Geophysical Research Abstracts
Vol. 12, EGU2010-10767, 2010
EGU General Assembly 2010

Diagnostic extrapolation of gross primary production from flux tower sites to the globe

Christian Beer (1), Markus Reichstein (1), Enrico Tomelleri (1), Philippe Ciais (2), Martin Jung (1), Nuno Carvalhais (1), Christian Rödenbeck (3), Dennis Baldocchi (4), Sebastiaan Luyssaert (5), Dario Papale (6), and the FLUXNET synthesis Team

(1) Biogeochemical Model-Data Integration Group, Max Planck Institute for Biogeochemistry, Jena, Germany (cbeer@bgc-jena.mpg.de), (2) Laboratoire des Sciences du Climat et de L'Environnement, Gif-sur-Yvette, France, (3) Biogeochemical Systems, Max Planck Institute for Biogeochemistry, Jena, Germany, (4) Policy and Management and Berkeley Atmospheric Science Center, University of California, Berkeley, California, USA, (5) Dept. Biologie, Universiteit Antwerpen, Belgium, (6) Department of Forest Environment and Resources, University of Tuscia, Viterbo, Italy

The uptake of atmospheric CO2 by plant photosynthesis is the largest global carbon flux and is thought of driving most terrestrial carbon cycle processes. While the photosynthesis processes at the leaf and canopy levels are quite well understood, so far only very crude estimates of its global integral, the Gross Primary Production (GPP) can be found in the literature. Existing estimates have been lacking sound empirical basis. Reasons for such limitations lie in the absence of direct estimates of ecosystem-level GPP and methodological difficulties in scaling local carbon flux measurements to global scale across heterogeneous vegetation. Here, we present global estimates of GPP based on different diagnostic approaches. These up-scaling schemes integrated high-resolution remote sensing products, such as land cover, the fraction of photosynthetically active radiation (fAPAR) and leaf-area index, with carbon flux measurements from the global network of eddy covariance stations (FLUXNET). In addition, meteorological datasets from diverse sources and river runoff observations were used. All the above-mentioned approaches were also capable of estimating uncertainties.

With six novel or newly parameterized and highly diverse up-scaling schemes we consistently estimated a global GPP of 122 Pg C y-1. In the quantification of the total uncertainties, we considered uncertainties arising from the measurement technique and data processing (i.e. partitioning into GPP and respiration). Furthermore, we accounted for the uncertainties of drivers and the structural uncertainties of the extrapolation approach. The total propagation led to a global uncertainty of 15 % of the mean value. Although our mean GPP estimate of 122 Pg C y-1 is similar to the previous postulate by Intergovernmental Panel on Climate Change in 2001, we estimated a different variability among ecoregions. The tropics accounted for 32 % of GPP showing a greater importance of tropical ecosystems for the global carbon cycle than previously thought. On the other hand, the total GPP of natural temperate ecosystems and in shrublands was estimated smaller than by applying a NPP/GPP ratio of 0.5 to inventory-based NPP. We estimated higher GPP values also for croplands.

Our thorough estimation of spatially distributed GPP provides a new dataset extremely valuable for benchmarking ecosystem process models.