Abstract volume

Can forest management change climate?
The impact of constructed urban wetlands on greenhouse gas balance and runoff treatment, Case Nummela

Outi Salminen (1), Sami Haapanala (2), Egle Küster (1), Pasi Valkama (3), Hannele Ahponen (1), Kaj- jar Küster (1), Jukka Pumpanen (1), Timo Vesala (2) and Eero Nikinmaa (1)
(1) University of Helsinki, Department of Forest Sciences; firstname.lastname@helsinki.fi
(2) University of Helsinki, Department of Physics; firstname.lastname@helsinki.fi
(3) Water Protection Association of the River Vantaa and Helsinki Region; firstname.lastname@vesiensuojelul.fi

Urbanization and associated imperviousness changes water balance causing increased flooding and draught. Runoff washes pollutants from urban surfaces degrading water quality in receiving waters. Climate change is expected to increase rainfall intensities and duration, as well as intensify heat and draught experienced during warm periods.

Wetlands are constructed in the urban areas primarily as mitigation tools to reduce changes in water balance and to improve water quality. The impact of wetlands on climate change is a balance composed by carbon (C) bound to fast growing and slowly decomposing vegetation, and the release of greenhouse gases (GHGs) from microbial decomposition. In our ongoing studies we investigate the role of constructed urban wetlands on both the water environment mitigation and the GHG balance.

Our case site has two constructed wetlands located in an urban watershed in Nummela, Southern Finland. Mitigation impact of the wetlands on water quality is continuously monitored for parameters such as turbidity and conductivity. Grab samples analyzed in laboratory complete water analyses for parameters such as the blue-green algae limiting nutrient phosphorus.

In natural ecosystems C emission from soils is mainly caused by decomposition and mineralization of soil organic matter. However, human interventions can easily cause the release of GHG from soil. Our investigation of the soil C pools showed significant decrease of the soil C content at the excavated constructed wetland areas compared to the surrounding undisturbed meadow landscape.

In order to further elucidate the wetland C dynamics, fluxes of three major GHGs (CO₂, CH₄, and N₂O), as well as the CO₂ exchange by surface vegetation, are measured during the snow-free period by closed chambers at areas of varying water table. Furthermore, the CO₂ and CH₄ exchanges are measured all year round with an eddy covariance technique, footprint area covering the entire constructed wetland. Finally, the CO₂ and CH₄ gas concentrations are also monitored in water at the inlet and outlet of the constructed wetland.

The assessment of water quality monitoring data over short rain and snowmelt events has shown good mitigation results even during wetland dormancy. However, monitored two month averages have indicated very modest pollutant reductions. Water quality is being monitored over a full hydrological year for a better understanding of event reductions and long term impacts. Continuous measurements of GHG concentration in water during winter 2012–2013 indicate that the site has been a source of CO₂ and CH₄ into the atmosphere. However, ice cover prevents the GHG emissions. The GHG concentrations in the water have been sensitive to changes in flow rates. Polluted spills within the urbanized areas have impacted water quality as well as GHGs released from the water at the monitored wetland.