Geophysical Research Abstracts
Vol. 18, EGU2016-4044, 2016
EGU General Assembly 2016

Simulating adaptive wood harvest in a changing climate

Rasoul Yousefpour (1,2), Julia Nabel (1), and Julia Pongratz (1)

(1) Max Planck Institute for Meteorology, Land in the Earth System, Hamburg, Germany (julia.pongratz@mpimet.mpg.de),
(2) now at Chair of Forestry Economics and Forest Planning, University of Freiburg, Germany

The world's forest experience substantial carbon exchange fluxes between land and atmosphere. Large carbon sinks occur in response to changes in environmental conditions (such as climate change and increased atmospheric CO_2 concentrations), removing about one quarter of current anthropogenic CO_2-emissions. Large sinks also occur due to regrowth of forest on areas of agricultural abandonment or forest management. Forest management, on the other hand, also leads to substantial amounts of carbon being eventually released to the atmosphere. Both sinks and sources attributable to forests are therefore dependent on the intensity of management. Forest management in turn depends on the availability of resources, which is influenced by environmental conditions and sustainability of management systems applied.

Estimating future carbon fluxes therefore requires accounting for the interaction of environmental conditions, forest growth, and management. However, this interaction is not fully captured by current modeling approaches: Earth system models depict in detail interactions between climate, the carbon cycle, and vegetation growth, but use prescribed information on management. Resource needs and land management, however, are simulated by Integrated Assessment Models that typically only have coarse representations of the influence of environmental changes on vegetation growth and are typically based on the demand for wood driven by regional population growth and energy needs.

Here we present a study that provides the link between environmental conditions, forest growth and management. We extend the land component JSBACH of the Max Planck Institute's Earth system model (MPI-ESM) to simulate potential wood harvest in response to altered growth conditions and thus as adaptive to changing climate and CO_2 conditions. We apply the altered model to estimate potential wood harvest for future climates (representative concentration pathways, RCPs) for the management scenario of "sustained yields" (SY), i.e. that wood harvest is not allowed to reduce wood carbon stocks below their present-day average state.

We find that the potentials for SY range from about 420 to 610 PgC cumulatively until 2100 depending on assumed future climate (RCPs 2.6, 4.5 or 8.5). They are thus substantially higher than the harvest prescribed in the context of the same RCPs for the coupled model intercomparison project (CMIP5), which ranged from about 130 to 210 PgC. The underlying drivers of the higher potentials of SY as compared to the RCP harvest are in all scenarios foremost avoided natural mortality, followed by avoided losses due to fire and windbreak. Further, usage of the increase in forest carbon stocks simulated with time under RCP harvest plays a large role in the first decades of the 21st century.

The potential wood harvest that we simulate accounting for environmental changes does not include considerations on biodiversity and other ecosystem services or technical feasibility. However, the substantially higher simulated harvest from SY as compared to that prescribed from the RCPs and the difference found between climate scenarios highlights the need to account for effects of environmental changes on vegetation growth also in socio-economic models and thus the need for a consistent representation of climate-landuse interactions.