

Influence of surface water variations on VOD and biomass estimates from passive microwave sensors

Emma Bousquet¹, Arnaud Mialon¹, Nemesio Rodriguez-Fernandez¹,
Catherine Prigent², Fabien Wagner³, Yann Kerr¹

¹ CESBIO (CNES/CNRS/INRAE/IRD/UPS), Toulouse, France.

² LERMA, Observatoire de Paris (CNRS), Paris, France.

³ FUNCATE, São José dos Campos, Brazil.



Introduction

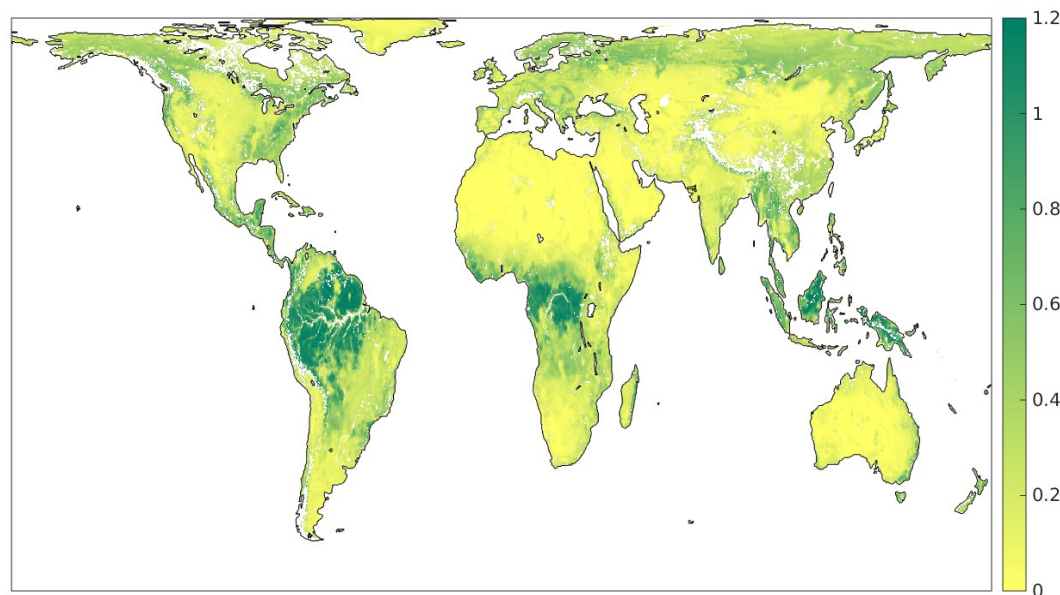
SMOS satellite

- Launched in 2009 by ESA
- Passive microwave observations at L-band ($f = 1.4$ GHz, $\lambda = 21$ cm)
- Simultaneous retrieval of top surface **Soil Moisture (SM, $\text{m}^3 \text{m}^{-3}$)** and **Vegetation Optical Depth (L-VOD)**
- Coarse spatial resolution (40 km resampled to 25 km) but high temporal resolution (global coverage in 3 days)

Vegetation Optical Depth (L-VOD) from SMOS-IC

- Linked to the biomass volume (AGB) and the Vegetation Water Content (VWC).
- At L-band : sensitive to woody elements (trunks, stems, branches).

