Projected climate change impact on primary production of forests in Finland

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During this century, mean annual temperature may rise 2-6 ºC and precipitation increase 10-20% in Finland. Modeling studies suggest that these changes, in combination with higher atmospheric CO_2-concentration, result in increased tree growth of several tens of percentages. On the other hand, an increased risk of drought spells during the growing season has been suggested to decrease forest primary production. Also the effect of changes in soil processes, especially in nitrogen uptake, may result in large changes in growth of boreal forests. However, constructing local- and regional-scale climate scenarios from Global Circulation Model (GCM) simulations is subject to large uncertainties. The bias of GCM simulations can have large effect on the actual timing of thermal season or timing of precipitation on the regional level. Here we present an estimate of the change of the Finnish forests' gross primary production (GPP) for different climate scenarios for the 21st century. Further, we accounted for changes in soil nitrogen and analyzed net primary production (NPP) under projected climate.

Climate scenarios were constructed combining a daily observed data set on a regular 10 x 10 km grid over Finland with simulated changes of an ensemble of 14 GCM simulations for low (SRES B1), moderate (AB1) and high (A2) emission scenarios for three future periods, 2011-2040, 2041-2070 and 2071-2100. The gross primary production of forests was estimated with the PRELES ecosystem model that has been developed and parameterized for the simulation of GPP, evapotranspiration (ET) and soil water balance in boreal conditions. The new GPP values will be used to force the OptiPipe model where different soil nitrogen levels are simulated and optimal solution in carbon allocation between different compartments could be solved.

Results show up to 70% increase in GPP and almost 40% increase in ET at whole country level. However, no pronounced increase in droughts could be derived from the results since soil water storage was higher in all projections at the end of century than under current climate. First preliminary results show even twofold rise in NPP under the highest emission scenario.