Preferential Canopy Uptake of Nitrate and Consequences for Deposition Monitoring in Forests of the Pacific Northwest, USA

Mark E. Fenn, Christopher S. Ross, and Susan L. Schilling

Throughfall deposition of N and S was measured in three national parks in Washington State and compared to NADP wet deposition. Throughfall deposition of NO_3 in the three parks was 80-90% lower than wet deposition of NO_3. In contrast, NH_4 deposition in throughfall was 1.5 – 2.8 times greater in throughfall. This strong preferential canopy uptake of wet-deposited NO_3 has now been reported for 38 stands in the Pacific Northwest region of the United States, 21 of which are newly reported data. The phenomenon sometimes occurs in other regions, but appears to be ubiquitous in the Pacific Northwest, and it complicates the interpretation of throughfall monitoring data. In more polluted sites (e.g., throughfall N deposition > ca. 3-4 kg/ha/yr) elevated levels of washoff of dry-deposited NO_3 from the canopy obscures detection of canopy consumption of NO_3. In the three parks simulated annual NH_4 deposition (CMAQ model) was 2.1 times greater than measured throughfall deposition of NH_4; simulated NO_3 deposition was 15.6 times greater than throughfall deposition of NO_3. Preferential canopy consumption of NO_3 was not observed in relatively low deposition forest sites in California, including Yosemite National Park and in the northern Sierra Nevada. The hypothesized mechanism for the preferential canopy NO_3 uptake in the Pacific Northwest is the result of NO_3 uptake by moistened stems, branches and bark. Total (wet + dry) inorganic N deposition was calculated for the three parks using sulfur deposition measurements from ion exchange resin throughfall collectors and wet deposition S/N ratios. It was assumed that S/N ratios are equivalent in throughfall and wet deposition and that throughfall S deposition fluxes approximate total S deposition inputs. Support for this approach of estimating total inorganic N deposition from throughfall data will be presented.

USDA Forest Service, 4955 Canyon Crest Dr., Pacific Southwest Research Station, Riverside, California, 92507 USA; mfenn@fs.fed.us Tel. 951-680-1565