Geophysical Research Abstracts
Vol. 15, EGU2013-8000, 2013
EGU General Assembly 2013

Effects of a trait-based parameterisation of litter decomposition

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Stocks of plant litter play an important role in the terrestrial carbon cycle. On a regional scale, litter stocks influence fire regimes, soil fertility, and soil organic matter formation. On the global scale, these factors influence global CO_2 and climate.

In many dynamic global vegetation models, the decomposition of plant litter is treated rather simplistically by aggregating leaf and woody litter into a single litter pool and using a common decomposition rate for all litter pools without taking different plant species or litter types into account.

Measurements, on the other hand, clearly show that a) leaf litter decomposes much faster than woody litter, b) litter from different plant species decomposes at different rates, and c) the temperature sensitivity of woody litter decomposition also is species-dependent.

The common modelling approach therefore clearly is incompatible with measurements. As a consequence, we modified the dynamic global vegetation model LPJ by a) introducing different litter pools for leaf and woody litter and by b) linking plant functional types to decomposition rates, as well as temperature sensitivities, of wood and leaf litter determined from two databases of plant traits.

These changes give a more realistic distribution of litter stocks in most biomes, with the exception of boreal forests. In a projection for future climate, using the SRES A2 scenario, the modified parameterisation leads to an increase in litter stocks by 35 PgC, as well as a decrease in atmospheric CO_2 by 3 ppm by 2100.

Despite the increase in litter stocks, the fire emissions increase less than when using the original parameterization, since the litter is redistributed to more humid regions.