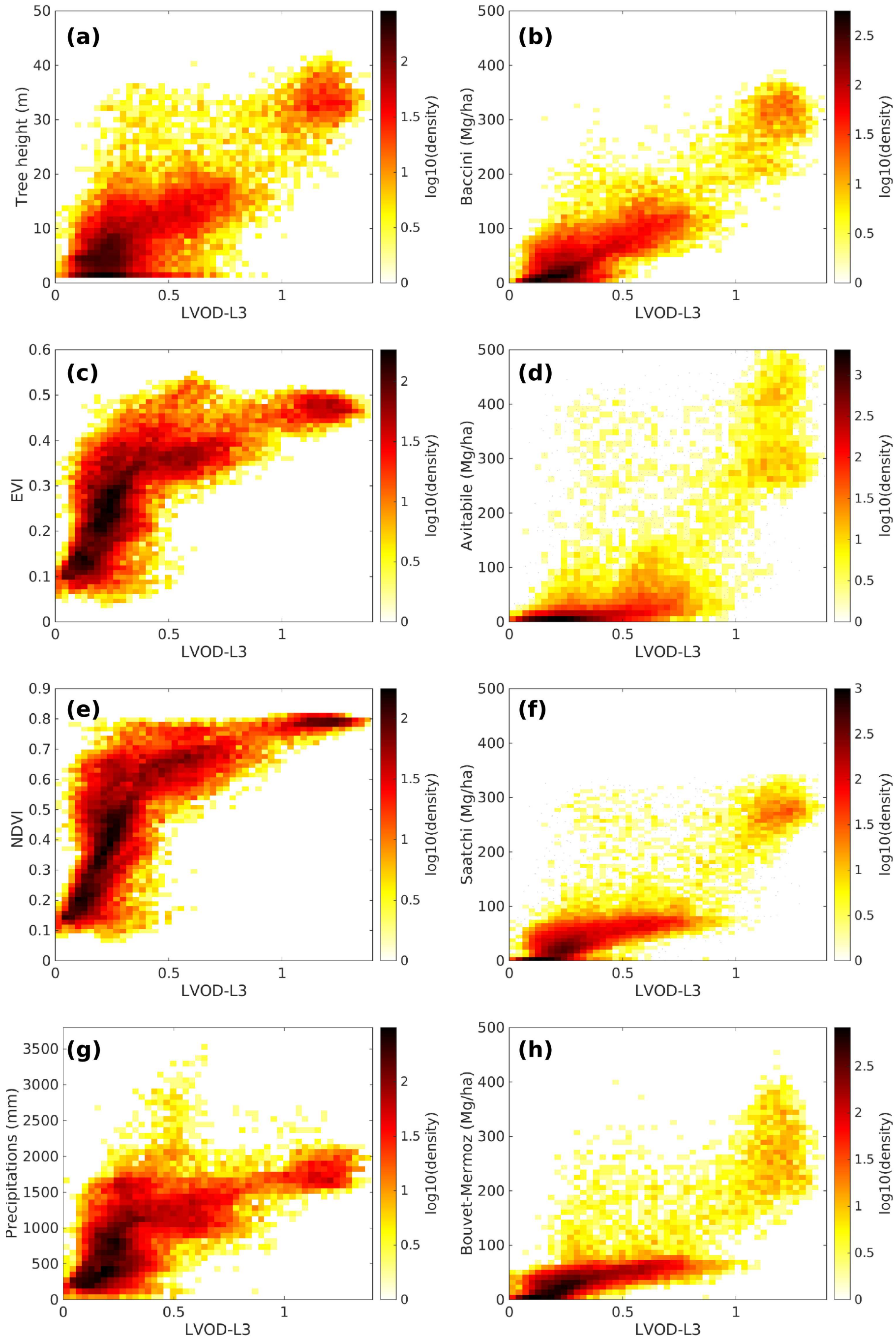

Figure S3. Density scatter plots of the 2011 annual mean of SMOS L3 L-VOD respect to (from top to bottom and from left to right): tree height, EVI, NDVI, cumulated precipitation, Baccini et al. (2012), Avitabile et al. (2016), Saatchi et al. (2011) and Bouvet-Mermoz AGB datasets.