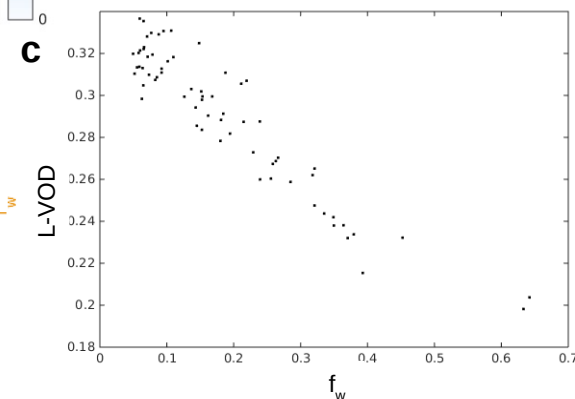
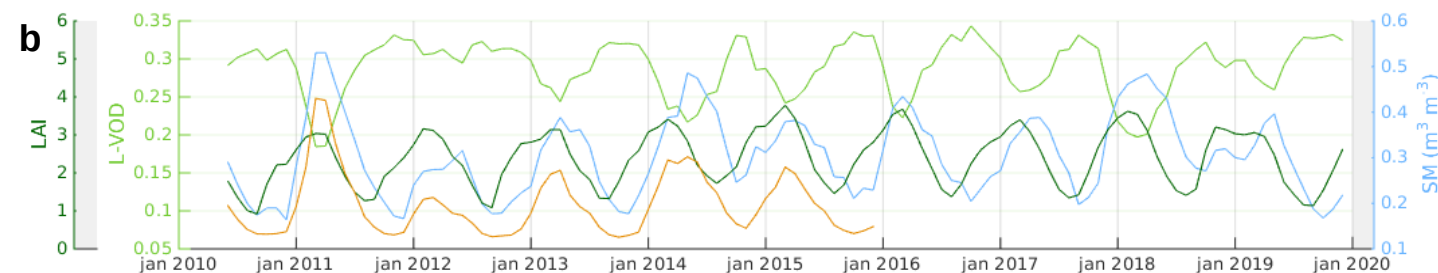
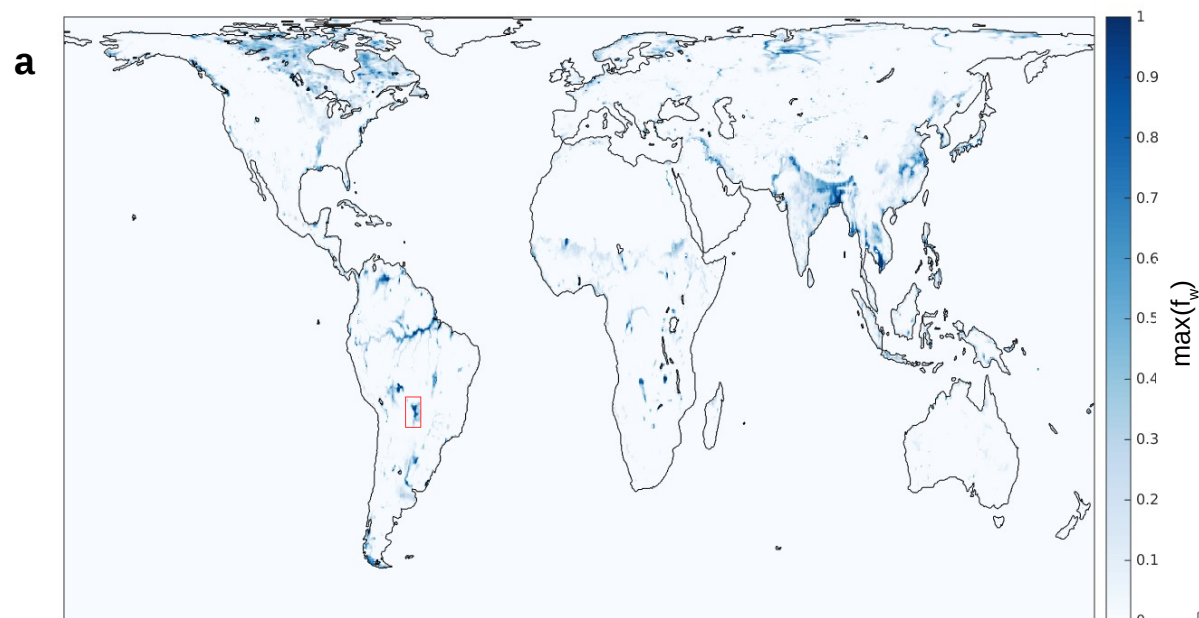
Liu et al., 2015 ; Rodriguez-Fernandez et al., 2018 ; Tian et al., 2018



