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Quantifying and modelling N retention and losses in forests

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Nitrogen (N) accumulations in forests are affected by many processes, dealing with atmospheric deposition, root uptake, mineralization, N2 fixation, nitrification, denitrification, and leaching of mineral as well as organic N. In turn, these processes are affected by climate, vegetation type, topographic position, and local variations in soil conditions, as these vary from dry to wet, frozen to non-frozen, shallow to deep, coarse to fine, acidic to neutral, and nutrient rich to poor. This presentation deals with (i) quantifying some of these processes at a well-studied tolerant hardwood forest watershed in Ontario, Canada (Turkey Lakes), specifically capturing the extent of retention and leaching of atmospherically deposited N, (ii) illustrating that N losses via denitrification are proportional to the wet-area coverage per watershed basin, and (iii) modelling how much N is retained in decaying wood and litter samples during and over the course of 10 years based on basic climate specifications (annual precipitation, mean January and July air temperatures) across North-American biomes. Quantifying gaseous N emissions and other N losses is accomplished geospatially and temporally by digital elevation modelling (via depth-to-water [DTW]) and hydrology modelling (Forest Hydrology Model [ForHyM]). This model uses daily rain, snow, and air temperature records, annual atmospheric N deposition rates, and basin specific soil for forest specifications as inputs. ForHyM also produces estimates for daily evapotranspiration, stream discharge, and soil moisture and temperature for driving the N uptake, loss and leaching processes. Generally, decaying forest litter and wood retain N better than C, which leads to gradually increasing N concentrations or gradually decreasing C/N ratios within the decomposing substrates.