Table S1. Main characteristics of the three SMOS L-VOD products used in this study.

	ESA Level 2	CATDS Level 3	INRA-CESBIO
Reference	Kerr et al. (2012)	Al Bitar et al. (2017)	Fernandez-Moran et al. (2017)
Version used	620	300	100
Soil texture	Ecoclimap	Ecoclimap	Ecoclimap
Land cover	Ecoclimap	Ecoclimap	IGBP
Soil temperature	ECMWF	ECMWF	ECMWF
Forward model	L-MEB (Wigneron et al., 2007)	L-MEB (Wigneron et al., 2007)	L-MEB (Wigneron et al., 2007)
Single-scattering albedo	Low vegetation: 0 Tropical and subtropical forest: 0.06 Boreal forest: 0.08	Low vegetation:0 Tropical and subtropical forest: 0.06 Boreal forest: 0.08	Parrens et al. (2017b, a)
Roughness	Low vegetation: 0.1 Forest: 0.3	Low vegetation: 0.1 Forest: 0.3	Parrens et al. (2017b, a)
Multi-orbit	no	yes, three orbits, L-VOD assumed to be correlated	no
L-VOD first guess	Computed from Ecoclimap LAI	Computed from Ecoclimap LAI	First inversion using a constant value of 0.5 and second inversion using a local average of the first retrievals
SM first guess	ECMWF	ECMWF	0.2 m^3/m^{-3}
Footprints with inhomogeneous land cover	SM and L-VOD retrieval only for major fraction. Contribution from minor fraction using ECMWF SM and Ecoclimap LAI	SM and L-VOD retrieval only for major fraction. Contribution from minor fraction using ECMWF SM and Ecoclimap LAI	SM and L-VOD retrieval for the whole footprint assumed to be homogeneous
Grid Sampling	ISEA 15 km	EASEv2 25 km	EASEv2 25 km

Table S2. Land cover classes of the International Geosphere-Biosphere Program (IGBP) dataset (Loveland et al., 2000) used in this study.

Number	Name	Description
2	Evergreen broadleaf	Lands dominated by broadleaf woody vegetation with a percent cover >60% and height exceeding 2 m. Almost all trees and shrubs remain green year round. Canopy is never without green foliage.
7	Open shrublands	Lands with woody vegetation less than 2 m tall and with shrub canopy cover between 10% and 60%. The shrub foliage can be either evergreen or deciduous.
8	Woody savannah	Lands with herbaceous and other understory systems, and with forest canopy cover between 30% and 60%. The forest cover height exceeds 2 m.
9	Savannah	Lands with herbaceous and other understory systems, and with forest canopy cover between 10% and 30%. The forest cover height exceeds 2 m.
10	Grasslands	Lands with herbaceous types of cover. Tree and shrub cover is less than 10%.
12	Croplands	Lands covered with temporary crops followed by harvest and a bare soil period (e.g., single and multiple cropping systems). Note that perennial woody crops will be classified as the appropriate forest or shrub land cover type.
14	Croplands and natural vegetation mosaics	Lands with a mosaic of croplands, forests, shrubland, and grasslands in which no one component comprises more than 60% of the landscape.

Table S3. Parameters of the fits of the AGB vs IC L-VOD of relationship of Fig. 5 using a logistic function (Eq. 2).

