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Spatial variation of water and element fluxes in throughfall of a tropical lowland forest, Panama

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Quantity and chemical quality of throughfall fluxes are influenced by incident precipitation, interception loss, dry deposition and canopy exchange processes. During the passage through the canopy, water and nutrient fluxes are spatially redistributed resulting in a heterogeneous input of water and dissolved nutrients into the soil. Furthermore, different tree species influence the deposition of aerosols and canopy exchange processes differently. In this study, we quantified (i) the spatial variation of throughfall water and element fluxes and (ii) the influence of fig trees (*Ficus insipida* Willd.).

The study was conducted in a tropical lowland forest in Panama (Barro Colorado Island 9˚10 N and 79˚50' W). Mean annual rainfall and temperature are 2600 mm and 27˚C, respectively. We sampled twelve pairs of plots, each involving a *F. insipida* plot (F) and a reference plot without *F. insipida* (R). Each plot was equipped with nine throughfall samplers, totalling 216 samplers, which were individually sampled in May, June and July 2012. We determined water volumes and concentrations of Ca, K, Mg, Na, NH_4^+, NO_3^-, TN, Cl^-, and organic C (TOC). Number of collectors needed to reach a standard error of 10% were calculated according to the methods of J.P Kimmins and B. Lawrence & I.J. Fernandez.

The weekly average water was 87 mm and those of the studied elements 661 mg/m^2 (TOC), K (545), Cl (367), TN (131), Na (111), Ca (98), NH_4^+ (77), Mg (48), NO_3^-(16). The highest variation in throughfall fluxes occurred for $NO_{3\,(R)}^-$ (coefficient of variation, CV = 94%) and $Ca_{(F)}$(80) and the lowest variation for $H_2O_{(F,R)}$(22) and $TN_{(R)}$(37). The largest difference in the spatial variation between F and R plots occurred for NH_4^+ ($CV_{(F)}$ % - $CV_{(R)}$ % = 19), Ca (17), K (-7) and NO_3^- (-23). To reach a standard error of the mean below 10%, most collectors are needed for $NO_{3\,(R)}^-$(98), $Ca_{(F)}$(77), $K_{(R)}$ (73), $Mg_{(F)}$ (72). Mean throughfall fluxes of Ca, K and NO_3^- were significantly ($p < 0.05$) different between F and R plots. Figs released more Ca and K than the remaining forest while they lost less or retained more NO_3^- .

Our results demonstrate that (i) up to 16 and 98 throughfall samplers are required to determine water volumes and element fluxes in a tropical lowland forest with a standard error $< 10\%$ and (ii) individual tree species can have a significant influence on throughfall volumes and chemical quality.