mean SMOS L-VOD, 2010-2019

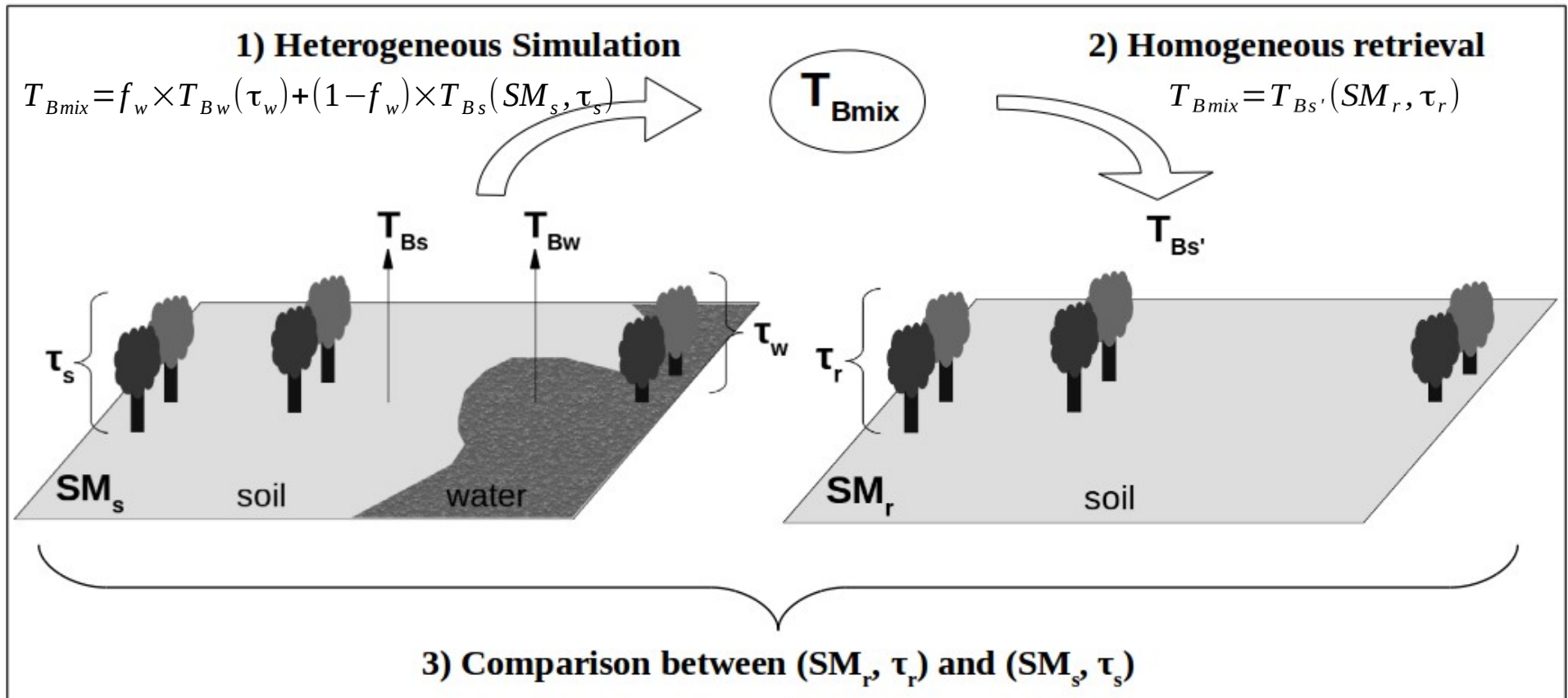
SMOS time series over flooded areas

- Over seasonally inundated areas (a), we observed an **anticorrelation** between SMOS-IC L-VOD, SM, f_w and LAI (b) with no phenological explanation.



- a) Maximum seasonal water fraction f_w from GIEMS-2 database (1992-2015) (Prigent et al., 2019)
- b) Time series of LAI, L-VOD, SM, and f_w over the Pantanal wetland (South America, red box in a)
- c) L-VOD vs f_w over the Pantanal wetland (06/2010-12/2015)

Modelling experiment



- Brightness temperatures (T_B) modelisation : L-Meb model (Wigneron et al., 2007).
- Dielectric constant of the soil : Mironov model.
- Vegetation layer modelisation : $\tau - \omega$ model (Mo et al., 1982).

