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Soil carbon model Yasso07 in a global Earth system model

T. Thum (1), S. Sevanto (2), P. Räisänen (1), T. Aalto (1), T. Bergman (2,3), V. Brovkin (4), H. Järvinen (1), T. Laurila (1), J. Liski (5), T. Raddatz (4), and the Soil carbon model Team

(1) Finnish Meteorological Institute, Global and Climate Change Research, Helsinki, Finland (tea.thum@fmi.fi), (2) Department of Physics, University of Helsinki, Helsinki, Finland, (3) CSC – IT Center for Science, Helsinki, Finland, (4) Max Planck Institute for Meteorology, Hamburg, Germany, (5) Finnish Environmental Institute, Helsinki, Finland, (6) Department of Mathematics and Statistics, University of Helsinki, Helsinki, Finland

The largest terrestrial carbon storage is located in the soil. Climate change might accelerate decomposition processes in the soil and thus release large amounts of carbon from the soil to the atmosphere via heterotrophic respiration. Interactions between heterotrophic respiration and climate are complicated and might include significant feedback effects. To assess what will happen to soil carbon stocks, coupled climate-carbon cycle models need to be up to date presenting our current knowledge of decomposition processes in the soil. Yasso07 is a new soil carbon model parameterized with a large experimental data set including litter decomposition data with wide global coverage.

Within the activities of the COSMOS Earth system modelling network (cosmos.enes.org), the atmosphere/terrestrial biosphere model ECHAM5/JSBACH (www.mpimet.mpg.de) is employed. We replaced the soil carbon decomposition submodel of the JSBACH with the Yasso07 submodel and compared its performance with the original formulation. The original model consists of a fast and a slow carbon pool. In Yasso07 the incoming litter is divided into four carbon pools according to the chemical composition of litter that depends on plant functional type; in addition, there are pools for woody litter and humus. We studied how these two soil models simulate soil carbon storage in equilibrium to today's climate. Yasso07 stored less carbon in the soil and had different dynamical responses to climate variations than the original version. For example, Yasso07 was more sensitive to drought. We also compared the model results to measured CO_2 fluxes from eddy covariance sites as well as CO_2mixing ratio measurements. At Pallas site in northern Finland the amplitude of the annual variation of CO_2 mixing ratio was closer to the measurements in the original model, but the timing of the annual cycle was better simulated by Yasso07. Our next step is to study how these two soil models will respond to different climate scenarios in a fully coupled climate model.