Modelling carbon sink of urban street trees and soil in Helsinki, Finland

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A high proportion of anthropogenic carbon dioxide emissions originate from urban areas, which has led cities to become interested in reducing their own emissions and determining how much carbon could be sequestered by their own vegetation and soil. The challenge with the latter is that our current knowledge on carbon storage is based on data and models from natural and forest ecosystems, whereas the response of vegetation and soil to environmental factors most probably is altered in urban green space where the soil conditions, water availability and temperature are highly variable. Therefore, ecosystem models are required to correctly account for urban vegetation and soil to understand and quantify the biogenic carbon cycle in urban areas.

In this study, urban land surface model SUEWS (the Surface Urban Energy and Water Balance Scheme) and the soil carbon decomposition model Yasso15 are used to simulate urban carbon cycle on two streets in Helsinki, Finland for years 2003-2016. Curbside trees (Alnus glutinosa and Tilia x Vulgaris) were planted while the two test streets were constructed in 2002. Thereafter, carbon and water fluxes and pools with detailed street tree soil compositions were monitored in 2002-2014. SUEWS creates a local spatially variable temperature and specific humidity environment which is used in the model runs. The modelled evaporation is evaluated against sap flow measurements and modelled soil moisture against soil moisture observations. The Yasso15 model is evaluated against loss-on-ignition based soil carbon measurements as it has not been previously evaluated in urban soils. The modelled carbon dioxide flux combined with the changes in the soil carbon stock is used to estimate the carbon cycle of urban street trees and soils.