Results : impact of flooding on L-VOD and AGB

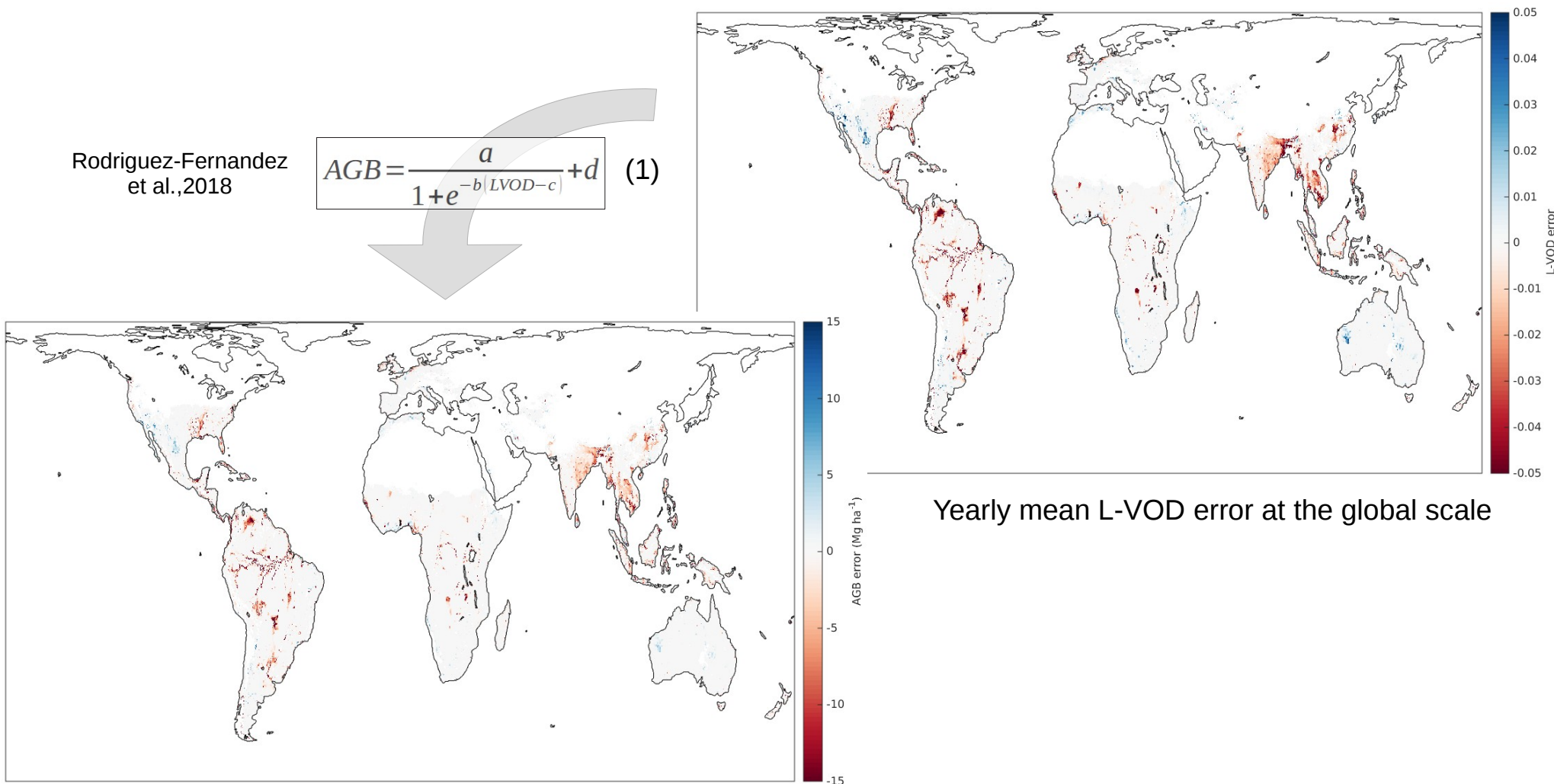
Error in Above-Ground Biomass derived from the error in yearly L-VOD (eq. 1)

=> **underestimation of L-VOD and AGB** over seasonally flooded areas.

=> limited impact at the yearly time scale, but can reach -50 Mg ha⁻¹ temporarily.

Rodriguez-Fernandez
et al., 2018

$$AGB = \frac{a}{1 + e^{-b|LVOD - c|}} + d \quad (1)$$



Yearly mean L-VOD error at the global scale

AGB error at the global scale (Mg ha⁻¹)