Title: Negative emissions from boreal forests - BECCS potentials and economic implications

Authors: Sabine Fuss, Florian Kraxner, Kentaro Aoki, Georg Kindermann, Dmitry Schepaschenko, Anatoly Shvidenko

Abstract:
Scientists and policy-makers lead an active debate on the possibility of using bioenergy in combination with carbon capture and storage (BECCS) to remove CO2 from the atmosphere. The over-all objective of this study is to analyze the theoretical in-situ BECCS potential from boreal forests with special emphasis on Russia. This paper also aims at identifying wider implications of a BECCS introduction. We first examine the technical potential of bioenergy production in Russia from domestic forest biomass by applying the global forestry model (G4M). In a second step, these results are used as input data to an engineering model (BeWhere) for optimizing scale and location of combined heat and power plants (CHP). Through overlaying with a geological suitability map, a theoretical potential for "in-situ" BECCS is derived.
First results indicate that by using less than 10% of the annual wood removals in Russia, the supply of 50 green-field biomass plants could be supplied and the energy generated from forest-based bioenergy could be tripled. The theoretical BECCS potential of negative emissions under this high-capacity scenario could be 2-4 MtCO2/yr. Moreover, co-benefits such as the substitution of bioenergy for fossil-fuel-based energy, leading also to an improvement in air quality with potentially large health benefits, need to be considered. Comprehensive planning of new bioenergy facilities and the corresponding feedstock production will lead not only to economic value added in terms of additional employment and a boost to rural development, but also open up opportunities for conserving the vast biodiversity in the boreal forest.

Title: Forest management certification - application of a new tool for certification mapping to the boreal forest

Authors: Florian Kraxner, Dmitry Schepaschenko, Sabine Fuss, Anders Lunnan, Georg Kindermann, Kentaro Aoki, Anatoly Shvidenko

Abstract:
During the past decades, forest management certification also became a tool to support a transition to and ensure sustainable forest management. However, the speed of certification has slowed down and there is an uneven split of the certified area with the majority located in the northern hemisphere. To date, there is insufficient empirical evidence on the impacts of certification to generate lessons learned on a global scale. While several published reviews of forest management certification provide some guidance for future work, most were based on geographically limited case studies, indirect information, and were not conducted by independent observers. This article's objectives are 3-fold: a) it aims at the improvement of existing statistical and spatial information by providing a methodology for assessing the global certified forest with special
emphasis on the boreal domain; b) to provide support to science and certification schemes with respect to impact assessments, support of strategies of future certification development and investments, and identification of hot-spot areas where e.g. some promotional activities might drive/accelerate certification; c) the article investigates how certification can contribute to the planning of other policy strategies, e.g. aiming at biodiversity conservation, REDD+, conservation of e.g. intact forests, and provision of science-based policy recommendations. It is demonstrated that the new tool allows the localization of certified forest area actively distinguishing between managed and unmanaged forest

areas. It also allows for localization of areas with large co-benefit potential. Knowledge of certified forest locations is key to develop certification also into a monitoring and verification tool.

Title: Reanalysis of live biomass of Russian forests

Authors: Dmitry Schepaschenko, Anatoly Shvidenko, Volodymyr Blyshchyk, Florian Kraxner

Abstract:
Live biomass (LB) is an essential indicator of terrestrial vegetation and carbon cycle. Russian forests cover 23% of the entire world's forest area and two-thirds of boreal forests. We estimated LB based on Land Information System of Russia (Shvidenko et al., 2010), which consists of hybrid land cover (Schepaschenko et al., 2011) and attributive database. LB of forests has been defined by a regionally distributed multi-dimensional set of regressions, which connect 6 fractions of live biomass (i.e. stem, branches, foliage, stump and roots, understorey, and green forest floor) with biometric indicators of stands (Shvidenko et al. 2007). In total, 9600 sample plots or empirical aggregations (Schepaschenko et al., 2005; Usoltsev, 2011) were used to develop the above models.
Total LB pool of Russian forest was estimated at 36.0 Pg C or 4.7 kg C m-2. European part accumulates 9.3 Pg C (or 5.7 kg C m-2) and Asian one - 26.7 Pg C (4.5 kg C m-2). Stem comprises 21.3 Pg C, branches - 3.6, foliage - 1.3, roots - 7.4, understory - 0.7 and green forest floor - 1.9 Pg C. Coniferous species accumulate 25.2 Pg C, mostly larch - 10.3 Pg C (or 4.2 kg C m-2), pine - 6.0 Pg C (4.8 kg C m-2) and spruce - 5.0 Pg C (5.9 kg C m-2). Uncertainties of the total LB of the country's forests are in limits ±5% (CI 0.9). We present a set of the equations and LB map of Russian forests at spatial resolution 230m.

Title: Global harvesting of wood under different socio-economic and climate mitigation scenarios

Authors: Nicklas Forsell, Petr Havlík, Anu Korosuo, Florian Kraxner, Stefan Frank, Hugo Valin, Mykola Gusti, Wolfgang Zhang, Annika Nordin, Tomas Lundmark, Michael Obersteiner

Abstract:
Climate change and current trends in the world's population, economic growth and other socioeconomic issues are expected to further increase the pressure on forests. Mitigation of climate change calls for increased use of wood resources for energy purposes, providing new opportunities and challenges for the traditional forest sector. Increasing world population, rapid economic growth in the developing countries, and changes in the consumption patterns of harvested wood products (HWP) accentuate the changes in the demand for material provision and production of these goods. Using the Global Biosphere Management Model (GLOBIOM), we analyze future development of the forest sector across two interconnected pathways: climate change mitigation efforts and socio-economic developments. The implication of these two pathways are shown in terms of their impacts on harvesting of wood and demand for HWP. We find that stringent climate change mitigation targets have only a slight effect on the use of industrial roundwood for material production. Instead, the results highlight that the harvests of industrial roundwood for material purposes are strongly affected by the anticipated socioeconomic development, mainly as a result of changing consumption patterns. On the contrary, for total roundwood harvests and woody biomass use for energy, climate change mitigation targets are found to have a stronger impact than socio-economic development, relating back to the anticipated rapid development of the bioenergy sector. In conclusion, the study stresses the importance of widening the discussion on climate change impacts also into accounting for socioeconomic issues when deciding on forest-related policies for the future.