Geophysical Research Abstracts
Vol. 20, EGU2018-18932, 2018
EGU General Assembly 2018

A detailed portrait of the forest aboveground biomass pool for the year 2010 obtained from multiple remote sensing observations

Maurizio Santoro (1), Oliver Cartus (1), Stephane Mermoz (2), Alexandre Bouvet (2), Thuy Le Toan (2), Nuno Carvalhais (3), Danae Rozendaal (4), Martin Herold (4), Valerio Avitabile (5), Shaun Quegan (6), Joao Carreiras (6), Yrjö Rauste (7), Heiko Balzter (8), Christiane Schmullius (9), and Frank Martin Seifert (10)

(1) Gamma Remote Sensing, Switzerland (santoro@gamma-rs.ch), (2) CESBIO, Université de Toulouse, France, (3) Max Planck Institute for Biogeochemistry, Germany, (4) Centre for Geo-Information, Wageningen University, The Netherlands, (5) European Commission, Joint Research Centre, Italy, (6) National Centre for Earth Observation (NCEO), University of Sheffield, United Kingdom, (7) VTT Technical Research Centre of Finland, (8) Centre for Landscape and Climate Research, University of Leicester, United Kingdom, (9) Department of Earth Observation, Friedrich Schiller University, Germany, (10) ESA ESRIN, Italy

Estimates of forest aboveground biomass (AGB) are debated because of the large difference between published values from in situ and remote sensing observations (Avitabile et al., GCB, 2016). Spaceborne remote sensing provides a synoptic view of forest biophysical properties globally; however, none is directly related to forest biomass. Still, by optimally exploiting the information content of the observations available in remote sensing archives, it is believed that the knowledge of the spatial distribution of forest biomass can be improved given that published estimates have mostly been based on a handful of the observations available.

In this respect, an innovative approach to estimate biomass globally was developed by combining spaceborne SAR, LiDAR and optical observations for around the year 2010 together with auxiliary datasets from forest inventories, additional remote sensing observations, climatological variables and ecosystems classifications. Modelling frameworks relating remote sensing data to biomass that were identified to adapt to different forest and environmental conditions and not requiring in situ data for training were selected. As none of them was yet capable of providing a true global mapping without systematic errors, a rule-based combination of EO-based estimates of biomass from the different algorithms was developed. Accordingly, estimates of standard error were generated. To disentangle scattering physics related to forest structural properties from other variables influencing the biomass (namely wood density and proportion of branches and needles), the retrieval estimated forest growing stock volume (GSV) in m3/ha. Key to the estimation of AGB was then the generation, first of its kind, of global estimates of wood density and stem-to-total biomass expansion factors from a large data pool of in situ measurements globally.

Estimates were generated at the spatial resolution of the remote sensing data (25 m) and assessed at several spatial scales from forest plot size to regional averages. The retrieval error for aggregated estimates at 1 ha scale was around 20-40% and estimates were found to be mostly unbiased. The validation exercise indicated that spatial patterns of biomass were well captured and reliability of the biomass estimates even in the wet tropics. This was initially considered to be beyond the capability of the EO datasets and algorithms available to this study. The estimates, however, present local biases and substantial uncertainties, primarily in regions where the remote sensing data available could only partially resolve forest structures (pockets of very high biomass) or the conversion from volume to biomass was poorly characterized.

The largest biomass pools were estimated in wet tropical forests and in temperate forests of the southern hemisphere. Lower AGB was estimated in boreal forest and for forests of the dry topics. With respect to existing biomass estimates (e.g., Saatchi et al., PNAS, 2011; Baccini et al., Nat. Clim. Change, 2012; Thurner et al., GEB, 2014; FAO, 2010), we identified overestimation of biomass in the tropics of the northern hemisphere by a factor 2. Understanding the overall quality of our estimates and assessing the impact of our global biomass estimates is foreseen for the meeting.