AGB	line	a [Mg/h]	b[-]	c[-]	d [Mg/h]	R^2
Avitabile	05th	264.367	13.115	0.846	4.351	0.998
Avitabile	Mean	369.890	8.921	0.732	5.158	0.999
Avitabile	95th	463.091	9.466	0.583	2.135	0.990
Saatchi	05th	345.590	4.458	0.926	-4.387	0.993
Saatchi	Mean	280.159	6.680	0.689	14.794	0.993
Saatchi	95th	289.762	9.857	0.548	33.859	0.993
Baccini	05th	455.774	2.785	0.964	-40.357	0.990
Baccini	Mean	422.744	3.400	0.729	-29.252	0.999
Baccini	95th	393.863	4.685	0.558	-6.444	0.997
Bouvet-Mermoz	05th	296.709	4.511	0.966	2.129	0.987
Bouvet-Mermoz	Mean	325.043	5.116	0.774	7.651	0.996
Bouvet-Mermoz	95th	355.989	7.267	0.589	19.731	0.994

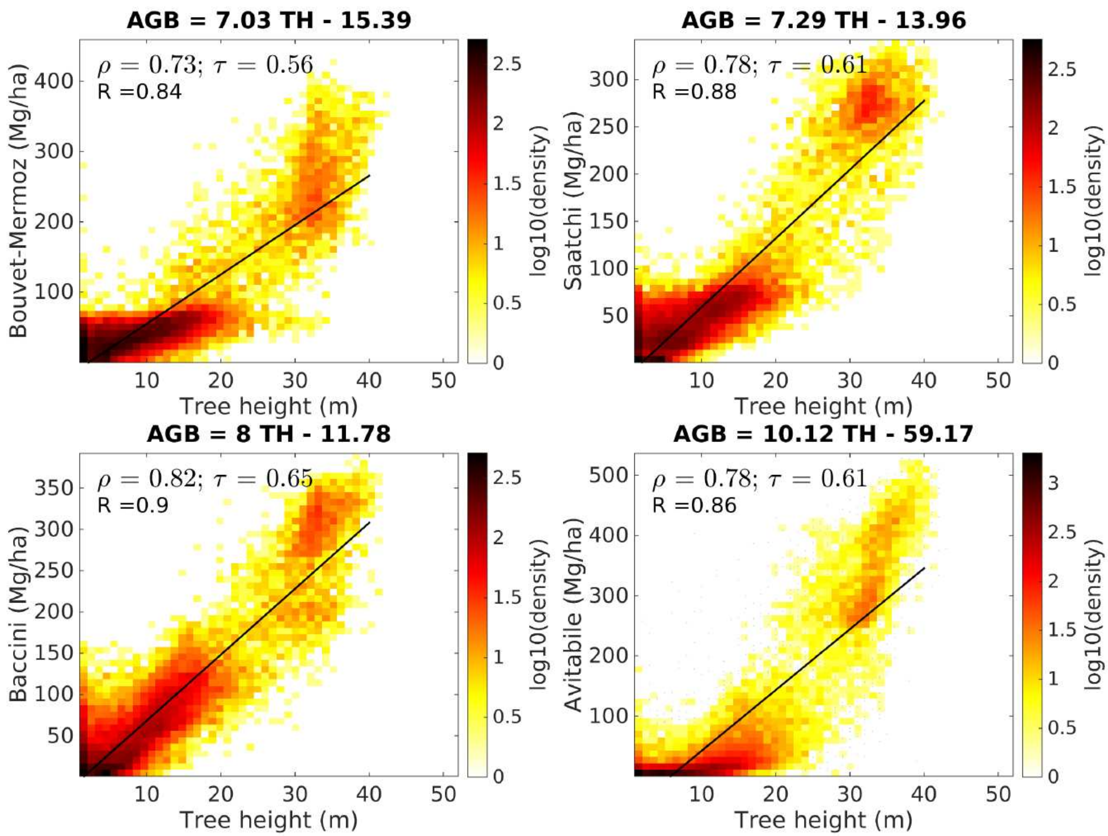

Figure S4. Scatter plots of the four AGB datasets as a function of Simard et al. (2011) tree height.