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The effect of increased air humidity on northern deciduous forest ecosystem - a FAHM study.

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At northern latitudes a rise in atmospheric humidity and precipitation is predicted as a consequence of global climate change. In 2006 an unique experimental facility for free air humidity manipulation (FAHM) was established in Estonia to study the functioning of deciduous forest ecosystem under altered humidity conditions. The experimental site contains humidified and control plots, each includes four types of forest ecosystem: two overstorey species (planted hybrid aspen (Populus tremula L. × P. tremuloides Michx. and silver birch (Betula pendula Roth.)) both split into two types according to understorey vegetation (diverse "forest" understory and early successional grasses). We investigated the productivity, biomass allocation and functioning of silver birch forest ecosystem in response to elevated atmospheric humidity (on average 7% over the ambient level) during four growing seasons (2008–2011). We hypothesized that elevated air humidity facilitates both above- and below-ground growth and accumulation of plant biomass.

During the first three experimental seasons height, stem diameter, and stem volume (D2H) increments of trees, biomass of understory in aboveground and fine root biomass in belowground were similar or significantly reduced in humidified plots. Only the fine root and rhizome biomass of the understory was twice higher in humidified plots. However, fine root turnover speeded up for both tree and understory roots. The trends in above-ground growth changed in 2011, when current annual increments of trees height, diameter, stem volume and fine root biomass were higher in humidified plots.

Functionally, trees hydraulic conductance was significantly higher and stem sap flux lower for humidified trees coinciding with significantly higher biomass of primary (in majority ectomycorrhizal) roots, morphologically thinner and longer root tips and higher specific root length. Humidification caused a shift in the root tips colonizing fungal community towards the dominance of hydrophilic taxa. Different structural and functional aspects of forest ecosystem acclimation to increasing atmospheric humidity in boreo-nemoral deciduous forests will be discussed.